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Biogeosciences
Discussions

Interactive comment on "New insights of $p\mathrm{CO_2}$ variability in the tropical eastern Pacific Ocean using SMOS SSS" *by* C. W. Brown et al.

Anonymous Referee #1

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Using new satellite products Brown et al. are able to develop a high-resolution data set (in both space and time) of pCO2 in the Eastern Tropical Pacific Ocean (ETPO), a highly variable region that plays an important role in global interannual air-sea pCO2 flux. While there have been previous efforts primarily using observation-based methods to describe pCO2 variability in the region, results vary due to incomplete spatial and temporal coverage of direct pCO2 measurements in this dynamic region. The availability of a new satellite SSS product allows Brown et al. to achieve high-resolution estimates of pCO2 and air-sea flux in the ETPO. They are able to resolve seasonal and interannual variability in three distinct subregions with unique physical drivers of pCO2, including jet wind induced upwelling, thermocline depth, and rainfall. Identification of these regional differences could significantly improve predictions of how fine-scale temporal and spatial variability in the ETPO impacts tropical ocean pCO2 flux estimates. A

longer data set that captures additional La Nina and El Nino events will be necessary to fully understand how ENSO also drives pCO2 and air-sea flux in the ETPO.

Brown et al. present an excellent analysis that will contribute to the efforts to understand pCO2 variability in the ETPO. I recommend publication in Biogeosciences after the authors consider a couple issues below that may improve the clarity of the science presented and how this work compares to previous studies.

1) In order to allow a more robust comparison of the results of this work versus previous studies using different methods, the authors should provide additional background on the look-up-table (LUT) method. Has the LUT method been described previously? If so, provide references. What SSS/SST-based algorithms result from this method for predicting pCO2 in the three distinct water masses shown in Fig 2? These relationships could be embedded in Fig 2 or presented in a separate table. It would also be informative to include a comparison of ETPO-wide flux estimates derived from this work and the work of Takahashi, Ischii, Landschutzer, etc in section 4.3. While the main focus of the Brown et al. analysis is fine-scale variability, annual pCO2 and flux estimates are also presented, and it would be useful to understand how the different methods compare in predicting overall annual flux from this region as well.

2) Similarly, while the difference between fCO2 and pCO2 will not impact the main conclusions on the influences of physical drivers on surface ocean pCO2 in the ETPO and how those compare between subregions, it will impact the absolute values of annual pCO2 and flux estimates presented in this manuscript and the authors' ability to compare to previous papers. This is important considering the community's goal of constraining regional fluxes to 0.2 Pg C year-1 (Bender et al. 2002, A Large Scale Carbon Observing Plan: In Situ Oceans and Atmosphere). If using pCO2, the authors should consider converting SOCAT fCO2 to pCO2. In addition, are Mauna Loa atmospheric observations used to calculate air-sea flux? If so, the authors could be introducing considerable errors by applying higher-latitude atmospheric CO2 to a lower-latitude region with less seasonal atmospheric CO2 variation. The authors should use

the GLOBALVIEW-CO2 marine boundary layer product for weekly atmospheric values at a latitude more appropriate for this tropical region.

Minor comments/edits:

Page 4598 line 13: define ITCZ

Page 4601 lines 12-14: What is the estimated uncertainty associated with the SMOS SSS? And lines 17-19: How about the uncertainty in OSTIA SST?

Page 4603 line 9: provide reference

Page 4603 line 17: provide longitudes for this region

Page 4603 lines 16-21: Consider also including comparisons to Ishii et al. 2014 and Landschutzer et al. 2014 (cited later in section 4.3) and the following:

Cosca, C. E., R. A. Feely, J. Boutin, J. Etcheto, M. J. McPhaden, F. P. Chavez, and P. G. Strutton (2003), Seasonal and interannual CO2 fluxes for the central and eastern equatorial Pacific Ocean as determined from fCO2-SST relationships, Journal of Geophysical Research: Oceans, 108(C8), 3278.

Feely, R. A., T. Takahashi, R. Wanninkhof, M. J. McPhaden, C. E. Cosca, S. C. Sutherland, and M.-E. Carr (2006), Decadal variability of the air-sea CO2 fluxes in the equatorial Pacific Ocean, J. Geophys. Res., 111.

Page 4608 line 1: also shown in Fig 8

Page 4611 section 4.3: What about comparisons to Cosca et al. 2003 and Feely et al. 2006?

Page 4611 line 24: change Sampling though to Sampling through

Figure 2: consider adding a box around the A, B, and C regions to clarify the extent of those water masses

Figures 7 and 8: clarify in the figure legends that this is LUT-derived pCO2

Interactive comment on Biogeosciences Discuss., 12, 4595, 2015.