NICAM-isotopeでシミュレートされた梅雨前線に関連する水安定同位体の挙動
Stable water isotope behavior associated with the Baiu front simulated by NICAM-isotope

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Stable water isotopes (SWI) are an observable water tracer that reflects integrated history of phase change and mixing. SWI are exploit not only for climate proxy (e.g. Dansgaard, 1993) but for studying precipitation systems.

The Baiu Front (BF) is stationary front during the late spring and early summer near Japan, which is the “boundary” between tropical and extratropical airmass. BF is characterized by large gradient of SWI as well as equivalent potential temperature. To study BF from the viewpoint of SWI, it is expected to improve our understanding about water cycle associated the front.

From observational study by Kurita et al. (2015), highest isotope ratio in water vapor near surface correspond to the warm airmass advection by southerly flow, while abrupt isotopic depleting corresponds to cold air advection associated with southward migration of BF. Rainfall results in isotopic depletion of water vapor since heavy isotopologues (HDO) preferentially condensate and are taken away from water vapor by rainout. In this study, we attempt to quantify the effect of water vapor (airmass) advection and depletion by rainout on isotopic variability associated with the BF.

We developed isotope-incorporated microphysics scheme based on NSW6 (Tomita, 2008), which is a version of microphysics scheme by Lin et al. (1983). We simulate the isotopic behavior associated with BF using this scheme on global cloud-resolving model NICAM (Satoh et al. 2008; 2014).

To check validity of our isotope-incorporated model, simulated values in our model are compered with observation at paddy field in Tsukuba, Japan (Wei et al. 2015; 2016). Although there is some discrepancy between the observation and our simulation, our model successfully reproduced ascending/descending timing of dD.

From composite analysis against to precipitation intensity by BF, dD contrast between north and south of BF reflects airmass difference in the case with weak precipitation, which consistent with Kurita et al. (2015). On the other hand, heavy precipitation case is almost same with weak precipitation case except for “V-shape” depletion near BF region. this result is consistent with temporal V-shape change in isotope ratio of precipitation associated with front passing (e.g. Celle-Jeanton et al. 2004).

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