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Dynamical downscaling of stable water isotopes over the Asian monsoon region using the regional circulation model COSMOiso

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As tracers of hydrological cycle, stable water isotopes (δ18O and δD) have been widely applied to investigate the hydrological changes in the Asian monsoon region, particularly in the geological past. Several isotope-enabled global circulation models have been employed to understand the spatiotemporal distribution of stable water isotopes in Asian monsoonal precipitation. However, all the global models use relatively coarse spatial resolution and thus cannot resolve regional details, particularly over the mountainous regions. Dynamical downscaling using higher-resolution regional climate models has been proven a useful approach to better characterize the spatial pattern of the Asian monsoon climate, particularly its hydrological cycles. But how the simulation of stable water isotopes over the Asian monsoon region could benefit from this approach remains largely unknown.

In this study, we use the isotope-tracking non-hydrostatic regional circulation model COSMOiso nested in a global circulation model ECHAM5iso with T31 resolution to capture the spatiotemporal pattern of stable water isotopes over the Asian monsoon region. Two different resolutions of COSMOiso have been used: 1x1 degree and 0.44x0.44 degree. Our preliminary results show that the dynamical downscaling of COSMOiso with 1x1 degree can significantly improve the simulation of stable water isotopes in precipitation over northern China compared to its global forcing. In contrast, the dynamical downscaling of COSMOiso with 0.44x0.44 degree improves the simulation of stable water isotopes over South Asia in summer, but strongly overestimates the values over East Asia in summer and autumn. This can be largely related to biases in the amount of precipitation in this experiment. It is noted that neither of the two regional model experiments exhibits better overall performance than that of ECHAM5iso with T106 resolution in simulating the stable water isotopes in precipitation. This indicates that the performance of regional dynamical downscaling of stable water isotopes over the Asian monsoon region might be strongly limited by its global forcing.