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Role of Unsteady Effects in Radiation Heat Losses in Turbulent Nonpremixed Flames A. CODY NUNNO, JEFFRY K. LEW, MICHAEL E. MUELLER, Princeton University — Accounting for heat losses due to radiation in turbulent nonpremixed flames is critical for predicting pollutants such as nitrogen oxides and soot. In reduced-order manifold approaches (flamelet models), the effects of heat losses require the computation of thermochemical states with reduced enthalpy. In this work, the role of unsteady effects in radiation heat losses is assessed by examining two methods for computing thermochemical states at reduced enthalpy. In the first method, unsteady flamelet equations including a radiation heat loss source term are solved at constant scalar dissipation rate, initialized with adiabatic solutions of the steady flamelet equations. In the second method, only steady flamelet equations with a radiation heat loss source term are solved but with a variable coefficient on the source term range from zero to unity. Both approaches are applied to the Sandia D flame. A priori analysis of the two methods indicates that the two methods are equivalent at larger scalar dissipation rates and/or smaller heat losses. A posteriori comparisons of Large Eddy Simulation (LES) with experimental measurements will be used to determine the relative effects of the two approaches on predictions of temperature, major species, and pollutants.

Austin Cody Nunno
Princeton University

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