

Influence of temperature and precipitation on decadal Baltic Sea level variations in the 20th century

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One of the major concerns associated with expected global climate changes are future sea-level variations (IPCC, 2001), since they may have a strong impact on coastal ecosystems and human societies. Future changes of sea-level on a global scale are believed to be brought about mainly by warming, and corresponding expansion, of the water column and, on somewhat longer time scales, by melting of the Greenland ice-sheet. On regional scales other factors may come into play. For instance, changes in the meridional overturning circulation in the North Atlantic can also be relevant in determining future sea-level changes in the North Atlantic basin (Knutti and Stocker, 2000). In coastal seas with complex boundary lines, such as the Baltic Sea, other climatic factors may modulate global sea level rise. Baltic Sea level variations at inter-annual to decadal timescales are generally believed to be caused essentially by variations in wind forcing, in particular (although not exclusive) by the North Atlantic Oscillation, the sea-level pressure sea-saw that pervades the inter-annual climate variability in the North-Atlantic European sector. Therefore, for the particular case of the Baltic Sea, changes in the NAO accompanying increasing concentrations of anthropogenic greenhouse gases may be, at least in the initial decades of global climate change, as important as other factors in determining global sea-level.

However, inter-annual Baltic Sea level variations can be partially, but not totally, explained by the wind forcing linked to the North Atlantic Oscillation and other atmospheric circulation patterns. Using regression analysis linking sea-level variations (as predictand) and sea-level-pressure, precipitation and air-temperature (included stepwise as predictors) it is shown that, in wintertime, precipitation and temperature variations also contribute to explain sea-level variability in the 20th century, in addition to sea-level-pressure. Thereby temperatures and precipitation values higher than normal lead to a positive contribution to sea level anomalies. In summer, only precipitation explains an additional part of the sea-level variability, also in the sense that higher precipitation is linked to higher sea-level anomalies. Together, temperature and precipitation can explain, in addition to the variance explained by sea-level pressure alone, about 15% of the total inter-annual sea-level variability, although for Helsinki in summer this value reaches 35%. Since sea-level-pressure is already correlated with temperature and precipitation, this value represents a lower limit for the influence of these two factors on sea-level.

Key References

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