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Projected Forecast of Hydrodynamic Conditions in the North Sea for the 21st Century

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A projected forecast of hydrodynamic conditions in the North Sea is carried out for the 21st century by means of a numerical simulation. The projection is calculated with the HAMSOM (Hamburg Shelf Ocean Model), a hydrodynamic model based on the finite difference method. The underlying primitive equations of motion are defined in z-coordinates on an Arakawa C-grid. Major stability constraints for surface gravity waves and the heat conduction equation are avoided by the implementation of implicit schemes. The employed turbulence closure scheme can be related to a Mellor-Yamada level 2 type formulation while a higher order scheme is incorporated for the Coriolis rotation in time.

The discretised model domain covers the entire North Sea whereas a quasi-orthogonal spherical grid is used which provides a mesoscale horizontal resolution of about 3x3 km. The maximum depth of 700 m is divided into 30 layers with successively increasing layer thickness. In order to force the model, results from two other models which have already been run for the IPCC scenario A1B are used as open boundary and surface forcing values, respectively. Thereby, results from the global MPI-OM model (Max Planck Institute - Ocean Model) are used at the open lateral boundaries and results from the REMO model (Max Planck Institute - Regional Model) are used for the meteorological forcing. Since these models cover a larger solution domain with a coarser grid resolution, an interpolation procedure is applied to adapt the external forcing data to the HAMSOM grid size. Also the temporal scale is changed from monthly means (MPI-OM) and 1-hourly means (REMO) to 6-hourly means (HAMSOM) by interpolation and extrapolation, respectively. The considered parameters are water temperature, salinity and sea surface elevation at the open lateral boundaries and air temperature, surface pressure, wind speed (direction and magnitude), cloud cover, precipitation and relative humidity at the ocean-atmosphere interface. The HAMSOM computations themselves are carried out with a time step of 5 minutes.

Statistical analysis of the results will reveal correlations between northern hemisphere circulation patterns and the North Sea hydrodynamics. Additionally, the model results will serve as a basis for investigating ecosystems in the North Sea by means of biological and/or chemical models.

The oral presentation introduces the current state of the investigation including available preliminary results. Hydrodynamic conditions calculated by the HAMSOM are exhibited as well as prepared forcing data calculated from the MPI-OM and REMO results.