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Time series of canopy intercepted water and dew observed in a tropical tree plantation by means of microwave radiometry

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During summer and autumn 2007, a 11 GHz microwave radiometer was deployed in an experimental tree plantation in Sardinilla, Panama. With this instrument, the opacity of the tree canopy was derived from incoming brightness temperatures received on the ground. A collocated eddy-covariance flux tower measured water vapor fluxes and meteorological variables above the canopy. It was found that canopy intercepted rain and dew formation modulated the diurnal opacity cycle. With an enhanced canopy opacity model accounting for water deposited on the leaves, we quantified the influence of canopy stored water (i.e. intercepted water and dew) on the opacity. With this technique it was possible to directly monitor high resolution time series of dew formation and rain interception during a period of two weeks. In contrast to through-fall measurements, this new technique allows to determine the amount of intercepted rain more precisely and during day and night since evaporation effects do not hamper the accuracy of the method. We found that during light rainfall up to 60% of the rain amount is intercepted by the canopy whereas during periods of intense rainfall, only 4% were intercepted. On average, about 15% of the rain amount was intercepted during rainfalls of medium intensities. By comparing the interception with the water vapor flux time series it was found that intercepted water is evaporated rapidly after it is deposited on the leaves, which resulted in an enhanced water vapor flux. Our study also provides the first direct measurements and quantifications of the temporal evolution of dew formation and evaporation in a tree canopy on a diurnal base. Dew accumulated during the night and until about 2 h after sunrise, when the water vapor flux began to exceed the dew formation rate. The dew continued to evaporate for another 3.5 h until the surface of the leaves was completely dry. On average, 0.17 mm of dew was formed during the night. Dew evaporation contributed 5% to the total water vapor flux measured above the canopy.