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Climate change impact on inland flood risks due to compound storm tide and precipitation events for managed low-lying coastal areas.

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Many coastal low-lying areas prone to coastal floods are protected by defense constructions. This often entails the establishing of artificial drainage systems to keep the hinterlands from flooding during heavy rain events. The coincidence of storm tide and heavy precipitation events may considerably limit the technical drainage capacity and lead to flooding. This situation can be exacerbated in the future due to changing conditions of both single drivers as well and their combinations. To assess the risks of inland flooding, a model based approach, combining the results from regional climate models with hydrological model for hinterlands and hydrodynamic model for coastal areas is established and applied. As a focus area, the water board Emden (Germany) and the gauge Knock are selected, which is a low-lying artificially drained area between the Ems river and the North Sea. For historical events, the main drivers leading to diminished drainage capacity and system overload were moderate storm series combined with the large-scale heavy precipitations. Whereas extreme storm tides or heavy precipitations alone posed no significant challenge for the system. The combinations of future emission scenarios (RCP2.6 and RCP8.5) and regionalized climate models (MPI-ESM and HadGEM2) together with local sea level rise projections are used to estimate the system overload and flood risk under the climate change conditions. For control period, the main cause of moderate system overload appears to be heavy precipitations rather than storm tides. For future projections, the importance and intensity of compound events will increase, reflecting changes in mean sea level and thus storm tides as well as intensification of heavy rain events.