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Evaluation of the pan-Arctic ecosystem scale greenhouse gas monitoring network.

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Due to logistical difficulties and winter extreme weather there are strong practical limitations on where and when monitoring sites can be run in the Arctic. Yet understanding the Arctic is essential. It is one of the regions that changes the most due to climate change, and its large stocks of carbon may be released when temperatures increase. To address these limitations this study assessed the current state of the arctic greenhouse gas monitoring networks, with the aim of identifying gaps in data acquisition that limit our ability to constrain Arctic carbon budgets.

We started with creating an inventory of Arctic (for this purpose north of 60•N) ecosystem scale greenhouse gas monitoring sites, with a focus on CO_2 and or CH4. This inventory consists of sites listed as part of major eddy covariance (EC) networks, those reported in personal communication with PI's and through an online query we send around. More than 100 sites where identified. Site activity differs drastically; some have been active for a season while others have been operational for decades. CO_2 fluxes were monitored at all these sites whereas CH4 measurements took only place at approximately one third of the sites, and generally for shorter durations.

Based on multivariate spatiotemporal clustering Arctic ecoregions were computed which served as the basis for a similarity metric of pan Arctic representativeness for these EC sites. Combining the representativeness with data availability yielded maps of spatiotemporal variability in data coverage for the fluxes of CO_2 and CH4. These maps clearly show the gaps in data acquisition both spatially and temporally, with wintertime fluxes and CH4 measurements being clear examples of areas with coverage gaps. Ideal locations for future network extensions have been computed based on representativeness minimization, in regions of interest (e.g. those with large carbon stocks) and in realistic locations (those with some infrastructure available). To validate our results further, a K-nearest-neighbor method was applied to differentiate between regions interpolated by the network and those that are extrapolated