Comments

General comments

The manuscript "Global scale benefit-cost analysis of coastal flood adaptation to different flood risk drivers" assesses the benefits and costs of four structural adaptation objectives at global scale until 2080. It further attributes the contribution of different flood risk drivers to the total adaptation costs under the 'Optimize' adaptation objective. For this analysis, the authors first assess coastal flood risk expressed in Expected Annual Damages (EAD), followed by the estimation of adaptation costs, before conducting a benefit-cost analysis (BCA) for each adaptation objective. The study finds that all adaptation objectives have a high potential for reducing flood risk in a cost-effective manner; further, the contribution of sea-level rise (SLR) dominates adaptation costs in most regions.

The study provides first estimates of the benefits of different structural adaptation objectives, taking into account a range of SLR and socioeconomic scenarios. It uses well-established methods and data and extends these for the purpose of this study, therefore providing new insights into the cost-effectiveness of adaptation strategies at the global scale. However, the manuscript in its current form has a number of limitations and I therefore propose to reconsider the manuscript for publication upon revision of the following issues:

Specific comments

1. As the study accounts for structural adaptation measures only, I would suggest adding this piece of information to the title of the manuscript.
2. While the introduction section cites the relevant background literature regarding coastal flood risk assessments, the current research gap is not pointed out clearly (l. 49-55). Consequently, the innovative aspects of this study do not become entirely clear. Similarly, previous work that has accounted for subsidence in assessing coastal food risk has not been cited (e.g. Hinkel et al. 2014, Nicholls et al. 2008, Hallegatte et al. 2013). Therefore, I suggest adding more detail to the respective sections.
3. L. 95: Please elaborate where the enriched GTSR data were acquired and how they were extended.
4. L. 116-119: How have the SLR projections been regionalized? Please provide more information.
5. To assess current exposure, you refer to the methodology of Huizinga et al. 2017. It remains unclear how exactly damages have been assessed without consulting the study of Huizinga et al. 2017. Please provide sufficient detail.
6. It is not clear to me why the HYDE database was used to assess current exposure as it has a coarse resolution and is rather outdated. In the discussion section (l. 477), the Global Human Settlement Layer (GHSL) is mentioned, which provides built-up land data of 2015 at resolutions of 30m, 250m, and 1km. Further, the GHSL data provide spatial population distributions at resolutions of 250m, 1km, 9 arcsecs, 30 arcsecs (https://ghsl.jrc.ec.europa.eu/download.php?ds=pop). Both GHSL datasets could be used in combination for assessing current exposure, which would increase consistency of the results while avoiding the use of correction factors if base year data do not align (l. 148-149).
7. The SSPs are introduced rather abruptly in l. 147, but further details are missing. Please provide a brief description of the SSPs along with the relevant literature (e.g. O'Neill et al., 2014; O'Neill et

al., 2017; van Vuuren et al., 2014). These pieces of information are also important to contextualize the results of the study (see also comment 18).

8. Some data for assessing exposure were downloaded from the SSP database, while others were not (e.g. GDP values). As the SSPs are the current state-of-the-art socioeconomic scenarios, I suggest using the national-level population projections as well as the GDP projections from the SSP database for the entire study period. Furthermore, spatial population projections based on the SSPs are available from Jones and O'Neill, 2016 at a resolution of 1/8 degree, downscaled to 30 arcsecs by Gao, 2017, and from Merkens et al., 2016, also at a resolution of 30 arcsecs. These may serve as a suitable basis for producing future simulations of built-up land, using the methodology of Winsemius et al 2016 (l. 151-153).
9. Section 2.1.5 provides a description of the results of FLOPROS rather than how the modeling approach was applied. I suggest stating the use of the FLOPROS data, and moving further explanation to the SI.
10. The scenario combinations (RCPs-SSPs) used for the analysis are briefly described in the results section (l. 292-296). I suggest moving the reasoning for using these scenario combinations to the methods section, along with additional background information.
11. Figure 3: It would be helpful if the results were contextualized in the text with regard to the respective drivers contributing to coastal flood risk under current and future conditions. Please also provide the country names for each ISO code.
12. In Figure 2 and Figures 5-8, a legend of the regions in gray color (i.e. no data?) is missing. Further, the scalebar of the BCR plot (panel b) does not allow for differentiating between BCRs > 1 and < 1. Additionally, the scalebar of the NPV plot (panel c) does not provide a signature for NPV = 0. The same holds true for panels b-e in Figure 9. I suggest adjusting the figures accordingly in order to increase the information conveyed by the figures. Furthermore, the administrative units in South Africa and Namibia (all panels) seem odd as they include areas of Botswana, which is a landlocked country. Please also revise the administrative unit data.
13. Figure 8: It would be interesting if the change in risk (panel d) was contextualized in more detail, providing explanations of increases and decreases in flood risk in the text (see also comment 18).
14. Figure 10: Some of the colors used for the World Bank regions are misleading as they align with those used for the flood risk drivers. Please revise the colors used.
15. Table 2: You mention in l. 120 that the 5th and 95th percentiles of the SLR projections are used for the sensitivitiy analysis. Do SLR low and SLR high refer to these percentiles?
16. Section 3.6 provides useful insights into the results of other studies, but lacks detailed explanation of the reasons for differences between this study and previous work. The results of this study are considerably higher than those of previous work despite the more refined inundation modeling approach used. I would suggest extending this section accordingly, by providing more context.
17. L. 477 please provide a reference for the GHSL data.
18. Contextualization of the results is largely missing in the discussion section (see also comments 7 and 16). It would be helpful for the reader if the different adapation objectives were discussed in more detail, addressing questions such as: What do different adaptation objectives mean/entail? Which would be more desirable based on the BCRs? Why does flood risk increase in certain regions under certain objectives (see also comment 13)? I suggest adding a section that elaborates these aspects to the discussion. Connected to this point, it would also be insightful if the benefits of the study were elaborated in more detail, for instance how other scholars and/or decision-makers could use the results.

Technical corrections

19. List of typos/mistakes found:
    - L. 26: ‘compared to’ stated twice
    - L. 27: remove ‘.’ after Raftery et al. (2017)
    - L. 100: hydrologically
    - L. 129: 30” x 30”
    - L. 212: remove ‘,’ after Jevrejeva et al. 2014
    - L. 380: add ‘,’ after South Asia
    - L. 473: locations
20. The manuscript uses British English and American English interchangeably, one example being ‘optimize’, ‘optimise’, ‘optimisation’ etc in section 2.3.

References (in addition to those already cited in the manuscript)

Gao, J.: Downscaling Global Spatial Population Projections from 1/8-degree to 1-km Grid Cells, NCAR Technical Note, NCAR/TN-537+STR, 2017.

Jones, B. and O’Neill, B. C.: Spatially explicit global population scenarios consistent with the Shared Socioeconomic Pathways, Environ. Res. Lett., 11, 84003, doi:10.1088/1748-9326/11/8/084003, 2016.

Merkens, J.-L., Reimann, L., Hinkel, J., and Vafeidis, A. T.: Gridded population projections for the coastal zone under the Shared Socioeconomic Pathways, Global and Planetary Change, 145, 57–66, doi:10.1016/j.gloplacha.2016.08.009, 2016.

O’Neill, B. C., Kriegler, E., Ebi, K. L., Kemp-Benedict, E., Riahi, K., Rothman, D. S., van Ruijven, B. J., van Vuuren, D. P., Birkmann, J., Kok, K., Levy, M., and Solecki, W.: The roads ahead: Narratives for shared socioeconomic pathways describing world futures in the 21st century, Global Environmental Change, 42, 169–180, doi:10.1016/j.gloenvcha.2015.01.004, 2017.

O’Neill, B. C., Kriegler, E., Riahi, K., Ebi, K. L., Hallegatte, S., Carter, T. R., Mathur, R., and van Vuuren, D. P.: A new scenario framework for climate change research: The concept of shared socioeconomic pathways, Climatic Change, 122, 387–400, doi:10.1007/s10584-013-0905-2, 2014.

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