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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Analysis of the PKT correction for direct CO_2 flux measurements over the ocean" *by* S. Landwehr et al.

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Review for "Analysis of the PKT correction for direction CO2 flux measurements over the ocean"

This paper describes a recent set of air-sea CO2 eddy covariance flux measurements. Four effectively closed-path CO2 sensors were used, two dried to minimize the bias due to H2O cross-correlation, two undried (i.e. sampling moist air). Using flux from the dried sensors as reference, the authors convincingly demonstrated that the correction scheme based on similarity theory (i.e. PKT correction) does not remove the bias in the measured CO2 flux from the undried sensors under conditions of large latent heat flux.

The direct measurement of air-sea CO2 flux is obviously essential for the understanding of global carbon cycling and climate, with the open path sensors (e.g. Licor 7500) widely used. Since its publication (Prytherch et al. 2010a), the PKT method has been tried by several authors to correct eddy covariance CO2 flux. Thus it is important for the paper under consideration to be published.

The content of the paper is sound. Moreover, Referee #1 (who published the PKT method) already agreed with the authors of this paper. I only have a few anecdotal and editorial comments below:

1) The authors missed an opportunity to strongly recommend the drying of IRGA sensors, which appears to be the most reliable method thus far for making CO2 measurements. 2) How does H2O cross-contaminate the CO2 flux? It's probably not related to sea salt, since the 7200 sensors are operated inline during this experiment. Knowing the cause for this cross-contamination might lead to improvement in open-path CO2 sensors. Any educated guesses? 3) This cross-contamination presumably cannot be clearly identified in the cospectrum. The authors can mention that spectral analysis by itself is inadequate as a quality control filter for CO2 fluxes. 4) For the gas exchange community, it would be insightful for the authors to obtain the data from Prytherch et al. 2010b and see what the k values from HiWASE are like only for conditions of near-zero latent heat flux.

Specifics

Another recent paper that utilized the PKT correction (and suggested that it did not work) is Ikawa et al. (2013) (www.biogeosciences.net/10/4419/2013/).

P 28282, line 18. Rather than "restricted to", it's more accurate to say "the EC method provides relatively robust CO2 flux measurement (uncertainty of $\sim$%) in regions with air-sea gradient. . ."

P 28283, line 9. The point of having a very high flow rate is to maintain a fully turbulent

flow. Would be more insightful to present the critical Reynolds number here in addition to the number of SLPM.

28285, line 9. What temperature was the inlet heated to, in order to preserve the latent heat flux? Water vapor is well known to be "sticky." Thus even in the absence of condensation, significant attenuation of water vapor flux at high frequencies is possible.

28287, line 3. The authors haven't showed that the IRGAdry measurements are completely unbiased. For example, was 97% of the H2O removed by the drier, as in Miller et al. (2010)? Also, is there any residual contribution of sensible heat flux to IRGAdry?

P 28288, line 2. The Wanninkhof (1992) parameterization is now widely accepted to be too high due to a bias in the global radiocarbon estimate. This should be acknowledged if cited. If the authors believe k to be a quadratic function of wind speed, the Sweeney et al (2007) parameterization would seem more appropriate.

Line 8. Why did IRGAwetA give much larger scatter than wetB?

P 28290, line 4. "To investigate the unsatisfactory. . ." instead of "in the light of the unsatisfactory. . ."

P 28290, line 15, parenthesize 0 in xc0 to be more consistent

p 28292, line 11. definition of F0TS? Line 21. "Overestimation of CO2 flux magnitude"

P 28294, line 3. As this is the summary section, rather than using nomenclatures, you can simply say that the PKT correction applied to undried IRGAs reduced the scatter but did not reduce the bias in flux compared to dried IRGAS. Line 11. ". . .to retrieve the true CO2 flux from. . ."

Fig 3 Legend "flux calculated based on the parameterization of. . ."

Fig 4. Legend "Difference between. . ."

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