Ocean feedback mechanism in a coupled atmosphere-ocean model system for the North Sea

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1. Coupled model system

Choosing an interactive coupling between atmosphere and ocean models was widely practiced in regional climate study over the last decades. The added value of the coupling is attributed to providing regional details and incorporating the feedback of the ocean in regional climate downscaling. Such coupled model system serves for a variety of purpose, such as detailed process studies, air-sea interaction studies and long-term simulations. However, the necessity of including the ocean component in the regional climate downscaling is still under evaluation. Here we present a coupled model system applied to the North Sea, comprising a regional ocean model HAMSOM (resolution 3 km), an atmospheric model REMO (resolution 37 km) and the coupler OASIS.

2. Results

The assessment presented in this study focused on the reaction of the ocean component. The uncoupled model experiment used the sea surface temperature (SST) from the global model as boundary input for the atmospheric model. The comparison of SST data revealed that spatial pattern of SST in coupled model simulation showed no major deviation from observations (Figure 1). In the uncoupled model simulation, a drift from observations was found when integrating the model for more than 10 years. This led us to revisit the individual years (1997 and 1999) to look for the mechanism of better performance in coupled model. We found that the cloud cover was responsible for correcting the heat flux errors in the uncoupled run. Therefore, we concluded that the local air sea interaction processes are responsible for damping these errors, in particular at the coastal waters, which leads to a better ocean model results.

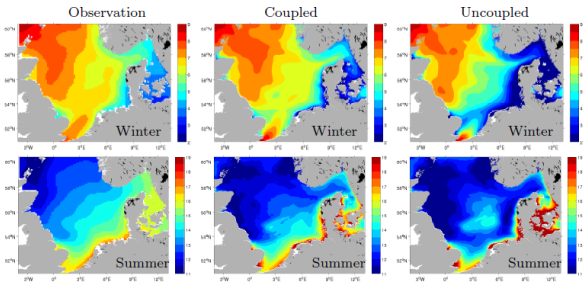

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Figure 1. Fourteen years mean SST (°C) of observations (Janssen et al, 1999, left column), coupled (middle column) and uncoupled (right column) experiments in February and August.

3. Summary

The coupled model simulation shows no major deviation from observations, thus it can serve as a tool for a free climate-model run. In the uncoupled model simulation, we found a drift from observations when integrating the model for more than 10 years. This drift is due to the accumulation of latent heat flux errors. The interactive coupling could damp these errors in a long-term simulation. Finally, it provides a better simulation in the coastal waters.