Response to Reviewer #3

Manuscript title: *"Wind and Phytoplankton Dynamics Drive Seasonal and Short-Term Variability of Suspended Matter in a Tidal Basin"*

We are grateful to Reviewer #3 for the careful and constructive review. The comments raised important points that helped us clarify the design of our experiments and the scope of our conclusions. Below, we address each comment point by point and outline the corresponding revisions implemented in the manuscript.

Reviewer comments are shown in **bold**, and our responses are given in regular font below each comment.

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Review of "Wind and Phytoplankton Dynamics Drive Seasonal and Short-Term Variability of Suspended Matter in a Tidal Basin" by Konyssova et al. (egusphere-2025-2135)

This is a long paper, trying to examine the seasonal and short-term variation of suspended matter in a tidal basin. Both numerical model and neural network are used in this study. However, it is very confusing to this Reviewer why the experiments are designed in this way. Do you really need both models?

The research is based on observational data collected over the past 20 years at two fixed locations. During this period, a wide range of possible forcing scenarios occurred. The typical duration of a wind event, which is defined as a continuous number of hours when wind blows from one direction, is about 5 hours, divided into eight sectors and utilizing hourly data (Rubinetti et al., 2023). To capture all these scenarios and the non-linear interplay between tidal and wind forcing that determines SPM concentrations, we applied a relatively deep Neural Network (NN). Using purely numerical simulations would not allow us to represent such a broad range of scenarios. Moreover, it was not feasible to set up a dedicated sediment module for this task. We lack detailed habitat mapping for the study area, and there are no reliable SPM flux measurements at the open boundary. In addition, the specific properties of the suspended particles in the region remain uncertain. The available SPM observational data reflect total concentrations, combining both organic and inorganic materials without differentiating between particle types. While the NN performs well in predicting SPM, it does not explain why SPM dynamics differ between the two stations, though the difference in depth is a contributing factor. This is where Lagrangian simulations provide valuable insight. They illustrate the delayed wind response at the deep station compared to the shallow site. This is a pattern that holds across different wind scenarios.

In the numerical modelling part, only tide forcing is considered because of its dominate role in driving the currents in the bay. However, wind is the key factor to be studied in

this work – the title of this manuscript starts with "wind". Why not include winds in the numerical modelling? Note that the so called tidally induced transport time scale (133 hours) is also comparable to the synoptic weather time scales (several days).

When we consider wind stress we account for different mechanisms of its influence on SPM dynamics, as wind stress determines shear in the water column and mediates wave-breaking processes. Tidal forcing, of course, also induces resuspension and the information about tidal phase and elevation is included in NN as well. However, in addition, tides strongly contribute to net transport (particles do not return to their original location after a tidal cycle) or advection of material within the domain due to its shallowness, complex topography and large tidal amplitudes (all non-linear terms - bottom friction, advection of momentum and non-linearity in the continuity equation- play significant role therefore such a strong net transport exists). Our Lagrangian simulations showed this tidally induced transport. Of course tidally induced transport can be modified by the winds; however, the tidally induced transport works permanently in time. To support this, we conducted additional simulations under moderate wind conditions, which showed that the main transport pathways were preserved, while wind forcing mainly increased dispersion (Konyssova et al., 2025).

Numerical model validation is only on tides using tide gauge data. However, the currents are not validated at all. The latter is relevant to the transport pathways. Note that the dynamical mechanisms are different. Accurate tides do not guarantee correct currents.

The model has been utilized in many studies (Fofonova et al., 2019; Kuznetsov et al., 2020, 2024; Neder et al., 2022; Sprong et al., 2020; Sidorenko et al., 2025) and has shown the ability to reproduce the tidal dynamics effectively. This same setup for the Sylt-Rømø Bight has also been implemented in Fofonova et al. (2019), where both sea surface heights and current velocities were validated.

The "passive tracers" used in the numerical model experiments in this work are actually Lagrangian particles as commonly referred to in the coastal ocean modelling community. These should be called "virtual particles", "Lagrangian particles", or simply "particles" in Lagrangian particle tracking modelling. In contrast, "tracers" (or "passive tracers") are often used in numerical dye experiments, which is associated with initial concentrations when they are released in the numerical model and their concentration change in space and time. It is better to change "tracers" to "particles" to avoid confusion. Otherwise, it is important to point out the tracers used in this study are different from other tracer model applications.

In the manuscript, we used the term "passive tracers" instead of "particles" to specify that the tracers (or particles) we released in our model are passive and do not have weight. We appreciate the reviewer's point that in some contexts, "tracers" may be associated with concentration-based dye experiments. To avoid potential confusion, we have added a clarification in the revised manuscript that our use of “tracers” refers to Lagrangian particles and is different from “dye” experiments.

Linear correlation is heavily used in the analysis (Figures 6 and 7). However, it is not clear at all whether a linear relationship exists between the two variables (SPM and wind speed). Actually, the scattered data points indicate a non-linear relationship.

While linear correlation offers a first-order diagnostic, we acknowledge that it may not fully capture the complex, non-linear relationships between wind and SPM concentrations. To better address this, we employed a Neural Network model, which is capable of capturing such non-linear interactions, as discussed in Section 3.3.

There are some awkward sentences and wrong word choices. For example, L20, “this study integrate …” should be changed to “in this study, we integrate …”.

We rephrased the sentence following the suggestion.

Some of the statements are not rigorous at all: Lines 269-270, “… patterns reflecting the combined influence of biological activity and meteorological forcing” – how do you know that?

We acknowledge the reviewer’s comment and have revised the sentence to be more cautious, referring to the forthcoming analysis rather than asserting conclusions upfront.

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