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A detailed modeling description of turbulent dispersion from continuous source: coupling Eulerian and Lagrangian stochastic models to simulate intermittent concentration time series incorporating meandering

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The dispersion of scalars in turbulent flows is relevant for many environmental applications. A full modeling description of the one point behavior of a scalar field in a turbulent flow is possible using a stochastic Probability Density Function (PDF) approach. Full one-point description requires, not only the knowledge of the local concentration PDF, but also the possibility to reconstruct a physically realistic time series generating the PDF. Here it is shown how an intermittent concentration time series, generated by a localized source in a fixed point in space, can be modeled by a system of Eulerian stochastic equations for velocity and concentration. The Eulerian stochastic time-series model is constructed based on the statistics generated by a Lagrangian stochastic particle model. The interaction by exchange with the conditional mean (IECM) model is used in both the Eulerian and Lagrangian frameworks. The model is applied to the case of a line source in homogeneous turbulence. The calculated time series includes the effects of the two time scales intrinsic to concentration fluctuations, namely meandering and relative dispersion. The intensity of concentration fluctuations, the cumulative distribution function of concentration, and time series of concentration are compared to experimental results.