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Soils in our big back yard: characterizing the state, vulnerabilities, and opportunities for detecting changes in soil carbon storage

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A number of diverse approaches and sciences can contribute to a robust understanding of the I. state, II. vulnerabilities, and III. opportunities for soil carbon in context of its potential contributions to the atmospheric C budget. Soil state refers to the current C stock of a given site, region, or ecosystem/landuse type. Soil vulnerabilities refers to the forms and bioreactivity of C stocks, which determine how soil C might respond to climate, disturbance, and landuse perturbations. Opportunities refer to the potential for soils in their current state to increase capacity for and rate of C storage under future conditions, thereby impacting atmospheric C budgets.

In order to capture the state, vulnerability, and opportunities for soil C, a robust C accounting scheme must include at least three science needs: (1) a user-friendly and dynamic database with transparent, shared coding in which data layers of solid, liquid, and gaseous phases share relational metadata and allow for changes over time (2) a framework to characterize the capacity and reactivity of different soil types based on climate, historic, and landscape factors (3) a framework to characterize landuse practices and their impact on physical state, capacity/reactivity, and potential for C change. In order to transfer our science information to practicable implementations for land policies, societal and social needs must also include: (1) metrics for landowners and policy experts to recognize conditions of vulnerability or opportunity (2)communication schemes for accessing salient outcomes of the science. Importantly, there stands an opportunity for contributions of data, model code, and conceptual frameworks in which scientists, educators, and decision-makers can become citizens of a shared, scrutinized database that contributes to a dynamic, improved understanding of our soil system.