GISS Planning for CMIP6

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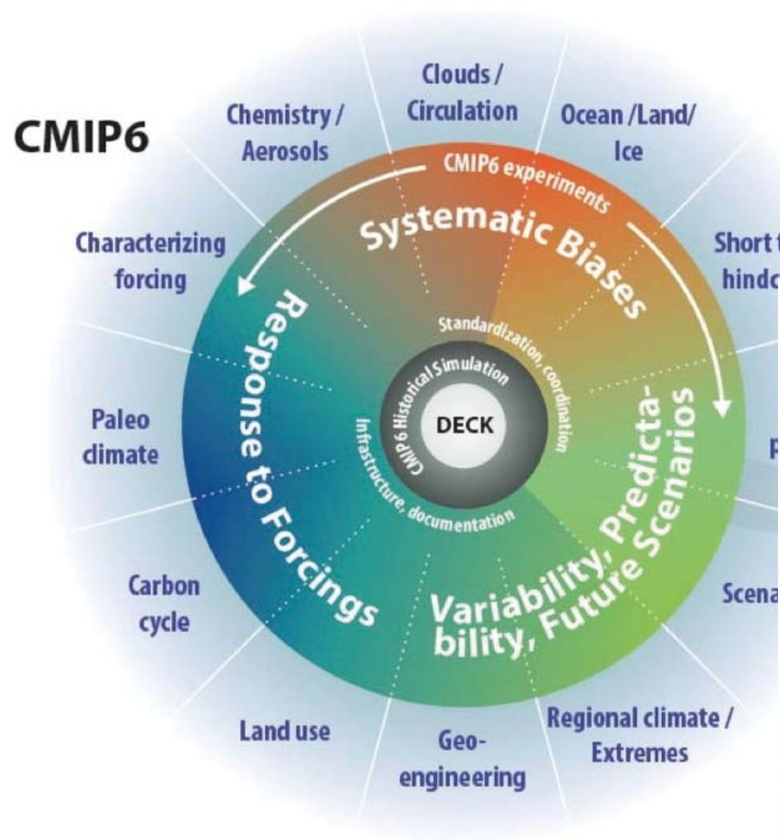

	Short Name of MIP	Long Name of MIP
1	AerChemMIP	Aerosols and Chemistry Model Intercomparison Project
2	C4MIP	Coupled Climate Carbon Cycle Model Intercomparison Project
3	CFMIP	Cloud Feedback Model Intercomparison Project
4	DAMIP	Detection and Attribution Model Intercomparison Project
5	DCPP	Decadal Climate Prediction Project
6	ENSOMIP	ENSO Model Intercomparison Project
7	FAFMIP	Flux-Anomaly-Forced Model Intercomparison Project
8	GDDEX	Global Dynamical Downscaling Experiment
9	GeoMIP	Geoengineering Model Intercomparison Project
10	GMMIP	Global Monsoons Model Intercomparison Project
11	HighResMIP	High Resolution Model Intercomparison Project
12	ISMIP6	Ice Sheet Model Intercomparison Project for CMIP6
13	LS3MIP	Land Surface, Snow and Soil Moisture
14	LUMIP	Land-Use Model Intercomparison Project
15	nonlinMIP	Non-linear Model Intercomparison Project
16	OCMIP6	Ocean Carbon Cycle Model Intercomparison Project, Phase 6
17	OMIP	Ocean Model Intercomparison Project
18	PDRMIP	Precipitation Driver and Response Model Intercomparison Project
19	PMIP	Palaeoclimate Modelling Intercomparison Project
20	RFMIP	Radiative Forcing Model Intercomparison Project
21	ScenarioMIP	Scenario Model Intercomparison Project
22	SensMIP	Sensitivity Model Intercomparison Project
23	SolarMIP	Solar Model Intercomparison Project
24	VolMIP	Volcanic Forcings Model Intercomparison Project

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Planned GISS CMIP6 Configurations

Multiple configurations w/variations for DECK runs:

1) GISS-E2.1 (ready)

   Vars: OMA vs MATRIX; R vs H ocean; L40 vs L96

2) GISS-E3 (mid-2016)

   C90+L96 (optional ext. to mesopause), same oceans; QBO, MATRIX aerosols, cloud microphysics, cold pool convection

3) GISS-E4 (2017-2018?)

   C180+L96, GO2 (GISS Ocean 2)

MIP foci

1) DAMIP - single forcing ensembles (SolarMIP/ VolMIP/LUMIP)
2) RFMIP - Essential complement to understanding responses
3) AerChemMIP
4) CFMIP
5) PMIP - ‘out-of-sample’ evaluations

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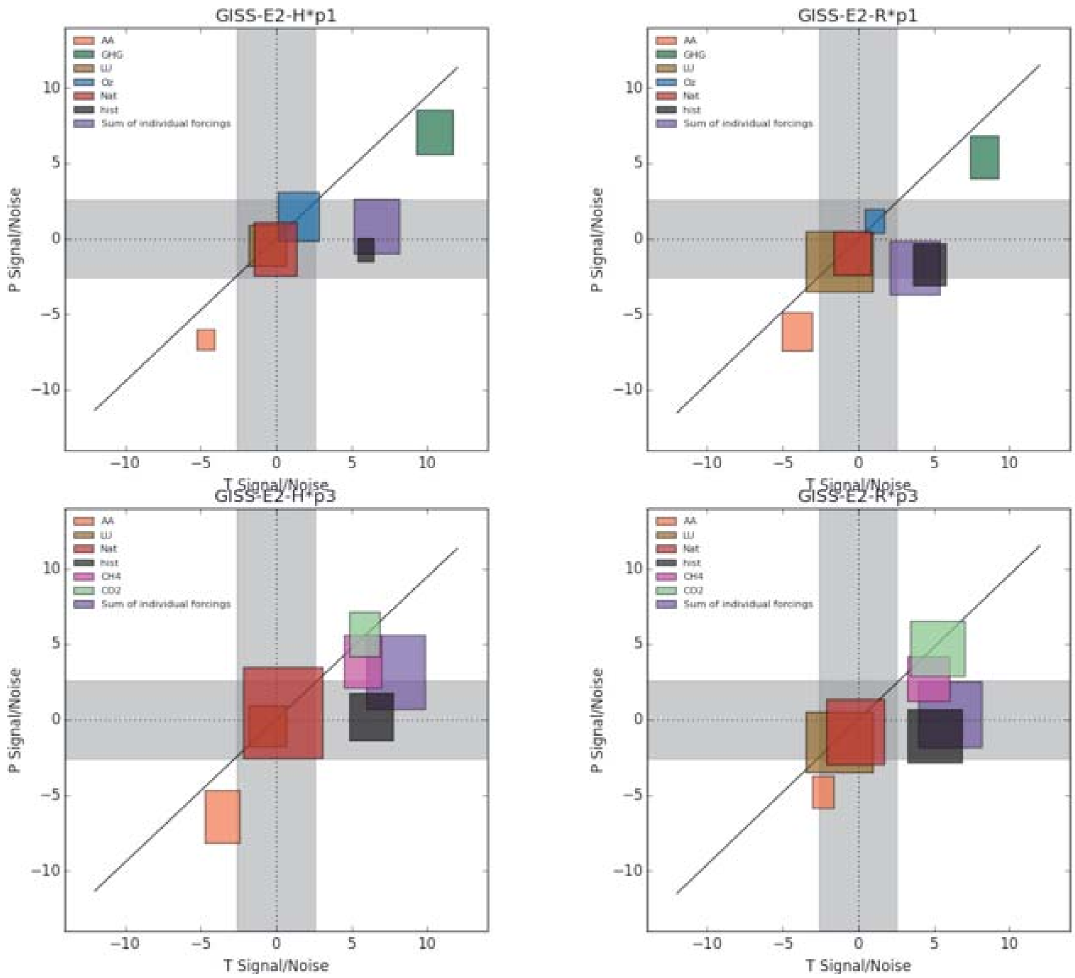
Use of single forcing ensembles

By concentration

By emissions



Different oceans

Marvel et al (2015)

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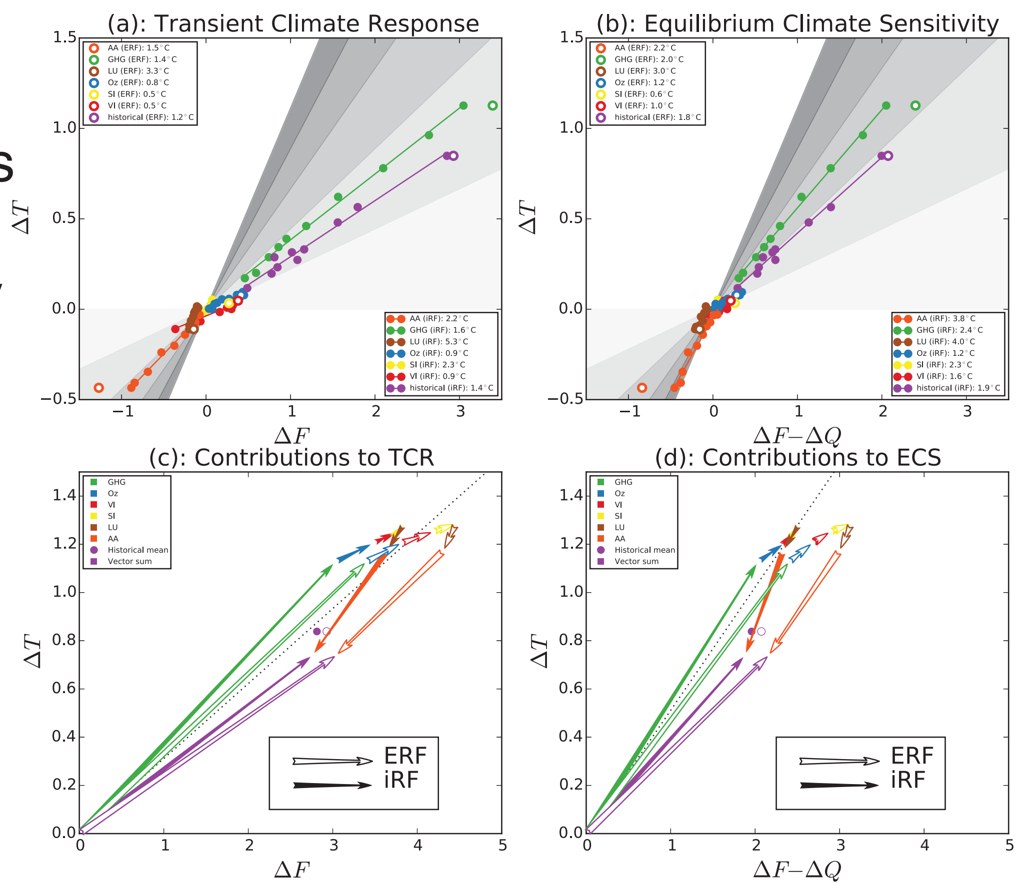
Efficacy of forcings in transient runs

Use historicalMisc runs + forcing calculations to assess predictability of TCR+ECS from historical transients

Historical runs ***underpredict*** sensitivity



Marvel et al, 2016

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Forcing improvements

Irrigation (water added to land surface, either from rivers or groundwater)

Greater differentiation in LU (crops, pasture etc.)

Volcanic forcing by emission

Solar forcing uncertainty

Aerosol forcing - uncertain pre-cursor emissions and atm. processing

Urban fractions

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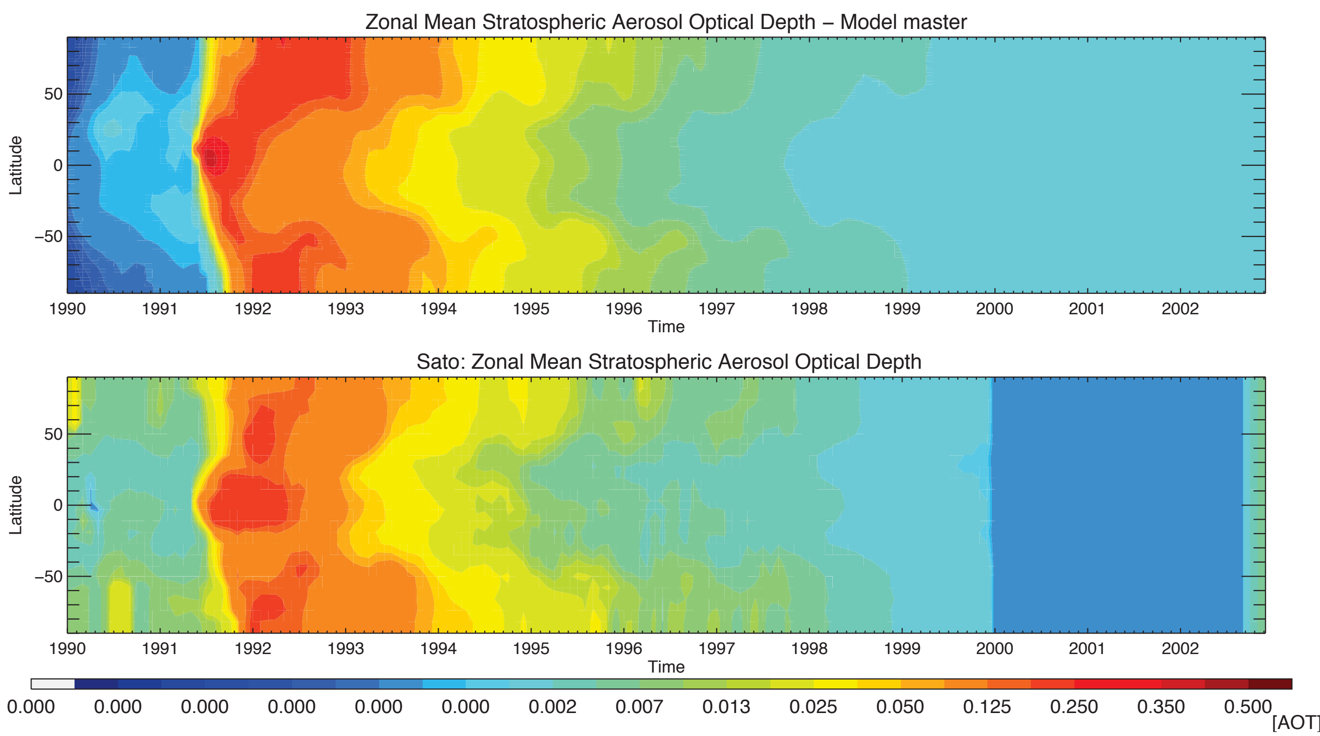
Interactive simulation of explosive volcanoes

Pinatubo AOD via GISS E2.1 + MATRIX



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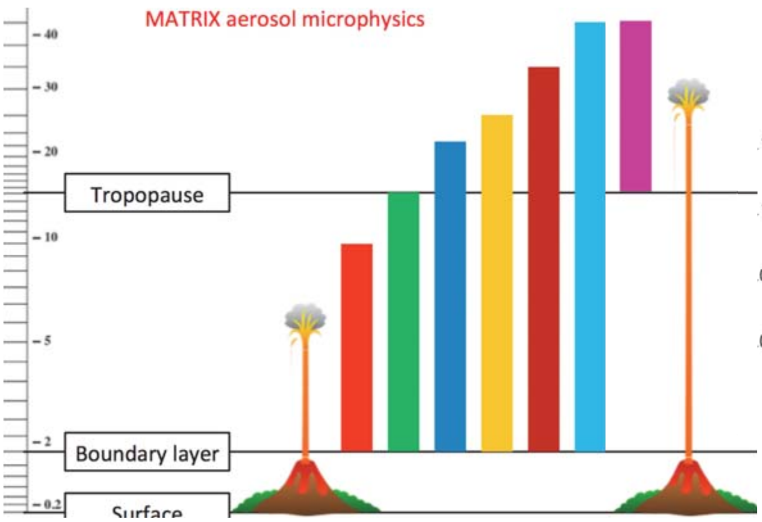
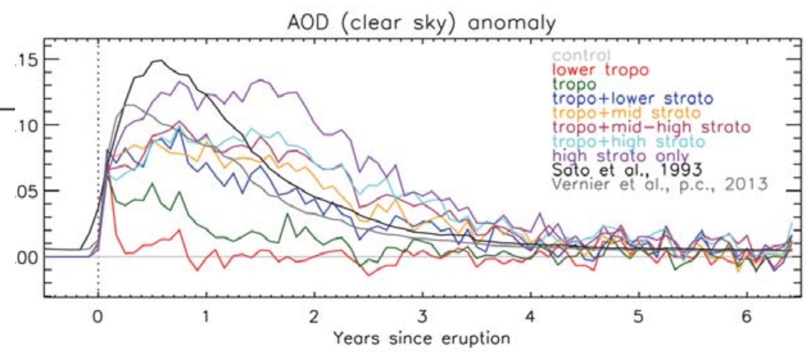
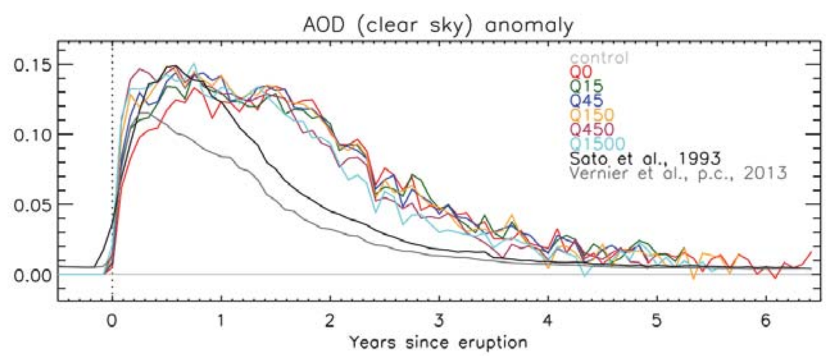
Importance of water injection as well as SO2?







H2O adds OH and speeds processing of SO2
No big impact on RF

GFDL participation in CMIP6

- Top priority MIPs
- Complementarity versus need to engage in same experiments
- Timing for MIPs
- Infrastructure and resources
- Beyond CMIP, interest in new diagnostics or alternative scenarios/activities (e.g. US-relevant)
- Potential for other coordinated modeling activities

Top priority MIPs for GFDL

- Too many MIPs to participate in all of them
- Detection/Attribution (DAMIP; Knutson, Dunne, Horowitz, others)
- Radiative Forcing (RFMIP; Ming)
- Cloud Forcing (CFMIP; Ming)
- Ocean (OMIP; Winton, Hallberg, Dunne)
- Flux Anomaly Forcing (FAFMIP; Winton, Hallberg, Dunne)
- Coupled Carbon Climate Cycle (C4MIP; Dunne)
- Land Use (LUMIP; Dunne/Shevliakova)
- Aerosol and Chemistry (AerChemMIP; Horowitz)
- Dynamics and Variability of the Strat-Trop (DynVar MIP; Horowitz)
- Global Monsoon (GMMIP; Ming)

Complementarity versus need to engage in same experiments

- General international view of science driving the MIPs via WCRP Grand Challenges
- Strong support for all modeling centers to perform scientifically relevant Tier 1 experiments for ensemble quorum and to foster understanding (NRC 2013 report)
- DOE/PCMDI only center part of Earth System Grid Federation
- There are many Tier 2 experiments that could be complementary between centers – ScenarioMIP prime example.
- GFDL target participation toward strengths in overall coupled model construction emphasizing state of the art development, high resolution/numerics/ecosystems in ocean, and land-atmosphere chemistry interactions
- GFDL collaborates with NCAR on sea ice (CICE) and unified clouds (CLUBB)
- Great desire for complementarity in sharing common physics, sea ice, dynamical cores, radiation schemes, biogeochemistry, etc.
- Possible complementarity in sharing dedicated CMIP data archive and analysis cluster for model intercomparison.

Timing for MIPs

- Internally, support for running the DECK periodically for assessment of development state
- GFDL is currently in a computational resource minimum and in the middle of a multi-year model development cycle
- Both of these factors put GFDL in no rush to participate in the MIPs
- We estimate FY17/FY18 as our main participation timeframe.
- Should US Centers Coordinate timing of participation?

Infrastructure and Resources

- For CMIP5, GFDL contributed 180Tb of data with 4 dedicated support scientists in the Modeling Systems Group and about 8 scientists running simulations, CMORizing and quality control.
- Current estimate is that CMIP6 data will be a daunting 1.5 Pb of public data.
- What scope of participation is driven, desired, and supported at the program manager, NOAA headquarters and OMB levels?
- We recognized that the CMIP effort competes with many other science efforts.

Beyond CMIP, interest in new diagnostics or alternative scenarios/activities (e.g. US-relevant)

- Extreme concern about DOE's perceived recent moves to restrict access to CICE development and very strongly believes in open source development
- Interest in research-oriented, sub-seasonal to seasonal prediction leveraging efforts at GMAO, NCEP, and NCAR to test high resolution model ideas and perform OSSEs
- Interest in very high res MIP (10km) focused on CONUS and the National Assessment for improved representation of regional climate change.
- Concern about rise of overall fidelity "metrics" that penalize novelty/risk-taking, and seek re-emphasis on analysis and diagnostics (e.g. NOAA-CPO funded task force for model diagnostics with NCAR)
- Similarly, interest in US-CLIVAR, NOAA-MAPP, NSF, NASA and DOE funded working groups focused on CMIP model analysis
- Ongoing interest in Climate Process Teams which have been a very successful means of bringing new science to multiple modeling centers.
- Interest in the Marine Ice Sheet MIP coming online (demonstrated interest at NOAA/GFDL, DOE/LBNL, NASA/JPL)
- Importance of scientist-to-scientist level coordination (HTAP, CCMI, CPTs, etc.)
- Where should ScenarioMIP fit in?
- Anything coming in the wake of COP21?

Potential for other coordinated modeling activities

- More use of GFDL models in weather forecast mode to enhance collaborations with NOAA/NCEP and NASA/GMAO (e.g. CAPT)
- More use of satellite observations in online simulators (e.g. COSP)
- Potential for coordinated efforts to address particular targeted challenges:
  - Radiative forcing
  - Reanalysis biases for improved air-sea-land fluxes of heat and freshwater
  - Capability based efforts (e.g. ENSO diversity working group)
  - Addressing fundamental uncertainties and biases (e.g. cold tongue/double-ITCZ, diurnal cycle, central U.S. precip.)

Community Earth System Model Plan for CMIP6

2016 US Climate Modeling Summit
March 9 2016

Jean-François Lamarque
CESM Chief Scientist
Atmospheric Chemistry Observations and Modeling
and Climate and Global Dynamics Laboratories
NCAR

CESM interest in MIPs

- Initial MIP participation selection based on specific interest by community (need someone to "champion" a MIP in order to be selected).
- CESM2 has made a strong investment in high-resolution and chemistry/biogeochemistry
- Members of CESM are on the organizing committees of several MIPs (AerChemMIP, DCPP, GeoMIP, ISMIP, LUMIP, OCMIP, PMIP, ScenarioMIP, …)
- Maximize usability of results (CORDEX, VIAAB) -> Are all interested parties around the table?

Jean-François Lamarque
lamar@ucar.edu

Planned versions: ocean at 1º

1. physical climate (1º, low-top)
2. + biogeochemistry (1º, CO_2 emission and/or concentration driven, low-top)
3. + atmospheric chemistry + biogeochemistry (1º, CO_2 emission driven, high-top)
4. physical climate (1/4º atm, low-top)

Jean-François Lamarque
lamar@ucar.edu

CMIP6 MIPs

MIP acronym	MIP name	Interest (H-M-L)	Name of primary sponsor(s)
AerChemMIP	Aerosols and Chemistry Model Intercomparison Project	H	Lamarque/Emmons
C4MIP	Coupled Climate Carbon Cycle Model Intercomparison Project	H	Lindsay
CFMIP	Cloud Feedback Model Intercomparison Project	H	Medeiros/Kay (CU)/Klein (LLNL)
DAMIP	Detection and Attribution Model Intercomparison Project	H	Tebaldi/Arblaster
DCPP	Decadal Climate Prediction Project	H	Danabasoglu/Meehl
GeoMIP	Geoengineering Model Intercomparison Project	H	Tilmes/Mills
GMMIP	Global Monsoons Model Intercomparison Project	M	Fasullo
HighResMIP*	High Resolution Model Intercomparison Project	M	Neale/Bacmeister
ISMIP6	Ice Sheet Model Intercomparison Project for CMIP6	H	Lipscomb (LANL)/Otto-Bliesner
LS3MIP	Land Surface, Snow and Soil Moisture	H	D. Lawrence
LUMIP	Land-Use Model Intercomparison Project	H	D. Lawrence/P. Lawrence
OMIP/OCMIP	Ocean Model Intercomparison Project	H	Danabasoglu
PMIP	Palaeoclimate Modelling Intercomparison Project	H	Otto-Bliesner
RFMIP	Radiative Forcing Model Intercomparison Project	H	Gettelman/Neale
ScenarioMIP	Scenario Model Intercomparison Project	H	Meehl/O'Neill/P. Lawrence
VolMIP	Volcanic Forcings Model Intercomparison Project	H	Mills/Otto-Bliesner
Data only			
CORDEX	Coordinated Regional Climate Downscaling Experiment	M	Mearns/Gutowski
DynVar	Dynamics and Variability of the Stratosphereâ€ Troposphere System	H	Marsh
SIMIP	Sea-Ice Model Intercomparison Project	H	Bailey/Holland/Jahn (CU)/Hunke (LANL)
VIAAB	VIA Advisory Board for CMIP6	H	Mearns/O'Neill
Not participating			
FAFMIP	Flux-Anomaly-Forced Model Intercomparison Project	M	
NonlinMIP	Nonlinear climate responses to CO2		

Jean-François Lamarque
lamar@ucar.edu

CMIP6 DECK + Tier 1

- Low resolution versions (years)
  - CAM: 5,000
  - CAM-BGC: 12,000
  - WACCM-BGC: 6,500
  - Total cost: ≈250M core-hours
- High resolution version (years)
  - CAM:1,750
  - Total cost: ≈260M core-hours

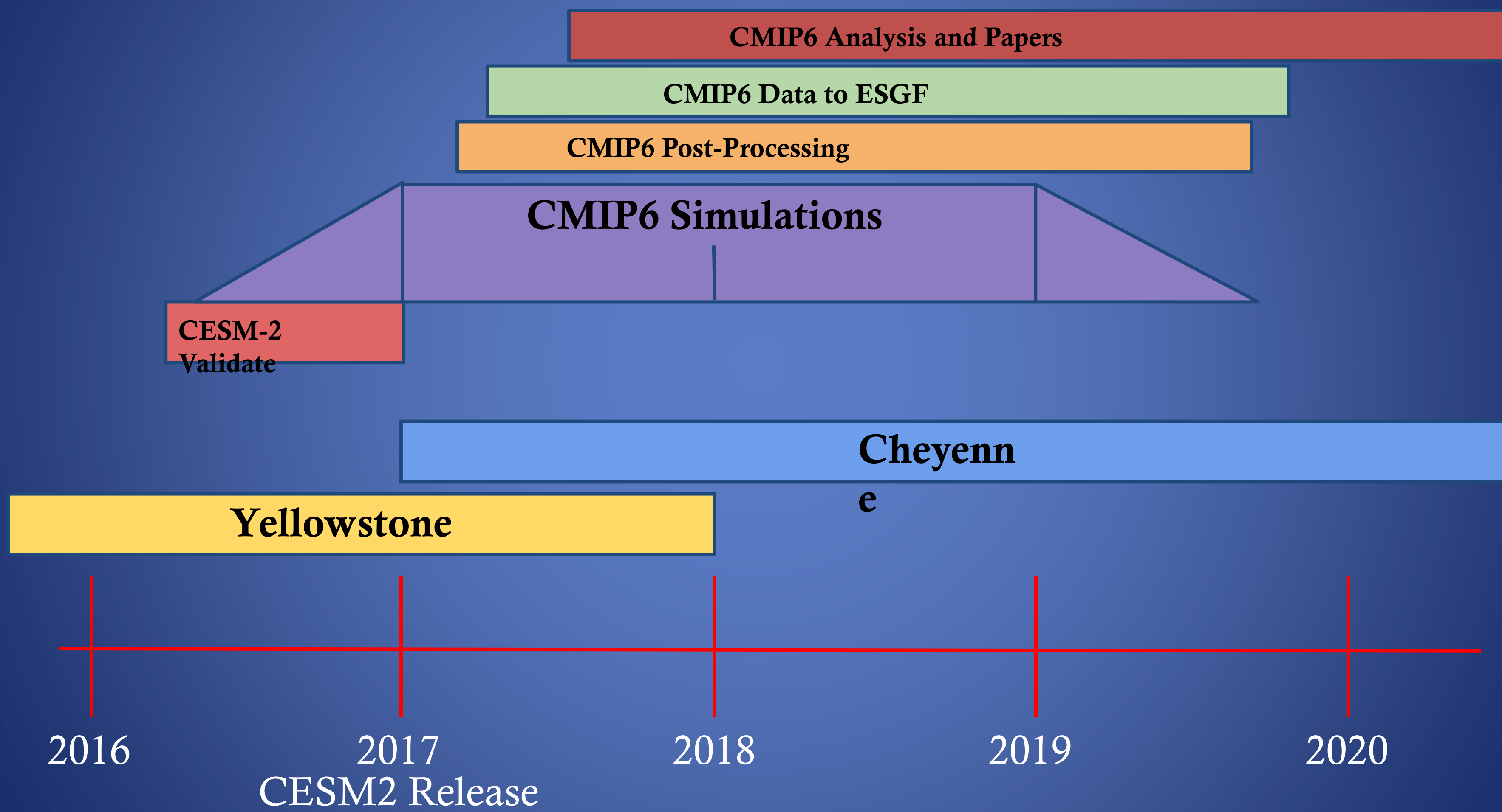
1) This is only for Tier 1 while a lot of interesting science resides in Tier 2/3 experiments

2) Large factor is #years performed at high-resolution.

Based on Yellowstone core-hours; 1 year (Yellowstone) ≈ 700M core-hours

Jean-François Lamarque
lamar@ucar.edu

NCAR CMIP6 Allocation Planning



Jean-François Lamarque
lamar@ucar.edu