GNSS Observations of Deep Convective Timescales in the Amazon

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In the tropics, deep precipitating convection dominates the weather and climate. Deep convection determines and is determined by the spatial/temporal distribution of water vapor resulting from complex interactions and feedbacks. However, observational systems, both surface-based and satellite-based, for the tropics tend to be inadequate for observing the convective-water vapor relationship, particularly for scales below mesoscale. For example, to understand the shallow-to-deep convective transition and organization on the mesoscale in the tropics and their relationship to the water vapor distribution, high frequency (~10 minutes), all weather observations are absolutely necessary. GNSS meteorology offers a durable, frequent, all-weather relatively inexpensive measures of column water vapor/precipitable water vapor. In this study, we utilize GNSS PWV for determining deep convective water vapor convergence time scales for the equatorial tropics, namely, Manaus in the central Amazon Basin. For a 3.5-year period, 320 observed deep convective events were analyzed. Two water vapor

convergence timescales are observed ; a roughly 8 hour period of weak water vapor convergence and a strong non-linear shallow-to-deep transition time scale of 4 hours. Within the 4 hour shallow-to-deep transition timescale, identifiable structure also exists. Maximum water vapor convergence is observed within 1 hour of the maximum precipitable water vapor value. During this final hour, rapid deep cloud growth and initiation of heavy precipitation occurs. This 4-hour shallow-to-deep transition time scale shows strikingly little variation, even when conditioned upon PWV values, diurnal vs. nocturnal convection, or measures of convective intensity (e.g., minimum cloud top temperature) . This suggest that the shallow-to-deep transition time is an intrinsic property of convection. The longer 8 hour timescale does show some conditional dependency on different measures of convective intensity or thermodynamic environment.

Analysis of these water vapor convergence time scales is currently being carried out for the CHUVA Belem GNSS Dense Network data set. Unlike Manaus, forcing in Belem is strongly associated with sea-breezes, providing an opportunity to examine the shallow-to-deep transition under different forcing. Result from this analysis as well as from Manaus will be presented. We argue that the GNSS-derived water vapor convergence time scale is valuable, not only for identify intrinsic characteristic of deep convection, but also for providing a metric for numerical modeling of deep tropical convection. CHUVA Manaus and GoAmazon2014 will provide and unprecedented opportunity to understand the shallow-to-deep transition in a Tropical continental region.