Inland flood risks associated with compound storm tide and precipitation events in the climate change perspective.

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Coastal protection of low-lying near-shore areas often lead to a necessity of an artificial drainage for the hinterland regions. This becomes relevant during heavy rain events and the problem is exacerbated when storm tides are occurring at the same time and the technical drainage capacity is diminished. In this study, we look at the risks of flooding for the Emden water board (Germany), which is located between the Ems river and the North Sea. In a model-based approach, a combination of hydrological model for the hinterlands, hydrodynamic model for the offshore water level conditions and the results from the regional climate models as a consistent driver for the potential inland flooding is used. The focus is on the combination of storm tide and heavy rain events, their impact and potential long-term changes. For historical events, the moderate storm tide series in a combination with the heavy large-scale rain lead to a drainage system overload. The separately occurred extreme storm tides or extreme precipitations posed no particular challenge for the system. The results from two regionalized climate models (MPI-ESM and HadGEM2) and two emission scenarios (RCP2.6 and RCP8.5) were used in the established model framework together with the local mean sea level rise projections to assess the risks of inland flooding under the changing conditions. While for the control period the heavy precipitations were found to be the main cause of moderate system overload, for the end of the 21st century the importance of compound events increased. This reflects both the intensification of heavy rain events and changes in the mean sea level, which lead to increased storm tides.