Response

We sincerely appreciate the reviewer thoughtful feedback and the time they dedicated to evaluating our work. Their comments have greatly helped us enhance the quality of our study and its presentation. We have carefully addressed each comment in the responses that follow and have implemented all changes in the revised manuscript.

Reviewer #2

This study used WRF-CMAQ with integrated high-resolution wetland type data, AIS-based ship emission inventories, and regional nitrogen deposition simulations to quantify nitrogen inputs to East Asian coastal wetlands from the perspective of source–sink coupling. The findings provide a scientific foundation for understanding how coastal ecosystems respond to anthropogenic activities and long-range nitrogen transport. This study has a certain level of innovation and logic. However, major revisions are still needed.

1.In this study, the simulated nitrogen deposition flux is the most important model result. However, there is no information about how the flux is simulated. I suggest adding the process in the Methods section.

- Thank you for your suggestion. We added the process of nitrogen deposition simulation to the methodology. Specifically as follows:

  In this study, total nitrogen (TN) refers exclusively to total inorganic nitrogen (TIN), defined as the sum of oxidized inorganic nitrogen species (NO2, NO, HNO3/NO3$^-$) and reduced inorganic nitrogen species (NH3 and NH4+). TIN was simulated for four representative months of 2017 (January, April, July and October), corresponding to winter, spring, summer and autumn. Selecting single representative months has been widely adopted in regional modelling to capture climatological seasonal characteristics under factorial experimental designs (Li et al., 2019; Qi et al., 2017). Each simulation used a five-day spin-up period to minimize the influence of initial conditions. In total, eight model experiments were conducted, consisting of four months and two emission scenarios. This simulation framework provided a consistent basis for evaluating both seasonal variations and the source-specific contributions of nitrogen deposition in East Asian coastal wetlands. The nitrogen deposition flux was directly output from the model. The dry deposition flux for each nitrogen species was calculated by the model based on the dry deposition velocity multiplied by the simulated surface-layer concentration. The wet deposition flux was simulated by scavenging nitrogen species from the atmosphere through both in-cloud and below-cloud processes.

2.The ship emissions inventory used in this study only considered NO_x, NH_3, $PM_{2.5}$, and PM_{10}. However, commonly used ship emissions inventories include SO_2, NO_x, $PM_{2.5}$, CO, hydrocarbons, and GHG species (Yi et al., 2025). This study highlights the impact of nitrogen species on coastal wetlands; however, this limitation still needs to be mentioned, as these species can interact with each other.

- Thank you for the reviewers' suggestions. During the simulation process, the list used actually did contain SO_2, NO_x, $PM_{2.5}$, CO, hydrocarbons and types of greenhouse gases, but this was not expressed clearly in the previous manuscript. Therefore, we supplemented the relevant explanations in the manuscript and increased the citations of the literature. The added content in the manuscript is as follows:

The resulting ship emissions inventory includes nitrogen oxides (NO_x), ammonia (NH_3), and particulate matter ($PM_{2.5}$, PM_{10}), sulphur dioxide (SO_2), NO_x, carbon oxygen (CO), hydrocarbons, and greenhouse gas (GHG) species (Yi et al., 2025).

3.In the process of calculating carbon sequestration, the authors did not mention which parameters are based on model results and which are based on literature.

- Both Section 2.3 in the manuscript and Section 1.3 in the attachment elaborate on the calculation method of NPP. SOL is calculated from the Global High-Resolution (3-hourly, 10 km) Surface Solar Radiation Dataset (1983-2018, monthly) described in the attachment. The values of $FPAR$ and ε are derived from the literature. All other parameters are derived from the model results. Relevant explanations have been supplemented in Section 2.3 of the manuscript. The added content in the manuscript is as follows:

  In the CASA model, biome-specific constant FPAR values were assigned to different coastal wetland types to reflect their contrasting canopy structures and vegetation cover. Specifically, an FPAR of 0.85 was used for mangroves, consistent with satellite-derived APAR estimates for dense mangrove forests (Zheng and Takeuchi, 2022). A moderate FPAR of 0.65 was adopted for salt-marsh wetlands, in line with typical growing-season FPAR (≈0.4–0.7) reported for marsh vegetation. For sparsely vegetated tidal flats, an FPAR value of 0.10 was chosen to represent the dominance of water and bare sediment and the low emergent leaf area during most tidal cycles (Hawman et al., 2023).

4.In Figure 1, the unit for nitrogen emissions is missing. Besides, the nitrogen emissions are not clearly defined: does the nitrogen here only include NO and NO_2, or does it contain other species?

- Thank you for your suggestion. In the original figure, N refers to the nitrogen element. To reduce ambiguity, we have added the explanation of this part in our hands. The added content in the manuscript is as follows:

  Overall, the nitrogen (N element) emission inventory and wetland type distribution in East Asia adopted in this study are shown in Fig. 1.

5.The first paragraph in Section 3.1 did not cite any figures, tables, or references. It is not clear where the results come from.

- Thank you for your suggestion. We added the citations of Table 1 and the references in the first paragraph of Section 3.1 of the manuscript.

6. There is a distinct mistake in Line 66 of the Supplementary Information (SI).

- Thank you for your suggestion. The reference error that existed here has been corrected.

Reference

1. Hawman, P. A., Mishra, D. R., and O'Connell, J. L.: Dynamic emergent leaf area in tidal wetlands: Implications for satellite-derived regional and global blue carbon estimates, Remote Sens. Environ., 290, 113553, https://doi.org/10.1016/j.rse.2023.113553, 2023.
2. Li, J., Nagashima, T., Kong, L., Ge, B., Yamaji, K., Fu, J. S., Wang, X., Fan, Q., Itahashi, S., Lee, H.-J., Kim, C.-H., Lin, C.-Y., Zhang, M., Tao, Z., Kajino, M., Liao, H., Li, M., Woo, J.-H., Kurokawa, J., Wang, Z., Wu, Q., Akimoto, H., Carmichael, G. R., and Wang, Z.: Model evaluation and intercomparison of surface-level ozone and relevant species in East Asia in the context of MICS-Asia Phase III – Part 1: Overview, Atmospheric Chem. Phys., 19, 12993–13015, https://doi.org/10.5194/acp-19-12993-2019, 2019.
3. Qi, L., Li, Q., Henze, D. K., Tseng, H.-L., and He, C.: Sources of springtime surface black carbon in the Arctic: an adjoint analysis for April 2008, Atmospheric Chem. Phys., 17, 9697–9716, https://doi.org/10.5194/acp-17-9697-2017, 2017.
4. Yi, W., Wang, X., He, T., Liu, H., Luo, Z., Lv, Z., and He, K.: The high-resolution global shipping emission inventory by the Shipping Emission Inventory Model (SEIM), Earth Syst. Sci. Data, 17, 277–292, https://doi.org/10.5194/essd-17-277-2025, 2025.
5. Zheng, Y. and Takeuchi, W.: Estimating mangrove forest gross primary production by quantifying environmental stressors in the coastal area, Sci. Rep., 12, 2238, https://doi.org/10.1038/s41598-022-06231-6, 2022.