Interactive comment on "Seasonal variations of air-sea CO_2 fluxes in the largest tropical marginal sea (South China Sea) based on multiple-year underway measurements" *by* W.-D. Zhai et al.

Anonymous Referee #2

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General comments

The authors present a large and interesting dataset for the South China Sea with 14 surveys realized from 2003 to 2008 and a revised estimate of the CO2 flux in this region. The objective of the paper is to assess the seasonal variability of the air-sea CO2 fluxes in 4 different physical-biogeochemical domains. The scientific approach and the methods are valid but the data should be better synthetized to support the points the authors want to make. As it stands the paper does not sufficiently highlight the main features of the dataset. The paper requires some rearrangement before being published. As the paper focuses on the seasonal variability using data from 14 surveys from 2003 to 2008 there is the implicit assumption that the year-to-year variability is

negligible. I think this should be discussed and if this hypothesis is validated, four seasonal maps could be presented instead of 3 figures for winter, 2 for summer, and 3 for autumn (figure 2). The data of the Pearl River plume should be studied separately as it is difficult to identify the effect of this river on the figures presented. Also the paper should show only the relevant correlations (e.g. fCO2-SST) with the corresponding equations and quality of the fit, rather than plotting the whole dataset, which makes the figures difficult to read (figures 7-10).

Specific comments

Introduction p. 7035: Figure 2 should not be mentioned here as it is not commented before section 4.4.

Sampling and methods

3.3. pCO2 determination p 7039 "CO2 concentration in the air near the sea surface was typically determined every 1 to 3h in the day and 4h in the night" The atmospheric air is sampled at 10m, which is not near the sea surface. This should be referred to as atmospheric CO2 throughout the text.

4 results

4.1. SST and salinity P 7040 "Generally the seasonal variations of SST in domains A, B, and D followed the seasonal cycle of long-term monthly mean SST at 20oN, 116oE (Fig. 3a)": Why is the location 20oN, 116oW chosen? It is hard to see the seasonal cycle for each domain on figure 3a. The seasonal cycle of SST in each domain should be shown based on the SST data of Tables 3, 4, 5 and 6. The same applies for salinity and wind speed.

4.2. Wind speed

Do the color bars on figure 4b correspond to QuickScat data? If so, what is the spatial and temporal average? If QuickScat data are used as mentioned in section 3.2, field data should be compared to QuickScat data. What is the purpose of comparing the

field data with the NCEP winds at 20oN, 116oE?

4.4. Distributions of sea surface pCO2

Figure 2 should be renamed to be introduced here. Each panel should be described: why is there 3 panels for winter, 1 for Spring etc...? The legend should be completed to describe the different panels. As the objective is to show the seasonal cycle, 4 seasonal maps should be presented. This section is tedious to read: it is a list of pCO2 values. It should be rewritten to highlight the main features of the pCO2 distribution.

4.5. Air-sea flux estimation

"The pCO2 variability was still remarkable both in terms of time and space": what does it mean?

5 Discussion

5.1. Factors influencing sea surface pCO2

This section should focus on the findings. All the cruises are plotted on the figures showing the pCO2 as a function of SST and pCO2 at 26oC as a function of salinity. This section should be rewritten to show only the relevant information, i.e. pCO2-SST when there is a relationship. There is no discussion on the impact of biology although this factor is mentioned p. 7046 ("biological productivity was enhanced") and p. 7049 ("upwelled nutrients driven primary production", "intensive phytoplankton blooms in the Luzon Strait"). In domain C, the influence of the MKRDW is mentioned but it would be interesting to specifically study the river plume. Concluding remarks Given the variability described in this work, the last paragraph is very speculative.

Figures

Figure 1 is difficult to read as there are so many things on it.

Figure 2. Missing legend for the 9 different panels a to i.

Figure 3a. If the purpose of this figure is to show the seasonal cycle it would be better to report the SST data on a monthly climatology.

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