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Multiscale Modelling of the Coastal Zone

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Following the demands of the community with respect to a sustainable development of the coastal zone, a multi-scale modeling system will be presented that is highly scalable on parallel platforms. The model system involves a 3rd generation spectral wave model (WWM-III) that is fully coupled to an unstructured 3D baroclinic circulation model (SELFE). Both models employ innovative semi-implicit numerical schemes that allow time steps that are not limited by the usual stability criteria; in the case of WWM-III, time step of the implicit schemes is limited by the physical time scales in the sense of Yanenko (1974). For the sake of efficiency the wave model has alternative implicit and explicit schemes, the latter being more efficient in global scales whereas the former can be used efficiently in any scale, albeit paying the price of losing one order in numerical accuracy. The explicit WWM-III follows the philosophy of WWIII utilitizing higher order schemes in all dimensions.

The coupled model was validated in different environments in the U.S. such as the Chesapeake Bay (Roland et al. 2012), the Gulf of Mexico with the super regional test bed (http://testbed.sura.org/), the Bay of Biscay (Bertin et al. 2012) and laboratory experiments e.g. the HISWA wave tank by Dingemans (1984) and the wave setup experiment by Boers (1996). Both models have demonstrated to be accurate, efficient and robust, and are available for free to the interested scientific community. We present the results of the experiments that have been done so far and discuss future challenges especially with respect to the numerical schemes and the further validation of the coupled system.

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