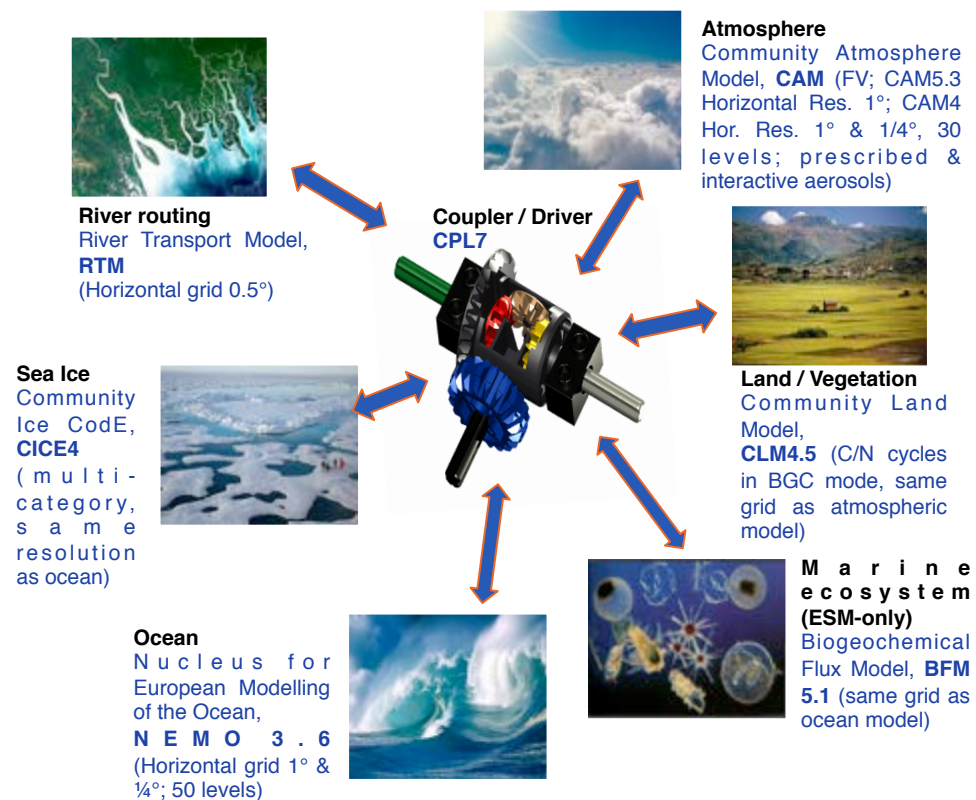


CMCC Climate (CM2) & Earth System Model (ESM2)



Expected delivery of CMIP6 SIMULATIONS

DECK & Historical simulations :
Summer/Fall 2018

CMIP6-Endorsed MIPs : Fall/
Winter 2018

<u>Configuration</u>	Model ready	Spin up started	DECK started	Post processing workflow ready	Data ready for ESGF	Data on ESGF
CMCC-CM2-SR5 (1°Atm x 1°Ocean)	Yes	Yes	NO. target=fall/winter 2017	Almost	NO	NO
CMCC-CM2-HR4 (1°Atm x 1/4 °Ocean)	Yes	Yes	NO. target=fall/winter 2017	Almost	NO	NO
CMCC-ESM2	Almost	NO. target=fall 2017	NO. target= winter 2017	Almost	NO	NO

Experience with CMIP6 forcing data

Solar: on-going utilization for Pre-Industrial spin-up and HighResMIP experiments (data easily adapted for both CAM4 and CAM5)

GHG historical concentrations: on-going utilization for Pre-Industrial spin-up and HighResMIP experiments (data easily adapted to mean annual fields for both CAM4 and CAM5)

Aerosols and anthropogenic emissions: work in progress – Issues with vertical distribution of emissions needed by CAM5. Not yet tested CO₂ and CH₄ emissions.

Ozone (volume mixing ratios): on-going utilization for Pre-Industrial spin-up and HighResMIP experiments (data easily adapted for both CAM4 and CAM5)

Nitrogen atmospheric deposition: data for Pre-Industrial and Transient periods were used in land and ocean “offline” simulations without any relevant issue

AMIP boundary (HadISST SST & sea-ice): daily fields are currently used for HighResMIP experiments without any relevant issue.



INM climate models for CMIP6

INM-CM4-8: A 2x1.5L21, top=10hPa; O 1x0.5L40

For **PMIP, ISMIP6**

INM-CM5-0: A2x1.5L73, top=0.2hPa, O0.5x0.25L40

For **DCPP**

INM-CM5-H: A 0.67x0.5L73, top=0.2hPa, O 0.167x0.125L40

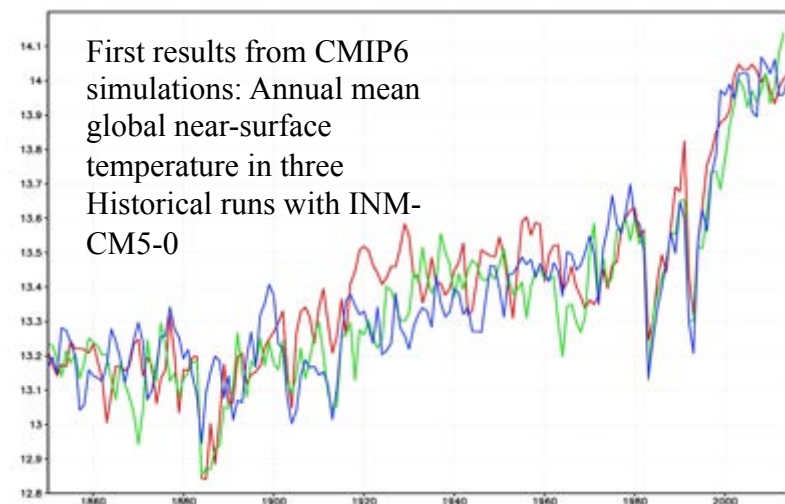
For **HiResMIP**

- Aerosol block has been switched on in climate model.
- Increase in number of vertical levels in the atmosphere allowed to improve stratospheric dynamics, including QBO and sudden stratospheric warmings.
- Climate model with high resolution (Atmosphere 0.67x0.5 L73, ocean 0.167x0.125 L40) was prepared for HiResMIP.
- Greenland ice sheet model was switched on in climate model for participation in ISMIP6.

We plan to submit data from DECK and Historical runs at the beginning of year 2018.

We plan to submit data for subprojects in the middle of year 2018.

We have started filling ES-DOC questionnaire.





INPE-BESM updates for CMIP6

	CPTEC AGCM	BAM 1.1
Cloud microphysics	Single-moment microphysics scheme (Rasch and Kristjansson 1998)	Double-moment microphysics scheme (Morrison et al. 2009)
SW and LW radiation	CLIRAD; Chou and Suarez (1999) and modified by Tarasova and Fomin (2000)	RRTMG; Iacono et al. (2008)
Shallow convection	Tiedtke (1983) diffusion scheme	UW shallow convection (Park and Bretherton 2009)
Deep convection	GD (Grell and Devéniy, 2002)	GDM (GD Modified, Figueroa et al. 2016)
Climatological Aerosol	N/A	Tarasova and Kubota (2017)

	BESM2.3	BESM2.8
Atmos	CPTEC AGCM3.0	BAM1.1
Ocean	MOM4p1	MOM5.1
Land	SSiB1	SSiB2
Ice	SIS1	SIS1

BESM 2.8 (CPTEC's BAM1.1-SSiB2-MOM5-SIS1), is the current production version of BESM to be used as the base model for CMIP6.

It has received several atmosphere physics upgrades, in addition to Ocean model version change, from MOM4p1 to MOM5

We have not started CMIP6 runs

INPE Supercomputer system is being upgraded, which shall delay BESM's CMIP6 runs until some time 2018.

ESGF: DECK runs shall start early 2018.

CMIP6 Historical run shall only be available latter 2018.

We have not yet started filling the ES-DOC questionnaire

Norwegian Earth System Model version 2 (NorESM2)

Summary of model changes compared to CMIP5 version:

- Based on CESM2 (NorESM1 based on CCSM4 and CESM1)
- Numerous updates on CAM6, CLM5, CICE5, CIME5 by the CESM community
- Components with NorESM specific updates:
 - CAM6-NorESM (atmosphere)
 - Update aerosol-radiation-cloud parameterization to new microphysics, including ice-nucleation; New treatment of secondary aerosols; Changes in parameterization of emissions of natural aerosol, aerosol mixing state
 - Improved conservation of angular momentum, energy conservation, zenith angle averaging in albedo estimation
 - DMS coupled to ocean biogeochemistry
 - CIME5 (coupler)
 - New option for computation of air-sea turbulent fluxes
 - MICOM (ocean)
 - New and improved physical parameterizations and improved dynamical formulation
 - Eddy permitting configuration
 - New ocean grids
 - HAMOCC (ocean biogeochemistry)
 - Riverine input of carbon and nutrients (climatology)
 - DMS coupled to atmosphere
 - Option for particle aggregation (particulate organic matter)
 - N deposition
- If CESM2 is postponed beyond the end of 2017, the model may need to use older model components.

Consortium Members

Center for International Climate Research, Nansen Environmental and Remote Sensing Center, Norwegian Institute for Air Research, The Norwegian Meteorological Institute, Uni Research, University of Bergen, University of Oslo

Experience with CMIP6 forcings: Limited experience so far. Close to test simulations with CMIP6 historic forcings.

Have you yet started any simulations, and if so which ones? No CMIP6 DECK or MIP simulations started yet.

When are you planning to submit model output from the DECK to the ESGF?

Finalization of model expected by Q1 2018 with submittal of first DECK simulations by Q2 2018.

When are you planning to submit model output from the CMIP6 historical simulations to the ESGF? Q2 2018.

When are you planning to submit CMIP6-Endorsed MIPs experiments to the ESGF? Start submitting OMIP experiments during Q2 2018. Submittal of other MIP experiments will start Q3 2018.

Have you yet started filling the ES-DOC questionnaire? No.

Configurations of NorESM2 for CMIP6.

- Low and Medium atmosphere/land and Medium and High ocean/sea-ice resolution.
- Vertical resolution Ocean 53 levels: Atmosphere 32 levels.
- Process complexity: Emission-driven GHG and atmospheric Chemistry.
- The first model configuration that will be run is _LM, then _LME, then _MM.
- Configurations with complex atmos. chem. (_LMEC) and higher resolution ocean/sea-ice components (_MH) might be run at a later stage.

NorESM2		_LM	_LME	_MM
RESOLUTION	Atmos. - Land	L: 1.9°x2.5°	L: 1.9°x2.5°	M: 0.9°x1.25°
	Ocean - Sea-Ice	M: 1°	M: 1°	M: 1°
PROCESSES	GHG	Concentration-driven	E: Emission-driven	Concentration-driven
	Aerosol	Emis.-driven, Compl. physics	Emis.-driven, Compl. physics	Emis.-driven, Compl. physics
	Atmos. Chem.	Simplified	Simplified	Simplified
	Ocean BGC.	ON	ON	ON
CMIP-DECK + CMIP6 Hist		AMIP, PreInd, Historic	PreInd, Historic	AMIP, PreInd, Historic
MIPs		AerChemMIP, CFMIP, DAMIP, DCP, LUMIP, OMIP, PMIP, RFMIP, ScenarioMIP, VoMIP, SIMIP	C4MIP, LUMIP	AerChemMIP, CFMIP, RFMIP, DAMIP, OMIP, ScenarioMIP, SIMIP

CMCC Models Status for CMIP6

<u>Configuration</u>	Model ready	Spin up started	DECK started	Post processing workflow ready	Data ready for ESGF	Data on ESGF
CMCC-CM2-SR5	Yes	Yes	NO. target=fall/winter 2017	Almost	NO	NO
CMCC-CM2-HR4	Yes	Yes	NO. target=fall/winter 2017	Almost	NO	NO
CMCC-ESM2	Almost	NO. target=fall 2017	NO. target=winter 2017	Almost	NO	NO

NOTE: SR – Standard Resolution (Atm/land = 1°x1°, Ocean/Seaice = 1°x1°)

HR – High Resolution (Atm/land = 1°x1°, Ocean-Seaice = 1/4°x1/4°)

The ending numbers indicate the CAM model core version

Expected delivery of CMIP6 SIMULATIONS

DECK & Historical simulations : Summer/Fall 2018

CMIP6-Endorsed MIPs : Fall/Winter 2018



CMCC model configuration and MIPS

NAME	atmosphere	ocean	aerosol	land surface	ocean biogeochemistry	sea ice	MIPs	DECK?
CMCC-CM2-SR5	CAM5.3 (1deg 288x192, 30 levels, top at ~2hPa)	NEMO3.6 (ORCA1 tripolar primarily 1 deg lat/lon with meridional refinement down to 1/3 degree in the tropics; 50 vertical levels; top grid cell 0.5 m)	MAM3	CLM4.5 (BGC mode)	none	CICE4	DCPP, GMMIP, ScenarioMIP, CORDEX-MIP	YES
CMCC-CM2-HR4	CAM4 (1deg 288x192, 30 levels, top at ~2hPa)	NEMO3.6 (ORCA0.25 1/4 deg from the Equator degrading at the poles; 50 vertical levels; top grid cell 0.5 m)	prescribed MACv2-SP	CLM4.5 (SP mode)	none	CICE4	HighRESMIP, OMIP	YES
CMCC-CM2-VHR4	CAM4 (1/4deg, 30 levels, top at ~2hPa)	NEMO3.6 (ORCA0.25 1/4 deg from the Equator degrading at the poles; 50 vertical levels; top grid cell 0.5 m)	prescribed MACv2-SP	CLM4.5 (SP mode)	none	CICE4	HighRESMIP	-
CMCC-ESM2	CAM5.3 (1deg 288x192, 30 levels, top at ~2hPa)	NEMO3.6 (ORCA1 tripolar primarily 1 deg lat/lon with meridional refinement down to 1/3 degree in the tropics; 50 vertical levels; top grid cell 0.5 m)	MAM3	CLM4.5 (BGC mode)	BFM5.1	CICE4	C4MIP, LS3MIP, LUMIP, OMIP, ScenarioMIP	YES



Low and medium atmospheric and medium and high ocean/sea-ice resolution.

- Vertical resolution Ocean 53 levels: Atmosphere 32 levels.
- Process complexity: **E**mission-driven GHG and atmospheric **C**hemistry.
- The first model configuration that will be run is **_LM**, then **_LME**, then **_MM**.
- Configurations with complex atmos. chem. (**_LMEC**) and higher resolution ocean/sea-ice components (**_MH**) might be run at a later stage.

NorESM2		_LM	_LME	_MM
RESOLUTION	Atmos. - Land	L: 1.9°x2.5°	L: 1.9°x2.5°	M: 0.9°x1.25°
	Ocean - Sea-Ice	M: 1°	M: 1°	M: 1°
PROCESSES	GHG	Concentration-driven	E: Emission-driven	Concentration-driven
	Aerosol	Emis.-driven, Compl. physics	Emis.-driven, Compl. physics	Emis.-driven, Compl. physics
	Atmos. Chem.	Simplified	Simplified	Simplified
	Ocean BGC.	ON	ON	ON
CMIP-DECK + CMIP6 Hist		AMIP, PreInd, Historic	PreInd, Historic	AMIP, PreInd, Historic
MIPs		AerChemMIP, CFMIP, DAMIP, DCP, LUMIP, OMIP, PMIP, RFMIP, ScenarioMIP, VoIMIP, SIMIP	C4MIP, LUMIP	AerChemMIP, CFMIP, RFMIP, DAMIP, OMIP, ScenarioMIP, SIMIP

Brazilian Earth System Model- BESM updates for CMIP6

Paulo Nobre, Silvio N. Figueroa

National Institute for Space Research – INPE

27 September 2017

Overview of BESM2.8 for CMIP6

- BESM 2.8 (CPTEC's BAM1.1-SSiB2-MOM5-SIS1) , is the current production version of BESM to be used as the base model for CMIP6.
- It has received several atmosphere physics upgrades, in addition to Ocean model version change, from MOM4p1 to MOM5
- We have not started CMIP6 runs
 - INPE Supercomputer system is being upgraded, which shall delay BESM's CMIP6 runs until some time 2018.
- ESGF: DECK runs shall start early 2018.
- CMIP6 Historical run shall only be available latter 2018.
- We have not yet started filling the ES-DOC questionnaire

BESM Upgrades for CMIP6

	BESM2.3	BESM2.8
Atmos	CPTEC AGCM3.0	BAM1.1
Oceam	MOM4p1	MOM5.1
Land	SSiB1	SSiB2
Ice	SIS1	SIS1

BAM 1.1 Physics

	CPTEC AGCM	BAM 1.1
Cloud microphysics	Single-moment microphysics scheme (Rasch and Kristjansson 1998)	Double-moment microphysics scheme (Morrison et al. 2009)
SW and LW radiation	CLIRAD; Chou and Suarez (1999) and modified by Tarasova and Fomin (2000)	RRTMG; Iacono et al. (2008)
Shallow convection	Tiedtke (1983) diffusion scheme	UW shallow convection (Park and Bretherton 2009)
Deep convection	GD (Grell and Dévényi, 2002)	GDM (GD Modified, Figueroa et al. 2016)
Climatological Aerosol	N/A	Tarasova and Kubota (2017)

INMCM: model progress from CMIP5 to CMIP6

1. Aerosol block has been switched on in climate model.
2. Increase in number of vertical levels in the atmosphere allowed to improve stratospheric dynamics, including QBO and sudden stratospheric warmings.
3. Climate model with high resolution (Atmosphere 0.67x0.5 L73, ocean 0.167x0.125 L40) was prepared for HiResMIP.
4. Greenland ice sheet model was switched on in climate model for participation in ISMIP6.

We plan to submit data from DECK and Historical runs at the beginning of year 2018.

We plan to submit data for subprojects in the middle of year 2018.

We have started filling ES-DOC questionnaire.

First results from CMIP6 simulations: Annual mean global near-surface temperature in three Historical runs with INM-CM5-0

