Developing NorESM2 for CMIP6

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CMIP6 after WGCM Oct 2014
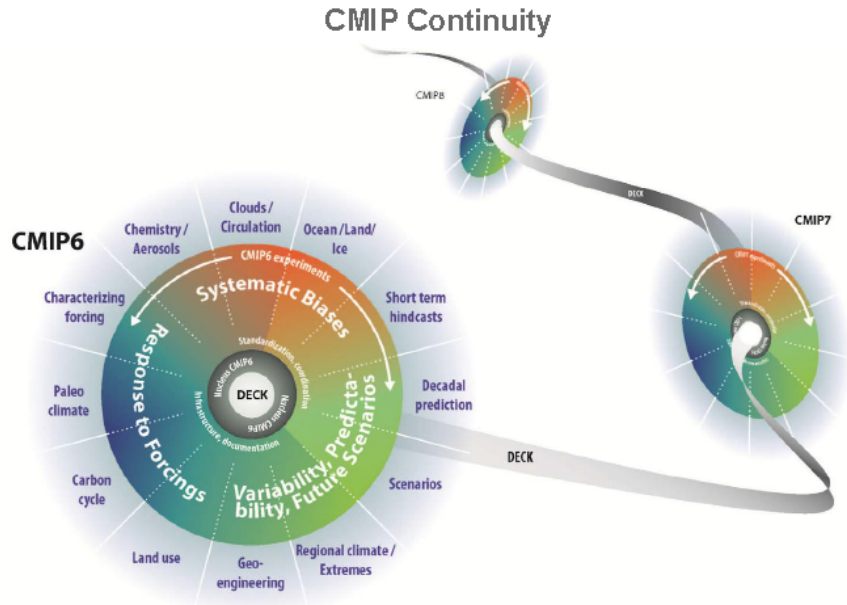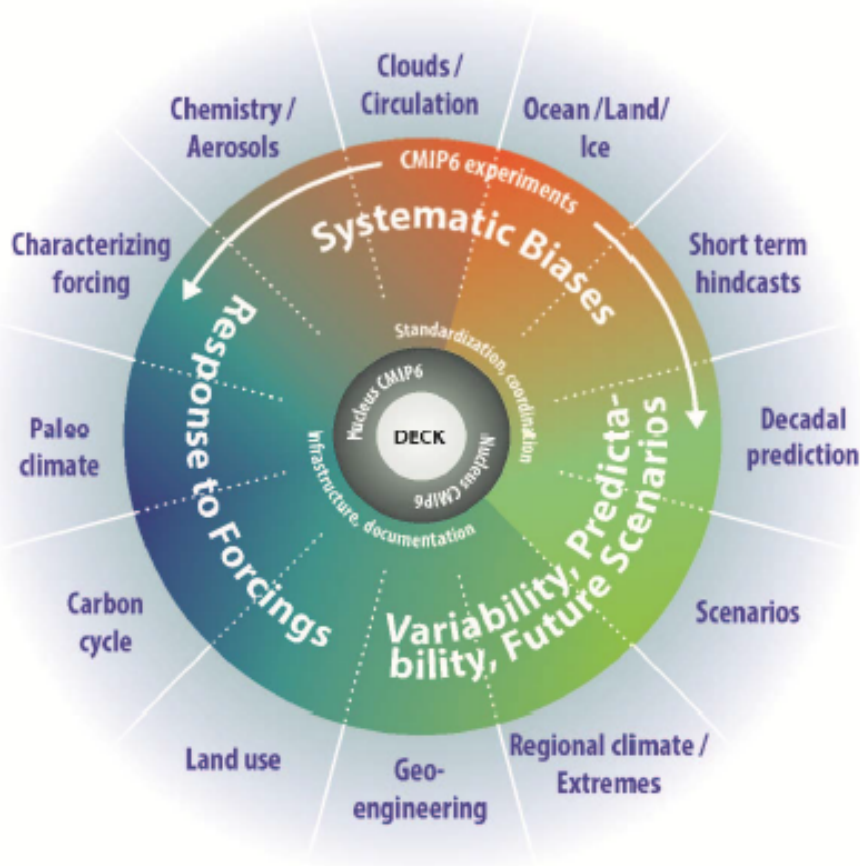
CMIP DECK

- A set of basic experiments modelling groups will nevertheless do in order to validate any model version as a tool for climate simulations.

- Not a part of CMIP6, but a prerequisite for using the model in any CMIP

- Ensure continuity of model tools between CMIPs

- Changes will follow the overall status of ESMs / GCMs over long time

Presently proposed experiments

1. AMIP: 1979-2014
2. Pre-industrial Controle; i.e. ca. 1850 conditions, (~500yrs or longer)
3. CMIP2: CO_2-conc. Increased 1% per year from PI-control until 4x, and kept constant up to year 150 (→transient climate sensitivity)
4. Abrupt kick: $4xCO_2$-conc. of levels at PI-control, up to year 150 (→equilibrium climate sensitivity)

Nucleus6

- An extension of CMIP DECK for CMIP6
- A prerequisite for using the model in CMIP6
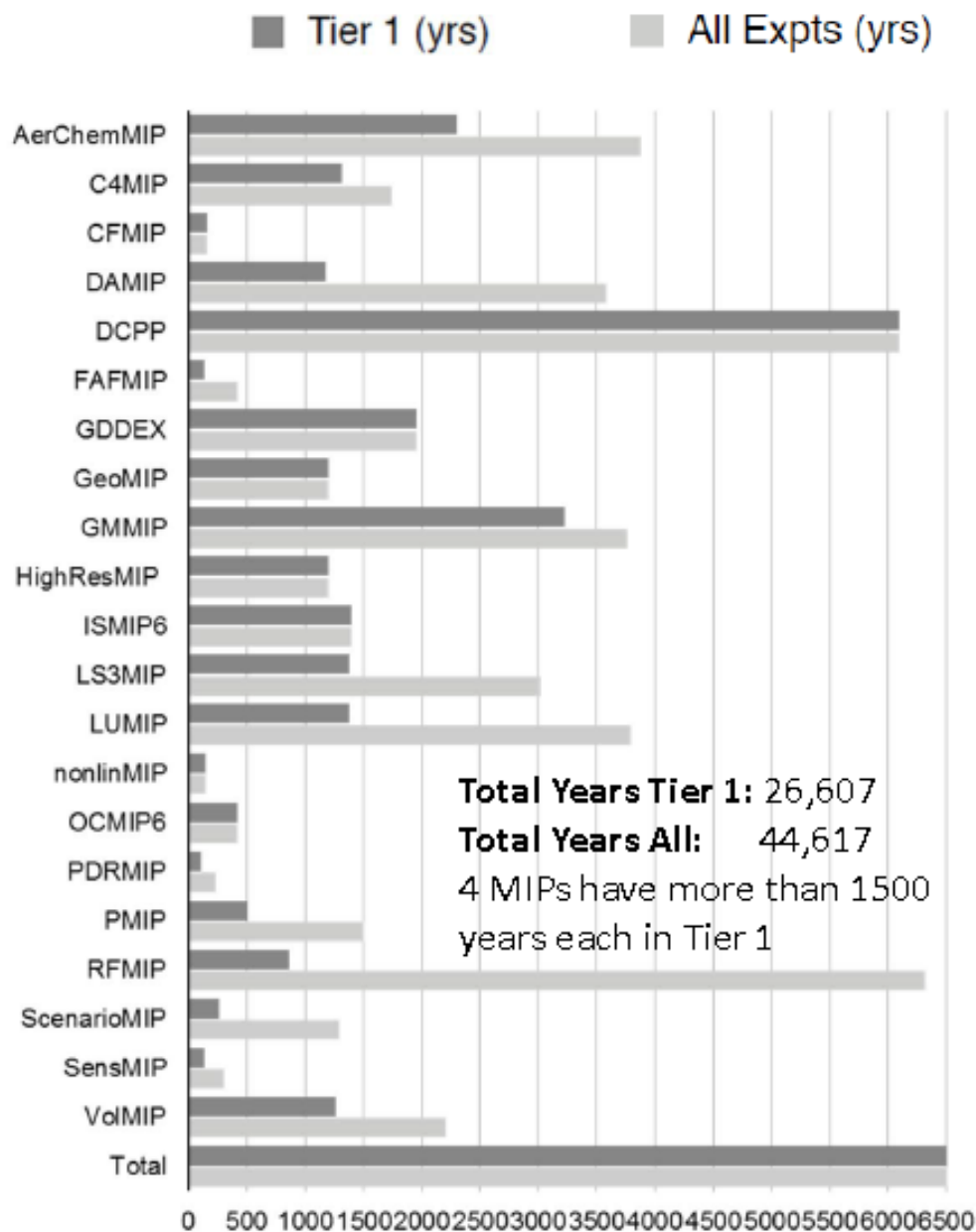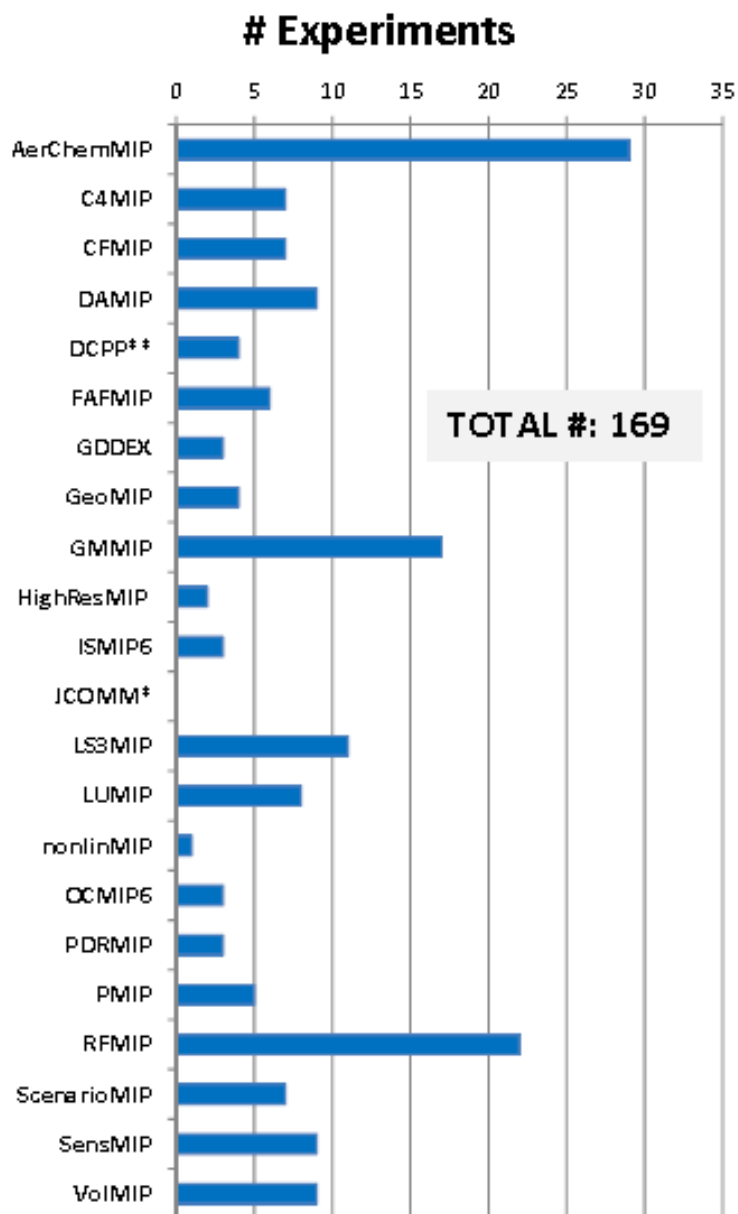
Presently proposed experiment

[A three-member ensemble] run for the historical period 1850-2014. (→comparison with observations and re-analyses)

MIPs

	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	FAFMIP	Flux-Anomaly-Forced Model Intercomparison Project
7	GDDEX	Global Dynamical Downscaling Experiment
8	GeoMIP	Geoengineering Model Intercomparison Project
9	GMMIP	Global Monsoons Model Intercomparison Project
10	HighResMIP	High Resolution Model Intercomparison Project
11	ISMIP6	Ice Sheet Model Intercomparison Project for CMIP6
12	JCOMM*	Coordinated Ocean Wave Climate Project
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	PDRMIP	Precipitation Driver and Response Model Intercomparison Project
18	PMIP	Palaeoclimate Modelling Intercomparison Project
19	RFMIP	Radiative Forcing Model Intercomparison Project
20	ScenarioMIP	Scenario Model Intercomparison Project
21	SensMIP	Sensitivity Model Intercomparison Project
22	VolMIP	Volcanic Forcings Model Intercomparison Project
	Diagnostic MIPs (i.e., no proposed experiments rather requesting that certain output is archived and/or contributing to the evaluation)	
23	CORDEX	Coordinated Regional Climate Downscaling Experiment
24	DynVar	Dynamics and Variability of the Stratosphere-Troposphere System
25	VIAAB	VIA Advisory Board for CMIP6

One MIP on Ocean and Sea-ice will probably be included

Feedbacks from modelling groups

Experiments

TOTAL #: 169

Tier 1 (yrs) / All Expts (yrs)

Total Years Tier 1: 26,607
Total Years All: 44,617
4 MIPs have more than 1500 years each in Tier 1

Feedbacks from modelling groups

Preliminary, initial interests
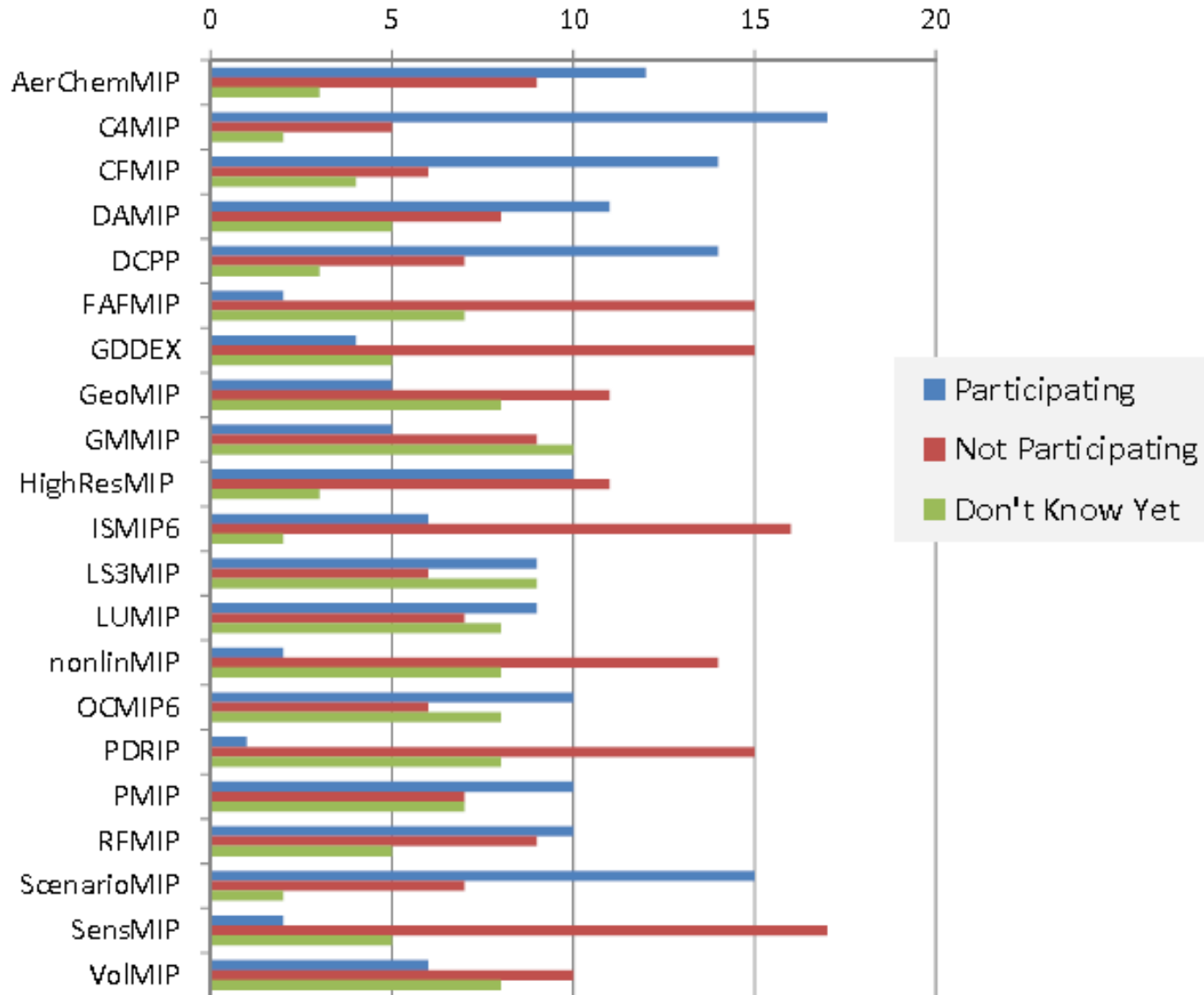
Main targeted MIPs for NorESM2

- **Tier 1 of** *(conditional)* **:**
  - *AerChemMIP,*
  - *DAMIP*
  - *RFMIP*
  - *C4MIP*
  - *OCMIP6*
  - *SensMIP*
  - *PRDMIP*
- *Possibly both Tier 1 and Tier 2 of ScenarioMIP*

CMIP6 Forcing Timeline

Finalize scenario choice, March 2015 (O'Neill, Tebaldi, van Vuuren)

WGCM CMIP6 Design

Timeline markers: Jan 1 2015 · April 2015 · July 2015 · Oct 2015 · Jan 1 2016 · April 2016 · July 2016 · Oct 2016 · Jan 1 2017

1st draft description of forcings · Review forcings descriptions · CMIP6 Design GMD Special Issue including forcing description
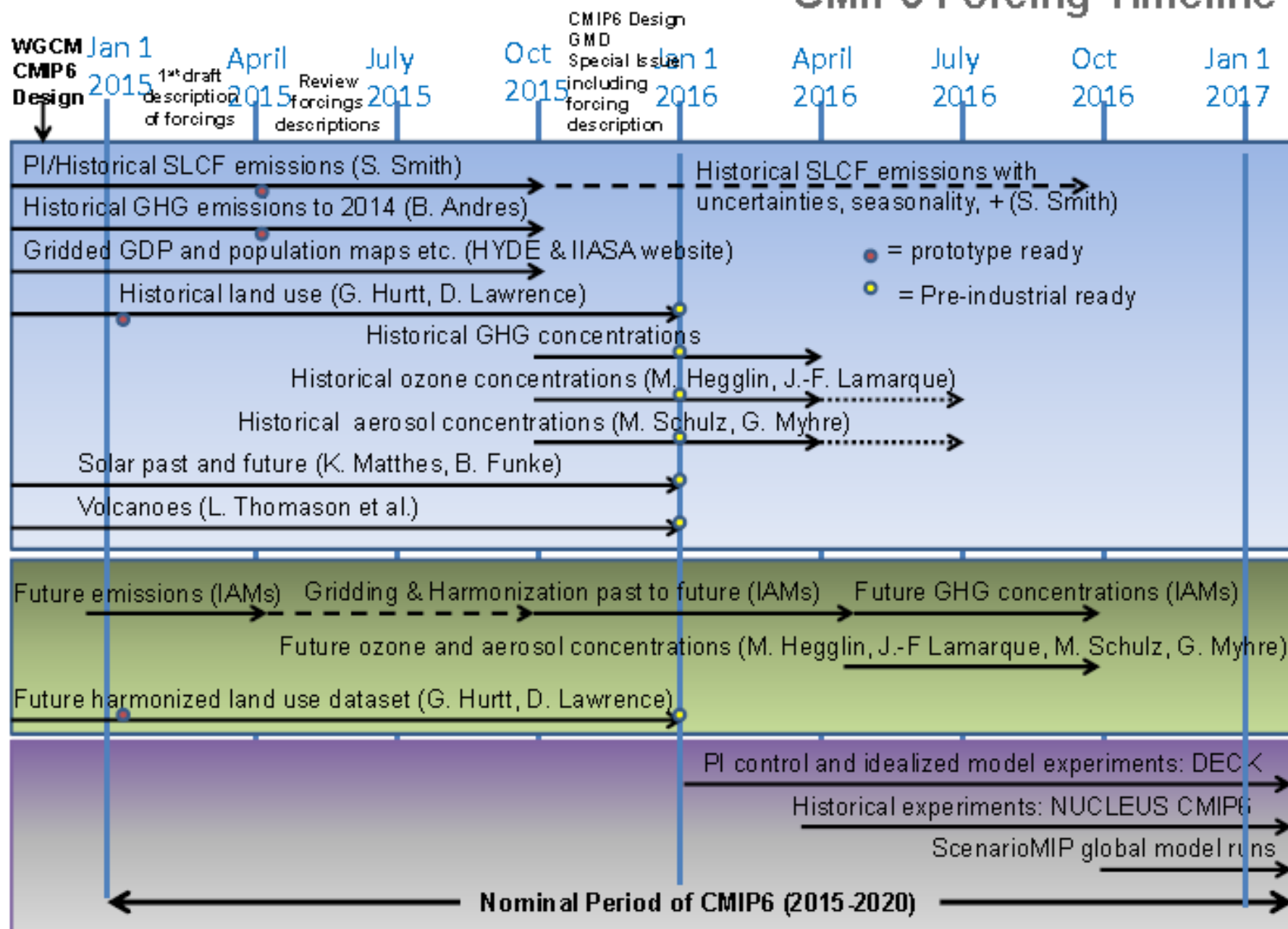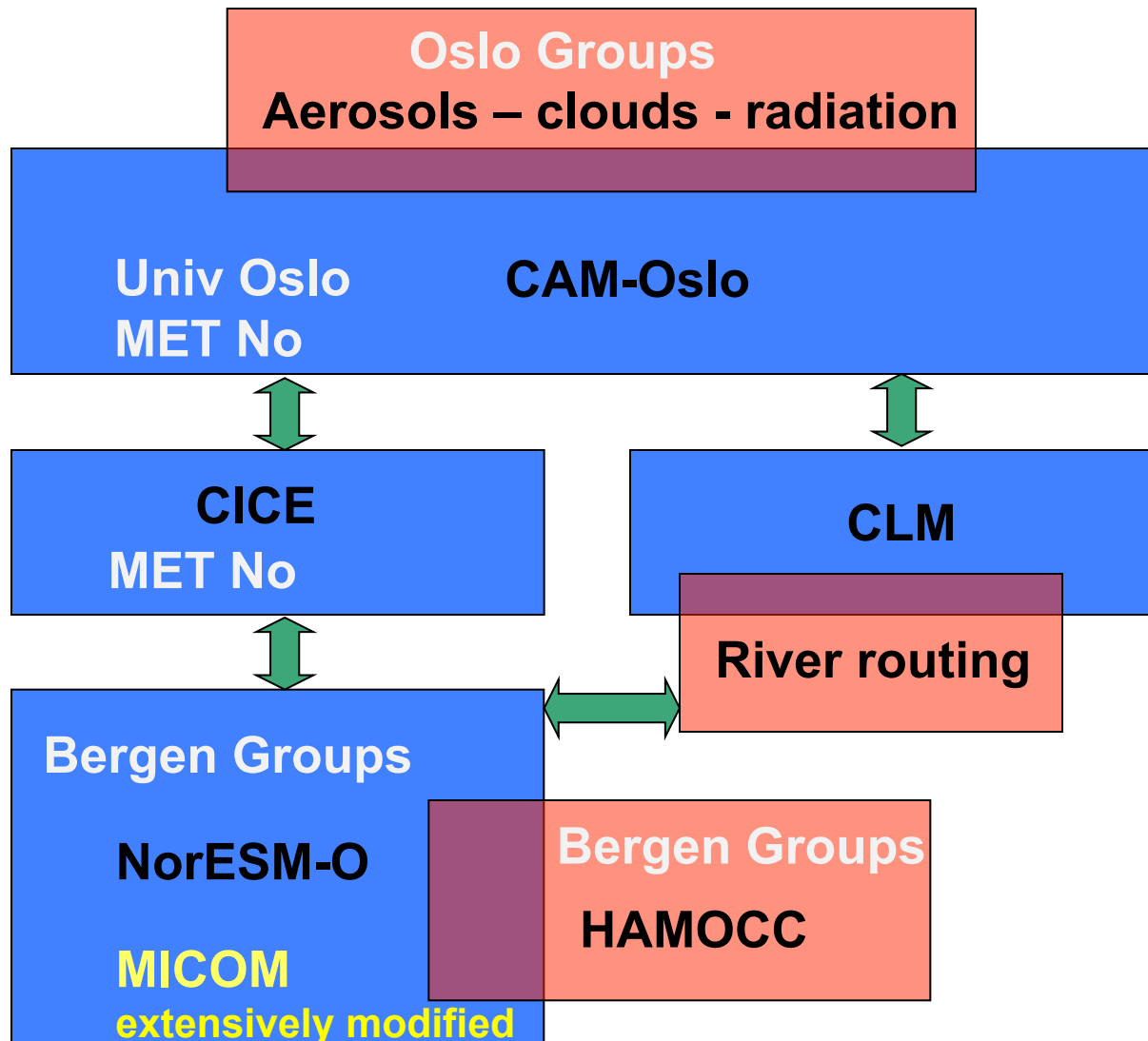
PI/Historical SLCF emissions (S. Smith) → Historical SLCF emissions with uncertainties, seasonality, + (S. Smith)

Historical GHG emissions to 2014 (B. Andres)

Gridded GDP and population maps etc. (HYDE & IIASA website)

Historical land use (G. Hurtt, D. Lawrence)

Historical GHG concentrations

Historical ozone concentrations (M. Hegglin, J.-F. Lamarque)

Historical aerosol concentrations (M. Schulz, G. Myhre)

Solar past and future (K. Matthes, B. Funke)

Volcanoes (L. Thomason et al.)

= prototype ready

= Pre-industrial ready

Future emissions (IAMs) Gridding & Harmonization past to future (IAMs) Future GHG concentrations (IAMs)

Future ozone and aerosol concentrations (M. Hegglin, J.-F Lamarque, M. Schulz, G. Myhre)

Future harmonized land use dataset (G. Hurtt, D. Lawrence)

PI control and idealized model experiments: DECK

Historical experiments: NUCLEUS CMIP6

ScenarioMIP global model runs

Nominal Period of CMIP6 (2015-2020)

NorESM framework and model components

Belongs to the «NCAR family»

Oslo Groups
Aerosols – clouds - radiation

Univ Oslo
MET No   **CAM-Oslo**

CICE
MET No

CLM

River routing

Bergen Groups

NorESM-O

MICOM
extensively modified

Bergen Groups

HAMOCC

Components in blue communicate trough the coupler CPL7.
Components in red are subroutines of blue components.

NorESM2 → CMIP6

CAM5.x (NCAR et al) → **CAM5-Oslo** (at present: CAM5_3_01 of cesm1_2_0)
Will probably change to CAM5.5, June 2015.
New Cloud and Radiation param.;
Optional CAM5-aerosols and Mozart chem

NorESM2_ME   (~2500 years)

- Main model version for CMIP6.
- Resolution 0.95° x 1.25° atm./land; 0.25° ocean/sea-ice.
- Full carbon cycle enabling emission-driven CO_2.
- Interactive aerosol-cloud-radiation.
- Also for concentration-driven CO_2. (**NorESM2_M**: ~2500 years)

NorESM2_LE   (~5000 years)

- Reduced resolution version for CMIP6.
- Resolution 1.9° x 2.5° atm./land; 1° ocean/sea-ice.
- Intended for complementing main MIP-exp., for very long simulations, and decadal predictability (DCPP if possible).

Aerosol issues for NorESM2

1. Missing soil dust sources, prognostic dust emissions, →*METNo*

2. Prognostic aerosols in cloud droplets / ice, → *METNo*

3. Nitrates and anthropogenic SOA, →*METNo/Uhel*

4. Nucleation of new particles and BVOC→SOA →*METNo/Uhel*

5. Prognostic, non-SS oceanic emissions (DMS, OM) → *METNo/ SthUniv,*

6. Further developed SS oceanic emissions → *SthUniv,*

7. Interactions with microphysics in convective clouds, →*UiO*

8. Aerosol – ice & mixed-phase clouds interactions, →*UiO*

– *Other issues?*

Norwegian
Meteorological
Institute

NorESM2 → Experiment AMIP-versions; no CMIP DECK
Should be possible to include in pure science-targeted MIPs

NorESM2_LEx /_Lx

– Increased complexity:

- Full on-line oxidant chemistry

- Sectional aerosols

NorESM2_Hx

– High-resolution; Reduced complexity: Could be part of HighResMIP if only AMIP-runs are permitted

- 0.25 degree atmosphere

- Prescribed aerosols and GHG conc.? Or as NorESM2_M