



The role of REddyProc's friction velocity filter in determining the carbon budget of croplands

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In Poyda et al. (2019), we determined the carbon balance of six cropland sites in Southwest Germany on the basis of half-hourly net ecosystem exchange (NEE) fluxes measured with the eddy covariance (EC) method over a period of eight years from 2010 to 2017. We came up with the finding, that the sites lost on average about one ton of carbon per hectare and year. This huge loss was surprising, because the sites have been used as croplands already over several decades, and one would expect that the sites should be close to steady-state. In April 2022, we performed a soil organic carbon inventory at one of the six sites, and compared it with carbon data collected in April 2009. The soil inventory data do not give any evidence for a carbon loss in the order of one ton of carbon per hectare and year. Based on the data collected in April 2009, the carbon stock size of the plowing horizon at that time was $39.1 \text{ t C ha}^{-1} \text{ yr}^{-1}$. The carbon stock size determined in April 2022 was in the same range and amounted $39.9 \text{ t C ha}^{-1} \text{ yr}^{-1}$ with a standard error of $1.9 \text{ t C ha}^{-1} \text{ yr}^{-1}$, what means that these data indicate that the carbon budget of the cropland is indeed in or close to steady-state. In Poyda et al. (2019), the NEE flux data were gap-filled with the widely used software tool REddyProc. In REddyProc, the user has the option to apply or not to apply the friction velocity (u^*) filter before gap-filling. In Poyda et al. (2019), the u^* filter was applied before gap-filling. We reprocessed the data for the year 2016, the only year with no winter time gaps, because a methanol fuel cell supplied the station with additional power, without applying the u^* filter. Without applying the u^* filter the cumulated annual NEE was $-2080 \text{ kg C ha}^{-1}$. Applying the u^* filter increased the NEE by 836 kg C ha^{-1} to $-1244 \text{ kg C ha}^{-1}$. We did the same comparison for NEE fluxes measured at the same site over the years 2019, 2020 and 2021, and we got a similar result. The application of the u^* filter increased the mean NEE by $+730 \text{ kg C ha}^{-1}$. The cumulated NEE was $-2832 \text{ kg C ha}^{-1}$ without u^* filter and $-2102 \text{ kg C ha}^{-1}$ with u^* filter. This positive bias is in the range of the EC based derived carbon loss and is able to explain a major part of the suspected positive bias. We recommend all REddyProc users to check their NEE data for this phenomena simply by processing the data once with and once without enabling the u^* filter and comparing both results.