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Fluctuations in Atmospheric Boundary Layer Plumes JAY BORIS, DAVID FYFE, Naval Research Laboratory, MIYOUNG OBENSCHAIN, Berkeley Research Associates, KEITH OBENSCHAIN, GOPAL PATNAIK, Naval Research Laboratory — Pollution and short-term health considerations require the accurate prediction of airborne contaminant transport in cities. Even when a stationary source emits tracer gases continuously, the resulting plume fluctuates vigorously in the turbulence that results from air passing over any typical landscape. Computing this flow properly requires large-eddy simulations that resolve the vortices shed from buildings, trees, and terrain because these coherent effects govern the “turbulent” dispersion of pollutants, tracer gases, and potentially toxic agents. This paper uses long-time, high-resolution detailed studies of one urban configuration, computed with 5-meter spatial resolution and sub-second temporal resolution, to quantify the deviations of passive tracer plumes from steady state. Even when concentration values at a point are averaged over long times, as an accumulating sensor might do, the range of probable values spans orders of magnitude. At a 5-km scale, averaging tracer concentrations for as long as an hour still leaves likely sampling fluctuations of plus or minus a factor of ten from the long-time average.

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