

Dear Editor and Reviewer,

We thank you again for your insightful comments, which have helped us to improve our manuscript. Below please find our point-by-point response to the reviewer's comments, shown in blue.

## **Response to Reviewer's Comments**

The revision has improved the clarification of the study. I have two more comments about the framing of the study.

Thank you for taking the time to review our revised manuscript and provide us with your thoughtful comments about the framing of our study. We are glad that you found our previous revision improved the clarity of our study.

1. My key take-away of the study is that subsurface parameterization is important to simulate hurricane response and the study proposes a new iterative method to improve the parameterization. However, this is not evident at all in the title, which only states nitrogen loading. So the title sounds like some biogeochemical improvement in modeling... I would suggest to change the title to reflect the importance of subsurface hydrological parameterization.

We appreciate your suggestion to revise the title to better reflect the importance of subsurface hydrological parameterization in simulating hurricane response. Here is our revised title:

Subsurface hydrological controls on the short-term effects of hurricanes on nitrate-nitrogen runoff loading: a case study of Hurricane Ida using E3SM land model (v2.1)

2. It would be helpful to include some more in-depth discussion on whether the iterative approach (key novelty in my understanding) can be extended to other watersheds.

Thanks for this great suggestion! We have added a subsection in the Discussion section to address this point. In it, we discussed the prospects and challenges of applying the iterative approach to other watersheds. We repeated it here:

### 4.1 Potential applications of the iterative parameterization approach

The iterative parameterization approach presented in this study demonstrates a promising method for improving subsurface hydrological simulations and can be easily extended to other watersheds. The use of a surrogate model to estimate model parameters reduces computational

costs while maintaining accuracy, allowing for efficient iterative refinement of the simulation results. This approach can be particularly beneficial for watersheds with complex hydrogeological characteristics, where traditional calibration methods may be computationally prohibitive or require extensive data sets.

Successful application of this method relies on prior knowledge of the most sensitive and important parameters to include in the parameterization process. Without a clear understanding of which parameters have the greatest impact on model predictions, the iterative approach may not effectively reduce uncertainty or improve simulation accuracy. Additionally, identifying key parameters can help to avoid over-parameterization, where the inclusion of too many parameters can lead to overfitting and degradation of predictive performance.