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A probabilistic framework for the assessment of climate change-driven coastal erosion risk

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Shoreline recession due to the combined effect of waves, surges, tides and sea level rise (SLR) is increasingly becoming a major threat to beaches, one of the main seaside tourist destinations worldwide. Given such an uncertain future climate and the climate-sensitive nature of many decisions that affect the long term, there is a growing need to shift current approaches towards probabilistic frameworks able to consider uncertainty.
We develop a methodology to assess climate change-driven coastal erosion risk based on the IPCC risk framework (IPCC, 2014), in which risk results from the interplay of hazard, represented by the coastal dynamics, exposure, described by physical and socioeconomic settings, and vulnerability, associated with the susceptibility and adaptive capacity of the system. The methodology consists of a multitiered process in which these components are developed individually but are finally integrated to derive expected losses.
A statistical method to generate beach erosion hazards must take into account that this impact involves two or more random variables (i.e. significant wave height, sea level), and that the erosion process depends on storm duration and antecedent beach conditions, which relies in turn on beach recovery between storms. Multiple simulations of a process-based approach that combine cross section–based equilibrium models and long-shore sinks allow the reconstruction of thousands of potential shoreline evolutions over the 21st century (Toimil et al., 2017).
Exposure is defined by the users' preferences (i.e. when they would rather go to the beach), expressed in terms of effective utilization rates and their purchasing power, as an indicator of how much they value the time for recreation (Toimil et al., 2018). Concerning vulnerability, aspects related to the typology, the quality (i.e. water, sand and services), and the number and distribution of access points and parking facilities are considered (Toimil et al., 2018).
We present a regional approach for the assessment of erosion risks triggered by climate-related extreme events and SLR. The framework is applied regionally over the Asturian coast, a 345 km coastline on the Cantabrian Sea (North of Spain), where the risk of loss of beach recreation as a proxy for tourism is provided in probabilistic terms.

References

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