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Estimation of Parameters in an Isotope-Enabled GCM with Data Assimilation and Satellite-Based Observations

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Stable water isotopes are powerful tools for understanding the hydrological processes and the cycle. 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 and the globally uniform parameters have been used without reasonable ground: they have been manually tuned to fit spatially sparse observations of precipitation isotopes.

This study estimates the isotopic parameters with an isotope-enabled GCM named MIROC5-iso and LETKF (Local Ensemble Transform Kalman Filter), a variant of the ensemble Kalman filter. This approach and recent advancement of satellite-based isotope observations enables the estimation of spatially and temporally variable parameters in an efficient way. In this study, two types of isotopic observation are assimilated in the estimation: in-situ observations for precipitation isotopes and satellite-based ones for vapor isotopes. 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).