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# Use of ensemble prediction technique to estimate the inherent uncertainty in the simulated chlorophyll-a concentration in coastal ecosystems*

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Phytoplankton blooms in coastal ecosystems such as the Wadden Sea may cause mortality of mussels and other benthic organisms. Furthermore, the algal primary production is the base of the food web and therefore it greatly influences fisheries and aquacultures. Consequently, accurate phytoplankton concentration prediction offers ecosystem and economic benefits. Numerical ecosystem models are powerful tools to compute water quality variables including the phytoplankton concentration. Nevertheless, their accuracy ultimately depends on the uncertainty stemming from the external forcings which further propagates and complicates by the non-linear ecological processes incorporated in the ecological model. The Wadden Sea is a shallow, dynamically varying ecosystem with high turbidity and therefore the uncertainty in the Suspended Particulate Matter (SPM) concentration field greatly influences the prediction of water quality variables. Considering the high level of uncertainty in the modelling process, it is advised that an uncertainty estimate should be provided together with a single-valued deterministic model output. Through the use of an ensemble prediction system in the Dutch coastal waters the uncertainty in the modelled chlorophyll-a concentration has been estimated. The input ensemble is generated from perturbed model process parameters and external forcings through Latin hypercube sampling with dependence (LHSD). The simulation is carried out using the Delft3D Generic Ecological Model (GEM) with the advance algal speciation module-BLOOM which is sufficiently well validated for primary production simulation in the southern North Sea. The output ensemble is post-processed to obtain the uncertainty estimate and the results are validated against in-situ measurements and Remote Sensing (RS) data. The spatial uncertainty of chlorophyll-a concentration was derived using the produced ensemble spread maps.

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