Geophysical Research Abstracts
Vol. 17, EGU2015-5217, 2015
EGU General Assembly 2015

Subsea climate modeling – challenges and first results

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Recent observations indicate that the East Siberian Arctic Shelf (ESAS) releases methane, which stems from shallow hydrate seabed reservoirs. The total amount of carbon within the ESAS is so large that release of only a small fraction, for example via taliks, which are columns of unfrozen sediment within the permafrost, could impact distinctly the global climate. Therefore it is crucial to simulate the future fate of ESAS' subsea permafrost with regard to changing atmospheric and oceanic conditions. However only very few attempts to address the vulnerability of subsea permafrost have been made, instead most studies have focused on the evolution of permafrost since the Late Pleistocene ocean transgression, approximately 14000 years ago.

In contrast to land permafrost modeling, any attempt to model the future fate of subsea permafrost needs to consider several additional factors, in particular the dependence of freezing temperature on water depth and salt content and the differences in ground heat flux depending on the seabed properties. Also the amount of unfrozen water in the sediment needs to be taken into account. Using a system of coupled ocean, atmosphere and permafrost models allows us to capture the complexity of the different parts of the system and evaluate the relative importance of different processes. Here we present the first results of a novel approach by means of a dedicated permafrost model which has been driven by oceanic conditions of the Laptev Sea region in East Siberia.