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Statistical regionalized storm surge scenarios for the German North Sea coast

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Anthropogenic climate change may alter the wind climate and, thus, the storm surge climate in the North Sea region. To estimate possible dimensions of the wind-induced changes of water level heights, future storm surge conditions have been investigated for the German North Sea coast using a statistical surge model which was forced by winds from the central North Sea. The statistical surge model which is an application of the surge model from van den Brink (Royal Netherlands Meteorological Institute (KNMI)) was fitted to five locations (two at the East Frisian coast, one in the Elbe estuary, and two at the North Frisian coast) using data from a hindcast (HIPOCAS) for 1958-2002. For the analysis of possible future changes at these five locations this model was forced with an ensemble of 17 data sets (wind speed, wind direction and sea level pressure) for 1950-2100. These data sets were obtained from simulations with the global climate model ECHAM5/MPI-OM which was driven by greenhouse gas emissions following the SRES A1b scenario and started with 17 slightly different initial conditions to assess the internal variability (ESSENCE project (KNMI)).
Comparing the 30-year time slices 1951-1980 and 2071-2100, the statistical analysis displays that there is a change in the distribution of the wind direction in central North Sea to more westerly winds. Storm surges at the German Bight coast are caused mainly by strong winds from south-west to north. Thus, the increase in winds from the south-west to west and the decrease of winds from the north-west to north in frequency and intensity are important for these coastal strips; and according to this the frequency of wind surges generally increase. Particularly the low wind surge caused by south-west winds will increase in frequency, while the high wind surge caused by north-west winds will slightly decrease. Because of the specific exposition and topography, the effects of the same wind situation are locally different along the German coast. As a consequence of this the two locations at the East Friesian coast showed smaller changes in the wind-induced sea level heights as the two locations at the North Friesian coast.