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A Lagrangian stochastic model to demonstrate multi-scale interactions between convection and land surface heterogeneity in the atmospheric boundary layer

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Near-surface turbulent mixing has considerable effect on surface fluxes, cloud formation and convection in the atmospheric boundary layer (ABL). Its quantifications is however a modeling and computational challenge since the small eddies are not fully resolved in Eulerian models directly. We have developed a Lagrangian stochastic model to demonstrate multi-scale interactions between convection and land surface heterogeneity in the atmospheric boundary layer based on the Ito Stochastic Differential Equation (SDE) for air parcels (particles).
Due to the complexity of the mixing in the ABL, we find that linear Ito SDE cannot represent convections properly. Three strategies have been tested to solve the problem: 1) to make the deterministic term in the Ito equation non-linear; 2) to change the random term in the Ito equation fractional, and 3) to modify the Ito equation by including Levy flights.
We focus on the third strategy and interpret mixing as interaction between at least two stochastic processes with different Lagrangian time scales.
The model is in progress to include the collisions among the particles with different characteristic and to apply the 3D model for real cases.
One application of the model is emphasized: some land surface patterns are generated and then coupled with the Large Eddy Simulation (LES).