A Data Assimilation Approach for Improving Characterization of Regional Carbon Dioxide Within the U.S. Mountain West

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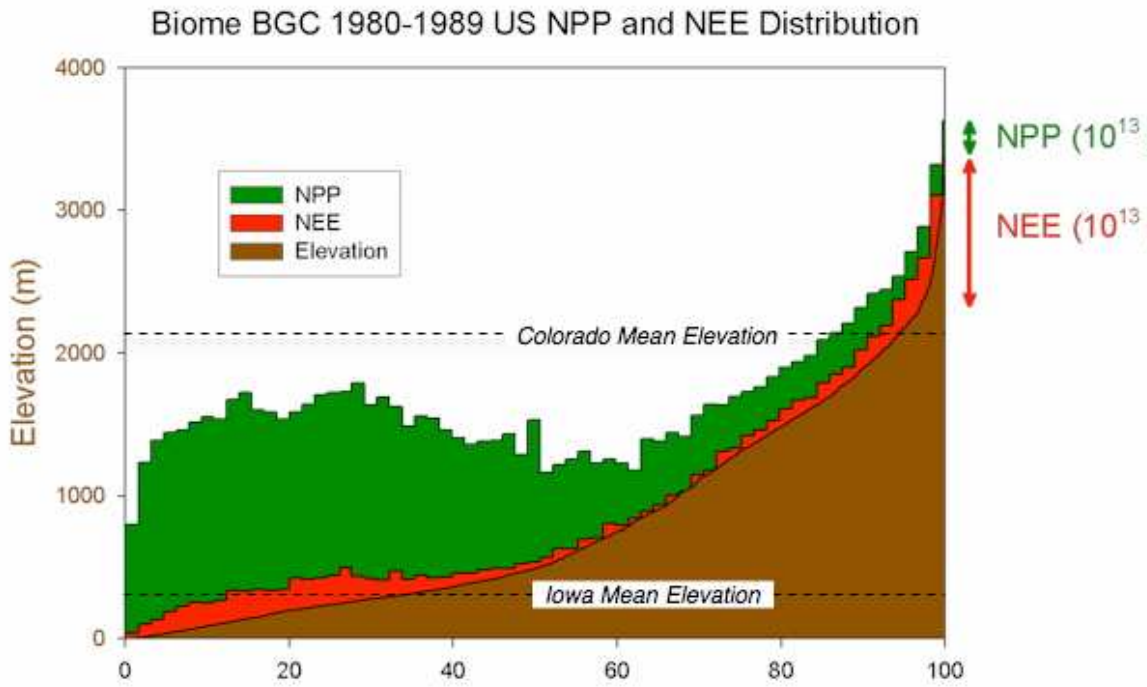
1. MOTIVATION
2. REGIONAL ATMOSPHERIC CONTINUOUS CO_2 NETWORK IN THE ROCKY MOUNTAINS (ROCKY RACCOON) & DATA MINING
3. DATA ASSIMILATION FOR IMPROVED FLUX RETRIEVALS IN THE MOUNTAIN WEST

Western Carbon Fluxes

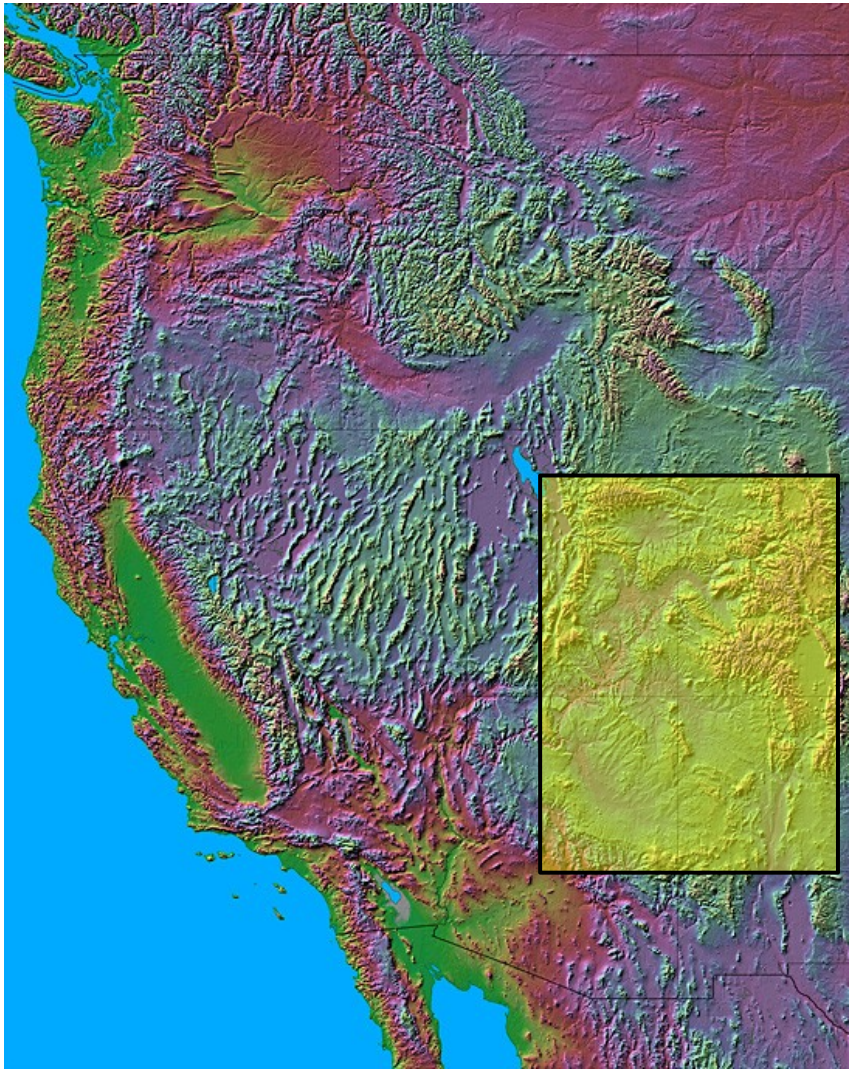
- Carbon fluxes over the US Mountain West are an important part of the total North American budget that are linked to long term carbon storage pools, some of which have persisted at low temperatures and have changed little over historical periods.

- Measuring the carbon flux over these pools will an important component of accurate regional and continental carbon flux characterization.



Essential questions (and Lofty Goals)

- How can we improve accounting of CO_2 fluxes (and their drivers) over the complex terrain of the US Mountain West?
- What is the sensitivity of Rocky Mountain CO_2 fluxes to warming, drought, fire, and pests?

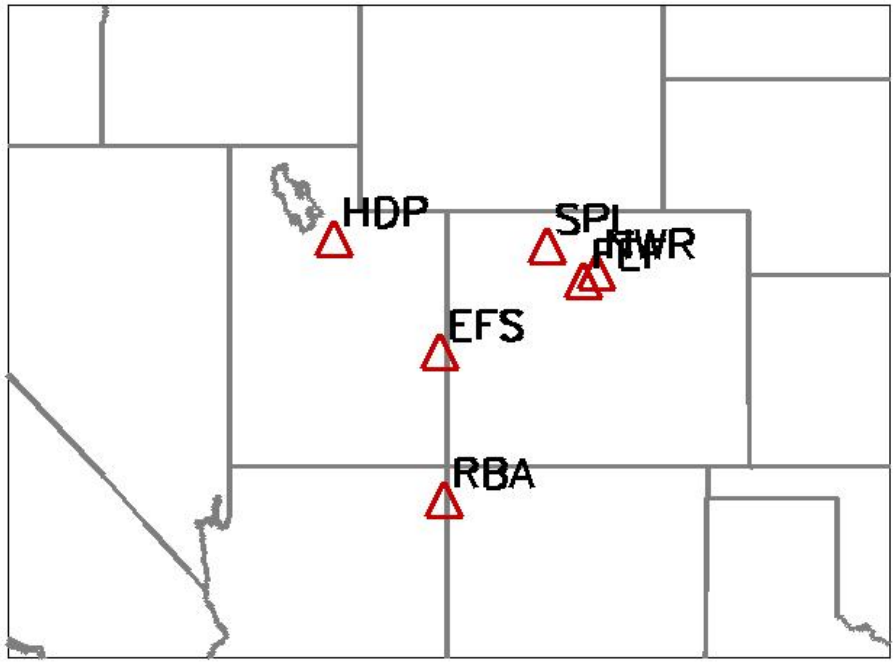


Challenges

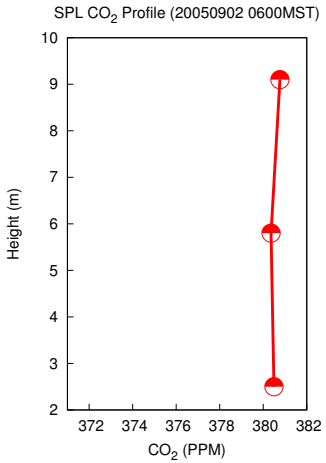
- The Mountain West is a complex of high elevation uplifted fault blocks, ridges, valleys and non-uniformly horizontal textured terrain over which dynamic boundary layer conditions preclude traditional eddy covariance techniques.
- A network of multi-level Autonomous Inexpensive Robust CO_2 Analyzer (AIRCOA) instruments in combination with vertical profiles from aircraft, and a trajectory model provide a way to estimate CO_2 flux over the Raccoon domain.

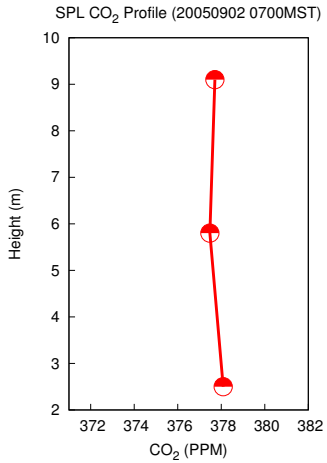
RACCOON Network Geography

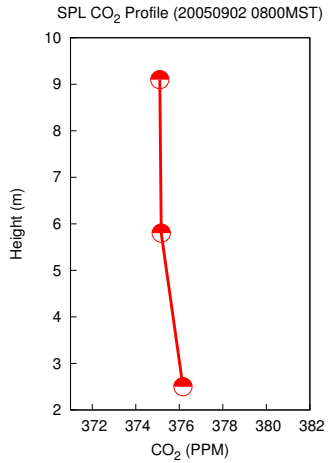
- The RACCOON Network consists of six towers across the US Mountain West.
- elevations: 1280 m-3523 m
  sample heights: 1.3 m-38.9 m
- The advantage of AIRCOA is low cost, and to increase accuracy and precision CO_2 analyzers are frequently calibrated and measurements represents time averages over 100 seconds, that are comparable to an accuracy less than one-half PPM.
- Fraser Experimental Forest (FEF), Niwot Ridge T-Van (NWR), Storm Peak Laboratory (SPL), Hidden Peak (HDP), Entrada Field Station (EFS), Roof Butte

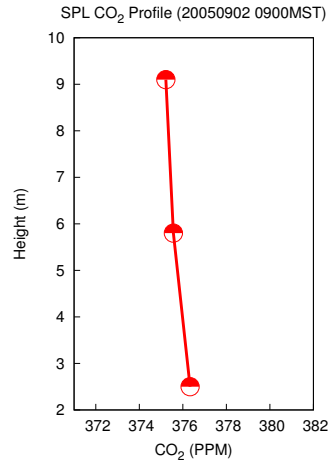


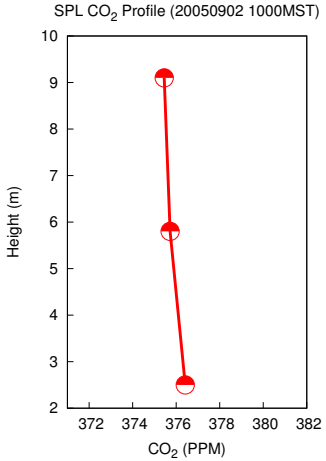
RACCOON Network Data: Vertical CO_2 Profiles

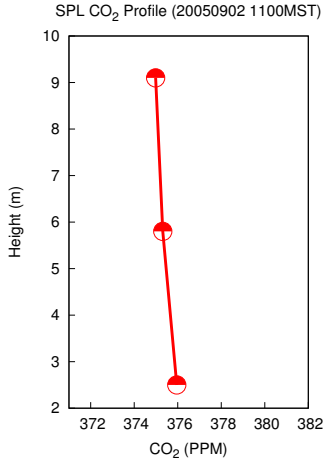


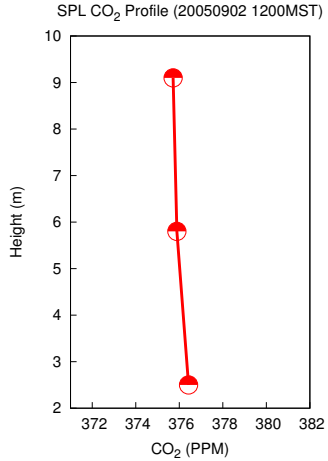


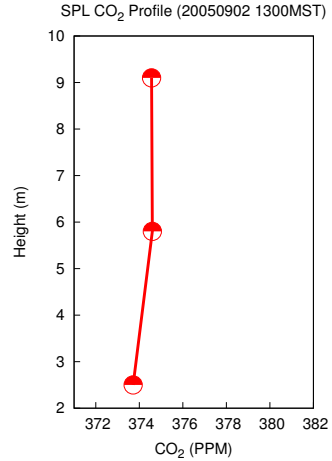




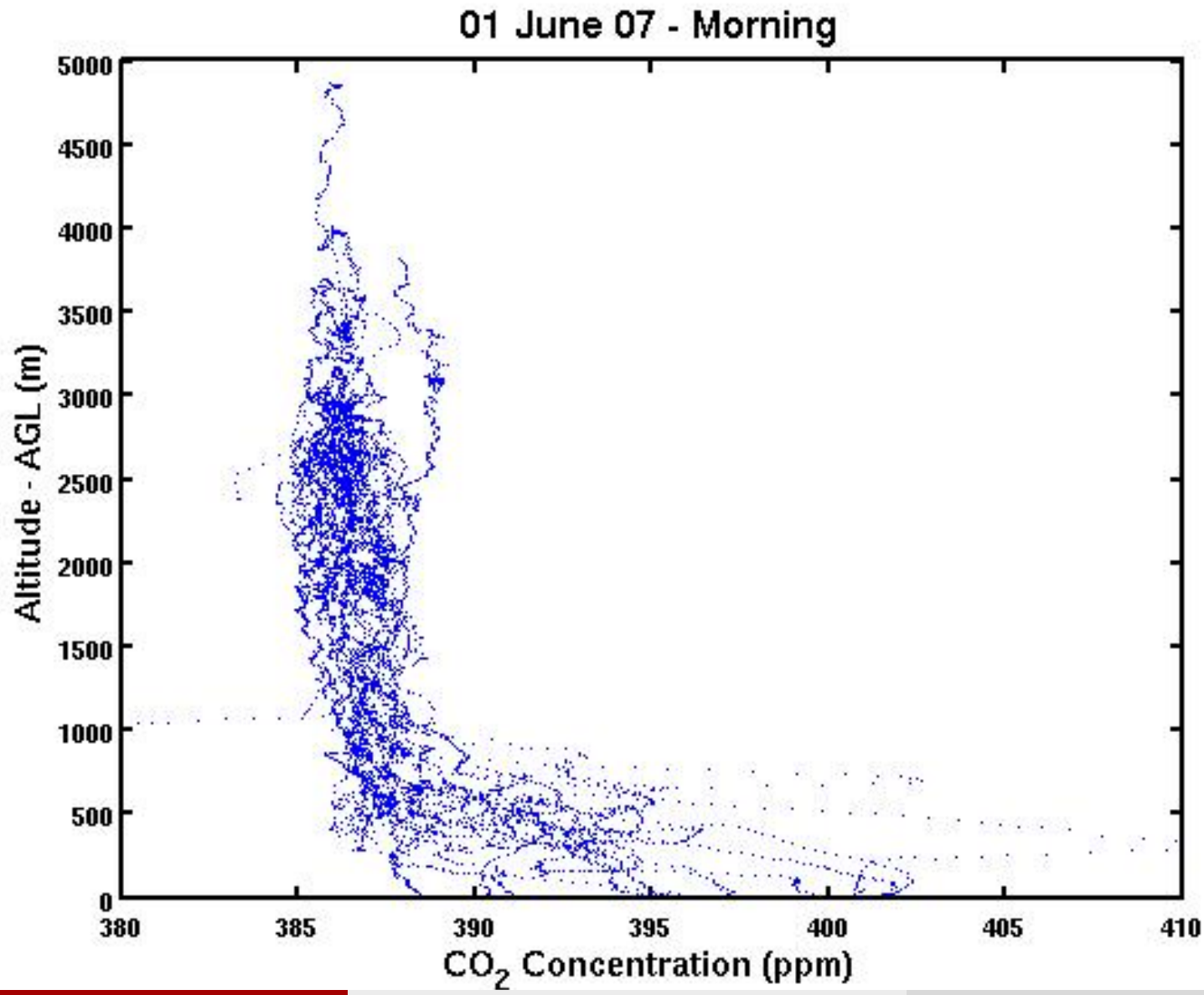




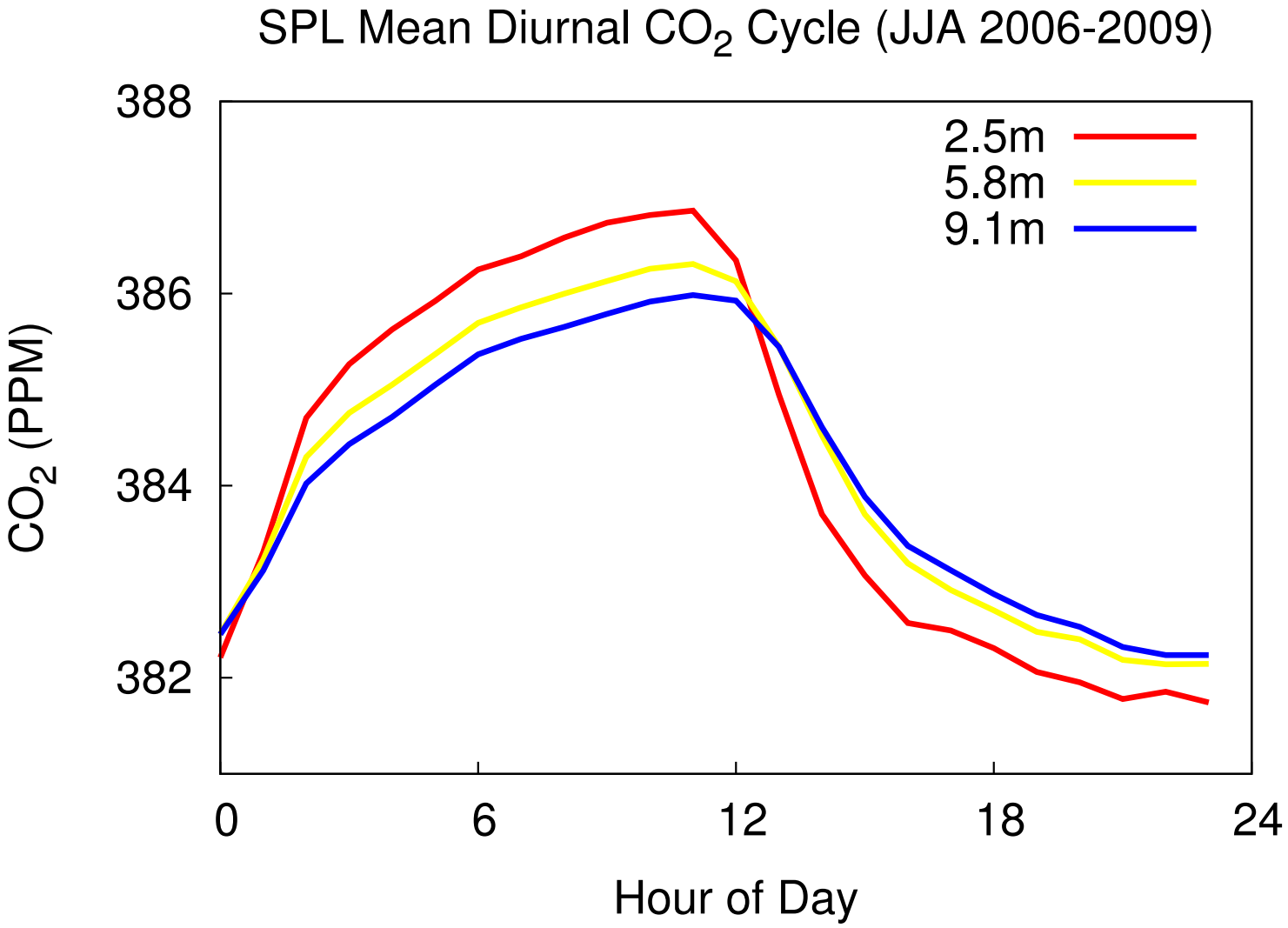




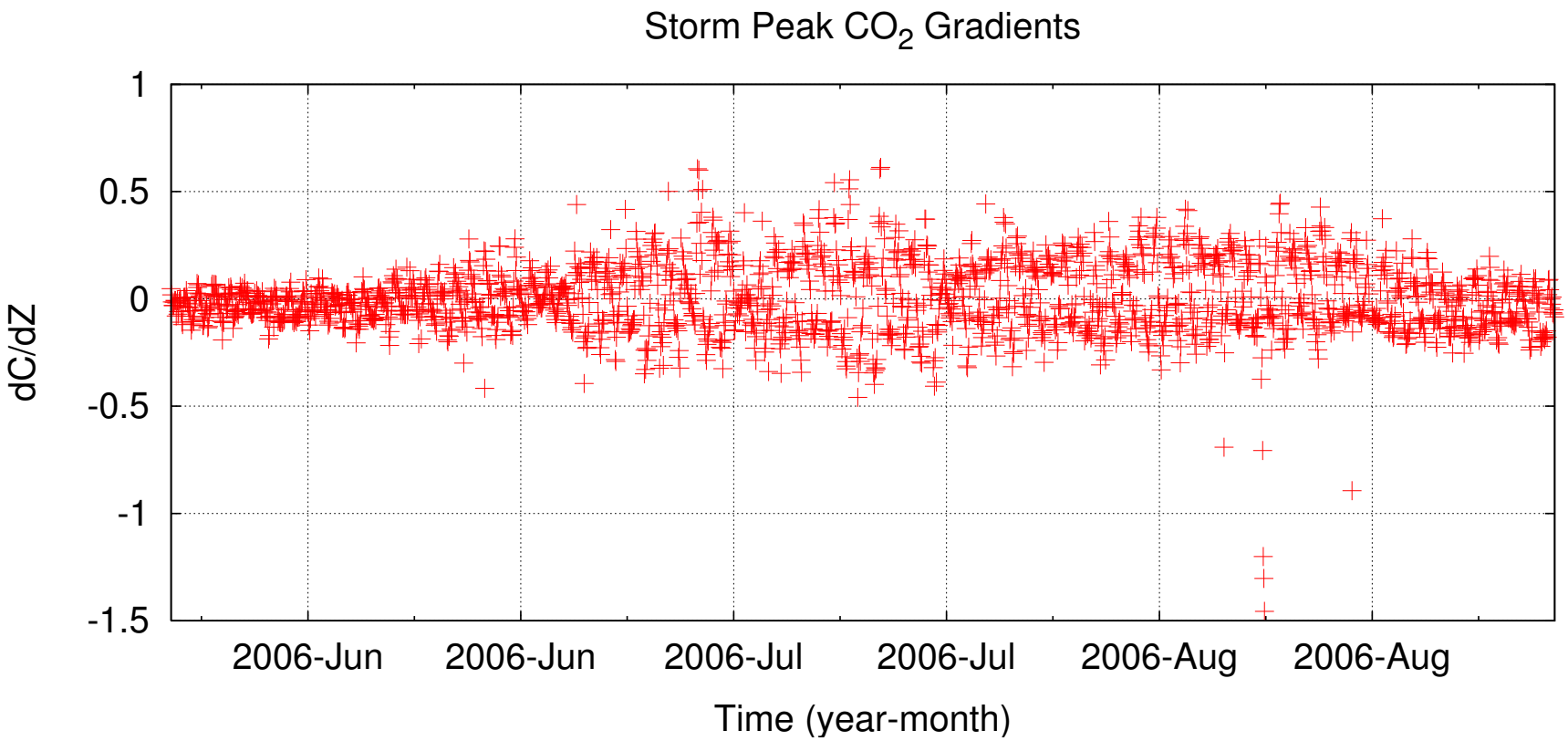
ACME '07: Vertical CO_2 Profiles



RACCOON Network Data: Diurnal CO_2 Averages

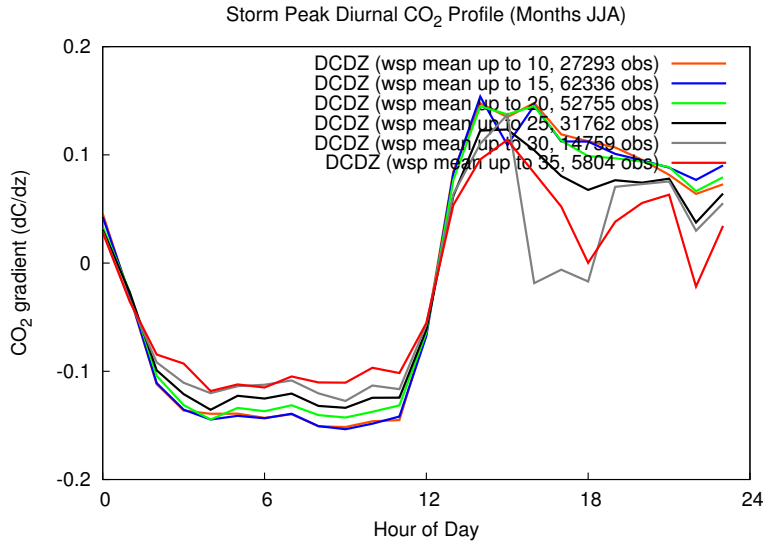


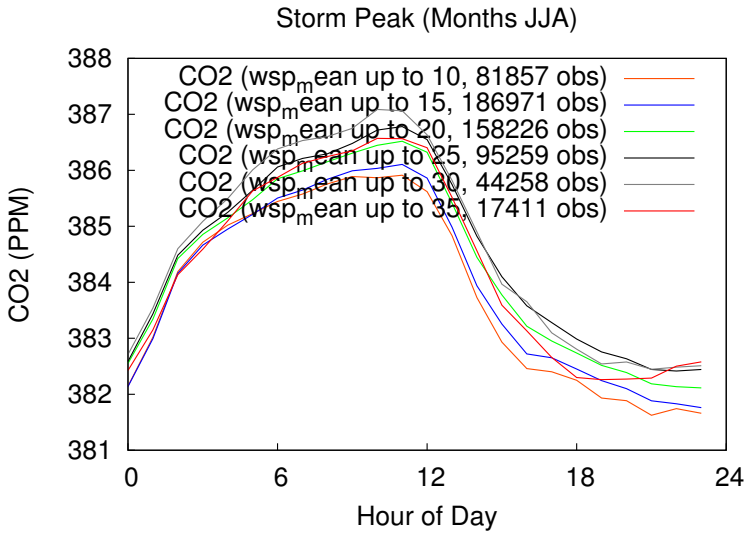
RACCOON Network Data: CO_2 gradient

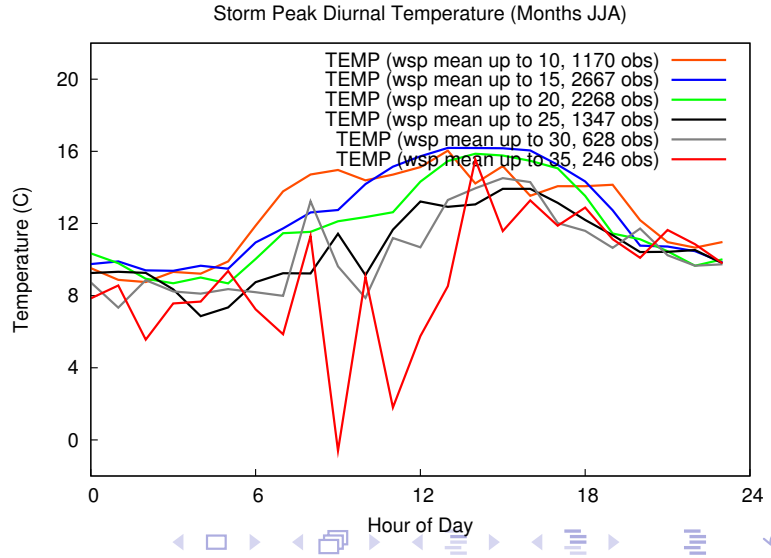


Data Mining: Subsetting CO_2 Data

- Our focus is on subsetting CO_2 for well-mixed versus local circulations, and selecting the right model level for comparison.
- Some example plots of CO_2, CO_2 vertical profile, temp. when subset for various wind speeds.







OSSE's for Network Design

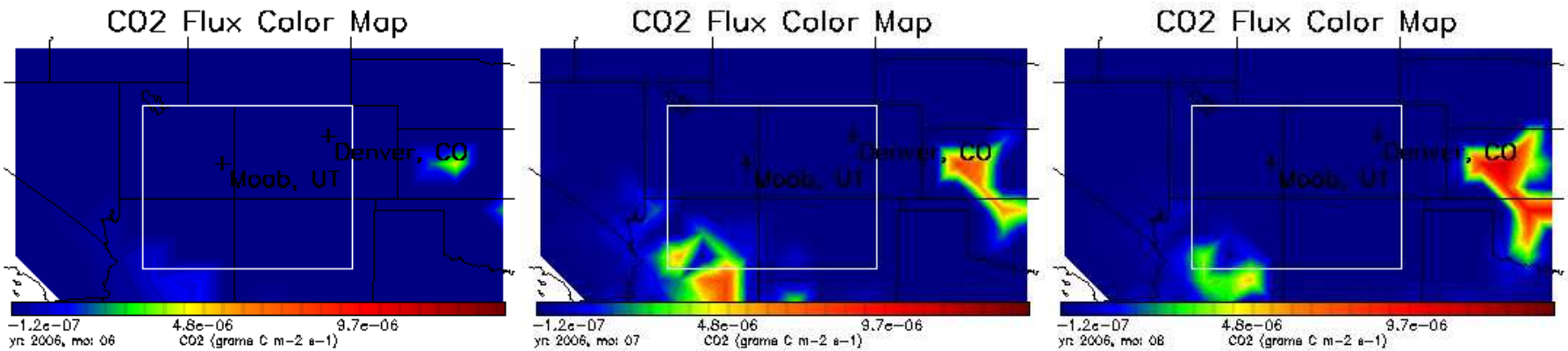
- A workable next-step in this work would be to run simulation experiments on the placement of a new tower in the RACCOON observation network through observing system simulation experiments (OSSE).
- Five to ten OSSE's over the RACCOON domain could be performed in a year.

Data Assimilation: CarbonTracker

- How do we use mountaintop and valley CO_2 observations in a $1^\circ \times 1^\circ$ model?
- *or* How do mountaintop and valley CO_2 data impact carbon fluxes?

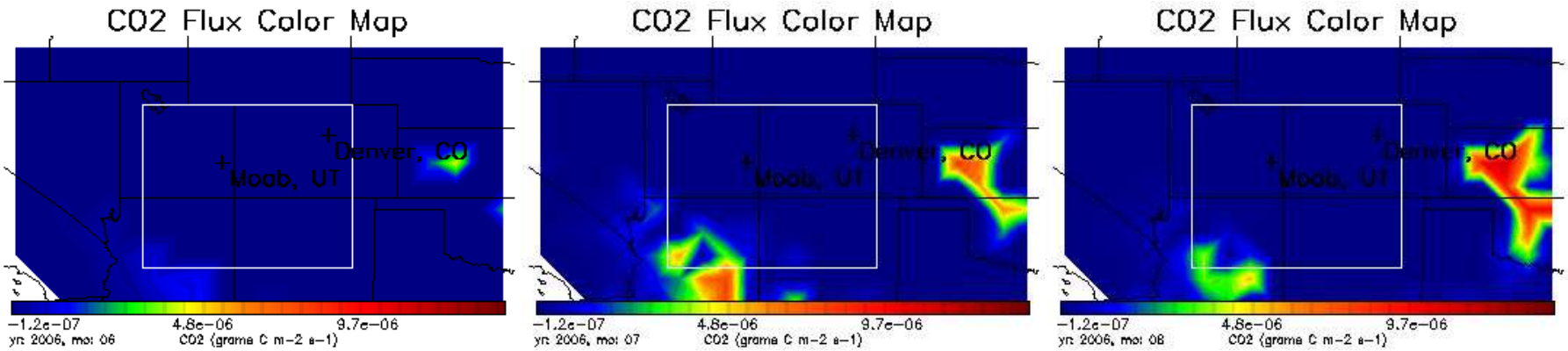
Branch Run Simulations with Different Collections of Data

- Runs with different subsets of RACCOON data (different collections of sites, times of day, weather conditions) could be done.



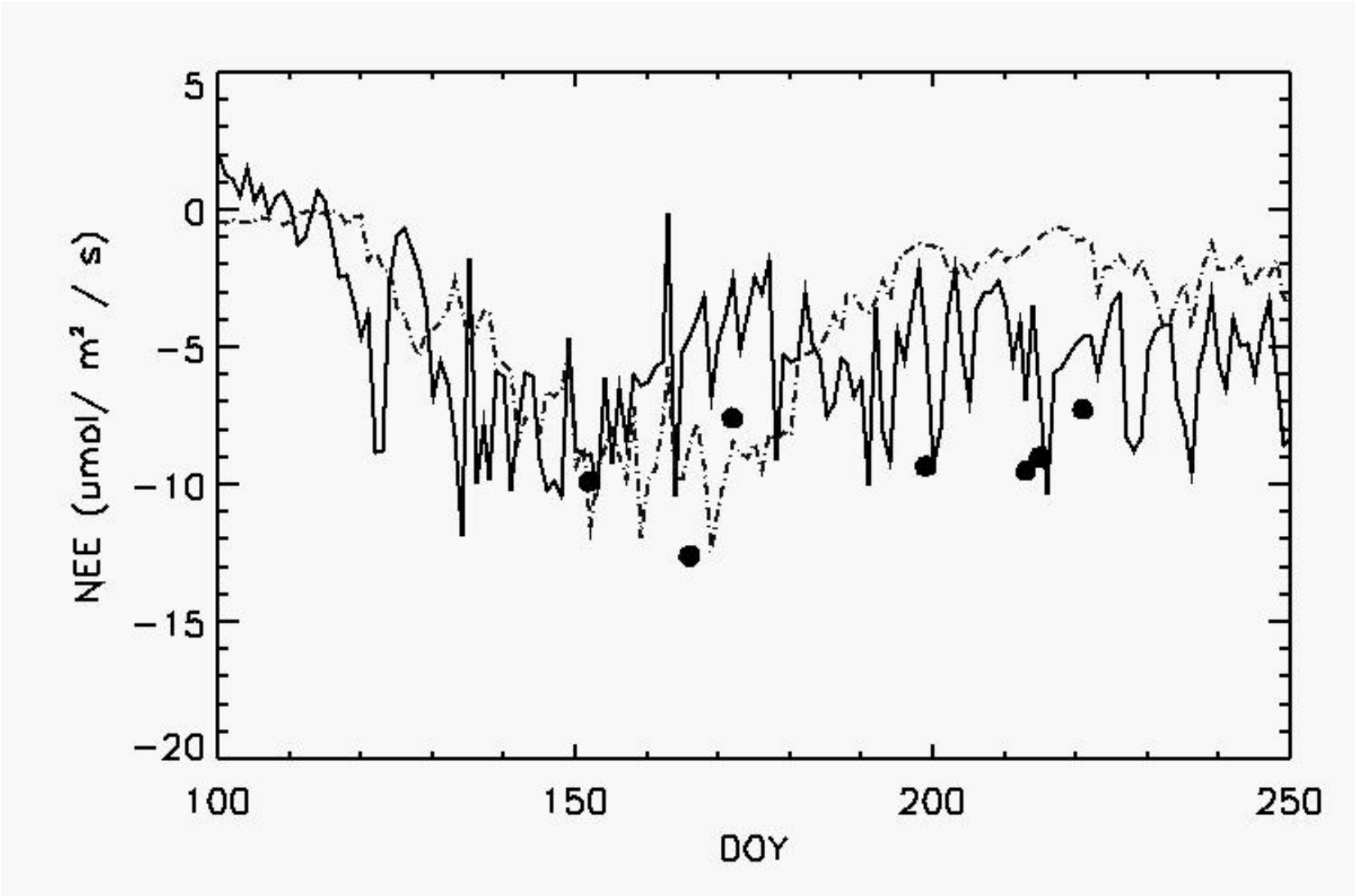
Branch Run Simulations Sensitivity Tests

- Runs where CT is modified to be more sensitive to the Rocky Mountain region (i.e. by changing ecoregion specification or base model), which would be a longer range proposed activity.



Summary Points: Comparison of CT,BLB,NWR

Dashed line: CT over ACME '07 Domain, **Dots:** Boundary Layer Budget estimates,
Solid line: NWR Tower data



Summary Points: "Why am I here?"

- Learn CarbonTracker internals.
- Make progress on OSSE's.
- Improve/revise research plans in coordination with CT team.
- Discuss data mining efforts of RACCOON data in context of future data assimilation improvement.

Thank you!

Acknowledgments

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