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The sources of long-term trends of airborne birch and grass pollen levels in Belgium

Airborne pollen may have a substantial contribution to respiratory allergies. In Belgium, ~10% is sensitive to birch pollen and ~15% to grass pollen. Since climate change and land-use change tend to enlarge the amount of allergenic airborne pollen and prolong the pollen seasons, even more people might be affected in the future.

Here we apply the pollen transport model SILAM (System for Integrated modeLling of Atmospheric coMposition) for attributing the long-term changes in the releases of pollen by birches and grasses to meteorology and vegetation dynamics in Belgium. The pollen transport model is driven by ECMWF ERA5 meteorological data in a bottom-up emission approach for the period 1982-2019. The pollen emission maps make out the dynamic vegetation component and are based on merging multi-decadal datasets of spaceborne NDVI with forest inventory data and grass distribution maps for 1982-2019.

Temporal trends are computed using Theil Sen slopes and the Area Under the Curve (AUC) of the modelled seasonal birch and grass pollen cycles based on daily pollen levels, and of the daily meteorological model input for the period 1982-2019. For each model gridcell we estimate the association between trends in pollen and meteorology using the Kendall correlation coefficient.

Results show that for the period 1982-2019 the increasing radiation, the decreasing precipitation and the decreasing horizontal wind speed are associated with a strong increase in birch pollen levels. The decreasing grass pollen levels in the air between 1982 and 2019 are associated with decreasing precipitation. This is mainly induced by the decreasing trend in grass pollen sources. The associations between meteorology and airborne birch pollen levels are much stronger than for grass pollen. Birch pollen production dynamics and wind speed and precipitation contribute to the higher amount of birch pollen in the air. The inter-seasonal variations in birch pollen production dampen the overall increase rate by ~7%. The grass pollen production dynamics introduced in SILAM resulted in 3.5 times less airborne grass pollen levels over the studied period.

Primary author: VERSTRAETEN, Willem (KMI)

Co-authors: Dr BRUFFAERTS, Nicolas (Sciensano); Dr KOUZNETSOV, Rostislav (FMI); Dr SOFIEV, Mikhail (FMI); Dr DELCLOO, Andy (KMI)

Presenter: VERSTRAETEN, Willem (KMI)