

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 #1

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General comments: The manuscript present seven field measurements in TA and pH with related parameters e.g., dissolved oxygen, water temperature and salinity in the North Yellow Sea (NYS) between May 2011 and January 2012. It investigated present status on seasonal variations of pH and Ω_{arag} (carbonate saturation state of aragonite) with related controlling mechanisms in the western and central parts of the NYS and then made future predictions of marine environment changes under the atmospheric CO₂ rising scenarios. The author mentioned that the high quality dataset of

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Ω_{arag} is the first reported for the NYS region. The Ω_{arag} data with pCO₂ levels in the NYS were, however, calculated from the pH and TA and might have large uncertainties or errors involved. For instance, the pHT (25°C) values in October 2011 listed in Table 1 may be problematic. The authors shall have double checks. The data are overall not typical and lack of new knowledge of the community since similar papers previously addressed the things what the authors proposed. The combined effects of global atmospheric CO₂ increase, regional environmental changes and local biogeochemical processes were proposed but not de-convoluted i.e., the contributions from each effect on low pH and Ω_{arag} . That caused the authors overestimated only based on one-year seasonal survey instead of decadal time-series and lost merits of the paper which data are.

The authors tried to do future predictions under the same season conditions in relation to the effects of the global and regional changes to address the changing of pCO₂, pH and Ω_{arag} status in the NYS. However, the data presented here may be only reflected to the one-year seasonal variation instead of the effects as mentioned above although the authors wanted to build up the case. Overall speaking, the manuscript needs to have a major revision if the paper could be accepted. The paper is also hard to read and to understand since the current presentation sometimes at 25 °C or sometimes in-situ is quite confusing and the data could be checked again. Finally, could it be possible to put all the hydrographic and carbonate data in the supplementary materials?

Specific comments: P3080: Could the title: “Subsurface low pH and carbonate...: combined effects of global atmospheric CO₂ increase, regional environmental changes, and local biogeochemical Processes” be changed to “ Subsurface low pH and carbonate...: present status and future predictions”?

P3081: In abstract, please take a good care of significant digits such as Ω_{arag} in one significant digit or two; pH, salinity, DO etc. Salinity is unitless without psu for the whole text.

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P3081, L5-6: Subsurface waters were nearly in equilibrium with air in May and June. Could it be added fCO₂ and pH values in May behind and June, respectively? fCO₂: 371±42 μatm, 392±35 μatm; pH (25 °C): 7.79±0.05, 7.79±0.07. pH shall be mentioned either at 25 °C or in-situ. Will pH presented in-situ be better than ones at 25 °C?

P3081, L9-10: It is the same for adding the fCO₂ and pH values in November behind and January, respectively

P3081, L19-20: Please clearly define typical North Yellow Sea bottom water mass

P3083, L166: “ ..with an area of 71 300 km² and a mean depth of 38 m”. Please add a reference or define the range in Fig. 1

P3087, L11: Significant digits of temperature shall be consistent in the following text and table.

P3087, L11: Please make clearly the two northern stations in Fig.1.

P3088, L02: The definitions of water masses could be moved to the section of the method.

P3088, L8-10: The comparison of chl-a in NYS to ones in the ECS will be good instead of the SCS. Overall, the data were so high, particularly in January. Please check!

P3088, L26-28: please add DO saturation numbers in after DO concentration.

P3089, L13: Fig.8 shows the bottom water pHT (25 oC). . . Could the plots be made from pHT (25 oC) to pHT (in-situ), please? Explain why the lowest pH<7.7 occurred? or data quality?

P3090, L4-26: Please check all the ΔpHT data in bottom waters again at 25 oC or in-situ. Could all the data be uniformed as in-situ?

P3091, L17: In the NYS, the apparent temperature coefficient of bottom water pHT in

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2011 was estimated at -0.0144 pH units °C⁻¹ (n=7, r =0.996), based on the survey averaged dataset summarized in Table 1. How do you get the slope: -0.0144 pH units °C⁻¹ (n=7, r =0.996)? Could you plot the pH vs Temp ?

P3091, L24: ..overall seasonal variation of 0.25 units in 2011.. Is 0.25 right?

P3092, L23-25: You could make a plot shown in the supplementary material.

P3092, L28: ..temperature normalized fCO₂ (at 25 oC)? How to calculate? Please add a reference.

P3093, L22: pH-DO correlation could be reported in the supplementary material.

P3094, L15: 0.55–1.0 μmolO₂ kg⁻¹ d⁻¹? How to get it? Just got 0.2 from Table1 between August and November.

P3095: In the 4.4 section (“Effects of Bohai Sea Water mass outflow”) be suggested to add the theoretical mixing line of two end-members into the graphs/section to identify effect of the two distinctive sources by water masses. The same question in mixed uses of the pHT (25oC) and pHT (in-situ) occurred. Could you make all pH at in-situ, instead of at 25 oC since ΔpHT data were derived from the pH(in-situ) and for comparison consistency, please?

P3097, L7-12: The statements related to low ΔpHT status, not only influenced by global atmospheric CO₂ increase and local respiration/remineralization, but also by major environmental changes may be vaguely descriptive. However, do you have any data or direct evidence to prove especially for the issue of environmental changes? Could the author quantify the contributions on each effect on the low ΔpHT status change? or make a preliminary first-order budget ?

P3103: in Table 1, could the authors add more information such as pHT(in-situ), DO (%saturation), DIC, calculated fCO₂(in-situ)? data range after average in each variable? Salinity is unitless. Please indicate the calculated ΔpHT data derived by pHT (in-situ)

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P3106: suggest to combine Figures 3,6, 7, and11into one new figure 3? Horizontal arrangement is each variable; Vertical column is in the order of month from January to November. or vice versa. The variables could be Temp., Chl-a, %DO, pHT (in-situ), σ_t etc.

P3106: suggest to combine Figures 4, 8, 9, and10 into one new figure 4? same as described above.

P3117-3118: suggest to combine Figures 14, and15 into one new figure? same as described above. Please add one more variable i.e., TA in.

P3119: Add 1:1 reference line into the graph and make both x and y scales the same.

P3120: why only compare three cruise data? Please add the DIC data and discuss it in the manuscript especially for the issue of the seasonal drops in subsurface pH and σ_t .

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