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Investigation of numerical, resolution, and subgrid-scale model effects on LES predictive quality of a variable-density jet GREGORY RODEBAUGH, LESTER SU, Johns Hopkins University — Large-eddy simulation (LES) provides a methodology to simulate complex, unsteady flows that are too expensive for DNS, and for which the RANS formulation gives poor results. To maximize the practical utility of LES, computations should be performed at the coarsest resolution that still provides satisfactory predictions. To have an a priori estimate of the required resolution for a given flow configuration, a thorough understanding of the nonlinear error interactions present in LES is needed; therefore, we seek to elucidate the effects of different subgrid-scale (SGS) stress and scalar flux models, at a range of resolution levels, on both the mixing properties and turbulent statistics of the flow. To isolate these effects in a non-homogeneous turbulent shear flow, we investigate an isothermal, axisymmetric turbulent jet, with either fixed or variable density, discretized by several explicit finite difference schemes in cylindrical coordinates. The results show that dynamic eddy viscosity based models for the momentum equation display less sensitivity to grid resolution than dynamic mixed models while capturing the mean flow well and reproducing fluctuations with reasonable accuracy. The mixture fraction evolution, however, is influenced negligibly by the choice of SGS scalar model at course to medium grid resolutions due to the use of upwind operators for its convective terms.

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