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Analysis of present and future potential compound flooding risk along the European coast

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The coastal zone is the natural border between the sea and the mainland, and it is constantly under the influence of marine and land-based natural and human-induced pressure. Compound floods are extreme events occurring in coastal areas where the interaction of joint high sea level and large amount of precipitation causes extreme floodings. Typically the risk of flooding in coastal areas is defined analysing either sea level or precipitation driven floodings, however compound floods should be considered to avoid an underestimation of the risk. In the future, the human pressure at the coastal zone is expected to increase, urging for a comprehensive analysis of the compound flooding risk under different climate change scenarios. In this study we introduce the concept of "potential risk" as we investigate how often large amount of precipitation and high sea level may co-occur, and not the effective impact due to the interaction of these two hazards. The effective risk of compound flooding in a specific place depends also on the local orography and on the existing protections. The estimation of the potential risk of compound flooding is useful to individuate places where an effective risk of compound flooding may exist, and where further studies would be useful to get more precise information on the local risk. We estimate the potential risk of compound flooding along the European coastal zone incorporating the ERA-Interim meteorological reanalysis for the past and present state, and the future projections from two RCP scenarios (namely the RCP4.5 and RCP8.5 scenarios) as derived from 8 CMIP5 models of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Sea level data are estimated by forcing the hydrodynamic model Delft3D-Flow with 6-hourly wind and atmospheric pressure fields. Based on sea level (storm surge and astronomical tide) and precipitation joint occurrence analysis, a map of the potential compound flooding risk along the European coast is proposed and critical places with high potential risk are identified. For these critical places, we plan to asses the potential compound flood risk driven by coinciding extreme values of sea level and river discharge. Finally, we analyse the atmospheric large scale processes that lead to compound floods and their variation under future climate change scenarios.