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Downscaling to study wave-current interactions in coastal areas: Unstructured grid model simulations in the North and Baltic Seas during a storm surge event

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Unstructured grid models provide a seamless framework from the global to the coastal scale and thus fully account for the large-scale influence of coastal ocean processes. A two-way coupled model system based on the unstructured grid model SCHISM (Semi-implicit Cross-scale Hydroscience Integrated System Model) and the surface wave model WWM-III (Wind Wave Model) is used to investigate a storm surge event that happened in the North and Baltic Seas in December 2013. SCHISM is an open-source community-supported code based on unstructured triangular grids and is designed for the effective simulation of 3D baroclinic circulation. The model system is forced by data originating from MyOcean products.

The results show that the highest effects of the wave-current interactions can be observed along the Dutch, German and Danish coastline. Strong longshore currents and a pronounced surface elevation setup are generated in the Wadden Sea during the storm surge event due to effects of the waves on the current system. The analysis of numerical simulations demonstrated that the significant wave height in coastal areas is substantially affected by the tidal signal and wave-current interaction.

The validation against observations justifies the superiority of using a coupled model system when investigating geophysical processes in the coastal areas, especially during storm surge events.