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Microphysical Modeling of Water Isotopic Composition in the Asian Summer Monsoon

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The summertime Asian Monsoon (AM) is the single most important contributor to water vapor in the UTLS and overworld stratosphere. Much of that water comes from sublimating ice, but the life cycle of the condensate lofted by overshooting convection is not well understood. We report here on insights into that life cycle derived from the first in-situ measurements of water vapor isotopic composition over the Asian Monsoon. The Chicago Water Isotope Spectrometer (ChiWIS) flew on high-altitude aircraft in the monsoon center during the StratoClim (2017) campaign out of Nepal, and in monsoon outflow during ACCLIP (2022) out of South Korea. Both campaigns sampled a broad range of convective and post-convective conditions, letting us trace how convective ice sublimates, reforms, and leaves behind characteristic isotopic signatures. We use the Bin Resolved Isotopic Microphysical Model (BRIMM), along with TRACZILLA backtrajectories and convective interactions derived from cloud-top products, to follow the evolving isotopic composition along flight paths in both campaigns. Results support the wide diversity of isotopic enhancements seen in both campaigns and show how temperature cycles downstream of convective events progressively modify environmental isotopic compositions.