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Four field seasons of δ13C methane emission measurements enhancing the automatic chamber monitoring in an Arctic Tundra.

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Methane emissions have been monitored by an automatic chamber method in Zackenberg valley, NE Greenland, since 2006 as a part of Greenland Ecosystem Monitoring (GEM) program. During most of the seasons the measurements were carried out from the time of snow melt (June-July) until freezing of the active layer (October-November). Several years of data, obtained by the same method, instrumentation and at exactly the same site, provided a unique opportunity for the analysis of interannual methane flux patterns and factors affecting their temporal variability. Such analysis (Mastepanov et al., Biogeosciences, 2013) led to hypotheses of different sources for the spring, summer and autumn methane emissions, and multiyear cycles of accumulation and release of these components to the atmosphere.
For the further investigation of these hypotheses it was decided to complement the monitoring system with a methane carbon isotope analyzer (Los Gatos Research, USA). The instrument was brought to the field during 2013 and was more or less successfully operating during four measurement seasons (2013, 2014, 2015 and 2017). Detecting both 12C-CH4 and 13C-CH4 concentrations in real time (0.5 Hz) during automatic chamber closure (15 min), the instrument was providing data for determination of δ13C of the emitting methane.
Despite a large number of technical problems, related to operations of this novel laboratory-oriented instrument in harsh field conditions, and a number of limitations in its application to the existing automatic chamber monitoring routines, the recent data confirms the feasibility of the chosen method for the further understanding of patterns and mechanisms of methane production, storage, transport and oxidation in soils of the high arctic tundra.