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A Projected Forecast of Hydrodynamic Conditions in the North Sea Using Bias Corrected Atmospheric Forcing Data

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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 investigation is based on the IPCC (International Panel of Climate Change) scenario A1B (AR4), where a regionalisation of this scenario is realised with the Hamburg Shelf Ocean Model HAMSOM.

In order to force the HAMSOM model, results from two other models which have already been run for the IPCC scenario are used as open boundary condition and surface forcing, respectively. Thereby, results from the global ocean model MPI-OM (Max Planck Institute - Ocean Model) are used at the open lateral boundaries of the North Sea domain and results from the regional atmospheric model REMO (Max Planck Institute - Regional Model) are used for the meteorological forcing at the air-sea interface.

In addition to the scenario period 2001-2100, the control period 1951-2000 is also analysed and used as a reference. To be consistent with the scenario period, the two models MPI-OM and REMO were run in free mode without any data assimilation for the control period, too. In the course of evaluating the REMO data, climatological monthly means of the REMO control run were compared with reanalysis data (NCEP and ERA40). This comparison revealed a model bias inherent in REMO which is composed of a contribution from the REMO model itself but also of an additional contribution from the inner dynamics caused by the free simulation mode. The former contribution can be identified by taking the difference between pure reanalysis data and a REMO run driven with that reanalysis data, where the latter contribution can be identified by taking the difference between a REMO run driven with reanalysis data and a REMO run driven with data coming from a free model run. The ratio of the respective contributions vary for different atmospheric variables but the total bias is indeed strong enough to yield unrealistic values of certain variables.

A bias correction method is introduced and applied for five atmospheric variables used to drive the HAMSOM model (air temperature, total cloud cover, wind speed, relative humidity and precipitation). In the correction method, spatial delta fields are created which reflect the difference between the climatological means of REMO data and of ERA40 reanalysis data for every single variable. These delta fields are imposed on the REMO data either additively or multiplicatively in order to shift the climatological means of REMO towards those of ERA40 but without altering short-term variability and long-term trends of the REMO time series.

The presentation is supposed to show analysed deviations of simulated atmospheric variables created by the REMO model, with respect to observed ones represented by reanalysis data. The bias correction method is described and the results of its application are presented. Furthermore, analysis of hydrodynamic conditions in the North Sea are presented, obtained from preliminary results of HAMSOM simulations driven with both, the corrected and uncorrected forcing data.