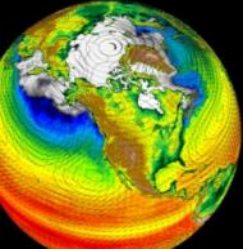
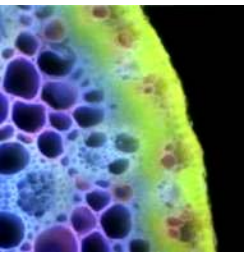
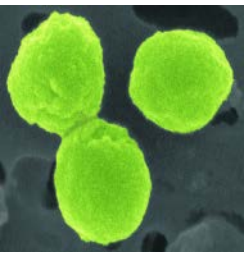


Accelerated Climate Model for Energy

ACME

Dorothy Koch

Earth System Modeling, BER

Accelerated Climate Model for Energy
"ACME"

Pending **multi-Laboratory climate model development Science Focus Area**

1. **Consolidate 7 multi-lab ESM Lab projects into 1**
2. **Develop model to directly support energy mission and BER science, climate projection**
3. **Improve the Community Earth System Model (CESM) for optimal performance on DOE Leadership Class Facility Computers (LCF's)**

Climate and Environmental Sciences Division (Geernaert, director)

Atmospheric Science

Atmospheric System Research

Atmospheric Radiation Measurement Facility

(4 managers)

Climate and Earth System Modeling

Earth System Modeling

Regional & Global Climate Modeling

Integrated Assessment

(3 managers)

Environmental System Science

Terrestrial and Subsurface Research

Environmental Molecular Sciences Laboratory Facility

(4 managers)

Data Informatics (1 manager)

Earth System Modeling (ESM) context

ESM mainly supports CESM development, in 3 areas:

1. **SciDAC Lab-led projects (about 20%), FY11-16. Co-managed with Computing (ASCR)**
   a) **"Multi-scale" scale-aware physics for variable mesh dycores (MPAS-O and CAM-SE)**
   b) **"PISCEES" variable mesh ice sheets**
   c) **"ACES4BGC" atmosphere, ocean and land BGC, tracer transport**
2. **University-led projects (about 20%), mainly also SciDAC, some paleo-climate**
   - **Current (ESM-RGCM) solicitation (applications are in), would support collaboration with ACME, SciDAC-Lab, or CESM-trunk**
3. **Laboratory collaborative projects (about 60%)**

Model development in 7 laboratory collaborative projects

	CSSEF	iESM	Polar	COSIM	IMPACTS	UV-CDAT	Hi-Res
ANL	X				X		
LANL	X		X	X	X	X	X
LBNL	X	X			X		
LLNL	X		X		X	X	X
ORNL	X	X				X	X
PNNL	X	X	X		X		
SNL	X						

Each Lab doing similar work on multiple projects
Projects overlapping in scope
** Not efficient **

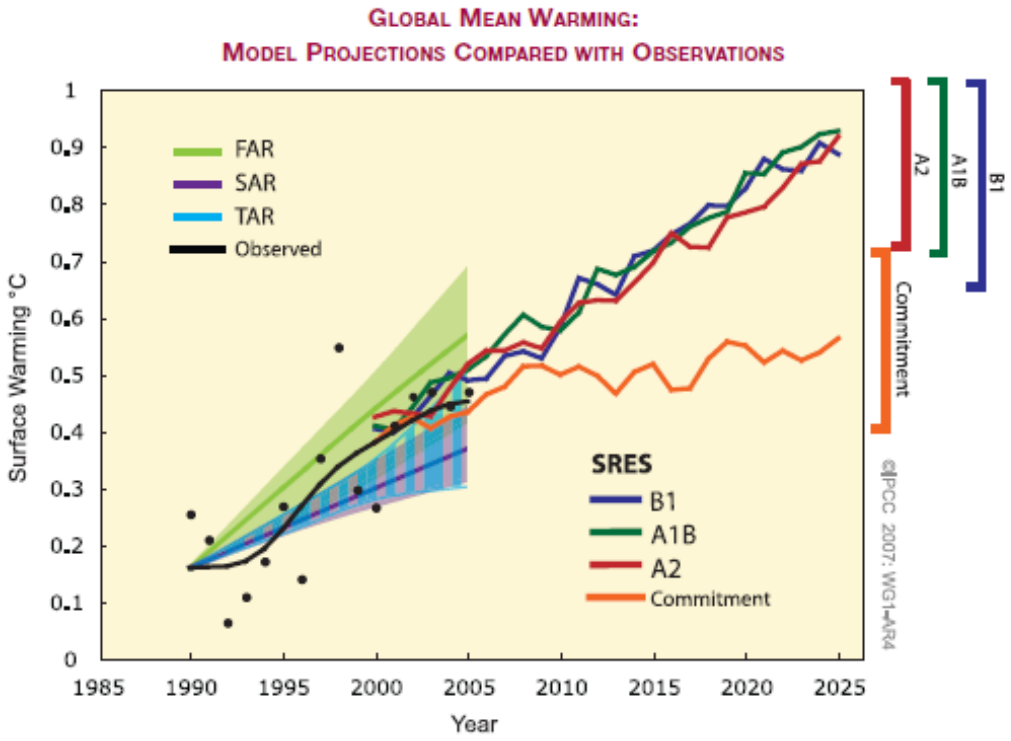
1. Restructure ESM Lab project portolio
Reduce 7 projects to 1;
Atmospheric activities from 8 to 4

ACME framework

Ultra-high resolution (12-25 km atmosphere, 15 km ocean) 80 year simulation:

- **1970-2010 hindcast with automated validation and calibration against observations**
- **2010-2050 projection, with uncertainty characterization.**

Performance of the <u>full coupled climate system</u> will be central and overarching for the project



2. ACME to address DOE-relevant Science

1. **How do the hydrological cycle, and water resources, interact with the climate system on local to global scales?**

Precipitation, surface fluxes

2. How do biogeochemical cycles interact with global climate change?

Secondary organic aerosols

3. How do rapid changes in cryospheric systems interact with the climate system?

Polar cloud/aerosol-cryosphere interactions

4. How do short-term variations in natural and anthropogenic forcings interact with natural variability and contribute to the rates of regional and global environmental change?

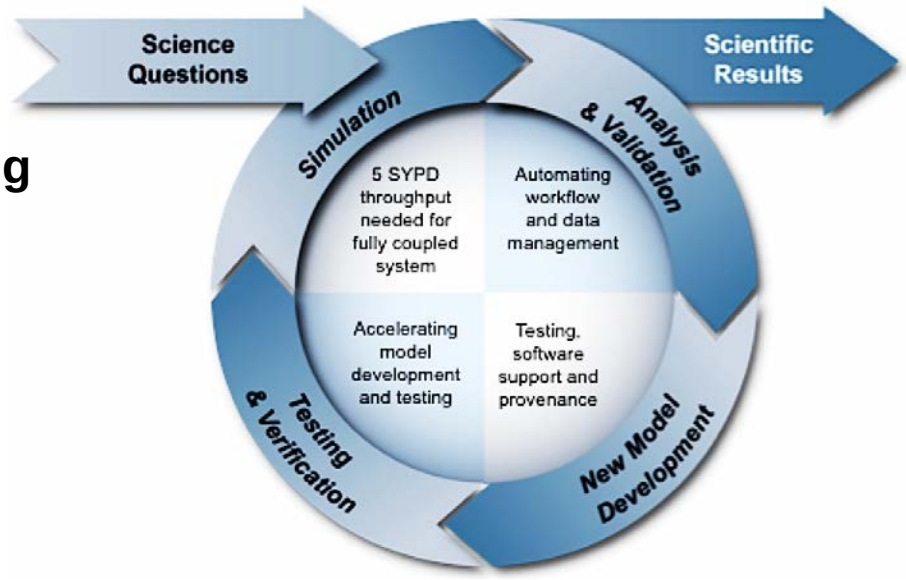
Aerosols, indirect effects; Cloud feedbacks

3. ACME to upgrade model to run on DOE computers

Existing and upcoming multi-core computational architectures at the Leadership Class Facilities (LCF's) challenge all science applications.

ACME would be poised to adapt to these architectures by upgrading the CESM codes in 3 areas:

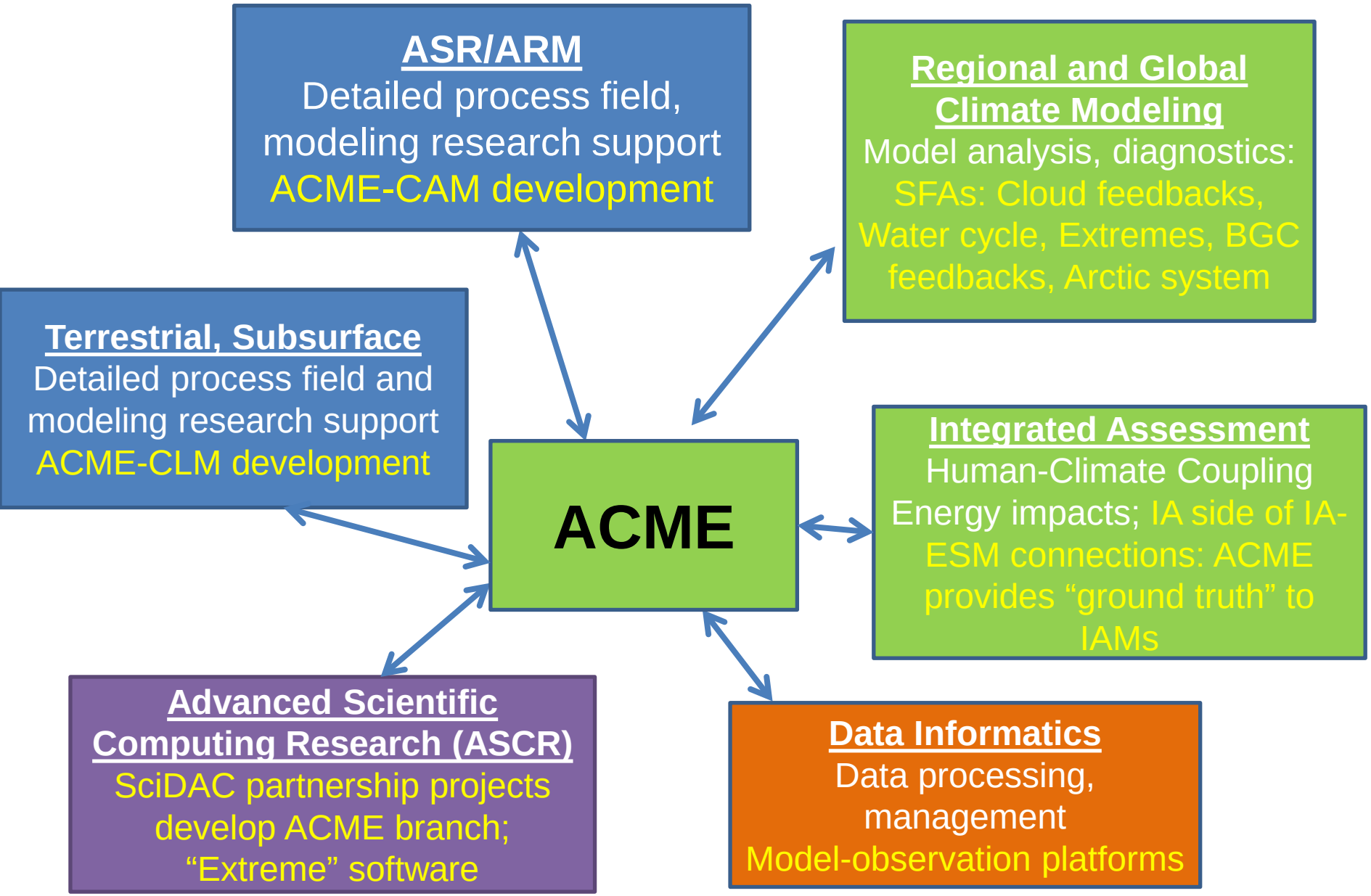
1. **Improve code to optimize performance on DOE machines (toward non-hydrostatic, 12 km)**
2. **Develop simulation/evaluation workflow to enable rapid model testing (e.g. using ARM, satellite data)**
3. **Software to improve and accelerate model development process; automated and embedded tuning and testing; modularity to facilitate process research input (e.g. cloud, aerosol microphysics)**



ACME timeline

- **Summer 2012:** discussions about DOE imperative to adapt CESM to next generation computer architectures
- **Winter 2012:** workshop on DOE-climate-computing (whitepaper)
- **Spring 2013:** establish leadership “Council” of 13 to coordinate 7 Labs across climate/computation modeling disciplines.
- **Summer 2013:** invitation for proposal
- Monthly “team-building” face-to-face meetings as proposal is constructed. Council calls twice per week.
- **Winter 2013:** proposal submitted
- **March 2014:** proposal review
- DOE is processing…

ACME Links within DOE



ACME-MB: ACME HQ Management Board

DOE Community is the first customer and partner in ACME

Climate model analysis (RGCM): 1PM

Integrated assessment (IAR): 1PM

Atmosphere (ASR): 2 PMs

Terrestrial (TES/ESS): 3 PMs

Data Informatics: 1PM

Computing (ASCR): 2 PMs

Facilities managers

Meet monthly; format for specific engagement TBD

ACME Links to CESM and other modeling centers

CESM:

- ACME would be a development branch of CESM with its own coupling capability
- ACME code to be released (to CESM)
- Ongoing funding support for CESM-trunk
- NCAR/CESM engagement in ACME proposal and through the FOA
- Ongoing exchange through CESM SSC, WG's, etc.

Other Centers:

- Modular codes with HPC capabilities to be shared
- DOE-NOAA MOU: potential for joint efforts
- Other potential engagement in multi-agency HPC efforts (e.g. ESPC, NUOPC)

ACME-ASR potentials…

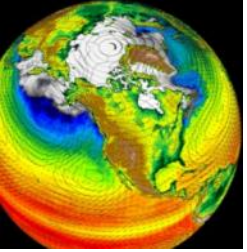
- ACME proposes to approach the hydrostatic limit over the next 3 years within a coupled climate simulation.
- Tell us: how it could support and use your research to solve critical atmospheric and climate questions:

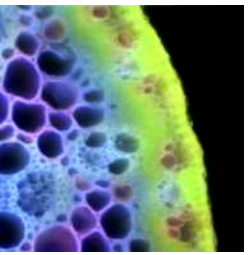
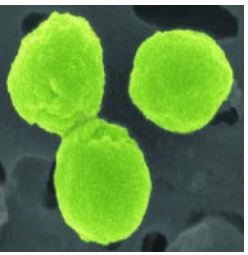
Within DOE: Dorothy Koch, Renu Joseph; Ashley Williamson, Sally McFarlane

ACME Atmosphere Team Leads: Phil Rasch, Peter Caldwell

ACME Atmosphere Task Leads:

Mark Taylor (numerics)
Hailong Wang (aerosol physics)
Peter Caldwell (Clouds and aerosol-cloud; Regionally refined model)
Shaocheng Xie (cumulus)
Phil Rasch (integration, testing)
Sahil Mahajan (SCAM)
Yuying Zhang (satellite simulators for diagnosis)



Questions?

Dorothy.Koch@science.doe.gov