

The paper entitled “Towards a robust hydrologic data assimilation system for hurricane induced river flow forecasting” discussed the use of the Hybrid Ensemble and Variational Data Assimilation framework for Environmental Systems (HEAVEN) developed in earlier published paper of the author for extreme flooding cases and in particular peak flow predictions. Acknowledging the methodology is not new, this study is providing several case studies with a different area of focus, in particular peak flow predictions. This manuscript is nice to read, however, it needs to be improved for better readability, and I have included my specific comments for each section below.

#### Abstract:

- Please add some quantitative results to the abstract to highlight the improvements achieved.

#### Introduction:

- Line 55-56: Please move the sentence related to the current flood \$ to line 50 before the mention of the climate change. It will help the flow of the paragraph to talk first about the current time, and then shift the focus to future and climate change impact.
- Line 113: compared to what? If you mean open loop state that please, if you mean other methods, maybe you want to add a few words to indicate that.
- Line 122: Add why focusing only on the peak flow. I assume this is since peak value matters the most in the inundation mapping and flooding extent, however, please explicitly mention as why this is the focus of the study.

#### Study Area:

- Figure 1: Could you add the main rivers to the zoomed panels in the watersheds? It helps visualize the USGS gauge locations (on main step/small creek) better.
- Figure 1: Would it be possible to add the polygons used in the SAC-SMA? There is only mention of the HUC8s in the domain, is that the level of refined lumped basins? I did not find further information in the manuscript text.
- Figure 1: How about color coding the USGS gauges to those that are impacted by regulation/lake/reservoirs versus the natural gauges? Or maybe we could use different symbols. This would help with the calibration/validation verification and discussions.
- Line 178: please cite the NOAA report.
- Line 191-192: Please add a reference for the claim related to the climate change impact.

#### Datasets:

- Line 213: Please cite the package Climata.
- Line 230: It states NLDAS is a dataset reasonable for operational purposes. Could you cite? I think there are better options available for precipitation currently, for example MRMS which has a better spatial resolution, and is used in operational models. If you have an example of operational use of NLDAS it would be nice to mention here.
- Line 237: how about using semi-distributed instead of spatially lumpd?
- Line 240: I think it is more appropriate to refer the readers to the main SAC-SMA reference and use Abbazadeh et al. 2018 study as a second reference.
- Line 242, is there a more recent reference, application that could be used?

- Line 245: Why 6 hourly? Is this used in operational? If yes, could you provide citation or reference? I have seen hourly studies before, but not sure why one do the 6 hourly unless due to limitation of the forcing. Later in the results it was mentioned the model outputs are hourly.

#### Data Assimilation:

- This section was hard to follow. It would benefit greatly of rethinking the presentation. This paper is not focused on introducing any of the methodology used here, therefore, authors could drop most of mathematics and instead use telling schematics (expanding the figure 2) that could help narrate the workflow. Given the previous papers were filled with extensive discussions of the mathematics behind it and probably less space for graphics and schematics, maybe you could do that instead in this paper. I would highly recommend the author thinks differently about presentation of the information in this section. Adding information on what parameters and what states were updated, would be beneficial to the reader.
- If author decides to keep the mathematics, please make changes to add subtitles and improve the flow of the discussion. Also Figure 1 of Abbaszadeh 2019 + Steps outlined in the manuscript were great narratives.
- Some of the text is exact copy of previous papers, please revise to the extent possible to avoid plagiarism.
- A general comment is the fact that several time it was mentioned this framework addresses all the uncertainties, maybe the author could narrate how that is been done. It was attempted through the methodology section, however it could be beneficial to highlight how each uncertainty is addressed. In particular I do not know what was done to address the forcing uncertainty, could you elaborate on it?

#### Model Calibration and validation:

- I do not follow this statement “This ensures the applicability of the calibrated model for predicting future events, ”
- Line 404 to 409 is relevant to dataset section for ET and also the discussion of choice events used for this manuscript. I think these lines could be moved to earlier sections.
- It is not defined what gauges were used in the calibration, for example for Galveston basin has so many gauges, are all used in the model calibration? I am not clear how fine the lumped basins were, HUC8 or just one big basin. Could you clarify that? Is each gauge used to calibrated just a portion of basin, or they are all together?
- What time step is used in the modeling and calibration? It was mentioned the model is running every 6 hours, did the calibration happen every 6 hour or daily? In Line 443 states the model output is hourly. I am confused on the time scale.
- Has there been a warm up period before the calibration, could you comment on it?
- How about including what parameters were calibrated? Maybe refer to the previous papers table if there is no need for repeating it.

#### Results:

- Figure 4. Why not displaying the NSE in the figures? NSE was used as the objective function.
- Line 458: SAC-SMA does not have any regulation/reservoir/lakes represented so it is a deficiency of the model as you stated, and it would be beneficial to differentiate between natural and regulated basins.

- Line 495: I cannot connect the dot why this methodology is specifically more important in peak flow estimation. Could you elaborate on that? Is it because the model is not decent in estimating the peak flow?
- Line 510: Elaborate what you mean by “sub optimal”
- Line 513: could you elaborate what should be done instead for hydrodynamical modeling?
- Lines 517-519. Repetitive, could be dropped.
- Lines 252-531. Do you think having a more frequent cycling could have helped Rita? Keeping the Assimilation window as a day, however, recycling more frequently? This would be kind of like using a smoother. Does this suggest this is a limitation of HEAVEN in improving the accuracy of short-lived events such as sub daily scale thunderstorms?
- Figure 6 and 7 could be combined, also adding the major river network would help the visual inspection. Maybe you could combine the size and color to convey more information just the POI as the figures are not busy.
- What is POI? It is probably a commonly used metric by the author, however, it is not clear to me what it stands for. Could you please define the metric before using it?
- Line 541. Nicely said!
- Figure 8. What is the green band? It is not in the legend of the figure. Is it referring to the time period that POI is based on it? It was not clear to me, whether the verification is based just the peak value or an even containing peak value. The green band here suggest the latter, however, it would be great if clarified and clearly stated.

### Conclusion:

- Please consider improving the conclusion section. It is not summarizing the study and the findings very well. Given this study is a use of HEAVEN for peak flow estimate and hurricane induced flooding, you could elaborate on it. Any discussion of the limitations? For example the Rita case and what could be done to resolve it.

### Editorial and Technical Corrections:

- Line 50: Literature is misspelled.
- Line 51: there is an extra space after parenthesis.
- Line 52: there is an extra “:” at the end of the citations.
- Line 53: how about using “evaporation” instead of “water evaporating”?
- Line 100: Extra “.” Before citations.
- Line 104: How about using a different word instead of “layers”, maybe components?!
- Line 107: How about changing “were designed” to “are commonly used”.
- Line 119: Please state the full name and put HAVEN in the parentheses. Similar format is used everywhere in the text for other abbreviations also, for example line 208 and 209. I have seen mostly defining the name and then putting the abbreviation in the parentheses.
- Line 162 and 165: There is first name of the authors in the citations. I think the HESS format required only the last name, please double check the policy. Same as line 206,
- Line 227: The sentence is being cut into two. Replace the “.” With “;”.
- Line 255: Please change the “in the above study” to “Abbaszadeh et al 2019”
- Line 318: Here is being misspelled.