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Modeling oxygen depletion forced by acetate discharge in the coastal waters of the North Sea

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Consequences of discharge of acetate produced during the production of X-ray contrast agents in the coastal waters of the Norwegian coast of the North Sea were analyzed with a set of mathematical models. The baseline seasonal variability of temperature, salinity, advection and turbulence were calculated with the Finite Volume Community Ocean Model (FVCOM) applied to the Southern coast of Norway. These data were used to force a vertical 2-Dimensional Benthic-Pelagic transport model (2DBP) coupled via Framework for Aquatic Biogeochemical Models (FABM) with a biogeochemical model OxyDep, considering phytoplankton, heterotrophs, nutrient, dissolved organic matter, particulate organic matter, and dissolved oxygen (DO). Acetate was considered as a chemical oxygen depletion substrate leading to the decrease of oxygen concentrations. We simulated seasonal variability at a 10 km long vertical transect with a spatial resolution of 50 m horizontally and approximately 2 m vertically. These calculations reproduced local minimum in the vertical DO distributions in 2 km distance from the discharge point, that corresponded to the observations. We conducted numerical experiments on the effects of doubling of the acetate discharge and on formation of acetate complexes.