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# An atmospheric perspective on the magnitude of and controls on methane emissions from the East Siberian Arctic Shelf to the atmosphere

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In recent years, the East Siberian Arctic Shelf (ESAS) has attracted attention as a potentially large source of methane (CH4) to the atmosphere, both at present and in warmer conditions projected by climate models for the coming decades. Yet, estimates of the current annual CH4 outgassing of the shelf as well as key controls of the emissions are highly uncertain. One reason for the uncertainties is limited data coverage. We estimated CH4 emissions from the ESAS to the atmosphere via atmospheric CH4 observations and a high-resolution regional geostatistical inverse model. For the first time, we made use of CH4 data obtained at a new observation station for atmospheric greenhouse gases, which is located in Ambarchik (Russia, Kolyma river delta). In addition, data from Barrow (Alaska) and Tiksi (Russia, Lena river delta) were used in the optimization. Based on the literature, we developed a set of potentially dominant spatiotemporal CH4 emission patterns. We used them to estimate prior emissions and assess hypotheses on the controls of the emissions. Results indicate that the ESAS CH4 emission budget is on the low end of literature estimates (0.4–1.5 Tg CH4 yr-1 compared to 0–17 Tg; 1 Tg = 1012 g). Retrieved spatial emission patterns indicate emissions originate predominantly from shallow areas of the ESAS. Seasonal variations indicate potentially large emissions during fall, continued emissions during the ice-covered period, and limited emissions during ice melt. This allows some speculation on the underlying emission controls. However, the explanatory power of the retrieved spatiotemporal emission patterns is limited due to limitations of the atmospheric data coverage and the model. Overall, the estimated budget indicates that the relevance of the ESAS for the present global atmospheric CH4 budget is small.