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Linking CO_2-advection estimates to vegetation structure at a forest site

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Surface exchange flux measurements of Net Ecosystem Exchange NEE are incomplete if only the turbulent flux is considered and advection neglected. However, including advective terms in the budget has not proven to be a robust alternative since the uncertainties inherent in advection estimates are large und thus increase the uncertainty and scatter of NEE estimates. The current study investigates some of the processes generating measured horizontal CO_2 concentration gradients, which are generally used to compute horizontal advective flux terms. In contrast to standard methodology where gradients are computed over 30 minute time frames and a spatial extend in the order of tens to hundreds of meters, the focus of this study is on short and small events such as coherent structures. Moreover, we consider the effect of vegetation structure on concentration gradients. Our results suggest that coherent structures might act as a transfer function between vegetation structure such as Plant Area Index PAI and subcanopy CO_2 concentration. Very local mixing of a CO_2 concentration distribution with strong vertical gradients by coherent structures is an alternative explanation for horizontal variability of subcanopy CO_2 concentration as opposed to consistent larger scale motion representative for the whole area under study, which is an often made assumption. The small scale variability of vegetation structure leads to high local variability of concentration gradients. Thus gradients are not representative for the scale they need to be to complement above canopy turbulent flux measurement with advective flux terms. Our findings do not directly improve the NEE budget but try to shed some light on the mechanisms generating the observed CO_2 concentration signal.