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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The impact of diurnal variability in sea surface temperature on the atlantic air-sea CO_2 flux" *by* H. Kettle et al.

Anonymous Referee #3

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This is an interesting contribution where the NOAA-COARE gas transfer velocity algorithm is implemented along with high resolution hourly satellite SST to determine diurnal variations in the air-sea CO2 flux. The paper is well written, concise and the figures are adequate. I have no problem recommending this for publication in Atmospheric Chemistry and Physics provided the authors address the following issues.

1. What would be the correct reference for Eq. 1. A similar –but more general expression was published by Liss and Slater in Fluxes of Gases across the Air-Sea Interface, Nature 247, 181-184, 1974. The authors should consider using this reference.

2. Page 15831. The MLD climatology is perhaps a bit outdated – at least it seems undocumented. Consider using the one by C. de Boyer Montegut et al., Mixed

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layer depth over the global ocean: an examination of profile data and a profile-based climatology, J. Geophys. Res. 109, C12003, doi: 10.1029/2004JC002378.

3. Page 15832. In description of Eq. (9) please include that S denotes salinity.

4. Page 15836, Eq. 22. What would be the correct reference here? In his table A1, Wanninkhof encourages readers to consult and cite the original publications.

6. Page 15837, eq 23. Instead of SVP, consider using pH2O, which seems to be the norm. Also, do you have the reference for eq. 24?

7. Page 15839. At lines 6-8 you state that "Here we see that including diurnal variability in SST ..... or no change in flux ....". Does this mean that uptake regions are not affected, or is it simply a result of there being no uptake regions in the study area?

8. Reading the abstract I was astonished by the apparently huge effect of diurnal warming that is found. In the abstract the authors state that including diurnal variations increases the Atlantic outgassing from 9.6 to above 30 Tg C a-1. But what does this number really mean? From Table 1 of Takahashi et al (2002), the net annual CO2 uptake of the Atlantic Ocean is 0.92 Pg C, this is 920 Tg C. Relative to this number the 20 Tg C difference found by the authors is actually not that large. Later in the paper is becomes clear that the paper deals with a limited region of the Atlantic, covering approximately 60S to 60N and 60W to 45E. Comparing again with Takahashi et al. Table 1; for the Atlantic between 50N and 50S they get an uptake of 520 Tg C a-1 So compared to these numbers the effect is in reality quite small. I'd like the authors to (1) be more true to the actual significance of their numbers in the abstract and elsewhere and to (2) to reflect a bit more on whether they believe that diurnal warming is a significant effect on global scales, or if this is just a local issue which may have a large impact in outgassing regions but will not affect the global carbon budget to a large extent.

9. As far as I can understand the potential effect of surface warming on ocean pCO2

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in itself, is not included. I.e. the fact that pCO2 increases approximately 4.32% per 1 degree increase in surface warming. The issue here lies with the fact that this effect may be missed out by many observations since water for underway pCO2 analyses tends to be drawn from intakes deeper than 2 m. This effect was included by McNeill & Merlivat and Olsen et al. In the SEVIRI region is will tend to increase daytime pCO2 and thus the outgassing. Why is this effect not included - or have I misunderstood. - After all you do discuss another effect which may cause diurnal waterside pCO2 variations, namely biology.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 15825, 2008.

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