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Signal-to-noise issues in measuring nitrous oxide fluxes by the eddy covariance method

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Recently-developed fast-response gas analysers capable of measuring atmospheric N2O with high precision (< 50 ppt) at a rate of 10 Hz are becoming more widely available. These instruments are capable of measuring N2O fluxes using the eddy covariance method, with significantly less effort and uncertainty than previous instruments have allowed. However, there are still many issues to overcome in order to obtain accurate and reliable flux data.
The signal-to-noise ratio of N2O measured using these instruments is still two to three orders of magnitude smaller than that of CO_2. The low signal-to-noise ratio can lead to systematic uncertainties, in the eddy covariance method, the most significant being in the calculation of the time lag between gas analyser and anemometer by maximisation of covariance (Langford et al., 2015). When signal-to-noise ratio is relatively low, as it is with many N2O measurements, the maximisation of covariance method can systematically overestimate fluxes. However, if constant time lags are assumed, then fluxes will be underestimated. This presents a major issue for N2O eddy covariance measurements.
In this presentation we will focus on the signal to noise ratio for an Aerodyne quantum cascade laser (QCL). Eddy covariance flux measurements from multiple agricultural sites across the UK were investigated for potential uncertainties. Our presentation highlights some of these uncertainties when analysing eddy covariance data and offers suggestions as to how these issues may be minimised.

Langford, B., Acton, W., Ammann, C., Valach, A. and Nemitz, E.: Eddy-covariance data with low signal-to-noise ratio: time-lag determination, uncertainties and limit of detection, Atmos Meas Tech, 8(10), 4197–4213, doi:10.5194/amt-8-4197-2015, 2015.