

# CESM Update

## Societal Dimensions Working Group Meeting

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# CESM Project Updates/Announcements

## CESM Tutorial

- 4th Annual CESM Tutorial on 12-16 August, 2013
- Application website available;
  - deadline 1 March, 2013
- Targeting about 80 participants – preference to early career scientists
- Thanks to Susan Bates for chairing the organizing committee
- Online tutorial materials available

<http://www.cesm.ucar.edu/events/tutorials/081213/announcement.html>



# CESM Computing: Status of Climate Simulation Laboratory (CSL) Proposal

- Dedicated climate model computing facility supported by the USGCRP
- CSL Yellowstone resources available at the NWSC Center – February 1, 2013-May 30, 2014
- Received 80% of requested compute resources and 60% of requested data storage resources
- Resources for Working Group simulations
- Additional “Community Projects” with cross-working group interest
- Additional “Advanced Scientific Discovery” (ASD) runs



# CESM Model Releases

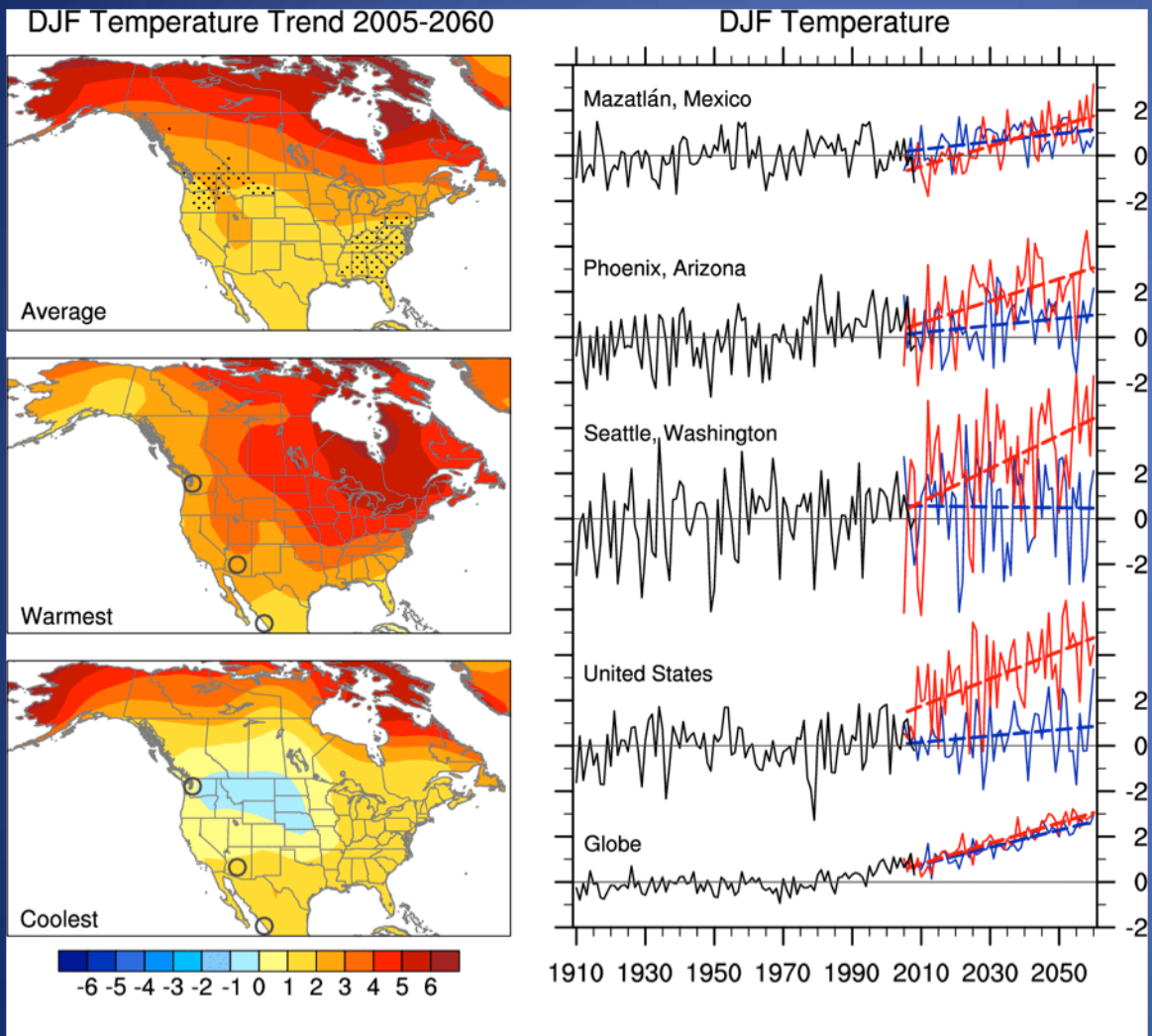
To enable computing on Yellowstone, multiple releases in early February

- cesm1.1.1 (support for new model features)
  - CAM-SE/CAM5 development code base
  - CAM5/CLM4.0 targeted defaults
    - Targeting “scientific support” for FV 1°, FV 2° 1850, 20<sup>th</sup> Century and RCP CMIP5 simulations
    - Out of box support for yellowstone, titan
- cesm1.0.5 (support for CMIP5 science)
  - Out of box support for yellowstone, titan
  - Scientific support for all CAM4 FV CMIP5 simulations
- ccsm3 (university community request)



# Community Integrations - Large Ensemble

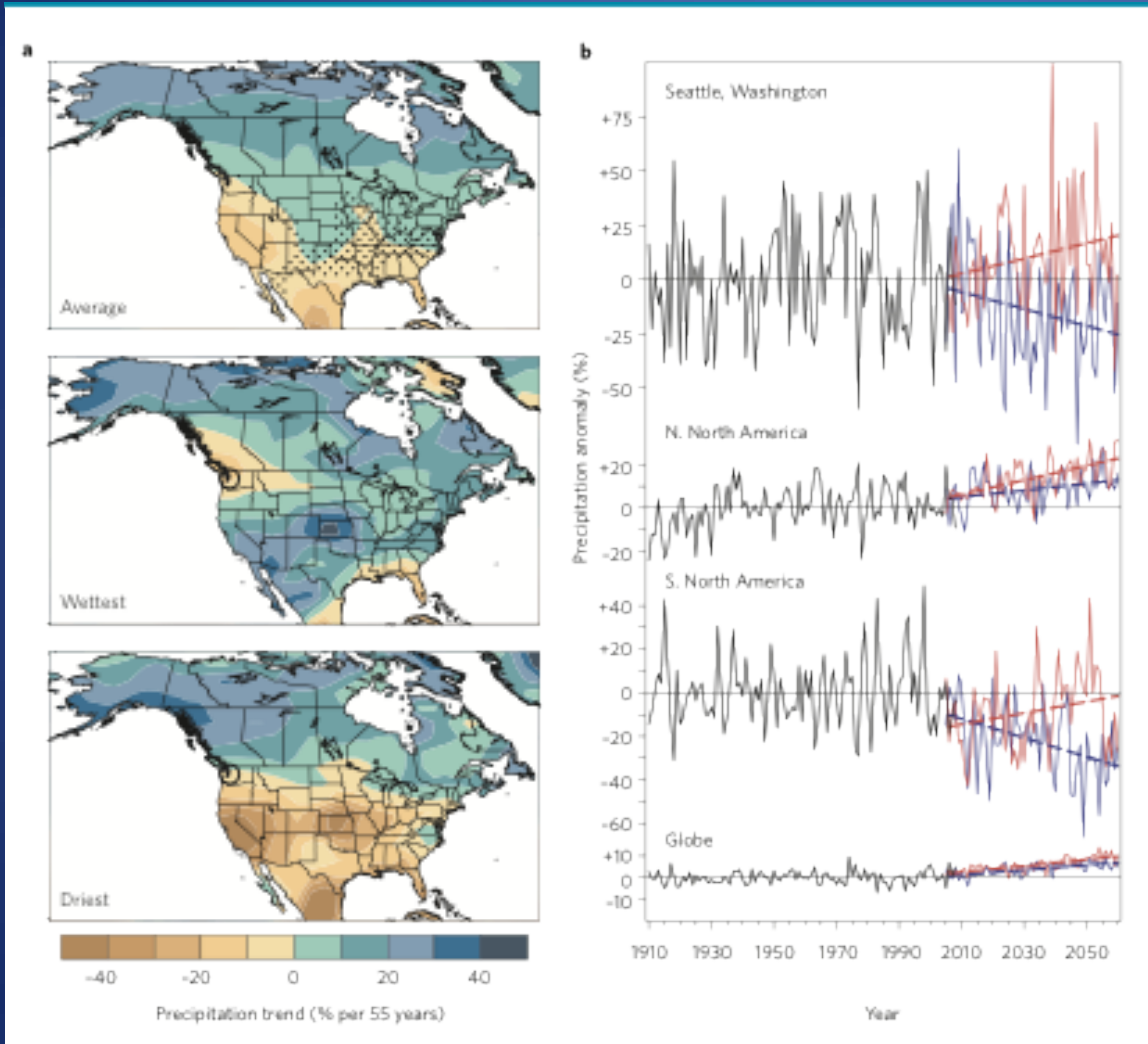
## Science Motivation



From Deser et al., 2012, Nature Climate Change

# Community Integrations - Large Ensemble

## Science Motivation



Purpose:

- To robustly determine simulated natural variability
- To assess climate extremes and their changing likelihood
- To investigate detection/attribution of climate changes in the 20<sup>th</sup>-21<sup>st</sup> centuries

From Deser et al., 2012, Nature Climate Change

# Community Integrations - Large Ensemble

- 30 members (perhaps more)
- 1900-2080 with RCP8.5 forcing scenario
- CESM-CAM5-BGC (1-degree) with prescribed CO2.
- Spin-up runs underway; long control will be available
- Initial state will vary by a round-off level change
- High-frequency output to be saved
  - Timeslice output for decades in 1850s, 1910s, 1990s, 2070s for downscaling runs
  - Smaller set of continuous daily fields for analysis

Thanks to Clara Deser and Jen Kay for leading the planning effort

<https://wiki.ucar.edu/display/ccsm/CESM+Large+Ensemble+Planning+Page>



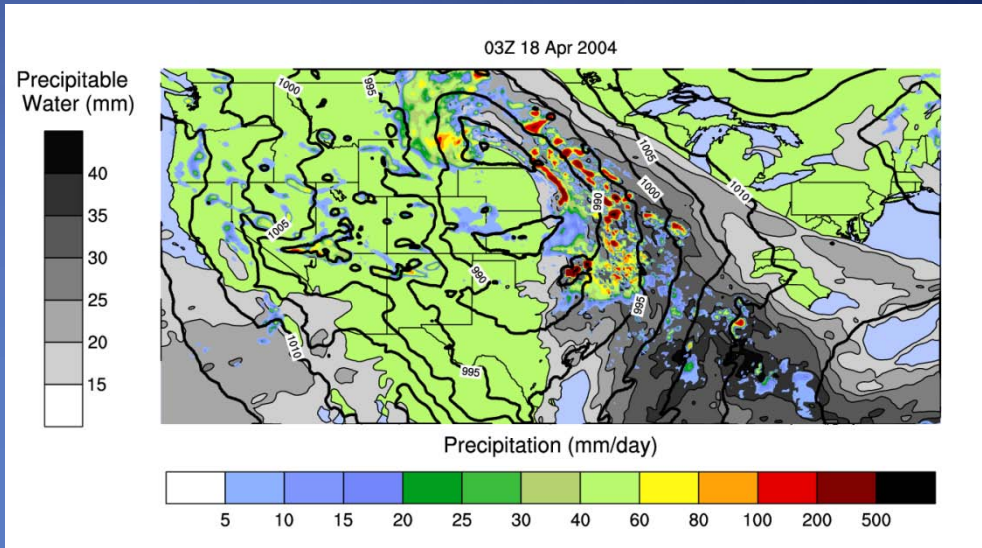
# Community Integrations – High Resolution Control

## Science Motivation

*Cubed Sphere*



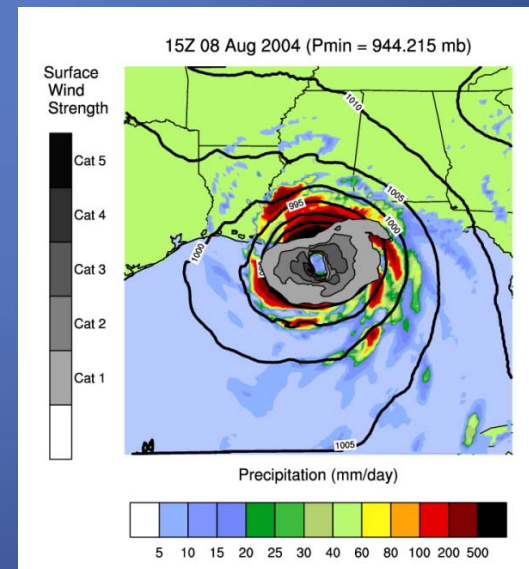
*Mid-west  
Spring time  
propagating  
systems*



*Regular lat-lon*



*Tropical Cyclones*



12-km  
CAM-SE  
Run

Slide courtesy of Rich Neale



# Community Integrations – High Resolution Control

- 25km atmosphere coupled to 1-degree ocean
- Multi-century integration (200-300 yrs)
- Requires CAM-SE configuration
  - Developments still underway
  - Hopeful that CAM-SE with new vertical advection will be released in May, 2013
- Integrations unlikely to start until later this year
- Community input on experiment design/desired output is welcome
- Planning will begin after the May release



# Current high resolution simulation underway

## Yellowstone Advanced Scientific Discovery

J. Small, F. Bryan, J. Tribbia, R. Tomas, D. Bailey, J. Dennis, A. Baker, J. Edwards, J. Caron, M. Vertenstein, T. Scheitlin, J. Bacmeister

### – Resolutions

- 25km CAM5/CLM4.0 (spectral element grid)
- 10km POP2 (62 level), CICE (tripole grid)
- 1/2° RTM (lat/lon grid)
- Resolutions allow for resolving ocean eddies and atmospheric hurricanes

### – Performance

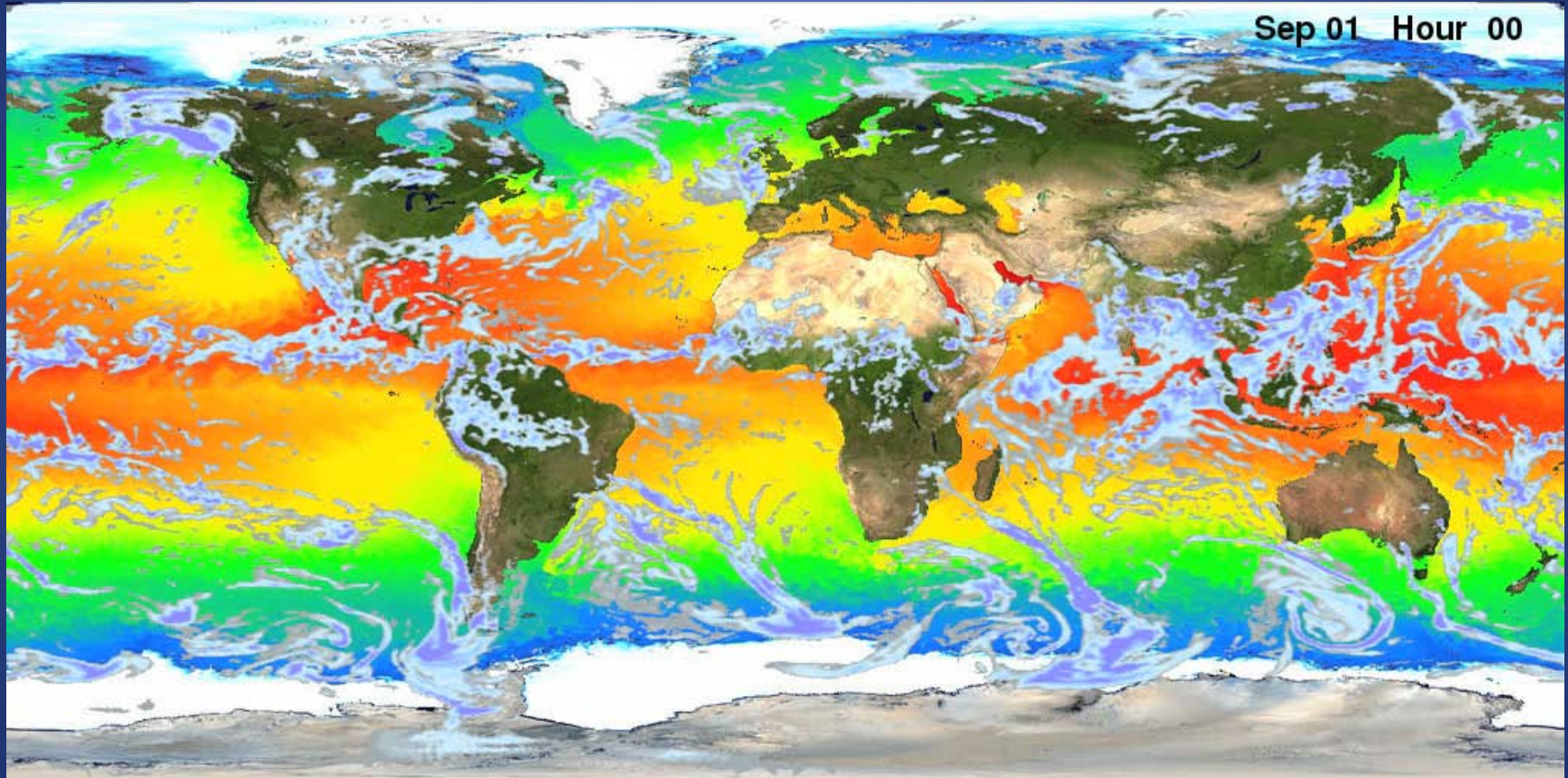
- ~2 model-years/day on 16,000 processors
- Previous LLNL atlas run of 25km CAM4/ 10KM POP2 (42 levels) had only 1/2 model-years/day on 4000 processors

– Target: multi-decade simulations (grand challenge goal)



# ASD Simulation: 10km ocean and 25 km atmosphere

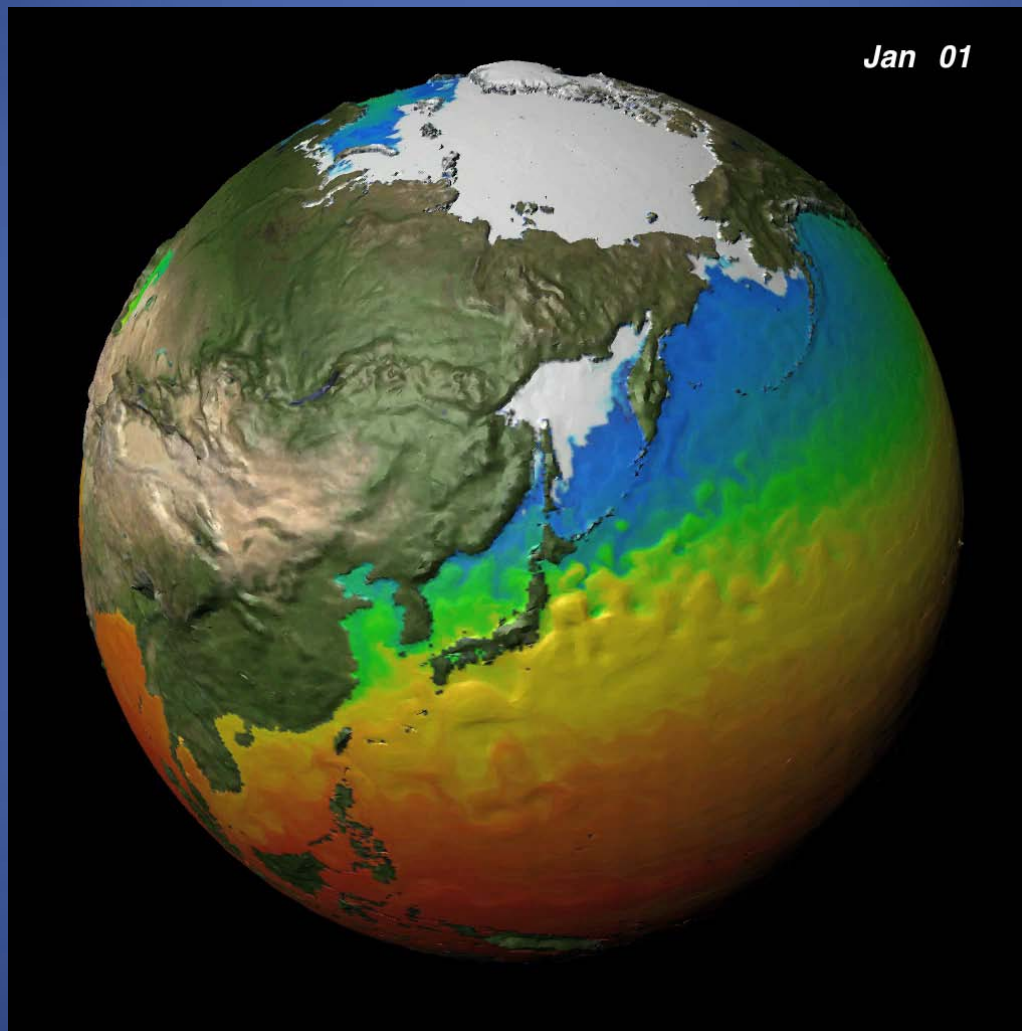
J. Small, F. Bryan, J. Tribbia, R. Tomas, D. Bailey, J. Dennis, A. Baker, J. Edwards, J. Caron, M. Vertenstein, T. Scheitlin, J. Bacmeister



3 months of simulated hourly Precipitation over SST and sea ice cover

# ASD Simulation: 10km ocean and 25 km atmosphere

J. Small, F. Bryan, J. Tribbia, R. Tomas, D. Bailey, J. Dennis, A. Baker, J. Edwards, J. Caron, M. Vertenstein, T. Scheitlin, J. Bacmeister



SST, Sea  
ice cover  
and Sea  
Surface  
Height

# Last Millennium Ensemble

- CESM-CAM5 at 2-degrees/gx1
- Simulations from 850-2005
- 10 members: Full Transient Forcings (Orbital, Volcanic eruptions, Land-use, Solar variability, GHG)
- 4 members each: Single Forcings (Volcanic, Solar, GHG)
- 1 member each: Single Forcing runs (Land-use, orbital)
- 1 run for uncertainty in amplitude of Solar Variability
- 2 members w/FV2-WACCM (Full Forcings)

Thanks to Toby Ault, Nan Rosenbloom, Esther Brady, Bette Otto-Bleisner

[//wiki.ucar.edu/display/ccsm/CSL+CESM+Community+Project+-+Last+Millennium+Ensemble+2012](http://wiki.ucar.edu/display/ccsm/CSL+CESM+Community+Project+-+Last+Millennium+Ensemble+2012)



# Questions/Comments?



# CESM Project Updates/Announcements

## Redesign of Model Output/Processing Workflow

- Need to streamline future processing/publishing for large intercomparison projects
- Need to reduce CESM data storage
- Maintaining the status quo not possible
- Effort led by John Dennis (CISL), Jim Edwards (CSEG), Mariana Vertenstein (CSEG)



# New (Evolving) Model Release Strategy

- Pre-set release dates
  - Should ease planning for developments and release resource needs
- Annual releases – in May
- Notable improvements in multiple categories
  - Scientifically validated (with control runs/ climate “assessment”)
  - Functional improvements (undergone routine testing)
  - Development only additions
- Note that this is a new way of doing business
  - Likely to evolve over time; input welcome





# Model Support Policy

- Released in November
- Includes
  - bug fixes,
  - script changes, and/or code for time evolution of supported machines
- Major releases of CESM supported for 5 years after release date or for 2 years after the next major release, whichever period is longer.
- CCSM3 support expired; CCSM4/CESM1 to 2015 at least
- <http://www.cesm.ucar.edu/models/cesmsupportpolicy-2012.html>



# CESM Project Updates/Announcements

## Bulletin Board



CESM SDWG Meeting  
January, 2013

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# CESM Project Updates/Announcements

## Redesign of Model Output/Processing Workflow

Some basic statistics comparing CMIP3 and CMIP5, specific to the NCAR submissions to both:

Category	CMIP3		CMIP5	
Models used	2 (CCSM3 and PCM)		5 (CCSM4, CESM1-BGC, CESM1-WACCM, CESM1-FASTCHEM, CESM1-CAM5)	
Total volume submitted	~ 9.2 TB (over 10 month period)		~136 TB (over one year period)	
Total volume generated	~120 TB		~1380 TB	
Total simulated years	~14,900		~28,500	
Number of model runs	107 total	73 (CCSM3)	555 total	91 (CCSM4 long-term)
		34 (PCM1)		400 (CCSM4 decadal prediction)
				64 (other configurations)
Experiments requested	12		37	
Output categories	6		19	
Number of requested fields	137		951	

Courtesy of Gary Strand

80% of requested Yellowstone CSL compute resources allocated  
But only 60% of data storage

