Technical University of Denmark

Uncertainty of long-term CO2 flux estimates due to the choice of the spectral correction method

Ibrom, Andreas; Geisler, Simon; Pilegaard, Kim

Published in:
Geophysical Research Abstracts

Publication date:
2010

Document Version
Publisher's PDF, also known as Version of record

Geophysical Research Abstracts
Vol. 12, EGU2010-11302-1, 2010
EGU General Assembly 2010

Uncertainty of long-term CO2 flux estimates due to the choice of the spectral correction method

Andreas Ibrom, Simon Geißler, and Kim Pilegaard
Risø National Laboratory for Sustainable Energy (DTU), Biosystems Division, Denmark (anib@risoe.dtu.dk)

The eddy covariance system at the Danish beech forest long-term flux observation site at Sorø has been intensively examined. Here we investigate which systematic and non-systematic effects the choice of the spectral correction method has on long-term net CO2 flux estimates and their components.

Ibrom et al. (2007) gave an overview over different ways to correct for low-pass filtering of the atmospheric turbulent signal by a closed path eddy covariance system. They used degraded temperature time series for spectral correction of low-pass filtered signals. In this new study, correction for high-pass filtering was also included, which made it anyway necessary to use model co-spectra. We compared different ways of adapting different kinds of model co-spectra to the wealth of 14 years high frequency raw data. As the trees grew, the distance between the sonic anemometer and the displacement height decreased over time. The study enabled us to compare the two approaches and different variants of them to give recommendations on their use.

The analysis showed that model spectra should not be derived from co-spectra between the vertical wind speed (w) and the scalars measured with the closed path system, i.e. CO_2 and H_20 concentrations, but instead with sonic temperature (T) w cospectra, to avoid low-pass filtering effects on the estimation of the co-spectral peak frequency (f_x). This concern was already expressed earlier in the above mentioned study, but here we show the quantitative effects.

The wT co-spectra did not show any height effect on f_x as it was suggested in generally used parameterizations. A possible reason for this difference is that measurements, like in all forest flux sites, took place in the roughness sub-layer and not in the inertial sub-layer. At the same time the shape of the relationship between f_x and the stability parameter ζ differed much from that of often used parameterizations (e.g. from Horst, 1997). The shift of f_x towards higher frequencies at stable atmospheric stratification was less pronounced, resulting in less amount of correction for low-pass filtering at night time and consequently higher annual net CO_2 uptake estimates. On the other hand our data indicate that the increase of f_x already starts earlier than expected, i.e. during the transition from unstable to neutral stratification. We derived an empirical model of the shape of $f_x(\zeta)$ with 4 parameters that is able to represent the observed effects.

References

Horst, T.W. 1997. A simple formula for attenuation of eddy fluxes measured with first-order-

response scalar sensors. Boundary-Layer Meteorology. 82:219-233.

Ibrom, A., E. Dellwik, N.O. Jensen, H. Flyvbjerg and K. Pilegaard 2007. Strong low-pass filtering effects on water vapour flux measurements with closed-path eddy correlation systems. Agricultural and Forest Meteorology. 147:140 -156.

Acknowledgements

This work has been funded by the EU-Infra structure project IMECC and the European Erasmus Mundus program. We especially thank the Risø – DTU's Wind Energy Department, namely Ebba Dellwik and Søren W. Lund, for their strong technical and scientific cooperation.