Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

A Virtual Study of Grid Resolution on Experiments of a Highly-Resolved Turbulent Plume PIETRO M. F. MAISTO, ANDRE W. MARSHALL, MICHAEL J. GOLLNER, University of Maryland, FIRE PROTECTION ENGINEERING DEPARTMENT COLLABORATION — An accurate representation of sub-grid scale turbulent mixing is critical for modeling fire plumes and smoke transport. In this study, PLIF and PIV diagnostics are used with the saltwater modeling technique to provide highly-resolved instantaneous field measurements in unconfined turbulent plumes useful for statistical analysis, physical insight, and model validation. The effect of resolution was investigated employing a virtual interrogation window (of varying size) applied to the high-resolution field measurements. Motivated by LES low-pass filtering concepts, the high-resolution experimental data in this study can be analyzed within the interrogation windows (i.e. statistics at the sub-grid scale) and on interrogation windows (i.e. statistics at the resolved scale). A dimensionless resolution threshold (L/D*) criterion was determined to achieve converged statistics on the filtered measurements. Such a criterion was then used to establish the relative importance between large and small-scale turbulence phenomena while investigating specific scales for the turbulent flow. First order data sets start to collapse at a resolution of 0.3D*, while for second and higher order statistical moments the interrogation window size drops down to 0.2D*.

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Date submitted: 31 Jul 2017 Electronic form version 1.4