# Constructing a Database of Terrestrial Radiocarbon Measurements

***Terrestrial Radiocarbon Database Workshop; Berkeley, California, 20–22 July 2011***

Soils play a large role in the global carbon (C) cycle, but soil C stocks and dynamics remain highly uncertain. Radiocarbon ($^{14}C$) observations provide critical information on the rates of exchange of soil C with the atmosphere and hydrosphere and how those rates vary with edaphic (soil-related) factors and over a range of time scales. For example, the degree to which radio decay has affected $^{14}C$ demonstrates the importance of short-range-order minerals for stabilizing organic C on millennial time scales in some soils. Time series that track the infiltration of "bomb" $^{14}C$ help identify the components of soil C that cycle on decadal to centennial time scales. Radiocarbon signatures in microbial biomass or respiration indicate shifts in substrate use that accompany vegetation, nutrient availability, or temperature change on even shorter time scales. Taken together, such measurements can be used to test and parameterize models of soil C dynamics.

A workshop at the Lawrence Berkeley National Laboratory was held to initiate the construction of a global database of $^{14}C$ measurements in soil and other ecosystem compartments such as litter or respired C. Although a wealth of such observations exist, they are scattered in small data sets held by individual researchers and have not been assembled or used for multisite analysis, global assessments, or model testing. Given the need for global synthesis products to evaluate and develop models of soil C across a range of spatial scales, the goal of the workshop is to assemble data in a common format for analysis and provide a continuing common repository.

Workshop participants defined a set of research questions the database will help answer, including, What is the C sequestration capacity of global soils? Does the age of organic matter vary predictably with depth across soil types? How do human activities modify the dynamics of C in soils, and do responses vary with soil type? How important is soil mineralogy as a control on C cycling over a range of time scales? How well do models represent C cycle processes, and how can they be improved?

Functional goals identified for the database include query capabilities; simple modeling tools to help users interpret $^{14}C$ data and assess errors; and the ability to combine data with gridded global attributes, such as temporally resolved temperature and precipitation, net primary production (NPP), and gross primary production, and a climate-based decomposition index. Near-term synthesis goals include analyzing depth profiles of $^{14}C$ across gradients in ecosystem state factors (climate, organisms, relief, parent material, time, and human influence) and soil orders, mapping surface soil $^{14}C$ values on soil temperature and moisture, and comparing soil C turnover times to NPP and soil C stocks.

Data sets were identified from 18 contributors and six continents, with $^{14}C$ measurements from soils representing nine soil orders, plant, and microbial tissues, and respiration fluxes. This first workshop, however, emphasized only U.S. contributors. Additional observations are sought, especially for other regions and different disturbance, experimental treatment, and land-use regimes, to expand the database and make it available to a wide community of scientists.

To contribute to the Terrestrial Radiocarbon Database, please contact Margaret Torn (mstorn@lbl.gov). The authors thank the National Soil Carbon Network for facilitating this workshop and the upcoming session on this topic at the AGU Fall Meeting.

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