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at the University of Worcester

Pollen allergy - the triggers

Dr Matt Smith
National Pollen and Aerobiology Research Unit

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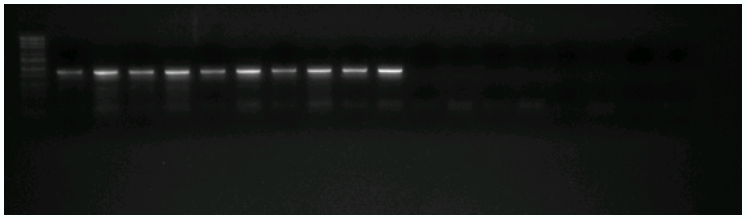
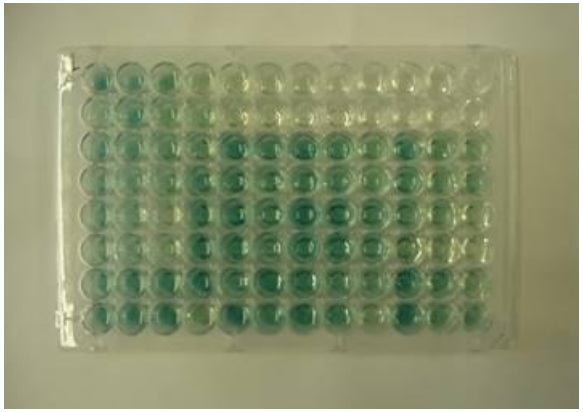
Analysis techniques

Light microscopy



DNA analysis

Agar plates - cultivable fraction of fungal spores



Immunoanalysis

Enzyme linked Immuno Sorbent Assay (ELISA)

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Volumetric spore trap (Hirst, 1952)

- Exposed rooftops
- Samples examined using light microscopy (pollen count)
- Continuous sampling
- Daily average pollen count (24 hrs)
- Time related samples (e.g. 2 hr values)
- Pollen grains of each type per cubic metre of air sampled (grains/m^3)

- Pollen grains from anemophilous (wind pollinated) plants
- Characterised by
  - Produced in huge numbers
  - Small (~20-40 µm),
  - Thin exine and smooth sculpture
  - However, many have larger grains and/or a more complex exine structure and features such as air sacs.

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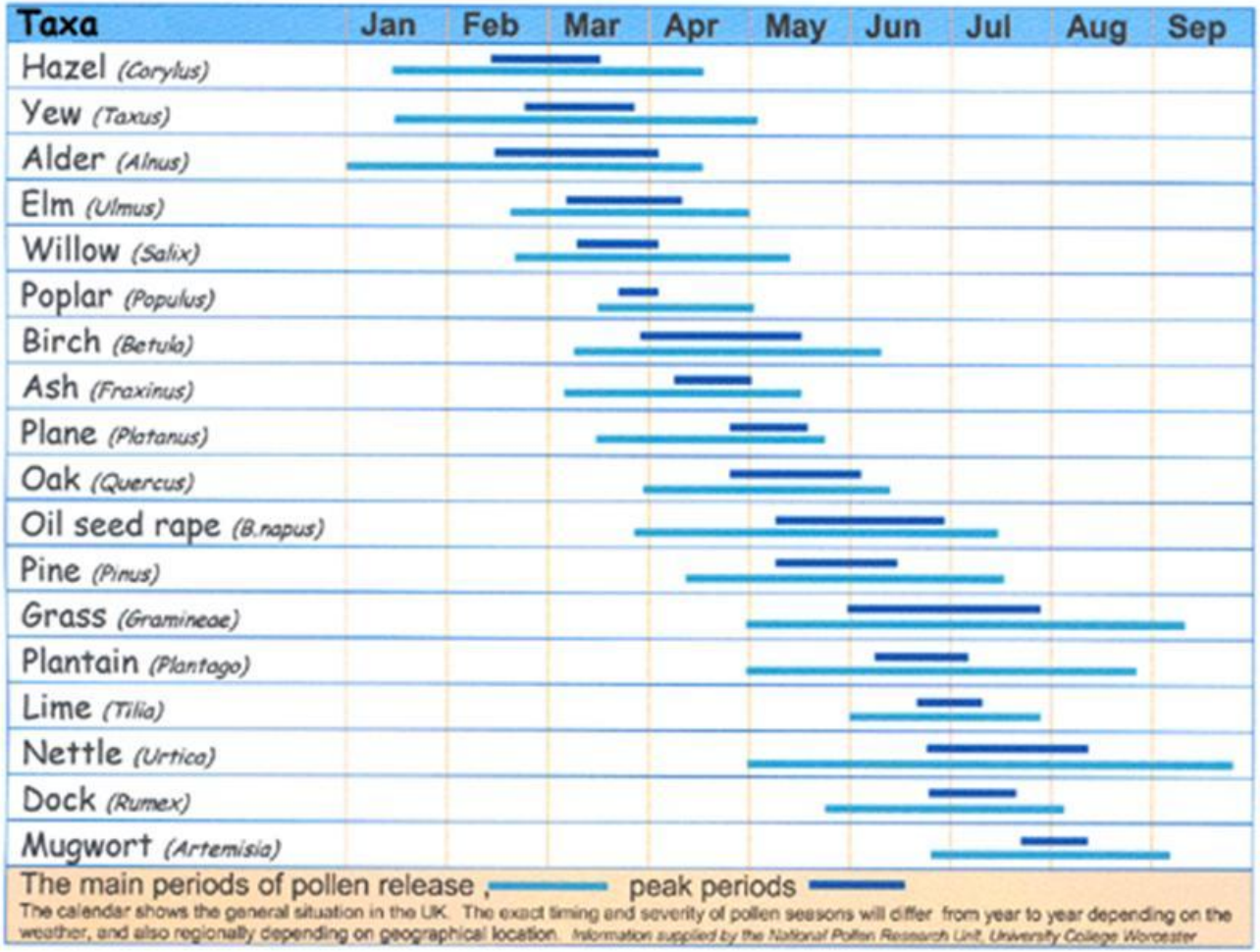
Seasonal variations - timing



http://www.worcester.ac.uk/businessandresearch/specialist/14511.html

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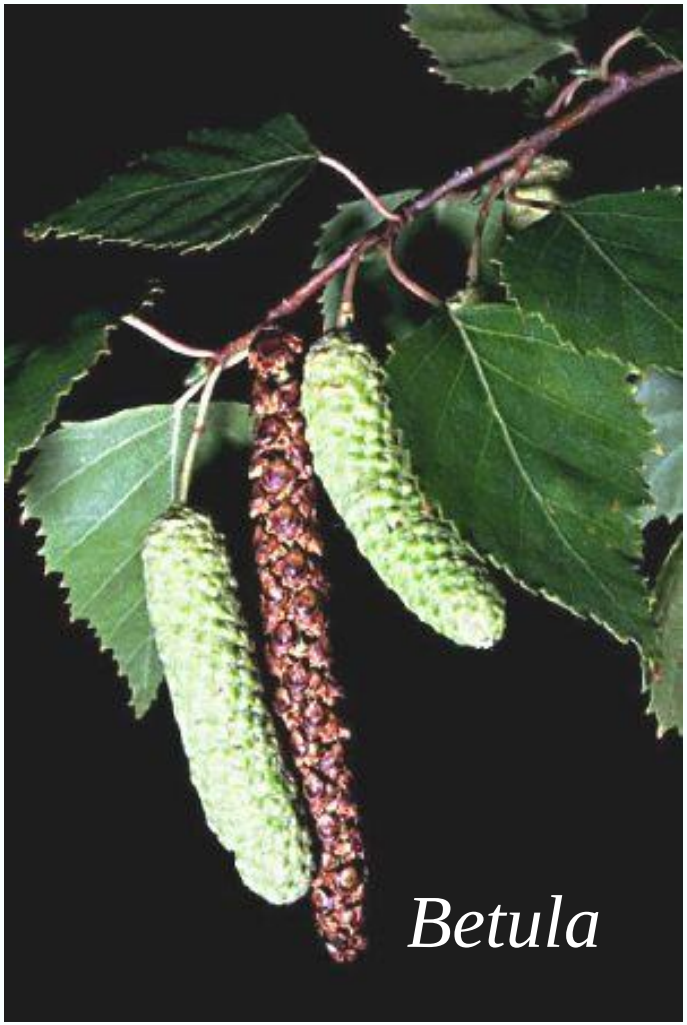
Weather factors: Trees



- In UK *Betula* flowers in April/May before leaves have expanded
- **Production:** Catkins start to develop during previous year
- Biennial rhythms
- **Timing** greatly dependent on temperature:
  - Vernalisation
  - Winter dormancy
  - Heat accumulation

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Weather factors: Grasses

Lolium perenne

(perennial ryegrass)

- **Production:** Weather conditions immediately before the pollen season
- **Start date:** differs by ~ 30 days
  - **Warm springs gentle start**
  - **Colder springs sudden rise**
- But must consider photoperiod response

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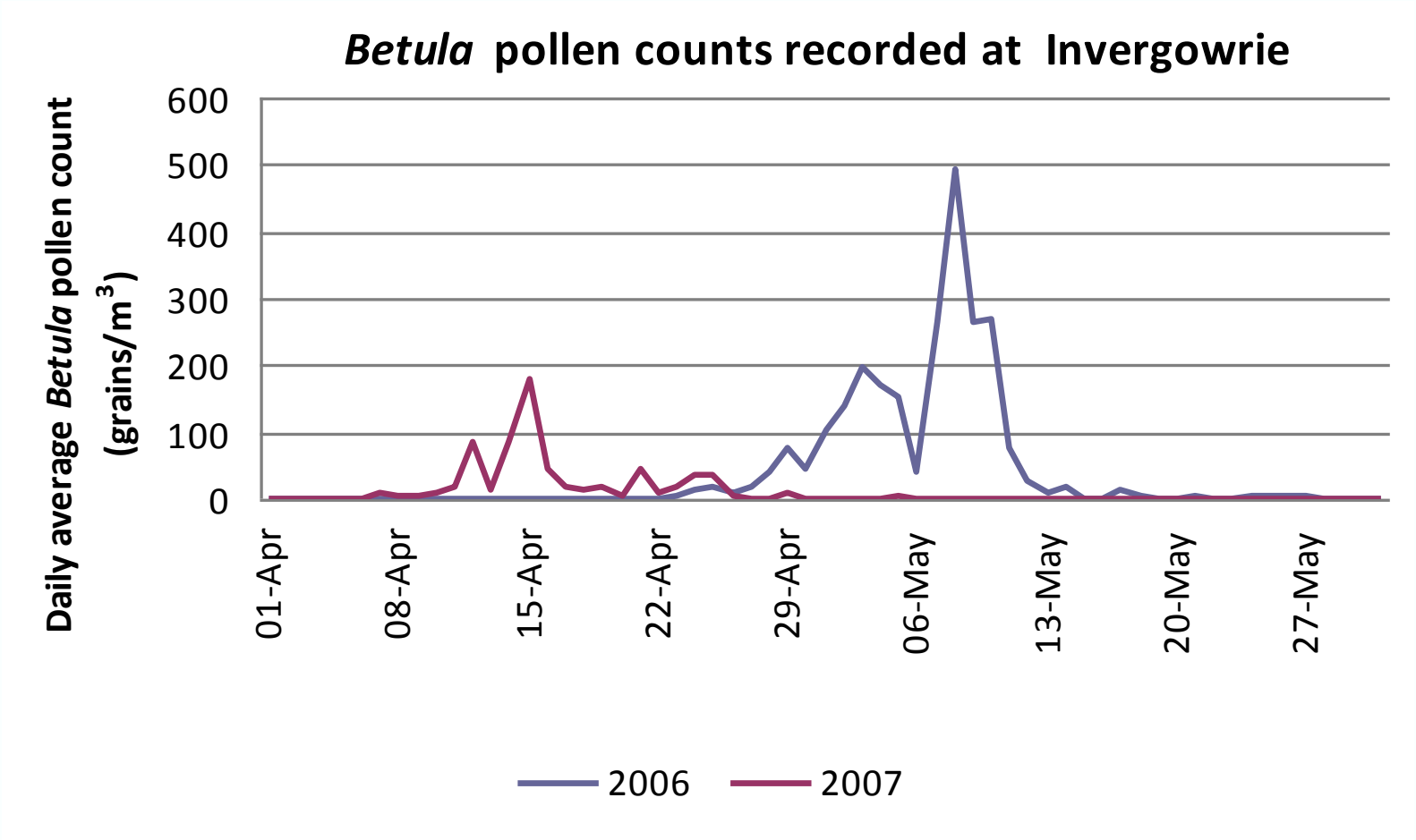
Variation in timing and intensity



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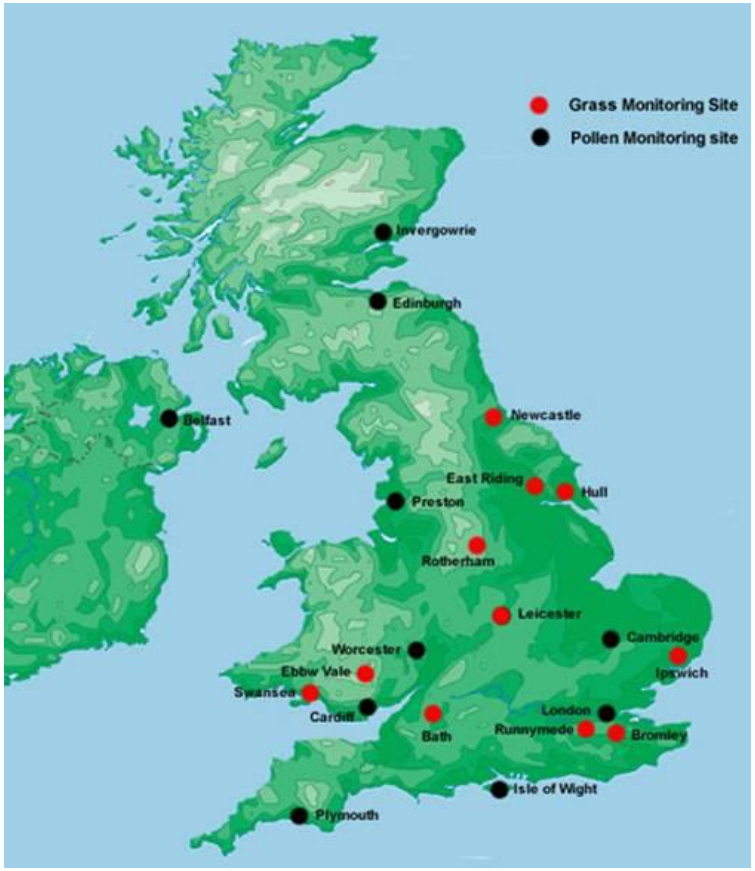
Regional variations



- Central regions higher counts than coastal
- Depends on species distribution (biogeographical regions)
- Later start and shorter seasons in north due to latitude and climate
- Urban areas lower counts than rural. Fewer and more remote sources
- Tree planting: e.g. *Platanus* (plane) trees in London

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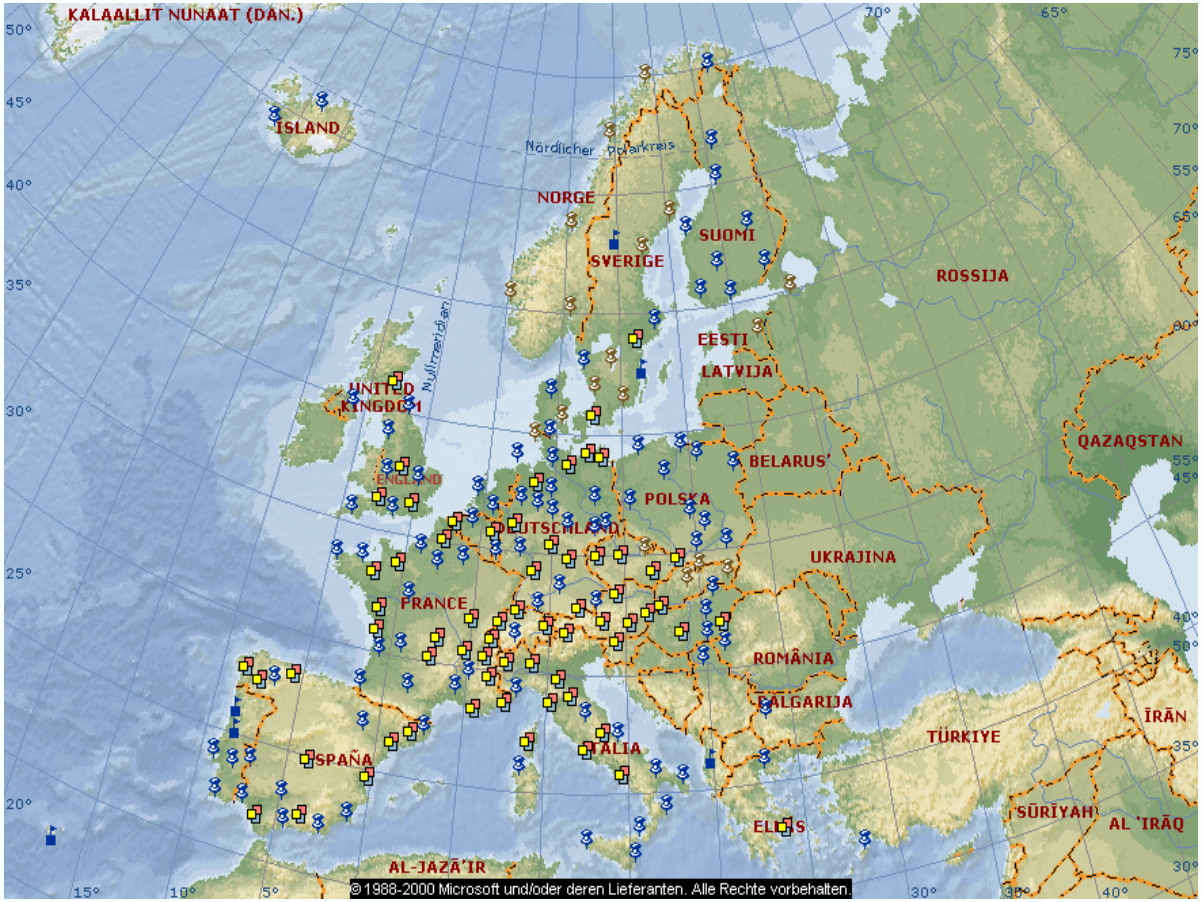
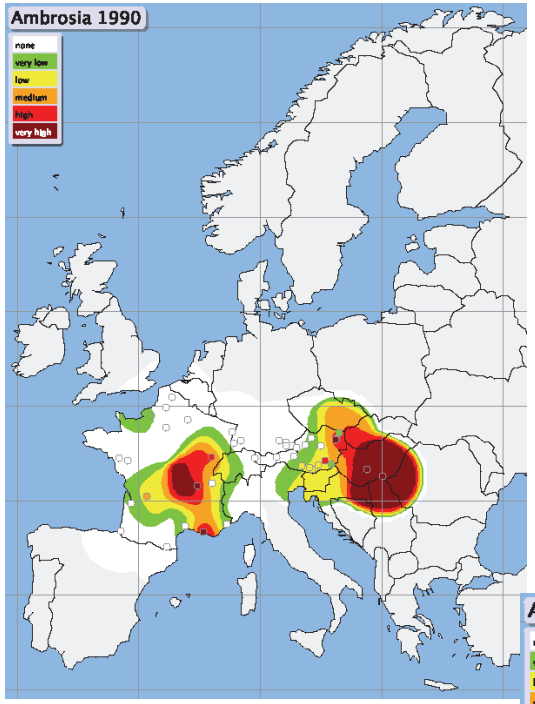
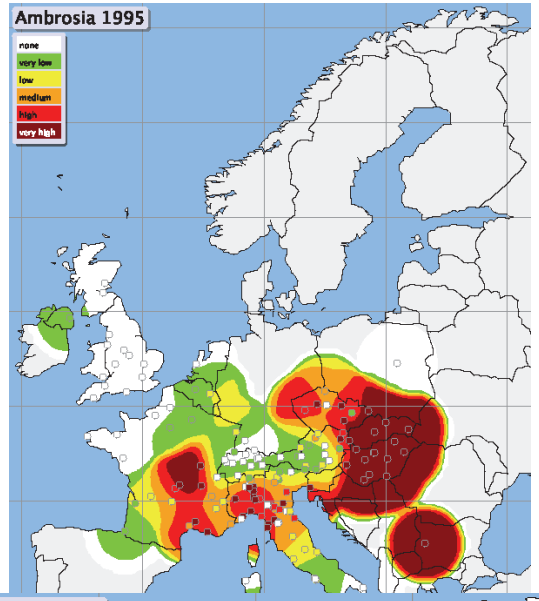
NPARU
National Pollen and Aerobiology Research Unit

European Aeroallergen Network




Ambrosia 1990
none
very low
low
medium
high
very high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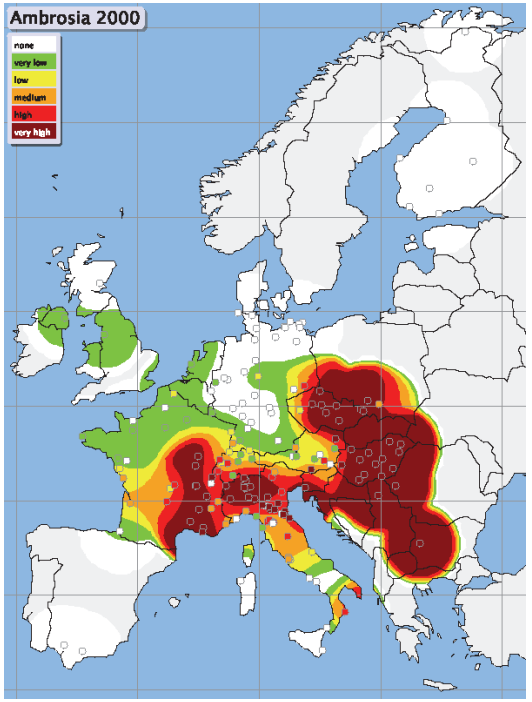
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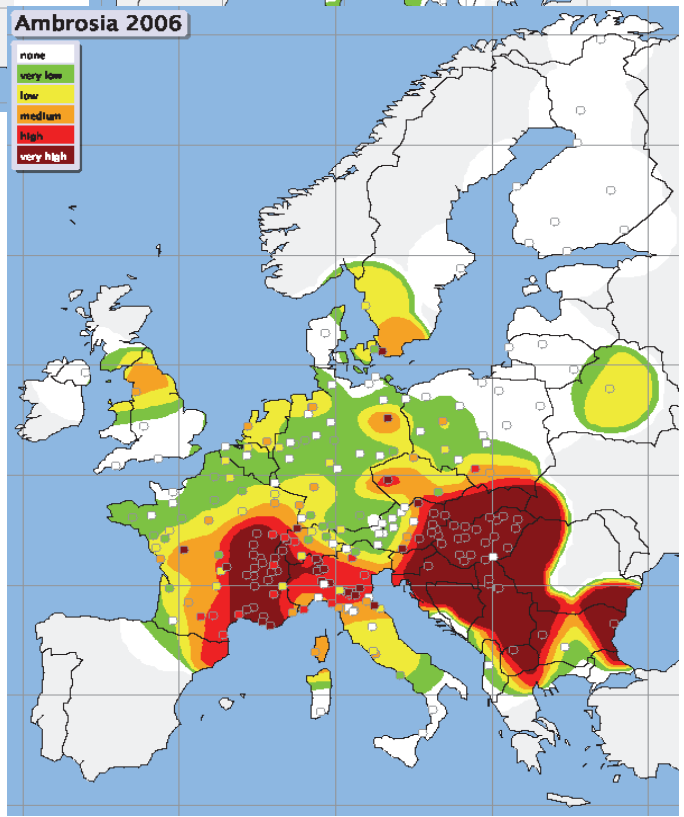
Ambrosia 2006
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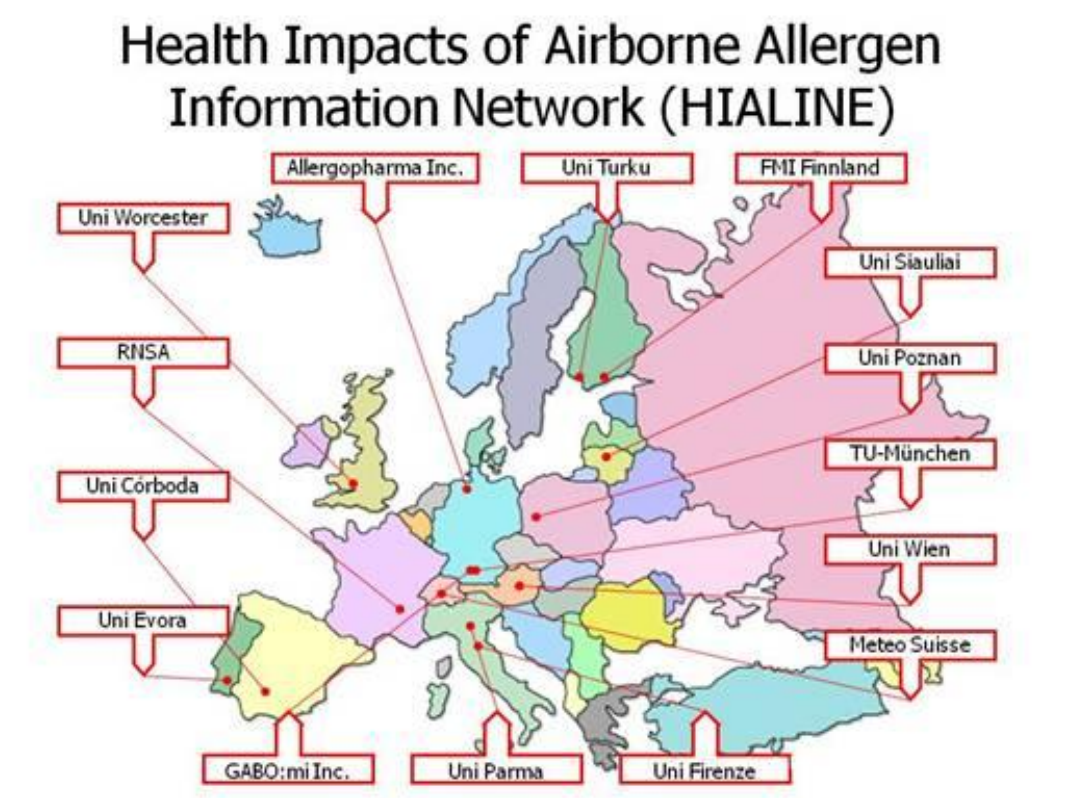
"Pollen from different trees, from different regions, from different years, and from different days can vary substantially in Bet v 1 released from their pollen"



- Buters et al. (2008) *Int Arch Allergy Immunol*;145:122–130
- Buters et al. (2010) *Allergy* DOI: 10.1111/j.1398-9995.2009.02286.x.

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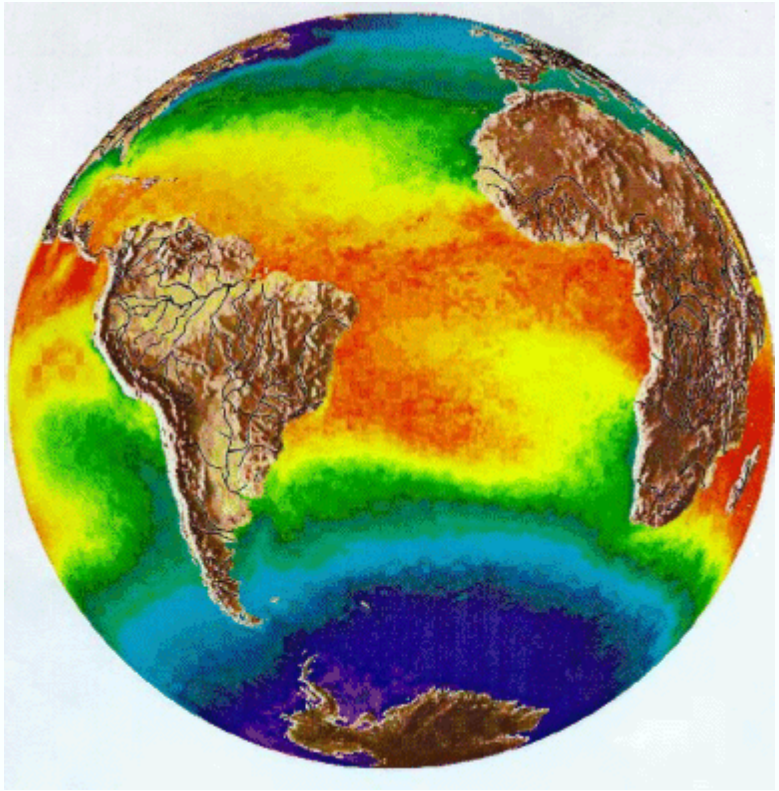
HIALINE

- ChemVol High Volume Cascade Impactor
- 800 l/min
- Different factions (PM10 & PM 2.5)
- Enzyme linked Immuno Sorbent Assay (ELISA) analysis for the major allergens from:
- birch (Bet v1), grass (Phl p 5), olive (Ole e 1)

The affect of climate change



- Increased temperatures on:
  - plant phenology
  - plant distribution
- Changes in precipitation
- Increased concentrations of CO_2 and the affect on plant productivity

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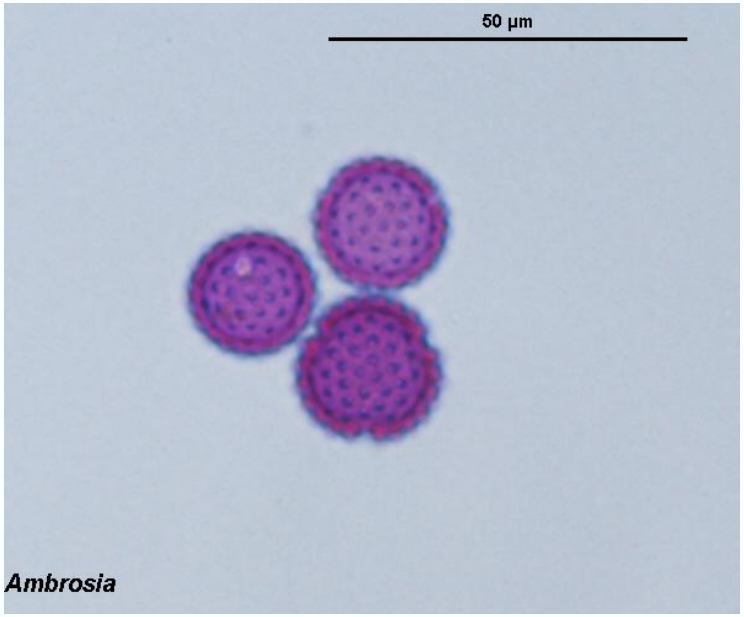
The affect of increased atmospheric CO_2 Plant physiology



Ambrosia

- *Ambrosia* spp.
- Pollen production effectively doubled from pre-industrial to present day levels of CO_2
- A further doubling occurred when CO_2 concentrations rose to a projected 600 ppmv.

Ziska, L. H. and Caulfield, F. A. (2000) *Australian Journal of Plant Physiology* 27(10): 893-898.

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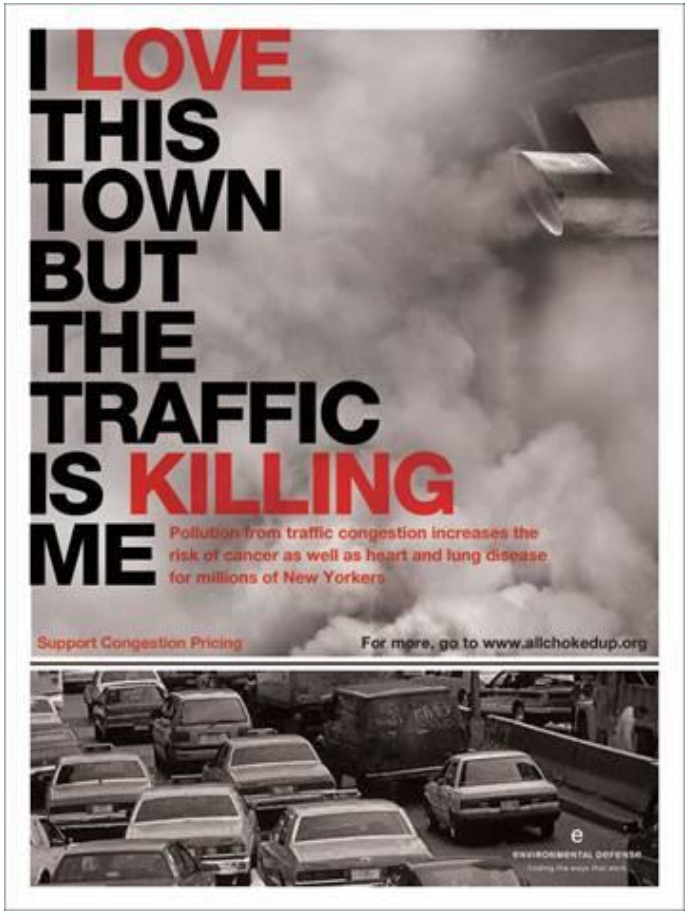
Direct affects of atmospheric pollution



- Pollen counts ~ 50% lower in cities than in rural areas but prevalence rates of seasonal allergic rhinitis generally as high or higher

- Pollutants may affect allergenicity of pollen directly via:
  - Contamination of the anthers
  - During flight of pollen through the air when dispersed

Emberlin, J (1998) Eur Resp Rev 8(53): 164-167

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Indirect affects of atmospheric pollution

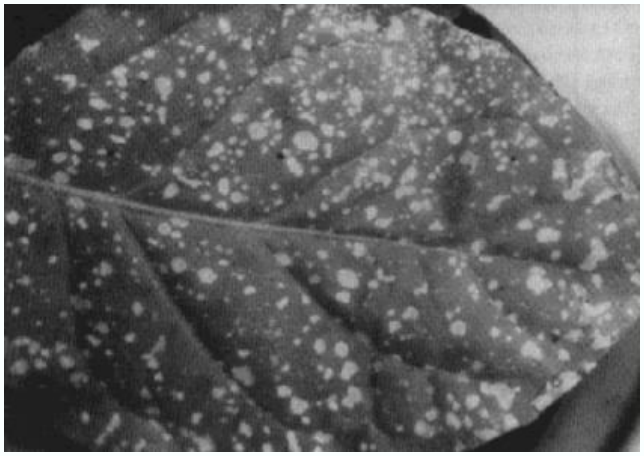

Photo of tobacco plant leaf damage due to ozone pollution showing symptomatic white spots

http://badc.nerc.ac.uk/community/poster_heaven_old/harrisond/slide3.html

- Pollution stress on plant growth
- Reduced net productivity leads to the production of fewer, smaller pollen grains and an increased number of deformed grains;
- However, evidence of increased allergenicity in pollen from plants grown in more polluted areas.

Emberlin, J (1998) Eur Resp Rev 8(53): 164-167

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Synergistic effects between aeroallergens and pollutants

- e.g. NO_2 and O_3 produced by vehicles can add the chemical group nitrate to protein molecules, particularly birch pollen proteins including the allergen Bet v 1

- Contact with nitrated proteins or nitrating substances from the environment might trigger immune reactions

- Nitration could boost the power of existing allergens, or even make benign proteins allergenic

Franze et al. (2005) *Environmental Science & Technology*, 39, 1673-1678

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Conclusion

- Pollen from wind pollinated plants most important in terms of allergy
- Meteorological data used to predict temporal variations in pollen counts
- New techniques in aerobiology include the analysis of airborne allergen concentrations
- Climate change can affect the timing and intensity of pollen seasons as well as the distribution of allergenic plants.
- Chemical air pollutants can affect the allergenicity of pollen

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