Poster Presentation

Impact of climate change on wave statistics in the estuary of the river Elbe

Stephan Mai · Hartmut Hein · Ulrich Barjenbruch

Federal Institute of Hydrology, Koblenz, Germany

Keywords Climate change · sea waves · estuary · Elbe · wave statistics · numerical model · SWAN · A1B sceanrio · wave height · wave period

Hydrodynamics in coastal waters and estuaries extend their influence on many ecological and water quality processes. Besides tidal water levels and currents, also sea waves are an essential part of hydrodynamics. Especially waves strongly influence the settlement and remobilisation of sediments over tidal flats as well as the stability of vegetation on forelands. Therefore changes in wave statistics need to be considered for a holistic view of climate change impacts.

The poster presents the application of a statistical approach to derive changes in wave statistics in case of climate change (Mai 2008). The approach links the statistics of water level, wind speed and direction to the statistics of wave parameters, like significant wave height, wave period and wave direction. This statistical transfer uses results of numerical simulations of wave propagation. With the input statistics of water level and wind for the current climate as well as for future climate projections, it is possible to estimate the changes of wave statistics.

This methodology will be exemplified for the estuary of the river Elbe between Cuxhaven and Hamburg. The wave parameters in the river Elbe were calculated as a function of water level and wind employing the numerical model SWAN. The calculations were carried out using a curvilinear computational grid of the topography of the year 2006 with a resolution of approx. 20 m along the river and approx. 2 m across the river (Berkhahn & Mai 2004). The changes in wave statistics were estimated on the basis of the statistics of water level and wind derived from the global climate run A1B MPI-OM, which was regionalised to the North-Sea with the coupled models HAMSOM/Remo (Pohlmann 2006) and to the estuary Elbe with the Model HAMSOM (Hein et al. 2012). For the emission scenario A1B, the changes in the statistics of significant wave height and mean wave period were evaluated for the Elbe between Glückstadt and Hamburg using the climate periods 1971–2000, 2021–2050, 2070–2099. In addition, a continuous analysis of the changes in wave statistics is presented for some focus areas along the river in order to account for multi-decadal fluctuations (Hein et al. 2011).

References

Berkhahn, V., Mai, S. (2004) Meshing Bathymetries for Numerical Wave Modelling. Proc. of the 6th Int. Conf. on Hydroinformatics, Singapore

Hein, H., Mai, S., Barjenbruch, U. (2011) Coastal Long Term Processes, Tidal Characteristics and Climate Change. Proc. of 5th SCACR Conf., Aachen

Hein, H., Mai, S., Barjenbruch, U. (2012) Uncertainties of Drying Periods of Coarse Coastal Climate Impact Models. Proc. of the 2nd IAHR Europe Conf., München

Mai, S. (2008) Statistics of Waves in the Estuaries of the Rivers Ems and Weser – Measurement vs. Numerical Wave Model. Proc. of the 7th COPEDEC Conf., Dubai

Pohlmann, T. (2006) A meso-scale model of the central and southern North Sea: Consequences of an improved resolution. Continental Shelf Res. 26, 2367–2385