



## Natural methane emissions at high latitudes: A study through the MAGIC2021 measurements campaign

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Methane is a potent greenhouse gas that plays a significant role in the global climate system. High latitude methane is a particularly sensitive subject due to the uncertainty in future gas release due to multiple factors such as the thawing of permafrost and the evolution of wetland cover. Thus, these regions have the potential to significantly contribute to global warming. In this study, we present the results of the MAGIC2021 campaign, which was conducted in Lapland around Kiruna, Sweden in August 2021. The campaign included measurements with atmospheric air sampler AirCores on board weather balloons, three research aircraft equipped with in-situ sensors, and ground-based measurements of gas total columns using EM27/SUNs. We focus here on the combined measurements of 0-30 km profiles by AirCore and by ATR42 research aircraft to investigate sources of methane in the region. To this end, we employed back-trajectory Lagrangian models and conducted an in-depth comparison between model (ERA5, CAMS) and campaign data in a multi-species approach combining CH<sub>4</sub>, CO<sub>2</sub> and CO. Our findings provide insight into the sources and transport of methane at high latitudes. They show that in order to properly study local sources of methane, it is mandatory to account for transported methane originating from regions as far as Northern Canada. Our work also highlights the importance of conducting in situ measurement campaigns like MAGIC2021, which provide valuable data for improving our understanding of atmospheric processes at high latitudes and informing the development of more accurate models and validate satellite retrievals. Plans for next campaigns will also be detailed.