Geophysical Research Abstracts
Vol. 16, EGU2014-11772-1, 2014
EGU General Assembly 2014

Ambrosia airborne pollen concentration modelling and evaluation over Europe

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Native from North America, Ambrosia artemisiifolia L. (Common Ragweed) is an invasive annual weed introduced in Europe in the mid-nineteenth century. It has a very high spreading potential throughout Europe and releases very allergenic pollen leading to health problems for sensitive persons.
Because of its health effects, it is necessary to develop modelling tools to be able to forecast ambrosia air pollen concentration and to inform allergy populations of allergenic threshold exceedance. This study is realised within the framework of the ATOPICA project (https://www.atopica.eu/) which is designed to provide first steps in tools and estimations of the fate of allergies in Europe due to changes in climate, land use and air quality.

To calculate and predict airborne concentrations of ambrosia pollen, a chain of models has been built. Models have been developed or adapted for simulating the phenology (PMP phonological modelling platform), inter-annual production (ORCHIDEE vegetation model), release and airborne processes (CHIMERE chemical transport model) of ragweed pollen. Airborne pollens follow processes similar to air quality pollutants in CHIMERE with some adaptations. The detailed methodology, formulations and input data will be presented.
A set of simulations has been performed to simulate airborne concentrations of pollens over long time periods on a large European domain. Hindcast simulations (2000 – 2012) driven by ERA-Interim re-analyses are designed to best simulate past periods airborne pollens. The modelled pollen concentrations are calibrated with observations and validated against additional observations. Then, 20-year long historical simulations (1986 – 2005) are carried out using calibrated ambrosia density distribution and climate model-driven weather in order to serve as a control simulation for future scenarios.

By comparison with multi-annual observed daily pollen counts we have shown that the model captures well the gross features of the pollen concentrations found in Europe. The spatial distribution is well captured with correlation equal to 0.7, but the daily variability of pollen counts remains to be improved with correlations varying between 0.1 and 0.75. The model chain captures reasonably well the inter-annual variability of pollen yearly mean concentrations, correlations, even not statistically significant due to the short length of time series, are positive for about 80% of sites. The main uncertainty in ambrosia pollen modelling is linked to the uncertainty in the plant density distribution.
Preliminary results of the impact of environmental changes on pollen concentrations in the future will also be shown.