

Terrestrial Carbon Fluxes for North America Estimated from NOAA-ESRL CO₂ Observations

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We present an analysis of terrestrial net CO₂ fluxes for the period 2000-2004. These fluxes consist of weekly global maps at ~70km×100km resolution that are consistent with observed atmospheric CO₂ mixing ratios, as well as with varying climatic conditions across different ecosystems. The flux maps are created in a newly developed ensemble data assimilation system that consists of the atmospheric Transport Model v5 (TM5), simple descriptions of terrestrial and oceanic carbon exchange, and an efficient Bayesian least-squares algorithm to optimize the net CO₂ fluxes from different ecoregions against CO₂ mixing ratios from the NOAA/ESRL/GMD observing network. Our analysis shows a terrestrial carbon uptake in North America of 0.49±0.57 PgC/yr over this period, partitioned 70/30% between the temperate and Boreal regions. Strongest uptake is attributed to areas dominated by mixed crop- and grasslands in the US Midwest, and evergreen forests in the east of the US, although our system can not fully separate ecosystem fluxes reliably in this period due to the sparsity of the network. Terrestrial carbon sinks in Europe and Boreal Eurasia averaged 0.28±0.64 PgC/yr and 0.89±0.93 PgC/yr respectively. Although qualitative agreement is seen with reduced uptake in Europe related to summer droughts in 2003, the size of the anomaly is smaller than observed from ground-based instruments likely due to the sparsity of European mixing ratio sites in our current configuration. We expect the increased 2005 network, combined with the extensive set of CarboEurope observations to put stronger constraints on the estimated exchange.

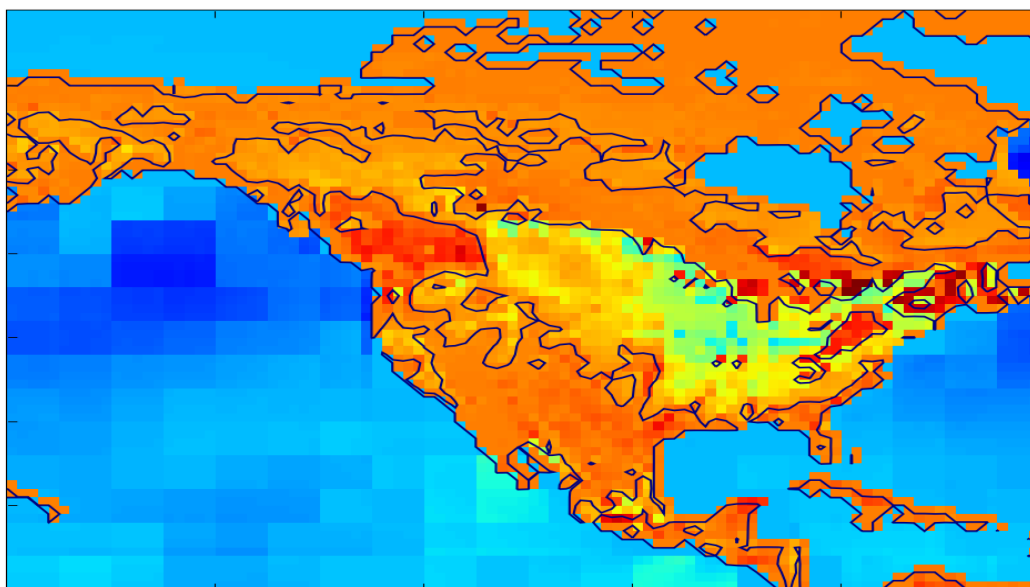


Figure 1. The annual mean pattern of net CO₂ exchange over North America for 2003 as derived from our data assimilation system. The zero-contour is in blue, maximum uptake in green corresponds to 0.7 $\mu\text{mol}/\text{m}^2/\text{s}$. Total terrestrial uptake for 2003 is 0.45±0.57 PgC/yr, partially offsetting the estimated 1.6 PgC/yr of fossil fuel release.