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Comment on nhess-2021-220

Anonymous Referee #1

Referee comment on "Investigating the interaction of waves and river discharge during compound flooding at Breede Estuary, South Africa" by Sunna Kupfer et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2021-220-RC1, 2021

The research paper entitled 'Investigating the interaction of waves and river discharge during compound flooding at Breede Estuary, South Africa' submitted to the NHESS journal aims to provide understanding of the effect of compound flood drivers on the flood extent in the open estuary where the variable water levels are due to combined signals of tides, surges, waves and river discharges. A numerical model is used to simulate flood events for various scenarios. While the methodology is quite simplified and limited, the paper provides better understanding of wave impact on upstream waters levels and as such brings some novelty to generally well understood tide, surge and river discharge combined actions. The paper is within the scope of NHESS, well-focused, concise with good discussion and explanation of model limitations, and I recommend for publication subject to major revision.

The introduction has a concise literature review, states current knowledge gaps for the compound flood modelling and defines the aim of the research. As the main focus/novelty is in contribution of waves to WLs, more overview of literature and their findings on that matter would be of benefits to a reader. Also, a discussion and comparative analysis with the authors' findings would be of use in the discussion section.

The study area concisely summarizes hydrology, hydrodynamic patterns and geomorphology of the region with some general overview of oceanic processes that influence the estuary.

The methods section describes datasets, hydrodynamic and wave models. The datasets for model validation are not extensive but I appreciate the difficulty in obtaining multi-location tidal and river gauges timeseries or ADCP data or wave data.

The performance of hydrodynamic model is arguable as some deficiencies in model accuracy in terms of water elevations exist (velocity magnitudes are not validated). the validation results show some significant discrepancies between the model and observations, this is further confirmed by RMSEs, which for tide+Q WL is 0.62 m. While this number is very high in the flood context, it seems from fig 3 that these discrepancies are primarily generated on low water peak of spring conditions while high water peaks (which are of relance in this study) are quite comparable. The separate analyses of RMSE for neap, spring tides and low and hight water would be useful in the process of validation.

The discrepancies could be due to the number of factors including spatial resolution of FES2014 tidal constituents and a number of constituents being simulated, as well as not including the non-tidal signals. Nesting or downscaling the boundary conditions from the regional model would be more appropriate, however I understand that due to the computational effort and timescales required here this may not be possible. Perhaps, setting the north and south downstream boundary as the no-flow wall boundary may play a role too. Finally, one-hour resolution of river discharge timeseries at upstream boundary could also contribute to the error. Also, it is not clear whether a 3D version of the model is used; the 3D-mode would be a better choice as the baroclinic conditions could be important in the region due to seasonal development of stratification. I encourage the authors to elaborate on these aspects in the model validation section.

In Table 3, I would suggest to present statistical analysis separately for spring, neap and average (and perhaps for close to peak values only) to better understand the source of an error.

In results section, the four selected scenarios represent only a combination of the most extreme (100-year RP) conditions. As such, this is a very conservative approach and does not explore all flood conditions and their probabilities of occurrence. In my opinion a combination of varied Qs and oceanic conditions such as the 'marginal', 'and', 'or' scenarios would provide better understanding of interactions and perhaps their non-linear effects. The readers would benefit from dependence analysis between Q and WLs. In recent years the use of Kendalls tau and copulas to construct a bivatriate models have been widely used in this type of analysis. I appreciate, however, that such statistical analyses would require a large effort and lead to a substantially different paper. I would suggest to discuss the interactions and dependencies in context of future work.

Figure 5, right panel. The colour scale could be refined to better reflect the differences. the interval of 0.3 is substantial in the flood context. The negative values in the range are not used.

Moreover, there is a number of typos (line 37- semicolon etc) which should be removed.

In overall, this is a well written and concisely presented paper that provides some insight to the effects of waves of typically considered river discharges and tidal signal. While the approach is simplified, omits important signals and does not explore interactions and dependencies, I would recommend the manuscript for publication in NHESS subject to additional discussion and aforementioned revision.