The Rocky Mountain Regional Atmospheric Continuous CO_2 Network

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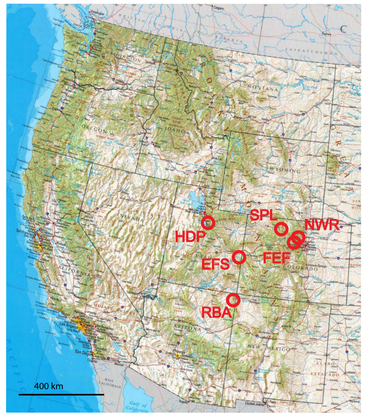
Overview: The Rocky Mountain Regional Atmospheric Continuous CO_2 Network (Rocky RACCOON) includes four high-alpine sites and two valley sites instrumented for continuous measurements beginning in August of 2005. We are utilizing these growing records to provide information on regional carbon exchange in the U.S. Central Rocky Mountains and Southwest, as well as to monitor the impact of disturbance on local valley-scales, with a goal of resolving key drivers of variability and trends in the carbon fluxes of mountain and semi-arid ecosystems, including drought, fire, and insect outbreak. Our data are available to the public on the internet in near real time to support quality control, local science, and larger scale synthesis efforts (http://raccoon.ucar.edu).



Panel 1. Existing Sites

The mountain-top RACCOON sites were selected to capture regionally representative air samples during well-mixed daytime or descending nighttime conditions. These include:

- Niwot Ridge (**NWR**) at 3523 m just west of Ward, Colorado
- Storm Peak Laboratory (**SPL**) at 3200 m near Steamboat Springs, Colorado
- Hidden Peak (**HDP**) at 3351 m near Snowbird, Utah
- Roof Butte (**RBA**) at 2982 m within the Navajo Nation in northeastern Arizona

An additional valley-bottom site was selected to observe the nighttime build-up of respired CO_2, but also produces daytime values similar to the other sites:

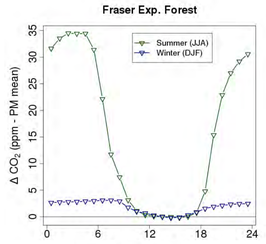
- Fraser Experimental Forest (**FEF**) at 2743 m in the St. Louis Creek Valley near Fraser, Colorado

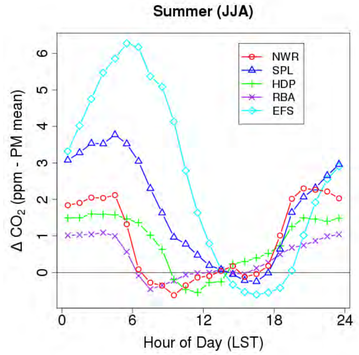
While another site intended to capture regional signals has turned out to also be sensitive to valley pooling:

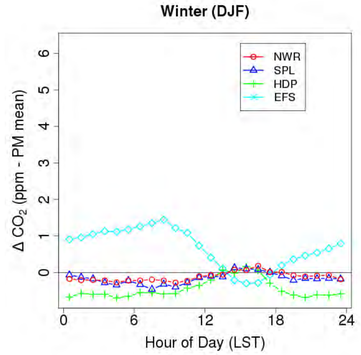
- Entrada Field Station (**EFS**) at 1280 m northeast of Moab, Utah

Panel 2. Diurnal Variations

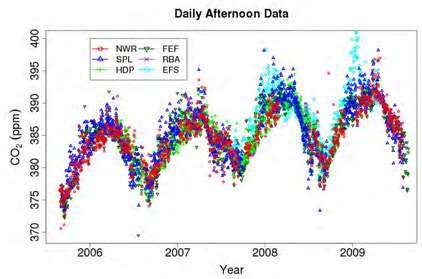
During summer, all sites show the influence of nighttime respiration and the onset of mixing and photosynthesis in the morning, however with important differences. NWR, HDP, and RBA show increasing CO_2 during the afternoon while CO_2 at SPL decreases. In winter the mountain-top sites show varying influences from the daytime lifting of valley CO_2 pools.



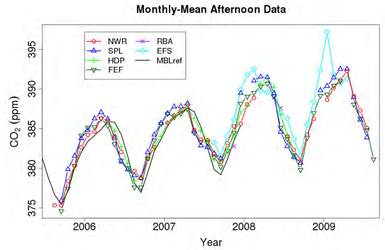


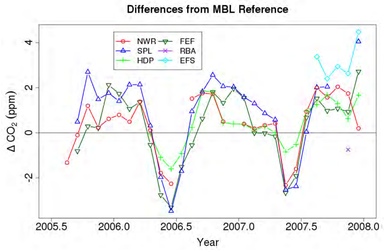


Panel 3. Comparisons to Background Concentrations



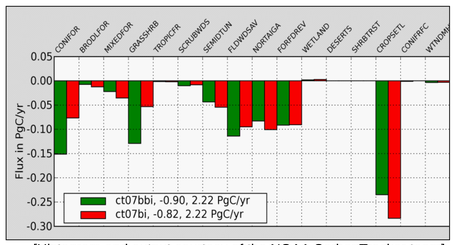
After filtering afternoon (1200-1600 LST) data for hourly standard-deviations < 1.0 ppm and local vertical gradients < 0.5 ppm, we compare to the GlobalView marine boundary-layer reference curve. These comparisons show consistent regional-scale flux signals that increase to the east, with a narrow uptake peak in spring and evidence of broader emission in fall and winter.



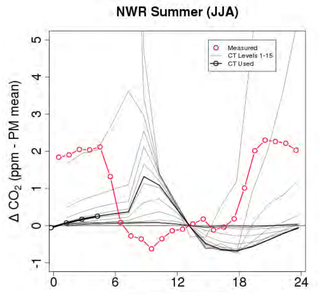


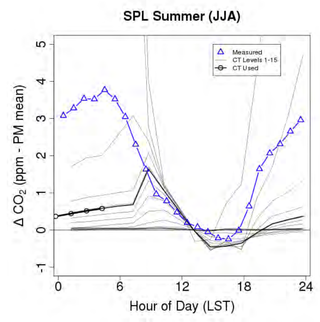
Panel 4. CarbonTracker Data Assimilation

Since 2007, data from NWR and SPL have been included in the NOAA CarbonTracker modeling effort. Inclusion of these sites led to decreased model uptake in coniferous forests and grasslands and increased model uptake in croplands in North America. However, coarse model topography results in the modeled sites being ~1000 m above ground, and having poorly matched summertime diurnal cycles. We are collaborating with the CarbonTracker team to improve the treatment of these mountain-top sites in the assimilation.



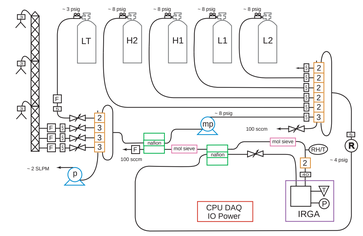
[Histogram and output courtesy of the NOAA CarbonTracker team]





Panel 5. Instrumentation and Intercomparison Efforts

CO_2 is measured using AIRCOA instrumentation (Stephens et al., WMO 2006) with four reference cylinders tied to the WMO CO_2 scale. The AIRCOA incorporate three daily checks of a surveillance gas introduced identically to sample air. In addition, we have had an ongoing intercomparison at NWR, with sub-weekly flasks collected by two different methods and measured by NOAA GMD. This intercomparison gives:



Network Flasks - AIRCOA = 0.07 ± 0.23 (n = 261); PFP - AIRCOA = -0.21 ± 0.39 (n = 249)