EFFECTS OF RADIATIVE PROPERTY MODELS AND TURBULENT RADIATION INTERACTION ON FLAME STRUTURE AND RADIATIVE HEAT TRANSFER IN OXYGEN-ENRICHED SOOTING TURBULENT JET FLAMES

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ABSTRACT. An oxygen-enriched ethylene/methane turbulent jet flame was simulated by using a transported PDF method to close properly the emission Turbulence Radiation Interaction (TRI) term whereas the absorption TRI term was modeled by considering the Optically-Thin Fluctuation Approximation (OTFA). The effects of four radiative property models, namely the Narrow-Band Correlated-K (NBCK), the Wide-Band Correlated-K (WBCK), the Full-Spectrum Correlated-K (FSCK) and a recent version of the Weighted-Sum-of-Grey-Gases (WSGG), on the predictions of flame structure and radiative outputs were quantified. Additional simulations were run without considering TRI. Model results show that WBCK and FSCK predict solutions in close agreement with the NBCK used as reference. Larger discrepancies were observed in the results of WSGG or when TRI is disregarded with deviations from the results of NBCK with TRI on the order of 20% for the radiative outputs. However, for this flame, the flame structure and soot production were found to be less sensitive to these two approximate radiation models.