

Interactive comment on “Subsurface low pH and carbonate saturation state of aragonite on China side of the North Yellow Sea: combined effects of global atmospheric CO₂ increase, regional environmental changes, and local biogeochemical processes” by W.-D. Zhai et al.

Anonymous Referee #2

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This manuscript “Subsurface low pH and carbonate saturation state of aragonite on China side of the North Yellow Sea: combined effects of global atmospheric CO₂ increase, regional environmental changes, and local biogeochemical processes” contains good dataset for an interesting research area in one of the important coast region in the Eastern Asia. This area, North Yellow Sea, have experienced mixing processes and regional environmental change. The carbon dynamics also showed seasonal variation in the bottom water in this area. However, while the author emphasized the

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combination effects as listed in the title; the authors discuss each effect independently and make this manuscript hard to follow. There are also gaps between the dataset and the conclusion for most discussion sections. This study needs critical evidence to reach these main ideas. Finally, this nine-month data is more suitable to explain spatial variation and likely seasonal variation, and is less likely to explain long-term variations. Thus, the manuscript could be benefited by focusing on the seasonal variation and mixing process; and might be some discussion on those long-term variations. This manuscript needs a major revision before it can be considered for acceptance. The major and minor comments are as follow:

Major comments:

1. The mixing process needs to be further quantified in this study. Please provide the method of the normalization of alkalinity at P3089 L21. Please clarify the assumption behind this calculation. If the mixing process between river and seawater were considered, this should be a two end-member mixing. Please also provide the TAlk value in the river end-member in this section to support this. In addition, please clarify the “long-term” mixing at L25-26 and how the evaporation and precipitation affect the TAlk values in Bohai Sea under such “long-term” mixing.

2. As comment #1, please clarify this statement in the last paragraph of Section 4.4, “The Bohai Sea water mass outflow had important impacts on the dynamics of subsurface pH (25C) and Ω_{arag} in the NYS. . . . Bohai Sea water mass out flow effectively increased the NYS mean bottom water Ω_{arag} ”. Please clearly point out how much proportion that conservative mixing affects these pH and Ω_{arag} variations. Please also clarify the large variation of Ω_{arag} among salinity 31.5 to 32.5. Furthermore, please also clarify the sentence in the abstract P3081, L21-23 “Out flow of the Bohai Sea water mass counteracted the subsurface Ω_{arag} reduction in the North Yellow Sea.” In addition to salinity, please also provide other signals, such as T-S diagram, to elucidate that the water was from Bohai Sea.

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3. Section 4.3, P3094, L2 to 4. Please also explain the effect of lateral transport as you also emphasize the outflow from Bohai Sea as mentioned in comment #1 and 2. P3094, L18-19, please clearly indicate what is included in “all regional/local processes”.

4. It is author’s choice to discuss the effect of varied atmospheric CO₂ value on carbonate system as in Section 4.2. The authors said “Therefore, air-equilibrated pH levels in the NYS declined by 0.13 pH units since the pre-industrial period” in this section. However, as the authors only have nine-month data and an over-simplified model in this discussion, there is still a gap to reach the conclusion: “This study showed that the carbonate system in the North Yellow Sea was substantially influenced by global atmospheric CO₂ increase” in the abstract. Such simplified model also conflicted with section 4.5 “Recent regional environmental changes”. Please consider such conclusion again. Furthermore, the atmospheric CO₂ in such coastal area might be affected by terrestrial sources and doesn’t fully match the global average. If possible, please provide local atmospheric CO₂ value. Please also provide the reference for those pre-industrial, present, and future air CO₂ values in this study.

5. In Section 4.5, please provide the reference or measured data for P3097 L5-7 “In the hydrological settings during the 1950s and 1960s, more Bohai Sea water and TALK were introduced into the NYS, and the above-mentioned seasonal acidification processes were mitigated much more than present.” Furthermore, please provide a better linkage between your data and the first paragraph in Section 4.5, P3096 L9-20.

6. The word “typical” in this study should be re-considered as this study only has nine-month data, and another paper in Bohai (Zhai et. al., 2012, Chinese Sci. Bull.) also only has short-term data.

7. Please improve the introduction. The title mentioned increasing air CO₂, regional environmental change, and local biogeochemical processes; but only increasing air CO₂ is emphasized in the abstract. Please balance these main ideas in the introduc-

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tion.

8. Please edit these two sentences in P3082, L24 to 27. They were very similar to the third paragraph in Page 1063 at Zhai et al., 2012, Chinese Sci. Bull.

9. Please keep the writing consistent over this study. For example, the importance of increasing nutrient discharge and reduction of terrestrial alkalinity inputs were emphasized in the last sentence of the conclusion (P3098, Line 1~3), but this statement was overlooked in the abstract. Major comment #2 also showed unclear/inconsistent between in the Section 4.4 and in the abstract. Another example is as minor comment #3.

Minor comments: 1. The author mentioned “several stations” in Fig. 6c. Please clearly point out these stations on the profiles.

2. Please also point out where “those northern stations” in P3087, L19 are on Fig 3f.

3. “China side of the North Yellow Sea” was only mentioned in the title. It was changed to “Chinese side of the North Yellow Sea” in the abstract and conclusion. However, the authors only used “NYS” in the other places. In addition, previous studies (such as Xue et. al., 2012) used “northern Yellow Sea” for this study area. Please check if “North Yellow Sea” is an official name. Finally, please modify the words in P3097, L15-16, western North Pacific continental margin to NYS as the data were only in NYS.

4. The author used several words to describe pH and Ω , such as “very low”, “critically low”, and “extremely low”. Please point out biogenic meaning behind them; otherwise these words should be deleted or merely used.

5. P3082, L27, please add a reference for the Redfield equation and delete “traditional”.

6. P3083, L21-22, please add reference to support this.

7. P3085, L19, please check if this is a “pH analyzer” or a “pH meter”. Also in P3086 L11.

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8. P3085, L18, please provide the volume of the HgCl₂ that was used for each sample, and also provide the volume of the sampling bottles. Also in P3086, L9.
9. P3085, L21, please write down the pH value of each standard buffer.
10. P3086, L12, Reference Material is for reference, not calibration.
11. P3087, L21, Instead of "small changes", please provide a number.
12. P3088, L2-4, please clarify which stations are affected. This sentence is more suitable in discussion.
13. P3088, L8-10, such comparison might be more appropriated for discussion.
14. P3088, L13-16, please clarify the relationship between these carbonate data and the red tides.
15. P3089, please add a topic sentence for section 3.2.
16. P3091, L20-24, not clear. Please check.
17. Please revise the following paragraphs if they were not edited after the major revision: P3088 L17 to 28; P3090 L4 to L13; P3096 L9-L21.
18. Please consider to be revised by professional English editing before the submission.

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