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Consistent formulation of convective transport in a Lagrangian particle model

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We report on the successful coupling of a Lagrangian Particle model (STILT, Stochastic Time Inverted Lagrangian Transport) to a mesoscale numerical weather prediction model (BRAMS, Regional Atmospheric Modeling System, Brazil version) for simulating time-reversed tracer transport. The offline transport within STILT is driven by output of fluxes (advective, convective) and turbulent parameters (vertical turbulent velocity variance, Lagrangian timescale) on the native grid of BRAMS at high temporal resolution. This ensures Lagrangian transport that is not only mass conserving, but also dynamically consistent with online transport within BRAMS. Special attention has been given to vertical transport: within BRAMS, shallow and deep convection is implemented as a mass flux scheme (Grell scheme), and fluxes are output for up- and downdraft as well as detrainment and entrainment; within STILT convection is implemented in form of a 3 column model (updrafts, environment, downdraft) on a fixed vertical grid, and particles step up or down with a variable time step and undergo a random decision for entrainment/detrainment. It can be shown that the implementation is fully reversible in time. To our knowledge, this represents the first stochastic Lagrangian transport model coupled to a mass flux scheme. First simulation results are presented for the COBRA-NA experiment conducted in summer 2003, where convective CO_2 signatures where observed from an airborne platform. Since the framework is coupled to surface fluxes and can be nested and thus operated at a wide range of scales, convective tracer signatures can be quantitatively compared to and validated against measurements.