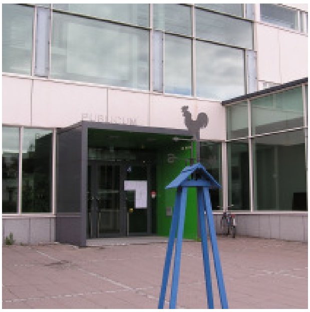
The 4th European Symposium on Aerobiology

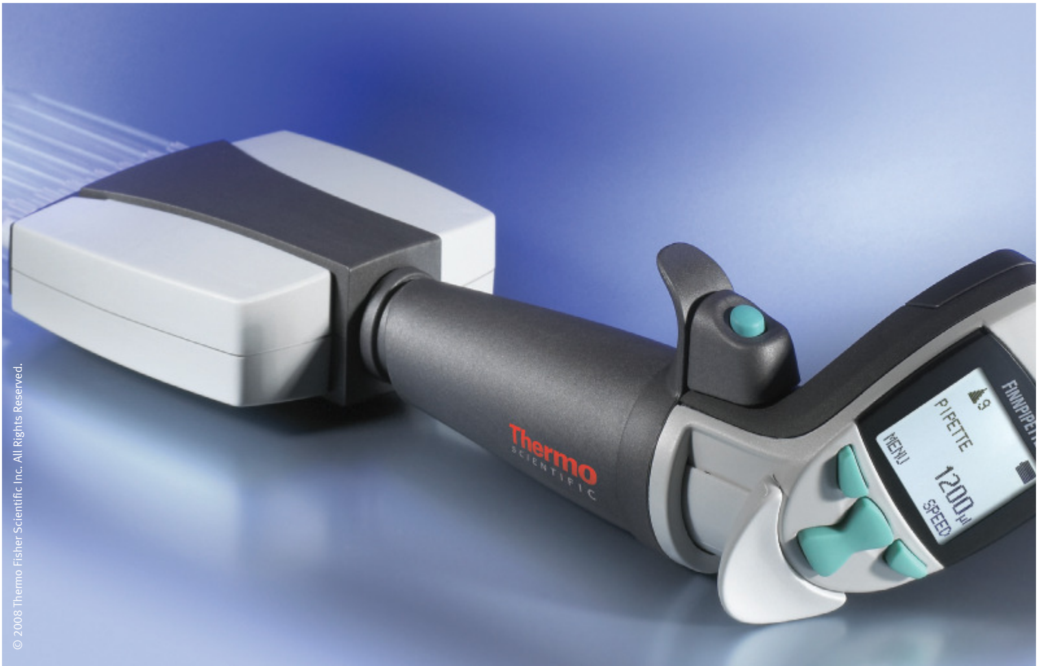
12-16 August 2008 University of Turku, Finland
Programme: www.utu.fi/4ESA2008

2nd edition

4th ESA 2008

ABSTRACTS





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Abstracts of the 4th ESA 2008

12-16 August 2008, University of Turku, Finland

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Edited by Mervi Oikonen

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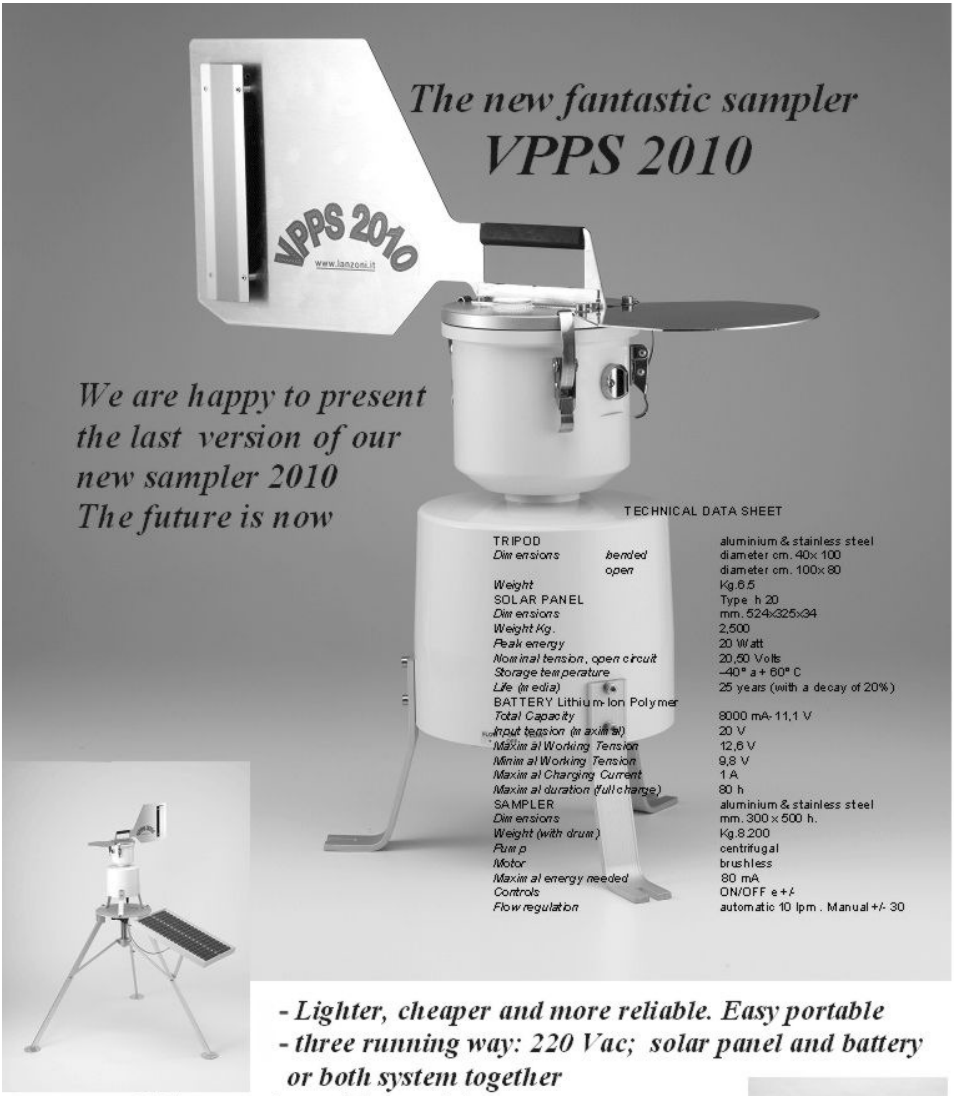

TECHNICAL DATA SHEET

TRIPOD		aluminium & stainless steel
Dimensions	*bended*	diameter cm. 40x 100
	open	diameter cm. 100x 80
Weight		Kg.6.5
SOLAR PANEL		Type h 20
Dimensions		mm. 524x325x34
Weight Kg.		2,500
Peak energy		20 Watt
Nominal tension, open circuit		20,50 Volts
Storage temperature		–40° a + 60° C
Life (media)		25 years (with a decay of 20%)
BATTERY Lithium-Ion Polymer		
Total Capacity		8000 mA-11,1 V
Input tension (maximal)		20 V
Maximal Working Tension		12,6 V
Minimal Working Tension		9,8 V
Maximal Charging Current		1 A
Maximal duration (full charge)		80 h
SAMPLER		aluminium & stainless steel
Dimensions		mm. 300 x 500 h.
Weight (with drum)		Kg.8.200
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Foreword to the 2nd edition

This abstract book contains the papers presented at the 4th ESA, the fourth European Symposium on Aerobiology, organised 12-16 August 2008 by the Aerobiology Unit of the University of Turku, Finland. This second edition which contains the late arriving abstracts will only be published electronically.

Following the spirit and objectives of the previous symposia in Santiago de Compostela 1996, Vienna 2000, and Worcester 2003, we want to bring together investigators with various scientific backgrounds, but who share an interest in aerobiology. We can now proudly host these up-to-date keynote lectures and outstanding oral and poster presentations by delegates from 23 countries. Our University has always been supportive to aerobiological research, our scientific meetings and pollen information service as a country-wide activity.

Our symbol, the wind vane stands for the major topics in our Symposium: winds blow over political borders and transport also particles of biological origin over long distances. Winds are also subject to change by the global climate change. Sharing our data and communicating our results in meetings such as this Symposium can bring us closer to understanding the phenomena in nature and help us reach our scientific goals.

The local organisers sincerely hope that you enjoyed the scientific programme, the commercial exhibitions as well as the social programme in our marine atmosphere. Not the organisers, but you participants make the symposium!

On behalf of organisers at the Aerobiology Unit, I want to express our gratitude to all our sponsors and to the staff and participants who contributed to the realisation of our meeting.

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SESSION 1. The effects of climate change to airborne pollen and spores

Keynote: Effects of climate change to pollen and spores. Jäger S.

Plant phenological trends in South Spain: response to climate change. García-Mozo H., Galán C., Mestre A.

Changes in the grass pollen season in Perugia, Italy, over the last 25 years. Frenguelli G., Tedeschini E., Minuti E.

Comparison of long-term trends in atmospheric pollen levels and pollen season patterns between a mid-European and an east-Mediterranean city: in search of common features. Damialis A., Kasprzyk I., Halley M.J., Vokou D.

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Ragweed phenology and cold summer in the Lyon area (France) in 2007. Déchamp C., Méon H., Guignard G.

Keynote: Effects of climate change to pollen and spores

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Aim of the study was to look for evidence of changes in the behaviour of pollen and spore seasons due to climate change. For obvious reasons, only a few types of allergological interest have been investigated. Persuasive corresponding trends were not really obvious, because of contradictory results in various (sub)climates and altitudes. Especially Betula pollen seasons seem to behave different from the rest of Europe in subpolar areas.

Daily pollen and spore counts have been used from the EAN database and the variables start, peak day, end, length of the season, number of days with respective pollen count, number of days over threshold, annual total, and peak value have been calculated for every single monitoring site, pollen(spore) type and year. Outliers have been filtered out by means of SPSS Ver 15.0 using histograms and the “explore” function and other exclusion parameters. Meta variables were geographical coordinates, Climates after Koeppen, and altitude, as well as intersections of them. Trends have been calculated using the two-tailed Spearman’s rho correlation feature for all primary variables and pure and/or sets of the meta variables. The amount of calculated trends was thus 501.760. We tried to group the results and to display overviews under various aspects.

Timing: The number of significant trends in timing is in equilibrium position. It is the result of earlier peak and end for Betula, earlier start and peak for Poaceae and Alternaria, and later start, peak, peak and end for Artemisia as well as a later peak and end for Ambrosia.

Duration: Less pronounced are changes for the duration: the duration of Betula pollen seasons shows a negative trend both in terms of number of days with Betula pollen reported and the length of the seasons. Grass pollen seasons became longer over time, so did the seasons of Artemisia, but not Alternaria nor Ambrosia. Both Artemisia and Ambrosia show an increase in the number of days with pollen reported.

Intensity: On the other hand, the intensity of the investigated pollen and spore seasons increased in a majority of cases, in particular for Betula and Alternaria. Poaceaee seasons had a negative trend. Artemisia showed no significant trends, and Ambrosia had only a positive trend in terms of annual totals.

Climates: In cool continental climates we found the highest proportion of negative timing trends, while hot climates showed rather tendencies to positive timing trends. With the exception of temperate warm and subtropical climates, a trend towards higher intensity was evident everywhere. Most changes were observed for hot and warm temperate and for continental and cold climates.

In humid climates, we see a trend for later timing, in reverse earlier timing in dry climates. Longer seasons prevail in humid climates, shorter seasons in arid climates. Positive trends for intensity were only found for humid areas – no significantly lower intensity in both climates.

Earlier seasons dominate in colder areas, later seasons in warmer areas, in particular in hot climates where longer seasons were observed in contrast to cool and cold climates which showed clearly shorter seasons. Positive trends for intensity dominate in all regions, no lower intensity is observed in all regions.

Altitudes: No negative trends are obvious in elevations below 150 m a.s.l., timing, duration, and intensity are positive in the plains. Timing becomes gradually earlier, the higher the altitude. For duration we found no convincing tendencies, but rather positive trends below 800 m and shorter above 1500 m. Intensity: positive trends are prevalent except of the subalpine region (> 1500 m).

Latitudes: The timing trends tended to rather earlier in low, and rather later in high latitudes. Longer seasons were observed for the south, shorter in the north, there were no clear common trends in between. Positive trends for intensity were prevalent everywhere, strongest in the central European belt.

Longitudes: Timing showed a tendency to earlier seasons in the west and up to 30° east, but no trends east of 30° E. No common trends concerning duration could be spotted for the west-east gradient. Intensity trends were positive in all longitudinal section, highest increase appeared in longitudes between Greenwich and 30° E.

Cold climates: A comparison for birch pollen seasons between subalpine and subpolar areas revealed an earlier start and less days with pollen count in both areas, but in addition an earlier end, shorter length, and higher annual total pollen counts in the subalpine climate.

The study could not give a precise answer whether several observed trends are specific for a pollen type or for a climatic or altitudinal range. To gain such information, additional pollen types (or groups of arboreal / herbaceous categories) have to be compared for defined geographical areas. For instance, the diverging results for Artemisia and Ambrosia deserve a consideration if and if yes why settled indigenous genera behave in another way than invasive neophytes. The results encourage to continue the investigation of effects of climate change to pollen and spores. A closer look has to be given to all available taxa in order to proof the surprising and sometimes diverging results of this preliminary study.

Acknowledgement: many thanks for data contributions from EAN members in various countries.

Plant phenological trends in South Spain: response to climate change

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The impact of climate change, and mostly of the climate warming, is being tracked in many physical and biological systems. In particular, plant phenology is considered such us one of the most important bio-indicators, because they can provide a high temporal and spatial information of the ongoing changes.

A project funded by the Andalusia Government has allowed the collaboration between the Aerobiologia Research Group of the University of Cordoba (Spain) (http://www.uco.es/aerobiologia) and the Spanish Institute of Meteorology (INM) (http://www.aemet.es) to analyse its Phenological Data Base.

Results are being correlated with aerobiological data of Andalusia (South Spain) in the case of reproductive phenophases of anemophilous species.

First analyses have been performed in three different locations of South Spain taking into account vegetative and overall reproductive phenology of different species of *Quercus, Populus, Ulmus, Corylus, Fraxinus, Morus, Vitis* and Poaceae.

First results have revealing a general advance of the foliation, flowering and fruit maturation of the studied species. This advance is being clearer in the arboreal species than in the herbaceous ones. Flowering patterns match with the aerobiological data observed for most of the studied species.

Changes in the grass pollen season in Perugia, Italy, over the last 25 years

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Many works carried out in the last decades have shown that pollen season for taxa flowering in winter and spring, in temperate regions, have tended to become earlier and, in general, the trends of pollination have shown significant variations, probably due to the continuous rising of the average surface temperature (warming climate).

The mean annual temperature in Perugia, central Italy, was about 1.0°C higher in the last two decades compared with that registered in the previous decades and, on average, there has been a different behaviour in the precipitation. The increase of temperature took place mainly in winter and spring while no significant variation was recorded during summer and autumn period. This work reports patterns in fluctuations in the airborne grass pollen presence in Perugia, over the last 25 years, in order to study the influence of warmer winters and springs in recent years on the behaviour of pollination of this taxon.

The grass pollen season in Perugia is typically mid-April to late July and the start dates showed a marked trend to an earlier beginning of the season (-0.5 day/year), as well as an earlier end and incidence of peak day. Both the peak values and the cumulative counts exhibit clear trends towards lower values and the year-to-year variation in the daily grass-pollen concentrations revealed significant differences correlated with the temperature before and during pollen season.

These trends support the theory that the grass pollination is greatly dependent on temperature, both during the months preceding the pollination, i.e. March, and during the release and dispersion of the pollen in the atmosphere, such as demonstrated in the same area for other spring taxa which, after a certain amount of chilling for breaking dormancy, require relatively warm temperatures to complete the reproductive growth. The observed trend for grasses is in contrast with those reported from central and North-Europe, where this taxon shows only a limited shift, but it is in accordance with the shift from temperate to Mediterranean climate and with the increase in the continentality index detected in Central Italy during the same period.

Comparison of long-term trends in atmospheric pollen levels and pollen season patterns between a mid-European and an east-Mediterranean city: in search of common features

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Climate change is expected to affect atmospheric pollen patterns resulting in higher loads of atmospheric pollen and/or earlier and longer pollen seasons, but the relevant evidence is not adequate yet. Many studies from Europe have reported increases in air temperature (particularly minimum) since the early 90's, whereas others have reported decreases in the annual rainfall.

In this work we used data from Thessaloniki (Greece) and Rzeszów (Poland), and we investigated for any concurrent changes of the annual pollen concentration and the pollen season patterns. Data used for Thessaloniki cover the period 1987-2005, whereas those for Rzeszów cover the period 1997-2005. We examined for trends in the pollen load time-series of those taxa, whose individual contribution to the total annual pollen concentration accounted for more than 0.5%. Moreover, we examined whether there are shifting patterns in the annual main pollen period. Possible trends in meteorological factors were also explored.

The salient feature of these data is that the atmospheric levels of pollen have been increasing in Thessaloniki; this is true for the majority of the individual taxa examined (12 out of 16) and for their aggregate. On average, the atmospheric pollen concentration is doubling every decade, but for some species the rate is much higher, with doubling times less than five years (*Carpinus, Plantago, Platanus*).

In Rzeszów, in contrast, increasing trends in airborne pollen levels were found only for Cupressaceae and Pinaceae and for the pollen aggregate. For the pollen-season related attributes (onset, peak, end and duration), there was no systematic tendency and the changes were more nuanced for both study areas.

In Thessaloniki, the observed increase in pollen abundance coincides with a rise in air temperature, which is the only meteorological factor to have experienced a sustained and significant change over the same period. In Rzeszów the only trend observed was in the annual amount of rainfall, slightly decreasing over the study period. Results for Thessaloniki indicating increase in atmospheric pollen loads and parallel increase of air temperature over the last 20 years could be interpreted as the result of climate warming. Given the lack of any systematic shift to an earlier or longer main pollen period, this also suggests a direct effect of temperature on pollen production. In Rzeszów, few trends were found, either for the pollen time-series or for the meteorological factors.

In consequence, the only feature that the two cities, located in different climatic and vegetation zones, share is in the absence of any pattern for the pollen-season related attributes. But, in the lower-latitude, warmer Thessaloniki, some allergenic pollen will increase dramatically, and if this persists, the episodes of respiratory allergy will become more frequent and/or severe. If results from Thessaloniki are representative of the Mediterranean, we could suggest use of biotic responses in such areas as bio-indicators of climate change.

Pollen production and pollination periods time tendencies in airborne pollen

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As there is a great interest in climate change and its possible outcome in plant pollination and its effects in human health, yearly variation in pollen airborne concentration and pollination period for the main sources of pollen in Badajoz (SW Spain) has been studied for 15 years (1993-2008), the aim is to know if there is any general tendency in this time period.

Aerobiologic results have been compared with meteorology data, temperature and rain, to find out possible relationships. Airborne pollen data has been obtained by a continuous sampling with a Hirst volumetric sampler.

Results show that there is a weak time tendency for the total airborne pollen concentration with an increase of 1,2% yearly (R^2=0,075), but in the same period the total rain decrease a 1,7% yearly (R^2=0,0546) and the mean annual temperature increase a 0,27% yearly (R^2=0,1103).

To know better this effect the monthly data (January-June) has been analysed, and results show different month tendencies, for the total pollen amount there is an increase in January, February and May, but a reduction in March and June.

In the main pollen types, Poaceae, *Quercus* and *Olea*, monthly tendencies are also different, for grasses pollen the tendency is a general reduction but in May, with a increase for this; for green oaks pollen there is an increase in April, May and June but a reduction in March, and for olives tree pollen May shows a increase tendency and a reduction in April and June.

For the date of the beginning of pollination in these three pollen types a time lag tendency has been observed, 0,58 days/year in grass, 0,70 days/year in green oaks and 1,01 days/year in olive trees.

Evidences of the advance of desertization in the South-Eastern Mediterranean areas of the Iberian Peninsula

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During the years 1995-2000, the Aerobiology team of the University of Cordoba made the analysis of the pollen content in the air of Chirivel (Almería), a rural area located in the south-eastern peninsula with sub-desert climate.

The results showed the different responses of the different components of the flora, arboreal and herbs, to situations of water stress. It was also noticeable, from the pollen spectrum recorded, that the presence of taxa corresponding to plant species better adapted to aridity, such as Amaranthaceae, Compositae and Lamiaceae, was more abundant than in other areas geographically close.

In summer 2007 the Hirst volumetric trap was put again into operation with the aim to observe the variations that could have been occurred in the average pollen spectrum of the area.

During this period of time, the climate conditions have been very variable, in particular the amount and distribution of precipitations. Rainfall every time is more irregular and disperses and less snowy phenomena occur.

The preliminary results have shown that the number of pollen types have slightly increased, mainly due to the records of some taxa belonging to plants better adapted to conditions of aridity, such Cariophyllaceae and Tamaricaceae. It has been also detected a longer pollen season in the case of Amaranthaceae, *Artemisia*, Oleacea and *Platanus*, that extend their flowering as a consequence of a less restrictive temperatures. In the case of Cupressaceae, Salicaceae, Ulmaceae and Fagaceae, it has been also observed an advance in their usual start of pollen season.

As preliminary conclusion, it could be extracted that in the last years the increasing aridity in some areas of the south-eastern part of the Iberian Peninsula is provoking, in one hand, alterations in the average behaviour of the local flora; on the other hand, a higher presence of plant species better adapted to aridity conditions might affect in the future to the plant biodiversity in the area.

Climatic change: negative effects on flowering trends of forest trees in Austria

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In reaction to Forest Decline and global warming effects, a long-term project has been launched in 1985 at the Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW) that aims to investigate processes of forest tree reproduction in seed orchards as well as in different forest stands.

Flowering and seed production processes are investigated since 1988. Examinations of Intercorrelation between pollen production, female blossom development and weather conditions shall allow a prediction of seed production and help to ascertain fitness of forest trees. In cooperation with the operators of several stations of the European Allergological Network (EAN) a forest Reproduction - Monitoring - Network has been established subsequently. (http://bfw.ac.at/rz/pollen.main).

During the first ten years in 7 locations of Austrian forest standings flowering (pollen) and seed production were examined. After this period, during which the regional correlation between pollen and seed production was established, seed trapping was stopped and only pollen traps (volumetric and gravitation types) are used.

Data of more than 45 stations are available and between 15 and 20 anemophilous tree species are registered at present. For the presented investigation only complete datasets from more than 15 years were taken into consideration.

First results show mostly positive trends or no significant trends north of the alpine ridge and in the east of Austria. The main object of this investigation is to point out first visible clear negative trends in pollination of forest tree species in certain regions of Austria and to analyze the climatically background.

As an example three negative trends in pollen production in Salzburg, Northern Tyrol and Eastern Tyrol are worth mentioning: the dropping pollen numbers of spruce (*Picea abies*) in the Pinzgau, the strong decrease of elm (*Ulmus*) pollen in Zams (N. Tyrol) and the decline of green alder pollen (*Alnus viridis*) in the region of Lienz (Eastern Tyrol).

After intensive causal analysis, using meteorological data of the “Zentralanstalt für Meteorologie und Geodynamik” (ZAMG) of the next closest station to the location of pollen trap, a connection to climate change in all this cases is evident:

- The decrease of spruce pollen (Pinzgau) started by the impacts of a heavy storm catastrophe called “Lothar” in December 1999, followed by storm effects in 2002, 2003 and 2004. The tree numbers of mature spruce had been diminished by about 40 % in this region during these six years.

- Dutch elm disease has advanced into “Oberes Inntal” (Zams) between 1993 and 2002 because the higher absolute minimum temperatures of April and May did not disturb the spread of the vector bark beetles (*Scolytus multistriatus, S. scolytus, S. triarmatus*).

(continues on next page)

- The regression of green alder, dependent on a minimum of soil moisture, may be proven by the comparison of increasing maximum temperatures and decreasing rain (snow) fall during wintertime in the respective region.

The increase of catastrophic storm and hail events northern of the alpine ridge will damage forest tree species more than in the past. The increase of temperature and the additional decrease of precipitation in the alpine valleys and especially southern of the alpine rim will especially affect tree species dependent on high soil moisture content.

Ragweed phenology and cold summer in the Lyon area (France) in 2007

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The growing and flowering of short ragweed (*Ambrosia artemisiifolia* L.) has been studied from the beginning of May to the end of September 2007, in the campus of Lyon1 University (France), along the tramway line (45°78' N, 46°86' E, 170 m). After the 15th of September, the gardeners cut off all ragweeds. The spot where measurements took place was planted of shrubs and the soil was covered of barks to prevent the growing of weeds, nevertheless ragweed grows very well there.

30 specimens were observed during 10 fortnights through 5 stages of vegetative development, from a height of less than 15 cm to over 100 cm. These data were compared with pollen counts and temperature averages (1982-2006) provided by the Lyon-Bron meteorological station, which is faraway from less than 10 km as the crow flies.

The male inflorescences, very difficult to observe, arose from the 15th of June. When they were ripe, with a more brown colour, they seemed to produce a very low quantity of pollen from the end of July. It is in accordance with pollen counts which were lower than the average of 26 previous years in Lyon-Bron (AFEDA carries out *Ambrosia* pollen counts since 1982 in this site).

2007 summer weather was in this part of France atypical. Cool temperatures and high raining falls were registered around Lyon area.Moreover, it also was the case in a lot of French areas except in the middle part of the Rhône Valley (Montélimar) where pollen counts increased.

The negative difference with the year 2006, in many sites where AFEDA traps are located, was important: the decrease for cumulative averages of temperature, during weeks 31 to 40 varied from 2.9% to 6.4% except in Montelimar where it did not rain and where temperatures were higher. A comparison with pollen counts of the previous year shows that their decrease was also important in these sites.

Lyon-Bron 2007 summer temperatures lower than the 25 precedent years average, seem an important contribution for a low recording of ragweed pollen counts. So this first attempt of ragweed phenology must be interpreted with precautions. Our data should also be compared with those of some colleagues* who have realized the same trial in the same region. It would be necessary to take in account the special climatic conditions of 2007 summer.At the end, in the future, in the same site, new phenological observations must be realized and compared with climatic analyses. In 2008, we have observed emergence of *Ambrosia* on two very different sites at the beginning of April.

*This is an international collaboration between USA (PAAA, Panamerican Aerobiology Association) and Europe (Swiss meteorological service and France, French Association For Ragweed Study (AFEDA).

SESSION 2. Gene Flow

Keynote: Ecological and evolutionary consequences of gene flow. Kuparinen A.

From pollen dispersal to pollen-mediated gene flow – or how to calculate the probability of pollination from pollen dispersal data. Schüler S.

Mesoscale modelling of pollen dispersal and implications for gene flow. Brunet Y., Dupont S., Tulet P., Pinty J.-P., Lac C., Escobar J.

Keynote: Environmental and evolutionary implications of genetically modified plants. Saloniemi I.

A new approach for modelling wind dispersal. Niggemann M., Bialozyt R.

Aerobiology and dispersal: Visualizing and experimenting with mini-thermals. Limpert E., Graber W.K.

Microclimatic determinism of pollen viability. Brunet Y., Foueillassar X., Dupont S.

Data in aerobiology: Towards improved recognition of variation. Limpert E., Burke J., Naire-Koivisto L., Rantio-Lehtimäki A., Stahel W.A.

Keynote: Ecological and evolutionary consequences of gene flow

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Gene flow is a process in which genes pass from one population to another. The mechanisms supporting gene flow in plants are pollen and seed dispersal, particularly when these occur over substantial distances. From this point of view, aerobiology typically focusing on pollen concentrations in the air, and pollen dispersal forecasting has much in common with plant ecology and evolutionary plant biology.

Interest in the rates of gene flow and its impact on populations arise from the fact that a population's viability is not only secured by sufficient amount of reproductive output, but also by the population's genetic structure. This can be seen in various processes: sufficient amount of genetic variability in fitness related traits supports a population's ability to survive in variable environments and to adapt to environmental changes. Small populations may suffer from inbreeding depression and pollen availability may also limit their reproductive output, so that the level of incoming gene flow may substantially affect the population's persistence.

The role of gene flow in affecting the response to environmental change is especially relevant now due to climate change. This is because the ability of a species to survive in a changing environment depends on its ability to disperse into new habitats in which conditions are more suitable. In parallel or instead, species can genetically adapt to changed conditions in their habitat. Adaptability of a population depends on the genetic variability in fitness traits within the population, but it can be substantially aided by gene flow from better adapted populations. In contrast to benefits seen in wild, in agricultural systems gene flow may be a severe problem. Breeding programs, certified seed production and maintenance of crop purity are all difficult in the presence of uncontrolled gene flow. The escape of transgenes into wild is also of great concern nowadays.

Estimation of rates of gene flow over different distances is important for various ecological and evolutionary studies in plants. To assess this, one needs to know pollen production dynamics, the pollen dispersal kernel, viability of dispersed pollen, and overlap of times suitable for fertilization in source and target populations. These all are questions studies by aerobiology, suggesting that interactions between aerobiology and plant ecology and evolutionary biology should improve our understanding of the processes regulating gene flow and ability to predict it.

From pollen dispersal to pollen-mediated gene flow – or how to calculate the probability of pollination from pollen dispersal data

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Pollen-mediated gene flow in cultivated plants and trees has become an attractive scientific subject in a variety of disciplines. Main applications are the risk analysis of GMOs and conservation plans for threatened plant species, but it facilitated also our basic understanding of evolutionary and ecological processes.

The methods for a quantification of gene flow can be roughly divided into two categories: first, estimations of gene flow via genetic markers such as paternity analysis, TwoGener analysis or classical Fst-approaches; and secondly, estimations of pollen dispersal via aerobiological analysis or modeling of pollen flow.

The methods of the first category, also referred to as effective or realized gene flow have the drawback that we see only the result of a long chain of different processes, such as pollen production, pollen emission, pollen dispersal, pollination, compatibility, fruit development etc. Since all these processes can be affected by the external drivers we are interested in, e.g. fragmentation, management practices or climate conditions, it is hard to disentangle which driver really affects which process.

The second category, also referred to as potential gene flow, has the disadvantage that the physical sampling procedures have a low representativity and that successful gene flow can hardly be derived from the physical pollen dispersal.

In the present paper, I introduce a new approach to derive measures of successful gene flow from data of physical pollen dispersal on the landscape level. Therefore, I analyzed the ratio between the settled pollen quantities and the number of receptive female flowers. My analysis shows, that the total number of pollinated ovules and the probability of successful gene flow depend on the quantity of settled pollen and on the number of female flowers in the settling area of the pollen. Pollen dispersal was simulated with the mesoscale meteorological model METRAS in which biological functions for pollen emission and viability have been integrated.

Following these results, approximately 1000 pollen/m² deposited downstream of the oak stand in a distance of 25 km, and lower amounts of pollen deposited up to 100 km away. These values of pollen deposition lay within the range of published field studies. Depending on the pollen production of the stand, the analysis of simulated pollen dispersal indicates successful gene flow at very low frequencies up to 100 kilometers downstream of the pollen source. Given a high female flower production, in a distance of 70 km about 1 pollinated flowers/m² can be expected and 0.3 pollinated flowers/m² in a distance of 110 km. In the direct surrounding of the stand, the probability of pollination ranges from 50 to 100 %. Sensitivity analysis with the total annual pollen production as variable parameter demonstrates that an increase of pollen production increases in particular the pollination close to the emitting stand.

The present approach allows to link local gene flow studies based on genetic markers with landscape wide estimates of potential gene flow. Thus, it facilitates our understanding of factors that shape contemporary gene flow on the landscape level.

Mesoscale modelling of pollen dispersal and implications for gene flow

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The growing introduction of genetically modified (GM) crops has generated a host of research efforts aimed at investigating the possibilities for coexistence between GM, conventional and organic farming systems. This is particularly true for maize, a plant that is extensively grown in Europe.

Published experimental and modelling studies aimed at characterizing pollen dispersal have shown that most pollen emitted by a source field deposits within a short distance from the latter, but also that the observed dispersal functions have long fat tails, making it possible for pollen to contaminate plants at rather long distances. Such possibility has been confirmed recently from

(i) a series of airborne measurements of pollen concentration and viability in the atmospheric boundary layer,
(ii) chamber measurements of pollen viability in a range of temperature and humidity conditions and
(iii) observations of fecundations in isolated plots of white-kernel maize, at several km from any maize field.

In order to better understand long-range dispersal of maize pollen an approach has been developed to simulate the trajectories and dehydration of pollen grains in the atmosphere at regional scale. To this purpose the non-hydrostatic mesoscale Meso-NH model has been modified so as to introduce source terms for pollen emission, conservation equations for pollen concentration and moisture as well as a deposition velocity. Several simulations are performed over the Aquitaine region in South-West France, on several days during the maize pollination period.

MesoNH is run in a two-way nested configuration including three nested computational domains down to a 2-km horizontal resolution. GIS-based landuse maps are used for the surface conditions, featuring all the maize fields of the region, as previously identified from satellite data.

Considering several days during which airborne measurements were performed at several times, observed and simulated concentration profiles are found to agree well throughout the atmospheric boundary layer. The simulations allow the pollen plume to be characterized through each day and deposition maps of viable pollen to be produced. The deposition rates at remote distances from the maize fields are in the same range as those measured in situ.

Test simulations are also performed using specific landuse patterns. For example, on a typical convective day a single 12-km square maize source plot is shown to generate a plume that extends over about 100 km in the mean wind direction, and the accumulated deposition downwind from the source exhibits a long tail spanning over five orders of magnitude.

In the future this modelling tool can be used in other domains of aerobiology, such as pollen transport in relation with allergies, pathogen dispersal and atmospheric microbiology.

Keynote: Environmental and evolutionary implications of genetically modified plants

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The implications of genetically modified (GM) plants are likely to range from beneficial to harmful. It is likely that most GM-plants will not cause any obvious consequences. Fortunately, in most countries the use of GM-plants is strictly regulated, which is likely to eliminate most direct problems.

Many of the main environmental pros and cons brought about by GM-crops are likely to be indirect. GM-plant based agriculture is going to change the use of agricultural chemicals and other technologies in many ways. These changes as such are going to have many implications. Besides that, it is impossible to study or predict the interactions between cultivated and natural plants in advance.

Cultivated plants and related wild species have always hybridized, and transgenic plants are not an exception from this rule. Hybridization is more common in cross-pollinating species, but as self-pollination is never absolute, gene flow is possible whenever some of the hybrids are fertile. Especially in cases where wild species are rare compared to crops, many of the wild species will be pollinated by crop pollen.

The consequences of hybridization are poorly understood. The result is likely to depend on the transgene, the fitness of its carries, cost of the transgene, genetic background and environment. Quite many of the presently used transgenes, like insect and virus resistances, are favorable in some circumstances in the wild as well: insect invasions will favor the increase of insect resistance genes, and use of herbicides will favor herbicide resistant weeds. In some cases transgene expression lowers the level of resources available for growth and reproduction, and this may slow down the spread of the transgene (cost of resistance) in situations where the selecting agent is not present.

The spread of a favorable transgene is likely to be fast in the wild, as transgenes are usually dominant contrary to genes of most traditionally bred varieties. Thus selection for transgenes is clearly more effective, as even a heterozygote has the beneficial phenotype. Strong selection is likely to favor and change the frequency of other, entirely unrelated, genes that are situated close to the transgene, and thus a new transgene must act together with other genes.

Crops are usually homozygous and uniform, but wild species and their hybrids offer a new background (alleles of the same genes) for the transgene. Crops are also grown in optimal and homogeneous environments, but the expression of transgenes may differ between hybrids and wild species that live in more challenging environments.

Data in aerobiology: Towards improved recognition of variation

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Frequencies of allergens and micro-organisms in the air as well as their effects on humans and the environment are of major concern. To characterize and summarize the data, several distributions have been used, among which the normal distribution is most popular. In fact, this model has become the standard of quantitative variation across the sciences.

Accordingly, data are summarized using the arithmetic mean and the standard deviation, by ± s, to indicate an interval which is meant to characterize the statistical variation. Often, however, the mere summary data immediately demonstrate that the normal distribution would not be a good fit, as in the case of 50 ± 50. A normal model with mean 50 and standard deviation 50 assigns a probability of 16% to negative values, which is not possible with, e.g., concentrations or any other variables that have to be positive. Moreover, the sign ± points to additive effects, but the processes that affect variation of, e.g., the number of air spora, are usually multiplicative, as are natural laws in general.

Here we
- (i) show how variation is usually characterized so far,
- (ii) point to the need to find an appropriate distribution,
- (iii) present basic features of multiplicative variation,
- (iv) exemplify them with data from aerobiology, and
- (v) discuss chances and possible ways ahead.

If, e.g., the mycotoxin content in houses has a median value (or geometric mean) of close to 50, with a standard deviation - that is now multiplicative - of about 3, then roughly two thirds of the data should be in the range from 17 to 150, i.e. from 50 divided by 3 to 50 times 3. Corresponding to the established form ± ***s*** for the normal distribution, this can be written 50 times/divide 3 (50 ^{x}/3), or, in general, * ^{x}/***s****.

The procedure shows that variation based on multiplicative effects can now be handled in a very similar fashion and as easily as that fitting to the popular (additive) normal distribution. Further data from various fields of aerobiology appear to be worth re-considering and re-analyzing. In addition, we expect to find typical values for medians and multiplicative standard deviations for, e.g., specific phenological data. Moreover, for the seasonal evolution of aerial pollen concentrations as well as, presumably, for that of allergens, forecasting models can be expected to be improved. In general, our thinking could further approach the way nature works. This should improve concepts, hypotheses and theories, not only in aerobiology.

During the 8th ICA at Neuchâtel, Switzerland, the above issues gave rise to an ad hoc "Working Group Data Analysis"*. We feel, indeed, that these efforts are worth evolving further. As an immediate possibility, we would be interested to help with re-analyses of data from current research.

* Limpert, E, Burke, J, Galán, C, Trigo, M, West, J, Stahel, WA, 2008. Data, not only in Aerobiology: How normal is the normal distribution? Aerobiologia 2008;:

A new approach for modelling wind dispersal

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When modelling dispersal, scientists are confronted with the trade-off between simple and fast versus complex and time-consuming models. The first are in many cases mathematical models based on the Gaussian distribution function and do not need many parameters. Some have long fat tails and others are combinations of different statistical distribution functions. Nevertheless, they all have in common that they do not include any component representing meteorological conditions (e.g. wind direction and speed).

In recent times, mechanistic models became a popular tool to disperse each seed individually. This kind of models can be very complex and are only useful if detailed information on flight characteristics is available. While simple models are good for general purposes and computational questions, the latter are more accurate in specific situations taking into account ballistics and meteorological data as well.

We investigate gene flow within the endangered floodplain species *Populus nigra* in Western Germany. For modelling pollen dispersal between many individuals, we look for a fast but not too simple approach. In combination with genetic parental analyses, we are going to calculate the risk of introgression by the common hybrid form *Populus* x *canadensis*. Additionally to the conservation issue we are interested in the consequences of an introduction of genetically modified hybrids into the landscape.

We propose a new dispersal kernel based on a mathematical approach that relies on meteorological data including wind direction and wind speed. The advantage of our kernel is that we can fall back on data that is frequently measured by local weather stations. Therefore, sufficient data are available without having to carry out time-consuming studies and to spend additional money.

Microclimatic determinism of pollen viability

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For cultivated species like maize, pollen viability is primarily determined by its hydric status. It is generally estimated that below a certain threshold in water content pollen grains become unable to germinate, in an irreversible manner.

In pollen dispersal studies it is therefore important to estimate pollen life duration, as a function of the climatic conditions encountered by pollen grains during their transport, or from a calculation of their dehydration rate.

For this purpose, a series of experimental measurements were performed in controlled conditions. Several varieties of maize pollen grains were introduced in a climatic chamber and submitted to a range of temperature (from 11 to 38°C) and relative humidity (from 50 to 92%) conditions. The percentage of viable pollen grains was determined at repeated intervals, as well as the pollen water content.

Pollen duration life is shown to be a strong function of the air saturation deficit, which characterizes air dryness. It varies from about 30 min in hot, dry conditions that can be encountered close to the ground surface in typical pollination conditions in Southern Europe, but increases to several hours in climatic conditions typical of the upper regions of the atmospheric boundary layer, where some proportion of emitted pollen has been found to travel.

A physical model calculating the dehydration rate of pollen and time variation in its water content is tested and validated against the chamber measurements. It allows pollen viability to be monitored during its transport at regional scale, and estimates of the risks of long-distance fecundation to be made. This is of great importance in the context of gene flow as well as in other areas of aerobiology.

Aerobiology and dispersal: Visualizing and experimenting with mini-thermals

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Thermals are of major importance for the dispersal of air spora. In general, they can be regarded as the basic phenomenon of movements of the atmosphere. In contrast to their importance, however, they are difficult to recognize, demonstrate, and to grasp.

This is particularly true for small thermals. Mini-thermals such as those generated by the human body are very difficult to demonstrate, though they appear to be most important for air spora both for take off and landing. We here consider an easy method of demonstrating such mini-thermals with the help of wind-dispersed seed.

Mini-thermals can be made visible by dust in sunlight or other lighting, but suitable dust is difficult to produce and control. We have tested cotton fibres and various wind-dispersed seeds, such as those of dandelion, of the Salicaceae, e.g. willows and poplars, and of thistles, but they were not very suitable for one reason or another. In contrast, we found that the seed of some species of the Asclepiadaceae was particularly suited. They can be obtained from florists, though often with difficulties only.

The seed of, e.g., *Asclepias fruticosa* is surrounded by approximately 200-300 fine hairs, each about 4 cm long, slightly twisted and forming a ball-shaped “parachute”, about 5-6 cm in diameter. The terminal velocity (vs) of an intact seed in still air is about 25 cm s-1. If the seed is removed and the “drifter” reduced to some 20 - 100 hairs, vs is reduced to about 5 cm s-1 only. Such a drifter is now well-suited to visualize mini-thermals.

This can be demonstrated by holding the hand almost vertical and slightly open, keeping the fingers slightly apart to leave some space for air movement. If the hand is now placed and kept about 5 cm below a drifter that is slowly moving downwards, it first stops falling and then starts to move upwards gently, with increasing velocity.

In this way, mini-thermals and air currents can be easily demonstrated and experimented with - without any special instrument. The resulting increase in our understanding of air movement and mini-thermals increases our knowledge of thermal phenomena and air movement in general and, of course, of aerial dispersal. Allied to a larger scale it also provides insight into the processes controlling weather and climate.

Starting from this simple experiment, even children can recognize and think about basic features of the atmosphere, including, e.g., the origin of wind, of global movements of the atmosphere, and the origin and development of deserts. Once recognized, singular dust particles hovering in the sunlight behind a window can be utilized for a little presentation.

We are grateful to Eleonore Schick, florist (www.elobana.de) for suggesting the use of Asclepiadaceae and providing initial seed, and to Roy Snaydon, emerited from Reading, U.K., for valuable comments.

SESSION 3. Developing methods in aerobiology

Microscopic image analysis system: Measurement of allergenic pollen load in the air. Lewandovski G., Hildebrand L., Sinclair La Rosa, N., Meinardus-Hager, G.

Real-time PCR quantification of *Aspergillus sydowii, A. versicolor* and *Stachybotrys chartarum* in indoor dust as compared to traditional culture and microscopy analyses. Yli-Mattila T., Saaranen S., Rantio-Lehtimäki A.

Bertin Technologies presents a new solution for rapid airborne contamination control. Desjonqueres Q., Lacote C.

Influence of weather-related factors on pollen production in forest tree species in Austria. Robitschek K., Litschauer R., Milasowszky N., Geburek T.

Synergy between chemical and biological pollution: interactions between allergenic pollen and atmospheric metal trace elements (MTE). Bosch-Cano F., Ruffaldi P., Toussaint M-L., Badot P-M., Richard H., Bernard N.

Microscopic image analysis system: Measurement of allergenic pollen load in the air

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The newly in aerobiology introduced staining solution named 'aroprot' yields differential staining of pollen from various taxonomic plants as well as of pollen within a certain species as seen during the routine pollen counts (2004 to 2007 in Münster, Germany).

The dye in 'aroprot' binds to proteins in the cytoplasmatic compartment of the pollen, whose colouration differs with a certain morphological and physiological state of the cells. The staining patterns of pollen could prove that 'aroprot' enables 1) a simple identification and 2) an estimation of the allergenic challenge from pollen in samples collected in standard procedures.

Pollen were collected at appropriate time from flowering plants in the vicinity of Münster, Germany. Samples were prepared according to aerobiological standards with glycerin-gelatine mixed with 'aroprot', supplied by AEROmedi B.V., Netherlands. For identification and for measurement of staining intensity of single pollen grains a microscopic image analysis was figured out and assembled. Criteria to establish a routine for identification and classification of intensity of the staining of each pollen, were generated by ocular microscopy.

Staining aerobiological standard samples with 'aroprot' enables an effective analysis of their microscope images using fuzzy logic:

1) relevant pollen genera (Betulaceae, Oleaceae and Gramineae) are identified with good confidence (>80%) besides by size and circularity, by thickness and shape of cell wall pattern as deduced from differential cytoplasmatic staining.

2) Identification of pollen genera in relation to time of appearance, taken together with the intensity of staining - indicating easily released pollen proteins - is a measure of the allergenic charge in the air.

We present the possibility of automated colour analysis of microscope images considering pollen of distinct species. This offers several advantages: analysis of pollen (and other biogen particles) is objective, rapid and effective, because the differences in staining can be precisely discriminated. This enables studies on the influence of origin, environment, climatic conditions, transport etc. on pollen release and on pollen physiology. Application of this method could be near to real time monitoring of allergenic pollen load in the air and medical relevant pollen forecast.

Real-time PCR quantification of *Aspergillus sydowii*, *A. versicolor* and *Stachybotrys chartarum* in indoor dust as compared to traditional culture and microscopy analyses

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TaqMan real-time quantitative PCR assays were used for the quantification of *Aspergillus sydowii, A. versicolor* and *Stachybotrys chartarum* DNA in indoor dust in Finland. Standard methods (with the ALK dust sampling device) were used for collecting dust samples from floors of houses having moisture damages. Traditional culture and microscopy analyses were performed with dust samples grown on THG, MEA and DG18 media for 7 and 10 days.

Three kits (Plant genomic DNA Miniprep kit of Sigma, FastDNA Kit of MP Biomedicals and UltraClean Soil DNA kit of MO BIO Laboratories) were tested for DNA extraction from dust samples.

It was possible to extract DNA with all kits tested, but the DNA obtained with Sigma kit was usually best for qPCR. DNA levels from dust samples were compared to standard curves obtained by using pure cultures of identified isolates of the three species.

Constant amount of *Geotrichum candidum* spores were added to certain dust samples and the amount of *G. candidum* DNA was estimated in dust samples by TaqMan real-time quantitative PCR in order to get an internal standard and to find out the efficiency of DNA extraction. The qPCR assays were not completely specific for the two *Aspergillus* species, but the qPCR assay of *Stachybotrys chartarum* was not affected by the DNA of *A. versicolor* and *A. sydowii*.

A. versicolor was detected in five dust samples of which four contained *A. versicolor* spores. The correlation between the amount of *A. versicolor* DNA and colony forming units detected with traditional analyses was significant ($p<0.04$) in seven dust samples, in which DNA was extracted with the Sigma kit. The coefficient of determination (R^2) of these samples was 0.54. In one sample *A. versicolor* was not detected, although it contained *A. versicolor* spores. The sensitivity of qPCR reaction for *A. sydowii* was lower and qPCR signals were very low in two samples containing different amounts of *A. sydowii* spores.

Stachybotrys chartarum was detected in one sample containing *S. chartarum* based on culture and microscopy analyses, but it was detected also in two samples, in which it was absent based on culture and microscopy analyses. This may be due to the higher sensitivity of the qPCR analysis or the fact that the germination % of *S. chartarum* spores is lower, but its DNA can survive for some time after the spores have died. Inhibition of PCR was found in three dust samples extracted with three different kits based on internal standards of *G. candidum*, but the inhibition could be eliminated using dilution series of DNA samples.

The work was supported by the Laboratory of Aerobiology at the University of Turku.

Bertin Technologies presents a new solution for rapid airborne contamination control

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Bertin Technologies (France) has developed its expertise in the collection cyclonic process and patented its Coriolis® technology, consisting in cyclone type operation to concentrate airborne biological particles into a liquid media.

A high air flow rate, up to 300L/min, can be performed in order to collect a representative sample of the airborne biocontamination. Thus, it improves the probability to detect a large panel of micro-organisms even if there are only present at a low concentration in the air. The cyclonic technology has been validated according to ISO 14698 recommendations for biological and physical efficiency in the collection of airborne spores, pollens or bacteria with a diameter upper than 0,5 µm.

The liquid sample delivered gives access not only to cultivable flora but also to viable and non cultivable flora. Information beyond cultivable flora, comes also from the compatibility with the whole range of microbiological analysis including not only microbiology, but also immuno-assays, PCR, flow cytometry.. Beyond impaction limits, the use of Rapid Microbiology Methods thus leads to specific and reliable results in a few hours response time.

Thanks to these advantages, the technology is adapted to a wide range of applications for indoor and outdoor contamination control. Indeed, the Coriolis® technology is adapted for aerobiocontamination control of clean rooms in pharmaceutical, cosmetic and food industries as well as hospitals, and also for environmental sampling near air cooling towers and others outdoor environments (molds in houses).

Based on the Coriolis® technology, Bertin offers a range of air samplers. Among them, the Coriolis®µ is a portable air sampler with a high air flow rate, which may be used in any place thanks to the battery. The Coriolis®θ offers a solution to outdoor long-time monitoring (up to 6 hours) and is used in several sampling stations throughout Europe, in the framework of MONALISA project with the contribution of the LIFE financial instrument of European Community. A specific equipment, Coriolis®MS has also been developed for military specifications.

Influence of weather-related factors on pollen production in forest tree species in Austria

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Aerobiology is the study of the atmospheric dispersal of airborne, fungus spores, pollen grains and micro-organisms. However, aerobiological observations are not only important in medical science, but also in forestry. Trees have to produce pollen and seeds to disseminate genes to the next generation and to maintain reproduction and regeneration.

The BFW (Research and Training Centre for Forests, Natural Hazards and Landscape) runs 21 pollen traps since 1988. These pollen traps are distributed all over Austria encompassing different regions and altitudes.

All pollen data are usually recorded approximately from February to June, whereas the exact start and end of pollen counting depends on favourable weather conditions for pollination.

Climate data for all pollen traps are provided by ZAMG (Zentralanstalt für Meteorologie und Geodynamik).

Weather-related factors like temperature, precipitation and relative humidity are correlated with pollen data in order to compare the influence of climate conditions on different tree species in Austria.

Particularly, since pollen traps are exposed on sites of very different environmental conditions comparisons will not only be carried at the national-wide scale, but also on lower geographical scales (local, regional). Furthermore, threshold values of pollen production of selected tree species are determined statistically using regression models.

The results are discussed in the context of the global climate change phenomenon.

Synergy between chemical and biological pollution: interactions between allergenic pollen and atmospheric metal trace elements (MTE)

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Interest into allergies coincides with the beginning of the industrialization; allergy went from the 6th to the 4th rank of pathologies during the last twenty years. In occidental countries, increase of allergies, in particular allergies to pollen, pollinosis, has become a major issue for health.

Allergies are triggered by the interactions between genetic factors and environmental factors, the respective contribution of each factor is not known yet. Many studies look into allergy prevalence according to environment type. They show that the pollinoses are more frequent in urban areas due to the atmospheric pollutants; they are different in nature and concentrations in cities and in countries.

When chemical pollution and biological pollution are joined together, the effects on health increase because atmospheric pollutants can modify pollen allergenicity. Different authors studied interactions between pollen and gaseous atmospheric pollutants. The interactions between Metal Trace Elements (MTE) and pollen are unknown, whereas it is well known that MTE are very dangerous for the health.

The objective of this work is to study interactions between atmospheric pollutants as MTE and allergenic pollen. Pollen grains are exposed to MTE, in a chamber in a laboratory and *in situ*, near polluted sites or far-away of all known polluted sites.

The first results of this study showed than pollen grains could be more allergenic because they fix atmospheric MTE, coming from exposition *in situ* or in laboratory. The concentrations of MTE are high whether the pollen grains have been collected near polluted sites or whether they have been exposed to high quantities of MTE. The parameter “concentration of pollutants” could play a part on capture of MTE by pollen. The pollinic structure could influence this capture too.

Future works include quantifying, for men, the allergenicity of pollens contaminated with MTE (contaminated in nature or in laboratory) in comparison with the allergenicity of non-contaminated pollens.

Key words: pollen, metal trace elements, atmospheric pollution, allergenicity.

POSTERS 1a. Models

The application of timeline to describe the abundance of airborne birch pollen. Sauliene I., Kanisauskas V., Mazilinaite R.

Are the birch trees in Southern England a source of *Betula* pollen for North London? Skjøth C.A., Smith M., Brandt J., Emberlin J.

Examining the relationship between start dates of plane (*Platanus acerifolia*) and birch (*Betula* spp.) pollen seasons in Poznan, Poland. Nowak M., Smith M., Stach A., Emberlin J.

Diurnal Cycle of Birch Pollen: Parameterization for Operational Modelling. Mahura A., Rasmussen A., Baklanov A.

Copenhagen – a significant source to *Betula* pollen? Skjøth C.A., Sommer J., Brandt J., Hvidberg M., Hansen K.M., Hertel O., Frohn L.M., Christensen J.

Interaction between Poaceae pollen, urban air pollution and temperature in Zagreb city. Herljevic I., Hrga I., Puntaric D.

A satellite-based map of the onset of the birch flowering of Norway. Karlsen S.R., Høgda K.A., Ramfjord H.

The application of timeline to describe the abundance of airborne birch pollen

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One of the main tasks for European aerobiologists is to solve allergenic plants' pollination forecasting problems or at least to standardise forecasting system. In order to qualitatively forecast pollen dispersion and concentration scientists investigate dependences between flowering phenology and pollen emission, estimate specificity of plant ontogenesis and pollen production, study the impact of meteorological factors on pollen dispersion, etc.

It is evident that pollen load (start of pollination, peaks, lasting of period, etc.) in the air can be significantly determined not only by pollen from local plants but also impacted by pollen transferred with long distance transport. However the main influence on an increase of pollen amount has pollination season of local vegetation.

For these reasons characteristics of them are essential for each case. In Lithuania we have just 4 years of data of aerobiological monitoring, but this does not break our purpose to find out regularities determined pollen concentration in the air. The aim of this investigation is to estimate which type of timeline describes emission of birch pollen due to the period (per day) in Lithuania.

The birch pollen data collected (during 2004-2007) from three aeropalinological stations located in Klaipeda, Siauliai and Vilnius was used for the analysis. The pollen season was defined by 5 % method. In the research we analysed few timeline processes.

To estimate the fixed pollen concentration during the time unit (per day) the time line AR (1): $X_t=aX_t-1+\varepsilon_t$, when $\varepsilon t \sim N(0,\sigma 2)$ was examined. The other AR (p) processes were investigated either.

The main results of research. It was found that the AR (1) timeline processes described the birch pollen concentration during the determined period best. The higher line ARMA models AR (2) and AR (3) did not work. The estimation of AR (p) model line p has shown us that AR (1) applies optimally in all the cases investigated.

Are the birch trees in Southern England a source of Betula pollen for North London?

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This paper examines high magnitude *Betula* pollen episodes during the main birch pollen season at North London, United Kingdom, with respect to source regions using a combination of trajectory analysis and a source map.

Betula pollen data were collected by volumetric spore trap at North London (2001-2005) following the standard method of the UK National Pollen Monitoring Network. A map of potential sources of *Betula* pollen in Northern Europe was produced using national statistics and forest inventories. Back-trajectories were calculated for all available bi-hourly *Betula* pollen counts within the pollen season defined using the 98% method (n = 1664).

Back-trajectories were then sorted using the following two criteria: (1) Back-trajectories representing the time of peak diurnal birch pollen count (one trajectory per day) for all available days with daily average *Betula* pollen counts >80 grains/m^3 were collated and examined as a group; (2) Back trajectories for bi-hourly counts recorded during episodes with diurnal patterns that were distinctly different to the mean daily cycle were investigated individually.

The highest densities of broad-leaved forest and birch trees within broad-leaved forests in the study area are located to the south and west of London. Average bi-hourly *Betula* pollen concentrations for all the days included in the study, and for all available days with daily average birch pollen counts above 80 grains/m^3, show that in general there is a peak between 14:00 and 16:00.

Back-trajectory analysis showed that, on days with daily average *Betula* pollen concentrations > 80 grains/m^3 (n = 60), 80% of air masses arriving at the time of peak diurnal birch pollen count approached North London from the south in a 180 degree arc from due east to due west.

Detailed investigations of three *Betula* pollen episodes were used to illustrate how night-time maximums (22:00-04:00) in *Betula* pollen counts could be the result of transport from distant sources or long transport times caused by slow moving air masses. High magnitude *Betula* pollen counts in North London are generally associated with air masses approaching the pollen-monitoring site from a southerly direction.

This combined with a night-time diurnal maximum suggests that *Betula* pollen recorded at North London could originate from sources found to the west and south of the city and not just trees within London itself. Possible sources outside the city include Continental Europe and the *Betula* trees within the broad-leaved forests of Southern England.

Examining the relationship between start dates of plane (*Platanus acerifolia*) and birch (*Betula* spp.) pollen seasons in Poznan, Poland

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The objective of this study is to determine whether start dates of the *Betula* and *Platanus* pollen seasons at Poznan are related, and to see if it is possible to use this relationship in a forecast model.

Daily average *Betula* and *Platanus* pollen counts for Poznan (1996-2007) were collected by volumetric spore trap. Relationships between the start dates of *Platanus* and *Betula* pollen seasons were examined using Spearman's Rank correlation test. The method used for modelling airborne *Platanus* pollen concentrations was simple linear regression analysis. The forecast models were constructed using data from 1996-2005 inclusive and tested using data from the 2006 and 2007 *Betula* and *Platanus* pollen seasons. The two years used to check the model were within the limits of the 1996-2007 dataset. Data were also checked to see whether outliers had a significant affect of the results of the analysis.

The results of Spearman's Rank correlation tests show that there were a number of significant correlations ($p<0.05$) between start dates of *Platanus* and *Betula* pollen seasons calculated using retrospective and threshold based methods. Start dates of the *Platanus* (dependent variable) and *Betula* (independent variable) pollen seasons calculated using different methods were entered into simple linear regression analysis.

The most accurate forecast using a retrospective method (95% method) for defining the start was 2 days early in 2006 and 4 days late in 2007 ($R^2 = 0.589$). Whereas, the most accurate prediction achieved using a threshold based method to define the start (start of the *Platanus* pollen season defined as the first day when counts were > 30 grains/m^3, and start of the *Betula* pollen season defined using the threshold of 100 *Betula* pollen grains cumulative total) was 1 day early in 2006 and 6 days late in 2007 ($R^2 = 0.392$). Note that so little *Platanus* pollen was recorded in 1999 at Poznan that the thresholds of > 20 and 30 grains/m^3 daily average were not reached.

The start of the *Platanus* pollen season at Poznan can be predicted by entering start dates of the *Betula* pollen season into simple linear regression analysis as the independent variable. The best results were obtained using start dates defined using the 95% method. The *Platanus* pollen season starts before the *Betula* pollen season has finished and so the 95% (retrospective) method is rather impractical.

A threshold based method would therefore have more practical uses. The next step will be to study the mechanisms that promote flowering (e.g. temperature) in both *Betula* and *Platanus* in order to produce effective forecast models for the start of the respective pollen seasons.

Diurnal Cycle of Birch Pollen: Parameterization for Operational Modelling

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The purpose of this study was to investigate patterns of the birch pollen counts over a diurnal cycle and propose a parameterization useful for the inclusion into operational and research short- and long-term modelling for birch pollen atmospheric transport and deposition at different spatial scales. The evaluation of patterns of diurnal cycles on monthly and interannual basis has been done based on analyzes of a long-term time-series of birch pollen counts from the Danish pollen measurement site in Copenhagen.

The suggested parameterization, based on a simple trigonometric function, includes dependences on a time of a birch pollen maximum and minimum occurrence on a diurnal cycle, averaged concentration at the end of the previous day, and a time shift. The multiple evaluations of the fitting curves have been done in order to obtain a continuous function representing relatively smoothed diurnal cycle variability.

The best curve representing the diurnal cycle was selected depending on a minimal difference between the mean observed birch pollen values vs. fitted values of polynomials and trigonometric functions. Further such function might be identified as a simple and useful variant of parameterization describing a common behavior of birch pollen diurnal variability.

Due to the fact that there are only two birch pollen measurement stations in Denmark with long-term measurements (Copenhagen and Viborg) the additional testing of parameterization would be needed with evaluation of the coefficients' variability and limits. In particular, within the POLLEN project, at least, the birch pollen data from the Finish and German measurement sites might be used for verification and identification of the latitudinal vs. longitudinal dependences.

Copenhagen – a significant source to *Betula* pollen?

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In Denmark, remote sources for birch pollen include Germany, Poland and most likely also Sweden. Research on atmospheric transport of birch pollen is based on the assumption that the most important sources of atmospheric birch pollen in Europe are the forests in Russia, Belarus, and Baltic and Nordic countries. However, long-range transport of birch pollen seems intermittent. It is therefore likely that most of the observed birch pollen in Denmark is related to Danish birch trees. However, birch is not a commonly used forest tree in Denmark. Therefore following hypothesis is formulated: "A significant part of the observed birch pollen in Copenhagen is related to trees outside the Danish forests".

In April-May 2003 we used simultaneous measurements of atmospheric concentration of Betula pollen in Copenhagen (Denmark) and the city of Roskilde, 40 km to the West of Copenhagen. Pollen slides were examined and the time series analysed. Atmospheric transport was analysed using a trajectory model by analysing all measured time series. Possible source areas was identified by combining satellite derived land-cover information and forest inventories on sub-national scale for Denmark, Germany, Poland and Sweden.

The observations for 2003 showed that the Betula pollen season was initiated the 22nd of April and ended the 8th of May. The concentrations peaked between April 22nd and May 5th. Lowest daily concentrations was measured the 25th of April and the highest the 26th. During the period April 27th-April 29th and May 1st, day concentrations are about a factor of two in Copenhagen compared to Roskilde. Peak bi-hourly concentration reached about 1000 grains/m2 during these episodes.

Air mass transport arrived from Southern Scania (Sweden) on the 25th and from Poland the 26th. The episodes with elevated concentrations in Copenhagen compared to Roskilde showed air mass transport from Roskilde to Copenhagen. On local scale, the source maps identified no significant broad leaved forest areas between Roskilde and Copenhagen. On regional scale the Germany and Poland and Several Swedish regions contained significant higher amount of *Betula* in the broad leaved forests. Interestingly, the most southern region in Sweden (Scania) contained limited amount of *Betula* trees compared to other Swedish regions.

Our hypothesis, that a significant part of the measured *Betula* pollen in Copenhagen is related to sources outside Danish forest is supported by this study. On local scale a potential source is likely to be Copenhagen itself including gardens parks and recreational areas. On the regional scale potential sources may be found in the German and Polish forest. Large amounts of *Betula* trees were also found in several Swedish regions, but no transport episodes from this area were identified.

The analysis indicate, that the governing processes for the pollen level may by analysed using a combined method of measurements, atmospheric transport models and emission maps. The analysis is likely to cover regional scale as well as local scale, as significant sources the *Betula* pollen level in Copenhagen are found outside Denmark as well as in the city itself.

Interaction between Poaceae pollen, urban air pollution and temperature in Zagreb city

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The airborne grass pollen can produce asthma and rhinoconjuctivitis in pollen allergic individuals. Studies have demonstrated that urbanization and high levels of vehicle emissions is correlated with the increasing frequency of pollen-induced respiratory allergy and people who live in urban areas tend to be more affected by pollen-induced respiratory allergy than those of rural areas. In urban cities among the components of air pollution there are high concentrations of ozone during the summer.

Ozone trends depend on substrate supply (emission of nitrogen dioxide by cars) and weather conditions and sunny days facilitate the transformation of nitrogen dioxide into ozone. Component of air pollution interact with inhalant allergens carried by pollen grains and urban air pollution affects both airborne pollen and airways of exposed subjects.

Pollen grains carry allergens that can produce allergic symptoms. They also interact with air pollution (ozone, particulate matter) in producing these effects. Furthermore airway mucosal damage and impaired mucociliary clearance induced by air pollution may facilitate the access of inhaled allergens to the cells of the immune system. Vegetation reacts with air pollution and environmental conditions and influence the plant allergenicity.

The city of Zagreb serves as a good model with which to study the interaction between grasses pollen- derived allergen and air pollution. It has 1 million inhabitants and very dense traffic and sunny days during the summer favour high levels of ozone. The climate favours the pollination of Poaceae which is one of the most important airborne allergen sources and which grows abundant through the entire city.

The aim of the study was to determine day to day pollen variation, and the effect of temperature and concentrations of ozone on atmospheric pollen concentration in Zagreb. A study was carried out during two seasons (2005 – 2006), using a 7 – day VPPS 2000 Hirst volumetric pollen trap.

The beginning of the grass pollen season is usually observed when the average daily temperature exceeds 13.5°C. The increasing in airborne concentrations of Poaceae pollen grains is a parallel with increasing of ozone levels (from May to July) and temperature.

In both study years the absolute peak of concentrations occurs in the second half of May when Poaceae pollen grains reach levels of about 200 grains/ m3 of air and concentration of ozone is about 100 μg/m3. After July the production and release of Poaceae pollen grains usually decreases, while ozone levels and temperature remain high since September. The conditions of Zagreb favour the interaction between Poaceae pollen, ozone and temperature is parallel increase of ozone, temperature and Poaceae pollen grains.

A satellite-based map of the onset of the birch flowering of Norway

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Birch (*Betula* spp.) is extremely common in all of Norway and birch forests constitute the forest line both upwards and northwards. In terms of vegetation zones, Norway comprises the nemoral zone, characterized by broad-leaved forest, in the south to the treeless arctic zone in the north, along a distance of about 1500 km. In addition, due to the mountainous topography of Norway, an altitudinal replacement of this north-south gradient can be found everywhere over much shorter distances. Thus, making pollen forecast of Norway is a challenging task. Hence, there is a need for better understanding of the spatial pattern of the pollen dispersal of birch.

The male flowering and leaf bud burst of birch are well correlated, which indicates that the observations of a phenophase as leaf bud burst could be used to determine the timing of local birch pollen release. Satellite image-aided analysis of phenology of natural vegetation provides a spatially complete coverage that can be used to interpolate traditional ground-based phenological observations. Hence, this indicates that the measurements of leaf bud burst of birch from remote sensing could be used to determine the timing of the local birch pollen release.

In this study we use MODIS-NDVI satellite data with 250 m spatial resolution and 16-days time resolution for the period 2000 - 2007 and birch pollen counts from 10 Burkard traps across Norway to characterize the onset of the birch flowering of Norway.

The correlation value (r) between the MODIS-NDVI defined onset and the date when the annual when the accumulated pollen sum reach 2.5% of the annual total where on average 0.74.

A map of all Norway that shows the 8-year mean (2000-2007) onset of the birch flowering was produced. The map provides good general information that can be utilized in The Norwegian pollen forecast service. Users of the service can for instance estimate an approximate time for the local birch flowering onset in their surroundings when the earliest start of the season (usually in the southern or western outer coastal areas) is reported through the forecasts, due to the time difference between the various zones on the map.

This study prove that remote sensing is a useful tool for characterizing the onset of the birch pollen season and to reveal regional differences not easily detected by pollen stations alone.

POSTERS 1b. Gene Flow, Methods

Meteorological impacts on pollen emission and spread – Introduction to an inter-disciplinary project. Schüler S., Piringer M., Robitschek K., Litschauer R.

Pre-seasonal long range transport of birch (*Betula*) pollen to Denmark. Skjøth C. A., Sommer J., Stach A., Smith M., Brandt J.

Automated pollen measurement background: pollen calendar revisited. Clot B.

How do airborne and deposition pollen samplers reflect the atmospheric dispersal of pollen? A case study from northern Finland. Sokol C., Ranta H., Hicks S., Heino S., Kubin E.

A tree specie inventory over Europe. Skjøth C.A., Geels C., Hvidberg M., Hertel O., Brandt J., Frohn L.M., Hansen K.M., Hedegaard G.B., Christensen J. H., Moseholm L.

An attempt of elemental analysis of airborne pollen. Polevova S.

Meteorological impacts on pollen emission and spread – Introduction to an interdisciplinary project

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Emission and spread of tree pollen are important processes, firstly, because pollen of several tree species act as major allergen in the human population, and secondly, because pollen dispersal is a crucial process in the life cycle of the predominantly wind-pollinated trees in temperate forests. Thus, pollen dispersal provides reproduction and gene flow, and contributes significantly to the genetic diversity within and among populations.

The present poster introduces a new project that aims at investigating and highlighting the meteorological factors causing local pollen emission and transport in a typical Central European forest of mixed deciduous and coniferous trees, and the development of a functional model for pollen emission.

We conduct measurements of pollen concentrations of spring flowering trees and meteorological conditions in a high-temporal resolution at three levels on a 30 m high tower within a 20 m high forest canopy in the “Lehrforst Rosalia” in Eastern Austria. The instrumentation consists of a special adapted pollen collector with three sampling units, which sample pollen from all directions in the same quantity, and which allow the recording of pollen concentration in a high temporal resolution.

The meteorological equipment consists of three ultrasonic anemometers and conventional temperature, humidity and radiation sensors, which measure meteorological data in the same heights as the pollen concentrations (above the canopy, within the canopy, and on the forest ground). In addition to the field campaign, pollen transport will be modelled with a Lagrangian particle model based on trajectories determined from a diagnostic wind field model fed also by the meteorological data of surrounding stations.

The project should improve knowledge on:

a) pollen emission with respect to different tree species common in Central Europe,
b) the meteorological parameters favouring pollen emission,
c) the horizontal and vertical pollen transport within and above the forest canopy, and
d) the ability of a Lagrangian particle model to correctly estimate ambient pollen concentrations.

The expected better understanding of pollen emission and spread of typical European forest tree species will help to develop a new generation of pollen dispersal models. Such models can be important tools for forest research and landscape management, for forecasting and monitoring of pollen allergy symptoms, and for a risk evaluation and monitoring of genetically modified trees.

Pre-seasonal long range transport of birch (*Betula*) pollen to Denmark

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Birch pollen is considered to be among the most important allergenic pollen types in the northern hemisphere. In Denmark, pollen allergy has increased among the population during the last 30 years. Currently about one million Danes suffers from seasonal allergic rhinitis. Birch has the potential for long-range transport. In Denmark, the official reported pollen forecast is based on the daily weather forecast, the pollen calendar and local 24-h pollen measurements. The present Danish pollen forecast does not include long-range transport. Episodes of long-range transport are intermittent and often outside of the main pollen season, when individuals will generally be unprotected. We therefore investigated whether Denmark receives significant quantities of birch pollen from Poland and Germany before local trees start to flower.

In 2006 we used a combination of phenological observations and pollen measurements in Poland (Poznan) and Denmark (Copenhagen). Seasonal and diurnal variations in birch pollen measurement from Copenhagen (2000–2006) were examined with the aim of identifying pre-seasonal episodes originating from long-range transport. The 2.5% accumulation method was used for identifying the start of the birch pollen season. If the daily average *Betula* pollen count exceeded 30 grains/m3 either before the local flowering season began or on the actual start day, the episode was chosen for investigation using back trajectory analysis. A map of potential sources of birch pollen was produced for Poland and Germany. In 2006, full flowering took place in Poznan between the 20th and 28th of April and daily average birch pollen concentrations varied between 739 and 2169 grains/m3. In Copenhagen phenological observations showed that local flowering was initiated on the 2nd of May. In Copenhagen three episodes with daily average birch pollen concentrations of 108, 244 and 41 grains/m3 were recorded on the 23rd, 26th and 27th of April, respectively. Backtrajectory analysis showed that for these three dates the air masses originated in Poland including the Poznan region where birch trees were known to be flowering. Eleven possible pre-seasonal long-range transport episodes in 2000-2006 were identified during analyses of the measured pollen data.All possible long-range transport episodes were investigated with back trajectories. In all investigated episodes, the air masses arrived in Copenhagen directly from either Germany or Poland.

Our work shows that Denmark receives significant quantities of airborne birch pollen before the season is initiated in Denmark. During that period individuals who are sensitised to birch pollen are generally unprotected. Such episodes will therefore have a full impact with respect to allergic reactions among the allergic population. Long-range transport episodes of birch pollen have occurred almost every year since 2000, and so it is likely that this is a general pattern. The use of back-trajectories indicates that atmospheric transport models will be able to forecast such episodes. The most effective way to improve the current Danish forecast is therefore to extend the current forecast with dynamical models that take into account pollen emission and atmospheric transport from countries such as Germany and Poland.

Automated pollen measurement background: pollen calendar revisited

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Recent developments in measurement techniques let think that automatic systems will soon be able to identify and count airborne pollen grains. These devices will deliver a large number of data that will require different verification and validation steps.

For the identification of pollen grains also, information concerning the plausibility of their presence and abundance in the air can be of importance.

This work presents a first attempt to make use of past pollen data in order to provide useful information in the context of automatic pollen monitoring with a device based on laser optics. The goal was to limit the number of taxa to be considered during each period of the year and explore the possible quantitative importance of incorrect identification.

Pollen types were first grouped according to their size, which is one of the information that such a device can easily provide. Then the seasonality of different pollen types and their relative concentrations were detailed.

The result is a new type of pollen calendar presenting the risk related to identification errors. This approach will be useful until automatic devices are able to identify every pollen type with sufficient accuracy.

How do airborne and deposition pollen samplers reflect the atmospheric dispersal of pollen? A case study from northern Finland

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We compare two >20 year long data sets of airborne and deposited pollen from northern Finnish Lapland (Kevo) and the middle boreal forest zone (Oulu) in terms of the plant taxa represented and their annual pollen quantities. The data were collected by a Burkard continuous volumetric air sampler and a modified Tauber trap, simulating the deposition of pollen at a sediment surface.

Tree pollen (*Betula*, *Pinus*) made up 93 % of total annual pollen in the air samples in Kevo, while in the deposition samples the tree pollen fraction was 61 %, and that of ground and field level plants (Ericaceae and Cyperaceae) 35 %. In Oulu the proportion of tree pollen in the air and deposition samples was 91 % and 89 %, respectively.

The annual fluctuations in the quantity of total pollen and tree pollen in both sampling systems were correlated, but no such correlation was detected for low growing plants, except Urticaceae in Kevo. This, together with the small amount of pollen of the Ericaceae and Cyperaceae species in the air suggests that pollen of these low-growing plants mainly reflects the vegetation of the sampling site. Tree pollen, on the other hand, becomes mixed in the atmosphere and may reflect the pollen production from a larger area. Urticaceae plants are rare around Kevo, and their pollen in the deposition pollen trap does not necessarily reflect even regional conditions.

We also considered the significance of airborne preflowering pine and birch pollen by including phenological observations from 1997 to 2006. Exceptionally strong pulses of preflowering *Betula* pollen were detected in Kevo in the years 2000 and 2002, nearly a month before the local onset of flowering which suggests that they are long-range transported.

In 2000, long-range transported pollen made up to 45 % of the annual airborne pollen catch, in 2002 the figure was 33 %. In 2002 also 30 % of preflowering pine pollen was detected, but this occurred only a few days before the onset of local flowering suggesting that its origin was from closer sources. Only in 2001 was pine pollen recorded around two weeks before the local flowering, and in this year it made up 28 % of the annual pine pollen sum. In Oulu the year 1999 was characterized by 80 % of long-range transported birch pollen one month before the local flowering.

Preflowering pine pollen made up 35 % of the yearly pine total in 1999, and occurred immediately before the onset of local flowering. From 1997 to 2006 the annual mean proportion of preflowering pollen is 24 % (Kevo) and 15 % (Oulu) for birch and 10 % (Kevo) and 6 % (Oulu) for pine. Whereas long-range transport in this study was detected quite often in birch it was rare for pine. This, together with the relatively low proportion of preflowering pine pollen is important for interpreting the origin of deposition pollen data.

A tree specie inventory over Europe

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Atmospheric transport models are used in studies of atmospheric chemistry as well as aerobiology. Atmospheric transport models in general needs accurate emissions inventories, which includes biogenic emissions such as Volatile Organic Compounds (VOCs) and pollen. Trees are important VOC and pollen sources and a needed requirement is specie distribution which takes into account important species such as *Betula* and *Alnus*. We present here a detailed tree species inventory covering Europe, parts of Africa and parts of Asia.

Forest inventories have been obtained for each European country, parts of Asia and parts of Africa. The national inventories vary with respect to number of species as well as the number of sub-regions each nation is divided into. The inventories are therefore harmonised within a GIS system and afterwards gridded to the model grid defined by the EMEP model: 50 km x 50 km. The inventory is designed to be used with existing land-use data, which separates forest cover into broad leaved, mixed and conifer forests. The final inventory includes 16 conifer species and 23 broadleaved species that are important for biogenic VOCs or pollen emission calculations. For example: Oak (*Quercus*), poplar (*Populus*), pines (*Pinus*), spruce (*Picea*), birch (*Betula*) and alder (*Alnus*). 774 regions with forest inventories are included, mainly on sub-national level.

The coverage of each specie ranges from national to European scale, where the latter includes allergy relevant species such as *Alnus* and *Betula*. For *Betula* the highest densities are up to 100% and are found in Scandinavia, the Baltic countries and Russia. The density of *Betula* decreases with latitude and the southern limit is northern to central Spain and parts of Italy. The density of *Alnus* has a maximum of about 50% in parts of Poland, the Baltic countries and Belarus. High densities are also found in southern Sweden, Germany and the Alp region. The southern limit is Northern to Central Spain and Italy.

The inventory show, that important pollen species such as *Betula* and *Alnus* are found in most of Europe where the highest densities are found in Scandinavia, the Baltic countries and Russia for *Betula* and in Poland, the Baltic countries and Belarus for *Alnus*, respectively. The inventory is gridded to the model grid defined by the EMEP model, which is also the basis for many emissions inventories throughout Europe. The inventory is therefore prepared for easy implementation into atmospheric transport models by providing an extension to already applied land use data such as the Corine Land Cover (CLC2000) or Global Land Cover (GLC2000). Possible applications of the inventory include emissions of VOCs and pollen, CO2 fluxes and dry deposition - in general calculations which are tree species dependent.

An attempt of elemental analysis of airborne pollen

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Airborne pollen may adsorb substances from the environment while transporting from the plant-producent to the trap. In case of a small volume (about 10000 μm^3) such as a pollen grain, a method of energy dispersive X-ray (EDS) analysis with an analytical scanning electron microscopy might be applied to the elemental analysis. This method in our case allows to detect the elements from sodium to uranium. The depth of EDS-analysis of a specimen is about 4 μm, though the complex pattern of the surface and specimen porosity might add a considerable error to the calculations.

The EDS-study of the pollen grains was carried out several times for the male gametophyte. A number of elements which have peaks in the spectrogram were detected. The localization of the elements in the pollen grains and in another locule and there migrations were studied.

For the study the pollen was trapped from the air on the carbonic sticky tape in the Duram's trap, exposed during the period of the most intensive pollination for the twenty-four hours. In spring – the 27–28 April 2007 – there is a peak in birch pollination, in summer – the 14–15 August 2007 – the maximum of wormwood, a lot of *Ambrosia* and *Chenopodium* pollen. The adhesive tape with the pollen was transferred on the beryllium specimen stub and analyzed by EDS SEM. The areas of a studied pollen grain without any other particles (sand, dust) were selected for EDS SEM. For reducing the calculation error an elemental mapping was produced for 5 individual pollen grains.

The elements, having good peak/background ratio and so reliably detectable in the spectrograms were revealed in the pollen: magnesium, aluminium, silicon, phosphorus, sulphur, chlorine, potassium and calcium. Other elements, including ecologically dangerous (lead, radioactive isotopes) were not detected, though they could be present in a concentrations lower than the revealing level (about 0,01 %). Preliminary elemental distribution maps and elemental spectra for the each pollen grain and the distribution tables of the relative concentration (mass %) for the each element were obtained.

Due to the preliminary studies it was found out, that the spectra and quantitative distribution of each element in the specimens are strictly confined taxonomically. In the iterations pollen grains might have considerably differencing characteristics (the error from 40% to 200%), which could overlap for the each individual element, but the general pattern of the element distribution turned to be taxon-sensitive. The relative taxa (wormwood and *Ambrosia* from the Asteraceae) showed the most similar spectra, than those of *Betula* and *Chenopodium*, belonging to the different orders.

From the taxonomical point of view the content of phosphorus, potassium and calcium was found to be most important. *Betula* pollen differs in more high phosphorus content, *Chenopodium* pollen (halophytic plant) is characterized by a large quantity of potassium and moderately raised chlorine content. Pollen grains of *Artemisia* and *Ambrosia* differ from those of *Betula* and *Chenopodium* in high calcium presence. Spectral peaks of magnesium, aluminium and silicon in all the studied specimens were equally low.

SESSION 4a. Indoor air hazards: Allergens

Keynote: House-dust mites and the indoor micro-climate. Spieksma F.Th.M.

The reduction of exposure to fungal spores in beds by the use of Amicor treated material in bedding: a double blind placebo controlled cross-over trial. Emberlin J., Robertson L., Warren A., Adams-Groom B., Smith M., Bustos Delgado I., Prieto Baena J.C., Marks R., Potter C., Wall S.

A study of the latex proteins concentration in hospital areas. Albertini R., Ridolo E., Peveri S., Ugolotti M., Usberti I., Pasquarella C., Sansebastiano G.E., Saccani E., Vitali P., Dall'Aglio P.

Birch pollen allergenic activity and personal allergen exposure in Finnish home environment. Yli-Panula E., Järvinen K., Tovey E.R., Rantio-Lehtimäki A.

Keynote: House-dust mites and the indoor micro-climate

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Observations under different conditions of weather and outdoor/indoor climate have shown that humidity is an important factor for the occurrence of house-dust mites in homes.

In moderate climate zones, numbers of mites increase during the summer period with relatively high humidity conditions indoors, and decrease during the relatively dry winter period when homes are heated. In homes with wet or damp (construction) materials significantly more mites are found than in dry homes. And at high altitude (over 1500 m), again in moderate climates, less mites are living than at sea level.

Laboratory studies under different humidity conditions have shown that for growth of mite populations relative air humidity of over 60% is required, with an optimum of around 80%.

In moderate climate zones of the world, these humidity requirements are best fulfilled at sea level, in summer time, when houses are not heated, and ambient air humidity usually is around 70%. If a house contains wet or damp materials, the areas of favourable mite growth conditions are larger than in dry homes. In beds and stuffed furniture humidity will often be high by water vapour production due to transpiration and breathing by humans, making these niches more or less permanent spots of mite populations.

Measuring the relative air humidity somewhere in a room may give inadequate information about the micro-climatical condition in the niches where the mites actually live that is in contact with or close to floors, carpets, furniture, and particularly in mattresses in beds.

The reduction of exposure to fungal spores in beds by the use of Amicor treated material in bedding: a double blind placebo controlled cross-over trial

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This work is part of a 4 year study which investigated the reduction of house dust mite and fungal allergens in bedrooms by the use of Amicor (fungicide) treated bedding and the subsequent effects on Asthma, Rhinitis and quality of life. The Amicor reduces fungi and so would disrupt the mite food chain. If this occurs, it may help to reduce symptoms.

A long term placebo controlled double blind cross over study was required as any new bedding will decrease exposure to allergens before re-colonisation, and also sensitivity to the allergens differs considerably between individuals.The aim of this part of the work was to determine whether significant differences occurred in the fungal spore load in the breathing zone on the subject's bed between the placebo and the treated bedding phases.

Fifty four subjects (all age groups) were selected on the basis of sensitivity to house dust mite (by skin prick test), suitable symptom profile and absence of exclusion factors e.g. severe asthma controlled by steroids. Each person used either placebo bedding or Amicor bedding (sequence at random) for 11 months, then changed over to the other type for an equal time for the same calendar months so acting as their own controls.

For 26 subjects contact plates were taken at the start of the study (before trial bedding fitted) to assess variance of fungal spores on the mattresses, pillows and duvets being used. Ambient fungal spores in the breathing zone on the bed were monitored with a MAS 100 sampler for the other 28 at the start and for all 54 subjects at each of 5 house visits over two years. Ethical approval was given by the National Health Service.

Contact plate results taken before the trial bedding was fitted ranged from 2 to 26 CFUs (mean 15 for 20 subjects; period March to May). Most spores were found on pillows. In contrast air samples taken in the breathing zone at this stage ranged from 13 to 296 CFUs (mean 58 for 25 subjects: period October to April). Numbers of CFUs in the air samples showed clear seasonal trends with highest counts in the summer and autumn.

For the breathing zone data, 60% of the 54 participants had their highest reading when they were using the untreated bedding. The average CFUs for breathing zone samples for the treated versus untreated bedding were not significantly different.

The results indicate that general environmental factors, especially seasonality, override the influence of anti fungal bedding versus ordinary bedding in the numbers of spores present in the breathing zone on beds.

A study of the latex proteins concentration in hospital areas

Albertini R. [1], Ridolo E. [2], Peveri S. [3], Ugolotti M. [3], Usberti I. [3], Pasquarella C. [4], Sansebastiano G.E. [4], Saccani E. [4], Vitali P. [5], Dall'Aglio P. [1]

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Allergy to natural rubber latex is an important occupational health concern among healthcare workers and groups risk of patients. Sensitization involves allergic manifestations in around half of cases. Only recent few reports on the measurement of latex allergens in airborne particulates have been published. Recently, has been introduced an ELISA method toward some latex allergens.

In Parma Hospital were approved a guideline for the prevention of latex allergic reaction in patients and health care workers to standardize behaviors in health care facilities, but latex safe recommendations not were related to environment latex effective detection. For this purpose our study has been performed in order to evaluate the environmental latex allergens contamination.

The concentration of latex proteins, sampled in air and dust at floor level, was monitored in different operating theatres, one of which in latex safe conditions, using respectively an AirFlow 300T Plus instrument, fitted with 25 mm PTFE filters and a 1800W vacuum cleaner fitted with nylon filters sampled. Were also sampled the particles present on sterile sheets. The immunoenzymatic method was then performed to determine the Hev b1, Hev b3, Hev b5 and Hev b 6.02 concentrations.

Hev b5 was found above the threshold, proposed for total latex allergen recovery, in all the rooms, whereas Hev b 6.02 was always found below the threshold in all the rooms. Hev b1 was found to have the highest concentration in the latex safe operating theatre. It wasn't possible to calculate Hev b3 concentrations.

For the sterile sheets were observed interesting values of latex allergens. Also for the dust in the operating theatres we have observed high levels of latex allergens.

Our results suggest that the latex safe conditions only at the "moment" of intervention are not sufficient to guarantee the environment absence of latex allergens. The our findings relating to latex particles on sterile sheets indicates that washing and sterilization procedures are insufficient to reduce the allergen count on these materials, which may therefore cause the spread of latex allergens in environments. The model of proposed sampling represents an effective system of control of quality for the protection of patients and operators.

Birch pollen allergenic activity and personal allergen exposure in Finnish home environment

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Pollen of birch (*Betula* spp) is the main cause of seasonal allergies in Finland. Birch pollen provokes symptoms in some 10 % of hay fever sufferers in Scandinavian countries. Earlier findings indicate that the main source for indoor pollen allergens is outdoor particles, which are carried indoors in footwear and clothes, rather than directly via air. It has been shown that the pollen can retain their allergenic activity long after the pollen season. The outdoor and indoor settled dust and outdoor airborne particles are the sources for indoor airborne allergenic activity.

The aims of this study were (1) to analyse the birch pollen allergenic activity in settled dust within the Finnish house: kitchen, bedroom and entrance corridor, and (2) to measure the airborne birch pollen allergen load indoors, to study the particle size of inhaled birch pollen allergens and to show the allergen concentration of settled dust in relation to indoor airborne allergen load.

The study (1) was carried out in spring 1998. The dust samples for birch pollen antigen analyses were vacuumed in 5 homes. The houses were situated at the rural neighbourhood area and they were without mechanical ventilation.

The study (2) was also carried out in southwestern Finland as well as the earlier study. The airborne birch pollen allergen study period included, the birch pollen season 2004 (from April 27th to May 10th), 2 days before, and 7 weeks after the season. The samples were collected using the nasal air samplers (Inhalix Pty Ltd., Australia), and vacuum cleaners equipped with a special collection device. Human IgE- and rabbit IgG-HALOgen immunoassays, and IgG-ELISA using rabbit antiserum were carried out for detecting birch pollen allergens and antigens, respectively.

The results of the study (1) show that the birch pollen antigens in settled dust were found in all three different rooms: in the kitchen, bedroom and entrance corridor. The concentrations of birch pollen antigenic activity were highest in the samples collected from the corridors.

In the study (2) the birch pollen allergens were found both outdoors and indoors during the whole study period. Both small micronic and pollen size fractions were present in air samples.

In conclusion, the study (1) supports our earlier findings that the allergens are carried indoors via footwear and clothes. To keep the windows closed during the birch pollen season does not prevent allergens to be carried indoors. To keep the entrance corridor clean should decrease the amount of allergens in homes.

In the study (2) we have shown for the first time that the nasal air sampler and HALOgen immunoassay can be used to detect birch pollen allergens in indoor and outdoor air. The use of the patient's serum enables the detection of allergens the patient has been sensitised to.

SESSION 5a. Phenological and monitoring networks

Keynote: Involving phenological networks and their information systems to monitor, predict and communicate start of flowering. van Vliet A.J.H., Mulder S., Bron W.A.

Integrated air quality monitoring in context of aerobiology. Skjøth C.A., Sommer J., Smith M., Brandt J., Hertel O., Stach A., Rasmussen A., Dahl Å., Bergmann K.-C., Emberlin J., Hvidberg M., Geels C., Hansen K.M., Frohn L.M., Christensen J.H., Hedegaard G.B., Gyldenkærne S., Ellermann T., Palmgren F., Løfstrøm P., Kemp K., Ketzel M., Berkowitz R., Moseholm L.

International collaboration project for forecasting allergenic pollen. Ariatti A., Gehrig R., Russo J.M.

A birch pollen forecast system in Switzerland. Pauling A., Gehrig R.

AirPath network group. Lai K.M., Emberlin J., Colbeck I.

The Danish operational pollen forecasting system. Rasmussen A., Mahura A., Korsholm U.S., Baklanov A., Sommer J.

PollenMonitor - a system for automatic determination of pollen concentration in ambient air. Zühlke D., Häusler M., Heimann U.

Keynote: Involving phenological networks and their information systems to monitor, predict and communicate start of flowering

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In The Netherlands phenological observations have been made since 1868 and continued till 1968 in various networks. In 2001 the Dutch phenological network was revived with the name Natuurkalender or Nature's Calendar. Because of the close cooperation with the Dutch national radio programme Vroege Vogels (Early Birds) and with currently over 30 organisations we managed to involve over 7.000 volunteer observers in our programme.

Phenological observations are made on not only plants but also on butterflies, birds, reptiles, amphibians, mammals and dragonflies. The Nature's Calendar strongly focuses on applying phenological information to socio-economic issues to increase the (financial) support for the continuation of the network. Human health and specifically hay fever is one of the important themes we address.

The Nature's Calendar has included several pollen producing plants in its observation network for which we gather observations on first flowering. Based on the historic observations we have developed temperature sum models. By combining these models with the daily weather observations and the daily 9-day weather forecast we make a start of flowering forecast for plant species. The observations and results of the Nature's Calendar programme attract a lot of media-attention via which we regularly inform the public on e.g. start of the hay-fever season.

To improve the communication on hay fever to patients and the medical sector we actively cooperate with the two pollen monitoring stations in The Netherlands, the Leiden University Medical Center and the Elkerliek Hospital in Helmond. Their weekly pollen counts are visualised in tables and graphs on our website (www.natuurkalender.nl). We furthermore work together with Siemens Diagnostics to improve the diagnostics of hay fever by medical specialists but also to improve the communication to hay fever patient.

In the presentation we present our way of working, the (ICT-) techniques that we use and we explain the factors that have made the Nature's Calendar successful. We will show that phenological networks can significantly add value to addressing the hay fever problem and that they preferably should closely work together with pollen monitoring stations and medical specialists.

Integrated air quality monitoring in context of aerobiology

Skjøth C.A. [1], Sommer J. [2], Smith M. [3], Brandt J. [1], Hertel O. [1], Stach A. [4], Rasmussen A. [5], Dahl Å. [6], Bergmann K-C. [7], Emberlin J. [3], Hvidberg M. [1], Geels C. [1], Hansen K.M. [1], Frohn L.M. [1], Christensen J.H. [1], Hedegaard G.B. [1], Gyldenkærne S. [1], Ellermann T. [1], Palmgren F. [1], Løfstrøm P. [1], Kemp K. [1], Ketzel M. [1], Berkowitz R. [1], Moseholm L. [1]

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The Integrated Monitoring method has been developed at the National Environmental Research Institute (NERI), Aarhus University, Denmark. Integrated monitoring uses a combination of measurements and model results to optimize monitoring and forecasting of air quality.

In general, the measured levels of air pollutants are used to warn the public and give trends of air pollution levels, whereas model results are used to extend measurements to areas not covered by stations, to gain further insight into processes such as atmospheric transport, physical and chemical conversion. This approach may be used in Aerobiology.

In this example, the integrated monitoring combines 5 different methodologies.

1: Birch pollen data obtained by volumetric spore traps in London, United Kingdom (2001-2005) and Copenhagen, Denmark (2000-2007).

2: Back-trajectories calculated for all available bi-hourly birch pollen counts at London and Copenhagen

3: A detailed European source map based on forest inventories and land use information.

4: The Danish Eulerian pollen dispersion model DEHM-Pollen.

5. A pollen emission model calibrated to available data in countries such as Germany, Poland, United Kingdom, Denmark and Sweden.

Birch pollen counts at London and Copenhagen have a distinct diurnal variation with maximum concentrations recorded during the day and low counts at night. Birch pollen episodes in London and Copenhagen with diurnal patterns that were distinctly different to the mean daily cycle (night-time peaks in concentration) were identified. These night-time peaks exceeded 3000 birch pollen grains/m^3.

Back-trajectories examined during the selected episodes with distinctly different diurnal patterns showed that air masses approached the traps from areas with high densities of birch trees. *Betula* pollen concentrations also varied spatially. For example, it was found that bi-hourly birch pollen counts were twice as high within Copenhagen compared to a site outside of the city.

Analysis using back trajectories, the pollen emission model and DEHM-Pollen indicate that sources of high birch pollen counts may sometimes be found within the cities. Conversely, birch pollen may also originate from distant sources, such as Germany, and arrive via long-range transport. *(continues on next page)*

Several models with different scales and purposes have been developed within air quality modelling at NERI. Each model is developed with a specific task in mind. Using these models in combination with measurements is termed integrated monitoring and is shown to increase current understanding of air quality to a large degree. Integrated monitoring may also increase understanding within aerobiology.

The results from the integrated monitoring method shows, that London and Copenhagen are likely to be affected by city sources of birch pollen as well as remote sources in other countries. Integrated monitoring has previously identified a similar pattern for other air pollutants such as nitrogen dioxide showing a distinct daily cycle and contribution from remote as well as city sources. An important component needed in order to extend the integrated modelling to aerobiology is the development of reliable source maps and emission models.

International collaboration project for forecasting allergenic pollen

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An international collaboration for forecasting ragweed pollen was launched through a discussion group, which met in the framework of the Pan-American Aerobiology Association Symposium held in June 2007 at the Pennsylvania State University.

ZedX, Inc., an Information Technology company based in Pennsylvania that specializes in weather driven models for agriculture applications, has provided operational support for the development of a restricted access pilot website for data collection and management. Ragweed phenological data for North America and Europe have been entered in the system throughout the 2007 season by the aerobiologists participating in the project.

Thanks to the continued interest of ZedX Inc., in 2008 the focus of the international collaboration will be on:

a) The development of a sustainable Internet-based public access platform to forecast aerial concentration of three to four major allergenic pollen types in Europe and North America;

b) The development of a restricted access Internet-based database of geographically referenced phenological observations of the major allergenic pollen producing plants for North America and Europe; and

c) The development of a restricted access Internet-based database of temporally and geographically contextual allergy symptoms.

This initiative is carried out under the auspices of the Pan-American Aerobiology Association, the International Association for Aerobiology, the American Academy of Asthma Allergy and Immunology, and the European Aeroallergen Network. The multilayered architecture of the system, encompassing public, private, and research components will ensure sustainability and will provide tangible benefits both to the allergy sufferers and to the scientific community.

A birch pollen forecast system in Switzerland

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In Europe around 15% of the population suffers from pollinosis. Pollen forecasts can assist the medical doctors by facilitating the timing of medicine intake. Moreover, pollen forecasts are a valuable tool for allergic persons to take measures for mitigating their symptoms and planning their leisure time. This highlights the need for regionally detailed pollen forecasts.

We present recent efforts to develop a birch pollen forecast system in Switzerland. The start of the modeling chain consists of a phenological model to forecast the onset of the flowering season. We used a sophisticated heat sum model that makes use of increasing weights of the daily air temperature at 12 UTC starting on February 1.

Routine calculations were made using data from the high-resolution numerical weather model COSMO (Consortium for Small-scale Modeling). This allows to produce daily maps of the starting date of the birch pollen season on a 7 km grid. This resolution is the minimum for complex terrain such as the Alps.

The phenological model performed very well in the verification process with an average error of 1-3 days. It has been operational for the first time in spring 2008. Furthermore, we demonstrate how emission parameterizations in combination with the distribution of birch trees can be used to estimate the actual pollen emission.

Emission was estimated using threshold values for temperature, relative humidity and wind speed. The distribution of birch trees was mapped combining the Swiss forest inventory and land use statistics. Calculations using COSMO data result in maps displaying the regions with emission.

In a first step, these maps are a useful tool for making the daily pollen forecasts, in a second step these maps can be used as input to a transport model. Finally, we present planned steps on how to calculate the transport and deposition of the emitted pollen, thus completing the modeling chain.

AirPath network group

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AirPath is a network group which focuses on airborne pathogens, outdoor environments and human health. The natural environment plays a significant role in controlling and determining the source, pathway, exposure routes and, ultimately, health risk of airborne pathogens to humans.

It is very important to understand the environmental pathways and properties of these pathogens and their link and mechanism in causing diseases in order to protect human health.

This working group aims to build a network and research capacity to tackle human health problems associated with airborne pathogens and the outdoor environment.

Two meetings were held at UCL in July and October 2007. A total of 16 members have attended the meetings. The network has representatives from aerosol physics, microbiology, medicine, epidemiology, aerobiology and meteorology.

The presentations and discussions were organised around 6 thematic areas plus a category for “others”:

1. What is in the air and outdoor airborne pathogens: state of knowledge
2. Current, developing and future techniques
3. Risk factors: humans, environments and activities
4. Prepare for the new challenge: environmental change and new and emerging diseases
5. Control and prevention in outdoor environments
6. Policy and international issues and research

The outcomes:

1. Website: http://www.ucl.ac.uk/cege/airpath/
2. Network: We have successfully developed a multidisciplinary network which links different disciplines together and provides a platform to facilitate discussion and collaboration.
3. Report and proposals: A final report is being prepared to summarise the outcomes of the meetings. This report will be submitted for publication in an international journal. There are various proposals developed and being developed directly due to this network.

The Danish operational pollen forecasting system

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In 1977 continuous monitoring of airborne pollen was started in Denmark, and since 1981 public pollen forecasts of birch, grass and mugwort have been performed for Copenhagen, Zealand, and from 1983 also for Viborg in Jutland. The public pollen forecast is site specific and gives the average concentration for the following day expressed in three levels: low, moderate and high.

In the summer 2005 a new automatic forecasting system was launched on the internet (http://www.pollenprognoser.dk) giving much more detailed information on the expected pollen concentration of grass and mugwort in Denmark for every 6 hour up to two days ahead. Since 2006 the automatic system also included the forecast of birch pollen.

The traditional official public pollen forecasts in Denmark are produced by the DMI meteorologist on duty in collaboration with the aerobiologist from AAF. The forecast is based on the weather forecast, the actual pollen counts and statistical material on the correlation between meteorological parameters and pollen concentrations.

The objective automatic product is based on the same statistical relations between meteorological variables, pollen emissions and pollen concentrations. But here the meteorological data are taken from the meteorological numerical weather prediction model DMI-HIRLAM (High Resolution Limited Area Model) with a horizontal resolution of 5 km. Vegetation maps and land use data are generated for the DMI-HIRLAM model system utilising data from on the CORINE database with 1 km resolution.

The traditional official public pollen forecasts are well established and easy to communicate. The scores are relatively high as in a typical season up to 80% of the pollen forecasts are correct. The validation of the objective automatic pollen forecasting system in Denmark shows that the scores generally not are quite as high as the subjective forecast. But the system gives much more detailed information and the public are favoured for the improved information system.

In 2008 the existing modelling system has been improved by the implementation of a new semi-operational dynamical modelling system for birch pollen covering the pollen emissions, atmospheric transport, dispersion and deposition of pollen particles. The system based on Enviro-HIRLAM is developed at DMI in cooperation with the Finnish Meteorological Institute and other European partners. Results of the statistical and the new dynamical forecasting system will be presented and discussed.

PollenMonitor - a system for automatic determination of pollen concentration in ambient air

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In the following contribution a system for automatic determination of pollen concentrations in ambient air is introduced. The system is able to sample particles that are bigger than 10µm.

The main steps of the analytical procedure are: separation of the particles, probe preparation, digitalization of the probe (the entire volume is covered by multiple 2D bright field scans) and the analysis of digitized probe. The article addresses the details of the computational analysis of the digitized probe.

In a first step we first reduce the stack of 2D scans representing the entire volume to a single, synthetic 2D image that represents the visual features of the original images. This image is then segmented in two stages. For the segmented objects a broad selection of rotation invariant feature values (e.g. shape, texture, etc.) is calculated. Using these feature values the objects are classified.

The classification process consists of three stages. First we linearly separate pollen and non-pollen objects (e.g. tire particles). The pollen objects then run through an OVA (one versus all) classification for every pollen species (trained beforehand). The third stage is an OVO (one versus one) classification only for selected pollen species. The selection of pollen species for the OVO run is based on OVA results. This method was inspired by Garcia-Pedrajas und Ortiz-Boyer 2006 on multi class classification.

We validated our method on shake probes. We will adapt the whole process for real probes, when pertinent data will be available.

The results presented here were gained using about 150 pollen objects per pollen species from 13 pollen species and about 280 non-pollen objects for training. We used balanced sets for training and testing. The recognition rates displayed below hold exclusively for the testing set.

Overview of recognition rates:

Pollen species	Average of **recall** [(# of correctly classified pollen)/ (# of pollen classified by human)]	Average of **precision** [(# of correctly classified pollen)/(# of pollen classified by computer)]
Allergological relevant pollen (*Artemisia, Betula, Alnus*, Poaceae, *Corylus*, *Secale*, *Ambrosia*)	94%	92%
Allergological not relevant pollen (*Acer, Fagaceae, Taxus, Quercus, Carpinus, Salix*)	96%	94%
Non-pollen objects	80%	90%

The incorporation of a rejection class ("Varia") is still under investigation.

As the system is easily adapted to new classes via retraining the method is open for other pollen species not mentioned yet.

SESSION 5b. Monitoring networks: Spores

Didymella spore concentrations in Cracow in 1997-2006. Stepalska D., Wolek J., Piotrowicz K.

Airborne spores of the aeroallergen *Alternaria* in the roof-top airstream over Edinburgh, Scotland, UK. Caulton E.

Intradiurnal variations of airborne pollen in Bursa, Turkey. Celenk S., Altunoglu M.K., Bicakci A., Canitez Y., Malyer H., Sapan N.

Aerobiology modeling of the wheat rust pathogen Ug99 for assessing potential pathways and timing of incursion and for supporting rust surveillance. Isard S.A., Ariatti A., Russo J.M.

Didymella spore concentrations in Cracow in 1997-2006

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Didymella is a saprobic or weakly pathogenic fungus found on wheat and barley leaves and its ascospores have been implicated in late summer asthma. *Didymella* is a member of the Pleosporaceae family belonging to the Ascomycetes class.

The aim of the study was to investigate a ten year period of *Didymella* spore occurrence, to find a trend in concentration in fungal spore season in the pre- and post-peak periods and to analyse the relationship between spore concentration and meteorological factors (maximum and minimum temperature, relative humidity, rainfall, sunshine hours, wind velocity).

Analysis was performed on the basis of data collected in Cracow using the volumetric method in 1997-2006. *Didymella* spore concentration showed seasonal fluctuations. There was no evidence of an upward trend in the June-August seasonal concentrations since 1997. On the basis of our many years' observations it was assumed that *Didymella* spore season exists 92 days (from 1 June to 31 August).

Data, for analysis need, were arranged in such a way that in each day of the season spore concentration and meteorological factor values observed in the consecutive years were noted. *Didymella* spore concentrations are characterized by occurrence of extreme values and their distribution is asymmetric when considered in the whole spore season and in particular days, weeks and months. In such situation it cannot be applied arithmetic mean and standard deviation. Therefore to define average concentration and to describe its variation median and quartile (25% and 75%) were selected.

The fungal spore season was divided into the pre- and post-peak periods. To define the peak day median distribution in the season was used. Generally in both pre- and post-peak periods the increase and decline in spore concentrations could be described using exponential function.

It was stated that the lowest percentage of explained by model variation was obtained for original data (R^2 = 16%), and the highest when concentrations in consecutive days of the season were expressed as median (R^2 = 84.2%). To find the relationship between spore concentration and meteorological factors stepwise multiple regression analysis was applied. It was stated that the lowest percentage of explained by regression model variation was obtained for original data, and the highest when concentration was presented as median and meteorological factors as arithmetic mean.

Results of multiple regression analysis showed that in the pre-peak period minimum temperature was the most influential variable which explained 57% of observed variation in spore concentration. During the post-peak period minimum temperature was still the most important factor and explained 46% of dependent variable variation.

Airborne spores of the aeroallergen *Alternaria* in the roof-top airstream over Edinburgh, Scotland, UK

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Airborne spores of *Alternaria* have been monitored over a seven year period, 2001-2007.

Only two *Alternaria* – specific studies have been published from the UK, an early one from Cardiff, Wales (1936) and a more recent one from Derby, England (2001). On the medical aspect, two studies were reported in 1930 and 1996: Other *Alternaria* – specific studies have been published including Australia (1997) and Spain (2001).

This study, the first to be undertaken in northern Britain, concerns seasonal variation and diurnal periodicity. Unlike the Derby study, which was long–term and in-depth, the period covered by the Edinburgh study, was too short to discern any trends over the short term.

In Scotland, the *Alternaria* season lasted on average 61 days extending from mid-June to late August in 2007, and from late June to mid-September in 2004. Total spore counts per season varied widely from year to year: 400 in 2005 and 2,357 in 2004.

Weather conditions with regard to wind (direction and speed) and the distance and direction of the origin sites of spore release, were found to be important factors. The height also of the Burkard spore sampler employed throughout the study (20m. a.g.l.) was an influential factor on the number of spores captured. Weather parameters in the region over the study period and diurnal periodicity will be discussed in the presentation.

Intradiurnal variations of airborne pollen in Bursa, Turkey

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The intradiurnal periodicity of Cupressaceae / Taxaceae, *Platanus* sp., *Olea* sp. and *Pinus* sp. were studied during one year period. The taxa were chosen on the basis of pollen grain abundance (more than 10% of total). The pollen sampled using a seven-day volumetric pollen trap.Twenty-four transversal transverses of microscope slides were analysed.

The intradiurnal trends of the total amount of pollen in 2005 were peaked at 11 to 17 o'clock. The daily pattern of pollen abundance has a maximum between 15:00 and 16:00 h, while a minimum occurs between 23:00 and 00:00 h.

The intradiurnal variations of Cupressaceae / Taxaceae, *Platanus* sp., and *Pinus* sp. were irregular and high concentrations were observed at different hours of the day while *Olea* sp. was regular and high concentrations of *Olea* sp. was observed between 10 and 19 o'clock.

Aerobiology modeling of the wheat rust pathogen Ug99 for assessing potential pathways and timing of incursion and for supporting rust surveillance

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Stem rust of common wheat caused by *Puccinia graminis* f. sp. *tritici* (Pgt), has been one of the most important diseases of wheat since the emergence of western civilization. In the U.S. and Canada for example, major regional epidemics of wheat stem rust have occurred numerous times in the 20th century including the years 1904, 1916, 1923, 1925, 1935, 1937, 1953, 1954, and 1965.

In these years, the pathogen was blown from overwintering areas in southern U.S. and Mexico into the major wheat production region in northern states and Canada. Major wheat stem rust epidemics have not occurred in North America for the past 25 years due primarily to the development and extensive use of wheat cultivars with race-specific major genes for resistance.

Stem rust race-specific genes Sr24 and Sr31 have been used worldwide in “green revolution” spring, facultative, and winter wheat providing the main component of stem rust resistance in many cultivars. However in 1999, susceptible Rust pathogens have been transported throughout the world by airflows multiple times in the past.

We are launching a project to integrate the extensive knowledge-base on wheat stem rust aerobiology and our aerobiology model within a modern cyberinfrastructure. Our goal is to construct a risk analysis of aerial pathways and timing of incursions of Ug99 into wheat production areas worldwide. We will also support the expanding efforts of plant pathologists to survey for rusts in wheat production regions.

SESSION 6. Allergology

Keynote: The Finnish Allergy Programme 2008-2018 – Time to Act and Change the Course. Valovirta E.

Keynote: Influence of environmental factors on pollen allergens. Behrendt H.

Clinical index: a tool for the determination of the allergic risk. Oliver G., Thibaudon M.

A challenge study of ocular allergy to determine thresholds of response to grass allergen. Emberlin J., Potter C., Wolffsohn J.S., Naroo S.A., Gupta N.

How "dead" is the Dead Sea? The potential allergenicity of the Dead Sea aeroallergens. Waisel Y., Geller-Bernstein C., Epshtein V.

The impact of grass pollen season severity on doctor consultation rates for hay fever. Recent trends in the UK. Emberlin J., Fleming D.

Pollen airborne allergen exposure reliability during 2007 in different bioclimatic areas by means of the relationship between pollen counts and allergen quantification. Rodriguez-Rajo F.J., Vega-Maray A., González-Parrado Z., Moreno-Grau S., Moreno-Grau J.M., Elvira-Rendueles B., Jato V., Fernández-González D., Seoane-Camba J., Suárez-Cervera M.

Pollen of *Artemisia campestris* can prolong symptoms of mugwort allergy. Jantunen J., Saarinen K.

Keynote: The Finnish Allergy Programme 2008-2018 – Time to Act and Change the Course

Valovirta E. and the Finnish Allergy Programme Working Group

Suomen Terveystalo, Turku, Finland

The prevalence of allergic diseases has grown in Finland, similarly to many other western countries. Although the origin of allergy remains unresolved, increasing body of evidence indicates that the modern man living in urban built environment is deprived from environmental protective factors (e.g. soil micro-organisms) that are fundamental for normal tolerance development.

The current dogma of allergen avoidance has not proved effective in halting the “epidemic”, and it is the Finnish consensus that restoring and strengthening tolerance should more be in focus. The national 10-year programme is aimed to reduce burden of allergies.

The main goals are to

1) prevent the development of allergic symptoms,
2) increase tolerance against allergens,
3) improve the diagnostics,
4) decrease work-related allergies,
5) allocate resources to manage and prevent exacerbations of severe allergies, and
6) decrease costs due to allergic diseases.

For each goal, specific tasks, tools and evaluation methods are defined. Nationwide implementation acts through the network of local coordinators (primary care physicians, nurses, pharmacists). In addition, three non-governmental organisations (NGOs) take care of the programme implementation.

The 21 central hospital districts carry out a three step educational process:

i) health care personnel,
ii) representatives and educators of NGOs, and
iii) patients and the general population.

For outcome evaluation, repeated surveys are performed and health care registers employed at the beginning, at 5 years, and at the end of the programme. The process will be evaluated by an independent external body.

The Finnish initiative is a comprehensive plan to reduce burden of allergies. The aim is to increase immunological tolerance and change attitudes to support health instead of medicalizing common and mild allergy symptoms. It is time to act, when allergic individuals are becoming a majority of Western populations and their numbers are in rapid increase worldwide. The Programme is associated with the Global Alliance of Chronic Respiratory Diseases (GARD), WHO.

Reference: Haahtela T et al. Allergy 2008;63: 634-645

Keynote: Influence of environmental factors on pollen allergens

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Clinical index: a tool for the determination of the allergic risk

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Every week, the RNSA (Réseau National de Surveillance Aerobiologique, French network of aerobiology) produces information relating to the RAEP (Allergic Risk due to the Pollen Exposure) for the following week. The information about the pollen content of the air, obtained by the analysis of samples collected by pollen traps is not sufficient to determine the allergic risk.

RNSA has organized a network of clinicians (specialists and non-specialists) in the main areas in France. The clinical data given by doctors allows us to follow the evolution and the intensity of allergic symptoms noticed on patients. These informations are sent to RNSA through the clinical report which sums up these informations indicating the evolution of symptoms but also the variation of their intensity. By assigning coefficients to each of these symptoms, it is possible to establish a clinical index for each area and even for every period:

A clinical index for a week, a month or a year allows to make comparisons to see if the evolution of the clinical index follows the evolution of the pollinic index.

The analysis in chart form of the correlation between clinical and pollinic index is interesting for many areas in France:

-in Lyon, the curve of the clinical index follow exactly the variations of pollinic index of birch, grasses and ragweeds.
-in Aix-en-Provence, the link between all these data is also significant. The curve of the clinical index increases or decreases following the presence of cypress, birch or grasses pollens.
-in Troyes, the birch and grasses pollinical indexes follow exactly the tendancies of the clinical index.

All these data allow to set up maps for allergic risk for each pollen, these maps being available one week. Six levels of allergic risk are indicated on these maps, the lower one is “nul” (map in white), the higher one being “very high” (map in dark red).

In addition with meteorological and phenological factors, the results of this study show how much clinical data are linked and source of precious informations for the RAEP determination. All these data permit us to establish a real forecast of the allergic risk.

A challenge study of ocular allergy to determine thresholds of response to grass allergen

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Ocular allergy is an important and increasingly prevalent aspect of allergy to pollen but little is known about thresholds of exposure that cause symptoms. The aim of the research reported in this paper is to investigate thresholds of response to grass allergen in subjects who have reported symptoms of ocular allergy and who have a positive skin prick test result to grass, which is the main outdoor aeroallergen in the UK. The overall objective is to improve pollen forecasting for people with eye symptoms due to grass pollen allergy. The study is part of a wider project which also assesses the effectiveness of various treatments.

150 adult volunteers were recruited on the basis of responses to a comprehensive questionnaire which indicated that they had symptoms of ocular allergy during the grass pollen season, and that they were suitable for the research (e.g. did not have severe asthma, eye disease). These people had skin allergy tests for pollen (grass, tree and weed), house dust mite, cat and dog. Those that had a positive result for grass were invited to take part in a grass pollen challenge study and assessment of treatments over four consecutive visits in the winter of 2007/8. Eighty -two volunteers were recruited to this stage.

On the first visit each subject was challenged in one eye with grass pollen allergen (Phl p5) in four increasing concentrations calculated on the basis of moderate to very high grass pollen counts in the area (i.e. 12 ng/ml, 24 ng/ml, 36 ng/ml and 48 ng/ml), until reactions occurred or if no reactions occurred the subject was recorded as negative. Saline was put into the other eye as a control.

Reactions were measured as ocular temperature, objective and subjective Bulbar redness (conjunctiva bottom of eye) and objective and subjective Palpebral redness (conjunctiva underside of upper eyelid), tear breaking, plus subject reported itching, stinging, watering and dryness. Ethical approval was obtained.

In the challenge tests 57 subjects had reactions across a range of measures and 25 were negative (no symptoms across the range). For self reported symptoms (itch, stinging, watering and dryness), most subjects (61%) reached a threshold at 36 ng/ml. A further 25% reported some symptoms at 48ng/ml. On the bases of ocular temperature, Bulbar and Palpebral redness, 10% subjects reached a threshold at 24 ng/ml, 29% reached it at 36 ng/ml and 30% at 48 ng/ml.

The results indicate that there is a considerable range of thresholds of response to grass allergen but that the majority of subjects in the group had a threshold across a range of measures at 36 ng/ml. For some subjects the threshold of response may not have been reached. The results give a useful guide for forecasting impacts of pollen counts.

However the allergen challenge was given in winter as one dose whereas natural exposure may be continual and cumulative over many weeks so the responses may differ. Also thresholds for individuals can vary through the season and with other factors.

How "dead" is the Dead Sea? The potential allergenicity of the Dead Sea aeroallergens

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The aim of the presented study was to monitor the airborne pollen and spores in the Dead Sea region, to identify the plant sources, i.e., local or transported, to measure the daily and the annual time courses of airborne pollen and spores concentrations and to find out which of those bears an allergenic risk for sensitized people. Such information would help us to mark "safe" seasons for the visitors to the region, during which the allergenic load of airborne particles around the Dead Sea will be below the risk level.

Air was monitored using "Rotorod" samplers that were placed in three places in the Ein Boqeq resort: 1) Roof of one of the hotels (10 m above GL), 2) The sea shore, 3) A public park planted with a rich selection of ornamental plants. The study was conducted during three consecutive years, but with one day of measurements every month. Skin Prick Test responses of tourists, psoriasis patients, as well as of local hotel workers, to 17 of the most common aero-allergens of the region were tested.

Results are as following:

A) Although located in the middle of a desert, the air around the Dead Sea is by no means free of aero-allergens.

B) During the study pollen of some 50 plant species and spores of 43 species of molds were identified. Some of them were recorded almost throughout the year, whereas others appeared only intermittently.

C) Day – night variations in pollen and spore loads were recorded. Most peaks were recorded during noon-time, whereas some times high allergen loads were found during the night.

D) The most common sensitivities were to pollen of the Poaceae, Cupressus, *Solidago*, *Artemisia vulgaris*, to pollen of the Chenopodiaceae and Amaranthaceae, as well as to mold spores (*Alternaria*, *Aspergillus*) and to house dust mites.

Allergic patients should consult a local allergologist, before travelling to the area in order to refrain from an undesired exposure to certain airborne allergens.

The impact of grass pollen season severity on doctor consultation rates for hay fever. Recent trends in the UK

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The United Kingdom has one of the highest prevalence rates for hay fever in the world, particularly among teenagers. Data from surveys which used the ISSAC questionnaires, found that in 13-14 year olds the rates were c. 38% with some regional variation. This exerts a high cost in terms of loss of productivity (including time off work or education or decreased capacity), imposes an economic burden for healthcare and treatments and it also impacts on quality of life.

The objectives of this study were to examine relationships between variations in pollen seasons and hay fever incidence as indicated by doctor consultations and to use this information, together with climate forecasts, to predict possible changes in incidence over the next decade.

Clear relationships can be demonstrated between the incidence of hay fever and the length and severity of pollen seasons. This relationship can be extended into the demands for health care for hay fever from family doctors. These points are illustrated by data from recent years in which annual patterns in the length and severity of pollen seasons for grass are reflected closely in variations in family doctor consultation rates.

For example in 2004, the grass pollen season in the midlands of the UK was mild due to high amounts of rain fall. The peak time lasted for about 3 weeks with a close coincidence with demand for doctor consultations for hay fever.

In contrast in 2006, the grass pollen season was severe and the duration of the demand for doctor consultations extended over 6 weeks. The number of consultations per week did not increase but the total of consultations in the season did and the sale of non prescription medications increased greatly.

Grass pollen seasons have tended to become more severe in the UK in recent years, especially since the mid 1990s. This trend appears to be largely due to weather patterns. These patterns and relationships can be used as a basis for the prediction of the possible short to medium term impacts of climate changes on the incidence of hay fever. The forecast of prevalence rates would require more factors to be included in the model.

For the Midlands area of the UK, models for climate change are used in conjunction with the data on pollen seasons for grass together with doctor consultation data for hay fever as a basis for predicting incidence rates over the next 10 years. Other variables such as sensitisation rates, pollution and land use changes have not been included at this stage.

The predictions outline the possible scenarios for incidence of hay fever in the Midlands of the UK over the next decade. The figures are based on a limited range of variables but they do provide insight into the possible demands on healthcare services and the economic and social burden of hay fever in a climate with changing weather patterns.

Pollen airborne allergen exposure reliability during 2007 in different bioclimatic areas by means of the relationship between pollen counts and allergen quantification

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Pollen allergy has a remarkable clinical impact all over Europe, even if it has been increased in the past decades. Effects of pollinosis include a decline in the quality of life of allergy-sufferers and socioeconomic costs. Exposure to allergens represents a key factor among the environmental determinants of asthma, which include air pollution.

The most common information available for pollinosis patients is the amount of airborne pollen grains and their temporal distribution. Nevertheless, intact pollen grains are unlikely to intrude into the deeper airways due to their bigger size, and this is the reason the aeroallergens quantification, as submicronic particles, should be included in allergic asthma epidemiologic studies.

In this way the purpose of this investigation is to assess the strength of the interrelationship between pollen counts and its atmospheric aeroallergen concentrations in different Spanish bioclimatic areas.

The study was conducted during the year 2007 by selecting common sources of pollinosis in each area. In Ourense (Northwest, suboceanic climate) the taxa *Platanus,* Poaceae and Urticaceae were selected, in León (Northwest, continental climate) Poaceae, and in Cartagena (Southeast, mediterranean climate) *Platanus, Olea* and Urticaceae.

The pollen data of these taxa were correlated with the allergenic activity quantification of the Pla a1, Pla a2, Lol p 1, Par j1 and Ole e1 proteins present in the atmospheric bioaresol. The content of airborne pollen was quantified by using a volumetric sampler Lanzoni VPPS 2000 and conventional counts with microscopy identification techniques.

The content of the atmospheric allergens was quantified by using a Burkard Cyclone sampler and enzyme-linked immunosorbent assay (ELISA) double sandwich modified technique. Spearman correlation analysis test was applied to determine the interrelationship between aeroallergen quantification and pollen counts.

In most cases we observed that the aeroallergen daily distribution curve follow very closely the variations of the daily mean pollen concentrations. Spearman correlation analysis test showed the most important relationship between Lol p1 allergen quantification and Poaceae pollen counts, with high R coefficient values and p>0,000. Lower value was registered for Urticaceae (p<0,047).

(continued)

In the Northwest suboceanic area pollen from Urticaceae was separated into two groups (*Urtica membranacea* type and *Parietaria* type). When only data from *Parietaria* pollen type was correlated with Par j1 allergen atmospheric concentrations, Spearman coefficient value and its probability rises (p>0,000). Finally, the *Platanus* pollen concentrations present high significative correlations only with Pla a1 aeroallergens and in the case of the Northwest suboceanic area.

As conclusion, the combination of pollen counts and the quantification of airborne submicronic proteins must be assessed to estimate allergen exposure reliably. The application of this specific and quantitative antigen-antibody technique to control the content of allergens in the air represents an important advance in the epidemiologic study of allergic respiratory diseases.

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Pollen of *Artemisia campestris* can prolong symptoms of mugwort allergy

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The pollen of field sagewort (*Artemisia campestris*) is not considered a threat to allergic people in the same way as the pollen of the more common mugwort (*Artemisia vulgaris*), although both species produce high amounts of pollen grains. We counted 1,500-6,500 capitula on three 60-80 cm mugwort shoots and 14,000 capitula on a 170 cm shoot, whereas three 40-60 cm sagewort shoots bore 1,500-2,400 capitula each. The flowering periods of the two species were compared by measuring pollen concentrations and monitoring the development of plant capitula in Joutseno, Southeast Finland.

Artemisia pollen was collected with two Burkard samplers. One was installed on the roof of a railway yard building (6 m) surrounded by dense sagewort vegetation along the rails (no mugwort within a distance of 100 m). The other sampler was at a distance of 1.5 km on the roof of a building (19 m) surrounded by several small patches of mugwort, but only one small patch of sagewort at a distance of 200 m.

In addition, rotorod-type samplers (30 min measurements, 1 m above ground) were simultaneously used in four sagewort and two mugwort patches at an average interval of five days between 23.7. and 5.9.2007. All measurements were taken between 8:30 and 10:30 a.m., because both species have the same circadian rhythm.

When pollen release was monitored hourly by rotorod-type samplers in one sagewort stand (3.8., 6:00-14:00), the pollen concentration began to increase at 8:00 a.m. (230 grains m^{-3}), reached its maximum at 9:00 a.m. (2,450 grains m^{-3}) and remained high up to midday (330–430 grains m^{-3}).

Since the pollen of mugwort and sagewort is virtually impossible to separate from air samples, the flowering of the two species was monitored between 23.7. and 5.9. by studying capitula in 12 sagewort (100-1,500 shoots), and 11 mugwort, habitats (20-100). The flowering period of sagewort was two weeks later than that of mugwort.

Over 50 % of mugwort shoots flowered between 23.7.-30.7. whereas the number of flowering shoots of sagewort peaked on 6.8. (58 %) and 13.8. (80 %).

Pollen concentration on the higher roof peaked during the high flowering periods of both species. Concentrations of over 30 grains m^{-3} were recorded on eight days: three occurred between 20.7. and 26.7. (mean 57; max 103 grains m^{-3}) and five between 9.8. and 14.8. (59; 86). On the railway yard high concentrations were measured on 20 days. The first two occurred on 27.7. (57) and 28.7. (46), whereas the rest were recorded between 2.8. and 19.8. (mean 121; max 390 grains m^{-3}).

The rotorod-type samplers resulted in the highest pollen counts in mugwort stands on 1.8. (1,040-2,510 grains m^{-3}) and in sagewort stands on 10.8. (900-6,170 grains m^{-3}). The last pollen grains in the sagewort sites were recorded on 5.9., and in mugwort stands on 23.8.

Due to its late flowering period sagewort can actually be responsible for the second peak of *Artemisia* pollen, which is believed to be a consequence of the flowering of late mugworts. Thus, sagewort is likely to increase and prolong allergic symptoms within its distribution area.

SESSION 7. Forecasting and modelling

Spatial variations in dynamics of *Alnus* (alder) and *Corylus* (hazel) pollen seasons in Poland

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The aim of the study was to analyse dynamics of *Alnus* and *Corylus* pollen seasons in Poland with reference to spatial and seasonal differentiations.

Aerobiological monitoring was performed in 10 cities, in 1994-2007. Geographical differentiation of the cities is given as their distance (km) from Warsaw (along latitudes and longitudes). 184 pollen seasons were analysed (94 for *Alnus*, 90 for *Corylus*). 5 parameters defining pollen season were considered: 1. beginning and end dates of five season phases (5, 25, 50, 75, 95% of annual totals), 2. pollen season duration (90% method), 3. skewnees and 4. kurtosis of airborne pollen curves, 5. annual pollen totals. Geographical effect on 5 pollen season parameters was estimated using mixed models with a year treated as a random factor.

The beginning of the *Corylus* pollen season in Warsaw started on about 53rd day of a year. The *Alnus* pollen season started about 9.5 days (SEE=1.4) later. Pollen season ends for both taxa did not show significant differences. The start of the season for both taxa was delayed by 3.3 (SEE=0.5) days for each 100 km towards east. Further phases of seasons did not show such a delay.

Year to year variation in dates of consecutive seasonal phases decreases e.g. SD of the pollen season start is 19 days while SD of its end is only 11 days. The *Corylus* pollen season as compared to *Alnus* lasted about 15 days longer. Season duration of both taxa decreases towards east by 3.5 days (SEE=0.7) and towards north by 1.3 days (SEE=0.6) for each 100 km. Season duration differs from year to year (SD=11.7 days).Seasonal dynamics of both taxa are skewed to the right. In cities located west of Warsaw dynamics is more skewed (except at Szczecin, Wrocław). Asymmetry decreases towards east by 0.16/100 km.

Almost all kurtosis values of pollen season dynamics were positive and higher in case of *Alnus*. Kurtosis value for both taxa increases together with delay of the pollen season beginning by about 4% per day ($p<0.0001$).

The studied taxa show different pattern of geographical tendency forming annual pollen totals. For *Corylus* mean pollen total increases mainly towards north (by 64%/100 km) and somehow less towards east (by 2%/100 km). For each city it can be calculated the characteristic date of the *Corylus* season beginning which maximizes the annual total. This date is span from 51 to 58 day of year in the north-south transect along Warsaw longitude.

For *Alnus* the annual total decreases by about 15%/100 km towards west and by 5%/100 km towards south. There is no clear date of the *Alnus* season beginning maximizing annual total. In the cities located to the west and south of Łódź the annual total decreases together with delay of the season beginning. In cities located to the north and east this relationship is opposite.

Comparable pollen data from two UK sites, 25 miles apart, suggest a forecast based on a single site is sufficient for that region

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Airborne pollen is the principal allergen in the outdoor environment, being the primary cause of seasonal allergic rhinitis, and an important cause of exacerbations of asthma. Historically in the East Midlands pollen levels have been recorded at two sites twenty-five miles apart, in Leicester and Derby. The aim of the present study was to compare pollen data obtained from both sites over the twelve month period from April 2006-April 2007. Monitoring was carried out using a Burkard volumetric spore trap. Twenty-six pollen types were identified by microscopy. Pollen counting and identification were carried out according to British Aerobiology Federation standardised techniques. Daily average concentrations were calculated as grains/m^3 of air sampled and a 95% method was used to determine the pollen season. Standard statistical methods including Spearman's rank correlation coefficient and Bland-Altman plots were used to compare the datasets. Pearson's correlation was used to assess any bias in the dataset after Bland-Altman analyses had been performed.

The most abundant pollen types for both cities were grass, birch, nettle, yew-type, oak and ash, of which all except nettle and yew are known to be allergenic. These six taxa peaked at levels greater than 300 grains/m^3 air/day, in contrast the remaining 20 taxa rarely if ever produced a maximum daily count higher than 100. Over 99.5% of the total birch, grass, nettle and oak pollen recorded during the twelve months was from the 2006 calendar year enabling start and finish dates to be calculated for these four taxa, and the seasons to be compared statistically. Season start and finish dates were close to each other at both sites, with the exception of Oak which exhibited a prolonged season in Derby. In addition, there were significant (P<0.0001) positive correlations between the counts obtained for the four taxa from the two sites.

Bland-Altman plots show little discrepancy between the amounts of pollen counted by the two sites on any given day. Spearman's rank correlation coefficient analysis showed no significant trend in the differences between the counts from the two sites as the average count increased for grass, nettle or oak. Birch showed a weak (P=0.028) negative relationship due to Derby having a high count on one day at the start of the season when Leicester had moderate, and a high count on one day towards the end of the season when Leicester's was low. Removal of those two days negates the relationship. The relationship could in part be a statistical artefact caused by a shorter pollen season for birch (n=20) compared to oak, grass and nettle (n=37, 56 and 103 respectively). Extending the defined season by a single day in each direction would result in no trend seen for birch.

The results demonstrate that it is possible to forecast pollen concentrations at one site using data taken from the other, at least within a 25 mile radius, which prevents the need for duplication of counts within the same geographical region.

POLLEN project of Academy of Finland: an outline

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The project “Evaluation and forecasting of the atmospheric concentrations of allergenic pollen in Europe” supported by the Academy of Finland aimed at development of an integrated modelling system for evaluating and forecasting the natural pollen emissions and transport on a European scale; and at application of this system for evaluation of the spatial distributions of pollen emissions and concentrations in Europe. The project has considered all parts of the pollen life cycle starting from its development during summer growing season, dormancy period in winter and early spring, release into atmosphere, transport with air masses and removal from the air due to sedimentation and scavenging. It also considered numerous supplementary issues, such as the data on birch phenological stages, possibilities of forecasting the total amount of pollen accumulated in catkins, ways to observe birch seasons from space, etc. The project has summarised the available information about the birch forests in Europe, created a necessary infrastructure for the operational birch season forecasting and demonstrated overall feasibility of such activity.

The main result of the project is the integrated model for birch pollen that has been created on the basis of SILAM system and evaluated via both multi-annual re-analysis and trial operational applications. For the emission module, a pioneering approach based on two heat-sum thresholds allowed real-time evaluation of pollen release rate using actual meteorological parameters as forcing. In SILAM, this algorithm is combined with several other parameterizations that take into account the actual humidity, wind and precipitation intensity. The total amount of pollen accumulated in catkins is precomputed before the start of the season following the algorithm also developed within the project.

A quick evaluation of the potential value of remote-sensing data for the pollen season forecasting has been undertaken and promising results have been reported.

Efforts towards high-resolution simulations of pollen season were undertaken and an idea of multi-model nested cascade was developed and is currently under implementation.

Finally, the project worked as a crystallization centre for the related discussions, which resulted in launch of the COST Action proposed by the POLLEN core group.

Evaluation of pollen distribution: observations vs. models, deterministic vs. probabilistic, remote sensing vs. in-situ, short-term forecast vs. long-term re-analysis

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Intense developments during recent years have opened-up a series of previously unknown possibilities in evaluation and forecasting the allergenic content of ambient air. In the observational field, an automatic recognition of pollen grains and direct monitoring of allergen content in air are becoming possible.

Advancements in remote sensing resulted in retrieval algorithms allowing (albeit indirect) observations of flowering season from space as a spatially coherent picture. Strong and far-reaching progress was achieved in the modelling systems, which for the first time overgrew the local and regional scales making it possible to compute forecasts and re-analysis of pollen distribution for the whole Europe. These and other achievements have brought the problem of assessment and forecasting the allergenic atmospheric composition to the level of understanding and tools maturity comparable with those of “classical” air pollution.

In the area of impact assessment, the knowledge is drastically more advanced than in the “classical” field: with all the existing uncertainties and yet-to-discover processes, the impact of allergenic pollen on human health is much better known and much more accurately quantified than e.g. the impact of fine particles on the lifetime expectance. As it always happens in a rapidly developing field, gaps and overlaps seem to show up creating both challenges and opportunities.

Leaving aside evidently irrelevant extremes (such as: why to measure if the models are becoming so good? Why to model if satellites provide so good maps? Why to bother with satellites if numerous automatic pollen sites are coming – much more accurate than any remote-sensing device? etc), it may be still important to try to understand the potential or already existing synergy between the fields.

The most-evident and well-known lessons learned from the classical air quality applications are:

(i) observations provide the ground truth for the specific point and specific time;

(ii) it may be more or less representative to the surrounding area;

(iii) the shorter the averaging period and the higher the levelof details of the observations the less representative they are;

(iv) chemical transport models provide an integrated representation ofpollution pattern, quantify the relations between the different processes;

(v) allow for re-analysis, short- and long-term forecasting, and evaluation of the atmospheric composition in the areas with no observational data available;

(vi) satellites provide vertically integrated or resolving information on pollutant concentrations, as well a set of indirect estimates of the real picture.

(continues on next page)

The list can be extended further and further and the second list of weak points of each methodology can also be easily compiled. However, it is clear that in many cases the strong point of one methodology covers the weaknesses of the other while the would-be overlaps can be used for cross calibration of the instruments.

These are being explored in the fields of classic air pollution – and, with certain amendments, can and should be explored in the field of allergenic air pollution. I will try to show that every isolated approach can give only part of the picture, possibly skewed or even outright wrong. To the opposite, it will be demonstrated that most of problems can be disclosed and comparatively easily handled if the independent ways of assessment are applied in a coherent manner.

Analysis and forecasts of the birch pollen season in Europe using atmospheric and biological models

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The paper presents a forecasting system of birch pollen long-range transport. The system was developed jointly by Finnish Meteorological Institute (FMI), the Aerobiology Unit of the University of Turku and the Department of Forest Ecology of the University of Helsinki in close collaboration with European Aeroallergen Network and 5 other European institutes - within the scope of POLLEN project of Academy of Finland and ESA-PROMOTE GMES Service Element.

Pollen is a known source of allergy-related deceases. The overall prevalence of seasonal allergic rhinitis in Europe is approximately 15%. Observational evidence and a theoretical ground are mounting that the pollen grains of the wind-pollinating plants, despite their large size, can be transported over hundreds and even thousands of kilometres and significantly affect pollen concentration in many regions making it less dependent on the local conditions.

Conventional predictions of pollen concentrations are made using phenological and pollen observations, pollen calendar and weather forecasts. The method works well when the local flowering has started, but is not able to forecast long-range transported pollen before or after local pollination. However, allergic persons should start their medication in advance of exposure to allergens and this can happen even weeks before start of local flowering. Because pollen does not know territorial borders, European wide numerical pollen concentrations forecasts are needed.

The pollen forecasting system consists of several sub-models. The system is based on a numerical weather prediction model (HIRLAM or ECMWF) which gives information to an atmospheric dispersion model (SILAM), to a phenological model (thermal time type) for starting date of flowering and to a pollen release model.

Numerical forecasts of birch pollen concentration in springs have been done at FMI since 2005 and model has been developed throughout these years. User experience at the University of Turku, Aerobiology Unit is positive and the model has improved pollen forecasts, especially in cases of long-range transport.

The recent status of the system and results for a few past years will be presented and their main features and quality will be discussed.

Predicting inter-annual variation of birch pollination intensity in different parts of Europe

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The reproductive output of birch (*Betula*) varies intermittently and extensively from year to year. The fluctuation affects the amount of airborne allergenic birch pollen exposure to allergenic birch pollen especially in North and Central Europe, where birch is the most important allergenic tree pollen type.

A model predicting the intensity of coming flowering would be a valuable tool for those responsible for pollen information services, and ultimately, for allergic people and allergologists. Moreover, such a model would be useful in estimating the pollen crop as input data for atmospheric dispersion models.

Based on the results form earlier studies, we hypothesized that weather (temperature, sunshine) during the growing season, together with resource allocation within the tree could be used to predict the intensity of the coming flowering. The allocation is reflected as a negative autocorrelation between reproductive out-put of consecutive years.

We tested the hypothesis with birch pollen data from 29 sites from Austria, Finland, France, Russia, Spain and Sweden. The data consisted of annual birch pollen sums (sums of daily average pollen counts) collected with the volumetric Burkard-spore trap. The criteria for data-sets were > 15 years of observations between 1986 and 2007. The weather data used were monthly averaged temperatures in ERA-grid cells (100 x 100 km) from the European Centre for Weather Forecasts.

We found that the average temperature of June was found to have the strongest and most consistent connection with the next years pollination intensity. A negative correlation between the pollen sums of consecutive years was found in 23 cases out of 29. For both parameters, the relationship was the strongest in Northern Europe. The two parameters, average temperature in June and annual pollen sum were used as explanatory variables in linear multivariate regression model.

The model predicted well the annual fluctuations of pollen loads especially in Northen Europe, but not in sub-arctic area or in NW Spain. This suggests that the model works best in boreal forest zone, where the average annual pollen sum is very high, and temperature during growing season strongly limits growth and reproduction.

On the other hand, the predictions tended to fail in areas where the pollen counts are constantly low or strongly affected by long-range transported pollen. In such cases, the annual pollen sums, calculated as a sum of daily average pollen counts per volume of air, may be strongly affected by stochastic factors such as rain, wind and long-range transport, during the pollination season. In other words, the annual pollen sum incompletely describes the annual flowering intensity.

Synchronized inter-annual fluctuation of flowering intensity affects the exposure to allergenic tree pollen in North Europe

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Many anemophilous, early-flowering tree genera include allergy plants of world-wide significance. We studied the synchronisation of high and low pollen years in the genera *Betula*, *Alnus*, *Corylus*, *Salix* and *Populus* and the cumulative effects that an increasing number of taxa has on the number of days of exposure to different levels of allergenic pollen in North Europe.

The proximal causes of the inter-annual variations of airborne pollen loads were analysed with a multiple regression analysis. The annual fluctuations of airborne pollen sums were compared between genera and found to be positively correlated among all combinations of genera at the three study sites.

Most correlations were statistically significant ($p<0.05$). The comparison between *Betula* and *Alnus* is discussed first. *Betula* pollen was clearly the most abundant airborne pollen type. The presence of *Alnus* pollen, however, significantly increased the predisposal to allergenic pollen.

At all sites, the number of days per year when the *Betula* and *Alnus* pollen counts together exceeded 10 and 100 grains m^{-3} of air, was found to be greater than the number of days when the *Betula* pollen counts alone exceeded 10 and 100 m^{-3} of air. The difference was statistically significant. In Kuopio, the difference was found to be statistically significant even for grains per 1000 m^{-3} of air of *Betula* and *Alnus* together compared with the same count of *Betula* pollen alone.

Betula, *Alnus* and *Corylus* belong to the order Fagales and have cross-reacting main allergens. The flowering of Alder and *Corylus* culminate at the same time, two to four weeks earlier than that of *Betula*. Due to synchronization of high and low years and the mostly non-overlapping flowering seasons, the time of exposure to pollen may be very long during the high years. Furthermore, *Alnus* and *Corylus* pollen may prime allergic people before the onset of the *Betula* season.

Predicting the start and peak dates of the Poaceae pollen season in Spain using process-based models

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Poaceae pollen affects 80% of allergy-sufferers both in Spain and across Europe. This family comprises hundreds of species, although only small number is responsible for most airborne Poaceae pollen and related pollinosis problems.

The present study examines variations in the timing of flowering between populations of Iberian Poaceae species from 12 sites in Spain. The spatial variation in pollen-season start-date for any given year was around a month; year-on-year differences at any given site ranged around one and a half months. The spatial variation in the pollen-season peak date was smaller, at around 15 days, while the year-on-year variation for the peak date at a given site was never greater than 20 days.

Two process-based models were developed, one to predict the start and another for the peak date of Poaceae pollen season respectively. These models take into account the effects of temperature, photoperiod and water availability on Poaceae flowering time in Spain.

Apart from predicting the start and peak dates of Poaceae pollen season, these models provide information on

(i) the Poaceae response to weather-related meteorological factors,
(ii) the period during which these factors affect grass growth, and
(iii) the relationship between photoperiod, temperature and water availability for flowering grasses.

Internal validation tests showed that the models accounted for 45% of the variance in start date and 68% of the variance in peak date. External validation was performed for 2006 and 2007 at all sites: the Root Mean Square Error for the actual and predicted dates was around 4 days for the start date and 6 for the peak date.

Analysis of the model estimates showed that a single model parameter set for all Spain taking into account different bioclimatic factors could be sufficient to account for the variability of Poaceae pollen season across space and time.

Satellite-based studies of the onset of the birch pollen season in Fennoscandia

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Satellite image-aided analysis of phenology of natural vegetation provides a spatially complete coverage that can be used to interpolate traditional ground-based phonological observations.

Phenological changes during the growing season can be studied by examining changes in the remote sensing-based normalized difference vegetation index (NDVI) value. The NDVI is defined as: NDVI = (Ch2 - Ch1) / (Ch2 + Ch1), where Ch1 and Ch2 represent reflectance measured in near infrared and red channels, respective.

The last years several studies in Fennoscandia by Northern Research Institute Tromsø (Norut) have found high correlation between surface observation of the phenophase leaf bud burst of birch and NDVI values. Since the male flowering and leaf bud burst of birch are well correlated this indicates that the observations of a phenophase as leaf bud burst could be used to determine the timing of local birch pollen release. In addition, recent studies have found moderate high correlation between NDVI values and the date for when the accumulated birch pollen sum reach 2.5% of the annual total. This is the case even where birch is not the dominant tree species.

First we used the low-resolution GIMMS-NDVI satellite dataset with 8 km spatial resolution for the 1982 to 2003 period. This dataset revealed a trend of about two weeks earlier onset of the birch pollen season in the southernmost parts of Fennoscandia and at the west coast of Norway, while at high altitude areas and in the continental north the situation was more stable or even with a weak delay trend.

The new generation of medium-resolution MODIS-NDVI satellite data with 250m spatial resolution covering the 2000 to 2007 period reveals details not found in the GIMMS-NDVI based map in topographical complex areas. When the two different dataset where combined to a time-series for the 1982 to 2007 period it indicate that the last years there is a trend of earlier onset of the birch pollen season also in the continental north and at high altitude areas.

These studies indicate that NDVI values computed from both low and medium resolution satellite data can be used to monitor the approximate onset date of birch pollen release. These studies also show that remote sensing is a useful tool to reveal regional differences in the onset of the birch pollen season not easily detected by pollen stations alone and can also be used to infer trends caused by a changing climate.

POSTERS 2a. Monitoring, spores

Ganoderma basidiospores in the atmosphere of Valladolid (Spain). Sánchez-Reyes E., Rodríguez-de la Cruz D., Pérez-Gorjón S., Fernández-González D., Sánchez-Sánchez J.

Sensitization prevalence and aerobiological profiles of fungal spores and pollen in the region of Porto (Portugal). Oliveira M., Ribeiro H., Jacinto T., Fonseca J., Ferraz de Oliveira J., Castel-Branco M.G., Delgado L., Abreu I.

Preliminary survey of fungal spore biodiversity in the nature reserve of "Sierra de Hornachuelos" in Andalucía (Spain). Bustos Delgado I., Angulo Romero J., Dominguez Vilches E., Galán C.

Ganoderma basidiospores in the atmosphere of Valladolid (Spain)

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Although a great amount of fungal spores are present in the atmosphere, it is common to find out significant differences according to the season, the meteorological variables and the geographical area studied.

We have carried out the first study of the aeromycota present in the atmosphere of Valladolid (North-Centre of the Iberian Peninsula) along two years (2005-2006). However, in this report only preliminary results obtained for *Ganoderma*, a cosmopolitan wood-rooting genus of dead and living hardwoods and conifers with allergenic potential, are presented.

Spore sampling was performed using a Hirst-type trap, Burkard model, placed on top of the Río Hortega University Hospital of Valladolid at a height of 24 m above ground level (690 m.a.s.l). The methodology used is that suggested by the Spanish Aerobiology Network (R.E.A). We used the SPSS program applying the Spearman´s test in order to establish the influence of the main meteorological factors on the spore concentrations along the principal period of emission (PPE) and the prepeak period (PRE).

Moreover, we have studied the intra-diurnal variations taking into account three different models:

- for the first model the value for each hour is represented by the sum of the values corresponding to that hour
- while in the second model an ideal day was obtained, dividing this sum of values for each hour by the number of days on which the spore type analyzed was present;
- in the third model it is important whether rainfall was registered or not, being selected just those dry days with a daily value equal or higher than the average, using the total number of days of the PPE period in both years as the denominator.

In the three cases the values for each hour are expressed as a percentage of the spore type´s total. For the graphical representation we have used a 3 hours running mean in order to smooth the tendency.

In 2005 the PPE lasted 108 days (from 8 July to 23 October), similar to the PPE for 2006 (105 days; from 16 July to 28 October), being observed a total number of 2100 and 3563 spores, respectively. The maximum daily values were registered on 4 September 2005 (69 spores/m^3), and 12 September 2006 (98 spores/m^3). Significant positive correlations were established with the mean and the maximum temperature in the PPE, south easternly winds during the PRE and with north westernly winds and the frecuency of calms in both periods. Otherwise negative significant correlations were found with precipitation, relative humidity, south westernly winds and wind velocity during the PPE and with total insolation and wind velocity during the PRE.

The intradiurnal pattern is very similar for the three models used. During the afternoon and the evening hours the percentage of presence is very low (1-2%), increasing gradually up to a 6-9% obtained around the first 10 hours of the day.

These results are in accordance with the characteristic spore morphology (spore wall thick and dark brown coloured) presumably well adapted to be dispersed in drought periods.

Sensitization prevalence and aerobiological profiles of fungal spores and pollen in the region of Porto (Portugal)

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In industrialized countries, the prevalence of allergy is increasing. Aerobiological studies describe the aeroallergens seasonal distribution in a given area. The combination of epidemiological and aerobiological studies is useful in choosing the allergens used in skin-prick tests (SPT), and in adjusting allergy alerting systems. This work aims to determine the most prevalent allergens in patients followed in a specialized allergy clinic in Porto and to compare these results with the most frequent airborne fungal spores and pollen in the same region.

Data from all SPT performed at the Allergology Department, from June 2005 to December 2007 was collected and a brief descriptive analysis of the sampled patients was performed. Sensitization was defined by a positive SPT result (allergen wheel diameter higher than histamine wheel diameter).

An aerobiological study was simultaneously conducted using a seven day Hirst-type volumetric spore traps. A total of 4056 patients performed SPT. The ages ranged between 1-95 years, with an average of 28±18 years, 25% of the patients younger than 13 years and 75% younger than 41 years. Approximately two-thirds (62%; n=2525) were females. Most patients lived in Porto district (89%; n=3600).

With respect to SPT results, 52% (n=2118) were sensitized to at least one allergen extract. The most frequent allergens were house dust mites (36.1%) followed by grass mixture (24.9%), *Secale cereale* (18.9%), *Triticum aestivum* (17.8%), weeds mixture (12.0%), *Plantago lanceolata* (9.8%), cat dander (7.9%), *Parietaria judaica* (7.2%), *Olea europaea* (4.3%), dog dander (4.1%), Ar*temisia vulgaris* (3.5%), *Platanus acerifolia* (2.5%), *Alternaria* spp. (2.5%), *Betula verrucosa* (1.9%), *Cladosporium* (1.2%), *Aspergillus* spp. (0.8%) and *Penicillium* spp. (0.7%).

The most abundant fungal spore in the atmosphere of Porto was *Cladosporium* (59.5% of the total fungal spore spectrum), with the highest concentrations found from June to October. *Alternaria* spp (1.2%) presented a similar seasonal distribution while *Aspergillus/ Penicillium* (0.8%) had a sporadic behaviour.

With regards to pollens, weeds were the most abundant group representing 39% of the total airborne pollen spectrum (*Parietaria* spp. 22%; *Plantago* spp.3%). Tree pollen constituted 35% of total pollen airborne spectrum (*Platanus* spp 8%; *Olea europaea* 3%; *Betula* spp. 2%). Grasses were the third most frequent group corresponding to15% of total spectrum. Pollens were mainly distributed throughout spring and summer.

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These results suggest differences between prevalence of IgE sensitization in allergic patients and the atmospheric sporopolinic spectrum, since elevated airborne concentrations do not match with high sensitization prevalence. So, *Cladosporium* was the most frequent spore type in the atmosphere, while *Alternaria* presented higher sensitization values. These differences might be due to the allergen content and standardization of SPT extracts.

Despite being a frequent cause of sensitization (8.7% of positive SPT), tree pollen, namely Pinaceae, Cupressaceae or Aceraceae which constituted approximately 15% of the airborne pollen spectrum, were not tested. In the future, these aeroallergens should be considered to be included in the SPT battery.

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Preliminary survey of fungal spore biodiversity in the nature reserve of "Sierra de Hornachuelos" in Andalucía (Spain)

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This study reports the results of the first aerobiological sampling of the atmosphere in the Nature Reserve of the "Sierra de Hornachuelos", an area of ecological importance, located northwest of the province of Cordoba (Spain). The area has a marked seasonality and the vegetation is Mediterranean forest dominated by several species of *Quercus* (mostly *Quercus ilex* subsp. *rotundifolia*). The aim of this research was to study the biodiversity of fungal spores present in the atmosphere of the nature reserve and their seasonality.

Sampling was carried out by volumetric spore trap over a one-year period. Spores were counted on daily slides. The spore trap (Hirst type) was sited on one of the highest hills in the area, at a height of 200 m from the valley floor, 450 m above sea level and approximately 15 km away from the nearest town. Weather data were provided by a meteorological station located near to the trap. The meteorological parameters included in the study were: relative humidity, rainfall and minimum, maximum and mean daily temperatures. Spearman's rank correlation tests were performed in order to determine the influence of meteorological factors on the incidence of the most abundant spore types in the atmosphere. The spores were classified in 77 different taxa. The most abundant taxa were *Cladosporium*, followed by *Ustilago, Coprinus, Diatrypaceae* and *Alternaria*. The total spore count during the study was 843,845. The months with the highest total were May and September.

Significant correlations ($p < 0.05$) were found between the 5 most abundant taxa and meteorological parameters. *Alternaria, Ustilago* and *Cladosporium* had positive correlations with temperature. The most important peak for *Cladosporium* occurred when precipitation was low and daily average temperature was high. *Alternaria* concentrations decreased during rainfall, and increased once rainfall had stopped, which was reflected by negative correlations with rainfall and relative humidity.

The genus *Ustilago* showed a notable presence during April, May and September and had negative correlations with relative humidity. The family Diatripaceae had positive correlations with rainfall and relative humidity. *Coprinus* did not show any significant correlations with the meteorological parameters.

A high diversity of fungal spores was observed in the reserve. The results of correlation analysis showed that fluctuations in temperature were the most important factor affecting spore concentrations including types like *Cladosporium, Alternaria* and *Ustilago* which are dry spores. Rainfall also has an important affect on spore concentrations.

Rain effectively washes all spores from the atmosphere. However, depending on the intensity of rainfall the dry spores will be washed out from the atmosphere, while the wet spores will increase their concentrations. The family Diatrypaceae, a wet spore type, is particularly affected by rainfall. Short periods of very heavy rain remove large amount of these ascospores from the atmosphere. However, concentrations will increase again as soon as the intensity of rainfall decreases. A longer-term study is necessary to understand all these fluctuations fully.

POSTERS 2b. Monitoring, pollen

The dynamic of Poaceae pollen seasons in Rzeszów (SE Poland).. Kasprzyk I., Walanus A.

A comparison between airborne *Betula* pollen counts in the northwest of Germany and the Netherlands. Wachter R., de Weger L., van der Smitte H., Ehrnsberger R.

Airborne pollen flora in the metropolitan city of Turkey. Celenk S., Bicakci A.,Tamay Z., Guler N., Altunoglu M.K., Canitez Y., Malyer H., Sapan N., Ones U.

Atmospheric *Ambrosia* pollen frequencies and association with temperature in Zagreb, Croatia, 2006-2007. Hrga I. Herljevic I., Stjepanovic B., Puntaric D.

Temporal and quantitative features of *Parietaria judaica* pollen production and Urticaceae pollen circulation in Thessaloniki (Greece). Fotiou C., Damialis A., Vokou D.

Pollen calendar of Rome (Italy). Travaglini A., Brighetti M.A., Serra M.C., Epifani C., Froio F.

Aerobiological investigations in Ryazan' (central Russia): the first results.. Posevina J., Severova E., Ivanov E.

Pollen calendar of Finland. Reiniharju J., Oikonen M., Saaranen S., Pätsi S., Pessi A.-M.

Aerobiology in Ukraine: achievements and future. Rodinkova V.V.

The dynamic of Poaceae pollen seasons in Rzeszów (SE Poland)

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Grasses (Poaceae) are one of the most important families among flower plants. They have high adaptation abilities, they occur in nearly all habitat types, plant communities, climatic zones. Grasses are characterised by a huge production of small pollen grains which can be transported even for several hundred or several thousand kilometres with masses of air.

Values of airborne grass pollen concentrations are not strictly dependent on the amount of pollen production. Important factors are elements of the environment, of which the most important are weather, species' flowering phenology, the type of plant communities in which they occur, anthropogenic factors. Only some species are characterised by pollen production large enough and/or the number of inflorescences on one individual large enough to pose a risk to allergic persons.

In many aerobiological studies, great variations in the pattern, duration and dates of the pollen season of different pollen taxa are stressed. We assume that there is some regularity in the pattern of the grass pollen season in Rzeszów. The aim of the study was also to estimate which of the selected environmental elements may have a connection with the characteristic dynamics of the pollen season of this taxon.

Aerobiological monitoring was conducted in Rzeszów (SE Poland) in 1997-2005. The volumetric method was used. In the years 2003-2004, phenological observations were carried out. The seven successive phenophases of the generative development of plants were distinguished.

Grass pollen seasons each year were similar to one another and in order to describe them, the method of fitting two bell curves was applied. The estimated grass pollen season is characterised by two periods of high or relatively high concentrations separated by a period of low concentration. Cause-and-effect relationships between the increase in the number of grass pollen grains and the increase in values of the weather elements were statistically significant.

Analysis has been shown with great probability that that on days on which maximum temperature, minimum temperature and sunshine rise, an increase in grass pollen concentrations will be noted, and in the case of air humidity, the concentration will decrease, but it wasn't proved the correlation between the time of occurrence of the low concentration period and meteorological elements.

We assumed that seasonality of pollen shedding could correspond to the curve of the atmospheric pollen season. Literature data and phenological observations of selected grass species indicate that those with abundant pollen production flower in a relevant order.

The analysis of the results shows that it is rather the pattern of flowering of successive grass species and meadow cutting dates, dependent on this pattern, which may be the main cause of the characteristic behaviour of the grass pollen season in Rzeszów.

A comparison between airborne *Betula* pollen counts in the northwest of Germany and the Netherlands

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One aim of the present study was to look for similarities and differences in airborne pollen load between neighbouring and far away monitoring sites in low areas of Northwest Germany and the Netherlands. Another central aspect was the question, if there are already recognizable effects of climate change on time and amount of pollen catch. The investigation focused on *Betula* because of its allergenicity and the prevalence of one species (*B. verrucosa*).

For the present study data were used that were collected using Burkard traps at three monitoring sites in northwest Germany, and two in the Netherlands. The three sites in Germany were Delmenhorst (city centre, close to Bremen), Ganderkesee (rural site; 8 km west of Delmenhorst) and Vechta (university campus; 40 km south of Delmenhorst). The two sites in the Netherlands were Leiden (270 km southwest of Delmenhorst; Northsea coast) and Helmond (250 km southwest of Delmenhorst).

Available pollen data from three different periods were used in the analysis: from 1982 to 2007 (the long-term collection sites Delmenhorst and the two Dutch sites), from 1994 to 2007 (Ganderkesee) and from 1997 to 2007 for Vechta. During the observation period (1982-2007), at all three long-term sites the pollen season reached its average peak within a few days (April 21st - 24th). The mean onset of the pollen season showed minor differences: Helmond on April 1st, Leiden on April 2nd and Delmenhorst one day later. The end of the season showed slightly larger differences (May 3rd, 6th and 9th).The highest degree of homology in the pollen season was reached in years with a late onset of the pollen season.

In years with an early onset and high pollen counts, the peak of the season shows larger differences (April 7th, 13th and 16th). Total annual counts were similar in Delmenhorst and Helmond, whereas counts in Leiden were one third of those counts; since 1995 there is a synchronous biennial rhythm at all monitoring sites.

Comparison of consecutive collecting periods (1982 - 1994 and 1995 - 2007) at the three long-term sites reveals earlier main peaks in the later period (difference of one to three days). Moreover there is a conspicuous early peak of sampled pollen for the later period at Helmond and Leiden. A comparison of the three German sites (1997 - 2007) showed a large similarity in peak of birch pollen season: April 18th for Delmenhorst and Vechta, April 19th for Ganderkesee. Mean total annual counts were similar in Ganderkesee and Vechta, and 60 % higher in Delmenhorst.

The comparison of the three German sites shows a somewhat better chronological agreement in *Betula* pollen season because of rather small distance from each other. Not to weighty differences between Delmenhorst and the Netherland sites indicate, that the German sites are representative for the lower part of Northwest Germany. At all three long-term sites there seems to be a clear effect of climate change: time of main pollen release tends to be earlier.

Airborne pollen flora in the metropolitan city of Turkey

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Atmospheric pollen is a major cause of allergies. In each geographical area there are different species that compound a characteristic airborne pollen calendar controlled by the meteorological conditions changeable in areas and years.

In this study, a continuous aerobiological survey of the atmosphere of Istanbul was carried out from 1st January 2006 to 31st December 2006 by means of the volumetric method. Istanbul is a city more than ten million inhabitants, situated at 28o 58' E, 41o 01' N in north-western Turkey. It is the only city in the world which spreads over two continents.

The pollen was counted at a magnification of × 400, in 24 transverse bands, and total daily counts were converted into the number of pollen grains per m^3 of air.

During the year 2006, a total of 13 755 pollen grains / m^3 which belonged to 53 taxa and 170 unidentified pollen grains were recorded.

In the region investigated, Cupressaceae / Taxaceae, *Platanus* sp., *Urticaceae*, *Pinus* sp., *Quercus* sp., *Pistacia* sp., Moraceae, *Fraxinus* sp., *Xanthium* sp., Poaceae and Compositae were responsible for the greatest amounts of pollen. During the study period the pollen concentration reached highest level in April.

Atmospheric *Ambrosia* pollen frequencies and association with temperature in Zagreb, Croatia, 2006-2007

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Allergy is the world widest disease of today. The most common source of allergies disease of respiratory system is pollen. The number of allergy patients is increasing from day to day, especially in urban areas. Type and concentration of pollen in the air depend from geography–climatic region, regional vegetation and meteorological conditions (mainly temperature).

The increasing problem of sensitization to ragweed pollen in Europe has triggered studies on *Ambrosia* pollen in Croatia. Ragweed (*Ambrosia* sp.) an originally North American species, has been expanding in Europe during the second half of 20th century. Because of its allergenic character, monitoring of ragweed pollen has been performed in Europe for years.

Ambrosia was found in Croatia in 1941 for the first time. Since then the plant migrated rapidly into new areas. However Croatia take place in the epicentre of *Ambrosia* expansion with the very high concentration of pollen find in the time of pollination (August and September) it is necessary planning of preventive actions for elimination that allergenic plant. With this action, concentration of pollen count will decrease on the level which does not cause appearance of symptoms of allergic diseases (less than 30 pollen grains per m^3 in the air).

The aim of the study was to determine and compare the airborne ragweed pollen count in two years in the city of Zagreb according to the onset, duration of season, peak values, temperature and total annual count.

Seven-day Hirst-type volumetric pollen traps were used for pollen sampling. Pollen concentration was expressed as the average number of pollen grains daily/m^3. The two (2006 and 2007) pollen season were investigated. Ragweed pollen is the third most abundant pollen type in atmosphere of Zagreb and accounted for 13% of total annual pollen spectrum in 2006 and 12% of total annual pollen count in 2007. The peak daily pollen concentrations were recorded at the end of August and in the first week of September when the temperature was highest.

The mean total annual concentration of ragweed measured in 2006 was 6,104 In 2007 measured decreasing number (3,012) of pollen grains caused by effective preventive actions and lower average temperature for 1,5°C than usual.

The results of this study are expected to help alleviate the symptoms of allergenic reactions in individuals with ragweed pollen hypersensitivity, thus improving their quality of life.

Temporal and quantitative features of *Parietaria judaica* pollen production and Urticaceae pollen circulation in Thessaloniki (Greece)

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Parietaria judaica (Urticaceae) pollen is renowned for its high allergenic potency. Given the species' impact on human health and its prevalence in urban areas of the Mediterranean basin, we kept records of its air-borne pollen in Thessaloniki, Greece, by use of a Burkard trap, and we studied pollen production in two populations differing in exposure (southern and northern), in the centre of the city. Effectively, we studied the pollen circulation characteristics of the whole Urticaceae family, since further distinction was not feasible under the optical microscope.

We monitored the two populations at regular time intervals throughout the year. We found the species to have two flowering periods, in spring and autumn; during these periods we kept records of the ratio of open hermaphrodite flowers in 45 shoots from each population, every 5 days.

In both flowering periods and populations, we estimated the pollen amount carried by 90 indehiscent hermaphrodite flowers. Flowering started nearly one week earlier in the population of southern exposure in spring, but not in autumn. The southern exposure population produced more pollen per flower and also more flowers per shoot in spring, but there was no difference in pollen production per flower between the two populations, in autumn. Pollen production per flower differed between flowering periods; in spring, it was more than double that in autumn.

Peak of flowering of *P. judaica* fairly coincided with the pollen load peak of the whole Urticaceae family. Even though this widely-distributed species displayed a second flowering period in autumn, very low to negligible amounts of Urticaceae pollen were then trapped. It derives, therefore, that species-flowering periods and pollen seasons do not necessarily coincide.

Pollen calendar of Rome (Italy)

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In this study, a pollen calendar is presented for Rome (Italy) (41°53'54'',12°28'50''). The city is situated in a plain nearby the Tyrrhenian Sea on the West and the Apennine Mountains on the North-East and Alban hills on the South.

The mean annual temperature is 16° C, the annual average rainfall is 700 mm, but from 1990 on, Rome is getting hot and more dry.

The vegetation is represented by urban woods and wide prairies present in large parks, ornamental flora, grasses, weeds and ruderal vegetation; but often we can try pollen coming from rural areas around the town or from the forest on the mountains as *Castanea*, *Fagus* or *Betula*. Pollen monitoring was carried out by means of a Hirst volumetric spore trap according to the IAA standard method in three different sites of the city: RM5 (Tor Vergata University), RM8 (CRA-CMA), RM6 (San Pietro FBF Hospital); two others stations have been used for a few years: RM7 (S. Eugenio Hospital) and a sampler at ground level in the Roman Foro area.

The calendar is based on results for about ten years of air monitoring (1996 – 2007) in RM5 and seven years in RM8. We have a great season of pollens, from February to June (*Cupressus, Corylus, Ulmus, Fraxinus, Populus, Betula, Alnus, Carpinus, Ostrya, Platanus, Quercus, Olea,* Poaceae) and a second one, less important, in Summer –Autumn (Cheno-Amaranthaceae, Polygonaceae, *Artemisia*, *Taraxacum*, *Ambrosia*, *Cedrus*)

The pollen calendar is an important tool for health of allergic people and ecological study. Different quantity of pollen collected and different length of pollination period were found in annual calendar. These results can be explained by meteorological factors, as rainfall and temperature. But, on the long period, the evaluation of pollen concentration in the air and its seasonal variation is important to monitoring the impact of climate change on plants.

Aerobiological investigations in Ryazan' (central Russia): the first results

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Aerobiological monitoring in Ryazan' (central Russia) was carried out for the first time in 2007 with gravimetric air sampler. The trap was located on the roof of the building about 20 metres above ground level in the city centre.

Forty pollen types were determined in the air during the season (March-October), seventeen of them form the main body of the spectrum. Arboreal pollen is dominated quantatively (87,56 % of total pollen count), but non-arboreal part of spectrum is more taxonomically diverse (23 pollen types).

The pollen season can be divided into three periods. The first one was associated with pollination of early flowering trees (*Betula, Acer, Salix, Quercus, Pinus, Fraxinus*) and took place from the mid-March till the end of May. Birch was dominated taxon during this period, its daily count reached 1561 p.g./cm^2. Almost all early flowering trees are characterized by short pollination period (14-18 days), very sharp increase and long gentle decrease of pollen count.

Usually the pollination curve has several pikes, the first one is always connected with the beginning of pollen season, the others are well correlated with fluctuation of the air temperature. Pollen grains of birch were registered for the first time a month before the start of pollen season. All episodes were associated with high air temperature and wind of south or south-east directions and we consider them as long transported.

The second pollen period took place during the first part of summer (June –mid July) and was associated mainly with grass pollen. Daily count did not exceed 20 p.g./cm^2, but pollination period was very long (86 days). Besides grass, pollen grains of *Betula, Pinus, Plantago, Urtica, Rumex* were registered during that time.

The third pollen period was characterized by the greatest taxonomic diversity. The main pollen types were *Artemisia, Chenopodiaceae, Plantago, Urtica, Poaceae, Ambrosia,* mugwort was the most abundant taxon. Ragweed is not typical for middle Russia, but in flora of Ryazan' region some populations of *Ambrosia* were registered. In aerobiological spectrum pollen grains of ragweed were observed permanently during August, but pollen count did not exceed 2 p.g./cm^2.

The main pollen season was over by the end of August. During September only single pollen grains of nettle, mugwort, ragweed and chenopods were registered in aerobiological spectrum.

Aerobiology in Ukraine: achievements and future

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Air pollution, amount of allergic patients is increasing day-by-day and other challenges of the quickly developing world [1] compel scientists to improve quality of registration of air pollution parameters, their monitoring and forecast. Following these requirements Ukrainian scientists are continue aerobiological studies was initially held in Ukraine per 30th years of previous century and at the end of the 20th century. Aeropalynological researches were fragmentary conducted for a steppe zone of Ukraine at 30th years of 20th century under supervision of the Prof. D. K. Zerov. Aeromonitoring was carried out in Ukrainian capital Kiev and area per 90 years of 20th century also. This study group was supervised by Dr. V. Savitsky. Palynological investigations were held in regional Ukrainian city Vinnitsa at the end of previous century too.

Sampling method used in every study of previous aerobiological period in Ukraine was gravimetric. But data was obtained by Ukrainian scientists correlate with data of European aerobiologists [2]. There are two pollination waves are registered in Kiev and Vinnitsa. Main plant taxa' which pollen were identified in the air of both cities are birch (*Betula* L.), alder (*Alnus* Mill.), oak (*Quercus* L.), wormwood (*Artemisia* L.), grasses (Poaceae) and plantain (*Plantago* L.) [3]. However, some differences also were recorded. Thus, amount of pine tree (*Pinus* L.) pollen was above of permissible concentration in the Kiev' air. Correlation between radiation levels and airborne Pinus' pollen quantity was recorded in Kiev also [3], while pollen group "*Amaranthus* L./Chenopodiaceae" were predominant in Vinnitsa' air [4]. Kiev were characterized by spreading of tree pollen mainly while in Vinnitsa "trees:weeds" ratio were approximately 1:1. These differences are corresponding with location of Kiev and Vinnitsa in forest and forest-steppe zones accordingly. Data for steppe zone were shown airborne weed pollen mainly [5].

Modern period of Ukrainian aerobiology was started in 2007 spring with airborn pollen researches are carried out in Ukrainian Marzeev Memorial Scientific Institute of Public Health and Medical Ecology. Energies of Ukrainian aerobiologists are jointed under the aegis of this Institute and united aerobiological research should be conducted in Ukraine. Aeropalynological network would yield a result for allergy forecasting in Kiev, Vinnitsa and Zaporizzha city. This arrangement of the pollen stations gives us possibility to collect pollen of all native zones Ukraine is located in: forest (Kyiv), forest-steppe (Vinnitsa) and steppe (Zaporizzha). The research is now started in Kiev is carried on volumetric Burkchard trap. The united group will study airborne spores also: this data should be collected in Ukraine for the first time and should be used for correct pollinosis' diagnostic and prevention. We hope our data should be included in the All-European aerobiological network and will be useful not only for Ukrainian patients.

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Pollen calendar of Finland

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Pollen sampling has been done in Finland since 1973 with Hirst-Burkard type samplers. Today, there are nine sampling sites: Turku, Helsinki, Joutseno, Vaasa, Tampere, Kuopio, Oulu, Rovaniemi and Kevo. Pollen concentrations are determined by stratified random sampling of microscopic fields.

During the pollen season, pollen reports are broadcast via radio, TV, newspapers and internet portals. The thresholds for pollen concentrations used in pollen reports are low, moderate and abundant. Finnish pollen data are stored in the database of European Aeroallergen Network.

The major allergenic pollen types in Finland are alders (*Alnus incana, A. glutinosa*), birches (*Betula pendula, B. pubescens*), grasses (Poaceae) and mugwort (*Artemisia vulgaris*). Hazel (*Corylus avellana*) grows in southern Finland naturally, and in central Finland as ornamental trees but the pollen concentrations are low and of little allergological importance.

Of the major allergenic pollens elsewhere in Europe, *Parietaria* does not occur in Finland. In the Finnish climate, *Ambrosia* does not grow to the stage of inflorescence. Long-range transported *Ambrosia* pollen grains have been detected in southern Finland sporadically in late August-early September during the 21st century. *Urtica* type pollens are abundant in June-July, but their allergenic importance in Finland has not been studied.

There is a big difference between time of beginning and the duration of pollen seasons between different parts of Finland, because the southernmost parts of Finland are in the temperate zone, and the climate in the northern parts of Lapland is arctic. Furthermore, Finland is over 1000 km long so that even within-country long-distance transport of pollen has occurred.

At most, the pollen season can start in March in Southern Finland and last until early September. The earliest observations of long-distance transported pollen grains of alder have been made in January, before local flowering.

The most important plant group in Finland producing allergenic pollen are the birches. Birch pollen season usually starts in Southern Finland in the last half of April and last until early July in Northernmost Lapland.

Grass pollen occurs on average from May to August in Southern and Central Finland. The Poaceae pollens are reported as a group, which consists of several species. In Northern Finland grass pollen season is usually weak.

Mugwort pollen commonly causes allergic symptoms from July to August in the whole country, up to the southern parts of Lapland.

Forecast models for daily variations of grass pollen in Tirana city (2002-2005)

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Daily forecast models were developed for grass pollen in Tirana city using meteorological data and pollen data for a period of five years (2002-2005). The forecast models were tested in two years, 2006 and 2007. The pollen data were analyzed with a Burkard Pollen trap places in Tirana at level of 15m above ground level and the meteorological data were obtained from Meteorological Office in Tirana for the years of the study. The statistical analyses were performed by and SPPS software statistical package.

Three different multiple regression models were used to predict the daily grass pollen counts in Tirana during pre-peak, peak and post-peak periods. The predicted and actual grass pollen counts were compared through correlation analysis to evaluate the curve of the prediction daily grass pollen for each period. All the models except the model for the post-peak period were able to predict the trend of the grass pollen counts.

A multiple regression model was able to forecast the daily variation of grass pollen counts during the pre-peak period. The pre-peak period was considered to be the period between the start of the grass pollen season until the maximum grass pollen counts were recorded with the pollen sampler. The temperature maximum and the pollen counts of two previous days were the best parameters to predict the daily grass pollen counts during the pre-peak period. The percent accuracy obtained was equal to 71% when the model was tested on data for 2006 and 65% in 2007.

A multiple regression model was used to predict the daily grass pollen counts during the peak period. The peak period was considered to be the period from the date when the maximum grass pollen counts were recorded with the pollen sampler till the 80% value of the cumulative daily pollen counts was reached. The variables used to forecast the daily grass pollen counts in the peak period were temperature minimum and the grass pollen counts of two previous days. The obtained percent accuracy was equal to 80% in 2006 and 67% in 2007.

A multiple regression model was constructed for the daily pollen counts during the post-peak period in Tirana. The variables used were temperature minimum and the daily grass pollen counts of two previous days. The accuracy achieved was 66% in 2006 and 86% in 2007.

POSTERS 2c. Allergology, Indoor air

Get rid of mugwort by rooting up shoots. Jantunen J., Saarinen K.

Assessment of indoor fungal and bacterial aerosol concentration in Pakistani residential dwellings. Colbeck I., Nasir Z.A.

Concentration and size distribution of fungal aerosol in residential flats with and without mould growth. Colbeck I., Lai K.-M., Altamirano-Medina H., Nasir Z.A.

Monitoring of fungal spores that might promote biodeterioration in antique books within the main Poznań University Library (Poland). Bustos Delgado I., Nowak M., Szymańska A., Stach A.

Characterization and identification of the microflora in Styrian wine cellars. Galler H., Haas D., Melkes A., Schlacher R., Feierl G., Mascher F., Buzina W., Marth E., Reinthaler F.F.

Get rid of mugwort by rooting up shoots

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Mugwort (*Artemisia vulgaris*) is a source of the most important allergenic pollen in late summer. It is an abundant weed which can quickly colonize patches of disrupted ground in urban areas.

Mugwort pollen does not disperse over long distances. When pollen was collected with rotorod-type samplers near mugwort stands (4 days, 26 samples in accordance with wind direction), concentrations decreased by 80 % from a distance of 1-10 m (mean 315; range 74-1,070 grains m^{-3}) to 30-50 m (63; 9-164). At distances of 90-150 m only 9-86 (mean 29) grains m^{-3} were recorded.

Due to its poor dispersal, exposure to mugwort pollen can be reduced by eliminating plants in gardens and residential areas. We compared the effect of cutting and rooting up shoots of mugwort on 15 sites located on uncultivated fields, wastelands and roadsides in Southeast Finland.

In each site five permanent sample plots (20 m2) were selected in 2004 or 2005. The plots (75) were divided into five groups, in which plots were managed either by cutting (C) or rooting up (R) in early July (J) or late August (A) i.e. before and after the flowering period. One plot in each site was left as an untreated control (co). The number of shoots were counted before the annual treatment.

During the first year the number of shoots decreased in both groups managed by rooting (RJ: mean 125-26, $p<0.05$; RA: 132-37, $p<0.05$ ANOVA, Duncan's post hoc test). The cutting of plants and controls resulted only in small changes in the mean number of shoots (CJ: 118-114; CA: 109-97; co: 115-111). All plots managed by rooting had a smaller number of shoots compared to the baseline, but 20-33 % of mown and control plots had more shoots.

After the second year treatment the number of shoots decreased by 35-54 % in all groups, even in the controls (51 %). The timing of the treatment had no effect on the number of shoots. By the end of the study in 2007 the plots had been treated two or three times. The number of mugwort shoots decreased by 95 % by rooting up, 90 % by cutting, and 65 % by doing nothing.

Mugwort is a weed species which suffers in dense vegetation like that in the overgrowing study sites. According to the first year result, rooting up shoots was the most effective way to remove mugwort, but pollen exposure can also be reduced by mowing before flowering. If the mugworts were cut in early July, the plants did not have time to flower during the late summer.

Assessment of indoor fungal and bacterial aerosol concentration in Pakistani residential dwellings

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Indoor bioaerosols are emerging as one of the significant factors which contribute to building related illness. There is a growing concern that exposure to bioaerosols may cause respiratory and infectious diseases.

Studies on indoor bioaerosols are sporadic and most have concentrated on total viable concentration of bioaerosols. However information on the size distribution is of great importance in order to determine resuspension parameters, residence time in air and deposition in the human respiratory system.

No data is available in Pakistan on indoor bioaerosol concentrations. Therefore, the present investigation was undertaken to assess the levels of bioaerosols in Pakistani households at three sites: two rural and one urban.

Forty two single family residences were selected and air samples taken with an Anderson six stage viable particle sampler, loaded with Malt Extract Agar, MacConkey Agar and Trypticase Soy Agar. Colony forming units (CFU/m^3) were enumerated for each stage and the total counts determined. In Lahore the highest total bacteria (13922 CFU/m^3) and fungal (5300 CFU/m^3) concentrations were found among the houses in slums.

However, the outdoor levels were generally higher than those indoors. The highest outdoor concentration of total bacteria and fungi was 20724 and 3286 CFU/m^3 respectively. On the other hand, in rural sites the maximum concentration of total bacteria and fungi was 29151 and 32756 CFU/m^3.

The indoor levels of bioaerosols were higher than outdoor in all of the samples, probably due to indoor cattle sheds and excessive use of wood as construction materials. Similarly, the upper concentration of gram negative bacteria was higher in rural houses than in the urban area. With reference to size distribution most of the total bacterial aerosols were present in stages 2-5 (2.1-7µm) while the highest concentration of gram negative bacteria occurred on stage 6 (0.65-1.1µm).

The maximum percentage of fungal aerosol was present at stages 4 (2.1-3.3µm) and 5 (1.1-2.1µm). The most frequent fungal genera were *Aspergillus, Penicillium*, *Fusarium* and yeast.

Concentration and size distribution of fungal aerosol in residential flats with and without mould growth

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Exposure to indoor fungal aerosol is of considerable concern to human health as it is associated with adverse respiratory heath effects. However, studies on levels of fungal aerosol in various residential settings are rare and sporadic. Most of these studies report only total counts of indoor fungi. However exposure to the occupants is not necessarily mirrored by only the number of total viable fugal spores.

Knowledge of aerodynamic particle size is crucial in determining their transport, residence time in air, resuspension and deposition in the human respiratory system. The present investigation was undertaken to assess the concentration and size distribution of fungi in single family studio flats in London.

Samples were taken from twenty flats during March 2007. The flats were of same age and were located on three floors. Five of the flats had a known mould history while the remaining fifteen were without any visible mould growth.

The samples were taken with an Anderson six stage viable particle sampler, loaded with Malt Extract Agar. The sampling interval was 5 minutes and after collection the agar plates were incubated at 25ºC for 48 hours. Data on humidity, temperature, water damage, visible mould, age of home, number of occupants and respiratory illness were recorded. Colony forming units (CFU/m^3) were enumerated for each stage and the total counts for all the stages were measured.

The total concentration of fungal aerosols in 'mould free' flats was in range 176-678 CFU/m^3 with a mean of 342 CFU/m^3. While in the flats with mould the mean concentration was 563 CFU/m^3 and a range of 303 – 1484 CFU/m^3. Outdoor levels of viable fungal spores were in the range of 169-424 CFU/m^3 with a mean of 283 CFU/ m^3.

Overall, the total concentration of viable fungi was slightly higher in the mouldy flats as compare to 'mould free' flats on the same floor. In terms of size distribution the highest percentage of viable fungi was collected from stage 4 (2.1-3.3μm) at all of the sites (mould, 'mould free' and outdoors).

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Monitoring of fungal spores that might promote biodeterioration in antique books within the main Poznań University Library (Poland)

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The study was carried out in the main library of Adam Mickiewicz University in Poznan, a late Renaissance style building from the late 19th century. The building is the most important library in Poznan, holding more than 4 million volumes, including a collection of antique books from the 15th century. The aim of this study was to assess the amount and type of fungi potentially problematic that might promote biodeterioration in books.

Airborne fungal spores were collected in the indoor air of the main library during the winter of 06-07. The sampling was performed twice a week, on Monday mornings and on Friday afternoons, during two months. Two different sampling techniques were used to determinate the whole range of fungal spores in the indoor air: an Andersen single stage bioaerosol sampler with agar plates, and a Hirst type portable sampler carrying a microscope slide. Both samplers were working simultaneously during 10 min at a rate of 10 litres per minute. The sampling took place in five rooms of the library, including an environment-controlled secure room containing antique books (15th to 19th century).

A total of 214,370 spores and 2,010 CFU (Colonies Forming Unit) were detected during the study period. Fifty five taxonomic types were identified using the two different samplers. Among the nine problematic types, only six were detected in both of the two samplers: *Alternaria,* Aspergillaceae (*Aspergillus/Penicillium*), *Chaetomium*, *Cladosporium*, and *Ulocladium*. *Periconia* is not considered to be problematic but this type also appears in both the Andersen and Hirst samples.

The genera *Aspergillus* and *Penicillium* were the most abundant types found using the two sampling techniques, the Andersen sampler recorded 1,360 CFU, and the Hirst type sampler collected 125,850 spores. Spores from the genus *Cladosporium* were the second most abundant with 170 CFU and 35,900 spores, respectively. More than 200,000 spores were detected using the Hirst type sampler and over 2000 CFU were recorded on plates from the Andersen sampler, during a period of 2 months.

A high diversity of spores, fifty five different types, was detected in the atmosphere of the library during this study. Among these fifty five types, nine have been described in the bibliography as being potentially problematic and could promote biodeterioration problems in paper, cardboard, leather or parchment. Such problems include erosion, changes in mechanical characteristics, spots, pigmentation, loss of structural integrity, stiffness or discolouring. These taxonomic types can also affect the ink and adhesive substances used in restoration.

Among these types *Aspergillus* and *Penicillium* were the most abundant in both sampling methods (plates and slides). The environmental-controlled secure room had considerably less spores in the air in comparison with the others four rooms sampled. However, further studies are necessary to confirm this evidence.

Characterization and identification of the microflora in Styrian wine cellars

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Maturing of wine requires high standards for the storage climate in wine cellars. Inadequate conditions in the cellar may favor the growth of various microorganisms.

Microbial activity in the wine cellar may for example contribute to the formation of 2-4-6 trichloroanisole (TCA) by *Penicillium* or *Trichoderma* by methylating chlorophenols to chloroanisoles. Trichloroanisoles in the air of the cellar cause a musty, moldy smell giving the wine a faulty taste. Moreover, high concentration of spores in the cellar air may affect the health of the employees.

Since February 2007, the microflora of cellars of 32 wine producers in the State of Styria, Austria, has been investigated as part of a research project.

Microbiological analyses of material and air samples were carried out in wine production and storages sites with cellars of various designs and locations. Additionally, air samples are analysed for the presence and concentration of trichloroanisoles. Moreover, the impact of seasonal differences, the ambient air and the cellar climate on the growth of mycelium-forming molds and bacteria were also investigated.

Results show that the concentrations of airborne mycelium-forming molds (impaction sampling method) in vaulted cellars during the summer months are significantly higher ($p<0.05$) than in concrete cellars. In vaulted cellars, the highest spore concentrations were 1.6x105 CFU/m³. In cellars without climate control, concentrations of airborne mycelium-forming molds were two times higher than in climate-controlled cellars. Increased spore concentrations in the ambient air did not significantly increase the spore concentrations in the air of the cellar.

Mold growth in wine cellars is primarily influenced by temperature control, but design and year of construction of the cellar also play a significant role. These results are the basis for investigation of the composition of mold species and their role in TCA synthesis in wine cellars.

SESSION 5c. Phenological and monitoring networks

The Portuguese aerobiological network: Results of pollen monitoring from 2002-2007

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Since 2002 that the RPA (The Portuguese Aerobiology Network) monitors the airborne pollen grains at the towns of Oporto, Coimbra, Lisbon, Évora and Portimão. Pollen information and forecasts are prepared and disseminated by the internet (www.rpaerobiologia.com) and media (Radio, Journal and TV). Counts are also available at the European Pollen Information Databank, in the University of Vienna (Austria). The aim of this study was to analyse the pollen content of the air of five monitoring stations of RPA: Oporto, Coimbra, Lisbon, Évora and Portimão.

Pollen counts recorded along the spring months of all years of monitorizations for each station were used. This means that, at the monitoring stations of Lisbon, Évora and Portimão, pollen counts of years 2002 to 2006 were used while, for Coimbra and Oporto, only 2003 to 2006 were analysed. The followed methodology was the standard Portuguese Aerobiology Network (RPA) methodology.

The highest total pollen counts were recorded in the south of the country, in Évora. The most important taxa in the atmosphere of the 5 monitoring stations by importance order were:

i) Oporto: Urticaceae (17,2%), Pinaceae (16,7%), Poaceae (16,6%), *Quercus* sp. (16,4%), *Olea europaea* (6,4%) and *Platanus hispanica* (6,0%);

ii) Coimbra: *Olea europaea* (22,7%), Pinaceae (21,8%), Poaceae (12,6%), Urticaceae (12,1%), Cupressaceae (8,0%) and *Quercus* sp. (7,6%);

iii) Lisbon: Urticaceae (34,8%), *Olea europaea* (14,7%), Poaceae (11,0%), *Quercus* sp. (10,3%), Cupressaceae (7,9%) and *P. hispanica* (6,7%);

iv) Évora: *Quercus* sp. (27,9%), Poaceae (26,2%), *Olea europaea* (11,2%), Urticaceae (9,2%), *P. hispanica* (9,1%) and Cupressaceae (4,2%) and

v) Portimão: *Olea europaea* (40,8%), Poaceae (15,2%), *Quercus* sp. (14,4%), Urticaceae (9,9%) and *Plantago* sp. (4,8%).

At south stations, Évora and Portimão, and at Coimbra site, the highest absolutes pollen values were recorded on May due to Poaceae and *Olea europaea* pollen counts. At south stations, *Quercus suber* was also important. At north and south center sites, Oporto and Lisbon, the highest absolutes pollen values were observed on April and March. In Oporto due to Pinaceae, *P. hispanica* and *Quercus* sp. pollinization and in Lisbon due to Urticaceae, *P. hispanica*, Cupressaceae and *Quercus* sp. pollinization.

This study permitted us to identify the airborne types present in the atmosphere of each city and gave us an indication of the allergenic pollen most frequent in each of the 5 studied regions.

Spread of aerobiological information in Lithuania: what we offer and what they expect?

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In climate change conditions the attention to the protection of human health is not satisfactory in Lithuania. The air quality monitoring consists (in principal) from physical-chemical measurements, which enable to appreciate only dynamics of anthropogenic pollution. The dust control is only one assessment of nature pollution.

Society of Lithuania is delimited from information of biological particles concentration in the air. Allergologists and mass media announce about increasing allergy provoked by pollen but precautionary work organized heavily. Until now in Lithuania we have not system or network to ensure society to get reliable information about aeropalinological situation timely.

The first Burkard spore trap mounted in Lithuania in Vilnius in 2001 and worked two years. The data from this station used for specific project and form this data the pollen calendar was made. Until this the research of airborne particles belongs to Physic or/and Botany institutes in Lithuania. All these investigations were as a part of integrated project. For this reason these investigations do not provided as aerobiological monitoring and main interest was concentrated on fungi spores.

Since 2003 Šiauliai university start to monitor the aeropalinological situation, the research data is collected in Department of Environmental Research and information is send to EAN data base and EPI. Links to this information is in Lithuanian Asthma Association home page.

During the two year period (2006-2007) Šiauliai University sent information to Lithuanian national TV and press for free. Announcements about pollen concentration in the air were together with forecast. Lots of informal communication with society we understood that such information is preferred and essential.

On purpose to improve the accessibility of aeropalinological information we prepare questionnaire and distributed among patients of allergologists. The analysis of this questionnaire will show the need of pollen affected population to pollen forecast. We expect to find the best and suitable tools for information spread. At the same time we will develop what is actually for patients.

Relationship among pollen concentration, production, surrounding vegetation and climatic conditions

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Pollen data monitored by Burkard 7day trap of pollen concentration in m^3 have been compared with pollen "rain" influx data registered by Tauber trap in Riga. Pollen influx have been monitored since 1997 and aerobiological monitoring by 7-day Burkard trap since 2003. The data obtained allow to compare both pollen composition and abundance, as well as to get information on pollen production, emission and pollen concentration in air.

Aerobiological monitoring has been carried out in the very central part of Riga. Burkard trap is located on the roof of the main building of University of Latvia, 23 m from the ground surface. At that level trap appear above surrounding buildings and trees in parks. Number of introduced exotic plant pollen appears in pollen slides besides of local and long transported pollen.

Measurements of pollen "rain" has been carried out in two sites: 1) at the western boundary of the city where are lot of one store private houses with small gardens and 2) at the eastern boundary, where dominate 9 to 12 storey apartment houses. Pollen influx in both sites show different volume of shrub and herb pollen, but similar tendencies in tree pollen productivity.

Both monitoring methods are different and have different goals, nevertheless reflect the changes in vegetation composition in Riga and its' surroundings, as well as, human impact and meteorological conditions.

Both pollen monitoring demonstrate high birch pollen productivity for year 2003. Their concentration in the air above Riga reached 5900 pollen/m^3 while in 2004 highest value was much lower - 550 pollen/m^3 and pollination season was longer.

Pollen "rain" data show similar tendency: 6500 p/cm^2 in 2003 and 780 p/cm^2 in 2004. Riga is surrounded by pine forests, but comparatively low pine pollen concentration is fixed in air (highest values 880 p/m^3 in 2003; 774 p/m^3 in 2004). This and also sharp fluctuation in number can be explained by rain during pine blossoming, because of high pine pollen concentration on 1 cm^2, however, there are observed tendency of some decrease. In years 1997-2002 number of pine pollen exceed 10 000 p/cm^2, but in 2004 it reaches just 7300 p/cm^2.

Pollen "rain" monitoring data reflect some changes in vegetation composition in the western green belt of Riga: decrease of *Pinus*, *Populus* and *Ulmus* and increase of *Alnus*, *Betula*, *Tilia* and exotic trees and shrubs in the, while in the eastern part are not observed significant changes for last 8 years.

The analysis of pollen data indicates significant influence of meteorological parameters on pollen concentration in air, while human impact is more reflected by pollen influx.

SESSION 8. Phenological trends

Keynote: Recent methods to quantify phenological changes, flowering season and intensity. Galán C.

A 2-threshold temperature sum model to describe the whole flowering period of Betula spp. Linkosalo T., Ranta H., Oksanen A., Siljamo P., Luomajoki A., Sofiev M., Kukkonen J.

Global warming and phenological models. Will they be still valid? The case of Cupressaceae in Italy. Torrigiani Malaspina T., Lucchesini P., Cecchi L., Morabito M., Orlandini S.

Poaceae phenology and its relationship with meteorological factors and pollen count in the air. León E., Dominguez-Vilches E., Galán C.

Exploring the possibility of an European phenological model for the purpose of pollen forecast. Scheifinger H., Koch E.

Phenology records as a complement to aerobiologic data in order to elaborate pollen information reports. Tormo R., Silva I., Gonzalo Á., Corchero A., Muñoz A., Pérez R.

Bio-monitoring of climate trend in the Mediterranean area. Orlandi F., Garcia-Mozo H., Galán C., Romano B., Diaz de la Guardia C., Ruiz L., del Mar Trigo M., Dominguez-Vilches E., Fornaciari M.

Keynote: Recent methods to quantify phenological changes, flowering season and intensity

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Along the time it has been manifested the need to deep on animal and vegetal phenological behaviour, and overall on the influence of the meteorological factors and the role of phenological data as bio-indicators of Climate Changes.

Some researches analyses the different phenophases as a qualitative variable, i.e. leaf unfolding or reproductive phenology along the time; some others refer to quantitative variables, i.e. flower intensity or fruit production. Nowadays, Field Phenology and Aerobiology are highly related and complementary sciences.

Atmospheric pollen counts offer information on flower intensity and flowering evolution along the season, mostly in anemophilous plants. On the other hand, field phenology improves aerobiological data understanding and it also offers additional information of plant behaviour.

Historical phenological databases are being more and more requested by researchers interested on different biological disciplines. They allow establishing phenological calendars but also to detect remarkable variations or trends of the average phenological dates. On the other hand, historical aerobiological databases offer information about possible changes on pollen spectrum in a zone due to changes on plant biodiversity, presence of new exotic or invasive species, or the loss or decrease of autochthonous ones.

The study of the influence of meteorological and pheno-climatic parameters on phenology allows obtaining forecast models for the different flowering events, even by creating computering programs for a higher accuracy of the different parameters. These models provide information on plant response to weather-related meteorological factors.

Aerobiological networks offer the possibility to realize spatial representation of data and possible changes. This is one of the main goals for researchers integrated in the European Aeroallergen Network (EAN), including the Spanish Aerobiology Network (REA) where different models for herbaceous and arboreal species have been developed at a local, regional or national level.

Orthophotographs and recently satellite images are useful tools in the creation of Geographical Information Systems (GIS) maps representing vegetation cover and even its phenological changes. They offer the possibility of precise measuring of distances or to calculate plant density. This sort of data joint to knowledge on pollen production per plant can offer information about the potential pollen emission in a given area which can improve emission models obtained analyzing pollen content data.

Moreover GIS are useful tools to offer visual information on the phenological behaviour in different areas. Geo-referenced data, such as floral phenology of a population or aerobiological data can be incorporated in a GIS to produce map layers. While the advent of GIS allows for compiling and manipulating spatially referenced data, modelling spatial patterns from areas where no data are available is possible by applying Geostatistic tools. Geostatistic is a family of statistical methods that describe correlations through space and time and can be used for quantifying the spatial correlation and sample interpolating through different procedures.

A 2-threshold temperature sum model to describe the whole flowering period of *Betula* spp

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Most events of spring phenology of boreal and temperate trees can be considered as point events: they take place on a specific moment in time. Therefore, also most phenological models aim to predict the timing of such point events.

When referring to the flowering of wind-pollinated trees like *Betula*, events such as the start, peak and end of the pollen release period can be modelled as point events. The whole flowering episode, however, is a continuous event, and for many applications, such as pollen forecasts and prediction of long-range transport episodes, a model that describes the whole flowering event would be more useful.

The aim of this study was to develop a phenological model that predicts the pollen release throughout the whole flowering period. The total amount of pollen released by boreal trees varies considerably from year to year, and the factors contributing to this variation are not sufficiently known. Therefore, our model focuses on the timing of the flowering event by predicting the normalized distribution of pollen release during the flowering period.

The model is based on the common Thermal Time model. In a TT model the phenological point event is considered to take place when accumulated temperature sum meets a preset threshold, while in our modification the model describes the pollen release through the flowering period. Our model has two temperature thresholds so that the flowering is predicted to start when the accumulated temperature sum, $S(t)$, meets the first threshold, T_1, and to end by meeting of the second threshold, T_2. The cumulative pollen release, $R(S)$, is modelled to depend on the accumulated temperature sum, so that between the two temperature sum thresholds the cumulative pollen release depends on a linear interpolation of the accumulated temperature sum:

$$R(S) = [S(t) - T_1] / [T_2 - T_1].$$

For model evaluation we used historical phenological data, collected by R. Sarvas in the years 1963 to 1971 in 16 sites in Finland for *Betula pendula* (45 datasets) and *B. pubescens* (84 datasets). The data was normalized on annual base.

The overall fit of the model to the data was good (R^2 for observed vs. predicted pollen release 0.97 and 0.98 for *B. pendula* and *B. pubescens*, respectively), predicting the progress of pollen release with good accuracy. Even though the model is fitted, day by day, to the whole flowering period and does not specifically emphasize the starting and ending dates of the flowering period, these dates were also estimated with accuracy similar to that of ordinary, point-event oriented Thermal Time models; the average prediction error of the starting and ending dates was of the same magnitude than for ordinary point-event models.

The 2-threshold model underestimated the length of the flowering period slightly, with the onset 1.2 to 1.5 days later than observed, and the end 3.1 to 5.1 days earlier than observed.

Global warming and phenological models. Will they be still valid? The case of Cupressaceae in Italy

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Cupressaceae family has been recognized as a unique source of an increasing number of winter pollinosis in Mediterranean countries. In the area of Florence, Central Italy, cypress (*Cupressuss sempervirens*) represents the only source of Cupressaceae pollen during winter months. Due to the high concentration of airborne pollen in the area, the impact on allergenic population is dramatically high.

A phonological model based on GGD °C index has been used as a tool to forecast start and end of CupMPS (cypress Main Pollen Season) in 2006 and 2007. On the basis of this model, 1386,2 °C GDD (calculated cumulatively summing daily mean temperature with threshold of 0 °C) resulted necessary from 1° October to get start of CupMPS, and 1576.9 °C to get the end. While in 2006 model simulation produced errors ranking from 3 to 4 days in forecasting start and end, in 2007 model simulation produced errors of more then 20 days.

The first aim of the study is to understand why a validated model did not performed satisfying simulation of male cypress phenology in 2007. The second aim is the improvement of the phenological model in order to make it applicable also in the climatic conditions that occurred in 2007.

A meteorological and climatic analysis of the winter-early spring season of 2007 was performed. Daily mean temperature during the period October 2006-Febbraury 2007 showed + 2.5 °C anomaly respect to daily mean temperature registered in last the period 1968-1995.

In order to fit the second aim, phenological observations during winter and early spring season for three years (from 2004 to 2007) were carried out visiting once a week 56 individuals selected on 7 populations of Cypress and monitoring the development of male flowers. Daily mean temperature were registred in each populations and Cypress pollen concentration was also monitored in the area of study. Start end end date of CupMPS were calculated for the period 1995-2007. A new phenological model was settled and validated introducing an upper temperature threshold (cut-off) to calculate GDD °C index.

On the basis of the new model 1150.6 °C GDD (obtained cumulatively summing daily mean temperature with threshold of 0 °C and cut-off of 10 °C) were necessary from 1 October to get start of CupMPS and 1332.8 °C GDD to get the end. The validation showed average errors ranking from 0 to 7 days.

Results show that both models are able to simulate male Cypress phenology in regular climatic conditionts. On the contrary, only the new model is able to simulate Cypress phenology when extremly warm winter occurs. On the basis of the scenarios proposed by the IPCC in 2007, “anomal” conditions occurred during winter 2007 could become “standard” conditions in the next future. Nevertheless present results make the new model able to simulate male Cypress phenology also when climate change scenarios will occurs.

Poaceae phenology and its relationship with meteorological factors and pollen count in the air

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Phenology is the study of the timing of periodic biological events in the animal and plant world as influenced by the environment (Schwarz, 2003). In plants, bud burst, leaf expansion, flowering, seed set, fruiting, seed dispersal and germination, all take place in due season. In temperate regions biological development through a season is mainly dependant on temperature, but also on day length and water supply. Phenological studies are important to our understanding of species interactions and community function. In aerobiology these studies are also important to provide a better understanding of pollen count in the air.

We have studied the most common species present in the city and mountain slopes of Cordoba, Spain. We chose ten sampling points in order to have a good representation of the main habitats where grasses grow. Those points where placed at different altitude, but also differ in other environmental factors such as topography, sun exposition, soil, vegetation. Main meteorological factors such as maximum, medium, minimum temperature, moisture, precipitation, evapotranspiration, as well as pollen concentrations in the air were also studied in relation to phenological evolution.

We found strong correlations between phenological evolution of most of the studied species and temperature, as well as evapotranspiration.

In relation with pollen concentration we found that *Brachypodium dystachion, Dactylis glomerata, Lolium rigidum, Stipa capensis, Trisetaria panicea* and *Vulpia geniculata* are the species that most contribute to pollen curve, especially those populations placed in the mountain slopes of Cordoba.

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Exploring the possibility of an European phenological model for the purpose of pollen forecast

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At the moment there are no real time observations of phenological phases over a wider area of Europe available, although individual countries have already installed real time observational systems. Also the intensity of pollen shedding respectively pollen source strength is not directly observed. Even measured pollen concentrations in the atmosphere are usually available with at time lag of at least a day.

Therefore a statistical description of the mechanisms is to be deduced, which relates the observed history of atmospheric variables with the phenology, the pollen source strength and the pollen transport.

Because pollen of plants can be transported over long distances (hundreds and in exceptional cases even thousands of km), it is necessary for the purpose of pollen forecast to define the phenological state of the plants over a large area.

Real time modelling of the phenological development over large areas poses a problem, because phenological models are typically fitted for regionally restricted phenological data sets. In this work we explore ways, how to formulate phenological models, which are able to simulate the phenological development over a large range of station latitudes, longitudes and elevations.

Phenology records as a complement to aerobiologic data in order to elaborate pollen information reports

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Blooming phenology records for plants of aerobiologic interest are needed to make accurate airborne pollen forecasts including their variation in concentration. Nevertheless traditional methods in phenology are oriented mainly to reproductive biology and have been predominantly made with entomophilous plants.

To obtain a suitable comparison between the daily variation of airborne pollen concentration and blooming it is necessary that results from phenology records have both of them a level variation as similar as possible. For anemophilous plants it is essential to verify that flowers are shedding pollen, so it is necessary to select both the suitable time of day and the meteorological conditions to confirm this situation. For herbaceous plants it is not possible to know previously the amount of flowers that will be produced, as in woody plants, because those directly depend on the rain water.

A method that provides a percent blooming estimation with the total one respect has been used, and results from this method have been used in the pollen forecasts reported through mobile SMS in Extremadura (SW Spain) in 2007 and 2008.

35 species have been selected for the phenology study which belong to 5 pollen types: Cupressaceae pollen type (*Cupressus sempervirens, C. arizonica, C. macrocarpa, Platycladus orientalis, Calocedrus decurrens*), Platanus pollen type (*Platanus hispanica, P. orientalis*), Quercus pollen type (*Quercus rotundifolia, Q. suber*), Plantago pollen type (*Plantago lanceolada, P. lagopus, P. coronopus*), Olea pollen type (*Olea europaea*), Poaceae pollen type (*Avena barbata, Avena sterilis, Molineriella minuta, Lamarchia aurea, Bromus diandrus, Bromus hordeaceus, Bromus lanceolatus, Phalaris minor, Cynosurus echinatus, Dactylis glomerata, Gaudinia fragilis, Cynodon dactylon, Vulpia geniculata, Trisetaria panicea, Sorghum halepense, Lolium rigidum, Agrostis pourretii, Agrostis castellana, Poa annua, Stipa capensis, Piptatherum miliaceum, Hordeum leporinum*).

Results show an association between blooming phenology and airborne pollen records for the pollen types, nevertheless in some cases a lack of correspondence in the peaks between blooming and airborne pollen could be noted that can reach up to a week.

This phenomena could be explained by a buffer effect between the pollen shedding from plants and their airborne presence in the atmosphere, by the different frequency between phenology record (weekly) and pollen trap (continuous), and by the different number of species involved in each pollen type just because e.g. this is bigger in Poaceae pollen type.

Bio-monitoring of climate trend in the Mediterranean area

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The aim of the present study is to investigate the efficiency of biomonitoring investigation as indicator of the climate trend in the Mediterranean area. In particular olive tree, the main arboreal crop widespread in this context, has been investigated, by the use of aerobiological apparatus, during the entire flowering phenomenon, strategically important in a wind and cross pollinated species.

The aerobiological data have been obtained from Perugia (Italy) and Cordoba (Spain) stations during 1982-2006 period, meanwhile other Italian and Spanish stations (Agrigento, Trapani, Messina, Catanzaro, Cosenza, Foggia, Avellino; Jaén, Granada, Malaga, Baena, Ciudad Real, Priego, El Cabril) have shorter data banks.

The Intergovernmental Panel on Climate Change scenarios, for the Mediterranean area, have been tested by statistical analysis between meteorological conditions and the biological phenomenon, correlating in each area the meteorological variables considering different time setting and the flowering events (initial, peaks and final moment).

In all the study areas the best correlation tests were carried out with the spring's temperatures trends and the pollen emission, confirming the importance of this preliminary period (forcing effect) in a xerophytic species such as olive tree. Only in some cases the temperatures registered in autumn before the spring of flowering were correlated to it, probably due to their implication in dormancy induction processes and consequently in the chronological events which from dormancy break arrive to flowering.

The aerobiological results confirm the strong relationships between the Mediterranean temperature trends and pollen emission dates: in particular the peak dates reveal an advance of the biological phenomenon during the 1982-2000 period (Global Warming scenario) and stable peak dates during the 2001-2006 period (Plateau temperature formation) probably related to a short-term decrease on spring temperature warming phenomenon in the Mediterranean area.

SESSION 9. Monalisa

Cyclonic pollen sampler: the results of the MONALISA project.. Thibaudon M., Sindt C., Carvalho E., Emberlin J., Brandao R., Rantio-Lehtimäki A., Stach A., Galán C., Clot B., Albertini R.

Pollen spectrum and *Parietaria* antigenic activity in the atmosphere of Cordoba (South Spain) by using Coriolis Delta trap. (MONALISA Project). Gómez Domenech M., García-Mozo H., Velasco M.J., Thibaudon M., Galán C.

Pre-season *Artemisia* pollen antigens in Coriolis samples (EU Life-project Monalisa). Rantio-Lehtimäki A., Ruotsalainen V.

Detection of airborne allergen (Art v 1) in relation to mugwort pollen in the atmosphere of Poznan, Poland. Gómez-Doménech M., Nowak M., Szymanska A., Grewling L., Galán C., Stach A.

Pollens and fungal spores monitoring in the Parma atmosphere (Italy): comparison between the results obtained with Burkard and Coriolis pollen-spore trap. (European Project "MONALISA"). Albertini R., Ridolo E., Peveri S., Ugolotti M., Usberti I., Dall'Aglio P.

Comparison between Poaceae pollen counts and ambient Phl p 5 concentration in Evora, south Portugal. Munhoz V., Martins R., Caldeira A., Antunes C.M., Caeiro E., Carvalho E., Brandao R.

Cyclonic pollen sampler: the results of the MONALISA project

Thibaudon M. [1], Sindt C. [1], Carvalho E. [2], Emberlin J. [3], Brandao R. [4], Rantio-Lehtimäki A. [5], Stach A. [6], Galán C. [7], Clot B. [8], Albertini R. [9]

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The MONALISA project aimed to develop a new method of collecting pollen based on immunological analysis that would allow an accurate measurement of antigenicity/allergenicity of particles in the air. The project was sponsored by EU with European Life Environment Programme.

During the study, a validation of the pollen data obtained from the bio-sampler cyclone "Coriolis" developed by Bertin Technology (France), led to the comparison with the Hirst pollen trap present on the sites of each partner (RNSA (France), NPARU (UK), UCO (Spain), UTU (Finland), UAM (Poland), UEVORA (Portugal), AIA (Italy), MeteoSwiss (Switzerland).

For this, an aliquot of the sample collected has been made into slides for analysis by optical microscopy to compare with data obtained from the Hirst trap.

Daiy sampling periods of 1 hour in 2006, and 6 hours in 2007 were made throughout the pollen season. Samples from the Hirst trap, impacting continuously, have been analysed for the same periods as the Coriolis samples. A correction factor is applied to each result to obtain a concentration in grains/m^3 during the time of sampling.

The results vary widely from country to country; the total quantities are often higher for Hirst traps, sometimes equivalent or rarely lower. These results also vary according to the pollen type and sometimes changing trend during the season. But overall the results from the Coriolis data and the Hirst data follow the same trends with peaks of pollen found on the same dates.

The diversity of pollen types obtained with the Coriolis bio-sampler is as variable as the quantities. Even though the majority of countries have a lower number of taxa for the Coriolis compared to the Hirst, others obtain the opposite. The main allergenic taxa are always in the two traps.

More experiments are planned to achieve better data collection by adapting the methodology.

Pollen spectrum and *Parietaria* antigenic activity in the atmosphere of Cordoba (South Spain) by using Coriolis Delta trap. (MONALISA Project)

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MONALISA (MOnitoring Network of ALlergens by Immuno-SAmpling) is a European Project focus to the development and testing of a new type of aerobiological sampler: Coriolis e. The main objective of the project was to demonstrate the use of this cyclonic air sampler such us an innovative air sampler, in association with immunological analysis methods, to validate a new approach to pollen monitoring in the air by on line antigenic/allergenic measurement. Coriolis e obtains liquid samples that allow both a visual and immunological analysis of biological particles.

Present study shows some of the results obtained during 2007 campaign in the city of Cordoba (South Spain) A comparison with other collecting samplers have been carried out. Pollen content values of different taxa obtained with Coriolis e was compared with those taken through a Hirst type spore trap. On the other hand, antigenic activity of *Parietaria*, detected in Coriolis e, has been compared with data obtained in Andersen traps.

The visual analysis of airborne pollen grains indicated that, in general, pollen concentrations of all the taxa detected with Hirst trap were higher than those detected with Coriolis e. This fact was especially remarkable in species flowering during April and May. However, similar pollen curve trends were observed.

Regards to the immunological analysis, we present the results of *Parietaria* allergens in the atmosphere of Cordoba. The antigenic activity of Parj1 and Parj2, detected through Coriolis e samples, was lower than those detected in the Andersen samplings. In general, the trend during the Urticaceae pollen season was contrary to the antigenic activity in the air, probably influenced by the pollen contribution of other Urticaceae species:

- Season start: the allergenic activity increases while the pollen concentrations are very low or zero.
- Peak of season: in most taxa, the allergenic activity decreases while the pollen concentrations increase.
- End of season: the allergenic activity increases while the pollen concentrations decrease.

Pre-season *Artemisia* pollen antigens in Coriolis samples (EU Life-project Monalisa)

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Pre-season peaks of birch pollen antigens in ambient air have been reported earlier. Therefore this phenomenon has generally been considered to be connected with tree pollination and catkin development releasing small-sized particles (orbicules) from the peritapetal membrane in the mature anthers. However, in the analyses of liquid samples collected with the Coriolis Delta (EU Life project MONALISA) the same phenomenon was observed in *Artemisia* pollen antigen analyses.

The flowers of *Artemisia* are totally different from tree catkins. The composite flowers are small, but produce a huge amount of pollen grains. Jantunen & al 2007 have reported a big mugwort (*Artemisia vulgaris* L) plant to produce 500-1000 million pollen grains. Pollen of *Artemisia* is a relevant cause of pollinosis in temperate and humid regions. Recently also the major allergen Art v 1 has been characterised.

In the MONALISA project *Artemisia*-ELISA analyses were carried out with polyclonal antibodies produced in rabbits (Animal Research Unit, University of Turku; using SQ lyophilisates by ALK Abelló).The SQ-unit concentrations varied between 0 and 4250/m^3 of air. Simultaneous pollen counts varied from 0 to 145 p.g./ m^3 of air. Because particle-size selective sampling was not in use, the particle size distribution of antigenic particles is not known.

Some other composite species might act as artefacts or there might be also some particles released from *Artemisia* plants before the flowering starts. Antigen concentrations (analysed with polyclonals) and pollen counts are often reported not to be intercorrelated.

Detection of airborne allergen (Art v 1) in relation to mugwort pollen in the atmosphere of Poznan, Poland

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Population quality of life is strongly influenced by the environmental conditions. During the last few decades, respiratory allergopathies have significantly increased. These diseases, in particular those related to pollen allergy, are more frequently reported in industrialized countries, leading to a general consensus that the rate of respiratory ailments is higher in industrialized areas than among people living in rural areas.

Most asthma crises appear to be provoked by pollen grains, although recent studies affirm that the solid particles larger than 20 µm are incapable of penetrating to the lower respiratory tract, and the average pollen size ranges from 15 to 40 µm.

Therefore, the existence of allergenic activity in the atmosphere is not only associated to the presence of pollen grains and fungal spores, but also to biological submicronic (<1µm) and even paucimicronic particles (<0.5 µm). The origin of these particles can be due to the rupture of pollen grains transported in the atmosphere or to the presence of allergens from other parts of the plant forming amorphous material with antigenic load. These particles are inhaled through until the interior of the bronchi and until the alveoli, causing asthmatic reactions, due to their size.

The aim of this study was to compare pollen counts of mugwort with the allergenic activity of Art v 1 in the atmosphere of Poznan.

The study was carried out between July and August of 2007 in the city of Poznan. For determining the antigenic activity an Andersen type sampler was used. This trap allows differentiating particles to six different diameters. Pollen data were taken by using a volumetric Hirst type spore-trap.

Pollen season occurred from mid July to the end of August. Peak day was detected on August, 8th, 137p g/m^3. A similar behaviour between pollen and the total allergenic load was observed during the period of mugwort pollen season. Nevertheless, during the previous and later period of pollen season a higher allergenic load in the air was observed.

Regarding to the particle size, lower percentage of allergenic load (12%) was detected in a size range of 0.9-1.2µm. On the other hand, higher percentage of allergenic load (23%) was detected in a size range of 0.25-0.35 µm, easily penetrate until the alveoli.

This study has been carried out within the framework of the Marie Curie European Project AEROTOP MTKD-CT-2004-003170 and Polish Ministry of Education and Science 128/E-366/6 PR UE/DIE265.

Pollens and fungal spores monitoring in the Parma atmosphere (Italy): comparison between the results obtained with Burkard and Coriolis pollen-spore trap. (European Project "MONALISA")

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Atmosphere allergens study has been implemented beside the traditional method (Burkard pollen-spore trap) with new aerobiological tool (as Coriolis trap) allowing the sampling of airborne substances and therefore their analysis. Aim of the multicentric European MONALISA project has been demonstrate, in different geoclimatic zones, the use of an innovative air sampler in association with immunological analysis methods to validate a new approach of pollen monitoring in the air by antigenicity/allergenicity measurement.

Aerobiological monitoring Centre of Parma in representation of Italian Aerobiology Association (AIA), is one of the Centres that participate to the project MONALISA. Parma (Italy), is 52 m above sea level, has 180.000 inhabitants; lies in the Po valley, to the South of the Po river. The climate is continental-temperate with predominant wind directions SW – NE.

Pollen traps were placed on the Meteorological Observatory tower at 18 meter from the ground, in the centre town. The pollen monitoring was performed in accordance with standard methods of the AIA, UNI 11108/2004, using a Burkard 7-day recording volumetric Spore-Trap and nearby was installed a continuous cyclonic air sampler (Coriolis Delta) dedicated to outdoor air monitoring of pollen grains and fungal spores. Coriolis sampling the particulate in a liquid medium allowing the counting particles and taxa identification and allowing molecular and serological assay for the aeroallergens analysis. We specifically focused our attention to the total number of pollen, number of taxa and monitoring of Poaceae, Urticaceae and *Alternaria*.

Coriolis captured a number of taxa higher than Burkard but a lower number of pollen or spores, above all when the peaks are elevated. The observation of daily single slide, showed a good correlation among the periods of peak. The evaluation of single allergens concentration by immuno-assay is in progress.

Aerobiological sampling with Coriolis represents a valuable tool and envisage further positive development. After some technical-procedural aspects will be definitively set and correlations between pollen counts and antigen concentration verified, Coriolis can constitute a valid instrument for outdoor aerobiological monitoring. Further and interesting developments could derive from the application of the great power of microarray-based miniature solid-phase immunoassays lies in their potential to investigate in parallel large numbers of analytes.

Comparison between Poaceae pollen counts and ambient Phl p 5 concentration in Evora, south Portugal

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Airborne pollen of grasses (Poaceae family) is the main aeroallergen in many european countries, namely in Portugal. Grasses includes many herbaceous species with an anemophyllous pollination. Their pollen can be found in the air all over the year but higher concentrations are reached in springtime (Mars to June). Exposure to its allergens is deduced from pollen counts of environmental air samples. The aim of this study is to analyse the relationship between these pollen counts and the concentration of allergen Phl p5, through a new sampling technology, developed under an European LIFE/ Environment program.

Airborne pollen were monitored with a Hirst-type sampler (Burkard 7-day pollen trap). Simultaneously, daily air samples were collected with a high volumetric cyclone-type sampler (Coriolis ® δ by Bertin Technologies, France) and Phl p5 concentration was measured from liquid samples through a “sandwich” ELISA with a kit from Indoor Biotecnologies®. Both samplers were placed side by side on a meteorological platform at the town center of Evora, 17 m above ground level and 320 m above sea level.

ELISA analysis were performed on samples collected between the 2th of Mars and 12 th of June 2007, which includes the main pollen season for grasses and *Phleum pratense*.

Pollen counts from both samplers were not correlated, with absolute values higher in Burkard sampler. Phl p5 concentration in air samples followed the same features of cyclone-type sampler but it was quantified even when pollen counts were low or null, particularly in the beginning of pollen season. Several peaks of allergen were detected at the end of March and on the 1st - 2nd of April.

Coriolis ® δ cyclone sampler allowed the quantification of Poaceae either by pollen counts and by an ELISA assay but further analysis on the efficiency of sampling and its relationship with biophysical parameters are needed. These results suggest that pollen counts may not reflect exposure to Poaceae pollen. Immuno-sampling could provide a better understanding of exposure to airborne pollen allergens, namely out of the pollen season.

POSTERS 3a. Monalisa

Quantification of Phl p 5 aeroallergen from outdoor air samples using an improved ELISA method. Antunes C.M., Caldeira, T., Martins M. R., Munhoz V., Thibaudon M., Carvalho E., Brandao R.

Quantification of Phl p 5 aeroallergen from outdoor air samples using an improved ELISA method

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The allergen exposure is nowadays determined from pollen counts, in air samples. However, there is not yet enough evidence to establish this technique as a reliable indicator of allergen exposure. Presently, there are only a few reliable and sensitive ELISA methods that allow the quantification of allergen from environmental air samples but none is known to work well with Poaceae allergen, mostly due to its very low concentration.

In this work, we developed a strategy that allowed the quantification of the one of the main allergen from *Phleum pratense*, Phl p5 using a modified ELISA method. The samples of airborne pollen were collected on a meteorology platform at the city of Évora using a "cyclone" technology collector (Coriolis ® δ by Bertin Technologies, France) and a modified ELISA method, using a Kit obtained from Indoor Biotechnologies, in order to determine its content in Phl p5.

This ELISA method was manipulated in order to improve its detection limits toward lower antigen concentration; several steps were engaged, especially antibody dilution and incubation periods at different steps of the method. The sampling had a daily frequency which totally overlapped the pollen season 2007. The sensitivity limit of the standard curve was diminished from 10ng/mL to ≈6ng/mL, as a result of the modifications introduced.

However, even after the development of an improved method the samples were found too diluted; although detectable, antigen quantification was not possible. At this stage two different strategies were followed: 1) Sample concentration by ultracentrifugation and 2) Addition of a constant amount of antigen to every sample in order to render it quantifiable. Parallel to the samples, a blank with the same amount of antigen was also prepared. It was found that the sample volume (1-2mL) was not sufficient to allow a significant concentration. In contrast, the second strategy allowed the quantification of all the analysed samples.

The Phl p5 concentration found in the samples collected from Mars to June 2007 varied between less than 1ng/mL to 20ng/mL, values impossible to detect with the standard methodology. In this work, an amenable methodology that enabled the quantification of airborne Phl p5 antigen was developed.

Inter-laboratorial assays and the quantification of a blank with known amount of antigen would be useful in order to standardize this methodology and allow the comparison of results from different laboratories. Correlation of these data with the pollen counts and clinical data may contribute to a better understanding of the allergen exposure and its consequences.

SESSION 10. Forensics

Keynote: Forensic palynology; pollen in the battle against crime

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Forensic palynology uses pollen and spores as trace evidence in the context of crime. Its main application is in investigating links between people or objects and places as for instance through comparing the pollen spectrum in soil on a suspect's shoes with that at a crime scene. It can also be used to indicate season of death or to indicate the general area or country where an object or substance has come from. It often works closely with soil analysis to produce collaborative evidence.

In some countries, including New Zealand and the UK, the use of forensic palynology is becoming well established. However in many places it is poorly developed or not used at all. This talk looks at some of the main applications and problems in forensic palynology and is illustrated with results from cases and research.

Pollen samples can be retrieved from a wide range of objects and substances including shoes, vehicles, hair, clothes, finger nails, nasal cavities, drugs, explosives, paint and firearms. The use of palynology has many advantages. Pollen is found virtually every where outdoors. It is slow to decay and can be used at any time of year. It can be location and season specific and only small amounts of material may be needed to yield a sufficient sample.

These advantages have to be balanced against notable disadvantages which include the fact that many plants have wide distributions so a pollen spectrum from a sample may not be location specific. The presence of pollen in a sample, for example from a substance, depends on exposure (time of year, being outdoors etc). Another limitation is that some grains may be identifiable to family level only.

In order to produce valid evidence great care needs to be taken at all stages to avoid contamination both to individual samples and between samples. Standard protocols need to be used for taking samples, processing and analysing them. All work needs to be done within the framework of legal requirements such as continuity.

One of the main problems is in comparing the results of samples to those from controls, for example pollen from a spade to that from grave soil. Transfer and retention of pollen from soil to an object will never be 100%, so complete matches are not possible. Also the pollen spectrum of an area can show variations over relatively small distances. Several questions arise here. These include how many control samples should be taken? How should the pollen spectrum be expressed in terms of the controls and their variance?

Statistical analysis of the data alone cannot provide the answers because much depends on the ecology of the plants involved and their distributions. Factors such as rarity, how much pollen is produced and dispersal mechanisms must be considered. The results of "matching" can be expressed in terms of probability but this can be calculated in different ways producing contrasting results.

Research needs to be focussed on aspects of transfer and retention of pollen together with assessments of methods of analysis and the development of new techniques to improve the specificity of matches, such as using DNA profiles of pollen grains instead of morphological features.

The application of pollen analysis in forensic soil examination when a scene of crime being the urbanized territory

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It is common knowledge that a presence of pollen and spore composition in soil stratifications being on material evidences (suspect and/or a victim) allows connect them with a scene of crime, especially when the pollen composition completely reflects features of vegetation community of a local site. The analysis of forensic expert practice shows, that one of the most difficult moments in solving identification tasks is still being interpretation and criminalistical estimation of the pollen method data. In the first place, it concerns the urbanized territories where it is necessary to know all prehistory of surface changes on a site under consideration for correct interpretation of research results.

In some cases, such superficial layer of ground has no “initial memory”, that is, it is not bond to the local site of a district and contains insignificant amount of pollen and spores. The same occurs with the surface layer of foot-paths, which are poured with sand or a mix of sand and gravel almost every year.

A rather steady combination of large (perennial) trees is typical for fast changing of a surface cover of ground, frequently taking place in modern cities. The application of pollen analysis is the most perspective, when such territories are being under investigation, because a pollen composition reflects features of vegetative community at a local site in short period of time more precisely. Two cases from our practice are described bellow.

When investigating a severe murder with dismemberment, a scene of crime presented a 30 years old lime-tree lane and a small park near to garages. A soil cover was changed there during construction works. The direct dependence from removal from trees of a pollen composition in comparative soil samples was established. On the base of a soil substance examination and data of pollen analysis it was able to prove, that the ground on the accused boots, was identical with the surface ground on the place of incident.

During investigation of bodily assault on a girl which took place in the beginning of May, a scene of crime presented itself a foot-path with an artificial covering (a sandy mix) nearby lime trees. A comparative study gave evidence of similarities of soil substance taken from the suspected boots with the soil substance of comparative samples.

However, the presence of significant amount of lime pollen grains in the soil taken from the suspected boots in comparison with the soil cover from the foot-path let us establish suspected person alibi, as the soil stratifications on his boots could be formed only in June-July after the incident had happened.

The especial care should be taken, when the surface layers are modified by adding of artificial fertile soils (for example on a base of pits). Pollen composition of pits does not connected with vegetation community of a local site, but has the individual attributes. This question still demands intensive study.

A comparison of kit based DNA extraction methods for use in forensic palynology

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The soil in every location has a unique pollen signature due to a combination of pollen transported in by the airflow and that deposited from local sources. Due to this, pollen in samples of soil from shoes and other items can be used as trace evidence in forensics. However, forensic palynology is underused by law enforcement agencies.

One reason for this is the limitation of morphology based methods. Identification of palynological samples using a DNA based method would be cheaper and quicker and would encourage more widespread use of forensic palynology. The first problem encountered when using a DNA based method is extraction of the DNA from the pollen grains.

A pilot study was carried out to compare two kit based extraction methods using different sets of primers (rbcL and pbsA/trnH). A mechanical lysis step was also introduced as an addition to each kit's standard method in order to properly disrupt the tough exine of the pollen grains.

Two kit based DNA extraction methods were used: Microlysis by Microzone and Mini Plant Kit by Qiagen. Manufacturers' instructions were followed with the exception of an additional mechanical disruption step. 0.02g of *Betula pendula* pollen was weighed out into 8 individual Eppendorf tubes. A small scoop was used to measure out consistent amounts of Ballotini acid washed silica beads into each tube. 100µl of distilled water was added to each of the tubes. The samples were shaken in a mechanical disruption instrument at 4.0ms-1 for varying lengths of time (0, 20, 40 and 60 seconds). The samples were then PCRd. A sample mix consisting of 10µl of sample and 3µl loading dye was run on a 0.7% agarose gel made up with 0.7g agarose powder, 100 TBE buffer and 6µl Ethidium Bromide. 100bp DNA ladder was run on either side of the samples.

These experiments show that that more DNA was extracted from the pollen samples using the Microlysis kit. However, the spin steps in the Mini Plant kit appears to remove PCR inhibitors more effectively causing bands that are present in the Mini Plant kit gel to be weaker/not present in the Microlysis gel.

The increased amount of DNA extracted using the Microlysis kit and the fact that pollen DNA in smaller quantities (e.g. forensic samples) could be more easily lost using the spin columns of the Mini Plant kit makes the Microlysis kit a better option for small quantities of DNA as long as the PCR conditions are optimised in order to remove the effects of the inhibitors present in the sample. This could be done by adjusting the annealing temperature or the concentration of Mg 2+ ions.

For samples where quantity of DNA is not a problem (e.g. standards) the Mini Plant kit would be a better option because although the amount of DNA extracted is less, the PCR does not require extensive optimisation as it seems to effectively remove inhibitors.

SESSION 4b. Indoor air hazards: Microbes

Keynote: Exposure assessment of environmental microbes. Hyvärinen A.

Indoor exposure to airborne fungal spores in Leicestershire, UK. Fairs A.,Wardlaw A., Pashley C.

Analysis of causes that affect fungus indoor occurrence in a hospital. Tormo R., Gonzalo Á., Silva I., Álvarez J.

Aero-mycology in wastewater treatment plant (Córdoba, Spain). Infante F., Jiménez J.M., Ranchal, M.

Actinomycetes inside wall cavities. Pessi A.-M., Kourula J.

Indoor and outdoor pollen concentrations in private and public spaces during the *Betula*, Poaceae and *Artemisia* pollen season. Hugg T., Rantio-Lehtimäki A.

Keynote: Exposure assessment for environmental microbes

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Microorganisms are ubiquitous, and hence, some microbial exposure takes place in all living environments. Nevertheless, most studies concerning exposure to microbes are from indoor environments. Microbial exposure in moisture damaged buildings has reached enormous public and scientific interest because its' adverse health effect, while at the same time there are indications that microbial exposure in early life is protective for allergy. The role of microbial communities surrounding us seems to be both "good" and "bad" in human health. These phenomena are acknowledged, but the causative agents behind associations are still obscure.

The potential agents consist of eg. microbial spores and cells of numerous species, fragments, components and metabolites, which are influenced by numerous factors and hence have huge temporal and spatial variation making the exposure assessment complicated. Proper methods for exposure assessment are critical in connecting the role of microbial exposure with the health effects.

Traditionally, microbial exposure has been determined with sampling of airborne microbes and detection of viable microbes with cultivation methods. More advanced molecular methods detecting not only viable represent promising tools to reveal exposure more detailed. These include eg. identification and quantification of microbial species, genera or groups with qPCR (quantitative polymerase chain reaction) and quantification of microbial groups by measuring their biological activity or structural components with immunoassays and GC-MS.

Another critical aspect in microbial exposure assessment is the sampling. Because of the great variation in airborne microbial levels, exposure assessment of microbes have recently been done a lot with house dust sampling, which has been considered to be an integrated sample over a longer period of time. Dust, however, is not airborne, but settled particles, most of which are too large to become airborne. Therefore, floor or mattress dust sample contains also material originating from other sources than air, which is the main exposure route for inhalation exposure. For the exposure assessment and epidemiological purposes, it would be essential to know how dust samples resemble the actual exposure for different microbial agents.

Microbial measurements are generally also used to determine if there are mould problems in the building, eg. to ensure microbial growth or to have indications of abnormal sources. Because of the nature of microbes being everywhere, it is very essential to understand if microbial finding is normal or abnormal in order to be able to interpret the results of microbial measurements. The methods used for mould detection should be well validated and known and the interpretation should be based on large reference material.

In Finland, the microbial methods used for detection of mould in homes have so far been based on cultivation. So called MVOC (microbial volatile organic compounds) measurements are not recommended, because they are not specific for mould growth but have several other sources in buildings. DNA-based qPCR-methods are recognized as one of potential tools, but is still under validation.

The causalities between environmental microbes and health effects are still unclear, but new advanced methods may provide better tools for exposure assessment. No method is so far superior and more validation and research is needed.

Indoor exposure to airborne fungal spores in Leicestershire, UK

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Exposure to airborne fungal spores induces an allergic response in sensitised individuals, with allergic manifestations including asthma, rhinitis and allergic bronchopulmonary aspergillosis (ABPA). Furthermore, exposure to *Aspergillus* and *Penicillium* has been associated with the development of asthma.

Indoor exposure to airborne fungal spores has not been fully characterised in UK residences and methods used for the collection and quantification of fungal allergens are not well standardised. In order to generate a comprehensive set of baseline data, Burkard continuous recording air samplers were used to collect 24 hour air samples from the living rooms of 100 residential properties within Leicestershire. Fungal spore concentrations were analysed by microscopy, identifying 20 morphologically distinct taxa in two-hourly intervals. Data was recorded utilising novel software, enabling higher efficiency of data manipulation. Property characteristics of interest were determined by questionnaire, and temperature and humidity were recorded using a continuous data logger.

Total airborne fungal spores ranged from 394-2567 (median = 1076) spores/m^3 air, with *Aspergillus/Penicillium*-type spores ranging from 43-256 (median = 87) spores/m^3 air. No obvious relationship was observed between total fungal or *Aspergillus/Penicillium*-type spore counts and age of building, floor covering or presence of pets. Indoor concentrations of *Aspergillus/Penicillium-type* spores ranged from 36-360% (median = 100%) of outdoor concentrations, highlighting the potential for indoor sources of *Aspergillus/Penicillium*-type fungi. In contrast, the percentage of total fungal spore concentrations relative to outdoor concentrations was much lower, typically ranging from 7-43.9% (median = 18.3%). Mann Whitney analyses of the data identified significant seasonal differences in total fungal spore concentrations but not *Aspergillus/Penicillium*-type concentrations, again illustrating the independence of outdoor factors on *Aspergillus/Penicillium*-type spore concentrations in residential properties.

This study provides baseline data which can be used in future studies to investigate airborne fungal spore exposure in homes of patients with fungal allergies. No significant relationship was found between individual property characteristics and airborne fungal spore concentrations to explain elevated fungal spore counts.

Analysis of causes that affect fungus indoor occurrence in a hospital

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Indoor fungus occurrence in a hospital can be explained by the existence of internal sources or by the introduction of fungus propagula through building access from outdoors to indoors.

To analyze the possible causes, an indoor aerobiological sampling in the hospital of Badajoz (SW Spain) has been set up during a whole year, using personal aerobiologic samplers in four places on two different floors and one outdoors as well. In each floor, a ward and an aisled room have been selected. As growing media the Sabouraud dextrose agar supplemented with chloramphenicol (SDA) has been used on Petri dishes.

Taking into account the outdoor fungus found, the following factors have been considered to explain the indoor fungus occurrence and their time changes in the study period: the number of people present at the wards of the two floors, the isolation of the four indoor places selected, the occurrence of building works on both floors and the furniture changes which took place in the rooms. 31 samples of 10 minutes long, each one of 10 litres per minute, have been done, weekly during the spring (13 samples) and fortnightly for the rest (18 samples).

1144 Colonies Form Unit (CFU) have been obtained, with an average of 190 CFU/m^3 outdoors and 24-64 CFU/m^3 indoors. Results show that there is no relation between number of people in the wards and the fungus occurrence, R^2 values are very low for both wards (0,0246 and 0,0151). In the same way, there is no relation between fungus occurrence outdoors and the first floor wards, although for this spatial situation this could be presumably the place with more relation.

Building works on the third floor room have raised the fungus occurrence up to a 45%, but the outdoor ones had not produced a similar effect. Nevertheless it might be considered that there is a seasonal pattern that could affect the results because the highest outdoor fungus amount have been sampled in summer, but no evidence has been appear at indoors.

Aero-mycology in wastewater treatment plant (Córdoba, Spain)

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The wastewater treatment plants (WWTP) present some specific risks for workers who operate in them (mechanical, physical, chemical, ergonomic and biological). It is necessary to consider that in Andalusia (Spain), there are more than 450 municipalities with a population superior to 2000 inhabitants, and the current regulations are forcing them to have systems of sewage treatment.

This Regulation indicates the studies that must be carried out for the evaluation of the biological risks (identification of the biological agents, and consideration of their sources of exposure, reservoirs, scientific information and possible epidemiological studies). Another decisive element in the configuration of this study is the diversity of purification systems.

The scheme of functioning of the wastewater treatment plant induces to question if the spores of fungi in the air are the same in a WWTP that works with a biological reactor, as with a system of aeration turbine, or a sludge drying plant.

The main objectives in this work were

1st.- A comparison of the presence / absence of fungal propagules in the different work-rooms and the outside of the sewage treatment plants.

2nd.- Knowledge of the temporal evolution of fungal concentrations in the air.

3rd.- Knowledge of the potential danger of fungal concentrations, and to propose possible measures to increase the safety of workers.

The study was carried out in three WWTP of the province of Cordoba (Spain); each of them with a different scheme of functioning. We used simultaneously two aerobiological volumetric samplers (one non-viable, Lanzoni VPPS 1000, and another one viable, Burkard Ltd.) from August'06 to July'07.

We compared the fungal presence on air between indoor and outdoor WWTP installations; we found similar fungal concentrations (indoor 47% of the aeromicoflora isolated and outdoor 53%). Likewise, there was a higher fungal concentration in the rooms of Pretreatment (64%), compared to the rooms of Dehydration (36%). We evaluated 16 taxa.

September'06 was the month in which the fungal presence in the air showed the highest value (32'76% of the total) whereas December'06 showed the lowest values (1'82%). *Cladosporium* has been, as it is habitual in the aerobiological samplings, the most abundant genus because it reached 31% of the total isolated, being February'07 the month with the maximum values and July'07 the month with the minimum values. Secondly we found *Aspergillus* with a 26'5% of the total of recorded fungi, reaching its highest concentrations in September'06, being absent in February'07.

Actinomycetes inside wall cavities

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There is an association between moisture-related microbial growth within the insulated precast concrete exterior walls of apartment buildings and levels of microbial concentrations indoors, especially with actinomycetes. However, level of actinomycete growth having affect on indoor air was observed relatively seldom in an unselected building data. Economical and sanitary importance of this phenomenon was therefore found reduced.

Yet the recent mild and thereby damp winters in Finland have raised the question of microbial growth inside the insulation layer of external walls again. Normally cold winters with prolonged period of low relative humidity have dried external walls structures. Recent moist winters have kept external walls wet, and in some cases even the internal wall structures have got moisture damaged.

In this tentative study, recent data of microbial growth within insulation layer of badly damaged precast concrete exterior walls were pooled. Data originated from insulation samples, cultivated on MEA, DG-18 and THG-media. Microbial growth was and assessed by relative scale (none-low-moderate-abundant).

Results show that actinomycetes occur in 44% of the samples in 2007-2008, and distinct (abundant) actinomycete growth in 22% of the samples. This is significantly more compared to an earlier study (Pessi, 1999) where abundant microbial growth was found only in 2.7% of all samples. Actinomycetes were dominant microbial group and fungal growth was found only sporadically. The growth occurred most often in southward and southwestward walls.

The results indicate that importance of microbial growth inside wall cavities may be underestimated in the most damaged concrete building stock in Finland, possibly due to changed wintry weather conditions.

Keywords: Air quality, Actinomycetes, mold, insulation, building envelope

Pessi et al. 1999. Microbial growth inside exterior walls of precast concrete buildings as a possible risk factor for indoor air quality. Proc Indoor air 99, 1: 899–904

Indoor and outdoor pollen concentrations in private and public spaces during the Betula, Poaceae and Artemisia pollen season

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A growing number of studies are researching indoor air concentrations of pollen in buildings, but to our knowledge no studies have dealt with the precise concentration of pollen inside private cars. Although the number of studies of pollen concentrations inside and outside buildings is increasing, little is known about the efficiency of penetration of pollen from outdoor to indoor air, and further.

We studied indoor and outdoor pollen concentrations in private cars, in private and public spaces throughout the *Betula*, Poaceae and *Artemisia* pollen season and assessed the risk of exposure to pollen grains.

The study was conducted in the towns of Lappeenranta and Joutseno, in the municipality of Rautjärvi and along Highway 6 in SE Finland between 14 July and 17 August, 2003, and between 3 and 23 May, 2004.

The pollen concentrations were measured inside two moving and parked cars, inside and outside a block of flats, a detached house, and the regional central hospital using rotorod-type samplers. Dust and ambient Burkard samples were also collected.

In 2003, both Poaceae and *Artemisia* pollen were recorded only on one day and in low concentrations (<10 pollen grains per cubic meter, pg/m^3) inside moving and parked cars, whereas the concentrations of *Betula* (0–15 vs. 0–12 pg/m^3) and *Pinus* (0–41 vs. 0–80 pg/m^3) ranged from low to moderate, respectively. The number of pollen grains on the inside surfaces of cars ranged from zero to 72 pg/cm^2 during the measurement periods.

In 2004, outdoor concentrations of *Betula* pollen grains ranged between low and abundant (0–855 pg/m^3). The corresponding indoor concentrations near the main front doors varied from low to moderate (0–17 pg/m^3) in the central hospital and were low (<10 pg/m^3) in both residential buildings. Indoor concentrations further from the main front door were low (<10 pg/m^3) at all study sites. Background values of Burkard sampler varied between 0 and 4311 pg/m^3 during the measurement period.

The numbers of *Betula* pollen grains on the indoor surfaces were higher in the less frequently cleaned apartment in the block of flats (0–2926 pg/cm^2) than in the more frequently cleaned detached house (0–99 pg/cm^2).

The concentrations of Poaceae and *Artemisia* pollen in the indoor air of the car during the flowering period were low, therefore, likely to cause reactions only in the most sensitive people. By contrast, even after the main flowering period the concentrations of *Betula* pollen were on a level high enough to cause reactions in individuals with allergies.

The concentrations of *Betula* pollen decreased substantially from outdoors to indoors and further toward the centre of the building, probably indicating relatively poor penetrating properties of the pollen grains and/or the short-lived presence of pollen grains in indoor air. The concentrations of *Betula* pollen inside the buildings during the peak flowering period were mostly at a level barely inducing reactions even in the most sensitive persons.

POSTERS 3b. Phenology

Spatial and temporal variations in the flowering phenology of birch (*Betula*) and its relation to birch pollen concentrations recorded at two sites in Poznań, Poland (2006-2007). Grewling Ł., Stach A., Jackowiak B.

The time series of bud burst (1846 to 2005) support the observations of climatic warming. Linkosalo T., Häkkinen R., Terhivuo J., Tuomenvirta H., Hari P.

Phenology as a tool for the revision of the bioclimatic cartography of Tunisia. Saadi H., Garcia -Mozo H, Galán C., Mokhtar Gammar A.

Relationship between phenology and aerobiology of Plantago spp. in León (Spain). González-Parrado Z., Fuertes-Rodríguez C.R., Vega-Maray A.M., Valencia-Barrera R.M., Fernández-González D.

The use of Geostatistics in the study of floral phenology of Poaceae. León E., García-Mozo H., Dominguez-Vilches E., Galán C.

Temporal and spatial variability of the most important phenological phases of alder in Czechia. Hajkova L., Nekovar J.

The use of a bioclimatic model to forecast olive yield in Northern Portugal. Ribeiro H., Cunha M., Abreu I.

Influence of climate changes on flowering phase of selected plants at Lithuania. Veriankaitė L., Bukantis A.

Spatial and temporal variations in the flowering phenology of birch (*Betula*) and its relation to birch pollen concentrations recorded at two sites in Poznań, Poland (2006-2007)

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The aim of the study was to compare the flowering times of two birch (*Betula pendula*) populations growing in Poznań. Phenological surveys and aerobiological monitoring was conducted simultaneously and the data obtained from these two methods were compared in order to show possible differences in flowering behaviour.

Betula pollen data were collected by Burkard volumetric spore trap at two pollen-monitoring sites in Poznań (2006-2007). One trap was sited on the roof of a thirteen story university students' dormitory (Esculap) at a height of about 33 m, approximately 1 km Southwest of the city centre (52˚24´N, 16˚53´E). The second trap was situated at a height of 22 m on the roof of the faculty of physics building in Morasko Campus (Adam Mickiewicz University) about 10 km to the north of the city centre and mainly surrounded by fields, meadows and woods (52˚27´N, 16˚55´E). The start of the birch pollen season was defined using the 2.5% method.

Phenological observations following the Łukasiewicz method were carried out for the same time period, in the same general area as the pollen-monitoring sites. One birch tree population was located in Cytadela Park about 800 m from the centre of Poznań and the other population was situated in Morasko Campus. Three main phenological stages were identified: 1) Start of flowering describes the period when the first 25% of catkins were open; 2) Full flowering was defined when 25-75% of the flowers were open; 3) End of flowering was used for the period when the last 25% of inflorescences were open. The phenological observations were performed two to three times a week.

In 2006, birch trees started flowering at the same time in both of the phenological observation areas, but in 2007 birch trees growing within the city flowered 2 days earlier than the trees on the outskirts. The duration and the end dates of the flowering period were also similar in the two populations.

The beginning of the birch pollen season (2.5% method) occurred at about the same time as the macroscopically observed start of flowering. However, daily average birch pollen concentrations > 30 grains/m³ were recorded 3 days before and 10 days after the observed flowering period in 2007. A similar situation occurred in 2006 when 43 birch pollen grains/m³ daily average were recorded 12 days after the end of flowering. There was not a notable difference in flowering behaviour between the two birch tree populations examined, which suggests that any variations in meteorological conditions between the centre of Poznań and the outskirts of the city are too small to influence this stage of plant development.

Phenological and aerobiological studies show that daily average birch pollen concentrations > 30 grains/m³ were recorded outside of the main flowering period, which could be the result of long-range transport. More simultaneous pollen and phenological studies are needed to confirm these results and to investigate the possible affects of long-distance transport of birch pollen on the timing and severity of birch pollen seasons.

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The time series of bud burst (1846 to 2005) support the observations of climatic warming

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Plants react to the temperature changes in the spring, so that the timing of their phenological events, like leaf bud burst and flowering, is determined by the temperature conditions prevailing before these events. Advancement in spring phenological events therefore reflects global warming.

In order to verify results from direct temperature measurements, we used phenological records for 160 years to estimate the amount of warming indicated by the advancement of spring phenological events. We utilised the time series of the flowering of six deciduous tree species, namely the grey and the black alder, the silver birch, the European aspen, the bird cherry and the rowan, and the time series of the leaf bud burst for the silver birch and the aspen.

The observations were made from a geographical area that lies between 60 °N latitude and the Arctic Circle at 66° 33' N and between 21 to 30 °E longitude, at altitudes lower than 200 m. Although the data-collection area is geographically large, being about 600 km from the east to the west and slightly more from the north to the south, it is climatologically homogeneous except for a trend along the south-north axis showing an average four-week delay in the dates of the spring events at the northern limit as opposed to the southern limit.

All the phenological observations in the series revealed evident trends, and linear regression models indicated statistically significant advancements of 3.3 to 11.0 days per century in the spring events. The earlier events showed greater advancement, which accords with the climate observations showing greater warming in winter and spring than in summer. The variation in the trends may reflect differences among the species or be due to measuring noise.

Simultaneously with the phenological observations, continuous meteorological observations were started in Finland. Our temperature data for Finland shows a clear warming trend. The temperature increase in spring, as determined with physical thermometers, is 1.50 °C per century for the spring months (March, April, and May) in Finland for the period 1847-2005. The increase is stronger in spring than in summer.

In order to convert the phenological trends into corresponding trends of temperature increase, we used Thermal Time models and simulated spring warming temperatures to iteratively find the amount of warming that corresponds to the observed phenological trends. Thus, we used the phenological time series as a "biological thermometer" of climatic warming.

According to our biological thermometer, the temperature increases ranged from 0.7 to 2.4 °C per century, with an average of 1.8 °C per century. In terms of the measuring precision of the methods, the two values are equal, despite the slightly higher value shown by the biological thermometer. Thus our biological thermometer corroborates the result of climatic warming previously obtained with physical thermometers at the meteorological stations in Finland.

Phenology as a tool for the revision of the bioclimatic cartography of Tunisia

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Phenological observations can improve the researches on the climatic borders between different geographical regions. The climatic description of the different regions of Tunisia (North Africa) has been studied from the 40`s decade (Emberger 1942) although it has suffered some revisions (i.e. Ben Boubaker 2000). Most of these revisions take into account topographical and climatic parameters but scarce bio-indicators have been included in these studies.

The main objective of the present study is to perform a new revision of the bioclimatic cartography of Tunisia taking into account biological aspects such as phenological behaviors of some indicative species.

In Tunisia, the number of continuous regular phenological observations throughout the years is very limited. Therefore, one of the aims of the present project is to create a phenological network in Tunisia. From autumn 2007 the vegetative and reproductive phenology of four indicative species of the country is being periodically recorded.

The autumnal phenophases monitoring on 2007 show clear differences among stations in Tunisian north area. The more we advance to the northern-west, where the highest rainfall and lowest temperature are recorded, the more number of individuals show a delay in the defoliation phases. The clearest delay is observed in the stations located in highest altitude. Coastal stations located in high altitude also show a marked delay in comparison with the rest of stations, and obviously with the coastal ones located at sea level.

In order to include phenological data as a tool for the revision of the bioclimatic cartography of Tunisia, three main aspects are being taken into account:

1) A comparative analysis of phenological data among different species and populations.
2) A comparative analysis of phenological data of each species at the different studied stations.
3) To implement a standardised methodology to create a national Tunisian Phenology Program, similar to other programmes running in different European countries.

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Relationship between phenology and aerobiology of *Plantago* spp. in León (Spain)

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In this study data phenological and aerobiological of *Plantago* spp. are presented. *Plantago* pollen is one of the most important pollen types in Europe and is always described as allergenic. Several authors in different places described that about 30% of patients are allergic to *Plantago*, most being polysensitized and, therefore, also allergic to the pollen of the plants, mainly Gramineae.

The study was carried out in the city of León (NW Spain) which has a Mediterranean climate.

Aerobiological samples were collected using a volumetric collector Hirst seven day recording trap, model Lanzoni VPPS 2000 from 1 January to 31 December of 2007. The samples were prepared and analysed by the method recommended by the Spanish Aerobiology Network.

The pollen season was estimated using the 95% method proposed by Andersen.

For the flowering phenology we had chosen eight points of sampling around the city of León. In each point we selected 30 individuals of *Plantago lanceolata*. To characterise floral phenophase was applied from the 30 March to end of flowering (at least once a week) in 2007. The flowering was divided in five phases for this study:

- Phase 0: Beginning when the inflorescences appear and finish when the first flower is opened.

- Phase 1: From the open the first flower to 25% of the flowers in the inflorescence are opened.

- Phase 2: It is the period of maximum liberation of pollen, finish when the 75% of the flower are opened.

- Phase 3: More of 75% of the flowers are opened and finish when all anthers have liberated the pollen.

- Phase 4: Beginning with the fruit formation and all anthers are empty of pollen grains.

The aim of this study was to establish a relationship between flowering observations and aerobiological monitoring.

Total *Plantago* spp. pollen grains counted was 672 pollen grains. The highest value recorded was 34 pollen grains/m^3 on 17 May and the week in which we collected the major amount of pollen grains was the 20th week (14-20 of May). The main pollen season started on 27 April (17th week) and finished on 9 September, with an of 139 days.

Taking into account phenological data of all points of sampling, we have observed that the flowering started in the 16th week of the year in the most of them. The flowering occurred one week before the main pollen period (MPP). The maximum concentration of *Plantago* spp pollen grains in the atmosphere of León at the same time that most of points of phenological sampling was in phase 2, matched with the moment of maximum liberation of pollen grains. It was in the 20th week of the year.

The use of Geostatistics in the study of floral phenology of Poaceae

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Traditionally, studies on floral phenology have been focused on changes suffered by the plants through time. Nevertheless variations through space have remained almost ignored, although most of natural phenomena show, as an inherent feature, a high degree of spatial continuity.

In this work we have used Geostatistics in order to study spatial variations of floral phenology, in several species belonging to Poaceae family, through a series of maps by using Geographical Information Systems. Interpolation by using linear Geostatistic allows us to estimate phenological data in wide areas based on a limited number of samples. Our data have been compared with the Poaceae pollen emission in the atmosphere in order to demonstrate which species and areas more contribute to the curve.

This study has been carried out during years 2003-2006 in the city and low feet of the mountains of Córdoba. Weekly phenological observations have been carried out in 10 sampling points randomly distributed through the study area.

We have assigned a value, from 0 to 4, from pre-flowering to fructification phases on three different species each year. Those species were chosen depending on its abundance, from a prior study on the phenology of 30 Poaceae species.

The Geostatistical analysis consisted on: 1) statistical descriptive analysis; 2) structural analysis; 3) Validation and Interpolation. Aerobiological data have been obtained following the REA standardized protocol (Galán et al., 2007))

Several phenological maps were obtained for each species. These maps show the variation in floral phenology throughout the whole study area. In general, it has been observed that:

1. Populations placed at lower areas first initiate their flowering
2. Populations that grow at different sampling points show differences in their phenological evolution, due to the microclimatic differences
3. Geostatistics proved their goodness in comparing phenological with aerobiological data
4. Populations placed at the mountains feet contribute the most to the pollen spectre of the city of Cordoba

Reference: Galán, Cariñanos, Alcázar & Dominguez-Vilches. (2007) Spanish Aerobiology Network (REA), Management and Quality Manual. Service of publications, University of Córdoba, Spain

Temporal and spatial variability of the most important phenological phases of alder in Czechia

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Phenology is the study of the times of recurring natural phenomena in plants and animals. The Czech Hydrometeorological Institute operates with a network of phenological stations encompassing field crops, fruit trees and wild plants according to the Methodical instructions number 2, 3, 10. There are also observed several very important allergenic species; for the subject of this case study has been chosen *ALNUS glutinosa* (L.) Gaert. Its pollen grains are one of the most important allergen.

Observing phenological phases (flower buttons visible, beginning and end of flowering) is important for identification of the pollen season. At wild plant stations, there are observed these phenophases in *ALNUS glutinosa* (L.) Gaert.: sprouting, first leaves, full leaves, flower buttons visible, beginning of flowering, end of flowering, bud creation, lignifications of sprouts, yellowing of leaves, defoliation and ripening of fruits.

Temporal and spatial variability of the chosen phenophases (sprouting, first leaves, full leaves, flower buttons visible, beginning and end of flowering) was explored with using statistical and GIS methods for the period 1992-2007 with respect to allergenic importance of the phenophases.

The timing of allergology important phenophases in the past century will also be executed according to historical stations.

The use of a bioclimatic model to forecast olive yield in Northern Portugal

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The increase of oliviculture demand and profitability led to the improvement and development of new cropping techniques, having in mind the maximization of the yield. In this perspective, the early-season indication of crop yields is an important instrument in the support of the decision making process in the olive sector.

This work aims to develop a bioclimatic forecasting model, for olive crop yields in Northeast of Portugal. The model was estimated along three different developmental stages: i) at flowering, considering only the regional pollen index; ii) at fruit growth with the addition of a plant water-stress index and iii) at fruit maturing with the addition of a phytopathological index.

Our study was conducted in the olive-growing region of Trás-os-Montes e Alto Douro located in the Northeast of Portugal. Olive regional pollen was sampled, from 1998 to 2006, using two Cour traps installed in the Valença do Douro (41º08'N, 7º33'W) and in Vila Nova de Foz-Côa (41º0'N, 7º26´W). The regional pollen index was calculated using a principal components analysis between the sums of the pollen sampled during the main pollination season in both sampling stations. The plant water-stress index was calculated through the monthly sum of the difference between the crop evapotranspiration and the occurrence of precipitation from June to August. The phytopathological index corresponded to number of rainy days that registered mean temperature between 15 and 25ºC during October. The bioclimatic model was fitted, by a stepwise multiple regression, to the olive production data from 1998 through 2006. Its external validation was performed using the leave-one-out cross-validation procedure.

Along the time period between flowering and fruit maturing, the explain ability of the bioclimatic forecasting model was increasing by the inclusion in the model of the post-flowering variables. The model fitted at the flowering stage showed that 63% of the regional olive production can be explained by the regional pollen index. The average deviation between observed and predicted production was 10% for the internal validation and of 13% for the external validation. The variable plant water-stress index allowed an increase in the forecasting accuracy of about 30%, and a reduction on the average deviation between observed and predicted production for 6% for the internal validation and of 11% for the cross validation. The final bioclimatic forecasting model, with all the three variables tested, was able to explain 97% of the regional olive fruit production annual variability, with an average deviation between observed and predicted production of 3% for the internal validation and of 6% for the external validation.

The hierarchical nature of this bioclimatic model enabled an update along the growing season, being the regional pollen index the variable with highest influence on olive yield. The plant water-stress and the phytopathological indexes were good quantitative indicators of the influence of the water stress and potential climatic situations to cause phytopathological attacks on the olive fruit yield.

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Influence of climate changes on flowering phase of selected plants at Lithuania

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Nowadays climate changes and associated effects are one of the most relevant fields of scientific researches. Considering that plants are very sensitive to fluctuations of meteorological elements, investigations of changes of vegetation is particularly important on purpose to estimate effect of climate change on particular vegetation phase. Such investigations have reasonably strong practical value.

Aerobiology is one of scientific fields where phenological (especially flowering) observations are particularly precious. Relations between plants flowering and observations of pollen concentration were established and reasoned of huge amount of scientific investigations.

The aim of this investigation is to estimate the flowering peculiarities of selected plants *Corylus*, *Betula* and *Tilia* during the period of 1970-1999, to calculate the active temperatures and to evaluate the dates of flowering of these plants in Lithuania by using different climate scenarios.

Phenological data were provided by Lithuanian Hydrometeorological Service. Three most common genera of woody plants in Lithuania were selected for analysis. Data for *Corylus* cases were collected from 14 agrometeorological stations and posts, for *Betula* cases from 15 and *Tilia* – 10, which represent Lithuania territory.

There were used representative data from adjacent stations for lack of flowering dates and calculations of sums of active temperatures. Sum of active temperature were calculated when temperatures over 0ºC till the start of flowering. The following calculations enable to estimate changes of flowering by applying different scenarios of climate changes and to present assumption of changing dates in Lithuania by changing air temperature.

Such integrated analysis allows not only using selected plants like bioindicators observed climate changes but also ensure for value information which will enable for aerobiologists to mould knowledge about changes in possibility of pollen observations. The results from research are presented.

SESSION 11. Meteorology, remote sensing, modelling, forecasts

Keynote: Evaluation and forecasting of the atmospheric concentrations of anthropogenic pollutants and allergenic pollen. Kukkonen J., Sofiev M., Siljamo P., Ranta H., Linkosalo T., Karppinen A.

Assessment of the strength in the relationship between pollen concentrations in urban/rural areas of Poznan (Poland) related to local vegetation sources and differences in allergen exposure. Fernandez-Sevilla D., Rodriguez-Rajo F.J., Stach A.

Long-term and short-term forecast models for Poaceae (grass) pollen in Poznan, Poland, constructed using regression analysis. Stach A., Smith M., Prieto Baena J.C., Emberlin J.

Modelling of birch pollen episodes with the model system COSMO-ART. Vogel H., Pauling A., Vogel B.

Dormancy release of early flowering trees *Corylus* and *Alnus* in Poznań, Central Europe: Proposal of thermal time prediction models and future IPCC trends. Rodriguez-Rajo F.J., Stach A., Smith M., Grewling L.

Keynote: Evaluation and forecasting of the atmospheric concentrations of anthropogenic pollutants and allergenic pollen

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This study presents an overview of the evaluation and forecasting in time of the atmospheric concentrations of anthropogenic pollutants and allergenic pollen. It has been shown in previous studies that high concentrations of allergenic pollen may occur simultaneously with high concentrations of anthropogenic air pollutants, mainly caused by meteorological conditions that control the diffusion of both of these pollutant categories; however, this is not always the case.

More specifically, there are currently numerous regional and continental-scale Air Quality Forecast and Information Systems in Europe. Some prominent examples are the EURAD modelling system in Germany, the PREVAIR, the “Your Air-” system in England and Wales, the Air Quality and Emergency Modelling System SILAM. However, any single modelling approach contains inherent uncertainties; the higher-resolution domains also commonly cover only a limited area. These forecasting systems address mainly anthropogenic air pollutants, and there are very few systems that can treat both anthropogenic pollutants and various allergenic pollen species.

We have developed a methodology and computed the concentrations of various chemical constituents of fine and coarse particulate matter ($PM_{2.5}$ and $PM_{10-2.5}$) in the whole of Europe, using the Lagrangian continental-scale atmospheric dispersion model SILAM. Model computations were performed for selected aerosol precursors, primary PM, sulphate, sea salt and particulate matter originated from forest fires. These computed aerosol constituents add up to approximately 50 - 80 % of the total mass of $PM_{2.5}$ on the average. In addition, the DMAT model was applied for the evaluation of concentrations originated from desert dust.

This presentation will address some selected results on global and European air quality, both in terms of anthropogenic and non-anthropogenic air pollution. We also aim to highlight some major gaps of knowledge and future research needs.

Assessment of the strength in the relationship between pollen concentrations in urban/rural areas of Poznan (Poland) related to local vegetation sources and differences in allergen exposure

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The pollen spectrum recorded by a single sampler in a given city frequently fails to reflect particular events that may occur in its surroundings as pollen from nearby vegetation can exert a profound local influence tend to be overlooked when interpreting results. It is questionable whether pollen data obtained in the urban areas could also represent the situation for rural/suburban areas.

The purpose of this investigation is to assess the strength of the interrelationship between the pollen sampling location and the pollen spectrum collected by examining differences between pollen concentrations recorded in an urban area (Eskulap) and a rural/suburban one (Morasko) both placed in the city of Poznan (Poland). The objective was to estimate the level of confidence that should be applied in considering records from only one sampling site to represent the other in relation to the relationship between atmospheric pollen content and meteorological parameters, the elaboration of predictive models and the allergenic risk at which people are potentially exposed to.

The study was conducted during the years 2005 to 2007, by selecting 6 pollen types considered as the most common sources of pollinosis in the area of Poznan. Three of them correspond to arboreal taxa (*Alnus, Corylus* and *Betula*) and the rest herbaceous pollen types (Poaceae, *Rumex* and *Artemisia*). Daily average pollen concentrations were collected at two sites in Poznan using Burkard volumetric spore traps. Differences between samples sites were performed by means Anova-Manova Scheffe test, Mixed-design ANOVA whitin-subjects effects test, measures of association by estimating R square values and Spearman nonparametric correlation test.

The results obtained in this study had shown that the pollen spectrum recorded by a single sampler in the centre of the city (Eskulap) fails to reflect particular events that occur in the sub-urban/rural areas (Morasko). This situation is mainly due to differences according with local sources of vegetation, microclimate or urbanistic characteristics.

Our results show that the degree of association between urban and rural areas pollen behaviour for arboreal taxa is higher than for the herbaceous plants, specially in the cases of *Artemisia* and *Rumex*. The pollen spectrum recorded by a single sampler tends to overlook the influence that local sources might exert, in particular for the herbaceous taxa.

The participation of arboreal pollen in the pollen fall of both sites had enough similarities to determine that is linked to regional conditions, while differences in the atmospheric pollen content of herbaceous plants between sites indicates to be due to local conditions. Urbanization creates a special environment with longer pollen seasons and higher pollen concentration traces through the day suggesting it is more difficult to avoid exposure to pollen allergens in the urban areas, increasing the risks of developing symptoms by overexposure.

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Dormancy release of early flowering trees *Corylus* and *Alnus* in Poznań, Central Europe: Proposal of thermal time prediction models and future IPCC trends

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The objective of this paper is to develop thermal time models that quantify the dormancy period, its duration and the consequent heat requirement needed to trigger flowering in *Corylus* and *Alnus* in Poznań, Central Europe. In this study, a sequential model predicting the number of days of dormancy, based on the accumulation of different temperature thresholds of Chill Hours during rest and Growth Degree DaysºC (GDDºC) during quiescence is described.

Daily average *Corylus* and *Alnus* pollen counts (1995–2006) were collected at Poznań by volumetric spore trap. Data for the North Atlantic Oscillation (NAO) were obtained from the NAO index, calculated from Gibraltar and Reykjavik. Chilling was deemed to have commenced when mean daily temperatures were <12.5˚C for two or more consecutive days. The end of chilling was marked as the first day when the mean daily temperature reached the minimum values and started to follow a positive trend or by taking into account the inflexion point of a polynomial second degree trend that followed temperatures from October of the preceding year to April of the same year as pollination. GDDºC were calculated from the end of chilling to the start of the pollen season. Relationships between the start dates of *Corylus* and *Alnus* pollen seasons and meteorological data and indices of the NAO from the preceding months were examined using Spearman's Rank correlation tests. Factors that influenced airborne *Corylus* and *Alnus* concentrations were entered into simple linear and standard multiple regression analyses with start dates of the respective pollen seasons.

On average, chilling took 76 days. The lowest coefficients of standard variation were found with a base temperature of 0ºC and an average chilling accumulation of 1020 CH. Mean GDDºC was 83 for *Corylus* and 137 for *Alnus* and the mean duration of heat accumulation was 33 days for *Corylus* and 41 days for *Alnus*. The lowest coefficients of standard variation were found with maximum temperatures and a base temperature of 0ºC. Daily mean temperature and rainfall data from the Climate Change HadCM3A2a emissions scenario for the 2020s, 2050s and 2080s and estimated values for future indices of the NAO were entered into regression models.

The results show that a theoretical increase in temperature and NAO indices caused the pollen season to advance between 12-29 days in the year 2080. High temperatures from January to March, especially from day 31 to day 40 from 1 January, will produce earlier starts to the pollen seasons of early flowering trees. NAO indices from December to February were also found to exert a strong influence on start dates. The addition of theoretical data, temperature increases calculated by the HadCM3A2a emissions scenario and calculated NAO indices, to the proposed regression models shows that the flowering of *Corylus* and *Alnus* will start earlier in a future climate.

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Long-term and short-term forecast models for Poaceae (grass) pollen in Poznan, Poland, constructed using regression analysis

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Airborne concentrations of Poaceae pollen have been monitored in Poznan for more than ten years and the length of the dataset is now considered sufficient for statistical analysis. The objective of this paper is to produce long-range forecasts that predict certain characteristics of the grass pollen season (such as the start, peak and end dates of the grass pollen season) as well as short-term forecasts that predict daily variations in grass pollen counts for the next day or next few days throughout the main grass pollen season.

The method of forecasting was regression analysis. Correlation analysis was used to examine the relationship between grass pollen counts and the factors that affect its production, release and dispersal. The models were constructed with data from 1994-2004 and tested on data from 2005 and 2006.

The forecast models predicted the start of the grass pollen season to within 2 days and achieved 61% and 70% accuracy on a scale of 1-4 when forecasting variations in daily grass pollen counts in 2005 and 2006 respectively.

This study has emphasised how important the weather during the few weeks or months preceding pollination is to grass pollen production, and draws attention to the importance of considering large-scale patterns of climate variability (indices of the North Atlantic Oscillation) when constructing forecast models for allergenic pollen.

Modelling of birch pollen episodes with the model system COSMO-ART

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To simulate the dispersion of pollen grains, in this study of birch pollen, we use the model system COSMO-ART. COSMO is a non hydrostatic mesoscale model and is part of the forecast system of the German Weather Service (DWD). ART stands for Aerosol and Reactive Trace gases and describes the chemical reactions and the aerosol dynamics. In contrast of several other CTM model systems our model system is fully online coupled, that means that for the transport processes consistent numerical methods for all variables are used. It has a modular structure and therefore it is easily possible to run it in a forecast mode.

Several modules were implemented to describe the primary emission of aerosols which are a function of different meteorological variables like temperature and wind speed. To describe the emissions flux of pollen the model includes the parameterisation of Helbig et al. (2004).

The basic idea of our parameterization is that the vertical flux of pollen grains F_e at the top of the vegetation is proportional to the product of a characteristic concentration and a characteristic velocity. It is obvious that the available pollen grains cannot be emitted into the atmosphere, if the meteorological conditions are unfavourable. This behaviour is taken into account by a meteorological adjustment factor. To calculate the settling velocity a parameterization of Aylor (2002) was used, which takes into account that the pollen grains can hydrate or dehydrate. The advantage of the simultaneous calculation of the transport and dispersion of all components is that it is possible to describe interactions of example between pollen grains and nitrogen oxides or soot.

To validate the implemented parameterizations birch pollen episodes were simulated that took place in Switzerland in 2006 and 2008. In order to determine the flux of pollen grains into the atmosphere, it is necessary to have information on the percentage contribution of birch trees for each grid point of the model domain. For that purpose a data set of birch trees in Switzerland was built with a horizontal resolution of 7 km using all available information. To take into account emission of birch pollen outside of Switzerland we used the data set of Koeble and Seufert (2001). For comparison with measurements we used the data from the national pollen network of Switzerland. By default there were only daily mean values of the pollen concentration available but for 4 stations we had data in a temporal resolution of 2 hours. Additionally to the pollen concentration also meteorological variables are measured. The comparison of the simulated temporal development of the pollen concentrations with the observed one will be presented and the capability of using such a model system for the pollen forecast will be discussed.

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SESSION 12. Ambrosia

Long-range transport of *Ambrosia* pollen to Poland. Smith M., Skjøth C.A., Myszkowska D., Uruska A., Puc M., Stach A., Balwierz Z., Chlopek K., Piotrowska K., Kasprzyk I., Brandt J.

Ambrosia pollen in aerobiological spectra of central Russia. Severova E., Skjøth C.A.

Ragweed pollution in Hungary, 1992-2007. Apatini D., Replyuk E., Novak E., Paldy A.

The Pannonian Plain as a source of *Ambrosia* pollen in the Balkans. Sikoparija B., Smith M., Skjøth C. A., Radisic P., Milkovska S., Simic S., Brandt J.

How to clearly use ragweed pollen counts. Déchamp C., Calleja M., Méon H.

Long-range transport of Ambrosia pollen to Poland

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The long-range transport of *Ambrosia* pollen to Poland is intermittent and mainly related to the passage of air masses over the Carpathian and Sudetes mountains. These episodes are associated with hot dry weather, a deep Planetary Boundary Layer (PBL) in the source areas and winds from the south. Such episodes can transport significant amounts of *Ambrosia* pollen into Poland.

The study investigates *Ambrosia* pollen episodes at eight sites in Poland during the period 7th to 10th September 2005, by examining temporal variations in *Ambrosia* pollen and back-trajectories. PBL depths in the likely source areas were calculated with the Eta meteorological model and evaluated against the mountain heights.

Considerable amounts of *Ambrosia* pollen were recorded at several monitoring sites during the night or early in the morning of the investigated period. Trajectory analyses shows that the air masses arriving at the Polish sites predominantly came from the south, and were in the Czech Republic, Slovakia and Hungary the previous day indicating these countries as potential source areas.

We have shown the progress of *Ambrosia* plumes into Poland from the south of the country, probably from Slovakia and Hungary, and demonstrated how Lagrangian back-trajectory models and meteorological models can be used to identify possible transport mechanisms of *Ambrosia* pollen from potential source regions.

Ambrosia pollen in aerobiological spectra of central Russia

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The genus *Ambrosia* is not typical for flora of central Russia, but it is widely spread in the southern regions (Krasnodar, Rostov) and migrates north along down railways. Now small populations of *Ambrosia artemisifolia* are discovered almost in all regions of European Russia. According to phenological observations in Ivanovo region, seeds of ragweed are imported together with sunflower seeds, germinate and flower yearly but are not able to produce mature fruits. Aerobiological observations reveal ragweed in pollen spectrum of all stations in central Russia (Moscow, Smolensk, St-Petersburg, Ryazan', Nyzhnyi Novgorod) except the most eastern one in Yaroslavl'. Pollination takes place almost simultaneously in the second part of August and usually is not very intensive. We use the longest dataset from Moscow station for analysis of pollination tendencies.

Before 2000 pollen grains of *Ambrosia* were not registered in aeropalynological spectrum of Moscow. The first ragweed pollen grains were observed on August 2000 (total pollen count 8 grains/m^3) and since that time concentration of *Ambrosia* constantly increases from year to year. Period with high pollen concentration (more then 5 pollen grains/m^3) is usually very short and does not exceed 3-4 days.

During some seasons (2004, 2006) pikes of concentration were observed several times. All episodes of *Ambrosia* pollen are associated with warm weather and wind of south, south-east or south-west directions. The change of wind direction immediately (within a few hours) leads to the dramatic decrease of pollen count.

The analysis of diurnal variation of pollen concentration shows two types of pollen distribution with pikes at 22 pm-4 am (the majority) and 10 am-14 pm.

Pollen episodes in 2006 (13-16.08, 26-29.08, 18-20.09) were studied with back-trajectory analysis. The trajectories were calculated using the transport model within Lagrangian air pollution model ACDEP (Atmospheric Chemistry and Deposition). Analysis showed that possible source areas for ragweed pollen in Moscow are southern regions of Russia and Ukraine.

Comparison of pollen counts in Moscow, Smolenks and Zaporozh'e (Ukraine) in 2006 revealed very strong similarity in time and duration of pikes in these cities. Smolensk is situated in the forest region where ragweed was not discovered, so we can consider all ragweed pollen in this city as long-transported. In Moscow at least a part of *Ambrosia* pollen can be local.

Local flowering usually takes place at the end of August and is characterized by diurnal rhythm with maximal concentration at 9-12 a.m. Nigh pikes of *Ambrosia* pollen are considered as the result of long distance transport.

Ragweed pollution in Hungary, 1992-2007

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Pollen grains of ragweed (*Ambrosia artemisiifolia*) are the most important ambient biological air pollutants in Hungary since the majority of patients with inhalative allergic diseases are sensitized to ragweed (35-60%).

The aim of this study was to investigate the changes in major parameters of ragweed pollen seasons based on data monitored by the Aerobiological Network (AN) of the National Public Health Service. AN was founded in 1992 with 3 monitoring stations and it has 19 traps throughout in Hungary by 2007. Each station uses Hirst volumetric sampler.

The major parameters to describe ragweed pollen season were yearly total pollen count, the highest daily maximum concentration and number of days with high and very high pollen load during the year.

The highest yearly total pollen counts are related only to 3 stations: Kecskemét (in the middle of Lowland) (1996-99, 2001, 2004, 2005), Pécs (in Southern Transdanubium) (1992-95, 2006) and Nyíregyháza (in North-East of Hungary) (2000, 2002, 2003, 2007).

The highest total pollen count was registered in 1999 in Kecskemét (21769 pollen grains/m^3) during the 15 years period. The highest pollen load was registered in 1999 with 80639 pollen grains/m^3 total amount of ragweed pollen counts for the whole country. Salgótarján (the Northest sampling site) has the lowest ragweed pollen load with 1174 pollen grains/m^3 maximum total pollen count from 1992 to 2007.

The highest daily maximum concentration varied between 6 towns, although it was registered in a three years period in Pécs (1994-1996) and in Debrecen /in the North Lowland Region/ (2001-2002). The highest daily ragweed pollen concentration monitored from 1992 to 2007 was 1419 pollen grains/m^3 (Debrecen, 2002). This parameter was the lowest also in Salgótarján, where the maximum daily concentration was 96 pollengrains/m^3 in the 15 years period.

Number of the days with pollen concentration higher than 30 pollen grains/m^3 (high loaded days) was the highest in Kecskemét in most of the years (from 1996 to 2003 and in 2005) and in Pécs (from 1992 to 1995 and in 2007). In the year of 2000 the number of days with pollen load >30 pollen grains/m^3 was the highest (397 days).

Very high loaded days with more than 100 pollen grains/m^3 were the most also in Kecskemét and in Pécs, but the number of these days was the highest in 2006 (235 days). Salgótarján is the only site where daily ragweed pollen concentration has never reached 100 pollen grains/m^3 during the 15 years.

Concerning the trend ragweed pollen load is decreasing in the whole country due to the effective ragweed control and the variation of the weather.

The Pannonian Plain as a source of *Ambrosia* pollen in the Balkans

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Pollen grains of *Ambrosia* are important aeroallergens in parts of southern and central Europe. *Ambrosia* pollen recorded at a specific location may be due to either local or remote sources or a combination of the two. Identifying these sources may increase understanding and be used in future forecasting of *Ambrosia* pollen concentrations. The aim of this study was to find likely sources of *Ambrosia* spp. pollen recorded at five pollen-monitoring sites in central Europe.

Daily average and diurnal variations (bi-hourly counts) in *Ambrosia* pollen concentration were recorded by volumetric spore traps at five sites (Novi Sad, Ruma, Negotin and Nis in Serbia and Skopje in Macedonia) during 2007.

Ambrosia plants start flowering early in the morning and so *Ambrosia* pollen grains recorded during the day are likely to be from a local source. Conversely, *Ambrosia* pollen grains recorded at night or very early in the morning may have arrived via long-range transport. *Ambrosia* pollen counts were analysed in an attempt to find possible sources of the pollen and to identify *Ambrosia* pollen episodes suitable for further investigation using back-trajectory analysis. The period 24-27/9/07 was selected for further analysis.

Mean diurnal variations and the magnitude of *Ambrosia* pollen counts during the 2007 *Ambrosia* pollen season showed that Novi Sad and Ruma (Pannonian Plain) and to a lesser degree Negotin (Balkans) were located near to sources of *Ambrosia* pollen. *Ambrosia* pollen concentrations generally peaked during the middle of the day and the concentrations at these sites were notably higher than at Nis and Skopje. Back-trajectory analysis showed that during the period 24-27/9/07 air masses brought *Ambrosia* pollen from the north to Nis and, on one occasion, to Skopje (Balkans) during the night and early morning after passing to the east of Novi Sad and Ruma during the previous day.

The results of this study identified the Southern part of the Pannonian Plain around Novi Sad and Ruma as being a potential source region for *Ambrosia* pollen recorded at Nis and Skopje in the Balkans.

How to clearly use ragweed pollen counts

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The aim of the study is comparing, in Lyon-Bron (Rhône department, France), ragweed flowering (Cour's trap,) with two methods, percent versus medical threshold. Percent method uses relative cumulate concentration of pollen trapped i.e. 2% of the flowering concentration. This method can only be used at the end of the season.

Medical observation founded upon patient's hypersensitivity threshold (T) to ragweed pollination, defined for Lyon-Bron by AFEDA in 1989, is used every year, since 1994, for communicating on the Web, a medical advice. It is diffused from week 26 to week 40. Two T: T5, T100 and the peak pollen concentration are distinguished. T are corresponding to a 5 or a 100 weekly pollen concentration/m^3 of air. T5 defines the allergy risk period, T100 the debilitating allergy risk period. Moreover this model of observation helps sufferers as it announces the timing of pollen peak third or fourth week after T5: this fact was validate in 70 percent (19/27) of cases. 1) The start and the end of ragweed pollen season are defined respectively by 2% and 90% of the annual pollen counts. The difference between 90 and 2% is considered as the duration of pollination.

During the 1982-2007 period, 2% takes place between the 215th [August 3rd] and the 232nd day [August 20th]; 50% takes place between the 237th [August 24th] and the 251st day [September 7th]; 90%, is between the 255th [September 11th] and the 277th day [October 3rd].

On top of this inter-annual variability is superimposed a very slight precocity of 6.8 (2%) and 4.7 (50%) days for the period 1982-2007. The time of the ragweed flowering (90%-2%) is currently of 39 days on average (1997-2007) with a slight increase of 6.3 days since 1982 due primarily to a slight precocity in the start of pollination. 2) The start of T5 takes place between the 209th [July 28th] and the 229th day [August 17th], average date: August 7th. The start of T100 takes place between the 231st [August 19th] and the 250th day [September 8th]. The start of peak takes place between the 227th [August 15th] and the 257th day [September 15th], average date: 1st September. For the period 1982-2007, T5 precocity is 2.32 days earlier, T100 precocity is 3.06 days earlier, pollen peak precocity is 6.7 days earlier.

The allergy risk period (5 grains and more) is constant till 2006 and decreased in 2007 (colder temperatures). The debilitating allergy risk period is decreasing of 4 to 5 days. It is the most severe period for sufferers as intensity of troubles is the highest, asthma is more frequent. Earlier pollination is due to climate change as increased seasonal average of temperatures is near 1° in Lyon-Bron since 1982.

Medical threshold is more adapted to the patient treatment than percents perhaps more adapted to flowering phenology. As we have started a study on ragweed phenological progression of the plant, it would be interesting to try comparing these observations with these two methods.

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