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On the evaluation of the sub-filter scalar variance and dissipation rate in large eddy simulation GUILLAUME BALARAC, HEINZ PITSCH, Center for Turbulence Research, Stanford University, VENKATRAMANAN RAMAN, University of Texas at Austin — In large-eddy simulations, the energy containing scales of the turbulence are resolved and the small scales have to be modeled. This is very important for flows with combustion, where the heat release typically correlates well with the rate of molecular mixing on the smallest scales. The mixture fraction describing mixing between fuel and oxidizer plays a central role in turbulent non-premixed combustion modeling. In particular, the sub-filter mixture fraction variance and the mixture fraction dissipation rate describe molecular mixing. Models for these quantities have been proposed in the past, but the performance of these models is often not of satisfactory accuracy given their importance for predicting the heat release. In the present work, a model based on a Taylor series expansion is proposed following the approach of Clark et al. [J. Fluid Mech., 1979]. The model is tested in an a priori study, and effects of expansion order and filter kernel are assessed. The results are discussed based on the notion of "irreducible error" recently introduced by Moreau et al. [Phys. Fluids, 2006]. The model is compared with the dynamic model and the results are analyzed to understand the validity of assumptions made in the dynamic procedure. Further numerical issues related to LES using implicit filtering are discussed.

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