THE INFLUENCES OF SPECTRAL MODELING OF RADIATIVE PROPERTIES AND SOLUTION METHOD OF THE RADIATIVE TRANSFER EQUATION IN SIMULATIONS OF NONPREMIXED TURBULENT JET FLAMES

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ABSTRACT Radiation is one of the important modes of heat transfer in combustion systems. The objective of this article is to compare the effects of various radiation models to simulate turbulent combustion systems. Both nonluminous and luminous methane–air nonpremixed turbulent jet flames are simulated using comprehensive combustion solver software, which consists of a finite-volume/probability density function-based flow–chemistry solver interfaced with a spectral radiation solver. Flame simulations are performed using various *k*-distribution-based spectral models and radiation transport equation (RTE) solvers, such as *P-1*, *P-3* and Photon Monte Carlo (PMC) methods, with/without the consideration of turbulence–radiation interactions. Turbulent–radiation interactions are found to drop the peak temperature by close to 150 K for a luminous (optically thicker) flame and 25–100 K for nonluminous (optically thinner) flames. RTE solvers are observed to have stronger effects on peak flame temperature, total radiant heat source and NO emission than the spectral models.