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Quantitative saltwater modeling for validation of sub-grid scale LES turbulent mixing and transport models for fire PIETRO MAISTO, ANDRE MARSHALL, MICHAEL GOLLNER, Department of Fire Protection Engineering, University of Maryland, College Park — A quantitative understanding of turbulent mixing and transport in buoyant flows is indispensable for accurate modeling of combustion, fire dynamics and smoke transport used in both fire safety design and investigation. This study describes the turbulent mixing behavior of scaled, unconfined plumes using a quantitative saltwater modeling technique. An analysis of density difference turbulent fluctuations, captured as the collected images scale down in resolution, allows for the determination of the largest dimension over which LES averaging should be performed. This is important as LES models must assume a distribution for sub-grid scale mixing, such as the ?-PDF distribution. We showed that there is a loss of fidelity in resolving the flow for a cell size above $0.54D^*$; where D^* is a characteristic length scale for the plume. Such a point represents the threshold above which the fluctuations start to monotonically grow. Turbulence statistics were also analyzed in terms of span-wise intermittency and time and space correlation coefficients. An unexpected condition for the core of the plume, where a substantial amount of ambient fluid (fresh water) is found, and the mixing process under buoyant conditions were found depending on the resolution of measurements used.

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