Regional Sea Level Changes in the German Bight, North Sea, Germany

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Introduction

Regional sea level rise and the associated impacts represent one of the Grand Science Challenges identified by the World Climate Research Programme. To a substantial amount the regional impacts of sea level rise will be experienced by corresponding changes in the extremes. Such changes comprise contributions from relative mean sea level changes, from changes in wave and storm surge climate, tidal dynamics, or from local changes such as caused by coastal engineering.

Mean Sea Level Changes

Over the past about 110 years mean sea levels in the North Sea increased at an average rate of about 1.6 mm/year, broadly consistent with the global estimate (Figure 1). Spatial variability exists with rates being somewhat larger in the eastern part of the German Bight, broadly consistent with patterns of vertical land movements and large scale atmospheric variability. Decadal variability in the rates of sea level rise is partly associated with the nodal tidal cycle and large scale atmospheric changes. Present rates appear to be high but still comparable to those observed earlier during the last century.

Extreme Sea Level Changes

Extreme sea levels have increased over the past about 150 years at a rate comparable to that of global mean sea level rise. The increase can be attributed primarily to mean sea level rise while storm surges and waves show pronounced interdecadal variability but no substantial long-term trend (Figure 2). Here the upper curve broadly represents storm surge variability while the lower curve is a rough proxy for mean sea level changes. Changes in tidal dynamics over some decades of years also had some influence (Figure 3).

Future Developments

While there is relatively high confidence in future changes of global mean sea level, regional mean sea level changes are less certain and less well explored. Future changes in extreme sea levels are highly uncertain, in particular because of the high uncertainty associated with future changes in wind wave and storm surge climate. The latter largely arises from corresponding uncertainties in wave climate change. It has contributions from different sources: different emission scenarios reflecting uncertainty about future socio-economic development, the range of different results produced by different models reflecting our imperfect knowledge, and the range of results obtained from one model using the same emission scenario reflecting natural climate variability (Figure 4).

More information and details in:


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