Biogeosciences Discuss., 10, C5847–C5850, 2013
www.biogeosciences-discuss.net/10/C5847/2013/

Biogeosciences Discussions
Open Access

Interactive comment on "Observed small spatial scale and seasonal variability of the CO_2-system in the Southern Ocean" *by* L. Resplandy et al.

Anonymous Referee #1

Received and published: 14 October 2013

The authors analyze the carbon chemistry data obtained by their CARIOCA float systems, which were deployed in the northern sub-polar zone in the Southern Ocean. They show how the small spatial scale variability (within 100 km and 20 days) of ocean dynamics, SST and biological activities affect the surface water pCO2 and hence the sea-air CO2 flux. On the basis of a principal component analysis of the data, the relative importance of the three main drivers (SST, DIC and biological production) for pCO2 is identified along the study area of the northern frontal zone of the sub-polar waters. They conclude that the small scale variability is as large as the large scale variability, and should be taken into consideration for the future carbon cycle studies of the Southern Ocean. The data set is one of the most unique and important sets of the observations of the Southern Ocean, and the analysis constitutes a significant and important contribution. I recommend the publication of this paper with minor revisions

consisting mostly of clarifications as outlined below.

Scientific and Technical Comments: 1) Page 13855, TITLE: The Southern Ocean is a vast place with highly variable processes controlling carbon chemistry. If the space allows, the title should be more geographically specific: for example . . . seasonal variability of the CO2 system in the northern sub-polar frontal zone of the Southern Ocean"?

2) Page 13857, lines 1-26: The large differences among the various independent estimates for the air-sea CO2 flux are not entirely due to the scarce CO2 observations as the authors imply in the Introduction. The differences are largely attributable to the definition of the Southern Ocean: some consider south of 50°S, Gruber et al (2009) use 44°S as the northern boundary, and Takahashi et a. (2009) use 30°S. Since the most intense CO2 sink zone is centered around 40°S between 30°S and 50°S, the "Southern Ocean" CO2 uptake flux is sensitive to the choice of the northern boundary.

3) Page 13860, Eq 1). What do the author mean by "max" (X (. . .)) and "min" (X (. . .)? I assume that the authors are looking for the amplitude of variation within the 20 day period. Do the "max' and "min" values are difference between the single max and min values? Or, do they indicate some sort of mean amplitude? The authors should explain it more clearly.

4) Page 13862, line 25: Here a biological quantity "Fluo" is introduced. Unlike SST and DIC, which can be defined explicitly, "Fluo" (which I assume fluorescence measurements) is a measure of biological activities, but is not quantitatively related to the primary production as evidenced by a number of papers on this subject. I realize that the authors use "Fluo" as an indicator for primary production because of the lack of any other biological parameters (such as change in nutrient concentrations), and support its use. However, I would like to see a short statement explaining caveat in using "Fluo" as a primary production indicator. Even if it reflects "qualitatively" the gross primary production, it is NOT an indicator for the net community production" which the authors wish to have. If "Fluo" indicate the gross production, then its use for the indicator for

BGD
10, C5847–C5850, 2013

net community production would tend to over-estimate the contribution of the biological contribution.

5) Page 13868, line 10: Here, the authors make an important statement relating the large-scale and small scale variability: " ... the strong signature of large-scale patterns on the variability of smaller spatial scales" . However, the large-scale patterns are not explained. Around 40° latitudes in the northern and southern hemisphere oceans, there is a zone where the effect on pCO2 of the seasonal change of temperature is compensated by changes in DIC, and the amplitude of seasonal change of pCO2 becomes zero (Takahashi et al., DSR-II, 2002). In the southern hemisphere, this occurs in a zone between STF and Sub-polar front, where this study was made.

6) Page 13868, lines 16-20: The authors point out that "It is interesting to note that the dominance of biological activity depends more on the region than a on the season of sampling". This is really puzzling. Is it possible that phytoplankton stop fluorescing when they are exposed to strong lights beyond a certain threshold level, that might occur in summer? Since I have only limited experience with fluorometer, I would advise the authors to consult with experts. I might speculate that, only when the light levels are reduced in winter, phytoplankton community responds to fluorometer.

7) Page 13889, Fig. 7: The Satellite SST along the float (Fig. 7-b) is compared with the Satellite SST 2007/03/28 (Fig. 7d). Fig. 7-b shows SST values ranging 6 to 7.5°C, whereas Fig. 7-d shows about -0.5°C. I suspect that one of them is labeled incorrectly. I assume that the red curves represent the float tracks, but the color does not correspond to the color scale. Please clarify.

Editorial Nature: 1) Page 13858, line 19: Correct typo to read "interpretation". 2) Page 13869, line 7: Correct typo to read ". . .. these patches of biological activity were located along the SAF. . .". 3) Fig. 4: Define and explain the color scale values. Are they correlation coefficients? 4) Fig. 6: Define and label the gray curves. 5) Fig. A1, A2 and A3: Define and explain the color scale values. Are they correlation coefficients?

BGD

10, C5847–C5850, 2013

6) Fig. A4: Define and label the grey curves.

Interactive comment on Biogeosciences Discuss., 10, 13855, 2013.