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Storm surges in Danish waters: tide gauge data as proxy for storm winds

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Storms in the North Sea can cause extremely high water along the Danish coastline leading to flooding and damage. Several sectors of society are interested in understanding the evolution of the occurrence rate of such events, and the historic record for storm surges is used to evaluate climatological rates. In the face of expected future climate change it is of interest to know how to detect that a significant change in storm surge rate has occurred. Tide gauge data are typically used to estimate surge rates. The storm surges occur as a combination of water being pressed against the coastline by the winds, and high tides, and in this work we will try to separate the two factors to see if the surge rate based on gauge data is consistent with surge rates based on gauge data with the tidal component removed. For the period where winds are well observed over Denmark a comparison will be made to evaluate whether extremes in selected directional winds can be detected via gauge data, with a view towards generating a historical surge rate for interior Danish waters, for use in assessment of climate change modelling scenarios. Conventional percentile regression, skewness analysis, and Monte Carlo bootstrapping methods are applied.