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PEVC-FMDF for Large Eddy Simulation of Compressible Turbulent Flows ARASH NOURI GHEIMASSI, MEHDI NIK, PEYMAN GIVI, Univ of Pittsburgh, DANIEL LIVESCU, Los Alamos National Laboratory, STEPHEN POPE, Cornell University — The filtered density function (FDF) closure is extended to a "self-contained" format to include the subgrid scale (SGS) statistics of all of the hydro-thermo-chemical variables in turbulent flows. These are the thermodynamic pressure, the specific internal energy, the velocity vector, and the composition field. In this format, the model is comprehensive and facilitates large eddy simulation (LES) of flows at both low and high compressibility levels. A transport equation is developed for the joint "pressure-energy-velocity-composition filtered mass density function (PEVC-FMDF)." In this equation, the effect of convection appears in closed form. The coupling of the hydrodynamics and thermochemistry is modeled via a set of stochastic differential equation (SDE) for each of the transport variables. This yields a self-contained SGS closure. For demonstration, LES is conducted of a turbulent shear flow with transport of a passive scalar. The consistency of the PEVC-FMDF formulation is established, and its overall predictive capability is appraised via comparison with direct numerical simulation (DNS) data.

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