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Estimating footprint and water vapor fluxes over inhomogeneous surfaces by the Lagrangin stochastic model

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This study examined the Lagrangian stochastic dispersion model for estimating water vapor fluxes and footprint over homogeneous and inhomogeneous surfaces. Over the homogeneous surface, particle trajectories were computed from a standard 2-D Lagrangian model forced by Eulerian velocity statistics determined by Monin-Obukhov similarity theory (MOST). For an inhomogeneous surface, the velocity and atmospheric stability profiles were computed using a second-order Eulerian closure model, and then these local profiles were used to drive the Lagrangian model. The model simulations were compared with water vapor flux measurements carried out above an irrigated bare soil site and an irrigated potato site. The inhomogeneity involved a step change in surface roughness, humidity, and temperature. Good agreement between eddy-correlation measured and Lagrangian model predicted water vapor fluxes was found for a wide range of stability conditions. Hence, this analysis suggests that second-order closure models can be used in conjunction with Lagrangian analysis to estimate scalar footprint in planar inhomogeneous flows.