Welcome

Dear Colleagues and Friends,

Aerobiology is a large family that includes allergists, atmospheric modellers, botanists, phenologists, microbiologists, meteorologists, mycologists and many more. We are very happy to welcome over 200 international experts from more than 30 countries in Europe and further abroad to the 6th European Symposium on Aerobiology.

We received 200 abstracts and, with the help of the scientific committee, we selected 100 to be oral presentations and 77 to be posters. It is a real success! It also means oral and poster presentations are arranged in two sessions that you can select from. We hope you will appreciate this programme and that this symposium will provide an opportunity for you to exchange ideas and develop future collaborations.

This is an important period for aerobiology. Reductions in public funding and the number of private contractors means that a lot of our laboratories face financial difficulties. However, the amount and quality of work we perform is recognized globally, and we will continue to strive for legal recognition and regulation of airborne biological particles in Europe as we obtained in France after many years of endeavour.

We must support the next generation who will carry on our work in to the future, and we are pleased to welcome a lot of young aerobiologists to Lyon.

Welcome in Lyon! I hope that you will enjoy our country and our town during this week together.

Michel Thibaudon, EAS president
On behalf of the ESA 2016 Organizing Committee

LOCAL ORGANIZING COMMITTEE

Michel Thibaudon (EAS President),
Henriette Méon, Samuel Monnier,
Gilles Oliver and Charlotte Sindt

LOCAL SCIENTIFIC COMMITTEE

Jean-Pierre Besancenot, Denis Charpin,
Chantal Dechamp, Nadine Dupuy
and Gérard Sulmont

INTERNATIONAL SCIENTIFIC COMMITTEE

Maira Bonini, Bernard Clot,
Giuseppe Frenguelli, Carmen Galan,
Regula Gehrig, Roy Kennedy,
Dorota Myszkowska, Ingrida Sauliene
and Matt Smith

ORGANIZING AND SCIENTIFIC SECRETARIAT

Michel Thibaudon
Directeur du RNSA
11, Chemin de la Creuzille
Le Plat du Pin
69690 Brussieu - France
Tel: +33 (0)6 80 02 48 33
E-mail: michel.thibaudon@wanadoo.fr
Web: www.pollens.fr

ADMINISTRATIVE SECRETARIAT

Alpha Visa Congrès / ESA 2016
Olivier Ginestet
624, rue des Grèzes
34070 Montpellier - France
Tel: +33 (0)4 67 03 03 00
Fax: +33 (0)4 67 45 57 97
E-mail: esa@alphavisa.com

www.alphavisa.com/esa/2016

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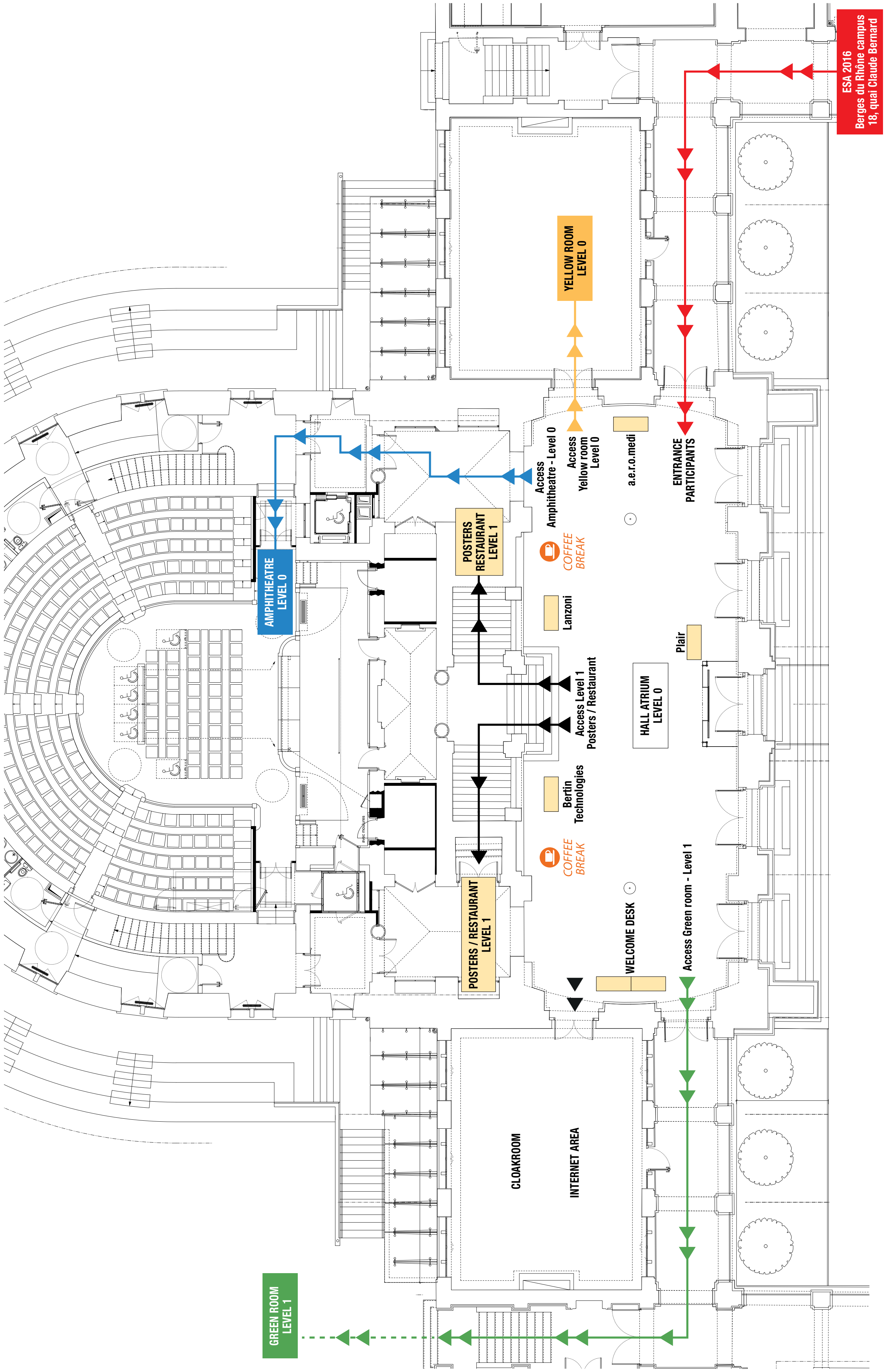
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Monday 18 July

14:00-14:30 **WELCOME** ***Amphitheatre***

14:30-15:00 **PLENARY SESSION** ***Amphitheatre***

LECTURE 1

Is pollen a pollutant?

Michel Thibaudon (Brussieu, France) and Roberta Savli (EFA Brussels, Belgium)

15:00-18:00 **PLENARY SESSION** ***Amphitheatre***

SESSION Aerobiology

Chairs: *B. Clot / C. Sindt*

- **O01 - Worldwide pollen monitoring Networks: the work of the IG Aerobiology & Pollution in the TF-40108**
  C. Antunes
- **O02 - Designing new automatically generated pollen calendars for the public**
  R. Gehrig
- **O03 - Modelled and observed surface soil pollen deposition distance curves for isolated trees of Carpinus betulus, Cedrus atlantica, Juglans nigra and Platanus acerifolia**
  B. Adams-Groom

Discussion

- **O04 - Relationship between airborne pollen grains, wind direction and land use in SW of Iberian Peninsula using Geographic Information Systems (GIS)**
  J.-M. Maya-Manzano
- **O05 - Assessing the abundance of airborne pollen and fungal spores at variable altitudes using an aircraft: how high can aeroallergens fly?**
  A. Damialis

Discussion

- **O07 - Decrease or increase? Temporal changes in pollen concentrations assessed by Bayesian statistics**
  S. Jochner
- **O08 - An algorithm for forecasting the total amount of airborne Betula pollen from meteorological elements of past years**
  Y.-T. Tseng
- **O09 - Effect of micro scale wind on measurements of airborne pollen concentrations using volumetric methods over a building rooftop**
  K. Miki

Discussion

19:00 **Welcome Ceremony** ***Lyon City Hall***

Tuesday 19 July - Morning

09:00-09:30 **PLENARY SESSION** ***Amphitheatre***

LECTURE 2

Challenges in aerobiology
Bernard Clot (Payerne, Switzerland)

09:30-10:30 **PLENARY SESSION** ***Amphitheatre***

SESSION Aerobiology

Chairs: I. Sauliene / L. Grewling

- **O10 – Geographic and temporal variations in Poaceae pollen exposure in Lombardy (Northern Italy)** - *M. Bonini*
- **O11 – Long-term variability of the tree pollen seasons in Krakow (SE Poland) against a background of meteorological conditions** - *D. Myszkowska*
- **O12 – Airborne Quercus pollen behavior in 4 different bioclimatic areas, Jerusalem and Tel-Aviv (Israel); Tulsa, Oklahoma (USA); Córdoba (Spain)** - *I. Helfman-Hertzog*

Discussion

10:30-11:00 **Coffee break – Visit of exhibition – Posters**

PARALLEL SESSIONS

11:00-12:30 **SESSION Aerobiology** ***Amphitheatre***

Chairs: J. Belmonte / E. Severova

- **O13 – Airborne Pollen and Fungal Spores in Garki, Abuja (North-Central Nigeria)**
  H.-O. Adekanmbi
- **O14 – Short seasons and nightly atmospheric circulation of allergenic pollen in Augsburg, Germany: is it really good news?** - *A. Damialis*

Discussion

- **O15 – Winter Pollination of Betula in South Anatolia – Is it Fact or Fiction?** - *A. Tosunoglu*
- **O16 – Case Study France: Analysis of plant occupation of public green spaces** - *S. Monnier*

Discussion

11:00-12:30 **SESSION Environmental studies: pollution, meteorology** ***Green Room***

Chairs: D. O'Connor / B. Crouzy

- **O27 – Impact of meteorological conditions on seasonal pollen index: outcome of 35 years of pollen re-analysis** - *M. Sofiev*
- **O28 – Controversial study: autumn vs spring conditions** - *L. Sukiene*

Discussion

- **O29 – Survey of biological ice nucleators in precipitation at the rural site of Opme, Puy-de-Dôme, France** - *P. Amato*
- **O30 – Estimating the bacterial source strength and the downwind influence of outdoor composting platforms** - *Y. Brunet*

Discussion

12:30-14:00 **Lunch – Posters – Coffee – Visit of exhibition**

Tuesday 19 July - Afternoon

PARALLEL SESSIONS

14:00-14:30 **LECTURE Ragweed** ***Amphitheatre***

Has allergy to pollen not increased the spread of common ragweed?
Bruno Chauvel (Dijon, France)

14:30-16:10 **SESSION Ragweed IRS/Cost SMARTER**

Chairs: *M. Bonini / H. Müller-Schärer*

- **O17 – Analysis of airborne *Ambrosia* pollen in Europe within the framework of Cost SMARTER**
  B. Sikoparija
- **O18 – Risk assessment of the leaf beetle *Ophraella communa*, a biological control candidate for *Ambrosia artemisiifolia*** – *H. Müller-Schärer*

Discussion

- **O19 – The potential impact of an exotic beetle on ragweed pollen in Europe** – *S. Lommen*
- **O20 – *Ophraella communa* and ragweed pollen reduction in the air of Northern Italy**
  M. Bonini
- **O21 – Italian ragweed pollen inventory** – *C. Skjoth*

Discussion

14:00-16:10 **SESSION Modeling/Forecasting** ***Green Room***

Chairs: *R. Gehrig / M. Sadys*

- **O31 – How to predict the shape of pollination season? Approaches to model calibration for birch and grass** – *M. Sofiev*
- **O32 – Modelling the intra- and inter- seasonal variations of birch pollen concentrations**
  O. Ritenberga
- **O33 – Progress, status and plans of MACC/CAMS pollen forecasting** – *M. Sofiev*

Discussion

- **O34 – Pollen forecasts for alder, birch, grasses and ragweed based on the numerical pollen dispersion model cosmo-art at 1 km resolution** – *A. Pauling*
- **O35 – Operational ragweed forecasting over the Rhone-Alpes region** – *F. Troude*
- **O36 – From the Smart Pollen – project to the Norkko-pollen service:**
  Results and experiences of the new kinds of pollen forecasts in Finland – *P. Siljamo*
- **O37 – Emissions of ryegrass pollen in South Eastern Australia** -*J. Silver*

Discussion

16:10-16:30 **Coffee break – Visit of exhibition – Posters**

Tuesday 19 July - Afternoon

16:30-17:30 **PLENARY SESSION** ***Amphitheatre***

SESSION Ragweed IRS/Cost SMARTER

Chairs: M. Bonini / H. Müller-Schärer

- **O22 - Estimating the economic effects of *Ophraella communa* on common ragweed pollen risks in South-Eastern France** - *R. Mouttet, B. Chauvel*
- **O23 - Results of the European Quality Control exercise for Ambrosia pollen** - *B. Sikoparija*
- **O24 - Relationships between ragweed and mugwort pollen seasonal parameters and assessment of their potential impact on health** - *C. Testoni, M. Bonini*
- **O25 - Stability of ragweed populations in Central Russia: self-maintenance or seed import?** *E. Severova*
- **O26 - 2015: evolution of Ambrosia pollen concentration in 5 traps in the Rhone-Alpes Region by AFEDA** - *C. Déchamp*

Discussion

PARALLEL SESSIONS

17:30-18:00 **POSTERS Ragweed** ***Amphitheatre***

Chairs: M. Bonini / H. Müller-Schärer

Title in bold letters = short oral presentation

- **PR34** - Comparative study of Ambrosia pollen and Amb a 1 allergen in Turkey - *A. Acar*
- **PR35 - Temporal Changes of Ragweed (*A. artemisiifolia, A. trifida, A. psilostachya*) Pollen Concentration In Latvia** - *O. Ritenberga*
- **PR36 - Pollen of common ragweed (Ambrosia artemisiifolia L.): Illumina-based de novo sequencing and differential transcript expression upon elevated NO_2/O_3** - *F. Zhao, D. Ernst*
- **PR37 - Effects of NO_2 on the pollen/seed production and flavonoid amount of common ragweed (Ambrosia artemisiifolia L.)** - *F. Zhao, D. Ernst*
- **PR38 - First volumetric data on ragweed pollen in Ryazan' (Central Russia)** - *I. Posevina*
- **PR39 - Regional pollen counts reflect local loads of Ambrosia spp. but not of Xanthium ssp.** *F. Zemmer*
- **PR40 - Can pollen concentrations measured at roof level represent local exposure to Ambrosia pollen in an urban area?** - *M. Atalgic*
- **PR41 - The interactive platform 'Signalement-Ambroisie' a participative tool for the fight against ragweed** - *S. Monnier*

17:30-18:00 **COST-Core Group meeting** ***Green Room***

18:00 **IRS Committee meeting** ***Yellow Room***

Wednesday 20 July - Morning

09:00-10:30 **PLENARY SESSION** ***Amphitheatre***

POSTERS A

Chairs: C. Sindt / M. Kmenta

Title in bold letters = short oral presentation

- **PA01** - Winter plants' pollination in Lviv (Western Ukraine) - *N. Vorobets*
- **PA02 - The determinant contribution of the first aerobiological experiments in the controversy on spontaneous generation theory** - *M. Bonini*
- **PA03 - Pollen calendars in three rural areas in the SW of Iberian Peninsula** - *M. Maya-Manzano*
- **PA04** - Atmospheric Pollen Content of Gaziantep Province, Turkey, 2011 - *A. Tosunoglu*
- **PA06** - Airborne pollen grains in Muğla, Turkey - *A. Güvensen*
- **PA08 -** 34 years of pollen counting: an evaluation of the temporal variation of 34 pollen seasons in Belgium - *L. Hoebeke*
- **PA09** - Airborne pollen of Uşak (Turkey) and the effect of meteorological factors - *A. Güvensen*
- **PA10** - Airborne pollen in Cáceres (SW Spain) - *A. Monroy-Colin*
- **PA11** - First year of aerobiological monitoring in Pisa (Italy) for the most allergenic plant families - fungal spores and their allergenic potential - *F. Ruggiero*
- **PA12 - Variations in pollen load with altitude** - *S. Jung*
- **PA13 - Behavior of profilins in atmosphere and in vitro, and their relationship with the performance of airborne pollen** - *I. Aloisi, D. Fernández-González*
- **PA14 - Predicting Daily airborne Ambrosia Pollen Concentrations in Pannonian Plain using Nonlinear Machine Learning** - *O. Marko*
- **PA15** - Long term trends of airborne Poaceae pollen concentration in Ankara province *A. Acar*
- **PA16** - Monitoring of Bet v 1 from Betulaceae pollen grains in two cities: The role of cross reactivity between pollen - *Ş. Alan*
- **PA17** - Assessment of Cupressaceae/Taxaceae pollen concentration in Middle and Eastern Black Sea region, Turkey - *N.-M. Pinar*
- **PA18** - Poaceae Pollen and Phl p 5 Allergen profile of two cities in Turkey - *T. Sarışahin*
- **PA19** - Comparing of airborne Alternaria and Cladosporium spore concentrations in Middle and Eastern Black Sea region, Turkey - *N.-M. Pinar*
- **PA20** - Atmospheric Pollen Profile of Kahramanmaraş - S Turkey, 2014 - *A. Tosunoglu*
- **PA21 - Single-stage impactor for pollen and fungal spores monitoring: what does it really capture?** - *E. Lanzoni*
- **PA22 - Platanus hybrida Biodistribution in the city of Evora, Portugal: Study of the potential allergenic pollen profile** - *A. Galveias*
- **PA23 - Airborne pollen spectra of Kocaeli (Izmit), Turkey** - *S. Celenk*
- **PA24 - The influence of the hot summer 2010 on pollen season in Moscow (Russia)** *O. Volkova*
- **PA25 - Comparison of two slide counting methods from a volumetric pollen trap: twenty-four latitudinal vs four longitudinal transects** - *G. Takat, S. Celenk*

Wednesday 20 July - Morning

- **PA26 – Trends in pollen seasons in Moscow, Russia** - *O. Volkova*
- **PA27 – Effects of meteorological factors on airborne concentrations of Artemisia pollen in Vienna, 2003-2015** - *M. Prentovic*
- **PA28 – Quantification of the atmospheric Olea pollen and Ole e 1 concentrations in two biogeographical areas** - *F.-J. Rodriguez Rajo*
- **PA29 – Aerobiology in mass media in Croatia** - *B. Stjepanovic*
- **PA30 – The combination of Goidanich index and the Plasmopara airborne spores as a tool to predict the downy mildew infection disease risks periods** - *F.-J. Rodriguez Rajo*
- **PA31 – Weed conditioning of common ragweed with allelochemicals and relationship to pollen allergy with air pollution** - *V.-J. Vojnich*
- **PA32 – Back trajectories and DNA-based species-specific detection allow tracking the transport of fungi in air masses – a case study of Leptosphaeria biglobosa spore transport from Jutland Peninsula to NW Poland** - *M. Sadys, A. Grinn-Gofron*

10:30-11:00 Coffee break – Visit of exhibition – Posters

PARALLEL SESSIONS

11:00-12:30 **SESSION New methods in Aerobiology** ***Amphitheatre***

Chairs: J. Buters / M. Smith

- **O38 – Automatic pollen monitoring: the MeteoSwiss validation site** - *B. Crouzy*
- **O39 – All-optical automatic pollen monitoring: towards an operational system** - *B. Crouzy*
- **O40 – A new algorithm for simultaneously estimating the concentrations of several types of airborne pollen using a laser optics system** - *S. Kawashima*
- **O41 – Improvement of parameters for automatically estimating concentrations of allergenic airborne pollens using laser optics** - *S. Matsuda*
- **O42 – Pollens, allergy and real time information** - *G. Oliver*

Discussion

11:00-12:30 **SESSION Botany / Phenology / Climate change** ***Green Room***

Chairs: C. Galán / C. Skjoth

- **O43 – Teachings of the phenological monitoring** - *M. Grégori*
- **O44 – Allergenic potential for a new garden in river banks of Badajoz (SW Spain)** *S. Fernández-Rodríguez*

Discussion

- **O45 – Airborne pollen records and phenology of *Fraxinus angustifolia*** - *A. Monroy-Colin*
- **O46 – The phenological phases of flowering and pollen seasons of selected tree taxa against a background of meteorological conditions in Kraków** - *D. Stępalska*

Discussion

12:30-14:00 Lunch – Coffee – Visit of exhibition – Posters

Wednesday 20 July - Afternoon

14:00-14:30 **PLENARY SESSION** ***Amphitheatre***

LECTURE 3

Ice nucleation by airborne bacteria and potential impacts on precipitation
Pierre Amato (Aubière, France)

PARALLEL SESSIONS

14:30-16:00 **SESSION New methods in Aerobiology** ***Amphitheatre***

Chairs: *M. Sofiev / O. Ritenberga*

- **O47 - ePIN: Electronic Pollen Information Network. Building a fully automated pollen monitoring network in Bavaria, Germany** - *J. Buters*
- **O48 - Recent results of Automatic and Online Pollen Monitoring using the BAA500** - *J. Oteros*

Discussion

- **O49 - Molecular approaches for the analysis of airborne pollen** - *R.-P. Mohanty*
- **O50 - A DNA-based methodology for airborne pollen identification in complex environmental samples** - *K. Leontidou*

Discussion

14:30-16:00 **SESSION Aerobiology** ***Green Room***

Chairs: *R. Albertini / J. Rodriguez-Rajo*

- **O51 - Density, Diversity and population dynamics of Fungal Spore Population in the Atmosphere of Arid land Area, Jordan** - *M. Abu-Dieyeh*
- **O52 - Detection of Amb a1 allergens in the atmosphere of Nortwest Turkey** - *S. Celenk*

Discussion

- **O53 - Comparative study of airborne Bet v 1 and *Betula* pollen concentrations in Barcelona and Vitoria (Spain)** - *J. Belmonte*
- **O55 - Correlation between airborne Poaceae pollen concentrations and allergen Phl p 5 levels** - *C. Galán*

16:00-16:30 **Coffee break - Visit of exhibition - Posters**

16:30-18:00 **PLENARY SESSION** ***Amphitheatre***

SESSION New methods in Aerobiology

Chairs: *V. Rodinkova / D. Magyar*

- **O56 - Next-Generation Sequencing applied to pollen and fungal identification in the atmosphere of Madrid (Spain)** - *A. Núñez*
- **O57 - Aerobiology based on drones** - *J. Belmonte*

Discussion

- **O58 - Automated Microscopic Scanning and Evaluation of Pollen in Standard Samples** *G. Meinardus-Hager*
- **O59 - Innovative bench test using Coriolis system to evaluate indoor air purifier** *V. Moulès, A. Proust*

Discussion

18:00 **IAA Council meeting** ***Yellow Room***

Thursday 21 July - Morning

09:00-09:30 **PLENARY SESSION** ***Amphitheatre***

LECTURE 4

From epigenetic to allergen avoidance
Frédéric De Blay (Strasbourg, France)

09:30-10:30 **PLENARY SESSION** ***Amphitheatre***

SESSION Allergy

Chairs: *D. Charpin / K. Bastl*

- **O60 – Influence of pollen diurnal variation on susceptible individuals well-being** - *I. Sauliene*
- **O61 – Spatiotemporal correlations between air pollutants and eye-, nose- and lung symptoms of individuals collected by a citizen science platform** - *L.-A. De Weger*
- **O62 – Climate and allergic sensitization to airborne allergens in the general population: Data from the French Six Cities Study** - *D. Charpin*

Discussion

10:30–11:00 **Coffee break – Visit of exhibition – Posters**

PARALLEL SESSIONS

11:00-12:30 **SESSION Allergy** ***Amphitheatre***

Chairs: *L. De Weger / M. Ugolotti*

- **O63 – Local and national monitoring of pollinosis using drug sales data** - *V. Auvigne*
- **O64 – Antihistamines sales reflect the Global Warming impact on plants pollination in Ukraine** - *V. Rodinkova*
- **O65 – Grass pollen season 2015, a multi method approach in three different European cities** *M. Kmenta*

Discussion

- **O66 – Cyanobacteria as Allergen Sources** - *N. Lang-Yona*
- **O67 – Identification of new allergens from Saccharum spontaneum(Kans grass) pollen and its IgE-mediated cross-reactivity with other dominant grass pollens of West Bengal, India: an immunoclinical insight** - *T. Basak*

Discussion

11:00-12:30 **SESSION Botany / Phenology / Climate change** ***Green Room***

Chairs: *G. Frenguelli / C. Antunes*

- **O68 – Is birch pollen season the footprint of birch flowering in Augsburg, Germany? Phenotypic plasticity and environmental drivers** - *F. Häring*
- **O69 – Temporal Changes in Oklahoma Cupressaceae Pollen** - *E. Levetin*

Discussion

- **O70 – Aeropalynology study of Abomey-Calavi city (Benin) during the high rainy season** *M. Tossou*
- **O71 – Phenological analysis of grasses (Poaceae) as a support for the dissection of their pollen season in Perugia (Central Italy)** - *S. Ghitarrini*

Discussion

12:30–14:00 **Lunch – Coffee – Visit of exhibition – Posters**

Thursday 21 July - Afternoon

PARALLEL SESSIONS

14:00-16:00 **SESSION Allergy** ***Amphitheatre***

Chairs: D. Caillaud / M. Prentovic

- **O72 - Short-term exposure to pollen and the risk of allergic / asthmatic symptoms: A systematic review and meta-analysis of the panel studies** - *T. Hugg*
- **O73 - Pollen exposure and clinical symptoms in patients treated by immunotherapy with birch and grass allergens – application for patients** - *D. Myszkowska*
- **O74 - Breathing in the Park: A Project to estimate the allergenicity of urban green spaces in Spanish Cities** - *P. Cariñanos*

Discussion

- **O75 - An educational animated sequence for explaining pollen allergies to children**
  M. Mottet
- **O76 - Pollens and epidemiological studies: pharmaco-epidemiology and panel studies in France** - *D. Caillaud*
- **O77 - Effects of birch and grass pollen exposure: air pollution, and weather type on antiallergic drug consumption in S Sweden: a time series analysis** - *Å. Dahl*

Discussion

- **O78 - Spore-sensitization is usually associated with other allergies including pollinosis in Ukraine** - *V. Rodinkova*
- **O79 - *Parietaria* and *Platanus*, botanical aspects and pollinosis** - *J. Belmonte*

Discussion

14:00-16:00 **SESSION Agronomy / Agriculture / Botany / Phenology** ***Green Room***

Chairs: J.-P. Besancenot / I. Kasprzyk

- **O80 - Pollen dispersal in a hybrid cereal canopy** - *M. Sadyś*
- **O81 - Male phenology of Mediterranean saltbush, *Atriplex halimus* L., and its relationship with airborne pollen concentrations**
  R. Pérez-Badia
- **O82 - *Ambrosia* in Europe, historical approach through dried herbarium specimens**
  G. Guignard

Discussion

- **O83 - *Ambrosia psilostachya* DC.: a new source of allergy in France?** - *R. Bilon*
- **O84 - Flowering phenology and pollen production of three *Artemisia* species in urban and rural environments** - *P. Bogawski*

Discussion

16:00-16:30 **Coffee break - Visit of exhibition - Posters**

Thursday 21 July - Afternoon

16:30-19:00 **PLENARY SESSION** ***Amphitheatre***

SESSION Fungal spores and culture heritage

Chairs: R. Kennedy / A. Grinn-Gofron

- **O85 - Development and use of in field detection systems for the plant pathogen *Alternaria brassicae* in vegetable Brassica crops**
  R. Kennedy
- **O86 - Alternaria spores in the air across Europe: Abundance, seasonality and relationships with climate, meteorology and local environment**
  C.-A. Skjøth
- **O87 - Temporal trends of airborne fungal spores in Catalonia NE-Spain (1995-2013)**
  J. Belmonte

Discussion

- **O88 - Modeling hourly and daily relationships between basic meteorological parameters and airborne fungal spore composition**
  A. Strzelczak
- **O89 - Coriolis air sampling, surface sampling and analysis by detection** - *J. Charbonnier*
- **O90 - Test of Hirst-spore traps performance for outdoor fungal monitoring during large demolition work at hospital**
  S.-T. Loeffert

Discussion

- **O91 - Exposure to molds in the indoor environment and respiratory health in older residents living in Lausanne**
  H. Niculita-Hirzel
- **O92 - First investigation of fungal spores in the Madeira air**
  A. Grinn-Gofroń
- **O93 - Use of survival analysis to determine the outbreak of three major fungal diseases of rice in India: An Aerobiological, Statistical and Phyto-pathological approach**
  M. Saha, T. Basak
- **O94 - Prevalence and methicillin sensitivity of *Staphylococcus* sp. in three different seasons of indoor bioaerosols of a library environment**
  T. Chakraborti

Discussion

19:30 **Dinning cruise**

Friday 22 July

08:30-09:00	**EAS New Committee**	***Yellow Room***
09:00-10:30	**EAS General Assembly**	***Yellow Room***

10:30-12:00 **PLENARY SESSION** ***Amphitheatre***

POSTERS B

Chairs: *B. Sikoparija / L. Sukiene*

Title in bold letters = short oral presentation

- **PB42 - Allergic sensitivity and genetic associations: study case of Lithuania** - *I. Sauliene*
- **PB43 - Prevalence of allergy to ragweed and other aero-contaminants in patients visiting outpatients clinics in 3 French geographic areas** - *D. Charpin, C. Fabre*
- **PB44 - Ecosystem change and modification allergic risk about two examples (pollen and insects)** - *J.-L. Brunet, C. Sindt*
- **PB45 - Proposing the evaluation of the Pollen Hay Fever Diary (PHD) by users** - *F. Zemmer*
- **PB46** - Ragweed risk assessment of Rhône-Alpes inhabitants - *C. Fontagné*
- **PB47 - Phenological and aerobiological behaviour of Castanea sativa Mill. in the Iberian Peninsula** - *M.-D. Hidalgo-Galvez, C. Gálan*
- **PB48 - Aerobiological Monitoring At High Altitude** - *L.-G. Pace*
- **PB49 - Herbarium Records to Investigate the Changing Phenology of Grasses** - *A. Mahdi*
- **PB50 - Phenology and aerobiology of Vitis vinifera in Montilla-Moriles, South Spain** *M. Martinez-Bracero, C. Gálan*
- **PB51** - Phenotypic plasticity in the flowering of 11 woody plant taxa: reflections in airborne pollen season - *A. Damialis*
- **PB52 - Environmental factors promote an increase in airborne grass pollen concentration and sensitization in S Sweden** - *A. Dahl*
- **PB53 - Potential sources of Ambrosia pollen in Northwest Turkey** - *S. Celenk*
- **PB54** - Trends of herbaceous airborne pollen in Malaga, southern Spain, during a period of 24 years (1992-2015) - *D. Gharbi*
- **PB55 - How does global warming affect plant pollination in Ukraine: a short overview** *A. Domashchenko*
- **PB56** - Pollen season variations during the last 26 years. A case study in Trentino, North Italy - *F. Cristofolini, J. Oteros*
- **PB57** - Ice nucleation activity in airborne and soil fungi - *J. Fröhlich*
- **PB58 - Ornamental trees and their relationships with pollen concentrations in three cities in the SW of Iberian Peninsula** - *M. Maya-Manzano*
- **PB59 - Relationship between airborne Parietaria pollen and Par j 1-2 concentrations in Santiago (North-Western Spain)** - *F.-J. Rodriguez Rajo*
- **PB60 - Ozone-induced chemical modifications of pollen coating** - *N. Visez*
- **PB61 - The relationship between birch pollen, air pollution and weather types in two Swedish cities** - *M. Grundström*

Friday 22 July

- **PB62 – How far can oak pollen be transported in the atmosphere a single day?**
  S. Fernandez-Rodriguez
- **PB63 – Impacts of land clearance by fire on spatial variation of pollen concentration**
  S. Jochner
- **PB64** - Sources of pollen grains at different types of a deposition in Altai (Russia)
  N. Riabchinskaia
- **PB65** - Alder pollen in Finland is ripened after a short exposure to warm days in early spring - *A. Saarto*
- **PB66 – Possible improvements in the determination of the flowering phenology in numerical pollen forecast models** - *H. Scheifinger*
- **PB67 – Applications of the Concentric Ring Method in Europe** - *J. Oteros*
- **PB68 – Prediction models of airborne Platanus pollen concentrations based on time series analysis** - *R. Pérez-Badia*
- **PB70** - Airborne Ambrosia pollen emission flux calculations based on the eddy covariance technique and Lagrangian dispersion modeling - *E. Gute, A. Pauling*
- **PB71 – Reciprocal effects of the amount of pollen released and fruiting dynamics: the case of oak trees** - *E. Schermer*
- **PB72 – The development of Ragweed Pollen Alarm System in Hungary and the possibilities of pollen forecast with COSMO-ART** - *D. Magyar*
- **PB73 – Interest for tracking deposited particles against the risk of biocontamination**
  I. Tovena Pecault, J. Clertant
- **PB74 – "Pollen Alarm" in Turkey** - *S. Celenk*
- **PB75 – Diurnal Cycles of Bioaerosols in NW Spain** - *A.-I. Calvo, D. Fernández-González*
- **PB76 – Airborne pollen collection and identification with an automated near-real-time pollen collection device: efficacy of the method** - *R.-W. Lucas*
- **PB78 – What is that yeast in the air: Airborne yeast diversity from a temperate climate**
  J. Mc Loud
- **PB79 – Fungal spores calendar of Parma (Northern Italy) from 2008 to 2014** - *M. Ugolotti*
- **PB80 – The main allergen of Alternaria alternata, Alt a 1, dominates in air fraction related to subspore fragments** - *L. Grewling*
- **PB81** - PEP725 Pan European Phenological Database www.pep725.eu - *H. Scheifinger*

Friday 22 July

PARALLEL SESSIONS

12:00-13:00 **SESSION Environmental studies: pollution, meteorology** ***Amphitheatre***

Chairs: *D. Myszkowska / S. Celenk*

- **O95 – Use of FTIR spectroscopy in the detection of biochemical changes of mugwort (*Artemisia* spp.) pollen under the influence of car traffic pollution** – *I. Kasprzyk*
- **O97 – Pollen goes a long way: long distance transport of airborne *Ambrosia* pollen to the UK and the Netherlands from Central and South Europe** – *L.-A. De Weger*
- **O98 – Long-distance transport of *Ambrosia* pollen from Pannonian Plain (Northern Balkan Peninsula) to Umbria (Central Italy)** – *S. Ghitarrini*

Discussion

12:00-13:00 **SESSION Workshop: flowmeter and normalization** ***Green Room***

Chair: *B. Clot*

- **O99 – Errors in the determining the flow rate of Hirst-type pollen traps** – *J. Oteros*
- **O100 – Normalization: 'Sampling and analysis of airborne pollen grains and fungal spores' CEN/TC 264/WG 39**
  M. Thibaudon

Discussion

13:00 **CONCLUSION, AWARDS** ***Hall – Level 0***

FINAL DRINK ***Garden***

LECTURES

Is pollen a pollutant?

Michel Thibaudon[1], Roberta Savli[2]

[1]*EAS - RNSA, Brussieu, France;* [2]*EFA Brussels, Belgium*

A pollutant is a substance introduced into the environment that has undesired effects, or adversely affects the usefulness of a resource. A pollutant may cause long- or short-term damage by changing the growth rate of plant or animal species, or by interfering with human amenities, comfort, health, or property values".

To date, elements considered "pollutants" have been understood as man-made, this is, originated by human activities that may impact negatively human health, provoking unhealthy effects that should be avoided.

Many European countries and the European Commission have regulated pollutants, to reduce their harm to our lives. There is a great deal of legislative texts covering chemical pollutants as well as outdoor and indoor air pollutants. However, these norms do not regulate biological particles present in the air, like pollens, even if they significantly impact the health and quality of life of 150 million people in Europe.

The World Health Organization has stated that allergies constitute an important public health problem, with 10-20% of the total European population suffering from pollen-induced allergies. Allergic rhinitis is closely associated with asthma suggesting the theory of "one airway, one disease".

It has been 10 years now that the aerobiology community is calling to have biological pollutants regulated in Europe. We study the airborne particles of biological origin, such as pollen grains, fungal spores, bacteria and allergens that are passively transported in the air. One of our European Aerobiology Society objectives this decade has been to develop a framework to monitor pollen in Europe. In 2012, this topic was declined by the European Commission during a Fairmode presentation by our colleague Mikhail Sofiev. One year later, we took the opportunity of the 2013 year of air quality to sensitize the European Parliament about the importance of regulating pollen particles.

People's daily lives are affected by pollen. The European Federation of Allergy and Airways diseases Patients' Associations (EFA) is also calling to have real-time pollen monitoring systems and to set pollen levels to set what is man-made pollen from intensive agriculture. Together, EAS and EFA we we wrote twice to the EU Commissioner of Environment at that time Mr Janez Potočnik and to the Members of the European Parliament. Despite our scientific data demonstrating the atmospheric concentrations of these biological particles, and health and social data showing the impact pollen pollution has in our health and economies, there has not been the political willingness needed to improve the situation.

We have been told that biological particles are natural and not anthropogenic, but that is restrictive to the forest and open nature. This approach does not take into account our urban areas that are colonized by allergenic species such as cypress, olive trees, birch, plane trees, ornamental grasses and ragweed, all planted and chosen by people. Neither it covers those industrial activities that increase pollen allerginiticy.

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We have been told that pollen and fungal spores sampling and analysis methods differed. Thanks to the Working Group 39 of CEN TC 264, we have solved this obstacle through the establishment of a validated European Technical Sheet CEN/TS 16868 entitled "Ambient air - Sampling and analysis of airborne pollen grains and fungal spores for networks related to allergy - Volumetric Hirst method".
We have been told that we cannot obtain accurate pollen values with some climate effects. Thanks to the persistent collection of pollen samples through the Cost action ES 0603 "Assessment of production, release, distribution and health impact of pollen", we have demonstrated the existence of thresholds levels for pollen. The European Academy of Allergy and Clinical Immunology (EAACI) has established the definitions for the thresholds, namely date of first pollination, peak pollination, and end of pollination.
Allergy and respiratory patients have been seen as second-class patients, living with the burden of an underdiagnosed disease, often non-reimbursed, with scarce research budgets, and poor prevention. However, accurate knowledge of prevalent aeroallergens can improve the diagnosis and treatment of patients with pollen allergy. Pollen information is crucial for patients as it enables a timely start of the preventive and symptomatic treatment of seasonal allergy problems.
Yet we are missing the legal framework to make this a reality. At the moment, there is no obligation to monitor and communicate about the pollen situation in Europe, in contrast to air quality regulations. Without European recommendation or legislations regulating pollen, it is likely that many European countries will no longer be able to support aerobiological monitoring.
In France, after nearly 10 years of discussion, the Ministry of Health obtained in January 2016 the obligation to monitor and inform about biological particles. This will allow RNSA, the French Aerobiology Network, to be nominated as the legal body for this coordination. It is a first important success. If more countries follow the French example, it may be easier to obtain a European legislation.
After the European Parliament failure to adopt the Written Declaration on the Burden of Allergy, a group of Members of the European Parliament has launched, with EFA and EAACI support, the Interest Group on Allergy and Asthma, a platform to promote allergy and asthma health in all policies like air quality. EFA and EAACI are working to have more MEPs joining the platform and increasing awareness about the need for pollen monitoring in Europe. To know more about the Interest Group follow the Twitter hashtag #EPAllergyAsthma.

The European Federation of Allergy and Airways Diseases Patients' Associations (EFA) is an alliance of 41 allergy, asthma and COPD patients' organisations in 25 European countries and it works for European patients with allergy, asthma and chronic obstructive pulmonary disease (COPD) to live uncompromised lives, have the right and access to the best quality care and a safe environment. www.efanet.org @EFA_Patients

Challenges in aerobiology

Bernard Clot

MeteoSwiss, Payerne, Switzerland

Has allergy to pollen not increased the spread of common ragweed?

Bruno Chauvel[1,2], Marilou Mottet[2], Rebecca Bilon[2]

[1]*INRA, UMR1347 Agroécologie, AgroSup Dijon, INRA, Université de Bourgogne, Dijon, France ;* [2]*Observatoire des ambroisies, INRA, Dijon, France*

Common ragweed (*Ambrosia artemisiifolia* L.) is an annual invasive weed which is particular in that it has been well known for the public-health-related problems caused by its allergenic pollen (1). Although many efforts have been made in order to control it by limiting its pollen production, it does not seem possible to limit its spread. Its late seed production in the season, which should facilitate management practices, does not seem sufficient to help managers to control the species. This brings up the question of whether the necessity to reduce pollen production (source of allergy) to relieve sick people has indirectly promoted the spread of the species or not.

In Europe, common ragweed colonizes disturbed habitats and various invasion processes are observed according to the region: ragweed can be present on roadsides, in cultivated fields or on riverbanks. One of the problems is to find, according to the stage of development of the plants, the method most appropriate for the habitat concerned by the presence of the plants (roadsides, riverbanks, fields, urban areas, etc.) in order to increase the success of their management.

The difficulty of controlling common ragweed could be explained by the large variability in all of its performance-related traits (2). Seed size, germination date (3), plant height and seed production are all highly variable traits that highlight the ability of the species to respond to different types of selection pressure. This variability is also observed from a genetic point of view. A high level of polymorphism is observed in the genome of *A. artemisiifolia*, which reflects large effective population sizes in a weed species known to have undergone a recent demographic expansion both in its native range and in invaded areas.

As far as cultivated fields are concerned, the aim of weed management in annual crops is to kill the plants in the hope of preventing them from producing new seeds which refill the soil seedbank. However, in perennial crops or along road verges, plant management is generally limited to mowing practices which reduce the development and are rarely conducted with the aim of preventing seed production (4).

More generally, whatever the method chosen, the high adaptability of the plant and the difficulty of managing simultaneously pollens (pollinosis) and seeds (invasion) are certainly responsible for the spread of the plant. New challenges such as resistance to herbicides or withdrawal of herbicide active ingredients will make common ragweed management more difficult. The pooling of successful management actions and the exclusion of practices that favour the spread of the species are necessary in order to prevent the situation from getting worse. However, regardless of the difficulty, the limitation of seed production should remain the main objective of common ragweed management.

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Ice nucleation by airborne bacteria and potential impacts on precipitation

P. Amato[1,2], M. Joly[1,3], E. Attard[1,‡], M. Sancelme[1], L. Deguillaume[3], A.-M. Delort[1,2]

[1]*Clermont Université, Université Blaise Pascal, Institut de Chimie de Clermont-Ferrand (ICCF), Clermont-Ferrand, France;* [2]*CNRS, UMR 6296, ICCF, Aubière, France;* [3]*Clermont Université, Université Blaise Pascal, Observatoire de Physique du Globe de Clermont-Ferrand (OPGC), Laboratoire de Météorologie Physique (LaMP), Clermont-Ferrand, France; CNRS, UMR 6016, LaMP/OPGC, Aubière, France; ‡ Now at: UMR CNRS-IPREM 5254, Université de Pau et des Pays de l'Adour, Pau, France*

At temperatures >-39°C, freezing of supercooled water requires the presence of particles, so called ice nucleating particles (INP). Their chemical composition and structure determine the temperature of freezing. While it is largely assumed that mineral particles nucleate ice formation only below -10°C, biological particles (notably the epiphytic bacterium species *Pseudomonas syringae*) can induce water freezing at up to -2°C. The formation of ice in clouds has direct impacts on Earth's radiative budget and often triggers precipitation, so knowledge of the nature, abundance and variability of INPs in the atmosphere is particularly critical for comprehending the fate of atmospheric water and the distribution of precipitation over the planet. Cloud water samples were collected aseptically from the Puy de Dôme atmospheric observatory for seeking warm temperature INPs. We determined that cloud water at this site carried up to 22 INP m^{-3} active at -10°C, and that most of them (65% to 100%) were biological. These findings, along with previous observations of others that biological INPs are largely represented in precipitation worldwide, corroborated their role in hydrological cycles (termed bioprecipitation). Focusing on living microorganisms, we then isolated several specimens of ice nucleation active bacteria from cloud water samples and identified them as *Pseudomonas syringae*, *Xanthomonas* spp. and *Pseudoxanthomonas* sp.; fractions of up to 4% of the cells in pure cultures were ice nucleation active, positioning them among the most efficient strains identified so far. In laboratory, their capacity to induce ice formation was shown to be potentially sensitive to Human emissions, suggesting that the natural capacity of bacteria to induce ice and disseminate with precipitation may be disturbed by Human activities. In cloud chamber, we investigated their survival as aerosols and estimated a half-life time of around 4 hours, a time long enough for allowing at least a fraction of the living cells aerosolized from the phyllosphere to travel thousands kilometers away from their emission source. In the cloud chamber, cells (including non viable cells) induced cloud freezing. The results suggested that ice nucleation active cells were preferentially precipitated thus providing experimental demonstration of the existence of bioprecipitation. Atmospheric numeric models are in development for taking into account these new actors in cloud processes.

Keywords: ice nucleation, bacteria, clouds, bioprecipitation

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From epigenetic to allergen avoidance

Frédéric De Blay

CHRU, Strasbourg, France

ORAL COMMUNICATIONS

Abstracts
Monday 18 July

Worldwide pollen monitoring Networks: the work of the IG Aerobiology & Pollution in the TF-40108

C. Antunes[1], M. Thibaudon[2], A. Galveias[1], J. Oteros[3], C. Galan[4], Matthias Werchan[5], U. Berger[6], J. Buters[3]

[1]*ICT – Instituto de Ciências da Terra, IIFA & Dep. Química, ECT, Universidade de Evora, EVORA, Portugal*; [2]*RNSA - Réseau National de Surveillance Aérobiologique, Brussieu, France*; [3]*ZAUM - Center of Allergy and Environment, Helmholtz Zentrum München & Technische Universität München, Munich, Germany*; [4]*Department of Botany, Ecology and Plant Physiology, University de Cordoba, Cordoba, Spain*; [5]*Foundation German Pollen Information Service, Berlin, Germany*; [6]*Department of Oto-Rhino-Laryngology, Research Unit Aerobiology and Pollen information, Medical University of Vienna, Vienna, Austria*

Currently no comprehensive information on pollen monitoring sites is available worldwide, a great disadvantage for networking and community services purposes, as the map in the "Atlas of allergy" is already outdated and/or incomplete (Buters 2014). It is expected that about 600 stations exist worldwide, however, in many cases no information, limited information, or false information on who, where, what and how monitoring in ambient air was performed. This is a great disadvantage as pollen data are often acutely needed and the absence of an updated database is an impairment to deliver in time. As such, we undertake the task of updating, maintaining and disseminating an inventory of pollen monitoring stations in the world (task force TF-40108 sponsored by EAACI).
The aim of this work is to create an updated inventory and to provide comprehensive information on the pollen monitoring networks worldwide.
The team, formed by working and advisory members, defined the criteria which needed to be captured and is compiling data to construct a database with detailed information about the existing national/regional networks or capture sites in the world. The exact location, person responsible and their contacts as well as the methodologies and type of data that each station is collecting is our major goal. This database is used to build a map, to be made available online on the EAACI Website, where all the details concerning each site will be easily accessed.
This will enable quick access to local pollen data and will greatly facilitate the establishment of collaborations in the field of Aerobiology & Pollution.

Acknowledgments: This work is sponsored by European Academy of Allergy and Clinical Immunology - EAACI (TF-40108) and by FEDER/COMPETE2020 through the project ICT-UID/GEO/04683/2013 (ref: POCI-01-0145-FEDER-007690) and has the support of the European Aerobiology Society-EAS as well as World Allergy Organization-WAO.

Keywords: Pollen, Aerobiology networks.

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1. Buters, J. T. M. (2014). Pollen allergens and geographical factors. Global atlas of allergy. C. Akdis and I. Agache. Zurich, European Academy of Allergy and Clinical Immunology: 36-38.

Designing new automatically generated pollen calendars for the public

R. Gehrig, F. Maurer, C. Schwierz

Federal Office of Meteorology and Climatology MeteoSwiss, Zurich-Flughafen, Switzerland

Pollen calendars are one of the most comprehensible tools for informing the public about the general development of the pollen season for a selected geographical area. They have been produced with a variety of methods and were distributed with great success since the beginning of pollen measurements. Current technologies, longer data series and changing user demands allow to develop new calculation methods.

For designing new pollen calendars for Switzerland the following requirements were formulated. The pollen calendars should be based on daily pollen load levels. People with allergies know the significance of pollen load levels, because pollen forecasts are traditionally communicated in this form, which conveys the allergic risk. A pollen level in the calendar should cover the period in which this level occurred in a defined number of years of the reference period. Thus the users are provided with the time windows in which a given pollen level can potentially occur. Further requirements for pollen calendars were an automatic generation of the calendars, a regular update and the possibility to draw calendars for single stations, regions or for specific pollen species.

The new pollen calendars of Switzerland are based on 20 years of data, from 1996 to 2015. This period was selected, because it is representative for a present-day pollen season. For a given species and station, daily pollen concentrations were transformed into pollen load levels. For each day of year (doy), the value of the daily pollen level in the calendar was set to the highest level that was reached on at least 10% of the dates in the reference period and within a 9 day moving window. To remove small gaps in the final calendar, a moving window of 5 days was applied. The pollen calendars were produced with the statistic program R in the framework of the CATs climate analysis tools of MeteoSwiss.

This new calculation method is flexible as different parameters can be chosen freely: the reference period, the size of the moving time window and the percentage level that determines the level shown in the calendar. Adjusting these parameters, also pollen calendars for fewer than 20 years can be calculated. Several stations can be grouped into regions or into a calendar for the entire Switzerland. The variability of the pollen season in Switzerland is best seen in pollen calendars for the pollen species.

The pollen calendars are made public on the MeteoSwiss website and will be updated each year (www.meteoswiss.ch). The new method allows the users to estimate the expected pollen concentrations during the course of the year in the well-known measure of pollen load levels.

Keywords: pollen calendar, public, pollen load levels.

O03

Modelled and observed surface soil pollen deposition distance curves for isolated trees of *Carpinus betulus, Cedrus atlantica, Juglans nigra* and *Platanus acerifolia*

B. Adams-Groom, C. Skjoth

Institute of Science and Environment, University of Worcester, Worcester, Worcestershire, United Kingdom

Source-distance relationships for pollen deposited in surface soil have been rarely undertaken, particularly for a single or isolated source. Deposition studies of pollen are of interest to both aerobiologists and palynologists, particularly for modelling purposes, but also for forensic palynologists who tend to examine surface soil during crime scene investigations. This research aimed to determine surface soil pollen deposition patterns from isolated tree sources and to compare the results to Gaussian model curves for the same trees.

Four isolated tree pollen sources were chosen in Worcester, UK, with lawn area along the sampling zone. These were: *Carpinus betulus, Cedrus atlantica, Juglans nigra* and *Platanus acerifolia*. These types occur in soil samples much less frequently many other wind-pollinated taxa and are therefore of greater interest to forensic palynologists. Since they nevertheless produce relatively large amounts of pollen, they are therefore well suited for local scale dispersion studies, as the regional scale contribution can be assumed to be low.

Samples were collected at 1, 5 and then every 10 metres, up to 100 metres distance from the main trunk of each source along the prevailing wind direction. Samples were subjected to acetolysis and heavy liquid separation to remove the soil matrix and examined for target taxa using light microscopy A Gaussian dispersion model was incorporated and estimated source strength using tree height and width and wind speeds on days when flowering was occurring and when the wind direction flowed along the sampling transect. This model simulated the expected concentration and deposition along the sampling transect.

The majority of pollen was deposited beneath the canopy for all four tree types (range: 63% – 94%) and the tailing off started from around the outer edge of the canopy in most cases. The amount of pollen deposited at 50 metres was no more than 2.6% of total deposition in the samples for any tree and at 100m no more than 0.2%.

The observational curves varied somewhat between each tree: *Carpinus* and *Cedrus* had an exponentially decreasing curve from the first sample, whereas *Juglans* and *Platanus* increased to the 5m point before decreasing. For *Platanus*, the pollen was emitted more broadly along the sampling transect up to the 40 m point, where it dropped away to a low percentage of 3.9%.

The models showed a similar exponentially decreasing curve but predicted that more pollen would be deposited along the sampling transect and for a greater distance than occurred in reality.

The majority of pollen is therefore, in line with other models and observational studies, deposited very close to the source. This research shows that most of it is deposited beneath the canopy for a single source tree and that, apart from the escape fraction, very little pollen is deposited more than 100m away.

Keywords: pollen dispersal, source-distance relationships, aerobiology.

Relationship between airborne pollen grains, wind direction and land use in SW of Iberian Peninsula using Geographic Information Systems (GIS)

J. M. Maya-Manzano[1], R. Tormo-Molina[1], S. Fernández-Rodríguez[2], Á. Gonzalo-Garijo[3], M. Sadyś[4], J. A. Oteros-Moreno[5], I. Silva-Palacios[6]

[1]*Vegetal Biology, Ecology and Earth Sciences, University of Extremadura, Badajoz, Spain*; [2]*Department of Construction, University of Extremadura, Cáceres, Spain*; [3]*Allergy department, Infanta Cristina University Hospital, Badajoz, Spain*; [4]*Computational and Systems Biology, Rothamsted Research, Harpenden, Hertfordshire, United Kingdom*; [5]*Centre of Allergy and Environment (ZAUM), Technical University of Munich, Munich, Bavaria, Germany*; [6]*Department of Applied Physics, University of Extremadura, Badajoz, Spain*

Introduction. Assessment of the airborne content (mainly pollen grains and fungal spores) in an extensive territory, with different landscapes is a difficult task because both vegetation diversity and winds affect directly the results. Thus, an application of the Geographic Information Systems (GIS) software and circular statistics in aerobiology can be found as helpful tools for this purpose. The aims of this study were: 1) to analyze the behaviour of airborne pollen grains using daily mean concentrations of 15 pollen taxa, 2) to discuss the hourly trends in the distribution of the main 5 pollen types and their relationship with the predominant wind direction, and 3) to analyze the influence of land use nearby the pollen traps, in areas of 10 and 20 km in diameter, surrounding the three cities studied.
Material and Methods. Maps of the main land use in the areas (buffer) of 10 and 20 km in diameter surrounding the pollen traps were created using GIS software, and image analysis software was used for quantifying the surface occupied by for each land use category based upon colour assessment.
Daily concentrations of pollen grains (15 taxa, measured with Hirst type traps) were analysed and compared with predominant wind directions measured in three localities of the SW Iberian Peninsula, i.e: Don Benito, Plasencia and Zafra, from March 2011 to March 2014.
Results. The main land use in Don Benito were irrigated crops and pastures (*Poaceae* sp. *Plantago* sp., *Astaraceae* sp.), in Plasencia, hardwood forests (mainly from *Quercus pyrenaica*, *Q. suber* and *Castanea sativa*), and in Zafra, pastures and hardwood forests (*Q. rotundifolia* and *Q. suber*). Comparison of the daily concentrations of pollen grains with the predominant winds and land use shows that the atmospheric concentrations of collected pollen grains in the trap reflect the source areas identified in the inventory, as happened with pollen types *Alnus glutinosa*, *Amaranthaceae*, *Anthemideae*, *Castanea sativa*, *Echium*, *Eucalyptus*, *Fraxinus-Phillyrea*, *Plantago*, *Poaceae*, *Rumex* and *Salix*. Nevertheless, these relationships were not found for the pollen types *Olea europaea*, *Quercus*, *Urticaceae* p.p. and *Urtica membranacea*.
Conclusions. This method could be helpful in order to estimate the contribution and potential risk of some pollen types. Airborne pollen concentration is related with the surrounding vegetation and land use distribution nearby traps most of the time. However, other factors as transport of particles to medium or long-distance, or even location of pollen trap within a city, also have a direct influence in the aerobiological content.

Keywords: wind direction, land uses analysis, GIS.

Assessing the abundance of airborne pollen and fungal spores at variable altitudes using an aircraft: how high can aeroallergens fly?

A. Damialis[1], E. Kaimakamis[2], M. Konoglou[2], J. Akritidis[3], C. Traidl-Hoffmann[4], D. Gioulekas[5]

[1]*1. Instriute of Environmental Medicine, UNIKA-T, Technical University and Helmholtz Centre of Munich, Germany, 2. CK-CARE, Christine Kühne – Center for Allergy and Research and Education, Switzerland, 3. Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece, Augsburg, Bavaria, Germany*; [2]*1st Pulmonary Department, "G. Papanikolaou" General Hospital of Thessaloniki, Thessaloniki, Greece*; [3]*Internal Medicine Department, "G. Gennimatas" General Hospital of Thessaloniki, Thessaloniki, Greece*; [4]*1. Institute of Environmental Medicine, UNIKA-T, Technical University and Helmholtz Centre of Munich, Germany, 2. CK-CARE, Christine Kühne – Center for Allergy and Research and Education, Switzerland, Augsburg, Bavaria, Germany*; [5]*Department of Pulmonary Medicine, Faculty of Medicine, Aristotle University of Thessaloniki, Thessaloniki, Greece*

Airborne pollen and fungal spores have been monitored mainly in highly populated, urban environments, where allergic manifestations are observed. However, the main sources of aeroallergens usually originate from outside cities' fringes. The aim of this work was to assess abundance of aeroallergens, spatially and temporally, and evaluate relevant risk at various environmental regimes and for a wide spectrum of plant and fungal taxa.
Aerobiological monitoring of pollen and fungal spores was conducted using a light aircraft and a car, during the main season of 2010 (March-July), which followed the same aerial and road route, respectively, at the same time. The study area extended horizontally within the city of Thessaloniki (northern Greece) and its suburbs (urban environment), the surrounding towns and villages (semi-rural environment) and a protected lake area (natural environment). Vertically, altitudes from sea level up to 2,000 m were investigated. Pollen and fungal spores were captured directly onto microscope slides and they were identified under light microscope, counted and analyzed.
In total, more than 25 pollen types and 20 spore types were detected. The most abundant ones recorded by airplane were from Pinaceae and *Quercus*, accounting for >54% of the total. In contrast, Poaceae were detected as the most abundant (>77% of the total) via car measurements. Both aircraft and car sampling yielded similarly high concentrations for *Cladosporium* and *Alternaria* spores, in the same order but at different magnitude. Pollen and spores were generally detected throughout the elevational gradient studied with no major differences between altitudes. Other than that, increased elevation resulted mainly in higher concentrations of Pinaceae and *Quercus*, but lower of Poaceae.
It is concluded that aeroallergens can have dire effects even outside the main season and source areas, with questions raised on previously thought of as allergy-free environments and time periods. Hence, urban biomonitoring alone is not considered an accurate and representative approach. Therefore, it is suggested that towards timely informing of allergic patients, additional biomonitoring methods need to be followed, like airplane aeroallergen sampling, which allows for more generalised pollen and spore abundance estimations, including also medium- and long-range transport of aeroallergens.

Keywords: Aerobiology, Biometeorology, Environmental Health.

Decrease or increase? Temporal changes in pollen concentrations assessed by Bayesian statistics

S. Jochner[1], A. Menzel[2], R. Gehrig[3], B. Clot[3]

[1]*Physical Geography / Landscape Ecology and Sustainable Ecosystem Development, Catholic University Eichstätt-Ingolstadt, Eichstätt, Germany*; [2]*Ecoclimatology, Technische Universität München, Freising, Germany*; [3]*MeteoSchweiz, Bundesamt für Meteorologie und Klimatologie, Zürich-Flughafen, Switzerland*

Recent aerobiological studies mostly apply linear models when analyzing changes in pollen concentrations over time. However, there exist indications that linear models are not necessarily suitable for describing these changes in recent decades since pollen concentrations of some pollen species are known to have decreased since 1990. In addition, some epidemiological studies also report no further increases of asthma, hay fever and atopic sensitization since the 1990s.

In order to describe the behaviour of pollen concentrations (an obvious factor contributing to the incidence of allergies) in a mathematically detailed way, we made use of Bayesian statistics that describe discontinuities (i.e. change points) and quantify the direction and speed of changes. We examined long-term aerobiological pollen data of *Betula* spp. (birch), *Corylus* spp. (hazel) and Poaceae ssp. (grass) from six stations in Switzerland (Basel, Buchs, Davos, Münsterlingen, Neuchâtel and Zurich) for the time period 1985 to 2014.

For all analyzed stations and species, the one change point model was considered as the best model. The only exception was Poaceae spp. pollen recorded at Davos that could be better described with the two change point model. All pollen records of *Corylus* spp. were characterized by increased pollen concentrations subsequent to the change point located between 1999 and 2000. *Betula* spp. pollen concentrations of Basel and Zürich, however, were associated with decreases following the calculated change points (located between 1995 and 2004). Only two stations (Basel and Neuchâtel) were linked to decreases in Poaceae spp. pollen concentrations in the period subsequent to the change point (located between 1994 and 2002).

Our results showed that only four out of 16 cases were associated with decreases in pollen concentrations in recent decades. Thus, we suggest that changes in sensitization rates might only partly be attributable to changes in pollen abundance. In addition, further studies should focus on the reason (climate, land use changes, etc.) responsible for changes in atmospheric pollen loads.

Keywords: Bayesian statistics, pollen concentration, Switzerland.

An algorithm for forecasting the total amount of airborne *Betula* pollen from meteorological elements of past years

Y.-T. Tseng[1], S. Kawashima[1], S. Kobayashi[2], S. Takeuchi[2], K. Nakamura[1], T. Fujita[3]

[1]*Graduate School of Agriculture, Kyoto University, Kyoto, Japan*; [2]*Hokkaido Institute of Public Health, Sapporo, Japan*; [3]*Yamato Engineering Company, Yokosuka, Japan*

The genus *Betula*, which is widely distributed throughout Hokkaido, Japan, disperses airborne pollen annually from April to June, and causes severe symptoms to hay fever sufferers. Due to changes in the pollen level each year, there is an urgent need to develop a more precise forecasting model for patients and for medical personnel's awareness of annual airborne pollen levels.
In this study, the pollen samples were obtained by a Durham gravitational trap during April–June from 1996–2015 in Hokkaido. Meteorological data from the summer months were collected from the Japan Meteorological Agency. Various forecasting models were developed by increasing two dimensions: the number of observed years and the number of meteorological variables that facilitate male flower formation, including temperature, solar radiation, and humidity. In order to discover potential predictive relationships, a training set included all airborne pollen data from 1996 to 2010 as dependent variables and meteorological data as independent variables. The estimated amount of airborne pollen was obtained in a test set. Several performance evaluations were conducted using the statistical indices (coefficient of determination and root mean square error) in order to select the best model, including the following: regression (training set), forecast (test set), and estimation (training and test set).
The results show that the forecasting model obtained the highest accuracy when using climatic data in June the year before. Also, it was found inappropriate to predict the airborne pollen count only by considering weather conditions in the previous year due to the low performance of those models. The best forecast performance (regression adjusted-r^2 = 0.93, forecast RMSE = 593) occurred with temperature (monthly average of daily maximum temperature), sunlight (solar radiation), and moisture (relative humidity) factors of the last three years, attaining a predictive ability better than the model with temperature and sunlight factors only (regression adjusted-r^2 = 0.78, forecast RMSE = 675). This emphasizes an important fact: that relative humidity also plays a critical role in forecasting how much airborne pollen will be dispersed in the following year. In addition, a comparison between two moisture factors indicates that relative humidity is more vital than precipitation. With increments in observation years, the best training set regression occurred when considering 3 years of climatic conditions and the best forecast performance occurred with 5 years of meteorological data. This study aimed to examine the best model to forecast annual airborne pollen. It clarifies that the model with high predictive power is constructed using meteorological conditions of the past few years instead of data from a single year. Meanwhile, by using climatic data of the past few years, it has become more feasible to disregard factors such as catkin number in the previous year.

Keywords: Betula pollen, forecasting model, meteorological elements.

Effect of micro scale wind on measurements of airborne pollen concentrations using volumetric methods over a building rooftop

K. Miki[1], S. Kawashima[1], B. Clot[2], M. Thibaudon[3], K. Nakamura[1], T. Fujita[4]

[1]*Graduate School of Agriculture, Kyoto University, Kyoto, Japan*; [2]*MétéoSuisse, Payerne, Switzerland*; [3]*RNSA, Brussieu, France*; [4]*Yamato Engineering Company, Yokosuka, Japan*

In order to minimise serious impacts of pollen on human health and exposure of pollen to those who are allergic, it is necessary to gain accurate data to provide precise predictions of the spatial and temporal distributions of pollen. This paper aimed to clarify the cause of differences in airborne pollen concentrations captured by different volumetric-type samplers in relation to the wind field around the traps. In order to examine the effect of the wind characteristics over the building rooftop on the pollen concentration, we discussed the observed results of pollen concentrations based on an additional experiment in which the wind path was bent by an obstacle.

A field experiment was carried out to evaluate the difference between the collection efficiency of the funnel inlet and of the wind vane intake. The pollen concentration was simultaneously evaluated by two automatic pollen monitors (KH-3000-01, YAMATRONICS, Japan). For one monitor, the conical glass funnel was installed with an inlet always directed to upward and with a maximum diameter of 65 mm. For the other monitor, the wind vane intake with an inlet always directed windward was installed. For more details, the full outline of the pollen monitoring system is available in Kawashima et al. (2007). The pollen observation was carried out over 55 days between April 8, 2014, and June 1, 2014, at the MeteoSwiss Station in Payerne, Switzerland (46°8’ N, 6°9’ E).

In the rooftop experiment to compare the intake parts of the volumetric samplers, the larger the wind vectors in the north-east direction, the larger the pollen concentration shown by the funnel intake. On the other hand, the larger the wind vectors in the south-west direction, the larger the pollen counts shown by the wind vane intake. The east-west wind directional vector represented approximately 43.8% and the north-west wind directional vector represented 27% of the differences between the pollen counts of monitors A and B. Changes in pollen concentrations coupled with the wind direction might be caused by an upward and downward wind path bent by the obstacle placed on the rooftop. Based on the other experiment performed to evaluate the wind field characteristics on the rooftop of the Kyoto University building, we clarified that the wind path is bent upward when the obstacle is located on the upstream side and the wind path is bent downward when the obstacle is put on the downstream side. Here, 78.3% of wind blowing into the obstacle was bent upward and 90.1% of wind blowing from the obstacle was bent downward. These facts can explain the results for the airborne pollen concentration over the rooftop in MeteoSwiss. The observed particle concentration is largely influenced by micro scale wind characteristics around the inlets of the bioaerosol monitoring devices.

Keywords: pollen concentration, micro scale wind, bioaerosol dynamics.

ORAL COMMUNICATIONS

Abstracts
Tuesday 19 July

Geographic and temporal variations in *Poaceae* pollen exposure in Lombardy (Northern Italy)

M. Bonini[1], C. Testoni[1], G. Cislaghi[1], P. Colombo[1], E. Chiodini[2], D. Berra[2], A. Molinari[3], S. Vercelloni[3], M.C. Tacca[4], E. Ferraioli[4], P. Mascagni[4], F. Ottoboni[5], A. Meriggi[6], P. Pignatti[6], N. Gibelli[6], E. Bellinzona[6], A. Pini[7], B. Paganoni[7], S. Cattaneo[8], M. Pilla[8], A. Palumbo[8], L. Papponi[9], T. Bianchi[9], A. Bertolotti[10], M. Zanca[11]

[1]*Department of Medical Prevention, LHA Milano Città Metropolitana, Parabiago, Milan, Italy*; [2]*Ospedale di Circolo, ASST Valle Olona, Busto Arsizio, Varese, Italy*; [3]*Prevention Laboratory, LHA Brianza, Lecco, Italy*; [4]*Desio Hospital, ASST Monza, Desio, Monza Brianza, Italy*; [5]*Lofarma, Milano, Italy*; [6]*Allergy and Immunology Unit, Salvatore Maugeri Foundation IRCCS, Pavia, Italy; [7]Public Health Laboratory, Local Health Authority Montagna, Sondrio, Italy; [8]Local Health Authority Insubria, Como, Italy; [9]Minoprio Foundation, Vertemate con Minoprio (CO), Italy; [10]Public Health Laboratory, Local Health Authority, Valle Padana, Mantova, Italy; [11]Allergy Unit, ASST Mantova Hospital, Italy*

Background: *Poaceae* is a family of grasses spread all around the world. Their pollen is released by different species and its allergenicity is well known. Grasses are present in different habitats, such as mountains, planes, meadows and different kind of cultivations. The aim of this study is to analyze geographic and temporal variations in *Poaceae* pollen exposure across Lombardy allowing future investigation of how these variations influence *Poaceae* pollen sensitization and can be related to climate and land use changes.

Materials and Methods: Pollen data were collected by 11 airborne pollen monitoring stations across Lombardy (Italy) by using volumetric spore traps of Hirst design. Daily average pollen concentrations are expressed as particles per cubic meter of air (p/m^3). Datasets were restricted to the period March-October, the main flowering period of grasses, and the years 2001 to 2015. Within this period, the sum of daily average *Poaceae* pollen concentrations (API=Annual Pollen Index), the peak value, the peak day and the number of days when daily average concentrations exceeded 1 p/m^3 were examined. Trends were calculated using a nonparametric statistical – Cox and Stuart test ($p<0.05$ significant).

Results: The main results are reported below. Milano (M) showed the greater API max (9177) in 2007; the lower API max (2543) was found for Vertemate con Minoprio (VM) in 2007, when also Legnano (L) and Pavia (P) recorded their own API max (respectively 7086 and 6995). While 2003 was the year of API max for Magenta (Mg) (5893) and Rho (R) (6741), 2013 for Casatenovo (C) (5457) and 2015 for Busto Arsizio (BA) (6229) and Sondrio (S) (3744). The greater API mean was found for M (5770) and the lower for VM (1593). The highest peak value was observed in 2015 for P (1275) and the lowest in 2012 for S (259); P showed also the highest peak mean value (333), VM the lowest one (117). Year of peak max and year of API max were the same for the following stations: BA (2015), C (2013) and Mg (2003). Five stations showed their peak max in 2015. A significant API downtrend was observed for L, M and R ($p=0.008$). Significant peak value downtrend was observed only for L ($p=0.008$). No significant trends were observed for the peak day: three stations showed a non significant uptrend (C, Mg and VM), whilst six a non significant downtrend (BA, L, M, R, P and S).

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Conclusions: This is the first study quantifying exposure to the *Poaceae* pollen in Lombardy, which varied over time and in different ways: since 2001 API decreased, in some cases also in a statistical significant way, in Southern and Central Lombardy, while in the North it seems to increase. The majority of the stations showed an advancing day of peak max. Many stations showed their day of peak max in 2015, the warmest year since 1880. Further studies might be required to assess climate change impact on *Poaceae* pollen seasonality and to correlate the observed trend with the variations of the land use.

Keywords: *Poaceae*, Pollen exposure, Northern Italy.

Long-term variability of the tree pollen seasons in Krakow (SE Poland) against a background of meteorological conditions

D. Myszkowska[1], K. Piotrowicz[2], J. Mitka[3], M. Zając[3], K. Szczepanek[3], E. Czarnobilska[1]

[1]*Clinical and Environmental Allergology, Jagiellonian University Medical College, Kraków, Poland*; [2]*Climatology, Jagiellonian University, Kraków, Poland*; [3]*Institute of Botany, Jagiellonian University, Kraków, Poland*

Since the beginning of the twenty-first century, the frequency of extreme meteorological events increased markedly, influencing the plants behaviour, including the trees flowering and pollination. The weather conditions at the beginning of the years are the most variable, as a result of mild winters and cold or hot springs in central Europe. The aim of the study was to find the regularities in the tree pollen seasons of the selected taxa in Kraków in 1991-2015 against a background of the meteorological conditions.
Both meteorological and pollen data were considered: air temperature (mean, minimum and maximum), rainfall, snow cover and the pollen seasons start calculated as the first day of the continuous occurrence of pollen grains, when no breaks appear on at least 5 successive days (∞1). Eight tree taxa of the relatively dense seasons were included: Alnus, Corylus, Ulmus, Populus, Fraxinus, Betula, Quercus and Pinus. Descriptive statistics was applied to compare the pollen season starts within the study period. The thermal seasons were designated on the basis of mean monthly temperature and the calculating method, which allows to calculate the date of air temperature transition over the threshold defining the beginning: 1) early spring (0°C); 2) spring (5°C); 3) early summer (10°C). Moreover, the sums of effective temperature above the threshold value (0°, 5° and 10°C) were calculated from the 1st of January or in some years, from the 1st of December of the year preceding the observation years.
The pollen seasons of the early-pollinating trees (Alnus, Corylus), started about the 25th of February, and varied evidently over a long term study up to 3 weeks. The pollen season beginning of the trees pollinating later (Ulmus, Populus, Fraxinus and Betula) fluctuated between the 26th of March and the 10th of April, and they were more stable than the early pollinating taxa. The later pollen seasons, of Quercus and Pinus were the most stable.
The preliminary results indicate, that the pollen season starts of Alnus and Corylus are strongly correlated with the beginning of thermal early spring ($rs=0.75-0.85$), the pollen seasons of the trees pollinating later (Ulmus, Populus, Fraxinus, Betula) are related to the thermal spring ($rs=0.45-0.55$) and finally, the pollen seasons of the late pollinating trees (Quercus and Pinus) are correlated significantly with the beginning of thermal early summer ($rs=\sim0.60$; $p<0.05$).
In case of Alnus and Corylus, which pollen seasons started in the most changeable weather conditions, the years of evident early (2002, 2008, 2014) and late season start (1992-1993, 2005-2006, 2013) were specified. The early pollen occurrence was caused by either short or mild winter, or by rapid warming over several days, which produced sudden tree pollination, although after this period meteorological conditions were again unfavorable. The late beginning of pollen seasons resulted from unfavorable meteorological conditions (low air temperature, low number of days with full insolation, long lasting snow cover).
The strong variability of tree pollen seasons, especially early-pollinating has an impact on the pollen allergy symptoms in sensitized patients, and can affect the immunotherapy, applied under control of the current pollen exposure.

Keywords: tree pollen, meteorological conditions, seasonal variability.

Airborne Quercus pollen behavior in 4 different bioclimatic areas, Jerusalem and Tel-Aviv (Israel); Tulsa, Oklahoma (USA); Córdoba (Spain)

I. Helfman-Hertzog[1], H. Kutiel[1], E. Levetin[2], C. Galán[3]

[1]*The department of Geography and Environmental studies, University of Haifa, Haifa, Israel*; [2]*Faculty of Biological Science, University of Tulsa, Tulsa, Oklahoma, USA*; [3]*Department of Botany, Ecology and Plant Physiology, University of Córdoba, Córdoba, Spain*

Introduction: *Quercus* (oak) is a large and widely distributed genus of trees in the Fagaceae. They flower during early spring. In recent years at different sites around the world, some *Quercus* species tend to flower earlier; such as 11 oak species in the Iberian Peninsula (Galan, et al, 2006). This study aims at determining the beginning and end of the *Quercus* pollination season in four different areas, to verify if the trend of earlier flowering is significant, and to analyze the impact of weather conditions during the main pollination season using three different methods for calculating the main pollination season.

Method: Airborne pollen was collected during 2010 to 2014 using a Hirst type volumetric spore trap. Each sampler was located near a meteorological station that measured local weather parameters. The main pollen season was determined using three percentage methods: 5%, 10% methods, which omit 2.5% and 5%, respectively at pollen season start and end. The third method was determining the pollen season limits as the period between the first and last days, respectively; registering 10% of the maximum daily concentration at the season start and end. A Shapiro-Wilk test was used to check for normality of *Quercus* pollen and weather data. Pollen concentrations were correlated with temperature, relative humidity, precipitation, wind speed and wind direction. Because data were not normally distributed, Spearman correlation was used.

Results: Using all three methods for Jerusalem and Tel-Aviv, the pollination season duration became shorter from 2010 to 2014. In Córdoba and Tulsa there was variability in the pollination season duration between the years. In all sites except Tel-Aviv, the pollination season started between the middle and end of March, in Tel-Aviv it started in mid-February. The pollination season ended between end of April and middle of May in all sites using all the three methods, except in Córdoba using the 5% method the season ended in mid-July.

In Jerusalem no significant correlation was found between pollen concentrations and meteorological parameters. Tel-Aviv and Tulsa showed positive correlations between *Quercus* pollen concentrations and temperature using the three methods; a negative correlation was found between *Quercus* pollen concentrations with relative humidity and rainfall during most of the years in all methods. The same trends were found in Córdoba except an opposite trend was found when using the 5% method.

Conclusions: During the five years of research, no changes in pollen season start were observed compared to previous research. At three sites, we found positive correlations between *Quercus* pollen and temperature and negative correlations with relative humidity and rainfall. The 5% method was not useful in Córdoba, as it created a long tail to the pollen season end. No preferred method to indicate higher correlation values was identified.

Keywords: Quercus, weather.

Airborne Pollen and Fungal Spores in Garki, Abuja (North-Central Nigeria)

O. T. Ogundipe, N. Ezike, O.H. Adekanmbi

Department of Botany, University of Lagos, Lagos, Nigeria

The ambient atmosphere is dominated with pollen and spores, which trigger allergic reactions and diseases and impact negatively on human health. A survey of pollen and fungalsporeconstituents of the atmosphere of Garki, Abuja (North-Central) Nigeria was carried out for one year (June 1st 2011-May 31st 2012). The aim of the study was to determine the prevalenceand abundance of pollen and fungal spores in the atmosphere and their relationship with meteorological parameters. Airborne samples were trapped using modifiedTauber-like pollen Trap, the recipient solutions were subjected toacetolysis. Results revealed the abundance of fungal spores, pollen, charredPoaceaecuticles, fern spores, algal cysts and diatoms in decreasing order of dominance. The atmosphere was qualitatively and quantitatively dominated by Poaceae, *Elaeis guineensis*, *Khaya senegalensis*, *Cyperus* spp., *Alchornea cordiforlia* and *Pentaclethra macrophylla* pollen during the late rainy/ harmattanseason than the rainy season. Numerous allergenic fungal spores were trapped throughout the sampling periods, among which*Alternaria*, *Fusarium*, *Cladosporium* and *Curvularia* dominated. These fungi have been implicated in allergic diseases and are dermatophytic, causing diverse skin diseases. Other pathogenic fungi found in the studied aeroflora were *Dreschlera*, *Helminthosporium*, *Torula*, *Pithomyces*, *Tetraploa*, *Nigrospora*, *Spadicoides*, *Puccinia* and *Erysiphe graminis*. Total pollen counts correlated negatively with rainfall, relative humidity and wind and positively with temperature. There was a positive but not significant correlation between the total fungal spores count and relative humidity

Keywords: Allergy, Atmosphere, Meteorological parameters, Pollen, Fungal spores, Garki.

Short seasons and nightly atmospheric circulation of allergenic pollen in Augsburg, Germany: is it really good news?

A. Damialis[1], F. Häring[2], J. Brunner[3], J. Buters[4], C. Traidl-Hoffmann[1]

[1]*1. Institute of Environmental Medicine, UNIKA-T, Technical University and Helmholtz Centre of Munich, Germany, 2. CK-CARE, Christine Kühne – Center for Allergy and Research and Education, Davos, Switzerland, Augsburg, Germany*; [2]*1. Institute of Environmental Medicine, UNIKA-T, Technical University and Helmholtz Centre of Munich, Germany, Augsburg, Germany*; [3]*Chair of Health Care Operations/Health Information Management, UNIKA-T, Faculty of Business and Economics, University of Augsburg, Germany, Augsburg, Germany*; [4]*1. ZAUM, Center of Allergy and Environment, Helmholtz Zentrum München, Technische Universität München, Germany, 2. CK-CARE, Christine Kühne – Center for Allergy and Research and Education, Davos, Switzerland., Munich, Germany*

Pollen dispersion has been widely studied worldwide due to the allergenic potency of specific plant species. However, few studies exist on the total biodiversity per study area and for multi-resolution timescales. The aim of the study was to estimate temporal patterns of airborne pollen abundance at yearly and bi-hourly scales for the whole spectrum of airborne pollen types.

Airborne pollen grains were collected in a bihourly basis in Augsburg, Germany, during 2015, using a 7-day recording Burkard volumetric trap. We estimated the total yearly pollen index and that of various pollen types. The pollen season start, peak and end, and duration were also detected. For the first time in Germany, the circadian rhythm for the total pollen diversity were investigated.

The pollen taxa with the highest atmospheric concentrations were (in descending order) grasses (Poaceae), birch (*Betula*), pine (*Pinus*), nettle (Urticaceae), spruce (*Picea*), ash (*Fraxinus*), oak (*Quercus*), cypress (Cupressaceae), plantain (*Plantago*) and poplar (*Populus*). Pollen of spruce, birch, ash, pine, grasses and oak contributed more than 80% to the total yearly concentration. Peak pollen concentrations can be as high as 1317 pollen per cubic metre for a day (from spruce and pine), 1249 from birch, 460 from grasses and 334 pollen per cubic metre of air from ash. Pollen season started mid- to late- March with hazel and alder and poplar. The peak of the pollen season was during April-May. Per taxon, the pollen season frequently lasted for less than one month (median=29 days). The shortest pollen season was observed in spruce (17 days) and the longest in plantain (119 days), alder (97 days) and nettle (79 days). Ragweed, mugwort, plantain and nettle pollen seasons lasted up to September. Birch pollen season started on 1 April and ended on 29 April, thus lasting for less than a month. Grasses pollen season started on 11 May and ended on 19 July, accounting for about 2.5 months. Regarding the circadian rhythm, pollen were observed in the air all day round. Most taxa exhibited clear diurnal pollen distribution patterns. Frequently, pollen peak concentrations occurred in the evening until early in the morning; fewer taxa displayed their peak daily counts during midday. Birch pollen were systematically higher during midnight, whereas grasses pollen during midday.

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Contrary to the widely-held assumption that the peak of airborne pollen is during midday (when temperature is higher), current results from Augsburg reveal a different situation: more pollen are often observed from the evening until early in the morning. Given the usually short duration of pollen season for many taxa and the very high annual pollen index for some of them, distribution of allergenic pollen for only some hours during the day can have dire effects for allergic patients. This information is valuable for everyday allergy management, so as to elaborate reliable forecasts of high-risk periods.

Keywords: Aerobiology, Biometeorology, Environmental Health.

Winter Pollination of Betula in South Anatolia – Is it Fact or Fiction?

A. Tosunoglu, A. Bicakci

Biology, Uludag University, Nilufer, Bursa, Turkey

Birch trees are monoecious, wind-pollinated and successful forest trees with wide distribution, covering many mid-sites of Europe and Asia. They start to flower at the age of 10-15 years and the female flowers usually become available for pollinating one day before the male flowers of the same tree; therefore, cross pollination is strongly preferred.

In Europe, the main pollination seasons of Betula begin in late April to late May in the north, at the end of March in the west and from the beginning to mid- April in central and east. Also, shorter or longer periods, low or high pollen concentrations can be seen in various European regions. Many cites were investigated before in terms of atmospheric pollen in Turkey. About the general and usual pollination of Betula, the main flowering period usually starts at the end of March and continues to mid-May.

In Turkey, species of Betula are naturally growing in the north and east parts of the country, but especially *Betula pendula* is a common tree which is frequently planted in parks, gardens, and roadsides of south Anatolia. If we think out of long range transport from the north, pollen grains of planted birch trees can be considered as allergen pollen source for this region. It is clearly known that, birch pollen induces a considerable clinical problem for up to 10 – 20% of the population in Europe.

In this work, we performed airborne pollen sampling volumetrically by Hirst type samplers in 3 different cities from Mediterranean region of Turkey (Hatay, Osmaniye, Kahramanmaraş), added our previous aeropalynological data for 2 cities (Antalya, Bodrum) and evaluate the unusual phenomenon; winter pollination of Betula for the region. Nevertheless, in southern Anatolia namely Mediterranean coast; we observed interesting peaks of Betula pollen grains in sampling cities, which were warning about the winter pollination of birch trees. The first flowering period was found generally between February and May, and the second period was from October to December.

The winter peak of birch trees may be the result of the light climate of the study area. Considering the well development of male flowers of Betula in late summer period in this region; termination of chilling temperatures may have followed by broken dormancy in early winter and may hinder the start of ontogenetic development. There is evidence that light climate plays a role in the start of this development and enables early pollen dispersal. Although atmospheric sampling and pollen identifications shows proofs for winter pollination of Betula in south Anatolia, it raised additional questions about the flowering phenology of widely used non-native species in parks and gardens.

Foundation: Tubitak-KBAG-212T135 research project.

Keywords: Birch, Winter pollination, Turkey.

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Case Study France: Analysis of plant occupation of public green spaces

S. Monnier, M. Thibaudon

RNSA, Brussieu, France

RNSA is part of an AIS (Aerobiological Information Systems and allergic respiratory disease management) Life project (2014-2017). The project aim is to develop the information base for policy on environment and health, in term of improved management of pollen-related allergic respiratory diseases in Europe.
In this project a case study has been implemented in France in order to provide recommendations for plant occupation of public green areas.
The specific objectives of this case-study are to assess pollen counts and allergen content in public gardens and on basis of the obtained results to formulate recommendations in order to protect allergic patients.
Two types of pollen traps are used in this study: Hirst pollen trap and Sigma 2 passive pollen trap (SLT). The SLT pollen traps are used for analysis of local pollen dispersion.
Within this case study, 7 Sigma 2 passive pollen traps (SLT) have been set up in two towns of France (Paris/Lyon) during the pollen season, in order to assess pollen count. In addition to these SLT pollen traps, 4 Hirst pollen traps are also used for this case study (2 in Lyon and 2 in Paris). Statistical descriptive analyses are conducted to obtain the distribution of the pollens in the gardens according to the 2 sampling methods.
The Sigma 2 pollen traps were implanted in public gardens over the ground at about 70 cm. These pollen traps were installed in proximity position in public gardens. Every day, the slides was changed and sent to the analysis laboratory where the slide containing biological particles have been analyzed by optical microscopy by a trained analyst. All the analyses are undertaken by RNSA in France. The first campaign of measurement was in 2015 (March-June) and the second measurement campaign in 2016 (March-June). The first results of the first campaign are interesting and the daily pollen data from Hirst pollen trap and Sigma 2 pollen traps has been statistically compared.
The results of this first measurement campaign show that there is a lot of allergenic species in the green gardens in Paris and Lyon like *Cupressaceae*, Birch, plane tree….
We need to take in consideration the health impact in the choice of vegetal species to implant in green areas and avoid to plant allergenic species.
A guide has been done with advices for species to avoid and species to plant in the green areas and parks in France: http://www.vegetation-en-ville.org/PDF/Guide-Vegetation.pdf.
The statistics of the results must be developed with meteorological and air pollution data in order to have a better representation of the results and take several parameters into consideration.
Characteristics of the project:
Project title: Aerobiological information Systems and allergic respiratory disease management? Project funded by LIFE 13ENV/IT/001107.
The project will be implemented in the following member State(s): Austria, Italy, France.
List of beneficiaries: Universita degli Studi di Firenze (dipartimento di Scienze delle Produzioni Agroalimentari e dell'Ambiente), Consiglio Nazionale delle Ricerche, Medizinische Universitaet Wien, Réseau National de Surveillance Aérobiologique, University of Pisa (department of Biology), Université Pierre et Marie-Curie.
Funding: European Union (EU).

Keywords: pollen, allergy, study.

Analysis of airborne *Ambrosia* pollen in Europe within the framework of Cost SMARTER

B. Sikoparija[1]; C. A. Skjøth[2*]; S. Celenk[3]; C. Testoni[4]; T. Abramidze[5]; K. Alm Kübler[6]; J. Belmonte[7]; U. E. Berger[8]; M. Bonini[4]; A. Charalampopoulos[9]; A. Damialis[9,10]; B. Clot[11]; Å. Dahl*; L. de Weger*; R. Gehrig[11]; M. Hendrickx*; L. Hoebeke*; N. Ianovici*; A. Kofol Seliger*; D. Magyar*; G. Mányoki*; S. Milkovska*; D. Myszkowska*; A. Páldy*; C. H. Pashley*; K. Rasmussen*; O. Ritenberga*; V. Rodinkova*; O. Rybníček*; V. Shalaboda*; I. Šaulienė*; J. Ščevková*; B. Stjepanović*; M. Thibaudon*; C. Verstraeten*; D. Vokou[9]; R. Yankova*; M. Smith*

[1]*Research Institute for Information Technologies in Biosystems, BioSense Institute, Novi Sad, Serbia;* [2]*Institute of Science and the Environment, University of Worcester, Worcester, United Kingdom;* [3]*Biology department, Science Faculty, Uludağ University, Bursa, Turkey;* [4]*Local Health Authority, Milano Città Metropolitana, Milano, Italy;* [5]*Center of Allergy and Immunology, Tbilisi, Georgia;* [6]*Swedish Museum of Natural History, Stockholm, Sweden;* [7]*Institute of Environmental Science and Technology (ICTA), Universitat Autònoma de Barcelona, Barcelona, Spain;* [8]*University Department of Ear, Nose and Throat Diseases, Medical University of Vienna, Vienna, Austria;* [9]*Department of Ecology, School of Biology, Aristotle University, Thessaloniki, Greece;* [10]*Federal Office of Meteorology and Climatology MeteoSwiss, Payerne, Switzerland;* [11]*Department of Plant and Environmental Sciences, University of Gothenburg, Gothenburg, Sweden; *al.*

Cost SMARTER aims to develop new innovative solutions for the sustainable management of *Ambrosia artemisiifolia* L. in Europe and to assess their cost-effectiveness. This study provides a baseline for the management and evaluation of this noxious plant by examining geographic and temporal variations in atmospheric *Ambrosia* pollen.
Airborne *Ambrosia* pollen data for the peak flowering period of *Ambrosia* (August-September), recorded during a 10-year period (2004-2013), were obtained from 242 monitoring sites. The mean sum of daily average airborne *Ambrosia* pollen and the number of days that *Ambrosia* pollen was recorded in the air were analysed. Mean values were calculated regardless of the number of years included in the study period. Linear trends were calculated and presented for sites with at least 80% records (>= 8 years). Trends were considered significant at $p < 0.05$.
There were few significant trends in the magnitude and frequency of atmospheric *Ambrosia* pollen (only 8% for the mean sum of daily average *Ambrosia* pollen concentrations and 14% for the mean number of days *Ambrosia* pollen was recorded in the air). The direction of any changes varied locally and reflect changes in sources of the pollen, either in size or in distance from the monitoring station. Pollen monitoring is important for providing an early warning of the expansion of this invasive and noxious plant.

Keywords: common ragweed, invasive alien species, pollen exposure.

Risk assessment of the leaf beetle *Ophraella communa*, a biological control candidate for *Ambrosia artemisiifolia*

H. Müller-Schärer[1], COST SMARTER team[2]

[1]*Biology, University of Fribourg, Fribourg, Fribourg, Switzerland*; [2]*http://ragweed.eu/task-forces/task-force-ophraella/, EU, Brussels, Belgium*

Common ragweed, *Ambrosia artemisiifolia* (L.), is a worldwide invasive weed originating from North America. This annual plant is causing great damage to our society due its highly allergenic pollen, and because it grows as a weed in many crops in Europe, where it is hard to control. The leaf beetle *Ophraella communa*, also native to North America, was accidently introduced into many countries in eastern Asia, where it is currently used as a successful biological control agent against ragweed. During field surveys in 2013 conducted in the frame of the EU-COST Action on "Sustainable management of *Ambrosia artemisiifolia* in Europe (SMARTER)" we found this beetle in more than 130 sites in Switzerland and Italy. During 2014 and 2015, this beetle extended its range by more than 300 km both west- and eastwards. Where it occurs, it significantly reduced pollen concentrations in the air and can cause complete defoliation and death of ragweed before flowering. Before the beetle can be actively spread to control ragweed across Europe, detailed target effects (efficiency) and non-target effects (host specificity) have to be conducted in order to balance benefits with costs. During 2014 and 2015, we conducted extensive host specificity tests both under controlled quarantine conditions and in open field tests in Northern Italy, using various designs for oviposition, and egg and larval transfer tests and both under no-choice and choice conditions. Test plants included other *Ambrosia* species occurring in Europe, taxonomically closely related crop plants (*Helianthus annuus* and *H. tuberosus*) and other native and exotic plant species. I will summarize these results together with a presently ongoing field experiment exposing sunflower seedlings to naturally overwintering *O. communa* in Northern Italy. In my conclusions, I will focus on potential risk by *O. communa* for sunflower used for oil production, green manure or as ornamentals, and for closely related native endangered species.

Keywords: ragweed, biocontrol, risk assessment.

The potential impact of an exotic beetle on ragweed pollen in Europe

S. Lommen[1] & the SMARTER Task Force Ophraella[2]

[1]*Dept. Biology, University of Fribourg, Fribourg, Switzerland*; [2]*European COST Action 'SMARTER', managed in, Fribourg, Switzerland*

The North American ragweed leaf beetle, *Ophraella communa*, is a candidate for biological control of common ragweed, *Ambrosia artemisiifolia*, in Europe, where this highly invasive, allergenic plant is widespread. The beetle larvae as well as the adults feed preferably from ragweed, and the species is already successfully used as a biocontrol in China. Since a few years, the beetle has established in large parts of Northern Italy and southern Switzerland, and climatic niche models indicate that it can expand its current distribution in Europe. We here present our first results on its potential impact on ragweed pollen production.
Field studies on natural *Ambrosia* populations in Northern Italy show that the impact of the beetle is highly context-dependent and extremely variable, varying locally and temporally, and from hardly any damage to ragweed, up to complete destruction before flowering and preventing any pollen release. We use population dynamics models to project the corresponding consequences for long-term ragweed population growth for these scenarios.
In the cases where ragweed was attacked but not killed before flowering, we also found a reduction in pollen release, due to destruction of the male flower heads. A preliminary laboratory experiment indicated that the viability and allergenicity of pollen grains of such defoliated plants is unaltered.
Altogether, we prove that *O. communa* can contribute to a reduction of the amount of airborne ragweed pollen under European conditions. This supports findings of reduced atmospheric concentrations of ragweed pollen in the Milan region since the beetle has there been recorded.

Keywords: biological control, defoliation, allergenicity.

Ophraella communa and ragweed pollen reduction in the air of Northern Italy

M. Bonini[1], B. Šikoparija[2], M. Prentović[3], G. Cislaghi[1], P. Colombo[1], C. Testoni[1], Ł. Grewling[4], S. Lommen[5], H. Müller-Schärer[5], M. Smith[4]

[1]*Department of Medical Prevention, Local Health Authority Milano Città Metropolitana, Parabiago, Milan, Italy*; [2]*BioSense Institute - Research Institute for Information Technologies in Biosystems, University of Novi Sad, Novi Sad, Serbia*; [3]*Research Group Aerobiology and Pollen information, Department of Oto-Rhino-Laryngology, Medical University of Vienna, Vienna, Austria;* [4]*Laboratory of Aeropalynology, Faculty of Biology, Adam Mickiewicz University, Poznań, Poland*; [5]*Department Biology, University of Fribourg, Fribourg, Switzerland*

The North American invasive alien *Ambrosia artemisiifolia* L. is considered to be an important weed in agriculture and source of highly allergenic pollen in many parts of the world, including Europe. The oligophagous leaf beetle *Ophraella communa* LeSage preferably feeds from *A. artemisiifolia*, and is successfully used as a biological agent to control this weed in China. It can prevent plants from producing pollen and seeds when it damages them before flowering. In 2013, this beetle was found in Southern Switzerland and Northern Italy, with high incidence and densities in the Milan area. European COST Action FA1203 (SMARTER, http://ragweed.eu) “Task Force *Ophraella*” is continuing to monitor the dynamics of *O. communa* and *A. artemisiifolia* in Northern Italy. We have previously shown, using linear regression models, that the exceptionally low amounts of airborne *Ambrosia* pollen observed in the Milan area in 2013 and 2014 could not be explained by meteorology in those years. We therefore suggested that the decrease might be related to the presence of large numbers of *O.communa*. We subsequently decided to examine airborne *Ambrosia* pollen levels and meteorological data recorded in 2015, the warmest year since 1880, to see whether *Ambrosia* pollen levels were higher or lower than expected at this time using the same regression models used in our earlier study.

Atmospheric concentrations of *Ambrosia* pollen are routinely monitored in the Milan region by sites belonging to the *LHA Milano Città Metropolitana* using volumetric spore traps. *Ambrosia* pollen data recorded at Legnano were used for the analysis, as this is the closest pollen-monitoring station to Malpensa airport where the meteorological data were collected. The variables of monthly meteorological data were consequently entered into one simple linear regression model and two multiple linear regression models that were constructed to predict the amount of *Ambrosia* pollen recorded at Legnano.

The trend towards lower amounts of airborne *Ambrosia* pollen recorded at Legnano, which was noted in the previous study, continued. The 2015 airborne pollen season was the third lowest since 2000, this was repeated at the other two stations in the Milan area - Magenta and Rho. The three linear regression models highly overestimated the amount of airborne *Ambrosia* pollen recorded in August and September in 2015.

In conclusion, we provide evidence that the presence of *O. communa* may again explain the lower levels of *Ambrosia* pollen recorded in the Milan region in 2015. On-going research aims to experimentally study the effect of meteorology on *Ophraella* development and on the impact of *Ophraella* on *Ambrosia* plant survival, pollen production and pollen release along an elevational gradient starting from the Milan area northwards, as well as to assess its health and economic impact.

Acknowledgments: We acknowledge support from EU COST Action FA1203 ″Sustainable management of *Ambrosia artemisiifolia* in Europe (SMARTER) ″ (http://ragweed.eu).

Keywords: Ambrosia, Ophraella communa, Italy.

Italian ragweed pollen inventory

C. Skjoth[1], C. Testoni[2], B. Sikoparija[3], A.I.A.-R.I.M.A.® [4], POLLnet[5], M. Smith[6], M. Bonini[2]

[1]*Institute of Science and the Environment, University of Worcester, Worcester, United Kingdom*; [2]*Department of Medical Prevention, Local Health Authority Milano Città Metropolitana, Parabiago (MI), Italy*; [3]*BioSense Institute, Research Institute for Information Technologies in Biosystems, University of Novi Sad, Novi Sad, Serbia*; [4]*Italian Monitoring Network in Aerobiology of the Italian Association of Aerobiology, Italy*; [5]*Italian Aerobiology Monitoring Network, Italy*; [6]*Faculty of Biology, Adam Mickiewicz University, Poznan, Poland*

This study provides the first spatially detailed and complete inventory of *Ambrosia* pollen sources in Italy – the third largest centre of ragweed in Europe. The inventory relies on a well tested top-down approach that combines local knowledge, detailed land cover, pollen observations and a digital elevation model that assumes permanent ragweed populations mainly grow below 745m.

The pollen data were obtained from 92 volumetric pollen traps located throughout Italy during 2004-2013. Land cover is derived from Corine Land cover information with 100m resolution. The digital elevation model is based on the NASA shuttle radar mission with 90m resolution. The inventory is produced using a combination of ArcGIS and Python for automation and validated using cross-correlation and has a final resolution of 5km x 5km. The method includes a harmonization of the inventory with other European inventories for the Pannonian Plain, France and Austria in order to provide a coherent picture of all major ragweed sources.

The results show that the mean annual pollen index varies from 0 in South Italy to 6779 in the Po Valley. The results also show that very large pollen indexes are observed in the Milan region, but this region has smaller amounts of ragweed habitats compared to other parts of the Po Valley and known ragweed areas in France and the Pannonian Plain. A significant decrease in *Ambrosia* pollen concentrations was recorded in 2013 by pollen monitoring stations located in the Po Valley, particularly in the Northwest of Milan. This was the same year as the appearance of the *Ophraella communa* leaf beetle in Northern Italy.

These results suggest that ragweed habitats near to the Milan region have very high densities of *Ambrosia* plants compared to other known ragweed habitats in Europe. The Milan region therefore appears to contain habitats with the largest ragweed infestation in Europe, but a smaller amount of habitats is a likely cause the pollen index to be lower compared to central parts of the Pannonian Plain. A low number of densely packed habitats may have increased the impact of the *Ophraella* beetle and might account for the documented decrease in airborne *Ambrosia* pollen levels, an event that cannot be explained by meteorology alone. Further investigations that model atmospheric pollen before and after the appearance of the beetle in this part of Northern Italy are needed to assess the influence of the beetle on airborne *Ambrosia* pollen concentrations. Future work will focus on short distance transport episodes for stations located in the Po Valley, and long distance transport events for stations in Central Italy that exhibit peaks in daily airborne *Ambrosia* pollen levels.

Estimating the economic effects of *Ophraella communa* on common ragweed pollen risks in South-Eastern France

R. Mouttet[1], M. Bonini[2], B. Chauvel[3], E. Gachet[4], T. Le Bourgeois[5], H. Müller-Schärer[6], M. Thibaudon[7], U. Schaffner[8]

[1]*Anses, Montferrier-sur-Lez, France*; [2]*Department of Medical Prevention, Local Health Authority Milano Città Metropolitana, Parabiago (MI), Italy*; [3]*INRA, Dijon, France*; [4]*Anses, Angers, France*; [5]*Cirad, Montpellier, France*; [6]*University of Fribourg, Fribourg, Switzerland*; [7]*RNSA, Brussieu, France*; [8]*CABI, Delémont, Switzerland*

Common ragweed, *Ambrosia artemisiifolia* L. (Asteraceae) is an invasive weed of North American origin that is widespread on other continents, including Asia, Australia and Europe. In Europe, its economic impacts were recently estimated to amount several billion Euros annually. In 2013, the ragweed leaf beetle *Ophraella communa*, which is native to North America and used as biological control agent of *Ambrosia artemisiifolia* in China, was detected at various sites in southern Switzerland and northern Italy. At sites where the beetle was present, up to 100% of the plants were attacked with damage levels high enough to completely defoliate and prevent flowering and seed set of most ragweed plants. Pollen monitoring studies in the Milano area revealed that since the establishment of *O. communa* ragweed pollen concentrations have dropped by approximately 80%. In the frame of a mandate by the French Ministries of Health, Agriculture and Environment, a working group was put together by the French agency for food, environmental and occupational health and safety (Anses) in order to assess both the potential risks and benefits of an establishment of *O. communa* in France. Capitalizing on a unique data set on the number of days with a ragweed pollen risk of > 3 (threshold of pollen concentration at which 100% of sensitive people express symptoms) and on the economic impacts of ragweed pollen in the Rhône-Alpes region in south-eastern France, we extrapolated the results of pollen concentration reduction observed in northern Italy to compare the potential economic effects of an establishment of *O. communa* in the Rhône-Alpes with the current costs inflicted by common ragweed in this heavily invaded region.

Keywords: *Ophraella communa*, *Ambrosia artemisiifolia* L.

Results of the European Quality Control exercise for *Ambrosia* pollen

B. Sikoparija[1], C. Galán[2], M. Smith[3], E. QC Working Group[4]

[1]*Research Institute for Information Technologies in Biosystems, BioSense Institute, Novi Sad, Serbia*; [2]*Department of Botany, Ecology and Plant Physiology, University of Córdoba, Córdoba, Spain*; [3]*Institute of Science and the Environment, University of Worcester, Worcester, United Kingdom*; [4]*European Aerobiology Society, International Aerobiology Association*

This study presents the results of a Europe-wide training and Quality Control (QC) exercise carried out within the framework of the European Aerobiology Society's QC Working Group and European COST Action FA1203 entitled "sustainable management of *Ambrosia artemisiifolia* in Europe (SMARTER)" and strengthened by the International Ragweed Society
A total of 69 analysts from 20 countries examined a test slide by light microscopy, which contained *Ambrosia* pollen and pollen from other Asteraceae that could be recorded in the atmosphere at the same time of year (i.e. *Artemisia, Iva,* and *Xanthium*). Daily average pollen concentrations produced by individual participants were compared with the assigned value and the bias was measured by z-score. Both the assigned value and standard deviation for proficiency testing were calculated following the consensus value principle (ISO 13528:2005) from the results reported by all the participants in the test.
It took a total of 531 days from when the exercise commenced until all 69 analysts reported their results. The most outliers were reported for *Artemisia* pollen concentrations followed by *Xanthium* and *Iva*. The poor results for *Artemisia* and *Xanthium* were probably caused by low concentrations on the test slide leading to larger bias due to unequal distribution of pollen over the microscope slide. Participants performed the best in identifying and quantifying *Ambrosia* pollen.
Performing inter laboratory ring tests with the same sample is very time consuming and might not be appropriate for large scale proficiency testing in aerobiology. Pollen with similar morphology should be included in the training process of aerobiologists.

Keywords: Aerobiology, Ambrosia, Quality Control.

Relationships between ragweed and mugwort pollen seasonal parameters and assessment of their potential impact on health

C. Testoni[1], E. Chiodini[2], D. Berra[2], G. Cislaghi[1], P. Colombo[1], M. Bonini[1]

[1]*Department of Medical Prevention, LHA Milano - Città Metropolitana, Parabiago, Milan, Italy*; [2]*Ospedale di Circolo Busto Arsizio, ASST Valle Olona, Busto Arsizio, Milan, Italy*

Background: Ragweed and mugwort are allergenic weeds, belonging to the *Compositae* family, having the same habitat, flowering in a quite similar period (August/September/October), diffused in the North Western Milan and South Varese area, one of the zones most infested by ragweed in Europe and where the leaf beetle *Ophraella communa* has spread from 2013. The aim of this study is to analyze the ragweed and mugwort pollen data obtained from aerobiological monitoring stations located in four towns in the above area and to assess the potential impact of their pollen levels on people.
Materials and Methods: The station of Legnano (L) is in function since 1995, Busto Arsizio (B) since 1998, Rho (R) and Magenta (M) since 2000. Pollen were sampled by Hirst volumetric traps. Data were analyzed and the significance of trends was assessed using a nonparametric statistical – Cox and Stuart test ($p<0.05$ significant). For each station and for every year, ragweed and mugwort Seasonal Pollen Index (SPI), peak value and its day and number of days exceeding the clinical thresholds proposed from various authors were assessed. The two periods since 1998 and 2000, the year after the first Regional preventive measure against ragweed, were analyzed in detail.
Results: The main results are reported below. Ragweed in B showed a greater SPI (avg=6194) than M (avg=5124), R (avg=4101) and L (avg=4030). A significant ragweed SPI downtrend was observed for L ($p=0.035$) and R ($p=0.035$). The highest peak value (C max) was observed in 2007 in M (1125 p/m^3), in 2009 in B (780 p/m^3), in 2006 in L (737 p/m^3), in 2002 in R (585 p/m^3). Significant C max downtrends were observed for B ($p=0.035$) and for L ($p=0.004$). B showed the highest number of days exceeding both the two ragweed upper clinical thresholds of 50 p/m^3 (avg=21 days) and 100 p/m^3 (avg=28 days). The highest mugwort SPI was found in R (avg=429), whilst in L, B and M was respectively lower (394, 384 and 266). A significant mugwort SPI downtrend was observed for L ($p=0.020$) and M ($p=0.035$). The highest mugwort C max was observed in 2000 for R (83 p/m^3) and for M (56 p/m^3), in 2002 for B (69 p/m^3), in 1999 for L (59 p/m^3). Significant C max downtrends were observed for all stations ($p=0.020$ for L and B; $p=0.035$ for M and R); significant Day C max uptrend was observed for R ($p=0.004$) and for B and L (both $p=0.020$). R showed the highest number of days exceeding the mugwort upper clinical threshold of 15 p/m^3 (avg=7 days).
Conclusions: Since 2000, due to the efficiency of prevention measures against ragweed and also to the spread of the leaf beetle *O. communa*, significant decreases in the SPI (for L and R) and in C max (for B and L) were observed. Despite this, ragweed still exerts a high pressure on mugwort: the Day C max of mugwort pollen is postponed and all other seasonal parameters show downtrends. People of this area are still exposed to ragweed values far above the upper clinical thresholds and less exposed to mugwort pollen.

Keywords: Ragweed, Mugwort, Pollen exposure.

Stability of ragweed populations in Central Russia: self-maintenance or seed import?

E. Severova, O. Volkova, S. Mayorov

Moscow State University, Moscow, Russia

Pollen of *Ambrosia* is an important aeroallergen that causes severe respiratory allergies during the late summer. *Ambrosia* pollen has been observed in the air of Moscow since 2001. Total annual catch varied from 1 pg/m^3 (2002) to 180 pg/m^3 (2006), peak values were usually registered during the last decade of August, maximal daily count was 74 pg/m^3 (2004). No temporal trends in total annual sums has been observed during the period 2001-2015. Previous investigations of diurnal variation of *Ambrosia* pollen showed that at least some pollen was local. Two species of *Ambrosia*, *A. artemisifolia* and *A. trifida*, are common in the South and South-east of Russia. Small populations of these species are known from all regions in the central part of European Russia. *Ambrosia* expansion to the North and North-West is dependent on local seed production and seed import. The aim of this study was to investigate if *Ambrosia* is able to survive during winter and to produce mature seeds in the central part of Russia or local populations in this Moscow area are totally maintained by seed import.

Seeds of *A. artemisifolia* and *A. trifida* were collected in natural populations and disseminated on November 2014 and April 2015 in cultivated soil in the Botanical Garden of Moscow State University. Seedlings of both species appeared in the middle of May, but germination ability of winter-planted seed were higher (*A. artemisifolia* 45%, *A. trifida* - 22%) than that of spring-crops (3 and 3,5% correspondingly). The time difference between phenological stages of winter and spring crops for both species was 1-2 weeks, but winter planted individuals were more robust. *A. trifida* was about a month ahead comparing with *A. artemisifolia*: the start of flowering was observed during the last decade of July, start of fructification - at the beginning of September. Mature seeds were collected at the end of October. The flowering period for *A.artemisifolia* (winter crops) was from the last decade of August till the end of October, the first fruits appeared during the last decade of October, but did not get the maturity because of serious frosts at the beginning of November. Light frosts in October did not affect the plants. Spring-planted individuals did not form seeds at all.

As a result, both *A. artemisifolia* and *A. trifida* showed the ability to survive during winter, stratification is a necessary stage for successful germination. *A. trifida* seems to be more adapted to the climatic conditions of Central Russia. This species is able to pass through the life cycle from seed to seed, while *A. artemisifolia* is not in time with seed maturation. Possibly the sustentation of *A. artemisifolia* populations more depends on seed import, while populations of *A. trifida* can be maintained by the own seed reproduction.

The study was funding by grant 14-50-00029 of Russian Science Foundation (RNF).

Keywords: Ambrosia, phenology, Central Russia.

2015: evolution of *Ambrosia* pollen concentration in 5 traps in the Rhone-Alpes Region by AFEDA

C. Déchamp[1], H. Méon[2], G. Guignard[3], J. Belmonte[4]

[1]*Association Française d'Etude des Ambroisies, Saint-Priest, France;* [2]*Ens Lyon, CNRS UMR 5276, LGL-TPE, Université Claude-Bernard Lyon 1, Villeurbanne, France;* [3]*CNRS UMR 5023 LEHNA, Université Claude-Bernard Lyon 1, Villeurbanne, France;* [4]*Biologia Animal, Biologia Vegetal i Ecologia, Universitat Autònoma de Barcelona, Bellaterra, Spain*

Since about 50 years, short ragweed is the first source of pollen related allergy in Lyon. So the French Association, for Ragweed Study, created in 1982, installed the first pollen monitoring station in the Lyon-Bron meteorological station (Lyon-East). The *Ambrosia* pollen, like every pollen, were collected by a Cour trap, always at the height of three meters. The concentrations are expressed as the number of pollen per one cubic meter. Studied criteria are the seasonal index, the weekly average concentrations, the weekly pollen peak, the length of the allergic risk in week (threshold 5), the length of the invalidating allergic risk (threshold 100).
In 2015 the Association treated 5 sites in the Rhone-Alpes Region: Belley, Ambérieu, Lyon-Bron, Nord-Isère (Lyon-Saint-Exupéry), Montélimar. The aim of the study was to evaluate the efficacy of the fight against the weeds and the evolution of the health criteria for an *Ambrosia* pollen allergic.
In the Ain department: Belley town was a control site, Ambérieu-Château-Gaillard was a site to supervise. In the Rhône department: Lyon-Bron was a site to supervise. In the Nord-Isère area: Lyon-Saint-Exupéry (Lyon-Great-East) was a site to supervise. In the Drome department, Montélimar-Ancône, was a site to supervise.
Belley a control site is stable and concentrations are less than 5 grains /m^3. In Ambérieu, the weekly season index, that was more or less stable from 2005 to 2014, increased 10 times in 2015. In Lyon-Bron, the weekly season index, that was decreasing since 1998, increased 5 times since 2014, fortunately rain arrived weeks 36 and 37! In Nord-Isère (Lyon-Saint-Exupéry), where concentrations were decreasing since the monitoring start in 1996, increased more than twice from 2014 to 2015, fortunately rain arrived week 37! At the end, Montélimar, that was the site where the concentrations were the highest in the past, decreased because precipitations were 206 mm week 37.
So everywhere except in the control station, *Ambrosia* pollen concentrations increased in the most *Ambrosia* polluted areas in France in 2015. The pollen season was very difficult for patients and fight against the weed was insufficient.

Impact of meteorological conditions on seasonal pollen index: outcome of 35 years of pollen re-analysis

M. Sofiev

Atmospheric Composition Research, Finnish Meteorological Institute, Helsinki, Finland

This discussion paper considers the effect of pollen transport conditions on the seasonal pollen index (SPI) and reveals the contribution of these factors to the SPI inter-annual variability. The consideration is based on a 35-years-long re-analysis 1980-2014 made with SILAM for all 6 pollen types presently simulated by the model.
The primary attention is paid to the impact of meteorological contribution on the SPI, which is quantified and shown to be a noticeable fraction to the SPI variability observed at the monitoring sites and presently attributed to the plant reproduction cycles. The re-analysis of pollen seasons in 1980-2014 was used to compute the SPI inter-annual variability with meteorological effects singled out. Throughout the re-analysis, the source term formulations and habitation maps were kept constant, which allowed attributing the obtained variability exclusively to the pollen release and transport conditions during the flowering seasons. It is shown that the effect is substantial. In particular, it amounts to 10-20% (grass) and 20-40% (birch) of the observed SPI year-to-year changes reported in literature. The phenomenon has well-pronounced spatial and taxon-specific patterns. In particular, the long-transported taxa, such as birch, showed higher sensitivity to inter-annual meteorological variability. The findings were compared with observation-based statistical models for the SPI prediction showing that such models highlight the same processes as the analysis with the SILAM model.
The re-analysis also revealed meteorology-induced trends of the SPI, which appeared not very large but still noticeable in some regions and for some taxa. Apart from changes in the season timing, such trends can serve as additional characteristic of the impact of climate change on the airborne pollen load in Europe.

Keywords: pollen reanalysis, interannual variability, seasonal pollen index.

Controversial study: autumn vs spring conditions

L. Sukiene[1], I. Sauliene[1], V. Kazlauskiene[2]

[1]*Siauliai University, Siauliai, Lithuania*; [2]*Lithuanian Hydrometeorological Service, Vilnius, Lithuania*

Plant biennial/triennial bearing strategy is well-known in horticulture. This situation is manageable and under control with intervention by using mechanical or chemical tools and harvest is successfully collected every year. A completely different situation is in nature where plant pollen load varies from year to year. Climatic conditions and physiological characteristics of plant is not under human control, but in order to increase the number of healthy days of life in a society where sensitivity to pollen allergens grows quickly, we are dealing with the so far unresolved issues. One of the key issues in shaping pollen forecasts is the issue of determination the correct emission start time. It is quite successfully dealing with counting an accumulation air temperature and humidity. However, the most difficult underlying problem is the forecast of pollen in the air in ordinary and during peak days as well. Anemophilous woody plants form the biggest amount of pollens, so disclosure causality of pollen emission intensity is important both for biodiversity and human health. To finding new knowledge in this a complex system, we analyzed impact meteorological conditions on the formation of pollen in the second half of the year. It is also considered association of cold-period changes and pollen fluctuation. We discuss relationship between meteorological conditions and woody plant behaviour in releasing of pollen.

Keywords: pollen emission, case study, Lithuania.

Survey of biological ice nucleators in precipitation at the rural site of Opme, Puy-de-Dôme, France

P. Amato[1], E. Stopelli[2], M. Sancelme[1], L. Nauton[1], L. Zimmerman[2], J.-L. Baray[3], F. Conen[2]

[1]*Institut de Chimie de Clermont-Ferrand, CNRS/Clermont Université, Aubière, France*; [2]*Department of Environmental Sciences, University of Basel, Basel, Switzerland*; [3]*OPGC/LaMP, CNRS/Clermont Université, Aubière, France*

Ice formation in clouds directly impacts Earth's radiative budget and often leads to precipitation. At temperatures above -39°C, freezing requires the presence of a particle, so called ice nucleating particle (INP). This catalyses the arrangement of water molecules into ice crystals and favors freezing of supercooled water at a temperature depending on the structural and surface properties of the particle. The most efficient INPs existing in nature are biological: while mineral aerosols do not trigger freezing at temperatures warmer than -10°C, biological particles (notably the bacterium species *Pseudomonas syringae*) can induce water freezing at up to -2°C. Biological INPs were shown to be widespread in the air, clouds and precipitation, and their abundance related to oxygen isotope ratios measurements in rainwater, which suggests their probable influence on freezing processes in the atmosphere and in the subsequent triggering of precipitation (this hypothesis has been termed bioprecipitation). In addition, *P. syringae* was reported in relatively high numbers along all the water cycle, including air, clouds and precipitation. However, the long temporal variability of such biological INPs in the atmosphere at a given site and its relation with local meteorology remains largely unclear. To date, there is no long term survey of biological INPs in the environment, but this is particularly critical for comprehending their role in the occurrence of precipitation at regional, then to global scale. We have set-up an automatic rain collector at the atmospheric observatory of Opme, puy-de-Dôme, France (altitude 680 m), for monitoring ice nucleation activity, focusing on biological particles. Ice nucleation profiles are measured systematically for every rain sample between 0°C and -15°C by immersion freezing assays using a semi-automatized instrument. This comprises a cryostat equipped with a camera and temperature probes, associated with a software for image analysis and data acquisition. Many relevant metadata are collected along: meteorological parameters, oxygen isotopes ratio and pH of rainwater, microbial cultures. The set up and the results of the survey since it is operating in October 2015 will be presented and discussed into environmental context.

Keywords: observatory, ice nucleating particles, bioprecipitation.

Estimating the bacterial source strength and the downwind influence of outdoor composting platforms

Y. Brunet[1], A. Galès[2], J.-J. Godon[2], N. Wéry[2]

[1]*ISPA, INRA, Villenave d'Ornon, France*; [2]*LBE, INRA, Narbonne, France*

Active and passive emission processes at composting sites result in the release of microorganisms that can then be transported by the atmospheric flow over some distance before they settle. Determining the impact of compost operations on bacterial source strength and on the distance from the site at which air concentration returns to its background value (the 'return distance') is a topic of importance for risk assessment. To this purpose, experimental campaigns were conducted in France at two outdoor composting sites, where air concentration measurements were performed at several locations downwind from the source, along horizontal transects aligned with the mean wind direction. All relevant microclimatic variables were also registered. Quantitative PCR was used to monitor the microbial indicators selected in a previous study in order to trace specifically the bioaerosols emitted from compost piles and evaluate their dynamics in the atmosphere. A simple Gaussian-type modelling approach was designed to estimate the source strength and the return distance from the measured concentration transects. The main factors of variation in terms of air concentration, source strength and return distance were found to be the site itself, then the operation type: overturning generates the largest amount of bacteria, followed by loading and screening. This affects the return distance, which also shows a weak variation with mean wind velocity. The generic character of this method combining atmospheric transport modelling with air concentration measurements makes it applicable to other cases of atmospheric dispersal from point or area sources.

Keywords: Compost, Atmospheric dispersal, Microbial aerosol.

How to predict the shape of pollination season? Approaches to model calibration for birch and grass

M. Sofiev[1], E. D. P. EAN data providers[2]

[1]*Atmosphreic Composition Research, Finnish Meteorological Institute, Helsinki, Finland*; [2]*EAN, Vienna, Austria*

The paper discusses the possibilities to improve the quality of the SILAM model predictions of birch and grass pollen concentrations throughout the whole pollen season.

Experience of the SILAM pollen forecasting showed that the initial goal – prediction of the season start – can be largely achieved by using a classical heat-sum threshold approach in case of birch or even via prescribed dates of the flowering start in case of grass. For birch, accuracy of a couple of days was achieved in several key regions, with problems persisting only in mountains where the spatial resolution of the European-scale model was insufficient. For grass, the fixed-date approach shows lower skills against the observations but the error was still about one week in well-represented areas.

Accuracy of predictions of the season development towards its peak values and then gradual end of flowering was noticeably less impressive. The season end date could be shifted by several weeks with strong distortion of the season shape. Improvement of the whole-season representation thus became a necessity.

As the first step, the habitation maps for both species were revised and much more accurate and high-resolution datasets created. After that, the season shapes errors were addressed.

For grass, the concept of prescribed climatologic shapes and dates suggested a simple refitting of the model parameterization with quality criteria targeting the whole season rather than just its start. As a result, the trapezoid shape was replaced with a sum of three truncated gamma-type functions. The coefficients were chosen based on 35-years-long Europe-wide reanalysis and data fitting.

For birch, the heat-driven season was kept as the cornerstone of the emission module. It was however concluded that an oversimplified broken-linear dependence of heat sum on temperature (with a cut-off at 3.5C) is among the reasons for incorrect season shape. Its modification towards double-sigmoidal dependence with pronounced saturation and a low-temperature tail improved the season representation and helped reducing the errors towards the end of flowering.

Keywords: SILAM pollen model, birch, grass.

Modelling the intra- and inter- seasonal variations of birch pollen concentrations

O. Ritenberga[1], P. Siljamo[2], M. Sofiev[2]

[1]*Faculty of Geography and Earth Sciences, University of Latvia, Riga, Latvia*; [2]*Finnish Meteorological Institute, Helsinki, Finland*

Pollen concentration in the air during the flowering season depends on numerous factors, some referring to pre-season and previous-year conditions, while others depend on current weather. These temporal and spatial scales can be separated for the purposes of forecasting the pollen concentrations.

With this paper, we present two statistical local-scale models, which combination allows for forecasting the daily pollen concentrations using historical pollen observations, meteorological data and weather models predictions.

The forecast of the general season severity is approached via a simple equation based on pollen counts of two previous years. It can possibly be corrected with mean June temperature, which, in case of Finland, brings about a marginal improvement in temporal correlation with the observed seasonal pollen index SPI. The formula works better in the areas with large SPI and strong inter-annual variability (e.g., in Finland), but has limited predictive capacity in the areas where SPI is low (e.g., UK). It is also conservative: tends to underestimate high years and overestimate low years.

Day-to-day variation of pollen concentrations are predicted with another local-scale statistical model, which involves several steps of transformations of both meteorological data and pollen observations, aiming at creating normally distributed homogeneous stationary datasets with linearized dependencies between the transformed meteorological predictors and pollen concentrations. These transformations resulted in substantial improvement of statistical features of the data and, consequently, higher efficiency of statistical procedures and better scores of the model. The transformed datasets are used for the model construction identification via multi-linear regression. The model has been parameterised and applied in Riga using 10 years of observations and evaluated using the years withheld from the training. The evaluation showed robust model performance with Odds Ratio = 30.

Keywords: birch pollen, intra-seasonal model, inter-seasonal model.

Progress, status and plans of MACC/CAMS pollen forecasting

M. Sofiev[1], C. M. T. CAMS modelling teams[2], E. D. P. EAN data providers[3]

[1]*Atmospheric Composition Research, Finnish Meteorological Institute, Helsinki, Finland*; [2]*CAMS-50, Paris, France*; [3]*EAN, Vienna, Austria*

This presentation reports the progress achieved within MACC project and its successor Copernicus Atmospheric Monitoring Service CAMS in multi-model forecasting of pollen concentrations in Europe.

One of the MACC objectives was to build a birch pollen forecasting ensemble benefitting from the experience of the multi-model air quality forecasts. This activity was coordinated by FMI, which shared the formulations of birch pollen source term among the other modelling groups and supported its implementation.

The 7-models-strong MACC ensemble started its operations in 2013 and its subsequent assessment was published in 2015 in the high-level journal “Atmospheric Chemistry and Physics”. The evaluation showed substantial benefits of the ensemble over the individual model simulations. The ensemble median showed very stable results and was essentially as good as SILAM. The analysis also revealed the basic features of the ensemble with regard to EAN observations, highlighted challenges in the source term formulations, and stressed the necessity of the inter-seasonal forecasting of the next-year total pollen load.

Based on existing agreements and resources available for CAMS-EAN cooperation, CAMS is continuing the birch forecasting in 2016 and is planning to add grass pollen for the 2017 season. Similar to the birch case, the forecasts will start from detailed assessment of the grass source term implementation in all models, which will be followed by the intercomparison study, again aiming at a high-impact journal paper.

Keywords: pollen forecasting, CAMS, modelling ensemble.

Pollen forecasts for alder, birch, grasses and ragweed based on the numerical pollen dispersion model COSMO-ART at 1 km resolution

A. Pauling[1], H. Vogel[2], B. Vogel[2], O. Fuhrer[1]

[1]*Federal Department of Home Affairs FDHA, MeteoSwiss, Zurich-airport, Switzerland*; [2]*Institute for Meteorology and Climate Research – Troposphere Research, Karlsruhe Institute of Technology (KIT), Eggenstein-Leopoldshafen, Germany*

Numerical pollen dispersion models such as COSMO-ART (COnsortium for Small-scale MOdeling - Aerosols and Reactive Trace gases) can provide spatially and temporally highly resolved pollen forecasts. COSMO is a non-hydrostatic mesoscale model that is used in operational weather forecasts in a number of European weather services.

COSMO-ART has been used operationally at MeteoSwiss to calculate birch, grass and ragweed pollen concentrations on a 6.6 km grid since a few years. Recent developments include the implementation of alder pollen which became operational in 2016. The domain covers central and southern Europe. At each grid point COSMO provides the meteorological variables to calculate the pollen concentration. The most important variables are temperature, humidity and turbulent kinetic energy. These forecasts are provided as concentration maps and are updated on a daily basis.

Very recently, a new operational model covering the greater Alpine area with a horizontal resolution of 1.1 km has been introduced at MeteoSwiss. As a consequence, the demand for computational power grew considerably. Using a high performance computer based on hybrid CPU/GPU design, this increase could be achieved without an increase in investment costs and power consumption. As the pollen module is calculated online with the weather, the pollen forecasts could profit from this development in two ways: First, the representation of the topography is much better which led to great improvements of the forecasts in complex terrain. Second, 1 km resolution allows the explicit formulation of convection. As a consequence, the removal of the pollen by the rain could be modelled in more detail.

The temporal resolution is up to 2 hours which allows detailed assessment of the diurnal cycle. Good agreement with observations was achieved at many observation sites. We discuss the effect of increasing the horizontal resolution from 7 km to 1 km. Future developments will focus on the key issues emission parameterization, plant distribution and season description.

Keywords: pollen forecasts, COSMO-ART, dispersion modeling.

Operational ragweed forecasting over the Rhone-Alpes region

F. Troude[1], C. Rieux[1], A. Provent[1], C.-E. Petitjean[1], M. Thibaudon[2], G. Oliver[2]

[1]*AIR Rhône-Alpes, Bron, France;* [2]*RNSA, Brussieu, France*

For 4 years, an operational ragweed platform has been forecasting ragweed concentrations over the Rhône-Alpes region during the pollen season.
The first step of the platform has consisted in modelling meteorological fields each Friday for the next week. The well-known WRF model developed by the National Center for Atmospheric Research (NCAR, USA) was used. The modelled domain has represented the Rhône-Alpes region with a 6 by 6 km horizontal resolution. Then the hourly meteorological fields were used to compute ragweed dispersion fields. This dispersion was calculated with the chemistry transport model (CTM) CHIMERE that we currently use for daily air quality forecast. CHIMERE is a deterministic mesoscale Eulerian model developed by Institut Pierre Simon Laplace & INERIS, CNRS, France. The CTM code was modified as described in Chaxel et al. (2012) to implement the ragweed dispersion. The pollen grains were considered as inert particulate matter. A spatial inventory of plant probability distribution was used. A simple phenological model accounting for large scale temporal variation of emissions and intraday emissions of pollen has been set up using measurements of pollen counts at a monitoring station influenced by nearby emissions.
Finally, the French aerobiology network (RNSA) allergic risk forecasts at measurement locations were used to adjust the first predicted results: an ordinary kriging method was applied. A forecast map of allergic risk forecasts was finally published in the weekly RNSA bulletin. Comparisons between forecasts and measurements were made and lead to optimistic results.

Eric Chaxel, Camille Rieux, Isabelle Rios, Michel Thibaudon, Gilles Oliver: Modelling ragweed pollen in Rhône Alpes (France) IRC Conference, Lyon, March 28th 2012.

From the Smart Pollen -project to the Norkko-pollen service: Results and experiences of the new kinds of pollen forecasts in Finland

P. Siljamo[1], A. Saarto[2], S. Pätsi[2], A. Sarkanen[1], A.-M. Pessi[2], M. Sofiev[1], M. Prank[1], P. Pylkkö[1], M. Aarnio-Frisk[1]

[1]*Finnish Meteorological Institute, Helsinki, Finland*; [2]*Aerobiology Unit, University of Turku, Turku, Finland*

What is Smart Pollen? Smart Pollen is a new pollen forecasting technology. It combines the SILAM atmospheric dispersion model output with manual analyses and corrections. Smart Pollen is based on close co-operation between the University of Turku, Aerobiology Unit (UTU) and Finnish Meteorological Institute (FMI), and the development funded by the Finnish Funding Agency for Innovation (Tekes) in 2014-2016.

What has been done? The Smart Pollen -project included research, technical construction and testing of the system, and piloting of pollen forecasts. In the research, the main aim was to improve the SILAM pollen model: refine existing models (birch and grass), add other important Finnish allergy species (alder and mugwort) to SILAM as prototypes, and add inter-annual variability to the birch model. The impacts of manual (human made) corrections on SILAM pollen forecasts were also evaluated.

The technical part of the project aimed at constructing the Smart Pollen tool. This comprised of the installation and learning of the editor tool. The tool was then used for checking and correcting of the SILAM pollen forecasts at UTU, and data flows between UTU and FMI. The final products and applications fetched the pollen data from FMI interface.

We piloted Smart Pollen forecasting during two seasons. A group of pharmacies showed daily local grass pollen forecasts as curves in their display panels during 2014. In spring 2015, a large health care service company in Finland tested birch pollen forecasts as part of their physicians' tools. Also, an animation map for birch pollen was launched in 2015 for public use, displaying an hour-to-hour forecast for one day.

The Smart Pollen project resulted in the publishing of Norkko® pollen forecasts in spring 2016. Beside the basic pollen forecast maps piloted in the project, a mobile application for general public was lauchded. The Norkko® mobile application (app.norkko.fi) displays local (birch) pollen forecasts for the first day as 2-hour resolution, and less frequently next two days.

Experiences: The project proved to be technically challenging. Many details had to be honed in order for the system to fill the operational requirements. In spring 2014, birch pollen counts were very high in Finland, but unfortunately the Smart Pollen birch forecasts were not ready and mainly grass pollen forecasts were shown. On the contrary in 2015, the Smart Pollen birch forecasts were ready and they fulfilled physicians' wishes, but the birch pollen counts were exceptionally low. The physicians, however, gave highly positive feedback on the pollen forecasts.

All in all, these two very different years pointed out the importance of man-made corrections to achieve sufficient accuracy for model based forecasts. The SILAM birch pollen forecasts were good enough that the editing work was not too hard, but small polishing and scale correction of the pollen level were necessary.

Keywords: atmospheric dispersion model, pollen forecast, pollen application.

Emissions of ryegrass pollen in South Eastern Australia

J. Silver[1], P. Rayner[1], E. Newbigin[2]

[1]*School of Earth Sciences, University of Melbourne, VIC, Australia*; [2]*School of Biosciences, University of Melbourne, VIC, Australia*

Allergic rhinitis (hay-fever) affects roughly one in six Australians (ABS, 2010), and is an upper airway allergic response to airborne allergens (e.g. pollen, dust, mould spores). Grass pollen is believed to be the most widespread outdoor aeroallergen in Australia (AIHW, 2011), and in South Eastern Australia much of the allergenic burden is attributed to pollen from rye grass (Lolium sp.; Schäppi et al, 1998), a common pasture grass for grazing livestock.

To characterise population exposure, we are developing a modelling framework to simulate emissions and transport of airborne pollen. We have customised a version of the CMAQ Modelling System (Binkowski & Roselle, 2003), a limited-area chemistry-transport model developed by the US EPA. The gas-phase and particulate-phase schemes were replaced by a single particulate type (rye-grass pollen). Emissions are parameterised as a function of land-use, rainfall, growing day, wind speed, humidity, vertical uplift and time of day. Meteorological drivers are produced by the WRF Model (Skamarock et al, 2005). In developing the emissions module, we relate the timing of the grass pollen season with spatio-temporal variation in satellite-derived land surface indices.

In this presentation, we compare two simulations from two versions of the emissions module. The first emissions scheme follows other studies, and is based on the product of three terms, respectively representing land-use, flowering and instantaneous-release (e.g. Zhang et al. 2014). The second emissions scheme builds on concepts of availability, production and loss. The meteorological and transport simulations were run for a small domain in South-Eastern Australia, and results are compared with pollen observations from the Melbourne Pollen Count, run by the School of Biosciences, University of Melbourne, Australia.

Keywords: Grass pollen, Transport modelling, Emissions modelling.

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ORAL COMMUNICATIONS

Abstracts
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Automatic pollen monitoring: the MeteoSwiss validation site

B. Crouzy, M. Stella, T. Konzelmann, B. Calpini, B. Clot

MeteoSwiss, Payerne, Switzerland

We first briefly discuss the motivations behind the automation effort for the pollen monitoring network of the Swiss national weather service (MeteoSwiss). Within the ambit of this project, a generic validation environment for automatic pollen monitoring devices has been set up in Payerne and is open to any candidate system: four different automatic systems, based either on air-flow cytometry or on image recognition, have been tested to date. Reference manual measurements are performed in the same way as current operational measurements and the use of a unique site for evaluation, where meteorological measurements are also available, gives a solid basis for comparing different devices. As soon as a device reaches pre-operational level, it can be integrated into the MeteoSwiss network and its suitability for operational use can be evaluated.
We propose a set of five criteria relevant for the evaluation of automatic operational systems: (1) no compromise can be made regarding the reliability of the monitoring methods; the ability to (2) count and (3) identify different bioaerosols are related but not completely equivalent tasks; (4) the investment and operational costs associated with the systems both need to be carefully evaluated; (5) the ability to count other aerosols than pollens might finally help justifying the high investments associated with the introduction of automatic devices in operational networks.
We present the validation procedure at MeteoSwiss in the light of the proposed criteria. The use of Hirst-type volumetric samplers as reference for automatic counts is only possible knowing the limitations of the traditional method. Hirst-type samplers running in parallel in Payerne allow us to gain an insight into the characteristic error resulting from limited sampling: for low pollen concentrations the manual counts cannot be considered as statistically significant. Differences in the physical characteristics of the air inlet also hinder the direct comparison of time-series obtained from different devices, with, in the worst case, a deviation depending on the wind speed (limited isokineticity). Finally, we compare the performance of the four systems tested in Payerne and present the current state of pollen monitoring network automation at MeteoSwiss.

Keywords: automatic monitoring, pollen, operational system.

All-optical automatic pollen monitoring: towards an operational system

B. Crouzy, M. Stella, T. Konzelmann, B. Calpini, B. Clot

MeteoSwiss, Payerne, Switzerland

We present the results of the 2015 and 2016 (in progress) validation campaigns of an air-flow cytometer (Plair PA-300) performed at the Swiss national weather service (MeteoSwiss). As an introduction we briefly describe the main features of the device (time-resolved scattering and fluorescence) in order to give an insight into the capabilities and limitations of the technique.

The evaluation of the ability to correctly determine aerosol physical properties was the first natural step of device validation. As a second step, basing on the raw optical parameters produced by the detector, we developed supervised learning algorithms (support vector machines and neural networks) for pollen taxa identification. We showed that using those techniques it is possible to obtain an estimation of the prediction reliability in addition to the mere classification. Having gained an insight into the identification capabilities of the device, we moved to a pre-operational test of the device, where the automatic counts were compared to reference manual counts (Hirst-type detector) performed in parallel. Manual and automatic counts were in very good agreement as far as the total pollen is concerned and the automatic device showed a reliability (one week interruption over five months) comparable to the one of the reference Hirst-type detector for the 2015 campaign. Although the 2015 calibration dataset was rather limited (6 fresh pollen types), we were able to satisfactorily follow the grass pollen season. Consequently, the goal of the 2016 campaign is to further extend the calibration dataset and follow the concentration of the most relevant allergenic pollen taxa.

One essential advantage of the tested device is the high sampling obtained in real-time: the hourly values of pollen concentration from the automatic device have the same degree of statistical significance as the daily values of the reference manual counts. The tested system could thus provide in real time information on exposure peaks, beyond the traditional daily averages obtained with a delay (typically one to nine days) from manual networks. Real-time data based on a statistically valid sample size could benefit patients (information on current exposure levels), doctors (information on sub-daily peaks) and forecasters (forecast based on timely information).

Keywords: automatic pollen monitoring, real-time, supervised learning.

A new algorithm for simultaneously estimating the concentrations of several types of airborne pollen using a laser optics system

S. Kawashima[1], M. Thibaudon[2], B. Clot[3], G. Oliver[2], K. Nakamura[1], T. Fujita[4]

[1]*Graduate School of Agriculture, Kyoto University, Kyoto, Japan*; [2]*RNSA, Brussieu, France*; [3]*MétéoSuisse, Payerne, Switzerland*; [4]*Yamato Engineering Company, Yokosuka, Japan*

To address allergic reactions to airborne pollen, the development of a simple, automatic pollen measuring methodology is required. Thus, we are developing a device and an algorithm that can automatically count airborne pollen using the basic technology of the laser optical study. The data obtained from this device will be effective in analyzing the dispersal dynamics of airborne pollen, as it provides detailed temporal variations in concentrations. We examined a new algorithm for simultaneously estimating the concentrations of several types of airborne pollen using a laser optics system.
In a pollen monitor, the sideward and forward scattering intensities of laser light by each particle are measured. The pollen counts derived from the automated method and those from the standard Hirst-type method were compared. Scatter plots of the forward and sideward scattering intensities for the monitored data were made. In a previous study, we have demonstrated the effectiveness of the extract window method for automated pollen monitoring using a laser optics system. This method employed a specific extract window for a specific type of pollen. We have developed a new algorithm for simultaneously estimating the concentrations of several major types of airborne pollens using two-dimensional data derived from the scatter plot for both the sideward and forward scattering light intensities. If each kind of pollen or particle shows a specific distribution pattern in the scatter plot, the observed distribution is a result of the superposition of the various patterns. In the two-dimensional scatter plots, the plot area was divided laterally and vertically into subareas consisting of a matrix of the extract windows. The observed counts in the multi window are used to perform regression analysis. We refer to this algorithm as "the multi window method for simultaneously estimating the airborne concentrations of several kinds of pollen."
We applied this method to the observed data in Western Europe. We have been performing a 10-year continuous cooperative study with MétéoSuisse and RNSA. Observational data have been accumulated for the study of the development and improvement of the automated pollen monitor by comparison with the standard Hirst-type observational data. The results of the algorithm applied to the data in 2013 showed appropriate regressions with higher coefficients of determination without any special processing for the observed data. The coefficient of determination for each type of airborne pollen using the multi window algorithm is as follows: *Poaceae*: 0.82, *Quercus*: 0.79, *Betula*: 0.87, *Cupressaceae*: 0.57, *Carpinus*: 0.79, *Salix*: 0.89, *Fraxinus*: 0.68, and *Platanus*: 0.80. The advantage of the multi window method is that the preliminary consideration of the pollen dispersal period of the target pollen is not a prerequisite for the estimation of the concentration by the pollen monitoring system.

Keywords: Airborne pollen concentration, Automatic observation, Laser optics technology.

Improvement of parameters for automatically estimating concentrations of allergenic airborne pollens using laser optics

S. Matsuda[1], S. Kawashima[1], M. Thibaudon[2], B. Clot[3], G. Oliver[2], K. Nakamura[1], T. Fujita[4]

[1]*Graduate School of Agriculture, Kyoto University, Kyoto, Japan*; [2]*RNSA, Brussieu, France*; [3]*MétéoSuisse, Payerne, Switzerland*; [4]*Yamato Engineering Company, Yokosuka, Japan*

Pollinosis is a serious global social issue. To address this health concern, it is necessary to monitor actual amounts of airborne pollen. However, it is a time-consuming and laborious process because counting airborne pollen is typically performed manually. Therefore, several studies have looked into automating pollen counting in real time. We are developing the automatic counting instrument by applying laser optics to allow easy and real-time measurements. In this study, we have calculated and considered the extracting parameters of airborne pollen for additional years and sites.
Measurements were taken in 2013 in Lyon, France, and in 2014 in Payerne in Switzerland. A Hirst-type pollen sampler and the automatic monitoring device for airborne pollen were set and the data were obtained. We improved the extracting parameters using the automatic airborne pollen monitor. In the device, the sideward and forward scattering of laser light caused by each particle is recorded in real time. We made a scatter plot of the forward and sideward scattered light and developed an algorithm to determine the appropriate rectangular area for detecting each pollen type, which we call the "extract window." On the scatter plot plane, we estimated the distribution of the correlation coefficient (R) between data obtained by the sampler and the pollen monitor. The preliminary extract window was set at the location where R was larger than 0.4. We considered the preliminary extract window in detail, and narrowed down the highly correlated options. Moreover, we determined the optimal extract window by comparing the proportion of the counts by the pollen monitor to those by the sampler. When the ratio was too large, it indicated that there was little target pollen in the extract window. On the other hand, when the ratio was too small, it indicated the presence of not only target pollen but also other kinds of pollen or dust.
For the 10 kinds of pollen collected in the experiment, the daily counts from the sampler were compared with those from the pollen monitor system. We selected several extract windows showing R values larger than 0.7. For *Ligustrum*, Moraceae, *Quercus*, *Betula*, Poaceae, Cupressaceae, *Plantago*, *Fraxinus*, Urticaceae and *Platanus*, the correlation coefficients were 0.89, 0.88, 0.83, 0.83, 0.81, 0.75, 0.70, 0.69, 0.64, and 0.60, respectively. We classified 10 kinds of target pollen into categories depending on their potential allergenicity. We found high potential allergenicity categories have high correlation coefficients. When monitoring is conducted with categorized pollen, we can use the particular extract window for a longer period of time. We investigated the relation between the locations of the extract window and the shape characteristics of pollen. For *Quercus*, *Ligustrum*, *Fraxinus* and *Platanus* which are the tricolpate pollen types, the intensity of the forward scattering tends to be lower as the pollen size becomes smaller.

Keywords: airborne pollen, automatic counting, extract window.

Pollens, allergy and real time information

G. Oliver[1], A. Marpillat[2], M. Thibaudon[1]

[1]*RNSA, Brussieu, France*; [2]*ADDAIR, Chateaufort, France*

Biological particles like pollens are causing pollinosis to nearly 18 to 20% of the population in Europe. Currently, the main method to determine pollen concentrations is based on a Hirst pollen trap system and microscopy analysis. The methodology is robust and efficient to provide reliable information but the results are available only a week after the sampling. Since a few years, lots of efforts have been done by the scientific community to build new automated instruments for pollen detection and identification.
One of these instruments is the FIDAS 200 of Palas, a size segregated optical particle counters. It has been certified by the TÜV for the measurement of particulate matter below 10, 2.5 (PM10, PM2.5). It allows getting the granulometric distribution of the particles in the two modes number and mass. To get pollen concentrations with this device, only the particles belonging to a 2-100 μm size range are considered, with a specific data treatment for particles between 10 and 50 μm.
A FIDAS 200 has been set up in Nice (France) in 2015, from March to the end of June, near the Hirst pollen trap located on the roof of a museum. The main goal was to determine if the FIDAS could be used to do pollen information. The first results show a good timing between the peaks of pollens on the two devices, and the correlation between the data is quite high ($R^2 = 0.76$). The experiment has been renewed in 2016 for the whole pollen season.
To provide a real time information, this device is complementary to the HIRST method: the historical data obtained by the RNSA (French network of Aerobiology) combined with this instrument is useful to get an alert of pollen burst.
In 2016, for a better prevention and to help allergy sufferers to adapt their treatments, a smartphone app (“metropollen”) has been launched to provide real time information about the allergy risk on the city of Nice, based on the data obtained with the FIDAS 200. The app is updated every day, giving forecast for the current day and the two days to come.

Keywords: pollen, allergy, real time information.

Teachings of the phenological monitoring

M. Grégori[1], K. Benkhelifa[2], F. Pautz[2], J.-P. Schmitt[3], M. Bonnefoy[4], M. Boulangé[5], G. Kanny[5]

[1]*ORSAS / Air Lorraine, Vandoeuvre-lès-Nancy, France*; [2]*Jardin Botanique du Montet, Villers-lès-Nancy, France*; [3]*Air Lorraine, Villers-lès-Nancy, France*; [4]*ORSAS, Vandoeuvre-lès-Nancy, France*; [5]*Université de Lorraine, Vandoeuvre-lès-Nancy, France*

Introduction: Phenological monitoring consists in the analysis of seasonal variations, growth and development of plants. We present the results of observations of pollination of species at allergic risk during two years.
Methods: Pollination observations were performed in the Montet Botanical Garden (Nancy, France) on 24 plants relative to the Lorraine flora. Plant development is monitored, from one to two times per week, depending on the season. The dates of the first and last pollen release are recorded for each specie. Observations were compared to the aerobiological data of Nancy, which have been conducted between February and October, in close coordination with the French aerobiology network (RNSA).
Results: In 2014 and 2015, pollination of hazel (*Corylus avellana*) occurs before the beginning of pollen counts: 24th and 29th December, respectively. Tardive mowing of herbaceous causes later in the season a new release of pollen (especially *Plantago lanceolata* and *Dactylis glomerata*) in October. *Alopecurus pratensis* appears to be an early indicator of the grass pollen season.
Discussion and prospects: Phenological monitoring enables to determine the beginning of allergenic species pollination. The choice of plants of interest, environment and exposure is essential. New practices such as late mowing may cause a temporal shift of pollen release during fall. Broadcast and accessibility of this information allow the implementation of preventive actions for sensitive public.
Conclusion: Phenological monitoring provides information in real time. It examines the influences of meteorology and human activities on the pollination of allergenic species and allows the settlement of preventive actions. The association of air quality monitoring Air Lorraine, the Regional Observatory of Health and Social Affairs in Lorraine (ORSAS-Lorraine), in partnership with the Montet Botanical Garden and the University of Lorraine, constitute a participatory networking of observers (Pollin'Air network) in order to i) assess the pollination of allergenic plants in different geographic locations in Lorraine, ii) map risks on the territory and iii) inform allergic population more precisely.

Keywords: Pollen, Allergy, Network.

Allergenic potential for a new garden in river banks of Badajoz (SW Spain)

S. Fernández-Rodríguez[1], A. Monroy-Colín[2], R. Tormo-Molina[2], J. M. Maya-Manzano[2], Á. Gonzalo-Garijo[3], I. Silva-Palacios[4]

[1]*Construction, University of Extremadura, Cáceres, Spain*; [2]*Plant Biology, University of Extremadura, Badajoz, Spain*; [3]*Allergy, Hospital Infanta Cristina, Badajoz, Spain*; [4]*Applied Physics, University of Extremadura, Badajoz, Spain*

Introduction: Urban green areas may be considered beneficial spaces but also potential areas as sources for allergenic airborne particles. Assessing the allergenic potential for public gardens is a valuable task for urban landscape design, taking into account pollination type, pollination length and allergenic pollen potential for the species used. This work aims to calculate the allergenic index from a recent public garden built in Badajoz.
Material and Methods: An area of 20 ha. has recently been gardened close to bank of the Guadiana river that cross Badajoz. Ornamental trees and shrubs were counted and identified and the allergenic index was calculated according Cariñanos et al. (2014).
Results: A total of 14688 specimens were counted belonging to 94 species. 11 species presented dioecy (*Acer negundo, Chamaerops humilis, Ginkgo biloba, Ilex aquifolium, Laurus nobilis, Phytolacca dioica, Pistacia lentiscus, Populus alba, Populus nigra, Salix alba, Salix babylonica*). Most species were trees, the rest include 20 shrubs, 2 climbers and 4 palms. 46% of species showed an entomophylous system of pollination, 45% show anemophilic one and 9% and amphiphilic system. According to literature 7 species were estimated with a high level of allergenic potential (level 4): *Cupressus arizonica, Cupressus sempervirens, Juniperus horizontalis, Juniperus oxycedrus, Olea europaea, Platanus hispanica* and *Platycladus orientalis*. The total value of allergenic index from the garden in first estimation was 0.002. The highest values were reached by *Liquidambar styraciflua* and *Morus alba*, due to the high number of specimens planted.
Discussion and Conclusion: This garden showed a high level of biodiversity. Most of specimens were 3-5 year old, so their development degree was low and consequently the allergenic index was low compared with other gardens that have older trees. Moreover, according to the number of specimens, the level of allergenicity represent 1,9% (level 4), 4.3% (level 3) and 3.5% (level 2). Likewise, only 12.1% of specimens showed and anemophilic or amphiphilic system of pollination.

Keywords: ornamental plants, aerobiology, urban green spaces.

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Airborne pollen records and phenology of *Fraxinus angustifolia*

A. Monroy-Colín[1], I. Silva-Palacios[2], R. Tormo-Molina[1], J. M. Maya-Manzano[1], S. Fernández-Rodríguez[3], Á. Gonzalo-Garijo[4]

[1]*Plant Biology, University of Extremadura, Badajoz, Spain*; [2]*Applied Physics, University of Extremadura, Badajoz, Spain*; [3]*Construction, University of Extremadura, Cáceres, Spain*; [4]*Allergy Section, Hospital Infanta Cristina, Badajoz, Spain*

Introduction: Narrow leaf ash (*Fraxinus angustifolia*) is a frequent monoecious tree growing on the banks of rivers in the West Mediterranean region. Pollination takes place in winter when rains are common and to understanding the airborne pollen pattern flower phenology is a great help. This work aims to relate phenology, source tree distribution, meteorology and airborne pollen records in that species.
Material and Methods: Aerobiological sampling was carried out in Badajoz (SW Spain) in the winter of 2015-2016 using Hirst type volumetric sampler. Meteorological station is close to the spore trap (2 m). Trees were geo-localized in an area of 300 m around the pollen station. Pollination phenology was studied in 10 specimens, five in the surrounding of pollen station and five 3 km apart, with a frequency of 3-4 days on average. The period studied was 1/11-28/2 (120 days). For phenology BBCH methodology was used.
Results: A total of 195 trees were counted in an area of 300 m radius, all of them concentrated in W and NW, close to the Gévora river. Pollen index for the period studied was 1026. Daily peak maximum pollen concentration reached 92 pollen grains/m^3 (16/12). Phenology of pollination ranged 8/12-22/1, with a maximum 8/1. Pollen records outside this period represent 8.3%. Nevertheless, maximum pollen concentration was reached twelve days before in relation to maximum pollination phenophase. Main Pollen Season (MPS 5-95%) lasted 47 days (10/12-25/1), 25 of them were rainy days. Hourly analysis for the ten days including pollen peak showed that maximum concentration was reached just after noon and with winds from W (45-135 grades) that they were the most frequent at that moment, pollen recorded when wind blew for that direction represented 70% of the total.
Discussion and conclusion: Non homogeneous distribution of pollen sources for *Fraxinus angustifolia* provided a good tool to demonstrate that wind direction plays a relevant role when aerobiological data should be interpreted according to sources distribution. Nevertheless, pollen records before pollination represented 1.1% and after pollination 7.2%, they are commonly interpreted as pollen coming from long distance. As the number of rainy days in the MPS studied was 53% this may distort peaks of pollen.

Keywords: pollination, narrow leaf ash, aerobiology.

The phenological phases of flowering and pollen seasons of selected tree taxa against a background of meteorological conditions in Kraków

D. Stępalska[1], D. Myszkowska[2], K. Piotrowicz[3], I. Kasprzyk[4]

[1]*Institute of Botany, Jagiellonian University, Kraków, Poland*; [2]*Department of Clinical and Environmental Allergology, Jagiellonian University, Kraków, Poland*; [3]*Institute of Geography and Spatial Management, Jagiellonian University, Kraków, Poland*; [4]*Department of Environmental Biology, University of Rzeszów, Rzeszów, Poland*

The aim of the study was to compare phenological observation to pollen seasons of selected early spring trees. Special attention was paid to meteorological conditions which favoured or not the tree flowering and pollen release. For this reason we used phenological observation, pollen counts and meteorological data in 5 sites in the center of Kraków, in 2009-2011. Phenological phases (5) of 4 tree species: *Alnus glutinosa, A. incana, Corylus avellana* and *Betula pendula* were analysed. It was stated that in case of *Alnus glutinosa* the pollen season often preceded the flowering period, while in *A. incana* those two phenomena were more correlated. In *Corylus avellana* the onset of the pollen season and phenological phases was simultaneous. However, pollen grains occurred in the air longer, even by dozen or so days. Phenological phases and pollen seasons in *Alnus* and *Corylus* were dependent on meteorological conditions. To define the relationship between pollen concentration and weather conditions, Spearman's rang correlation analysis was applied. High *Alnus* and *Corylus* pollen concentrations were found in sunny days with maximum temperature over 10^0C, no precipitation and when a snow cover was gone. In case of *Betula* phenophases of the full pollination period usually coincided with periods of high pollen concentrations. However, *Betula* pollen sometimes appears earlier and stays in the air longer than the flowering period of local trees in the nearest vicinity. This situation indicates the long distance transport or secondary deposition.

Keywords: phenophases, pollen seasons of trees, weather conditions.

ePIN: Electronic Pollen Information Network. Building a fully automated pollen monitoring network in Bavaria, Germany

J. Buters[1], J. Oteros[1], M. Sofiev[2], M. Smith[3], C. Traidl-Hoffmann[4], A. Menzel[5], C. Bergmann[6], R. Wachter[7], B. Clot[8], C. Schmidt-Weber[1]

[1]*Zentrum Allergie und Umwelt (ZAUM), Technischen Universität München, München, Bayern, Germany*; [2]*Finnish Meteorological Institute (FMI), Helsinki, Finland*; [3]*University of Worcester, Worcester, United Kingdom*; [4]*Institut für Umweltmedizin, Technischen Universität München, München, Bayern, Germany*; [5]*Chair of Ecoclimatology, Technischen Universität München, München, Bayern, Germany*; [6]*Allergie-Centrum-Charité, Charité-Universitätsmedizin Berlin, Berlin, Germany*; [7]*Pollenflug Nord, Ganderkesee, Germany*; [8]*Swiss Meteorological Institute, Payerne, Switzerland*

Pollen monitoring is mostly performed manually. There is, however, a need for rapid reporting of pollen counts in addition to the alleviation of the workload of manual operation. We investigated the different steps needed for building an automatic pollen monitoring network in Bavaria, Germany. First, we tested the performance of the automatic pollen monitor BAA500, by comparing its data with data from a Hirst-type pollen trap at the same location. Next, during 2015, we built a new manual Bavarian pollen monitoring network with 27 Hirst-type pollen traps, including all closed operating traps from the German Polleninformation Network (PID).
We set up the manual network and solved all logistic and scientific problems that come from building one of the densest Hirst-type networks Worldwide. The manual network is needed to determine the minimal number of automatic pollen traps needed for a representative network and selecting their optimum location. The selection of monitoring locations was based on: 1. Coverage of Bavarian land surface and population, but also 2. trying to represent the different environmental and climatic areas and 3. selecting the best positions to increase the predictability of pollen amounts based on forecasting models. Traps were located under optimal local monitoring conditions. To determine the optimal local conditions for the stations we surveyed European experts on aerobiology and obtained a consensus on conditions to set-up monitoring stations.
The manual network was operational during 2015. All pollen traps were calibrated under identical conditions (the clocks, the pumps, the electrical systems, the flow rates). All the stations were managed at a central location in Munich. Every week, at the central lab we received all the sampled drums, prepared the pollen slides and sent empty drums to each monitoring station. At the same time, we sent the pollen slides to experienced aerobiologists all over Europe to be analyzed. Aerobiologists performed the analysis of the pollen slides by using the same standard protocol. An external Quality Control programme was implemented for checking the quality of the analysis.
The most informative locations were selected by applying redundancy and clustering analysis. Both analysis gave us a similar conclusion: only 8 pollen traps are needed to cover most of variability in pollen dynamics. We found that three large groups of stations could be differentiated: 1. An extensive central cluster agglomerating most of the stations 2. a cluster agglomerating the stations located at the coldest areas of Bavaria and 3. a cluster of the Northern part of Bavaria. At the same time, we found the existence of eight sub-clusters related with different environmental conditions.
We are now replacing these 8 stations by automatic pollen monitors and incorporating our network into local law to guarantee continuity.

Keywords: Air trap, Automation, On-line monitoring.

Recent results of Automatic and Online Pollen Monitoring using the BAA500

J. Oteros[1], G. Pusch[1], I. Weichenmeier[1], U. Heimann[2], R. Möller[2], S. Röseler[3], C. Traidl-Hoffmann[4], C. Schmidt-Weber[1], J. T.M. Buters[1]

[1]*Zentrum Allergie und Umwelt (ZAUM), Technical University of Munich, München, Bayern, Germany*; [2]*Helmut Hund GmbH, Wetzlar, Germany*; [3]*Department of Dermatology, Universitätsklinikum Aachen, Aachen, Germany*; [4]*Technical University of Munich, Munich, Germany*

Pollen is monitored in Europe by a network of about 350 pollen traps, all operated manually. To date, automated pollen monitoring has only been feasible in areas with limited variability in pollen species. There is a need for rapid reporting of airborne pollen as well as alleviating the workload of manual operation. We report our experiences with a fully automated, image recognition based pollen-monitoring system, BAA500.

The BAA500 sampled ambient air intermittently with a 3-stage virtual impactor at 60m^3/h in Munich, Germany. Pollen was deposited on a sticky surface that was regularly moved to a microscope equipped with a CCD-camera. Images of the pollen were constructed and compared with a library of known samples. A Hirst-type pollen trap was operated simultaneously.

Over 480,000 particles sampled with the BAA500 were both manually and automatically identified, of which about 46,000 were pollen. Of the automatically reported pollen, 93.3% of the pollen were correctly recognized. However, compared with manually identification, 27.8% of the captured pollen were missing in the automatic report, most reported as unknown pollen. *Salix* pollen grains were not identified satisfactorily. The daily pollen concentrations reported by a Hirst-type pollen trap and the BAA500 were highly correlated (r=0.98).

The BAA500 is a functional automated pollen monitor. Its software can learn, and so we expected its performance to improve upon training. Automated pollen counting has great advantages in work-load reduction and rapid on-line pollen reporting. However, we are still at the beginning of performing a routinely pollen monitoring worldwide based on BAA500. The biggest disadvantage of BAA500 during last years for performing routinely monitoring was its mechanical reliability. In this presentation we will show the mechanical reliability of the BAA500 on several European locations during the last years and in 2016, and how we expect the functioning in the future. Public automatic-online data available at: http://www.hund.de/en/service/pollen-monitor.html.

Keywords: Air Quality, Automation, Environmental Monitoring.

Molecular approaches for the analysis of airborne pollen

R. P. Mohanty, M. A. Buchheim, E. Levetin

Biological Sciences, The University of Tulsa, Tulsa, Oklahoma, United States

Reliable microscopic detection of pollen from air samples requires considerable expertise. In addition, identification is often limited to the genus or family level and, thus this method also fails to detect any overlap of pollination season between different species that bear morphologically similar pollen. A case in point is *Juniperus* in Oklahoma where different species pollinate at different times of the year, yet there are some periods when different *Juniperus* species release their pollen simultaneously. The objective of this project is to develop molecular methods for the identification of pollen belonging to various *Juniperus* species captured by Burkard sampling. In addition to the Oklahoma air samples, the present study was also carried out to investigate the occurrence of airborne Cupressaceae pollen registered in London, Ontario, Canada on 15 Jan 2014.

The atmosphere in Tulsa, OK (USA) was monitored with a 7-day Burkard sampler and analyzed by microscopy using standard methods. A second Burkard sampler was used for molecular analysis. A set of species-specific primers and probes were designed for *J. ashei, J. pinchotii* and *J. virginiana* for use in qPCR analyses. Numbers of pollen grains determined by microscopy were compared with estimates obtained from qPCR using a Spearman correlation coefficient analysis. Cupressaceae pollen was detected in the Tulsa atmosphere from October through April with microscopy. Based on the microscopic presence of Cupressaceae pollen on Burkard samples, 109 samples were tested with the species-specific primers and probes. Trajectory analysis was performed using the HYSPLIT model from NOAA.

The qPCR counts for total *Juniperus* pollen showed a statistically significant correlation with the microscope counts, $R=0.92$, $p<0.001$. Quantitative PCR data also revealed overlapping pollen seasons. The qPCR data indicated a 5 days (in two years) overlap in the fall for airborne pollen from *J. pinchotii* and *J. ashei*. Similarly, pollen from both *J. ashei* and *J. virginiana* was detected in air samples comprising 8 days (in two years) in January and February. Our qPCR results with species-specific primers for *J. ashei* provide unequivocal evidence of long-distance transport for mountain cedar pollen from southern Oklahoma and Texas. The qPCR pollen count for Tulsa on 12 Jan 2014 showed 55,285 *J. ashei* pollen grains registered in the sample. In addition, the PCR results also show that *J. ashei* was the pollen registered in London, Ontario on 15 Jan 2014. The molecular data strongly supports the forward trajectory analysis for 12 Jan 2014.

In summary, we showed that DNA from pollen grains can be extracted from air-samples and that qPCR is a rapid method to identify and quantify specific pollen types and determine pollen season overlap where species and genera cannot be distinguished by microscopy. Our study also provided compelling evidence of long distance transport for *J. ashei* pollen from Oklahoma and Texas to Canada.

Keywords: qPCR, *Juniperus*, Long distance transport.

A DNA-based methodology for airborne pollen identification in complex environmental samples

K. Leontidou[1], C. Vernesi[1], D. Vokou[2], J. De Groeve[1], F. Cristofolini[1], A. Cristofori[1]

[1]*Department of Biodiversity and Molecural Ecology, Fondazione Edmund Mach, San Michele all' Adige, Trento, Italy*; [2]*Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Thessaloniki, Greece*

Metabarcoding is a promising DNA-based method for identifying airborne pollen from environmental samples, with potential advantages over microscopic methods. This method requires several preparatory steps of the samples, with the extraction protocol being of fundamental importance to obtain optimal DNA yield. Currently, there is no clear consensus in sample preparation and DNA extraction, especially for gravitational pollen samplers. Here, we present a DNA-based method to analyse environmental samples collected by both volumetric (Burkard spore trap) and gravitational samplers (Tauber trap). Results obtained are compared to those from microscopic analysis. DNA extraction was tested for three variables (extraction kit, bead beating, lysis) on pure pollen (single species) and the best combination was applied to environmental samples (pollen mixtures of different taxa). For the environmental samples, an improved protocol for the preparation of pollen pellets was established: DNA was extracted from the pollen and a short fragment of chloroplast DNA (cpDNA) was amplified by universal primers for plants (trnL). After PCR amplification, 30 amplicons were Sanger-sequenced and taxonomic assignment was accomplished through comparison to a reference custom-made database, including important widespread anemophilous taxa from the study area (Eastern Italian Alps). Results of metabarcoding with the trnL primers were consistently similar to those with microscopic analyses. For the environmental samples collected by volumetric trap, 75% of the taxa identified with the microscope were also identified by molecular analysis, which proved more efficient in identifying taxa even at the species level. We plan to apply a semi-quantitative analysis by Next Generation Sequencing in order to assess the pollen spectra of different Natura 2000 habitats in the Alps.

Keywords: trnL metabarcoding, taxonomic identification, next-generation sequencing.

Density, Diversity and population dynamics of Fungal Spore Population in the Atmosphere of Arid land Area, Jordan

M. Abu-Dieyeh[1], R. Barham[2]

[1]*Biological and Environmental Sciences, Qatar University, Doha, Qatar*; [2]*Biology and Biotechnology, The Hashemite University, Zarqa, Jordan*

This study was initiated to investigate variations in the seasonal and intradiurnal distribution of airborne fungal spores of Zarqa area and to correlate these variations with metrological factors. The study was based on daily spore trapping using the Burkard seven day recording volumetric spore trap, hence another objective was to compare results with a previous study on Zarqa using settle plate exposures. Pearson correlation coefficient was used to correlate the mean daily fungal spore concentrations with daily data of the meteorological parameter.

A total of 76396 fungal spores belonging to 41 genera of fungi were identified. The maximum trapped fungus was *Cladosporium* (49.34%); the other common fungal spores are *Puccinia* uridospores (11.14%), *Alternaria* (7.70%), *Ustilago* (7.62%), and *Drechslera* (4.03%). However the rest (20.11%) was attributed to 36 genera of fungi.

April was the month of the highest mean daily density with (27.82 spore m^{-3}), while January was the least (= 6.87 spore m^{-3}). Two peaks were recorded one in April (The maximum daily density =139.58 spore m^{3}) and the other was in June (70.42 spore m^{-3}). March was the month of highest diversity. Total daily spore count showed a significant positive correlation (P = 0.05) with maximum temperature and a significant negative correlation (P = 0.05) with relative humidity. Significant correlations were also obtained between metrological parameters and daily counts of all common genera. Significant differences in intradiurnal fluctuations were observed from June to November 2009. The mean monthly and total annual counts of fungal spores were both significantly favoured the period 20:00-4:00 h. The most common genera *Alternaria, Cladosporium, Drechslera* and *Puccinia uridospores* showed significant differences between the three periods with 20:00-4:00 period had the greatest values of daily spore counts.

Differences in species composition, abundance, and temporal (seasonal and diurnal) distribution of Zarqa aerospora were observed between spore trapping (the present study) and settle plate exposures (a previous study) methods. It was suggested that the two methodologies can be complementary to each other and not sound to be comparable except in the fact that *Cladosporium* was the most common fungi in the atmosphere of Zarqa area.

Most of the prevailed airborne fungi in Zarqa area were reported in the literature as allergenic or sometime as pathogens for human, animal or plants. Therefore spore calendars based on daily spore densities were constructed for the first time.

Keywords: Airborne fungal spores, Arid land, Seasonal and intradiurnal variation.

Detection of Amb a1 allergens in the atmosphere of Nortwest Turkey

S. Celenk

Biology Department, Uludag Unversity, Bursa, Turkey

Background: *Ambrosia* pollen is an important aeroallergen in North America originally and, as last decade reported, in most European countries. *Ambrosia* spp. pollen grains can be dispersed by air masses far from their source. Air temperature, humidity and solar radiation on pollen grains in the atmosphere could impact on the ability of long distance transported (LDT) pollen to maintain allergenic potency. The aims of the study to detect of the major allergen of *Ambrosia artemisiifolia* (Amb a 1) in the atmosphere of uninfected areas for a potential trigger of allergic reaction and to compare daily *Ambrosia* spp. pollen grains/Amb a 1 amount in per m^3.
Methods: We collected samples by ChemVol sampler for allergen detection. Chemvol collects particles at 800 l/min and it contains 2 impaction stages PM>10 micron and 10 > PM>2.5 micron. Calculation of Amb a 1 in the air samples was performed by antibody-based two-site immune enzymatic assay (ELISA). Evaluation of these methods for collecting and quantifying airborne pollen allergens has been performed during the HIALINE project (www.hialine.com).
Results and Discussion: Samples were collected for 63 days during the investigated period in 2014 . Amb a 1 was recorded on 54 days and pollen grains on 43 days. Daily average Amb a 1 levels varied from 0.29 to 263.3 pg m^3 and were significantly correlated with daily average *Ambrosia* sp. pollen concentrations (adjusted R^2 value is 0.78; spearman correlation coefficient = 0.81; p = 0.006) The mean seasonal *Ambrosia* pollen potency was 3.44 pg Amb a 1/pollen. The findings suggest that that Amb a 1 have a potential trigger of allergic reaction even in areas where the Ambrosia is not widely distributed. This study was founded by TUBITAK project no114Z698.

Keywords: aerobiology, ragweed, amb a 1.

Comparative study of airborne Bet v 1 and *Betula* pollen concentrations in Barcelona and Vitoria (Spain)

J. Belmonte[1], U. Hirhish[1], C. De Linares[1], J. Martínez[2], X. Aguinagalde[3]

[1]*Institut de Ciència i Tecnologia Ambientals (ICTA-UAB), Universitat Autònoma de Barcelona, Bellaterra, Cerdanyola del Vallès, Barcelona, Spain*; [2]*Department of Immunology, Microbiology and Parasitology, Universidad del País Vasco, Vitoria-Gasteiz, Spain*; [3]*Laboratorio de Salud Pública de Álava. Departamento de Sanidad y Consumo, Gobierno Vasco, Vitoria-Gasteiz, Spain*

Introduction: Birch trees (*Betula* sp.) are abundant in North, Central and Eastern Europe, while scarce in the Mediterranean territories, especially in Spain, where they only grow in mountains in the northern regions and are sometimes used as ornamental. In North, Central and Eastern Europe, this genus is the source of one of the most important allergenic pollen causing 10-20% of the allergies in the general population. Bet v 1 is recognized as the major allergen. Our study provides a comparative study between Bet v 1 and *Betula* pollen concentrations in the atmosphere of two localities of North Spain, with the aim to better know the potential risk of allergy to these particles in the area.

Methods: Daily samples were collected using a Burkard multi-vial cyclone sampler and a Hirst trap placed in the roof of the Faculty of Biosciences at the Universitat Autònoma de Barcelona, in Bellaterra-Barcelona, and in the roof of the Faculty of Pharmacy at the Universidad del País Vasco, in Vitoria, along year 2014. The allergen analyses were performed using Indoor Biotechnology ELISA kits and the pollen analyses followed the methodology proposed by the Spanish Aerobiological Network (Red Española de Aerobiología, REA). The Spearman rank correlation test was applied to correlate daily Bet v 1 and birch pollen concentrations.

Results: Bet v 1 is present in the atmosphere of Barcelona and Vitoria showing a similar dynamics than *Betula* pollen but with the particularity that the maximum values of Bet v 1 are registered the day before the pollen peak value (in Barcelona, more than 250 ng allergen/m^3 in April 11th and 39 pollen/m^3 in April 12th; in Vitoria more than 250 ng allergen/m^3 in April 8th and 29 pollen/m^3 in April 9th). Spearman test showed a positive and significant correlation in both cities (Barcelona 0.180 and Vitoria 0.570; $p<0.01$). However, Bet v 1 was also measured in days where no birch pollen was observed and vice versa.

Conclusions: The detection of this North, Central and Eastern European allergen in the Spanish localities of Vitoria and Bellaterra-Barcelona shows that Bet v 1 should be taken into account also in North Spain, where it can be a cause of allergenic symptoms. The combination of aerobiological data with airborne allergenic load data is helpful to reliably assess the risk of allergy and asthma exacerbation.

Keywords: Bet v 1, Betula pollen, Aeroallergens.

Correlation between airborne Poaceae pollen concentrations and allergen Phl p 5 levels

C. Galán, M. P. Plaza, P. Alcázar

Department Botany, Ecology and Plant Physiology, University of Córdoba, Córdoba, Spain

Background: The major cause of pollinosis all over Europe is due to grass pollen (Burbach et al., 2009) and it is one of the most important airborne allergen sources worldwide. The allergen Phl p 5 has the highest rates of sensitization (>50%) in patients with grass pollen allergy (Tripodi et al., 2012) and It is presented only in pollen grains (Anderson et al., 2003). Early and effective estimation of exposition to aeroallergen is essential for allergy-sufferers. Recent research, however, has shown that airborne pollen levels alone do not always offer a clear indicator of exposure to aeroallergens. Furthermore, there are different weather and environmental parameters that affect to airborne pollen and aeroallergen concentrations.
Objective: This study aims to evaluate correlations between airborne grass pollen and Phl p 5 concentrations in Córdoba (southern Spain), for finding out if pollen counts alone suffice to explain changes in allergic symptoms.
Methods: Monitoring was carried out from 2012 to 2014. Hirst-type volumetric spore trap was used for pollen collection, following the protocol recommended by the Spanish Aerobiology Network (REA). Aeroallergen sampling was performed using a low-volume cyclone sampler, and allergenic particles were quantified by ELISA assay. Besides, the influence of main meteorological factors on local airborne pollen and allergen levels was surveyed.
Results: Daily airborne grass pollen concentration displayed year-on-year differences. The grass pollen season differed along the three studied years, with different length and sinuosity of the curves. A general advance was observed in the pollen season during 2013 and 2014, respect to 2012. The cumulative annual pollen index (pollen grains in whole season) also varied considerably, ranging from a minimum of 3,005 in 2012 to a maximum of 9,296 in 2014. Spearman correlation test shows a positive and significant correlation ($p < 0.01$) between daily aeroallergens and airborne pollen concentrations during all the studied years. Concerning meteorological parameters, it has been obtained a significant correlation between airborne pollen and minimum temperature, relative humidity and precipitation, during the three studied years. However, there is no clear relationship between allergens and weather variables.
Conclusions: There is a close correlation between grass pollen and aeroallergen Phl p 5, although this relation is irregular. Pollen potency is different in the three studied years and it did not necessarily match pollen-season-intensity. There is a close relationship between weather conditions and pollen emission but it is not certain with aeroallergen levels and the same meteorological parameters.

Keywords: Poaceae, airborne pollen, aeroallergens.

Next-Generation Sequencing applied to pollen and fungal identification in the atmosphere of Madrid (Spain)

A. Núñez[1], G. Amo de Paz[2], Z. Ferencova[2], A. Rastrojo[3], A. M. García[1], A. Alcamí[3], A. M. Gutiérrez-Bustillo[2], D. A. Moreno[1]

[1]*Escuela Técnica Superior de Ingenieros Industriales, Universidad Politécnica de Madrid (ETSII-UPM), Madrid, Spain*; [2]*Department of Biología Vegetal II, Universidad Complutense de Madrid, Madrid, Spain*; [3]*Centro de Biología Molecular Severo Ochoa, CSIC - Universidad Autónoma de Madrid, Madrid, Spain*

Pollen and fungal spores monitoring in urban environments has an important clinical interest because of their potential for causing allergy-related diseases: asthma, rhinitis, atopic eczema, etc. Moreover, some opportunistic fungi can develop dangerous diseases, especially to immunocompromised individuals, such as aspergillosis or fungal pneumonia.

We have studied the fungal and pollen communities from two different sampling sites in the city of Madrid (Spain) during different seasons using both traditional (microscopy) and Next-Generation DNA Sequencing (NGS) methods.

The results obtained for fungal determination show that high-throughput sequencing yields much greater diversity than microscopy analyses, identifying groups and species that are hardly detected or identified by morphology. Moreover, *Ascomycetes* (and *Capnodiales* within this group) are the most abundant fungi at all seasons analyzed according to both NGS and traditional methods. An increment in *Basidiomycetes* abundance was also detected from winter to spring time.

In regard to pollen determination, the outcome from NGS technology strongly correlates with the results from morphological identification, allowing us to detect the noticeable change of pollen communities from winter season (peak of *Pinales*) to spring (peak of *Fagales*). Again, sequence-based analyses can recognize a wider diversity but some technical adjustments are necessary to reach precisely the taxonomic level of species.

Altogether, our results show that NGS technologies are a promising alternative for pollen and fungal identification in aerobiology, although more studies comparing traditional and NGS methods are still needed in order to obtain accurate results.

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Keywords: Pollen and Fungal identification, Next-generation sequencing, Urban aerobiology.

Aerobiolgy based on drones

J. Belmonte[1], F. J. García[2], J. Roldán[2], C. De Linares[1]

[1]*Institute of Environmental Science and Technology, ICTA-UAB, Universitat Autònoma de Barcelona, Bellaterra (Cerdanyola del Vallès), Barcelona, Spain*; [2]*Dronesphere, Valle Gran Rey, La Gomera, Spain*

In the recent years drones have become a common tool in the society and have been given a lot of uses, from the personal use as elements with leisure purposes to the elaboration of photo-video reportages and getting to very specialized uses by companies and R+D projects.
Dronesphere, a drone operating company based in the Canary Islands, and the Point of Information on Aerobiology of the Institute of Environmental Science and Technology of the Universitat Autònoma de Barcelona (PIA, ICTA-UAB) have developed and patented a system that enables drones to obtain aerobiological samples. At present the Dronesphere aerobiological system has been used successfully in Spain, in Tenerife (Canary Islands), Bellaterra (Cerdanyola del Vallès) and in El Baix Empordà (Girona) to measure pollen, spores and allergens and a project is being developed to study La Gomera island (Canary Islands) for three years, under the patronage of the Cabildo Insular de La Gomera.
The Dronesphere system will be presented, together with results from aerobiological campaigns with drones and comparative analyses of results from drones and from Hirst and Burkard Cyclone samplers. As an example, the amount of pollen and spores captured with drone flights around palm tree plants and around *Musa* plants were much more biodiverse and rich than the coetaneous sample in a Hirst trap.

Keywords: Pollen and spores, Allergens, Drones.

Automated Microscopic Scanning and Evaluation of Pollen in Standard Samples

G. Meinardus-Hager[1], L. Hildebrandt[2]

[1]*a.e.r.o.medi B.V., Oldenzaal, Netherlands*; [2]*exScience, Bochum, Germany*

Standard method in aerobiology is sampling particles from the air with a Hirst type trap: It provides a time and volume related protocol of all particular materials in the air. Microscopic inspection may yield detailed information on occurrence, number, size and shape of pollen, spores and other particles of biological or non-biological origin.

Objective of our Microscope Image Analysis System (**MIAS)** is to introduce in this field of investigation modern but non-expensive techniques to combine the advantages of the standard collection method with the automation of microscopic inspection and image analysis.

The **MIAS** is based on:

a) **Standard methods** for the sampling and staining of aerobiological samples to have a clear contrast from other particles, and recognisable features of the pollen surface typical for each pollen species.

b) The **aeroIScope®**, an automatic scanning light microscope, designed to simulate the routine pollen counting: Free programmable scanning pattern in a 24 x 72 mm area applicable to 10 standard slides with accuracy in movement of 0.2 μm to obtain a series of fitting images. The optical magnification is chosen to see the relevant details of the appropriate grains in the image, and an Intelligent Automatic Focussing accounts for variations in sample properties. To spare storage and calculation capacities one single focus level picture at each frame is made: To make 3x100 pictures per slide needed for routine analysis, takes about 60 min and needs 75 Mb storage capacities.

c) The **image analysis program PCS** is performing three processes: To enable complex calculation the digital colour images are **transformed** to a fixed format and grey values. Secondly an analysing routine scans these pictures for **segments**, which correspond to that of particles searched for. Thirdly values of numerous parameters of the indicated image segments related to the size, average brightness and distribution of intensity are calculated. A classification of distinct pollen grains is possible by **comparing** the selected segments and their parameter values with the criteria typical for this pollen. It takes five minutes to select one kind of pollen from 300 images.

Conclusion: Using MIAS® the analysis of pollen becomes objective and effective: The technical specification of the aeroIScope® provides automatically series of fitting images which

- enables comfortable evaluation on a screen, independent form eye inspection,
- provides photographic documentation with clear relation to position on the slide,
- has a quality suitable for digital analysis to **detect,** and **classify** distinct pollen from these images.

aeroIScope® is a modular system open to possible adaptations in **software**, but also in magnification of **the optical system** with appropriate alterations in **mechanics**.

Keywords: automated microscope, image analysis, pollen classification.

Innovative bench test using Coriolis system to evaluate indoor air purifier

V. Moulès, A. Proust

VirHealth, Lyon, France

To evaluate the capacity of indoor air purifier to decontaminate confined space, we have developed innovative bench tests and optimized experimental protocols. To mimic confined space, we used a nebulization chamber to create stable contaminated atmospheres with good reproducibility using a multi-nebulization process with concentrated and calibrated microorganism solutions. A Coriolis system was used to optimize yields and reproducibility in the collecting process of microorganisms generated in the chamber. The decontamination device is placed inside the chamber and its efficiency is determined by harvesting air chamber samples at different time points. The rate of destruction of microorganisms is determined by quantify the among of infectious microorganisms in the air chamber before and after the device functioning time. Artificial atmospheres contain 5.10 ^{E}6 virus/m^3, 2.10^{E}7 bacteria/m^3 and 10^{E}6 molds/m^3 with a large panel of microorganisms including clinical and environmental strains. Nebulization chamber is located in Biosafety Level 3 core facility for a best control of physical parameters and to generate artificial atmosphere containing high pathogenic microorganisms such as MERS Coronavirus and avian influenza virus.

To answer the scientific and technologic needs of customers, we have developed innovative protocols for the generation of complex atmosphere containing a mix of bacteria and mold environmental strains or a mix between virus, bacteria and mold strains.

Keywords: Air purifier, bench test, microorganism.

ORAL COMMUNICATIONS

Abstracts
Thursday 21 July

Influence of pollen diurnal variation on susceptible individuals well-being

I. Sauliene, L. Sukiene, J. Greiciuviene

Siauliai University, Siauliai, Lithuania

During allergenic plants pollination, most of susceptible individuals are forced to limit their outdoor activities. In order to improve quality of life and leisure, individuals can get benefit from forecast on airborne pollen load. Employment of pollen forecast is weak in Lithuania until now. Although pollen effect on individual health is visible both from skin prick test results and self-reports about wellbeing. Our research aimed to figure out which daypart is more appropriate for outdoor activities of individuals allergic to particular pollen type. The permission to conduct this study was issued by the Lithuanian Bioethics Committee (No. 158200-13-633-200). In this study 349 individuals volunteered, age from 18 to 77 years old (average age – 37). All volunteers had positive reaction at least to one of allergens. Each participant measured well-being and filled questionnaire by themselves. We analyzed results of skin prick tests done with allergens of birch family, grass and mugwort. We found that load of birch and alder pollen is evenly distributed over the day, whereas hazel pollen is most abundant 12:00-16:00 (UTC). According to pollen data in Lithuania grasses spread pollen during whole daytime, mugwort has shorter period: from morning to midday. 54 % of individuals declared that pollen load had no impact on their sleep quality. More than half of the study subjects evaluating pollen effect on their everyday activities noted that they did not experience any tiredness.

Keywords: allergic rhinitis, skin prick test, Lithuania.

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Spatiotemporal correlations between air pollutants and eye-, nose- and lung symptoms of individuals collected by a citizen science platform

L. A. de Weger[1], J. Wesseling[2], R. Hoogerbrugge[2], A. J. van Vliet[3], P. S. Hiemstra[1], J. K. Sont[4]

[1]*Department of Pulmonology, Leiden University Medical Center, Leiden, Netherlands*; [2]*Centre for Environmental Quality (MIL), National Institute for Public Health and the Environment, Bilthoven, Netherlands*; [3]*Environmental Systems Analysis Group, Wageningen University, Wageningen, Netherlands*; [4]*Department of Medical Decision Making, Leiden University Medical Center, Leiden, Netherlands*

Background: According to the last report of the European Environmental Agency(1), up to 93% of the urban population in the European Union is exposed to levels of $PM_{2.5}$ above World Health Organization guidelines and up to 98% to levels of ozone above these guidelines. Health risks resulting from air pollution are substantial, and include heart disease, stroke, respiratory diseases and premature deaths. However, the proportion of the population affected by less severe disease is much larger than the proportion suffering from severe diseases. In spite of this, most epidemiological studies focus on the severe outcomes, because these data are usually better available. In this study we focus on nose-, eye- and lung symptoms, which can have a strong impact on public health and on economy (e.g. health care costs, lost work and school days).
Objective: The aim of this study was to determine whether symptom data collected by the citizen science platform Allergieradar.nl(2) can be used to identify individuals that experience adverse health effects following exposure to the most relevant pollutants: PM_{10}, O_3 and NO_2 and pollen.
Methods: Local pollutant concentrations were calculated for every hour using adaptations of the Dutch standard calculation models for air quality(3). We assessed to what extent these data and daily pollen counts (Leiden University Medical Center) were related to eye, nose and lung symptom scores in individuals participating in the citizen science platform Allergieradar.nl[2] between 1 Jan - 31 Aug 2014 and 1 Jan - 26 Oct 2015. The data were analysed using the software package Intercooled STATA 11.0 (StataCorp, USA). Data from participants with less than 6 entries were not used in this study.
Results: In the analyses the correlation coefficients between daily symptoms scores of 237 participants (5174 valid entries) and pollen or local pollutant concentrations were determined. Correlations coefficients> 0.7 were found for either nose, eye or lung symptoms of 30, 9, 18 and 13 individual participants with pollen, NO_2, PM_{10} and O_3, respectively.
Conclusions: Our study indicates that marked interindividual differences exist regarding the strength of the relationship between symptoms and one or more component of air pollution or pollen. In the future this may enable us to provide personalized information to individuals regarding potential risk of exposure to air pollution or pollen.

Keywords: air pollution, symptoms, citizen science.

References:

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Climate and allergic sensitization to airborne allergens in the general population: Data from the French Six Cities Study

D. Charpin[1], M. Ramadour[1], F. Lavaud[2], D. Caillaud[3], F. de Blay[4], G. Pauli[4], I. Annesi-Maesano[5]

[1]Université Aix-Marseille, Marseille, France ; [2]Hôpital Maison Blanche, Reims, France ; [3]Université de Clermont-Ferrand, Aubière, France ; [4]Hospices Civils de Strasbourg, Strasbourg, France ; [5]EPAR, IPLESP UMR-S 1136, Inserm et UPMC, Sorbonne Universités, Paris, France

The aim of the proposed oral communication is to highlight possible geographical variations in skin test reactivity. The study includes 6,461 schoolchildren, aged 9-11 years, living in six large or relatively large cities scattered around France. The abstract does not specify in what year(s) the survey was conducted, but this is a minor issue. The protocol is a compelling one in many ways. The obtained results have a real interest in the sense that a difference in the prevalence of sensitization to each airborne allergen or to various allergens grouped into 'indoor' and 'outdoor' categories was found between cities, even after adjusting for potential confounding factors.

However, the "climatic" explanation provided by the authors is less convincing. Indeed, the focus is on the opposition between "coastal" and "inland" cities but the only two "coastal" cities (Bordeaux and Marseille) are also the southernmost ones. There is no guarantee that a coastal or subcoastal city located further north (as Brest, Caen, or Rouen) would exhibit the same characteristics. Conversely, it is not clear that a city located in the South but away from the sea (Toulouse, for instance) would exhibit the characteristics described here as "inland". In my opinion, there is not enough evidence to suggest that the proximity to the sea and incidentally the humidity are the main factors which explain the reported geographical variations. The latitude and, as a consequence, the temperature may also play an important role, and even a more crucial role. This comment is further enhanced by the fact that emphasis is placed on birch pollen.

There is clearly no question of completing the initial survey, limited to six cities, but one suggestion might be to qualify the explanation of the main results and to shift the focus out of the hypothesized relationship between "maritimity" and allergic sensitization in schoolchildren.

Local and national monitoring of pollinosis using drug sales data

V. Auvigne[1], L. Léger[2], G. Oliver[3], M. Thibaudon[3]

[1]*OpenHealth Company, Vannes, France*; [2]*Ekipaj, Angers, France*; [3]*RNSA, Brussieu, France*

Since the late nineteenth century pollinosis (pollen allergies) has been regularly increasing. Nevertheless, few health indicators are available to monitor this phenomenon either at local, national or continental level. Assessment of the epidemiological evidence of short-term links between pollen exposure, pollution and seasonal allergic rhinitis requires the availability of such indicators. Anti-allergic drug consumption within general population is a data source which can be used for this purpose.

In France, the purpose of the OpenHealth.fr project is precisely to design and publish indicators to monitor the health of the French population. These indicators are based on the analysis of medication sales data from pharmacies. Currently seven indicators are published daily, including one covering the incidence of allergies.

The data that is used is data from the sale of medication used to treat seasonal allergic rhinitis. These are mainly antihistamines. Since 01/01/2009, the data has been sent every day by over 5000 pharmacies that are representative of pharmacies in metropolitan France (23% of all pharmacies). This data is used to build an Advanced Health Indicator ("Indicateur Avancé Sanitaire", or IAS). The IAS is standardized at the local level using the values observed in January each year. Spatio-temporal dynamics of allergic reactions are visualized using maps and time series.

At a national level, Temporal dynamics are characterized by a seasonal occurrence of allergic reactions with two main peaks: in March-April and in May-June. The dates for these peaks vary by about one month from one year to the next. At the local level many phenomena can be observed: an increase in symptoms at the end of January around the Mediterranean region, a peak of activity in late August and early September in the Rhône valley... At their peaks, the IAS values are 50 to 100% greater than in periods where there is no pollen activity.

The peaks in allergic reactions described by the IAS are concomitant with the main peaks in pollen activity: Cypress in late winter around the Mediterranean, broadleaved trees and then grasses at the national level in spring, ragweed in the Rhône valley in late summer. These results are compared with those of general practitioner networks. They could be used to better understand the relative importance of the different allergens in terms of public health, as well as the interactions between pollination and pollution.

Keywords: Allergy, real-time, surveillance.

Antihistamines sales reflect the Global Warming impact on plants pollination in Ukraine

V. Rodinkova[1], A. Bogomolov[2]

[1]*Pharmacy, Vinnitsa National Medical University, Vinnitsa, Ukraine*; [2]*Phthisiology, Clinical Allergology&Immunology, Vinnitsa National Medical University, Vinnitsa, Ukraine*

Background: It's known, that allergenicity of the plant pollen differ among species. Despite the high tree pollen count in spring in Ukraine, the most people who manifest the pollen allergy symptoms are admitted to hospitals in May and early summer in Ukraine. The grass pollen season starts at that time whereas the Poaceae pollen counts remain low and moderate. One should keep in mind that self-treatment is common in Ukraine so the hospital admission data may not represent the true picture of how many people are actually suffering from allergy at any given moment. More insight can be gained through analyzing the antihistamine sales at the regional drug stores. That is why we checked the patterns of sales of the anti-allergic remedies from 2008 to 2015 and compared them with the pollen count.

Method: The sales data of the antihistamines for systemic use (ATC code R06) in Vinnitsa region was obtained using the System of market research «PharmXplorer» which belongs to the «Proxima Research®» company specialized in the pharmaceutical marketing in Ukraine. The monthly fluctuations of the sales of packs quantity (pieces) were analyzed. The pollen counts obtained from the database of the Vinnitsa Regional Aerobiology Research Group at the Vinnitsa National Medical University. Pollen count was performed in 2009-2015.

Results: The highest sales were noticed in July in 2008-2010. In 2010 high sales were found in May and in June too, at the period coinciding with grass pollination, while the highest annual pollen count was determined in April and the lowest – in May 2010. It corresponds to the clinical records showing that even low Poaceae pollen concentration provoke the seasonal allergy symptoms in Ukraine.

In 2011 the peak sales were seen in June. In 2012 the highest numbers were registered in May and June while in 2013 and 2014 they were observed in March and May. These sales correspond well with the early onset of both tree and grass pollination seasons in these years. Moreover, very low sales were seen in March and April 2015. This year was characterized with the lowest tree pollen count in the entire observation period. The highest sales corresponded to grass pollination too. It was seen in May and in June 2015.

The decrease of sales in July and in August, despite of high *Ambrosia* and *Artemisia* pollen count in these months, can be explained by the patients' lower sensitivity to mugwort allergens and restricted areas of ragweed in comparison with grasses in Vinnitsa Region.

Conclusion: Antihistamines sales pattern reflects both low and extremely high tree pollen count and corresponds to the shift of the grass pollen season to May-June in the recent years in comparison to the situation six-eight years ago when the peak pollination occurred in June and July in Ukraine. Pollen monitoring and forecasting is an important tool enabling to warn sensitive individuals about the actual concentration of aeroallergens.

Keywords: antihistamines, pollen count, grass season.

Grass pollen season 2015, a multi method approach in three different European cities

M. Kmenta[1,2], K. Bastl[1], K.-C. Bergmann[3,4], S. Hewings[5], M. Kramer[5], S. Pätsi[6], A.-M. Pessi[6], A. Saarto[6], M. Skinner[5], B. Werchan[3,4], M. Werchan[3,4], R. Zetter[2], U. Berger[1]

[1]*Department of Otorhinolaryngology, Medical University of Vienna, Vienna, Austria*; [2]*Department of Paleontology, University of Vienna, Vienna, Austria*; [3]*Department of Dermatology, Venerology and Allergology, Charité-Universitätsmedizin, Berlin, Germany*; [4]*Foundation German Pollen Information Service, Berlin, Germany*; [5]*Allergy Therapeutics plc., Worthing, United Kingdom*; [6]*Aerobiology Unit, University of Turku, Turku, Finland*

Background: The Poaceae family (grasses) is the fourth-largest plant family in the world and has nearly a ubiquitous distribution. Furthermore, the grass family releases the most widespread aeroallergens in the world with sensitization rates up to 30%. The grass pollen season is composed of several pollination periods of many different grass species. Hence, it is not homogenous and more than one peak may occur during one grass pollen season. Moreover, different grasses are represented in different biogeographical regions and their allergenicity varies from species to species.
Methods: The most prevalent grasses in the areas of Vienna (Austria), Berlin (Germany) and Turku (Finland) were included in this study and examined by use of three different approaches: phenology, pollen monitoring and symptom data evaluation. Field observations were performed at several locations, representing a variety of different land covers (e.g. urban vegetation, rail track vegetation, natural monuments and public parks) within the political borders of the respective cities. All grass species present in the observation areas were identified and individual numbers of every species were recorded to determine the most prevalent grasses. The phenological results were compared with local pollen measurements as well as averaged data entries from the Patient´s Hayfever Diary (PHD; www.pollendiary.com), including exclusively symptom data reported from people in the area of the respective cities and surroundings.
Results: Preliminary results indicate that common meadow grass (*Poa pratensis*) and fescue grass species (*Festuca* spp.) are important contributors within the grass pollen season at the three European observation sites. The flowering of orchard grass (*Dactylis glomerata*) and false-oat grass (*Arrhenatherum elatius*) indicate a greater importance in Berlin (Germany) and Vienna (Austria), whereas a broader spectrum of diverging grass species contributed in Turku (Finland) to the main grass pollen season. Hence, distinct grass species show regional differences and unique grass compositions depending on the locality.
Conclusion: This study displays a unique approach linking phenological observations, pollen measurements and symptom data evaluation in order to give insights into the contribution of multiple grass species in different European regions to the main grass pollen season and their impact on the allergic burden of grass pollen allergy sufferers.

Keywords: Poaceae, Symptom data, Phenology.

Cyanobacteria as Allergen Sources

N. Lang-Yona[1], L. Vogel[2], B. Weber[1], U. Pöschl[1], J. Fröhlich-Nowoisky[1]

[1]*Multiphase chemistry department, Max Planck Institute for Chemistry, Mainz, Germany*; [2]*Paul Ehrlich Institute for Allergy Research, Langen, Germany*

Cyanobacteria are considered a potential health hazard, mainly due to exotoxin production. Projections on global change-related increase in cyanobacteria biomass have pointed out health risks with increasing levels of toxins. Due to the ability to disperse in the air, usage as food supplements, and the extensive use of cyanobacteria for biofuel production, a proper characterization of their health risks is needed. In this work, we investigated and characterized eight cyanobacteria species for their allergenic potential. The cyanobacterial taxa were initially tested for an allergic reaction using ELISA, cell-culture, and immunoblot assays. Allergenic activity was observed for all cyanobacteria taxa in all three assays. The allergenic compounds were separated by a sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE), and identified after electroelution procedure by mass spectroscopy analysis. The detected allergenic proteins ranged in size between around 10-100 kDa, with more than one allergenic protein observed for each species. Further results of the cyanobacterial allergen characterization will be presented and discussed. Our results suggest that cyanobacteria are a challenge for the immune system, especially for sensitized communities. This health risk may be modulated by climate change, and therefore should be considered and encountered properly.

Keywords: Cyanobacteria, Allergenicity, Health Risk.

Identification of new allergens from *Saccharum spontaneum* (Kans grass) pollen and its IgE-mediated cross-reactivity with other dominant grass pollens of West Bengal, India: an immunoclinical insight

T. Basak, K. Bhattacharya

Department of Botany, Visva Bharati(a central university), Santiniketan, West Bengal, India

Background: *Saccharum spontaneum*(SS) pollen were reported to be airborne but inadequate information was reported on its allergenic potency from West Bengal, India. The present study aimed to profile the sensitization of allergic individuals to SS pollen and to characterize the IgE binding proteins that may be responsible for type-I hypersensitivity along with investigates the invitro cross-reactivity of SS pollen and other dominant grass pollen species.
Method: Volumetric assessment of airborne grass pollen was performed in Santiniketan. The Ammonium sulphate precipitated antigenic profile of Kans Grass pollen extract along with dominantgrass pollen extracts from *Cynodon dactylon*(Cd), *Chloris barbata*(Cb), *Digitaria ciliaris*(Dc),*Eragrostis tenella*(Et), *Oryza sativa(*Os),*Imperata cylindrica*(Ic), *Saccharum officinarum*(So) and *Zea mays*(Zm) were analyzed by SDS-PAGE followed by Periodic acid-Schiff (PAS) staining. 134 patients withasthma, rhinitis or both, answered an questionnaire and were skin prick tested (invivo) with SS pollen antigen. The allergenic extract was used to set up in vitro immunoenzymatic tests like ELISA &IgE specific Immunoblotting to identify the specific IgE binding proteins in a panel of sera from 12 immunotherapy-free subjects who were monosensitized to SS pollen. ELISAinhibition has been used to identify cross-reactivity among grasses pollen whereas immunoblotinhibition demonstrates a component-based allergenic relationship.
Results: *Saccharum spontaneum* flowers from July to October though grass pollen were trapped inBurkard throughout the year. Ninety-four of the 134 patients (70.1%) had a positive skin test topollen of SS. Three components of 38 kDa, 55.7kDa and 97.2kDa were predominant both in itsintensity and frequency of recognition by human IgE antibodies, were identified as the majorallergens of *S. spontaenum* pollen. Four of the six IgE-binding components, including the majorallergen, seem to be glycoproteins, as confirmed by the Periodic acid-Schiff staining. Ic, Cd and Cb showed 50% inhibition with 5, 10 and 20 µg of protein followed by Zm, Os, Dc, Et within theconcentration range studied. Immunoblot inhibition demonstrated the presence of 26, 38, 55.7 and 97.2 kDa as shared IgE binding components between SS and other dominant grasses pollen.
Conclusion: Identification of three major allergens and Cross-reactivity of SS pollen allergens withother grass pollen has been delineated in this study.

Keywords: Allergy, IgE specific Immunoblotting, Cross-reactivity.

Is birch pollen season the footprint of birch flowering in Augsburg, Germany? Phenotypic plasticity and environmental drivers

F. Häring[1], A. Damialis[2], C. Traidl-Hoffmann[2]

[1]*Institute of Environmental Medicine, UNIKA-T, Technical University and Helmholtz Centre of Munich, Germany, Augsburg, Germany*; [2]*1. Institute of Environmental Medicine, UNIKA-T, Technical University and Helmholtz Centre of Munich, Germany, 2. CK-CARE, Christine Kühne – Center for Allergy and Research and Education, Davos, Switzerland, Augsburg, Germany*

Environmental change largely influences plant phenology. This is particularly true for flowering, including pollen release. What has not been concluded upon up to date is to what extent flowering phenology is reflected in pollen abundance and season. This is of utmost importance for allergenic pollen, like *Betula* species. The aim of this study was to investigate the occurrence of flowering of *Betula pendula* in Augsburg, Germany, under different environmental regimes and to check the relationship with the airborne pollen season.
60 Individual *B. pendula* trees in different sites (urban, semi-urban and rural) in a radius of 22 km around a volumetric Hirst-type sampler were examined for two full flowering years during 2014-2015. Bud burst and flower development dates were investigated, along with anther opening, pollen emission (start, peak and duration) and flower desiccation. Observations were made every two days before full flowering and every day within the main pollen season. Airborne pollen were recorded daily using a volumetric Hirst-type sampler. In parallel, meteorological data were also obtained either using nearby meteorological stations or by attaching temperature/humidity loggers on selected trees. Flowering dates were compared with those of the airborne pollen season so as to detect potential synchronicity. The dates of flowering and pollen season progress were regressed against meteorological values to decide on the driving factors of flowering and pollen season onset and offset. Additionally, the Urbanization Index of each site was assessed, based on Corine Land Cover database.
Flowering of *B. pendula* on average took place from 3 to 12 April in 2014 and 9 to 17 April in 2015. In 2014 flowering occurred about two weeks earlier than in 2015 (ANCOVA, $p<0.001$). The flowering season started and ended about two weeks earlier (R^2 equal to 0.75 and 0.69, respectively) but the season length being stable. *Betula* spp. pollen season in 2015 commenced one week earlier than the *B. pendula* floweringperiod. Overall, flowering phenology (start, peak, end, duration) at a regional scale can only explain 40.6% of the pollen season in Augsburg ($p<0.001$). It was found that air temperature was the main variable influencing both flowering and pollen season: although all phenological traits were sensitive, the start seems to be the most responsive to temperature ($p<0.001$). The Urbanization index was also closely correlated with the start of the flowering season ($p<0.001$), with flowering taking place earlier in urban environments.
Flowering is sensitive to air temperature. Pollen season is according to the phenological data and the Urbanization Index also affected by environmental regimes, but this not as prominent. Airborne pollen season does not necessarily reflect the flowering of the respective plant species, regardless of whether the latter is dominant in the regional vegetation. This raises questions on whether the influence of pollen long-distance transport is underestimated and on the effects of large-scale atmospheric circulation patterns.

Keywords: Aerobiology, Environmental Health, Phenology.

Temporal Changes in Oklahoma Cupressaceae Pollen

E. Levetin, R. Prava Mohanty, M. Flonard, M. Treglia

Biological Science, University of Tulsa, Tulsa, OK, USA

Members of the Cupressaceae produce abundant allergenic airborne pollen. In Oklahoma the family is represented by 5 species of *Juniperus*, and the pollen is registered in Tulsa for 8 months of the year. The expansion of *Juniperus* populations in the Great Plains has been studied by ecologists for several decades. In Oklahoma, the focus has been on the expansion of *Juniperus virginiana*, which is now distributed throughout much of the state including the Tulsa area. Other *Juniperus* species are not near Tulsa with the closest population of *J. ashei* 250 km from Tulsa and the closest *J. pinchotii* population 400 km away. Pollen from these species is carried to Tulsa by long distant transport events. Although several *Juniperus* species are important aeroallergens in North America, little is known about long-term changes in *Juniperus* (Cupressaceae) pollen concentrations. The current study examined trends in airborne Cupressaceae pollen and the prospects for future increases under climate change.

The atmosphere in Tulsa, Oklahoma, has been monitored with a Hirst-type sampler (Burkard Manufacturing) since December 1986. Pollen concentrations were determined and pollen season metrics calculated for spring Cupressaceae pollen representing *J. virginiana*, as well as for Cupressaceae pollen registered in fall during the *J. pinchotii* pollen season and in winter during the *J. ashe*i season. Pearson correlations were used to examine changes over time. Current and future distributions of *Juniperus* species were modeled using machine-learning algorithms, based on locality data and a suite of environmental parameters including climate, soil, and elevation.

Analysis of spring Cupressaceae pollen data from 1987 to 2015 showed considerable variability in pollen metrics. Start date varied 6 weeks, season length from 18 to 62 days, cumulative season total pollen (CST) from 1,708 to 12,566, and peak concentration from 442 to 2,699 pollen/m^3. When analyzed over time, there were significant increases in both CST ($r=0.67, p<0.0001$) and peak concentrations ($r=0.57, p<0.001$). Tulsa data for Cupressaceae pollen registered in fall and winter were highly variable but showed no significant changes in pollen metrics. Recent locality data for *J. virginiana, J. ashei, J. pinchotii,* and *J. monosperma* and environmental variables were used to model future habitat suitability. These models indicate the species' ranges are shifting north and also expanding for *J. virginiana* and *J. monosperma* under future climate change scenarios.

In conclusion, spring Cupressaceae pollen in the Tulsa atmosphere has shown significant increases over time paralleling *J. virginiana* population increases in Oklahoma. There were no significant changes in the incursions of *J. ashei* and *J. pinchotii* pollen. Computer models of habitat suitability indicate continued expansion of *J. virgniana* and *J. monosperma* in the future, suggesting that airborne pollen levels will also continue to increase.

Keywords: Climate change, Cupressaceae pollen, Juniperus virginiana.

Aeropalynology study of Abomey-Calavi city (Benin) during the high rainy season

G. M. Tossou[1], T. F. Lopez[1], A. Akpovi[1], M. Del Mar Trigo[2]

[1]*Université d'Abomey-Calavi, Département de Biologie Végétale, Abomey-Calavi, Benin;* [2]*University of Malàga, Department of Botany, Malàga, Spain*

The pollen content of the atmosphere of the town of Abomey (Benin) was analyzed during the rainy season. The Hirst device, based on the volumetric method was used to capture particles. A total of 35 pollen grains and 12 spores per cubic meter of air belonging to 32 genera and 7 families were captured. The most dominant taxa are respectively *Acacia auriculiformis* (Leguminosae-Mimosoideae) with 34.54%, Poaceae (30.59%), *Combretum indicum* (Combretaceae) is 7.61% and *Elaeis guineensis* (Arecaceae) 2.38 %. The pollen analysis has highlighted the good representation of taxa that flourished during the study period. The positive correlation between the amount of pollen grains, temperature, and wind speed and negative between pollen grains and rainfall.

Keywords: Aeropalynology, Hirst device, Meteorology, Pollens, Abomey-Calavi.

Phenological analysis of grasses (Poaceae) as a support for the dissection of their pollen season in Perugia (Central Italy)

S. Ghitarrini, E. Tedeschini, G. Frenguelli

Department of Agricultural, Food and Environmental Sciences (DSA3), University of Perugia, Perugia, Italy

Grasses (Poaceae) are a major cause for allergic diseases worldwide. Monitoring the presence of their pollen in the atmosphere is of primary importance for symptoms interpretation and therapy planning. Microscopic pollen identification and counts do not allow the detection at species or genus level because of the stenopalynous nature of the family. Nevertheless, the assessment of the flowering times of different species (which are not simultaneous, but come in succession from spring to late summer) would be important, because not all grass allergens are cross-reacting and allergic patients could be differentially sensitized. In this work a phenological survey was carried out in five stations located on the urban territory of Perugia (Central Italy), from April to September 2015, recording the alternation between flowering phenophases of 19 grass species and estimating their contribution to the airborne pollen load of the area through the calculation of a Phenological Index. Moreover, pollen grains of the different species were collected and observed, confirming the impossibility to make a discrimination during microscope pollen counts. The prevailing grasses in terms of contribution to the pollen rain in the studied area resulted to be *Dactylis glomerata* and, to a minor extent, *Lolium perenne* during spring and early summer, and *Cynodon dactylon* during late summer. Data should be validated repeating the survey in successive years and possibly using bio-molecular tools, but the obtained information could be relevant in the diagnosis and treatment of grass pollen allergies.

Keywords: Poaceae, phenology, Central Italy.

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Short-term exposure to pollen and the risk of allergic / asthmatic symptoms: a systematic review and meta-analysis of the panel studies

T. Hugg, M. Kitinoja, N. Siddika, J. Jaakkola

Center for Environmental and Respiratory Health Research (CERH), University of Oulu, Oulu, Finland

Background: Practically all people are exposed to allergenic pollen grains and moderate proportion of population can react to this exposure. However, there are no previous systematic reviews on the relation between short-term exposure to pollen and the risk of daily allergic / asthmatic symptoms.
Objective: We conducted a systematic review and meta-analysis of panel studies on the relations between pollen exposure and the risk of allergic / asthmatic symptoms and studied whether such relations differ according to type of exposure and outcome.
Methods: A systematic literature search of the PubMed and the Scopus databases was conducted until November 2014, and reference lists of relevant articles were reviewed. Original articles, the design of cohort, longitudinal, follow-up, case-control and cross-sectional studies in children or adults were selected according to a priori criteria. Two authors independently evaluated eligible articles and extracted relevant information. We used random-effect model to calculate the summary effect estimates (EE) with their 95% confidence intervals (CI). Heterogeneity was evaluated using the Q-statistics.
Results: Thirteen eligible studies with a varying follow-up period (6–35 weeks) and sample size (22–154 panelists) were identified. The summary effect estimates for the relation between pollen exposure (an increase of 10 pollen grains per m^3 of air) and lower respiratory symptoms was 1.08 (95% CI 0.97–1.20, Q-statistics 14.63 (4), P=0.002). The summary effect estimates were elevated for nasal symptoms (EE 1.15, 95% CI 0.99–1.33, Q-statistic 6.49 (2), P=0.011) and asthmatic symptoms (EE 1.01, 95% CI 1.00–1.01, Q-statistic 0.28 (2), P=0.597). Substantial heterogeneity was observed between study-specific effect estimates in most of the analyses.
Conclusion: This study provides evidence that short-term exposure to pollen increases the risk of asthmatic symptoms. However, the small number of studies in each meta-analysis and relatively high heterogeneity between study-specific effect estimates limits conclusions.

Keywords: Pollen exposure, allergy / asthma, meta-analysis.

Thursday 21 July

Pollen exposure and clinical symptoms in patients treated by immunotherapy with birch and grass allergens – application for patients

D. Myszkowska, M. Mazur, M. Ziemianin, E. Czarnobilska

Clinical and Environmental Allergology, Jagiellonian University Medical College, Kraków, Poland

Availability of information about the pollen exposure is important for the therapy and prophylaxis of allergic rhinitis and/or asthma. Such a form is the individual electronic application to evaluate the intensity of symptoms with feedback information about the current and forecasted pollen concentrations. A prototype application within the pollen database for Krakow was arranged, to complete the patient symptoms score and to generate predictive models for grass and birch pollen. The aim of the study was to compare the clinical symptoms in patients treated by immunotherapy (SIT) with birch and grass allergens in 2014-2015 and to present the effectiveness of model predictions, and the preliminary results of application functioning in patients.

The logistic regression models constructed on the basis of the daily pollen concentrations and meteorological data in 1998-2011 were verified in 2012-2015. The graphical presentation of model predictions was exposed in frame of the pollen database twice a week. The application was tested by the group of 30 patients (aged 10-62 yrs), treated by birch and/or grass allergen immunotherapy.

Logistic regression models have shown the efficacy expected at 65.2% for birch pollen and 68.5% for grass pollen. Forecasts generated in 2012-2015 showed a satisfactory level of compliance with the actual values for both taxa. The highest efficiency was demonstrated for birch forecast in 2012 (76.0%) and grasses in 2015 (65.8%).

Patients, who filled in an online application, manifested allergenic symptoms of the upper respiratory tract (all patients) in both years (2014-2015), especially in time of the birch and grass pollen exposure. Additionally, the local food-related allergy symptoms occurred in 6% of patients after one year of SIT, while in 3% after the second year.

Birch pollen exposure was four times as high in 2015 as in 2014, while in case of grasses, the pollen concentration was about 30% lower. In spite of that, only 10% of patients sensitive to tree/grass allergens showed an increase in symptoms score in 2015, while in 75% of patients treated with grass allergens higher symptoms were observed.

The variability of the seasonal pollen exposure in both studied years influenced some patients only. The application for patients seems to be a practical tool for them and also for medical doctors, making the control of the immunotherapy more effective.

Keywords: pollen exposure, allergic symptoms, patients application.

Breathing in the Park: A Project to estimate the allergenicity of urban green spaces in Spanish Cities

P. Cariñanos[1], M. Casares-Porcel[1], C. Díaz de la Guardia[1], M. J. Aira[2], M. Boi[3], C. Cardador[4], B. Elvira-Rendueles[5], S. Fernández-Rodriguez[6], J. M. Maya-Manzano[7], R. Pérez-Badía[4], D. Rodríguez de la Cruz[8], F. J. Rodríguez-Rajo[9], J. Rojo-Úbeda[4] E. Sánchez-Reyes[8], J. Sánchez-Sánchez[8], R. Tormo-Molina[7], A. M. Vega-Maray[10]

[1]*Botany, University of Granada, Granada, Spain*; [2]*Botany, University of Santiago de Compostela, Santiago de Compostela, Spain*; [3]*Biology, Area of Botany, University of Islas Baleares, Palma de Mallorca, Spain*; [4]*Institute of Environmental Science, University of Castilla-La Mancha, Toledo, Spain*; [5]*Chemistry and Environmental Engineering, Polytechnic University of Cartagena, Cartagena, Spain*; [6]*Construction, University of Extremadura, Cáceres, Spain*; [7]*Plant Biology, Ecology and Earth Sciences, University of Extremadura, Badajoz, Spain*; [8]*Institute Hispano-Luso of Agricultural Research, University of Salamanca, Salamanca, Spain*; [9]*Plant Biology and Science of Soil, University of Vigo, Orense, Spain*; [10]*Biodiversity and Environmental Management (Botany), University of León, León, Spain*

Urban green spaces are areas of recreation of urban dwellers that must comply with the requirements of sustainability and health in the context of current city. However, the lack of planning in the design of these spaces, coupled with low biodiversity and massive use of a few species, lead to the implantation of trees involved in processes of adverse reactions for the population. This job presents an approach to the allergenic potential of different parks located in several spanish cities, by applying a new allergenicity index, which considers the biological parameters of tree species growing in the space (strategy of pollination, duration of the period of flowering and allergenic potential), as well as other factors related to its activity as a source of emission of allergens. The resulting value of this index enable to classify each park based on its allergenicity: 0, value does not constitute any risk to population, up to 1 in those with abundant species of maximum allergenicity. In this study, a total of 20 parks located in different climatic zones of Spain and of very different types: urban, modern, historic park, boulevard and squares, have been analysed. The results obtained after the application of the index reveal that some of them recorded a value of index higher than 0.30, sufficient to cause allergic symptoms to the people suffering from pollen allergy any season of the year. The index also identifies those species more contributive to the allergen value of the park, emphasizing among them those from the Cupressaceae, Betulaceae and Moraceae families, and to a lesser extent, Oleaceae and Platanaceae. Other factors that have an impact on the value of resulting allergenicity is the presence in the parks of populations of anemophilous allergenic species and density of trees per hectare. The possibility of cross-reactions between species of the same family, and a greater number of male individuals in the case of dioecious species are also aspects to consider. It can be concluded that the index is an effective tool to estimate the allergenic potential of urban green areas, so that they corrective measures for situations that may pose a risk to people suffering from pollen allergy can be proposed.

Keywords: Urban Parks, Index of Allergenicity, Allergenicity Pollen Value.

An educational animated sequence for explaining pollen allergies to children

M. Mottet[1], M. Beauxis-Aussalet[2], B. Chauvel[3], R. Bilon[1]

[1]*INRA, Observatoire des Ambroisies, Dijon, France*; [2]*GIP FTLV, Dijon, France*; [3]*UMR Agroécologie, INRA, Dijon, France*

Introduction: Common ragweed (*Ambrosia artemisiifolia* L.) is an invasive plant that causes serious allergies. Raising awareness among the general public is indispensable for controlling this plant (Chauvel and Martinez, 2013). The Observatory of ragweeds has put together the educational tool Captain Allergo to help young people to know more about common ragweed.
Methods: Exchanges between teachers and researchers led to the realization of a tool associating playing and sciences and comprising a super hero, four rotating roll-ups (vertical posters) and three floor mats with basic information on common ragweed. The children complete their workbooks and then Captain Allergo recalls two fundamental messages in a video: people have to protect themselves from the pollen and uproot the plant prior to pollen production.
Results: In 2015, 15 sessions were organized and 578 children attended this activity. The trainings offered to teachers and activity leaders made it possible for them to be introduced to common ragweed and to discover the different stages of the animated sequence.
Discussion: The Captain Allergo animated sequence was well received. The main concepts and messages seem to have been understood and the children's enthusiasm materialized in varied ways. Today, our aim is to diffuse the animated sequence over the whole country. The character Captain Allergo could even be adapted so as to suit other pollinoses.
Conclusion: This educational activity focusing on an allergenic plant has met with great success among young people and managers. Its deployment over the whole country will allow us to raise awareness among both children and parents.

Funding and partners: The kit containing the animated sequence, the workbooks and a teacher's booklet was funded by the French Ministry of Health, Inra and the ARS (Regional Health Agency) Burgundy. The GIP-FTLV (life-long education) has conceived the educational content of the kit and manages its diffusion through the Canopé network; the Ligue de l'Enseignement de Côte-d'Or organization and the Observatory of ragweeds provide activity leaders with training.

Bibliography: Chauvel B. and Martinez Q. 2013. Allergie à l'ambroisie : quels moyens pour empêcher l'invasion ? *Revue française d'allergologie*. 53, (3), Édition 8e Congrès francophone d'allergologie, 229–234.

Keywords: Captain Allergo, Ambrosia artemisiifolia, Science to children.

Pollens and epidemiological studies: pharmaco-epidemiology and panel studies in France

D. Caillaud[1], J.-P. Besancenot[2], M. Thibaudon[2]

[1]*Pulmonary Dpt, University Hospital, Clermont-Ferrand, France*; [2]*Aerobiology, RNSA, Brussieu, France*

Background: Pollens vary widely in their capacity to produce and disperse allergens which triggers allergies. However, the identification of the allergenic potential of pollens is often problematic.
Objective: This study aims to describe how epidemiological studies may help to confirm that pollen exposure is associated with clinical allergy symptoms like seasonal allergic rhinoconjunctivitis and asthma
Methods: Temporal pharmaco-epidemiological studies have demonstrated pollen involvement in hay fever and asthma. Panel studies are able to evidence a dose-response relationship.
Results: Poaceae, Birch, Carpinus, Ragweed, Plane, Urticaceae, Olive trees and Cypresses are involved in pharmaco-epidemiological studies. There are statistically significant relationships between Poaceae, Birch and Ragweed's pollen counts and pollinosis symptoms in panel studies. More studies are needed to positively identify other pollens.
Conclusions: A number of pollens meet the criteria for allergenicity in epidemiological studies. However, further studies are needed to confirm the potentially allergenic role of others.

Keywords: Epidemiology, Pollens.

Effects of birch and grass pollen exposure: air pollution, and weather type on antiallergic drug consumption in S Sweden: a time series analysis

Å. Dahl[1], M. Grundström[1], D. Chen[2], T. Ou[2], H. Pleijel[1]

[1]*Biological and Environmental Sciences, University of Gothenburg, Gothenburg, Sweden*; [2]*Earth Sciences, University of Gothenburg, Gothenburg, Sweden*

In order to develop integrated air quality forecast systems for allergy sufferers, we need to understand what situations are especially connected to the risk of allergic inflammation. They depend on the typical pattern of pollen dispersal in a certain landscape, to the impact of the chemical composition of the air, and to the short-term weather situation. Certain meteorological factors, such as dry and warm air, and low wind speeds promote high pollen concentrations, and weather is equally important for the emission and dispersal of air pollutants. In a parallel study, we have related the air quality situation to Lamb's weather types, which constitute a physically based classification scheme to accurately break down the complexities of weather patterns into relevant pieces. We then found that the risk for exceeded threshold values to occur simultaneously for pollen and pollutants was higher in certain weather types.
In the present study, we use a time-series approach, using generalized additive and distributed lag models to find the concentration-response relationship of airborne pollen and allergy reactions, and the timing and lag structure of the impacts, in two cities in SW Sweden. As a proxy for allergy symptoms, we use the demand for antihistamines, expressed as prescribed and sold over-the-counter (OTC) daily doses (DDD). Furthermore, we check additive effects of nitrogen oxides, ozone, and particles on the well-being of allergy sufferers in multivariate models, and analyze the structure of lagged effects. Thirdly, we relate the demand for antihistamines to synoptic weather, as described by Lamb Weather Types (LWT), not only at the present day, but also at key lag intervals previous to the present exposure.

Spore-sensitization is usually associated with other allergies including pollinosis in Ukraine

V. Rodinkova[1], A. Bogomolov[2], O. Bobelo[3], B. Plotytsia[4]

[1]*Pharmacy, Vinnitsa National Medical University, Vinnitsa, Ukraine*; [2]*Phthisiatry, Allergology&Clinical Immunology, Vinnitsa National Medical University, Vinnitsa, Ukraine*; [3]*Alergocentr-KPP, Vinnitsa, Ukraine*; [4]*Medicine No 1, Vinnitsa National Medical University, Vinnitsa, Ukraine*

Background: Spore-sensitization cannot be effectively determined with the common skin prick tests (Ref?). However, this sensitization type can be important for patients? In order to establish the rate and pattern of spore-sensitization in Vinnitsa region we analyzed the medical records of IgE-tested patients of the Regional Clinical Allergy Centre “Alergocentr-KPP”.

Methods: The records of 59 patients admitted to the clinicians with allergy complaints during September-December 2015 were analyzed. All patients were tested for IgE levels with Quantitative Multiparameter Assay profiles (Inhalation 2 and Paediatric Inhalation panels)(Ref?). Panels include allergens of *Aspergillus fumigatus, Cladosporium herbarum, Penicillium notatum, Alternaria alternata*. Interpretation of specific IgE classes was carried out using the common scheme from Class 0 (negative result) to Class 6 (a very high concentration of antibodies).

Results: Patients were aged from 15 to 58 years old and 60% of them were females. All of the individuals tested were polysensitized. They react to house dust mites, pollen and allergens of animals. However, just 25 of them (44%) were detected to be spore-sensitive. The highest number of them (13 or 52%) were sensitive to *Alternaria* allergens. The IgE levels varied from low to high (50,27 UI/ml max) for such cases. Approximately 48% of patients were sensitive to *Aspergillus*, but the sensitization levels varied from low to high concentration in this case (5,52 UI/ml max). *Cladosporium* spore counts were highest in Vinnitsa during each season. However the number of *Cladosporium*-sensitive individuals was the same as *Alternaria*-sensitive patient numbers but levels of their sensitization was average. The lowest rate was noted for *Penicillium* with only 3 patients showing sensitization. Seven patients were sensitized for two spores types, 4 – for *Aspergillus* and *Alternaria*, 2 for *Cladosporium* and *Alternaria*, and one for *Aspergillus* in combination with *Cladosporium*. Four patients had increased IgE levels for the *Aspergillus, Alternaria* and *Cladosporium* at the same time. One patient was sensitized for all 4 spore allergens.

Among pollens, the greatest effect in the tested group was caused by Poaceae allergens (*Phleum* and *Secale*). They increase IgE levels to high, intensively high and very high values. Other allergens of importance included *Alnus, Corylus, Betula* and *Artemisia*.

Conclusion: Despite spores occurring mainly indoors, their effect must be noted in the outdoor atmosphere as well. Allergy sufferers should be aware of the possible risks occurring from spores outdoors. This awareness is especially important in case of polysensitized individuals.

Keywords: spore allergens, immunoblotting, polysensitization.

Parietaria and *Platanus*, botanical aspects and pollinosis

J. Belmonte, C. De Linares

Institute of Environmental Sciences and Technology, ICTA-UAB, Universitat Autònoma de Barcelona, Bellaterra (Cerdanyola del Vallès), Barcelona, Spain

Parietaria (Urticaceae family) is a genus native to temperate and tropical regions and very frequent in the Mediterranean and the Atlantic landscapes. It is a wind-pollinated weed, commonly found in the countryside and urban areas, growing on walls and soils rich in nitrogen. Pollination occurs in different moments along the year, and is difficult to be clearly established due to the low variability of the pollen morphology inside the family. However, there is no doubt about the clinical significance of *Parietaria* pollen with regard to *Urtica* pollen (other genus not tested) and about its responsibility for a high percentage of multiseasonal symptoms.

The major allergens of *Parietaria* isolated and characterized are Par j 1 and Par j 2 (from *Parietaria judaica*), showing a prevalence of 95% and 82% respectively among allergic patients. They are small non-specific lipid transfer proteins (LTP) that present a conserved structure and are classified as profilins. LTPs are present in pollen of several other species of trees, grasses, and weeds as well as in many fruits and vegetables. Following the platform for allergen knowledge (Allergome.org), there are 25 different allergens in the case of Par j 1 and 22 in that of Par j 2 that present sequences of high similarity. However, IgE cross-reactivity is no correlated with the sequence similarity. Par j 1 has also been identified in *Parietaria mauritanica* and *Parietaria officinalis*. Two minor allergens from *P. judaica* have also been isolated and characterized. Par j 3 is a profilin showing the highest sequence homology with others 28 different profilins of pollen types but presenting cross-reaction with only two allergens (Bet v 2 and Che a 2). Par j 4 is a Calcium-Binding Protein (Pj CBP) with a high degree of homology to other allergenic CBP.

Platanus is the only genus in the Platanaceae family. It is native to the Northern Hemisphere and, although it grows in the wild in riparian and wet habitats, it is mainly found in cities, planted as ornamental tree, and cultivated as a forestry tree. *Platanus* are wind-pollinated trees producing and disseminating huge amounts of pollen grains in a short period of time, mainly during spring. Although its allergenicity has not been recognized since the end of the 20th Century, there is no doubt nowadays of its clinical relevance.

Four allergens have been identified, isolated and characterized from *Platanus acerifolia*. Pla a 1, an invertase inhibitor, and Pla a 2, a polygalacturonase, are major allergens, showing a prevalence of 84% and 83% respectively among allergic patients. Pla a 3, a non-specific LTP, is a minor allergen (27.3%) that cross-reacts with several foods, and is involved in a LTP pollen/food syndrome. After Allergome.org, Pla a 3 presents sequences of high similarity with 43 different allergens but homology sequences with only 4 (Art v 3, Ole e 7, Par j 1, Pru p 3). Pla a 8, a profilin, is a novel allergen recently isolated.

Keywords: Pollen, Pollinosis, Allergen.

Pollen dispersal in a hybrid cereal canopy

M. Sadyś[1], J. West[2], M. Spiller[3], J. Melichar[4], G. Stiewe[3], A. Reynolds[1]

[1]*Computational and Systems Biology, Rothamsted Research, Harpenden, United Kingdom*; [2]*Plant Biology and Crop Science, Rothamsted Research, Harpenden, United Kingdom*; [3]*Syngenta, Bad Salzuflen, Germany*; [4]*Syngenta, Whittlesford, United Kingdom*

In collaboration with Syngenta, lab and field experiments at Rothamsted Research aim to optimise hybrid cereal production by improving pollination and seed production. We examine barley pollen dispersal within the plant canopy and meteorological factors affecting pollination success. The overall goal of our project is to determine the extent to which seed-set (yield) in hybrid cereal seed production systems can be maximized with respect to positioning of pollen producing restorer plants, their height and proportion of pollinator to male-sterile plants. The project's findings can be applied to other hybrid cereals.

Different proportions of pollen producing restorer plants were used, i.e. 0%, 2%, 4%, 8%, 16% in 9 m × 9 m field plots of otherwise male-sterile plants, along with various plot architectures (random mix, 1 in 6 and 1 in 12 lines, and restorer plants in the centre of the plot). All plots were sown in 3 replicates. Simultaneously, a set of restorer plants were also grown in a glasshouse. Once, the pollination started, they were placed in a wind tunnel and exposed to different wind velocities (< 7 m s^{-1}). The pollen discharge rate was tested using several Rotorod air samplers. At the field, a total of 32 active and 30 passive air samplers were set up at 4 plots containing restorer plants in the center, in 4 cardinal directions. A weather station along with 3 ultrasonic anemometers (at 0.5, 1 and 2 m above the ground level) was placed within the plant canopy. Pollen measurements were taken throughout a one-week period (May 2015), from 09:00 to 12:00 UTC, on days when no rainfall occurred. Air samplers were then preserved at the laboratory and examined using a light microscope in order to establish the pollen concentration during the flowering period. Two months later, two replicates of ear samples were collected in order to examine the seed set, taking into account the distance between restorer and female plants. One sixth of each plot was then harvested to measure the yield.

Wind tunnel experiments indicated that the highest pollen release was found at 6 m s^{-1}, and with no damage to pollen grains at 5 m s^{-1}. Pollen counts decreased monotonically with increasing distance from the crop (at 1 m away from the source, pollen count was 65%, while at 3 m only 14-16%). Preliminary field results showed that plots with the pollinator concentrated in the centre did not perform well (12-63%, 12-74%), since the seed set greatly depended on the dominant wind direction, whilst the seed set in mixed plots greatly depended on the pollinator concentration (40-77%). Received results will be then modelled using in-house state of art bioaerosol dispersal model. This experiment is currently undergoing a replication.

Keywords: Poaceae, pollen dispersal, seed set.

Male phenology of Mediterranean saltbush, *Atriplex halimus* L., and its relationship with airborne pollen concentrations

R. Pérez-Badia, J. Rojo, M. Serrano, S. Sardinero, F. Fernández-González

Environmental Sciences, University of Castilla-La Mancha, Toledo, Toledo, Spain

Airborne pollen from the species belonging to the family *Amaranthaceae* (including *Chenopodiaceae)* is the main responsible for pollinosis during late summer and early autumn. In Spain, the prevalence of sensitization to this pollen type is of 30-40% in allergy sufferers. Furthermore, certain allergenic proteins from *Amaranthaceae* pollen show cross reactivity with other allergens, which can increase the severity of the allergy symptoms. For this reason, it is important to study the airborne pollen concentrations of this pollen type and locate its most significant sources of emission.
In this study, the male phenology of the Mediterranean saltbush, *Atriplex halimus* L., has been followed during a three-year period (2009, 2011 and 2012) in central Spain, in the city of Toledo and surroundings, along the valley of the River Tagus, where this species grows associated to halo-nitrophilous soils and thus covers large periurban areas. Besides, this species is frequently planted in hedges of fields or in road embankments. The intensity of flowering of *Atriplex halimus* L. was estimated as percentage of opened male flowers, and this figure has been compared with the atmospheric concentrations of the *Amaranthaceae* pollen. The pollen season has been characterized using a Hirst-type volumetric pollen trap during the period 2005-2012.
The pollen season of *Amaranthaceae* occurred from early May to early October, and the peak of pollen was recorded between 7th July and 13th September depending on the year (daily mean = 35 ± 19 pollen /m^3). The mean of annual pollen index was 757 ± 277 and the pollen season was very long, but characterized by low intensity in daily concentrations. The highest concentration values were recorded from late August to middle September. The observed male flowering period of *Atriplex halimus* during the years 2009, 2011 and 2012 occurred from 22nd August to 14th September (mean of these three years), when the peaks of pollen concentrations were recorded.
In conclusion, the floral phenology of the male flowers of *Atriplex halimus* L. can be used as an important indicator to predict the highest concentrations of the *Amaranthaceae* pollen. Monitoring the floral phenology of this species in cities where it is very common, can be useful to alert allergic people on the days before the pollen peak concentrations occur.

Keywords: phenology, airborne Amaranthaceae pollen, central Spain.

Ambrosia in Europe, historical approach through dried herbarium specimens

G. Guignard[1-2], H. Méon[2-3], B. Jacquy[4], C. Déchamp[2]

[1]*Université Lyon, Université Claude-Bernard Lyon 1, CNRS UMR 5023 LEHNA, Villeurbanne, France;* [2]*AFEDA, Saint-Priest, France;* [3]*Université Lyon, Université Claude-Bernard Lyon 1, Ens Lyon, CNRS UMR 5276, LGL-TPE, Villeurbanne, France;* [4]*Herbiers de l'Université Claude-Bernard Lyon 1, Lyon, France*

Since a few years, some *Ambrosia* taxa different from *Ambrosia artemisiifolia* L. were observed, their occurrences and localization were studied through old dried herbarium specimens. *Ambrosia* and *Franseria* synonyms taxa were checked among the most admitted ones: *Ambrosia artemisiifolia* L., *Ambrosia psilostachya* DC. *Ambrosia tenuifolia* Sprengel, *Ambrosia trifida* L. and *Ambrosia maritima* L., the only European native *Ambrosia* species, marine sands of the Mediterranean.

Specimens are located in various regions and countries, from the second middle part of the XIXth century to the beginning of the XXth century, they were gathered by several collectors. All details contained in the labels give some precious informations: for instance in Brandenbourg (Germany) the occurrence of *Ambrosia artemisiifolia* in 1849 allows the comparison between ancient and present distributions, this taxon has been recently identified in this region. Similarly, the three taxa *Ambrosia psilostachya, Ambrosia tenuifolia* and *Ambrosia trifida,* which seemed poorly known until last years in Europe, were however present since the years 1850's. Conversely, *Ambrosia maritima* labels show that they were quite common in Europe, especially in France, mainly in the Mediterranean area, i.e. Italia, Algeria, Tunisia, Egypt…

Keywords: ambrosia, botany, dried specimens.

Ambrosia psilostachya DC.: a new source of allergy in France?

R. Bilon[1], S. Monnier[2], M. Thibaudon[2], B. Chauvel[3]

[1]*INRA, Observatoire des Ambroisies, Dijon, France*; [2]*RNSA, Brussieu, France*; [3]*UMR agroécologie, INRA, Dijon, France*

Ambrosia psilostachya DC. (western ragweed) is a perennial Asteraceae native to North America introduced in France at the end of the 19th century. It is one of the four American ragweed species present in France and recent observations have provided evidence of its expansion in perturbed habitats of southern France.
Ambrosia psilostachya originates from Western North America (Basset & Crompton, 1975) and is observed in France in ruderal and cultivated habitats, but also in open or perturbed semi-natural environments (grasslands). A recent study (Fried et al., 2015) showed that *A. psilostachya* occupies the same habitats as *Ambrosia artemisiifolia* (annual plant), but it was found at the most stable places in these habitats. This perennial species is less frequent in stressful pioneer habitats, suggesting a preference for an intermediate level of disturbance.
In the Camargue region in the South of France, a very high density of *A. psilostachya* was observed in grasslands. The development of these populations could be favoured by overgrazing during long periods of use as pasture. As *A. artemisiifolia* has not developed high densities of plants in this region yet, the pollen trapped in this area could be thought to be produced mainly by *A. psilostachya*. A study was set up in collaboration with ANSES and RNSA with the installation of three passive Sigma2 Like-trap (SLT) sensors for measuring the presence of *A. psilostachya* pollen in connection with the field observation of plants. Measures of pollen emissions were estimated between areas with different high levels of plants (two traps) and on a site with no plant observed in the area. SLT samples were collected weekly for two months, from late July to late September 2014.
The number of pollen grains trapped is important, with an average of 200 (from 9 to 421) and 300 (from 9 to 763) pollen grains per week in the areas with high densities of plants, as against low counting in the control site (from 0 to 6). Maximum counts were observed in August (weeks 33 to 36) and pollen density was strongly affected by rainfalls. The effect of the pollen emission on health is presently not known.
These measures are the first ones in France aiming at assessing the presence of *A. psilostachya* pollen in France. Potentially favoured by global changes, *A. psylostachya* evolution certainly requires better consideration in France, so as to avoid the development of a new allergenic species.

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Keywords: Biological invasion, Ambrosia psilostachya, allergy.

Flowering phenology and pollen production of three *Artemisia* species in urban and rural environments

P. Bogawski[1], Ł. Grewling[1], A. Frątczak[2]

[1]*Faculty of Biology, Laboratory of Aeropalynology, Adam Mickiewicz University, Poznań, Poland*; [2]*Faculty of Biology, Department of Plant Taxonomy, Adam Mickiewicz University, Poznań, Poland*

Artemisia spp. pollen is considered one of the main allergy causes in central Europe. Aerobiological monitoring stations are the dominant sources of information about *Artemisia* pollen concentration. However, there are evidences that the concentration at trap level (normally placed 10-30 m above ground) poorly reflects the real concentration at ground level. Using pollen production and the timing of flowering in local populations it is possible to estimate the risk of exposure to allergenic pollen. In addition, little is known about the timing of flowering of different species of *Artemisia* in rural and urban environments. Moreover, there is no quantitative information about the differences in *Artemisia* pollen production between urban and rural area. To fill these gaps we designed a field experiment to analyze different *Artemisia* species composition, population density, flowering phenology and pollen production in urban and rural area.
The study was carried out in Poznań, Western Poland (2012-2014). Four successive flowering phases in three *Artemisia* species (*A. absinthium, A. campestris, A. vulgaris;* n=1100 plants) were observed using an international BBCH phenological scale: beginning of flowering, full flowering, flowering finishing and end of flowering. Pollen production per flower (n=525 flowers) was investigated by Cruden method. The number of pollen grains per inflorescence, plant and population was also estimated.
A. vulgaris started to flower as first at the turn of July and August (mean=31st July). On average, *A. absinthium* started flowering 6.5 days after *A. vulgaris* and *A. campestris* started flowering 10.4 days after *A. absinthium*. In urban area *A. absinthium* and *A. campestris* were found sporadically, so we only observed flowering phenology in *A. vulgaris* urban populations, in which this species started to flower 7.5 days earlier than in rural area. All the mentioned differences were statistically significant at $p<0.01$. In rural area, pollen production per flower in *A. absinthium* was significantly lower (mean=4882 pollen grains; $p<0.001$) than in *A. vulgaris* (mean=9747 pollen grains) and *A. campestris* (mean=9274 pollen grains). Due to the large number of hermaphrodite flowers within an inflorescence, *A. absinthium* produced the highest number of pollen per inflorescence ($2.0*10^5$ pollen). *A. vulgaris* and *A. campestris* produced significantly less pollen per inflorescence ($1.0*10^5$ and $0.6*10^5$ pollen grains, respectively). Pollen production per plant was comparable in *A. vulgaris* and *A. absinthium* ($1.6*10^8$ and $1.4*10^8$ pollen grains, respectively), but *A. campestris* produced significantly less pollen per plant ($0.8*10^8$ pollen grains). Urban populations of *A. vulgaris* produced similar amount of pollen per flower and per inflorescence as rural populations. However, the number of pollen grains per plant was significantly higher in urban ($3.8*10^8$ pollen grains) than in rural area.
Concluding, urban-rural differences in flowering phenology and pollen production in *Artemisia vulgaris* are significant and can mask such differences between different *Artemisia* spp.
This work was funded by National Science Center Grant No. 2011/03/D/NZ7/06224.

Keywords: pollen production, flowering, *Artemisia* spp.

Thursday 21 July

Development and use of in field detection systems for the plant pathogen *Alternaria brassicae* in vegetable Brassica crops

R. Kennedy

Moreton Morrell College, Warwickshire College Group, Warwick, United Kingdom

Fungal pathogens occurring on vegetable brassica crops can be difficult to control despite the usage of fungicidal sprays. At present, designating disease risk (forecasting) involves the use of mathematical models which summarise the effect of environment on key life cycle stages of target pathogens. Many plant disease forecasting systems use environmental data to determine the risk of pathogenic infection in crops (Magaray et al., 2004). Approaches based on the direct measurement of fungal spores in the air have been developed and used to determine risk (Kennedy, 2000; Caulderon, 2002; Carisse, 2006). Detecting airborne spores of fungal plant pathogens is a useful approach in crop protection because at this stage the spores have not infected the crop. A lateral flow device for in-field detection of air-borne conidia of the brassica pathogen *Alternaria brassicae* (Berk) Sacc. has been successfully developed and tested. This device can detect epidemiological small numbers of *A. brassicae* spores in air samples collected using a cyclone spore trap. Laboratory tests with the device demonstrated it specificity and sensitivity to *A. brassicae* conidia. The predictive ability of the device was tested in the field in conjunction with an infection model for *A. brassicae*. Field tests demonstrated the ability of the system to predict *A. brassicae* development in vegetable brassica crops. The infection model predicted the occurrence of infection based on environmental monitoring of temperature during leaf wetness periods in the field. The use of the device may overcome many of the difficulties in using prediction systems based on mathematical models alone.

Keywords: *Alternaria brassicae*, detection, Lateral flow device.

Alternaria spores in the air across Europe: Abundance, seasonality and relationships with climate, meteorology and local environment

C. A. Skjøth[1], A. Damialis[2,3], J. Belmonte[4,5], C. De Linares[4,5], S. Fernández-Rodríguez[6], A. Grinn-Gofroń[7], M. Jędryczka[8], I. Kasprzyk[9], D. Magyar[10], D. Myszkowska[11], G. Oliver[12], A. Páldy[10], C. H. Pashley[13], K. Rasmussen[14], J. Satchwell[13], M., Thibaudon[12], R. Tormo-Molina[15], D. Vokou[3], M. Ziemianin[11], M. Werner[16]

[1]*National Pollen and Aerobiology Research Unit, University of Worcester, Worcester, UK;* [2]*Institute of Environmental Medicine, UNIKA-T, Technical University of Munich, Germany;* [3]*Department of Ecology, School of Biology, Aristotle University of Thessaloniki, Greece;* [4]*Institute for Environmental Sciences and Technology (ICTA-UAB), Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain;* [5]*Department of Animal Biology, Plant Biology and Ecology, Faculty of Biosciences, Universitat Autònoma de Barcelona, Cerdanyola del Vallès, Spain;* [6]*Department of Construction, Polythecnic School, University of Extremadura, Spain;* [7]*Department of Plant Taxonomy and Phytogeography, University of Szczecin, Poland;* [8]*Institute of Plant Genetic, Polish Academy of Science, Poznań, Poland;* [9]*Department of Environmental Biology, University of Rzeszów, Poland;* [10]*National Public Health Center, Budapest, Hungary;* [11]*Department of Clinical and Environmental Allergology, Jagiellonian University Medical College, Kraków, Poland;* [12]*Reseau National de Surveillance Aerobiologique (RNSA), Brussieu, France;* [13]*Aerobiology Unit, Institute for Lung Health, Department of Infection, Immunity and Inflammation, University of Leicester, Leicester, UK;* [14]*The Asthma and Allergy Association, Denmark;* [15]*Department of Plant Biology, Ecology and Earth Sciences, Faculty of Science, University of Extremadura, Spain;* [16]*Department of Climatology and Atmosphere Protection, University of Wrocław, Wrocław, Poland*

We explored the temporal and spatial variations in airborne *Alternaria* spore quantitative and phenological features in Europe using 23 sites with annual time series between 3 and 15 years. The study covers seven countries and four of the main biogeographical regions in Europe. The observations were obtained with Hirst-type spore traps providing time series with daily records. Site locations extend from Spain in the south to Denmark in the north and from England in the West to Poland in the East. The study is therefore the largest assessment ever carried out for Europe concerning *Alternaria*. Aerobiological data were investigated for temporal and spatial patterns in their start and peak season dates and their spore indices. Moreover, the effects of climate were checked using meteorological data for the same period, using a crop growth model. We found that local climate, vegetation patterns and management of landscape are governing parameters for the overall spore concentration, while the annual variations caused by weather are of secondary importance but should not be neglected. The start of the *Alternaria* spore season varies by several months in Europe, but the peak of the season is more synchronised in central northern Europe in the middle of the summer, while many southern sites have peak dates either earlier or later than northern Europe. The use of a crop growth model to explain the start and peak of season suggests that such methods could be useful to describe Alternaria seasonality in areas with no available observations.

Keywords: Alternaria, Europe, Climate.

Temporal trends of airborne fungal spores in Catalonia NE-Spain (1995-2013)

J. Belmonte[1], A. Vélez-Pereira[1], C. De Linares[1], R. Delgado[2]

[1]*Institut de Ciència i Tecnologia Ambientals (ICTA-UAB), Universitat Autònoma de Barcelona, Bellaterra, Cerdanyola del Vallès, Barcelona, Spain*; [2]*Departament de Matemàtiques, Universitat Autònoma de Barcelona, Bellaterra, Cerdanyola del Vallès, Barcelona, Spain*

Fungal spores are important airborne biological components that can be found in any time of the year. The study of these particles has three main interests: their effects on human health, primarily as allergy inducers; their infectious potential for crops, which can result in losses of production; and their relationship with meteorological conditions, which makes them a tool to indicate changes in the meteorological patterns.

The aim of this study was to establish the temporal trends of fungal spores in 8 aerobiological sites of Catalonia (3 along the littoral, 4 inland and 1 in a mountain area), using data of the period 1995–2013. We selected 20 fungal spore taxa from the database of the Catalan Aerobiological Network (Xarxa Aerobiològica de Catalunya, XAC): 5 Ascospore types, 5 Basidiospore types and 10 Conidiospore types. Their mean daily concentrations were converted to Annual Fungal Spore Index (AFSI) by summing up the yearly data. We used the nonparametric Spearman's Rho and Mann–Kendall tests to determine the significant trends, then the Theil–Sen estimator to calculate the magnitude of the change in the significant series and finally the Wilcoxon–Mann–Whitney test to determinate if the proportional annual change is significantly different from zero, according to each station and each spore taxon.

From the taxa studied, the most prevalent were the conidiospore *Cladosporium*, and the basidiospores *Agrocybe* and Coprinaceae. *Agrocybe* was the only fungal spore taxon showing a significant trend in all stations, with annual increases between 21% (Vielha) and 7% (Bellaterra). *Drechslera-Helminthosporium* was the taxon that showed a greater decreasing trend, ranging between 1% (Bellaterra) and 20% (Roquetes-Tortosa).

The analysis of the proportional annual change showed 14 taxa presenting significant trends. In 12 taxa the trends were positive: all basidiospores (*Agaricus*, *Agrocybe*, Coprinaceae, *Ganoderma* and Telephoraceae), the Ascospores *Pleospora* and Xylariaceae and the Conidiospores *Alternaria*, *Aspergillus/Penicillium*, *Cladosporium*, *Epicoccum* and *Torula*. Between them, *Agrocybe*, and *Aspergillus/Penicillium* were the taxa with the highest values and *Torula* the one with the lowest. The 2 taxa showing significant negative trends were *Drechslera-Helminthosporium* (highest value) and *Curvularia*. *Arthrinium*, *Chaetomium*, *Leptosphaeria*, *Pithomyces*, *Stemphylium* and Venturiaceae did not show significant trends.

Regarding the temporal trends by stations, the mountain station Vielha and the rural site Lleida showed the highest significant positive changes, while the southern and the inland Girona and the littoral stations Tarragona and Roquetes-Tortosa showed the highest stability. Barcelona, Bellaterra and Manresa did not show significant trends.

Keywords: Fungal spores, Trends, Catalonia.

Modeling hourly and daily relationships between basic meteorological parameters and airborne fungal spore composition

A. Strzelczak[1], A. Grinn-Gofron[2], B. Bosiacka[2], A. Bednarz[2], S. Pawlowska[2]

[1]*West Pomeranian University of Technology, Szczecin, Poland*; [2]*Department of Plant Taxonomy and Phytogeography, University of Szczecin, Szczecin, Poland*

We explored the impact of meteorological parameters on daily and hourly counts and composition of 24 fungal spore taxa in order to identify key factors and to compare the performance of those two kind of models. Aerobiological study was carried out from 1 April to 30 September 2013 in Szczecin, Poland, with Hirst-type spore traps while meteorological data covering the entire study period (average air temperature, dew point temperature, relative humidity, wind velocity, precipitation) were supplied by a weather station located at the same place. The relationships between weather parameters and hourly/daily numbers of selected airborne fungal spores were examined using the Spearman's rank association test and ordination methods. Comparison of daily and hourly models revealed that basic meteorological parameters can to a large extent explain the 24-hour averaged concentrations and composition of airborne fungal spores but are not sufficient for determining hourly relationships. The primary reason is probably that the hourly spore concentrations fluctuate considerably while the basic meteorological parameters remain rather stable. There are probably other parameters causing such changes in spore content. Averaging the spore concentrations into daily mean values is a kind of "relationship smoothing", which eliminates the oscillations and, therefore, the quality of daily models can be better. That could mean, that basic meteorological parameters determine the overall daily sum of spores in the air, as expressed by their average values, but do not sufficiently explain the hourly variations. Further studies are needed to reveal additional parameters which could increase the accuracy of models for hourly spore contents.

Keywords: airborne fungal spores, spore composition, ordination models.

Coriolis air sampling, surface sampling and analysis by detection

N. Dupuy[1], M. Thibaudon[2], J. Charbonnier[1]

[1]ANALYZAIR, Brussieu, France; [2]RNSA, Brussieu, France

Exposure to fungi and moulds that grow indoors when sufficient moisture is available, is clinically associated with respiratory symptoms, allergies, asthma…
To detect indoor moulds, there are various methods as air sampling or sampling from surfaces.
With Coriolis, we can make air sampling. Air, and particles, are drawn at a high rate and propelled into a cone containing a liquid. The particles are adhered to the walls of the cone. Coriolis have a better sensibility than classic impactors; indeed, it permits to use different methods for detection of cultivable and non-cultivable moulds.
For the sampling of contaminated surfaces, there are different methods: adhesive strips, swabs and contact dishes. Those two last methods give information only on the cultivable flora (which can grow on the culture media). Moreover, there is a long response delay related to the incubation.
The adhesive strips are put on apparent moulds on plane surface and the analysis is immediate by detection on optical microscopy. Contact dish permits to detect easily microbiological contamination on plane surface. Swabs are used for inaccessible areas or irregular surfaces. Moulds on the swabs are spreaded on a specific culture media in a Petri dish. For the contact dish, the culture media is applicated on the contaminated surface during 15 seconds and the dish is incubated.
For the Coriolis, the liquid collected (containing particles) is colored and filtered on a membrane. Then, the membrane is placed on a slide and the analysis is made by optical microscopy.

Concerning the results, of a qualitative point of view, adhesive strip permit to identify every apparent moulds. Coriolis and adhesive strips are essential for the research of cultivable and non-cultivable moulds. Swabs are practice for irregular surfaces but it is necessary to be careful because some moulds don't grow on some classical culture media. For the contact dish, it is the same problem, if moulds don't find their growth substrates in the culture media; they won't grow on the dish.
In our experience, on a quantitative point of view, *Cladosporium spp*. is the most frequent mould in habitat. After, we find *Aspergillus spp*. and *Penicillium spp*. And the 4th mould is *Stachybotrys chartarum* which is very toxic, allergenic and pathogen.
To conclude, all methods of sampling and analysis based on detection thanks to culture of molds viable and cultivable, leave aside a considerable number of non-cultivable fungi.
It is important to associate classic analysis culture and methods of analysis by direct detection (optical microscopy).

Keywords: moulds, indoor air, Coriolis.

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Thursday 21 July

Test of Hirst-spore traps performance for outdoor fungal monitoring during large demolition work at hospital

S.T. Loeffert[1], P. Vanhems[1,2], M. Thibaudon[3], E. Tissot[3], P. Cassier[4], C. Dananché[2], T. Bénet[1,2], M . Perraud[4], M.P. Gustin[5]

[1]*Claude Bernard 1 University, Lyon, France;* [2]*Hospital hygiene - Epidemology Unit, Edouard Herriot Hospital, Lyon, France;* [3]*RNSA/Analyzair-Lyon, France;* [4]*Environmental Safety and Biology Laboratory, Edouard Herriot Hospital, Lyon, France;* [5]*Institut of Pharmaceutical Sciences and Biology (ISPB), Claude Bernard 1 University, Lyon, France*

Objectives: Demolition can generate fungal spore's suspension which has been associated with a variety of adverse health effects such as high risk of invasive aspergillosis (IA) in immunocompromised patients. One block of the 32 blocks of Edouard Herriot University Hospital (EHUH) (France) is being entirely demolished to give way to the construction of a new building. All the care activities continued in the near blocks. The aim of this study was to analyze the performance of a Hirst-type spore traps (HTSP) for monitoring outdoor fungi spores in hospital ongoing major deconstruction work.
Methods: Between January and December 2015, 3 periods of deconstruction work occurred at EHUH: (P1) gutting and asbestos removing, (P2) Demolition of the floors, (P3) Excavation and earthwork. Since January, outdoor was continuously monitored by volumetric sampler model Lanzoni VPPS-2000 (Bologna, Italy, Analyzer®) placed on the roof in front of deconstruction site with a mean flow rate of 10 $L.min^{-1}$. *Aspergillaceae* (*Aspergillus* spp. + *Penicillium* spp.) spores and Total fungal load (TFL) impacted on adhesive tape were identified using a microscope and expressed by spore/m^3/day. A control HTSP was placed on a building located 5 km South East far. Reading resolution for TFL and AFL (lowest variation detected by HTST) were respectively of 20.23 and <5 particles/m^3/day. A daily environmental survey of AFL and TFL with air sampler was also started in 8 wards located around the demolition site. Air sampling was realized outdoor with an agar impact sampler (Air-Ideal 90 mm, Biomérieux®) by impaction onto Sabouraud Chloramphenicol agar. At each sample location 2 nutritive agars were realized and incubated 48h at 37°C for AFL identification and 5 days at 30°C for TFL. Comparison and correlation of fungal spores loads sampled with impact sampler and HTSP were realized after a log-transformation using respectively non parametric test and Pearson's cross correlation analysis. P-values <0.05 was considered statistically significant.
Results: Significant differences were observed between HTSP of Gerland and EHUH for AFL ($p=5.16x10^{-8}$). In Bonferroni p-adjusted analysis, those differences were observed respectively for Gerland vs EHUH between P1 - P2 ($p=1.3\ x10^{-5}$) and P1 - P3 ($p=8.4\ x10^{-6}$). For HTSP of EHUH, AFL variations were observed between night monitoring without any demolition activities around and day monitoring (p=0.057) $_{95\%}$CI [-0.003; 0.388]. This observation was increased in P3 (p= 0.0003) $_{95\%}$CI [0.20; 0.66]. In Pearson's analysis, correlation of AFL sampled with impact sampler and HTSP was significant only for P3 (p=0.046) $_{95\%}$CI [0.0037; 0.37] (n=109 days). Between HTSP of Gerland and EHUH, similar results were observed for TFL during the 3 periods ($p=1.39\ x10^{-11}$) $_{95\%}$CI [0.38; 0.61] (n=156 days).
Conclusion: HTSP seems to be efficient for outdoor monitoring of TFL but lack of sensibility for AFL. HTSP correlate with impact sampler only in P3 were AFL were higher, suggesting that this design needs high AFL in a more continuous manner than peaks. Further studies including cost efficiency are needed to better determine HTSP sensibility. TFL monitoring is a reliable tool to determine fungi repartition during all deconstruction period and permit to obtain an original data collection needed to be further analysis.

Exposure to molds in the indoor environment and respiratory health in older residents living in Lausanne

H. Niculita-Hirzel[1], D. Savova-Bianchi[1], P. Wild[2], A. H. Hirzel[3], B. Santos-Eggimann[4]

[1]*Institut for Work and Health, University of Lausanne and Geneva, Epalinges-Lausanne, Switzerland*; [2]*INRS, Nancy, France*; [3]*Computer Science Center, University of Lausanne, Lausanne, Switzerland*; [4]*Institute of Social and Preventive Medicine, University of Lausanne, Lausanne, Switzerland*

Indoor air pollution has been associated to adverse respiratory health effects in children, adults and in older persons. However, although a large number of studies explore the impact of airborne fungal particle content on the respiratory health of children or adults, only scarce information exists on older persons' exposure to airborne fungal particles in the indoor environment and on the consequences of such an exposure on their respiratory health. The specific objective of the present study was to contribute to filling the gaps in the knowledge on the airborne mold profiles that affect the respiratory health in the older population. To reach this objective, the mold species profile was determined in the indoor air of 270 residences of 289 Lausanne inhabitants older than 65 years that are a part of the Lc65+ cohort. Electrostatic dust collector (EDC) sampling devices have been used to sample the microbiome during summer, autumn and winter periods between June and February 2014. The diversity of viable fungal species have been determined from samples cultured on DG18 media, although that of fungal species represented by the overall fungal particles - viable and dead – have been characterized directly from the EDC samples by high throughput sequencing of the ITS1 region. The respiratory health data as well as characteristics of the buildings were extracted from Lc65+ database. The season effect on fungal species diversity has been tested. Association of viable and overall mold community profiles with the respiratory symptoms of the inhabitants was determined by unconditional logistic regressions. In order to propose preventive solutions, the building characteristics that can favor the development of fungal communities harmful for respiratory health have been explored.

Keywords: indoor fungal community, Illumina sequencing, culturable fraction.

First investigation of fungal spores in the Madeira air

A. Grinn-Gofroń[1], L. Sousa[2], I. Câmara Camacho[2], R. Camacho[2]

[1]*Plant Taxonomy and Phytogeography, University of Szczecin, Szczecin, Poland*; [2]*Life Science Competence Centre, Madeira University, Funchal, Madeira, Portugal*

A seven year aeromycological study was performed in the city of Funchal with the purpose to determine the anamorphic spore content of this region and its relationship to meteorological factors. The sampling was carried out with a Hirst-type volumetric spore trap following well-established guidelines. The major peaks were registered during spring (April–June) and autumn period (September–November). The lowest spore levels were recorded between December and February in each year. Over 14 taxa of anamorphic fungal spores were observed with *Cladosporium* being the most prevalent fungal type accounting for 78 % of the total conidiospores. The next in importance was *Alternaria* (5.4 %), *Fusarium* (4.7 %), *Torula* (3.9 %) and *Botrytis* (1.9 %). Total counts during the period studied were considerably lower comparatively to other mainland stations, probably due to the insular condition of the region. For that reason, the weather-related parameters have a weak influence on airborne conidial counts and their distribution over the year. Temperature was the most important meteorological parameter that favoured release and dispersal of the conidiospores, whereas rainfall revealed a negative effect. Despite the low concentration levels found in our region, the majority of the fungal genera identified are described as potential aeroallergens. This study provides the seasonal variation of the conidiospores and the periods when the highest counts may be expected, representing a preventive tool in the allergic sensitization of the population.

Keywords: fungal spores, monitoring, Madeira.

Use of survival analysis to determine the outbreak of three major fungal diseases of rice in India: An Aerobiological, Statistical and Phyto-pathological approach

M. Saha, K. Bhattacharya

Department of Botany, Visva Bharati (a central university), Santiniketan, West Bengal, India

The aim of the study was to assess the concentration of airborne pathogenic fungal spores over a paddy field in relation to meteorological parameters with an object to prepare epidemiological models and efficient forecasting systems for most important fungal diseases viz. blast, brown spot and false smut. Aeromycological survey was carried out by two different volumetric samplers operated for five consecutive crop seasons over a rice field in West Bengal, India. Volumetric assessment of airborne fungal spores was performed in the experimental sitefor 2 consecutive years using an Andersen sampler and a Burkard Slide Sampler for trapping culturable and nonculturable types of fungal spores.
The dominant genera trapped by Burkard sampler were *Cladosporium*, *Memnoneilla*, *Trichoconis*, *Stemphyllium*, smut spores, *Helminthosporium* sp etc. The major types recorded by Anderson sampler were *Aspergillus niger*, *Aspergillus clavatus*, *Penicillium claviformae*, *Trichoderma lignorum*Correlation between fungal spore count and meteorological factors such as maximum and minimum temperature (˚C), rainfall (mm), relative humidity (%) and wind speed (mph) were calculated using Pearson's Product Moment method. Adjusted p-values are reported considering multiple comparisons. To find the effects of different meteorological parameters on spore count, a generalized linear model [GLM: log (spore count/ m^3 of air) = Intercept + 0.004*age - 0.0114*max T - 0.0028* RH - 0.0124*Rain - 0.0122* wind speed with AIC value 1741.524.] with log link, is fitted. R.3.1.2 software is used for all computations. The five years pooled data analyzed for regression analysis and correlation matrix showed that the maximum temperature, relative humidity, rain fall and wind speed could explain seasonal dynamics of airborne culturable and non-culturable fungal spore types over rice field in the study area. The highest spore/ CFU count was in post Manson season for five sampling years probably due to moderate temperature (17°-32°C), low relative humidity (58%-71%), low wind speed (< 5 km/ h) and complete absence of rainfall. The regression model based on the spore count and meteorological variables supplemented by host factors is found to be useful for prediction of rice diseases. Spread of these diseases was modeled by using a non-parametric Kaplan-Meier Estimator and a semi-parametric Cox proportional hazard model. Both models produced hazard rates for each disease. Each disease was categorized into different grades based on the disease severity. A cumulative logit model was used to predict the outbreak of each disease on the basis of five years pooled data. The occurrence of blast disease was favored with high temperature, low relative humidity and less rain fall but brown spot and false smut disease was favored with moderate temperature.

Keywords: epidemiology, survival analysis modeling, disease forecasting.

Prevalence and methicillin sensitivity of *Staphylococcus* sp. in three different seasons of indoor bioaerosols of a library environment

T. Chakraborti[1], R. Chaudhari[1], J. Paul[2], K. Mukhopadhyay[1]

[1]*School of Environmental Sciences, Jawaharlal Nehru University, New Delhi, India*; [2]*School of Life Sciences, Jawaharlal Nehru University, New Delhi, India*

Introduction: Bioaerosols are particulate matters of biological origin which includes, living organisms like, bacteria, virus, fungi, their metabolites, toxins, pollens, plant and animal fragments. Bioaerosol exposure measurement in indoor environment has become a major concern as it is directly associated with human health hazards. In context to bacterial infections, methicillin resistant *Staphylococcus aureus* (MRSA) is a leading cause in humans worldwide. In this present study, we analyzed the indoor bioaerosol of Jawaharlal Nehru University (JNU) Library environment where thousands of student studying everyday and we enumerate staphylococcal load among total bacterial count in three different seasons along with their antibiotic sensitivity.

Methods: Reading room, third floor, fourth floor and fifth floor as well as the outdoor environment of JNU library were sampled in active hours by settle plate technique in triplicates for 30 min exposure in the first week of May, July and September which represents three different seasons i.e., pre monsoon, monsoon and post monsoon respectively. After the total bacterial count we further screen them for total gram positive and gram negative and eventually total *Staphylococcus* sp. through different biochemical tests that are catalase, coagulase, mannitol fermentation, colony morphology and confirmatory Monotech kit. MIC (minimum inhibitory concentration) of oxacillin were tested against *Staphylococcus aureus* isolates by broth dilution technique as per CLSI guidelines. Further, confirmation of *S. aureus* strains has been done through *femA* gene amplification through PCR (Polymerase chain reaction). To confirm the methicillin sensitivity, *mecA* gene amplification will also be performed (if any).

Result & Discussion: During the period of sampling in indoor, temperature was in between 27.9ºC – 33.1ºC, relative humidity varied between 30.3% – 51% and indoor-outdoor (I/O) ratio was within 0.074 – 0.5. The total bacterial load in library varied in between 58 – 86 CFU, total gram positive bacteria were 46 – 61 CFU and total gram negative bacteria were 12 – 25 CFU in three different seasons. On the basis of morphological and biochemical tests, 43 Gram positive isolates were found to be *Staphylococcus* sp. Although total obtained bacteria were found to be greater in pre monsoon period, the number of *Staphylococcus* sp. identified during monsoon period was highest. Among these 43 Staphylococcal isolates 10 were identified by confirmatory biochemical tests as coagulase positive *S. aureus*. These 10 isolates were further screened to check their methicillin sensitivity. All *S. aureus* isolates were found to be methicillin sensitive showing MIC values of 2 to ≤ 0.5µg/ml.

Conclusion: Prevalence of *Staphylococcus* sp. together with MRSA in University Library environment during three different seasons was assessed through this study. Presence of no MRSA strains from total obtained *S. aureus* indicates the absence of any potential health hazards in relation to MRSA infection in this environment.

Keywords: Bioaerosol, Library environment, *S. aureus*, MRSA

ORAL COMMUNICATIONS

Abstracts
Friday 22 July



Use of FTIR spectroscopy in the detection of biochemical changes of mugwort (*Artemisia* spp.) pollen under the influence of car traffic pollution

I. Kasprzyk[1], J. Depciuch[2], E. Roga[2], M. Parlinska[2]

[1]*Departament of Environmental Biology, University of Rzeszów, Rzeszów, Polska*; [2]*Institute of Nuclear Physics, Polish Academy of Sciences, Krakow, Polska*

The air pollution affects pollen morphology, viability, germination as well as pollen production. It may alter the allergenic potency of pollen, inducing substantial molecular changes of proteins. The goal of the investigation was to determine the impact of traffic-related pollutants on the morphology and molecular compounds of allergenic mugwort pollen. Scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR) and curve-fitting analysis of amide I profile was applied to assess the potential biochemical changes. Pollen was collected from 5 plants from each three sites with different intensity of car traffic. The measurement of pollen grains showed that the higher car traffic was, the smaller pollen grains were. In the FTIR spectra, specific peaks corresponding to nucleic acids, polysaccharides, proteins, lipids and water were identified. The obtained results clearly show that traffic pollution had the impact on quantitative and structural changes of mugwort pollen. The highest level of carotenoids at wavenumber 950 cm^{-1} was noticed in pollen collected from unpolluted site, but pollen collected in site with the highest traffic had more polysaccharides (1032 cm^{-1}). The largest differences in the course of spectra were found in proteins region. The amide I region of FTIR pollen spectrum from site without traffic clearly differed, which was also visible in percentage values of the protein's secondary structures. In pollen collected from unpolluted site the highest level of both β-sheet (1600 cm^{-1}) and α-helix (1650 cm^{-1}) was detected. These differences could be a consequence of mutations or protein alterations caused inter alia by air pollutants. Modification in protein content and in their structure may increase the risk of allergy, sensitization in predisposed people as well as immunogenicity of the allergens. The detailed investigation of pollen macromolecules may help in the allergy diagnosis, explaining the etiology of disease and then justifying the use of immunotherapy. The investigations proved that the pollen chemical composition may be a good indicator of air quality and FTIR can be helpful in biomonitoring.

Keywords: FTIR spectroscopy, mugwort pollen, pollution.

Pollen goes a long way: long distance transport of airborne *Ambrosia* pollen to the UK and the Netherlands from Central and South Europe

L. A. de Weger[1], C. H Pashley[2], B. Šikoparija[3], C. A. Skjøth[4], I. Kasprzyk[5], Ł. Grewling[6], M. Thibaudon[7], D. Magyar[8], M. Smith[9]

[1]*Department of Pulmonology, Leiden University Medical Center, Leiden, The Netherlands*; [2]*Department of Infection, Immunity and Inflammation, University of Leicester, Leicester, United Kingdom*; [3]*Department of Biology and Ecology, University of Novi Sad, Novi Sad, Serbia*; [4]*National Pollen and Aerobiology Research Unit, University of Worcester, Worcester, United Kingdom*; [5]*Department of Environmental Biology, University of Rzeszów, Rzeszów, Poland*; [6]*Laboratory of Aeropalynology, Adam Mickiewicz University, Poznań, Poland*; [7]*Reseau National de Surveillance Aérobiologique, Brussieu, France*; [8]*Department of Aerobiology and Air Hygiene, National Public Health Center, Budapest, Hungary*; [9]*Institute of Science and the Environment, University of Worcester, Worcester, United Kingdom*

Background: *Ambrosia artemisiifolia* (common ragweed) is an alien invasive species. Some areas of Europe are highly infested with the plant, such as the Pannonian Plain, parts of Ukraine, and the Rhône Valley in France. *Ambrosia* pollen can cause allergic rhinitis, conjunctivitis and allergic asthma, and in the highly infested areas the prevalence of *Ambrosia* sensitization has increased dramatically. In the UK and the Netherlands most observations of ragweed are single plants and the pollen counts are low. However, on September 4-6 2014 in Leicester (UK) and Leiden (NL) atmospheric pollen concentrations reached more than 30 pollen/m^3.
Objective: The aims of this study were (1) to determine whether the *Ambrosia* pollen during the episode could be the result of long distance transport, since local sources are not known to be present, (2) to identify the potential sources of the pollen (3) to describe the conditions that facilitated this possible long distance transport.
Methods: Bihourly pollen data (pollen/m^3) were collected at ten sites in Europe. Back trajectory and atmospheric dispersion calculations were performed using HYSPLIT_4.
Results: Back trajectory calculations indicate that air masses that passed over Leicester and Leiden at higher altitude (1500m) originated from source areas on the Pannonian Plain and Ukraine. During this transport some air masses turned off to the south and passed over the Rhône Valley. Dispersion calculations showed that the atmospheric conditions allowed the *Ambrosia* pollen from the Pannonian Plain to reach the higher levels and enter the air masses moving to Northwest Europe where they could deposit to ground level. In addition, the Rhône Valley, which is nearer to Leicester and Leiden, was found to be a possible source of *Ambrosia* pollen recorded during the episode, but a very minor contributor in comparison to the Pannonian Plain.
Conclusions: The ragweed pollen recorded in Leicester and Leiden on September 4-6 2014 were most likely not produced by local sources but transported via long distance transport from potential source regions in Eastern Europe, i.e. the Pannonian Plain and Ukraine and to a minor extent in southern Europe, i.e. the Rhône Valley.

Keywords: Ambrosia, back trajectory analysis, long distance transport.

Long-distance transport of *Ambrosia* pollen from Pannonian Plain (Northern Balkan Peninsula) to Umbria (Central Italy)

S. Ghitarrini, E. Tedeschini, G. Frenguelli

Department of Agricultural, Food and Environmental Sciences (DSA3), University of Perugia, Perugia, Italy

Ragweeds (*Ambrosia* spp.) are herbaceous plants belonging to Asteraceae family. Most of them are native of North America, but several species have been introduced to the Old World and some have been naturalized. Between them, *A. artemisiifolia* is probably the most allergenic. It arrived in Europe via the importation of contaminated seed in a lot of countries and it started expanding in late 19th century, becoming an invasive plant. The species is still spreading and new cases of sensitization to its pollen are registered every year. In Italy the most affected regions are Lombardia and Friuli Venezia Giulia in the North of the country, plus some sporadic populations in Lazio and Campania (Central-Southern Italy), while it is almost undetected elsewhere. Anyhow, its pollen grains have been often detected in anomalous concentrations also in the atmosphere of Perugia (Umbria), like in other areas of Central Italy. These concentration peaks, which always occurred in the first half of September in this area- but not every year - overtook the threshold value for clinical symptoms (5 pollen/m^3). This study was performed to verify that in this area the anomalous peaks observed in September 2002, 2009, 2014 and 2015, were provoked by air mass movements from regions highly populated with *Ambrosia*, a phenomenon that has been already observed in Europe, rather than by an increase of local populations. Air-mass back-trajectories on Perugia were computed (by HYSPLIT model tool) for the days in which peaks occurred in the different years and it was noted that they actually derived from Pannonian Plain (Central-Eastern Europe), a region in which the weed is extremely spread. Conversely, it was observed that in the years which do not show the anomalous peak in September, but only a lower one in August due to local flowerings (e.g. 2010, 2011, 2012 and 2013), air masses on Perugia moved from other European areas where ragweed is not present. The analysis proved that long-distance transport of *Ambrosia* strongly contributes to the concentration of its pollen in the atmosphere of Umbria (Central Italy) and depends on meteorological factors. Thus, for a better information of allergic patients, an integrated approach between aerobiology and meteorology would be needed, especially in the alert period of this area, identified in the first half of September.

Keywords: Ambrosia, pollen, Central Italy, long distance-transport.

Errors in the determining the flow rate of Hirst-type pollen traps

J. Oteros[1], F. Hofmann[2], G. Laven[3], S. Röseler[3], R. Wachter[4], J. T.M. Buters[1]

[1]*Zentrum Allergie und Umwelt (ZAUM), Technical University of Munich, München, Bayern, Germany*; [2]*Ökologiebüro, TIEM Integrated Environmental Monitoring, Bremen, Germany*; [3]*Institut für Arbeitsmedizin und Sozialmedizin, RWTH, Aachen, Germany*; [4]*Pollenflug Nord, Ganderkesee, Germany*

Standardization of the working methodology inside pollen monitoring networks is vital. The calibration of the monitoring instrument and the working methodology are the most studied topics in standardisation. The most extensively used system for pollen monitoring is based on the Hirst design. The Hirst type volumetric pollen trap has been adopted as standard by most of pollen networks worldwide because of its advantages in reliability and precision.
The knowledge about the exactly suction flow rate of Hirst traps is essential for calculating the sampled pollen concentrations. Usually, Hirst traps are calibrated to work with a nominal flow rate of 10 l/min. We detected an error in accuracy of the flow rate of Hirst traps calibrated by standard flowmeters using electronic heatwire anemometers for control. This error has never been described in the literature. This error can be explained as the flowmeters themselves already have an air flow resistance. So, the air resistance through the inlet of the trap is different when the flowmeter is being used for calibrating the flow rate than when the inlet is free of the flowmeter in routine operation. The situation that the trap is calibrated with a higher air resistance than during routine operation results in different flow rates depending on the air resistance through the inlet and, therefore, monitoring is done under a higher flow rate than was originally calibrated.
In this experiment we checked a total of 26 Hirst traps from different commercial brands. We checked the flow rate of each trap: 1) by the original flowmeters and 2) by an electronic flowmeter with negligible air resistance (thermal anemometer). We determined an uncertainty error in accuracy (bias) in the range of +4 to +124 %, on average 35 % between the real suction flow rate during a routinely monitoring (enhanced flow of 10,4 l/min to 21,9 l/min) compared to the nominal flow rate of 10 l/min as calibrated. The error depends on individual trap and flowmeter with no systematic differences between the different commercial trap brands. In cooperation with the manufacturers a solution for correcting this error would be preferable in order to assure comparable data for a standardised aerobiological monitoring network.

Keywords: Flow rate, Flowmeter, Quality Control.

Normalization: 'Sampling and analysis of airborne pollen grains and fungal spores' CEN/TC 264/WG 39

M. Thibaudon[1], S. Monnier[2]

[1]*EAS/RNSA, Brussieu, France,* [2]*RNSA, Brussieu, France*

Pollen grains and fungal spores are considered in some European countries as an air pollutant as well as fine particles suspended in air (PM10, 2.5). In Europe, European Aerobiology Society (EAS) in coordination with International Association for Aerobiology (IAA) manage problems of sampling, analysis, quality control, development and information.

With the number of national networks of aerobiology which is increasing it is necessary to standardize the techniques of sampling and analysis of biological particles in order to obtain the same methodology and the same operating procedures. This is why at the initiative of the EAS president, the French Aerobiology Network (RNSA) made a request to AFNOR in 2011-2012 and was accepted as part of a European approach CEN.

In April 2013, the CEN 264 accepted the creation of a WG 39 (working group) which met in late October 2013 in Lyon to write a corrected version of the final document "Sampling and analysis of airborne pollen grains and fungal spores". A final meeting of WG 39 was held in March 2014 in Berlin (VDI) and was followed by a proposal for signing the CEN during the second quarter of 2014.

The last version of this standard was approved by CEN/TC 264 on September 2015 and the CEN National Members were granted a three-month term for consultation at national level. Finally the draft CEN/TS 16868 "Ambient air - Sampling and analysis of airborne pollen grains and fungal spores for allergy networks - Volumetric Hirst method" has been published on December 2015. The aim of this standard is to improve the quality of analysis and standardize procedures. The document specifies the procedure to measure and to analyse continuously the concentration of airborne pollen and fungal spores using the volumetric Hirst method. The paper describes both the sampling and analysis procedures.

In the beginning of 2016, it was decided to convert the technical sheet in a norm (conversion from CEN/TS to prEN 16868).

The main reasons of this conversion to a norm were:

- A needed standardized method for a future European legislation: adding biological particles to chemical particles for the airborne monitoring;
- Adding complementary information like:
  - Synergy between pollen and fungal spores' exposition and air pollution in order to decrease the risk of Health impact;
  - Providing more information on allergy risks to clinical centres;
  - Thresholds of pollen exposure in order to involve patients in clinical trials;
- Homogenization of European practices: this standard will support the quality improvement of the sampling and the analysis methods in Europe.

Currently, a working document of prEN 16868 is being drafted by WG 39. A first meeting was held in Vienna - on 3 and 4 February 2016. The circulation of a first working draft within WG 39 was done on March 2016. The next meeting will be in Lyon (France) on July 2016 during the ESA congress in order to discuss on different issues like: Information on allergy risks to clinical centers and allergic patients; consolidate the link between pollen counting and information to clinical centres; the bias error on flowmeter, the counting and sampling area (microscope slide) to consider the best ratio-time for analyzing the area / quality of the measurement…

POSTERS

PA01

Winter plants' pollination in Lviv (Western Ukraine)

N. Vorobets[1], N. Kalinovych[2], K. Voloshchuk[2]

[1]*Pharmacognosy and Botany, Danylo Halytsky Lviv National Medical Univer, Lviv, Ukraine*;
[2]*Botany, Ivan Franko National University, Lviv, Ukraine*

Investigation of botanists for ages 19-20 centuries showed that alder and hazel blooming in Western Ukraine (Lviv city region) happens in March and April. Until recently, it is believed that allergy to the pollen of these species also occur within this period. The aim of this study is to analyze variations of *Alnus* and *Corylus* genus pollen seasons in relation to meteorological parameters at two sites in Lviv city, in the West Ukraine. A gravimetric method was used for airborne pollen sampling. Qualitative and quantitative pollen analysis was performed under a light microscope (x400). Weather behaviors was assessed by reviewing the changes in daily atmospheric circulation type's affecting the Lviv region during the 2011–2015, and through examining statistical atmospheric indicators such as temperature and humidity. The beginning of *Corylus* pollination was on 13, 13, 6 of March, and on 1 and 26 of February in 2011, 2012, 2013, 2014, and 2015, respectively. The beginning of *Alnus* pollination was on 20, 15, 6 of March, and on 19, and 4 of February in 2011, 2012, 2013, 2014, and 2015, respectively. Duration of pollination lasted 32, 36, 54, 36, 41 days - for *Corylus* and 26, 17, 49, 32, 36 days for *Alnus* during the same years. The highest Betulaceae pollen concentration was recorded in March in 2011-2012, 2014-2015. In December of 2015 and in January of 2016, we observed flowering hazel, and in January and February 2016 - the flowering alder. This evidently is associated with climate change in the region. Over the past 20 years the effects of climate change have led to the increase in average temperatures in January and February up to 1-2^{0}C that altered the beginning of flowering in this region. In addition, rainfall has increased in the Ukrainian Carpathians. Meanwhile, West Ukraine and Lviv city region is a province of forests embraces more than 28.7% of its square. The Betulaceae family species are prominent members of these forest communities and is certainly a significant contributor to the incidence of pollinosis. According to the forecasts in the next 20-30 years the warming continues, it means an early spring for plants. The flowerings of plants occur according to the seasonal climate changes and in general are a major factor that affects the pollen concentration in the atmosphere. Over the next years in Lviv region there will be no period for pollen in the air - pollen of plants that bloom in the fall we see through to November, and in December and January will be Betulaceae pollens. Meteorological variables such as temperature and air humidity can be treated as risk indicators for increases in allergy cases. Our studies over the last decade have shown that the dates of blossom-time of both species are in need of correction. The pollen-sensitive individuals can be at high risk starting from February because of the high airborne pollen concentrations, which only showed a transient decrease, when the temperature fell or there was precipitation.

Keywords: pollination, Alnus, Corylus.

The determinant contribution of the first aerobiological experiments in the controversy on spontaneous generation theory

M. Bonini[1], R. Albertini[2], M. Zanca[3]

[1]*Department of Medical Prevention, LHA Milano - Città Metropolitana, Parabiago, MI, Italy*; [2]*Department of Clinical and Experimental Medicine, University of Parma, Parma, Italy*; [3]*Allergy Unit, ASST Mantova Hospital, Mantova, Italy*

The question of spontaneous generation was an ancient and controversial one, but many scientists in the XIX century often argued that all biological sciences could only progress when the idea of spontaneous generation was totally vanquished. Belief in the spontaneous generation of life had been almost universal from the earliest times until the XVII century.
The "spontaneous generation" refers to the possibility that living organisms have origin without the intervention of other adults of the same species, in other words, a form of alternative generation to the "normal" one, the parent-son model. The Italian scientist Francesco Redi (1626-1698), a member of the Cimento Academy of Florence, was the first to initiate in 1668, an experimental "attack" on the question of spontaneous generation on insects. It is only from the XVIII century and especially in the XIX century that it was possible to assist to a heated and intense debate and to an endless dispute over many years on the generation of airborne and fermentation microorganisms, involving numerous European scientists from different fields. The conclusive experimental demonstration was made by Pasteur in the second half of the XIX century and in a few years accepted by the entire scientific community. The majority of the scientists during this period approached this delicate question using a series of experiments that today we would define "aerobiological type". The experiments were conducted by each author by using different methods and tools, from simple glass bottles containing infusions until rudimentary and complex instruments which they invented, equipped with filters or suction apparatus (aeroscope) to monitor microorganisms in the air (bacteria, moulds, protozoa). In this work, the aerobiological experiments performed during the XVIII century (L. Spallanzani, Italy; L. Joblot, France; J. T. Needham, United Kingdom) and those performed during the next century (F. Schultze, T. Schwann, H. Schroeder and T. von Dusch, Germany and J. Tyndall, Ireland) are described. Last but not least, also those of the very famous French scientists F.A. Pouchet and L. Pasteur are reported. In conclusion, this was a real scientific revolution for that time, significantly contributing to disclose a new world, the airborne microorganisms, and launching definitively "experimental science". Therefore, the aerobiology can claim itself within the biomedical sciences to hold a positive result disavowing by many experiments one of the oldest theories which was hindering for many centuries: we could define this as "scientific progress".

Keywords: Aerobiology, Spontaneous generation, Aerobiological Experiments.

PA03

Pollen calendars in three rural areas in the SW of Iberian Peninsula

J.-M. Maya-Manzano[1], R. Tormo-Molina[1], S. Fernández-Rodríguez[2], Á. Gonzalo-Garijo[3], I. Silva-Palacios[4]

[1]*Department of Vegetal Biology, Ecology and Earth Sciences, University of Extremadura, Badajoz, Spain*; [2]*Department of Construction, University of Extremadura, Cáceres, Spain*; [3]*Department of Allergology, Infanta Cristina University Hospital, Badajoz, Spain*; [4]*Department of Applied Physics, Engineering Agricultural School, University of Extremadura, Badajoz, Spain*

Introduction: Pollen calendars are valuable tools for helping allergists to forecast the pollen concentrations in a best way and for trying to optimize resources (drugs ad treatments). Also it is quite important for patients, who are able to manage and adapt their lifestyle to periods with high pollen concentrations, and avoid unnecessary expositions in the seasons with more risks.

Material and Methods: Sampling was taken from March 2011 to March 2014 in Don Benito, Plasencia and Zafra (SW of Spain). Hirst pollen traps were used continuously. Pollen grains were identified and counted at x400 microscopic optical magnification according to literature guidance's methodology. Pollen calendars were created following the methodology of Spanish Aerobiology Network (Galán et al. 2007). 20 taxa were studied and classified in four categories depending on their abundance, in null value (below 1 grain/m^3), low, moderate or high values in white, green, yellow or red color. Depending on the pollen type, they were also classified in four categories, according of their anemophilous/entomophilous character, seasonal pollen index (SPI), and their allergenic capacity. All the factors previously mentioned show a pollen concentration threshold classified in low, medium or high percentage of sensitized population, able to develop the symptoms associated to the presence of these pollen types.

Results: *Quercus* was the most abundant pollen type in the three cities, with a continuous presence in the atmosphere along the year, showing peaks in April and May. *Poaceae* was the second one in Don Benito and Plasencia, whereas in Zafra was *Olea europaea*. All of them were quite important in spring. Particularly in Don Benito, were recorded high concentrations of *Platanus* during March and April. In Plasencia appeared medium concentrations of *Alnus glutinosa*, where this pollen type was important. *Amaranthaceae*, *Anthemideae Cupressaceae*, *Pinaceae*, *Rumex*, *Urticaceae* p.p. and *Urtica membranacea* showed a continuous distribution in the atmosphere. Other such as *Ulmus, Platanus* and *Salix* were recorded during a short period of time. May was the month with the major variety of pollen types in the atmosphere.

Conclusions: Despite of some pollen types showed a continuous presence in the atmosphere, due to being integrated by a great number of different taxa with occurrence along the year or having a wide length of growing, the most of the pollen types that were studied showed main pollen seasons well defined.

Keywords: Pollen calendar, airborne pollen, rural areas.

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PA04

Atmospheric Pollen Content of Gaziantep Province, Turkey, 2011

A. Tosunoglu[1], H. Akgul[2], D. Yilmazkaya[3], A. Bicakci[1]

[1]*Biology, Uludag University, Nilufer, Bursa, Turkey*; [2]*Biology, Akdeniz University, Center, Antalya, Turkey*; [3]*Biology, Gaziantep University, Center, Gaziantep, Turkey*

Airborne pollen grains are inhalant allergens natural source related. When released by the sources in sufficient amounts, allergenic pollen may evoke allergic responses. Therefore, determination of pollen types and their concentrations are very important especially in the atmosphere of highly populated cities. These data prove helpful in the treatment of patients suffering from such diseases. For this reason, studies of the airborne pollen variability and concentrations in different areas have been carried out by researchers worldwide and Turkey as well.

Airborne pollen distribution in Gaziantep was measured volumetrically during the year 2011. A total of 20390 pollen grains/m^3 belonging to 44 taxa were recorded annually during the study period. Among the taxa recorded, 24 belonged to arboreal (84.88%) and 20 to non-arboreal taxa (15.12 %).

Seven plant taxa taken as predominant pollen types (>5%) with the greatest influence in the atmosphere, Cupressaceae/Taxaceae (33.75%), *Quercus* (15.13%), *Pinus* (13.25%), *Poaceae* (7.86%), *Morus* (6.15%) and *Platanus* (5.18%) showed maximum pollen distribution in the atmosphere. The season of maximum pollen concentration was from March to May, with a high prevalence of arboreal pollen grains.

Foundation: This study is funded by Tubitak -109S086.

Keywords: Aerobiology, Pollen concentrations, South-west Anatolia.

PA06

Airborne pollen grains in Muğla, Turkey

A. Güvensen, U. Uğuz, A. Eşiz Dereboylu, N. Tort

Science Faculty, Ege University, Bornova, Turkey

In this study airborne pollen grains of Muğla (Turkey) was investigated volumetrically from 01 February 2014 to 31 January 2015 using Lanzoni VPPS 2010. According to our results a total of 20468 pollen/m^3 pollen grains, 18183 pollen/m^3 of which belong to arboreal taxa and 2125 pollen/m^3 grains from non-arboreal taxa were identified. Highest woody pollen concentration was recorded in April (8016 pollen/m^3), March (4757 pollen/m^3), May (3854 pollen/m^3) and June (736 pollen/m^3). Herbaceous pollen showed highest concentration respectively in May (426 pollen/m^3), June (388 pollen/m^3), April (363 pollen/m^3), July (254 pollen/m^3) and August (186 pollen/m^3). In Muğla atmosphere total pollen grains consist of 88.87% arboreal, 6.48% non-arboreal plants, 3.79% Poaceae and 0.86% unidentified pollen grains. A total of 46 taxa were identified and from these taxa 25 belong to arboreal and 21 taxa to non-arboreal plants. At the end of the one year dominating woody taxa were respectively Pinaceae (10722 pollen/m^3, 52.4%), *Quercus* spp. (4082 pollen/m^3, 19.94%), *Olea europaea* (1251 pollen/m^3, 6.12%) and Cupressaceae/Taxaceae (929 pollen/m^3, 4.52%); herbaceous taxa were Poaceae (775 pollen/m^3, 3.79%), *Plantago* spp. (275 pollen/m^3, 1.26%) Urticaceae (235 pollen/m^3, 1.14%), Chenopodiaceae/Amaranthaceae (227 pollen/m^3, 1.05%) and *Rumex* spp. (157 pollen/m^3, 0.76%). During study period the distribution of woody pollen in the atmosphere was highest in April (8016 pollen/m^3). Herbaceous pollen showed highest concentration in May (426 pollen/m^3). In Muğla atmosphere 86.88% of annual pollen grains were recorded in March, April, May and July.

Keywords: Atmospheric pollen, pollen calendar, Muğla city.

34 years of pollen counting: an evaluation of the temporal variation of 34 pollen seasons in Belgium

L. Hoebeke, C. Verstraeten, T. Desmedt, N. Bruffaerts, A. Packeu, M. Detandt, M. Hendrickx

Mycology & Aerobiology service, Scientific Institute of Public Health, Brussels, Belgium

The Belgian pollen and spore monitoring network is managed by the Mycology & Aerobiology service of the Scientific Institute of Public Health since 1982. Its main objective is to rapidly deliver information about the presence of these allergenic biological particles to practitioners, pharmaceutical companies and allergy sufferers. This data helps to diagnose and evict high risk periods. The monitoring of the pollen and spores is done in five different sampling sites in Belgium using a Burkard volumetric spore trap.

Our current work analyzes the fluctuation of airborne pollen concentration in time and characteristic dates of the season (start, end and peak dates of pollination) for the sampling sites in Brussels. The start date is defined here as the first day when 5% of the total annual number of pollen grains is recorded.

For the first time in Belgium, we analyze the trends over a 34 year's period for a selection of seven pollen types (birch, hazel tree, alder, plane, ash tree, grasses and Artemisia). These pollen types comprise those that are currently the most clinically relevant in Belgium (4/7) and those that are not currently clinically relevant in Belgium but that are known to be allergenic in other European countries and frequently found in Belgium (3/7).

On the basis of annual counts, we observe an increase of tree pollen and a decrease of herbaceous pollen. The maxima observed for daily counts are reached earlier in the year for grasses and plane. These results open several research perspectives related to, among others, the impacts of climate change and of environmental management.

Keywords: pollen, season, fluctuation.

PA09

Airborne pollen of Uşak (Turkey) and the effect of meteorological factors

A. Güvensen[1], U. Uğuz[1], A. Eşiz Dereboylu[1], N. Tort[1], P. Baran[2]

[1]*Biology, Ege University, Science Faculty, Bornova, Turkey*; [2]*Biology, Uşak University, Faculty of Science and Art, Uşak, Turkey*

Airborne pollen distribution in the city of Uşak was investigated volumetrically during one year between 1 February 2014 - 31 January 2015. According to our results a total of 14683 pollen/m^3 pollen grains, 13065 pollen/m^3 of which belong to arboreal taxa and 1533 pollen/m^3 grains from non-arboreal taxa were identified. During the study period a total of 54 taxa were determined. Of these 28 of them belong to arboreal plants, 25 to non-arboreal plants and Poaceae. In the region investigated, dominating woody taxa were Pinaceae (5020 pollen/m^3, %34.19), *Quercus* spp. (4715 pollen/m^3, %32.11), Cupressaceae/Taxaceae (1679 pollen/m^3, %11.43) and *Fraxinus* spp. (857 pollen/m^3, %5.84); herbaceous species were Poaceae (453 pollen/m^3, %3.09), Chenopodiaceae/Amaranthaceae (224 pollen/m^3, %1.53), *Plantago* spp. (189 pollen/m^3, %1.29) and *Rumex* spp. (154 pollen/m^3, %1.05), respectively. During study period highest woody pollen concentration was recorded in May (5498 pollen/m^3), April (4863 pollen/m^3) and June (1417 pollen/m^3). Herbaceous pollen showed highest concentration in May (396 pollen/m^3), June (340 pollen/m^3), July (202 pollen/m^3) and August (190 pollen/m^3). On the other hand, the effects of temperature (ºC), relative humidity (%), total rainfall (mm) and wind speed (m/s) on pollen dispersion was examined during a study year. Our results showed that pollen concentrations of dominant woody and herbaceous plants in Uşak atmosphere exhibited a positive relationship with mean daily temperature in dissemination period of these taxa. Also changes in relative humidity and total rainfall lead to differences on the pollen concentration of atmosphere. However no significant relation were found between wind speed and pollen concentration during the study period.

Keywords: Pollen concentrations, Atmospheric parameters, Uşak city.

PA10

Airborne pollen in Cáceres (SW Spain)

A. Monroy-Colín[1], E. Moreno-Paredes[1], J. Chaparro-Morán[1], S. Fernández-Rodriguez[2], J. M. Maya-Manzano[1], R. Tormo-Molina[1]

[1]*Plant Biology, University of Extremadura, Badajoz, Spain*; [2]*Construction, University of Extremadura, Cáceres, Spain*

Introduction: The city of Cáceres is located in the SW of Spain, being the second in Extremadura region in relation to population (c. 95 000 inhabitants). Surrounding landscapes are dominated by oaks agro-sylvo-pastoral systems (dehesas) and cereal dry crops under Mediterranean climate. The aim of this study is provide general aerobiological data about the main airborne particles and related it with pollen sources distribution and meteorology.
Material and Methods: Airborne particles were captured using volumetric spore trap (Hirst) located at the School of Tecnhology building at the University of Extremadura, on a third floor terrace. Period of sampling was from October 2014 to September 2015. A meteorological station was located close (3 m) to the spore trap. Main airborne particle analysed includes pollen from trees (*Acacia, Alnus, Betula, Casuarina, Castanea, Cupressaceae, Corylus, Erica, Eucalyptus, Fraxinus, Morus, Olea, Arecaceae, Pinaceae, Platanus, Populus, Quercus, Salix, Ulmus*) and from herbaceous plants (Amaranthaceae, Apiaceae, Brassicaceae, Asteraceae -3 types-, *Echium*, *Plantago*, Poaceae, *Rumex*, *Typha*, Urticacae).
Results: Average meteorological values for the period of study were 17.3 ºC and 314.3 mm of rain. Temperature was 1 degree higher than normal values (16.3ºC) and rain represented only 57% in relation to normal values (551 mm). Winter was colder and dryer and Spring hotter both than normal values. For pollen from trees April was the month with the highest pollen concentrations, being *Quercus* the most abundant pollen in the air and secondly *Plantago* and *Rumex*. May was the second month in relevance, pollen from *Olea*, Pinaceae, Poaceae, *Rumex*, *Plantago* and also *Quercus* were the responsible for that values. Cupressaceae pollen appeared from October to April, autumn sources included junipers from natural vegetation and winter sources are ornamentals cypresses and related species.
Conclusions: Airborne pollen from trees in Cáceres were dominated by *Quercus* species from spontaneous vegetation, firstly *Quercus ilex* subsp. *ballota* and secondly *Q. suber*, *Q. pyrenaica*, *Q. coccinea* and *Q. faginea*. Olive crops close to the city are responsible for the *Olea* airborne pollen, the second in importance. Ornamental Cupressaceae (mainly *Cupressus* and *Platycladus*) and spontaneous *Juniperus* represent the third airborne pollen from trees. A dry winter and a hot spring influenced the seasonal pattern of aerobiological representation in the period studied. From herbaceous sources grass family play the first place and secondly plantains and sorrels, all of the mainly in spring (April and May).

Keywords: aerobiology, seasonal pattern, pollen sources.

PA11

First year of aerobiological monitoring in Pisa (Italy) for the most allergenic plant families - fungal spores and their allergenic potential

F. Ruggiero, G. Bedini

Department of Biology, Pisa University, Pisa, Italy

Introduction: The most important biological component of ambient air is pollen, as its allergens are the driver of airborne allergic diseases (1). Pollen allergy has a remarkable clinical impact over Europe. In this context, AIS LIFE ENV/IT/001107 project (http://www.ais-life.eu) aims to the widening of the Tuscan monitoring network for aerobiological components. It included, for the first time, the installation of system for monitoring pollens - fungal spores and the description of the cycles of pollination and sporulation by pollen trap VPPS 2000 in Pisa (2).
Materials and Methods: The sampling procedure and the count of the airborne pollen grains and fungal spores is based on UNI 11108:2004. Aerobiological samples were obtained with a "Lanzoni VPPS 2000" pollen trap installed on top of the Biology Department building in Pisa, via Derna 1, about 17 m from the road pavement. Pollen grains of eight families: Betulaceae, Cupressaceae – Taxaceae, Asteraceae, Fagacee, Oleaceae, Urticaceae, Poaceae, Platanaceae and spores of *Alternaria* sp.pl. have been counted every day since 4 November 2014. Cycles of pollination and sporulation, the main pollen seasons (MPS), and the main spore season (MSS) were calculated according to (3, 4).
Results and discussion: We recorded a cumulative value of 38781.49 pollen grains per m^3 and 12846.02 spores per m^3 in 2015. The highest value was contributed by Cupressaceae – Taxaceae families, with 16032.5 pollen grains (41%); followed by Urticaceae with 6881.05 (18%), Fagaceae with 6777.87 (17%) and Oleaceae with 2923.14 (8%). The highest airborne pollen concentration (APS) were found in the spring months, March with 13031.48 (33.6%), April with 5001.15 (13%) and May with 8323.15 (21.5%), with a total of 26355.78 pollen grains per m^3 of air (68.01 % of the total). On the contrary, December was the month with the lowest pollen concentration (0.27% of total APC). Additionally, in March 2015, Cupressaceae – Taxaceae and Urticaeae reached maximum APC with 10294 and 1654 respectively. Finally, in May 2015, botanical families that reached maximum APC were Fagaceae with 3615.7, Oleaceae with 2052.6 and Poaceae with 1488.85. Concerning, the highest airborne spores concentration of *Alternaria* spp. was in August with 4011.7 (31.23%), while the lowest value was in February, with 4 (0.03%). As regards MPSs, the longest MPS were in Urticaceae, with 207 Julian days, Oleaceae with 142, Coryloideae with 108 and Fagaceae with 104; while, the shortest is in Platanaceae with 30. Finally, MSS for *Alternaria* spp. was 155.
We applied the concentration values provided by POLLnet (Italian Aerobiological Network) to the MPSs and MSS. Thus, belonging to high concentration, with the highest number of days were Fagaceae with 52 days, Cupressaceae – Taxaceae with 38, *Alternaria* with 36 and Oleaeceae with 24. As regards, medium concentration, with the highest number of days were *Alternaria* with 110, Urticaceae with 102 and Oleaceae with 49. Finally, in low concentration were Urticaceae with 82, Coryloideae with 81, Betuloideae – Asteraceae with 53 and Poaceae with 46.

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Conclusions: The total pollination curve in 2015 showed two different peaks, dominated mainly by the Cupressaceae – Taxaceae and Fagaceae. The longest MPS were in Urticaceae with 207 Julian days and Oleaceae with 142 and Coryloideae with 108 and Fagaceae with 104. Fagaceae and Cupressaceae – Taxaceae families had the highest number of days in high concentration, with 52 and 38 respectively. The effective green management may be a useful tool in order to reduce allergenic pollen load, as avoiding to plant new cypress trees, especially near human populations centres and trimming of cypress hedges before the pollination season and agronomical research for hypoallergenic trees (5). The aerobiological monitoring represents a unique tool to supply local real data to allergologists, enabling them to calibrate the drugs therapy for their patients and providing immediate advantages both for patients' health and for better management of the national healthcare system (6).

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PA12

Variations in pollen load with altitude

S. Jung[1], N. Estrella[1], S. Jochner[2], A. Damialis[3], A. Menzel[1]

[1]*Ecoclimatology, Technical University of Munich, Freising, Germany*; [2]*Physical Geography, Catholic University of Eichstätt-Ingolstadt, Eichstätt-Ingolstadt, Germany*; [3]*UNIKAT, Technical University of Munich, Augsburg, Germany*

In general, airborne pollen mainly originates from local sources, usually mirroring dominant vegetation in the study area. The distance of pollen transport is also based on (micro-) climatic conditions, land cover and topography. The objective of this project is to study daily/sub daily variations in pollen counts of various woody and herbaceous plant species during the vegetation period with altitude. With increasing altitude temperatures decrease and precipitation increases. This supports the general pattern that pollen season is shortened and pollen amount is reduced at higher sites. The pollen captured in the pollen traps to a certain extent has its origin from the immediate surrounding. Thus, it mirrors local species distribution. The pollen trap shortly below the summit of Zugspitze has an alpine environment without any vegetation nearby. Therefore, this trap can be used to detect short-, middle- and long-range pollen transport. Measurements were carried out with three volumetric pollen traps installed at the altitudes 450 m a.s.l (Freising), 700 m a.s.l (Garmisch-Partenkirchen), and 2700 m a.s.l (Schneefernerhaus near Zugspitze) from north of Munich towards the highest mountain of Germany. Pollen immission was recorded during the years 2014-2015. For detailed investigations pollen of the species *plantago, quercus,* Poaceae, Cupressaceae, Cyperacea*,* *betula* and *platanus* were chosen, because those are found in appropriate quantities. First results show that the total amount of pollen at Schneefernerhaus for *plantago, quercus,* Poaceae, Cupressaceae, Cyperaceae and *betula* is only about 20% in comparison to Garmisch, whereas *platanus* can exclusively be found at the Zugspitze region. Furthermore there are daily differences in the pollen counts in yearly sum between morning (24:00 -12:00) and afternoon (12:00- 24:00). In Garmisch the amount of pollen measured for *quercus,* Poaceae, Cupressaceae, Cyperaceae *and betula* is twice as high in the morning than in the afternoon. There is no statically significant difference for *plantago* and *platanus*. At Schneefernerhaus the pollen amount is distinctly higher in the morning than in the afternoon for all observed species, except for *betula*. This phenomenon might be caused by diurnal variations in the boundary layer as well as local mountain wind systems (changing wind direction from morning to afternoon time). Further investigation will connect pollen concentrations to weather data including temperature, wind speed, wind direction and humidity.

Keywords: Pollen Concentration, Altitude, Climatology.

Behavior of profilins in atmosphere and *in vitro*, and their relationship with the performance of airborne pollen

I. Aloisi[1], S. del Duca[1], P. de Nuntiis[2], P. Mandrioli[2], D. Fernández-González[3]

[1]*Biological, Geological and Environmental Sciences, University of Bologna, Bologna, Italy*; [2]*Institute of Atmospheric Sciences and Climate, CNR, Bologna, Italy*; [3]*Biodiversity and Environmental Management and Institute of Atmospheric Sciences and Climate, University of León and CNR, León and Bologna, Spain and Italy*

In recent years, it has been demonstrated that the air carries not only airborne pollen but also plant particles of smaller size having allergenic activity and this contributing to the real allergenic activity in the atmosphere. Moreover, several meteorological features drastically affect the occurrence of pollen grains in the air and allergen release from the grain itself. Temperature, relative humidity, rainfall and wind speed represent the most significant factors affecting airborne pollen concentration.
The purpose of this study was to analyze the dynamics of airborne pollen and allergen in two Mediterranean cities having contrasting meteorological conditions. The sampling was performed by Hirst volumetric trap and Cyclone sampler from March to June 2015 in León (Spain) and in Bologna (Italy). The dynamics of pollen concentration were compared to the amounts of airborne pan-allergen profilin present in the atmosphere.
The pollen counts showed that *Pinus, Populus, Poaceae* and *Cupressaceae* pollens were the most common in both the cities, while other pollen was abundant in Léon but not in Bologna (i.e. *Plantago, Q. pyrenaica, Q. rotundifolia* and *Rumex*) or vice versa (i.e. *Parietaria* and *Oleacea*).
The research demonstrated that, even if the city of León was characterized by a greater amount of pollen grains during the analyzed period, the total amount of airborne profilin was comparable between the two cities. Both the pollen grains as well as profilin concentration followed in a similar curve, and showed several peaks during the analyzed period. However, peaks in pollen and profilin content were often misaligned, with the peak of the pan-allergen following the peak of airborne total pollen. To further investigate this phenomenon and given that a rapid diffusion of allergenic proteins in isotonic media has been demonstrated for different pollen grains, we decided to reproduce *in vitro* pollen hydration and to follow protein release during this process. Pollen deriving from different allergenic plant species was analyzed for protein release both during the first 10 min of hydration but also after longer times (max 50 min). Protein release during the early steps of hydration was constant feature for *Populus, Olea, Phleum* and *Parietaria* pollen, that showed a large release of proteins within the first 10 min after hydration. The trend in protein release was different for *Ambrosia*, that showed increasing protein release during hydration. *Betula* did not show protein release within 50 min hydration. Among the released proteins, also the pan-allergen profilin was extruded from the grain and, even in this case, different pollens showed different trends in its release.
The rapid activation and release of allergenic proteins of several pollens appears to be the main cause of the allergenic activity of these pollen grains and the different times in their release could explain the misaligning of airborne pollen peak and profilin peak in the atmosphere

Keywords: Aeroallergen, Profilin, Pollen.

PA14

Predicting Daily airborne *Ambrosia* Pollen Concentrations in Pannonian Plain using Nonlinear Machine Learning

O. Marko, M. Panic, D. Jakovetic, P. Radisic, B. Sikoparija

Research Institute for Information Technologies in Biosystems, BioSense Institute, Novi Sad, Vojvodina, Serbia

This study examines possibility for using nonlinear machine learning in building models for predicting daily concentrations of airborne *Ambrosia* pollen. Apart from describing a framework for constructing the most accurate prediction model the study aims to assess different approaches to deal with missing data which is a common issue in airborne pollen sampling using Hirst type pollen and spore traps.
The study was based on sixteen years (2000–2015) of atmospheric concentrations of *Ambrosia* pollen collected in Novi Sad and mean daily meteorological data (i.e. temperature, humidity, precipitation and wind speed) measured at a regional meteorological station situated at approximately 10km from the pollen-monitoring site. Missing data were completed by using several interpolation methods (nearest neighbor, linear, polynomial, and spline), and their influence on the model performance was recorded. Chosen interpolation methods are both computationally inexpensive and are known to perform well when the lengths of the missing value gaps are low (as it was the case in our dataset). Forecasting models were built by applying three different nonlinear machine learning tools (i.e. artificial neural networks, support vector machines, and random forests). A variety of combinations of predictors were tested (e.g. meteorological parameters alone, meteorological parameters and past pollen measurements) in order to get the best balance between the computational complexity and the prediction accuracy. In order to validate the developed models, predicted values were compared to real measurements in the test year (not used for model training) and checked to what extent developed model improves forecast compared to classical calendar model (15 years average). The following statistical parameters were evaluated the correlation coefficient and the root-mean-square-error (RMSE).
A satisfactory performance was recorded for the models that used datasets where missing data were completed by using piecewise cubic interpolation methods. Accuracy of models was notably improved if pollen concentrations from the beginning of the year until the forecasted day were included into predictors. For example model using past meteorological parameters and only very few pollen predictors (i.e. annual cumulative pollen concentration until predicted day) showed a correlation coefficient of 83% over entire year (79% for the period 1st July - 31st September) and RMSE 56 PG/m^3 over entire year (110 PG/m^3 for the period 1st July - 31st September), which is about 10% improvement in correlation and about 17% in RMSE compared to classical calendar model.
In source regions of airborne *Ambrosia* pollen, such as Pannonian Plain, nonlinear machine learning tools are able to support building reasonably accurate forecasts of daily *Ambrosia* pollen concentrations even if only simple meteorological measurements are available.

Keywords: machine learning, ambrosia, concentration forecasting.

PA15

Long term trends of airborne Poaceae pollen concentration in Ankara province

A. Acar[1], N. M. Pınar[1], Ş. Alan[2], T. Çeter[3]

[1]*Biology, Ankara University, Tandoğan, Ankara, Turkey*; [2]*Bülent Ecevit University, İncivez, Zonguldak, Turkey*; [3]*Kastamonu University, Kuzeykent, Kastamonu, Turkey*

One of the most important allergens which cause allergic disease of upper and lower respiratory system is the effect of the airborne pollen grains belonging to Poaceae (Grass) family. The Poaceae family is well represented in Turkey with the most abundant genera causing pollinosis are: *Phleum* sp., *Dactylis* sp., *Lolium* sp., *Festuca* sp., *Poa* sp. and *Cynodon* sp. In our country, the allergy to Poaceae pollen is very common and in some seasons its effects are increase. 28.1% of 227 patient who has seasonal allergic rhinitis are detected sensitive to grass pollen and 80, 7% of 374 children who has atopic grass pollen sensitivity has been reported in Ankara. The aim of this study was to determine trends in the airborne Poaceae pollen concentration and pollination period for the principal sources of pollen in Ankara, the capital of Turkey, over 20 years of monitoring (1990-2015). Airborne pollen was monitored by continuous sampling with a Burkard volumetric sampler. Pollen trends were investigated by linear regression and correlation analysis using mean annual and monthly pollen concentrations. The aerobiological results were compared with meteorological data (temperature, rainfall, relative humidity and wind speed). As a result of study, it's identified that 80-93% of the total concentration were the pollens of arboreal taxa, 4-8% were the pollens of nonarboreal taxa and 5-12% for the Poaceae. In the region investigated, Poaceae pollen grains generally were recorded between April-September during the study period. Maximum annual Poaceae pollen concentration was detected in 2009 while minimum concentration was found in 1995. Generally, the highest pollen concentrations were observed in May and June, while the lowest concentrations was observed in January and February. There was a statistically significant monthly Poaceae pollen concentration trend in June among the years. It was assumed that increase of the mean temperature and wind speed and decrease of the daily rainfall and mean humidity could cause an increase in the Poaceae pollen production in 2009. In addition, this increase could be based on using Poaceae members in urban landscape commonly. Information obtained from these kind of studies will help us to determine both the knowledge of the distribution mechanisms of allergic pollen and minimizing the negative effect on the health of pollen sensitive people in densely populated cities as Ankara.

Keywords: Poaceae, pollen, long-term, atmosphere, Ankara, Turkey.

PA16

Monitoring of Bet v 1 from Betulaceae pollen grains in two cities: the role of cross reactivity between pollen

Ş. Alan[1], A. Acar[2], T. Sarışahin[1], M. Derendeli[1], A. Kaplan[1], N. M. Pınar[2]

[1]*Biology, Bulent Ecevit University, Zonguldak, Turkey*; [2]*Biology, Ankara University, Ankara, Turkey*

Bet v 1 and its homologues allergens are responsible for majority of pollen allergy in Northern hemisphere. Recent studies have showed that pollen load in the air doesn't reflect allergen exposure of sensitized patients. In the presented study, Bet v 1 concentration and pollen counts belonging to genera of Betulaceae in the atmosphere of Ankara and Zonguldak city were monitored during one year (2015). Ankara city has an arid climate and annual average precipitation around 330 mm. Zonguldak city has an oceanic climate and annual average precipitation is about 1217 mm. There are some differences between two cities in case of distribution of Betulaceae family species. While many deciduous trees belonging to Betulaceae family such as *Corylus*, *Carpinus*, *Alnus* and *Ostrya* are native to Zonguldak, *Betula* species are mainly used for landscaping in Ankara. Both sampler were placed next to each other on a roof of a building at Ankara University and in the same way both sampler also were placed at Bülent Ecevit University in Zonguldak. Pollen grains (PG) were counted in the daily samples, collected by volumetric pollen and spore trap. Bet v 1 sampling was carried out between March and June in 2015 by using BGI900 Cascade High Volume Air Sampler (900L/min.).The air samples were collected on two different polyurethane filters (PUF).Two different filter parts (PM10 and PM2.5) were analyzed separately. PUF's were extracted in $(NH_4)_2CO_3$ buffer, aliquoted, lyophilized and stored -20 ⍰ until use. Concentration of Bet v 1 were measured by ELISA technique. Higher *Betula* pollen concentration was recorded in Zonguldak (133,9 PG/m^3) and was followed by Ankara (34.4 PG/m^3). About more than 80% of Bet v 1 allergens were found in the PM10 fraction in both cities. Total Bet v 1 allergen concentrations are obtained as follows in Ankara 263.19 pg/m^3, in Zonguldak 89,65 pg/m^3. Maximum allergen concentration was obtained as in fraction PM10 (38.333 pg/m^3) on 24/04 in Ankara, while it was detected on the level of 13.48 pg/m^3 in the same fraction on 11/04 in Zonguldak. Maximum pollen concentration was obtained on 18/05 in Zonguldak (92.5 PG/m^3), while in Ankara it was detected on 10/04 with 6.9 PG/m^3. It has been found that there is a significant positive correlation between *Ostrya* pollen counts and Bet v 1 concentrations (0.341, $p<0.01$), instead of *Betula* pollen (0.151, $p<0.01$), in the result of the Spearman's correlation analysis. Despite of high pollen concentrations obtained in Zonguldak, there is no corresponding allergen level. Having the most of *Betula* pollen recorded in one day, it is hard to say allergens levels associated to the pollen. On the other hand, we assumed that allergens levels recorded in Zonguldak may originate from other genera of Betulaceae, especially *Ostrya.* (Project No: TUBITAK, 113Z762)

Keywords: Bet v 1, Ankara, Zonguldak, monitoring, pollen, ELISA, Turkey, Betulaceae, cross reactivity.

Assessment of Cupressaceae/Taxaceae pollen concentration in Middle and Eastern Black Sea region, Turkey

N. M. Pınar[1], T. Çeter[2], A. Acar[1], Y. Türkmen[1]

[1]*Biology, Ankara University, Tandoğan, Turkey*; [2]*Kastamonu University, Kuzeykent, Turkey*

The species of Cupressaceae and Taxaceae families have a both natural wide spread and quite common landscape in our country. The millions airborne pollen which belong to Cupressaceae family are also released into the atmosphere. Their long term pollination between February and September causes allergic disease like seasonal rhinitis, conjunctivitis and asthma. In this study, Cupressaceae/Taxaceae pollen concentration which belongs to five provinces in the middle and east black sea region was evaluated for two year. The study was carried out for two year (2011-2012). Five Burkard volumetric pollen trap were used for sampling from the atmosphere in Artvin, Gümüşhane, Sinop, Giresun and Çankırı provinces. Daily pollen count has been expressed as daily average of pollen grains per cubic meter of air sampled per day. Then the concentration of pollens were projected as weekly, monthly and annually. Cupressaceae / Taxaceae pollen was found on almost all year round during the study period in 5 provinces. The highest pollen concentration was determined in Çankırı and Artvin among the provinces. The highest concentration of pollen in Artvin atmosphere was observed in April in both 2011 and 2012 years. The highest concentration of pollen in Gumushane atmosphere was detected in May during two years. In 2011, the highest pollen concentration in Sinop atmosphere was monitored in April, while it was detected in June 2012. The highest pollen concentration in Çankırı atmosphere in May 2011, while in 2012, it was observed in April. In Giresun atmosphere, the highest Cupressaceae/Taxaceae pollen concentration in March 2011, while it was determined in April 2012. Cupressaceae / Taxaceae pollen was found as one of the most common taxa in the atmosphere among the cities. This is because, both taxa are used more in the urban landscape and producing large amounts of pollen due to wind pollination of these family members. Because of the high impact of Cupressaceae pollen allergy, the polinization period and peak days of pollen should be given on meteorological bulletins, internet, radio, television and newspapers constantly for informing allergic people. (Project no: TUBITAK COST EUPOL, 109S265)

Keywords: Cupressaceae, Taxaceae, pollen, Black sea region, atmosphere,Turkey.

PA18

Poaceae Pollen and Phl p 5 Allergen profile of two cities in Turkey

T. Sarışahin[1], Ş. Alan[1], M. Derendeli[1], A. Acar[2], A. Kaplan[1], N. M. Pınar[2]

[1]*Biology, Bulent Ecevit University, Zonguldak, Turkey*; [2]*Biology, Ankara University, Ankara, Turkey*

Poaceae family include grasses has many cosmopolitan species and grass allergens have a conserved protein sequence. On the other hand, cross reactivity between allergens is very common in Poaceae family. So grasses are considered the most allergenic pollen type all over the world. Transportation of pollen and other airborne are well known, but there is a few information about allergen transportation. In this study, we aimed to evaluate monitoring Phl p 5 levels in two cities for a year and investigating whether meteorological factors could regulate allergen release from pollen into the atmosphere and showing it is short distance transportation.

Material and Methods: Ankara, is the capital of Turkey, located in Central Anatolia with about 4.5 million population. It has also arid climate which is distributed plant species belonging to mainly Poaceae family. Zonguldak is located Northwest part of Turkey. It has oceanic climate. Pollens were collected from Burkard pollen and spore trap and counted daily. Phl p 5 sampling were carried out between March-October during 2015 by using BGI900 Cascade High Volume Air Sampler (900L/min.). Both traps were placed next to each other on the roof of the buildings where in two cities. The ambient air was sampled on two different polyurethane filter (PUF).Two different filter parts (PM10 and PM2.5) were analyzed separately. PUF's were extracted in ammonium carbonate buffer, aliquoted, lyophilized and stored -20 °C until use. Concentrations of Phl p 5 were measured by ELISA technique.

Results: In total 423.6 pollen/m^3 Poaceae pollen were found in the air of Ankara and Zonguldak cities. It has been found that Poaceae pollen concentration in Ankara (278 pollen/m^3) was higher than Zonguldak (145.6 pollen/m^3). On the other hand, we observed that there is a dramatic differences between Phl p 5 concentrations between two cities. In Zonguldak total Phl p 5 concentration was 79.5 pg/m^3, while 4873.63 pg/m^3 was recorded in Ankara atmosphere. About 90% of the allergen was found in the PM10 fraction in both cities. Maximum allergen level was measured as 128.58 pg/m^3 for PM10 on 02/06/2015 in Ankara, while it was detected as 36.18 pg/m^3 for PM10 on 07/07/2015 in Zonguldak. The highest allergen concentration was measured about one month after the main pollen season in Zonguldak.

Discussion: Considering that species belongs to Poaceae family were mainly distributed in Ankara, there is a reasonable difference between Phl p 5 allergen concentrations. However it is hard to explain in differences of Phl p 5 allergen concentrations between cities with plant distribution completely. Main wind direction which is from south in the Zonguldak could be drift effect for allergens. Due to pollen counts and releasing dates of allergen in the atmosphere, we determined that Phl p 5 concentration increase just before the observation of the higher grass pollen levels in the atmosphere of both cities. (Project No: TUBITAK, 113Z762).

Keywords: Phl p 5, Ankara, Zonguldak, monitoring, pollen, ELISA, Turkey, Poaceae.

PA19

Comparing of airborne *Alternaria* and *Cladosporium* spore concentrations in Middle and Eastern Black Sea region, Turkey

N. M. Pınar[1], T. Çeter[2], S. Akdoğan[2], A. Acar[1]

Biology, Ankara University, Tandoğan, Ankara, Turkey[1] *Biology, Kastamonu University, Kuzeykent, Kastamonu, Turkey*[2]

Fungal spores are significant airborne allergens which cause allergic sensitization. Recent studies reported a strong association between asthma symptoms and thunderstorms that could be defined by an increase in airborne fungal spore concentrations. The most common molds *Cladosporium* and *Alternaria* are known to be important causes of allergies. In this study, *Cladosporium* and *Alternaria* spore concentration from five provinces in the Middle and Eastern Black Sea region were examined and compared for two years. The study was carried out from June 2010- June 2012. Five Burkard volumetric pollen traps were used for sampling from the atmosphere in Artvin, Gümüşhane, Sinop, Giresun and Çankırı provinces. Daily spore counts were expressed as daily average of pollen grains per cubic meter of air sampled per day. The concentration of pollens were projected monthly and annually. As a result of study it was identified that 347.785 spore/m^3 *Cladosporium* and 27.462 spore/m^3 *Alternaria* in Çankırı; 358,781 spore/m^3 Cladosporium and 40.088 spore/m^3 *Alternaria* in Sinop; 334.703 spore/m^3 Cladosporium and 10.676 spore/m^3 *Alternaria* in Giresun; 159.737 spore/m^3 Cladosporium and 6510 spore/m^3 *Alternaria* in Artvin; 192.708 spore/m^3 Cladosporium and 14.771 spore/m^3 Alternaria in Gümüşhane were recorded during the study period. Spores of both taxa were recorded almost all year round however they were detected at a maximum level generally in July in five provinces. The highest concentrations of *Alternaria* and *Cladosporium* spores occurred during summer from June to September in five provinces. *Cladosporium* and *Alternaria* spores can induce decreased respiratory functions and development of allergic symptoms between May and October, and especially during July. Our analysis showed these two molds were at higher levels in the atmosphere of the study regions. Therefore, sensitized people should keep themselves away from such activities, keep their doors and windows closed and use filtered air conditions during the risky months in these provinces (TUBITAK COST EUPOL, 109S265).

Keywords: *Alternaria*, *Cladosporium*, spore, atmosphere, Black Sea region, Turkey.

PA20

Atmospheric Pollen Profile of Kahramanmaraş - S Turkey, 2014

A. Tosunoglu[1], S. Bekil[1], H. Akgul[2], C. Uygun[3], A. Bicakci[1]

[1]*Biology, Uludag University, Nilufer, Bursa, Turkey*; [2]*Biology, Akdeniz University, Center, Antalya, Turkey*; [3]*Biology, Sütçü İmam University, Center, Kahramanmaraş, Turkey*

There is a body of evidence which suggests that the frequency of atopic diseases, particularly those induced by pollen allergens are increasing and atopic diseases have become more common in recent years. The allergenic content of the atmosphere varies according to climate, geography and vegetation. Determination of the type and proportions of pollen grains in the atmosphere is useful for patients who suffer from pollen allergies. Due to the health impact of pollen grains, pollen calendars have been prepared worldwide for many years.
The aims of this study are to investigate the airborne pollen distribution and variability, and to present the preliminary data of pollen seasons for the region.
An aeropalynological study was performed in Kahramanmaraş city of Turkey with a Hirst-type volumetric 7-day pollen and spore trap for the year 2014. 17614 pollen grains as a total value belonging to 47 taxa were recorded during the study period, and pollen grains from woody plant taxa had the largest atmospheric contribution of 89.90 % and 22 taxa. However, 25 herbaceous plant taxa constituted 9.85 % of the annual total pollen count, and 0.25 % were unidentified. Predominant pollen types belonged to Cupressaceae/Taxaceae (46.26%), *Platanus* (14.38%), *Quercus* (11.07%), *Pinus* (6.31%), *Poaceae* (4.82%), *Moraceae (4.23%), Olea europaea (3.17%)* and generated 90.23% of the annual total. Additionally, in *K*ahramanmaraş atmosphere pollen concentrations peaked with maximum monthly pollen index of 28.30% in February, continued in high levels in March-May period and prominently decreased in summer.
Foundation: This study is funded by Tubitak – KBAG – 212T135.

Keywords: Palynology, Aerobiology, Pollen concentrations.

Single-stage impactor for pollen and fungal spores monitoring: what does it really capture?

E. Lanzoni[1], D. Fernández González[2], P. Mandrioli[3]

[1]*LANZONI s.r.l., Bologna, Italy*; [2]*Dept. of Biodiversity and Environmental Management, University of León, León, Spain*; [3]*Institute of Atmospheric Science and Climate, CNR, Bologna, Italy*

Since the 70s the mostly used instrument to monitor the concentration of atmospheric pollen and fungal spores was the Hirst Volumetric Spore Trap, recommended by the International Biological Program (1964-1974) through the Integrated Research Program of Aerobiology (1970-1971) and later widely adopted by National networks of airborne pollen monitoring. The Hirst spore trap is a single-stage impactor were the particles collector is a tape or a microscope slide. Despite the spreading of this type of sampler, there are still relevant problems that limit its reliability as measuring instrument. These problems can arise both from producers and by users. The main requirement of this instrument, like with other kind of aerosol samplers, is represented by the capture (or collection, or sampling) efficiency, which depends on size, density, shape and aerodynamics of the particles being sampled. In other words, capture efficiency (E%) is the ratio between the particles present in the flow upstream the collector and the particles which will be deposited. As regards the Hirst type sampler, it does not seem that, up to this moment, the sale of this instrument is accompanied by the capture efficiency certificate. Normally the volumetric spore trap is used to measure the atmospheric concentration of pollen grains and fungal spores and therefore the capture efficiency tests are usually carried out with particles with aerodynamic diameter of 2, 10 and 50 microns. These measures cannot be done in open air, but must be carried out in laboratories equipped with solid aerosol generators and suitable measuring instruments. Samplers with the same efficiency are the necessary condition for the constitution of a monitoring network. In order to compare measurements made with these instruments, it is necessary to undertake a weekly control of both the intake air flow, which for Hirst trap is 10 LPM, and the cleaning of the orifice. As everybody knows, there are environmental parameters to which each sample point is subjected: instrument position, surrounding vegetation, prevailing wind direction, etc., and therefore the user must take into account the influence of these parameters on the final results. Finally, to complete the standardization of the whole process, from the atmospheric monitoring to the generation of concentration data, it will be necessary to adopt a standardized procedure for sample analysis in order not to increase the limit of error. These are the basic considerations that must be applied to transform a data archive generated by different tools and different methodologies, in a data network made up of standardized tools and methodologies. Lanzoni s.r.l. is constantly trying to improve its products and therefore is starting a process to obtain a capture efficiency certificate for VPPS samplers, issued by an officially recognized organization, to ensure end users that these instruments are reliable.

Keywords: capture efficiency, standardization, monitoring parameters.

PA22

Platanus hybrida Biodistribution in the city of Evora, Portugal: Study of the potential allergenic pollen profile

A. Galveias[1], R. Arriegas[1], I. Calhau[1], L. Lopes[2], A. Costa[3], C. Antunes[3]

[1]*Instituto de Ciências da Terra, IIFA & Dep. Química, ECT, Universidade de Évora, Évora, Portugal*; [2]*Hospital Santa Lúzia, Elvas, Portugal*; [3]*Instituto de Ciências da Terra, IIFA, Dep. Química, ECT & Instituto de Ciências Agrárias e Ambientais Mediterrânicas, Universidade de Évora, Évora, Portugal*

Grasses and olive are the most relevant allergenic species described in the Alentejo region, nonetheless aggravation of allergic symptoms in the early spring, unrelated with those species pollen seasons, has been reported, particularly in urban environment. Plane trees are widely used as ornamental plants and as such are commonly found in urban environment, however, its allergenic profile is essentially unknown. Although plane trees (*Platanus hybrida*) are common in the city of Évora, and one of the most representative species in Évora showing pollination prior to the grasses and olive, neither the biodistribution nor its allergenic profile have been evaluated so far. The aim of this work was to characterize the biodistribution in the urban environment of Évora and to evaluate the allergenic profile from *P. hybrida* pollen.
Plane tree location and phenology was evaluated using Google Earth application tools. Pollen from *Platanus hybrida* and *Dactylis glomerata* was extracted with ammonium bicarbonate buffer, lyophilized and stored at -80ºC until analysis. Protein content was determined by the Bradford method. SDS-PAGE followed by western blot, using allergic patient sera (obtained from the Hospital do Espírito Santo de Evora – HESE), were performed to evaluate the allergen profile of the pollen. Cross-reactivity was assessed by solid phase immunoblot.
A large number of adult plants has been identified around the historic city center, where most of the schools, hospitals and other services are located, places highly frequented by the population. Half of the patient exhibited sensitization to pollen extracts of *P. hybrida*. Cross-reactivity of *P. hybrida* with *D. glomerata* was found. Western blot analysis has shown several immunoreactive bands in the Mr 10-90 kDa range. Immunoreactive bands were also observed in the protein profile according to the pI in the pI range 4.0-´6.1. Although several bands are common to *D. glomerata*, a band with ~50kDa was observed in *P. hybrida* but not in *D. glomerata*.
These results show that plane trees are higly abundant in the city center, hence elevated pollen exposure is expected. Moreover, it evidenced allergens found in *P. hybrida* pollen and cross–reactivity between *P. hybrida* and highly allergenic species, such as *D. glomerata*. Taken together the results suggest that *P. hybrida* probably contributes for aggravation of pollinosis in the early spring in the city of Evora.

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Airborne pollen spectra of Kocaeli (Izmit), Turkey

S. Celenk, H. Malyer, G. Saitoglu

Science Faculty, Biology Department, Aerobiology Laboratuvary, Uludag University, Bursa, Turkey

Background: A 3-year aerobiological study was performed in the atmosphere of Kocaeli, Turkey, to determine the pollen types in the region and the months in which the highest concentrations of allergenic pollens occur.
Methods: Airborne pollen sampling was carried out with a 7-day volumetric trap (Hirst type) in Kocaeli, Turkey. Pollen trap placed about 20 m above ground level, on the roof of the hospital, which was located in the center of the city. A study conducted during 3 yearly periods from 20 March 2010 to 31 December 2012.The sampling method, slide preparation, and data interpretation were performed according to the standard method of the REA and pollen concentrations were expressed as a number of pollen grains per cubic meter per day (p/m3/24h). The pollen was counted at a magnification of x400, in 4 longitudinal lines and total daily counts were converted into the number of pollen grains per cubic meter (m3) of air. A pollen calendar of investigated prepared on the basis of 10-day means.
Results and Discussion: During three years, as a mean a total of 22,890 pollen grains / m^3 which belonged to 55 taxa and 617 unidentified pollen grains were recorded. In the region investigated Cupressaceae (22.42%), Gramineae (11.18%), Urticaceae (7.76%), *Pinus* sp. (7.14%), *Ambrosia* sp. (6.00%), *Quercus* sp. (5.54%), *Platanus* sp. (5.13%), *Fraxinus* sp. (4.86%), *Alnus* sp. (3.90%), *Olea* sp. (2.93%), Chenopodiaceae (2.67%), *Corylus* sp.(2.48%), *Plantago* sp. (2.37%), *Morus* sp. (1.83%), *Artemisia* sp. (1.27%) , Castanea sp. (1.20) were responsible for the greatest amounts of pollen, 95.4% of aeroflora and these pollen types equal to or greater than 1% grain of pollen/m^3 of air. During the study period, the pollen concentration reached the highest level in April. The data presented here may be useful in predicting the beginning of the pollination season and identifying of pollen types sensitive individuals expose in the investigated region. This study was founded by TUBITAK project no 109S032.

Keywords: Aerobiology, pollen calendar, allergenic pollen.

PA24

The influence of the hot summer 2010 on pollen season in Moscow (Russia)

O. Volkova, E. Severova

Higher Plants, Lomonosov Moscow State University, Moscow, Russia

In the summer 2010, Russia had a record-breaking heat lasted for two months from mid-June till mid-August. July 2010 became the hottest month ever recorded. The average July temperature in Moscow was about 6.5 °C above the average value (26,4°C) with the highest temperature measured 38.2°C on July 29th. At the same time July was the driest month ever measured since 1993 with the total humidity reached only about 67 % of the average value. The goal of this study was to analyze the influence of extreme temperature and humidity conditions on the pollen spectra of 2010 and next seasons. Pollen data were obtained by Hirst-type volumetric trap located in Moscow on the roof of meteorological station.

We consider that extreme conditions of 2010 were reflected in the very intensive *Betula* pollination in 2012. Seasonal pollen index (SPI) of *Betula* in 2012 was 5 times higher than the average counts and reached 118057 pollen grains/m^3 with daily maximum 21121 pollen grains/m^3 (April 26). The delayed response of *Betula* was connected with the time of catkins development. Male catkins of *B. pendula* begin to form in late May – early June of the season preceding the pollination (Kostina et al., 2015). In 2010 the meteorological conditions in late May/early June didn't differ from the average and didn't affect the catkins development. *Betula* SPI registered in 2011 was within the long-term average value (9937 pollen grains/m^3). However, the heat wave has affected the intensive shoot branching in 2010 (Kostina et al., 2015) and the formation of large amount of male catkins in 2011 that leaded to intensive *Betula* pollination in 2012.

The other arboreal taxa were not affected as much as *Betula*. SPIs of *Populus* and *Tilia*, registered in 2011, were the highest over a period of observation. *Alnus* SPI was also considerably high in 2011 but within the upper quartile of data. *Alnus* (Puc, Kasprzyk, 2013), *Populus* and *Tilia* set male inflorescences in autumn of the year preceding pollination. The hot summer of 2010 didn't affect the process of catkin formation, but it has influenced the active shoot branching. That has leaded to the formation of large amount of male catkins in autumn 2010 and intensive flowering in 2011.

Since the heat wave started in mid-June, summer flowering herbs were the most influenced taxa. The start date of Poaceae was 14 days earlier than the average. Similar tendency was observed for *Urtica*, Chenopodiaceae and *Artemisia*, the start dates were 5, 36 and 8 days earlier than the average. SPIs of Poaceae and *Artemisia* were 1.4 and 2.6 times lower than the average value (985 and 496 pollen grains/m^3). SPIs of *Urtica* (10845 pollen grains/m^3) and Chenopodiaceae (182 pollen grains/m^3) were close to the long term average value.

The study was funding by grant 14-50-00029 of Russian Science Foundation (RNF).

Keywords: heat wave, extreme condition, pollen season.

PA25

Comparison of two slide counting methods from a volumetric pollen trap: twenty-four latitudinal vs four longitudinal transects

G. Takat[1], S. Celenk[1], M. Smith[2]

[1]*Science Faculty, Biology Department, Aerobiology Laboratory, Uludag University, Bursa, Turkey*; [2]*Department of Physical Geography, University of Worcester, Worchester, United Kingdom*

Pollen data were recorded at Bursa for one year from 6 September 2013 to 6 September 2014 by Hirst type volumetric trap (Lanzoni VPPS 2000). The method of investigating pollen/spore grains has previously been twenty-four latitudinal transects that examine 22.47 % of the total sample surface. However, this method is time-consuming. The main objective of this study is to investigate whether reducing the number to four longitudinal transects (i.e. 12.85% of the total surface area) would have a significant effect on daily average and bi-hourly pollen concentrations, as well as the main characteristics of the pollen season. The study found that a change in the counting method does not impact on the main characteristics of the season or pollen types. For the four longitudinal transect method, the peak level of pollen was witnessed in April with 38 taxa identified and a total of 13708 p/m^3 counted (13623 p/m^3 identified and 85 unknown). On the other hand, when using the twenty-four longitudinal transect method the peak was also seen in April with 37 taxa identified belonging to a total 11964 p/m^3 pollen counted (11922 p/m^3 identified and 42 unidentified). As a result, this study can be used to justify changing the sub-sampling method used at the Aerobiology Laboratory, Uludag University, to four longitudinal transects.

Keywords: pollen counting, aerobiological samples, latitudinal-longitudinal transects.

PA26

Trends in pollen seasons in Moscow, Russia

O. Volkova, E. Severova

Higher Plants, Moscow State University, Moscow, Russia

Pollen grains play a significant role in the pathogenesis of respiratory allergies, which are increasing in severity during last decades. One of the factors responsible for this increase can be climate change that influences the timing and the intensity of the pollen season.

This study presents the results of analysis of variations in seasonal pollen index (SPI) of the main airborne taxa in relation to meteorological data. Pollen data were collected in urban and rural environment: by Hirst-type volumetric spore trap located in Moscow (1993-2015) and by Tauber trap located in Moscow area 50 km west from the city (2008-2015). Selected meteorological parameters (annual average temperature, annual total rainfall, annual average humidity) recorded over the same time were also examined in order to put the analysis into context. Simple linear regression analysis was carried out in order to investigate trends over time. Correlation analysis was used to establish relationships between data obtained by different sampler types in different environment.

There isn't any significant trends of annuals values of total rainfall and average related humidity during the study period. Statistically significant increase (by 0.08°C) is only observed for the average annual temperature ($p = 0.0440$; $R^2 = 0{,}1876$) which was connected with trends towards warmer May ($p = 0.0255$; $R^2 = 0{,}2255$), July ($p = 0.0244$; $R^2 = 0{,}2285$) and August ($p = 0.0018$; $R^2 = 0{,}3923$) temperatures.

Hirst-type volumetric data. There is a significant increase in the SPI for *Betula* ($p = 0.0253$; $R^2 = 0.2163$), *Corylus* ($p = 0.0066$; $R^2 = 0.2788$), *Pinus* ($p = 0.0347$; $R^2 =0.2367$), *Populus* ($p = 0.0318$; $R^2 = 0.2435$) and *Quercus* ($p = 0.0075$; $R^2 = 0.3514$). For herbaceous taxa a statistically significant increase was observed only for *Urtica* ($p = 0.0004$; $R^2 = 0.5152$).

Tauber trap data. The significant increase of annual pollen influx was only observed for *Betula* - the dominant taxa of pollen spectrum ($p = 0.0347$; $R^2 = 0.5518$).

Data on *Betula* pollen obtained in both trap types is strongly correlated with each other ($p = 0.0347$; $R^2 = 0{,}5518$). For other taxa, correlations are low and non-significant. The lack of clear trends and correlations may be due to the considerably short (8 years) data set from the Tauber traps.

Thus, the increase in annual temperature during last decades is reflected in the increase of seasonal pollen index of some arboreal and herbaceous taxa. Trends are distinctly visible on data obtained by volumetric trap. Annual pollen influx in Tauber traps varied considerably, significant trend are only observed for *Betula* pollen. Data on *Betula* pollen obtained by different sampler types are strongly correlate with each other.

The study was supported by the Russian Foundation for Basic Research, grant №16-34-00804.

Keywords: Burkard, Tauber trap, trends.

Effects of meteorological factors on airborne concentrations of *Artemisia* pollen in Vienna, 2003-2015

M. Prentovic, M. Kmenta, K. Bastl, S. Jaeger, U. Berger

Department of Otorhinolaryngology, Medical University of Vienna, Vienna, Austria

Background: The timing of pollen release and dispersal of pollen is influenced by several parameters like weather conditions and land use. *Artemisia* is a widely dispersed genus in Europe that benefits from disturbed areas caused by urbanization and agriculture. *Artemisia* pollen affects human health in terms of a pollen allergy in the late summer and cross-reactivity with with *Ambrosia* pollen. Therefore, it is important to monitor changes in pollen release of *Artemisia* (amount of pollen, start/end date of appearing, peak day, duration of the season…).
Methods: Pollen data was collected in Vienna during the period of 2003-2015. The *Artemisia* pollen season was defined using the standard method of the European Aeroallergen Network (EAN; https://ean.polleninfo.eu/Ean/) starting with 1% and ending with 95% of the annual total pollen amount. Monthly and 10-day average values of meteorological factors, such as air temperature, total precipitation and relative humidity, as well as the Seasonal Pollen Index (SPI) were used to estimate the influence on pollen release. Spearman´s correlation analysis and a linear regression model were used in order to determine the parameters with the highest influence on the *Artemisia* pollen season. A trend in the *Artemisia* pollen season was observed for the analysed period using the Mann-Kendall test and the Sen´s slope estimator.
Results: The average duration of an *Artemisia* pollen season amounted to 61 days. The highest SPI was recorded in 2004, the lowest in 2015. A significant decrease in the intensity of the *Artemisia* pollen in Vienna was observed from 2003-2015 (-36 pollen/year, $p<0.05$). The mean minimum temperatures in the second half of July showed the most significant negative influence on the SPI of *Artemisia*. A strong significant relationship was obtained between the SPI, the end date, the season duration and the amount of precipitation ($p<0.01$).
Conclusion: This study confirms the hypothesis that higher temperatures in July have a significant negative influence on the *Artemisia* pollen season. In addition, the amount of rainfall in the second half of August also shows an effect on the SPI and the season duration. A notable decreasing tendency of *Artemisia* pollen suggests that an increase in summer temperatures in Vienna could be the key reason for the observed shifts in the pollen season of this weed species.

Keywords: Artemisia pollen, Aerobiology, Temperature.

PA28

Quantification of the atmospheric *Olea* pollen and Ole e 1 concentrations in two biogeographical areas

F. J. Rodríguez Rajo[1], A. Vara[1], M. Fernández-González[1], Mª J. Aira[2], B. Elvira-Rendueles[3], J. M. Moreno[3], A. García-Sánchez[3], Mª J. Martínez-García[3], S. Moreno-Grau[3]

[1]*Plant Biology and Soil Sciences, Universiy of Vigo, Ourense, Spain*; [2]*Botany, University of Santiago, Santiago Compostela, A Coruña, Spain*; [3]*Chemical and Environmental Engineering, Politechnical University of Cartagena, Cartagena, Spain*

The *Olea* pollen is currently an important allergy source, not only in the Mediterranean basin. In some regions of Southern Spain, olive pollen is the main motive of allergic sensitization, exceeding the 40% of the sensitized individuals in the Murcia region. Due the scarce presence of olive trees in Northern Spain, limited to some cultivations in the South of the Galicia region where also grows wild, only the 8% of the sensitized individuals showed positive results for *Olea* pollen. The aim of the paper was to assess the behavior pattern of the *Olea* pollen and its aeroallergens in the atmosphere as this information could help us to improve the prevention of clinical symptoms.
Airborne *Olea* pollen and Ole e 1 allergens were quantified in Cartagena (Southeastern Spain) and Orense (Northwestern Spain) during a 10 years period: from 2003 to 2008 in Cartagena and from 2009 to 2013 in Ourense. A Lanzoni VPPS 2000 sampler and a Burkard Cyclone sampler were used for pollen and allergen quantification. Pollen grains were counted following the protocol proposed by the Spanish Aerobiological Network (R.E.A.), and the allergen airborne samples by means the Moreno-Grau et al (2006) protocol.
The *Olea* blossom timing takes place during the month of May in the studied areas. The flowering period is advanced several days in the Southern area of Spain. The average of the yearly total pollen concentration during the studied years was 1764 pollen grains in Cartagena and 253 in Ourense. The average of the yearly total allergen concentration was 10184 pg in Cartagena and 240 pg in Ourense. Therefore, the higher concentrations were registered in Cartagena for both Ole e 1 and pollen concentrations. The rates between sites also varied, with values 8 times higher for pollen concentrations and 40 times higher in the case of the allergens. An alternate bearing pattern could be observed, characterized by the fact that in years with high pollen values the lower allergen concentrations were registered and vice versa. But not only year-to-year variations were detected, as in some flowering seasons allergen concentrations didn't matches the atmospheric pollen values. Thus, previous Ole e 1 peaks were detected regarding the pollen curve observed during the years 2008 in Cartagena or 2009 and 2012 in Ourense. The Pearson correlation coefficient and the determinant coefficient between pollen and Ole e 1 concentrations showed higher values in the case of Cartagena.

Keywords: Olea, Ole e 1, pollen.

Aerobiology in mass media in Croatia

B. Stjepanović[1], I. Hrga[1], A. Večenaj[1], A. Krivohlavek[1], A. Stampar[1], M. Špehar[2]

[1]Teaching Institute of Public Health, Zagreb, Croatia; [2]Institute of Public Health Sv. Rok, Virovitica, Croatia

Allergic diseases are among the most widespread diseases and represent significant public health problem. This problem is also recognized in Croatia and therefore it is of great importance to inform citizens on daily load of allergens.
Croatia has 16 monitoring stations that all use Hirst-type samplers. For screening of slides was used horizontal sweeps method. Stations cover the continental and mediterranean part of the country. As the flora is specific for each part, these information are useful to local citizens as well as the tourists. Teaching Institute of Public Health Dr Andrija Stampar is a coordinator of pollen forecast for entire Croatia. We collect data from monitoring stations and reproduce them daily (or twice weekly) as a unique information on our web site. Among these 16 cities, 6 of them have continuous every day monitoring (using daily sampling head) and these information on daily pollen load is well accepted in public. Information is shown in Android and iPhone app. in a form of colour and following number scale. This enables our citizens to continuously follow pollen forecast and control their symptoms. Since the application was launched, other media (radio, television, newspaper…) recognized the importance of such information. Due to constant enquiries of citizens, each pollen season is followed by numerous articles, TV reports, talk shows, radio advertising and education of both children and adults on the allergenic plants.

Keywords: aerobiology, mass-media, pollen forecast, pollen

PA30

The combination of Goidanich index and the *Plasmopara* airborne spores as a tool to predict the downy mildew infection disease risks periods

F.-J. Rodrígez Rajo[1], E. González-Fernández[1], A. Piña[1], D. Outeiriño[1], M. Fernández-González[1], Mª J. Aira[2]

[1]*Plant Biology and Soil Sciences, University of Vigo, Ourense, Spain*; [2]*Botany, University of Santiago Compostela, Ourense, Spain*

The particular climate of the North-western Spain, with high relative humidity and temperatures during the grapevine vegetative cycle, can specifically favour the development of fungal diseases in crops. One the most important diseases is downy mildew, caused by *Plasmopara viticola* Berk et Curt. de Toni. The most common pest management method includes the routine application of chemical treatments. As a consequence, a high number of chemical treatments (between 8 and 11 applications during the vine vegetative cycle) were applied, most of them unnecessary. The main goal of this paper is the implementation of a system containing phenological data, biological sensors (the airborne spore levels of the fungus) and the prediction of the favourable environmental conditions for the pathogen (based in the Goidanich Index) which would clearly lead to a lower number of treatments and a reduction in economic costs and environmental damage.
The study was carried out in a vineyard located in Cenlle (North-West Spain) during the years 2005-2013 along the active *Vitis vinifera* vegetative cycle (from 1 April to harvest date). An aerobiological study was performed using a Lanzoni VPPS-2000 volumetric spore trap located inside the vineyard. In order to ascertain the possible disease infection periods, the infection risk cycle (IRC) was calculated following the methodology proposed by Goidanich (1994).
The duration of the grapevine cycle ranged from 154 days during the year 2011 to 176 days in 2008. The presence of *P. viticola* was not constant in the atmosphere of the vineyard during the grapevine cycle. In general terms maximum spore counts were observed from the second fortnight of April to the first fortnight of May and from last week of June to last week of September. The highest total *P. viticola* spore concentrations were recorded in 2010 with 1255 spores and the lowest in 2005 with a total value of 210 spores. The highest number of infection cycles were recorded during the 2009 harvest, with a total of 16 cycles. The years with fewer infection cycles were 2008, 2011 and 2012 (13 cycles) followed by 2010 and 2013 (15 cycles). A linear regression analysis developed to predict the airborne spore concentrations accounted for the 95,9% of the spore concentration variation. The accuracy of the regression model was tested by means of the fitted comparison of the observed and predicted *P. viticola* spore concentrations during the 2014 and 2015 harvest (both years were not used to train the model).

Keywords: Plasmopara, Goidanich, Aerobiology.

Weed conditioning of common ragweed with allelochemicals and relationship to pollen allergy with air pollution

V.-J. Vojnich, E. Pölös

Department of Horticulture, Kecskemét College, Kecskemét, Hungary

Common ragweed (*Ambrosia artemisiifolia*) has become the most widespread weed in Hungary. It causes a significant economic damage, and it causes pollen allergy affecting 20% of the country's population (JUHÁSZ - JUHÁSZ, 2002). Therefore its reduction has become a major task. An environmental-friendly method has been developed for its destruction by bioherbicids. This bioherbicide contains contained allelochemical retardants. Allelochemicals are active chemical inhibition ingredients between plants (allelopathy). This method was applied in the urban areas in the city of Kecskemét, Hungary.

During the high (31-100 parts/m^3) and very high (101- parts/m^3) concentrations of ragweed pollen (period between August 8th 2015 and September 19th 2015), the ozone concentration in the air exceeded health limit (120 mg/m^3) on seven occasions, which significantly worsened the symptoms of pollen allergy patients. One particular group of starting pollutants are the nitrogen oxides, originating from vehicles exhaust emissions. From these nitrogen-oxides, with the effect of solar radiation, ozone (O_3) arises. The examinations of researchers in Vienna (http[1]) confirmed that high concentration of ozone in the air increases the plants' (such as ragweed) allergen content as well. The main reason for this is that high proportion of ozone charged species' protein essence strongly reacts with immunoglobulin-E antibodies, which play a significant role in the formation of the allergy. Nitrogen oxides (**NO_x**) destroy the exterior protective covering of ragweed pollens, therefore resulting the irritate effect in respiratory tracts.

Common causes of the high production of ragweed pollen are (among others) the steady increase of CO_2 in the atmosphere - and global warming. Particulate (**PM_{10}**) concentrations during the high and very high ragweed pollen production times (from August 08. till September 19. 2015.) exceeded the health limit (**50 μg/m^3**) on thirteen occasions, which is very dangerous, since it is potentially harmful even in the lowest concentrations (http[2]). The main sources of particulate are the exhaust gases and coal burning. These have an effect of increasing the rate of respiratory diseases (for example asthma and chronic bronchitis diseases), including pollen allergy as well. In 2015 at the Pulmonary Care Institute in Kecskemét, almost 80% (3220 people) of the 4033 patients registered with pollen allergy produced allergic symptoms for ragweed pollen as well. Compared to 2014, the number of registered pollen allergy patients increased by 222.

Keywords: Common ragweed (*Ambrosia artemisiifolia*), allelochemical, ozone effect.

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PA32

Back-trajectory modelling and DNA-based species-specific detection methods allow tracking of fungal spore transport in air masses

A. Grinn-Gofroń[1], M. Sadyś[2], J. Kaczmarek[3], A. Bednarz[1], S. Pawłowska[1], M. Jedryczka[3]

[1]*Department of Plant Taxonomy and Phytogeography, University of Szczecin, Szczecin, Poland*; [2]*Computational and Systems Biology, Rothamsted Research, Harpenden, United Kingdom*; [3]*Institute of Plant Genetics, Polish Academy of Sciences, Poznań, Poland*

Leptosphaeria maculans and *L. biglobosa* are fungal pathogens causing the blackleg disease in oilseed rape (*Brassica napus* L.) plants. Due to significant economic losses caused in Europe, North America and Australia, aerobiological monitoring of ascospores was conducted. Information about the spore levels in the air and identification of the potential location of inoculum sources can greatly help to predict the exact time of the fungicide application and possible further disease development. Recent advances in molecular detection of living organisms allow introducing novel methods to the study of microbial ecology. Changing habitats by airborne fungi is difficult to track with microscopy because different species produce identical or very similar spores.

Measurements of the ascospore concentration were taken continuously for a decade (2006-2015) using a 7-day volumetric spore trap. The air sampler was located in Szczecin (NW Poland) at the border with Germany. Microscopic analyses were then followed by a statistical examination. DNA-based monitoring allowed us to track in the air *Leptosphaeria maculans* and *L. biglobosa*, in spite of identical shape and size of their spores. The fungi were identified with the help of dual-labelled fluorescent probe that was targeted at the β-tubulin gene fragment of either species of *Leptosphaeria*. Real-time PCR technique enabled the detection of minute amounts of DNA of selected fungal species. This information was combined with rearwards trajectories, allowing tracking of past movements of the air masses using the Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model. The distribution map of oilseed rape was produced using the Spatial Production Allocation Model (SPAM).

Over the last decade (2006-2015) two certain events of the long distance transport of *Leptosphaeria* spp. spores to Szczecin located in the NW Poland were identified. It was demonstrated that both times the spores originated from Jutland Peninsula (northern Germany and southern Denmark) and they belonged to *L. biglobosa*. The unsuitable time for oilseed rape infection made the fungus change its original host to vegetable brassicas and weeds. The authors discuss the potency of molecular techniques in the study of the transport of fungal spores of particular species, races and genetic variants.

The expansion of *Leptosphaeria* spp. and similar pathogens towards Eastern European countries, such as Lithuania or Russia may stop only if the disease management in the western countries improves. However, this may be a difficult task to complete, as the acreage of agricultural crops rises constantly. This causes problems in efficient control of numerous pathogens and possible further infection of the crops in neighboring countries. Furthermore, a consecutive flux of airborne inoculum spores from Germany to Poland can be expected in following years. It can be routinely studied using molecular tools such as real-time PCR or LAMP.

Keywords: DNA-based detection method, long distance transport, β-tubulin gene.

Comparative study of *Ambrosia* pollen and Amb a 1 allergen in Turkey

A. Acar[1], Ş. Alan[2], M. Derendeli[2], T. Sarışahin[2], A. Kaplan[2], N. M. Pınar[1]

[1]*Biology, Ankara University, Tandoğan, Ankara, Turkey*; [2]*Biology, Bülent Ecevit University, İncivez, Zonguldak, Turkey*

Common or short ragweed (*Ambrosia artemisiifolia* L.) is a destructive invasive species that is important weed in agriculture and a source of highly allergenic pollen. It is native to North America but has been introduced to many Northern parts of Turkey. There are some modellings that showing pollen of *Ambrosia* could be enter our country from abroad, especially through West Black Sea region. In this study, it is aimed to establish a correlation between pollen counts and the allergens released from these by monitoring *Ambrosia* pollen and Amb a 1 allergens. Ankara located in Central Anatolia with about 4.5 million population. It has also arid climate. Zonguldak, located Northwest part of Turkey, has oceanic climate. Pollen were collected from Burkard pollen and spore trap and counted daily. Amb a 1 sampling was carried out between July-October during 2015 by using BGI900 Cascade High Volume Air Sampler (900L/min.). Both sampler were placed next to each other on a roof of a building at Ankara University and in the same way both sampler also were placed at Bülent Ecevit University in Zonguldak. The ambient air was sampled on two different polyurethane filter (PUF). Two different filter parts (PM>10 and 10> PM>2.5) were analyzed separately. PUF's were extracted in ammonium carbonate buffer, aliquoted, lyophilized and stored at -20 ? until use. Concentrations of Amb a 1 were measured by ELISA technique. The Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling system was performed to calculate backward trajectories to analyse the path of air masses on peak days of both pollen and Amb a 1. The sum of seasonal *Ambrosia* pollen indexes were 717.9 for Zonguldak and 42.3 for Ankara. But similar allergen concentrations were obtained for the two cities. Total allergen levels were measured for the two cities as follows; $5{,}61 \times 10^{-3}$ U/m^3 and $5{,}59 \times 10^{-3}$ U/m^3 Ankara and Zonguldak respectively. Majority of the allergen was found in the PM10 fraction in both cities (67% for Ankara, 72% for Zonguldak). The highest allergen concentration was measured on 24/08/2015 in Zonguldak ($5{,}90 \times 10^{-3}$ U/m^3) and on 28/08/2015 in Ankara ($1{,}67 \times 10^{-3}$ U/m^3). The backward air mass trajectory analysis was performed on peak days (28th August-1st September) of pollen in both cities. It showed that the main sources of *Ambrosia* pollen was seemed to be Crimea region. However, considering pollen and allergen levels were obtained in both cities, there is prominent differences allergen levels per pollen. The main wind direction in Zonguldak city from South to Black sea may be has drifting effect on allergens which is much smaller than pollen. In addition, antibodies that have been used in this study may react with other pollen proteins such as Art v 1 from *Artemisia vulgaris* which show high sequences homology with Amb a 1. So it is not possible to say clearly that allergen levels recorded in Ankara atmosphere may originate from *Ambrosia* pollen. (Project No: TUBITAK, 113Z762)

Keywords: Amb a 1, *Ambrosia*, pollen, Ankara, Zonguldak, Turkey.

PR35

Temporal changes of ragweed (*A. artemisiifolia, A. trifida, A. Psilostachya*) pollen concentration in Latvia

O. Ritenberga[1], L. Kalnina[1]

Faculty of Geography and Earth Science, University of Latvia, Riga, Latvia

Pollen-related sensitization already reached a substantial fraction of European population. Ragweed is known as a main aeroallergen especially in central Europe, but not in northern latitudes because of: (i) relatively low concentration of ragweed pollen; (ii) rare occurrence of ragweed plant. According to list of vascular plant taxa of Latvia, there are three adventitious species of ragweed (*Ambrosia artemisiifolia, Ambrosia trifida and Ambrosia psilostachya*), classified as *rare* and *very rare* in Latvia. Mentioned plants are included in the quarantine-plant list of Latvia. Despite the fact of *rare occurrence*, Ambrosia first has been detected in Latvia in 1900 (*A.trifida*) and flowering ragweed plants have been found throughout the country since 1970s, except N, NE part of Latvia. Most frequent places of ragweed plant occurrence are at the southern border of Latvia with more continental climate comparing to Riga.

Aerobiological monitoring by Burkard trap has been operating since 2003 in Riga (N56°57'02", E24°06'57") and in the year 2008 in Rēzekne (southern part of the country). Herbarium data were taken from the Institute of Biology at the University of Latvia. Pollen samples were analysed using 12 vertical traverses, thus giving bi-hourly count. Pollen counts were recalculated to bi-hourly and diurnal concentration.

Aerobiological monitoring has been started in 2003, first ragweed pollen started to appear in the year 2008. Several parameter of ragweed pollen season have positive tendency during the years 2008-2015. Thus, (i) length of period when ragweed pollen observed – in Riga it rises from 19 days to 34 days; (ii) seasonal pollen index increases from 5 to 30 pollen/m^3; (iii) number of days with ragweed pollen increases from 4 to 24 days; (iv) max daily pollen concentration - has positive trend during last eight years - values changed from 2.7 to 5.4 pollen/m^3. Daily concentration of ragweed pollen still is below 10 pollen/m^3, at the same time occurrence of ragweed pollen become more and more permanent during end of July to end of August. In the years 2009, 2012, flowering *A. artemisiifolia* plants were found in Riga (central part) and Daugavpils (southern part of country).

Regular occurrence of Ambrosia pollen in samples, presence of flowering plants on the territory of Latvia leads to conclude, that ragweed pollen in air is mostly has local origin. It still not known either ragweed is able to produce seeds in these latitudes or seeds: (i) were brought and planted together with wheat seeds; (ii) were brought via railway, which is one of main transport ways from Russia-Belorussia-Ukraine to Baltic Sea.

Keywords: ragweed, Latvia, Pollen.

PR36

Pollen of common ragweed (*Ambrosia artemisiifolia* L.): Illumina-based de novo sequencing and differential transcript expression upon elevated NO_2/O_3

F. Zhao[1], J. Durner[1], J. B. Winkler[2], C. Traidl-Hoffmann[3], T.-M. Strom[4], D. Ernst[1], U. Frank[1]

[1]*Institute of Biochemical Plant Pathology, Helmholtz Zentrum München, Neuherberg, Germany*; [2]*Research Unit Environmental Simulation, Helmholtz Zentrum München, Neuherberg, Germany*; [3]*UNIKA-T, Technische Universität München, Augsburg, Germany*; [4]*Institute of Human Genetics, Helmholtz Zentrum München, Neuherberg, Germany*

Background: Common ragweed (*Ambrosia artemisiifolia* L.) is a highly allergenic annual ruderal plant and native to Northern America, but now also spreading across Europe. Air pollutions and climate change will not only affect plant growth, pollen production and duration of the whole pollen season, but also the amount of allergenic encoding transcripts and proteins of the pollen. The objective of this study was to get a better understanding of transcriptional changes in ragweed pollen upon NO_2 and O_3 fumigation. This will also contribute to a systems biology approach to understand the reaction of the allergenic pollen to air pollutions and climate change.
Materials and Methods: Ragweed plants were grown in climate chambers under controlled conditions and fumigated with 40 ppb NO_2 (control) and 80 ppb NO_2 (treatment). The experiment was repeated using clean air (control) and 80 ppb NO_2 (treatment). In the other setup plants were fumigated with 40 ppb O_3 (control) and 80 ppb O_3 or 120 ppb O_3 (treatment).
Results: Illumina sequencing and de novo assembly revealed differentially expressed transcripts, belonging to different gene ontology (GO) terms that were grouped into biological process and molecular function. Transcript levels of the known ragweed encoding allergens were clearly up-regulated under elevated NO_2, whereas the amount of allergen encoding transcripts was more variable under elevated O_3 conditions.
Conclusions: The transcriptional changes in ragweed pollen upon elevated NO_2 fumigation indicates that air pollutions will alter the transcriptome of the pollen. The changed levels of allergenic encoding transcripts may have an influence on the total allergenic potential of ragweed pollen.

Keywords: Ambrosia artemisiifolia, Allergen, NO_2, O_3, Pollen, Ragweed, Transcriptome.

PR37

Effects of NO_2 on the pollen/seed production and flavonoid amount of common ragweed (*Ambrosia artemisiifolia* L.)

F. Zhao[1], W. Heller[2], S. Stich[2], J. Durner[2], J. B. Winkler[2], C. Traidl-Hoffmann[3], A. Holzinger[4], W. Kofler[4], D. Ernst[2], U. Frank[2]

[1]*Institute of Biochemical Plant Pathology, Helmholtz Zentrum München, Neuherberg, Germany*; [2]*Helmholtz Zentrum München, Neuherberg, Germany*; [3]*UNIKA-T, Augsburg, Germany*; [4]*Universität Innsbruck, Innsbruck, Austria*

Background: Common ragweed (*Ambrosia artemisiifolia* L.) is an annual ruderal plant that is native to Northern America but is nowadays spreading across Europe. Its pollen is known to be highly allergenic. Air pollution, e.g. NOx and climate change is affecting plant growth, pollen production and duration of the pollen season. Flavonoids, important secondary metabolites are known to play an important role in recognition processes during pollination and quercetin has been demonstrated to be an important germination-inducing compound. Additionally binding of these compounds to allergens may be involved in the immune responses and a direct interaction of allergens with flavonoids has been shown.
Materials and Methods: In this study, ragweed plants were grown during the entire vegetation period under 40 ppb NO_2 (control) and 80 ppb NO_2 (treatment).
Results: The pollen amount per inflorescence increased from about 80 mg to 145 mg, while the seed production per plant decreased from about 1500 mg to 950 mg in both generations upon elevated NO_2 concentrations. Elevated NO_2 had no effect on the amount of total water-soluble and methanol-extractable phenolic metabolites. Diode array spectra indicated quercetin and kaempferol derivatives, as well as hydroxycinnamic amides. Upon elevated NO_2 the level of five metabolites was significantly changed.
Conclusion: Our data on *A. artemisiifolia* fumigated with elevated NO_2 support the hypothesis that the overall allergenicity might be increased by an increased pollen amount and differences in metabolite changes. As the overall seed production decreased under elevated NO_2 the dispersal of *A. artemisiifolia* should not be enhanced by this air pollutant.

Keywords: *Ambrosia artemisiifolia*, pollen, seed, pollutant.

PR38

First volumetric data on ragweed pollen in Ryazan' (Central Russia)

I. Posevina

Ecology and natural management, Ryazan' State University, Ryazan', Russia

Pollen of Ambrosia is one of the main cause of pollinosis in late summer. The first floristic findings of *Ambrosia artemisifolia* in Ryazan' region were made in 1982, now few populations of two ragweed species, *A. artemisifolia* and *A.trifida,* are known from the North and South areas. In the air of Ryazan' (N 54°37', E 39°37') *Ambrosia* pollen has been detected since 2007 with gravimetric trap, 2015 was the first year of observation with Lanzoni volumetric trap. The aim of the study was to get the first numerical data on pollination of *Ambrosia* in Ryazan' city. According to the gravimetric data total annual catch varied from 9 pg/ cm^2 (pg= pollen grains) (2013) to 49 pg/ cm^2 (2008), peak values were usually registered during the second part of August. Maximum daily count was registered in 2008 (16 pg/ cm^2).
The first pollen of ragweed in 2015 was detected on July 25. Till mid-September *Ambrosia* pollen was permanent component of the air spectrum, but daily count did not exceed 3-5 pg/m^3. Seasonal maximum was observed on September 17-18, when daily counts were 16 and 20 pg/m^3. Analysis of the diurnal variation showed that daily maximum took place during night (00-02) or early morning (06-08). It is well-known that pollination of *Ambrosia* has very clear diurnal rhythms with maximum between 9 am and noon. Peak concentrations during night and early morning indicate non local origin of pollen. The high concentration of *Ambrosia* pollen on September 17-18 was correlated with the South and South-East wind. The change of wind direction have immediately leaded to the decrease in pollen count. Back trajectories calculated for this episode (http://www.art.noaa.gov/ready/hysplit4.html) showed that possible source areas for *Ambrosia* pollen in Ryazan' were Eastern Ukraine and Southern Russia. We consider that pollination of *Ambrosia* in Ryazan' is a combination of transport episodes (sharp peaks) and local flowering with low pollen concentration.

Keywords: Ambrosia, volumetric trap, central Russia.

PR39

Regional pollen counts reflect local loads of *Ambrosia spp.* but not of *Xanthium ssp.*

F. Zemmer

Fatih University, Istanbul, Turkey

In Istanbul *Ambrosia* is the major pollen contributor in late summer. While *Xanthium* is a frequent weed, airborne pollen concentrations are less relevant. In autumn 2014 the author observed a population of estimated 100 ragweed plants on the main transit road in the western suburbs and *Ambrosia artemisiifiolia* seems now to be established in Turkish Thrace (1). Within the study area populated by 1,2 million people, this study aimed to determine local pollen loads of *Ambrosia* and *Xanthium* potentially leading to allergic morbidity and to compare them with regional representative data.

Method: Durham samplers were positioned for five weeks from mid-August to mid-September in ten sites at ca. 2.5 m height and ca. 10 m distance from buildings and with no direct vegetation source within 100 m, where possible. Slides were collected on 22.08, 29.08, 05.09, 12.09 and 17.09.2015 and grains counted on 1 cm^2. Volumetric sampling was performed in Buyukcekmece over the same time span at rooftop representing the regional spectrum.

Analysis: Two Factors ANOVA without replication for the total grains/cm^2 sampled at each location over five weeks was used to understand the difference in concentrations of *Ambrosia* ssp. and *Xanthium* spp. between neighbourhoods. Weekly pollen sums obtained from volumetric counts (grains/m^3 day) were correlated with grains/cm^2 collected with Durham samplers.

Results: There was no significant difference in total pollens between locations. However, the difference between pollen types was highly significant. This is due to the five-fold amount of *Ambrosia* pollen (1106 grains /cm^2) trapped in comparison to *Xanthium* (198 grains /cm^2). Volumetric pollen sums were 514, and 40 respectively over the same period.

Most *Ambrosia* pollen were trapped in location 4 (168 grains /cm^2), followed in ascending order by 10, 9, 3, 8,7, 6, 2, 5 and 1. Similar amounts of *Ambrosia* pollens in locations 10 and 9 to location 4 (where there is a known population of *Ambrosia*) imply individual stands in the vicinity. To which extend the known population influences other locations will be further explored.

While *Ambrosia* correlated fairly well (0,83), there was no correlation for *Xanthium*. The latter is explained by the mainly self-pollinating nature of *Xanthium* and the minor buoyancy of grains due to their size. In short, *Xanthium* pollen may be of greater relevance at local level, than one would infer from counts obtained with a volumetric trap. In fact, preliminary results from a clinical study (2) indicate sensitization to *Xanthium* despite low counts observed in volumetric samples.

Keywords: Ambrosia type pollen, local and regional loads, correlation.

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PR40

Can pollen concentrations measured at roof level represent local exposure to *Ambrosia* pollen in an urban area?

M. Atlagić[1], P. Radišić[2], B. Šikoparija[2]

[1]*Laboratory for palynology, Novi Sad, Serbia*; [2]*BioSense Institute, Novi Sad, Serbia*

Minimum requirements for aerobiological monitoring recommend sampling to be located above the local pollen sources, usually on the roof of a building. However, a number of studies confirmed that local pollen sources could have a notable influence on airborne pollen concentrations, bringing the question to what extent values recorded by roof level pollen trap are suitable for estimating the exposure in dose response analysis. The aim of this study was to assess local pollen exposure by examining the relationship between outdoor and indoor pollen concentrations. The study also examines whether roof level concentrations are representative of airborne *Ambrosia* pollen concentrations recorded at street level.
The study was conducted in the city of Novi Sad during 2006. Airborne pollen was sampled simultaneously for 24h by using three Hirst type pollen traps situated: (1) on the roof of the Faculty of Sciences building at 25m above the ground; (2) outdoors at the street level ventilation window of local nursery institution; (3) indoors in the activity room of the same nursery institution. In order to represent conditions throughout ragweed pollen season, sampling was repeated during days with low (<30Pollen Grains/m3) and high daily pollen concentrations (>200 Pollen Grains/m3). By taking samples from different 12 nursery institutions at various distances both from the roof trap and from the local *Ambrosia* populations were represented. Spearman's correlation analysis was used to find out whether hourly pollen concentrations were significantly related, while Wilcoxon Signed Rank Test was used test whether there were significant differences in their magnitude.
There was a statistically significant correlation ($p < 0.01$) between overall hourly airborne *Ambrosia* pollen concentrations recorded indoors, outdoors at the street level and by the roof level pollen trap. Notably lower total sum of hourly concentrations of airborne *Ambrosia* pollen was recorded indoors (3111 Pollen Grains/m^3) compared to the street level (85873 Pollen Grains/m3) and roof level (89031 Pollen Grains/m^3) traps. This relationship was maintained throughout ragweed pollen season regardless distance from the local ragweed sources and from the roof trap. The results of Wilcoxon Signed Rank Test show there is no significant difference ($p = 0.781$) between amounts of pollen recorded in the roof trap and outdoor street level traps.
In the Pannonian Plain, where regional sources are expected to dominate over local sources, airborne *Ambrosia* pollen concentrations recorded at roof level represent street level concentrations. *Ambrosia* pollen concentrations in indoor air are significantly lower compared to outdoor values indicating exposure indoors could be considered negligible.

Keywords: airborne pollen, *Ambrosia*, local exposure, indoor air, roof level measurements.

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PR41

The interactive platform « Signalement-Ambroisie » a participative tool for the fight against ragweed

S. Monnier[1], M. Thibaudon[1], A. Gelas[2], S. Waitz[3], N. Vigier[3]

[1]*RNSA, Brussieu, France*; [2]*ARS Auvergne-Rhône-Alpes, Lyon, France*; [3]*Air Rhône-Alpes, Bron, France*

Ragweed is an annual plant that came from North America and colonizes many territories and particularly the Rhône-Alpes region.
It's an invasive species very present in France and in many countries in Europe like Hungary for example. An invasive species is an alien living species that becomes a disturbance agent "harmful" to the indigenous biodiversity of natural or semi-natural ecosystems from which it was established.
Its pollen is highly allergenic and just a few grains are enough to trigger allergic symptoms in susceptible individuals. This invasive and dangerous plant for health releases his pollen from August to September. Over 280.000 Rhône-Alpes peoples are potentially allergic to ragweed (according to a study by ARS published in 2014) and more than 3.6 million Rhône-Alpes peoples were exposed to ragweed pollen for more than 20 days at a sufficient concentration level to trigger symptoms in all sensitive people. The health symptoms experienced by sensitive people is mainly manifested as rhinitis, conjunctivitis, tracheitis, and in some cases can trigger acute asthma attacks. The treatment of these pathologies cost 15 million euros (annual public expenses related to ragweed allergy in Rhône-Alpes), and health costs is increasing.
To fight more efficiency against ragweed and reduce health costs, the Rhône-Alpes region has set up reporting platform ambrosia in order to mobilize the public and involved everyone in the fight against this invasive species To fight more efficiency against ragweed and reduce health costs, ARS Auvergne-Rhône-Alpes, the Rhône-Alpes Region, Air Rhône-Alpes and RNSA launched in 2014 an interactive platform "Signalement-Ambroisie" in order to mobilize the public and involved everyone in the fight against this invasive species. "Signalement-Ambroisie" is a simple three-step process that allows everyone to be an actor in the fight against ragweed. The interactive platform "Signalement-Ambroisie" allows reporting ragweed with different channels: web, smartphone, mail, and phone. This platform has allowed, the last two years, several thousand reports leading to the uprooting of almost 150 000 ragweed feet.
"Signalement-Ambroisie" is for field actors a dynamic management tool of the presence of ragweed in their territory (tracking, monitoring ...). For the general public "Signalement-Ambroisie" allows everyone to be actor in the fight against ragweed and represent a positive communication support. Finally, for the "supervisors" of the fight against ragweed, "Signalement-Ambroisie" allows the collection of a large-scale ragweed data in order to have the map of the presence of the plant.
The animation, the monitoring and the support of field actors for the use of "Signalement-Ambroisie" are made by the RNSA, ARS Auvergne-Rhône-Alpes and Air Rhône-Alpes.

PB42

Allergic sensitivity and genetic associations: study case of Lithuania

I. Sauliene[1], D. Kainov[1], L. Sukiene[1], J. Greiciuviene[1], A. Zinkeviciene[2]

[1]*Siauliai University, Siauliai, Lithuania*; [2]*State Research Institute Centre for Innovative Medicine, Vilnius, Lithuania*

The prevalence of allergic rhinitis (AR) in children with non-allergic parents is 13% and in children with at least one allergic parent is 44%. This observation supports inherited component of AR. To find possible association of AR with genetic factors researchers performed genome-wide association studies. However, only few associations were reproduced in replication studies. Low reproducibility could be associated with different demographics, broad-range of diagnostic tests and allergens used for allergic sensitization (AS)/AR assessments. We performed replication study in Lithuanians.
In our study we used skin prick test (SPT) for AS assessment and carefully selected set of allergens prevalent in Lithuania. In particular, among analysed individuals we found that 63% were SPT positive. Interestingly, only 5,6% individuals were sensitive to four pollen allergens, 4,2% individuals were sensitive to two moulds, and 14,4% individuals were sensitive to both cat and dog dander. Only 0,2% individual was sensitive to all 4 types of allergens. Among SPT-positive individuals we found 31,7% Betulaceae -, 40,3% Poaceae -, 46,1% Artemisia-, 16,2% Helianthus -, 5,1% Alternaria-, 5,1% Cladosporium, 22,0% cat dander-, 22,5% dog dander-, 32,4% mite- sensitive cases.
To find genetic associations with AS we genotyped our volunteers using Illumina CoreExom chip. We looked at 23 known SNPs associated with AR in allergen-specific sub-cohorts. We identified 13 SNPs ($p \leq 0.05$) in our sub-cohorts. In particular, we found 3 SNPs shared between different sub-cohorts and 10 SNPs specific to certain AS sub-cohort. Importantly, for the first time, SNP rs7775228 was associated with dog allergen-specific AS. Thus, careful assessment of AS allowed us to detect 13 known genetic variants associated with AS in relatively small sub-cohort of Lithuanians.
We thank all the volunteers who participated in this study. This study was performed on AEROINFRA infrastructure and funded by a grant No. VP1-3.1-ŠMM-07-K-03-069 from the Research Council of Lithuania.

Keywords: pollen, allergic rhinitis, skin prick test.

PB43

Prevalence of allergy to ragweed and other aero-contaminants in patients visiting outpatients clinics in 3 French geographic areas

C. Fabre[1], T. Rakotozandry[2], D. Basset-Steme[3], M. Grosclaude[3], J. Vitte[4], D. Charpin[5]

[1]*Nîmes University Hospitals, Nîmes, France*; [2]*Pneumonology & Allergy, Marseille University Hospitals, Marseille, France*; [3]*Private practice, Valence, France*; [4]*Marseille University Hospitals, Marseille, France*; [5]*Pulmonology & Allergy, Marseille University Hospitals, Marseille, France*

Background: Ragweed is a spreading weed which has a high allergic potential. There is a lack of epidemiological data in France regarding its role in allergic rhinitis.
Objective: To assess the hierarchy of allergic sensitization in contiguous geographic areas with the objective of monitoring in the future the spread of this allergy.
Methods: Selection of patients was performed during an outpatient visit in one of 3 specialized clinics in Valence, one of the most contaminated area, Bagnols which is less contaminated and Marseille, which is much less involved. All patients 18 to 65 years old visiting these clinics during one calendar year have been selected. Those patients got a skin prick test evaluation to a set of common inhaled allergens and measurement of specific IgE against ragweed, *Dermatophagoides pteronyssinus*, cat dander cypress and grass pollen allergens. Pollen counts were performed in the 3 locations and compared.
Results: 212 patients were enrolled in Marseille, 100 in Bagnols and 38 in Valence. The sex-ratio (M/F) was equal to 0.63 and the mean (+/-SD) age to 40 (+/-13). In Valence, according to skin test and IgE measurements, ragweed sensitization ranked n°1, followed by grass and cypress pollens. In Bagnols, cypress pollen sensitization ranked n°1, followed by ragweed. In Marseille, cypress allergens ranked n°1 according to skin tests and n°2 according to IgE, whereas *Dermatophagoides* ranked n°1 according to IgE. In Marseille as well as in Bagnols the proportion of patients with positive IgE to ragweed was much higher than the number of patients with positive skin tests.
Conclusion: There is a strong correlation between exposure and sensitization. Subsequent analysis will be performed on prevalence of symptoms of allergic rhinitis. Those data will, in the future, constitute a basis to monitor future trends.

Keywords: Allergy, Pollen, Sensitization.

PB44

Ecosystem change and modification allergic risk about two examples (pollen and insects)

J.-L. Brunet[1], C.Mardini[1], M.Bouvier[1], C.Sindt[2]

[1]*Clinique Charcot, Sainte-Foy-lès-Lyon, France ;* [2]*Réseau National de Surveillance Aérobiologique, Brussieu, France*

Global warming and the multiple human migration are causing an evolution of ecosystems with today's unprecedented global expansion of many insects, including a modification of the certain species range. Balance floras depends on abiotic conditions that are the state of the air, soil and water, as themselves are dependent of climatic conditions. In one century foliation and pollination start dates have shifted forward by one ten days. The results of the work of scientific teams working on the ground are particularly useful for analyzing the evolution of allergy risks linked to ecosystem transformation.

PB45

Proposing the evaluation of the Pollen Hay Fever Diary (PHD) by users

F. Zemmer

Fatih University, Istanbul, Turkey

The Pollen Hay Fever Diary (PHD) was launched to aid diagnosis of allergy, follow up on treatment and to obtain regional threshold levels for symptom development (www.eas-aerobiology.eu). It yielded important outputs (1) (2) (3) and the PHD App has made it ever easier for users to record their symptoms (4). While users provide data, their engagement with the website, the evaluation of the PHD itself by the user would be a valuable aspect to investigate.

As a country administrator of Turkey using the PHD to generate threshold levels for Istanbul in the frame of a two-year campaign, I see low user enrolment and inconsistency in data supply. While user enrolment can be facilitated through communication, getting users to record data on a regular basis requires understanding the perceptions of the users.

The aim here is to suggest an embedded evaluation system in pollendiary.com that assesses the impact of the pollen hay fever dairy on the users over a defined time span. The EAN as provider may be interested to know:

How big was the impact of the PHD on the user?

Did its use change the understanding of their allergy/change the attitude of users?

Did the PHD affect actions of users?

The questionnaire could be constructed starting with pre-coded questions for gender, age, the most useful sections of the PHD, etc., then continue with a Likert 6 scale to assess attitudes (strongly agree-strongly disagree, don't know) for questions like "The PHD has increased my knowledge on pollens I am allergic at"; "It helps me control my condition better"; "Recording symptoms is time consuming." etc. Data could be analysed in Excel and/or other statistical programmes depending on the sophistication level of the questionnaire. Input from business analysts is deemed useful in the construction of the evaluation concept.

Upon interest and with input from EAN providers, a core group could be established that issues the final evaluation method and pilots the questionnaire in (a) selected country(ies) and then implement it in all interested countries that are operating pollendiary.com.

Keywords: Pollen Hayfever Diary (PHD), evaluation proposal, EAN.

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PB46

Ragweed risk assessment of Rhône-Alpes inhabitants

C. Fontagné[1], C. Rieux[1], F. Troude[1], C.-E. Petitjean[1], M. Thibaudon[2], G. Oliver[2]

[1]*Air Rhône-Alpes, Bron, France*; [2]*RNSA, Brussieu, France*

Within the framework of the 2nd air quality monitoring plan (“PSQA 2011-2015”), Air Rhône-Alpes has calculated the Rhône-Alpes inhabitants’ ragweed level exposure for 4 years.
Based on the ragweed forecast platform, the pollen season was simulated over the Rhône-Alpes region with a 3 by 3 km horizontal resolution. Reanalysis meteorological fields were calculated with the well-known WRF model developed by the National Center for Atmospheric Research (NCAR, USA). Then the hourly meteorological fields were used to compute ragweed dispersion fields using the chemistry transport model (CTM) CHIMERE developed by Institut Pierre Simon Laplace & INERIS, CNRS, France. The CTM code was modified as described in Chaxel et al. (2012) to implement the ragweed dispersion. Then the French aerobiology network (RNSA) measurements were used to adjust the first modelled results: an ordinary kriging method was applied. Daily allergic risk maps were derived from these results.
The BatiPopulation database developed by LCSQA (Laboratoire Central de la Surveillance de la Qualité de l'Air) provided information about location and density of the inhabitants over the region at the building scale. These data combined with allergic risk level maps assessed the risk level for the inhabitants.
The annual effective dose per inhabitant modelled showed a relative stability in 4 years. From 2012 to 2015, 2.8 to 3.6 millions of Rhône-Alpes inhabitants were exposed more than 20 days to a high level of risk leading to allergic symptom.

Eric Chaxel, Camille Rieux, Isabelle Rios, Michel Thibaudon, Gilles Oliver 2012: Modelling ragweed pollen in Rhône Alpes (France) IRC Conference, Lyon, March 28th 2012.

Keywords: ragweed, exposure, Rhône-Alpes.

PB47

Phenological and aerobiological behaviour of *Castanea sativa* Mill. in the Iberian Peninsula

M. D. Hidalgo-Galvez[1], H. García-Mozo[1], A. Mestre[2], R. Botey[2], C. Gálan[1]

[1]*Botany, Ecology and Plant Phisiology, University of Cordoba, Spain*; [2]*AEMET, Madrid, Spain*

Chestnut (*Castanea sativa* Mill.) is a deciduous, monoecious and partially anemophilous species, abundant in temperate forests and cultivated areas of Europe. The vegetative and reproductive phenology of this tree was analyzed in different 13 sites of the Iberian Peninsula during 1986-2012. In this area, the average budburst date occurs in April and the leaf unfolding between April and May. Flowering takes place between May and June, and fruit ripening continues until October. It is between November and December when the leaves change of colour and fall. Phenological trends indicated a delay in most of vegetative phenophases, except leaf unfolding. On the other hand, it is noticeable the observed advance of reproductive phenophases (flowering and fruiting) in most of the study localities related to the temperature increase trend, overall in spring and summer temperatures. Statistical results indicated that phenological changes in leaf unfolding and flowering showed a negative correlation with temperature.
A lack of phenological data in the Southern of Spain led us to start in 2015 a chestnut phenological survey in 8 different points of the North mountains of Córdoba province. Phenophases analysis was defined and carried out in detail for this species, always with the base of the general BBCH scale. Moreover, a chestnut airborne pollen analysis is being carried out in one of the natural areas. The combination of phenological and aerobiological analysis for this studied specie in Southern Europe is given interesting preliminary results. It was detected that phenology and airborne pollen data in this pilot site are closely related with temperature and rainfall. Moreover it seems that the origin of the first pollen grains registered was from remote populations to the study area. Finally, pollen season was longer in the natural area than in the city, where pollen grains detected only transported long or middle distance.

Keywords: Chesnut, Phenology, Pollen.

Aerobiological monitoring at high altitude

L.-G. Pace[1], L. Boccacci[1], M. Casilli[1], P. Di Carlo[2]

[1]*Department of Life, Health and Environmental Sciences, University of L'Aquila, L'Aquila, Italy*; [2]*Department of Physical and Chemical Sciences, University of L'Aquila, L'Aquila, Italy*

The monitoring of pollen at high altitude can be used to observe the phenological changes due to climate changes. The aerobiological approach, strictly linked to meteorology, can be considered very important in gathering information on data relevant to the protection of plant biodiversity (1). In the monitoring station of the Alpine Garden University of Campo Imperatore (2,117 m), Gran Sasso, we collected the first data on the dispersion of pollen and fungal spores at high altitude during the summer (July to September) of years from 2009 to 2013 with standard method of the Italian Aerobiology Association. Meteorological data were provided by stations of the Hydrographic Institute. The correlations between bioparticles concentrations and the movement of air masses justify the presence of the pollen transported in the high altitude site through a long-distance transport or from close sites through a vertical transport. Back trajectories were computed using the HYSPLIT model of the Air Resources Laboratory NOAA.

The principal botanical families monitored which present higher concentrations are: *Urticaceae* (34%), *Fagaceae* (30%), *Gramineae* (25%), *Pinaceae* (23%), *Cupressaceae/ Taxaceae* (16%), *Oleaceae* (14%), *Asteraceae* (13%), *Corylaceae* (7%) and *Myrtaceae* (1%). Fungal spore present in higher concentration are *Cladosporium* (92%), *Alternaria* (5%) and *Epicoccum* (1%).

Different weather patterns, particularly variable at high altitude, cause a significant difference in the concentration of pollen and fungal spores. It was noted the presence of pollen of plants that live at lower altitudes as the Chestnut and Olive or even Ragweed, an herbaceous plant living in coastal areas. This phenomenon is due to the vertical transport carried out by air masses crossing lower altitudes, and to the phenomenon of transportation from remote sites. Recent studies carried out on plant communities showed an invasion of plants from warmer environments and the regression of plant species adapted to the cold with the consequent loss of biodiversity. The continued aerobiological monitoring can be an important tool for environmental data collection related to global change (2). The phenomena as rising temperatures, decreasing and erratic rainfall, melting glaciers, global warming, pose a real threat to the entire biodiversity.

In conclusion, the long-term continued use of aerobiological monitoring can be an important tool for environmental data collection that will allow to analyze the phenological changes due to changing climate conditions at high altitude.

Keywords: High altitude bio-particles, Back-trajectories, Global change.

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PB49

Herbarium Records to Investigate the Changing Phenology of Grasses

A. Mahdi, J. Hawkins

Biology, University of Reading, Reading, Berkshire, United Kingdom

Herbaria are becoming important resources for studying phenological change because they record the phenological state of specimens of many species collected from many locations and over long periods. Modelling of pollen load associations with climate parameters is generally at the level of all grasses, and although herbaria have the potential to provide species-level information, grasses have hardly been considered in herbarium-based phenological studies. We explore the associations between flowering stage and climate parameters of common UK grass species using herbarium data as a source. We selected 11 species of grasses that were both common and well represented the University of Reading Herbarium (RNG). From >2900 specimens collected between 1900 and 2000 in different areas of the British Isles we recorded the flowering stage following a modified BBCH scale. Gridded temperature and rainfall data from the meteorological station closest to the sampling location for each specimen were sourced, and sets of three month averages calculated. Linear regression models were used to determine the associations of the climate parameters on flowering. Eight of the 11 species we studied are flowering later in the year. Based on the regression analyses, three of these species, *Anthoxanthum odoratum* L, *Dactylis glomerat*a L, and *Holcus mollis* L. that were delayed the longest were also significantly delayed ($R^2 > 0.1$, P-value <0.01). Early flowering stages were better than full flowering stages in the strength of association with climate parameters. Error is associated with including all specimens flowering on the day of collection, when that day might be early or late in a protracted flowering period; focusing only on early flowering stages reduces this error. We found that one species, *Deschampsia cespitosa* L., was the only species showing significantly earlier flowering date as average monthly spring temperature increased, though this species' flowering was delayed as rainfall increased. Herbarium data may present a source of data on climate associations and flowering. They are a rich resource of flowering date data, even for grasses which compared to petaloid flowers must be more closely examined to record flowering stage. Analysis of herbarium data may provide one route to determine the individual phenological responses of different grasses to changing climate.

Keywords: Grass, Herbaria, phenological change.

Phenology and aerobiology of *Vitis vinifera* in Montilla-Moriles, South Spain

M. Martínez-Bracero, M. J. Velasco-Jiménez, P. Alcázar, C. Galán

Botany, Ecology and Plant Physiology, Córdoba University, Córdoba, Spain

Introduction: Grapevines are one of the main worldwide perennial crops growing from template to tropical regions, from 50ºN to 43ºS, with the larger surface of vineyards in Europe. The Spanish area under vineyards supposes 14% of the total in the world, but it represents the third as far as production is concerned. Climate is one of the factors most affecting wine productions; temperature and water availability directly affect the grapevine phenology. Knowledge on phenology in plants with economic interest have great importance to allow the rationalization and optimization of the cultural practices. The main goal of this study has been focused on the phenological behavior of grapevine in Montilla-Moriles (Córdoba, southern Spain). The specific goals are: to study the phenological behavior of different varieties in this studied area; to compare airborne pollen and fungal spores in different areas with different cultivars and in samplers based on different principles.

Material and Methods: This study has been carried out in seven different vineyards belonging to the Montilla-Moriles Protected Designation of Origin (PDO); located in Montilla and Moriles in the south of the province of Córdoba, southern Spain. The airborne pollen and fungal spores monitoring was conducted using a Hirst-type volumetric pollen and spore trap and 7 local impact samplers distributed in the different cultivars. The phenological study was carried out throughout the active *Vitis* season during 2015. Phenological weekly observations, or twice a week observations during the flowering stages, have been done. Four varieties of *Vitis* have been studied: Pedro Ximenez, Verdejo, Muscat small grains and Chardonnay. The phenological scale of Lorenz et al. (1994), following the BBCH standardized scale for phenological grapevine observations, was selected as standard tool. The five principal stages were monitored: 1 leaf development, 5 inflorescence emergence, 6 flowering, 7 development of fruits and 8 rippering of berries.

Results: Results have shown significant correlations between concentrations recorded with the Hirst-type volumetric spore trap and the 7 local impact samplers for both, pollen and fungal spores. The main factor affecting pollen concentration during this year, characterized by warmer temperatures (18.02ºC) and low precipitation (304 mm), was temperature. Phenological differences were highest between varieties in the same zone than for the same variety comparing different vineyards. The phonological study showed that the most advanced variety was Chardonnay, followed by Verdejo, later Muscat small grains, and the last one was Pedro Ximénez.

Keywords: Phenology, Aerobiology, *Vitis vinifera*.

PB51

Phenotypic plasticity in the flowering of 11 woody plant taxa: reflections in airborne pollen season

A. Damialis[1], A. Charalampopoulos[2], E. Diamanti[2], V. Almpanidou[2], A.-M. Maraidoni[2], A. Simeonidou[2], E. Staikidou[2], I. Tsiripidis[3], T. Mavromatis[4], D. Vokou[2]

[1]*1. Department of Ecology, School of Biology, Aristotle University, Thessaloniki, Greece, 2. Institute of Environmental Medicine, UNIKA-T, Technical University and Helmholtz Centre of Munich, Augsburg, Germany*; [2]*Department of Ecology, School of Biology, Aristotle University, Thessaloniki, Greece*; [3]*Department of Botany, School of Biology, Aristotle University, Thessaloniki, Greece*; [4]*Department of Meteorology-Climatology, School of Geology, Aristotle University, Thessaloniki, Greece*

Environmental change largely influences plant phenology. This is particularly true for flowering, including pollen release. What has not been concluded upon up to date is to what extent flowering phenology reflects in pollen season. The aims of this study were: A) to investigate the plasticity of flowering in a wide spectrum of woody plant species under different environmental regimes, B) to check for relationships between the flowering season of the selected species and the airborne pollen season of the respective taxa so as to detect commensurate changes.

In total, 14 taxa were studied: *Corylus avellana*, *Cupressus arizonica*, *C. sempervirens* var. *horizontalis*, *C. sempervirens* var. *pyramidalis*, *Juniperus communis*, *J. oxycedrus*, *Olea europaea*, *Pinus brutia*, *Platanus orientalis*, *Quercus frainetto*, *Q. ilex*, *Q. petraea*, *Q. pubescens*, and *Thuja orientalis*. Each was studied in at least two sampling stations differing in elevation, direction or both, and for one or two flowering seasons over the period 2004-2011. In total, 225 individuals were examined for all sites, years and species. The progress of flowering (flower sprout and pollen emission (start, peak and duration)) was investigated every two to three days, from flower differentiation to flower desiccation. Phenological data were regressed against rainfall, minimum, maximum and cumulative air temperature and relative humidity in an attempt to identify the driving factors of flowering onset and offset. Specifically for cumulative temperature, different start dates were examined and also different threshold values. Flowering dates were compared with the respective daily dates of airborne pollen season and of pollen abundance per taxon, collected by use of a Hirst-type volumetric sampler.

For 11 taxa, flowering started and/or peaked earlier at stations at lower elevation or southern direction. Differences were also observed between families, genera and also years. Cumulative temperature (above 0 °C) proved to be the driving factor of flowering onset and end for all species (p<0.001, R^2>0.70). Overall, higher temperature led to earlier onset of the flowering season. The other meteorological factors examined did not yield any statistical significance. Airborne pollen season did not always coincide with the respective flowering dates of the selected species. Sometimes flowering preceded pollen season, as in the case of *C. avellana*, for up to one month. In contrast, in several other cases the pollen season occurred earlier in the overall study area than the flowering season at micro-sites within this study area.

The phenotypic plasticity of flowering provides evidence of the responsive ability of woody plants particularly to temperature. Airborne pollen seasons of studied genera and families do not necessarily reflect the flowering of the most representative in local vegetation plant species. The role of pollen long-distance transport is highly underestimated.

Keywords: Aerobiology, Biometeorology, Flowering phenology.

PB52

Environmental factors promote an increase in airborne grass pollen concentration and sensitization in S Sweden

Å. Dahl[1], A. Bjerg[2], H. Nomoto[1]

[1]*Biological and Environmental Sciences, University of Gothenburg, Gothenburg, Sweden*; [2]*Pediatrics, Astrid Lindgren Children's Hospital, Stockholm, Sweden*

Grass pollen sensitization rate in Western Sweden has increased significantly since the beginning of the 1990's. At least partly, this trend is likely to be associated with environmental factors leading to changes in the size or nature of the pollen load. Those factors could be of meteorological nature. The present climate change entails an increasing trend in temperature and precipitation, which are known to be important for reproductive output in grass. Furthermore, habitats have been transformed by changes in land management and increasing nitrogen deposition during the last decades, resulting in altered abundance of different grass species. We wanted to find out which species contribute most to ambient grass pollen concentration, and if these species could have been favoured in a changed landscape.
In this study, we investigated the relationship between meteorological factors during a key developmental period and grass pollen index, to assess the role of the climatic changes, and found a clear positive trend. We assessed the pollen production of the 12 most common grass species in herbarium collections from the Gothenburg region, in order to identify the most significant contributors. An index combining anther length, numbers of flowers per spikelet and number of spikelets per inflorescence was constructed. During two summers, the flowering phenology of nine of these twelve species was observed to analyse the match with the course of the pollen season, as reflected in results from the volumetric spore trap. Peaks in airborne pollen coincided with flowering peaks of *Dactylis glomerata*, *Poa pratensis*, *Lolium perenne*, and *Festuca pratensis;* the observed positive trend in pollen indices may be related to factors causing an increased abundance and productivity especially of these species. Their ecology, as reflected by their nitrogen requirements and competitive ability, will be discussed in relation to different factors leading to eutrophication and habitat changes during the last 50 years in S Sweden, as well as to climate change, and the consequence for allergy sufferers.

Keywords: grass pollen allergy, grass pollen concentration, Poaceae, climate change, eutrophication, land management, South Sweden.

PB53

Potential sources of *Ambrosia* pollen in Northwest Turkey

S. Celenk, H. Malyer

Biology Department, Uludag University, Bursa, Türkiye

Ambrosia pollen is an important allergen in North America originally and, as last decade reported, in most European countries. It was reported that the affected area was the northeast in Turkey, and ragweed has not been yet recorded in other parts of the country. The study investigates *Ambrosia* pollen episodes during the peak period of 5 yearly periods between 2010-2015 by examining source regions in *Ambrosia* pollen and back-trajectories at Bursa, Turkey. The HYSPLIT back trajectory model was used to identify a potential source of atmospheric *Ambrosia* pollen. Peak levels of *Ambrosia* pollen were recorded at monitoring sites during the night in the year 2010, 2012 and 2013 and mid-day in 2011 and 2014. Back-trajectory analyses showed that the air masses arriving at the sampling station predominantly came from the North or Northeast, and were in Russia, Ukraine and Romania during the previous days. Results indicate that these countries are potential source areas for *Ambrosia* pollen infection for the Bursa. Note that atmospheric concentrations of *Ambrosia* pollen exceeded the clinical threshold during some years in investigated region. Taking into consideration the high allergenicity of *Ambrosia* pollen, the present findings suggest that the number of sensitized individuals might significantly increase in the near future.
This study was founded by a grant from TUBITAK (project numbers 109S032 and 114Z698) and supported by Scientific Research Unit of Uludag University (project number UAP(F)-2011/76).

Keywords: Ragweed pollen, Bursa, back trajectory.

Trends of herbaceous airborne pollen in Malaga, southern Spain, during a period of 24 years (1992-2015)

D. Gharbi, M.-M. Trigo, M. Recio

Department of Plant Biology, Faculty of Science, University of Malaga, Spain

Long term airborne pollen records represent a good tool to study the relationship between climatic trends and the biological behavior of plants, since airborne pollen is considered as a bio-indicator of the reaction of plants to climate change. The aim of this study is to search for the trends followed by the pollen concentrations of grasses (Poaceae) and Amaranthaceae and Urticaceae - two of the most important weeds from an allergological point of view - in the atmosphere of Malaga (South of Spain) during the period of 1992-2015, as well as their relationships with meteorological parameters. For that, the atmosphere of the city was sampled over these years by using a Hirst volumetric pollen trap (Hirst, 1952), which operated uninterruptedly during the whole period of study. This device was placed on the roof of the Faculty of Science at a height of 15 meters above ground level. The methodology followed was the one proposed by the Spanish Aerobiology Network, the REA (Galán *et al.,* 2007).
The trends showed by the studied taxa were determined by means of simple linear regression, whereas the relationships between meteorological and aerobiological data were established by Spearman's rank correlation coefficient.
The duration of the main pollen season (MPS) tends to decrease in the case of Urticaceae (-0.65 day/year) and Poaceae (-1.92 day/year) but, in the case of Amaranthaceae, it increased as average at a ratio of +0.33 day/year. Regarding Poaceae and Urticaceae, this behavior can be attributed to an earlier end of the pollen season, rather than to delay in the start date, while earlier start and end dates were observed in the case of Amaranthaceae.
Regarding the peak a trend to the delay in the date in which it occurred was observed for Amaranthaceae and Urticaceae, while, in the case of Poaceae, a trend to its advance has been reported. Moreover, an increase in the value of the annual pollen index was noted in the case of Poaceae and Urticaceae along the whole period of study, while a decrease can be shown in the case of Amaranthaceae.
In addition, it has been possible to observe very interesting results concerning climatic trends that could explain possible effects of climatic change on the pollination of the studied taxa studied. In fact, significant annual tendencies for some meteorological parameters have been observed. Over the analyzed period, a clear upward trend in mean temperature has been registered, as well as in maximum and minimum temperatures, with significant regression coefficient values. Not only there is a tendency to an increase of temperatures, but also to decreasing relative humidity values and increasing sunshine hours, which confirm that a dryness process is taking place in Mediterranean basin.
Spearman's correlation tests were carried out between pollen concentrations during MPS and meteorological parameters. Significant and negative correlation coefficients were obtained between Poaceae and Amaranthaceae pollen and average temperatures (minimum, maximum, medium) as well as, relative humidity. Vice-versa, these correlations were positive and significant between Urticaceae and average temperatures. In addition, positive and significant correlation coefficients were obtained with wind speed, for almost the all taxa studied.
As a conclusion, remarkable changes in grass and weed pollen season behaviors can be considered as indicators of the phenomena of climate change in the Mediterranean area.

Keywords: Climate change, herbaceous taxa, pollination trends.

PB55

How does global warming affect plant pollination in Ukraine: a short overview

A. Domashchenko[1], V. Rodinkova[2], O. Palamarchuk[2], L. Kremenska[2], I. Motruk[3]

[1]*Medical Department №1, Vinnitsa National Medical University, Vinnitsa, Ukraine*; [2]*Department of Pharmacy, Vinnitsa National Medical University, Vinnitsa, Ukraine*; [3]*Department of Hygiene and Ecology, Vinnitsa National Medical University, Vinnitsa, Ukraine*

Background: December 2015, January and February 2016 were noted as the most abnormally warm months on record history. NASA reports, that Ukraine is among the territories where the temperatures have increased most relatively to the 1951-1980 averages. Significant change of plant pollination patterns is seen there for the last years.
Method: Pollen data from 1999 to 2000 were obtained by gravimetric sampling at three monitoring stations in different districts of Vinnitsa city located in the Centre of Ukraine in a Forest-Steppe zone. Pollen collection from 2009 to 2014 used volumetric methods employing a Burkard trap placed on the roof of a Vinnitsa Medical University building. Samples were taken from March 1 until October 31. Meteorological data was obtained from the website TuTiempo.
Results: Season peak values can be recorded for *Alnus* currently one month earlier than it was in the years 1999-2000. It might be connected with the pre-seasonal accumulative temperature increase during January-March period. *Betula* seasonal maximum is observed around 20 days earlier than during the years 1999-2000. Early *Betula* peaking might be connected with the fast degree day sum accumulation within the March preceding the pollen season. Clear bi-annual pollination mode was observed for birch with intensive pollination in every even year while odd years were characterized by relatively weak pollination despite the weather condition. Earlier peaks similar to that in *Betula* was observed for *Corylus, Carpinus, Fraxinus* and *Ulmus* in a year 2014 and 2016 as well. Trees with flowering at the end of April – beginning of May including *Quercus, Juglans, Pinus* did not show significant pollination change yet. Grass pollination season is shifted for the approximately one month earlier than it was seen in the years 1999-2000 too. A changing pattern of ragweed pollen season is recorded in Vinnitsa during the last 4 years. Natural pollination based on photoperiodism were seen in Vinnitsa at the end of August and were clearly predictable in Vinnitsa until the year 2010 when the temperature increase changed the peak timing for two weeks early. The new pollination mode can be described as a “three-maximum” season. It includes pollen concentration increase at the beginning of August, at the end of August and in September. The shift of the last pollen maximum toward the mid or end of September is observed due to temperature increase. *Ambrosia* pollen concentrations can be decreased significantly by droughts.
Conclusion: Plants respond differently to global warming. The pollen season changes can affect sensitive individuals causing hay fever symptoms at a time which was unusual before. Further studies of pollen season changes are required in order to perform the adequate seasonal allergy control.

Keywords: global warming, pollen season, hay fever control.

Pollen season variations during the last 26 years. A case study in Trentino, North Italy

F. Cristofolini[1], E. Gottardini[1], J. Oteros[2]

[1]*Fondazione Edmund Mach (FEM), San Michele all'Adige, Italy*; [2]*ZAUM, Centre of Allergy and Environment, Technical University of Munich, Munich, Germany*

Airborne pollen records are strongly correlated with flowering intensity of the anemophilous species in the trap location site and surroundings. Studies during recent decades have revealed a trend towards rising airborne pollen counts in Europe and a clear advance in flowering dates. In the present study* a long data series (1989-2014) of daily airborne pollen concentration was considered. Data were collected at S. Michele all'Adige (46°12'N, 11°08'E), Trentino, North Italy, following standardized procedures (UNI 11108:2004). The sampler is located at the bottom of an alpine valley surrounded by high mountains that make it a perfect experimental lab to study the alpine environment. A total of 38 taxa representative of the local pollen spectrum were considered and ten aerobiological parameters were calculated, including, among others, pollen index, pollen season start date and duration. The aim of the study is to detect if there are significant trends in airborne pollen amounts and in pollen season start dates.
The results show a statistically significant increasing trend for 35 pollen taxa (Makesens statistic; $p<0.05$). Only Poaceae family shows a decreasing (but not significant) trend, probably due to land use changes in the study area with a consistent reduction of open green areas for new buildings construction. Sixteen (11 woody species) taxa anticipate the pollen season start date. The results of this local study are generally in agreement with other large-scale studies. Considering that a larger amount of pollen and a longer season of allergenic pollen might increase the risk for allergic people, aerobiological monitoring assumes a great importance as human health protection tool.

* The study was partially founded by Provincia Autonoma di Trento.

Keywords: Alpine pollen, Climate change, Phenology.

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Ice nucleation activity in airborne and soil fungi

J. Fröhlich[1], T. C.J. Hill[2], B.-G. Pummer[1], P. Yordanova[1], G.-D. Franc[3], U. Pöschl[1]

[1]*Multiphase Chemistry Department, Max Planck Institute for Chemistry, Mainz, Germany*; [2]*Department of Atmospheric Science, Colorado State University, Fort Collins, CO, USA*; [3]*Plant Sciences Department, University of Wyoming, Laramie, Wy, USA*

The role of biological ice nuclei (IN) in cloud formation and precipitation, and possible feedback cycles is a topic of increasing interest. Biological IN can be expected to be important for clouds and cloud regions warmer than -15°C, as they can trigger ice formation at these unusually high subzero temperatures. The best-known biological IN are common plant-associated bacteria of the genera *Pseudomonas, Pantoea,* and *Xanthomonas,* which have also been found in air, cloud water, and rain. All express isoforms of the same IN-active protein. The proteins are anchored in the outer membrane and can form large aggregates triggering ice nucleation at up to -1.5°C. Ice nucleation activity (INA) has also been found in some fungal species isolated from plants or insects, but systematic surveys of airborne and soil fungi for INA are rare and the sources, diversity, abundance, effects, and properties of atmospheric IN produced and released from fungi are not well characterized. By determining the INA of fungal colonies obtained from various air and soil samples, we found that diverse IN-active fungi from more than one phylum are not only present in air and soil, but can also be abundant components of the cultivable community. Four IN-active species were isolated from air samples collected either at a forest, grassland, or urban sampling site. The IN-active isolates were identified by DNA-sequencing as *Sarocladium* (formerly: *Acremonium*) *implicatum, Fusarium* sp., *Isaria farinosa,* and *Penicillium* sp., and induce freezing between -4° and -8°C. Furthermore, we found IN activity starting at -5°C in the widespread soil fungus *Mortierella alpina,* which we isolated from a range of different land use and ecosystem soil types. Except for *Fusarium*, the isolated species were not previously known as biological IN. However, we isolated an IN-active *Fusarium* from an air sample. Further characterization of the INA of all isolates by filtration, heat, enzymatic, and chemical treatments points to a proteinaceous compound being responsible for the activity. Particularly interesting is the observation of cell-free nanometer-sized IN-active macromolecules that can be easily washed off the mycelium. Associated with or adsorbed onto soil dust particles, these IN-active macromolecules may impact cloud glaciation, indicating a higher contribution and importance of biological IN – and in particular fungal IN – than previously assumed.

Keywords: Bioaerosol, Fungi, Ice nuclei.

PB58

Ornamental trees and their relationships with pollen concentrations in three cities in the SW of Iberian Peninsula

J.-M. Maya-Manzano[1], R. Tormo-Molina[1], S. Fernández-Rodríguez[2], Á. Gonzalo-Garijo[3], I. Silva-Palacios[4]

[1]*Department of Vegetal Biology, Ecology and Earth Sciences, University of Extremadura, Badajoz, Spain*; [2]*Department of Construction, University of Extremadura, Cáceres, Spain*; [3]*Department of Allergology, Infanta Cristina University Hospital, Badajoz, Spain*; [4]*Department of Applied Physics, University of Extremadura, Badajoz, Spain*

Introduction: Ornamental urban trees provide a high number of benefits; nevertheless, some damage or negative factors may be included, as being responsible for pollen allergies. To assess properly airborne pollen influence on inhabitants it is necessary to take into account pollen sources distribution. The aim of this work was to analyze the importance of ornamental trees distribution and try to relate it with airborne pollen records using volumetric pollen traps.

Material and Methods: Three localities in the SW of Iberian Peninsula were studied, Plasencia, Don Benito and Zafra, belonging to the Extremadura region (Spain). Volumetric Hirst pollen traps recorded pollen continuously for three years (from March 2011 to March 2014). Ornamental trees in streets, squares and parks were identified, counted and mapped, as well as those trees that appeared 100 m around the urban perimeter with allergenic significance, such as *Cupressus* sp. and *Olea europaea*, and due to its proximity and its influence in the pollen content inside the urban area. We studied the relationship between the airborne pollen records and the number of trees, closeness to traps, pollination system and wind direction.

Results: A total of 17635 trees belonging to 67 species were counted. Density of trees per 1000 inhabitant ranged 130-270. About 80% of ornamental tree species showed total or partial entomophilous pollination system. Five species represent more than 50% of total ornamental trees: *Platanus hispanica*, *Olea europaea*, *Ulmus minor*, *Acer negundo* and *Melia azedarach*. More than 4/5 of airborne pollen comes from trees. Average total pollen concentration ranged 93-102 in g m^{-3}. A close relationship between the abundance of ornamental trees, its distribution within the city and wind direction with airborne pollen concentrations were appreciated; in Don Benito for *Platanus* (15 g m^{-3}), *Cupressaceae* (5 g m^{-3}) and *Arecaceae* (0.5 g m^{-3}), in Plasencia for *Pinaceae* (2.4 g m^{-3}), *Fraxinus-Phillyrea* (1.6 g m^{-3}) and *Alnus* (0.6 g m^{-3}), and in Zafra for *Olea europaea* (24 g m^{-3}) and *Ulmus* (0.5 g m^{-3}).

Conclusions: The mapping of ornamental trees within urban areas is useful information for detecting possible local patterns of abundance in the concentrations of some pollen types. Therefore, *Alnus glutinosa*, *Fraxinus* sp. in Plasencia, *Arecaceae* sp. and *Platanus hispanica* in Don Benito or *Ulmus minor* in Zafra were planted as ornamental trees with a high frequency, and this fact seems to be related with their pollen concentrations.

Keywords: ornamental trees, urban green infrastructure, airborne pollen.

PB59

Relationship between airborne *Parietaria pollen and* Par j 1-2 concentrations in Santiago (North-Western Spain)

F.-J. Rodríguez Rajo[1], A. Vara[1], M. Fernández-González[1], P. Castiñeiras[2], Mª J. Aira[2]

[1]*Plant Biology and Soil Sciences, University of Vigo, Ourense, Spain*; [2]*Botany, University of Santiago, Santiago de Compostela, A Coruña, Spain*

The Urticaceae family includes a number of well-known plants, *Urtica* and *Parietaria* being the most widespread. Only *Parietaria* is considered an important allergenic genus. *Parietaria judaica* L is the most common species of this genus in the Mediterranean countries with a prevalence of 60% to 80% in Italy or Greece and 50% in southern France. In Europe, the sensitization to *P judaica* is higher in the south than in the north. In Spain, depending on the area, the sensitization reaches between 25% and 50% in the Mediterranean area, whereas in the northwest area the prevalence is lower (6%-25%). Exposure to allergens represents a key factor among the environmental determinants of asthma. The most common information available for pollinosis patients is the concentration of pollen grains in the bioaerosol and their temporal distribution. However, in recent years, discordance between pollen concentrations and allergic symptoms has been detected. The purpose of this research is to evaluate the relationship between *Parietaria* pollen concentrationss and the atmospheric Par j1-2 aeroallergen concentrations in Santiago de Compostela (NW-Spain) during the *Parietaria* flowering period from 2011 to 2015. *Parietaria* pollen is quantified by using a volumetric sampler Lanzoni VPPS-2000. A Burkard multivial Cyclone Sampler was used for the atmospheric allergens collection. The content of the atmospheric allergen was quantified by using a Burkard Cyclone sampler and enzyme-linked immunosorbent assay (ELISA) double sandwich modified technique. Meteorological data were obtained from the Spanish National Institute of Meteorology.

Parietaria pollination usually occurs from May to the summer months. The year with the higher pollen total value is 2012 with 897 pollen grains. In this year the maximum pollen daily concentration was registered the July 25th with 48 grains/m^3. The year with the higher allergen total value was 2015 with 263 pg. In this year the maximum aeroallergen daily concentration was registered the July 23th with 94 pg/m^3.

There are some discordances between daily *Parietaria* pollen concentrations and Par j1-2 levels with allergen peaks in previous periods than the maximum pollen concentrations such us the year 2012 or retarded allergen peaks in the year 2015. The model to forecast the pollen content in the air includes the allergen concentration and the maximum temperature as independent variables. The PCA analysis and the correlations conducted showed that temperatures are the most important factors for the presence of both, *Parietaria* and Par j1-2 in the atmosphere.

Keywords: Par j1-2, *Parietaria*, Elisa.

Ozone-induced chemical modifications of pollen coating

N. Visez[1], S. Gosselin[1], J. Farah[1], M. Baroudi[2], D. Petitprez[1]

[1]*PC2A - Physicochimie des Processus de Combustion, Université de Lille 1, Villeneuve d'Ascq, France*; [2]*Laboratoire des Sciences de l'Eau et de l'Environnement, Université Libanaise, Tripoli, Lebanon*

The pollen coating is a layer, or droplets, of organic compounds deposited onto the surface of pollen grain. The following chemical families were identified on the pollen coating: saturated and unsaturated fatty acids, alkanes, alkenes, alcohols, aldehydes, ethers, amino-alcohols and phenolic compounds. The pollen coating plays important role for pollen-water interactions during germination and its constituents may also be implicated as adjuvant of the allergenic reaction.
Pollen may be altered by air pollution in different ways: physical degradations (like cracks), chemical changes (including protein nitration) and sticking of particles. Those alterations produced changes in allergenic potential, an easier dispersal of allergen and a decrease in germination. Only little information is however available on the modification of the pollen coating by pollution.
In this work, pollen from *Pinus halepensis* was exposed to ozone in laboratory conditions: 16 hours of exposure with an ozone concentration from 100 to 1300 ppb. Coating was extracted by aqueous or organic solvents; after several steps of preparation (filtration, solvent evaporation and derivatization) samples were injected into gas chromatography with either flame ionization or mass spectrometry detector.
The coating of pollen was modified by laboratory ozone exposure. Increases in the quantities of dicarboxylic acids, short-chain fatty acids and aldehydes were observed. 4-hydroxybenzaldehyde was the main reaction product and its formation was linearly increasing with the ozone concentration. 4-hydroxy-benzaldehyde is very likely produced via the ozonolysis of acid coumaric monomers constitutive of the sporopollenin and was not formed from the ozonolysis of constituents of the pollen coating. This assumption was checked by exposing defatted-pollen to ozone.
These chemical modifications may have effects on pollen germination, on lipids adjuvant effects to allergenic reaction and cloud condensation activities of pollen or pollen parts.

Keywords: Air pollution, Ozonolysis, Bioindication.

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The relationship between birch pollen, air pollution and weather types in two Swedish cities

M. Grundström[1], Å. Dahl[1], T. Ou[2], D. Chen[2], H. Pleijel[1]

[1]*Department of Biological and Environmental sciences, University of Gothenburg, Gothenburg, Sweden*; [2]*Department of Earth Sciences, University of Gothenburg, Gothenburg, Sweden*

Exposure to elevated air pollution levels can aggravate pollen allergy symptoms. The aim of this study was to investigate the relationships between urban air pollutants NO_2, O_3 and PM_{10} and airborne birch (*Betula*) pollen in Gothenburg and Malmö, Sweden, 2006-2012. Further, the influence from large scale weather pattern on pollen/pollution related risk, using Lamb Weather Types (LWT), was analysed. Daily LWTs were obtained by comparing the atmospheric pressure over a 16 point grid system over the southern Sweden (scale ~3000km). They include two non-directional types, cyclonic (C) and anticyclonic (A) and eight directional types depending on the wind direction (N, NE, E... etc.). LWTs with dry and moderately calm meteorological character (A, NE, E, SE) were associated with strongly elevated air pollution (NO_2 and PM_{10}) in Gothenburg. Birch pollen levels were exceptionally high under E and SE types in both cities. For most weather situations in both cities, simultaneously high birch pollen together with high air pollution had larger over-the-counter (OTC) sales of antihistamines than situations with high birch pollen alone. LWTs NE, E, SE and S had the highest OTC sales in both cities. LWTs A, NE, E and SE were associated with high pollen and air pollution levels in Gothenburg and therefore classified as high risk weather. In Malmö corresponding high risk LWTs were NE, E, SE and S. Our study shows that LWTs represent a useful tool for integrated air quality forecasting/warning.

Keywords: birch pollen, air pollution, weather type, antihistamine.

How far can oak pollen be transported in the atmosphere a single day?

S. Fernández-Rodríguez[1], J.-M. Maya-Manzano[2], S. Fernández-Rodríguez[3], M. Smith[4], R. Tormo-Molina[2], A. Reynolds[5], I. Silva-Palacios[6], Á. Gonzalo-Garijo[7], M. Sadyś[5]

[1]*Construction, University of Extremadura, Cáceres, Extremadura, Spain*; [2]*Department of Plant Biology, Ecology and Earth Sciences, University of Extremadura, Badajoz, Extremadura, Spain*; [3]*Department of Construction, University of Extremadura, Cáceres, Extremadura, Spain*; [4]*Institute of Science and the Environment, University of Worcester, Worcester, United Kingdom*; [5]*Rothamsted Research, Rothamsted Research, Harpenden, United Kingdom*; [6]*Department of Applied Physics, University of Extremadura, Badajoz, Extremadura, Spain*; [7]*Department of Allergology, Hospital Universitario Infanta Cristina, Badajoz, Extremadura, Spain*

Introduction. The pollen grains of *Quercus* spp. (oak trees) are considered to be allergenic. This study aimed to establish the distance to which *Quercus* pollen can be transported in a single day during favourable wind conditions.
Material and Methods. Daily mean and hourly records of airborne *Quercus* pollen concentrations were collected from 2011 to 2013 using Hirst type air samplers. The traps were situated in Plasencia (PL), Don Benito (DB) and Zafra (ZA) in the Extremadura region (41,635 km^2) in South-West Spain. The mean diurnal variation of all days with a daily average airborne *Quercus* pollen concentration ≥80 g m^{-3} was studied. The distance that *Quercus* pollen can be transported in appreciable numbers was calculated using cluster analysis of back trajectories representing the air mass movement above the source areas (oak woodlands), and by using a state-of-the-art dispersion model. Initial data screening was performed using descriptive statistics and normality test (Shapiro-Wilk test). Spearman's rank test was used to examine the relationship between the occurrence of *Quercus* pollen in the air and meteorological parameters, except for the association between pollen concentration and wind direction which was investigated using circular statistics.
Results. Two types of *Quercus* distribution maps were produced. The two main potential sources of *Quercus* airborne pollen captured in SW Spain are *Q. ilex* subsp. *ballota* and *Q. suber*. The highest concentrations were recorded in two days; on the 11th of May 2012 for PL and ZA, and on the 17th of April 2013 for the three cities studied. The time air masses spent inclusively over the territory of the Extremadura region varied and, on average, was equal to 30% (PL), 34% (DB) and 29% (ZA). In accordance with our observations the model predicts that dispersal is most effective on warm days with a light breeze, i.e. under conditions that might occur in the spring in temperate latitudes.
Conclusions. Daily mean *Quercus* pollen concentration can exceed 1,700 g m^{-3}. High *Quercus* pollen concentrations were mostly associated with moderate wind speed events (6-10 m s^{-1}), whereas low concentrations were usually associated high wind speed (16-20 m s^{-1}). In PL and ZA *Quercus* pollen is transported from two independent sources, while in DB airborne *Quercus* pollen originates from a single source. The minimum distances between aerobiological stations and *Quercus* woodlands have been estimated as: 40 km (PL), 66 km (DB), 62 km (ZA).

Keywords: Aerobiology, holm oak and cork sources, HYSPLIT.

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Impacts of land clearance by fire on spatial variation of pollen concentration

S. Jochner[1], M. Simmons†[2], A. Menzel[3]

[1]*Physical Geography / Landscape Ecology and Sustainable Ecosystem Development, Catholic University Eichstätt-Ingolstadt, Eichstätt, Germany*; [2]*Lady Bird Johnson Wildflower Center, Ecosystem Design Group, University of Texas at Austin, Austin, USA*; [3]*Ecoclimatology, Technische Universität München, Freising, Germany*

Austin, Texas, is one of the five worst places with respect to allergies. In winter, mountain cedar (*Juniperus ashei*) is producing high pollen amounts exerting the so-called cedar fever in individuals allergenic to this pollen species. In this study, we evaluated to which extent the effects of prescribed fires in a semi-arid ecosystem decrease pollen concentrations at the local scale.

The study was performed on patches characterized by human-induced fire disturbances and unmanaged forests (control sites) within the research area of the Lady Bird Johnson Wildflower Center located in the southwest of Austin. Airborne pollen were sampled on four consecutive days in January 2015 using ten personal volumetric air samplers installed at 1.5 m a.g.l. Air was aspirated at 10 l/min through a vertically oriented intake and pollen was deposited on microscope slides coated with petroleum jelly. Microscope slides were inserted every second hour during 8 am and 6 pm. In total, we collected, prepared and analysed 240 samples. Each station was equipped with meteorological devices to account for influencing factors such as wind speed and direction.

Mean cedar pollen concentrations differed across the studied days and ranged between 270 (16^{th} January) and 7,378 pollen grains / m^3 (17^{th} January). In addition, we found clear diurnal patterns with peak values between 8 am and 9 am as well as 2 pm and 3 pm. However, this pattern differed on some days attributable to prevailing meteorological conditions. Pollen concentrations were on average 15 % lower at burnt vs. control plots. Comparing pairs of adjacent plots even revealed a reduction of up to 50 %.

Therefore, local land management, e.g. prescribed fires, can alter pollen concentrations drastically. A walk across previously burnt areas may trigger less severe symptoms for allergic people during the flowering period of mountain cedar. Our results add to the knowledge about individual cedar pollen exposure in heterogeneous areas and help improving mitigation strategies

Keywords: Juniperus ashei, land management, prescribed fire.

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Sources of pollen grains at different types of a deposition in Altai (Russia)

N. Riabchinskaia[1], G. Nenasheva[1], N. Malygina[2]

[1]*Altai State University, Barnaul, Russia*; [2]*Institute for Water and Environmental Problems, SB RAS, Barnaul, Russia*

Primary biological aerosol particles (PBAP) are a very diverse group of atmospheric aerosols, consisting of acteria and archaea, fungal spores and fragments, pollen, viruses, algae and cyanobacteria, biological crusts and lichens and others like plant or animal fragments and detritus. Pollen grains are the largest in (from 10 to 100 mkm) representatives of PBAP, have mostly seasonal spread (Tormo et al., 2010). PBAP are condensation nuclei significant influence on the formation of clouds and precipitation and, consequently, on the hydrological cycle and climate, especially at the regional level (Despre´s et al., 2012). The study of pollen spectra carried with precipitation, not received due attention. The vast majority of aerosols (about 80 % of the total quantity) fall out to the ground surface with precipitation, and only near 20 % fall out through dry depositions (Croft et al., 2010). The main aim of this study was that, when the data of different types of precipitation (dry / wet) to identify the main areas where pollen spectra in the Altai Territory can be entered.

Altai Krai is located in the center of the Eurasian continent, at the border of several natural and climatic zones. A significant part of the region's territory is characterized as a forest-steppe zone with a lot of natural and anthropogenic landscapes, accompanied by continental climate. It provides a rich diversity of natural vegetation and cultural associations (Ryabchinskaya et al., 2015).

To assess the formation of the pollen spectrum in the territory of Barnaul (the capital of Altai Krai) in 2015 with the help of Burkard trap (dry deposition) was conducted monitoring of the airspace in the presence of pollen grains. At the same time a trap was set for the selection of precipitation (wet deposition). Samples precipitation (Tauber trap) was filtered through a filter with a pore diameter of 1 micron, is then prepared and analyzed for the presence of pollen grains. On the date when the pollen spectrum obtained by dry and wet deposition, varied, were built by backward trajectories HYSPLIT to determine sources of income of the pollen grains.

As a result of analysis, it was found that the finding of the season of pollen in the air, with the help of a registered Burkard trap lasts from mid-April to mid-September, which corresponds to phenological observations in the Altai krai (Nenasheva, 2013). When analyzing samples of precipitation, selected with the help of Tauber traps pollen grains recorded long before the pollination of plants. As pollen grains have been found in winter precipitation (snow). Mainly in samples of precipitation are allocated pollen grains of wood that explain the morphological structure of grain, which allows transferred over long distances. In winter uniforms (snow) found pollen grains of birch *(Betula pendula Roth),* pine (*Pinus sylvestris L.*), poplar *(Populus sp.)* and willow *(Salix sp.)*.

Thus the main source of income adventive plant region of pollen in the spring is to the south of Kazakhstan. In winter, pollen grains can be entered from the territory of the Baltic and southern Scandinavia. In some cases the possible drift of biological aerosols from the Aral-Caspian and Caucasus regions.

Keywords: biological aerosol, HYSPLIT-model, precipitation.

PB65

Alder pollen in Finland is ripened after a short exposure to warm days in early spring

A. Saarto[1], T. Linkosalo[1], E. Le Tortorec[2], M. Prank[3], A.-M. Pessi[1]

[1]*Aerobiology Unit, University of Turku, Turku, Finland*; [2]*University of Jyväskylä, Jyväskylä, Finland*; [3]*Finnish Meteorological Institute, Helsinki, Finland*

We developed a model predicting the daily pollen release of alder and used data collected with pollen traps on seven locations in Finland over the years 2000 to 2014 to evaluate the model. We utilized meteorological data from adjacent weather stations of Finnish Meteorological Institute to drive the model. We estimated the model parameters by minimizing the sum of squared errors (SSE) of the model. The results suggest that Alder pollen ripens after a couple of warm days in February, while the whole flowering period typically takes 3 weeks. We did not find other climatic features than temperature having an impact on the timing and length of flowering period.

Our model was able to predict the onset of pollen season with similar accuracy as models describing only the start of the flowering period. When predicting the end of the flowering period, the accuracy of our predictions was not as good, but it seems that this result is compromised by the outliers in the data, produced by long-range transported pollen after the local flowering has already ended. Therefore we conclude that this model can be used to predict the alder flowering season in Finland. The starting date of temperature sum accumulation is in February, so with the presented parameterization the model cannot be used to predict the flowering in more southerly locations, where alder flowering may start already in January. For those locations, model parameters should be re-estimated with local data.

Keywords: Alnus, male flowering, temperature.

PB66

Possible improvements in the determination of the flowering phenology in numerical pollen forecast models

H. Scheifinger[1], B. Szabo[1], H. Gallaun[2], S. Natali[3], S. Mantovani[3], I. Meran[1]

[1]*Kundenservice Klima Ost, ZAMG, Wien, Austria*; [2]*Joanneum Research GesmbH, Graz, Austria*; [3]*SISTEMA, Wien, Austria*

In Europe, 150 million people suffer from allergies, making them Europe's most common chronic diseases. Allergic rhinitis is typically triggered by environmental allergens, such as pollen grains from a variety of plants. Birch trees (predominantly *Betula pendula*) constitute the source of one of the most important tree pollen allergens in Central and Northern Europe. Timely and reliable warning before pollen are released into the atmosphere means a substantial support for physicians and allergy sufferers. Recently developed numerical pollen forecast models have become a means to improve the pollen forecast service, which however still requires refinement.
For the experiments here presented the numerical pollen forecast model of the SILAM system from the Finnish Meteorological Institute was used.
One of the problem areas for the numerical pollen forecast concerns the correct timing of the beginning and end of the flowering period of the species under consideration, which is identical to the period of pollen emission.
One approach aims at improving the phenological model by increasing the precision of the input temperature. The begin and end of the flowering period are both governed essentially by the temperature sums accumulated before the entry of flowering and during flowering. Phenological models are sensitive to temperature biases. If the assimilation of additional temperature information (e.g. ground measurements as well as satellite-retrieved air / surface temperature fields) is able to reduce systematic temperature deviations of the numerical weather model, the precision of the timing of the modelled phenological entry dates might be enhanced. With a number of sensitivity experiments the effect of a possible temperature bias on the modelled phenology and the pollen concentration in the atmosphere was determined. In another step the actual bias of the 2 m temperatures of the numerical weather forecast model, the assimilation of remotely sensed temperature information and its effects on the modelled phenology and pollen concentrations were evaluated.
Another approach to improve the precision of the phenological entry dates consists in the assimilation of land surface phenology (LSP) from satellites into the numerical forecast procedure. The relationship between GP (ground phenology) and LSP has been analyzed. The phenological model will be validated against GP data of birch beginning of flowering and GP-derived indices (eg. spring index). Both validations, the validation of the GP – LSP relationship and the validation of the SILAM phenological model, are to be compared. It was also determined whether the assimilation of the additional NDVI information from space can in fact improve the phenological information and the modelled pollen distribution in the numerical pollen forecast model.

Keywords: numerical pollen forecast, phenological model, remote sensing.

PB67

Applications of the Concentric Ring Method in Europe

J. Oteros[1], C. Galán[2], D. Fernández-González[3], C. Schmidt-Weber[1], J. T. M. Buters[1]

[1]*Zentrum Allergie und Umwelt (ZAUM), Technical University of Munich, München, Bayern, Germany*; [2]*University of Córdoba, Córdoba, Spain*; [3]*University of León, León, Spain*

Air quality is a major issue for humans owing to the fact that airborne particles have multiple implications for life quality, ecosystem dynamics and environment. Scientists are therefore particularly interested in discovering their origin. Mapping pollen concentrations is also of great interest for several purposes: e.g. health impacts, ecological or agronomical.
The Concentric Ring Method is a new method for modeling the relationship between airborne particles concentrations and emission sources in surroundings at a given distance. A third-degree polynomial relationship between the air particles at a particular point and the distance from the source was observed, signifying that the nearest area to a point is not always the most correlated with its air features. Here we show the results of Concentric Ring Method applied to different airborne particles and in several geographical areas: *Olea* pollen and *Quercus* pollen at extensive areas of Iberian Peninsula and *Betula* pollen at Bavaria in central Europe. These results have been used for predicting the Pollen Index at unmonitored areas and performing accurate pollen maps. This work shows the averaged dispersion pattern of airborne particles and could be implemented in different disciplines related to atmospheric aerosol, thus providing a new approach with which to discover the dynamics of airborne particles.
The results presented here about the sampling area of a Hirst pollen trap for each pollen kind should be interpreted as a more realistic value than the thumb rule of 30 km.

Keywords: Concentric Ring Method (CRM), Geostatistics, Pollen Index.

Prediction models of airborne *Platanus* pollen concentrations based on time series analysis

R. Pérez-Badia, B. Lara, A. Rapp, J. Rojo

Environmental Sciences, University of Castilla-La Mancha, Toledo, Toledo, Spain

Platanus pollen is an important cause of hay fever in many Spanish cities, where this pollen comes from the London planetree, *Platanus orientalis* L. *var. acerifolia* Dryand in Aiton (= *Platanus hispanica* Mill. ex Munchh.), widely used as an ornamental species in parks, gardens and urban green areas. The aim of this study is to generate models using time series to predict the concentrations of *Platanus* pollen during the pollen season.
Airborne *Platanus* pollen was monitored using a Hirst volumetric spore trap. The pollen time series for the period 2005-2012 was decomposed using seasonal-trend decomposition procedure based on LOESS smoothing, and three different components in the temporal series were obtained (seasonal, trend and residual). The decomposition was carried out taking into account periodic cycles (seasonal) of 1 and 3 years. The seasonal component showed the periodic behaviour of the pollen concentrations and the residual component was modeled following partial least square regression using variables from the pollen concentration of the previous days and meteorological variables such as temperature, relative humidity, sunlight and rainfall. The models were validated with Spearman correlation test and Wilcoxon signed-rank test from independent data of the years 2013 and 2014, not included in the models.
The decomposition of the data series of *Platanus* pollen showed good results with seasonality of 1 year and 3 years, although the seasonality of 3 years obtained a better model fit. This result could be explained by the pattern of periodic pruning carried out in the city of Toledo. Considering the seasonality of 3 years, two models were generated, one with data from previous 1-3 days which accounts for 70% of the variance and other with data from previous 4-6 days which accounts for 69% of the variance. The validation of these two models showed no significant differences between estimated and observed values, with coefficients of correlation R = 0.54 and R = 0.44, respectively.

Keywords: London planetree pollen, meteorological variables, time series analysis.

PB70

Airborne *Ambrosia* pollen emission flux calculations based on the eddy covariance technique and Lagrangian dispersion modeling

E. Gute[1], A. Pauling[1], B. Sikoparija[2]

[1]*Federal Office of Meteorology and Climatology, MeteoSwiss, Zurich, Switzerland*; [2]*Research Institute for Information Technologies in Biosystems, BioSense Institute, Novi Sad, Serbia*

Pollen emission flux is a key parameter in numerical dispersion modelling. However, the measurement of this parameter is extremely difficult. In this study, a novel methodology for calculating the emission flux of airborne *Ambrosia artemisiifolia* L. (ragweed) pollen was designed and tested. The method is based on the eddy covariance technique, which is commonly used to quantify gas emission rates over natural ecosystems and agricultural fields.
High frequency wind measurements (10 Hz) are conducted simultaneously with high frequency airborne *Ambrosia* pollen measurements (7.5 minutes) in the centre of a 10m x 10m homogeneous *Ambrosia* pollen source located near Novi Sad, Serbia. Wind data were measured using a 3D sonic anemometer (YOUNG 8100) at a height of 2.5 m and airborne pollen was collected using Burkhard SporeWatch samplers at 0.5m and 5m above the canopy (1.8m and 6.3m above ground, respectively). To ensure local origin of the recorded pollen, all other sources of *Ambrosia* pollen were removed within a radius of 500m. All measurements were performed during the peak period of the ragweed pollen season. We tested the method by using a 12 hour dataset (6 am to 6 pm local time) on August 30, 2015.
Collected data were processed by using a combination of eddy covariance analysis software - TK3 [1] and the Lagrangian stochastic dispersion model - WindTrax [2]. The TK3 software is used as a preprocessor of the wind data. Calculated values of variances and stability are forwarded to the model. WindTrax combines preprocessed wind data with pollen concentrations and calculates emission fluxes as well as touchdown locations of the pollen resulting from dispersion processes.
We demonstrate that the suggested method is applicable for *Ambrosia* pollen flux calculations. Further work will apply the methodology over the entire *Ambrosia* flowering season in order to test the methodology for different source strengths and a variety of meteorological conditions. The results will be valuable for verifying and tuning pollen emission parameterizations used in numerical pollen dispersion models.

Keywords: emission flux, eddy covariance, *Ambrosia*.

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Reciprocal effects of the amount of pollen released and fruiting dynamics: the case of oak trees

E. Schermer[1], A. Siberchicot[1], M.-C. Venner[1], S. Delzon[2], V. Boulanger[3], D. Fouchet[1], J.-M. Gaillard[1], F. Débias[1], S. Sauzet[1], S. Venner[1]

[1]*Evolutionary ecology, University of Lyon1, Villeurbanne, France*; [2]*Evolutionary Ecophysiology, INRA Bordeaux-Aquitaine, Bordeaux, France*; [3]*ONF, Fontainebleau, France*

Masting, or mast seeding, is a reproductive strategy commonly reported in perennial plants, and is characterized by highly variable, synchronous seed production at the population scale. Masting has major impact on biodiversity and some important economic issues, especially for oak tree species. Because mechanisms underlying masting are still largely unknown, the question of whether, and to what extent, masting will be impacted by climate change is currently impossible to answer. The pollination process, from pollen production up to pollination success, seems to be central to the fruiting dynamic of plants. Theoretically, cross-pollination combined with density-dependent pollen limitation can induce synchronized flowering and seeding. In addition, large seed crop a given year may cause severe resource depletion for the plant that should produce few or no pollen in subsequent years. Consequently, years characterized by both high pollen production and high fruiting success should be followed by years of low/no seed production. We investigated the importance of pollination process on masting pattern using a two-step study.

First, we developed a Resource Budget model that takes into account both cross-pollination and resource depletion of trees in relation to the high cost of fruiting. Our model simulates inter-annual fruiting dynamics very similar to what is observed in nature. We unexpectedly found that, although out-cross pollination is the key driver of fruiting synchrony, masting is most intense when pollination is less efficient within plant populations.

Second, we analysed oak species (*Quercus sp.*) pollination data to assess inter-annual dynamics of airborne pollen emission from a 15-year daily monitoring in 60 localities in France (RNSA). In support to our prediction, we showed that years with high amounts of pollen released were followed by years of low pollen availability. In addition, we found that pollen emission is synchronized between neighboring localities, which suggests a strong potential effect of climate on the temporal on pollination and fruiting dynamics.

Understanding the impact of climate on pollen emission, combined with theoretical issues of the mechanistic model, should help making realistic predictions about the future of masting in the context of climate change.

Keywords: fruiting dynamics, pollination process, oak trees.

PB72

The development of Ragweed Pollen Alarm System in Hungary and the possibilities of pollen forecast with COSMO-ART

D. Magyar[1], A. Pauling[2], O. Udvardy[1], G. Mányoki[1], A. Páldy[1], K. Zink[3]

[1]National Public Health Center, Department of Air Hygiene and Aerobiology/Hungarian Aerobiological Network, Hungary; [2]Federal Office of Meteorology and Climatology, Federal Department of Home Affairs FDHA, Switzerland; [3]Empa - Swiss Federal Laboratories for Materials Science and Technology, Laboratory for Air Pollution/Environmental Technology

Common ragweed is in particular widespread in Eastern and Central Europe. In Hungary almost 80 % of the arable land is infested and ragweed became the most important agricultural weed during the last 20 years. The estimated value of the yield loss, the cost of control and the health expenses (cost of treatments, price of medicines, value of lost working days) sum up a total of 500 million Euro yearly. Besides other allergenic plants like grass and birch pollen affecting about 95% and 20% of all hay fever patients in Europe, ragweed sensitization is the greatest problem in Hungary; almost 60% of allergic patients - meaning 1.5-2 million people - suffer from ragweed allergy. Even the number of days with >100 ragweed pollen/m^3 are high in Hungary (2010: 28, 2011: 27, 2012: 18, 2013: 17, 2014: 22, 2015: 17). Maps of spatial distribution of pollen grains are useful tools to provide a reliable information of the current pollen load. However previous ragweed pollen maps did not visualize concentrations above 100 pollen/m3. Therefore an isarithmic map was introduced to inform populations in highly polluted areas, having categories above 100 pollen/m^3. The Ragweed Pollen Alert System (R-PAS) is based on the daily pollen measurements carried out in 19 cities in Hungary using 7-day Hirst-type spore traps. At each week of the pollen season, a map is issued indicating the spatial distribution of the weekly average airborne ragweed pollen concentration. Ragweed finds its optimal living conditions in the Pannonian Biogeographical Region (PBR), therefore it is necessary to inform the public about the airborne pollen concentration not only in Hungary, but also other PBR countries. The possibilities of ragweed pollen forecast was tested using the extended numerical weather prediction system COSMO-ART. It was found that the time of concentration peaks could be predicted in the western part of Hungary. In other PBR regions, however, the system's domain is not available, therefore the forecast cannot be performed. Expansion of the domain would be useful also to create a better prediction for South and West Europe, by adding data to improve the model with long distance pollen transport from the main pollen source PBR.

PB73

Interest for tracking deposited particles against the risk of bio-contamination

I. Tovena Pecault[1], M. Thibaudon[2], J. Clertant[3], P. Godefroy[4]

[1]*DLP, CEA CESTA, Le Barp, France*; [2]*RNSA, Brussieu, France*; [3]*ANALYZAIR, Brussieu, France*; [4]*WINLIGHT SYSTEM, Pertuis, France*

In many industries (optics, lasers, space, automotive…), the deposited particle control is of great importance to avoid deleterious product contamination. That's why, in the frame of the Laser MégaJoule, CEA-CESTA has developed, in collaboration with Aix Marseille University and Winlight System, a real time device for the deposited particles counting and classification upon time: CLEAPART-100[1, 2]. The particles larger than 5 μm are collected on a 100 cm^2 collective glass plate and the results are displayed in real time to detect each contamination event.

In the health industries as well, the interest for settling method has been existing for a long time till Koch in 1881[3]. In 1955, Wells and his co-workers [4] found that airborne microbes were associated with dust particles. In 1996, W.Whyte[5] tried to convince the "cleanliness community" and argued that a program set up to monitor pharmaceutical production should be based on settle plates rather than volumetric sampling. Following Mr. Whyte advice, we have compared on line deposited particles measurements (CLEAPart-100) with biocontamination measurements (settle plates and bio-collectors) and we demonstrate an interesting correlation between settling particles and viable particles (bacteria & mold).

Keywords: metrology, sedimented particles, biocontamination.

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PB74

'Pollen Alarm' in Turkey

S. Celenk[1], H. Malyer[2], N. Sapan[3]

[1]*Biology Department, Uludag University, Bursa, Turkey*; [2]*Biology Department, Uludag Universtiy, Bursa, Turkey*; [3]*Faculty of Medicine, Uludag University, Bursa, Turkey*

Background: The aim of the aerobiological studies most cases are to give detailed information about airborne pollen to doctors and sensitive individuals and help to treatment. Pollen information has been disseminated for several decades and computer-based programs have increased the number of users. Pollen and e-health application was combined with the most country and special application was created for showing alarm level of aeroallergens. Similarly, an application was created for four districts of Bursa, Turkey by Aerobiology Laboratory of Uludag University.
Methods: Airborne pollen sampling was carried out with a 7-day volumetric trap (Hirst type). Traps located four districts of Bursa, Turkey. The method for evaluation of slides and threshold values was used suggested by REA.
Results and Discussion: Aeroallergen information, particularly forecasts, is of value to those who produce and stock health care. In this study, a smartphone based application was created for four different area of Bursa, Turkey. The application consists of four different modules as aeroallergen report, a pollen calendar, general information on aeroallergens, and some advice for allergy sufferers. The module of "aeroallergen report" presents three different types of aeroallergen grouped as grass (Gramineneae), threes (Cupressaceae, Betulaceae, Fagaceae, Oleaceae) and weeds (Urticaceae, Artemisia, Ambrosia, Platanus, Chenopodiaceae). The threshold values defined as low, moderate, high and very high. Information about aeroallergens plays an important role in the timing of prophylactic medication and this kind of application will be helpful for the sufferers increasing the quality of life. This study was founded by Uludag University Research Foundation project no HDP(F)2015-22 .

Keywords: online application, threshold value, aeroallergen.

Diurnal Cycles of Bioaerosols in NW Spain

A. I. Calvo[1], D. Fernández-González[2], D. Baumgardner[3], A. Castro[1], A. Mª Vega-Maray[4], R. Mª Valencia-Barrera[4], R. Fraile[1]

[1]*Department of Physics, IMARENAB, University of León, León, Spain*; [2]*Biodiversity and Environmental Management, Institute of Atmospheric Sciences and Climate, University of León, CNR, León, Bologna, Spain, Italy*; [3]*Droplet Measurement Technologies Inc, Boulder, Colorado, United States*; [4]*Biodiversity and Environmental Management, University of León, León, Spain*

Exposure to a certain type of biological particle such as pollen and fungal spores induce allergic responses and therefore exacerbate reactions in the allergenic diseases.
Methods to detect primary aerosol biological particles (PBAPs) have been generally based on sampling by impaction, followed by analysis using optical microscopy. In the recent years has been applied other technique based on the fluorescence spectroscopy to identify PBAPs.
Measurements of airborne particles were made at the university campus of León, Spain (42° 36’ 50” N, 5° 33’ 38” W, 846 m asl) in May and June, 2015 with a Wideband Integrated Bioaerosol Spectrometer (WIBS). In addition, an analysis of pollen concentration, assessed by Optical Microscopy of aerosol samples performed with volumetric Hirst spore trap, has been made. The WIBS inlet and impaction trap were placed on the roof of the Faculty of Veterinary, approximately 15 m above the ground.
WIBS detects particles in the size range from 0.5 to 20 μm and identifies bioaerosols from their fluorescent emissions. The WIBS further differentiates bioaerosols by their equivalent optical diameter (EOD) and the intensity of emissions in two wavebands when excited at 280 nm and 370 nm wavelength. The bioaerosols can be roughly classified as bacteria, fungal spores or pollen grains using their EOD and spectral fingerprints as metrics to compare with a bio-library of bioaerosols that have been compiled from laboratory studies.
The particle population in general shows a diurnal cycle; however, the bioaerosols not only have a more pronounced oscillation, but the fraction of particles that are bioaerosols tend to maximize in the early hours of the morning. The bioaerosol fraction represents almost 25% of the total particle population in the measured size range during this time period, decreasing to < 10% during the day. In addition, there is a strong correlation with the meteorology, i.e. humidity and wind speed. Humidity controls the release mechanisms of some fungal spore species and the liberation of allergens, so it can be a relevant factor to be considered as a possible cause of respiratory allergy phenomena.
Finally, although the majority of the bioaerosols are identified as fungal spores (*Cladosporium, Aspergillus, Alternaria, Oidium*…) and pollen grains (mainly *Poaceae, Quercus, Plantago, Rumex* and *Urticaceae*), the highest concentrations are those that do not match any of those that were classified in the bio-library.
The results of this study will be discussed with respect to what is currently known about the production and transport of pollen and fungal spores and their relation to meteorological conditions.
Finally, this study should be considered as a proof of principle about the possibility of using light induced fluorescence methods for aeroallergens detection in ambient air.

Keywords: Bioaerosols, Wibs, Pollen.

PB76

Airborne pollen collection and identification with an automated near-real-time pollen collection device: efficacy of the method

R. W. Lucas[1], L. Bunderson[2], N. Allan[2], K. Lambson[2]

[1]*Pollen Sense, Phoenix, AZ, USA*; [2]*Pollen Sense, Castle Dale, UT, USA*

The developed world is currently experiencing an epidemic in the prevalence of asthma and sinus allergies, collectively costing more than €300 billion annually in healthcare and lost productivity expenses worldwide. Allergens contained in pollen have increased in virulence and will likely continue to intensify as the atmospheric concentration of carbon dioxide continues to rise. While pharmacological options exist, few effective decision support tools are available for allergy sufferers. This is due, in part, to the difficulty in obtaining accurate pollen count information. Current pollen sampling and reporting methods require 24-96 hours of continuous air sampling followed by manual preparation of slides, and tedious counting of pollen grains with a microscope by a trained expert. The current method is laborious, prone to error, and prevents airborne pollen concentrations from being reported at temporal or spatial scales meaningful for individual decision-making.
The goal of this study was to evaluate the efficacy of a relatively low-cost automated pollen sampling device that can report pollen concentrations in near real-time and to determine whether the device could produce high quality digital images of pollen grains with discernible identification characteristics, without the use of a pollen stain or mounting medium. Results were obtained using an automated Pollen Sense APS-100 device and a Burkard volumetric spore trap located immediately adjacent to one another (within 3 m) in an open, outdoor area free from local sources of tree pollen. Tests were conducted during the early spring season in the metropolitan area of Salt Lake City, Utah, USA, an area with a high prevalence of respiratory illness due to compromised air quality.
The automated APS-100 consistently collected and automatically captured images with clearly visible key surface characteristics of the following pollen genera: *Salix, Populus, Juniperus, Pinus, Ulmus, and Acer*. Examples of important identifying characteristics include distinct long furrows on *Salix* pollen and the penta-porate *Ulmus* pollen. Lending confidence to the APS-100 results, samples collected with the Burkard contained the same suite of pollen genera. Mold spores were also detected on both devices. Innovative lighting and high quality optics appear to be favorable for positive pollen identification, even without a mounting medium or stain, and thereby facilitating automated identification of pollen genera via machine vision identification algorithms. Finally, the resolution of the APS-100 was sufficient to additionally provide near real-time data regarding particulate matter (PM) sized 10 μm, 2.5 μm, and potentially 1μm. A fully automated device enables a dense network of pollen data acquisition, providing scale-relevant coverage, and can therefore aid sufferers and caretakers of allergenic and respiratory illness to make informed decisions about their daily activities that could impact their well-being.

Keywords: automated pollen collection, automated pollen identification via machine vision, forecasting.

PB78

What is that yeast in the air: Airborne yeast diversity from a temperate climate

J. McLoud, E. Levetin, B. Medlin

Biology, University of Tulsa, Tulsa, OK, United States

The atmosphere contains a tremendous diversity of airborne fungi including both conidia-forming fungi and yeast-like fungi. Airborne conidial fungi have been well characterized through spore trap sampling as well as culture-based sampling. However, the diversity of airborne yeast is virtually unknown. Yeast cells generally cannot be identified by microscopy on spore trap samples. Using culture-based air sampling yeast colonies are frequently recovered, but these are often placed in a single category. This is confounding, as there are >1,500 species of yeast currently known with some being allergens or opportunistic pathogens. Since several yeasts may cause health problems, the diversity of these airborne yeasts should be characterized. The current study was undertaken to increase our understanding of airborne yeast diversity.

A single stage impaction sampler with yeast medium agar was used to collect air samples on the University of Tulsa campus (Tulsa, Oklahoma) from 31 Aug to 7 Dec 2015. One-minute samples were collected one day each week during the morning, noon, and late afternoon. Following incubation, yeast colonies were identified by microscopy and colony morphology. Yeast cultures were isolated, and subcultures were used to collect cell lysates. Each lysate was used in a polymerase chain reaction to amplify DNA of the nuclear ribosomal ITS region. The DNA sequences were analyzed using BLAST from NCBI and MycoBank. Yeasts were identified by BLAST results. Cultures that were similar in pigmentation and morphology to *Rhodotorula mucilaginosa*, were not sequenced. Putative *Rhodotorula* isolates were tested with genus-specific primers using end-point PCR, and positive cultures were classified as *Rhodotorula sp*.

During the 14 weeks of viable sampling, yeast-like fungi were present in 71% of all air samples and total yeast concentrations ranged from zero on 5 October to 2941 CFU/m^3 on 21 September. The mean yeast concentrations from all air samples (n=42) was 336 (SE±76) CFU/m^3. Yeasts isolates were identified as *Bullera pseudoalba, Bulleromyces albus, Bulleromyces sp., Candida batistae, Candida sp., Cryptococcus magnus, Cryptococcus nemorosus, Dioszegia zsoltii, Hannaella luteola, Hannaella sinensis, Komagataella sp., Komagataella pastoris, Rhodotorula paludigena, Rhodotorula sp., Sporidiobolus pararoseus,* and Tremellales. The most numerous yeasts were *Bulleromyces, Cryptococcus, Hannaella, Komagataella,* and *Rhodotorula*.

Culture-based sampling is effective for determining the diversity of viable airborne yeast species, but has limitations associated with limited sampling duration and sampling medium bias for specific fungi. Future studies will overcome these limitations by using molecular techniques with 24 hr Burkard air samples.

Keywords: yeast, diversity, viable sampling.

PB79

Fungal spores calendar of Parma (Northern Italy) from 2008 to 2014

M. Ugolotti[1], P. Vitali[1], R. Albertini[2]

[1]*Hospital Hygiene Unit, University Hospital of Parma, Parma, Italy*; [2]*Department of Clinical and Experimental Medicine, University of Parma, Parma, Italy*

Introduction: Fungal spores are of great interest in aerobiology because of their impact on human health causing allergy, infection or producing toxin and volatile organic compounds. Through the aerobiological monitoring is possible to establish the seasonal behaviour of fungal spores and the spores calendar can be, very useful for preventive intervention, diagnosis and clinical management. The aim of our study was to examine variations in time of selected fungal spores in Parma, Northern Italy.
Materials and Methods: Fungal spores were collected in the city of Parma (Northern Italy) by volumetric spore trap, according to the methods of the Italian Association of Aerobiology. A selection of fungal spores were analysed from 2008 to 2014 (*Alternaria* spp., *Epicoccum* spp., *Helminthosporium* spp., *Pleospora* spp., *Polytrincium* spp., *Stemphylium* spp., *Torula* spp. and *Phytomices* spp.) We checked aerobiological data regarding spore season according to Jäger et al. 1996: start, end duration, peak date were investigated as the number of days from January 1st (DOY); SPI (Seasonal spore Index) as spore and peak value as spore/m^3; furthermore we have used Microsoft Excel for linear regression analysis and SPSS 23 software for the non-parametric test of Spearman. Temperature (°C), relative humidity (%) and total rainfall (mm rain) were analyzed.
Results: The dominant spore was *Alternaria* spp (69%), that had the highest peak value in September (1022 spore/m^3); the lowest was *Polytrincium* spp. (0.16%) with the lowest peak value in August (10 spore/m^3); *Pleospora* spp spore season starts earlier (February), ends earlier (July) and lasts longer (194 DOY); *Pithomyces* spp spore season starts later in June and had the shortest season (98 DOY). The greatest diversity of fungal spores was assessed along the summer and autumn season, being September the month that registered the highest number of different spore types, followed by August. We have found significant ($p<0.05$) this parameter of this spores: a decrease of SPI for *Torula* spp ($p=0.03$); earlier start for *Stemphylium* spp ($p=0.03$); a shorter season for *Pleospora* spp. ($p=0.04$) and *Polytrincium* spp. ($p=0.03$).
Conclusions: Airborne fungal spores from different groups are present in outdoor air in Parma, some of them at very high concentrations (*Alternaria* spp.). The highest concentration of fungal spores mainly occurred during summer and autumn while, low temperature may have conditioned the lowest fungal spore registration along winter season.

Keywords: fungal spores, aerobiology, monitoring.

PB80

The main allergen of *Alternaria alternata*, Alt a 1, dominates in air fraction related to subspore fragments

L. Grewling, P. Bogawski, A. Szymańska, Ł. Kostecki, M. Nowak

Faculty of Biology, Laboratory of Aeropalynology, Adam Mickiewicz University, Poznań, Poland

Introduction: *Alternaria* sp. is one of the most important allergenic fungi. Fungal allergens are produced by both spores and hyphae. The hyphal fragments, much smaller than fungal spores, while becoming airborne may reach lower respiratory tract. Due to the measurement method the small parts of fungal mycelium are not however considered in routine allergy forecast, that is solely based on information related to the fungal spores concentrations in the air.
Aim: To determine the concentrations of the main allergen of *Alternaria alternata* (Alt a 1) in three air fractions, i.e. PM>10µm, 2.5>PM>10µm, and 0.12>PM>0.25µm.
Methods: *Alternaria* spores were collected in 2014 by volumetric spore trap of Hirst design and Alt a 1 by high volume cascade impactor located in Poznań (Western Poland). Concentrations of Alt a 1 were determined by ELISA. Only days with spore concentration >100 spores/m^3 were taken into account in statistical analysis (n=53 days). Correlations between spores and Alt a 1 in three air fractions were determined by Spearman rank correlation test.
Results: The highest concentrations of Alt a 1 were detected in 2.5-10µm air fraction. It was almost 50% higher than in the air fraction related to *Alternaria* spores. In 0.12>PM>0.25µm stage the amount of Alt a 1 was extremely low (~1% of total Alt a 1). The maximum daily *Alternaria* spore level was recorded 2nd of August (1307 spore/m^3), while the highest concentration of Alt a 1 was observed two weeks earlier (19th of July, 10.9 pg/m^3). The correlations between daily levels of *Alternaria* spores and Alt a 1 detected in all air fractions were statistically significant (r=~0.600; p<0.05). However the allergenicity of *Alternaria* spores varied daily from around 0.001 to 0.008 pg Alt a 1/spore.
Conclusion: The highest level of Alt a 1 was observed in 2.5-10µm air fractions. The vegetative hyphal fragments or dissected fungal spores should be therefore considered as a main source of *Alternaria* allergens. The quantitative analysis of fragmented mycelium would be highly desirable practice in routine aeroallergen monitoring to reliable estimate the risk of fungal allergy to sensitized patients.
This work was funded by Polish National Science Centre grant No. 2013/09/D/NZ7/00358.

Keywords: fungi, allergy, cascade impactor.

PB81

PEP725 Pan European Phenological Database www.pep725.eu

H. Scheifinger, T. Hübner, E. Koch, A. Paul, M. Ungersböck and 22 European Partners

ZAMG, Vienna, Austria

Phenology – the timing of seasonal activities of animals and plants – is perhaps the simplest process in which to track changes in the ecology of species in response to climate change (IPCC 2007).
PEP725, the Pan European Phenological Database is a European research infrastructure to promote and facilitate phenological research. Its main objective is to build up and maintain a pan European phenological database with an open, unrestricted data access for science, research and education. So far 20 European meteorological services and 7 partners from different phenological network operators have joined PEP725.
In most European countries, phenological observations have been carried out routinely for more than 50 years by different governmental and non-governmental organisations and following different observation guidelines, the data stored at different places in different formats. This has been really hampering pan European studies as one has to address many network operators to get access to the data before one could start to bring them in a uniform style.
www.PEP725.eu offers a single entry point to more than 11 800 000 phenological records, all of them are classified with the BBCH scale. The first datasets in PEP725 date back to 1868; however, there are only a few observations available until 1950. Having accepted the PEP725 data policy and finished the registry the data download is quick and easy and can be down by different criteria as for instance the selection of a specific plant or all data from one country.
But www.PEP725.eu also shows a real time monitoring of ground phenology. Real time phenological monitoring has been state of the art in single countries but always ended at the national borders. Since spring 2016 one can follow the phenological events on www.pep725.eu in real time mode and can watch how the "green wave" is moving from 46° northern latitude up to the northern polar circle or over more than 2500 km across Europe.

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LIST OF PARTICIPANTS



ABRAMIDZE Tamar
Immunology
Center for Allergy & Immunology Research
2-6 Lubliana Street
0159 TBILISI – GEORGIA
abramidze@yahoo.com

ABU-DIEYEH Mohammed
Biological and environmental sciences
Qatar University
PO Box 2713
2713 DOHA – QATAR
dandelion@qu.edu.qa

ACAR Aydan
Biology
Ankara University
Faculty of Science
06100 ANKARA – TURKEY
aydanacar24@gmail.com

ADAMS-GROOM Beverley
Institute of Science and Environment
University of Worcester
Henwick Grove
WR2 6AJ WORCESTER – UK
b.adams-groom@worc.ac.uk

ADEKANMBI Helen Olusola
Botany
University of Lagos
234 LAGOS – NIGERIA
oadekanmbi@unilag.edu.ng

AFONINA Svetlana
Plair SA
Chemin des Aulx 18
1228 PLANS-LES-OUATES
SWITZERLAND
safonina@plair.ch

ALAN Senol
Bulent Ecevit University
Ozerpasa Cad. Incivez
67100 ZONGULDAK – TURKEY
palynology@gmail.com

ALBERTINI Roberto
University of Parma
Via Gramsci 14
43126 PARMA – ITALY
roberto.albertini@unipr.it

AMATO Pierre
CNRS - ICCF
24 avenue Blaise Pascal
63171 AUBIÈRE – FRANCE
pierre.amato@univ-bpclermont.fr

ANTUNES Celia
Chemistry - Institute of Earth Sciences
University of Evora
School of Sciences and Technology
Rua Romão Ramalho 59
70000-671 EVORA – PORTUGAL
cmma@uevora.pt

ATLAGIC Milica
Biology and ecology
Faculty of Sciences
Trg Dositeja Obradovica 2
21000 NOVI SAD – SERBIA
milicaatlagic15@gmail.com

AUVIGNE Vincent
OpenHealth Company
3 allée Nicolas Leblanc
56038 VANNES – FRANCE
v.auvigne@openhealth.fr

BASAK Tanmoy
Botany
Visva Bharati University
c/o Prof. Kashinath Bhattacharya
Visva Bharati (central university)
SANTINIKETAN - WEST BENGAL 731235
INDIA
tanmoy.basak1@gmail.com

BASTL Katharina
Medical University of Vienna
Währinger Gürtel 18-20
1090 VIENNA – AUSTRIA
katharina.bastl@meduniwien.ac.at

BELMONTE Jordina
Institute of Environmental Science
and Technology
Universitat Autònoma de Barcelona
Edifici Z - Carrer columnes s/n
Cerdanyola del Vallès
08193 BELLATERRA – SPAIN
jordina.belmonte@uab.cat

BEN SALEM Nabil
Air Rhône-Alpes
3 allée des Sorbiers
69500 BRON – FRANCE
nbensalem@air-rhonealpes.fr

BESANCENOT Jean-Pierre
RNSA
11 chemin de la Creuzille
69690 BRUSSIEU – FRANCE
rnsa@rnsa.fr

BILON Rebecca
Observatory of Ragweeds - Inra
17 rue Sully
BP 86510
21065 DIJON – FRANCE
rebecca.bilon@dijon.inra.fr

BOCCACCI Linda
MESVA
University of L'Aquila
Piazzale S. Tommasi
67100 L'AQUILA – ITALY
lindola5@hotmail.it

BOGAWSKI Pawel
Aeropalynology
Adam Mickiewicz University
Faculty of Biology
Umultowska 89
61-614 POZNAN – POLAND
bogawski@amu.edu.pl

BONINI Maira
Medical prevention
Local Health Authority Milan 1
Via Spagliardi 19
20015 PARABIAGO - MILAN – ITALY
Mbonini@ats-milano.it

BRASSEUR Anthony
Évaluation des risques
Anses
14 rue Pierre et Marie Curie
94701 MAISONS-ALFORT – FRANCE
anthony.brasseur@anses.fr

BRUNET Yves
UMR 1391 ISPA
Inra
71 avenue Edouard Bourleaux
33140 VILLENAVE-D'ORNON – FRANCE
brunet@bordeaux.inra.fr

BUTERS Jeroen
ZAUM - Center of Allergy & Environment
Technical University of Munich
Biedersteinerstrasse 29
80802 MUNICH – GERMANY
buters@tum.de

CAILLAUD Denis
Pulmonary-allergology
University Hospital
Rue Montalembert
63003 CLERMONT-FERRAND – FRANCE
dcaillaud@chu-clermontferrand.fr

CARIÑANOS-GONZALEZ Paloma
Botany
University of Granada
Faculty of Pharmacy
Campus de Cartuja
18971 GRANADA – SPAIN
palomacg@ugr.es

CELENK Sevcan
Biology
Uludag University
Art and Science Faculty
Aerobiology laboratory
2° floor, L217 - Görükle
16059 NILÜFER-BURSA – TURKEY
sevcancelenk@hotmail.com

CHAKRABORTI Trina
School of Environmental Sciences
Jawaharlal Nehru University
Lab 117
NEW DELHI - DELHI 110067 – INDIA
trnchakraborti@gmail.com

CHARBONNIER Jennifer
Analyzair
11 chemin de la Creuzille
69690 BRUSSIEU – FRANCE
jennifer.charbonnier@analyzair.fr

CHARPIN Denis
Pulmonology and allergy
Aix Marseille University
Hôpital Nord
Chemin de Bourrelly
13015 MARSEILLE – FRANCE
denis-andre.charpin@ap-hm.fr

CHAUVEL Bruno
Observatory of Ragweeds - Inra Dijon
17 rue Sully
BP 86510
21065 DIJON Cedex – FRANCE
bruno.chauvel@dijon.inra.fr

CHAVANET Armelle
Bertin Technologies
Parc d'activité du Pas du Lac
10 bis avenue Ampère
78180 MONTIGNY-LE-BRETONNEUX
FRANCE
armelle.chavanet@bertin.fr

CLERTANT Julien
Analyzair
11 chemin de la Creuzille
69690 BRUSSIEU – FRANCE
analyzair@analyzair.fr

CLOT Bernard
Federal office of meteorology
& climatology
MeteoSwiss
Chemin de l'Aérologie 1
1530 PAYERNE – SWITZERLAND
bernard.clot@meteoswiss.ch

CROUZY Benoît
MeteoSwiss
Chemin de l'Aérologie 1
1530 PAYERNE – SWITZERLAND
benoit.crouzy@meteoswiss.ch

CUNY Damien
APPA
235 avenue de la Recherche
59120 LOOS – FRANCE
damien.cuny@univ-lille2.fr

DAHL Åslög
Biological and environmental sciences
University of Gothenburg
Box 461
405 30 GOTHENBURG – SWEDEN
aslog.dahl@bioenv.gu.se

DAMIALIS Athanasios
Chair & Institute of Environmental Medicine
Technical University of Munich - UNIKA-T
Klinikum Rechts der Isar
Neusasser Str. 47
86156 AUGSBURG - BAVARIA – GERMANY
thanos.damialis@tum.de

DAVET Alain
Cabinet Médical
CRF
Au Village 11
1483 MONTET - BROYE – SWITZERLAND
davetal@bluewin.ch

DE BLAY Frédéric
Pneumologie
Hôpitaux Universitaires de Strasbourg
Nouvel hôpital civil
BP 426
67091 STRASBOURG Cedex – FRANCE
frederic.deblay@chru-strasbourg.fr

DE WEGER Letty A.
Pulmonology
Leiden Universtiy Medical Center
Albinusdreef 2
2333ZA LEIDEN – THE NETHERLANDS
l.a.de_weger@lumc.nl

DÉCHAMP Chantal
AFEDA
25, rue Ambroise
69800 SAINT-PRIEST – FRANCE
afeda@wanadoo.fr

DOMASHCHENKO Anastasia
Medical department #1
Vinnitsa National Medical University
56 Pirogov Street
21018 VINNITSA – UKRAINE
domashenko_o@mail.ru

DUBACQ Sophie
Bertin Technologies
Parc d'activité du Pas du Lac
10 bis avenue Ampère
78180 MONTIGNY-LE-BRETONNEUX
FRANCE
sophie.dubacq@bertin.fr

DUPUY Nadine
RNSA
11 chemin de la Creuzille
69690 BRUSSIEU – FRANCE
rnsa@rnsa.fr

ERNST Dieter
Institute of Biochemical Plant Pathology
Helmholtz Zentrum München
Ingolstädter Landstr. 1
85764 NEUHERBERG – GERMANY
ernst@helmholtz-muenchen.de

FABRE Christine
Nimes University Hospitals
SAAMI
Place du Professeur Debré
30029 NÎMES – FRANCE
christine.fabre@chu-nimes.fr

FENET Olivier
RNSA
11 chemin de la Creuzille
69690 BRUSSIEU – FRANCE
rnsa@rnsa.fr

FERNÁNDEZ-GONZÁLEZ Delia
Biodiversity and environmental
management
University of León
Campus de Vegazana, s/n
24071 LEÓN – SPAIN
mdferg@unileon.es

FERNÁNDEZ-RODRÍGUEZ Santiago
Construction
University of Extremadura
Avenida de la Universidad s/n
10003 CÁCERES – SPAIN
santiferro@unex.es

FRENGUELLI Giuseppe
Agricultural, food and environmental sciences
University of Perugia
Borgo XX Giugno, 74
06121 PERUGIA – ITALY
giuseppe.frenguelli@unipg.it

FRÖHLICH Janine
Multiphase chemistry
Max Planck Institute for Chemistry
Hahn-Meitner-Weg 1
55128 MAINZ – GERMANY
j.frohlich@mpic.de

GALÁN Carmen
Botany, ecology and plant physiology
University of Córdoba
Campus de Rabanales
Edificio Celestino Mutis - 3° planta
14071 CÓRDOBA – SPAIN
bv1gasoc@uco.es

GALVEIAS Ana
Chemistry - Institute of Earth Sciences
University of Evora
School of Sciences and Technology
Rua Romão Ramalho, 59
7000-671 ÉVORA – PORTUGAL
anagalveias@gmail.com

GEHRIG Regula
Federal office of meteorology & climatology
MeteoSwiss
Operation Center 1
PO Box 257
8058 ZÜRICH-AIRPORT – SWITZERLAND
regula.gehrig@meteoswiss.ch

GHARBI Dorra
Plant biology
University of Málaga
Facultad de Ciencias
Campus de Teatinos
29071 MÁLAGA – SPAIN
dorra.gharbi@uma.es

GHITARRINI Sofia
Agricultural, food and environmental sciences
University of Perugia
Borgo XX Giugno, 74
06121 PERUGIA – ITALY
sofia.ghitarrini@unipg.it

GRÉGORI Marielle
Air Lorraine - ORSAS
20 allée de Longchamp
54600 VILLERS-LÈS-NANCY – FRANCE
gregori.orsas@gmail.com

GREWLING Lukasz
Aeropalynology
Adam Mickiewicz University
Faculty of Biology
Umultowska 89
61-614 POZNAN – POLAND
lukaszgrewling@gmail.com

GRINN-GOFRON Agnieszka
Plant taxonomy and phytogeography
University of Szczecin
Faculty of Biology
Waska 13 Street
71-415 SZCZECIN – POLAND
agofr72@gmail.com

GRUNDSTRÖM Maria
National pollen and aerobiology research
University of Worcester
St Johns Campus
Charles Darwin Building
WR2 6AJ WORCESTER – UK
m.grundstrom@worc.ac.uk

GUIGNARD Gaëtan
Biology
AFEDA - University Claude Bernard Lyon 1
UMR CNRS LEHNA
7 rue Raphaël Dubois
69622 VILLEURBANNE – FRANCE
guignard@univ-lyon1.fr

GÜVENSEN Aykut
Biology
Ege University
Faculty of Science
35320 BORNOVA-IZMIR – TURKEY
aykut.guvensen@ege.edu.tr

HÄRING Franziska
Institute of environmental medicine
Technical University of Munich
Neusäßer Straße 47
86156 AUGSBURG – GERMANY
franziska.haering@tum.de

HELFMAN-HERTZOG Ilanit
Geography and environmental studies
University of Haifa
199 Aba Khoushy Ave
Mount Carmel
39105 HAIFA – ISRAEL
ilaitay@netvision.net.il

HOEBEKE Lucie
Mycology and aerobiology
Scientific Institute of Public Health
Juliette Wytsmanstreet 14
1050 BRUSSELS – BELGIUM
lucie.hoebeke@wiv-isp.be

HOFMANN Frieder
Ökologiebüro TIEM
Rennstieg 25
28205 BREMEN – GERMANY
f.hofmann@oekologiebuero.de

HUGG Timo
University of Oulu
Center for environmental & respiratory health research - Aapistie 5 B
90014 OULU – FINLAND
timo.hugg@oulu.fi

JOCHNER Susanne
Catholic University Eichstätt-Ingolstadt
Physical geography, landscape ecology & sustainable ecosystem dev.
Ostenstraße 18
85072 EICHSTÄTT – GERMANY
susanne.jochner@ku.de

JOUAN Michel
RNSA
11 chemin de la Creuzille
69690 BRUSSIEU – FRANCE
lilya.michel.jouan@wanadoo.fr

JUNG Stephan
Professorship of ecoclimatology
Technical University of Munich
Hans-Carl-von-Carlowitz-Platz 2
85354 FREISING – GERMANY
stephan.jung@wzw.tum.de

KASPRZYK Idalia
Environmental biology
University of Rzeszów
Zelwerowicza 4
35-601 RZESZÓW – POLAND
idalia@univ.rzeszow.pl

KAWASHIMA Shigeto
Graduate School of Agriculture
Kyoto University
Kitashirakawa Oiwake-cho, Sakyo-ku
KYOTO 606-8502 – JAPAN
sig@kais.kyoto-u.ac.jp

KENNEDY Roy
Agri Tech
Warwickshire Colleges
Cranfield University - Pershore College
Avon Bank
WR10 3JP PERSHORE – UK
r.kennedy@warwickshire.ac.uk

KMENTA Maximilian
Otorhinolaryngology
Medical University of Vienna
Währinger Gürtel 18-20
1090 VIENNA – AUSTRIA
maximilian.kmenta@meduniwien.ac.at

KOFOL SELIGER Andreja
Institute of Public Health Republic of Slovenia
Trubarjeva 2
1000 LJUBLJANA – SLOVENIA
andreja.seliger@ivz-rs.si

KUDSK Per
Agroecology
Aarhus University
Forsoegsvej 1
4200 SLAGELSE – DENMARK
per.kudsk@agro.au.dk

LANG-YONA Na'ama
Multiphase chemistry
Max Planck Institute for Chemistry
Hahn-Meitner Weg 1
55128 MAINZ – GERMANY
n.lang-yona@mpic.de

LANZONI Elena
Lanzoni
Via Michelino 93/B
40127 BOLOGNA – ITALY
e.lanzoni@lanzoni.it

LAVEN Gottfried
Universitätsklinikum Aachen
Pauwelsstraße 30
52074 AACHEN – GERMANY
glaven@ukaachen.de

LEONTIDOU Kleopatra
Biodiversity and molecular ecology
Fondazione Edmund Mach
Via E. Mach 1
38010 SAN MICHELE ALL' ADIGE, TRENTO – ITALY
cleopatra.leontidou@fmach.it

LEVETIN Estelle
Biological science
University of Tulsa
800 S. Tucker Dr.
74104 TULSA, OK – USA
estelle-levetin@utulsa.edu

LOEFFERT Sophie
Hospital hygiene - Epidemology unit
Edouard Herriot Hospital
5 place d'Arsonval
69437 LYON – FRANCE
sophie.loeffert01@chu-lyon.fr

LOMMEN Suzanne
Biology
University of Fribourg
Chemin du Musée 10
1700 FRIBOURG – SWITZERLAND
suzanne.lommen@unifr.ch

LUCAS Richard W.
Environmental science
Pollen Sense
43106 N 44th Dr
85087 PHOENIX, AZ – USA
rich@pollensense.com

MAGYAR Donat
Air hygiene and aerobiology
National Public Health Center
Albert Flórián út 2–6
1097 BUDAPEST – HUNGARY
magyar.donat@gmail.com

MAHDI Aseel
School of Biological Sciences
University of Reading
The Harborne Building
23 Brighton Road
RRG6 6AS READING – UK
a.mahdi@pgr.reading.ac.uk

MARKO Oskar
BioSense Institute
Dr Zorana Djindjica 1
21000 NOVI SAD - VOJVODINA – SERBIA
ockapmapko@gmail.com

MATSUDA Soken
Graduate school of agriculture
Kyoto University
Kitashirakawa Oiwake-cho
Sakyo-ku
KYOTO 606-8502 – JAPAN
matsuda.soken.28n@st.kyoto-u.ac.jp

MAYA-MANZANO Jose María
Plant biology, ecology and earth sciences
University of Extremadura
Avenida de Elvas s/n
06006 BADAJOZ – SPAIN
jmmaya@unex.es

MCLOUD Josh
Biology
University of Tulsa
2820 E. 6th Street
Lorton Hall, #201
74104 TULSA, OK – USA
mcloudjosh@gmail.com

MEINARDUS-HAGER Georg
a.e.r.o.medi
Hinmanweg 9h
7575 BE OLDENZAAL
THE NETHERLANDS
georg.hager@aeromedi.org

MÉON Henriette
AFEDA - Claude Bernard University Lyon 1
2 rue Dubois
69622 VILLEURBANNE Cedex – FRANCE
henriette.meon@univ-lyon1.fr

MIKI Kenji
Graduate school of agriculture
Kyoto University
Kitashirakawa Oiwake-cho
Sakyo-ku
KYOTO 606-8502 – JAPAN
kmikikyoto@gmail.com

MOHANTY Rashmi Prava
Biological sciences
The University of Tulsa
800 S. Tucker Drive
Oliphant Hall
74104 TULSA, OK – USA
ram800@utulsa.edu

MONNIER Samuel
RNSA
11 chemin de la Creuzille
Le Plat du Pin
69690 BRUSSIEU – FRANCE
samuel.monnier@rnsa.fr

MONROY-COLÍN Alejandro
Plant biology, ecology and earth sciences
University of Extremadura
Avenida Elvas s/n
06071 BADAJOZ – SPAIN
bioamc@outlook.com

MORENO Diego A.
Escuela Técnica Superiorn Ingenieros Industriales
Universidad Politécnica de Madrid
C/ José Gutiérrez Abascal 2
ETSII-UPM
28006 MADRID – SPAIN
diego.moreno@upm.es

MOTTET Marilou
Observatory of Ragweeds - Inra
17 rue Sully
BP 86510
21065 DIJON – FRANCE
marie-helene.mottet@dijon.inra.fr

MOULÈS Vincent
VirHealth
RTH Laeenec
11 rue G. Paradin
69008 LYON – FRANCE
v.moules@virhealth.fr

MÜLLER-SCHÄRER Heinz
Biology, ecology & evolution
University of Fribourg
Chemin du Musée 10
1700 FRIBOURG – SWITZERLAND
heinz.mueller@unifr.ch

MYSZKOWSKA Dorota
Clinical and environmental allergology
Jagiellonian University Medical College
Sniadeckich 10
31-531 KRAKÓW – POLAND
dorota.myszkowska@uj.edu.pl

NICULITA-HIRZEL Hélène
Institut for Work and Health
Route de la Corniche 2
1066 EPALINGES-LAUSANNE
SWITZERLAND
helene.hirzel@hospvd.ch

NÚÑEZ Andrés
Física aplicada e ingeniería de materiales
Universidad Politécnica de Madrid
C/ José Gutiérrez Abascal 2
ETSII - UPM Metalurgia, Esc 5 - 1º D
28006 MADRID – SPAIN
andres.nunez@upm.es

O'CONNOR David
Chemistry
Dublin Institute of Technology
Kevin Street Lower
D08 NF82 DUBLIN – IRELAND
david.x.oconnor@dit.ie

OLIVER Gilles
RNSA
11 chemin de la Creuzille
69690 BRUSSIEU – FRANCE
gilles.oliver@rnsa.fr

OTEROS Jose
Center of Allergy and Environment (ZAUM)
Technical University of Munich
Biedersteiner str. 29
80802 MUNICH – GERMANY
oterosjose@gmail.com

PACE Loretta Giuseppina
Life, health and environmental sciences
University of L'Aquila
Via Vetoio
67100 L'AQUILA – ITALY
loretta.pace@univaq.it

PASHAEI KOORABBASLOO Mehdi
Siba Sang
#10 Rezvan 10 Alley
Rezvan Avenue - Bahar Blvd.
1659754191 TEHRAN – IRAN
ardltyr@ymail.com

PAULING Andreas
Federal office of meteorology
& climatology
MeteoSwiss
Operation Center 1
PO Box 257
8050 ZURICH-AIRPORT – SWITZERLAND
andreas.pauling@meteoswiss.ch

PÉREZ-BADIA Rosa
Environmental sciences
University of Castilla-La Mancha
Avenida Carlos III s/n
45071 TOLEDO – SPAIN
rosa.perez@uclm.es

PINAR Nur Münevver
Biology
Ankara University
Faculty of Science
06100 TANDOGAN – TURKEY
pinar@science.ankara.edu.tr

POSEVINA Iuliia
Ecology and natural managment
Ryazan State University
Svobody, 46
390006 RYAZAN – RUSSIA
posevina_julia@mail.ru

PRENTOVIC Marija
Otorhinolaryngology
Medical University of Vienna
Spitalgasse 23
1090 VIENNA – AUSTRIA
marija.prentovic@meduniwien.ac.at

PROIETI Marine
RNSA
11 chemin de la Creuzille
69690 BRUSSIEU – FRANCE
rnsa@rnsa.fr

PROUST Anaïs
VirHealth
Domaine La Buire
7-11 rue G. Paradin
69008 LYON – FRANCE
a.proust@virhealth.fr

RAND Jessica
RNSA
11 chemin de la Creuzille
69690 BRUSSIEU – FRANCE
rnsa@rnsa.fr

RASMUSSEN Karen
The Danish Asthma and Allergy Association
Universitetsparken 4
4000 ROSKILDE – DENMARK
kr@astma-allergi.dk

RIABCHINSKAIA Natalia
Altai State University
61 Lenin Avenue
Academic building «M»
656049 BARNAUL – RUSSIA
ryabchinnatalia@gmail.com

RIGAUD Sylvain
RNSA
11 chemin de la Creuzille
69690 BRUSSIEU – FRANCE
rnsa@rnsa.fr

RITENBERGA Olga
Faculty of geography and earth sciences
University of Latvia
Rainis boulevard 10
1056 RIGA – LATVIA
olga.ritenberga@lu.lv

RODINKOVA Victoriia
Pharmacy
Vinnitsa National Medical University
56 Pirogov Street
21018 VINNITSA – UKRAINE
vikarodi@gmail.com

RODRÍGUEZ RAJO F. Javier
Plant biogy and soil sciences
University of Vigo
Sciences Faculty
32004 OURENSE – SPAIN
javirajo@uvigo.es

RUGGIERO Franco
Biology
University of Pisa
Via Derna 1
56126 PISA – ITALY
franco.ruggiero@for.unipi.it

SAARTO Annika
Aerobiology unit
University of Turku
Vesilinnantie
20014 TURKU – FINLAND
annika.saarto@utu.fi

SADYS Magdalena
Computational and systems biology
Rothamsted Research
West Common
AL5 2JQ HARPENDEN – UK
magdalena.sadys@rothamsted.ac.uk

SARISAHIN Tuba
Biology
Bulent Ecevit University
Ozerpasa Cad. Incivez
67100 ZONGULDAK – TURKEY
tsarisahin@gmail.com

SAULIENE Ingrida
Siauliai University Research Institute
Vilniaus Street 88
76285 SIAULIAI – LITHUANIA
ishauliene@gmail.com

SAVLI Roberta
EFA & ADPA
35 rue du Congrès
1000 BRUSSELS – BELGIUM
roberta.savli@efanet.org

SCHEIFINGER Helfried
Kundenservice Klima Ost
ZAMG
Hohe Warte 38
1190 WIEN – AUSTRIA
helfried.scheifinger@zamg.ac.at

SCHERMER Eliane
LBBE
CNRS UMR 5558 UCBL 1
43 boulevard du 11 Novembre 1918
69100 VILLEURBANNE Cedex – FRANCE
eliane.schermer@univ-lyon1.fr

SEVEROVA Elena
Higher plants
Moscow State University
Biological Faculty
Leninskie Gory 1-12
119234 MOSCOW – RUSSIA
elena.severova@mail.ru

SIKOPARIJA Branko
BioSens Institute
Research Institute for Information
Technologies in Biosystems
Dr Zorana Djindjica 1
21000 NOVI SAD – SERBIA
sikoparijabranko@gmail.com

SILJAMO Pilvi
Meteorological Research
Finnish Meteorological Institute
Erik Palmenin aukio 1
00560 HELSINKI – FINLAND
pilvi.siljamo@fmi.fi

SILVER Jeremy
School of Earth Sciences
University of Melbourne
3010 MELBOURNE, VIC – AUSTRALIA
jeremy.silver@unimelb.edu.au

SINDT Charlotte
RNSA
11 chemin de la Creuzille
69690 BRUSSIEU – FRANCE
rnsa@rnsa.fr

SKJØTH Carsten
Institute of Science and Environment
University of Worcester
Henwick Grove
WR2 6AJ WORCESTER – UK
c.skjoth@worc.ac.uk

SMITH Matt
University of Worcester
Insitute of Science and the Environment
Henwick Grove
WR2 6AJ WORCESTER – UK
aeromattsmith@gmail.com

SOFIEV Mikhail
Atmospheric composition research
Finnish Meteorological Institute
Erik Palmenin Aukio 1
00560 HELSINKI – FINLAND
mikhail.sofiev@fmi.fi

SORIN Edouard
Analyzair
11 chemin de la Creuzille
69690 BRUSSIEU – FRANCE
analyzair@analyzair.fr

STEPALSKA Danuta
Institute of botany
Jagiellonian University
Kopernika 27
31-531 KRAKÓW – POLAND
stepalska@op.pl

STJEPANOVIC Barbara
Living and working environment
Atampar Teaching Institute of
Public Health
Mirogojska 16
10000 ZAGREB – CROATIA
barbara.stjepanovic@stampar.hr

STRZELCZAK Agnieszka
West Pomeranian University of Technology
Papieza Pawla VI 3
71-459 SZCZECIN – POLAND
agstrzelczak@zut.edu.pl

SUKIENE Laura
Environmental research
Siauliai University
Vilniaus Street 88
76285 SIAULIAI – LITHUANIA
laura.shukiene@gmail.com

SZABO Barbara
Climatology
ZAMG
Schuetzengasse 26/4/9
1030 VIENNA – AUSTRIA
barbara.szabo@zamg.ac.at

TARRADE Pascale
Puy de Dome
Fredon Auvergne
83 avenue de l'Europe
Site de Marmilhat
63370 LEMPDES – FRANCE
pascale.tarrade@fredon-auvergne.fr

THIBAUDON Michel
RNSA
11 chemin de la Creuzille
69690 BRUSSIEU – FRANCE
michel.thibaudon@wanadoo.fr

TOSSOU Monique
Plant biology
University of Abomey-Calavi
BP 4521
01001 COTONOU – BENIN
tossou@bj.refer.org

TOSUNOGLU Aycan
Biology
Uludag University
Science and Arts Faculty
Gorukle Campus
16059 BURSA – TURKEY
aycanbilisik@uludag.edu.tr

TROUDE Florence
Modelling
Air Rhône-Alpes
3 allée des Sorbiers
69500 BRON – FRANCE
ftroude@air-rhonealpes.fr

TSENG Yi-Ting
Environmental science and technology
Kyoto University
Graduate school of agriculture
Kitashirakawa Oiwake-cho - Sakyo-ku
KYOTO 606-8502 – JAPAN
tseng.yiting.36x@st.kyoto-u.ac.jp

UGOLOTTI Manuela
Hospital hygiene unit
University Hospital of Parma
Via Gramsci 14
43126 PARMA – ITALY
manuela.ugolotti@gmail.com

VIGIER Nicolas
Air Rhône-Alpes
3 allée des Sorbiers
69500 BRON – FRANCE
nvigier@air-rhonealpes.fr

VISEZ Nicolas
PC2A
Université de Lille 1
Cité scientifique - Bâtiment C11
59655 VILLENEUVE-D'ASCQ – FRANCE
nicolas.visez@univ-lille1.fr

VOJNICH Viktor József
Horticulture
Kecskemét College
Erdei Ferenc tér 1-3
6000 KECSKEMÉT – HUNGARY
vojnich.viktor@kfk.kefo.hu

VOLKOVA Olga
Higher plants
Moscow State University
Biological Faculty
Leninskie Gory 1-12
119234 MOSCOW – RUSSIA
olgavolkova-msu@yandex.ru

WAITZ Sébastien
Air Rhône-Alpes
3 allée des Sorbiers
69500 BRON – FRANCE
swaitz@air-rhonealpes.fr

ZEMMER Franziska
Hazırlık Okulu
Fatih University
Buyukcekmece
34500 ISTANBUL – TURKEY
fzemmer@gmail.com

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a.e.r.o.medi
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Bertin Technologies
Parc d'Activités du Pas du Lac
10 bis avenue Ampère
78180 MONTIGNY-LE-BRETONNEUX – FRANCE
coriolis@bertin.fr

Lanzoni
Via Michelino 93/B
40127 BOLOGNA – ITALY
info@lanzoni.it
www.lanzoni.it

Plair
3 chemin du Pré-Fleuri
1228 GENEVA – SWITZERLAND
info@plair.ch
www.plair.ch

List of sponsors

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coriolis@bertin.fr
www.bertin-technologies.com

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rnsa@rnsa.fr
www.pollens.fr

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www.stallergenes.com

Thermo Fisher Scientific
marketing-fr.idd@thermofisher.com
www.thermofisher.com/fr

VWR International
fr.vwr.com