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Biogenic Volatile Organic Compound emission patterns of two hyperdominant tree species distributed in an environmental gradient in central Amazonia

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Biogenic Volatile Organic Compounds (BVOCs) regulate large-scale biogeochemical cycles by influencing both plant performance and atmospheric chemical and physical processes. Tropical forests are the dominant source of these compounds to the global atmosphere. But modeled emissions from tropical vegetation carry high uncertainty due to the challenge of scaling relatively few observations across the great diversity of species and environments. Also, there remains large uncertainty in modeled emission estimates from tropical vegetation due to a poor understanding of the biological and environmental controls on emissions. It is known that BVOC compositions are conserved within plant species, but that emission quantities may vary significantly with photosynthetic capacity, carbon and nutrient investment tradeoffs, and the environment. A predictive framework for emission capacities requires an improved mechanistic understanding of BVOC variation across plant populations. Here, we measured the emission capacity of BVOCs and plant functional traits of two hyperdominant tree species from central Amazonia—Protium apiculatum and Eschweilera bracteosa—distributed along a topographic and edaphic environmental gradient at the Amazon Tall Tower Observatory (ATTO) site. Our objective was to quantify the partitioning of BVOC plasticity among plant traits, environment, and their co-dependencies. We measured functional traits of i) leaves (leaf area, specific leaf area, leaf dry matter content, leaf thickness, force to tear, stomatal size and density, leaf vessel density), ii) wood (stem and twig wood density, stem and twig wood water content, active xylem depth), and iii) whole plants (proportions of basal area to total height, active xylem area to basal area, crown area and volume to basal area). We also measured net photosynthetic rate, stomatal conductance, and leaf flux and within leaf content of BVOCs. All measurements were carried out for five individuals of each tree species and at each environment—plateau (terra-firme), white-sand forest (campinarana), and valley—from October to December 2018. Protium is the most studied tree genus in Amazonia in terms of stored BVOCs, and previous studies have shown that Protium apiculatum does not store isoprenoids - the biggest group of BVOCs. However, our results showed that it emits isoprene, which is a not stored compound and the largest emitted to the atmosphere. Eschweilera is the most abundant tree genus in Amazonia, and previous measurements indicated that several species emit isoprene, but there is no information about stored BVOCs. The three environments of this study provide different microclimates and resources to plants, which can have implications on plant functional strategies to produce and emit BVOCs. In this light, we will present results on how the potential different plant strategies for each environment, in terms of functional traits, may structure and affect BVOC emissions. In addition, we will present estimates of the BVOC contributions of the two species populations for each environment, by taking into account the distribution of each tree individual of both species. This research is a new approach that has empirical foundation for scaling up BVOC emissions of different tropical vegetation landscapes.