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Boundary condition models and large eddy simulation of pollen transport in the atmospheric boundary layer

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The recent development of genetically modified crops and questions about cross-pollination and subsequent contamination of natural plant populations enhanced the importance of understanding wind dispersion of airborne pollen. A critical question to be addressed is how far from the source field pollen grains will be advected. Numerical simulations can be a useful tool to study pollen dispersal in a variety of configurations, thus capturing effects of aerodynamic properties of the pollen, geometrical properties of the field, topography, local vegetation, wind conditions, atmospheric stability, etc. Specifically, Large Eddy Simulation (LES) is a technique that allows us to study the typical distances reached by pollen grains and, at the same time, resolve the larger coherent structures which strongly affect the pollen dispersion. The main objectives of this work are twofold: To explore and evaluate a new model for pollen fluxes near the ground which is also used to specify the pollen concentration boundary condition. For this purpose, we use the theoretical profile for suspended particles derived by Kind (1992) and further extended to include effects of the canopy on the eddy diffusivity and to account for atmospheric stability. The second objective is to simulate the dispersal of pollen grains in the atmospheric surface layer using LES with this boundary condition model and compare with field data. Airborne concentrations as well as ground deposition from the simulations are compared to experimental data to validate the approach. The results are encouraging.