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Interannual to decadal variability in a control experiment using MIROC4 – a high-resolution AOGCM for the near-term climate prediction

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Preliminary results, especially mean climate and interannual to decadal variability, in a general circulation climate model, Model for Interdisciplinary Research on Climate (MIROC) version 4, are presented. The model is developed by the Center for Climate System Research (CCSR), the University of Tokyo; National Institute for Environmental Studies (NIES); and Japan Agency for Marine-Earth Science and Technology (JAMSTEC). MIROC4 is an updated model from the previous version MIROC3_hires, which was used to contribute to the IPCC AR4. Most of the model components are the same as MIROC3_hires, but the atmospheric component is changed to T213 spectrum model from T106 one to inform adaptation policies for near-term climate changes. The ocean component is the same as that used in MIROC3_hires, whose horizontal resolution is 0.28125° zonally and 0.1875° meridionally, while the latitudinal range where the Gent-McWilliams (GM) parameterization is applied is changed in order to improve the climatological distribution of SST. The other components, sea ice, land surface process, and river routing models, are also same as the previous model. To obtain the radiative balance, parameters associated with radiation, clouds, and aerosols are tuned. Using this model, spin-up and control experiments (120 years) under the condition of year 1950 without flux adjustment were conducted.

Globally averaged 2-m temperature (T2) and SST are not drifted, and biases in the SST field, typically warm bias in the high-latitudes and cold bias in the low- and mid-latitudes, are reduced in MIROC4, especially in the Northern Hemisphere. Associated with the reduction of the warm SST bias in the high-latitudes, sea ice in the Northern Hemisphere becomes thicker in MIROC4 than MIROC3_hires.

The Atlantic meridional overturning circulation (AMOC) is relatively weak in MIROC4, and mean volume transport of the North Atlantic Deep Water (NADW) is 12–13 Sv (Sv $\equiv 10^6$ m^3/s), which is 1–2 Sv weaker than that obtained by MIROC3_hires. However, the 120-year integration is not enough to spin-up AMOC, and the NADW transport will be greater in the end of the control experiment.

Simulated ENSO signal in MIROC4 is improved. The standard deviation of the Niño-3 index in MIROC3_hires was 0.33, but that in MIROC4 it is 0.57 (observation $\sim$ 0.8). Not only the Niño indices, but also distribution of ENSO related fields, e.g. PNA pattern, are better simulated than MIROC3_hires.

The time series of PDO obtained as the EOF1 of low-pass filtered (7 years) SST over the Pacific shows that a 20-year variation is dominant, and explains 37% of the total variance in the MIROC4. Its spatial distribution becomes more realistic than that in MIROC3_hires.

Currently, only the spin-up and control experiments are finished using MIROC4. We will conduct near-term climate prediction experiments for the coming decades to contribute for CMIP5/IPCC AR5.