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Extreme water levels for the design of dikes in the German North Sea coast

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In this paper investigations on the most adverse superpositions of different processes leading to extreme water levels at the German North Sea coast are presented. Emphasis was given to the combined effects of tides, storm surges, external surges formed in the NE-Atlantic and mean sea level rises. The investigations have been carried out using a nesting sequence of flow models downscaling from the north-western European Continental Shelf to the German Bight. Hind cast simulations of the extreme storm surges in 1967, 1976 and 1999 resulted in good agreement with observations. Isolated simulations of a number of external surges, observed at the German North Sea coast, were realised successfully as well. The results of superimposing the different effects show that sea level rises and external surges with long wave lengths have a stronger impact on nearshore water levels during flood phase and high tide. On the other hand most storm surges are of shorter duration and their effect on the coastal water levels is stronger during low tide. Compared to the observed storm-water levels of the three events the most adverse superpositions of the various effects lead to increases of the water level of up to 2.2m and 1.6m respectively with and without sea level rise. Comparisons of the obtained results with the design water levels adopted for the dikes bordering the Elbe Estuary are presented as well.