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Unphysical scalar excursions in large-eddy simulations[1] GEORGIOS MATHEOU, Jet Propulsion Laboratory, California Institute of Technology, PAUL DIMOTAKIS, California Institute of Technology — The range of physically realizable values of passive scalar fields in any flow is bounded by their boundary values. The current investigation focuses on the local conservation of passive scalar concentration fields in turbulent flows and the ability of the large-eddy simulation (LES) method to observe the boundedness of passive scalar concentrations. In practice, as a result of numerical artifacts, this fundamental constraint is often violated with scalars exhibiting unphysical excursions. The present study characterizes passive-scalar excursions in LES of a turbulent shear flow and examines methods for error diagnosis. Typically, scalar-excursion errors are diagnosed as violations of global boundedness, i.e., detecting scalar-concentration values outside boundary/initial condition bounds. To quantify errors in mixed-fluid regions, a local scalar excursion error metric is defined with respect to the local non-diffusive limit. Analysis of such errors shows that unphysical scalar excursions in LES result from dispersive errors of the convection-term discretization where the subgrid-scale model (SGS) provides insufficient dissipation to produce a sufficiently smooth scalar field. Local scalar excursion errors are found not to be correlated with the local scalar-gradient magnitude.

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