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N2O eddy covariance fluxes: From field measurements to flux calculation

Margaux Lognoul, Alain Debacq, Bernard Heinesch, and Marc Aubinet

University of Liège - Gembloux Agro-Bio Tech, Unit TERRA, Ecosystems-Atmosphere Exchanges, Passage des Déportés, 2, B-5030 Gembloux, Belgium

From March to October 2016, we performed eddy covariance measurements in a sugar beet crop at the Lonzée Terrestrial Observatory (LTO, candidate ICOS site) in Belgium. N2O and H_2O atmospheric concentrations were measured at 10 Hz using a quantum-cascade laser spectrometer (Aerodyne Research, Inc.) and combined to wind speed 3D components measured with a sonic anemometer (Gill HS-50). Flux computation was carried out using the EddyPro Software (LI-COR) with a focus on adaptations needed for tracers like N2O. Data filtering and quality control were performed according to Vickers and Mahrt (1997) and Mauder and Foken (2004). The flags were adapted to N2O time series.

In this presentation, different computation steps will be presented. More specifically:

1) Considering that a large proportion of N2O fluxes are small (within $\pm$ 0.5 nmol m-2 s-1), the classical stationarity test might lead to excessive data filtering and in such case, some searchers have chosen to use the running mean (RM) as a detrend method over block averaging (BA) and to filter data otherwise. For our dataset, BA mean fluxes combined to the stationarity test did not significantly differ from RM fluxes when the averaging window was 300s or larger, but were significantly larger otherwise, suggesting that significant eddies occurred at the 5-min timescale and that they were not accounted for with a shorter averaging window.

2) The determination of time-lag in the case of N2O fluxes can become tricky for two reasons : (1) the signal amplitude can differ from one time period to the next, making it difficult to use the method of covariance maximization and (2) an additional clock drift can appear if the spectrometer is not logging on the same computer than the anemometer. In our case, the N2O signal was strong enough to solve both problems and to perform time-lag compensation according to the covariance maximization, with a default value equal to the mode of the lag distribution. The automatic time-lag optimization suggested by EddyPro was not used as it gave inconsistent values for our dataset.

3) The effect of high frequency spectral correction was also investigated by comparing different in-situ methods to evaluate how using spectra or co-spectra – averaged or not – can affect results.

Finally, a preliminary analysis of N2O fluxes dynamics will be presented.