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Sea level rise in the German Bight as one of the main contributors to changing storm surge statistics

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Sea Level Rise (SLR) is one of the major consequences we are facing in times of a warming climate. Different analyses and recent scientific publications identify mean sea level rise as the main driving factor for increasing storm surge heights over the last century (e.g. Haigh et al., 2008), resulting in a higher risk of inundation for the affected coastal areas. Although storm surge heights in the German North Sea area are expected to increase over the next century due to changes in the wind statistics (Woth et al., 2006), the projected mean sea level rise will remain one of the major contributors. Therefore, regional and global sea level rise are subjects to many ongoing scientific research efforts. Improved estimates of sea level change over the last 165 years in the German Bight are the outcome of the German research project AMSeL. Different methods are used to generate and analyse observed mean sea level time series from tide gauges providing high quality data sets. Parametric fitting approaches as well as non-parametric data adaptive filters, such as Singular System Analysis (SSA) are applied. For padding non-stationary sea level time series, an advanced approach named Monte-Carlo autoregressive padding (MCAP) has been introduced (Wahl et al., 2010). A 'virtual station' is estimated from 15 single stations covering the entire German North Sea coastline. The estimated linear trend (of relative mean sea level) for the entire period is 1.3 $\pm$ 0.15 mm/a, 1.6 $\pm$ 0.2 mm/a from 1901 onwards and 3.4 $\pm$ 1.4 mm/a for the reduced period since 1970 (quoted errors are 2σ-standard errors). Additionally, the reconstructed mean sea level time series for the German Bight shows different patterns of sea level change than global reconstructions, which is not fully understood up to now. Detailed examination of the datum and height changes of respective coastal areas and the gauge sites over time is a crucial part of the overall assessment and a potential source for uncertainties.

In the German Bight, a period of positive acceleration of sea level rise occurred at the end of the 20th century, followed by a period of negative acceleration. Another still ongoing period of positive acceleration started around 1970, leading to high recent and current rates. The latter are in the order of 5 mm/a and slightly higher than those observed around 1900. However, it will be essential to keep in view the sea level observations within the next years, to prove whether a period of negative acceleration will take place again or whether the period, with its start point around 1970 denotes the beginning of an accelerated sea level rise due to anthropogenic impacts.

Furthermore, significant differences exist between the estimated rates of sea level rise for the eastern and the southern part of the German Bight, indicating stronger land subsidence along the eastern part.

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