Geophysical Research Abstracts
Vol. 21, EGU2019-13383, 2019
EGU General Assembly 2019

The long-term variability of extreme storm surges in the German Bight during the last Millennium

Andreas Lang

Extreme high sea levels (EHSL) caused by storm surges constitute a severe damage potential for low-lying coastal environments such as the German Bight. High-frequency observations from tide gauges in the region show a marked variability during the last couple of decades, but are not sufficiently long to derive a statistically meaningful relation with modes of climate variability on longer scales. Here we downscale a global 'Last Millennium' simulation using a regionally coupled climate system model to investigate their long-term variability and associated large-scale forcing mechanisms in the climate system over 1000 years.
We find that simulated storm surge statistics compare well with observations from the tide gauge record at Cuxhaven, but show large interannual to centennial variations in the high-impact return water levels which arise independent of preferred systematic oscillations. Moreover, EHSL are to a large extent decoupled from variations of the background sea level (BSL), which exhibits more spectral power at lower frequencies. Large scale circulation regimes associated with periods of high EHSL are similar to those associated with elevated BSL, but the location of the respective centers of action of the governing sea level pressure (SLP) dipole differs. While BSL variations correlate well with the wintertime North Atlantic Oscillation, EHSL variations are rather associated with a dipole between northeastern Scandinavia and the Gulf of Biscay, leading to a stronger local north-westerly wind component in the North Sea. Potential links with solar or volcanic forcing are masked due to the high EHSL variability.
The high, irreducible internal variability stresses the uncertainties related to traditional extreme value estimates based on shorter subsets which fail to account for such long-term variations. Together with the independence from variations of the background state this complicates the estimation of high-impact water levels and may mask a theoretical increase due to a distribution shift with anthropogenic sea level rise. That is, existing estimates of future changes in EHSL may be dominated by natural variability rather than climate change signals, requiring larger ensembles to assess future flood risks.