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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Very severe storm tides in the German Bight (North Sea) and their potential for enhancement" *by* Iris Grabemann et al.

Anonymous Referee #2

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The paper presents an interesting analysis of plausible amplifications of storm tides at the German Bight and the Ems estuary. These amplifications are investigated in terms of numerical model simulations that account for changes in storminess from climate change scenarios, changes in the timing of the tidal phase and spring tide conditions for the open coast; in addition to SLR and increase of river discharge for the Ems estuary. Results show that the largest amplification of the storm tidal levels (up to 50cm) at the open coast arises from a shift of the tidal phase with respect to the storm peak. In the Ems estuary, the SLR causes the largest amplifications at the mouth, while its effects are negligible in the inner part of the estuary. The opposite is true for an increase of the river discharge. Finally, the effects of closing the storm surge barrier of the estuary is also investigated. Closing the barrier produces an increase of the

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water levels at the outer part of the estuary and a decrease in the inner part. However, the effects in the inner part depend on the river discharge and for how long the barrier is closed.

Although this study is interesting and relevant, I agree with the first reviewer that the manuscript should be proof-red by a native speaker and many commas are missing (I listed some in the minor comments below). In addition, how some sentences are structured and some terminology used makes the reading difficult. Specifically, I recommend to state first what it was done, and then give the reasons why it was done in that way, instead of the opposite order. The paper is long and it addresses several different scenarios and analyses (climate changes scenarios, changes in the tidal phase...), so the use of generic terms in some cases (e.g. L218 "data set") makes difficult the reading because it is not clear to which simulation/data set the authors are referring to. In addition, I would use "event" instead "ensemble member" e.g. L239, L247.

In the introduction and discussion, I am also missing more references of other studies using a similar approach than in this paper as well as other studies made for the German Bight region. For example, Arns et al. (2015) analyzed the non-linear effects of different SLR scenarios on the peaks of storm tides at the German Bight and Santamaria-Aguilar et al. (2017) assessed the effects of these scenarios on the storm surge hydrographs. In addition, Wahl et al. (2011) developed a statistical approach for generating a large number of storm surge events.

I find the section of data, methods and experiments difficult to read and follow due to the large number of datasets, models and simulations made/used. However, the summary and discussion is well structured and clear. I recommend to rephrase first sentence of section 2.2 and to re-structure the section ordering the different data sets e.g. Start with the hydrodynamic model used, hindcast forcing, and climate change scenarios and models. (However, it is very clear in the diagram of Figure 2). In some cases, the reading would be easier if the type/variables is specified e.g. "multi-decadal hindcast"

or “climate realizations”, which can refer to atmospheric forcing or water levels. It would also be interesting to know the length of the hindcast and climate scenarios period i.e. specify the years.

Minor comments:

Title: I suggest to change “very severe” for extreme, which is the term commonly used in the literature and actually, it is also used in the manuscript e.g. L138 (Here and along the manuscript). In addition, enhancement can also be changed to “amplification”, which is the term used more often along the manuscript.

L1. Change “essential” for major

L20. This sentence is vague.

L25. Environmental threat-> Natural hazard/threat

L27.Inflicted heavy losses-> caused large damages

L29-30. Rephrase. The use of commas is not correct in this sentence.

L30. Risk of what?

L31. Remove associated with anthropogenic climate change.

L32. Storm surge-> If storm tides is the term used, please be consistent along the manuscript.

L32-33. Link this sentence with the previous one. In addition, references can be added as e.g. Arns et al. 2015

L61. . . .forcing, a possible amplification can occur or possible amplifications

L63-64. Add comma after variations and considered.

L65. Comma after study.

L68. The climate realizations used, comprising CMIP3 and CMIP5 scenarios, reflect

only. . ..and local bathymetric changes or changes in the local bathymetry.

L75. Comma after set. Remove distinct

L76. Simulations of what?

L79. Comma after surges

L82. Comma after estuary.

L84. Comma after Emden

L94. Comma after Bight

L99. The Ems estuary is situated in the southern German Bight, at the border. . . (Remove North Sea because the location of the German Bight was already specified).

L136. Rephrase. For instance, “The methodology used to investigate the potential amplification of the storm tide events comprises four steps”

L141. It is not clear here how an event is defined, which is explained in L212-215. These lines should be moved to this section as they are part of the methods and not of the results.

L152. If the SLR is not included in the simulations of climate scenarios of the North Sea model, why the largest spring tide of each climate scenario is used and why it would change between them? Are the climate scenarios for different periods? How is the tide extracted from the simulated water levels?

L153. Comma after two.

L154-155. Rephrase this sentence.

L166. Remove “To the North Sea” and add “ocean” boundary of the German Bight model.

L204. Comma after conservation.

L217. Comma after 3.

L219. Remove comma.

L238. Comma after EH.

L243-245. Divide the sentence in two and add commas.

L251. Comma after EH.

L252. Change “except”-> “with exception of”

L254. Comma after water and members.

L258. How much was the increase? These lines are too vague: “few centimeters”, “not a substantial increase”, “nearly no changes”. . ..

L262. Rephrase. Single high waters?

L264-266. Move to section 2.5.

L278-279. There is no need of explaining again where Elbe mouth and Amrum are located.

L285. Change differing to different.

L285. Comma after Amrum.

L287. Rephrase: “The olive curves of both Elbe mouth and Amrum correspond to the same simulation, which incorporates both the largest spring tide and the phase shift of the tide”.

L289-291. Use duration above MHW instead of time period

L299. Comma after amplification.

L300. Comma after the parenthesis. Is EH_a instead of EH?

Figures 7 & 8. Dashed lines cannot be clearly differentiated. I also recommend to add

a line showing the MHW level in figure 8 as the changes of the duration above this level are discussed.

L318. Was a simulation with a SLR of 0.5m also performed? This was not mentioned before.

L325. The highest

Figures 9, 10 & 11. Font size of legends, axes and labels is too small.

L326. Add parenthesis (HW).

L330. Rises-> raises

L338. Comma after addition. Is decreasing-> decreases.

L350-357. I do not understand these lines and why are in this section. Rephrase them and move them to the discussion. (Or simply remove them, because it is repeated in lines 435-438)

L380. Increases o causes an increase of.

L382. Highest-> High or an increase of the highest

L412. There-> They are from

L413. Clarify this line. The absence of considerable increase of storm surges correspond to the magnitude or frequency? Because this study is focused only on 3 types of events, but it does not include any analysis of changes in the trends/ variability of storm surges.

L433. Rephrase.

LL460. Particular

References:

Arns, A., Wahl, T., Haigh, I. D., and Jensen, J. (2015). Determining return water levels

at ungauged coastal sites: a case study for northern Germany. Ocean Dyn. 65, 539–554. doi:10.1007/s10236-015-0814-1.

Santamaria-Aguilar, S., Arns, A., and Vafeidis, A. T. (2017). Sea-level rise impacts on the temporal and spatial variability of extreme water levels: A case study for St. Peter-Ording, Germany. J. Geophys. Res. Ocean. 122, 2742–2759. doi:10.1002/2016JC012579.

Wahl, T., Mudersbach, C., and Jensen, J. (2011). Assessing the hydrodynamic boundary conditions for risk analyses in coastal areas: a stochastic storm surge model. Nat. Hazards Earth Syst. Sci. 11, 2925–2939. doi:10.5194/nhess-11-2925-2011.

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