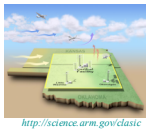
Regional Carbon Fluxes and Land Surface Forcing in the Southern Great Plains during CLASIC and NACP intensives

Torn, M.S.[1], W.J. Riley[1], M.L. Fischer[1], T. J. Jackson[2], R. Avissar[3], S.C. Biraud[1], D. Billesbach[4], C. Sweeney[5], P. Tans[5], M. Lowenstein[6], J. Lopez[6], and J.A. Berry[7]

[1]Lawrence Berkeley National Laboratory, mstorn@lbl.gov, 510-495-2223; [2]USDA-ARS, [3]Duke University, [4]University of Nebraska, Lincoln, [5]NOAA-ESRL; [6]NASA AMES, [7]Carnegie Institution



http://science.arm.gov/clasic

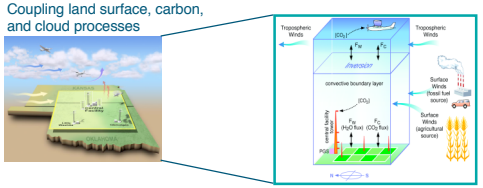
ABSTRACT

In June 2007, a regional campaign will take place in the U.S. Southern Great Plains (SGP) to estimate surface fluxes of CO_2, water, and energy at 1 to 100 km scales. The goal of this campaign is to understand the influence of land cover, moisture gradients, and atmospheric transport on these fluxes and their estimation. As part of the North American Carbon Program (NACP) we will focus on comparing top-down and bottom-up flux estimates.

The work will be integrated with the Cloud and Land Surface Interaction Campaign (CLASIC), a multi-agency effort to study interactions among land surface fluxes, the convective boundary layer, and cumulus clouds in SGP. See http://science.arm.gov/clasic

This poster describes the ongoing carbon cycle measurements and the experiments planned for June 2007 in the ARM Climate Research Facility in SGP. Data streams are available via www.archive.arm.gov

Coupling land surface, carbon, and cloud processes



EXPERIMENTS IN JUNE 2007

- Generating finely resolved estimates of CO_2, latent heat, and sensible heat fluxes for the SGP, using distributed ecosystem models and eddy flux data. **(Experiment 1)**
- Examining influence of soil moisture and land cover on fluxes, using measurements from eddy flux towers, helicopter, remotely sensing instruments (ER-2), and local soil moisture probes. **(Experiment 2)**
- Quantifying PBL–troposphere mixing by fair weather cumulus **(Expt 3)**
- Generating regional flux estimates using atmospheric data from Lagrangian (air mass following) flights **(Experiment 4)**
- Testing models of residual layer dynamics

ATMOSPHERIC CARBON MEASUREMENTS At 60 m and by Aircraft

60 m tower:
- Continuous CO_2, CO, and radon concentrations
- NOAA-ESRL flasks
- Flasks for ^{13}C and ^{18}O diel and keeling plots
- Flasks for high precision $^{14}CO_2$

Cessna 206 and CIRPAS Twin Otter:
- Continuous CO_2 and CO concentrations (CO and CH_4 from NASA's Argus)
- NOAA-ESRL 12-flask samplers
- Flasks for high precision $^{14}CO_2$

Expt 1. Regional CO_2, Water, and Energy Fluxes and Surface Forcing for CLASIC ("Bottom up")

Land-surface fluxes of energy, water, and CO_2 will be modeled at 250 m resolution and aggregated to 10 km using a land surface model (ISOLSM), MODIS data, and Mesonet meteorological forcing. Fluxes will be ingested to a tracer model embedded in MM5. CO2 will be used as a constraint on evapotranspiration fluxes.

Goal 1. Produce fine scale, tested, land surface forcing maps for CLASIC

Goal 2. Produce regional CO_2 flux estimates, to compare with top-down estimates based on boundary layer budgeting and inverse modeling.

Expt 2. Intensive Land Surface Characterization at Three Super Sites

Intensive ground observations will focus on three **Super Sites** in the major SGP land cover types (winter wheat, pasture, oak forest, summer crops). Each super site will have at least three **eddy flux towers** and measurements of soil moisture and energy balance.

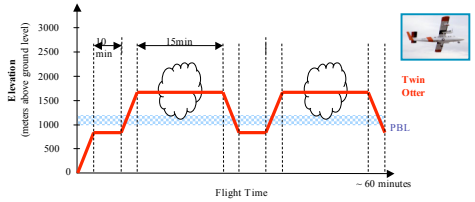
The Duke Helicopter Observation Platform (HOP) will measure CO_2, water, and energy fluxes in the boundary layer, including the surface layer a few meters above the surface.

Soil Moisture will be studied with airborne observing systems, including PSR and MODIS Airborne Simulator and JPL Passive/Active L and S band (v2). The ER-2 is flying.

Measuring ecosystem fluxes at Duke FACE. (Roni Avissar)

Expt 3. PBL-Free Troposphere Mixing Under Conditions of Fair Weather Cumulus

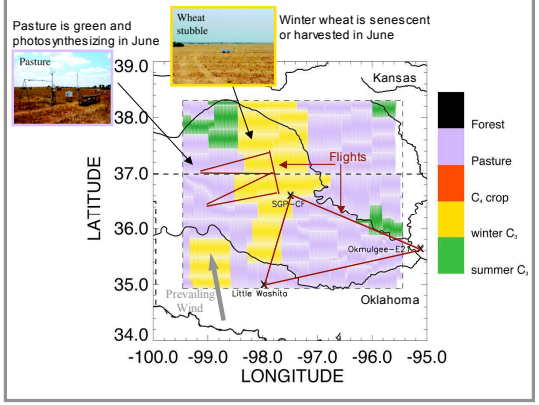
To improve models of cloud-induced fluxes and entrainment, airborne measurements of CO_2 and related species in the boundary layer and free troposphere, made on days with fair weather cumulus, will be analyzed with tracer-transport and atmospheric dynamics models.



Expt 4. "Top Down" Regional CO_2 Flux Estimation Using Lagrangian Flights

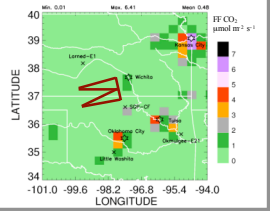
We will use atmospheric concentration data to estimate surface fluxes and understand atmospheric transport. Planned approaches include:
- Forward modeling of regional meteorology and CO_2 concentrations using mesocale models (MM5, SIB-RAMS) with embedded CO_2-tracers;
- Boundary layer budget models of varying complexity; and
- Inverse modeling using STILT.

Land Cover, Flight Paths, and Super Sites (x)



Fossil Fuel Emissions Southern Great Plains

A weekday in June 2002



CONCLUSION

Measurements of surface energy, clouds, aerosols and carbon cycle gases during CLASIC will be exploited to provide the best possible land surface inputs to the cloud and climate models, and to conduct a North American Carbon Program Intensive for estimating carbon fluxes from ecosytems and fossil fuel emissions at the regional scale. In fact, the ARM SGP is unique among the NACP regions for the comprehensive linkage of surface and atmospheric dyanamics, may be the only NACP region with complete plans for regional flux intercomparisons.

ACKNOWLEDGMENTS

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