Summary

The article "Integrated hydrodynamic and machine larning models for compound flooding prediction in a data-scarce estuarine delta" describes a framework based on deterministic hydrodynamic modeling and artificial intelligence (A.I.) to estimate compound flood events. The authors assessed three different techniques of machine learning (i.e., A.I. model) using the results from the hydrodynamic model, which used thousands (e.g., 6,000) different environmental forcings combinations. The compound flood event described in this manuscript is based on coastal (e.g., wind velocity, atmospheric pressure, and astronomical tides) and fluvial and pluvial stressors. This study aims to use the results from the trained A.I. model to predict compound flood in a scarce-data region such as Pontianak, Indonesia.

General Comments

I will like to congratulate the authors for writing a great manuscript. This manuscript was very well put together that tells a story in an organized and scientific manner. However, some essential details were omitted from this first draft. First, the hydrodynamic model calibration/validation is missing from section 2.2. I understand that the authors reference the reader to another article (currently under review) for more details on the hydrodynamic model. But in any flood modeling, it is crucial to discuss the hydrodynamic model calibration/validation, especially when the outputs of this model will be used as input in another model. At a minimum, the authors should dedicate a paragraph (if not a subsection) to discuss the results and method of the hydrodynamic model calibration/validation without going into much detail since the authors can reference another article.

Second, the flooding scenarios selected (e.g., Table 1) used to describe compound floods using the hydrodynamic model lacks information. For example, the authors should explain why they selected that certain combination of environmental factors and related to any observations or datasets. Finally, the authors do not give any information on the coupling occurring between the different hydrodynamic models to assess compound floods. This aspect is crucial in this type of research, and at least a subsection should be dedicated to explaining these model pass information between them to account for compound floods. Nevertheless, before I can accept the article for publishing, it needs to go through a major revision that will require a re-revision from the reviewers. The authors should recall that the main purpose of publishing a research article like this is to adopt the proposed methods and apply them to their region of interest. Therefore, it is crucial to include as much detail as pertinent to replicate the proposed work. Please find below some specific comments and questions that need to be addressed in the revised version of the author's manuscript.

Specific Comments

Section 1

- Line 25: the authors should include the following publications as part of this citation: Santiago-Collazo et al. (2021), Gori et al. (2022), Hsiao et al. (2021), Ghanbari et al. (2021)
- Line 26: the authors should include the following publications as part of this citation: Ikeuchi et al. (2017), Wahl et al. (2015)

- It needs a paragraph of a literature review of previous modeling frameworks that uses a deterministic model to train an A.I. model. This will help put in context to the reader earlier attempts of this modeling approach. This might be the first attempt to simulate compound flood events, but other studies might focus on different processes such as subsurface flow and even at other disciplines such as transportation and structural engineering. Some questions that can be answered from including this paragraph might be the following:
    - Is this the first study that uses a deterministic-A.I. modeling framework to estimate compound floods? If not, how was it then, and what was their approach?
    - Have other researchers used a deterministic-A.I. modeling framework to estimate different parameters outside of surface flow physics?

Section 2.1

- It will be beneficial for the reader to include an additional figure with the study area's topographic/bathymetric elevation map and land use/land cover maps and soil type maps since all these parameters will affect surface runoff modeling than subsequently will affect the compound flood magnitude. If there is no such data available as a map format, the authors should indicate it in the manuscript. This will highlight the date scarcity in the region.
- Consider adding the Kapuas River watershed area and compare it with the total island extent. This will help the reader put the extension of this watershed into context, rather than just saying that it is the longest island river.
- Figure 1: need to include in the figure caption that the solid black line represents the Kapuas River Watershed on the insert map. Also, mention that the blue lines represent waterbodies.

Section 2.2

- Line 76: need to add a reference to cite the SLIM 2d hydrodynamic model. Similar to the SWAT+ citation on Line 94
- Need to add a paragraph or subsection of the calibration/validation of both deterministic models used: SLIM 2D and SWAT+
- Line 85-89: How far inland does the mesh extend through the river? Does it penetrate through the riverine floodplain or stop at the river bank's height? Does the digital elevation model (DEM) used in the hydrodynamic model (details are not given) penetrate beneath the water to capture the full river bathymetry (i.e., description of the terrain surface underwater), so the riverine cross-section is described fully, or does it reflect the water surface elevation? If the complete riverine cross-section is not available from observed data, which cross-sectional area do the authors use? These details are not given in the text nor Figure 2.
- Figure 2: include a bathymetry elevation as a color-filled contour with the unstructured mesh, so the reader can examine if there are any canyons or through underwater that will affect the coastal processes flood modeling. The authors may also consider adding the mesh resolution like a color map, see Figure 3 on Bislkie et al. (2020).
- Line 90-92: information about the different environmental factors considered in the study was given in Table 1. However, information regarding the astronomical tide forcing is not given, just from the model that was obtained. I think that more information should be given since, at the discussion session, the authors concluded that tidal forcing is the factor that

most affects the compound flood levels in the regions. The authors should answer the following questions within the text:

  - What is the average tidal amplitude (e.g., micro-tidal, meso-tidal, macro-tidal)?
  - What is the dominant tidal constituent (e.g., M2, S1, K1, etc.)?
  - What is the tidal regime (i.e., period) at the region (e.g., diurnal, semi-diurnal, or mixed)?

- Line 92-93: the authors should explain in more detail the coupling procedure between SWAT+ and SLIM 2D. Also, the authors should locate on a map the riverine boundary conditions in the SLIM 2D model and clearly specify the total amount of locations. The following questions should be answered in the text of the manuscript:
  - What type of coupling is occurring between the models (e.g., one-way, two-way, tightly, or fully coupling)?
  - How often (e.g., each computational time step) does the exchange of information happen?
  - Do the SWAT+ model runs first and independently, and once it finishes the simulation, it passes the information to SLIM 2D, or do both models run simultaneously?
  - Is the location of the riverine boundary conditions in the SLIM 2D model inland enough (i.e., away from the coast) that coastal processes will not affect the water levels? If not, the authors should justify the selection of that location.
- Line 93-95: the authors do not give any information regarding the hydrologic modeling using SWAT+. Since it does not reference another publication, at least a subsection should be dedicated to providing more details of this model. This information is crucial since the SWAT+ model computes the pluvial and fluvial processes in the compound flood simulation in SLIM 2D. For example, Silva-Araya et al. (2018) described their hydrologic and hydrodynamic model in separate subsections before describing the coupling technique in an additional subsection. The following questions should be answered in the text of the manuscript:
  - Does infiltration processes are taken into consideration?
  - How many sub-watershed was the Kapuas River watershed divided into so it was suitable to model in SWAT+?
  - What is the extent of the SWAT+ model? A figure should be included.
  - What was the temporal resolution of this model?
  - Did the rainfall vary in time and space through the domain?
- Line 95-96: the authors should include in Figure 1 (or on an additional figure) the location of the gauge where the observational data was obtained. What type of observational data was used to evaluate the model performance (e.g., stage, discharge, high-water marks, etc.)?

Section 2.3

- This section lacks much essential information for the reader, and it is not clear. This section is one of the most important in the manuscript since it will control the compound flood event being simulated. The following questions should be answered in the text of the manuscript:
  - Table 1:
    - From where were these values chosen, and why these values themselves?

        - Why do the tables display only a single value of discharge, whereas, in Line 109, the authors said that the datasets (including riverine variables) were recorded hourly? Is the value shown in the table represents the annual peak discharge, the average value, etc.?
    - Why 6,000 simulations and not 1,000 or 10,000? Need to justify the author's decision.
    - How was the combination of the different parameters chosen? Did the authors use any statistical approaches, such as a Monte Carlo Simulation, or used a random distribution?
    - Why the hydrodynamic model was run for 10 months and not 12 or 6 ?

Section 2.4.1

- Line 108-109: why did the authors select just one and two hours before the flood event as the prior conditions? It has been shown that rainfall events that occur three days before a flood event have measurable effects on the compound flood levels (Bilskie et al., 2021). The authors need to justify their selection. What was the SLIM output temporal resolution?
- Table 2: the biggest tidal variations occur within 6 to 12 hours before/after their peak level, depending on the tidal regime. Therefore, it does not make sense to vary their tidal elevation (which is not given in Table 1 nor the text) by one or two hours since the values are very similar. It will make more sense that the authors tested scenarios that considered the high and low tidal elevation, which can be 6 to 12 hours apart.

Section 3

- Line 155-157: need to cite other studies that confirm your statement that a model with those values of NSE and RMSE is a "good proxy" of the real system.
- Line 158-161: this can be moved to Section 2.
- Figure 5: the authors should comment if the low impact of rainfall to compound flood events might be related to the small amount of rainfall used. Also, can the selection of a lumped-parameter hydrologic model (SWAT+) used in this study affect the surface runoff quantity fed into the hydrodynamic model?
- Add a vertical axis label to Figure 5.
- Improve the resolution of Figures 3, 6, and 7.

Section 4

- The authors should comment if the low accuracy of the A.I. model during the testing phase is related to the calibration/validation of the hydrodynamic model? If the hydrodynamic model is inaccurate in predicting real-life floods, then the A.I. model will have low accuracy.
- Why is the biggest impact of the compound flood levels due to tidal conditions? How do these findings relate to the physical processes occurring at this location? Have other studies drawn similar conclusions regarding the importance of tides in a compound flood event? The authors should talk more about this.

Section 5

- The conclusion session needs improvement. For example, topics in the discussion section should be at the conclusion section, such as modeling limitations and future research.

- The authors should also include as part of their modeling limitation the use of the SWAT+ model to quantify the pluvial and fluvial processes in their compound flood event. The SWAT+ model is a conceptual-based, lumped-parameter hydrologic model. Therefore, this model has many limitations when computation spatially- and time-varying surface flow compared to physically-based, distributed-parameter hydrologic models capable of having a spatial distribution of precipitation and watershed properties through a computational grid.

Technical Corrections

- Line 111: it should say "Statistic tool" and not "atistic tool"

References

A. Gori et al. (2022). "Tropical cyclone climatology change greatly exacerbates U.S. extreme rainfall–surge hazard." Nature Climate Change.

S. Hsiao et al. (2021). "Flood risk influenced by the compound effect of storm surge and rainfall under climate change for low-lying coastal areas." Science of the Total Environment.

F. L. Santiago-Collazo et al. (2021) "An Examination of Compound Flood Hazard Zones for Past, Present and Future Low-gradient Coastal Land-margins." Frontiers in Climate Change.

M. Ghanbari et al. (2021). "Climate Change and Changes in Compound CoastalRiverine Flooding Hazard Along the U.S. Coasts." Earth's Future

T. Wahl et al. (2015). "Increasing risk of compound flooding from storm surge and rainfall for major US cities." Nature Climate Change.

H. Ikeuchi et al. (2017). "Compound simulation of fluvial floods and storm surges in a global coupled river-coast flood model: model development and its application to 2007 Cyclone Sidr in Bangladesh." Journal of Advances in Modeling Earth Systems.

M. V. Bilskie et al. (2020). "Unstructured finite element mesh decimation for real-time Hurricane storm surge forecasting." Coastal Engineering.

W.F. Silva-Araya et al. (2018). "Dynamic modeling of surface runoff and storm surge during hurricane and ropical storm events." Hydrology.

M.V. Bilskie et al. (2021). "Enhancing flood hazard assessments in coastal Louisiana through coupled hydrologic and surge processes."Frontier in Water.