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Energy balance and non-turbulent fluxes

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Often, the sum of the turbulent fluxes of sensible heat and latent heat from eddy covariance (EC) measurements does not match the available energy (sum of net radiation, ground heat flux and storage changes). This is referred to as energy balance closure gap. The reported imbalances vary between 0% and 50% (Laubach 1996). In various publications, it has been shown that the uncertainty of the available energy itself does not explain the gap (Vogt et al. 1996; Moderow et al. 2009). Among other reasons, the underestimation is attributed to an underestimation of turbulent fluxes and undetected non-turbulent transport processes, i.e. advection (e.g. Foken et al. 2006). The imbalance is typically larger during nighttime than during daytime as the EC method fails to capture non-turbulent transports that can be significant during night (e.g. Aubinet 2008). Results for the budget of CO2 showed that including non-turbulent fluxes can change the budgets considerably. Hence, it is interesting to see how the budget of energy is changed. Here, the consequences of including advective fluxes of sensible heat and latent heat in the energy balance are explored with focus on nighttime conditions. Non-turbulent fluxes will be inspected critically regarding their plausibility. Following Bernhofer et al. (2003), a ratio similar to Bowen's ratio of the turbulent fluxes are defined for the non-turbulent fluxes and compared to each other. This might have implications for the partitioning of the available energy into sensible heat and latent heat. Data of the ADVEX-campaigns (Feigenwinter et al. 2008) of three different sites across Europe are used and selected periods are inspected.

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