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Investigations on soil organic carbon stocks and active layer thickness in West Greenland

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The soil organic carbon (SOC) pool in the first 300 cm of arctic soils includes about 50 % of the estimated global terrestrial belowground organic carbon, which makes about 1024 Pg C and up to 496 Pg within the upper permafrost one meter. Being a sensible ecosystem, the Arctic is sensitive to climate change. Hence, thawing of permafrost-affected soils to greater depth and for longer periods increases the release of CO_2 and CH4 to the atmosphere, which queries soils as an important carbon pool. Especially in arctic environments, sparse soil data and limited knowledge of soil processes cause underestimation of SOC stocks. Due to different regional climatic conditions, changing soil-environmental conditions result in varying soil organic carbon contents in Greenland. In West Greenland, coastal oceanic conditions turn into continental climate at the ice margin showing less precipitation, higher insolation and increasing permafrost thickness.
The objectives of this study are (i) to determine SOC stocks and active layer thickness (ALT), (ii) to identify main environmental factors influencing SOC stocks and ALT, and (iii) to specify differences of SOC stocks, ALT and influencing factors induced by a climatic trend in West Greenland.
Respecting different climatic conditions, one study area is situated next to the ice margin in the Kangerlussuaq area and the second one is located near Sisimiut at the coast. Both study areas (2 km^2) are representative for each region and have similar environmental settings. Soil samples were taken from depth increments (0-25, 25-50, 50-100, and 100-200 cm) at 80 sampling locations in each study area. Additionally, we addressed soil moisture content (TDR-measurements), ALT, and soil horizons, vegetation (types, coverage), and terrain characteristics (aspect, geomorphology) at each sampling point.
As a preliminary result, at the coast the average SOC stock is 13.1 kg/m^2 in the upper 25 cm and about 35.9 kg/m^2 in the first 200 cm. The amount of SOC stocks is slightly connected to terrain with higher values at depressions and decreasing values upslope. We assume for the Sisimiut area that south (SE, S, SW) facing areas have high SOC stocks due to higher biomass production because of higher insolation. In both study areas, plant growth, aspect, and soil moisture affect the amount of ALT, which is low beneath dense and tall dwarf shrub vegetation on flat plains and depressions having high soil moisture contents. At north facing slopes, absence of direct insolation results in low ALT less than 14 cm at the Kangerlussuaq study area. Soil moisture content, ALT and occurrence of permafrost as well as vegetation type and coverage reflect the climatic trend from the coast to the ice margin in West Greenland.