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NARROW BAND-WISE IDENTIFICATION OF TURBULENCE-RADIATION INTERACTION IN RESOLVED AND SUBFILTER SCALES

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ABSTRACT. Turbulence-radiation interaction (TRI) is investigated in the framework of both Reynold-Averaged Navier-Stokes (RANS) and large-eddy simulations (LES) turbulence modeling, addressing the impact of both resolved-scale and subfilter-scale fluctuations on the mean and on the filtered radiation field, respectively. The target configuration is a methane-air jet diffusion flame. To the authors' best knowledge, this is the first study where the importance of subfilter-scale TRI correlations is assessed across the radiation spectrum. Due to the functional dependence of the Planck function on temperature and wavenumber, the temperature self-correlation dominates as one moves towards higher wavenumbers. However, for the narrow bands more relevant for the radiative transfer, all correlations within the radiative emission term are comparable. Absorption-TRI is less important than emission-TRI, but it can be non-negligible for strongly-absorbing bands. The validity of the optically-thin fluctuations approximation is verified across the spectrum for both RANS and LES calculations.

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