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The influence of tree morphology on stemflow generation in a tropical lowland rainforest

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Even though stemflow usually accounts for only a small proportion of rainfall, it is an important point source of water and ion input to forest floors and may, for instance, influence soil moisture patterns and groundwater recharge. Previous studies showed that the generation of stemflow depends on a multitude of meteorological and biological factors. Interestingly, despite the tremendous progress in stemflow research during the last decades it is still largely unknown which combination of tree characteristics determines stemflow volumes in species-rich tropical forests. This knowledge gap motivated us to analyse the influence of tree characteristics on stemflow volumes in a 1 hectare plot located in a Panamanian lowland rainforest. Our study comprised stemflow measurements in six randomly selected 10 m by 10 m subplots. In each subplot we measured stemflow of all trees with a diameter at breast height (DBH) > 5 cm on an event-basis for a period of six weeks. Additionally, we identified all tree species and determined a set of tree characteristics including DBH, crown diameter, bark roughness, bark furrowing, epiphyte coverage, tree architecture, stem inclination, and crown position. During the sampling period, we collected 985 L of stemflow (0.98 % of total rainfall). Based on regression analyses and comparisons among plant functional groups we show that palms were most efficient in yielding stemflow due to their large inclined fronds. Trees with large emergent crowns also produced relatively large amounts of stemflow. Due to their abundance, understory trees contribute much to stemflow yield not on individual but on the plot scale. Even though parameters such as crown diameter, branch inclination and position of the crown influence stemflow generation to some extent, these parameters explain less than 30 % of the variation in stemflow volumes. In contrast to published results from temperate forests, we did not detect a negative correlation between bark roughness and stemflow volume. This is because other parameters such as crown diameter obscured this relationship. Due to multicollinearity and poor correlations between single tree characteristics with stemflow volume, an assessment of stemflow volumes based on forest characteristics remains cumbersome in highly diverse ecosystems. Instead of relying on regression relationships, we therefore advocate a total sampling of trees in several plots to determine stand-scale stemflow yield in tropical forests.