The added value of high-resolution river runoff forcing for simulating long-term ecosystem dynamics and biogeochemical cycling in northern European shelf seas

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Regional climate change and anthropogenic activities are altering land-based freshwater runoff and nutrient loads to northern European shelf seas, which both leave their imprint on the hydrography and biogeochemistry of coastal ecosystems on annual to multi-decadal timescales. Long-term simulations forced by regional climate models have been proven as powerful tools to identify these impacts on the variability of the North Sea and Baltic Sea ecosystems. However, the simulations are prone to substantial biases concerning the land-sea coupling. Long-term river discharge forcing for regional ocean models usually needs to be compiled from different data sources and climatologies. Typically resulting in patchy, inconsistent datasets. Additionally, the contribution of smaller river catchments and day-to-day discharge variability is not adequately resolved. In this study, we used two novel high-resolution river runoff datasets to simulate 66-years ecosystem hindcasts with the 3D coupled physical-biogeochemical NPZD-model ECOSMO II, to study the role of river discharge forcing for the quality of the ecosystem simulation. The forcing datasets are based on consistent long-term reconstructions of the hydrological discharge model (HD) at 5 min. resolution and the mesoscale hydrological model (mHm) at 0.0625° resolution, both covering the entire northern European catchment region. We compare long-term seasonal and annual statistics of salinity, oxygen, inorganic nitrogen and phosphorus from the model simulations to those from a reference simulation with standard runoff, compiled from various data sources, and to those estimated from observations. Furthermore, potential bottom-up effects on lower-tropic-level dynamics are investigated, by comparatively analyzing long-term variability in phytoplankton biomass and primary production in model simulations forced by different runoff products.