**Session Proposal**

# Session Title

The challenge and opportunity for precise assessment and prediction of soil carbon sequestration and storage across spatial and temporal scales

# Session Organizers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | Name | Affiliation | Email |  |
| 1 | Aizhen Liang | Northeast Institute of Geography and Agroecology, CAS | [liangaizhen@iga.ac.cn](mailto:liangaizhen@iga.ac.cn) | Primary contact |
| 2 | Michael Thompson | Iowa State University | [mlthomps@iastate.edu](mailto:mlthomps@iastate.edu) |  |
| 3 | William Horwath | University of California, Davis | [wrhorwath@ucdavis.edu](mailto:wrhorwath@ucdavis.edu) |  |
| 4 | Zhongjun JIA | Northeast Institute of Geography and Agroecology, CAS | [jia@iga.ac.cn](mailto:jia@iga.ac.cn) |  |

# Session Description

This session will provide a platform for critical evaluation of key parameters associated with long-term soil carbon sequestration and short-term carbon storage, both essential to improve soil health, agricultural productivity, and climate resilience. Topics will include but not be limited to:

1. Conceptual differences between sequestration and storage of soil carbon across spatial-temporal scales and soil management that promotes SOC sinks.

(2) Abiotic and biotic drivers of carbon stabilization that are key to both realizing and tempering expectations for carbon sequestration. Examples include (a) the impacts of faunal-mediated physical mixing of decomposing residues and soil minerals on SOC sequestration, (b) the impacts of erosion on organic matter loss under different cropping systems, and the impacts of erosion and crop production on inorganic carbon loss and accumulation.

(3) Identification of key parameters that limit SOC sequestration and storage capacity under different scenarios of management intensity.

(4) Assessment of experimental protocols best suited to measure and improve rate coefficients for soil carbon turnover models, both including inorganic carbon and organic carbon.

(5) Coupling biogeochemical process models with landscape-scale models to improve local and global SOC predictions. Example include (a) integration and optimization of erosion and drainage models with process models like CENTURY, RothC, or DNDC, and (b) using those coupled models to predict watershed-scale carbon dynamics under specific agriculture-climate-geographical conditions.

# Relevance

This session aligns with the congress’s theme by addressing critical challenges in understanding, modeling, and predicting the soil carbon cycle, emphasizing its role in nutrient cycling, biodiversity conservation, ecosystem sustainability and soil health. The session will highlight innovative research and management approaches to characterize and optimize SOC sequestration and storage while addressing nutrient retention and utilization to enhance resilience in the face of environmental change.

# Format

The format of the proposed session will be oral presentations and panel discussions with globally recognized experts in the fields of carbon dynamics and storage. A pre-session survey will be emailed to global experts in this field. The survey will focus on identifying key challenges and knowledge gaps related factors and issues that affect and constrain the soil’s ability to store both inorganic and organic C and explore potential mitigating outcomes to address climate change and manage soil health.

# Proposed Speakers

1. Jonathan Sanderman, Associate Scientist

Woodwell Climate Research Center, USA

Email: [jsanderman@woodwellclimate.org](mailto:jsanderman@woodwellclimate.org)

<http://scholar.google.com.au/citations?user=ZaF_IbQAAAAJ&hl=en>

Dr. Sanderman’s work focuses on the role that soils can play in climate mitigation and sustainable food production. He seeks to understand the processes that add, remove, and transform carbon in soils, ranging from coastal marshes to tropical forests and working farmlands. His research encompasses both place-based, experimental work and large-scale computer modeling.

1. Bradley A Miller, Assoc. **Professor**

[Department of Agronomy](https://www.agron.iastate.edu/people/miller-bradley/), [Geospatial Laboratory for Soil Informatics](https://www.agron.iastate.edu/glsi/), Iowa State University, USA

Email**:** [millerba@iastate.edu](mailto:millerba@iastate.edu)

Website: <https://www.agron.iastate.edu/people/miller-bradley/>

Dr. Bradley Miller leads the Geospatial Laboratory for Soil Informatics, focusing on digital soil mapping and soil geomorphology. Dr. Miller’s research seeks to improve soil maps to enable property owners, farmers, and policymakers to make informed decisions about land use. Soil maps provide insights into soil erosion potential, nutrient levels, and other factors affecting the health of ecosystems. His team uses geographic information systems, remote sensing, and spatial modeling to study and manage soil resources. Recent work includes (1) studies of machine learning methods to predict topsoil thickness and its uncertainty across the state of Iowa, (2) optimizing sampling methods for field-scale soil maps, and state-wide estimates of organic carbon in Iowa soils.

1. Engil **Pereira**, Associate Professor

School of Earth, Environmental, and Marine Sciences

The University of Texas Rio Grande Valley

E-mail: [engil.pereira@utrgv.edu](mailto:engil.pereira@utrgv.edu)

Website: <https://www.soilecologylab.com/research-1>

Dr. Pereia’s work in soil science is broad-ranging and includes studies of long-term impact of different tillage practices on dryland cotton and sorghum grain crops in a semi-arid climate, meta-analysis of carbon sequestration in sandy soils, and studies of the impact of biochar amendments on soil carbon and soil health.

1. Johannes **Lehmann**, Professor

School of Integrative Plant Science, Soil and Crop Sciences Section

Cornell University, 909 Bradfield Hall, USA

E-mail: [cl273@cornell.edu](mailto:cl273@cornell.edu)

Website: <https://lehmannlab.cals.cornell.edu/>

Dr. Lehmann’s research projects include nano-scale observations of soil micro-aggregates and pyrogenic carbon particles and their importance to the global carbon cycle. His group has improved basic understanding of forms and dynamics of organic matter in soil and how that knowledge can inform sustainable soil management. Much of his research has focused on biochar as a long-lived form of carbon removal from the atmosphere. Biochar research includes basic insights into its behavior in soil, effects on plant growth, microbial composition and dynamics, as well as life-cycle assessment of greenhouse gas emissions.

1. **Keith** Paustian**, *Senior Research Scientist***

Colorado State University

Nature Resource Ecology Laboratory

Email: [Keith.Paustian@colostate.edu](mailto:Keith.Paustian@colostate.edu)

Dr. Paustian’s work focuses on terrestrial greenhouse gas cycling in agriculture, forestry and land use change. It encompasses ecosystems modeling using CENTURY and DAYCENT, quantification of greenhouse gas emissions, from agricultural management systems and land use change, construction of decision support systems with intuitive user interfaces and simplified data entry to put complex modeling and GHG assessment tools in the hands of farmers, ranchers, project developers, policy-makers, students and other scientists.

1. **Francesca Cotrufo, Professor**

Colorado State University

Department of Soil and Crop Sciences

E-mail: [francesca.cotrufo@colostate.edu](mailto:francesca.cotrufo@colostate.edu)

Dr. Cotrufo is a soil ecologist and biogeochemist internationally recognized for her work in litter decomposition and soil organic matter dynamics. Her research focuses on understanding the mechanisms and drivers of soil organic matter’s formation and persistence and their response to global environmental changes and disturbances. Her work helps inform climate and land use policy and management, and Cotrufo pursues applied research aimed at proposing soil management practices that regenerate healthy soils and mitigate climate change.

1. Asmeret Asefaw Berhe, Professor

Department of Life & Environmental Sciences

University of California, Merced

Email: [aaberhe@ucmerced.edu](mailto:aaberhe@ucmerced.edu)

Professor Berhe's research is broadly focused on soil science and global change science. The main goal of her research is to understand the effect of changing environmental conditions on vital soil processes, most importantly the cycling and fate of essential elements in the critical zone. She studies the effect of climate changes (specifically rainfall and temperature) on storage and stabilization of soil organic matter and cation nutrient budgets. Other work includes nano-scale biogeochemistry of iron oxides, especially how the size and concentration of oxides in soil control stabilization and destabilization of organic matter.

1. Yongcun Zhao, Professor

Institute of Soil Science, Chinese Academy of Sciences

Email: [yczhao@issas.ac.cn](mailto:yczhao@issas.ac.cn)

Website: <http://english.issas.cas.cn/res/rd/sri/dir/202307/t20230725_333834.html>

Professor Zhao is the director of Soil Resource and Information Research Division of the Institute of Soil Science. His research themes focus on soil carbon sequestration across hierarchical scales by coupling the process and mechanistic models. The major accomplishments have been made on multi-dimensional optimization of soil carbon budget associated with spatial-temporal variability, machine-learning prediction, sampling design strategy, and digital soil mapping. Dr. Zhao identified the economics- and policy-drivers for soil organic carbon accumulation in Chinese cropland, and the key findings are widely adopted by the scientific communities and the relevant stakeholders. Dr. Zhao actively works for numerous professional organizations and scientific journals such as the President of Soil Genetic Classification and Soil Geography Specialty Committee, Soil Science Society of China.