Oral Presentation

Process based downscaling of a global climate model into the Elbe estuary

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Continuous long-term simulations of the Elbe estuary are discussed for present-day conditions as well as for future conditions. The simulations are conducted with a limited area model of the Elbe estuary, which is offline nested into a baroclinic circulation model of the North Sea. Both models are forced by a regional climate model (REMO). Discharges are included from improved rainfall-runoff modeling of the catchment area of the Elbe river (Lingemann, 2012). The analysis is concentrated on tidal characteristics (e.g.: tidal high-, low-water and tidal range). Publications (eg. Müller, 2011) show the increase of the tidal constituents at the Elbe river mouth. These changes propagate into the estuary and may cause non-linear changes of the overtides.

Both nested models of the North Sea and Elbe estuary are implemented by the established hydrodynamic model HAMSOM, the applicability of the model for both North Sea and the estuary is shown by validation against tide gauges. The limitation of computer power for such long-term runs allows only relatively coarse topographic representations of the river area (Hein, 2012). However, via some numerical optimizations, the applicability of nested model downscaling technique for long-term regional coastal climate simulation is feasible.

The use of only one (and also uncoupled) member of an ensemble is to understand as one scenario for future changes. Therefore, model experiments for different scenarios of sea level rise are analyzed. Discharge related changes in are discussed in respect to an ensemble of more than 40 members. For future conditions, the results of the process based downscaling technique is compared with stochastic extrapolations. By the circumstance that the results precisely do not contain the comprehensive local anthropogenic changes of the waterway (e.g. shipping proposes) the simulation is to understand as the reproduction of the hydrodynamic inherent changes only. With respect to yet another model experiment the influence of morphologic uncertainties on the tidal characteristics is modeled.

Process based downscaling of a global climate model into an estuary is a quite well functional method to estimate future changes – if an uncertainty analysis of the results is done. Non-stationary and multi-decadal hydrodynamic behavior of an estuary to climate change can be estimated. Future investigation should analyze, both barotropic and baroclinic causes of the variability. An additional critical challenge in supporting adaptation is the linkage between vulnerability research and coastal management decisions.

References

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