Introduction, Aim & Methods

Human society faces unprecedented challenges arising from environmental changes (e.g., desertification, Ozone Layer destruction, pollution, air, water, and soil), natural disasters, ... through both natural and human induced processes. Understanding the climate change impact is an essential task before making predictions and providing solutions. The aim of this work embedded in the Bonus INFLOW project is providing an approach of understanding mechanisms of climate change and natural variability of ecosystems by the example of the Baltic Sea. By modelling diverse time slices of the Baltic Sea under different climatic conditions (e.g., Little Ice Age (LIA), Medieval Climate Anomaly (MCA or MoWP), and Modern Warming Period (MoWP)), and combine the results with sedimentological data it is possible to get some answers for the question of natural variability. Here, the emphasis is set to the modelling part of the projects work.

Model Validation & 'delta change'

The most reliable modeled variables are temperature, salinity, oxygen concentration, and phosphate concentration. The model variations of salinity, oxygen, and phosphate are slightly smaller than the observed ones. The modeled variability of temperature is about the same magnitude as the observed variability. The DIN variability is slightly higher in the model than in the observations, but that may be caused by the smaller sample size, especially for the winter values. Furthermore, the analyzed variables of the model and the observations are strongly correlated with a Spearman's rank correlation coefficient. The deviation from the centered root mean square is for all variables but the DIN winter values smaller than one. Finally, the model reflects the most important variables and therefore the general conditions of the Baltic Sea ecosystem in a very good way.

Medieval Climate Anomaly & Little Ice Age

The external forcing affects the complex physical, biological, and geochemical processes as well as the resulting conditions of the Baltic Sea in a significant way (Zillen et al. 2000, 2010). These facts are well reflected by the realized model simulations. Though the models are limited to reflect the reality due to technically and theoretically reduced complexity, the results of the model simulations especially the physical variables are noteworthy reliable.

Conclusions

The adaptations of the external forcing variables affect nearly all processes and conditions of the ecosystem. An important prerequisite to validate the model output for past scenarios is the comparison with proxy data.