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Ingeborg Callesen (1), Andreas Brændholt (2), Marion Schrumpf (3), Andreas Magnussen (4), Michel Vorenhout (5), Lars Vesterdal (1), and Klaus Steenberg Larsen (1)

(1) University of Copenhagen, Department of Geosciences and Natural Resource Management, Denmark (ica@ign.ku.dk), (2) Technical University of Denmark, DTU Environment, DK-2800 Lyngby, Denmark, (3) Department Biogeochemical Integration, Max Planck Institute for Biogeochemistry, Jena, Germany, (4) Cperf Aps, DK-2840 Holte, Denmark, (5) Freshwater and Marine Ecology (IBED-FAME), University of Amsterdam, the Netherlands

Within a framework developed from Jenny's (1941) conceptual model of soil formation, soil attributes such as SOC stocks can be empirically modelled based on soil forming factors: climate, organisms, relief, parent material and man. Spatial correlation of SOC stocks at the ICOS site Sorø, Denmark was correlated with important environmental controls (soil water and aeration status). SOC to 40 cm depth was measured in 10 cm segments of ca. 100 soil cores sampled in a grid design (30 x 30 m). The water tables at high and low positions were logged daily, and soil redox potential was measured continuously along three elevation gradients at a soil depth of 20 cm during 2015 – 2017 along with iron rod assays. A visual assessment of drainage class using photos and field descriptions of soil morphology confirmed a diverse drainage pattern from well-drained to very poorly drained soil with a shallow water table depending on the relief (LiDAR based high resolution digital elevation model) and depth to subsoil parent material that consisted of dense calcareous till.

Low-lying, wet areas had strongly reducing conditions with a reduction potential (Eh) of -150 to 50 mV for most of the year, except in late summer, where Eh fluctuated following rain events until permanent water saturation was re-established. In upland areas a winter water table occasionally prevailed around 50 - 70 cm soil depth. These soils did not have an Eh lower than 7-800 mV indicating an aerobic soil environment throughout the year.

The network of ditches indicates that high SOC stocks have accumulated in water saturated conditions, and that these areas today have water tables governed by the ditches promoting surface runoff when surplus precipitation is present.

The SOC stock variability could be explained by the DEM and DEM derivatives including mapping of the presence of ditches that explain the current water regime and soil aeration. A spatial understanding of soil aeration and temperature can guide the design of soil respiration measurements at the stand scale and improve area based upscaling.