EGU22-324
https://doi.org/10.5194/egusphere-egu22-324
EGU General Assembly 2022

Different drivers of Sea Level Variability at the North – Baltic Sea transition

David Ek, Lea Poropat, and Céline Heuzé
Department of Earth Sciences, University of Gothenburg, Gothenburg, Sweden

Global mean sea level is rising, however not uniformly. Regional deviations of sea surface height (SSH) are common due to local drivers, including surface winds, ocean density stratifications, vertical land- & crustal movements and more. The contribution of each background driver needs to be better understood to create reliable sea level rise projections, enable effective local policymaking and aid in urban planning decisions.

In this study, we assess region-specific historic sea levels along the western Swedish coastline (Kattegat, Skagerrak & South Baltic Sea).

We use monthly satellite altimetry observations spanning 26 years and daily observations spanning 6 years, as well as in situ tide gauge measurements to identify SSH covariance between sub-regions. We employed a number of manual statistical methods and found that SSH variability in the Skagerrak and Kattegat Seas behaves differently than areas south of the Danish Straits. While typically the correlation between SSH time series from different locations declines with distance, this is not seen at the entrance to the Baltic Sea due to the complexity of the region. To investigate this further and identify underlying primary forcings, we introduced re-analyzed ERA5 estimates of climatic drivers such as 10m-winds, sea surface temperature and sea level pressure, and tested these against principle components of the SSH variability signal within these regions. Zonal winds are most important for determining short-term sea level variability in areas north of the Danish Straits, while neither of these drivers successfully explain observed sea level variability south of them. As freshwater discharge from rivers and tributaries to the Baltic Sea is large, pressure- & density gradients may be more important as SSH regulators in this area.

Additionally, we used neural networks to try to capture non-linear dependencies between the sea level drivers and sea level that are not apparent from statistical analyses. By predicting sea level at selected locations from different combination of drivers, we can determine which drivers have the highest influence. While feedforward neural networks did successfully predict some variability, they prove rather limited as delays between signals are present. Future tests using recurrent neural networks with a long short-term memory architecture might prove more successful.