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Tensor Diffusivity and Lagrangian Particle Methods A. LEONARD, California Institute of Technology — We consider the tensor diffusivity model for large-eddy simulation and its connection with lagrangian particle methods for the vorticity transport equation and for the scalar advection equation. If ϕ is a scalar field being advected by an incompressible velocity field $\mathbf{u}$ then application of the tensor diffusivity model results in the term $-\frac{\sigma^2}{2}\bar{S_{ij}}\partial^2\bar{\phi}/\partial x_i \partial x_j$ on the RHS of the filtered advection equation, where $\bar{S_{ij}}$ is the filtered strain rate tensor and σ is the width of the gaussian filter. Previous investigators have shown, in a priori tests, that this model yields results that are relatively well correlated with the actual subgrid scale terms. Also previously noted is the fact that one has negative diffusion along the the principal axes of $\bar{S_{ij}}$ that correspond to positive eigenvalues. Examples are given where the negative diffusivity produces meaningful backscatter of energy into the resolved scales. Also shown is that lagrangian particle methods have a truncation error that produces exactly the tensor diffusivity model. For 3D vorticity transport and scalar advection, the particle velocity must be slightly modified from the local velocity.

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