Geosci. Model Dev. Discuss.,
doi:10.5194/gmd-2016-273-RC1, 2016

Geoscientific Model Development Discussions

Interactive comment on "The FuGas 2.1 framework for atmosphere-ocean coupling in geoscientific models: improving estimates of the solubilities and fluxes of greenhouse gases and aerosols" *by* Vasco M. N. C. S. Vieira et al.

Anonymous Referee #1

Received and published: 20 December 2016

The manuscript "The FuGas 2.1 framework..." by Vasco M. N. C. S. Vieira and colleagues is an interesting study presenting a model which aim is to improve parameterization of air-sea gas exchange. The model is based on previous work by the same first author but on top of that, it presents the differences in gas fluxes in European coastal seas between the model and previous parameterizations.

The manuscript looks promising but still has at least one large problem (and some minor ones) which needs to be addressed before it is published. This is the very reason I suggest it needs a major revision. Namely it does not convincingly state why

the new parameterization is supposed to fit better experimental data. Lines 295-6 contain the following statement: "The red markers [in Fig. 3] representing the ZRb03 iWLP give the best example." I believe the "example" is actually "fit" but I do not see why the red triangles (representing ZRb03 iWLP) are supposed to be best fit. That is unless the authors imply that the obsolete Wannninkhof 1992 is the one they are fitting. That would be wrong because even its author suggests using his newest formula from Wanninkhof, R. (2009) [1]. This new function is closer to Nightingale et a;. 2000, also shown in Fig 3. And "Rb03 WLLP" seems closer to it. Maybe I have misunderstood the authors' intentions (for example I have no idea what the following is supposed to mean: "the comprehensive algorithms split the data points into two distinct scatter lines, the upper line for kw obtained under rougher sea-surfaces and the lower line for kw obtained under smother ones") but I have not been convinced why "ZRb03 iWLP" is supposed to be better. This certainly needs some additional arguments in any revised version.

The "renowned functions" in Fig. 3, as the authors call them, miss some other important ones like Ho et al. 2006 [2] and Sweeney et al. 2009 [3]. In fact the recommendations of a special discussion session "Relationship between wind speed and gas exchange over the ocean: Which parameterisation should I use?" on the latest SOLAS Conference (Kiel, 2015) are:

"For gas transfer of CO2 over the oceans the relationships proposed in Nightingale et al. (2000), Sweeney et al. (2007), Ho et al. (2006), and Wanninkhof et al. (2009) are recommended. They are very similar and fall within the overall uncertainty of DT measurements."

The manuscript has also some minor problems, easy to address:

- equations (13) based on Zhang et al. 2006 (eq. 3) and (18) based on Jeffrey et al. 2010 (eq. 5 and 6) are both badly mangled, most probably by the Copernicus editing software (I had the same problem with a manuscript I was a co-author of) with all "1/2"

values changed to “1.2” and other errors

- Ks is dependent on theta (equation 7) which should be explicitly shown

- the Wind Log-Linear Profile (equation 14) is actually the Monin-Obukhov similarity theory which could be directly named and cited (either the original 1954 Russian language paper or its English translation http://mcnaughty.com/keith/papers/Monin_and_Obukhov_1954.pdf)

- “the alternative model” of Liss and Slater (1974) [line 81] is not really alternative but rather needed for gases which airside resistance (1/ka) is not negligible)

- The “E-C” acronym, introduced in line 275, is never explained and has to be guessed as (non-obvious) eddy covariance / correlation

- “calculus” is used multiple times in the manuscript in the meaning of “calculation” (the Enlish language meaning is narrow and covers only derivatives and integrals)

- ocean deep waters are not formed in “pole regions” [line 46] but rather sub-polar ones, mainly Nordic Seas (Norway and Labrador Seas) of the North Atlantic

- it is not clear from the caption of Fig. 1 what is subtracted from what.

Suggested literature:

[1] Wanninkhof, R. (2014), Relationship between wind speed and gas exchange over the ocean revisited, Limnol and Oceanogr: Methods, 12, 351-362, doi:10.4319/lom.2014.12.351.

[2] Ho, D. T., C. S. Law, M. J. Smith, P. Schlosser, M. Harvey, and P. Hill (2006), Measurements of air-sea gas exchange at high wind speeds in the Southern Ocean: Implications for global parameterizations Geophys. Res. Let., 33, L16611, doi:16610.11029/12006GL026817.

[3] Sweeney, C., E. Gloor, A. R. Jacobson, R. M. Key, G. McKinley, J. L. Sarmiento,

and R. Wanninkhof (2007), Constraining global air-sea gas exchange for CO2 with recent bomb C-14 measurements, Global Biogeochem. Cycles, 21(2), GB2015 doi:10.1029/2006GB002784.

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