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The role of land cover, land use, and atmospheric transport for the mismatch of flowering and atmospheric pollen seasonality

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Perspectives

(1) Grassland land use, cutting regimes and agri-environment measures (AEM)

(2) Post-season pollen transport of an alpine *Alnus* species

(3) A first climatology of pre-season long-range pollen transport to Bavaria

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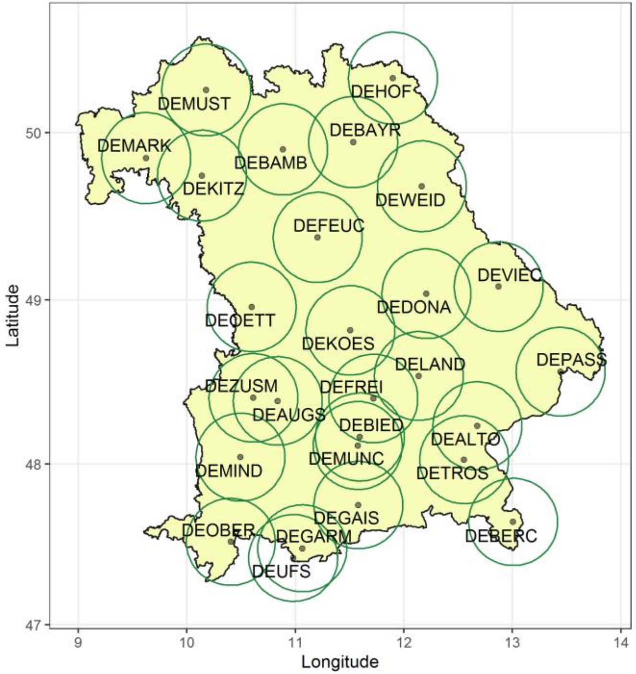
(1) Grassland land use, cutting regimes and agri-environment measures (AEM)

- Grass pollen from 27 stations in Bavaria, Germany, linked to potential pollen sources in 30-km surrounding.
- Agricultural sources from InVeKos with agricultural land use types and cultivation intensity (CI).
- Non-agricultural grasslands additionally identified from OpenStreetMap.
- Potential source areas (PSA) calculated in 500 m steps:

$$PSA_{CI} = \frac{\sum_1^n [A_{grassland,i,n} / (CI_{i,n}{}^3 + 1)]}{A_{concentric\ ring,i}}, i = 1 \dots 60$$



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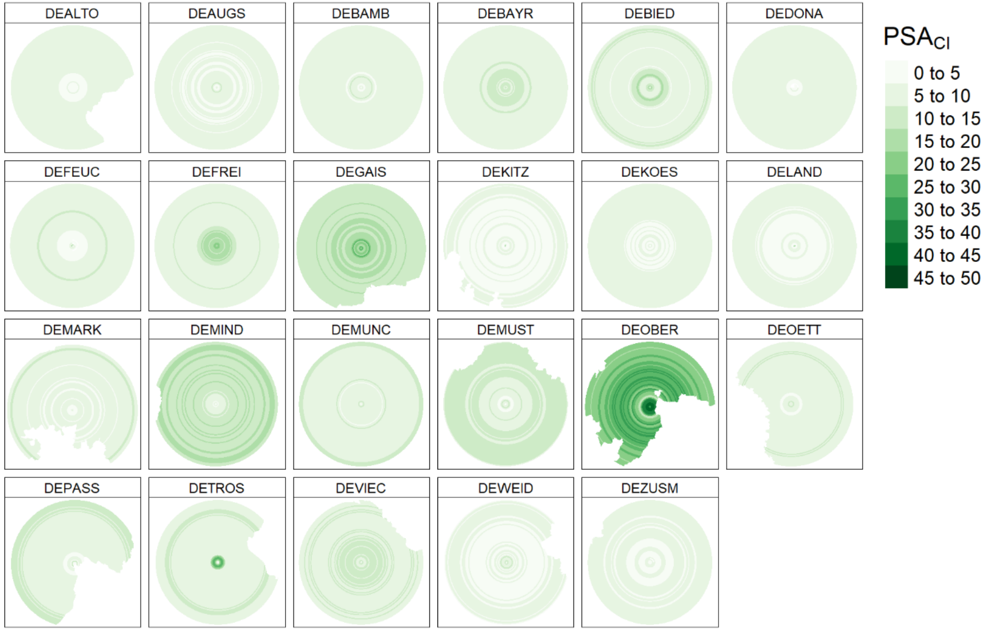
Potential pollen source areas



- Consistent PSA pattern distributed across stations.
- More integrated potential source areas appeared in the inner rings.
- Highest coverages found in DEFREI / DEGAIS / DEMIND / DEOBER.

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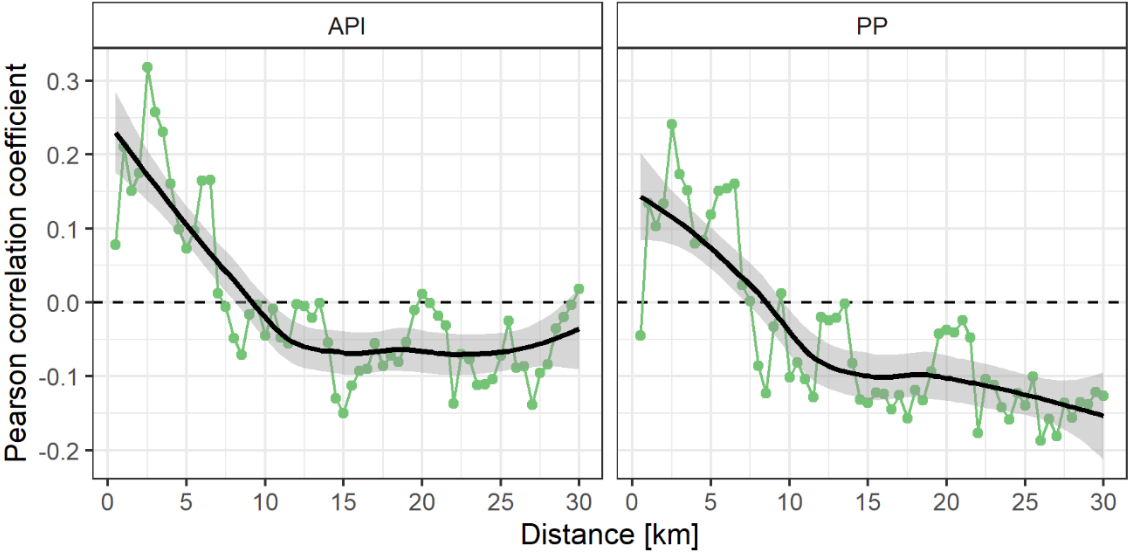
Correlations between stepwise PSA_{CI} and pollen indices



- Correlations of annual pollen integral (API) and pollen peak (PP) were similar.
- Peak of correlation coefficients reached at around 2.5 km.
- Coefficients fluctuated around 0 further in intermediate to long distances (> 10 km).

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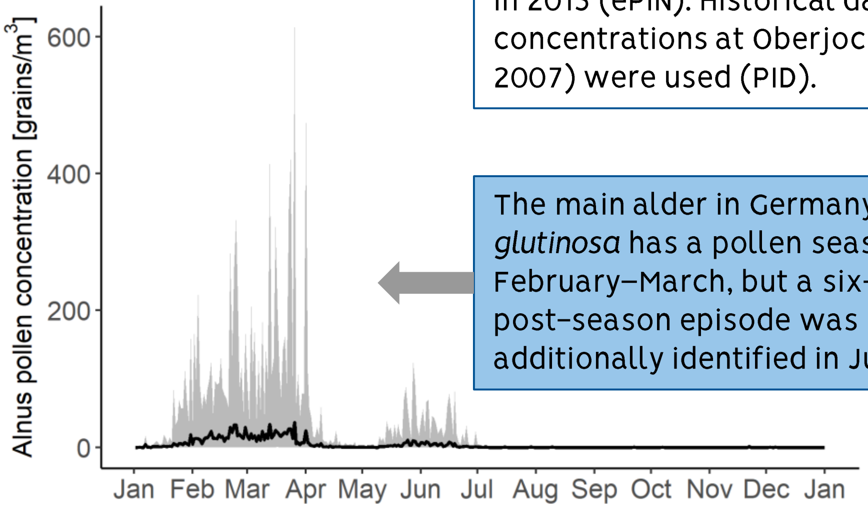
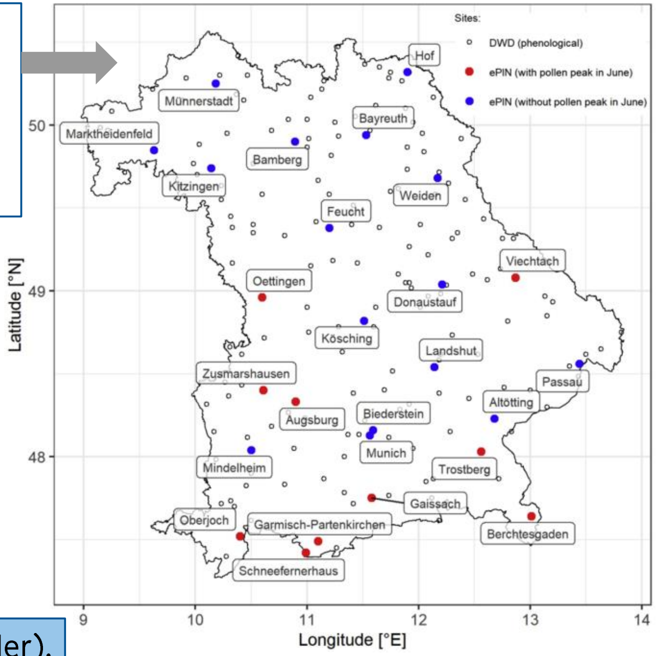
(2) Post-season pollen transport of an alpine *Alnus* species

Daily *Alnus* pollen concentrations were recorded at 26 Bavarian sites in 2015 (ePIN). Historical daily pollen concentrations at Oberjoch (1995 – 2007) were used (PID).



The main alder in Germany, *A. glutinosa* has a pollen season February–March, but a six-day, post-season episode was additionally identified in June.



Recorded pollen at 10 sites in June stemmed from *A. viridis* (green alder), originating from the alpine region with later flowering period in June.

Ghasemifard et al. (2020)

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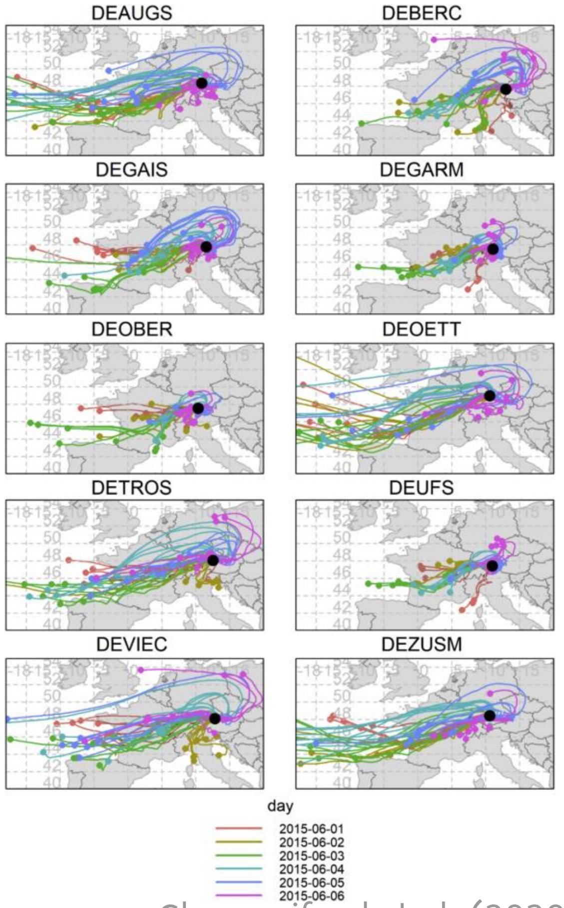
HYSPLIT backward trajectories

- 72-h backward trajectories were calculated at 3-h intervals using high spatial and temporal resolution ERA5 reanalysis data and the HYSPLIT (hybrid single-particle Lagrangian integrated trajectory) model.

- Air masses were identified dominantly westerly and south-westerly from the alpine region in Switzerland and Austria, where relevant areas of *A. viridis* as potential pollen sources exist.



Ghasemifard et al. (2020)

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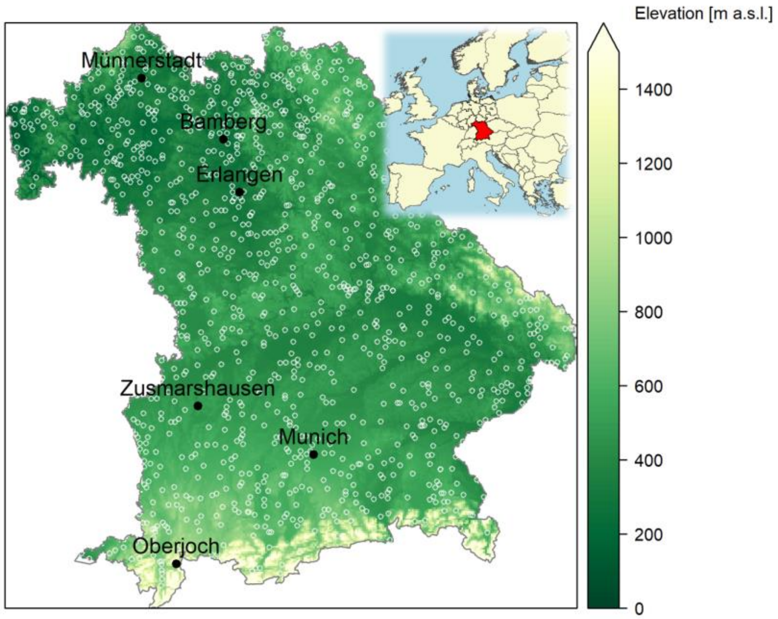
(3) A first climatology of pre-season long-range pollen transport to Bavaria



- Daily atmospheric concentrations of allergenic pollen were available for six stations across Bavaria and a common time period of 1987 to 2017.
- Seven pollen taxa (*Alnus*, *Artemisia*, *Betula*, *Corylus*, *Fraxinus*, *Pinus*, and *Poaceae*).
- Phenological beginning of flowering data from DWD and interpolated maps

Menzel et al. (2021)

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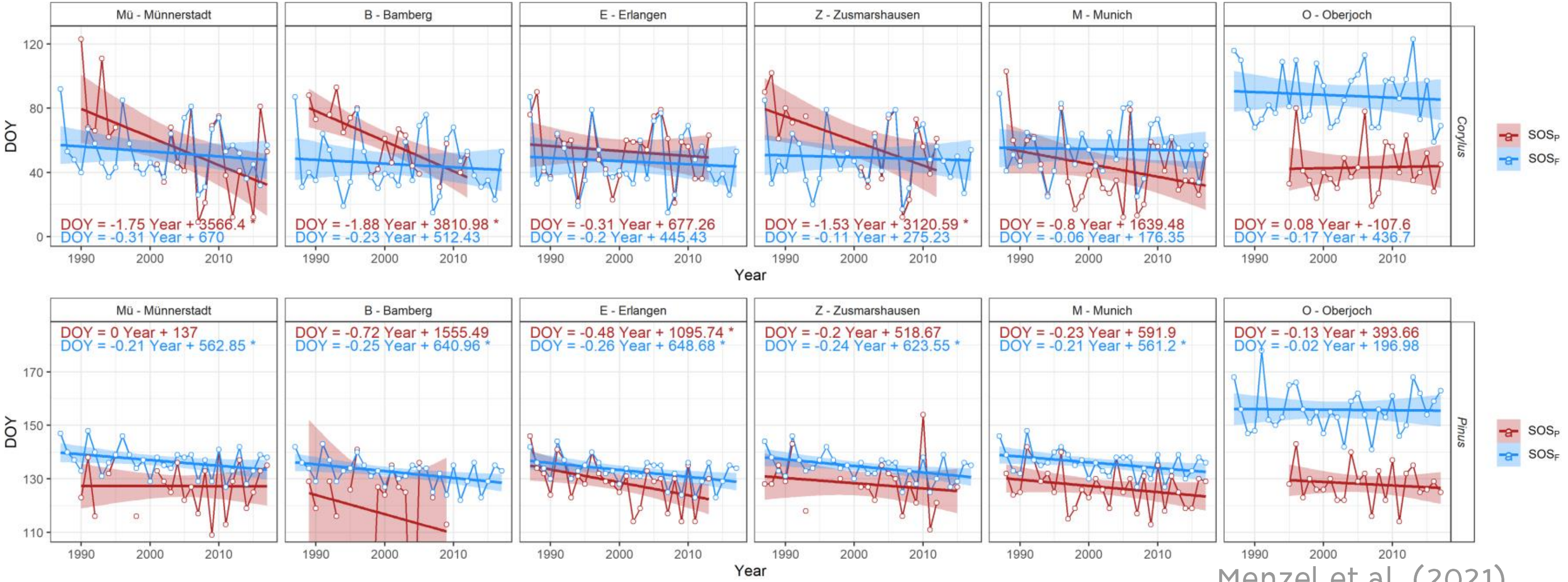
Start of pollen and respective flowering season

Considerable differences found between start of the pollen season (SOS_P) and start of flowering (SOS_F).



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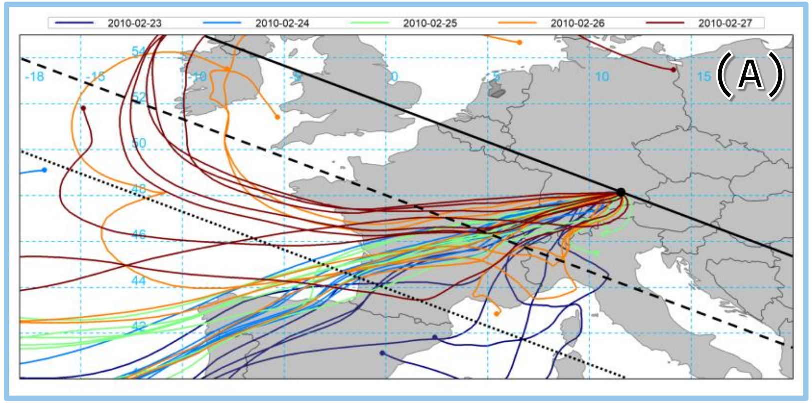
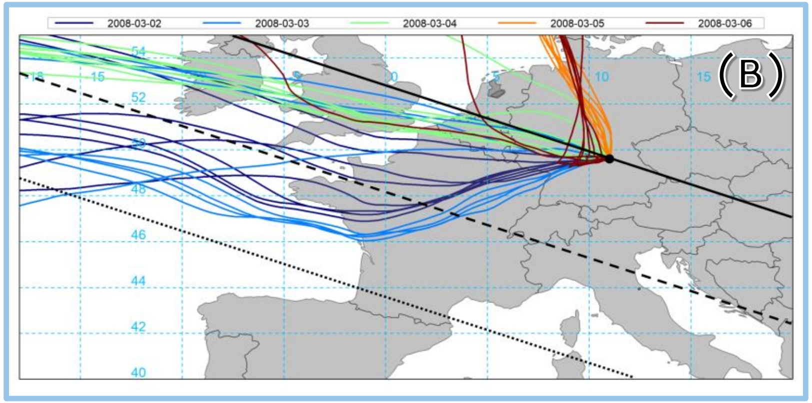
Likelihood of pre-season transport and HYSPLIT models



Corylus – Munich – 2010
SOS_P – DOY 56
SOS_F – DOY 73
Pre-season transport confirmed



Fraxinus – Erlangen – 2008
SOS_P – DOY 63
SOS_F – DOY 106
Pre-season transport partly confirmed

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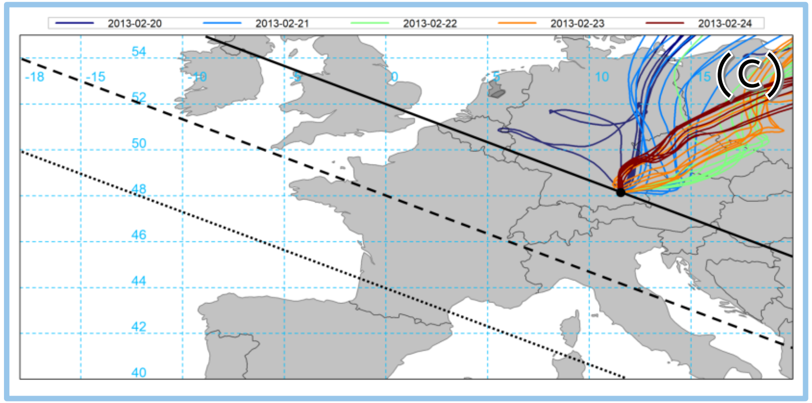
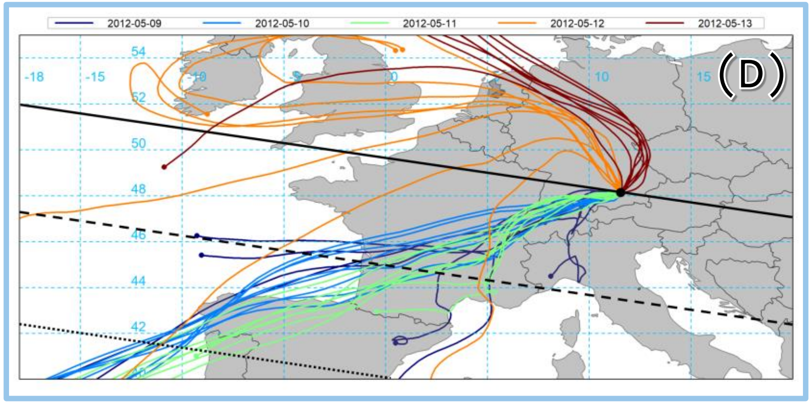
Likelihood of pre-season transport and HYSPLIT models





Alnus – Munich – 2013
SOS_P – DOY 53
SOS_F – DOY 75
Pre-season transport rejected

Pinus – Munich – 2012
SOS_P – DOY 131
SOS_F – DOY 133
Additional long-range transport likely

Menzel et al. (2021)

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References

- Ghasemifard et al. (2020) High post-season *Alnus* pollen loads successfully identified as long-range transport of an alpine species, Atmospheric Environment 231. doi: 10.1016/j.atmosenv.2020.117453
- Jung et al. (2021) Impact of local grassland sources on grass pollen (*Poaceae*) emission in Bavaria, Germany, submitted.
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