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Regionalization of turbulent fluxes in an inhomogeneous landscape by combining aircraft measurements and footprint analysis

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During the REGAFLUXES campaign in May 2008, airborne eddy covariance measurements were performed with a small environmental research aircraft over the "Münsterland" region in Northwest Germany. This inhomogeneous landscape is dominated by agricultural areas, forests and shrubs with scales of a few hectares. To relate the flux measurements from the airplane to different land use types on the ground an analytic footprint model.... was tested and applied. The footprint areas (typically 35 km^2 to 80 km^2 in size) were geo referenced and then merged with high resolution (30 x 30 m) land use data, resulting in a quantification of up to twelve different land use types within the respective footprints. The resulting composition of the footprints set the basis for the up-scaling of the fluxes from the footprint areas to the regional scale. The prerequisite for this procedure lies in the similarity of the composition of the footprints on the one hand and the regional scale area on the other hand. Mean fluxes were calculated from 99 flight segments and subsequently used for the up-scaling. The mean CO_2 flux was -0.69 mg m^{-2} s^{-1} (deposition) and the H_2O flux was +0.17 g m^{-2} s^{-1} (evapotranspiration). Due to similar land use, these fluxes could be scaled up from the area of the "Münsterland" (1510 km^2) to the region of the "Westfälische Bucht" (6054 km^2).