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Towards the first circumarctic N2O budget – Extrapolating to the landscape scale

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The Arctic is warming at twice the rate of the rest of the globe. While it has been increasingly highlighted that thawing permafrost accelerates soil organic matter decomposition, research on biogeochemical N cycling is still underrepresented. Arctic nitrous oxide (N_2O) emissions have long been assumed to have a negligible climatic impact but recently increasing evidence has emerged of N_2O hotspots in the Arctic. Even in small amounts, N_2O has the potential to contribute to climate change due to it being nearly 300 times more potent at radiative forcing than CO_2. Therefore, the 'NOCA' project aims to establish the first circumarctic N_2O budget. Following intensive N_2O flux sampling campaigns at primary sites within Northern Russia and soil N_2O concentration measurements from secondary sites across the Arctic, we are now entering the phase of spatial extrapolation. Challenges to overcome are the small-scale heterogeneity of the landscape and incorporating small features that can function as N_2O hotspots. Therefore, as a first step in upscaling the N_2O fluxes, high resolution imagery is needed. We show here novel high-resolution 3D imagery from an unmanned aerial vehicle (UAV), which will be used to upscale N_2O fluxes from plot to landscape scale by linking ground-truth N_2O measurements to vegetation maps. This approach will first be applied to the East cliff of Kurungnakh Island in the Lena River Delta of North Siberia and is based on 2019 sampling campaign data. Kurungnakh Island is characterized by ice- and organic-rich Yedoma permafrost that is thawed by fluvial thermo-erosion forming retrogressive thaw slumps in various stages of activity. Overall, 20 sites were sampled along the cliff and inland, covering the significant topographic and vegetative characteristics of the landscape. The data from this scale will provide the basis for extrapolating, by using a stepwise upscaling approach, to the regional and finally circumarctic scale, allowing a first rough estimate of the current climate impact of N_2O emissions from permafrost affected soils. Available international circumarctic data from this and past projects will be synthesized with an Arctic N_2O database under development for use in future ecosystem and process-based climate model simulations.