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Landscape fluxes of CO2 derived by satellite based aggregation of flux tower measurements and validated against airborne measurements

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A pilot project on upscaling eddy correlation measurements of CO2 from ground to landscape has been conducted over the Island of Zealand Denmark. The ground reference measurements are conducted within the framework of the Nordic centre for Studies of Ecosystem Carbon Exchange and CarboEurope and comprises continuous eddy correlation measurements over three distinct surface types, beech forest, wheat fields and grassland. During an intensive field campaign conducted in August 2003, the data collection was supplemented through airborne flux measurements comprising six flights.

It is demonstrated how the atmospheric fluxes of carbon dioxide can be derived form the airborne measurements and how these observations can be assigned to the land surface using a foot print model. The environmental control of the carbon dioxide fluxes is evaluated using both historical data and data from the time of the flight overpass. With respect to carbon sequestration, the leaf area index is found is found to be the single most important state variable whereas solar radiation, air temperature and humidity are found to be the most important forcing variables.

The spatial distribution is derived on the basis of MODIS vegetation index EVI with a spatial resolution of 250 m which are combined with area distributed meteorological data estimated by traditional data and remote sensing.

For the soil respiration, it is found that soil temperature and soil moisture are nearly equal significant in predicting the soil respiration. The spatial distributed of the soil

temperatures are derived form satellite data whereas the soil moisture in the upper soil column is estimated by use of a hydrological model operating in Geographical information system.

The ground level flux distribution along the flight track is calculated as the sum of modelled carbon sequestration and soil respiration. In average the values are rather close to balance but large spatial diversity is found depending on surface type.

The airborne measurements of total carbon exchange are calculated for the same areas. It is found that there is an encouraging agreement between the airborne and the modelled/measured tower flux measurements.