Diagnosing tropical precipitation and relative humidity relationship

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Observational and modeling studies have shown a close relationship between tropical convective precipitation and relative humidity (RH) in the troposphere. Thus, changes in the pattern of RH can directly influence that of precipitation. We show preliminary multi-instrument analysis of zonal–mean and zonally varying distributions of RH from the European Center for Medium-range Weather Forecasts (ECMWF), the Global Positioning System Radio Occultation (GPSRO) and the Modern-Era Retrospective Analysis for Research and Applications (MERRA), and precipitation climatologies from the Global Precipitation Climatology Project (GPCP) in 2007-2009. At seasonal timescales, correlations between RH and precipitation show a latitudinal lag of ~7° between the peaks of the two distributions, implying that large-scale horizontal transport interacting with local convection strongly affects water vapor dynamics and kinematics. This latitudinal lag decreases with altitude, and it almost disappears in the mid-troposphere, providing additional information on the impact of circulation on precipitation patterns. Studying the relationship between GPSRO RH and precipitation, we observe that strong precipitation is initiated at a drier atmosphere: ~10% drier than what ECWMF and MERRA reanalyses suggest. Observationally constraining the RH-precipitation relationship is critical to the improvement of convective parameterization schemes in Global Circulation Models (GCMs). This work is a new application of the GPSRO dataset providing new, and exciting, information about water vapor dynamics and kinematics.