Modeling sub-grid scale mixing of vapor in diesel sprays using jet theory

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Abstract

In a reacting diesel spray the flame stabilizes at the lift-off location. It is widely known that mixing in reacting sprays is an important factor in the determination of the lift-off length. These details can be captured using computational techniques using CFD with a very fine mesh resolution. Use of a coarse resolution over-predicts mixing due to large numerical diffusion and thus reduces the lift-off length. In this study a sub-grid scale model based on classical jet theory is presented, where the vapor-air mixing is modeled with a combined Lagrangian and Eulerian approach. The vapor is transported as a Lagrangian particle consistent with jet mixing and transport theory until the jet mixing is resolved by the mesh scale. In this way, the results show improved predictions of vapor-tip penetration and lift-off length with coarse mesh resolutions. The new model offers a potential tool for investigating reacting sprays with coarser mesh resolution in order to save computational time.

Key words: Reacting Sprays, Lagrangian approach, Lifted flames, Jet theory, Mixing

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