A new metric to help understand Amazon rainforest precipitation

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In the Amazon rainforest, the chain of events that turns a small-scale process like a localized increase in evaporation into a towering storm cloud is long and twisted. To understand the complex dynamics that lead to precipitation, and to identify the relative importance of various processes, researchers need high temporal resolution, all-weather observations over many years. Such observations have traditionally been scarce for tropical continental environments, such as the Amazon, where logistics are difficult.

In recent years, however, Global Navigational Satellite System (GNSS) stations have provided a way to gather these measurements of atmospheric water vapor. In their study, Adams et al. use 3.5 years of observations from a GNSS meteorological station in Manaus, Brazil, to analyze the processes that turn localized dynamics into deep convective rainfall.

To identify which physical processes are most important in contributing to cloud formation, growth, and precipitation, the authors developed a new metric called the "water vapor convergence time scale." Moist air is more buoyant than dry, so understanding water vapor convergence is important to understanding the development of deep convective cloud formation. Using their metric derived from GNSS water vapor observations, the authors identify two main time scales relevant to Amazon convective storm formation.

Starting about 12 hours before precipitation onset, the authors find that

localized evaporation is the most likely dominant factor in moistening the atmosphere. Then, about 4 hours before the onset of deep convective precipitation, water vapor convergence becomes dominant. This 4-hour period of strong water vapor convergence before heavy rainfall encompasses the transition from shallow to deep convection. This transition is a process during which small, scattered cumulus clouds grow into deep convective towers. The authors find that this 4-hour shallow-to-deep convection transition time scale is not dependent on the season, the intensity of the convective precipitation, or the time of day.

More information: GNSS Observations of Deep Convective Time Scales in the Amazon, *Geophysical Research Letters*, DOI: 10.1002/grl.50573, 2013 onlinelibrary.wiley.com/doi/10 … 2/grl.50573/abstract

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