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Analysis of Subgrid-Scale Backscatter in Turbulent Reacting Flows JEFFREY O'BRIEN, JAVIER URZAY, MATTHIAS IHME, PARVIZ MOIN, AMIRREZA SAGHAFIAN, Center for Turbulence Research, Stanford University — In Large-Eddy Simulations of turbulent flows, subgrid-scale (SGS) backscatter of kinetic energy can cause numerical instabilities and the physical mechanism of backscatter is not well understood. While some effort has been made to analyze the phenomenon in inert flows, the behavior of backscatter in reacting flows has been largely unexamined. In this study, Direct Numerical Simulations of inert and reacting supersonic, temporal, hydrogen-air mixing layers are analyzed to assess the effects of compressibility and combustion on SGS backscatter. As in inert, incompressible flows, it is found that a large fraction of the flow domain experiences backscatter at any given time. However, unlike in earlier incompressible studies, the intensity of the backscatter is considerably weaker than that of the forwardscatter such that net backscatter is not observed when averaging in a homogenous direction. In addition, a relationship between the SGS dissipation and eddy viscosity is derived to quantify effects of compressibility. Six allowed combinations of these effects are identified, and their relative frequency is evaluated for both reacting and non-reacting flows. It is found that backscatter occurs preferentially in regions with positive eddy viscosity and local expansion.

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