5.5 Regional CO_2 and H_2O budgets and fluxes over homogeneous and heterogeneous land surfaces

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The uptake of CO_2 by vegetation was studied experimentally in June 2001 on a regional scale of several hundreds of square kilometers using a Lagrangian budgeting approach. For this purpose, CO_2 and meteorological parameters were measured from a small aircraft over a flat homogeneous and productive temperate forest in the Landes region, south of Bordeaux. During one flight with perfect Lagrangian conditions an average midday (12:30 - 14:30 UTC) forest CO_2 uptake rate of 16 ± 2.5 µmol m^{-2} s^{-1} was observed. The derived CO_2 flux for the experimental area was about 15 % smaller than the local net ecosystem exchange (NEE) measured by eddy covariance at a tower north of the flight domain, and about 12 % higher than model estimations, which were based on remote sensing (satellite) data. The contribution of anthropogenic emissions to the regional CO_2 budget was estimated from simultaneous CO measurements on the same platform to be less than 0.5 µmol m^{-2} s^{-1} (Schmitgen et al., 2004).
Secondly, the impact of local differences in surface structure and land use on the spatial and temporal distribution of greenhouse gases in the near surface boundary layer was investigated during an airborne observation campaign in August 2004. Atmospheric concentrations of gases (H_2O, CO_2, CO, NO, NO_2, NO_y) and several meteorological parameters were measured with high spatial and temporal resolution over intensively managed farmland of the Jülicher Börde. Additionally a hyperspectral scanning system was deployed downlooking to measure spatio-temporal variations of photosynthesis at canopy level, in order to quantify the biological activity of the vegetation. Preliminary results suggest that surface structures were mapped into the distribution of CO_2 and H_2O, showing pronounced small scale patterns in both, concentrations and fluxes, and in the correlation between the measured anthropogenic and biogenic trace gases. The correlations can be used to identify and separate biological (photosynthesis and transpiration) and anthropogenic activities (traffic, industry and power plants), allowing to quantify the contributions of different sources and sinks to the CO_2 and H_2O budgets.

Schmitgen, S., Geiß, H., Ciais, P., Neininger, B., Brunet, Y., Reichstein, M., Kley, D., Volz-Thomas, A. (2004): Carbon dioxide uptake of a forested region in southwest France derived from airborne CO2 and CO measurements in a quasi-Lagrangian experiment. - J. Geophys. Res. 109, D14302: doi:10.1029/2003JD0043