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Assessment of the sources contributing to the observed atmospheric methane over the Arctic region based on the CHIMERE model

Thibaud Thonat, Marielle Saunois, Philippe Bousquet, and Isabelle Pison
LSCE, Gif-sur-Yvette, France (thibaud.thonat@lsce.ipsl.fr)

Understanding the recent evolution of methane emissions in the Arctic is essential to interpret the global methane cycle, considering its uncertainties and the high climate sensitivity of the Arctic region, which can lead to potential feedbacks. A polar version of the CHIMERE chemistry-transport model is used to simulate the evolution of tropospheric methane in the Arctic in 2012, including all known regional anthropogenic and natural sources. CHIMERE simulations are compared to six continuous measurement sites in the Arctic region. In winter, the Arctic is dominated by anthropogenic emissions; emissions from continental seepages and oceans, including from the East Siberian Arctic Shelf, also play a decisive part in more limited parts of the region. In summer, emissions from wetland and freshwater sources dominate over the whole region. The model is globally able to reproduce the seasonality and intensity of methane concentrations measured at the sites. All of them are substantially impacted by all types of Arctic sources, except for biomass burning. This indicates that an appropriate modelling framework combined with methane atmospheric continuous observations enables us to gain knowledge on the regional methane sources. Sensitivity tests are also performed, showing that the choice of wetland and freshwater emission models, and the inclusion of methane sinks, are critical in correctly representing simulated methane concentrations.