Title: First soil-specific calibrated measurements of soil moisture in a Central Amazonian tropical forest

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Project Abstract: Soil moisture plays a key role in hydrological, biogeochemical and energy budgets, which means that accurate soil moisture measurements are required to characterize and model feedbacks between these three systems and to quantify fluxes and processes. Accurate soil moisture measurements are difficult because of logistical constraints in remote areas such as the Amazon. In this study, we evaluated the need for field based calibration of time domain reflectometers (TDR) for moisture content measurements in tropical forest soils. We also present soil moisture data time series from a deep soil profile in an undisturbed forest at the ZF2 field site near Manaus, Brazil. High resolution time series of soil moisture in tropical forests are limited, especially in the central Amazon, and most of the tropical soil moisture data that are available have been collected from shallow soils (typically < 1 m). An unusual aspect of this study is that it examines soil moisture across wet- and dry-seasons in a tropical forest down to nearly 15-m depth. Comparison of TDR calibrations between the widely used general or "factory" calibration based on the Topp equation and a third degree polynomial calibration based on dielectric permittivity and moisture content measurements from local pit soils showed substantial differences. We found that the general TDR equation underestimated volumetric moisture contents (θ_v) by 22-42%. The calibration using local soils to quantify the TDR permittivity-water content relation was much more accurate. The magnitude of the differences between the calibration approaches suggests that use of the general equation may result in significant error when applied to humid tropical forest soils. The calibrated wet- and dry-season θ_v data showed a variety of depth and temporal variations highlighting the importance of soil textural changes, root uptake depths, as well as event- to seasonal-precipitation effects. Data such as these are greatly needed for improving our understanding of ecohydrological processes within tropical forests and for improving models of these systems in the face of changing environmental conditions.