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Bounded Stochastic Shell Mixing Model: Further Development and Application to Inhomogeneous Scalar Mixing T. VAITHIANATHAN, YANJUN XIA, LANCE R. COLLINS, Cornell University — Xia and Collins [*Physics of Fluids* **23** (6):065107, 2011] developed the Bounded Stochastic Shell Mixing (BSSM) model that takes into account the multi-scale nature of the turbulent mixing process. They successfully applied the model to mixing of isotropic scalars with an initial double-delta probability density function (PDF). To enforce the scalar bounds, they introduced a novel "zeroth mode" that precisely cancels the inherently non-conservative random terms in the formulation. The extension of the model to the mixing of inhomogeneous scalar fields uses notional particles that move with a fluctuating velocity that is chosen to conform with the underlying turbulent energy spectrum. A consistency condition further requires the particle motion in the direction of the mean scalar gradient be carefully connected to the generation of the scalar fluctuation. The appropriate constraint has been derived and is enforced by the numerical algorithm. This new formulation has been applied to turbulent mixing of a scalar slab of specified thickness. (In the limit of zero thickness, this reduces to the classical "line source" problem.) We analyze multiple scalars so that differential diffusion can be considered as well as the effect of the thickness of the slab (relative to the turbulence length scales). The predictions of the BSSM model compare well with direct numerical simulations.

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