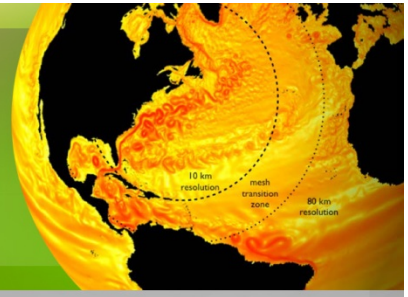
ACME
Accelerated Climate Model for Energy



ACME Ovierview

David C. Bader

ACME Council Chair

December 9, 2014

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Why ACME?

The Accelerated Climate Modeling for Energy Project is an ongoing, state-of-the-science Earth system modeling, simulation, and prediction project that optimizes the use of DOE laboratory resources to meet the science needs of the nation and the mission needs of DOE.

Over the next 10 years, the ACME project will assert and maintain an international scientific leadership position in the development of Earth system and climate models at the leading edge of scientific knowledge and computational capabilities. With its collaborators, it will demonstrate its leadership by using these models to achieve the goal of designing, executing, and analyzing climate and Earth system simulations that address the most critical scientific questions for the nation and DOE.

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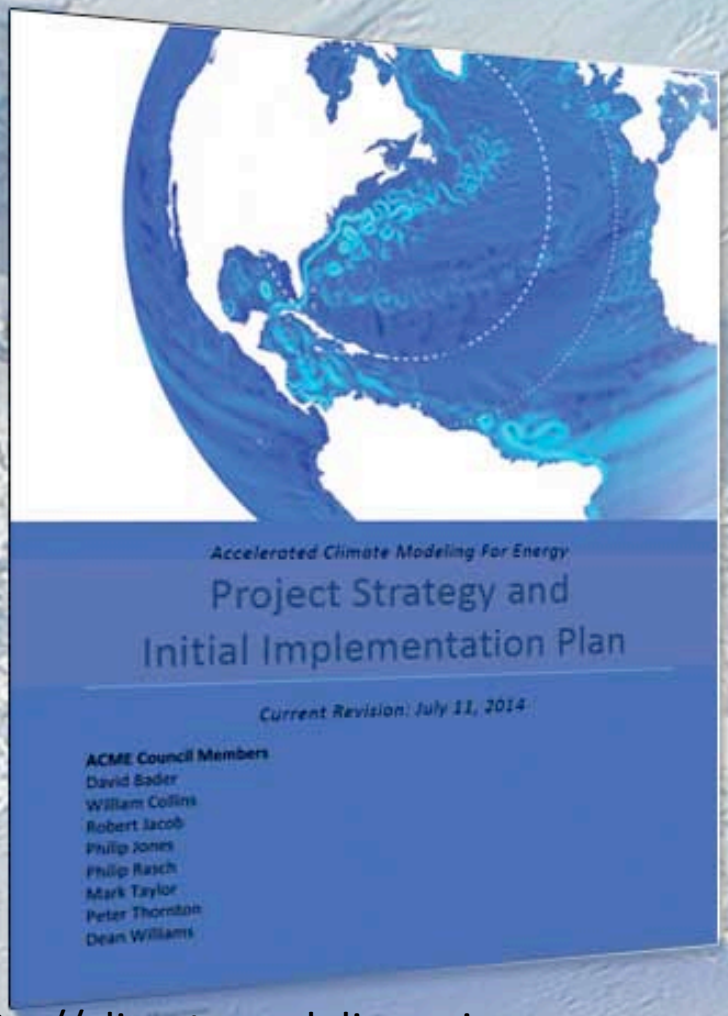

http://climatemodeling.science.energy.gov/publications/accelerated-climate-modeling-energy-acme-project-strategy-and-initial-implementation

ACME Project Elements

- a series of **prediction and simulation experiments** addressing scientific questions and mission needs;
- a well documented and tested, continuously advancing, evolving, and improving **system of model codes that comprise the ACME Earth system model**;
- the ability to use effectively **leading (and "bleeding") edge computational facilities** soon after their deployment at DOE national laboratories; and
- **an infrastructure** to support code development, hypothesis testing, simulation execution, and analysis of results.

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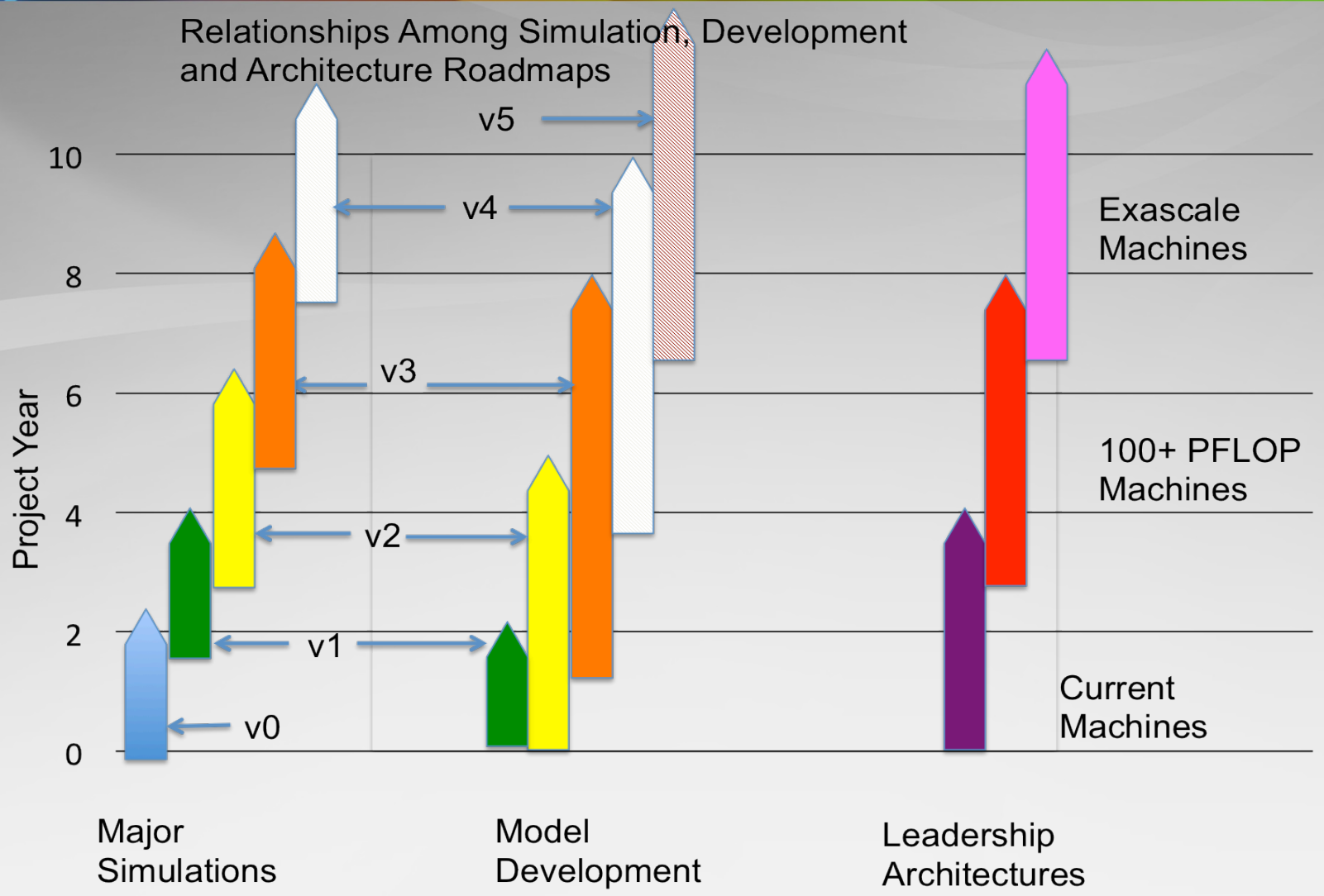
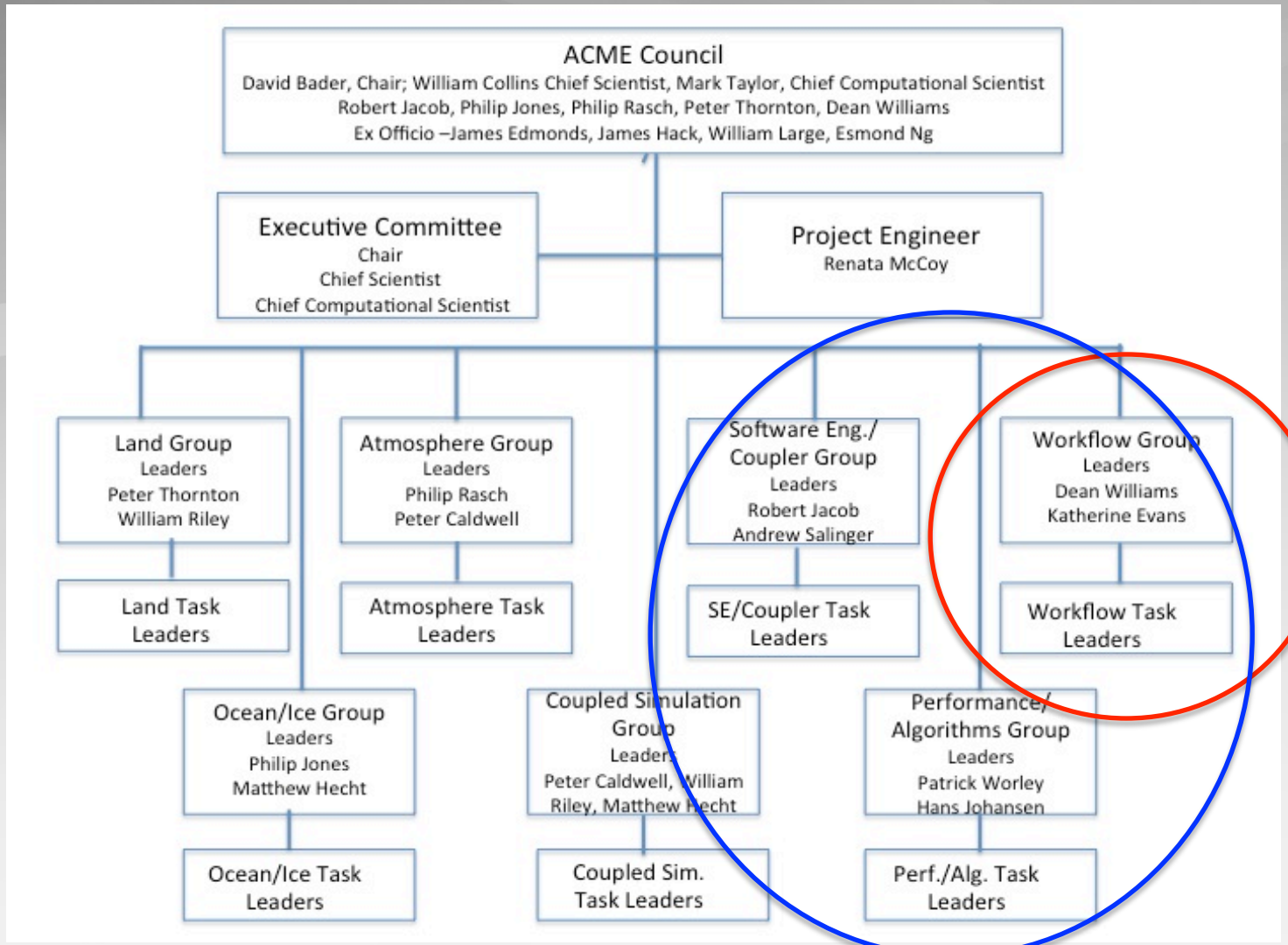
ACME Roadmap



Management Approach

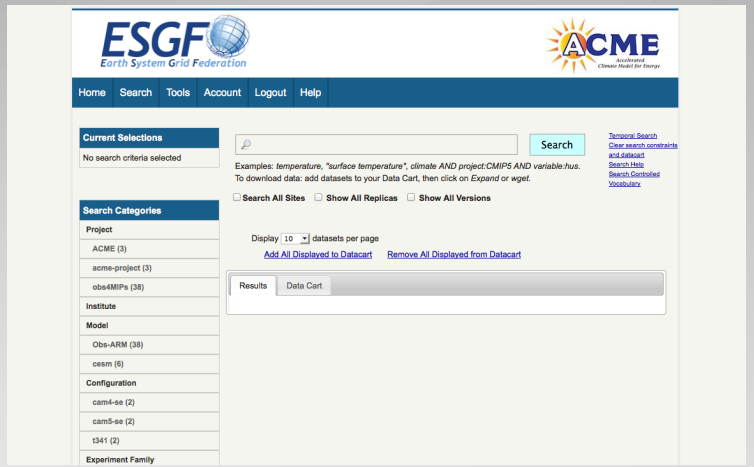


Computational Science

- Software Engineering Group
  - Repository and initial code base
  - Testing infrastructure & Development workflow
  - Communication Tools
- Performance Group
  - Automated performance tracking
  - Watercycle prototype running on Titan, Mira, Edison
  - GPU tracer advection code ported into ACME v0
- Workflow Group
  - CADES: ACME's dedicated server for ESGF data publishing
  - Atmosphere and Land diagnostics packages in UV-CDAT
  - UV-CDAT 2.0 release (and installed on ORNL Rhea)

CADES data server

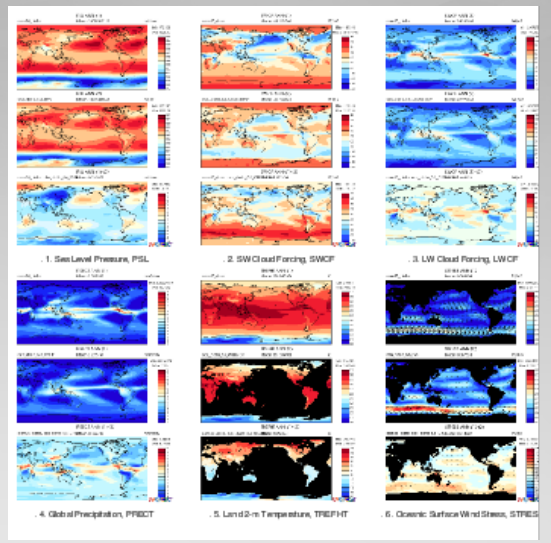
- ESGF node to host ACME data
  - Initially populated with DOE URH project data. Climatologies from
    - CAM4-EUL/POP
    - CAM4-SE/POP
    - CAM5-SE/POP
  - Access limited to ACME group until data is ready for public release

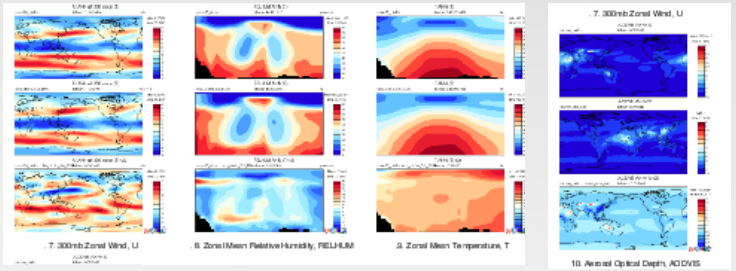


- ACME inputdata server
  - SVN server to replace public CESM data server
  - 0.5TB of data initially
  - Initial condition and boundary condition data for all ACME supported configurations

UV-CDAT

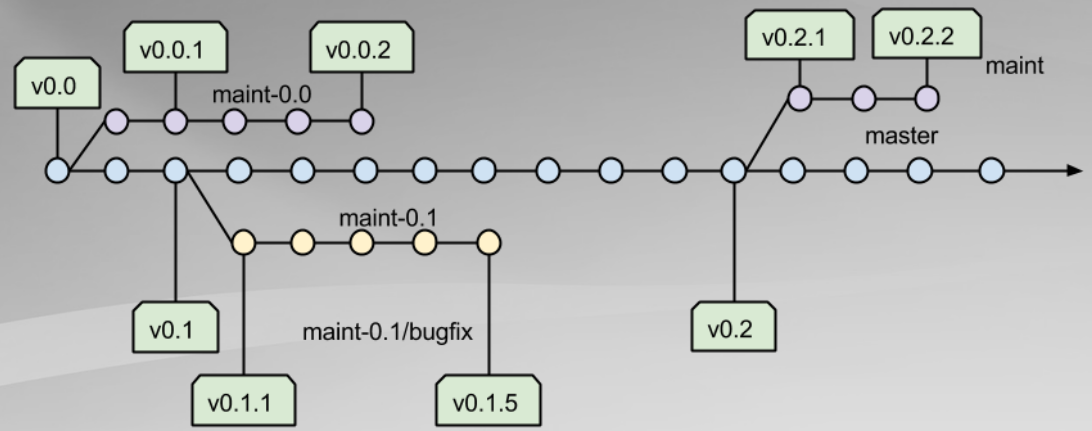
- UV-CDAT 2.0 released
- Installed on Rhea (OLCF Viz cluster)
- Includes UVCMetrics
  - Produces hundreds of static plots modeled after the AMWG diagnostics package
  - Has been run by friendly users
- Developed package to produce Atmosphere Tier 1 plots:
- Quick look at climatology files
  - http://climate.llnl.gov/acme/diagnostics/climo/ACME_climo.html





Atmosphere Tier 1 plots from UV-CDAT

ACME Repository



commit on acme/release-v0.0 (v0 branch)

commit on master (devel branch)

tag

commit on maint-0.1 branch

- ACME repository up and running on github
- 50 registered users
  - v0.0: Model used by DOE UHR project (now part of ACME)
  - v0.0.1: Maintenance branch of v0.0 model (so we can continue to run this model on Titan)
  - v0.1: ACME starting point (CESM1_3_beta10)
  - v0.2: Bring in new CLM infrastructure work from NCAR
- Possible next tags:
  - v0.3: DOE Polar Project modifications
  - v0.4: MPAS-O

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Supported Platforms

- Created list of supported platforms and configurations
- Status & contact maintained on confluence
- LCFs + institutional clusters
- Automatic testing running on 3 platforms
- Tests running manual on 6 platforms
- Code running but not tested on many additional platforms

Location	Machine	Compiler	POC(s)	Machine File Pushed	Tests Run Successfully (Manually)	Tests Run as Jenkins Slave	Comments
NERSC	Hopper (Cray XE6)	PGI	Jeffrey Johnson	X	X	X	need 'module load perl'
	Edison (Cray XC30)	Intel	Jeffrey Johnson	X	X		need 'module load perl'
							I: Fixes in "integration" stage
ALCF	Mira, BGQ	bgxl	Jayesh Krishna	X	I		Some Mira tests require Az's fix (in azamat/machinefiles/depends_mira)
							to run successfully - this change will be merged to next/master soon.
							See Mira Test Results for more information.
ALCF	Cetus, BGQ	bgxl	Jayesh Krishna	I			I: Machine/Configuration files in "integration" stage
							Manually going through the tests that FAILed and was in PENDing.
OLCF	Titan	PGI	Matthew Norman	X			
OLCF	Titan	Intel	Rick Archibald	X			Currently builds, but is failing for the water cycle benchmark case. It may be in enough shape to try with the test suite though, to help in debugging.
OLCF	Titan	Cray	Rick Archibald	X			The Cray port will not work until a bug in the POP2 source is fixed (that the oth compilers do not care about), or until we move to MPAS-Ocean.
Laptop	Max, OSX 10.x	gfortran	Jeffrey Johnson	X			
ANL	Blues, Linux	pgi	Robert Jacob				
ANL	Blues, Linux	intel	Robert Jacob				
ANL	Blues, Linux	gfortran	Robert Jacob				
LANL	Mustng&Wolf, Linux	pgi	Doug Jacobsen	!			Blocked until we have a standard place for input_data to be stored.
LANL	Mustng&Wolf, Linux	intel	Doug Jacobsen	!			Blocked until we have a standard place for input_data to be stored.
LANL	Mustng&Wolf, Linux	gfortran	Doug Jacobsen	!			Blocked until we have a standard place for input_data to be stored.
LBNL	Lawrencium, Linux	pgi	Jeffrey Johnson	X			need 'module load perl xml-libxml'
ORNL	OIC CLuster, Linux	gfortran	Daniel Ricciuto				
PNNL	Cascade, Linux	intel	Balwinder Singh	X	X		
PNNL	Cascade, Linux	NAG	Balwinder Singh	X			
PNNL	Olympus&Sooty, Linux	intel	Balwinder Singh	X			
PNNL	Olympus&Sooty, Linux	NAG	Balwinder Singh				
PNNL	Olympus&Sooty, Linux	PGI	Balwinder Singh	X			
PNNL	Olympus&Sooty, Linux	gfortran	Balwinder Singh				
SNL	RedSky, Linux	intel	James Foucar	X	X	X	
SNL	Desktop, Linux	gfortran	James Foucar	NA	NA	X	Build-only

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Watercycle Prototype

- Prototype simulation used for initial testing and cost estimates
- Modeled after ACME v0.0 (DOE UHR project). Coupled CAM5 simulation with with updates to the atmosphere to match anticipated ACME v1:
  - ¼ degree, 64 levels
  - 50 tracers (20 are test tracers for now)
  - POP and CICE on tx01 grid
  - CLM4.0 on ¼ degree grid
- Running on Titan, Mira, Edison, with automated performance data collection
- Will be used to examine atmosphere performance within coupled system, to see the impact of increased levels and increased numbers of tracers.
- For I/O testing, we created a typical high-resolution output set, with monthly and daily means and select high frequency (6h and 1h) output.

Performance Tracking

- Performance monitoring and characterization is critical: We want to focus our resources on those components which impact ACME's proposed simulations.
- Based on our prototype simulations, current expectations are:
  - Watercycle and Cryosphere simulations will consume most of our cycles
  - BGC simulations will be done at lower resolutions
  - Atmosphere will remain the most expensive component and the one in need of the most work to achieve 5 SYPD
  - MPAS-O: significant performance improvements expected over POP, due in part to improve scalability and unstructured mesh capability. Initial results suggest MPAS-O may already be capable of 5 SYPD.
  - MPAS-I: Existing CICE model is the rate limiter in ACME v0 simulations due to poor scaling. How will MPAS-I change this?
  - Land and Land Ice models are not expected to have significant performance impact, with the exception of the long spinup times needed for the land model

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Questions?