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Corrigendum to
"Global-scale benefit–cost analysis of coastal flood adaptation to different flood risk drivers using structural measures" published in Nat. Hazards Earth Syst. Sci., 20, 1025–1044, 2020

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Some corrections are necessary to the above-mentioned paper. We found an error in our code for the conversion between US dollar values at market exchange rate (MER) to purchasing power parity (PPP). This affected the cost estimates used in the paper. All of the analyses have now been carried out using the corrected code, and the results are reported in this corrigendum. Using the corrected code, the main messages and implications of the paper remain unchanged, but the individual results reported in the text, tables, and figures do change. This corrigendum reports the corrected text, tables, and figures, and these supersede the information in the original paper. The Supplement has been corrected, too. The corrigendum is structured as follows: firstly we provide the updated tables and figures, and secondly we provide the corrected text (in bold) in an overview table.

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1 Corrected tables and figures

Table 1. Global overview of benefit–cost analysis for the different adaptation objectives (benefits, costs, and NPV are in USD billion 2005).

		Benefits	Costs	BCR	NPV
Protection constant	RCP4.5–SSP2	9706	359	27	9347
	RCP8.5–SSP5	18 730	445	42	18 285
Absolute-risk constant	RCP4.5–SSP2	11 550	820	14	10 730
	RCP8.5–SSP5	23 020	999	23	22 021
Relative-risk constant	RCP4.5–SSP2	11 019	498	22	10 521
	RCP8.5–SSP5	22 095	606	36	21 489
Optimize	RCP4.5–SSP2	11 468	459	25	11 008
	RCP8.5–SSP5	22 923	603	38	22 320

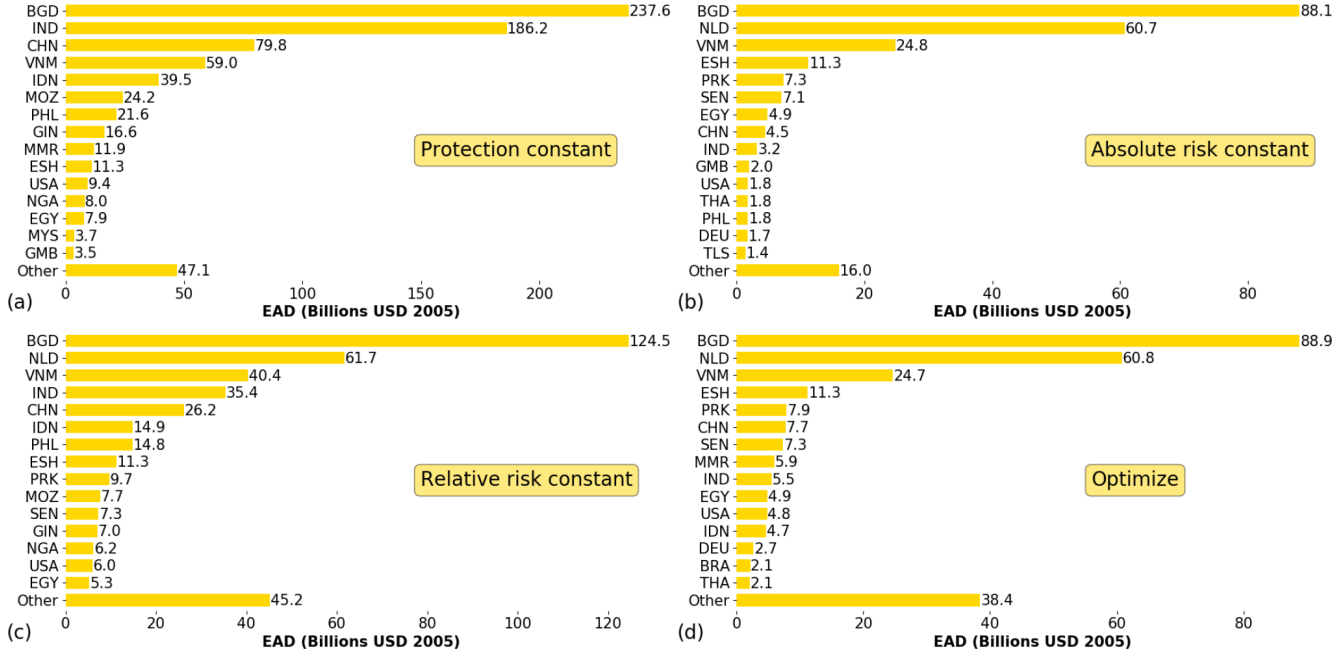

Figure 4. Top 15 countries with coastal flood risk in **(a)** 2080 if protection standards are kept constant, **(b)** 2080 if absolute risk is kept constant, **(c)** 2080 if relative risk is kept constant, and **(d)** 2080 if protection standards are optimized for the scenario RCP4.5–SSP2. Note that the countries and value on the x axis change for each graph. The countries are denoted by ISO 3166-1 alpha-3 codes.

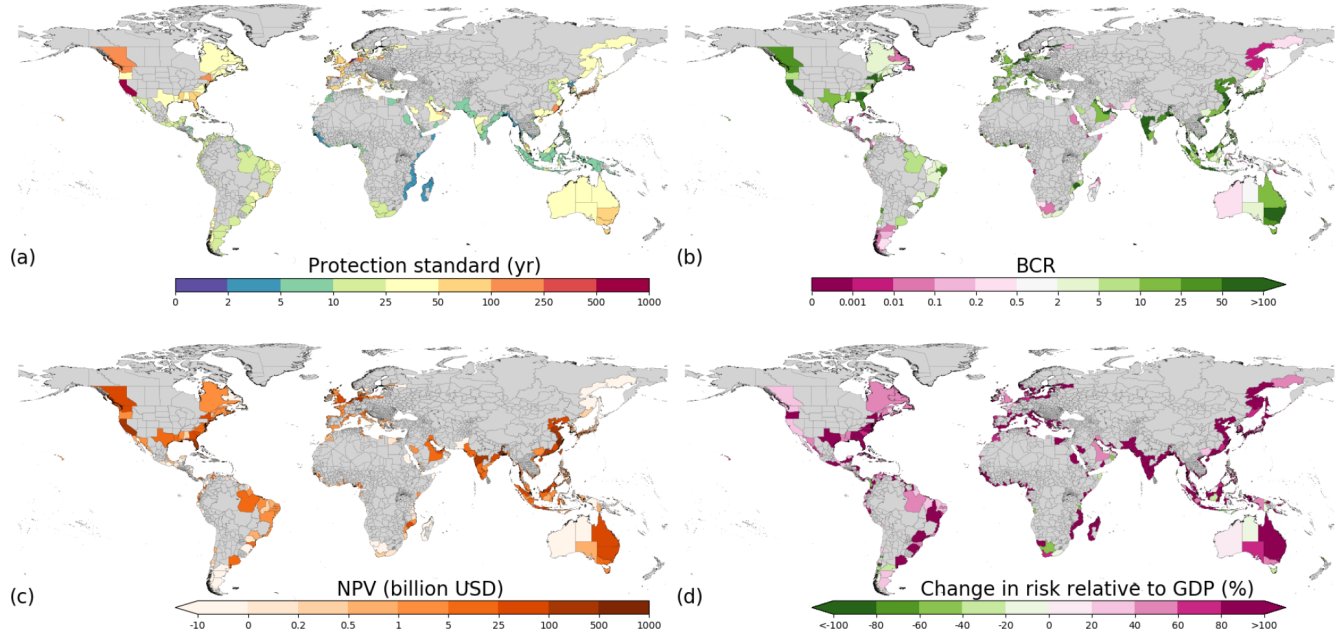

Figure 5. Protection constant adaptation objective results of **(a)** protection standards, **(b)** BCRs, **(c)** total NPV, and **(d)** change in risk relative to GDP for RCP4.5–SSP2. Note that the protection standards **(a)** are the same as FLOPROS estimates. Regions with no data are indicated in grey.

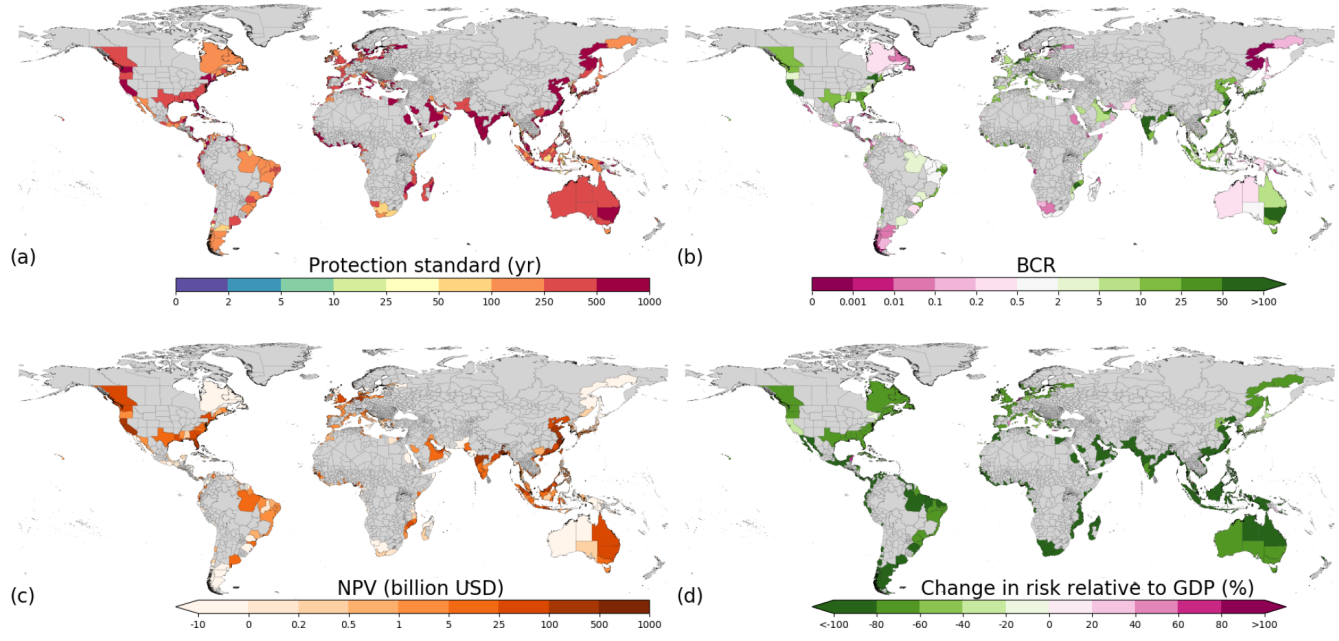

Figure 6. Absolute-risk-constant adaptation objective results of **(a)** protection standards, **(b)** BCRs, **(c)** total NPV, and **(d)** change in risk relative to GDP for RCP4.5–SSP2. Regions with no data are indicated in grey.

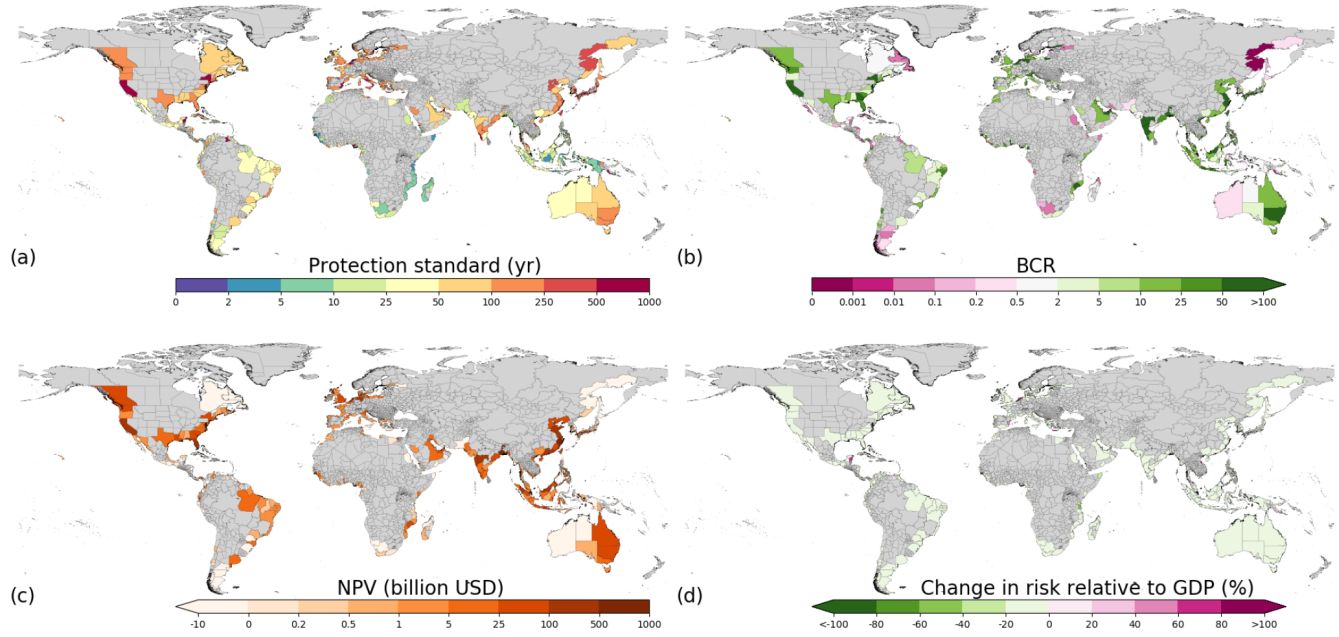

Figure 7. Relative-risk-constant adaptation objective results of **(a)** protection standards, **(b)** BCRs, **(c)** total NPV, and **(d)** change in risk relative to GDP for RCP4.5–SSP2. Regions with no data are indicated in grey.

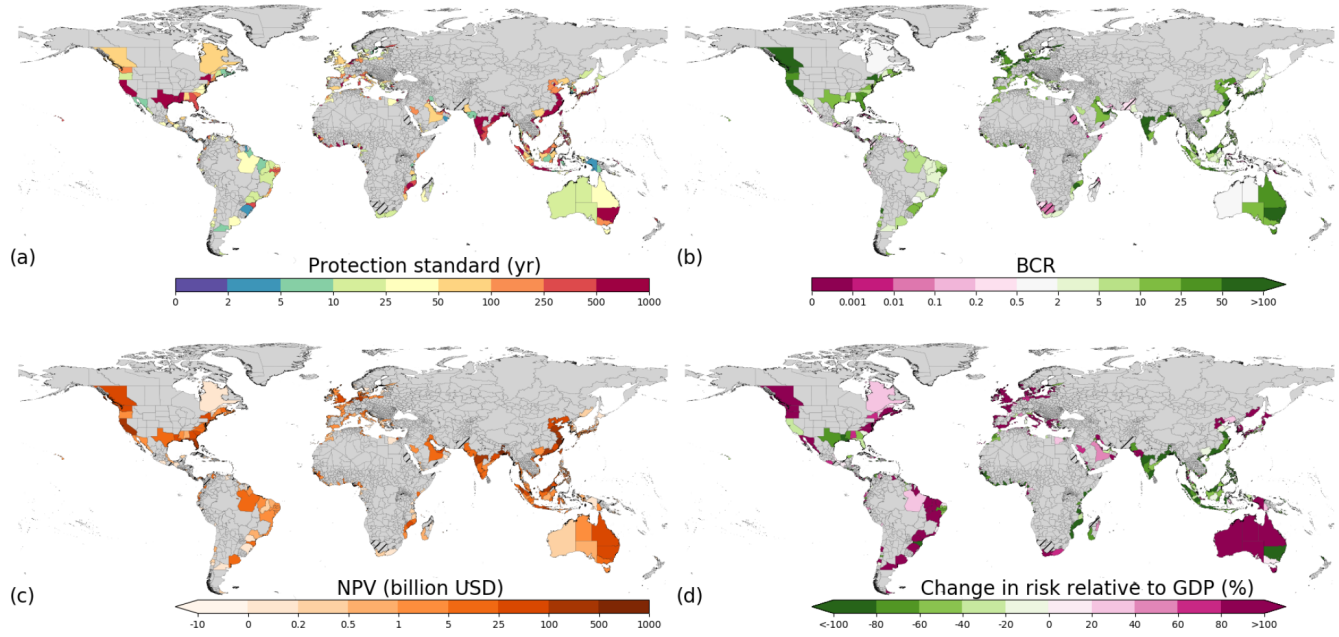

Figure 8. Optimize adaptation objective results of **(a)** optimal protection standards, **(b)** BCRs, **(c)** total NPV, and **(d)** change in risk relative to GDP for RCP4.5–SSP2. Regions where no optimal protection standards are found are indicated with hatched lines, and regions with no data are indicated in grey.

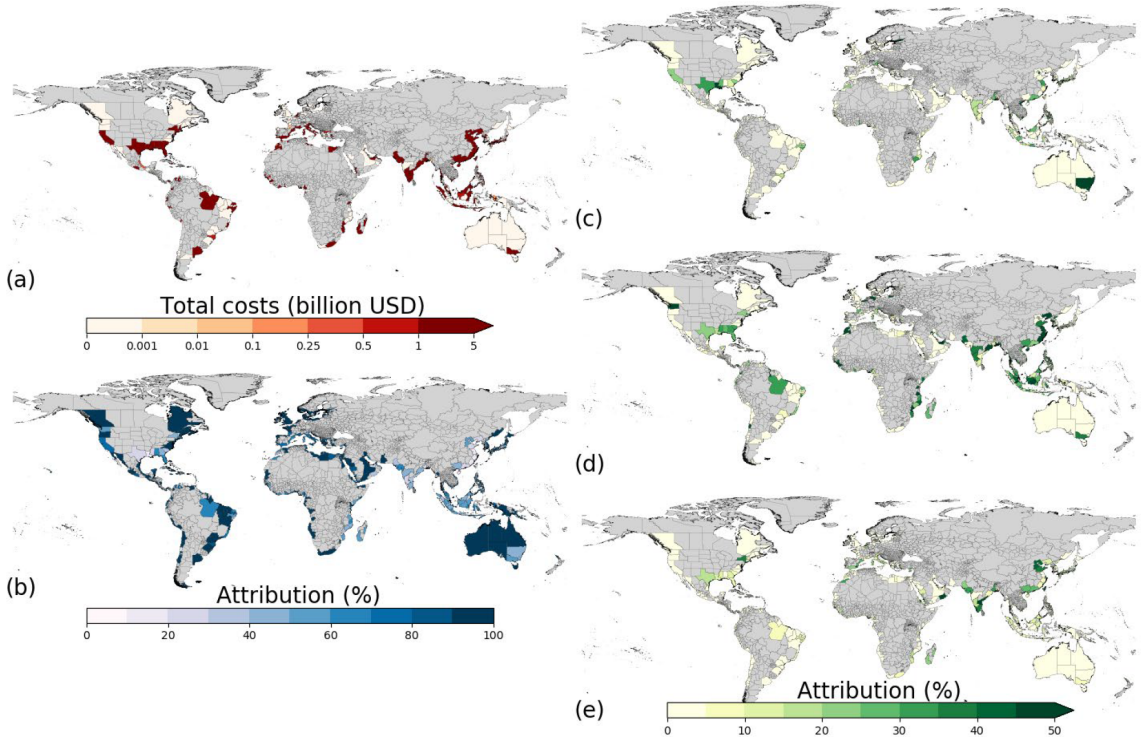

Figure 9. Attribution of costs overview for RCP4.5–SSP2, with **(a)** total costs, **(b)** attribution of sea-level rise (ATR_{SLR}), **(c)** current optimizing (ATR_{CUR}), **(d)** attribution of socioeconomic change (ATR_{SEC}), and **(e)** subsidence (ATR_{SUB}). Note that the attribution of SLR is on a different scale, and regions with no data are indicated in grey.

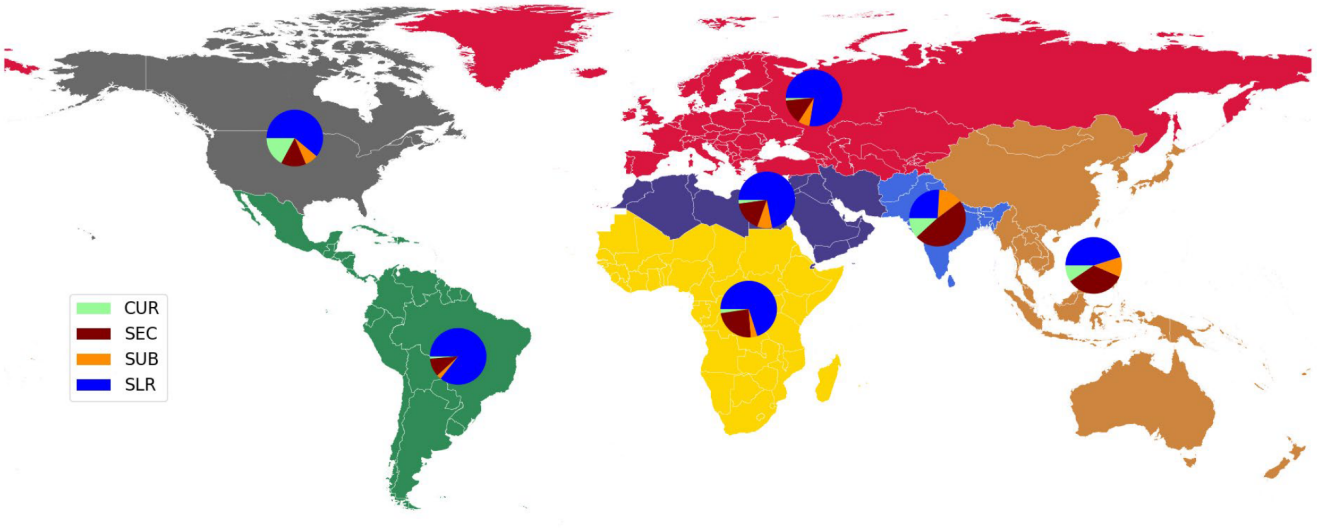

Figure 10. Attribution of costs of adaptation for World Bank regions under the optimize adaptation objective and RCP4.5–SSP2 for optimizing to current conditions (CUR), socioeconomic change (SEC), subsidence (SUB), and sea-level rise (SLR).

Table 2. Sensitivity analysis of model runs with different input parameters. BCRs are standardized to the model run with RCP4.5–SSP2, discount rate of 5 %, and O&M costs of 1 %. SLR low refers to sea-level rise using the 5th percentile and SLR high to the 95th percentile.

	Eastern Asia and Pacific	Europe and central Asia	Latin America and Caribbean	Middle East and northern Africa	North America	Southern Asia	Sub-Saharan Africa	Global
Reference BCR	23	116	6	34	32	28	8	25
Sensitivity to SSP projection								
SSP1	1.32	1.01	1.17	1.06	0.95	1.51	1.61	1.28
SSP3	0.74	0.82	0.76	0.82	0.87	0.50	0.45	0.70
SSP4	1.11	0.97	0.94	0.88	1.02	0.95	0.47	1.02
SSP5	1.68	0.97	1.44	1.17	1.16	2.00	2.13	1.62
Sensitivity to SLR projection								
SLR low	1.07	1.08	1.17	1.19	1.17	1.02	1.16	1.09
SLR high	0.97	0.65	0.80	0.70	0.86	0.94	0.89	0.89
Sensitivity to discount rate								
r 3 %	1.53	1.06	1.48	1.30	1.35	1.69	1.72	1.51
r 8 %	0.68	0.72	0.62	0.74	0.77	0.54	0.49	0.65
Sensitivity to O&M rate								
O&M 0.1 %	1.16	1.12	1.12	1.08	1.13	1.13	1.14	1.14
O&M 2 %	0.88	0.88	0.86	0.88	0.93	0.88	0.87	0.88

2 Corrected text

Section	Corrected text
3.2	The total share of EAD residing in the top 15 countries is estimated at **86** % in the optimize adaptation objective (USD **280** billion per year globally).
3.3	In the *protection constant* adaptation objective, the benefits outweigh the costs for the majority of the regions (**78** %; **612** of the 784 sub-national regions assessed). In the *absolute-risk-constant* adaptation objective (Fig. 6), … and therefore a lower number of sub-national regions (**71** %; **557**) have a positive BCR, although this is still very high. In the *relative-risk-constant* adaptation objective (Fig. 7), … as is the case for the absolute-risk constant, namely **71** % of the sub-national regions assessed. In the *optimize* adaptation objective (Fig. 8), … In most sub-national regions, the benefits exceed the costs when upgrading protection standards (**78** %). … there is still an increase in relative risk in **36** % of the sub-national regions assessed, under the optimize adaptation objective.
3.4	The total costs exceed USD 1 billion for **10** % of the sub-national regions assessed … (Fig. 9a) and exceeding 90 % of the total costs in **63** % of the sub-national regions. Figure 10 shows the attribution … , accounting for between **26** % (southern Asia) and **86** % (**Latin America and Caribbean**) of the costs of adaptation. … This is especially the case for the **Northern America** and the Pacific and southern Asia regions, with values of **17** % and **12** % respectively. The relative contribution of socioeconomic change is largest in eastern Asia and the Pacific, southern Asia, and sub-Saharan Africa, with values of **34** %, **49** %, and **24** % respectively. Of all drivers, subsidence is the least dominant, with values up to **11** % (eastern Asia and Pacific) and **14** % (**southern Asia**).
3.5	Globally, BCRs range between **6** and **116** for the different model runs (**25** for the reference) … They cause the largest changes in BCR, with standardized values of **0.45** and **2.13** found in southern Asia and sub-Saharan Africa. Differences in SLR input affect the BCR by a factor of up to **0.35** … The O&M costs show BCRs that are more in line with the reference model run, with higher or lower values up to **0.16**.
3.6	Hinkel et al. (2010) attributed adaptation costs … In our results we find values between USD **10.1** billion and **16.5** billion for the European Union for the scenarios RCP4.5 and RCP8.5 respectively. … while our study estimates the global costs of adaptation for the optimize adaptation objective between USD **459** billion and **603** billion for the RCP4.5–SSP2 and RCP8.5–SSP5 respectively. In our study, we found that for the optimize adaptation objective, **78** % of the sub-national regions have a BCR higher than 1, … it amounts to **3.3** % of the global coastline.
4	We find that all four adaptation objectives … with a BCR of **25**, while the protection constant adaptation objective shows the lowest NPV (USD **9.3** trillion), with a BCR of **27** for the RCP4.5–SSP2 scenario. At the regional scale, … This ranges from **78** % for the optimize adaptation objective to **71** % for the absolute-risk-constant adaptation objective. … compared to current values in **36** % of the sub-national regions assessed. We assess the sensitivity … positive BCRs (between **6** and **116** globally) for the optimize adaptation objective. Attributing the total costs for the optimize adaptation objective, … and 90 % of the total costs in **63** % of the sub-national regions.

Data availability. The results of this study for all RCP and SSP combinations for protection standards and change in risk relative to GDP, B : C ratio, and NPV for all four adaptation objectives are available at https://doi.org/10.5281/zenodo.4275517 (Tiggeloven, 2020). Figures of the results of the RCP8.5–SSP5 combination are available in the Supplement.

References

Tiggeloven, T.: Benefit-cost analysis of adaptation objectives to coastal flooding at the global scale (Version 2) [Data set], Zenodo, https://doi.org/10.5281/zenodo.4275517, 2020.