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Biotic and abiotic controls on carbon storage in aggregates from grassland soils in the Northern Limestone Alps of Germany

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Alpine and pre-alpine grassland soils in Bavaria provide important ecosystem services and are hotspots for soil organic carbon (SOC) storage. However, information on the underlying factors that control SOC stabilization via soil aggregation is limited. In three grassland soils with the same parent material but at different elevation (Fendt: 600 m.a.s.l, Graswang: 860 m a.s.l and Esterberg: 1,260 m a.s.l), we studied the soil aggregate distribution and associated SOC according to aggregate size classes (large-macroaggregates > 2,000 μm , small-macroaggregates 250-2000 μm , microaggregates 63-250 μm , silt plus clay particles <63 μm). Furthermore, the biomass and abundance of different ecological groups of earthworms were determined. Our results showed an increase in SOC contents and aggregate stability with elevation. SOC and N stocks of bulk soils showed the same trend as OC contents in aggregates. Principal component analysis revealed that carbonates, SOC, aboveground plant biomass and the earthworm biomass are the main facilitating agents of aggregation and SOC and N storage in grassland soils of the Northern Limestone Alps of Germany