

Attributing changes in streamflow response to transpiration and canopy interception changes after defoliation from 2017 Hurricane Maria in Puerto Rico

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Hurricane Maria, a nearly Class-5 hurricane that crossed Puerto Rico on 20 September, 2017, brought heavy rainfall and winds in excess of 250 km/hr. We posed the following hypotheses: (1) the near-total defoliation across Puerto Rico from Hurricane Maria cut off transpiration, resulting in higher base flow and shallower recession slopes for up to a year; (2) the magnitude of this change was proportional to percent forest cover. Across Puerto Rico, we identified 21 streamgages that had natural flow regimes (no impoundments, wastewater discharges, or water withdrawals) and that had mostly uninterrupted streamflow record for the year before and year after the hurricane. We tested for slowing of flow recession using a master recession curve (MRC) approach, where the master curve is constructed from the assemblage of monotonic storm flow recessions, and an asymptotic base flow value can be computed. In the absence of transpiration, recession slopes would be shallower as higher soil moisture content and higher water tables move more water to the stream and slow the recession. MRC recession slopes were not different in the pre- and post-Hurricane years, but tended (non-significantly) toward shallower slopes in the months immediately following the hurricane. Resulting differences among base flows were strongest in the first month, when base flows were greater than either the pre-Hurricane or ensuing post-hurricane periods ($p=0.0002$, Kruskal-Wallis non-parametric one-way ANOVA). We believe the restoration of pre-hurricane evapotranspiration was caused by rapid understory regeneration in the forest. The defoliation followed by recovery in understory growth and evapotranspiration were mirrored by an increase and gradual (~10 weeks) recovery in vapor pressure deficit across an elevation transect in the Luquillo Mountains of eastern Puerto Rico. Thus in the Puerto Rico forest, the effect of Hurricane Maria on streamflow diminished in importance after the first few months.