

Estimation of parameters in an isotope-enabled GCM with data assimilation

*Atsushi Okazaki¹, Masahiro TANOUE³, Kanon Kino², Alexandre CAUQUOIN², Kei Yoshimura²

1. Hirosaki University, 2. The University of Tokyo, 3. Meteorological Research Institute

Stable water isotopes are powerful tools for understanding the hydrological cycle and paleoclimate. They have been implemented in general circulation models (GCMs) to help interpret the isotopic signals in precipitation and moisture. Most isotope-enabled GCMs share common isotopic parameterizations for processes such as surface evaporation from open water, condensation from vapor to ice in supersaturation conditions, and evaporation and isotopic exchange from liquid raindrops into unsaturated air. However, parameters in the processes have been poorly constrained in the previous studies: they have been manually tuned to fit spatially sparse observations of precipitation isotopes. Globally uniform parameters have been used without reasonable ground. Besides, manual tuning is a time-consuming task.

This study estimates the isotopic parameters with an isotope-enabled GCM named MIROC5-iso and LETKF, a variant of the ensemble Kalman filter. Two types of isotopic observation are assimilated in the estimation: in-situ precipitation isotope observations and satellite-based ones. The method enables the estimation of spatially variable parameters in an efficient way. MIROC5-iso with the estimated parameters improved performance in simulating isotope ratios in precipitation and vapor. In the presentation, we will discuss the advantage of the estimated parameters by showing the model's performance in simulating climates different from the present, e.g., Last Glacial Maximum (LGM).

Keywords: stable water isotopes, isotope-enabled GCMs, parameter estimation, data assimilation