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Modeling Permafrost Observations in the East Siberian Arctic Shelf: Case study - Dmitry Laptev Strait.

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It is well known that the Arctic contains a huge amount of organic carbon buried not only inland but also within the Arctic Ocean (AO) sedimentary basin, the "Arctic carbon super pool". Areas of Arctic shelf and slope, containing a major proportion of the AO organic carbon pool, represent more than 86.5% of the AO sedimentary basin. The East Siberian Arctic Shelf (ESAS), which is a sub-sea continuation of the coastal flat accumulative plain of the Northern Yakutia and Kolima-Indigirka Lowland, flooded by Holocene transgression at 5-10 kYr ago, covers $\tilde{4}$7% of the whole area of the Arctic shelves which is $\tilde{5}$0% of the Arctic Ocean. Sedimentary basins within the ESAS are extremely large and thick, containing a vast natural hydrocarbon pool of free gas, hydrates, and methane-bearing fluids, and are favorable for methane generation. The ESAS sub-sea permafrost stability is a key to whether sequestered ancient methane escapes throughout the seabed to the water column and further to the atmosphere.

Currently, there are very few observational data on the ESAS sub-sea permafrost state and thermal regime. We present a conceptual permafrost dynamics model to explain the observations and to gain insight in the future permafrost evolution within this region. The developed model covers the latest climatic and glacio-eustatic cycle. The permafrost dynamics is computed based on the paleogeographic scenario, a geological model, the initial temperature distribution, and the geothermal heat flux. The computer simulations are performed using a 1-D and 2-D finite element models solving the non-linear heat equation with the phase change. In order to explain the collected observations several keys assumptions are made regarding the surface conditions and in particular the potential thermokarst development. We conducted a sensitivity analysis with respect to soil properties and the timing of the thermokarst development. The modeled results show a good comparison with collected observations. We successfully modeled the temperature and the permafrost thickness in several kerns.