

Group Reports: Japan (Team MIROC, NICAM & MRI)

Michio Kawamiya
JAMSTEC

Lineup of Japanese models for CMIP6

	MIROC6- CGCM	MIROC- ESM2	NICAM	MRI- ESM1.2	MRI- AGCM3.2
Resolution (Atm.)	140km and 60km	280 and 140km	14, 28, 56km	120km	20km
Resolution (Ocean)	1deg. X 0.25-0.5deg.	1deg. X 0.5-1deg.	n.a.	1deg. X 0.3-0.5de g.	n.a.
Top	0.004hPa	0.004 and 3hPa	40 or 50km	0.01hPa	0.01hPa
Biogeo- chemistry	No	Yes	No	Yes	No
Institutions	AORI/UT, JAMSTEC, NIES	JAMSTEC, AORI/UT, NIES	AORI/UT, JAMSTEC, RIKEN	MRI	MRI

■ Participation in endorsed MIPs

	Short name of MIP	MIROC6	MIROC-ES2(L/H)	NICAM	MRI-ESM1.2	MRI-AGCM3.2
1	AerChemMIP	0	1	0	1	0
2	C4MIP	0	1	0	1	0
3	CFMIP	1	0	1	1	0
4	DAMIP	1	0	0	1	0
5	DCPP	1	0	0	1	0
6	FAFMIP	1	0	0	1	0
7	GeoMIP	0	1	0	1	0
8	GMMIP	1	0	0	0	0
9	HighResMIP	1	0	1	1	1
10	ISMIP6	0	1	0	1	0
11	LS3MIP	0	0	0	1	0
12	LUMIP	0	1	0	0	0
13	OMIP	1	1	0	1	0
14	PMIP	0	1	0	1	0
15	RFMIP	1	0	0	0	0
16	ScenarioMIP	1	1	0	1	0
17	VolMIP	0	1	0	1	0
18	CORDEX	1	1	0	1	0
19	DynVar	1	1	1	1	0
20	SIMIP	1	1	0	1	0
21	VIAAB	1	1	0	0	0
		13	13	3	17	1

Model improvements (1): examples from MIROC6 (Update from MIROC5)

AGCM (T85L81)

- Shallow convection
- High-Top TOA (3hPa → 0.004 hPa)
- SOA, Oceanic organic Aerosol
- Scattering by non-spherical cloud ice
- Non-orographic GWD
- modified CMT, water leak fixed, etc.

OGCM

- Higher resolutions (1.4°L50 → 1°L63)
- Tripole coordinate
- Improved TKE estimate under sea-ice

Land Surface Model

- Subgrid snow cover distribution
- Wet land due to snow melting

Current status of CMIP6 experiments (**Done**, **On-going**, **Preparing**)

DECK

CMIP6 historical simulations using v6.0/v6.1 forcing datasets

FAFMIP

DAMIP

OMIP

CFMIP

DCPP

HighresMIP

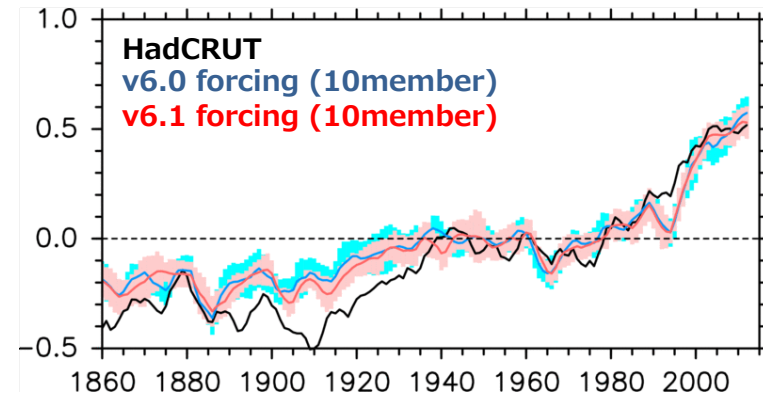
GMMIP

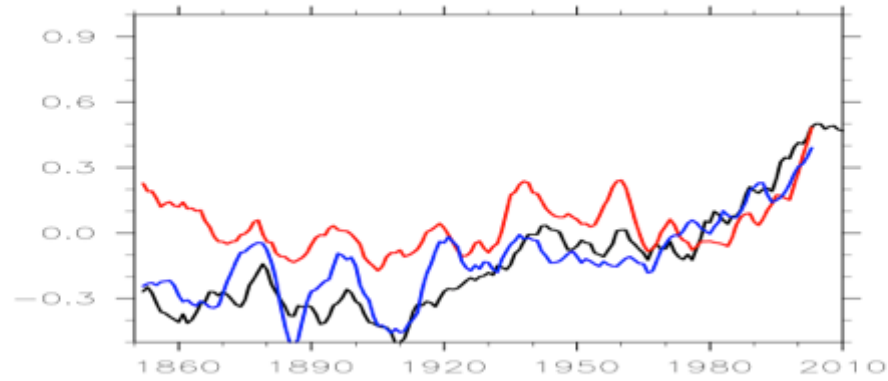
LS3MIP

RFMIP

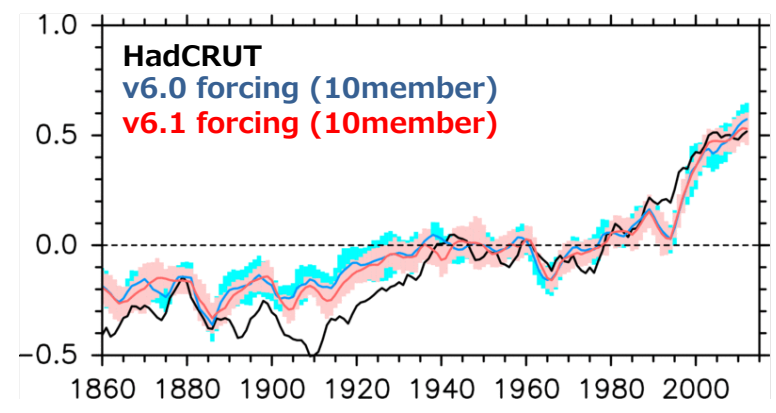
ScenarioMIP

Global-mean SAT (5yr running-mean; Ref: 1961/90)





CESM2
 Red: CMIP6
 Blue: CMIP5
 5 year running mean
 1961-1980 base period



MIROC-ES2L/H

	CMIP5 "MIROC-ESM & MIROC-ESM-CHEM"	CMIP6 "MIROC-ES2L & MIROC-ES2H"
AOGCM	MIROC4 with - Atm.: T42/L80 - Ocean: 1.4°L50	MIROC5 for "ES2L" - Atm.: T42/L40 - Ocean: 1.0°L63 MIROC6 for "ES2H" - Atm.: T85/L81 - Ocean: 1.0°L63
Atmospheric chemistry	None for MIROC-ESM CHASER for ~-CHEM	None for MIROC-ES2L CHASER for MIROC-ES2H
Land eco./ biogeochem.	SEIB-DGVM (C cycle with Dynamic vegetation & land- use change)	VISIT-e (C & N cycles with land-use change)
Ocean eco./ biogeochem.	OEKO-v1.0 (NPZD type; C & closed N cycles)	OEKO-v2.0 (NPZD type; C/N/ P/Fe/O cycles)
Throughput	20 sim. years / day	5 sim. years / day

Preparation for CMIP6 with MIROC-ES2L/H

- MIROC-ES2L is in final tuning phase; MIROC-ES2H is under development
- DECK Simulations by MIROC-ES2L will start around the end of 2017
- Data submission: Mid 2018~ ?
- ES-DOC: not yet

■ CO₂ Response of Earth System Models

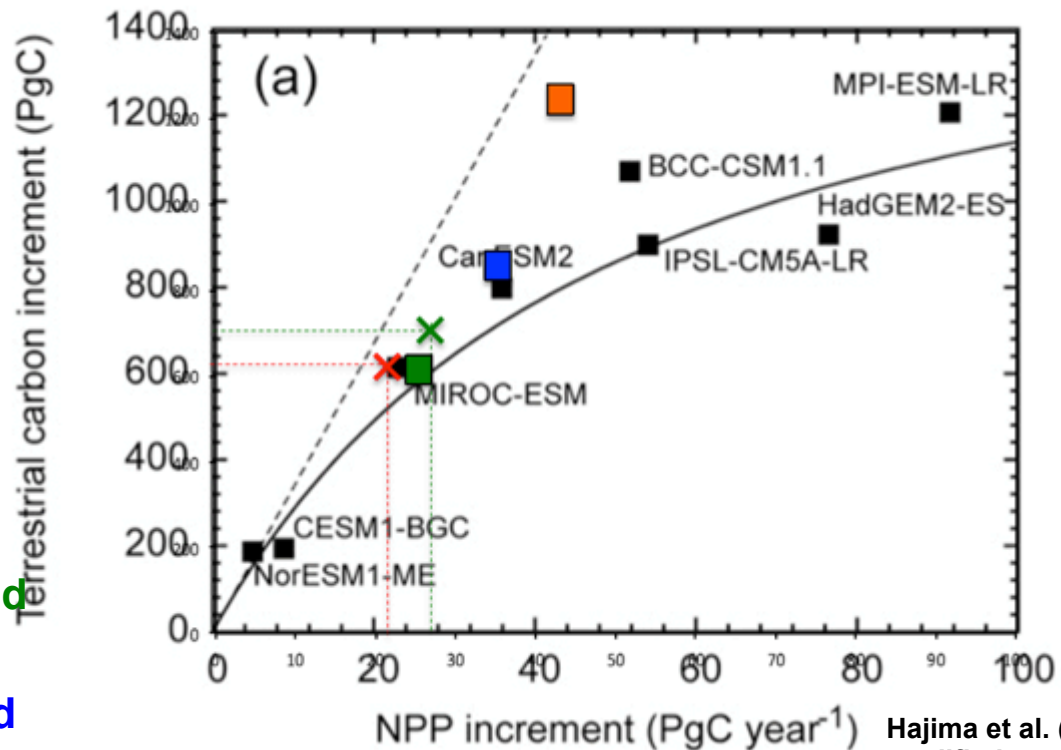
× ESM-mode BGC-coupled,
no nitrogen fertilization

× ESM-mode BGC-coupled
nitrogen fertilized

■ Land-only-mode, BGC-coupled

■ Land-only-mode BGC-coupled
Leaf nitrogen fixed at in-situ
observed level

■ Land-only-mode, BGC-coupled
Nitrogen fertilized, x10



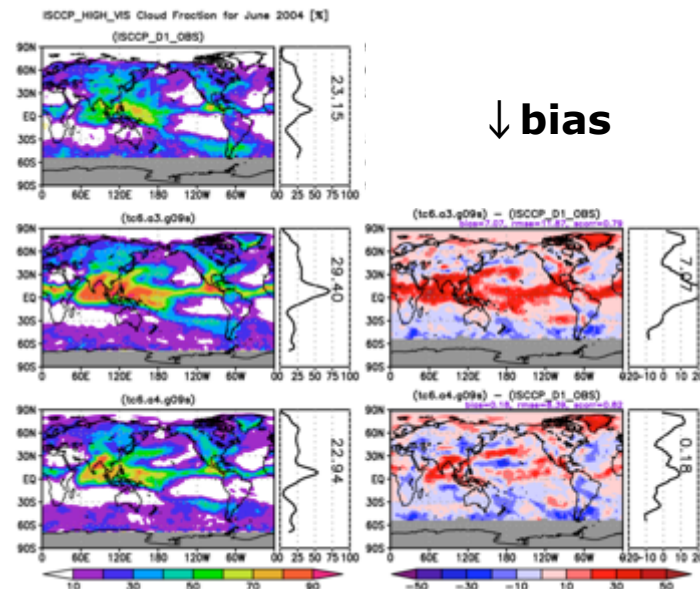
Hajima et al. (2014),
modified

MIROC-ESM has been in the middle range of CMIP5 model scatter in terms of response to CO₂ increase, which remain true even after incorporating nitrogen cycle.

■ NICAM Setup & Sensitivity Test for HighResMIP

- Modified cloud microphysics (Roh & Satoh 2014) including revisit of evaporation process.
- Natural aerosol from NICAM-SPRINTARS.
- Anthropogenic aerosol from simple plume model (Stevens et al 2017).
- High resolution SST/ICE & topography, ozone, GHG, solar variability etc. already tested.

ISCCP High cloud fraction satellite, previous & updated NICAM



Excess of high cloud fraction is improved by modifying evaporation process in cloud microphysics scheme.

MRI's activities for CMIP6

- Overview of **MRI-ESM2**

- Specifications

- atmosphere: MRI-AGCM3.5 -- TL159 (~120km), L48→**L80** (top:0.01hPa)
 - a new stratocumulus parametrization, non-orographic GWD, improved double-moment cloud physics, etc.
 - ocean/sea ice: MRI.COM4.4 – 1° x 0.5° (→**0.3°** near the EQ), L50→**L60**
 - vertical mixing: Noh-Kim → GLS, ...
 - atmos. chem.: MASINGAR-mk2r4 (aerosol, TL95**L80**) + MRI-CCM2.1 (ozone, T42**L80**)
 - carbon cycle: HAL (land) + MRI.COM4 (ocean) – same as in MRI-ESM1

- Forcings

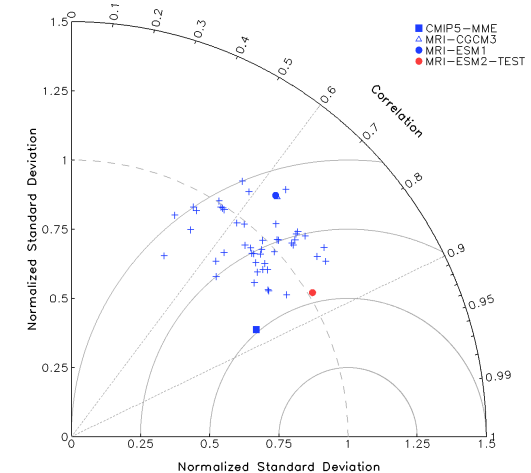
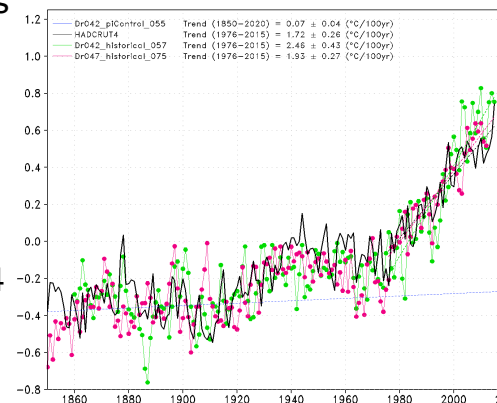
- GHG concentrations/emissions, SLCF emissions, land use, solar (incl. particle forcings) , strat. Aerosol
 - v6.2 is used

- Preliminary results

- Preliminary historical simulations
 - Realistic global SAT change
 - Smallest errors in SW CRE

- Submission to ESGF

- DECK: Q2 2018 – Q3 2018
 - CMIP6 historical: Q2 2018 – Q3 2018
 - CMIP6-Endorsed MIPS: Q3 2018 – Q4



■ MRI-AGCM

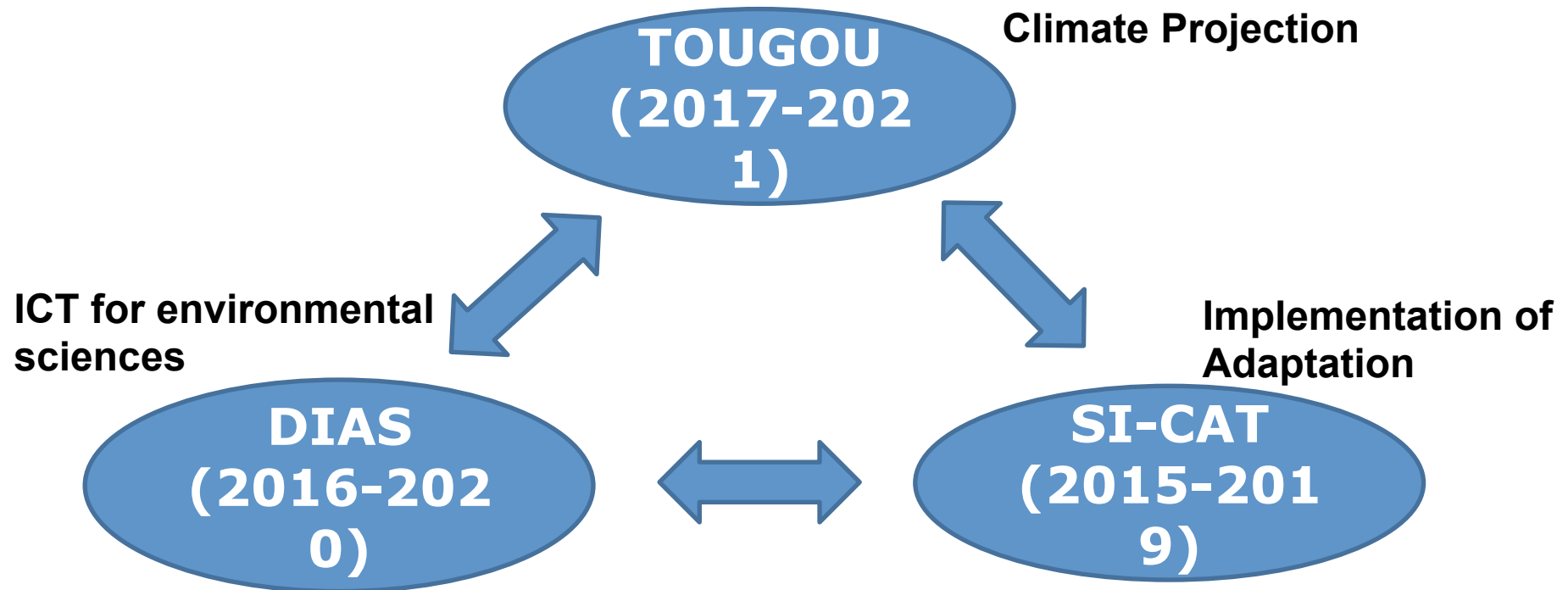
- Contributing to HighResMIP and DynVarMIP
- Model Versions and Resolutions
 - MRI-AGCM3.2 TL959L64 (20km resolution)
 - same version already submitted to CMIP5
 - DECK+Tier1,3
- Output
 - $\sim 2\text{TB/yr} \times 150\text{yr} = 300\text{TB}$ for Tear1 output
- Status
 - Now: testing with CMIP6 forcings
- Plan
 - Q4/2017 start DECK
 - Q2/2018 submit DECK/historical to ESFG
 - Q4/2018 submit all to ESFG

■ Integrated Research Program for Advancing Climate Models (TOUGOU)



- 5-year project : (2017-2021)
- Budget: JPY 550M for FY2017
- Structure
 - Theme A. Climate change projection and model development on global scale
 - Institute : AORI/UT, JAMSTEC & NIES, PI : Masahiro WATANABE
 - Global change projection, event attribution etc.
 - Theme B. Carbon cycle, climate sensitivity, tipping element etc.
 - Institute : JAMSTEC, NIES, CRIEPI, RIST, PI : Michio KAWAMIYA
 - Biogeochemical cycle, socio-economic scenario etc.
 - Theme C. Integrated climate change projection
 - Institute : MRI/JMA, PI : Izuru TAKAYABU
 - Downscaling, high resolution modeling etc.
 - Theme D. Integrated hazard projection
 - Insitute : DPRI/Univ. Kyoto et al., PI : Eiichi NAKAKITA
 - Meteorological disaster, economical impact etc.

■ Global change research programs funded by MEXT



- DIAS to contribute to ESGF as a Tier 2 server
- CDNOT Member from DIAS: Dr. T. Nemoto of U. Tokyo
- Mr. T. Inoue (RIST) is helping maintain collaboration between TOUGOU and DIAS

■ Answers to the inquiry (1)

- Brief overview of your CMIP6 model including a summary of model changes compared to CMIP5 version (if applies)
 - MIROC6: See page 4
 - MIROC-ES2(L/H): See page 5
 - NICAM: See page 6
 - MRI-ESM: See page 7
 - MRI-AGCM: Same version already submitted to CMIP5 (see page 8 for details)
- Experience with CMIP6 forcings
 - MIROC6: Has already done CMIP6 historical simulations using both of v6.0 and v6.1 forcing datasets.
 - MIROC-ES2(L/H): Processing ver.6.2 data so they are compatible with our model
 - NICAM: Performing sensitivity experiments using the HighResMIp forcings.
 - MRI-ESM: Ver.6.2 is used for GHG concentrations/emissions, SLCF emissions, land use, solar (incl. particle forcings) , strat. Aerosol
 - MRI-AGCM: Now testing with CMIP6 forcings
- Have you yet started any simulations, and if so which ones?
 - MIROC6: DECK, CMIP6 historical simulations, FAFMIP are done; DAMIP, OMIP are on-going; Other MIPs are in preparation and trial phase.
 - MIROC-ES2(L/H): Not yet
 - NICAM: No.
 - MRI-ESM: No (spin-up phase)
 - MRI-AGCM: No

■ Answers to the inquiry (2)

- First results from CMIP6 simulations
 - MIROC6: See figures in page 4
 - MIROC-ES2(L/H): Not yet
 - NICAM: None
 - MRI-ESM: None
 - MRI-AGCM: None
- When are you planning to submit model output from the DECK to the ESGF?
 - MIROC6: 2018 - 2019
 - MIROC-ES2(L/H): Mid 2018~
 - NICAM: No plan for DECK simulations.
 - MRI-ESM: Q1/2018
 - MRI-AGCM: Q2/2018
- When are you planning to submit model output from the CMIP6 historical simulations to the ESGF?
 - MIROC6: 2018 - 2019
 - MIROC-ES2(L/H): Mid 2018~
 - NICAM: No plan.
 - MRI-ESM: Q1/2018
 - MRI-AGCM: Q2/2018

■ Answers to the inquiry (3)

- When are you planning to submit CMIP6-Endorsed MIPs experiments to the ESGF
 - MIROC6: 2018 - 2019
 - MIROC-ES2(L/H): Late 2018~
 - NICAM: 2018 - 2019
 - MRI-ESM: Q4/2018
 - MRI-AGCM: Q4/2018
- Have you yet started filling the ES-DOC questionnaire?
 - MIROC6: No
 - MIROC-ES2(L/H): Not yet
 - NICAM: No.
 - MRI-ESM: No
 - MRI-AGCM: No
- Any additional feedback to the WGCM and CMIP Panel? We will make sure that the issues you raise are discussed at the WGCM-21 meeting.
 - MIROC6: Difference in forcing datasets does not largely affect the global-mean SAT time series of MIROC6 historical simulations
 - MIROC-ES2(L/H): None
 - NICAM: None
 - MRI-ESM: No
 - MRI-AGCM: No