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Impact of climate change on wind and storm surge conditions in the outer Elbe estuary (North Sea)

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Long-term changes in storm surge conditions of the North Sea may occur as a possible consequence of anthropogenic climate change and may further endanger human safety and activities. Four transient future climate projections of storm surge conditions in the North Sea for 2001 to 2100 were compared to reference simulations for 1961 to 2000 to estimate possible future wind-induced changes in case of anthropogenic climate change. These climate projections incorporate two different scenarios of future emissions (IPCC A1B and B1) and two initial conditions of the driving climate model. In this study we will present the wind-induced surge changes for the outer Elbe estuary (southeastern North Sea). Special emphasis is given to the dependence of the climate signals to specific wind sectors.
Generally, the time series of severe wind speed and surge (given by the 99.5 percentiles) in the outer Elbe estuary show strong fluctuations on time scales of decades for the four future climate realizations. Superimposed there is a tendency towards an increase of severe surge up to the end of the 21st century which appears to be small compared to the variability between and within the different climate projections. Severe surge occurs for strong winds blowing from westerly sectors. There is a general tendency that stronger winds come more frequent from the westerly sectors. Changes in frequency distributions of wind directions show also decadal variations. In detail, the four future climate realizations show significant differences in magnitude and patterns of the climate change signals. These uncertainties with respect to emission scenarios and models will be discussed for the whole time series as well as for 30-year time slices 1961-1990 and 2071-2100. Restricting to these time slices, the ensemble of future climate projections will be enlarged by previous simulations for the IPCC scenarios A2 and B2 obtained with different global and regional circulation models.