Regional Mean Sea Level Changes in the German Bight

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The changes of global mean sea level (GMSL) and its possibly accelerating rise is of great interest in both science and public. Since mean sea level changes depend on regional conditions the analysis for the GMSL can only hardly be used for regional purposes but the different regions of the world have to be investigated seperately.

The region of the German Bight, the south eastern bight in the North Sea bounded by the Netherlands, Germany and Denmark is considered in detail here. The changes of the regional mean sea level (RMSL) in the German Bight are analysed by constructing one single time series out of the tide gauge data of 15 locations. The reconstruction is based on an empirical orthogonal function analysis and covers the time span from 1924 to 2008. The trend of the resulting time series is calculated to be 1.7mm/yr for this time period. Decadal trends are analysed over the whole time period and an acceleration is found in the last periods. The longest data available is from the tide gauge of Cuxhaven, which goes back to 1843. This provides the opportunity to also compare the decadal rates of sea level change to periods of the 19th century. The analysis shows that the high trends of the last periods are not extraordinary high, but such high and even higher trends already occurred earlier.

To understand the reasons which cause the changes of the RMSL the influence of different factors potentially driving RMSL changes is analysed. For that purpose a multilinear regression is performed. Different depending variables are tested for the regression in order to find an appropriate model representing the RMSL, finding sea level pressure (SLP) and GMSL to be the best input data. To get the best approximation a leave-one-out cross validation is conducted and the arithmetic mean of the resulting coefficients is taken for the model. From this procedure results a function which describes the RMSL only depending on the SLP and the GMSL. The regression model has a correlation of 0.86 with the time series for the RMSL over the whole time period from 1924 to 2008. Thus the model describes the RMSL very good on an annual scale. However, it is not generally satisfactory on decadal scales.

As the input data is also available for time spans before the year 1924 from observations and after the year 2008 from climate models the regression model result can be extended and thus be used to get estimates for the RMSL as well for the past as for the future.