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Modeling effect of CO_2 leaks on the biogeochemistry of water column and sediments.

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1D benthic-pelagic coupled biogeochemical model, BROM (Bottom RedOx Model, Yakushev et al., 2017) supplemented by a bubble transport module was used to analyse the results of the 2018 field experiments of bubbling with CO_2 in the Horten Havn (Norway). BROM combines a relatively simple ecosystem model with a detailed biogeochemical model for the water column, benthic boundary layer (BBL), and sediments, with a focus on oxygen and redox state. BROM consists of a 2-dimentional vertical transport module (BROM-transport) and a biogeochemical module (BROM-biogeochemistry) coupled through the Framework for Aquatic Biogeochemistry Model (FABM) BROM considers interconnected transformations of species (N, P, Si, C, O, S, Mn, Fe) and resolves organic matter (OM) in nitrogen currency. OM dynamics include parameterizations of OM production (via photosynthesis and chemosynthesis) and OM decay via oxic mineralization, denitrification, metal reduction, sulfate reduction and methanogenesis, with a decreasing rate of OM decay in this sequence. To provide a detailed representation of changing redox conditions, OM in BROM is mineralized by several different electron acceptors and dissolved oxygen is consumed during both mineralization of OM and oxidation of various reduced compounds. The model allowed to simulate changes in pH and pCO_2 that were measured with sensors. The model is also applied for the North Sea conditions to analyse the potential CCS origin leaks bigeochemical effects using the information of the pockmarks distributions and scenarios of potential leaks.