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Wavelet multi-resolution analysis of energy transfer in turbulent premixed flames JEONGLAE KIM, MAXIME BASSENNE, Center for Turbulence Research, Stanford University, COLIN TOWERY, Department of Mechanical Engineering, University of Colorado Boulder, ALEXEI POLUDNENKO, Laboratories for Computational Physics and Fluid Dynamics, Naval Research Laboratory, PETER HAMLINGTON, Department of Mechanical Engineering, University of Colorado Boulder, MATTHIAS IHME, JAVIER URZAY, Center for Turbulence Research, Stanford University — Direct numerical simulations of turbulent premixed flames are examined using wavelet multi-resolution analyses (WMRA) as a diagnostics tool to evaluate the spatially localized inter-scale energy transfer in reacting flows. In non-reacting homogeneous-isotropic turbulence, the net energy transfer occurs from large to small scales on average, thus following the classical Kolmogorov energy cascade. However, in turbulent flames, our prior work suggests that thermal expansion leads to a small-scale pressure-work contribution that transfers energy in an inverse cascade on average, which has important consequences for LES modeling of reacting flows. The current study employs WMRA to investigate, simultaneously in physical and spectral spaces, the characteristics of this combustion-induced backscatter effect. The WMRA diagnostics provide spatial statistics of the spectra, scale-conditioned intermittency of velocity and vorticity, along with energy-transfer fluxes conditioned on the local progress variable.

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