Reviewer 2:

This manuscript investigates the spatial and temporal responses of chlorophyll-a to spring dust optical depth across the Chinese marginal seas from 2003 to 2023. By utilizing daily anomalies from reanalysis products and a reconstructed gap-filled Chl-*a* dataset (OCNET), the study delivers an important and timely message: synoptic-scale atmospheric forcing and air–sea heat exchanges act as crucial physical pathways modulating regional upper-ocean stratification and biological variations, rather than focusing solely on the commonly studied nutrient fertilization effects. The manuscript is generally well-written, clearly structured, and addresses a topic of significant relevance to marine atmospheric chemistry and coastal ecology.

The contrasting patterns discovered between the Northern Region (cyclone-induced warming and moisture leading to initial Chl-*a* suppression and delayed enhancement) and the Southern Region (anticyclone-induced cooling and drying leading to rapid mixed-layer deepening and immediate Chl-*a* increase) are scientifically compelling and robustly analyzed. Overall, the manuscript is suitable for publication in the journal after addressing a small number of minor comments. In particular, some technical descriptions would benefit from enhanced clarity, and the quantitative interpretations should be slightly tempered given the uncertainties inherent in the reanalysis products. These are relatively minor issues that can be readily addressed in revision.

Response: Thank you for reviewing our manuscript and for your constructive and encouraging comments. Following your suggestions, we have strengthened the manuscript by providing a more comprehensive evaluation and discussion of the applicability and uncertainties of the OCNET chlorophyll-a product over the Chinese marginal seas, together with additional validation analyses against satellite observations. We have also clarified several technical descriptions, improved the presentation of the figures, and corrected grammatical errors throughout the manuscript. Point-by-point responses to your comments are provided in blue below.

Specific comments

Regarding data and methodology clarification, the authors utilize the OCNET neural network ensemble to generate a gap-free daily Chl-*a* product. Although the dataset shows strong overall agreement with satellite-derived Chl-*a*, the present analysis focuses on optically complex coastal waters and short-lived dust events. Please clarify whether, and if so how, OCNET performance has been evaluated for Chinese marginal seas and under high-DOD conditions, when the original oceancolour retrievals may be limited or affected by aerosol contamination. A brief discussion of potential smoothing of localized episodic extremes and the resulting uncertainty in event-scale Chl-*a* anomalies would help contextualize confidence in the short-term responses.

Response: Thank you for your constructive comment. We agree that the applicability of the OCNET product in optically complex Chinese marginal seas and during episodic dust events warrants further clarification. The performance of the OCNET product has been evaluated in previous studies against both satellite and in situ observations, demonstrating good skill (R^2 = 0.93; relative bias = 4.09%; RMSE = 0.237) in reconstructing gap-free daily Chl-*a* fields (Hong et al., 2023; 2025). Following the reviewers' suggestions, we have added an additional evaluation over the Chinese marginal seas using the daily Level-3 merged Chl-*a* product (25 km resolution) from the ESA GlobColour project, generated using the Average Weighted (AVW) merging algorithm from multiple satellite sensors.

As shown in Fig. R1a, the missing rate of the daily GlobColour observations during spring generally exceeds 80% over coastal regions and nearly approaches 100% in some nearshore areas, suggesting the inherent limitations of satellite observations in cloudy and optically complex coastal waters. Consequently, the number of collocated valid daily samples available for comparison is limited to no more than 300 across most grid cells (Fig. R1b). Based on the available collocated observations, good agreement is shown between OCNET and GlobColour. The climatological mean spring Chl-*a* distributions are generally consistent (Figs. R1d–f), with spatial correlation coefficients exceeding 0.5 over most of the study region (Fig. R1c). Stronger agreement is observed in the Southern Region than in the Northern Region, where the waters are more optically complex. Overall, these results indicate that OCNET generally reproduces the large-scale spatial distribution of Chl-*a* and, by providing continuous daily coverage, overcomes the substantial data gaps that limit satellite observations in coastal waters.

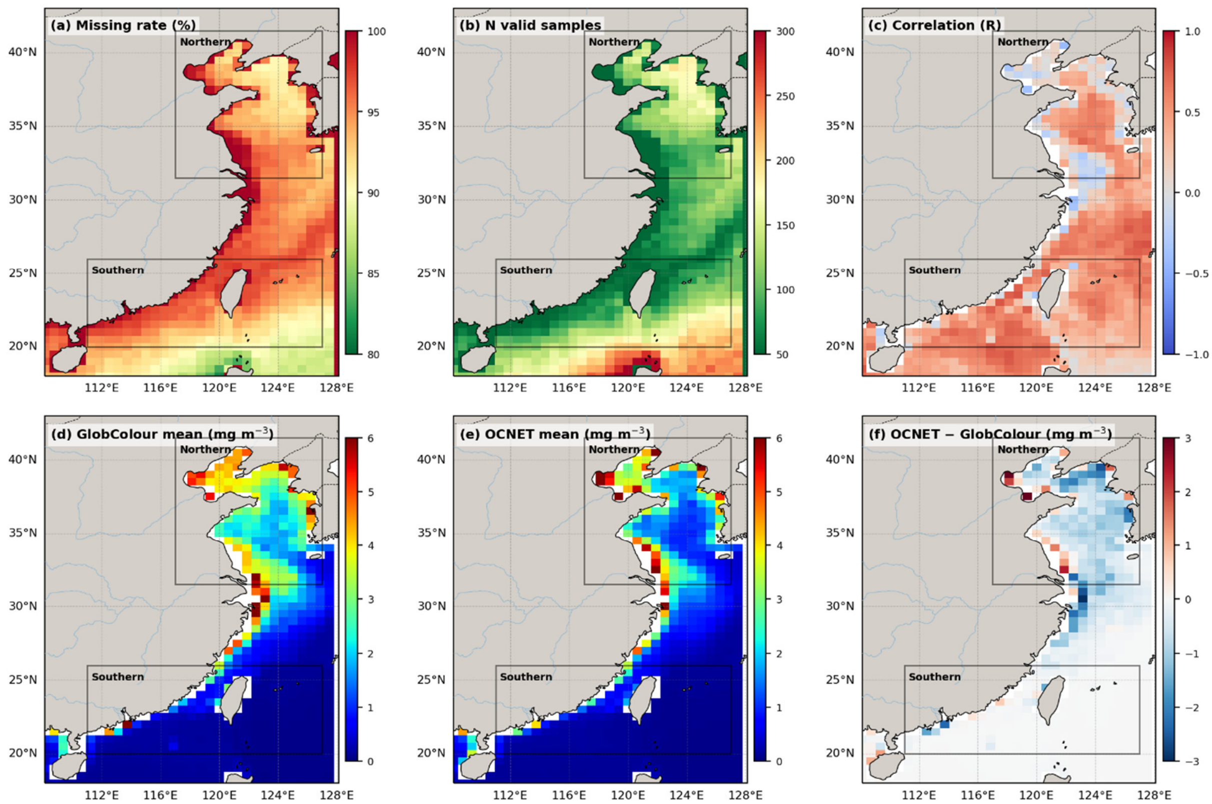

Figure R1. Spatial comparison between the GlobColour daily Level-3 merged chlorophyll-a product and the reconstructed OCNET chlorophyll-a product over the Chinese marginal seas. (a) Missing rate of the GlobColour observations during the study period. (b) Number of collocated valid daily samples used for comparison between GlobColour and OCNET. (c) Spatial correlation coefficient (R) between the two products based on collocated observations. (d) Climatological mean spring chlorophyll-a derived from GlobColour. (e) Climatological mean spring chlorophyll-a derived from OCNET. (f) Mean difference between OCNET and GlobColour (OCNET − GlobColour).

To further evaluate the robustness of OCNET during dust events, we compared OCNET and GlobColour using collocated valid satellite observations under all-, low-, and high-dust conditions (Fig. R2). Overall, OCNET reproduces the observed Chl-*a* variability well in the Southern Region under all conditions (R = 0.93, slope = 0.79–0.85), whereas agreement is relatively lower in the optically more complex Northern Region (R = 0.64–0.77, slope = 0.50–0.74), indicating that OCNET generally captures Chl-*a* variability in the Chinese marginal seas, particularly over the less optically complex southern shelf. Across dust conditions, agreement remains largely comparable, with only a slight reduction under high-dust conditions in the Northern Region, while the Southern Region remains consistently high. It should be noted that regression slopes are consistently below 1, and that both the scatterplots and boxplots show a smaller standard deviation and narrower value range for OCNET than for GlobColour. This suggests a modest smoothing of localized Chl-*a* variability, a common feature of machine-learning reconstructions that infer missing observations from surrounding spatial and temporal information. We therefore acknowledge that the reconstructed Chl-*a* product is subject to greater uncertainty in optically complex coastal waters and that the smoothing effect may slightly attenuate short-term Chl-*a* variability. A corresponding discussion has been added to the revised manuscript (Lines 424–440, Fig. S1–S2).

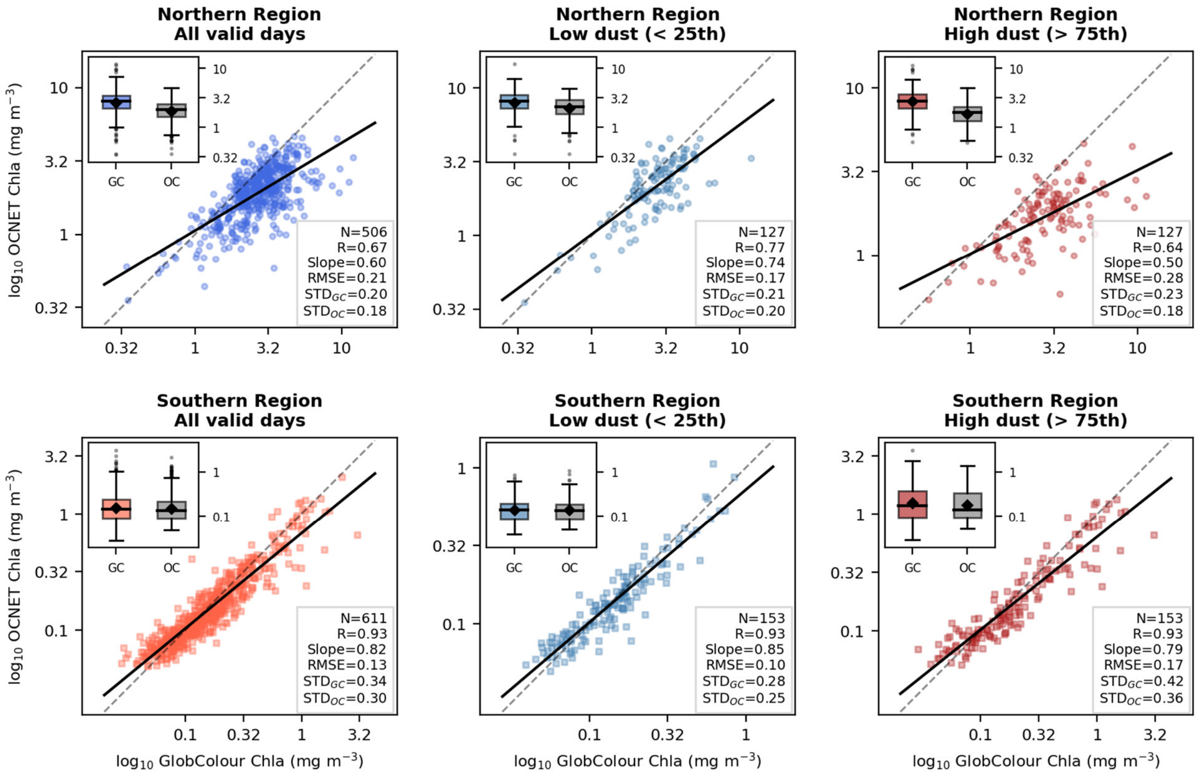

Figure R2. Comparison of chlorophyll-a between OCNET and the GlobColour observations using collocated valid samples over the northern (upper panels) and southern (lower panels) Chinese marginal seas under all observations, low-dust conditions, and high-dust conditions. The dashed line represents the 1:1 relationship, and the red line denotes the linear regression fit. Insets show boxplots of chlorophyll-a distributions for GlobColour (GC) and OCNET (OC). The corresponding statistics, including the number of collocated samples (N), correlation coefficient (R), regression slope, root-mean-square error (RMSE), and standard deviation (STD), are shown in each panel. To ensure sufficient sample size for statistical comparison, low- and high-dust conditions were defined as the 25th and 75th percentiles of daily DOD calculated from the collocated valid samples, respectively.

Line 47: “Sea of Japan” should be revised to “Sea of Japan / East Sea.” Including “East Sea” follows international naming practice and improves geographic neutrality and accuracy.

Response: We thank the reviewer for this suggestion. We have revised "Sea of Japan" to "Sea of Japan / East Sea" to follow international naming conventions and improve geographic neutrality (Line 47).

Line 57: "though the response vary" -> "though the responses vary"

Response: Thank you for catching this grammatical error. We have corrected "the response vary" to "the responses vary" in the revised manuscript (Line 57).

Line 91: "which obtained from" -> "which was obtained from".

Response: Thank you for this correction. We have revised "which obtained from" to "which was obtained from" in the revised manuscript (Line 95).

Line 175: “response to dust” à “responses to dust”

Response: Thank you for this correction. We have revised "response to dust" to "responses to dust" in the revised manuscript (Line 191).

Line 344: "contribute comparatively minimal" -> Please revise to "contribute comparatively minimally".

Response: Thank you for this suggestion. We have revised "contribute comparatively minimal" to "contribute comparatively minimally" in the revised manuscript (Line 360).

Figure 1: It would be helpful to label the locations of major regional seas, such as the Bohai Sea and Yellow Sea, on the map to improve readability of the study area.

Response: We thank the reviewer for this helpful suggestion. We have added labels for the major regional seas, including the Bohai Sea and Yellow Sea, to the map in Figure 1 to improve readability and clarity of the study area (Figure 1).

Figure 8: The temporal ordering of the lag-day bars is not immediately clear. Please add explicit lagday labels or ticks to make the evolution from lag 0 to lag 10 easier to interpret.

Response: We thank the reviewer for this comment. We have added explicit lag-day labels/ticks to Figures 8-9 to clearly indicate the temporal progression from lag 0 to lag 10, making the evolution of the chlorophyll-a response easier to interpret (Figures 8-9).

References:

Hong, Z., Long, Di, Li, X., Wang, Y., Zhang, J., Hamouda, M. A., and Mohamed, M. M.: A Global Daily Gap-filled Chlorophyll-*a* Dataset in Open Oceans During 2001–2021 from Multisource Information Using Convolutional Neural Networks, Earth System Science Data, 15, 5281–5300, https://doi.org/10.5194/essd-15-5281-2023, 2023.

Hong, Z., Long, Di, Shan, K., Zhang, J.-M., R. Iestyn Woolway, Liu, M., Mann, M. E., and Fang, H.: Declining Ocean Greenness and Phytoplankton Blooms in Low to Mid-latitudes Under a Warming Climate, Science Advances, 11, https://doi.org/10.1126/sciadv.adx4857, 2025.