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Interactive comment

Interactive comment on "A cross-scale study for compound flooding processes during Hurricane Florence" *by* Fei Ye et al.

Fei Ye et al.

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Dear Reviewer,

Thank you for taking time to help us improve the manuscript. We agree on many points you raised, and we will address them in a later reply and in the revised manuscript. Before that, we would like to briefly comment on a few points.

<Reviewer Comment #1>

We agree with the reviewer that "The tuning of friction values is intentionally kept to minimum in favour of simplicity" is not a good statement. We will add more details on calibration in the revised version.

Calibration was indeed an important step during our model setup. The friction of the baseline model was tuned in wet area (river, estuary, ocean; lower than 1 m above MSL) and on higher grounds (higher than 3 m above MSL) separately. In the wet area, drag coefficients were tested within a range of 0.001-0.01. Commonly accepted default value of 0.0025 gave good error statistics near the landfall site; but as you can see from the attached figure, there is not a lot of sensitivity in the range of 0.001-0.005.

In the watershed, drag coefficients were tested within a range of 0.01-0.5. The optimal value was chosen based on the High Water Marks (HWMs) comparisons at over two hundred locations, collected by USGS. A small friction value within this range tended to under-predict the elevation at HWMs, and a large value led to over-prediction. Values with the range of 0.02-0.05 gave good error statistics. We chose 0.025 because it gave slightly better results in the Cape Fear River watershed near the landfall. Note that this is the parameterization adopted for the region influenced by Florence. Spatially varying parameterization of bottom friction for different systems is an on-going effort as we study more recent hurricanes and operationalize the model along the East Coast and Gulf Coast. However, as we presented in Ye et al. (2020), Zhang et al. (2020) and Huang et al. (2021), the choices described above seem to work fine in general for other systems as well.

Note that we have already published extensive model validation and sensitivity test results with respect to other parameterizations (e.g., 2D vs 3D etc.) in the above-mentioned citations. We feel that we should focus on new findings in this paper instead of presenting similar findings once again.

<Reviewer Comment #3>

For the baseline run, the real time ratio to simulation time is 80 with 1440 Intel Skylake cores on TACC's Stampede2 and 30 with 480 Intel Skylake cores on W&M's Sciclone. So, a 3-day simulation will take 0.9 hours using 1440 cores or 2.4 hours using 480 cores. Although the model covers a large domain, most of the elements are 2D, making it efficient enough for operational forecast. We will add this information into the revised manuscript.

<Reviewer Comment #5>

This is a very good point, and we will add more explanations into the revised manuscript. In short, the few large errors are likely the result of similarly under-resolved bathymetric/topographic features, with minor contributions from other factors such as DEM uncertainties.

Our tests show that the simulated elevation on the High Water Marks (HWMs) in the watershed is sensitive to: grid resolution, precipitation, river inputs through the land boundary, and bottom friction. Grid resolution and quality is the most important factor, as explained in the last paragraph of Section 4.3. Misrepresentation of flood routing can easily lead to errors of a few meters near some very localized features like ditches, highways etc. How to resolve all important small features efficiently is an on-going research area.

The defects in grid quality can lead to large errors that are not likely to be rectified by tuning other parameters. To fix the remaining few large errors away from the landfall site, grid quality should be examined first. The continuous improvement on this model grid is part of an ongoing effort of operationalizing the model along the US East Coast and Gulf Coast, and we will report this in future studies. Other factors such as uncertainties in DEM, precipitation and the river flow through land boundary also play minor roles.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2020-389, 2020.

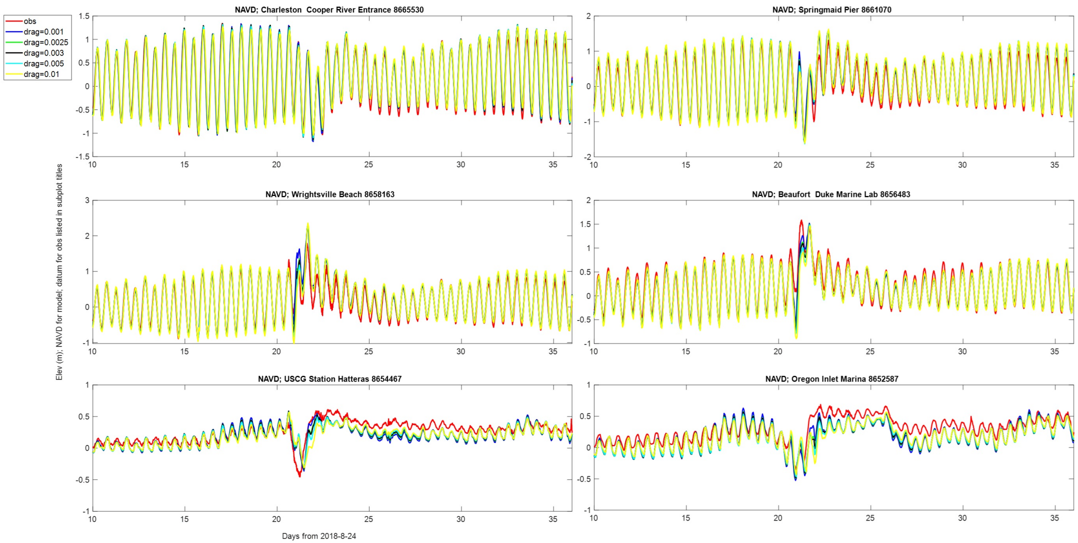

Fig. 1.

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Discussion paper