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Climate variability, extremes and trends of total sea level variations of the Baltic Sea

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The total sea level change of the Baltic Sea is a combination of wind-driven large volume changes (LVCs), local sea level variations (water level raised by wind and seiche) and wind waves including the sea level change by climatic-driven water density changes and the global sea level rise. The ocean surface velocity is a combination of Ekman surface flow, baroclinic and barotropic flow components and Stokes drift. The first two components can be calculated by standard hydrodynamic 3-dimensional ocean circulation models. But the calculation of the Stokes drift needs an additional approach. The Stokes velocity is a function of the significant wave height and period. It is important for the generation of Langmuir circulation which in turn contributes to the vertical mixing near the ocean surface and to the wind-driven surface transport. We used the Kiel Baltic Sea ice-ocean model (BSIOM) coupled with a simple fully integrated wave model to determine total sea level changes of the entire Baltic Sea for the period 1979-2016. BSIOM has been forced by ERA-Interim reanalysis data (1979-2016). The coupled model system allows the calculation of the total sea level change on a 2.5 km model grid of the entire Baltic Sea as a combination of large volume changes (LVCs), local sea level variations and wind waves including the sea level rise due to climatic-driven water density changes. Thus, combining sea level changes of different time and space scales. Different areas of the Baltic Sea show different trends in significant wave heights over different seasons. During winter, an increase of significant wave height is mainly associated with the retreat of the sea ice cover. There is also an increase of significant wave height of about 5 cm/decade in the eastern Gotland basin during winter. In summer and autumn we found negative trends strongest in the south-western Baltic Sea. Extreme total sea level variations occur if LVCs coincide with local sea level variations and wind waves.