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ISRad: the International Soil Radiocarbon Database

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Soil organic matter (SOM) is a key ecosystem and societal resource, as it stores large amounts of carbon while regulating soil nutrient availability and water holding capacity. Despite its clear importance, we still have relatively poor ability to understand and forecast SOM dynamics. In particular, we need to understand the timescales associated with different mechanisms of C stabilization and how those can be altered by climate change. Radiocarbon is the most powerful tool we have for assigning timescales to soil C cycling. In open systems like soils, the degree to which radioactive decay of radiocarbon has occurred in SOM reflects the time it has been isolated from exchange with the atmosphere over hundreds to tens of thousands of years. Fractionating SOM with different chemical or physical methods can help link those longer timescales of stabilization to specific mechanisms. The radiocarbon content of microbially respired carbon dioxide can give information on the age of carbon being returned to the atmosphere – a measure of the time it takes for C to transit the soil system. All of these measures can be predicted by global carbon cycle models as well as measured directly, meaning that radiocarbon provides important constraints on our understanding of soil carbon cycling.
For example, a recent comparison of synthesized bulk soil radiocarbon data with model estimates of SOC age (He et al., 2016, Science 353: 1419-1424) indicated that models from the coupled model intercomparison project 5 (CMIP5) overestimated the mean radiocarbon content and thus underestimated the mean age of SOM to a meter depth and demonstrated that this leads to model overestimation of SOC sequestration potential.

Despite the importance of radiocarbon as a constraint for soil C cycling, and recent increases in the number of papers reporting radiocarbon data, efforts to synthesize these data globally have been limited to bulk soil radiocarbon measurements. ISRaD, the International Soil Radiocarbon Database, is intended to be an open source platform for synthesizing the diverse array of soil radiocarbon data available and a destination repository for future radiocarbon analyses. ISRaD is built on previous work by Mathieu et al. (2015, Global Change Biology 21: 4278-4292) and He et al (2016), and adds new information on soil fractions, fluxes, incubations, and interstitial measurements from soil water and gases. Currently, ISRaD includes data compiled from nearly 200 individual studies spanning over 400 locations across the globe. While ISRaD is already a useful tool for compiling and analyzing radiocarbon data from a wide range of sample types and measurement locations, the full potential of this resource will be realized through participation in the continued development and management by the broader scientific community.