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Processes maintaining the localized maxima in lower stratospheric water vapor over the boreal summer Asian monsoon region are investigated using trajectory and cloud models that resolve the detailed cloud microphysical processes, with observation-based convection and radiation schemes. We examine the impact of convective influence along parcel trajectories on cloud formation and dehydration by tracing the trajectories through time-dependent fields of convective cloud top heights estimated from global rainfall and geostationary brightness temperatures. Parameters such as the rainfall threshold used for identification of deep convection are derived by comparison with the CloudSat deep convective cloud top product as enhanced by colocated CALIOP measurements. The simulated water vapor field at the 100 hPa level and cloud occurrence frequencies in the tropical tropopause layer (TTL) are constrained by corresponding observations from MLS and CALIPSO, respectively. The observed maximum in the 100 hPa level water vapor field over the Asian monsoon region is only present in the simulation with convective influence, indicating the importance of convective hydration for the summertime water vapor distribution. Convection moistens the 100 hPa level over the Asian monsoon by  $\sim 1$  ppmv, where  $\sim 75\%$  of this moistening is due to convection occurring locally within the monsoon region. Convection also increases the cloud occurrence frequency in the TTL over the southern sector of the Asian monsoon anticyclone by  $\sim 20\%$ . Parcels are convectively hydrated in the southeastern sector of the anticyclone, transported westward by the anticyclonic circulation, and dehydrated in the southwestern sector. The relative importance of extreme convective events that inject ice and water vapor near or above the tropopause will also be examined.