Biogeosciences
Open Access
Discussions

Interactive comment on "Comparing solubility algorithms of greenhouse gases in Earth-System modelling" *by* V. M. N. C. S. Vieira et al.

R. Wanninkhof (Referee)

rik.wanninkhof@noaa.gov

Vieira et al. compare the effect of two solubility algorithms applied to gas fluxes and surface water trace gas inventories, using temperatures at two different depths, for the European coastal oceans . They conclude that the different solubility algorithms can lead to millions of tons differences in CO_2 and hundreds of tons of CH_4 and N_2O in the top meter of the ocean in the modeled region. The modeled surface area is not mentioned so it is difficult to assess if this is the case, although my rough estimate suggests less than a million ton CO_2 assuming a 5 % difference in solubility.

The paper is confusing and difficult to comprehend. The basic premise that solubility algorithms differ and this has an impact on the thermodynamic driving force is not novel. Neither is the issue that the measurement depth and associated temperature

difference can have an impact on calculated gas inventories.

Part of the confusion is the inconsistent terminology regarding solubility in this paper and the literature at large. The Henry law solubility coefficient should be in (mol/l/atm). The "dimensionless[scalar]" Henry law solubility coefficient, Kh referred to in the text is better expressed as the Ostwald coefficient(see section 8-11Reid, R. C., J. M. Prausnitz, and B. E. Poling, 1987: The properties of gases and liquids. McGraw-Hill.).

A second issue is the confusing application of the basic gas exchange bulk formula and boundary layer theory, especially the aqueous mass boundary layer. The basic bulk formula is

F = kw (Cw-Co)

Where Co is the top of the boundary layer in equilibrium with the gas concentration in the atmosphere. It can be expressed as p* Kh where p is the fugacity of the gas in air in question. That is, in basic form the gas solubility does not come into play for waterside concentrations when calculating fluxes.

I could not follow much of the paper and it will confuse readers. For instance, from first principles the solubility does not affect the gas transfer velocity (k(600)) as shown in figure 4 [except in case of bubbles]. The difference shown in figure 1 is the way the gas transfer velocity is calculated. It is because k600 is estimated through the measurement of fluxes and concentration difference in air and water (see top of page 15928) . As an aside, k600 does not seem to be defined anywhere. The figure caption for figure 4 "Bias in observed transfer velocity" is therefor not correct. It's the bias in the calculated gas transfer [using eddy correlation]

The grammar and syntax needs to be improved.

There is not a lot of novel science and once the discussion is streamlined it can be condensed in a couple of pages. It can then be incorporated into the companion paper "improving estimations of greenhouse gas transfer velocities"

Interactive
Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

Interactive comment on Biogeosciences Discuss., 12, 15925, 2015.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper