Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2016-313-RC2, 2016


Atmospheric Measurement Techniques Discussions

# *Interactive comment on* "Eddy covariance carbonyl sulphide flux measurements with a quantum cascade laser absorption spectrometer" *by* Katharina Gerdel et al.

**Anonymous Referee #2**

Received and published: 7 December 2016

This manuscript presents a methodological approach to calculate eddy covariance flux of carbonyl sulfide (COS). The topic is very actual and interesting, however I cannot recommend the current version of the manuscript for publication in AMT, because of the following major points:

- Performance of QCLAS gas analysers have been already evaluated in the past for other gases (CH4 and N2O). The authors use filtering and analysis approaches to deal with laser drift affecting the low frequency and random noise affecting the high frequency, which are already well know in the flux community.

- The authors did not report a detailed description of EC processing steps and corrections, which I would expected for this kind of technical paper. For instance, it is not



clear for me if the COS dry mole fraction (corrected also for spectroscopic effect) was used for calculating fluxes (as it should be). In the data acquisition chapter it was only mentioned that "molar densities were measured . . ..".

- One of the main conclusion of the study is that fluxes obtained with several filtering strategies are not differing so much. Moreover, the validation is performed for CO2 and H2O against independent measurements, and not for COS.

- I agree that the use of recursive high-pass filtering is the only approach to deal with laser drift, especially in case of very small fluxes. However, by using this strategy, the true signal may be also filtered out. I believe that optimization of the setup (e.g. QCLAS insulation, minimize variation of ambient temperature, etc..) is the first prerequisite for obtaining defensible measurements.

- Related to the estimations of flux random uncertainty, I would recommend to look at the comprehensive paper by Rannik et al. (2016).

Minor comments:

- pag.4 L16. How much is the sensor separation (in vertical and horizontal directions)?

- pag.4 L22. 3d coordinate rotation is not recommended. Instead, standard methods are the 2d or planar fit.

- pag.4 L30-34 How the authors have decided on these threshold values ? How many 30 min runs are included in each of these subsamples?

- pag.5L10 and Fig.1 Why the cross-covariance functions look so smooth? Is this because of low-pass filtering? Please explain.

- chapter 3.3 and fig.3. The noise at high frequency range of the COS cospectrum is something normal, considering the probably low signal-to-noise ratio of this dataset, and the fact that a single run cospectrum is shown. Instead, I would recommend doing this kind of analysis using ensemble average cospectra. I am sure that visually the

noise will be much less. How the cospectra of CO2 and H2O look like?

- pag.7 L.15. Were the ustar thresholds visually estimated? Or how was it done?

- pag8 L.9-10 Sorry to say, but this is a very dangerous statement, which gives a wrong message to the reader. The random uncertainty is intrinsically part of EC flux measurements, and the low frequency fluctuations are not necessarily due only to instrumental noise (laser drift), but can be also real.

Rannik, Ü., Peltola, O., and Mammarella, I.: Random uncertainties of flux measurements by the eddy covariance technique, Atmos. Meas. Tech., 9, 5163-5181, doi:10.5194/amt-9-5163-2016, 2016.

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-313, 2016.