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Large scale, regional, CH4 and net CO_2 fluxes using nested chamber, tower, aircraft flux, remote sensing, and modeling approaches in Arctic Alaska

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The topographic, environmental, biotic, and metabolic heterogeneity of terrestrial ecosystems and landscapes can be large even despite a seemingly homogeneous landscape. The error of estimating and simulating fluxes due to extant heterogeneity is commonly overlooked in regional and global estimates. We evaluate the pattern and controls on spatial heterogeneity on GHG fluxes over varying spatial scales and compare to standard estimates of NEE and other greenhouse gas fluxes. Data from the north slope of Alaska from up to a 16 year flux record from up to 7 permanent towers, over 20 portable tower locations, and hundreds of hours of aircraft fluxes, are used to evaluate the spatial variability of fluxes and to better estimate regional fluxes. Significant heterogeneity of fluxes is identified at varying scales from sub-meter scale to >100km. A careful consideration of the effect that heterogeneity causes when estimating ecosystem fluxes is critical to reliable regional and global estimates. The combination of tower, flux aircraft, remote sensing, and modeling can be used to provide reliable, accurate, regional assessments of $CH_4$and CO_2 fluxes or large areas of heterogeneous landscape.