

Interactive comment on “Progressive eutrophication behind the world-largest super floating macroalgal blooms in the Yellow Sea” by Q. Xing

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Dear reviewer,

Thank you very much for your thoughtful comments and suggestions on our work. All of your concerns were responded and modifications were made accordingly.

This paper intends to show the trend of eutrophication in the Yellow Sea in the past years, based on “a nutrient pollution index” as well as the satellite derived chlorophyll concentration. And the authors try to relate the trend with the floating macroalgal

C3336

blooms. I feel that there are some new results, but some concerns exist. The comments are as follows.

1. The index of “AWCPI-NP” provides the main result or proof of this paper, so it would be needed to describe the index in much detail. In Eq (1) why is the “lower limit” used? The parameter of area “A” is from the “annual reports of SOA”, but it’s not clear how this parameter is derived or calculated (by SOA), e.g. by remote sensing or in situ sampling? The authors should also try to demonstrate that the index is qualified in/capable of characterizing the real pollution level of the Yellow Sea.

Response: Amendments with references were made to explain how the parameter “A” in Eq (1) was obtained: “TIN, PO4-P as well as other marine environmental parameters, were regularly measured through in-situ sampling (Qu et al., 2006; SOA, 2010), these data with scattering sites were reprocessed with a method of Kriging Interpolation to give their 2-D horizontal distributions; then, according to the limit for each parameter, e.g., TIN, PO4-P in Table 1, the area of each level (A) was calculated.”

There is no top limit for the level-V, so the usage of the “lower limit” is the better way for evaluation of the overall nutrient pollution status. We gave an annotation in Table 1 in the revision: “*Water quality level II, III, IV and V are corresponding to relatively clean water, slightly polluted water, mediumly polluted water, and heavily polluted water, respectively. Level V has only a lower limit for each pollutant’s concentration.”

As demonstrated in Fig. 2, the real pollution could be characterized in two ways: one is a list of all the pollution levels and their corresponding polluted areas; the other is the derived index of AWCPI-NP which is on the basis of pollution levels and their corresponding polluted areas. Both the two ways gave the real pollution level of the Yellow Sea, only in different ways for different purposes. The latter, area-weighted index (AWCPI-NP), is capable of evaluating the whole status in an appropriate way; this similar strategy of data-processing has been widely used in geostatistics especially for unevenly sampled field data, e.g, a case of surface temperature in Mann and Jones

C3337

(2003). And, as we discussed, the increasing Chla, as an index of ecological response to increasing nutrient pollution, suggested the AWCPI-NP was capable of characterizing the real pollution level of the Yellow Sea.

Mann M.E. and Jones P.D.: Global surface temperatures over the past two millennia. *Geophysical Research Letters*, DOI: 10.1029/2003GL017814, 2003.

2. Is it appropriate to include the Bohai Sea in the study area? If the authors thought the pollution material from the Bohai Sea would flow into the Yellow Sea, it would also be possible from the East China Sea to the Yellow Sea. If so, why is the East China Sea not included (in the analysis) ? And the "Large Yellow Sea" (P7031, L23; P7032, L13) seems not a word that is often used scientifically.

Response: The name of the Bohai Sea is thousands of years old, and its boundary is loosely defined. In a modern geo-morphographic view, e.g., from bathymetric chart, it is an appropriate way to integrate the two namely different seas (the Bohai Sea and the Yellow Sea) for scientific research (as "Large Yellow Sea" or "Yellow Sea basin" in this paper). Compared to the semi-enclosed Yellow Sea basin, the East China Sea is an open sea with clean waters; waters from the East China Sea mainly dilute the pollution of the Large Yellow Sea. According to the regional circulations, the polluted coastal waters from the East China Sea don't likely impact the Yellow sea; Xing et al. (2012) showed no pronounced impacts on Chl-a from polluted waters of the East China Sea or the Yangtze River (please see Fig.1 for its location).

3. How is the Eq.(3) derived ?

Response: Eq. (3) was clarified by amending "which was a regression function between MODIS and SeaWiFS monthly Chl-a which were spatially and temporally matched".

4. P7036 L15-20: " : : the eutrophication process in the Yellow Sea might lead to the macroalgal blooms." I would say that eutrophication is one of the causes of the bloom,

C3338

but the data shown in that paragraph didn't prove that the eutrophication is the main or dominant cause (which the phrase 'lead to' implies). As pointed out by the author in the following lines that the Bohai Sea has a higher trophic status than the Yellow Sea, but the bloom didn't occur in the Bohai Sea.

Response: We are focusing on why there was a sudden growth of floating macroalgal blooms in the Yellow Sea since 2007. As given by experience from other places, generally speaking, macroalgal blooms were considered as the result of eutrophication (Morand and Briand, 1996; Menesguen et al., 2006; Smetacek and Zingone, 2013). For the super macroalgal blooms in the Yellow Sea especially since 2007, with the background of progressive eutrophication in the past 10 years and more, it is reasonable for us to deduce that the increasing eutrophication might lead to the sudden growth of macroalgae in the Yellow Sea.

Yes, source of macroalgae, local current circulation, water temperature, water optical field (clarity), sea surface irradiation, trophic status and many other conditions might contributed to the MAB in the Yellow Sea. The Bohai Sea had macroalgae but not the floating species as in the Yellow Sea. We were focusing on the most possible reasons of the sudden outburst of floating macroalgae. We have discussed other possible reasons that might lead to the supper algal blooms in the last section, and in the revision, we amended: "Due to the limitations in traditional observations as we mentioned in the introduction, previous studies (Liu et al., 2013 and therein) didn't observe this process of progressive eutrophication in the study area; however, this evolution in nutrient status is definitely non-ignorable for exploring the reasons of the non-linear outburst in the growth of macroalgae." And, we also toned down the conclusions in the revision, which is also shown in the new abstract: "The progressive eutrophication observed over the 2001-2012 period is a non-ignorable process for exploring the reasons of the non-linear outburst in the growth of macroalgae, i.e. green tides, in the Yellow Sea since 2007."

5. P7036 L21-23: "We can expect that the net nutrients flow". That argument seems like a pure guess (and thus meaningless), and the authors should avoid going too far

C3339

away from the data.

Response: Thanks for your suggestion. We followed your suggestion and deleted this sentence.

6. P7037 L11-13: "The agreement : : : suggest that the progressive eutrophication drove the super MAB: : :". P7037 L 19-21: " : : : suggests that the biomass in 2001-2012 was driven by the increase in nutrients." I think the data cannot support the arguments. The correlation relationship by two items simply means that they have potential correlation, and it does not necessarily tell us that one thing "drives" another one.

Response: Yes, considering the couplings between nutrients and algae (micro- and macro-), we made these initial inferences from the correlation analysis, and further analysis and discussion were made in the last section of discussion. Here, we modified these descriptions: "drove" was changed to be "might induce"; "was driven" was replaced with "might be driven".

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