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A new Lagrangian particle model: applications in atmospheric boundary layers

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We present a new 3D Lagrangian particle model that is able to correctly reproduce tracer diffusion, pair and tetrad dispersion properties in a 3D turbulent flow, statistically homogeneous and isotropic. The velocity field attached to each marked particle is a superposition of wave-numbers logarithmically spaced, and with an energy content in agreement with Kolmogorov spectrum of turbulent kinetic energy. Each velocity component is generated by an Ornstein-Uhlenbeck process with proper inertial range correlation time. Different single particle multi-scale velocity fields are matched together to correctly reproduce spatial correlation of groups of particles, when these are close by. We show that Richardson law for pair dispersion and its extension to the separation of tetrads of particles are correctly reproduced. The Lagrangian particle model is a perfect candidate for sub-grid scale modeling of tracer trajectories in larger scale models: as an application, we present results of Lagrangian turbulence in a convective planetary boundary layer described by means of a Large-eddy simulation.