International Decade of Soils Workshop (IDOS)

March 14-16 2016
UCAR Foothills Campus in Boulder, CO
Sponsored by the Carbon Cycle Interagency Working Group

Workshop Organizers

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Goals

- Determine state of science regarding predicting C stocks and fluxes
- Priority list and rationale for inclusion of processes in models
- Rationale and plan for benchmarking models, and identification of data needs and availability

Suggested outcomes

- SOCCR-2 soils subchapter outline
- Position papers in Biogeochemistry
  - relative importance of various factors affecting soil carbon and ability to effectively model the factors
  - what constitutes soil vulnerability and resilience, how quantified, and how might it be manipulated
  - plan for benchmarking models using data resources identified by the group

Scope

We will celebrate the International Year of Soils, and now, the International Decade of Soils, by convening interdisciplinary experts in a workshop to discuss the capacity for resilience and vulnerability of soil carbon in response to global change. We lack a comprehensive understanding of factors influencing resilience and vulnerability, the effects of edaphic factors, and the timeframes over which resilience and vulnerability may be affected. The recent COP21 summit in Paris focuses attention on carbon stabilization, and understanding, predicting, and manipulating soils is one technique in our collective toolbox. In addition, the White House Office of Science and Technology Policy is calling for a new commitment to research and education in food and agriculture from all sectors https://www.whitehouse.gov/blog/2016/01/13/food-and-agriculture-21st-century

These themes will help to inform the Soils chapter in the upcoming second State of the Carbon Cycle Report (SOCCR-2). SOCCR-2 will summarize contemporary understanding of carbon stocks, fluxes, and drivers in North America and will provide input into the next National Climate Assessment. Objectives of SOCCR-2 are to summarize how natural processes and human interactions in North America affect the global carbon cycle, how socio-economic trends affect greenhouse gas concentrations in the atmosphere, and how ecosystems are influenced by and respond to greenhouse gas emissions, management decisions, and concomitant climate effects.

We seek to promote greater understanding and predictive capacity of the critical role of soils in generating feedbacks to climate. Soil carbon cycling is strongly mediated by microbial activity, but microbial processes are difficult to measure *in situ* and are crudely represented in most biogeochemical models. From the perspective of microbes, soil organic matter is simply a substrate to be consumed, but biotic relationships (e.g., competition, mutualism, succession) and abiotic conditions (e.g., temperature, moisture, mineralogy, stoichiometry, spatial accessibility, texture) affect microbial function and carbon dynamics in complex ways, and these other factors are also a priority for improving understanding of soil C cycling. There is a growing set of microbe-enabled models at different scales, but the benefits of different frameworks and levels of biological complexity have not been systematically evaluated—particularly in the context of understanding soil response to environmental change, or in comparison to other important modeling updates such as aggregation or association with soil minerals. In addition, there is no consensus on the types and availability of experimental and observational data that could be used to test any of these models. Further, overarching processes like land-use change and erosion could be much more important in governing the fate of soil C, than properly accounting for microbes or soil minerals.

We have invited researchers with experience in microbial ecology, manipulative experiments, meta-analyses, and modeling related to global change including warming, altered precipitation, substrate supply, and changes in N deposition. We would like to explore how microbial community function and composition, and biotic-abiotic interactions over a range of scales control cycling of carbon and nutrients and ultimately the fate of C in soils. We seek to develop pathways to collate experimental data for comparisons of different configurations of models, and to prioritize testing of different aspects of models. A recent DOE workshop focused on identifying data resources for belowground ecology http://tes.science.energy.gov/workshops/belowground.shtml provides a summary of data resources.

Vulnerability of soils to global change (Theme 1)
1. What is the state of the science regarding measuring and predicting carbon stocks and fluxes?
2. How do we expect soil carbon stocks and fluxes to respond to global change, including warming, N deposition, and land management? What is needed to better predict response to changes in the carbon cycle?
3. How do carbon stocks and fluxes vary across the landscape and what are the causes? How well do models predict these differences?
4. What data is being used to test and benchmark the models?

Factors influencing soil carbon cycling (Theme 2)
1. What is the relative importance of biological, chemical, and physical factors in soil carbon cycling (in terms of stocks/fluxes)?
2. What is the relative importance of small-scale (e.g. organic-mineral associations, microbial physiology) vs large scale (e.g. erosion, land use change) effects on global C stocks and their response to global change?
3. Which processes are implicitly included in existing models and which are excluded?
4. Of processes excluded from models, what should be the priority for inclusion and why? Of processes included in models, are there improvements needed?
5. What data is needed to test and benchmark the models?

Microbes in models (Theme 3)
1. What do we need to know about microbial ecology to represent microbial processes in models? What else is required?
2. How can we test whether including explicit microbes in models provides an improvement in model efficacy?
3. How can we collaborate to develop a benchmarking dataset for testing different structures of microbial models, and for identifying appropriate parameters?

Workshop Agenda:

Monday, March 14

| 8:30 – 9:00 A.M. | Arrival and coffee |
| 9:00 – 9:20 A.M. | Introduction (Melanie Mayes and organizers) |

- Welcome
- Describe goals and workshop agenda
- Questions, feedback, and impressions

9:20-9:35 A.M.   SOCCR-2 Overview (Gyami Shrestha and Nancy Cavallaro)

9:35 – 11:00 A.M.   Pre-workshop homework for the four groups
- Present slides responding to the questions for 10 minutes each, with 10 minutes of questions to each group
- Overarching questions/discussion

11:00 – 11:15 A.M. Break and snacks

11:15 – 12:15 P.M. Plenary session on theme questions and breakout sessions (Kate Lajtha)
- Overview discussion of all three theme questions and relation to homework
    - What are the most important things we want to address here?
    - What outcome(s) would we like to have?

12:15 – 1:30 P.M.   Lunch at cafeteria

1:30 – 3:00 P.M.   Theme Breakout Groups (to be assigned at workshop)
- Discuss motivating questions
    - What is the state of the art?
    - Major knowledge gaps, data gaps, modeling gaps?
    - What are the higher priority issues? What is tractable to address in this workshop?

3:00 – 3:15 P.M.   Break

3:15 – 5:00 P.M.   Reconvene plenary (Julie Jastrow or Gyami Shrestha)
- Each theme presents state of the art, knowledge gaps, and higher priority issues (10 minutes)
- Discussion/questions (10 minutes each theme)

5:00 P.M.   Adjourn

7:00 P.M.   Dinner at local restaurants

Tuesday, March 15

8:30 – 9:00 A.M.   Arrival and coffee

9:00 – 9:45 A.M.   Plenary session (Vanessa Bailey)
- Any announcements

- Recap of higher priority activities for each group
- Reconsiderations? What did you think about last night?
- Questions/open discussion

9:45 – 12:00 P.M.   Theme Breakouts
- Discussion focused on prioritizing topics and planning outcomes
  - What can we contribute?
    - Position paper
    - Other product (plan for benchmarking activity?)
    - SOCCR-2
  - Outline goal and activity

   10:00 – 10:15 A.M.   Break

12:00 – 1:30 P.M.   Lunch at cafeteria

1:30 – 2:30 P.M.   Plenary discussion (Rose Abramoff)
- Each theme presents prioritized items and proposed outcomes (10 minutes)
- Discussion/questions (10 minutes each theme)

2:30 – 5:00 P.M.   Theme breakouts
- Writing sessions
  - Outline the outcome – overarching goals, major resources needed and available, sticking points, timeframe

   3:15 – 3:30 P.M.   Break

5:00 P.M.   Adjourn

7:00 P.M.   Dinner at local restaurants

Wednesday, March 16

8:30 – 9:00 A.M.   Arrival and coffee

9:00 – 10:30 A.M.   Morning plenary session (20 minutes each group, plus questions) (Melanie Mayes)
1. Wrap-up discussion from each group -- What has been accomplished? What is most important? What is still missing?

2. Paths forward

10:30 – 10:45 A.M.   Break

10:45 – 11:45 A.M.   Themes reorganize and make plans and timeframes for finishing project
- BEFORE you leave the workshop, each theme please send to the organizers
  - WHAT are you going to do?
  - By WHEN?
  - WHO is involved and WHAT is their role?

11:45 – 12:00 P.M.   Close and thank you