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Isoprene emission in central Amazonia - from measurements to model estimates

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Isoprene regulates large-scale biogeochemical cycles by influencing atmospheric chemical and physical processes, and its dominant sources to the global atmosphere are the tropical forests. Although global and regional model estimates of isoprene emission have been optimized in the last decades, modeled emissions from tropical vegetation still carry high uncertainty due to a poor understanding of the biological and environmental controls on emissions. It is already known that isoprene emission quantities may vary significantly with plant traits, such as leaf phenology, and with the environment; however, current models still lack of good representation for tropical plant species due to the very few observations available. In order to create a predictive framework for the isoprene emission capacity of tropical forests, it is necessary an improved mechanistic understanding on how the magnitude of emissions varies with plant traits and the environment in such ecosystems. In this light, we aimed to quantify the isoprene emission capacity of different tree species across leaf ages, and combine these leaf measurements with long-term canopy measurements of isoprene and its biological and environmental drivers; then, use these results to better parameterize isoprene emissions estimated by MEGAN. We measured at the Amazon Tall Tower Observatory (ATTO) site, central Amazonia: (1) isoprene emission capacity at different leaf ages of 21 trees species; (2) isoprene canopy mixing ratios during six campaigns from 2013 to 2015; (3) isoprene tower flux during the dry season of 2015 (El-Niño year); (3) environmental

factors – air temperature and photosynthetic active radiation (PAR) - from 2013 to 2018; and (4) biological factors – leaf demography and phenology (tower based measurements) from 2013 to 2018. We then parameterized the leaf age algorithm of MEGAN with the measurements of isoprene emission capacity at different leaf ages and the tower-based measurements of leaf demography and phenology. Modeling estimates were later compared with measurements (canopy level) and five years of satellite-derived isoprene emission (OMI) from the ATTO domain (2013-2017). Leaf level of isoprene emission capacity showed lower values for old leaves (> 6 months) and young leaves (< 2 months), compared to mature leaves (2-6 months); and our model results suggested that this affects seasonal ecosystem isoprene emission capacity, since the demography of the different leaf age classes varied a long of the year. We will present more results on how changes in leaf demography and phenology and in temperature and PAR affect seasonal ecosystem isoprene emission, and how modeling can be improved with the optimization of the leaf age algorithm. In addition, we will present a comparison of ecosystem isoprene emission of normal years (2013, 2014, 2017 years) and anomalous years (2015 - El-Niño; and 2016 - post El-Niño), and discuss how a strong El-Niño year can influence plant functional strategies that can be carried over to the consecutive year and potentially affect isoprene emission.