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Estimates of the unsteady extinction frequency in turbulent non-premixed flames with simple stochastic models JOHN HEWSON, Sandia National Laboratories — The prediction of statistics for flame extinctions is a key challenge in predictive modeling for non-premixed turbulent combustion. Here we use a simplified measure of unsteady flame extinction based on the excess dissipation above a steady-state extinction scalar dissipation rate integrated over time, a quantity referred to as the dissipation impulse. The dissipation impulse that leads to extinction has been related to the shape of the so-called S-curve describing steady-state flame phase state. The statistics for extinction frequency given this model are studied using a simple Ornstein-Uhlenbeck process to describe dissipation rate evolution. This predicts an extinction rate as a function of (1) the characteristics of the steady-state flame behavior through the S-curve, (2) the probability that the extinction dissipation rate is exceeded and (3) the frequency with which the extinction dissipation rate is observed. The extinction frequency is further interpreted in the context of the analogous Fokker-Planck (FP) equation for the flame temperature-dissipation probability phase space. In the FP context the rate is a function of the phase-space advection fluxes and the probability densities. This suggests simplified estimates for rates of extinction in turbulent non-premixed flames may be possible with less computational effort than has typically been required.

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