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Ecosystem nutrient budget in a Central Amazon forest: the role of nutrient stocks and flows in biogeochemical cycling

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Soils of tropical forests generally have low fertility, therefore nutrient cycling has great importance in these ecosystem functions, once these soil elements are essential for vegetative tissue and plant metabolic processes. Understanding and quantifying the processes that involve nutrient acquisition, storage, and output in plants, and their relationship with forest productivity and biomass, is essential to characterize the ecosystem nutrient dynamics and understand how global environmental changes, such as the increase in CO2 can affect forest processes. Therefore, we investigated the nutrient dynamics of a *terra firme* forest in Central Amazonia, near Manaus, Brazil through the quantification of stocks, flows, and nutrient use efficiency in different compartments to estimate forest nutritional balance. We quantified the biomass stocks in the forest compartments – fine root, leaves, litterfall and stems – and their macro (N, P, Ca, Mg e K) and micronutrients (Fe, Mn e Zn) content. We estimated the nutrient fluxes through productivity rates, the nutrient stocks, and the nutrient efficiency, the inverse of nutrients concentration. Most of this information was available from the AmazonFACE (Free-Air CO2 Enrichment) baseline data. The study area has 8 permanent plots monitored since 2015 with periodic field collections and monitoring. We hypothesized that the macronutrient that cycles more efficiently in the ecosystem will potentially be the most limiting element to forest net primary productivity, adding to a better understanding of nutrient allocation and cycling, and greater accuracy in predictions from global vegetation dynamics models. The total forest biomass (above and belowground) in our study site was 200.85±0.52 Mg C ha-1 and the productivity 9.79±0.22 Mg C ha year-1. These results are higher than previous studies reported in the amazon forest. Ecosystem nutrient flow was greater in leaves > litter standing crop > fine roots > stems. On the other hand, ecosystem nutrient stocks were greater in stems > leaves > fine root > litter standing crop. Our preliminary results show that phosphorus stock and flow are lower than other macronutrients, being, therefore, cycled more efficiently than other elements studied here. This suggests that phosphorus is potentially the macronutrient that most limits net primary productivity. For nitrogen, we observe a low-efficiency use, which was expected since this element is abundant in Central Amazon soils; for potassium an intermediate efficient use, so the order of stocks and flows is N > K > P. For micronutrients nutrient efficiency use was as follows: zinc > magnesium > iron. These results suggest that phosphorus could be considered the most limiting macro nutrient to forest net primary productivity while zinc availability could also play a role. Our estimates of nutrient stocks and flows

for a Central Amazon forest would improve our understand different nutrient dynamics and demands that impact biogeochemical cycles and functioning of these forests.