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Coastal flooding: coupled model system for the German Bight

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This study addresses the coupling between wind wave and circulation models on the example of the German Bight and its coastal area called the Wadden Sea (the area between the barrier islands and the coast). This topic reflects the increased interests in oceanography to reduce the model errors of state estimates at coastal scales. The uncertainties in most of the presently used models result from the nonlinear feedback between strong tidal currents and wind-waves, which can no longer be ignored, in particular in the coastal zone where its role seems to be dominant. A nested modelling system is used to produce reliable now- and short-term forecasts of ocean state variables, including wind waves, water level, hydro- and sediment dynamics. Here we present analysis of wave and hydrographic observations, as well as the results of numerical simulations. The data base includes ADCP observations and continuous measurements from data stations. The individual and collective role of wind, waves and tidal forcing are quantified. The performance of the coastal modelling system is illustrated for the cases of several extreme events. The role of coupling processes on tides, water level and wind waves in the coastal areas is investigated by performing a series of sensitivity experiments. Effects of ocean waves on sea level variability and coastal circulation are investigated considering wave-dependent stress, wave breaking parameterization during several extreme events. Also the effects which the water level and circulation exert on the wind waves are tested for the coastal areas using different parameterizations. The improved skill resulting from the new developments in the coastal modelling system, in particular during extreme events, justifies further enhancements of the coastal wave and storm-surge predictions.