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Effect of regional scale model coupling in simulating North Sea under a climate change scenario.

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Modeling climate change related alterations in North Sea is very challenging due to the sharp changes in bottom topography, fresh water influx from the Baltic Sea and water mass intrusions from the North Atlantic. Therefore, finding an ideal model setup which simulates all the above conflicting factors is important and to attain this high resolution regional models are often employed. When run in projection mode for a climate scenario their boundary conditions have to be derived from coupled climate models which normally have coarser resolution. These forcing fields are not necessarily in equilibrium with the regional model set up and could result in model drift. We used the high resolution regional model, HAMburg Shelf Ocean Model (HAMSOM) to study the changes in North Sea under a climate change scenario. Two A1B scenario runs were simulated, one in which the model was forced using the data from a global model (uncoupled) and other in which the ocean model was fully coupled with an atmospheric model (REMO). Comparison between the model simulations reveal that there is a significant influence of coupling in simulating trends in physical parameters like temperature and salinity of the North Sea. The coupled simulation tends to be warmer by about 1˚C by the end of 21^{St} century when compared to the uncoupled simulation. This change is very significant because it is almost half of the projected warming over North Sea by the end of 21^{St} century. The comparison of surface salinity values from both simulations reveal that coupled model tend to be fresher especially in the German Bight and Norwegian coastal current region. This also suggests that there is a significant difference in simulating Baltic outflow/inflow between the two simulations. The variability patterns of SST and SSS as revealed by time evolution are identical in both simulations even with contrasting magnitudes. Independent results from a global model with enhanced resolution over North Sea (including the Baltic Sea) suggest strong freshening of North Sea especially in eastern coasts. The uncoupled regional simulation does not reveal any such freshening, whereas the coupled simulation shows a weak freshening of the coastal North Sea. The changes associated with temperature and salinity could result in significant changes in the stratification and influence ecosystem changes. The study will also focus on disentangling the influence of natural variability and anthropogenic climate change on North Sea.