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Regional CO2 fluxes estimated over North America for 2004 using a geostatistical inverse model

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Global inverse models have identified an overall CO_2 sink in the Northern Hemisphere terrestrial biosphere, but the spatial distribution of the sink within the North American and Eurasian continents is still subject to high uncertainty. Regional-scale inverse models provide the opportunity to infer sub-continental scale CO_2 fluxes, and have recently become feasible due to the availability of continuous atmospheric CO_2 measurements at continental locations and improvements in high-resolution atmospheric transport models. In addition, the geostatistical approach to inverse modeling, in contrast to Bayesian approaches, can estimate CO_2 sources and sinks at relatively fine resolution without the use of prior flux distributions from biospheric models, thereby providing an independent validation tool for bottom-up understanding of flux (Michalak et al. 2004; Mueller et al., 2008).

The results from a regional geostatistical inversion study over North America are presented, which estimates CO_2 fluxes at a 1°x1° spatial and an 8-day temporal resolution for 2004, using continuous atmospheric CO_2 measurements from 9 continental tower locations (Hirsch et al., in prep) and weekly flask measurements where available (Figure 1). Auxiliary variables significantly related to flux (e.g. Leaf Area Index, Fire Counts or Population Density) are selected using statistical variable selection techniques, and then incorporated directly into the inverse model. These variables help to constrain 1°x1° fluxes in areas under-sampled by the atmospheric measurement network, while their relationships to flux, as estimated by the inversion, provide insight into the magnitude of the processes controlling CO_2 flux variability as seen through the atmospheric data (Gourdji et al., 2008). Net annual fluxes are compared to output from two biospheric models to identify regions within North America where bottom-up and top-down methods for flux estimation converge for this year. Improved understanding of regional carbon budgets and the processes controlling CO_2 fluxes at regional to continental scales, from studies like this one, can help to inform management strategies for maintaining (or increasing) terrestrial carbon stocks across North America.

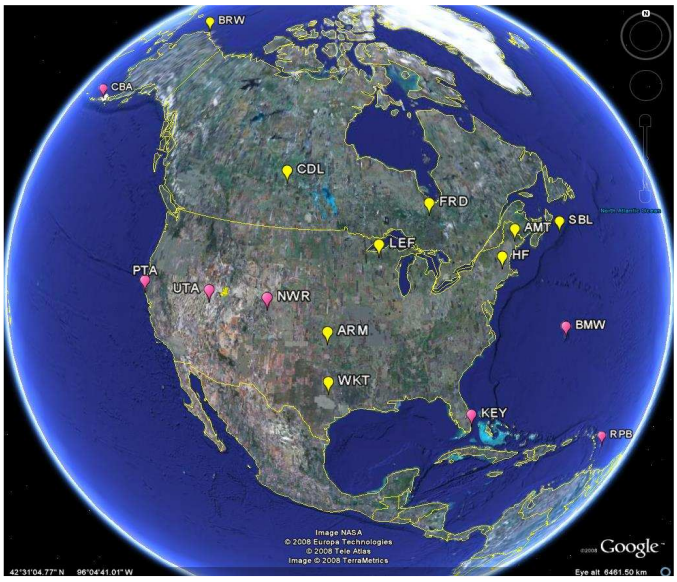

Figure 1: Continuous measurement locations (in yellow) and flask sampling sites (in pink) used in North American regional geostatistical inversion.

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