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Urban-Dome GHG Monitoring: Challenges and Perspectives from the INFLUX Project

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Quantification of carbon dynamics in urban areas using advanced and diverse observing systems enables the development of measurable, reportable, and verifiable (MRV) mitigation strategies as suggested in the Bali Action Plan, agreed upon at the 13th Conference of the Parties of the UNFCCC (COP 13, 2007). The National Institute of Standards and Technology (NIST), supports the Indianapolis Flux Experiment (INFLUX). INFLUX is focused on demonstrating the utility of dense, surface-based observing networks coupled with aircraft-based measurements, advanced atmospheric boundary layer observation and modeling to determine GHG emission source location and strength in urban areas. The ability to correctly model transport and mixing in the atmospheric boundary layer (ABL), responsible for carrying GHGs from their source to the point of measurement, is essential. The observing system design, using multiple instruments and observing methods, is intended to provide multi-scale measurements as a basis for mimicking the complex and evolving dynamics of a city. To better understand such a dynamic system, and incorporate this into models, reliable representations of horizontal and vertical transport, as well as ABL height, GHG mixing ratio measurements are planned for 11 tower locations, 2 are currently in operation with the remaining 9 planned for operational status in early to mid-2012. These observations are complimented by aircraft flights that measure mixing ratio as well as ABL parameters. Although measurements of ABL mixing heights and dynamics are presently only available intermittently, limiting efforts to evaluate ABL model performance and the uncertainties of GHG flux estimates, expansion of them is planned for the near future. INFLUX will significantly benefit from continuous, high resolution measurements of mixing depth, wind speed and direction, turbulence profiles in the boundary layer, as well as measurements of surface energy balance, momentum flux, and short and long wave radiation fluxes.

NIST is working with partner institutions to develop the measurement science and measurement tools needed to improve the accuracy and comparability of surface-based measurement approaches for MRV purposes. The current project phase is focused on determination of emission source location with a spatial resolution of approximately 1 km2 and of sources strength to within 20% uncertainty, in part for comparison to inventories. Additionally, the demonstration of a robust, dense observing network methodology will provide a means to characterize urban GHG domes and provides a calibration method for remote sensing measurements whether taken by on-orbit, terrestrial, or airborne observations. The Indianapolis Flux experiment is the initial research effort to demonstrate this approach to emissions verification. Lessons learned in INFLUX are expected to be extensible to other urban and regional settings, suggesting further research to be conducted for areas having significantly different terrain and meteorology.