



atopica®

atopic diseases in changing
climate, land use & air quality

6th March 2015

Climate variability and
change
over Europe. Connections
to pollen concentrations.



Main objectives of WP1

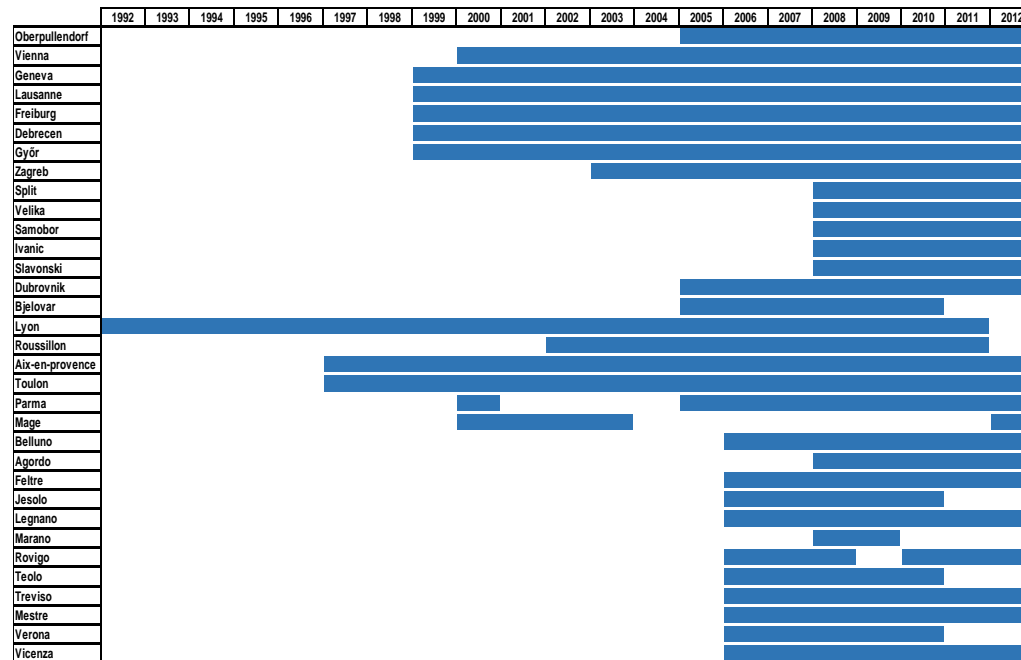
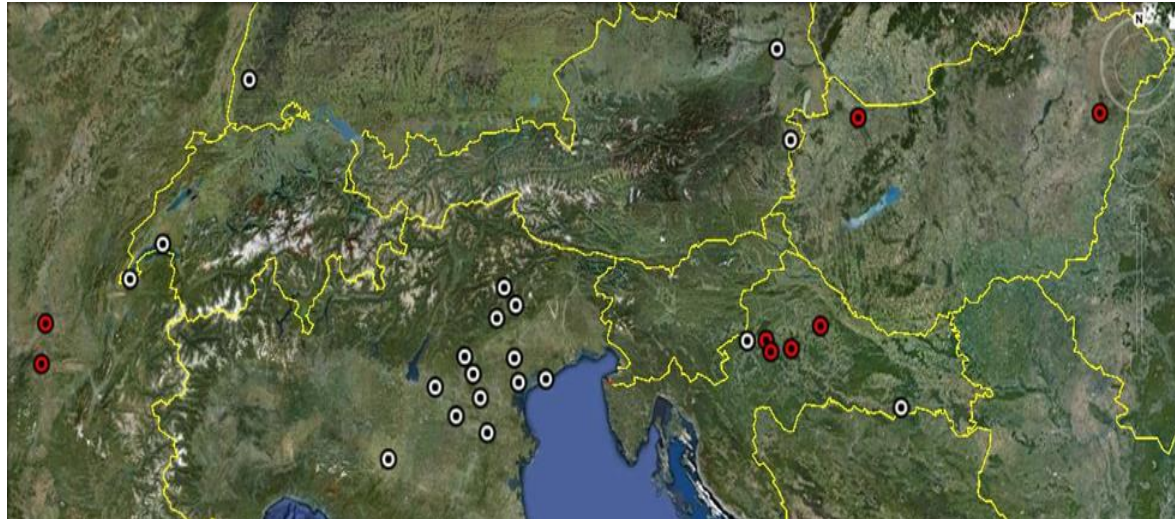
- Review available climate change information over Europe and provide climate information for calculations of ambrosia distribution, along with new targeted climate projections as needed by the project.
- Identify climate conditions most suitable for high pollen concentrations (daily to seasonal scale) and assess how these may change in future climate projections.
- Assess uncertainties in climate projections as a contribution to the assessment of overall uncertainties in pollen simulations.

Are there seasonal conditions conducive to high pollen concentrations?

Methodology

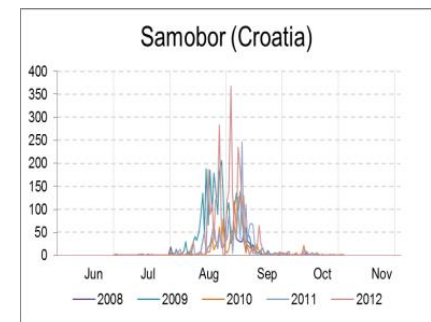
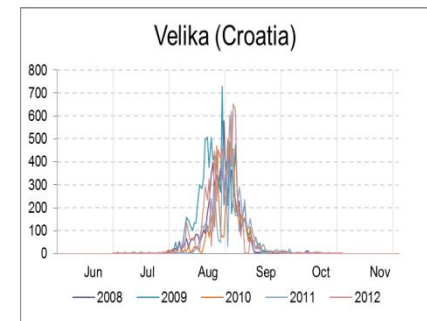
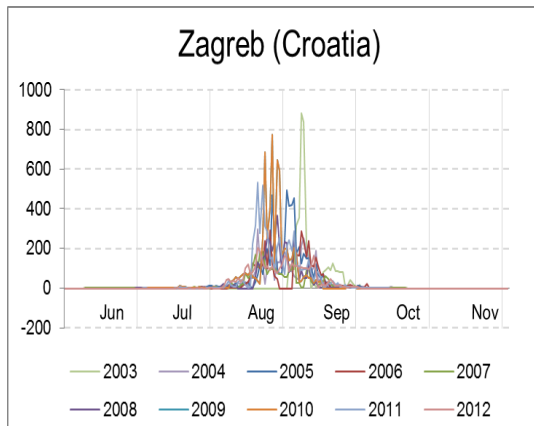
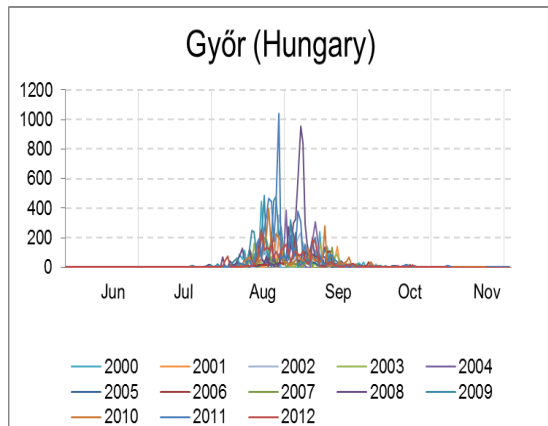
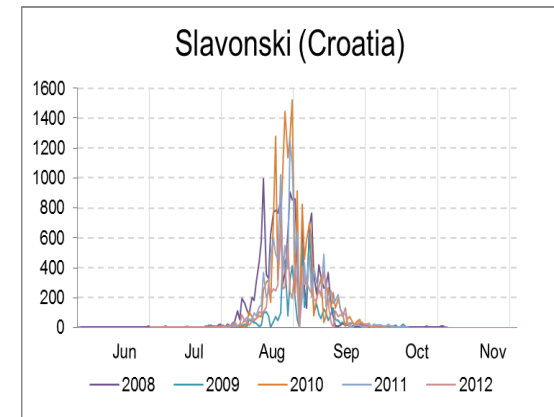
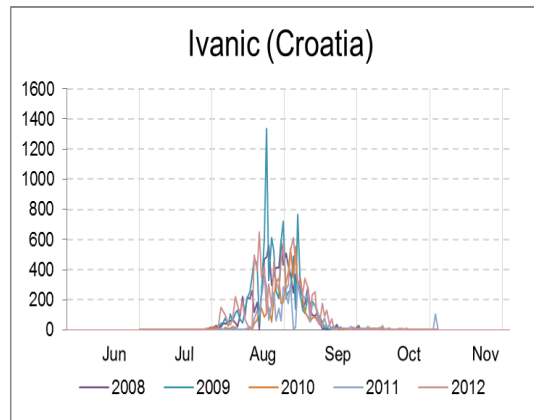
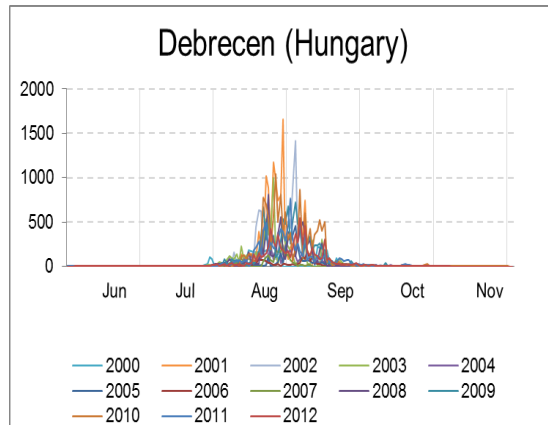
- Analysis of seasonal climate variables that are expected to affect pollen concentrations (emissions, dispersal, removal)
 - Temperature
 - Precipitation
- Identify climate indices that best correlate with available pollen observations
- Assess whether these indices may change in future climate projections, thereby affecting potential production of pollen
- Focus on “Pollen Hotspot” of southeast Europe (Croatia, Hungary)

Pollen sites with data available in the ATOPICA database

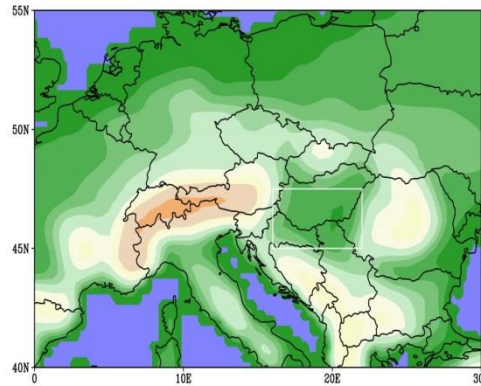


Climate Variability and Change over Europe. Connection to Pollen Concentrations

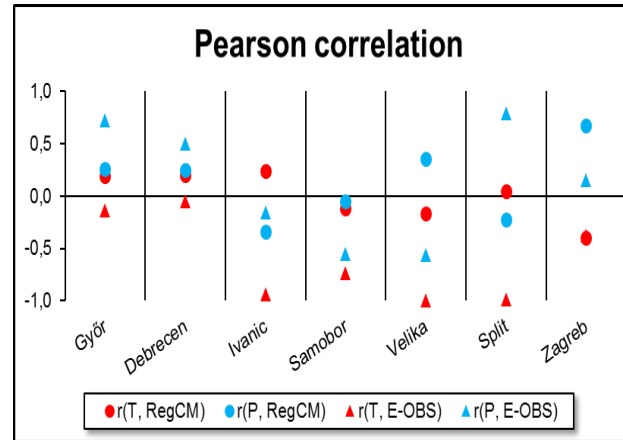
Highest pollen sites in the ATOPICA database



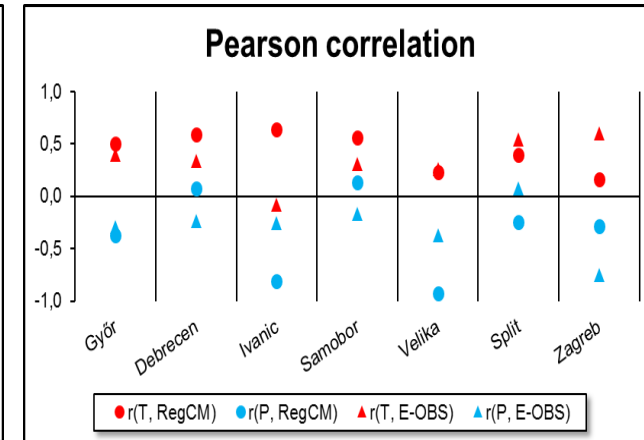
Correlations between pollen and climate indices



T,P, June-July



T,P, August - September



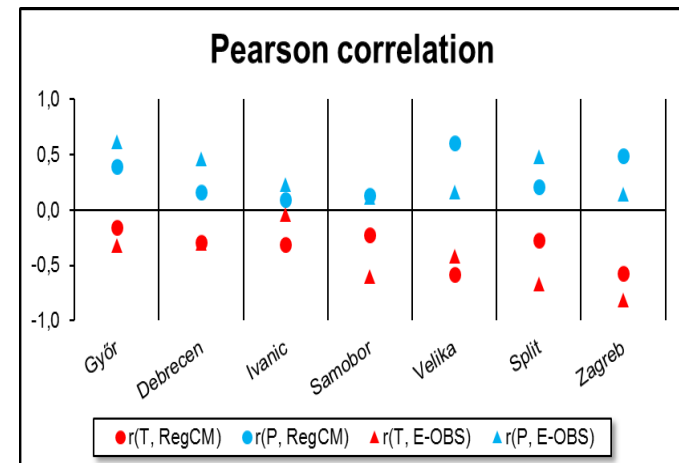
Temperature index: $\overline{T(\text{June} - \text{July})} - \overline{T(\text{August} - \text{September})}$

Precipitation index: $\overline{P(\text{June} - \text{July})} - \overline{P(\text{August} - \text{September})}$

Pollen peak season: august-september

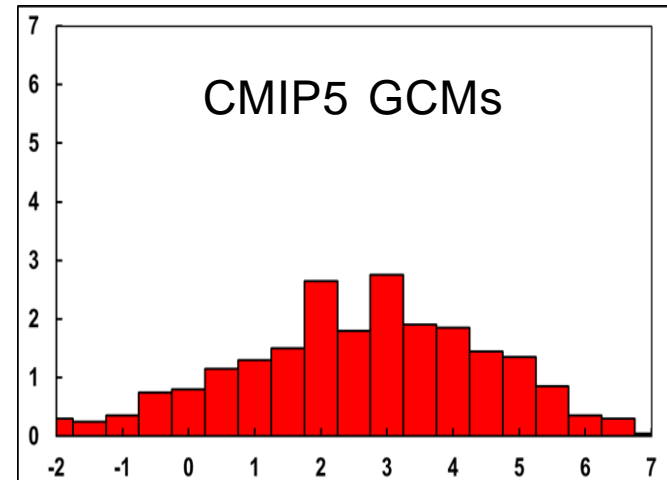
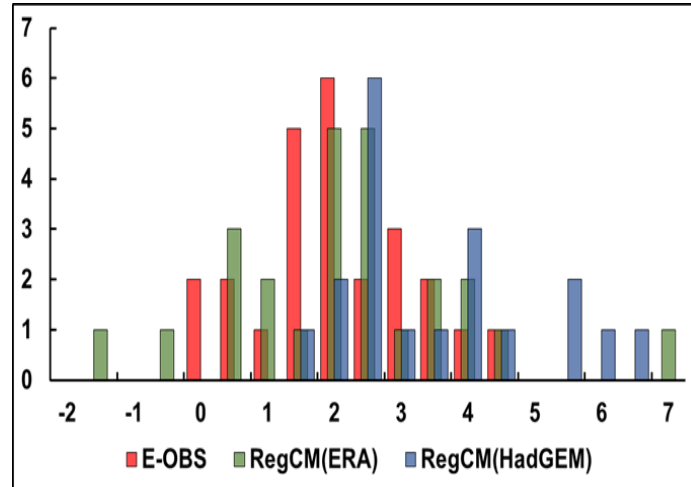
Pollen term: $\sum \text{Pollen}_{\text{aug,sep}}$

Temperature and Precipitation Indices

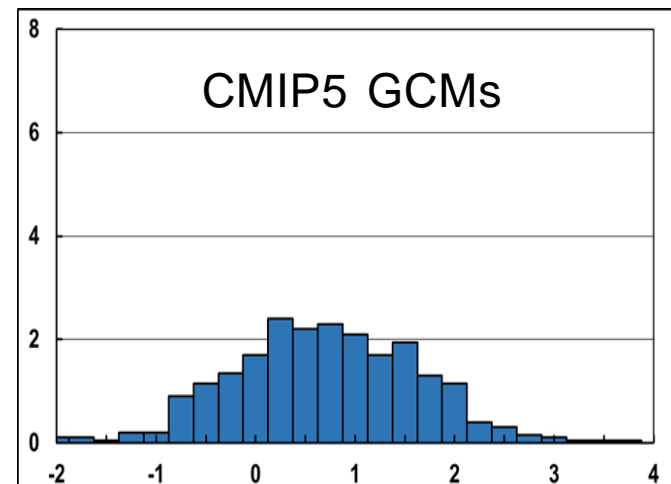
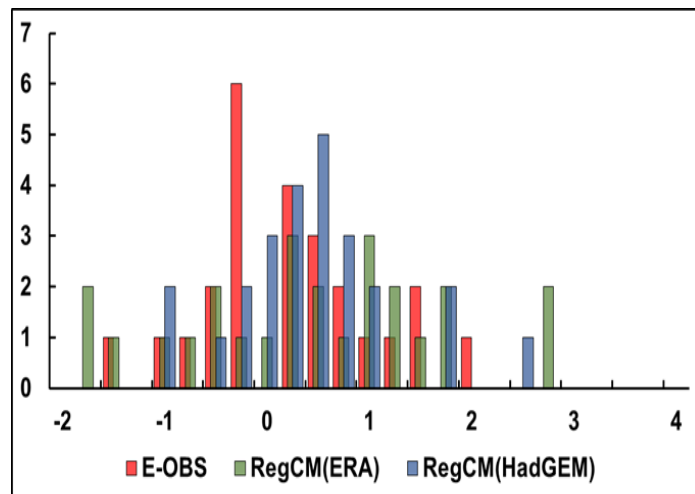


Distribution of the pollen/climate indices for S.E. Europe

Temperature index ($^{\circ}\text{C}$)



Precipitation index (mm/day)



Climate Variability and Change over Europe. Connection to Pollen Concentrations

- We identified temperature and precipitation indices for the Southeastern Europe pollen hot-spot. These are based on values during the pre and peak pollen seasons which correlate reasonably well with pollen concentrations
- The most conducive conditions for high pollen concentrations are found to be wet/cool during the pre-pollen season (June-July) and dry/hot during the peak pollen season (August-September)
- The regional model RegCM (one of those used in ATOPICA) can reproduce the observed pollen-climate correlations
- The indices identified can potentially be used for seasonal forecasts of pollen concentrations

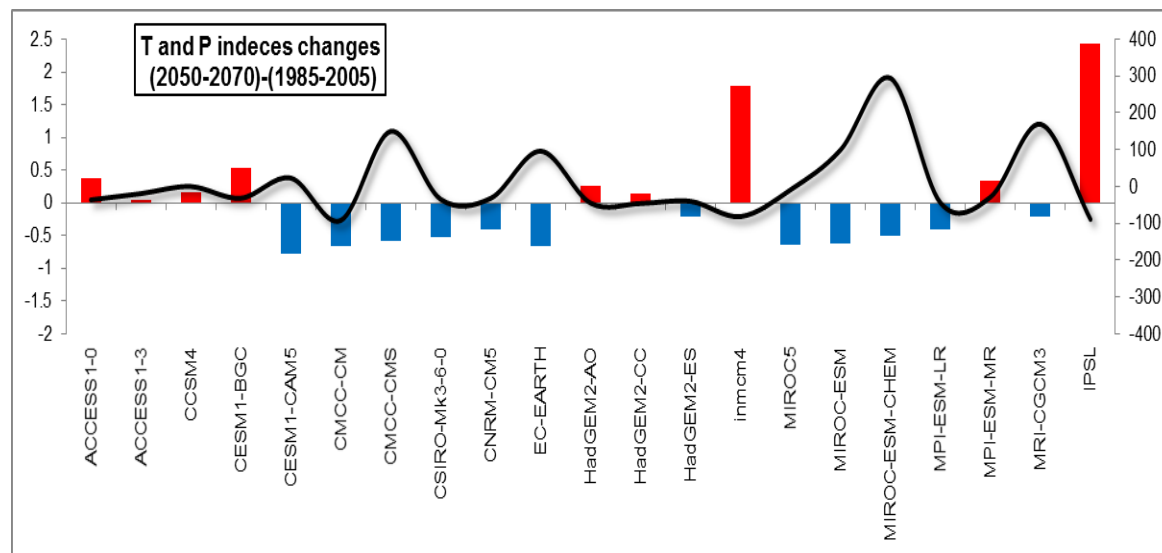
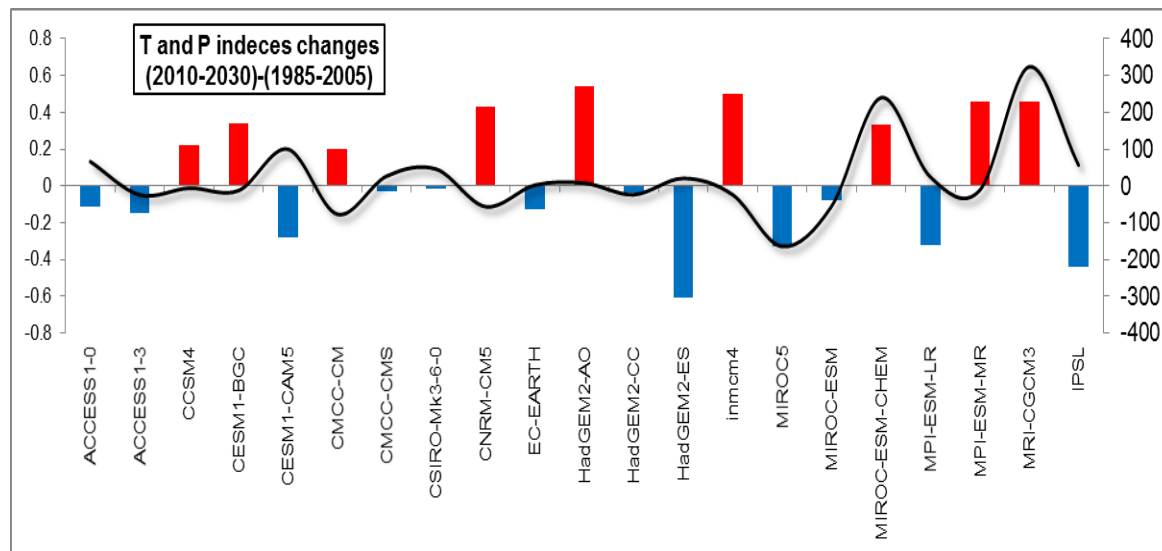
Will seasonal conditions conducive to high pollen concentrations change in the future?

Methodology

- Analysis of changes in climate/pollen indices under future climate change scenarios in different ensembles of projections.
 - CMIP5 (20 Global models)
 - CORDEX (5 Regional models)
- Important: No assumptions in changes of ambrosia distribution
- Focus on “Pollen Hotspot” of southeast Europe (Croatia, Hungary)

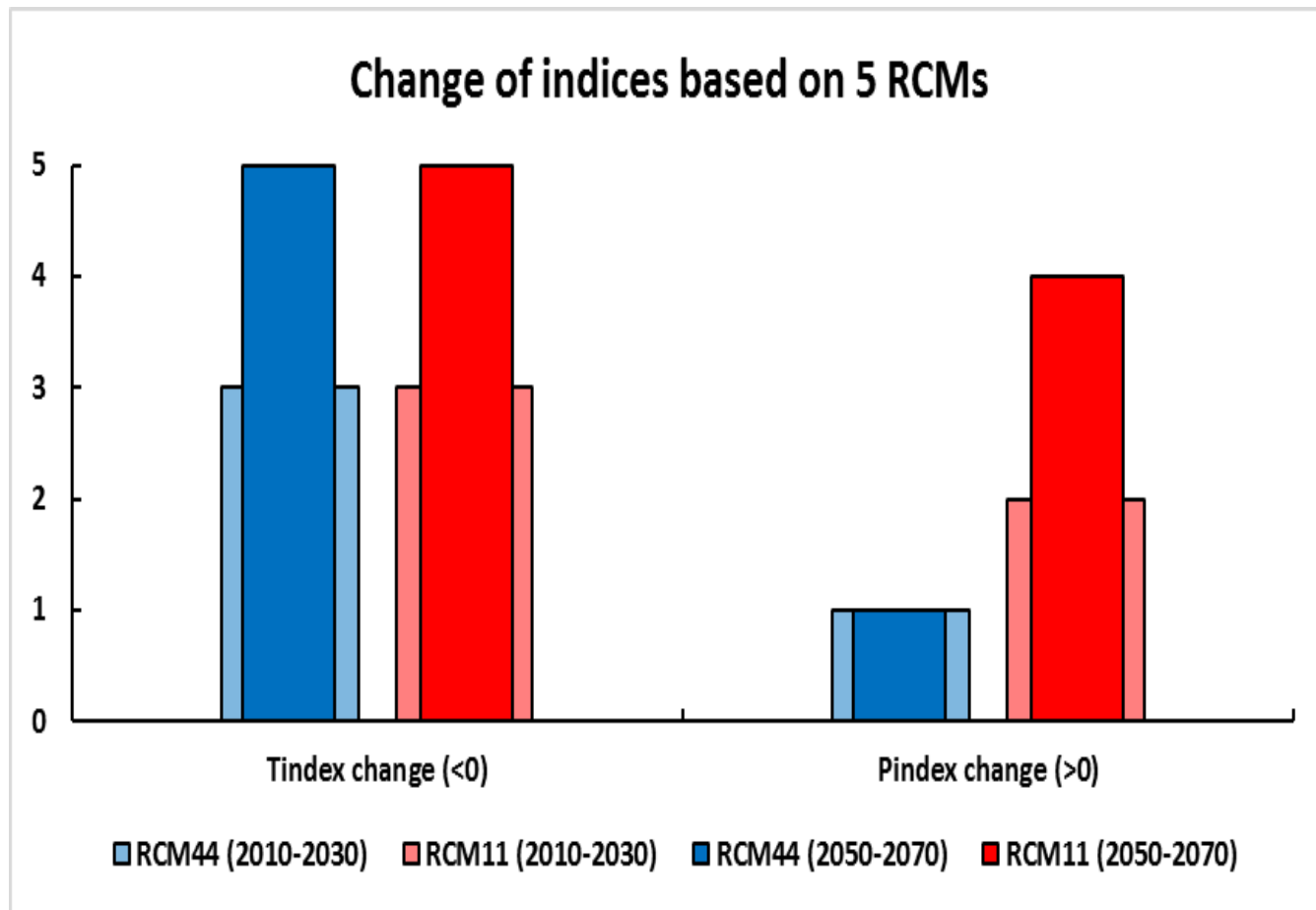
Changes in T and P pollen/climate indices in the CMIP5 GCMs

Bars: Temperature
Lines: Precipitation



Climate Variability and Change over Europe. Connection to Pollen Concentrations

Changes in T and P pollen/climate indices in the CORDEX RCMs



Number of models projecting more favorable pollen conditions based on changes in the seasonal pollen/climate indices

- Based on an analysis of changes in pollen-climate indices over the Southeast Europe Hot-spot region, the CMIP5 ensemble of GCMs does not provide a clear indication of significant changes in pollen potential
- The CORDEX ensemble is more suggestive of an increase of potential for high pollen concentrations in the Southeastern Europe Hot-spot based on the temperature index.
- The analysis does not take into account changes in ambrosia distribution

Scientific Question

Can we find relationships between changes in mean climate variables and pollen concentrations?

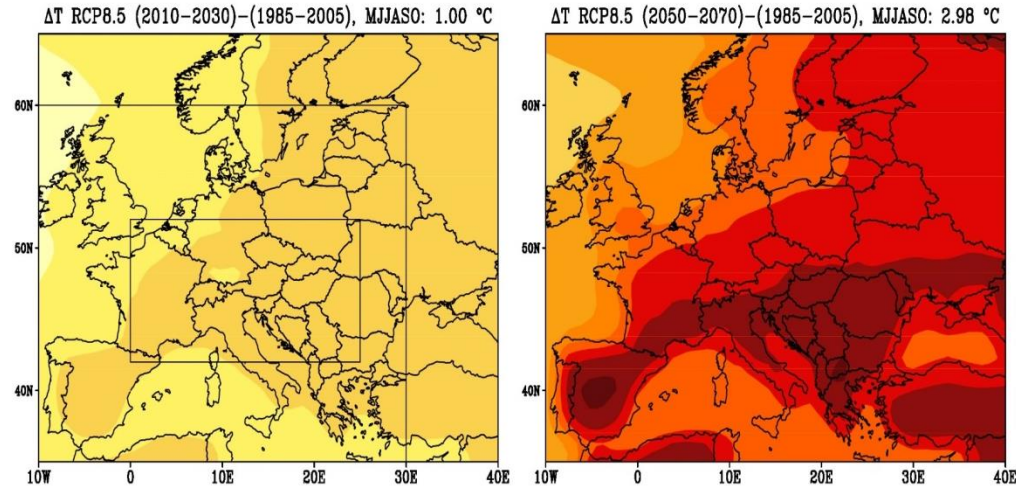
Methodology

- Attempt to find relationships between changes in climate variables and pollen over Europe based on the regional model simulations (climate and pollen) in ATOPICA (WP1,WP2)
 - Also includes considerations of changes in Ambrosia distribution and invasion rate
- Application of these relationships to larger ensembles to estimate uncertainty ranges
- Focus on “European pollen” region

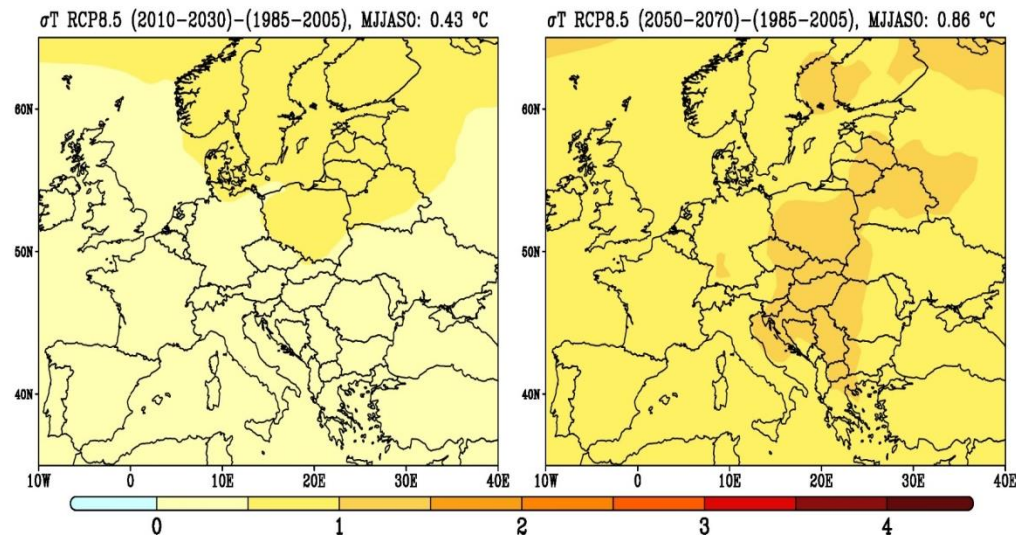


Temperature change during the pollen season (MJJASO) over Europe in the CMIP5 ensemble

**Mean Change
(°C)**

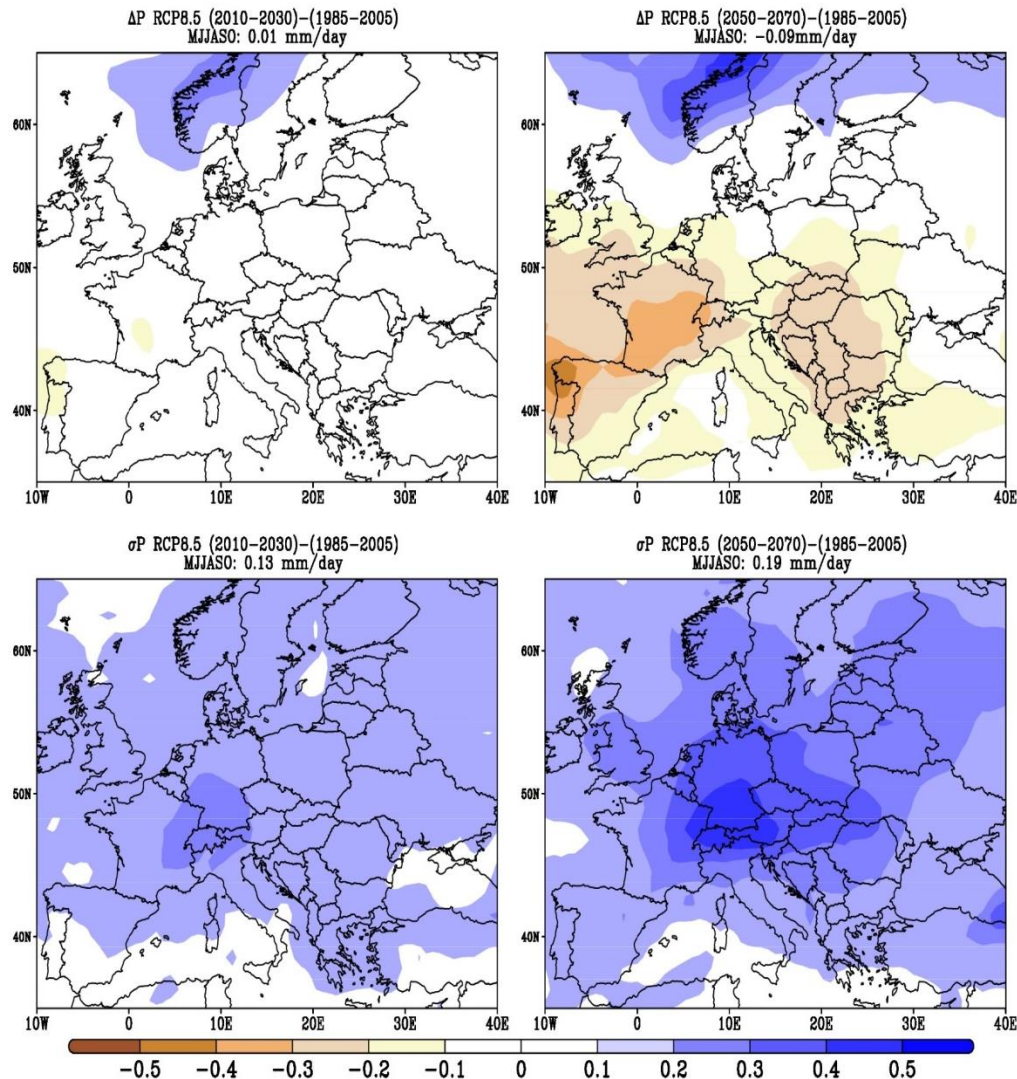


**Inter-model
Standard
Deviation (°C)**



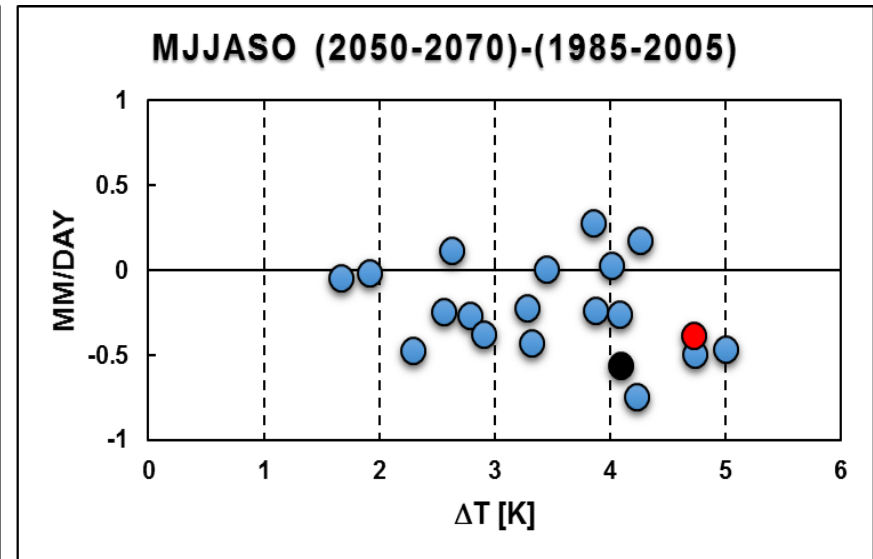
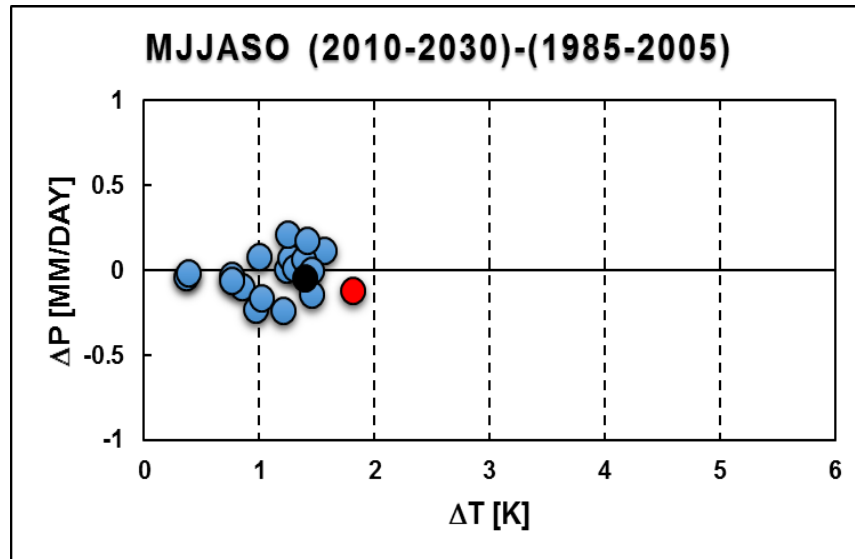
Precipitation change during the pollen season (MJJASO) over Europe in the CMIP5 ensemble

**Mean Change
(mm/day)**



**Inter-model
Standard
Deviation
(mm/day)**

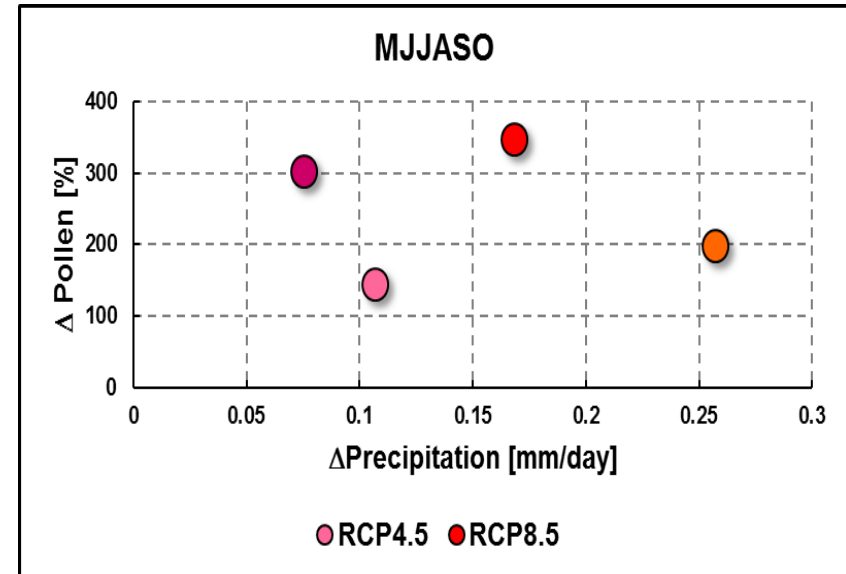
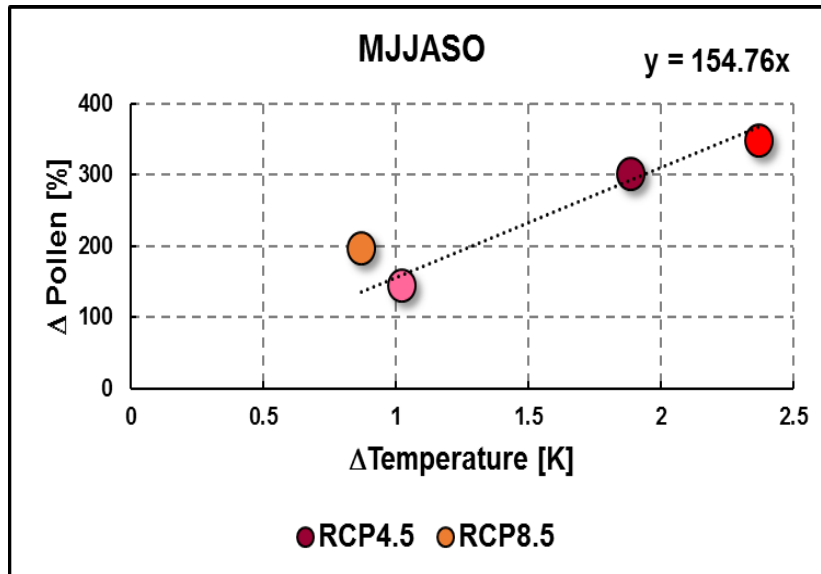
Temperature vs. precipitation change during the pollen season (MJJASO) over Europe in the CMIP5 ensemble (RCP8.5)



Red: HadGEM2-ES (RegCM)

Black: IPSL-CM5A-MR (WRF)

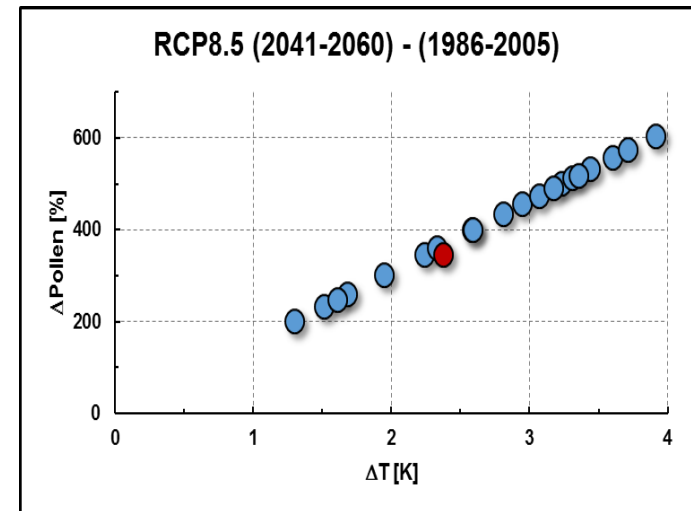
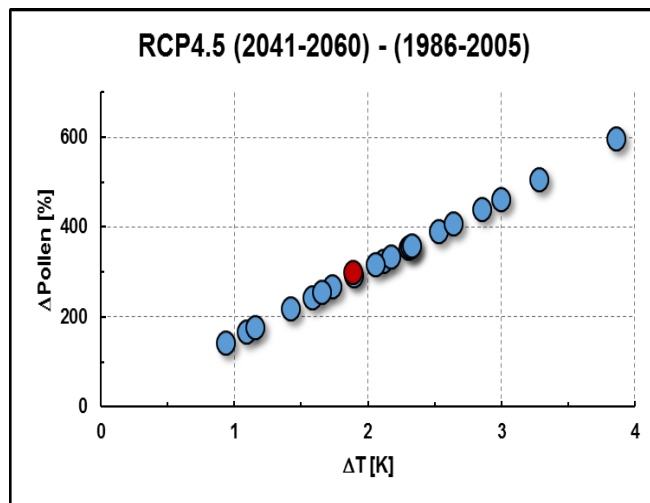
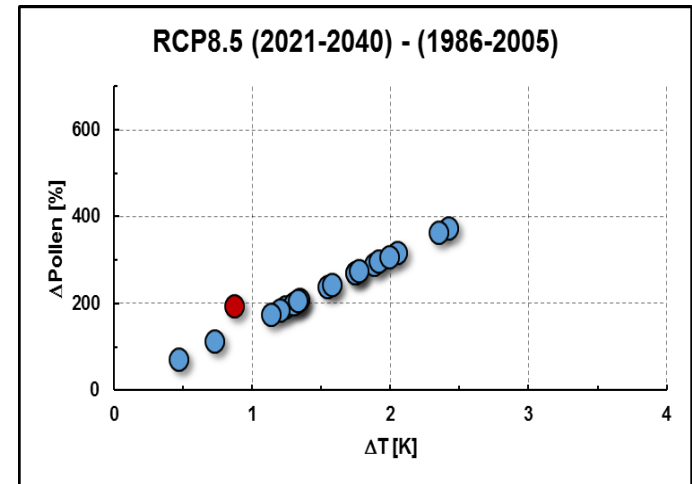
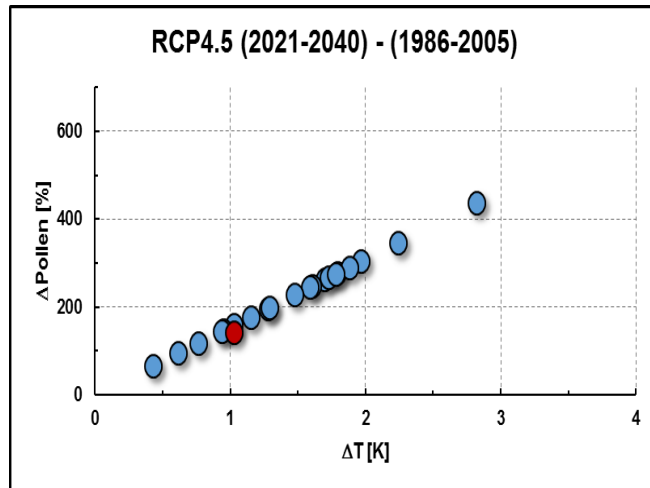
Pollen vs. temperature and precipitation change over Europe in different time slices of the RegCM4 simulations



**RCP4.5 and RCP8.5 scenarios
2021-2040 and 2041-2060 time slices**

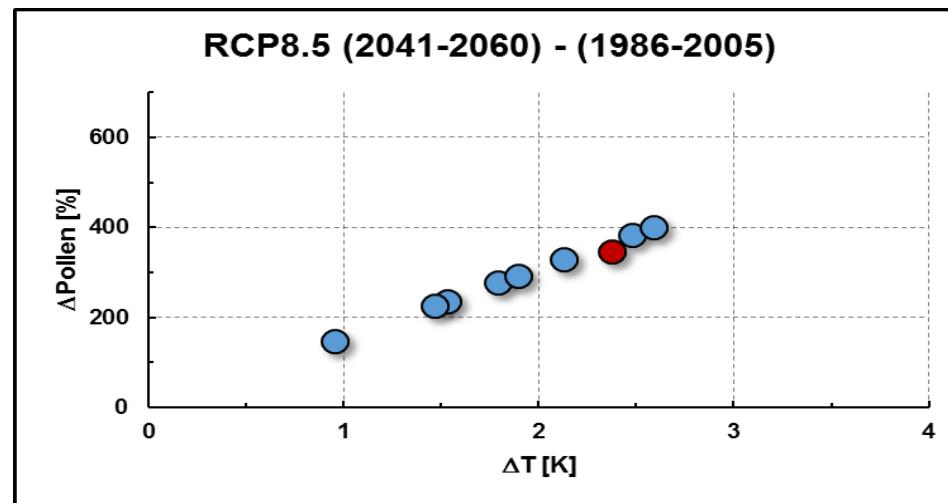
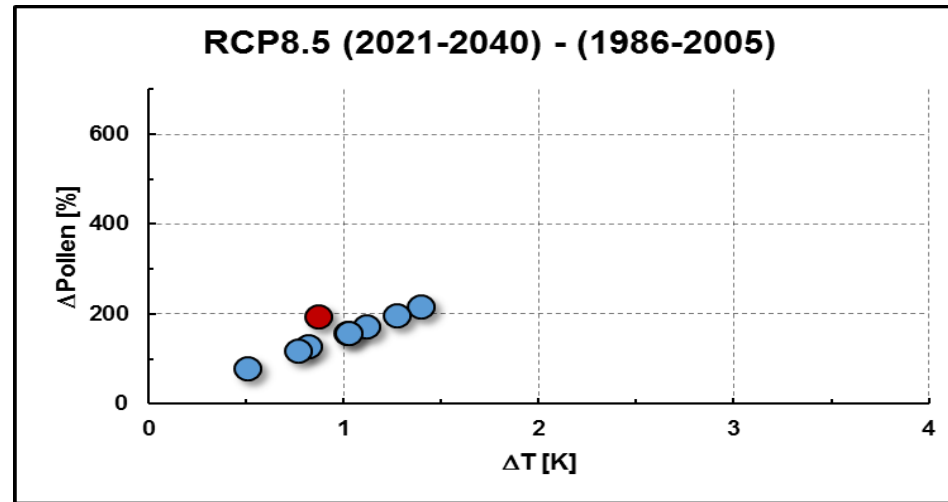


Pollen changes in different CMIP5 GCM projections



Red dot is actual result from the RegCM model

Pollen changes in different CORDEX RCM projections



Red dot is actual result from the RegCM model

Conclusion III

- Based on analysis of one of the ATOPICA models, there appears to be a direct relationship between temperature change and bulk pollen amount over the broad European region and the time slices and scenarios considered in ATOPICA
- This relationship can be used to estimate uncertainties associated with different model projections
- The analysis needs to be extended to the other ATOPICA model

Key messages from WP1

Key messages

- Seasonal climate conditions most conducive for high Ambrosia pollen amounts over the southeast Europe “pollen hotspot” (Hungary and Croatia) consist of wet/cool conditions during the pre pollen months (June-July) and dry/hot conditions during the peak pollen months (August-September)
- A pollen-climate index was devised to identify such conditions, which can potentially be used for seasonal pollen prediction over the region
- Pollen burdens averaged over the European region appear to exhibit a quasi-linear dependence on temperature increase (at least in one model), which can provide a useful tool to estimate mean pollen response to climate change and related uncertainties



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THANK YOU

