DOE Climate and Earth System Modeling Portfolio Priorities

Gary Geernaert
Division Director
Climate and Environmental Sciences Division
Biological and Environmental Research

January 31, 2012
CESM Advisory Board Meeting
Why DOE?
The Energy-Climate Nexus

Greenhouse gases are emitted during energy production... and climate change will impact energy production

DOE seeks to:

• Understand the effects of GHG emissions on Earth’s climate and the biosphere

• Provide world-leading capabilities in climate modeling and process research on clouds and aerosols, and the carbon cycle

• Provide unique, world-leading capabilities in cloud and aerosol observations and large scale ecological experiments

• Build foundational science to support effective energy and environmental decision making
Green Ocean Amazon (GOAmazon) 2014

- Study **interactions of the tropical rain forest and cloud systems**: role of biogenic aerosols, surface fluxes as well as impact of pollution on cloud system developments

- Deployment of the ARM Mobile Facility and G1 aircraft to Manaus, Brazil in 2014

- **All CESD programs are collaborating** to leverage this investment and improve the representation of these processes in Earth system models

- International coordination (e.g., Brazilian scientists and research institutions). Opportunities for U.S. scientists and other Federal agencies to collaborate.
Next Generation Ecosystem Experiment

- **Goal:** Develop Earth System Model simulation of Arctic Ecosystem evolution under climate change by developing a process-rich ecosystem model, from bedrock to the top of the vegetative canopy, at the scale of an Earth System Model (ESM) grid cell (e.g. 30x30 km grid size)

- **Approach**
  - Collaborative effort among DOE National Laboratories and universities, with opportunity for leveraging through external collaboration with other agencies
  - Interdisciplinary, multi-scale approach to advance predictive understanding through coupled modeling and process research
A new DOE climate research strategy

- Why now
- Inputs
- Philosophy
- Vision/Mission
- New strategic goals
• Why now?
  – Public, congressional interest
    • Efficient, effective, meaningful science; uniqueness
    • Of value to society: high resolution, certainty, role in climate sensitive decisions
  – Stakeholders desire for involvement:
    • model resolutions and certainties of future climate

• New strategic plans of relevance
  – DOE: climate/energy nexus
  – USGCRP: science, adaptation, decision support, outreach

• Inputs to process
  – USGCRP strategic plan and goals: adv science, inform decisions
  – DOE packaging: EERE, PI
Climate & Environmental Sciences Division Strategic Goals

1. Synthesize new process knowledge and innovative computational methods advancing next generation, integrated models of the human-earth system.

2. Develop, test and simulate process-level understanding of atmospheric systems and of terrestrial ecosystems extending from bedrock to the top of the vegetative canopy.

3. Advance fundamental understanding of coupled biogeochemical processes in complex subsurface environments to enable systems-level prediction and control.

4. Enhance the unique capabilities and impacts of the ARM and EMSL scientific user facilities and other BER community resources to advance the frontiers of climate and environmental science.

5. Identify and address science gaps that limit translation of CESD fundamental science into solutions for DOE’s most pressing energy and environmental challenges.
Climate Modeling Investment: 63M

1. Balance of DOE Laboratory (60%) and University (40%)
2. Balance of model development (60%) and analysis (40%)
3. Climate model investments are focused on the Community Earth System Model
4. Collaboration between DOE Laboratories and NCAR (e.g. in SciDAC, CSSEF projects)
5. Portion of DOE Laboratory funding shifting to “Scientific Focus Areas” for increased long-term investment (e.g. COSIM at LANL; PCMDI at LLNL)
DOE CESM priorities: Atmosphere, 9M

- **Atmosphere**: Clouds, aerosols, chemistry
- **PNNL, LLNL, Universities**
- **DOE interests:**
  - Links to ARM, Atmospheric Research program, GoAmazon
  - Research: Cloud feedbacks, aerosol indirect effects, precipitation changes
  - Energy mission: fossil-fuel impacts, wind, solar potentials
DOE CESM priorities: Land 8M

- **Land: Terrestrial ecosystems, soils**
- **ORNL, LBNL, PNNL, Universities**
- **DOE interests:**
  - Links to Terrestrial Ecosystem Systems program, NGEE, iESM (IA-ESM links)
  - Research: Carbon sources/sinks, feedbacks to atmosphere
  - Energy mission: Natural vs human carbon sources, energy-water-land connections, biofuel potentials
DOE CESM priorities: Ocean, cryosphere, 8M

- Ocean, sea-ice, ice sheets
- LANL, Universities
- DOE interests:
  - Research: Sea-level rise projections, Arctic and global climate change
  - Energy mission: Coastal vulnerabilities, Arctic exploration potentials
DOE CESM priorities: Numerics, 9M

- Numerical methods, dynamical cores, high-resolution
- ORNL, LBNL, LANL, Universities
- DOE interests:
  - Links to Advanced Scientific Computing Office
  - Research: Leadership class computation, variable resolution
  - Energy mission: Resolve regions of interest, climate extremes
DOE CESM priorities: Analysis tools, 10M

- Diagnostics, testbeds, UQ methods, visualization and analysis tools, metrics
- LLNL, LBNL, ANL, others, Universities
- DOE interests:
  - Link to Advanced Scientific Computing Office
  - Testbed links to ARM, ASR, TES
  - Research: Enable rapid model validation, calibration; UQ guides development
  - Energy mission: Towards tools for energy stakeholders
UCAR support, 5M

- Climate model analysis and development
- Cooperative agreement (3M) and other awards (2M)
- DOE interests:
  - CESM climate model analysis
  - Complement, and strengthen connection with, DOE Laboratory model development
Thank you!

Gary Geernaert
Gerald.Geernaert@science.doe.gov
http://science.energy.gov/ber/research/cesd/