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Global analysis of the uncertainties prevailing in global-scale assessment of coastal flood damage and adaptation costs under 21st century sea-level rise

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Global scale assessment of coastal flood damage and adaptation costs under 21st century sea-level rise are associated with a wide range of uncertainties including those in future projections of socioeconomic development (SSP scenarios), of greenhouse gas emissions (RCP scenarios), and of sea-level rise (SLR). These uncertainties also include structural uncertainties related to the modeling of extreme sea levels, vulnerability functions, and the translation of flooding-induced damage to costs. This raises the following questions: what is the relative importance of each source of uncertainty in the final global-scale results? Which sources of uncertainty need to be considered? What uncertainties are of negligible influence? Hence, getting better insights in the role played by these uncertainties allows to ease their communication and to structure the message on future coastal impacts and induced losses. Using the integrated DIVA Model (see e.g. Hinkel et al., 2014, PNAS), we extensively explore the impact of these uncertainties in a global manner, i.e. by considering a large number (~3,000) of scenario combinations and by analyzing the associated results using a regression-based machine learning technique (i.e. regression decision trees). On this basis, we show the decreasing roles, over time, of the uncertainties in the extremes' modeling together with the increasing roles of SSP and of RCP after 2030 and 2080 for the damage and adaptation costs respectively. This means that mitigation of climate change helps to reduce uncertainty of adaptation costs, and choosing a particular SSP reduces the uncertainty on the expected damages. In addition, the tree structure of the machine learning technique allows an in-depth analysis of the interactions of the different uncertain factors. These results are discussed depending on the SLR data selected for the analysis, i.e. before and after the recently released IPCC SROCC report on September 2019.