Poster #1-10

Complexity of CO_2, CH_4 and Energy Exchange Measurements at NGEE Arctic Sites, Alaska

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Two sites with continuous permafrost were established as part of Next-Generation Ecosystem Experiments (NGEE Arctic) to measure ecosystem scale gas exchange via Eddy Covariance (EC): Utqiaġvik (Barrow - US-NGB, Arctic coastal plain polygon tundra) in 2012 and Council (US-NGC), a subarctic lichen rich tussock tundra in 2017. Both sites (also registered AmeriFlux sites) have ongoing CO_2, CH_4, and energy exchange measurements. In order to measure these exchanges we are applying the EC method, a micrometeorological technique. The atmosphere contains turbulent motions of upward and downward moving air that transport trace gases. The EC method provides the measurement of this vertical flux of transported air parcels by correlation of the fluctuations in CO_2 or CH_4 with fluctuations in vertical wind speed. Measurements at US-NGB show a high degree of inter-annual and seasonal variability in meteorology and fluxes. This site encounters a very short complete snow-free season of approximately two months despite a several months long Polar day. Despite being established only July 2017, US-NGC also shows distinctive flux distributions, enabling first impressions of the heterogeneity of this tussock tundra environment. In order to interpret this variability and decipher these diverse fluxes, we apply a variety of models, such as footprint analyses and light response models. In the High Arctic, these data analyses and interpretations come with challenges not experienced in lower latitudes. For example, nighttime definition and data partitioning is critical for accurately estimating respiration rates; however, Arctic sites experience 24 h daylight during summer months (Polar day), making it difficult to partition between day and night. Respiration estimates are required to determine the gross primary productivity of an ecosystem and its ability and efficiency in converting light into photosynthate and thus carbon. Additionally, the quality (UV light) and quantity (longer path length) of light received at high Arctic sites differs significantly from lower latitudes. Furthermore, these sites have several weeks without rising sun over the winter months (Polar night), causing hoar frost to accumulate on transducers and exposed mirrors of EC instruments. The frost creates large gaps in data collection, making year-round measurements in high latitudes challenging; in lower latitudes, the rising sun melts the frost, causing only a few hours of gaps rather than continuous gaps. Continuous CO_2, CH_4, and energy eddy flux measurements at NGEE Arctic sites improves our understanding of these ecosystems, which can be implemented into earth system models and improve the fidelity of model predictions.