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Advection: intermittency aspects of CO_2 fluxes

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Horizontal and vertical advection of CO_2 was investigated with a focus on high frequency aspects of horizontal advective fluxes. Measurements were carried out in the framework of the experiment "ExchanGE processes in mountainous Regions" (EGER) at the FLUXNET site Waldstein/Weidenbrunnen (DE-Bay), a forest site in the Fichtelgebirge Mountains in Southern Germany. The setup comprised vertical profiles of wind speed, temperature and CO_2 at two high towers as well as horizontal profiles of wind speed, temperature and CO_2 in the subcanopy. The latter were instrumented with individual closed path infrared gas analyzers at each sample point in addition to sonic anemometers. The multi-instrument design yields continuous high frequency time series and thus allows the detailed analysis of short lived temporal structures not commonly accounted for in advection estimates. To investigate individual features of the scalar concentration and wind field that affect the commonly used 30 minute averages of advection, the following temporal characteristics are studied: stationarity, intermittency, event duration, the effect of coherent structures on advective fluxes, the sampling bias of 30 minute advection estimates due to short lived events. Among the spatial characteristics studied are: structure size and spacing, which can be used as an indication how representative the signal is for the "control volume". The study aims to characterize an observed advection signal as the result of one of the following three situations: a homogeneous wind field and homogeneous sloping scalar concentration field, stationary in time for more than 30 minutes versus a dynamic non stationary locally varying scalar concentration and wind field creating an advection signal due to the asymmetric structure or occurrence of events versus a combination of both which is assumed to be most realistic.