Biogeosciences Discuss., 7, C4021–C4023, 2010
www.biogeosciences-discuss.net/7/C4021/2010/
Anonymous Referee #4
Received and published: 23 November 2010

Response

We would like to thank the anonymous reviewer for very helpful and thoughtful comments that have improved the paper. In the revised paper, we have addressed all the concerns of the reviewer. In this response, we have interspersed our responses to reviewer comments below (in blue, Helvetica 11 font in the supplemental file) and revised the paper accordingly. In the online version of our response, we have added the RC4 to denote referee comment and AR response.

RC4. General comments: The paper presents surface water pCO_2 distribution on the Bering Sea shelf calculated from measured TA and DIC collected in the spring and summer of 2008. The surface water pCO_2 fields are then also extended into the Bering Sea by the use of MLR. The annual air-sea flux of CO_2 is calculated and compared to previous results. The authors conclude that the Bering Sea shelf is a stronger sink for CO_2 than shown previously. The strong sink during summer is attributed to a large biological drawdown over much of the shelf, only partly countered by warming. The paper is well written and structured and adds to the limited amount of studies of surface water pCO_2 and CO_2 fluxes on the Bering Sea shelf. However, some issues needs to be addressed before publication.

Specific comments:

RC4. (1) I am missing a discussion on the importance of surface water circulation and mixing of different water masses in the studied area with regards to surface pCO_2. How far out does the shelf water region extend? Also, it is not quite clear what the importance of the riverine input is. Is it insignificant as the authors use salinity normalised TA in the discussion?

AR. In the revised paper, we additionally discuss surface water circulation and mixing. We had delineated the shelf region as those areas shallower than 200 m although we recognize that this is intrinsically somewhat arbitrary. The river runoff appreas to have minor impact on most of the Bering sea shelf. In a companion paper, Mathis et al., show that the NE part of the shelf is influenced by Alaskan river outflow but this appears restricted to close to shore.

RC4. (2) Questions regarding the MLRs: The observed pCO_2 values showed a span of 180- 520 uatm and the MLR model maps showed 350-450 μatm. I wonder if there was an investigation on the more "extreme" pCO_2 values that were not captured by the MLRs. Did they belong to a specific region or time, could they be linked to a specific process not captured with the parameters in the MLR? Could you see an "extreme" value in any of the supporting parameters in these cases? Do you know if it was the calculated TA or calculated DIC that "missed"? Are you reporting the R-sq or the adjusted R- sq for the MLR-results? Were they similar? Did you use your MLR equations on the Takahashi data set to compare the results? How far off the shelf are you confident that your approach works? You state that there is an associated unique pCO_2 error for every point; were there any particular regions that seemed to work better/worse?

AR. There was no apparent time or spatial pattern to the extreme pCO_2 values that were not captured by the MLR method. We suspect that we may be missing the impact of sea-ice melt (in Fig 4 C in summer) in the extreme cases. We are reporting r sq. We could not use the MLR equations for the Takahashi datasets since Taro did not report nutrient or oxygen data with T, S, and pCO_2. In the revised paper, we restricted the MLR analysis in this paper to the shelf areas (<200 m deep), and did not report results of the MLR for the open-ocean areas of the Bering Sea. The MLR approach has been used for water-column and mixed-layer studies. The MLR fits below the mixed layer tend to have smaller standard deviations and for example, have been used for GLODAP climatology, climatologies of Goyet et al., and often for crossover analysis for comparisons of data from different cruises. The MLR fits for the surface/mixed layer have larger standard deviations and used by Lee et al., 2002, Bates et al., 2006, for example. We did not find any specific region that had better or worse results.

RC4. (3) When talking about sinks, any thoughts about where this carbon is likely to end up? Burial in the sediments, off-shelf transport, outgassing.. which would be the dominant process?

AR. We have added a couple of statements about where we think CO_2 ends up. This is speculative of course, but it is likely that remineralization of organic matter restores seawater pCO_2 values during the winter. Sea-ice dampens or blocks gas exchange so higher pCO_2 winter water is likely advected off the shelf or northwards through the Bering Strait.

Technical comments:

RC4. Repeated text on line 10-11 on p. 7279

AR. We have corrected the text in the revised paper.

RC4. Table 1: In the header it reads: Bering Sea annual flux flux

AR. We have corrected the typo in the revised paper.

RC4. Fig 3. The figure text states that the original hourly wind data is shown in blue in each plot; however in the bottom plot it is red.

AR. We have corrected the figure in the revised paper.

RC4. Fig. 4. The red text in the plot is somewhat blurry; it would be nice to have a different colour and sharper (if it is necessary at all, since it is mentioned in the figure text).

AR. We have corrected the figure in the revised paper. The pdf produced a slightly blurry image but revised paper has higher resolution tif files

RC4. Fig. 5 and Fig 7. Larger text on the axes of the plots would be an improvement. The ice-% captions in figure 7 definitely needs to be larger. For figure 5, perhaps it isn't necessary to repeat "at each hydrocast station during. . ."?

AR. We have corrected the figure in the revised paper.

RC4. Fig. 12 The figure text is really, really long. . . One suggestion is to remove the non-corrected comparison plots and instead plot the results for the different areas in sep- arate plots (and then the areas would not need to be mentioned in the figure text, but are stated inside each plot).

AR. We have shortened the figure caption as suggested.