GFDL's CMIP6 activities and participation

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GFDL's historical participation in CMIP/IPCC

- GFDL has participated in all past Coupled Model Intercomparison Projects (CMIP) and contributed to all IPCC assessments to date
- CMIP3 participation with coupled models (CM2.0, CM2.1) and significant contributions to AR4 assessment
- GFDL's CMIP5 generation models (CM3, ESM2M, ESM2G, HiRAM) included aerosol-cloud feedbacks and a closed emission-driven carbon cycle
- Lab-wide contributions to AR5 assessment spanning diverse leadership and participatory roles

Expanded scope of CMIP6 compared to CMIP5

WCRP Grand Challenges: (1) Clouds, circulation and climate sensitivity, (2) Changes in cryosphere, (3) Climate extremes, (4) Regional climate information, (5) Regional sea-level rise, and (6) Water availability, plus an additional theme on "biospheric forcings and feedbacks"

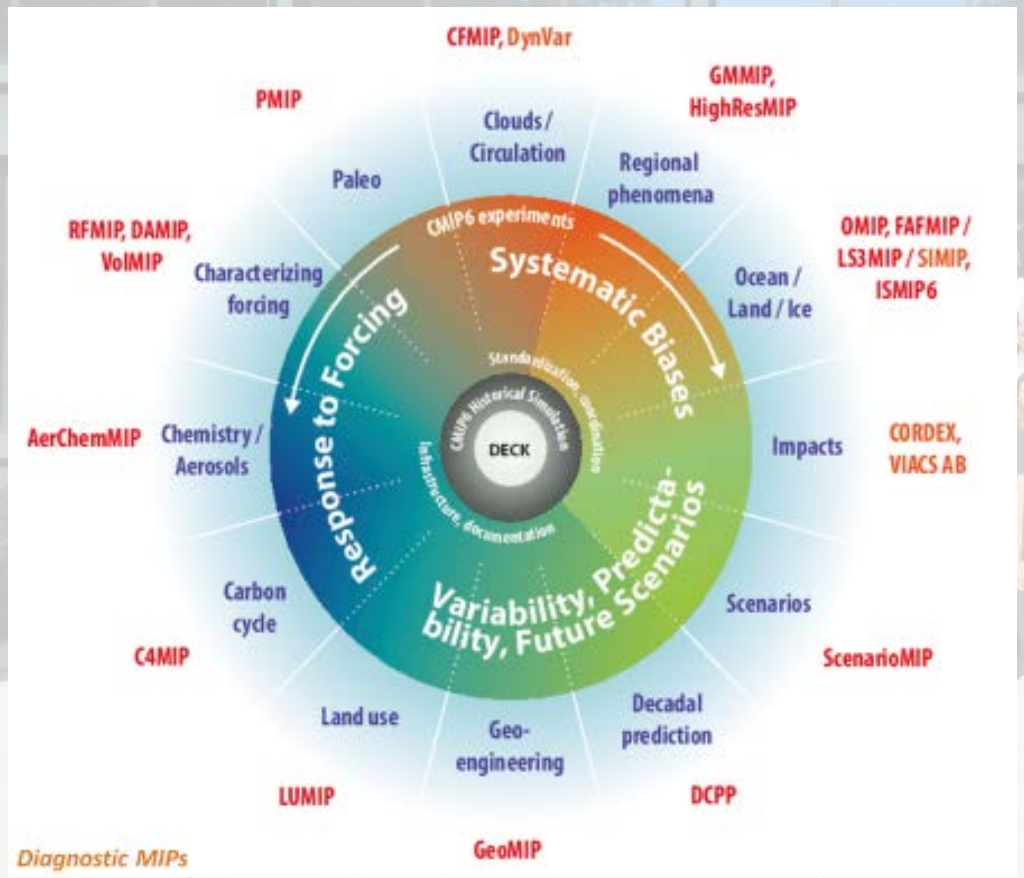
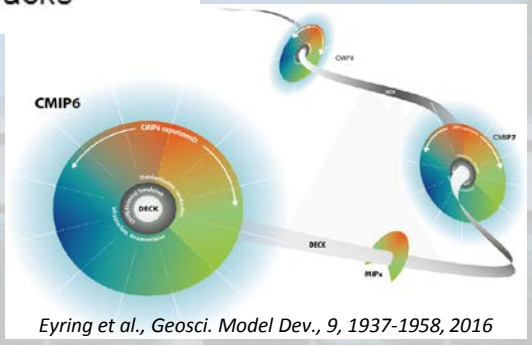


Image: http://crescendoproject.eu/about/crescendo-in-cmip6/



Eyring et al., Geosci. Model Dev., 9, 1937-1958, 2016

- Core simulations performed routinely (DECK)
- CMIP6 entry card (Historical)
- 21 endorsed Model InterComparison Projects (MIPs)
- Comprehensive Data Request and Quality Control
- ES-DOC
- DOIs

GFDL's Models for CMIP6

- GFDL continues its participation in CMIP6/AR6 with two new models (all new components) and an existing CMIP5 model
- New models focus on increased resolution/complexity
- CM4
  - C96 (100km) atm/land, 33 atm levels, 'lite' chemistry
  - 0.25 deg ocean/ice with new reduced ocean biogeochemistry
- ESM4 (closed carbon cycle)
  - C96 (100km) atm/land, 49 atm levels, full chemistry
  - 0.5 deg ocean/ice, comprehensive ocean biogeochemistry model
  - Comprehensive land including vegetation plasticity, hillslopes, microbes, and N cycling
- ESM2M (AR5 closed carbon cycle model)
  - C48 (200km) atm/land, 24 atm levels, 1 deg ocean/ice/ocean biogeochemistry

GFDL's contributions to CMIP6

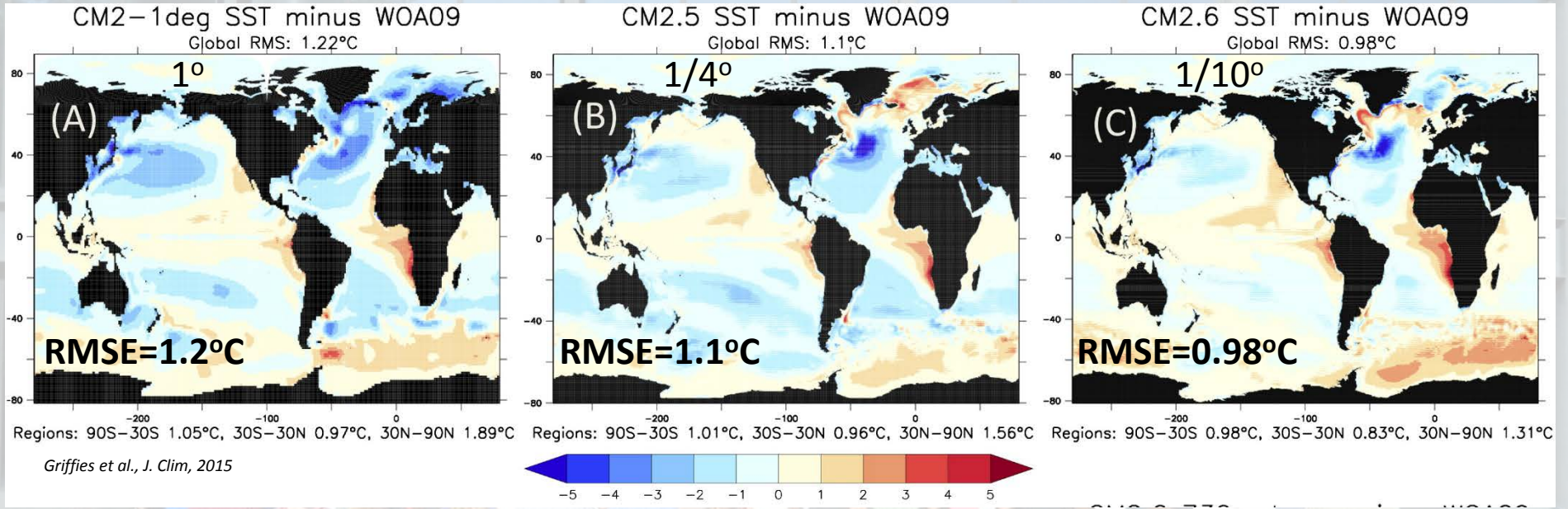
- DECK and CMIP6 entry card (both CM4 and ESM4)
- GFDL leading and/or participating in 12 MIPs
  - Led/Contributed to Special Issue in *Geoscientific Model Development*
  - Multiple groups and expertise; numerous experiments and ensembles
    - **AerChemMIP**: Aerosols and Chemistry
    - **C4MIP**: Coupled Climate Carbon Cycle
    - **CFMIP**: Cloud Feedback
    - **DAMIP**: Detection and Attribution
    - **DCPP**: Decadal Climate Prediction Project
    - **DynVar**: Dynamics and Variability of the Stratosphere-Troposphere System
    - **FAFMIP**: Flux-Anomaly-Forced
    - **GMMIP**: Global Monsoons
    - **LUMIP**: Land-Use
    - **OMIP**: Ocean and Ocean Biogeochemistry
    - **RFMIP**: Radiative Forcing
    - **ScenarioMIP**: Future Scenarios
- Production: ~10,000 simulation years (Tier 1 expts only)
- Estimated 1Pb of publicly served data (188Tb in AR5)

CMIP6 Teamwork at GFDL

Comprehensive lab-wide efforts to ensure GFDL's leadership and participation in CMIP6/AR6

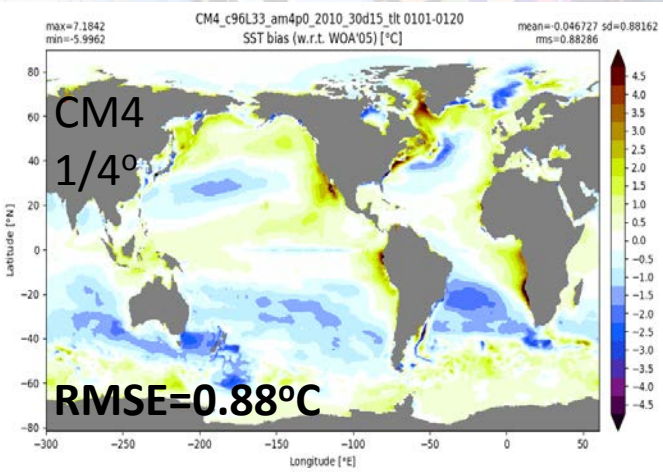
- Model Development Team (MDT) Steering Committee
- Model Development Working Groups
  - (AWG, LWG, OWG, CWG, ESWG, DET)
- Modeling Systems Group
  - (CMIP6 Model Development Liaison, FRE Team, Data Portal Team, ES-DOC liaison, …)
- Technical Services Group
  - (Computing Systems at GFDL, ORNL, …)
- Administrative Group
- Tremendous efforts behind the scenes
- CMIP6 coordinator

From CM2 to CM4: improved SST biases



Griffies et al., J. Clim, 2015

- CM4's SST errors are similar to CM2.6 (GFDL's previous best simulation)
- We expect these can be improved further with higher ocean resolution as was seen going from CM2.5 to CM2.6 or with an eddy parameterization



Thank you!

Backup Slides

CMIP6 Data Request

Data volume overview, upto tier 1 and priority 1 -- provisional

Data volumes are estimated for nominal model with 1 degree resolution and 40 levels in the atmosphere and 0.5 degrees with 60 levels in the ocean. The "Requesting MIP" - the MIP specifying the data required to meet their scientific objectives. The "designing MIP" (columns) is the MIP specifying the experimental design. For volume estimation, data is assumed to be on a regular 1-degree grid unless specifically requested on another grid (e.g. the native model grid) The figures below represent work in progress: are still omissions and flaws, more details are on the Data Request home page.

	CMIP	AerChemMIP	C4MIP	CFMIP	DAMIP	DCPP	FAFMIP	GeoMIP	GMMIP	HighResMIP	ISMIP6	LS3MIP	LUMIP	OMIP	PMIP	RFMIP	ScenarioMIP	VolMIP	TOTAL
CMIP	32T																	32T	3.3T
AerChemMIP	10T	130G													3G	641G		11T	5.3T
C4MIP	4.1T		1.5T		780G			521G				385G	209G		760G		782G		9.1T	6.6T
CFMIP	11T			3.5T														14T	13T
DAMIP	6.2T				8.9T													15T	8.4T
DCPP	108G					1.7T												1.9T	1.7T
FAFMIP	3.8T						622G											4.5T	3.5T
GeoMIP	8.5T							3.0T										11T	2.7T
GMMIP	47G								188G									235G	170G
HighResMIP	49T									4.1T								53T	44T
ISMIP6	544G										799G							1.3T	420G
LS3MIP	264G											2.1T				1.3T		3.6T	3.4T
LUMIP	573G		494G									175G	618G			599G		2.5T	872G
OMIP	17T													4.9T				22T	4.9T
PMIP	8.1T		370G												7.4T			16T	10T
RFMIP	6.5T															876G		7.4T	6.0T
ScenarioMIP																			
VolMIP	6.5T																11T	17T	10T
CORDEX	7.6T															6.9T		14T	4.9T
DynVar	2.7T								245G							980G	1.5T	5.5T	2.8T
SIMIP	653G																	653G	338G
VIACSAB	7.3T		618G	265G	2.9T	2.7T	239G	3.3T	131G	310G	2.3T	136G	301G		2.9T		11T	34T	20T
TOTAL	106T	130G	2.5T	3.7T	11T	4.3T	859G	6.0T	302G	4.2T	2.7T	2.4T	840G	4.9T	10T	876G	17T	11T	190T	

http://clipc-services.ceda.ac.uk/dreq/tab01_1_1.html