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Effects of soil fertilization on aboveground biomass in an old-growth forest in Central Amazon

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The Amazon covers an extensive area of tropical rainforest that directly affects global water and Carbon cycles. The biomass stored in this forest is a result of the dynamic balance between rates of mass gain due to productivity, and losses due to respiration and mortality. In general, these forests concentrate about 70-80% of biomass in the aboveground part, and the regional variation of AGB (aboveground biomass) can be explained by the compositional, structural, climatic and by differences in soil propriety and fertility between East-West gradient in the Amazon basin. This gradient drives a large set of variations in tree growth and mortality, resulting in differences on the forest structure and dynamics. In this context, direct manipulation of nutrients in soils is a powerful tool to investigate which elements limit tree growth and forest productivity. While nitrogen (N) is accumulated along soil development and age, the availability of rock-derived phosphorus (P) and cations may limit the ecosystems' functioning, including the potential increase in the productivity in response to elevation on CO2 concentrations in the atmosphere. To understand these patterns, a long-term, large-scale soil fertilization experiment in Amazonian forests (AFEX) was implemented in the Central Amazon. In 2017, 32 permanent plots were installed in areas of old-growth continuous forest belonging to the Biological Dynamics of Forest Fragments Project (PDBFF), in a full factorial design, with four blocks chosen at random, where 8 plots (each with a size of 50x50 m) were installed with different fertilization treatments for each block. The treatments are: P, N, cations, Control (no fertilization), N+P, N+cations, P+cations and N+P+cations. To estimate the effects of soil fertilization on AGB, we calculated the difference between biomass before and after four years of fertilization (2017 to 2021), using allometric equations performed data from diameter about 5,000 individuals (DAB ≥ 10 cm) measured annually and wood density. We analyzed the data with two different approaches, at the community and at genus level, considering three most abundant genera: *Eschweilera*, *Pouteria* and *Protium*. At community level, our results showed only non-significant trends between AGB in plots where N, P and cations were added. At genus level, we observed that *Eschweilera* and *Protium* had a negative relationship to N and *Pouteria* had a positive trend. Conversely, only *Protium* increased AGB with P addition. *Pouteria* and *Protium* was negatively affected by cations, while *Eschweilera* showed no response. These results indicate that, although overall positive or negative trends in biomass increment appear at the community level, the highly diverse forest studied does not have a homogeneous response to nutrient addition, and that each taxonomic group could potentially be limited by different nutrients. In the long term, we expect that these patterns may change the forest structure, dynamics and composition and, consequently, the stocks of biomass, impacting the functionality of these forests. These results improve our understanding of the role of nutrients affecting forest biomass, and may reduce uncertainties in vegetation dynamics models and predictions on environmental changes.