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A temporal study of permafrost thaw for a subarctic peatland in northern Sweden

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Peatlands or mires contain about one third of the global terrestrial carbon pool and are located on between 3-6% of the global land area. In boreal and sub-arctic regions peatland cover about 3.5 million km^2 and are underlain with continuous, discontinuous, sporadic and isolated patches of permafrost. In these areas the soil organic carbon (SOC) pools are stable and decomposition is suspended only as long as the soil is frozen or in an anaerobic state. Climate warming is projected to be greater in the high latitudes where most northern peatlands are found. Observed mean annual air temperatures in northern Sweden have increased by 2-3^{o}C since the 1950s. This is causing permafrost thaw and increasing the vulnerability of peatland C, especially in discontinuous and sporadic permafrost area. A growing number of studies have examined the impact of climate-induced thaw and the potential vulnerability of carbon stored in frozen peatlands.

Thawing permafrost leads to changes in the form and function of northern peatlands. This is characterised by the transition of dry palsa mires to wetter peatland pits, depressions and pools. These new hydrological regimes also lead to increased production of methane through subsequent decomposition of plant material. Increases in temperature therefore leads to changes in permafrost distribution, receding palsa areas, geomorphology (thermokarst terrain), hydrology (thus affecting plant community structure, productivity, increased wetter vegetation communities) and C efflux.

An increasing number of studies examining the impact of climate change on peatlands in these regions and measurement of CO_2 and CH_4 fluxes occurs at several discrete peatland sites across the sub-Arctic. However, regional estimations of these fluxes are limited. Geospatial technologies may be used to aid the understanding of the patterns and processes that are occurring in these transition mires over space and time. Several satellite and airborne images have been acquired for Stordalen mire, a palsa peatland in northern Sweden, over a temporal period of 40 years. The imagery database comprises of aerial and satellite imagery from 1970 to 2013. Two studies in the mid-2000s found that the palsa peatland had become wetter in the period from 1970 to 2000. We are continuing this work to see if that trend has continued and to determine if the rate of thaw has increased in the period between 2000 and 2013.