

## ***Interactive comment on “Costs of sea dikes – regressions and uncertainty estimates” by Stephan Lenk et al.***

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Received and published: 10 January 2017

A. The authors apply an empirical approach to derive a functional form for the costs of construction of coastal dikes as a function of height. With this purpose, they set up several regression models with costs as predictand and several. They estimate the parameters of these models using cost data from the Netherlands and Canada. The main conclusion is that, somewhat surprisingly, the costs can be mainly described by a linear function of dike height, with no (or very small) fixed costs.

> We appreciate this insightful comment and agree with the surprising conclusion. As outlined in the manuscript, higher-order components contribute to the costs so that the linear function is indeed somewhat surprising. Other colleagues commonly use unit costs and implicitly make the assumption of a linear relationship. Our results give

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empirical support for this assumption.

B. My general evaluation of the manuscript is positive, although there are some issues that the authors may want to address in a revised version.

> We appreciate the positive evaluation.

1. One general point is that the English needs some editing. This does not deter from understanding the current version, but the text will benefit from copy-editing before eventual publication.

> We are sorry that the English is not of sufficient quality. We will ensure another native speaker proof reads this.

2. One main concern is that the authors quite freely extrapolate the results obtained from these two regions to offer recommendations 'worldwide'. I think this can be an oversimplification, especially the conclusion that the fixed costs seem to be so low. Will this conclusion also apply to other regions with a weaker tradition of adaptation to sea-level rise or to areas that so far have not been threatened by sea level rise so far? I can imagine that in those regions the fixed costs can be substantial.

> We agree with the reviewer. As suggested by RC1 we would drop the last sentence of the abstract where recommendations worldwide were mentioned. Moreover, we would add a paragraph to the summary discussing the limitations of the transferability of our findings and parameters.

Some particular points

3. 'Sea-level rise represents the least uncertain consequence of climate change and there is considerable interest in comparing coastal flood damage with adaptation costs. It is not clear what the authors mean with this sentence. The range of estimations of future sea-level rise is very broad and it depends on physical mechanism, like land-ice dynamics, that is not well understood and that it is actually not implemented in current climate models. Perhaps the authors mean that it is certain that global sea-level will

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rise, but the magnitude and its regional distribution is very uncertain, much more than temperature. There may be areas where sea-level will fall or rise, for instance in the Northern Hemisphere at high latitudes, depending on the rate of melting of Greenland and Antarctica.

> The reviewer makes a good point. Our statement could be misleading. Accordingly, we would change it to “Sea-level rise represents a foreseeable consequence of climate change and there is considerable interest in comparing coastal flood damage with adaptation costs”.

4. ‘The latter investigated costs for coastal protection of low-lying delta areas using project-oriented case studies for the Netherlands, New Orleans, and Vietnam.’ ‘The latter’ is here too unspecific, as there is a sentence in between. It is not clear whom the authors are referring to.

> We agree and would simply fix the problem by providing the reference at the end of each sentence.

5. ‘They also analysed the relationship between dike height, dike cross-section, and costs of raising dikes at a very coarse level and depending on the site’ analyzed at a very coarse level and depending on the site the relationship... As it stands now the sentence could mean that the dikes were built at very coarse level.

> We thank the referee for finding this flaw and would change it accordingly.

6. ‘Second, what is the range of uncertainty that needs to be considered?’ I think the authors mean what are the sources of uncertainty that need to be considered

> Here we disagree with the referee. We actually mean the range in the sense as mentioned eg in the abstract, ie the range enclosing 95% of spreading. But as this seems to be ambiguous that could lead to a misunderstanding we will insert a clarifying statement to that effect.

7. ‘The report provides high-level long-term estimates in the preparation phase and we

do not have any information if any of the planned dike has actually been constructed to date' what does 'high-level' mean here?

> This terminology was taken from the Canadian report (p.25). But we agree with the referee that it is not clear. Accordingly, we would drop "high-level long-term".

8. ' provides information about the expected flood levels in 2100' is this the expected relative mean sea-level rise or extreme sea-level rise events ? If the latter,. which percentile?

> The report is based on the "Sea Dike Guidelines" by Ausenco Sandwell (2011) and takes into account sea-level rise, subsidence, reference tide, storm surge, wind set-up, and wave height. Different return periods are mentioned for storm surges, estuarine reaches, and seismic design. For our work it is secondary how the necessary crest heights have been designed, we explore the provided crest heights and corresponding costs. Accordingly, we prefer not to confuse the reader by providing too many details.

9. 'dike constructions of 1 m to 5 m height or raise' of raise ? the sentence is unclear

> We agree and would rephrased the sentence: "For the Canadian data ... it can be seen that the costs are spread over a wide range roughly between 5,000EUR/m and 40,000EUR/m for dike construction or raise with final heights of 1m to 5m."

10. 'In Fig. 1(a) it can be seen for the Canadian data, that the 4 models all have similar shapes and their deviations are small' delete comma after data

> We agree.

11.'Fig. 2. It can be seen, that the uncertainty encloses a rather large range which is increasing (due to the log-normal definition)' delete comma after seen

> We agree.

12. 'The cost estimate for raising a dike in Canada by one metre encompass roughly 6,000 EUR ' encompass is not the right word here, I think

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> We agree and will simplify the statement by stating 'The cost for raising a dike in Canada by one meter is estimated to be 6,000 EUR.'

13. 'Nevertheless, few values are also located outside the 95 % ranges suggesting, that the log-normal distribution might only be a first approximation.' delete comma after suggesting. The word 'also' is irritating here. Do the authors mean 'In addition, few values are...

> We agree and would remove the comma as well as "also".

14. 'Moreover, it can be seen that the difference between the land uses is smaller than between the countries. ' This is a somewhat sloppy wording. The authors mean that the influence of land use is smaller than the influence of country

> We agree and would change the manuscript accordingly.

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Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., doi:10.5194/nhess-2016-270, 2016.

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