

Evidence and estimates of significant warming-associated methane release on the East Siberian Arctic shelf

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Arctic Ocean is relatively small, but its methane producing potential is incredibly high due to the presence of permafrost being a huge reservoir of organic matter and trapped methane, both in a free gas form and hydrate form. East Siberian Arctic Shelf (ESAS) is the broadest and shallowest shelf in the World Ocean and is the most strongly impacted by warming. Methane emissions from the ESAS are controlled by the current state of subsea permafrost. The gas release can occur abruptly due to phase transition from frozen state to unfrozen as permafrost degradation occurs, from hydrates to free gas. We analyzed the sonar images recorded in some hot spot ESAS areas (Fig. 1), and found that methane releases occur as flare-like bubble-induced emissions with rates up to dozens or even hundred grams per m² per day, having high spatial and temporal variability. At these locations, estimates of methane flux in water and its atmospheric concentrations are far above the mean values (Fig. 2). As methane pool turnover time in the water column reaches up to 1000 days, over this period the gas is being distributed across huge areas and may be released to the atmosphere far away from its original sources on the ESAS.

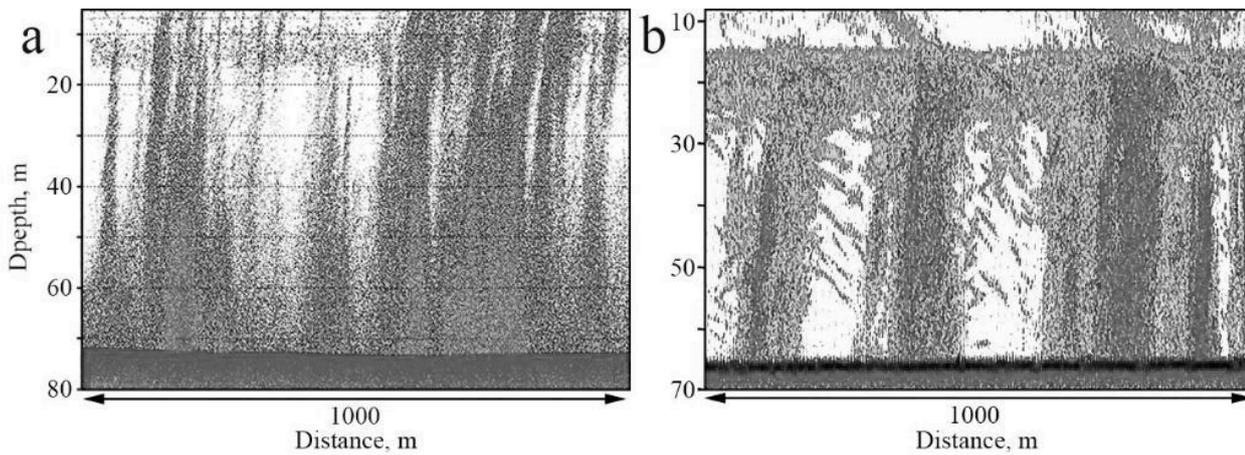


Figure 1. Sonar imagery of the seep fields revealed in the ESAS area, with flux rates as following: 1.6 l/min (a) and 76.2 l/min (b)

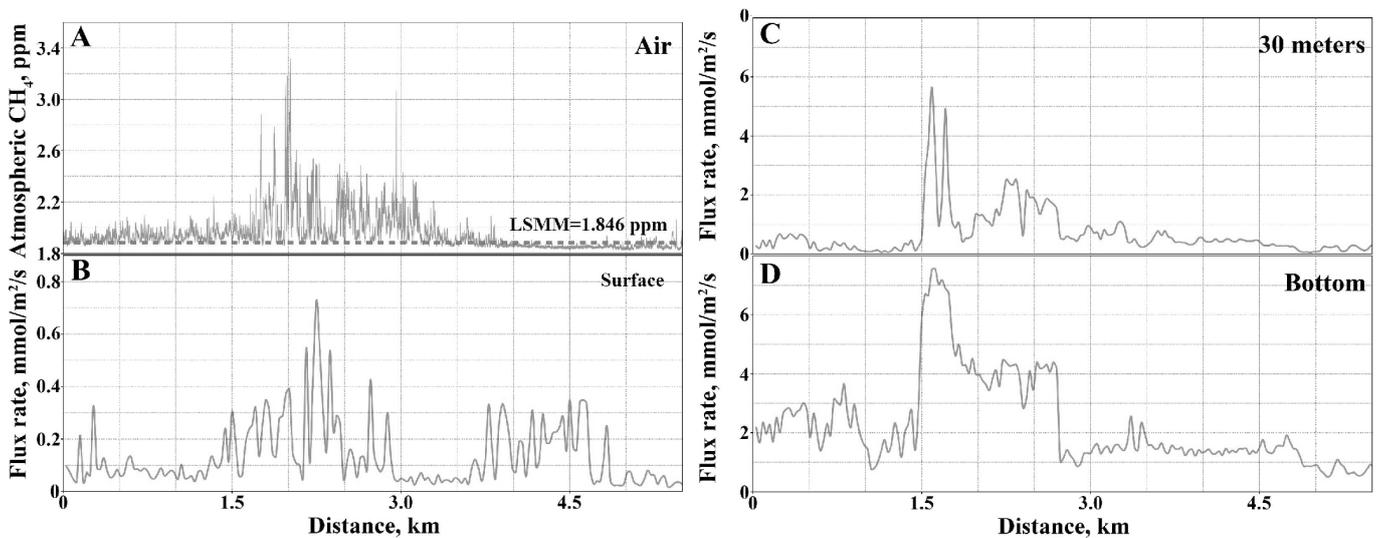


Figure 2. Measured methane concentration in the air (A) and estimated methane fluxes at different depth levels in the underlying seawater (B, C, D) in one of the seep field areas. LSMM in panel A stands for Latitude Specific Monthly Mean (1.85 ppm).

References

Shakhova, N., Semiletov, I., Salyuk A., Yusupov V., Kosmach D, and Ö. Gustafsson, Extensive methane venting to the atmosphere from sediments of the East Siberian Arctic Shelf, *Science*, 327 (5970), 1246-1250, 2010.