Japanese modeling groups’ perspectives:

MIROC, MRI, and NICAM

Masa Watanabe (Univ of Tokyo, Japan)
CMIP6 experiments with MIROC/MRI/NICAM

✓ **MIROC6, MIROC-ESM & MRI-ESM** participated in DECK

✓ SSC members in 9 MIPs, in which we contributed to coordinate Tier 1/2 experiments:
  - *(MIROC6)* CFMIP, DCPP, RFMIP, DAMIP, LS3MIP
  - *(MIROC-ESM)* C4MIP, AerChemMIP, PMIP, COVID-MIP
  - *(MRI-ESM)* OMIP

✓ **NICAM** and **MRI-AGCM** contributed only to HiResMIP

✓ **MIROC6** produced a large ensemble (50 members) for historical and SSPs
Recent highlights in MIROC/MRI/NICAM science activities

✓ Using large ensembles \((N=50)\) for attributing past climate changes & projections
✓ Probabilistic event attribution
✓ Earth system assimilation and prediction
✓ Toward exa-scale high resolution simulations

**1951-2010 trends in the zonal SST gradient**

Combined four LEs suggest the observed strengthening of the SST gradient can arise from internal variability

Watanabe, Dufresne, Kosaka, Mauritsen & Tatebe (2020 Nature CC)

**Scenario dependence of the Arctic amplification**

Ono et al. (2021 Comm Earth & Env, in rev)
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   - Yukiko Imada (MRI) has started serving as a member of LHA EPESC WG3
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**d4PDF** database for Policy Decision making for Future climate change

100-member ensembles with 60km AGCM + 20km RCM for EA, downscaling, and any other applications

- Without global warming
- Present day (AMIP)
- Future climate (+1.5, +2, +4K)

Mizuta et al. (2017 BAMS)

Courtesy of Y Imada
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MRI-AGCM

d4PDF database for Policy Decision making for Future climate change

Regional attribution of
- Heatwaves
- Heavy rain
- Tropical cyclones
- Severe snowfall
- etc.
(>70 papers)
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**First version Earth system prediction system using MIROC-ES2L**

- Nino3 SST vs CO2 flux in assimilation
- Hindcast skill for air-sea CO2 flux variability

- Anti-correlation between CO2 flux & Nino3.4 SST well reproduced
- 2yr prediction skill for the CO2 flux improved in some ocean regions
- Need to assimilate Earth system variables
Recent highlights in MIROC/MRI/NICAM science activities

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Chihiro Kodama (JAMSTEC) is serving as a member of LHA Digital Earths

**High-res modeling toward digital twin**

Snapshots from 10 global storm resolving models

1000-mem super ensemble using NICAM for Typhoon predictability

Ongoing activity outside of CMIP6 (RCEMIP, DYAMOND etc)

Satellite Obs.

NICAM

$\Delta x=220\text{km}$

NICAM

$\Delta x=3.5\text{km}$

Shibuya et al. (2021, PEPS)

Shibuya et al. (2021, JMSJ)

Courtesy of M Satoh & C Kodama
Recent highlights in MIROC/MRI/NICAM science activities

The Gulf stream and Kuroshio current are synchronized

The Kuroshio/Gulf Stream synchronization was simulated only in high-res CGCMs (GFDL and MIROC) but not in conventional CMIP6 models!

Kohyama, Yamagami, Miura, Kido, Tatebe & Watanabe (2021 Science)