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Improved storm surge prediction: Event based comparison of atmospheric forcing data in the North Sea – Baltic Sea transition area

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Extreme storm surges can cause devastating damage to low-lying coastlines. In this context, analyses of historical storm surge events are fundamental in order to identify local-scale, empirical relationships between complex atmospheric weather patterns and the sea level. These relationships provide valuable knowledge for projections of the present and future damage potential of storms and storm surges. In order to obtain improved storm surge predictions, historical events are reconstructed using hydrodynamical storm surge models, for which it is essential to have an accurate driving meteorological forcing. For the recent past, high-quality operational weather forecasts and reanalysis products overlap in time. This allows for an intercomparison of their ability to reproduce the meteorological forcing mechanisms that may lead to storm surges.

The focus of this study is to make recommendations on the use of atmospheric forcing datasets used as input for storm surge modelling of the North Sea – Baltic Sea area. To do so, 10m wind fields produced by the DMI-HIRLAM numerical weather prediction forecast system from the Danish Meteorological Institute are compared with the ERA-Interim based UERRA HARMONIE/V1 regional reanalysis leading up to specific historical storm surge events along Danish coastlines. Three events from the Danish North Sea coast and three events from the Danish Kattegat coasts between the years 2002 and 2013 are assessed. The DMI-HIRLAM model system has undergone stepwise development cycles during this time, while the quality of the UERRA dataset is expected to be more consistent over the study period. Following the analysis, we present recommendations and perspectives for the use of atmospheric forcing data as input for storm surge modelling in the region, based on validation against wind station data.