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Modeling Laptev Sea methane seeps impacts on water column carbonate system

EVGENIY V. YAKUSHEV AND ANFISA BEREZINA

Norwegian Institute for Water Research

Presenting Author: eya@niva.no

Progressive permafrost thawing leads to excessive transport of organic matter from the land and massive bubbling methane (CH_4) release from degrading subsea permafrost in the Arctic shelf. The “extreme” aragonite under-saturation and low pH in the Laptev Sea can be explained by an excessive production of carbon dioxide connected o mineralization of land origin OM or /and oxidation of methane in the areas of intensive seeping.

Here, we analyze consequences of CH_4 oxidation on the carbonate system state in the methane seepage areas. We use biogeochemical model BROM [1] coupled with a vertical 2 Dimensional Benthic-Pelagic Model 2DBP and bubble fate model [2]. BROM is a detailed biogeochemical model for the water column, benthic boundary layer (BBL), and sediments. BROM considers interconnected transformations of species of N, P, Si, C, O, Mn, Fe, S. BROM includes a module describing the carbonate equilibrium allowing to calculate pH and carbonates saturation states, as well as processes of formation and dissolution of carbonates. The model's alkalinity variations take into account changes connected with redox reaction consuming or releasing proton. Methanogenesis and aerobic and anaerobic methane oxidation are also parameterized. The gas bubble fate module parameterizes bubbles rising and dissolution. An application of the model allowed to estimate connection between an intensity of CH_4 release in the area [3] and changes in the carbonate system and to evaluate a volume of water affected. This research was funded by the Research Council of Norway: 315317 BEST-Siberian.

References:

[1] Yakushev E. et al. (2017) Geosci. Model Dev., 10, 453-482

[2] Yakushev E. et al. (2021) Int. Journal of Greenhouse Gas Control. 2021. 111: 103464.

[3] Shakhova N et al . (2015) Phil. Trans. R. Soc. A373: 20140451.