

Overview of the Coupled Model Intercomparison Project Phase 6 (CMIP6) Experimental Design and Organization



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16-18 May 2016

2016 International Land Model Benchmarking (ILAMB) Workshop

Washington DC, USA

Please see the CMIP Panel website for additional information and updates:

<http://www.wcrp-climate.org/index.php/wgcm-cmip/about-cmip>

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CMIP6 Organization

- **CMIP Panel** (V. Eyring (chair), S. Bony, J. Meehl, C. Senior, B. Stevens, R. Stouffer, K. Taylor) which is responsible for direct coordination of CMIP and overseeing the whole CMIP process.
- **WGCM Infrastructure Panel** (WIP, co-chairs V. Balaji & K. Taylor): Establishes standards and policies for sharing climate model output; puts the data request together technically (M. Juckes).

CMIP6 Design

Based on an extensive period (two years) of community consultation

- Summer 2013 CMIP5 survey and Aspen & WGCM/AIMES 2013 meetings
- Initial proposal for the design of CMIP6 (Meehl et al., EOS, 2014).
- Feedback on this initial CMIP6 proposal has been solicited until September 2014.
- The WGCM and the CMIP Panel have then finalized the CMIP6 design at the WGCM 18th session (October 2014, Grainau) in consultation with the model groups and MIP co-chairs.

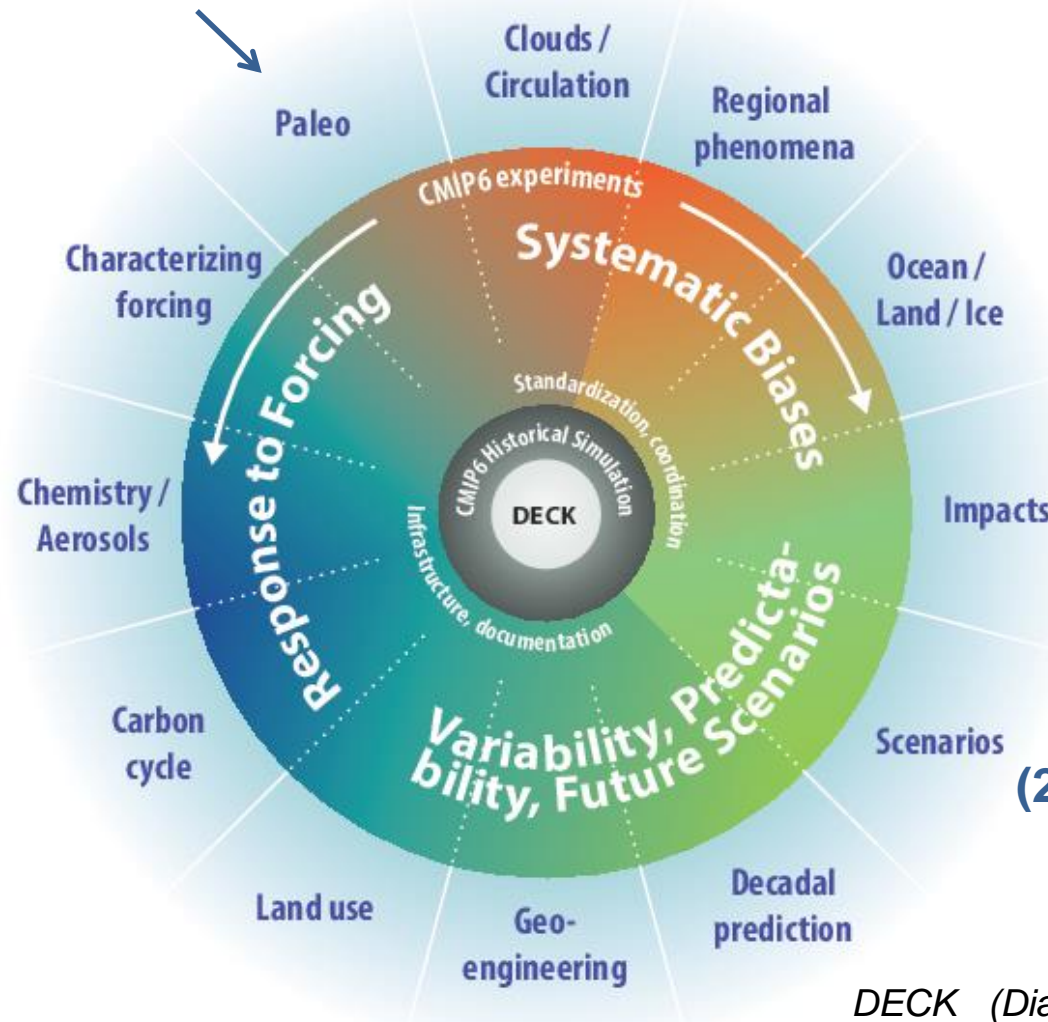


CMIP6 Design: Scientific Focus

- The **scientific backdrop** for CMIP6 is the **WCRP Grand Challenges**:
 1. Clouds, Circulation and Climate Sensitivity
 2. Changes in Cryosphere
 3. Climate Extremes
 4. Regional Sea-level Rise
 5. Water Availability
 6. Decadal Predictability
 7. Biogeochemical forcings and feedbacks
- The specific experimental design is focused on **three broad scientific questions**:
 1. How does the Earth System respond to forcing?
 2. What are the origins and consequences of systematic model biases?
 3. How can we assess future climate changes given climate variability, predictability and uncertainties in scenarios?

CMIP: a More Continuous and Distributed Organization

(3) CMIP-Endorsed Model Intercomparison Projects (MIPs)



(1) A handful of common experiments

DECK (entry card for CMIP)

- AMIP simulation (~1979-2014)
- Pre-industrial control simulation
- 1%/yr CO₂ increase
- Abrupt 4xCO₂ run

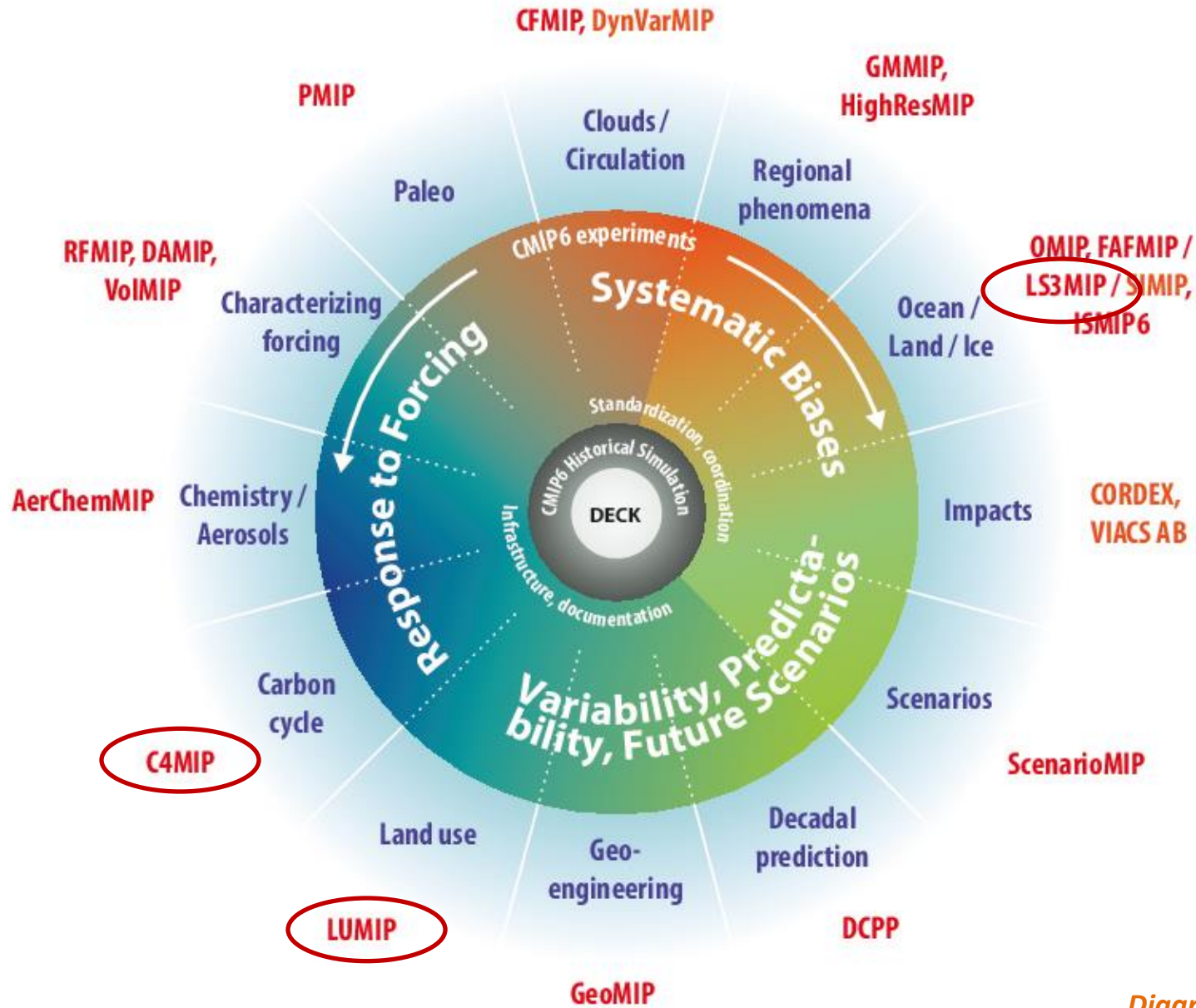
CMIP6 Historical Simulation (entry card for CMIP6)

- Historical simulation using CMIP6 forcings (1850-2014)

(2) Standardization, coordination, infrastructure, documentation

DECK (Diagnosis, Evaluation, and Characterization of Klima) & CMIP6 Historical Simulation to be run for each model configuration used in CMIP6-Endorsed MIPs

21 CMIP6-Endorsed MIPs

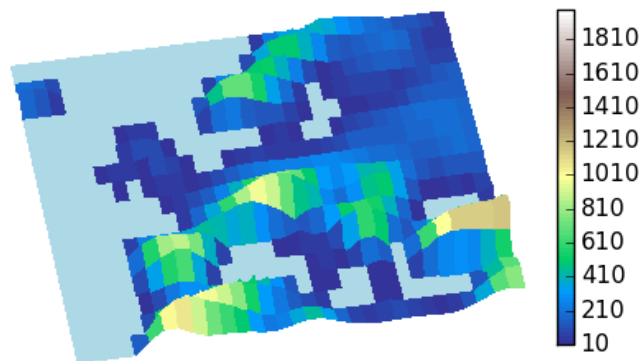


Diagnostic MIPs

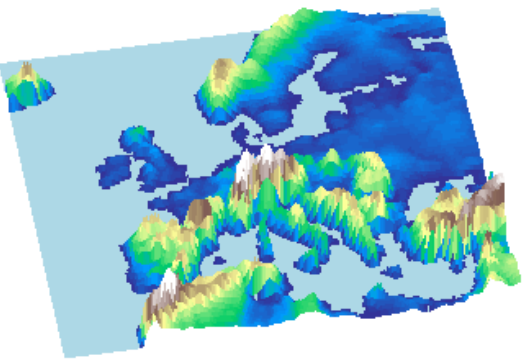
Models are Increasing in Complexity and Resolution

From AOGCMs to Earth System Models with biogeochemical cycles, from lowres to highres

130 km resolution orography

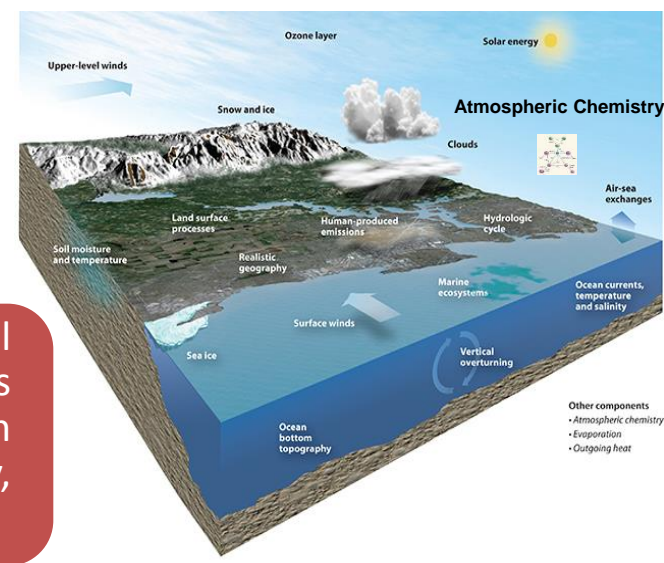


25 km resolution orography



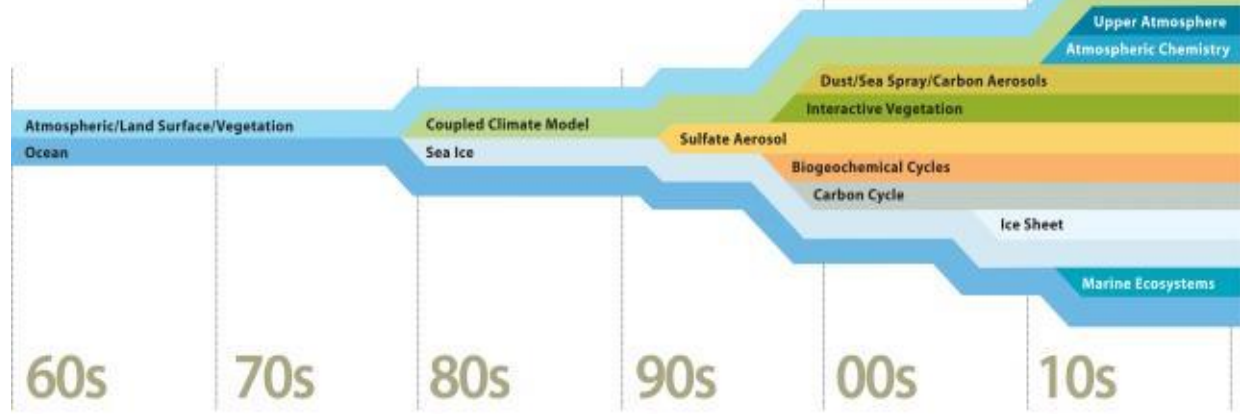
II. Allows to study processes as horizontal resolution is increased to “weather-resolving” global model resolutions (~25km or finer)

I. Improvements in physical processes already included in GCMs



III. Allows to study new physical and biogeochemical processes and feedbacks (e.g., carbon cycle, permafrost, chemistry, aerosols, ice sheets)

Growth of Climate Modeling

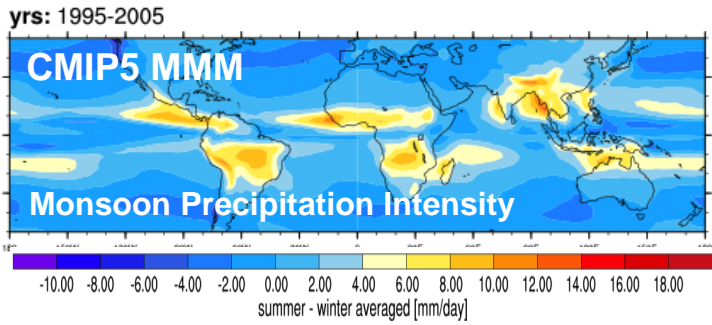


How to characterize the wide variety of models in CMIP6?

- Routine Benchmarking and Evaluation Central Part of CMIP6 -

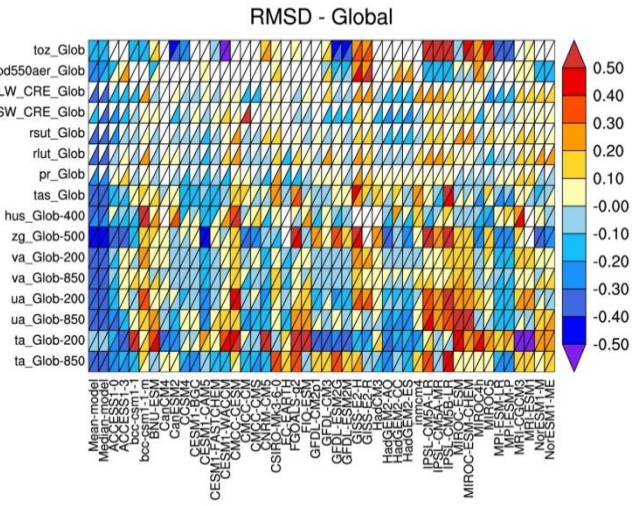
Tools such as the community-wide **Earth System Model Evaluation Tool (ESMValTool)**, Eyring et al., ESMValTool (v1.0), GMD, 2016) and the **PCMDI Metrics Package (PMP)**, Gleckler et al., EOS, 2016) to produce well-established analyses as soon as CMIP model output is submitted.

Similar to **Figure 9.7 of AR5**



Broad Characterization of Model Behavior
(incl. IPCC AR5 Chap 9 & 12 diagnostics in ESMValTool)

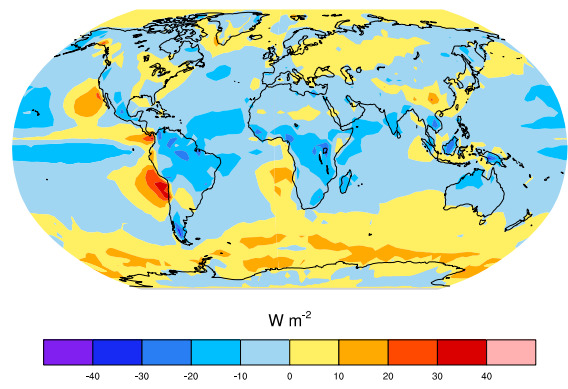
Running alongside the ESGF



Link to projections

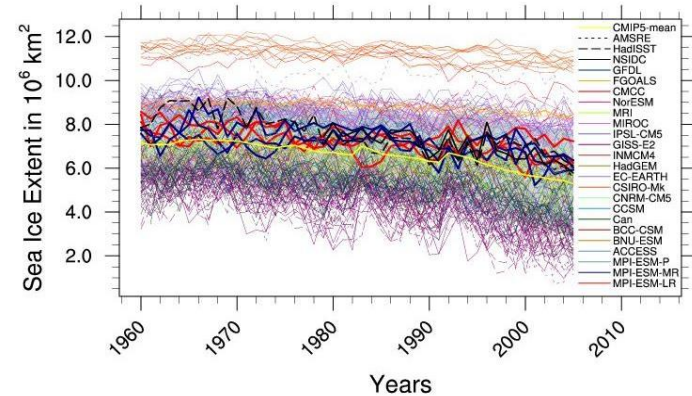
Similar to **Figure 9.5 of AR5**

Net Cloud radiative effect against CERES EBAF (2001–12)

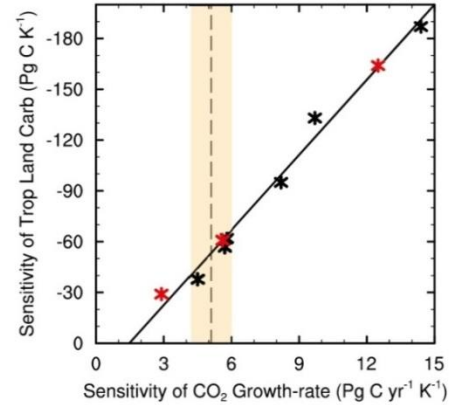


Similar to **Figure 9.24 of AR5**

September Mean Arctic Sea Ice Extent



(b) Tropical Land carbon feedback



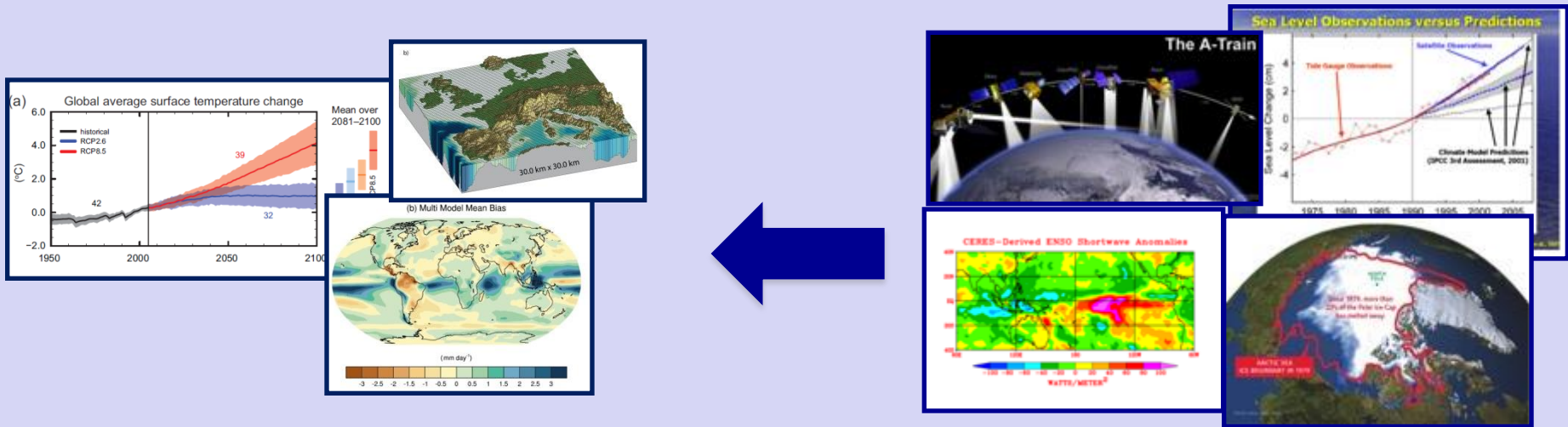
Similar to **Figure 9.24 of AR5**

Under-Exploited Observations for Model Evaluation

Observations for Model Intercomparison Projects (obs4MIPs)

WCRP Data Advisory Council's (WDAC) Task Team on Observations for Model Evaluation

Co-Chairs: Peter Gleckler and Duane Waliser

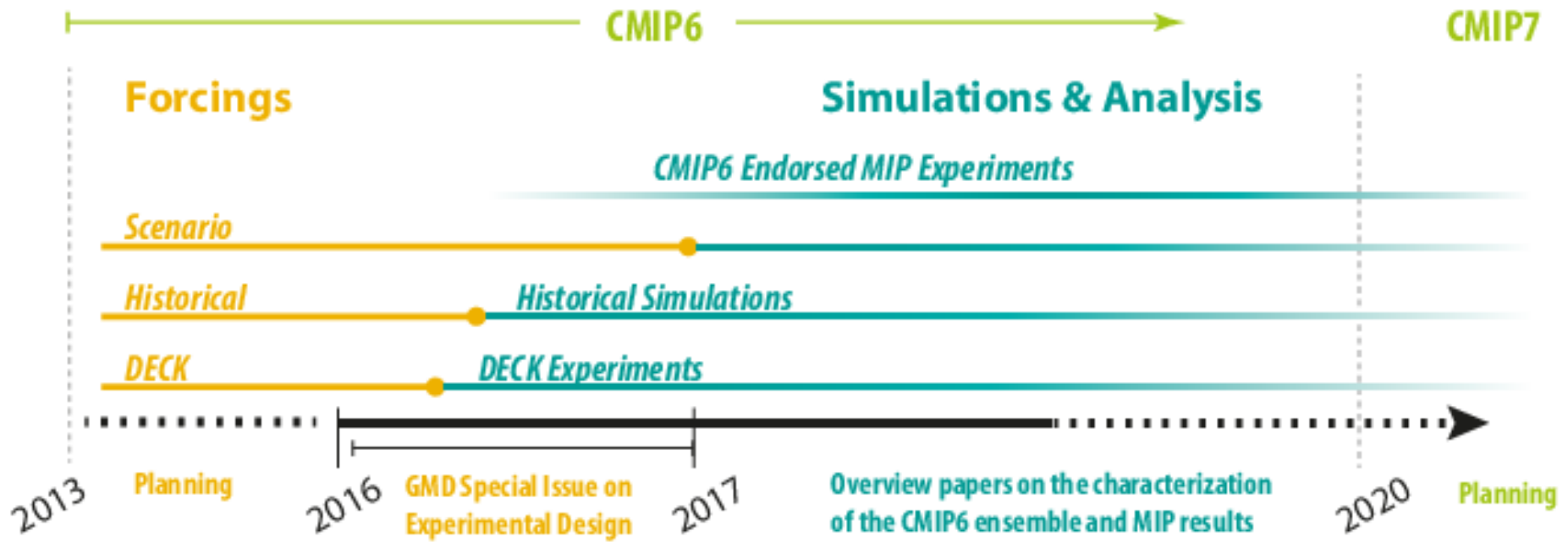


How to bring as much observational scrutiny as possible to the CMIP process?

How to best utilize the wealth of satellite observations for the CMIP process?

- Obs4MIPs has defined a set of technical specifications and criteria for developing observational data sets that are technically aligned with CMIP model output (with common file format, data and metadata structure).
- Over 50 datasets that conform to these standards are now archived on the ESGF alongside CMIP model output ([Teixeira et al., BAMS, 2014](#)), including ESA CCI data.
- obs4MIPs has been enthusiastically received by the community; Archive is growing

CMIP6 Timeline



CMIP6 Status

- CMIP6 Experimental Design finalized
- Forcing datasets for DECK and CMIP6 historical simulations finalized by end of April
- CMIP6 Simulation Period (2016-2020)
- Infrastructure in preparation (including data request) by WGCM Infrastructure Panel (WIP)

CMIP6 Participating Model Groups: > 30 using a wide variety of different model versions

21 CMIP6-Endorsed MIPs that build on the DECK and CMIP historical simulations to address a large range of specific questions with WCRP Grand Challenges as scientific backdrop.

CMIP6 Climate Projections part of a CMIP6-Endorsed MIP (ScenarioMIP)

- New scenarios span the same range as the RCPs, but fill critical gaps for intermediate forcing levels and questions for example on short-lived species and land-use.
- Forcings for future scenarios available by end of 2016, climate model projections expected to be available within the 2018-2020 time frame.

A Central Goal of CMIP6 is Routine Evaluation of the Models with Observations

- Efforts to develop community tools and to couple them to the ESGF are underway

Geosci. Model Dev. Special Issue on CMIP6

- Overview of the CMIP6 Experiment Design and Organization (Eyring et al., GMD, 2016)
- Experimental design from all CMIP6-Endorsed MIPs
- Description of the CMIP6 forcing data and infrastructure

=> We expect CMIP6 to continue CMIP's tradition of major scientific advances

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