Analysis of the 2018 drought characteristics using tall tower CO2 and CH4 concentration and meteorological measurements at the ICOS Svartberget observation site

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The 2018 summer in Sweden was one of the hottest and driest in the last 100 years and caused an unprecedented amount of wildfires, damaged forests and severe problems in the agricultural sector. The severity of the draught can be visualized using different month by month drought indices such as the Standardised Precipitation Evapotranspiration Index, the SPEI (https://spei.csic.es/map) as shown in Fig 1. The study objective is to investigate the impact of the drought year 2018 on CO2, CH4 and CO concentrations measured at ICOS Sweden sites, and to analyze the implications of these observations for natural and anthropogenic carbon fluxes.

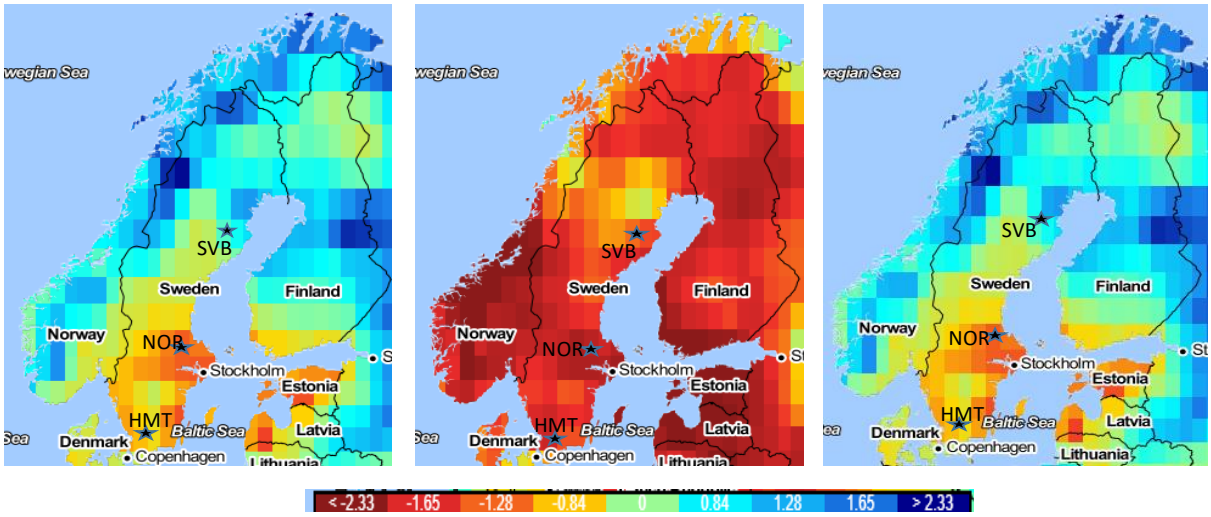

Figure 1: SPEI index for the month of May for 2017, 2018 and 2019 respectively. The stations are marked with a star.

The ICOS (Integrated Carbon Observation System) Sweden network includes three tall tower atmospheric stations at Hyltemossa (HTM), Norunda (NOR) and Svartberget (SVB). Concentration of gases (CO2, CO and CH4) collected from these towers at 150 m height along with meteorological variables such as air temperature, air pressure, relative humidity, wind speed and wind direction for the year 2018 will be used to analyze the drought impact on these greenhouse gases. Similar data for 2017 and 2019 is available for comparing the intensity and characteristics of the 2018 summer drought. The preliminary analysis shows a reduced CO2 seasonal cycle amplitude in 2018, which we relate to a lower ecosystems productivity during the drought period.

The ICOS Carbon Portal also provides an online tool to estimate the footprint areas for a user specified location based on the STILT (Stochastic Time Inverted Lagrangian Transport; Lin et al., 2003) transport model. The tool is capable to calculate the potential contributions of natural fluxes and anthropogenic emissions to the atmospheric CO2 concentrations at any selected ICOS atmospheric station. The footprints can be combined with estimates of a) the net terrestrial CO2 exchange flux from the Vegetation Photosynthesis and Respiration Model (VPRM) to determine the biogenic CO2 contribution and b) anthropogenic emissions from the Emissions Database for Global Atmospheric Research (EDGAR) to determine the anthropogenic CO2 contribution to the simulated CO2 concentration at the stations. This footprint analysis will help to examine the station characteristics under different environmental conditions.