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Calibration of a Forecasting Algae Bloom Operational System in the North Sea: Use of Remote Sensing Images

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The ecological state of the North Sea surface water can be indicated by ocean variables such as the Chlorophyll-a (Chlfa) concentration. Chlfa is the principal photosynthetic pigment and is common to all phytoplankton and can therefore be used as a measure of phytoplankton biomass. The D-Water Quality (GEM) model developed at Deltares is a generic ecological model that simulates transport of substances in a water system along with various ecological processes. This model is able to estimate the Chlfa concentration operationally for the North Sea. Models are always prone to errors due to assumptions made for simplification and the use of numerical approximations. Such errors can be reduced through the use data assimilation and thus can significantly improve the forecast. The use of remote sensing images in improving the forecast is attractive due to its spatial coverage. A sensitivity analysis using the model-independent and computationally inexpensive adaptive Morris method has been carried out to identify the significant parameters. Accordingly, the model has been optimized with respect to the MERIS remote sensing data of Chla by means of the generic simulated annealing algorithm. The algorithm has been redesigned in an innovative parallel framework that optimizes the searching procedure while considerably reducing the number of iterations. The optimization is carried out over the years 2003-2008. From the results we conclude that the optimization has improved the model results to better match the MERIS data at the surface in all regions, and in particular along the Dutch and the English coast. Validation of the optimised model results to independent in situ data indicates global improvements. The model forecasting capability is validated against insitu measurement and presented in this paper.