

The pollen season in the UK in relation to weather parameters and how a new generation of atmospheric models may improve current pollen forecasting.

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& PollerGEN consortium

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Background

- Hayfever: A large impact on life
 - Affects life quality
 - Is expensive
 - Interacts with asthma
 - Large geographical variations
- Forecasting of pollen carried out in most European countries including UK, typically using
 - Observations
 - Weather data
 - Statistical approaches
- New approaches are emerging within
 - Detection
 - Modelling
 - Integration
- Status of UK pollen detection and its future

	SSR - birch	SSR - ragweed
Europe	24.2	14.1
Austria	19.4	8.5
Belgium	17.6	3
Denmark	57.4	17.1
Germany	37.6	14.4
Greece*	9.8	11.7
Finland	34	2.3
France	8.4	9
Hungary	20.1	53.8
Italy	9.4	3.5
Netherlands	26.9	18.6
Poland	27.7	10.8
Portugal	6.8	12.4
Switzerland	50.3	18.6
UK*	19	7.9

Standard Sensitization Rates from allergy centres in different European Countries (Burbach et al, 2009).

Corylys (hazel) pollen
allergenic potential 4
(scale 1-5)



Size: ~ 25 μm
Season (Worcester):
January-March

Alnus (alder) pollen
allergenic potential 4
(scale 1-5)



Size: ~ 25 μm
Season (Worcester):
January-March

Betula (birch) pollen
allergenic potential 5
(scale 1-5)



Size: ~ 20 μm
Season (Worcester):
April-May

Quercus (oak) pollen
allergenic potential 4
(scale 1-5)

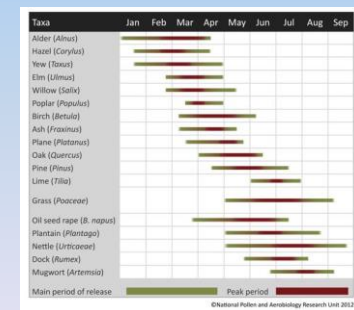
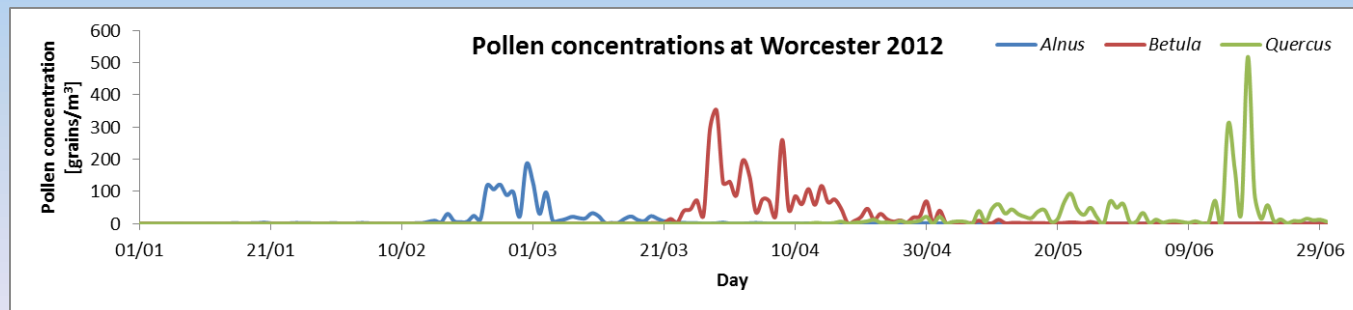


Size: ~ 30 μm
Season (Worcester):
May-June

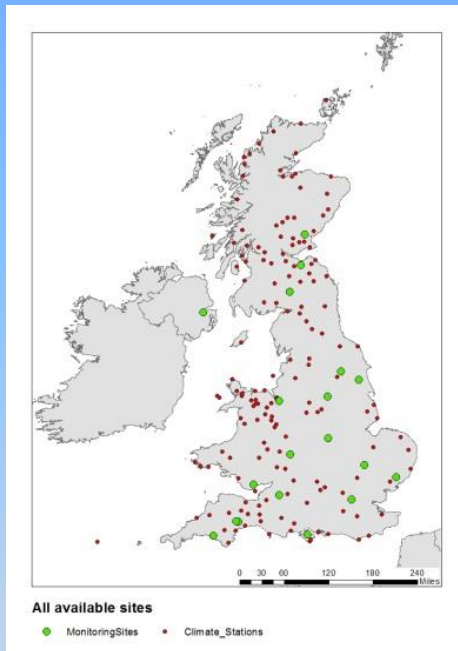
Poaceae (grass) pollen
allergenic potential 5
(scale 1-5)



Size: ~ 35 μm
Season (Worcester):
May-August



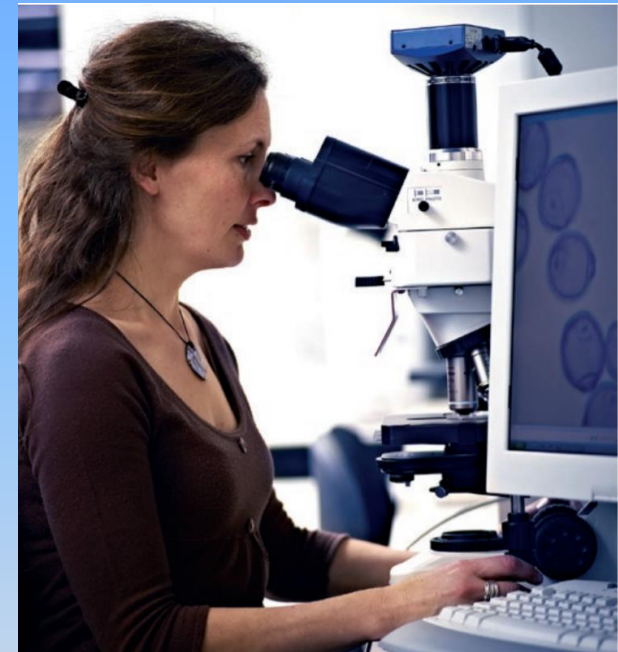
Detection methods



Climate stations and UK pollen monitoring network, both operated by UK Met Office from ~ 15 March 01 September. Worcester and Leicester are research sites with extended detection of species and year-round monitoring.



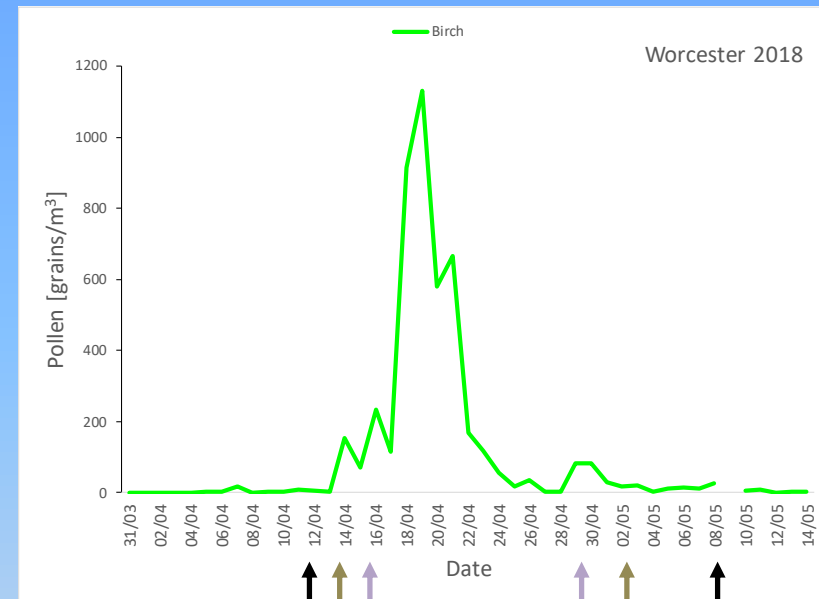
Back-bone in the UK pollen monitoring network: A pollen and spore trap of the Hirst design (Hirst, 1952).



Morphological identification of pollen carried out by specialists and microscopes

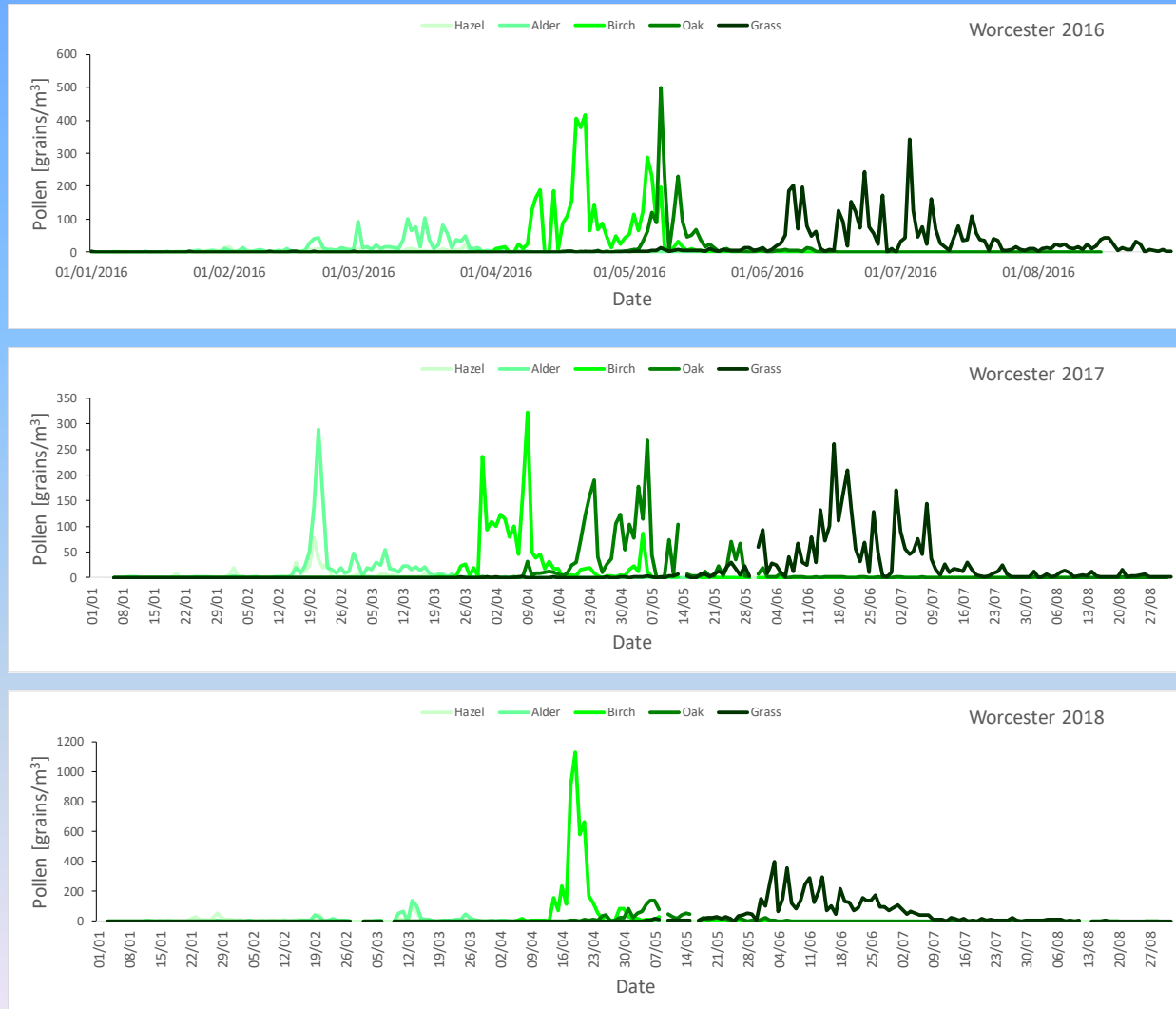
Detection methods - terminology

- Annual (or Seasonal) Pollen Integral
 - Integral over time of pollen concentration, which can be obtained by summing the average daily concentration over the given period of time.
- Main Pollen Season (MPS)
 - Duration of time when pollen or spores are present in the atmosphere in significant concentrations at a location. There are different methods to define the main season start and end.
- Pollen Calendar
 - A graphical representation of the annual characteristics of major airborne pollen or spores recorded in a given location, which is an average of several years of data (a minimum of 5 years is generally recommended).
- Pollen Concentration
 - Expressed as (Pollen grains/m³). The number of airborne pollen grains or spores per unit volume of air. Averaging time for the concentrations can vary, e.g. commonly used periods are one day, or two hours. Can be compared across years, sites etc.
- Pollen Count
 - The result of the slide analysis or the raw data. It is an integer quantity. Obtained from the microscopic analysis which cannot be compared (e.g. from one microscope to the other, or one study to the other) and needs conversion to concentrations.



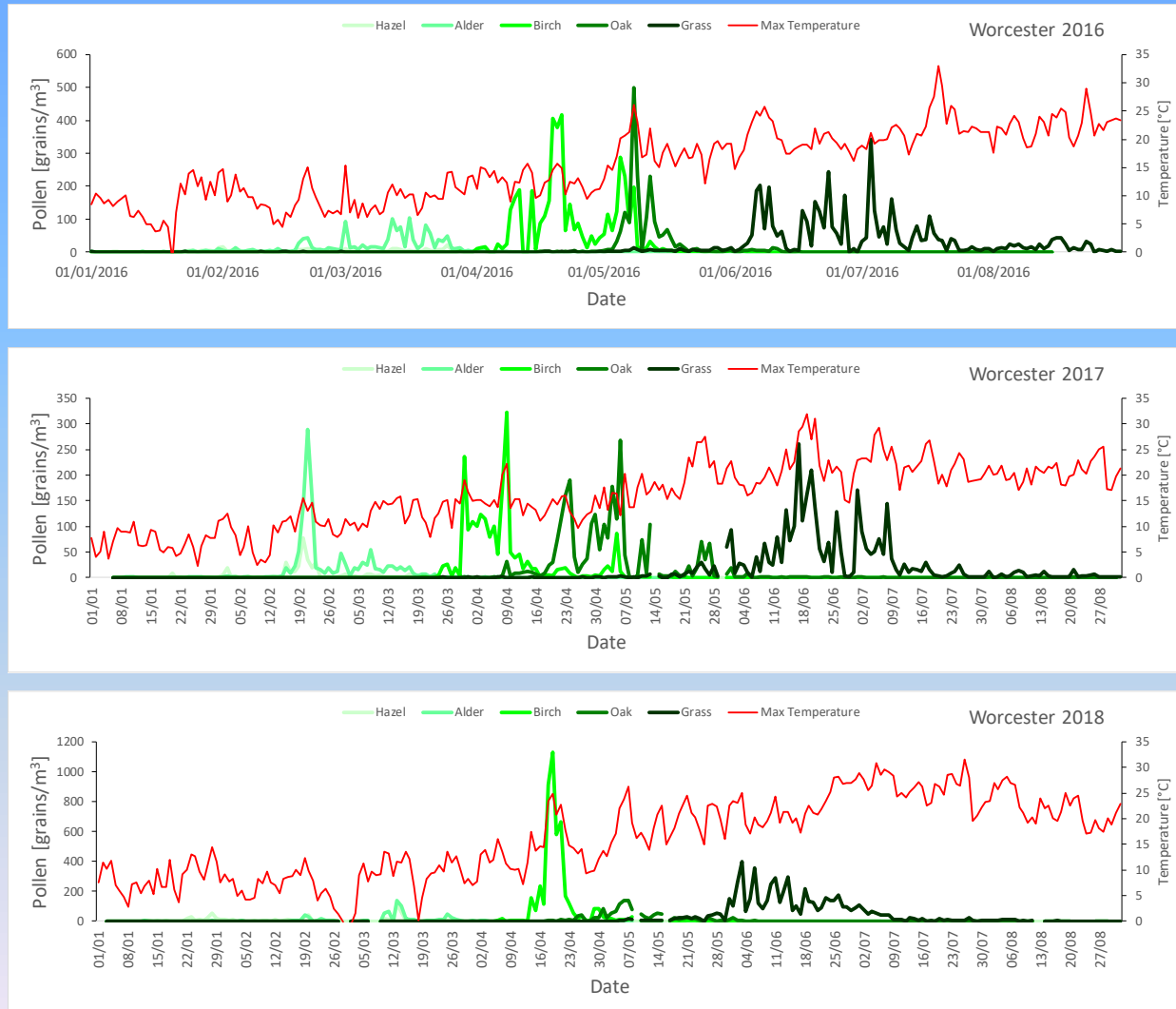
Start and end of pollen season calculated using three common approaches. 1: 98% - black, 2: 95% - olive, 3: 90% - purple, respectively.

Pollen records and weather - locally



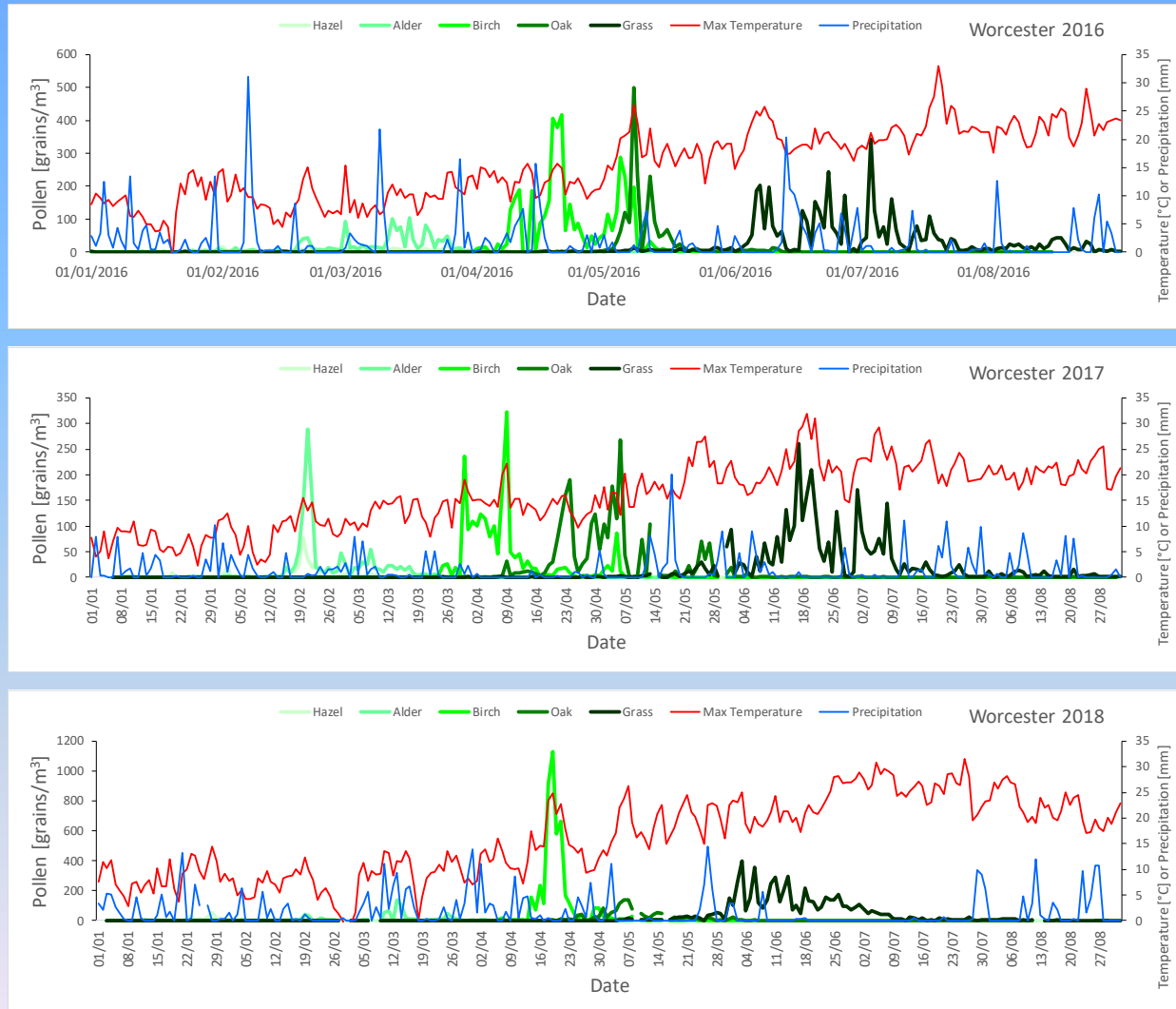
Seasonal development of most important pollen types in Worcester during 2016, 2017 and 2018.

Pollen records and weather - locally



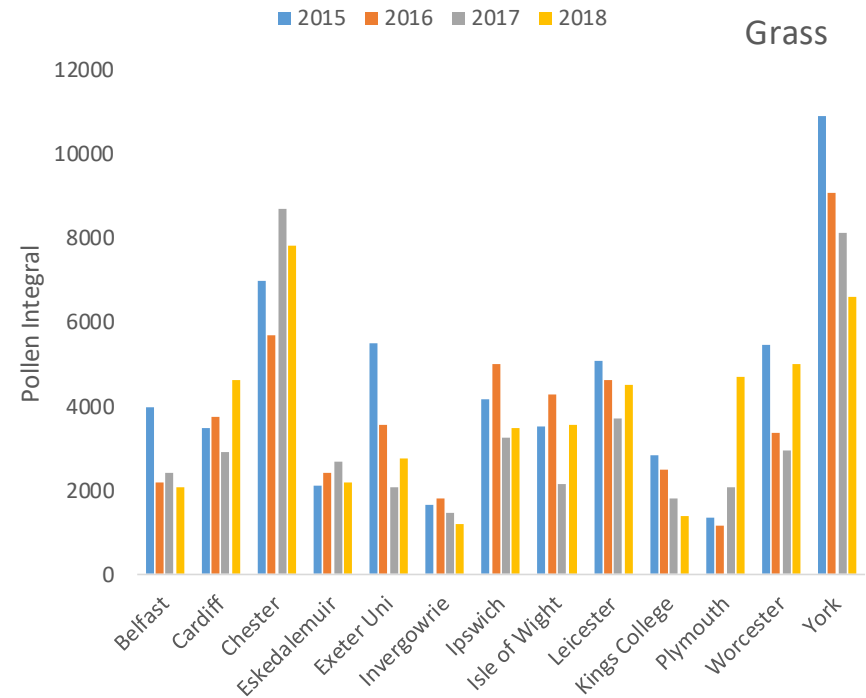
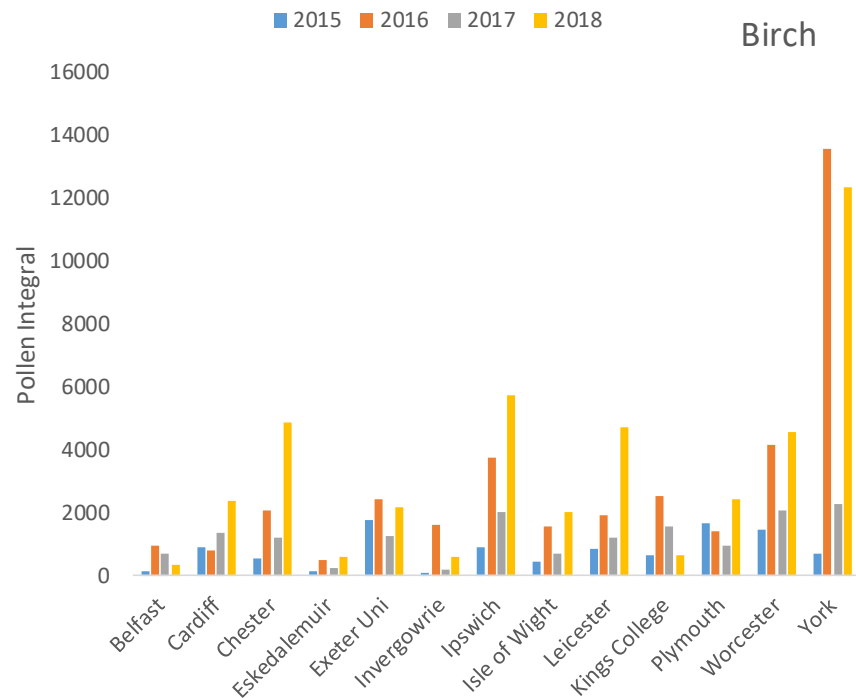
Seasonal development of most important pollen types in Worcester during 2016, 2017 and 2018 combined with maximum temperature from Pershore

Pollen records and weather - locally



Seasonal development of most important pollen types in Worcester during 2016, 2017 and 2018 combined with maximum temperature and precipitation from Pershore

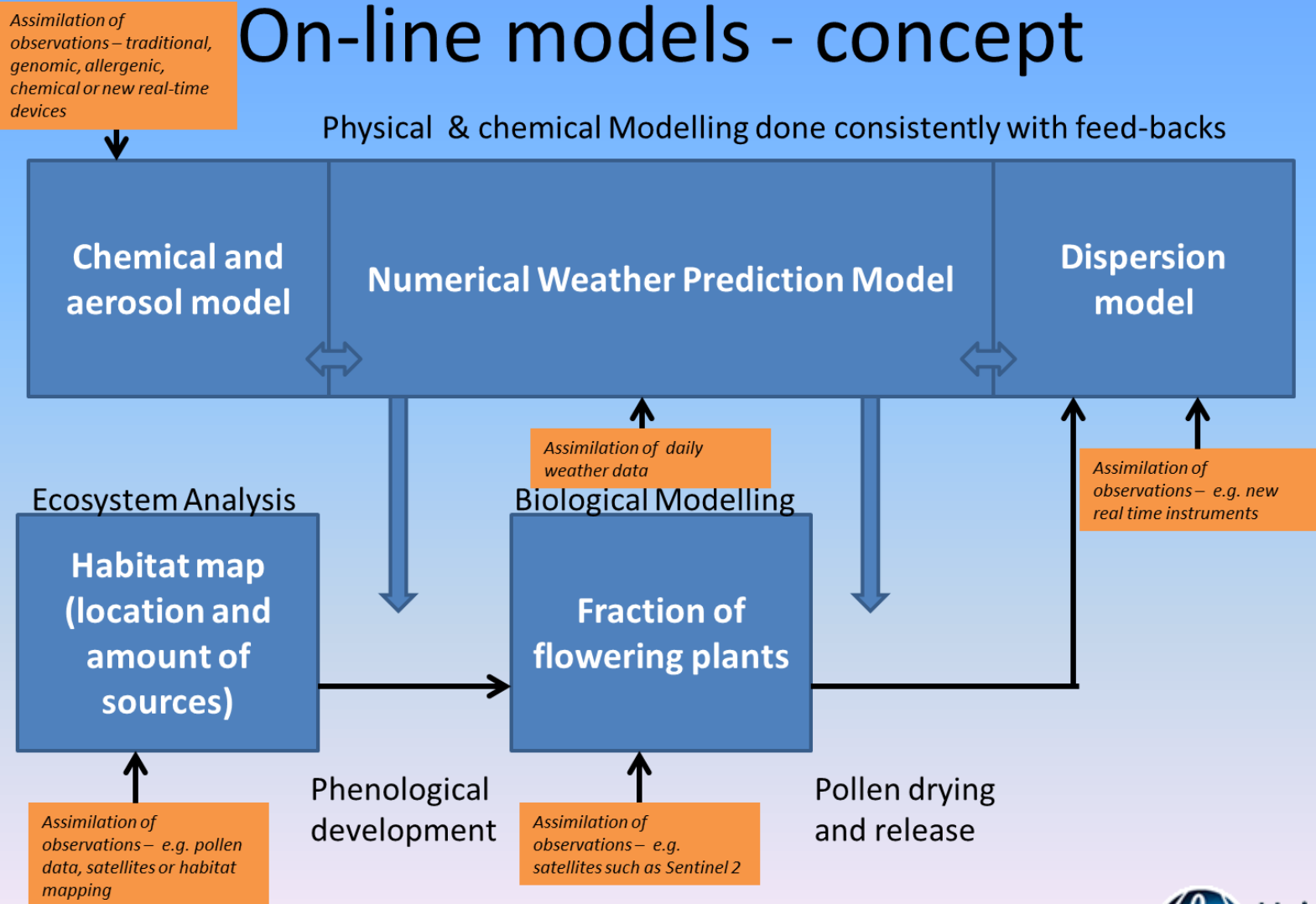
Pollen season - nationally



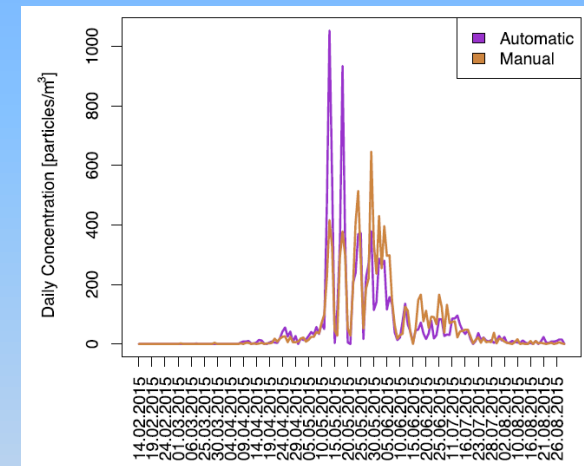
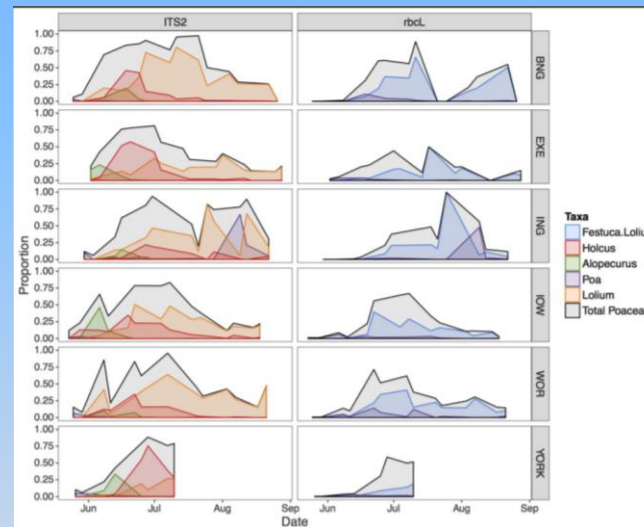
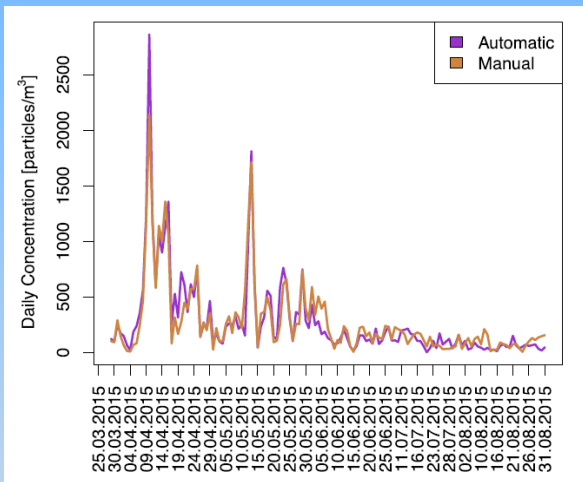
Seasonal pollen integral throughout the country of grass and birch during the period 2015-2018 from the UK network operated by the UK Met Office

New approaches

On-line models - concept

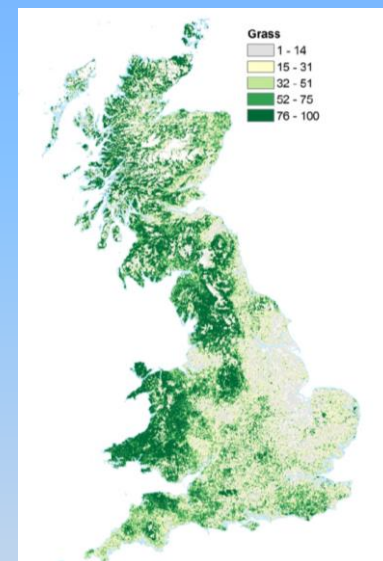
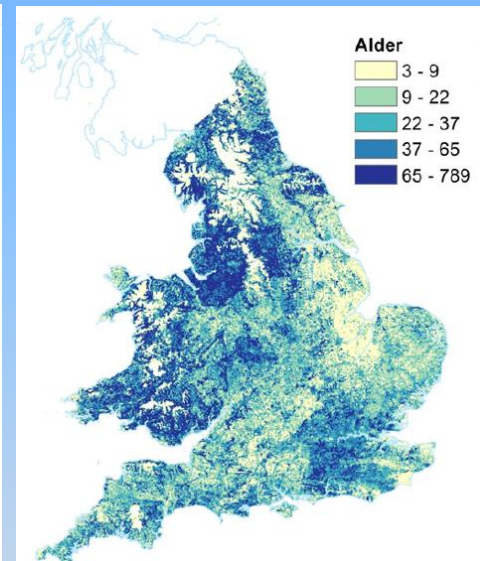
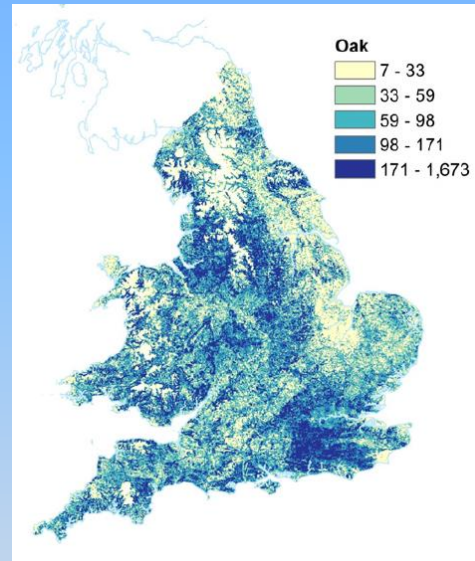
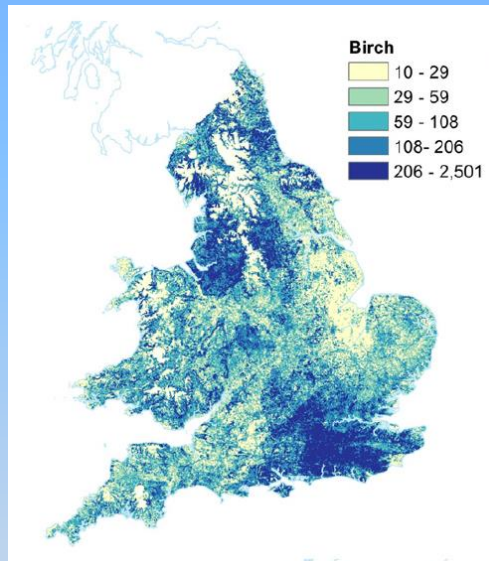


New approaches - detection



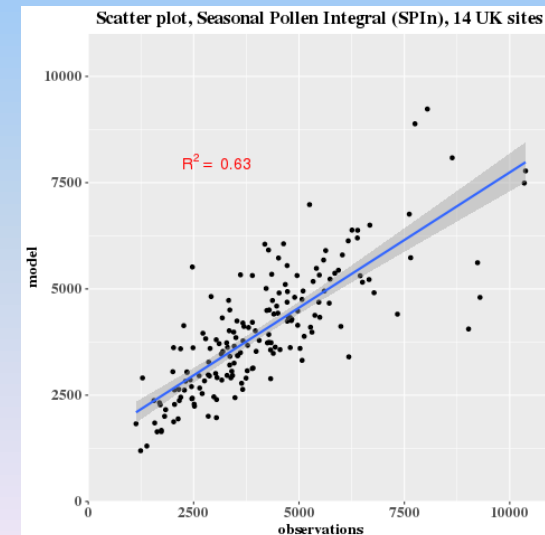
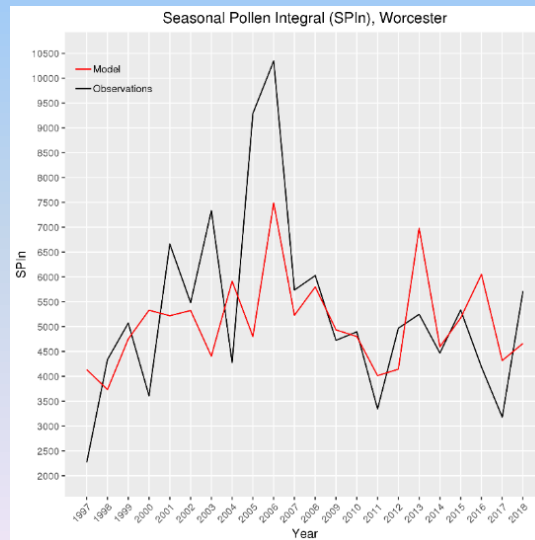
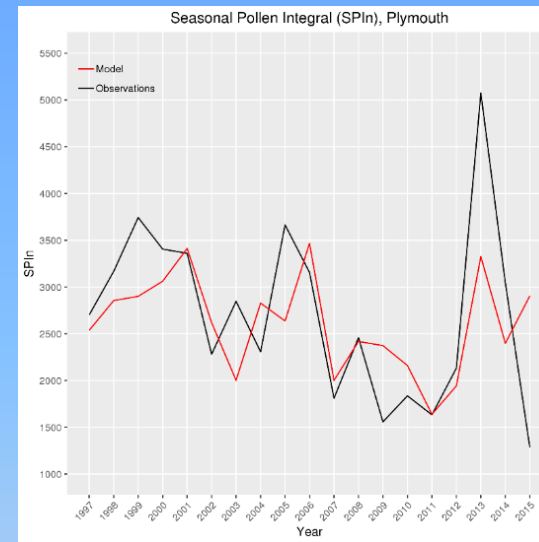
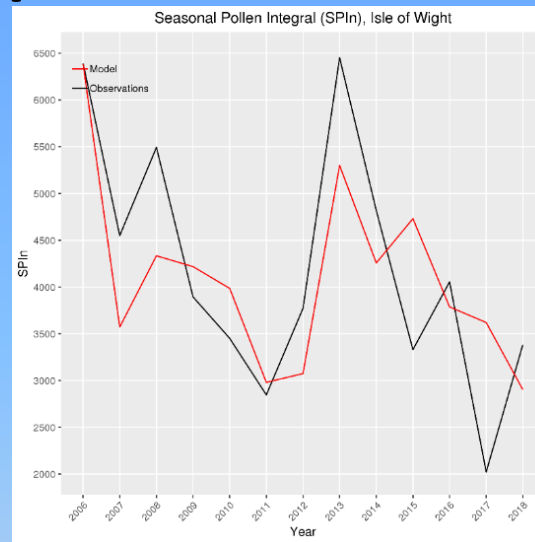
New approaches for detection: Left: Total pollen concentration provided by the real-time instrument Plair PA-300 (Crouzy et al, 2016), Middle: grass pollen at the species level provided using metabarcoding from molecular genetics (Brennan et al, 2018, 2019), Right: Grass pollen concentration provided by the real-time instrument Plair PA-300 (Crouzy et al, 2016).

New approaches – mapping sources



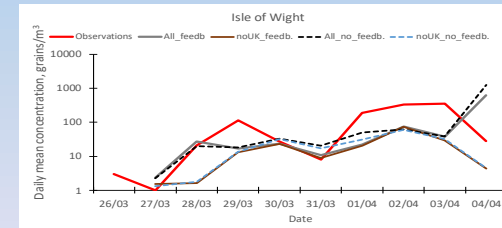
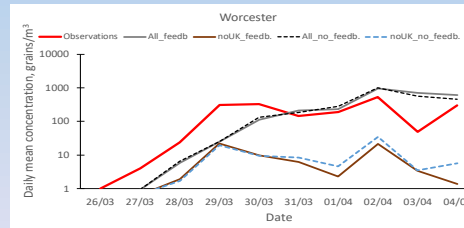
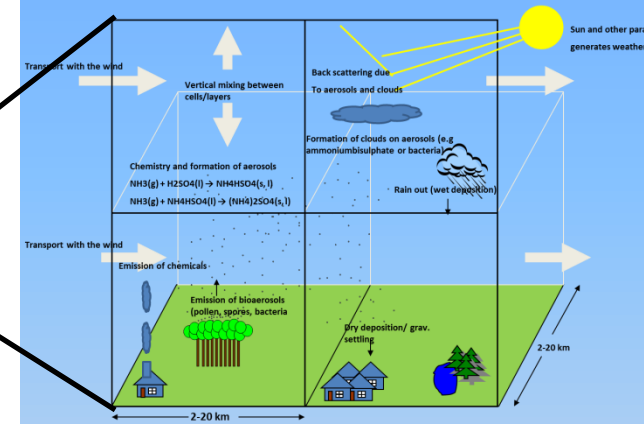
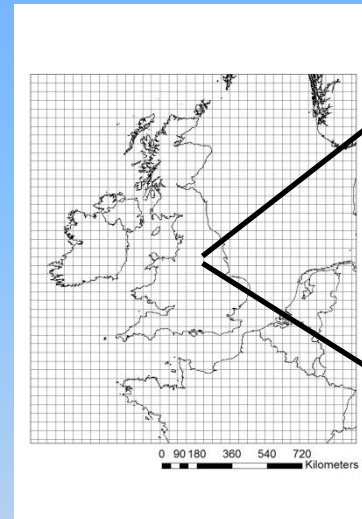
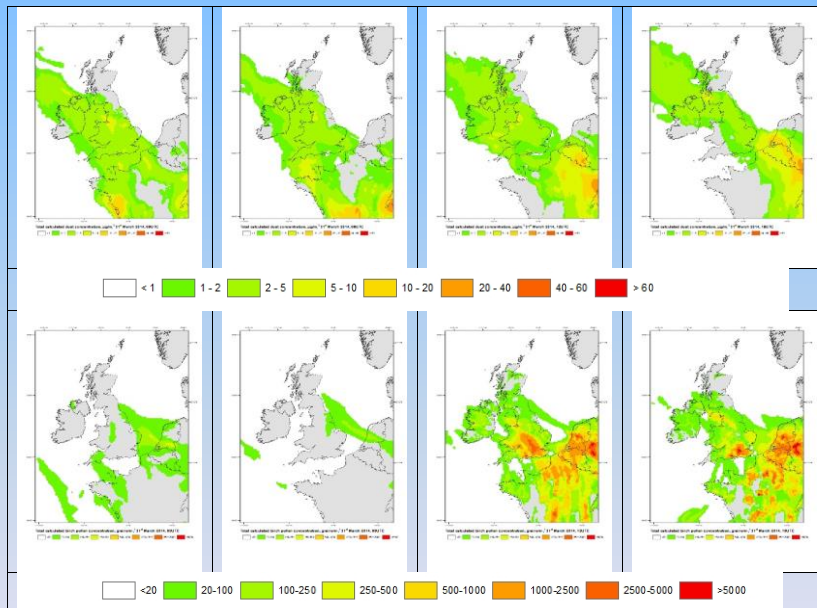
Detailed mapping of pollen sources in the UK at the genera level (McInnes et al, 2017).

New approaches – source strength



Modelling annual pollen integral using pre-season and within season weather parameters (Kurganskiy et al, in prep).

New approaches – disp. model



Source attribution of birch pollen concentrations with and without radiative feedback within WRF-Chem with bioaerosol extension, Skjoth et al, (2019)

Conclusion

- The pollen season in the UK
 - Varies from year to year
 - Varies between sites
 - Depends on:
 - Pre Season meteorology,
 - Within season meteorology
 - Local abundance of sources
 - Long distance transport
 - 2018 season special for birch & grass
- Existing approaches for warning
 - Site based
 - Time consuming detection method
 - Geographical limitations
 - Limitations concerning import
- New approaches used in research
 - Real time methods
 - Molecular methods
 - Geographical mapping methods
 - Atmospheric modelling
 - Integrating everything
- Future forecasting methods of hayfever?: **This will change. It is just a matter of time!**

Acknowledgements and support:

