Understanding soil organic carbon abundance and persistence at continental to global scales

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It is important to understand not only how much C soils store, but also how long this C persists. Climate change is rapidly altering the C cycle, yet information on the drivers of soil organic carbon (SOC) abundance (C storage) and persistence (retention of stored C) across continental regions and at the global scale is still limited. Previous studies have shown that the amount and age of soil SOC are strongly influenced by the interaction of climate, vegetation, and mineralogy. However, these findings are based primarily on studies from temperate regions and on fine-scale studies. Here, we present insights into SOC cycling across scales, based on a new large-scale radiocarbon and mineral dataset for sub-Saharan Africa (AfSIS), and for the global scale (ISRaD). We show that controls on SOC abundance and persistence differ substantially between major pedo-climatic regions. For example, mineral controls on SOC abundance and persistence are more important in moderately weathered soils in seasonal climate zones than in highly weathered soils in humid climate zones. Soils in arid climate zones store organic C for periods comparable to those in seasonal climate zones, yet overall store less SOC; likely reflecting climatic constraints on weathering, carbon inputs and microbial decomposition. These findings have implications for our understanding of large-scale SOC dynamics in general and for modeling efforts. The unique controls on SOC abundance and persistence in the identified pedo-climatic regions limit the ability to extrapolate outside of these regions and should be used to constrain statistical models for global soil mapping products and for benchmarking global C models.