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Feasibility study on footprint-based spatial flux decomposition from multiple eddy covariance measurements in a mosaic landscape

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Various "natural tracer experiments" that have been successfully performed during the last decade, indicate that there is a potential of estimating true surface fluxes from (too) small landscape units from spatially distributed flux measurements (Göckede et al., 2006; Reth et al., 2005). More recently, first such efforts have been presented mainly for airborne measurements (Mauder et al., 2008; Hutjes et al., 2010) but also for a ground-based set-up consisting of 2 stations and fields (Neftel et al., 2007). On the other hand, it has been pointed out that footprint models may easily be overcharged by efforts to inversely determine fluxes (Schmid, 2006).

On this poster, we present a first effort to transfer the existing approaches to a local station network of seven eddy covariance sensor pairs installed 100 to 500 m apart in a flat agricultural landscape dominated by three land use types. Fluxes measured include the sensible and latent heat flux as well as CO_2 flux. The footprint models by Hsieh et al. (2000) and Kormann and Meixner (2001) are used to quantify the contribution of each land use type to the flux measured at each station (van de Boer et al., 2011).

Various ways to (i) estimate land use type fluxes from station fluxes and the footprint contribution matrix and (ii) identify situations where this approach may be inapplicable are tested against each other, as well as against independent reference measurements. The latter are obtained from stations left out of the inversion process (cross validation) and, for the special case of CO_2 flux from a harvested field, area-averaged chamber measurements of soil respiration. Our preliminary results indicate that spatial flux decomposition can indeed help to reduce large footprint-induced errors. In particular, this is the case for bare field soil respiration measurements, which are highly sensitive to contamination by photosynthetic CO_2 flux signals from surrounding cropped fields. However, the correction also adds a high amount of uncertainty, which can be attributed both to the footprint modelling process, and the treatment of residuals during the inversion process.

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