Mini-symposium and short training course on

New Advances in Land Carbon Cycle Modeling

Who should attend?
Modelers who want to gain simplicity in coding, diagnostic capability, and computational efficiency for your carbon cycle models
Students, post-docs and young scientists who want to learn carbon cycle modeling with CLM

What are you going to learn?
New theory on land carbon storage dynamics
Matrix representations of land carbon, nitrogen, and phosphorus cycles
A unified diagnostic system for full understanding of uncertainty sources
Carbon cycle data assimilation system for both flux- and pool-based data
Semi-analytic spin-up for computational efficiency

Who are going to teach?
Anders Ahlström, Stanford University, USA
Yizhao Chen, NFU, China
Philippe Ciais, LSCE, France
Zhenggang Du, Northern Arizona University, USA
Yuanyuan Huang, LSCE, France
Debbie Huntzinger, Northern Arizona University, USA
Lifen Jiang, Northern Arizona University, USA
Charlie Koven, Lawrence Berkeley National Laboratory, USA
David Lawrence, National Center for Atmosphere Research, USA
Hank Leoscher, NEON, USA
Chris Lu, Northern Arizona University, USA
Yiqi Luo, Northern Arizona University, USA
Markus Müller, MPI-BGC, Germany
Kiona Ogle, Northern Arizona University, USA
Jim Randerson, UC Irvine, USA
Zheng Shi, University of Oklahoma, USA
Carlos Sierra, MPI-BGC, Germany
Yingping Wang, CSIRO, Australia
Jianyang Xia, ECNU, China
Sha Zhou, Columbia University, USA

Where and When?
Northern Arizona University, Flagstaff, AZ 86011, USA
May 19-26, 2018. Arriving on May 19 and leaving on May 27. Classes on May 20-26 except May 23 for hiking

What funs may you have?
Hiking in Grand Canyon; Mixing with top scientists in the field; Networking with fellow attendees

What is the cost?
Self-paid traveling and lodging plus registration fee of $100 for the mini-symposium and $750 for both symposium and training course.
Fee will cover coffee, lunch, local transportation, rental of meeting rooms, and others.

How to apply?
Send your application, using form from http://www2.nau.edu/luo-lab/?workshop, to Dr. Lifen Jiang, Lifen.Jiang@nau.edu, by February 1, 2018.
We will select up to 30 applicants by February 15, 2018 to attend the training course.

Tentative schedule
Starting Day 2, participants will use either your own models or demo version of CLM4.5 for training on matrix approach.

Day 1: Mini-symposium
  Carbon cycle research
    Philippe Ciais: Progress and challenges in carbon cycle research
    Yiqi Luo: Theoretical foundation of carbon cycle in terrestrial ecosystems
  Model development
    Charlie Koven: CLM and ELM development
    Yingping Wang: Coupled carbon-nitrogen-phosphorus models
    Yuanyuan Huang: Matrix solution to carbon cycle in CLM

Model Intercomparison projects (MIPs)
  Jim Randerson: C4MIP
  Deb Huntzinger: MsTMIP
  Carlos Sierra: Time scales and system-level diagnostics of the carbon cycle
  Zhenggang Du: Traceability analysis of coupled carbon and nitrogen models
  Sha Zhou: Post-MIPs analysis to identify sources of uncertainty

Data assimilation and ecological forecasting
  Hank Leoscher: Imperatives and Challenges in ecological forecasting
  Kiona Ogle: Bayesian analysis of data and models
  Zheng Shi: Data assimilation with matrix models to improve forecasting
  Yizhao Chen: Super ensembles of multiple matrix models to improve land carbon cycle predictions

Day 2: Learning basic concepts and structures of carbon models, including carbon flow diagrams and carbon balance equations of your models
  Introduction of carbon cycle models
    Dave Lawrence: Recent development of CLM5.0
    Participants make presentation to induce their own models
  Examples of carbon flow diagrams and balance equations
    Yuanyuan Huang: Carbon balance equation of ORCHIDEE
    Charlie Koven: Carbon and nitrogen balance equations in CLM4.5
    Yingping Wang: Carbon, nitrogen, and phosphorus balance equations in CABLE
    Anders Ahlström: Carbon cycle equations in LPJ-GUESS
  Carbon balance equations in participants’ models (by working groups, each having 5 trainees plus one instructor, up to 6 groups):
    A table is distributed to trainees for developing carbon transfer pathways
    Participants extract the carbon balance equations of their own models

  Participant presentation
    Carbon balance equations in participant’s models

Day 3: Re-organization of the carbon balance equations into one matrix equation and coding the matrix equations
  Re-organizing the carbon balance equations into a matrix equation
    Yuanyuan Huang: Example from ORCHIDEE
    Zhenggang Du: Example from CLM carbon-nitrogen coupling
Participants: To create a matrix equation each for their models
Carlos Sierra: Compartmental systems and general properties of matrix equations
Participants: Present their matrix equations

Programming of matrix equations (by working groups)
1. A standard coding procedure is distributed to attendees
2. General instruction of coding matrix equation

Day 3 Evening: Markus Müller: demo of biogeochemistry model database (BGC-MD), and the CompartmentalModels python packages

Day 4: Hiking

Day 5: Review on matrix representation of carbon cycle models and introduction of a diagnostic system
Review
Participants: present their carbon balance equations, matrix equations, and coding
General discussion

The unified diagnostic system (more technical)
Yiqi Luo: The 1-3-5 scheme for uncertainty analysis
Jianyang Xia: Traceability analysis
Sha Zhou: Three techniques for post-MIPs uncertainty analysis
Yuanyuan Huang: Uncertainty analysis with matrix equations of CLM, ORCHIDEE, and LM3V

Day 6: Uncertainty analysis
Development of diagnostic capability (by working groups)
Participants: adding diagnostic variables in their models
Participants: adding a module for semi-analytic spin-up in their models
Participants: running the models at the same single site

Uncertainty analysis
Participants: generating models output of diagnostic variables for uncertainty analysis with the 1-3-5 scheme

Brainstorm on possible products
Comparison of spin-up among models?
Traceability analysis?
Other ideas?

Day 7: Discussing the new modeling activities with the matrix approach
Workshop products
Participant: Presenting implementation of matrix approach to attendees’ models
Technical challenges in implementing the matrix approach
General discussion

Other applications
Yuanyuan Huang: Parameter sensitivity analysis with ORCHIDEE
Lifen Jiang: Traceability analysis of carbon cycle at Duke and Harvard forests
Zheng Shi, Carbon cycle data assimilation system
Anders Ahlström: Attribution analysis with matrix model
Publications
Lead authors, topics, and timelines.

Adjourn

Readings

New theory

Matrix representation of carbon and nitrogen cycle models

Traceability analysis

Spin-up

Data assimilation