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Forest net ecosystem CO_2 exchange in sloping terrain as derived by eddy covariance

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The experimental ecological study site Bily Kriz (49°30′N, 18°32′E; 800–900 m a.s.l.) is located in the Moravian-Silesian Beskydy Mountains, the Czech Republic. The experimental forest is a $\sim$ 40 years old Norway spruce (*Picea abies* /L./, Karst) monoculture with a leaf area index of $\sim$ 9 m^2 m^{-2} in 2016. Eddy covariance (EC) measurements of energy and trace gas fluxes have a more than decade long tradition at this site. The EC tower is situated on a ridge on a steep roughly south oriented planar slope with a regular inclination of 13°. North of the site, there is a W-E-oriented mountain crest with a shallow saddle. The ridge and slope force the flow above the canopy in two main regimes, namely upslope and downslope. However, due to the complexity of the tower-surrounding topography also other flow patterns can be observed from time to time. As a further consequence of this complexity, common EC flux filtering approaches such as the u_*-filtering are not applicable at this site. Recently, an additional below-canopy EC system was installed to support the interpretation of the above canopy derived EC data. Amongst others, such a below-canopy system provides readings of the standard deviation of vertical wind (σ_w) within the canopy. The correlation of σ_w between above and below canopy EC measurements remarkably differs for the cases of decoupling and the cases of full coupling between below and above canopy air masses. Thus, once an objective site-specific threshold in this σ_w correlation is experimentally determined, it can be used as an EC flux filtering approach.

The ultimate goal of the overall site setup is to provide defensible annual sums of forest carbon exchange in topographically complex terrain. This particular study aims to assess the applicability of the introduced two-level filtering in such terrain. Furthermore, it aims to evaluate the effect of the two-level filtering on the above canopy measured EC CO_2 fluxes. We use an initial 6-month example period (August-January) to demonstrate first results of this study. The data suggest that the two-level filtering is applicable also in such complex terrain. Furthermore, the two-level filtering increases the magnitude of both nighttime and daytime above-canopy CO_2 fluxes in comparison to single-level filtered CO_2 fluxes. These characteristics are similar for both upslope and downslope regimes. In contrary, the patterns of above canopy derived CO_2 fluxes substantially varies with main wind direction above canopy.

For robust final conclusions to our aims, at least one full year of simultaneous below- and above-canopy measurements is needed to capture the entire spectrum of environmental, stability and phenological conditions and their impact on decoupling.