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Exploring the Relation Between Soil Salinity on Soil Organic Carbon Dynamics in Global Terrestrial Ecosystems

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Soil Organic Carbon (SOC) is a fundamental component of terrestrial ecosystems, connected to climate regulation, nutrient cycling, and soil health. The influence of soil salinity - referring to the concentration of soluble salts in the soil solution - on SOC content is acknowledged (1,2), but there is limited understanding regarding the precise direction and extent of SOC's response to varying levels of soil salinity in real field conditions. This study explores the relationship between soil salinity and SOC content, necessary for understanding carbon sequestration processes, climate change mitigation, and terrestrial carbon stock stability. Using the SOC of 60,392 soil samples collected globally since 1950, we developed a statistical model (General Additive Model) and analyzed soil salinity's relation with SOC dynamics while controlling the role of other environmental parameters. According to the results of the statistical analysis, we estimate that an increase in soil salinity from 1 to 5 dS m-1 would be correlated with a decrease in SOC, equivalent to dropping from 0.92 g kg-1 above the mean predicted SOC (31.77 g kg-1) to 6.34 g kg-1 below the mean predicted SOC (-700%), while considering other influencing environmental factors such as precipitation and temperature. Our results show the minor contribution of salinity to SOC while other factors such as climate, vegetation, and land management practices exert more substantial effects on SOC content. Key covariates in relation with SOC include soil nitrogen, anthropogenic phosphorous input, and soil pH. Additionally, our study estimates the effects of one standard deviation increases in soil salinity of the analyzed soil samples on topsoil (0 –20 cm) SOC content, showing a 6.98% decrease in SOC. These findings highlight the importance of considering diverse factors in understanding SOC dynamics, providing insights into mitigating the impacts of soil salinity and climate change on terrestrial ecosystems.

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References

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