Measurements and Modeling of Greenhouse Gases and the Planetary Boundary Layer for the Boston Metro Area and the Northeastern Megalopolis

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The accuracy of greenhouse gas (GHG) emission and air quality simulations reflects the fidelity of the atmospheric transport model employed that in turn is highly dependent on the accuracy of the meteorological input data. We describe a multi-scale measurement network and model-data analysis framework for the Boston Metro region, with extension to the mid-Atlantic urban corridor. Observations include a network of automated concentrations of CO_2 and CH_4 inside and outside the urban domain, near the surface, on towers and tall buildings, total column measurements using the sun as a source, aerosol LiDAR data defining atmospheric structure, and meteorological data. The model-data analysis framework includes a Lagrangian particle dispersion model (LPDM), the Stochastic Time-Inverted Lagrangian Transport (STILT), driven by meteorological fields from the North American Regional Reanalysis (NARR) and Weather Research and Forecasting (WRF) model, and an inversion framework. We show examples of data and discuss the observational network's sampling design and a plan for extension to the NE urban corridor of the US. These urban studies are demonstrating the feasibility and value of incorporating advanced instrumentation such as the Mini Micro Pulse LiDAR to evaluate and improve the fidelity of the WRF simulations of atmospheric transport and structure in the planetary boundary layer, thereby reducing the uncertainty of top-down inverse model estimates of GHG emission fluxes.

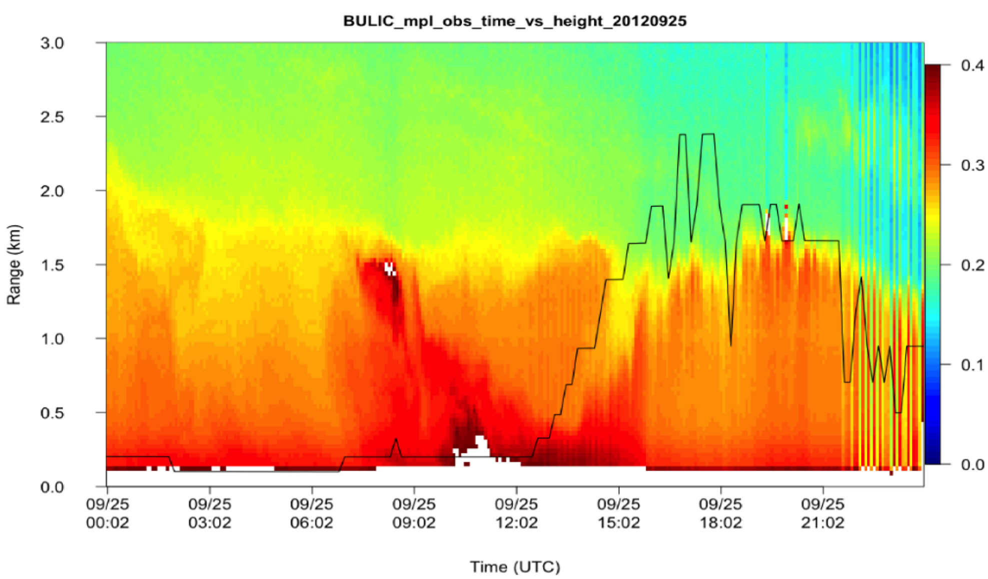

Figure 1. WRF Model PBL Height (black line) versus Mini Micro Pulse LiDAR Aerosol Backscatter Data.