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Soil Organic Carbon Stocks in Arctic Deltaic Sediments: Investigations in the Lena River Delta.

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The soil organic carbon stock (S_{SOC}) of deltaic sediments in arctic permafrost regions is known to be significant but is insufficiently investigated so far. Previous S_{SOC} studies were conducted mainly in the comparatively well studied Mackenzie River Delta (area: 13,000 km^2) in Canada. The few studies from other arctic delta regions report only the gravimetric carbon (C) contents and are limited to the active layer depth at the time of sampling.

Since C deposits in permafrost regions are likely to become a future C source, more detailed investigations of the presently frozen likely carbon-rich sediment and soil layers in other arctic delta regions are of importance. Our investigations were performed on Samoylov Island in the southern-central part of the Lena River Delta (32,000 km^2) which is the largest arctic delta and the fifth largest delta worldwide. Samoylov Island is representative for the Lena River Delta's first terrace and the active floodplains.

Within this study a new portable Snow-Ice-Permafrost-Research-Establishment (SIPRE) auger was used during a spring field session to obtain 1 m deep frozen soil cores (n = 37) distributed over all known soil and vegetation units. These cores are analyzed for bulk contents of nitrogen (N) and C, ice content and bulk density (BD) and to determine the S_{SOC} including the rarely investigated currently permanently frozen layers up to 1 m depth on Samoylov Island.

Our study provides evidence for high S_{SOC} for a depth of 1 m for the investigated area ranging between 6 kg m^2 and 54 kg m^2. Considering the spatial extent of different soil units on the two geomorphological units of Samoylov Island, the area-weighted average S_{SOC} were 31 kg m^2 (n = 31) for the first terrace and 15 kg m^2 (n = 6) for the active floodplain. For the correspondent soil units of Turbels and Orthels in circumpolar permafrost regions, Tarnocai *et al.* 2009 reported a mean S_{SOC} of 27 kg m^2 (min: 0.1 kg m^2, max: 126 kg m^2) for a depth of 1 m.

For up-scaling over the soil-covered areas only, we excluded all water bodies from the geomorphological units studied (first river terrace and the active floodplains) and additionally corrected the extent of the first terrace's land area by reducing it by the percentage of small water ponds and cracks detected by high-resolution aerial photography for Samoylov Island. We scaled the area-weighted S_{SOC} averages estimated for the two geomorphological units of Samoylov Island across the corrected total land areas of the Lena River Delta's first terrace (9,400 km^2) and the active floodplains (3,500 km^2) leading to total organic soil carbon storage estimates for a depth of 1 m of 290 Tg C and 50 Tg C, respectively.

References:

Tarnocai, C., Canadell, J.G., Schuur, E.A.G., Kuhry, P. Mazhitova, G. & Zimov, S., 2009. Soil organic carbon pools in the northern circumpolar permafrost region. Global Biogeochemical Cycles 23, GB2023: 11p.