Soil Carbon Measurement by Laser-Induced Breakdown Spectrometry

Autumn S. Wang and C.W. Rice
Kansas State University

Measuring total soil carbon is essential for accurately estimating carbon inventories and changes in different landscapes and ecosystems. Current technologies for measuring soil carbon require extensive time for processing and analysis. Developing more efficient methods of measuring soil carbon is important for developing soil C storage in national inventories and for C offset markets. Laser Induced Breakdown Spectroscopy (LIBS) may provide an efficient means to reduce process and analysis time; however, LIBS needs to be evaluated for field use. It is possible that LIBS analysis may be applied directly from unprocessed soil cores but this application needs to be tested. The recovery of C was evaluated from different added organic or inorganic C materials to soil. For added organic C with total C concentrations ranging from 2 to 15%, the R^2 values ranged from 0.73 to 0.99 in tested soils. For inorganic C with total C concentrations ranging from 2 to 8%, the values were above 0.97 for all tested soils. The LIBS measurement is influenced by a number of soil properties. We tested the relationship between the LIBS C signal and soil water content, particle size distribution, mineralogy, bulk density, plant residue, and inorganic particles. In this paper, we also present results from reconstructed soil cores to develop methodologies for processing variation in soil properties that would normally occur in soil profiles. LIBS is a promising tool in investigating spatial variability of carbon concentrations in soils, which is a key step to a better understanding of carbon cycling in terrestrial ecosystems.