Changes in wave contribution to total sea-level in response to high-end climate scenarios

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Context and Motivation

Total water level at the coast is made-up of a combination of mean-sea-level, and time-varying effects. As well as decadal scale sea-level rise caused by global warming and thermal expansion, the short-term contributions can also be impacted by climate change. Components of tide, storm surge, and waves all combine to give a total sea-level at the coast.

The RISES-AM project aims to address coastal impacts of climate change for high-end emissions scenarios i.e. where global average warming is projected to exceed 2°C with respect to pre-industrial temperatures. We review physical projections at global and regional scales for surface wave climate by 2100 with RCP4.5 and RCP8.5 scenarios.

Model evaluation

Dynamical downscaling and model nesting. Global model resolution ~ 0.83° High resolution (right) resolution ~ 12km. Downscaling improves coastal geometry and bathymetry resolution, and adds more detailed outputs at the coast. Global model provides incoming swell waves

How will average and extreme waves change around Europe in the coming century?

Future Wave Climate Projections

An ensemble of 7 CMIP5 models is used to drive a global wave model in order to explore potential changes in wave climate around Europe. The historic wave climate is compared with projections from RCP4.5 and RCP8.5 over the 21st Century. The change in both average and extreme wave conditions are considered, with the latter most pertinent to coastal erosion and flood events. In addition a regional atmosphere and regional wave model are used to provide downscaled climate projections for a single CMIP5 model. The EC-Earth model, downscaled through EURO-Cordex is used to force the wave models. The global wave model is forced with 3-hourly winds, and the nested European model is forced with 6-hourly winds, and hourly swell-waves.

Results to be published in UKCP18 and paper with JGR-Oceans

Conclusions

Mean significant wave height projected to decrease in future around North West Europe. However, the extremes are projected to increase at many locations, due to decreasing sea-ice, and changing storm track. The decline in mean wave height is robust, but there is more uncertainty around the change in extreme waves, and a more complex spatial pattern. The downscaled results are supported by the analysis of a multi-model ensemble. Again, the reduction in mean wave height is clear, but changes in extremes are inconclusive. Hazards and impacts of extreme waves can be investigated by looking at projected changes close to the coast, and major cities.

Modelling Future Waves