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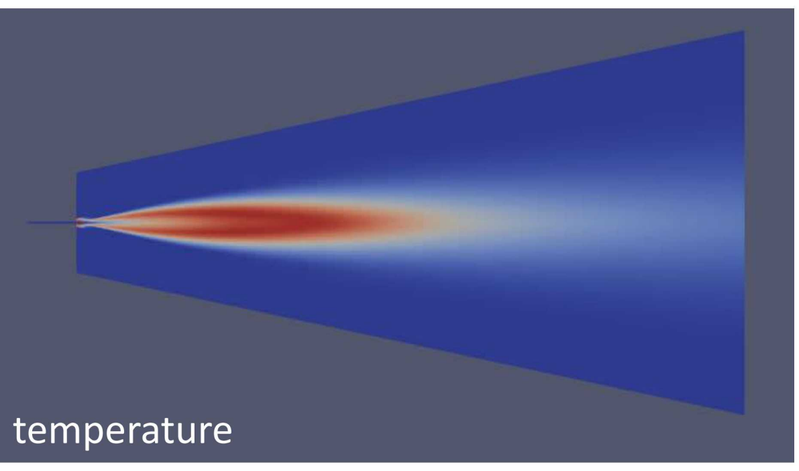

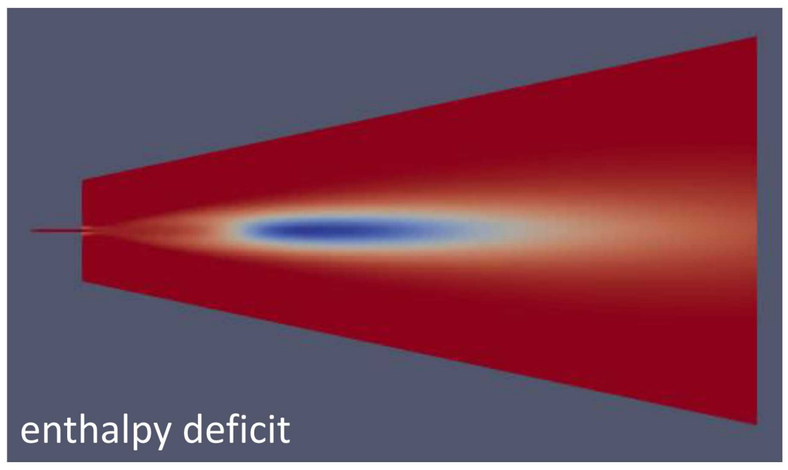

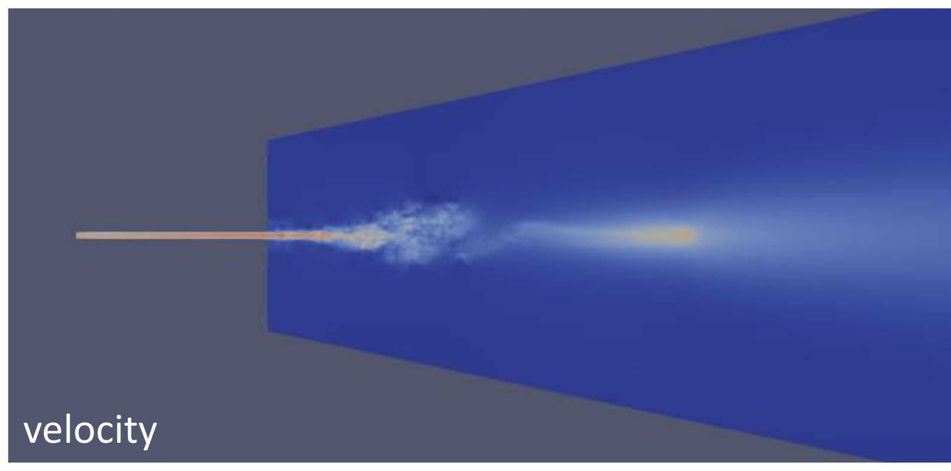

Jet Flame Radiation with Soot

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Abstract

This project aims to understand the effects of various parameters on the soot and enthalpy evolution in jet flames. Jet velocity, soot rate factor, gas radiation factor, and fuel type were found to have competing effects on the soot production, radiative losses, and time scale of the flame.

Introduction

Flames are characterized by a *residence time* τ (the time for a stoichiometric mixture of products to pass through the visible flame volume) and a *radiant fraction* χ_R (the ratio of radiative heat transfer to chemical energy released).

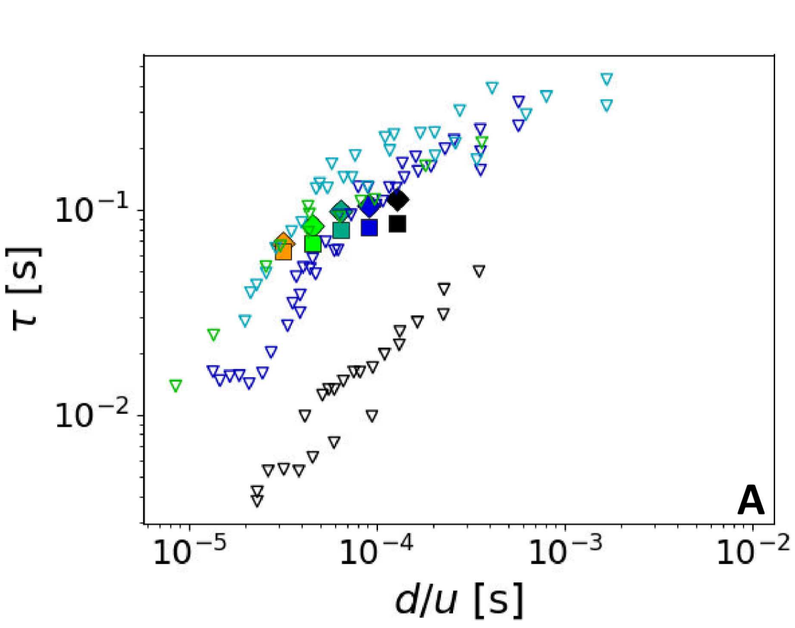
$$\tau = \frac{\rho_f W_f^2 L_f f_s}{3\rho_0 d^2 u}, \quad \chi_R = \frac{\gamma''}{f'' h_c}$$

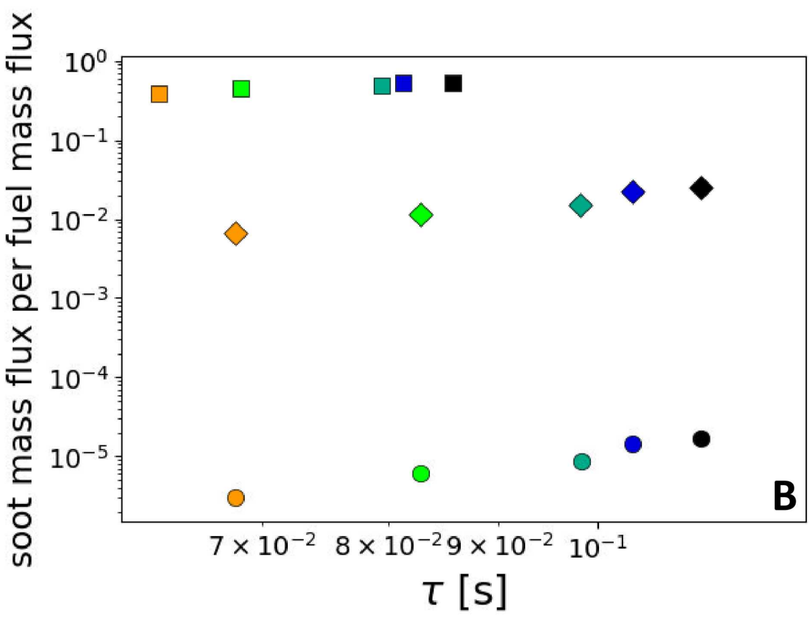
Methods

Simulations were run using SIERRA Fuego, Nalu, and Syrinx. Analysis was performed using ParaView and Python. The sooting propensity was varied artificially to mimic a range of fuels.

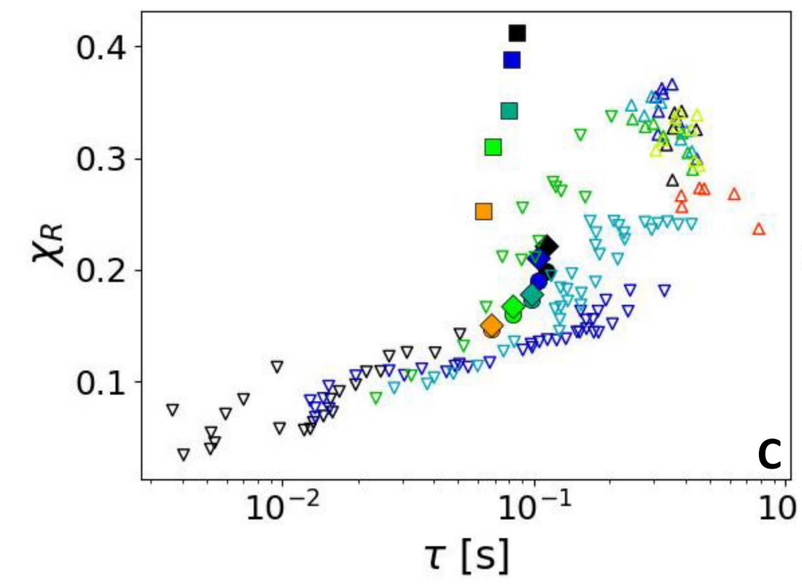
Results and Discussion

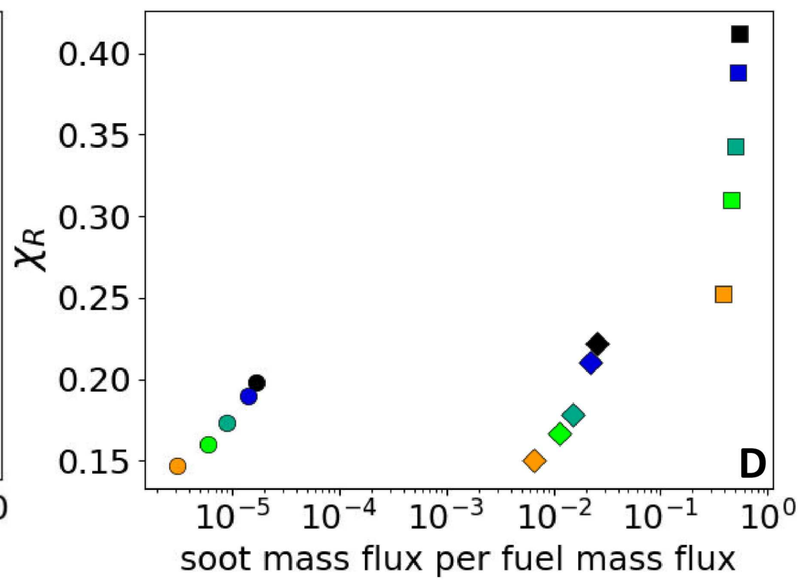
Velocity drives mixing and limits residence time (A). Increased residence times lead to increased soot and radiation, until increased radiation limits soot. (B).



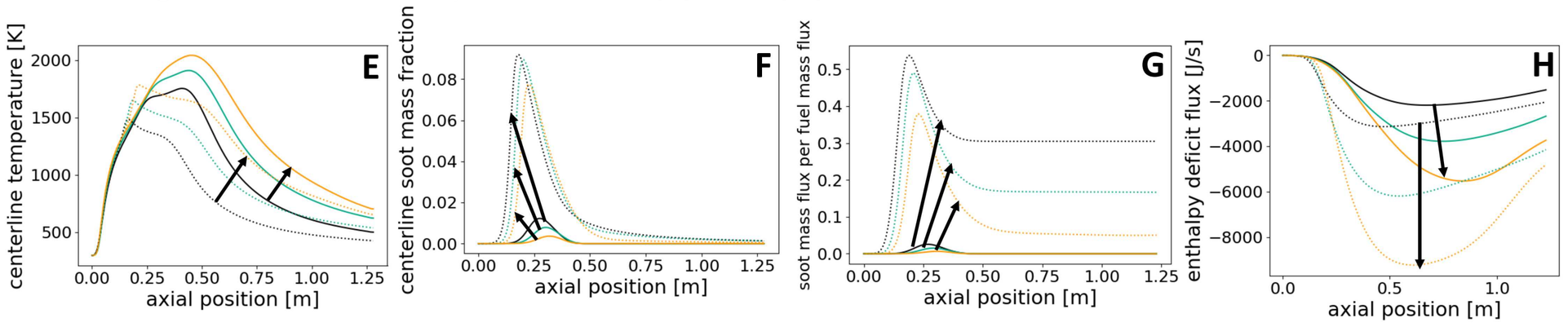


Short residence times limit soot formation and radiant emissions (C). Increased soot leads to increased radiation, until radiation losses limit soot (D).





Evolution along the jet (E-H). Increasing velocity indicated by arrows on (E) and (H); increasing soot indicated by arrows on (F) and (G).



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[2] Zeuthen, E.; Blunck, D. *Energy Fuels,* 2017, *31*, 14150-14160.

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