Sensitivity of stable water isotopic values on the convective parameterization schemes

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Abstract

Here we show how stable water vapor isotopes, which are sensitive to the convective condensation rates, may be useful for evaluating convective parameterizations. By varying one of the least constrained convection parameters in the NCAR Community Atmosphere Model (CAM), namely the timescale for consumption of convective available potential energy (CAPE), τ, the simulated precipitation experiences substantial changes in response to changes in both the deep and shallow convection schemes—increasing τ from the standard 2 hours to 8 hours increases the contribution from shallow convection. The lowest order effect of increasing τ is a decrease (increase) in lower (upper) tropospheric condensation rates, with approximately the opposite vertical structure for the change in simulated isotopic signature. Increasing τ from the standard 2 hours to 8 hours also provides a better match to satellite-observed water vapor isotope ratios, albeit with some uncertainty related to the quality of currently-available satellite measurements. Thus, the incorporation of water vapor isotopes into GCMs provides additional constraints on convective parameterizations, especially as more and better quality water vapor isotope measurements become available.