Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Representation of the Essential Flame-Turbulence Dynamics using Specific Flame-Vortex Interactions PAULO L. K. PAES, The Pennsylvania State University, JAMES BRASSEUR, University of Colorado, Boulder, YUAN XUAN, The Pennsylvania State University — Many engineering applications involve turbulent reacting flows, where nonlinear, multi-scale turbulence-combustion couplings are important. Directly resolving the complex fluid dynamics involved in these applications is associated with prohibitive computational costs, which makes it necessary to employ turbulent closure models and turbulent combustion models to account for the effects of unresolved scales on resolved scales. Most of these existent closure models rely on some assumptions about the turbulence dynamics and the scale separation between turbulence and the different combustion processes. A better understanding of the turbulence-combustion interactions is required for the development of more accurate, physics-based sub-grid-scale models for turbulent reacting flows. Instead of developing an extreme-resolution, high Reynolds number turbulent flame simulation that is limited to a localized part of the regime diagram, in this work, we propose to develop a series of numerical experiments of simplified interactions between a laminar premixed flame and specified vortex distributions of varying strengths and scales to capture the essential flame-turbulence dynamics over distinct premixed turbulent combustion regimes. The response of the laminar flame to different vortex time and length scales is investigated and the physical relevance of each dataset to practical turbulent premixed flames is discussed.

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Date submitted: 01 Aug 2016 Electronic form version 1.4