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# Comparison of Source Partitioning Methods for $CO_2$ and $H_2O$ Fluxes Based on High Frequency Eddy Covariance Data

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Source partitioning of eddy covariance (EC) measurements of $CO_2$ into respiration and photosynthesis is routinely used for a better understanding of the exchange of greenhouse gases, especially between terrestrial ecosystems and the atmosphere. The most frequently used methods are usually based either on relations of fluxes to environmental drivers or on chamber measurements. However, they often depend strongly on assumptions or invasive measurements and do usually not offer partitioning estimates for latent heat fluxes into evaporation and transpiration.
SCANLON and SAHU (2008) and SCANLON and KUSTAS (2010) proposed an promising method to estimate the contributions of transpiration and evaporation using measured high frequency time series of $CO_2$ and $H_2O$ fluxes - no extra instrumentation necessary. This method (SK10 in the following) is based on the spatial separation and relative strength of sources and sinks of $CO_2$ and water vapor among the sub-canopy and canopy. Assuming that air from those sources and sinks is not yet perfectly mixed before reaching EC sensors, partitioning is estimated based on the separate application of the flux-variance similarity theory to the stomatal and non-stomatal components of the regarded fluxes, as well as on additional assumptions on stomatal water use efficiency (WUE).
The $CO_2$ partitioning method after THOMAS et al. (2008) (TH08 in the following) also follows the argument that the dissimilarities of sources and sinks in and below a canopy affect the relation between $H_2O$ and $CO_2$ fluctuations. Instead of involving assumptions on WUE, TH08 directly screens their scattergram for signals of joint respiration and evaporation events and applies a conditional sampling methodology.
In spite of their different main targets ($H_2O$ vs. $CO_2$), both methods can yield partitioning estimates on both fluxes. We therefore compare various sub-methods of SK10 and TH08 including own modifications (e.g., cluster analysis) to each other, to established source partitioning methods, and to chamber measurements at various agroecosystems. Further, profile measurements and a canopy-resolving Large Eddy Simulation model are used to test the assumptions involved in SK10.

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