Relating Laboratory-Scale Dispersion Experiments to Full-Scale Field Data from Jack Rabbit II

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Urban areas create complex turbulence, dispersion, and flow patterns that affect downwind and ground level pollutant concentrations. The urban canopy also alters atmospheric boundary layer wind profiles due to wake turbulence generated from wind flow around buildings and within street canyons. This can result in challenging situations for local officials or emergency responders who must plan for or remediate infrastructure after major chemical, biological, or radiological (CBR) incidents. While many dispersion models can capture the downwind effects from buildings, some fall short in terms of accuracy or ease of use. As a result, field and laboratory tests are often employed to simulate releases and are critical in refining current dispersion models. This project leverages data from the Special Sonic Anemometer Study that occurred as part of the 2016 Jack Rabbit II (JRII) field study. JRII was conducted at Dugway Proving Ground (DPG), UT, where large releases of chlorine gas were dispersed within an array of 83 CONEX shipping containers of various sizes. The CONEXs were meant to mimic buildings within an urban area, with the goal of providing information to improve models and emergency response techniques. During the Special Sonic Anemometer Study, flow and turbulence around the obstacles were measured from a network of 30 sonic anemometers dispersed around the CONEX array. An upwind 32m sonic tower at the JRII test site was also analyzed for near neutral atmospheric conditions. A 1:50 scaled model of the JRII study area and neutrally buoyant boundary layer has been developed and tested within EPA’s Fluid Modeling Facility (FMF) Meteorological Wind Tunnel (MWT) to examine the complex flow and dispersion patterns within this scaled mock urban environment. Flow visualizations were conducted to observe the localized effects of the buildings, which also help to interpret quantitative data gathered within the wind tunnel lab. These data include wind velocity flow measurements collected through Laser Doppler Velocimetry (LDV), as well as neutrally-buoyant tracer concentrations that simulate ground-level and elevated releases. This presentation will discuss current and ongoing wind flow data analyses from the sonic anemometers and the scaled wind tunnel study, with an emphasis on microscale processes occurring between and in lee of buildings. The ultimate goal is to use the wind tunnel and field datasets to improve urban parameterizations in Gaussian dispersion models, which are important tools for efficient and precise emergency preparation and response applications.