GNSS Precipitable Water Vapor and Characteristics of Tropical Deep Convection

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Tropical weather is dominated by deep atmospheric convection, a multi-scale phenomenon, which is highly dependent on the water vapor distribution. Traditionally, the tropics have been under observed for meteorological and climatological studies. Here, we focus on the use of GNSS to estimate precipitable water vapor (PWV) in order to characterize convective events on the mesoscale. In addition, we argue that large-scale networks, such as being proposed by COCONET can provide important information on the interaction (e. g. feedbacks) between large-scale humidity structure and deep convection. For mesoscale convective events, we present data from two distinct tropical region, the deep convective regime of the central Amazon and the North American Monsoon of late boreal summer. Specifically, water vapor convergence, d (PWV)/dt, a proxy for convective intensity, is shown to have characteristic times-scale of around 4 hours in the Amazon; with seasonal dependence, shorter time scale during the wet season. In the North American Monsoon region (generally less humid than the Amazon), convergence times are longer (~ 5 to 6 hours) and the magnitude of the jumps in PWV are much greater. Physically, this may imply a threshold, non-linear type dependence of convection on initial PWV values.

At larger spatial-scale, a Caribbean-based network of GNSS PWV can help to investigative outstanding problems in tropical regimes, including
1) the observation of apparent bimodality in the statistical distribution of tropical water vapor values (which has implications for tropical atmospheric dynamics) and;
2) the strong non-linear relationship (as noted above) between PWV and tropical rainfall which has been argued to be evidence for self-organized criticality of tropical deep convection.