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The Airborne Carbon in the Mountains Experiment (ACME): initial modeling results

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Mountain forests represent a large portion of gross primary productivity within the United States and a significant potential net CO2 sink. We conducted the Airborne Carbon in the Mountains Experiment (ACME) in May and July of 2004 to explore methods for constraining regional-scale CO2 fluxes over complex terrain and to collect measurements useful for devising and testing strategies for long-term monitoring of these fluxes. We flew a total of 54 hours on the NCAR C-130 aircraft over large regions of the Colorado Rocky Mountains, making continuous measurements of CO2, CO, O3, and water vapor concentrations among other measurements. The flights were conducted according to a combination of experimental designs, including morning to afternoon Lagrangian flux measurements, regional survey measurements for assimilation into a high-resolution atmospheric model, morning sampling of nocturnally respired CO2 and its concentration by topography and dispersion by turbulence, and direct flux measurements. Initial results of ACME will be presented. During the Lagrangian experiments and regional surveys, we observed CO2 drawdowns of several ppm in boundary-layer CO2, representing significant CO2 uptake by the forests. Also, in large mountain valleys we observed on the order of 30 ppm of respired CO2 pooling as deep as a few hundred meters and persisting until 10 AM. The atmospheric mesoscale model RAMS (Regional Atmospheric Modeling System) and a Lagrangian Dispersion Model are used to simulate the vertical profiles of CO2 in the mountain valleys. Model results show good agreement with observations on the depth of the CO2 pooling. Approaches to derive surface CO2 fluxes in mountainous terrain from

observed CO2 concentration data will be discussed, in particular the application of the new regional-scale ecosystem-atmosphere assimilation model RAMDAS (RAMS data assimilation system) and a Lagrangian Dispersion Model in a receptor-oriented mode.