EGU21-13194, updated on 20 Apr 2021
https://doi.org/10.5194/egusphere-egu21-13194
EGU General Assembly 2021

Pyrogenic carbon and forest dynamics during drought in Amazonian forests

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During extreme drought events, aboveground biomass (AGB) dynamics in Amazonian forests are altered through reduced productivity and increased tree mortality and carbon loss. Tree adaptations developed in response to historical drought may reduce the severity of carbon loss. Past droughts were likely associated with fire, which produced Pyrogenic Carbon (PyC), a form of carbon formed by the incomplete combustion of biomass burn and fossil fuel. PyC has specific properties that improve soil fertility and water holding capacity and decrease aluminium toxicity, among others. PyC can be found in different concentrations across the Amazon Basin, since it can be produced by local fires and aerosol deposition. It is unknown whether PyC could explain tree adaptations or contributes to Amazon forest dynamics, especially for extreme drought events. We hypothesize that PyC in soil can serve as a proxy of fire history and fire/drought adaptations and also support the forest during drought events because of its properties, decreasing mortality rates and maintaining rates of AGB gain equivalent to a non-extreme drought year. To evaluate this hypothesis, we used a dataset with more than 70 plots with repeat censuses distributed across the Amazon Basin and classified extreme drought events using maximum cumulative water deficit (MCWD) analysis. Soil samples were collected from the same plots during an intensive fieldwork campaign and PyC was quantified by hydrogen pyrolysis (HyPy). Forest plots were classified into high and low PyC based on the median across the whole dataset. Our preliminary results show that during extreme drought events, plots that have a greater concentration of PyC had significantly higher rates of AGB gain when compared with plots with lower concentrations of PyC (t-test, $p < 0.05$). During non-extreme drought years there was no significant difference in rates of AGB gain between plots with different concentrations of PyC. When we focus on plots with lower concentrations of PyC there is a significant decrease in rates of AGB gain during drought years compared to non-extreme drought years (t-test, $p < 0.05$). However, in plots with high concentrations of PyC there is no significant difference in rates of AGB gain, showing trees are able to maintain normal forest dynamics during extreme drought years. We conclude that PyC has an important role in mediating drought resistance and productivity in Amazonian forests.