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Influence of coordinate correction on calculation of vertical advection

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Different physical, chemical and biological processes in the soil-vegetation-boundary-layer system were investigated during the EGER (ExchanGE processes in mountainous Regions) project at the FLUXNET station Waldstein Weidenbrunnen in Germany. Turbulence structure, advection and flux gradients of meteorological and chemical quantities were observed within two intensive observation periods in September and October 2007 (IOP 1) and in June and July 2008 (IOP 2). Measurements of a sonic anemometer including vertical velocity are available for two longer periods, September 2007 to February 2008 and May 2008 to October 2008.

Vertical advection is determined by CO_2 concentration gradient and mean vertical velocity. The small values of the later cause a high source of uncertainty to vertical advection calculation. To correct influences of sensor misalignment, obstacles or local topography, the planar fit coordinate rotation is carried out. The influence of time span and classification in wind sectors as well as the effect of data quality on the correction of vertical velocity and therefore on the calculation of vertical advection were tested.

On the one hand vertical velocity was corrected with a planar fit rotation using all data and on the other hand with a planar fit for separate sectors of wind direction. The later was furthermore distinguished into two datasets: one selected according to neutral stratification and the other quality filtered using friction velocity. Best values are obtained using the last method, showing a distribution of mean vertical velocity close to zero and no dependence on wind direction, which the method using all data still shows. However, no big difference can be observed in the resulting vertical advection comparing the three alternatives of correcting vertical wind velocity. Regarding mean diurnal courses of vertical velocity for the dataset of September 2007 to February 2008, it is negative at night and positive during the day. However for the shorter period of IOP 1 mean daily values of vertical velocity are displaced by about + 4 cm s^{-1} when calculated with planar fit correction coefficients obtained by the half year period. Thus it is important to find an appropriate time span for the coordinate rotation to avoid an over- or underestimation of vertical velocity and consequently vertical advection, which in this case leads to high negative mean values throughout the day. For a shorter planar fit period mean vertical advection is closer to zero, with mainly positive values at night and slightly positive and negative values by day.