**Atmospheric
Chemistry
and Physics
Discussions**

Interactive
Comment

Interactive comment on "The effects of experimental uncertainty in parameterizing air-sea gas exchange using tracer experiment data" *by* W. E. Asher

W. E. Asher

Received and published: 4 November 2008

Responses to Comments from Andrew Watson on ACPD-2008-0388

Review: *I have no problem with the analysis of the wind-wave facility measurements, which have comparatively large measurement errors on the actual gas concentrations (7% on He-3 for example). Asher shows that these lead to a substantial proportion of the scatter in the gas exchange estimates. I do however, have some reservations on the analysis of the ocean dual tracer experiments.*

These, as Asher notes, generally have lower uncertainties on the measurement of gas concentrations (2% or thereabouts), but there is an additional uncertainty in the mixed layer depth that is not present in the wind-tunnel experiments, and this dominates in the

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

calculations made in the present work. The assumption is made that the uncertainty on this depth is 20%. This may be a good assumption for experiments conducted in stratified waters where the mixed layer depth is defined by a pycnocline, which may change rapidly. However, it is I think unduly pessimistic for experiments made in well-mixed coastal environments. The ones with which I8217;m most familiar were those performed in the North Sea. For precisely the reason that it was important to define the mixed layer depth accurately, these were conducted in a region off the Dutch coast where the water column is mixed from top to bottom, so that the mixed layer is defined by the bathymetry, which was well-characterized and uniform. 20% is too high an estimate for the uncertainty in mixed layer depth in those experiments 8211; it8217;s more like 10%.

Response: It is correct that the uncertainties in the mixed-layer depths for the dual-tracer data from the North Sea and Georges Bank experiments are less than that for the open ocean. For example, Wanninkhof et al. (1993, JGR-Oceans) report an uncertainty for the water depth of ś1.8 m with an average value of 35.4 m for a total uncertainty of 10%. Similar uncertainties are available for the North Sea/Dutch Coast experiments, which list typical depths of 20 m ś 1 m (e.g., Jacobs et al., 2002, JGR-Oceans). In order to address this issue the field results have been separated into the continental shelf data and the open ocean data. Figure 6 is now shown in two parts, with the shelf DT data plotted with the Monte-Carlo model run using a 10% variance in depth and the open ocean using the 20% variance. The discussion of the dual-tracer experiments has also been expanded to include this issue.

Specific comments:

it would be a good idea to provide references for the first few sentences in this section, thus for some of the "several new oceanic data sets", the "new information concerning the fundamental mechanisms of controlling air-water exchange" etc.

Response: Agreed. Done.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

The reference for origin of the purposeful dual tracer method should be Watson et al 1991, not Wanninkhof et al 1993. (I hope my co-referee will concur!)

Response: Done.

Equation 3: The second "delta" is not well-defined. As written it could mean:

Ln(He2/Sf62) - Ln(He1/Sf61)

or

Ln ((He2-He1)/(Sf62-Sf61)),

where the subscripts 1 and 2 denote the measurements made at the beginning and end of the interval delta-t.

Response: Part of the problem here, I think, is that there was an error in the original version of Equation 3, where there should be a negative sign on the right-hand side of the equation. This mistake has been corrected. However, a sentence of clarification has been added following the equation stating that the delta term refers to the difference in the ratio of concentrations between times 1 and 2.

Equation 3: Also, the equation looks to me to be wrong: surely it should contain the atmospheric values of atmospheric He and sf6? The concentrations in the expression are actually the deviations from the values in equilibrium with the atmosphere, not the absolute concentrations.

Response: Typically it is assumed that the two gases are injected into the ocean surface in large enough quantified that the atmospheric concentrations may be assumed to be zero. Under this assumption, the analysis only makes use of the change in the ratio of the concentration of the two gases in the water as discussed in Wanninkhof et al. (1993) and Jacobs et al. (2002). This is now mentioned in the text.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 16693, 2008.