WGCM and CMIP update

WGNE 35

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November 2020

Online

WORLD METEOROLOGICAL ORGANIZATION

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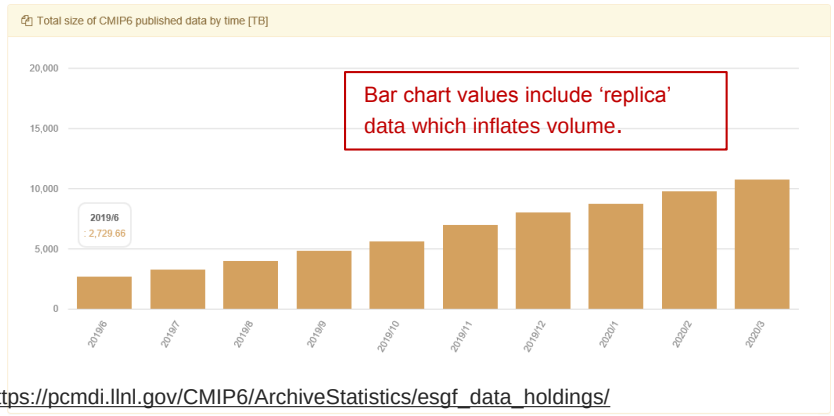
Intergovernmental Oceanographic Commission

International Science Council

WCRP World Climate Research Programme

CMIP6: Progress and Status of MIPs

- 312 distinct experiments for CMIP6 are steadily being populated.
- Result being used in IPCC AR6 report in prep.
- Model output now being served by ESGF from 38 institutions (56 models or versions)
- currently more than 7.5 PB of data and climbing (compared to 1.7 PB total in CMIP5)
- .



https://pcmdi.llnl.gov/CMIP6/ArchiveStatistics/esgf_data_holdings/

model	AerChemMIP	C4MIP	CDRMIP	CFMIP	CMIP	DAMIP	DCPP	FAFMIP	GMMIP	GeoMIP	HighResMIP	ISMIP6	LS3MIP	LUMIP	OMIP	PAMIP	PMIP	RFMIP	ScenarioMIP	VolMIP
4AOP-v1-5																		1/3		
ACCESS-CM2	3/5				5/10			7/7										5/5	4/12	
ACCESS-ESM1-5	3/5	8/10	6/6		7/20	3/9											1/1	6/6	4/12	
ARTS-2-3																		1/4		
AWI-CM-1-1-HR											3/3									
AWI-CM-1-1-LR											3/3									
AWI-CM-1-1-MR	1/5				4/8											8/800			4/8	
AWI-ESM-1-1-LR					2/2												3/3			
BCC-CSM2-HR											1/1									
BCC-CSM2-MR		3/3		5/5	7/13	3/9	1/8		3/3				1/1	7/7					4/4	
BCC-ESM1	18/26				5/9															
CAMS-CSM1-0	1/2				5/11				1/3		1/1								5/10	
CAS-ESM2-0					5/11			7/7							1/1					
CESM1-1-CAM5-CMIP5							1/40													
CESM1-CAM5-SE-HR											3/3									
CESM1-CAM5-SE-LR											3/3									
CESM2		3/3	1/1	24/24	7/27	3/8		5/5	1/3			4/4	5/7	12/16	2/3	8/800	3/3	6/6	4/12	
CESM2-FV2					5/9															
CESM2-WACCM	17/19				5/9					3/5								1/1	5/17	
CESM2-WACCM-FV2					5/9															
CIESM					5/9				1/3										3/3	
HadGEM3-GC31-HH											3/3									
HadGEM3-GC31-HM											5/13									
HadGEM3-GC31-LL	2/2			22/22	5/15	3/12					4/14		2/2	2/2				7/12	3/9	
HadGEM3-GC31-LM											2/10									
HadGEM3-GC31-MH											1/1									
HadGEM3-GC31-MM					5/11		7/70				6/14					4/600			2/4	1/10
IITM-ESM					5/5				1/1										2/2	
INM-CM4-8	1/1				5/5												3/3		4/4	
INM-CM5-0	1/5				5/14														4/8	
INM-CM5-H											3/3									
IPSL-CM6A-ATM-HR											1/1									
IPSL-CM6A-LR	3/20	2/2		16/16	6/69	6/59	15/305		2/23	3/3	1/1		4/6	7/12	1/4	1/200	3/6	14/52	8/50	
IPSL-CM6A-LR-INCA	8/8																	2/2		
KACE-1-0-G	1/3				5/7														4/12	
KIOST-ESM					5/5														3/3	
LBLRTM-12-8																		1/3		
MCM-UA-1-0	1/1				4/5														4/4	
MIROC-ES2L	1/1	12/12	8/8		7/20									5/5	1/1		4/4		5/9	
MIROC6	20/30			5/6	5/63	11/33	2/20	7/7	1/5				4/4	1/1	2/4	7/700		11/21	8/157	
MPI-ESM-1-2-HAM	3/6				4/5														1/2	
MPI-ESM1-2-HR	1/10				5/16		1/5	6/6			3/3								4/16	
MPI-ESM1-2-LR	2/13	7/20	2/2		6/25								5/8	15/22			2/2	6/11	4/40	
MPI-ESM1-2-XR											3/3									
MRI-AGCM3-2-H											2/2									
MRI-AGCM3-2-S											2/2									
MRI-ESM2-0	35/45	5/5		11/11	7/29	5/23		7/7	3/11						3/10		2/2	6/6	8/17	
NESM3					5/13												2/2		3/6	
NICAM16-7S											1/1									
NICAM16-8S											1/1									
NICAM16-9S											1/1									
NorCPM1					6/75		2/80													
NorESM1-F					1/1												3/3			
NorESM2-LM	21/40	4/4	4/4		7/9	3/9								5/5	3/3	6/800	2/2	13/39	4/8	
NorESM2-MM	3/3				5/7													3/3	4/4	
RRTMG-LW-4-91																		1/1		
RRTMG-SW-4-02																		1/1		
RTE-RRTMGP-181204																		1/1		
SAM0-UNICON					5/5															
TaiESM1	1/1				5/5														1/1	
UKESM1-0-LL	36/57	11/13	7/9		7/27					4/12			2/2	9/20				6/6	7/52	

CMIP
The World Climate Research Programme's Coupled Model Intercomparison Project

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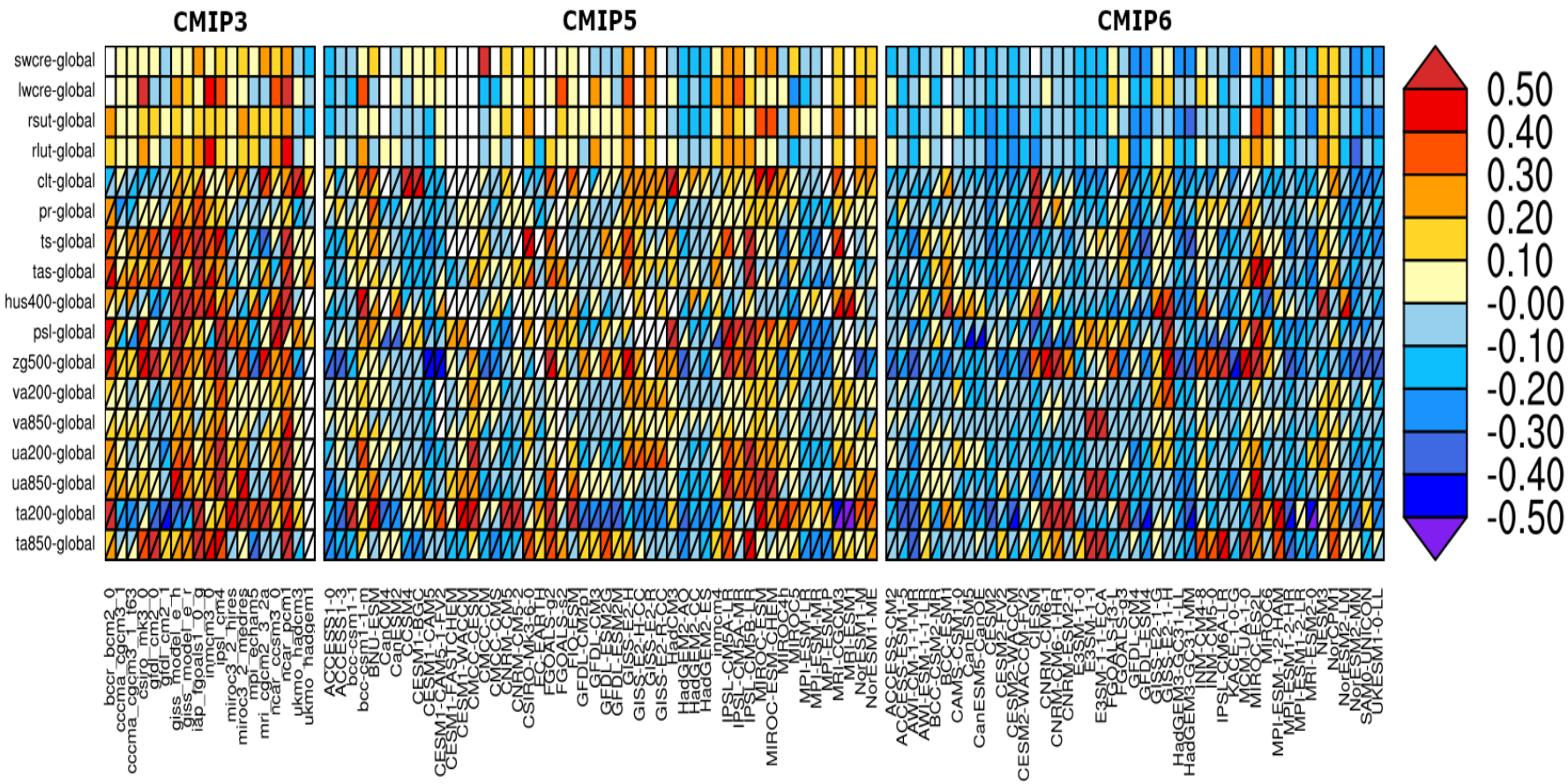
WGCM highlights

- WGCM/CMIP panel has led the analysis of the CMIP6 multi-model range of climate sensitivity (Meehl et al, 2020) and more detailed analysis is happening e.g. under CFMIP (Zelinka et al 2020; Bock et al, 2020)

- Many science highlights emerging from other MIPs
  - Application of ESMValTool to CMIP6 ensemble (Bock et al, 2020)
  - Carbon Feedbacks (Arora et al, 2020)
  - Role of High Resolution (Vanniere et al, 2018)
  - RFMIP – characterisation of ERF and adjustments (Smith et al, 2020)
  - ScenarioMIP comparison with CMIP5 (Tibaldi et al, 2020, Forster et al, 2020)
  - Detection and Attribution (Gillet et al, 2020)
  - PMIP – Mid-Holocene evaluation (Brierley et al, 2020)
  - DynVAR – Response of SSW (Ayarzagüena et al 2020)
  - …..

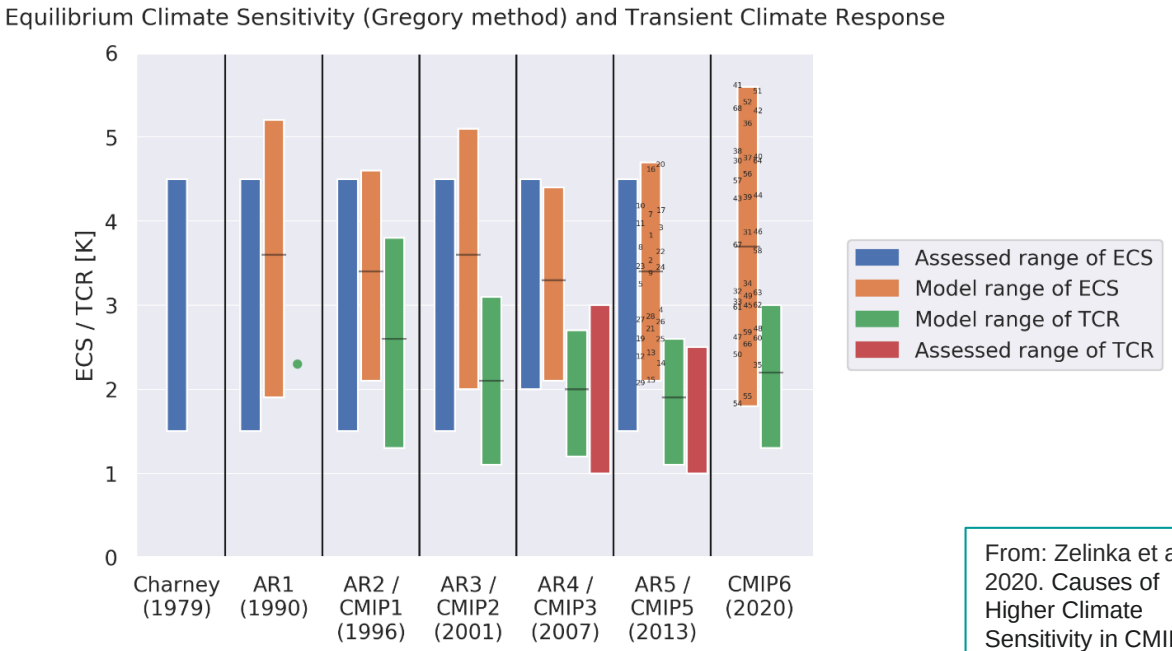
ESMValTool: Model Improvement

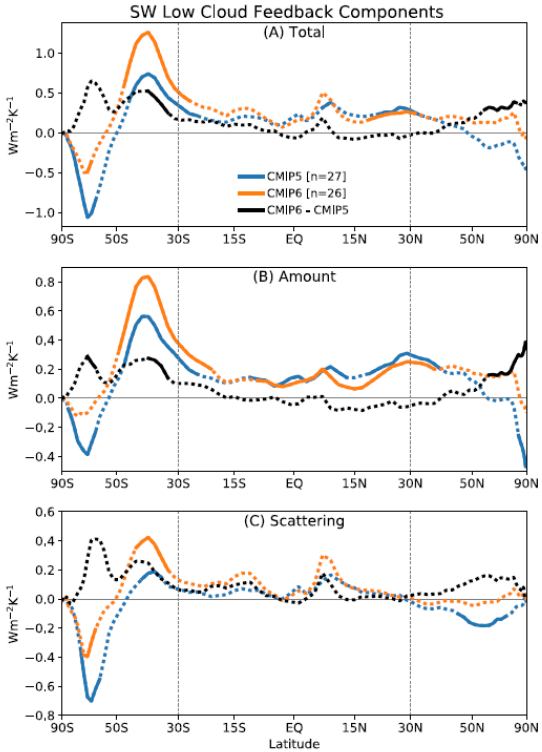


Bock et al., JGR: Atmospheres, 2020

Climate Sensitivity in CMIP6

- As a follow-up to the Barcelona CMIP workshop, held in March, 2019, the CMIP panel has led the development and submission of a paper laying out the history of quantifying climate sensitivity and comparing the CMIP6 multi-model ensemble sensitivity to previous results.
- The CFMIP community has led a paper on the causes of the higher ECS





From: Zelinka et al, 2020. Causes of Higher Climate Sensitivity in CMIP6 Models GRL

From: Meehl, Senior, Eyring, Flato, Lamarque, Stouffer, Taylor, and Schlund, 2020. Context for interpreting equilibrium climate sensitivity and transient climate response from the CMIP6 earth system models; *Science Advances, in press.*

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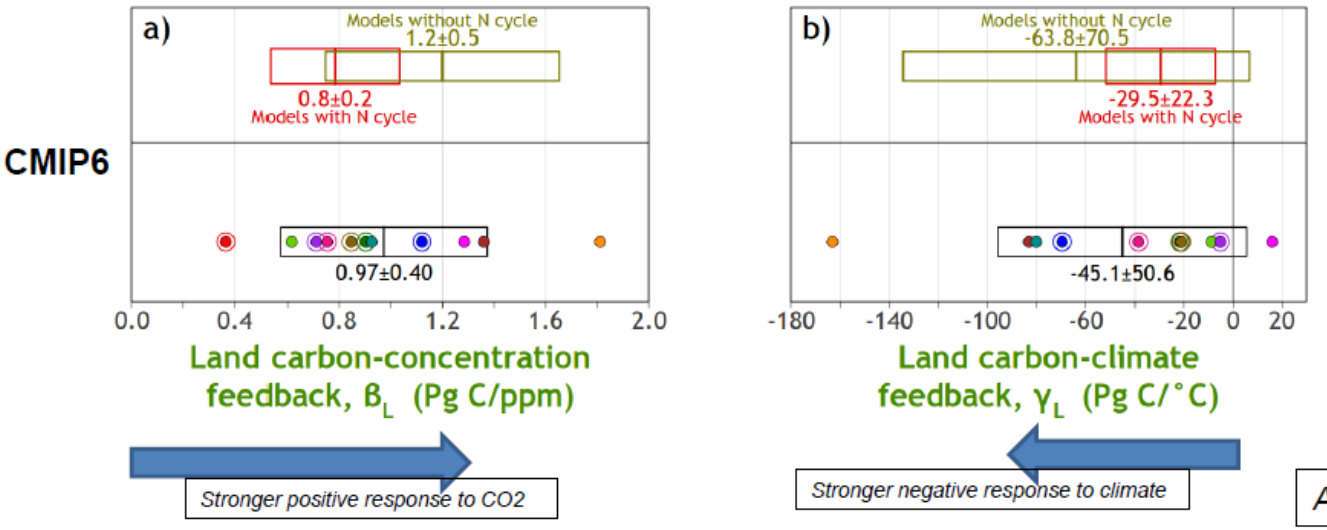
Carbon Feedbacks in CMIP6

C⁴MIP: Carbon cycle feedback analysis & Zero Emissions Commitment

Vivek Arora, Andrew MacDougall, Chris Jones, Pierre Friedlingstein

Land carbon feedback components



Arora et al. (2020, in prep.)

Circles around the coloured dot indicate models that include land nitrogen cycle.

- **Biggest advance** is having more models (approx. half) with a land-nitrogen cycle. There is a tendency for these to have reduced feedback responses.
- **Models with nitrogen cycle over land** exhibit weaker strengths of the feedbacks and a narrower spread across models.

Benefits from inclusion of additional processes (e.g. nitrogen cycle) or components (e.g. ISMIP6)

CMIP-IPO and Infrastructure

- CMIP has grown into a very large and complex multi-national undertaking. Although it mobilizes a huge (~ $1B) investment, and its results are essential to a vast array of stakeholders, it is organized by a small group of passionate volunteers in the CMIP Panel and WIP. It is not sustainable in its current form.

- A recent call for an International CMIP Office (CMIP-IPO) has delivered several excellent bids and the selection process is currently underway

- WMO resolution-67 to set up a task team to discuss sustaining/operationalising parts of CMIP infrastructure was passed and a WCRP led task-team has been working up a detailed document for WMO council-73 (2021)

- How the CMIP-IPO will interact with the new WCRP structures is under discussion, but opportunities for closer WGCM-WGNE interactions under the new structure looks very promising.

WGCM Future Plans

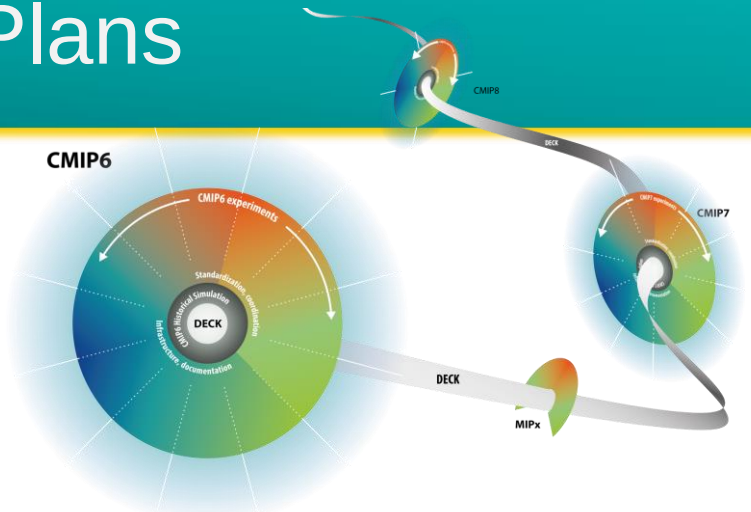
1. Planning for CMIP7
   - Community Consultation
   - CMIP6+ (CovidMIP – AQ and climate impact of pandemic)

2. Multi-Model Ensembles
   - Motivate and co-ordinate enhanced research on MMEs and LMEs
   - quantify confidence/uncertainty in assessments and derived products

3. Global and regional modelling interactions
   - Stronger links on HighResMIP/CORDEX intercomparisons
   - Model-Data home and Regional climate for societies structures

4. Outreach to impacts and User communities
   - CMIP-IPO to coordinate activity

CMIP Future Plans



- CMIP6 was very ambitious 23 endorsed MIPs; >300 experiments.
- Results will fuel climate research for years to come (CMIP5 results continue to be used; CMIP results also fuel a vast range of derived climate information products and services.
- CMIP-IPO will help with logistics of organizing and delivering this massive effort and out-reach to the wider community in support of the CMIP Panel and WIP
- WGCM, CMIP Panel, and WIP will undertake a substantive consultation in the coming year involving the climate science community, modelling centres, data centres, and other stakeholders to develop plans for CMIP7

Planning for CMIP7

Initial gathering of “Hallway” conversations

- CMIP6 too complex (number of experiments, data requirements, ..)
- Some MIPs have very few participants
- Issues with ES-DOC, forcings, ….
- Is this the best/most useful science/kW or science/FTE?

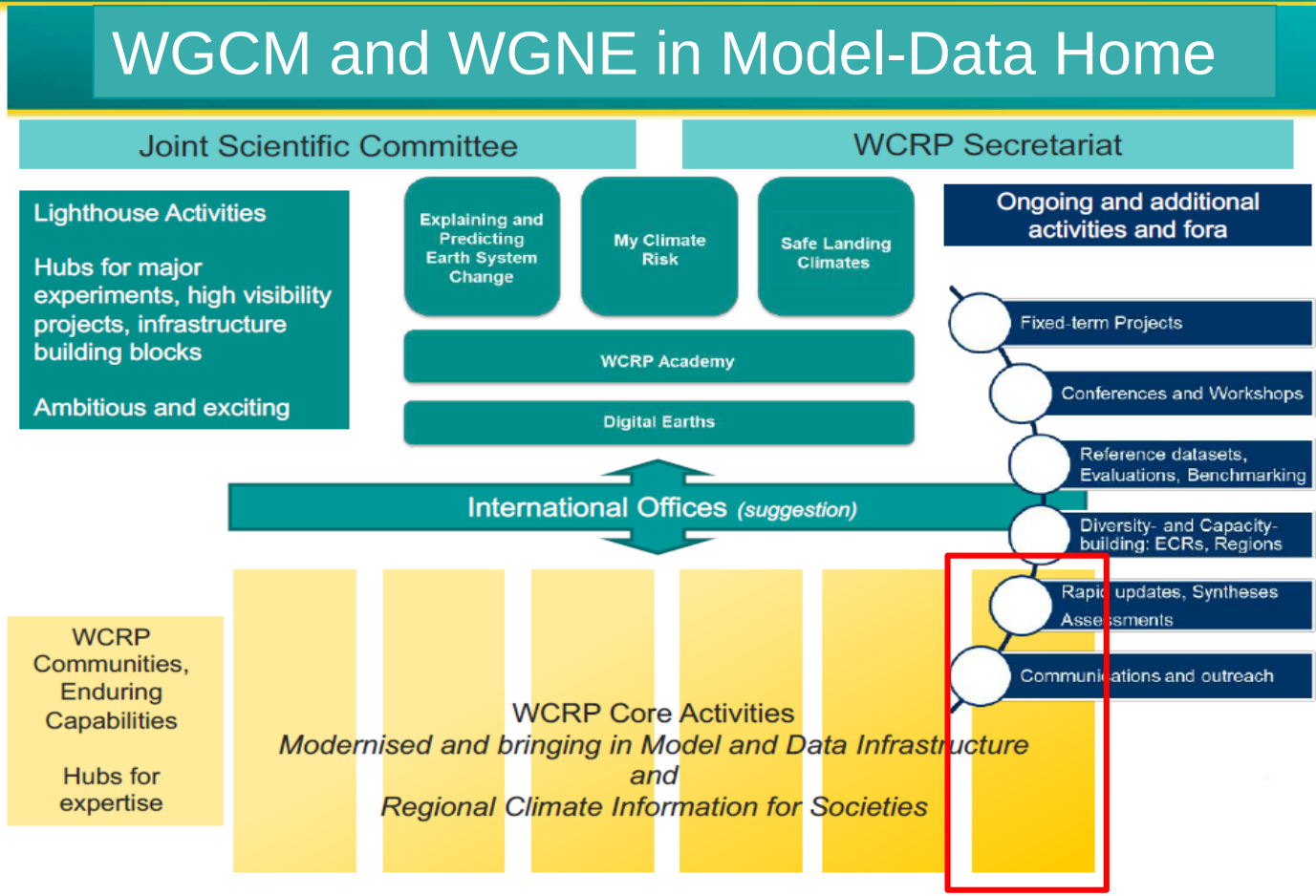
CMIP5 survey (Stouffer et al., BAMS, 2017) shows that a lot of concerns expressed in that document are still valid…

A new survey(s) should

- Focus on the right groups: Modeling groups, MIP steering groups, Stakeholders
- Focus on potential ideas such as
  - Separation of science targets and “run-of-the-mill” simulations
  - Should the MIPs be re-evaluated? How to handle new MIPs
  - What is the value of the DECK?
  - Can we satisfy all stakeholders with CMIP7?

WCRP structure: Model-Data home

- Model-Data home will include the current modelling and data working groups and DAOS.
- Options to align this home with the CMIP-IPO or not are under discussion.
- SSG representing these communities will govern (ex-officio from other homes, WWRP, GAW, GCOS and other panels)
- Great opportunity for WGCM-WGNE coordination on ES model development



'Earth system Modelling and Observational Capabilities'

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