Yukimoto, S., H. Kawai, T. Koshiro, N. Oshima, K. Yoshida, S. Urakawa, H. Tsujino, M. Deushi, T. Tanaka, M. Hosaka, S. Yabu, H. Yoshimura, E. Shindo, R. Mizuta, A. Obata, Y. Adachi, and M. Ishii, 2019: The Meteorological Research Institute Earth System Model version 2.0, MRI-ESM2.0: Description and basic evaluation of the physical component. *J. Meteor. Soc. Japan*, **97**, 931-965. https://doi.org/10.2151/jmsj.2019-051

Plain Language Summary:

A new earth system model MRI-ESM 2.0 was developed at the Meteorological Research Institute. As a result of enhancement of the atmospheric vertical resolution and various improvements for the cloud scheme, the aerosol model, and the ocean model, the performance in present-day climate reproduction has significantly improved in many aspects compared to the former model MRI-CGCM3. Root-mean-square-error (RMSE) of the shortwave radiation distribution at the top of the atmosphere reduced by about 42% compared to MRI-CGCM3 (Figure 1). Performance is also improved in expressing climate change and variability. For example, the observed global mean surface temperature change from the mid-19th century to the present is reproduced quite well. The stratospheric quasi biennial oscillation is now represented realistically.

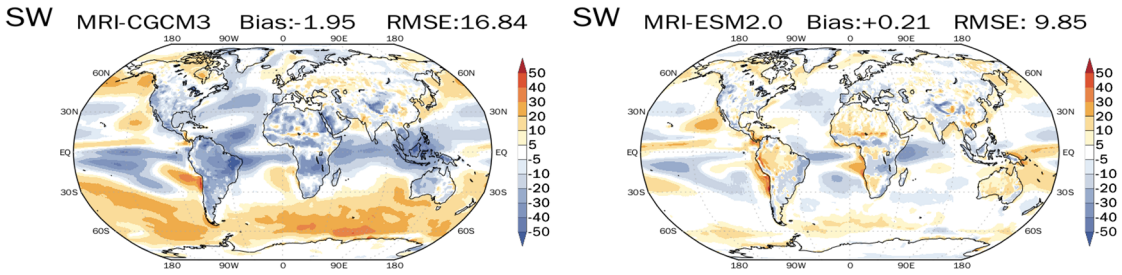

Figure 1. Biases (relative to the CERES-EBAF observations) of the annual-mean shortwave radiation at the top of the atmosphere in present-day climate reproduction with MRI-CGCM3 (left) and MRI-ESM2.0 (right). The global average biases and RMSEs are indicated at the top. Units are W m^{-2}.

- As a result of various improvements for the cloud scheme including the introduction of a new stratocumulus scheme, the underestimated biases in cloud reflection in the Southern Ocean that were persistent in the CMIP5 models have been significantly reduced.
- The accurate radiation distribution led to the implied ocean heat transport very close to the observation-based estimation, which contributed to the reduction of biases in the surface temperature distribution.
- The overall change in the global surface temperature relative to the preindustrial level is well reproduced, though the multi-decade-long change in the temperature trend since the middle of the 20th century is somewhat exaggerated.