THE NOAA CMDL TALL TOWER OBSERVING NETWORK: NEW RESULTS AND PLANNED EXPANSION

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ABSTRACT
The National Oceanic and Atmospheric Administration's Climate Monitoring and Diagnostics Laboratory has been working to build a network of tall tower monitoring sites over the US since the early 1990's. Tall tower CO_2 mixing ratio measurements are sensitive to upwind fluxes over scales of hundreds of kilometers. Such measurements therefore place strong constraints on estimates of regional scale carbon budgets. We have used the Stochastic Time Inverted Lagrangian Transport (STILT) model to evaluate the relative contributions of upwind sources and sinks to simulated CO_2 mixing ratios at existing and proposed new tower sites. For example, sampling footprints from STILT have been combined with estimates of hourly ecosystem CO_2 fluxes from the Simple Biosphere (SiB) model to investigate the spatiotemporal influence of different biomes on observed CO_2 concentrations at the towers. Contributions of fossil fuel and oceanic CO_2 fluxes can also be quantified using this method.

BACKGROUND
Continuous observations of CO_2 and CO mixing ratios and meteorological parameters are currently being made at three tower sites, along with weekly flask samples that are analyzed for a variety of trace species [*Bakwin et al*, 1998]. Approximately nine new tower sites are planned for the next several years. Fig. 1 shows the proposed network through 2007. We plan to make continuous measurements of CO_2 and CO from three heights on each tower (~30m, 120m and >400m). Meteorological parameters (T, RH, wind speed and direction) will be measured at each sampling height. Flask samples will be collected at least once per day from the highest sampling level and will be analyzed for CO_2, CO, CH_4, N_2O, SF_6, H_2, isotopes and a variety of halocarbon and hydrocarbon species. Additional capabilities for flask sampling, such as vertical profiling, may eventually be implemented. The continuous

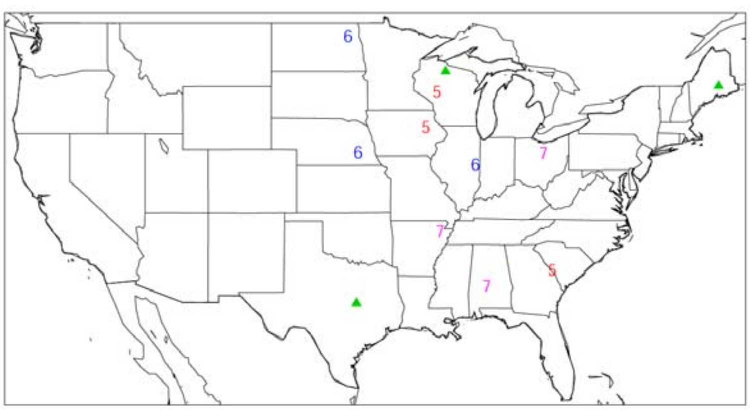

Fig. 1. Proposed NOAA/CMDL Tall Tower Network in 2007.

CO measurements along with the flask samples are expected to provide information about the transport history and upwind influences affecting observed CO_2.

ANALYSIS

Gloor et al. (2001) used modeled back-trajectories along with observations of C_2Cl_4 to estimate that the footprint for tall tower concentration measurements is of order 10^6 km^2. Tall tower measurements can therefore effectively constrain estimates of carbon sources and sinks on regional and continental scales. We have used the STILT Lagrangian particle dispersion model [*Lin et al.*, 2003; *Gerbig et al.*, 2003] to estimate sampling footprints for current and proposed tower sites (Fig. 2). These STILT footprints can be combined with estimates of biogenic, fossil fuel and oceanic CO_2 fluxes to investigate their relative contributions to expected variability. Of particular interest are results obtained using hourly biogenic CO_2 fluxes calculated by the Simple Biosphere (SiB) model [*Denning et al.*, 1996; *Schaefer et al.*, 2002], which provide insight into factors influencing the diurnal cycle of CO_2 within the planetary boundary layer.

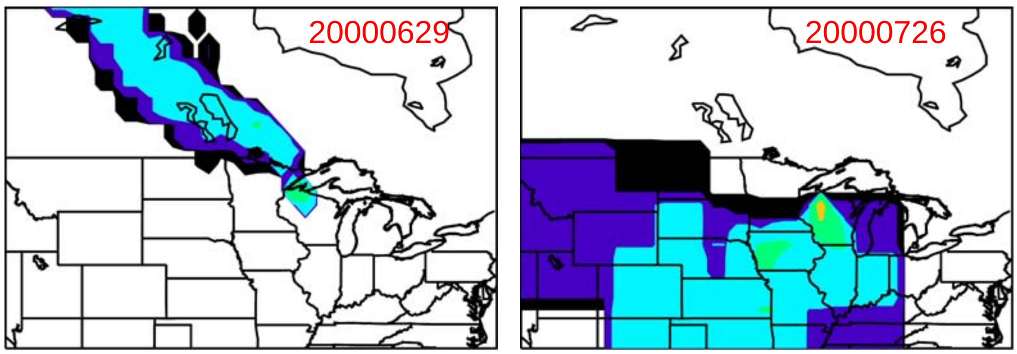

Fig. 2. STILT footprints for two time periods in Summer 2000. Footprints represent 5-day composites. The contour scale is logarithmic with each step corresponding to a factor of 10.

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