The authors thank the reviewers for a very detailed reading of the paper and substantive comments that have clearly improved the research and its presentation. Below are the original comments in blue color and italics and our responses below them.

 # Anonymous Referee #2
Received: 04 October 2024

Summary

The manuscript provides a modeling study to simulate the effects of Ida on pluvial flooding in New York City's Jamaica Bay watershed. The major advancement is that the authors parameterize soil infiltration and a stormwater conveyance system as a drainage rate, which shows improved model performance when compared against high water marks. The authors also performed a sensitivity study by shifting the storm tracks and the timing of rainfall. Overall, the article is well written. The results are reasonable. I have a few concerns and hope the authors could address them.

General comments

1. *My primary concern is the simplified approach used for modeling urban drainage, which, while practical, presents several limitations. A notable drawback is that the single-parameter drainage rate requires calibration specific to an event and lacks generalizability, making the method less practical especially when there is limited data for calibration. The method also neglects detailed factors like varying land cover and the complexities of urban drainage systems. The authors should provide a more compelling rationale for adopting this method over more detailed urban stormwater models.*
   We acknowledge the concern regarding the simplified approach used for urban drainage modeling. The decision to adopt this method was influenced by the challenges involved in assembling a detailed hydrologic and hydraulic (H&H) model, as highlighted in the paper. Currently, no comprehensive simulation of Ida for the area in question exists, and we are collaborating with NYC-Emergency management and published Version 1 of the Ida flood map(Kasaei et al., 2024).

   However, progress is being made to address the issue of calibration data scarcity. The simulation conducted on September 29th, 2023, illustrates how more data is becoming available, particularly with the ongoing deployment of 500 sensors as part of the Floodnet.nyc project. This project is expected to significantly improve data availability, paving the way for more refined model calibrations (e.g. with rain-rate dependent drain rates), and enhancing the generalizability of future simulations.

2. *The sensitivity experiments that shift storm tracks and timing appear over idealized. Altering storm tracks should realistically affect the intensity and spatial distribution of rainfall, among other storm characteristics. Although it may be challenging for the authors to accurately capture these changes, it remains crucial for them to justify their approach and discuss the associated limitations and uncertainties.*
   We agree the sensitivity experiments are simplistic, but they serve the purpose of demonstrating our model and exploring potential worst cases in spatial and temporal storm variations. For both spatial and temporal scenarios, the wind also shifted along with the rain. Also, we have now improved the temporal shift by also shifting the storm surge.
   We have modified the text to acknowledge this simplicity, stating:
   > "These experiments are simplistic and true variations and uncertainties in storms can affect a wide range of storm characteristics including intensity and spatial distribution of rainfall. However, a comprehensive study of Ida forecasting uncertainties is beyond the scope of this paper."

3. *The manuscript focuses solely on the impact of rainfall, which is suitable for studying pluvial flooding. However, the title and various sections refer to compound flooding. It remains unclear how compound flooding, particularly in relation to the co-occurrence of storm surge, high tide, or coastal*

flooding, is relevant to this study. The manuscript briefly mentions these factors but does not adequately explain how the study's findings apply to scenarios involving compound flooding.
We appreciate the reviewer's feedback regarding the title and scope of the study. We acknowledge the importance of ensuring the manuscript accurately reflects its focus. Our study primarily aims to simulate extreme pluvial flooding caused by Hurricane Ida, which, as highlighted in lines 16, 21, and 75 of the manuscript, was primarily driven by heavy rainfall. As such, our core objective is to enhance the COAWST model by incorporating rain and drain rates to better simulate such rainfall driven events. While we did explore the potential for compound flooding through sensitivity analyses, the primary focus of this study remains on pluvial flooding. To better clarify this and address the concern, we have revised the manuscript's title to more clearly reflect the emphasis on pluvial flooding. We have also made clear in the Introduction that potential compound flooding scenarios were considered through sensitivity tests. This will ensure the title and introduction more accurately align with the study's scope.

Specific comments:

1. *P5L130. "The drain rate can be a negative when it is locally greater than the rain rate." This is reasonable. But is there a limit for the range of drain rate?*
   Change made to make the sentence clearer:
   > "The drain rate is always negative (a volume sink representing stormwater system and infiltration) while the rain rate is always positive (a volume source), and the net rate of volume change (precipitation-drain rate) can be negative when it is locally greater than the rain rate."

2. *Section 2.2.2 A bit more details on the model setup would be very helpful. For example, how are the two models nested? A zoomed map showing the high-resolution grid on top of the larger scale grid would help reader understand the bigger picture.*
   Change made. We added explanation of the nested model boundary condition in section 2.2.2:

   > ("The open boundaries of the nested model are set using Chapman conditions for the free surface, Flather conditions for 2D momentum, and radiation conditions for 3D momentum, and the gradient condition is applied for salinity and temperature, effectively holding them constant within the domain.").

   in addition, we added a figure showing the regional model and the nested model boundaries inside it (Fig. 2a).

3. *P7L175. Figure 8 is referenced earlier here. The authors may correct the order of figures.*
   Thank you for your insightful comment. We acknowledge that Figure 8 is referenced earlier in the text, specifically regarding the coastal water level range during the simulation period in Jamaica Bay. We chose to reference Figure 8 sooner due to its relevance to the water level range, even though the figure appears later in the paper as it is about temporal shift of the storm. We believe this structure better supports the flow of the discussion, but we will ensure that the figure numbering and placement are consistent throughout the manuscript.

4. *P10L230 "buy"*
   Change made. Thank you so much for noting it.

5. *P12L268. "base model". Since you are running one model, "baseline simulation" may be more accurate.*
   Change made. Used "baseline simulation" instead.

6. *P12L268. "infiltration, no spatial or temporal shifting of rain, no temporal shifting of rain", repeated expression.*
   Change made. Removed the repeated expression.

7. *P12L277. "This discrepancy". Could it be other reasons? Such as the uncertainty in the atmospheric forcing?*
   We appreciate the reviewer's suggestion. While our analysis primarily attributes the discrepancy to the omission of infiltration and stormwater drainage, we agree that uncertainties in atmospheric forcing (e.g., wind, precipitation) could also play a role. We will acknowledge this in the text:

   > "This discrepancy is likely attributed to the model's omission of infiltration and storm water drainage; however, it is important to acknowledge that other factors, such as uncertainties in atmospheric forcing, could also contribute to this discrepancy."

8. *P12L281-283. I would recommend providing full time series of such validation results, either provided here or in the supporting information.*
   Change made. We added the time series as an additional figure as the reviewer suggested in the supplementary material.

9. *P14L297-298. This is a bit confusing. Please consider rephrasing.*
   We have now rephrased the text to avoid confusion:

   > "According to the CN calculations in Section 2.4, Hurricane Ida is estimated to generate an average of 58 mm of runoff over a 3-hour period, which corresponds to a runoff rate of approximately 19 mm/hour (or 0.75 inch/hour). This establishes the necessary rate at which stormwater must be managed to ensure proper drainage."

10. *P16L333-334. This is true. It seems that many areas have flow speed over 1 m/s. And the top speed of 4 m/s seems too high. Is this reasonable for urban flooding? Also, I think the grid resolution cannot resolve streets. When you zoom in, it may be more clear to look at the spatial patterns of flow speed.*

    We appreciate the reviewer's comment. Regions with flow speeds over 1 m/s generally occur in areas with steep slopes around 20 degrees (see Figure 2 for the DEM). For flow speeds greater than 3 m/s, the slopes tend to be even steeper. However, as noted in the limitations section, the use of bare-earth DEM may underrepresent buildings and streets, which could impact flow speed accuracy in some areas. This improvement could be addressed in the future to make it feasible to analyze the spatial patterns in more detail.

11. *Section 3.3.2. The results are only superficially mentioned here. More figures and discussions should be provided.*
    Thank you so much for your suggestion. We added one more figure and discussion as reviewer suggested.

12. *P19L407-409. This is a bit confusing. Please elaborate.*
    While our model and the curve number method use hourly-accumulated rainfall data, short duration rain bursts likely exceeded the system's capacity. For example, intense rain within a short period (less than an hour) would produce much higher runoff rates than the hourly average suggests. These peaks likely overwhelmed the system, contributing to flooding. This also explains why our model's calibrated drain rate of 6 mm/hour is lower than the design stormwater capacity of 44 mm/hour, as short bursts can create momentary runoff much higher than the hourly accumulation captures.

We revised the sentence to make it more clear:

> "However, we should consider that it is likely that brief, intense rain bursts, rather than the hourly MRMS rain rates that were used in this study, caused most of the flooding by overwhelming the stormwater system."

Figures:

13. *Figure 1 is a bit confusing as it is difficult to distinguish between land and ocean. Blue contour is also confusing. The authors may also consider showing the watershed boundary.*
    Change made. The watershed boundary added to the figure.

14. *Figure 11 Magnified views at selected regions will be helpful to interpret the modeled flooding.*
    Thank you so much for your feedback. As we mentioned in the original manuscript, we are using a bare earth DEM and according to the grid resolution we do not resolve most street valleys, only the largest ones. As such, although the model shows the spatial variability of flood map for Ida, zooming into the streets may cause confusion as we do apply the model on a bare earth DEM.

15. *Figure 14, Is the difference only presented in this region? A figure with a greater extent and zoomed views may help interpret the results.*

Change made. We added the difference flood map for second scenario of temporal shift, and the zoomed in panel to help the reader to understand better. We do see some other area with additional flood depth in east and west side of the bay. We are zooming in on the Hamilton Beach area as an example.

Kasaei, S., Orton, P., Ralston, D., and Warner, J.: Post-tropical cyclone Ida (2021) flood map for New York City's Jamaica Bay watershed (1), Mendeley [dataset], 10.17632/hs2zt6ngwd.1, 2024.