Radiocarbon as a tracer of carbon age and transit time in soils

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Radiocarbon is the most powerful tool we have for quantifying timescales of carbon cycling among atmosphere, oceans and land, on timescales from years to decades (bomb ^{14}C) to >60,000 years. Wally Broecker was a pioneer in applying and interpreting radiocarbon in all three reservoirs. The vulnerability of large stores of soil organic carbon to global environmental change remains one of the largest uncertainties in current carbon cycle models.In open systems like soils, a model is required to interpret radiocarbon data quantitatively, especially as bulk samples contain carbon with a wide range of ages. Separating organic matter into fractions with different chemical or physical characteristics links timescales to specific mechanisms of stabilization and information on how ages are distributed around a mean bulk value. Measuring radiocarbon in microbially respired carbon dioxide provides a measure of the age of carbon being returned to the atmosphere –i.e. the time it takes for C to transit the soil system. To date there have been few attempts to synthesize the growing number and kinds of soil radiocarbon data available into a global picture of C dynamics - a challenge originally posed by Wally Broecker as the need of a "Geosecs" for soils. Accomplishing this goal requires not only synthesizing the diverse array of available soil radiocarbon data but also ways to use them to test and improve carbon cycle models. We report on progress in implementing an International Soil Radiocarbon Database (ISRaD; https://international-soil-radiocarbon-database.github.io/ISRaD/) and a framework for model-data comparisons to improve predictions of future soil carbon storage.