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Abstract

A three-dimensional Lagrangian random flight model was constructed for numerical simulations of maize pollen dispersion. The model simulates the paths of tracer particles which are interpreted as individual pollen grains, with particle motion determined by the mean flow and a stochastic turbulent velocity. The Lagrangian approach was chosen because it can be extended to complex flow regimes. The capacity of the model to simulate measured patterns of pollen deposition was tested by comparing simulations to measurements for a small maize canopy isolated within a large field of soybeans near Ames, Iowa, USA in August 2003. For this application, measurements from a single point meteorological observation were used to generate a surface layer wind profile over the maize canopy and surrounding soybean field. The method used to construct the wind field included development of internal boundary layers as the airflow passed from one canopy surface to another. The dispersion model produced spatial patterns of particle deposition that included the sharp near-source deposition gradient consistent with observations. The model tended to over-predict particle deposition near the source field and under-predict deposition at greater distances. Inclusion of the effect of the roughness difference between the maize canopy and the surrounding soybean canopy on the flow field was found to be essential for simulation accuracy. Agreement with observations improved considerably by including an approximation for vertical motions induced by changes in surface cover. These results indicate that the Lagrangian random flight model provides a realistic simulation of pollen dispersal from an isolated maize canopy. A more complete hydrodynamic model should be explored to better represent the influence of surface inhomogeneities on winds and turbulence.

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