EGU24-11691, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-11691
EGU General Assembly 2024

Development of the Isotope-enabled Fully Coupled Model MIROC6-iso

Yifan Li[1,2], Alexandre Cauquoin[2], Atsushi Okazaki[3], and Kei Yoshimura[2]
[1]Graduate School of Frontier Sciences, The University of Tokyo, Kashiwa, Japan (yifanli@iis.u-tokyo.ac.jp)
[2]Institute of Industrial Science (IIS), The University of Tokyo, Kashiwa, Japan
[3]Institute for Advanced Academic Research / Center for Environmental Remote Sensing, Chiba University, Chiba, Japan

Understanding Earth's climate is more important than ever, as it allows us to anticipate future changes and their potential impact on human society. The study of paleoclimate is crucial for understanding the mechanisms that have driven past climate variations, including natural oscillations, external forcings, and feedback processes within the Earth's climate system. Stable water isotopes ($H_2{}^{18}O$ and $HD^{16}O$) can serve as tracers to analyze the origins of water vapor, precipitation, and cloud formation, thereby enhancing our understanding of evaporation, condensation, and precipitation processes.

In order to understand coupled dynamics process, such as such as atmospheric convection/cloud formation, land surface processes, and sea ice effects according isotope insight, we developed an isotope-enabled fully coupled model(atmosphere-land-ocean coupled model), MIROC6-iso.

MIROC6 is the newest version of the Model for Interdisciplinary Research on Climate (MIROC) series. MIROC6 has updated the physical parameterizations in all sub-modules and vertical resolution. The overall reproducibility of mean climate, internal climate variability, midlatitude atmospheric circulation and tropical climate systems in MIROC6 is better than that in MIROC5.

Based on the AGCM MIROC6-iso to which stable water isotopes are implemented into the atmosphere and land-surface component[1], we implemented the stable water isotopes into the ocean and sea-ice component at first. Then, we make the atmosphere, land-surface, ocean and sea-ice component coupled and enabled them to interacted with each other.

We performed the simulation under the preindustrial period (PI), corresponding to the climate conditions at 1850 CE. In the ocean component, we employed a spin-up process by separately running the ocean model COCO-iso from the ocean component of the CGCM MIROC6-iso for 4000 years. This was done to establish initial conditions for the ocean part of CGCM MIROC6-iso, ensuring that the ocean component operates directly under equilibrium conditions.

CGCM MIROC6-iso shows a good performance in simulating isotope ratios in precipitation. Additionally, we compared the d-excess of precipitation, as well as the isotopic delta values of the ocean surface and deep ocean. We also examined the relationship between the isotopic delta

values and both temperature and sea surface salinity.

CGCM MIROC6-iso may has many potential applications in climate analysis, such as analyzing the monsoon wind fields in monsoon cycles, as well as the coupled mechanisms of the atmosphere and ocean in ENSO, monsoon and so on. Then it can be used to analyse the climate of the past. We hope this new model could contribute to CMIP6/PMIP4.

[1] Okazaki, A., Li, Y., Kino, K., Cauquoin, A., and Yoshimura, K., Evaluation of a newly developed isotope-enabled AGCM MIROC6-iso under the present climate, AGU 2023, San Francisco (USA), December 2023.