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On the simulation of allergenic pollen exposition and its atmospheric transport on regional scale

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In Germany approximately 30% of the population is vulnerable to pollinosis (hay fever). Exposure to allergenic pollen affects vulnerable persons recurring seasonally, but depending on the individual susceptibility to individual pollen species. To prevent the suffering the patients usually use preventive drugs and rely on the current pollen forecast.

However, recently used pollen forecast models mainly consider temperature sums to predict pollen exposition by different plant species. The models often fail to describe the impact of regionally variable environmental conditions on plant growth which depends on the soil characteristics that affect the water and nutrient availability.

Furthermore, water and nutrient availability may significantly affect the pollen yield and its allergenic potential. Thus, the improvement of the simulations of the exposition of allergenic pollen by plants and atmospheric pollen loads on the regional scale could improve the preventive medication of vulnerable persons.

We propose a new soil-plant-atmosphere model system that allows a dynamic ressource aquisition for the plant biomass growth to account for the allergenic potential of exposed pollen and the subsequent pollen transport in the atmosphere.
Therefore, to simulate pollen exposure the land surface model Expert-N (soil-plant-system model) was coupled to the Weather Research and Forecast model (WRF). Expert-N uses site specific physical soil properties to simulate the nutrient and water transport, and the carbon and nitrogen turnover, as well as the interactions between plant and soil. The allergenic potential of pollen yield is simulated using a new C- and N-allocation model which accounts for the production of carbon-based secondary compounds (CBSCs). These CBSCs are involved in the determination of the allergenic potential of pollen. The WRF model is used to predict the weather conditions for plant growth. Depending on the weather conditions pollen exposed by the plants is then released into the atmosphere and transported using the WRF-Chem model, an upgrade of the WRF model, to simulate matter transport in the atmosphere.