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Natural Hazards and Earth System Sciences
Discussions

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

Anonymous Referee #3

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Thanks for the opportunity to review this manuscript. The article presents a coupled hydrologic-hydrodynamic modeling framework to simulate compound coastal flooding considering the impacts of various flood drivers (coastal, fluvial and pluvial). The SCHISM is used for baroclinic simulation (with vertical grids) of coastal processes. To account for inland processes the authors have used National Water Model (NWM) outputs at the land boundary (set at 1m above sea level) and used ERA re-analysis products for rain-on-grid simulations to hindcast flooding dynamics due to Hurricane Florence. They further run their model under baseline and sensitivity runs to quantify the contribution of different sources of flooding in various compound flood hazard situations. The idea of integrated modeling that couples detailed hydrologic and hydrodynamic modeling schemes to simulate the nonlinear behavior of interactions between

various flood sources at coastal regions is interesting and is currently going on in various research groups around the globe. To me the novel aspect of this work is having very much detailed representation of hydrology (via NWM based on WRF), river morphology and coastal ocean dynamics (via a 3D baroclinic model). The manuscript is well written and can be of interest of community, thus I suggest publication in NHESS, however after a major revision. The major issue to me is that, despite the efforts of authors to calibrate/validate their model, on the hydrologic fluvial side the model does not seem well calibrated, and the significant error in NWM prediction (both timing and magnitude of peak) can pose a significant error to the overall estimates. Also, not clear to me how the pluvial flooding processes (from direct rainfall) is treated here. More detailed comments below:

Major comments: - Hydrologic processes are not well represented here. River flow hydrograph estimates from NWM are significantly different than the observed flow at USGS gauges (see Figure 6). About 2-3 days of lag in peak flow estimation and up to 100% error in peak flow magnitude can pose a significant error in overall inundation and coastal water level dynamics if propagated through the system. Timing (and magnitude) of peak runoff plays a significant role in extreme water level dynamics in freshwater-influenced coastal systems and getting these hydrologic characteristics right plays a major role in accurate estimation of extent/intensity of compound flooding. This might partially explain the wide range of difference (up to 4 m) between simulated and estimated high water marks (Figure 11), with a considerable number of points having estimation error greater than 1m (Figure 11e).

- Could not find any information on how the pluvial processes are handled in the model. Rain-on grid modeling (L174) is a good contribution to the field which I acknowledge, but how the underlying processes and variables that contribute to the runoff generation are accounted for is vague. How infiltration capacity is accounted for? How drainage infrastructure contribution is accounted for (in urban settings)? How the generated runoff is routed between pixels? This is even more important when the results suggest

that flooding in a significant portion of coastal land in dominated by "precipitation only" (Figure 15c).

Minor comments: Figure 1: red text (in the left panels) is not readable in print. I'd also add some space between rows in the legend. Figure 3: Black text is really hard to read on the dark blue background. Figure 4 is confusing. Hurricane track is numbered right-to-left (Panel a) and vertical grid points are numbered Left-to-Right (Panels b and c) L110: what "LSC" stands for? L120: "10 m above sea level", you mean mean sea level? if yes, is it regional or global. Please be more specific about this. L133: what "CFL" stands for? L143: Explain what is HYCOM first time use it in the manuscript. L174: Simply said rainfall is routed. Please, elaborate more on this, how exactly routed? How infiltration capacity incorporated? L189: "4-6 days" in observed or modeled events? The modeled and simulated peaks seem to be few days apart themselves. Figure 9: Better to compare detided signal here. These gauges are extremely tidal influenced and estimation skills of the model for stochastic processes is diluted by highly predictable astronomic tides. L275 & L284: describing errors "quite satisfactory" and "reasonable agreement", when mean absolute error in estimated high water levels is 0.73 m and with nearly 20% of points having error >1m, is a subjective description. I'd avoid such statements and simply let the readers decide whether if such estimation errors are reasonable according to their required accuracy and project objectives.

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