Estimates of the Sampling Footprints of Current and Future Tall-Tower Continuous Monitoring Sites

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CMDL began making continuous measurements of CO_2 and other species from tall (>400 m) towers in 1992 to investigate land-based sources and sinks of carbon dioxide. CO_2 mixing ratios in the planetary boundary layer are highly variable, and many factors need to be considered when interpreting data from the tower sites. Atmospheric transport models can provide the meteorological context for the observations, and, in particular, backward running models provide estimates of the upwind "sampling footprint" or "region of influence" corresponding to a particular observation (Figure 1). In this study we use two independent models to examine the sampling footprints of existing and potential future tall-tower monitoring sites. The first model is the Stochastic Time-Inverted Lagrangian Transport (STILT) model, which has been used for analysis of aircraft data. The second model is the adjoint version of the Tracer Model Version 5 (TM5), which has been used to analyze CMDL discrete air samples data. These results will inform analysis of data from existing sites and can be used to aid site selection for future sites. In particular, we will explore spatial and temporal correlations among the observations, and we will identify potential future tower sites that are highly sensitive to the domain of the Midwest Intensive phase of the North American Carbon Program.

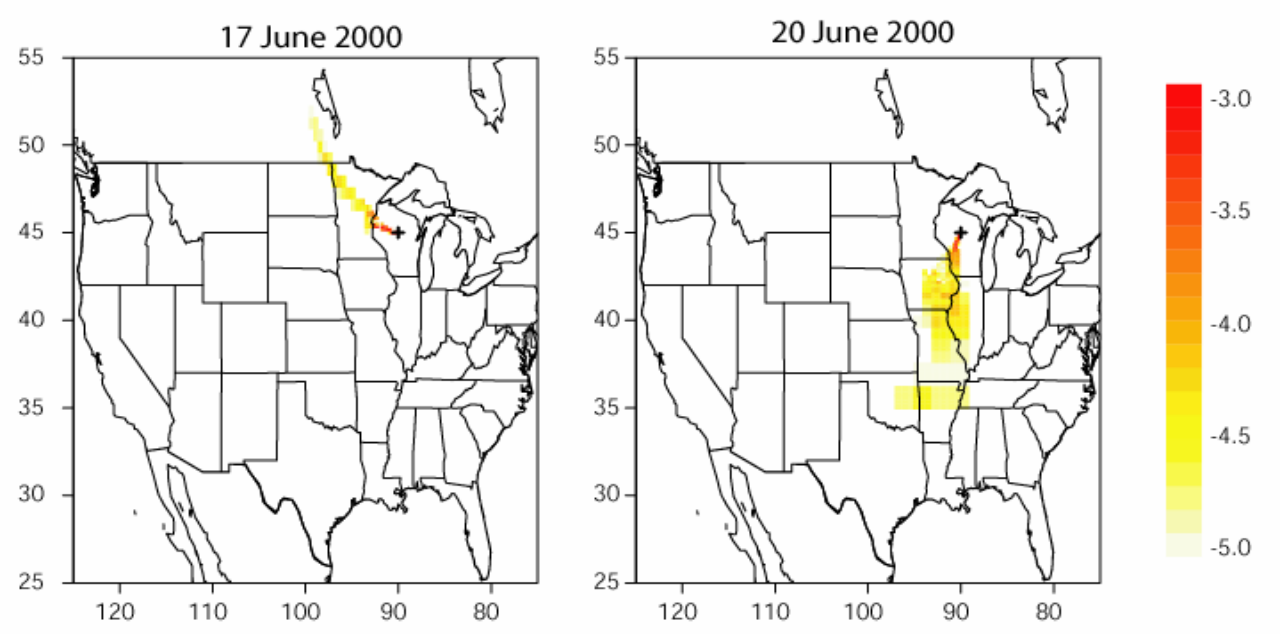

Figure 1: Typical sampling footprints from the STILT model for the WLEF tall-tower monitoring site. Colors represent the log of the sensitivity (ppm (μmol^{-1} m^2 s). The model was initiated at 500 m above ground level at 1900 UTC, and the sensitivity was integrated backward in time for 72 hours.