Regional and Global Climate Modeling

Strategic Goal
To enhance a predictive understanding of climate variability and change by analyzing global and regional models in conjunction with observations.

Approx. Funding Distribution

- Univ Effort, 40%
- Lab Effort, 60%

5 Science Focus Areas

- Biogeochemical Cycle
- Clouds & Climate Variability and Change
- High Latitude
- Water Cycle
- Extremes

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RGCM Overview

Analysis to enhance understanding of predictability at regional and global scales

- Climate Variability & Change
- Cloud Processes
- High Latitude Feedbacks
- Water Cycle
- Extremes
- Analysis of BGC feedbacks

Cross-cutting Foundational and Enabling Capabilities

Foundational Capabilities
Regional and Global Climate Modeling

Analysis to enhance understanding of predictability at regional and global scales

- Climate Variability & Change
- Cloud Processes
- High Latitude Feedbacks
- Water Cycle
- Extremes
- Analysis of BGC feedbacks

- Metrics to evaluate models
- Test beds
- Diagnostic Tools
- Uncertainty Characterization
- MIPs
- D&A
- Extreme Events & Tipping Points
- Climate Feedbacks and Process interactions
- Regional Modeling
- Hierarchy of Models

Model Development
Observations & Process Knowledge
Research Goals:

- Identify and quantify **feedbacks** between biogeochemical cycles and the climate system.
- Quantify and **reduce the uncertainties** in ESMs associated with these feedbacks.

Research Objectives:

1. Develop new **hypothesis-driven approaches for evaluating ESM processes using observations and models** at site, regional, and global scales.
2. Investigate the degree to which contemporary **observations can reduce uncertainties**, using an “emergent constraint” approach.
3. **Evaluate the performance of biogeochemical processes and feedbacks** in Coupled Model Intercomparison Project (CMIP) ESMs, CESM, and ACME models.
4. Create an **Open Source benchmarking software system** that leverages lab, field, and remote sensing data sets.

International Land Model Benchmarking (ILAMB)

ILAMB Goals: Develop internationally accepted Benchmarks for model performance, advocate design of open-source software system, and strengthen linkages between experimental, monitoring, remote sensing, and climate modeling communities

- DOE’s Biogeochemistry–Climate Feedbacks Scientific Focus Area (SFA) has developed a free, open source analysis and diagnostics package that assesses 24 variables from ~45 datasets using a wide variety of metrics.
- Version 2 (in python) will improve modularity and extensibility, and will be released at the next ILAMB Workshop in May 2016.
ILAMBL 2016 Workshop in Washington (May 16–18, 2016)
Jointly led by ESM and RGCM

• 60+ participants – including international -11 modeling centers represented -many research labs & universities.

• Agenda will focus on benchmarking tools, new model evaluation metrics, and next generation modeling/benchmarking challenges & priorities.

• Extensive tutorial sessions for the ILAMB package over two days with hands-on training.

• Breakout groups on MIPs, process-specific experiments, extreme event metrics, design of perturbation experiments, high latitude and tropical systems, and remote sensing.

• Participants asked to identify observational data needs and gaps in data availability.

• Special plenary session on uncertainty quantification (UQ) methods and tools.

• Engaging the community in the workshop report.
Future Directions for the BGC Feedbacks SFA

- Ocean biogeochemistry benchmarking
- Data assimilation for determining the contemporary carbon state and improving model process representation
- Small but frequent workshops focused on mechanisms/processes, phenomena, and perturbation experiments
- New studies on deforestation, drought, mortality, and CO₂ enrichment
- New metrics for coastal/estuarine processes, riverine nutrients, bi-directional canopy and marine ecosystem fluxes
- Open Model Benchmarking Architecture (OpenMBA) software infrastructure
- Integration with uncertainty quantification (UQ) packages and offline transport models
- Design simulation protocol for future MIPs in CMIP7, conduct model experiments, and evaluate ecosystem responses and feedbacks to Earth’s climate system
Community Engagement for ILAMB

- Software engineering is co-led by ORNL, UCI, and LBNL, and the CESM and ACME Land Model Working Groups.
- Will be incorporated into PCMDI Metrics Package and the WGNE/WGCM Climate Model Metrics Panel.
- Expect it will be adopted by various model–data intercomparison studies and used for CMIP6 analysis including C4MIP.
  - Connections with modeling centers, measurement activities, and MIPs, including GEWEX, iLEAPs, MAREMIP, MsTMIP, TRENDY/RECCAP/GCP, GSWP3, and future FACE-MIP and LBA-DMIP.
  - Looking for community participation in the regular telecons and in the development phase of the activity. [Contact: Forrest Hoffman, Bill Riley, Jim Randerson]
  - Will be convening community workshops to offer training sessions on using the benchmarking system, starting in May 2016.
Current Participants:
Forrest Hoffman, Bill Riley, Jim Randerson, Gretchen Keppel-Aleks, David Lawrence, Charlie Koven, Jiafu Mao, Sean Swenson, Mingquan Mu, Nate Collier, Keith Moore, Umakant Mishra, Scott Elliott, Jinyun Tang, Xiaojuan Yang (and others)

Friends of ILAMB:
[Your Name Here!]