EGU General Assembly 2024

EGU24-18954, updated on 22 Mar 2024
https://doi.org/10.5194/egusphere-egu24-18954
EGU General Assembly 2024


# Amazonian understory response to elevated $CO_2$

**Tomas Domingues**[1], Amanda Damasceno[2], Sabrina Garcia[3], Izabela Aleixo[3], Juliane Menezes[4], Iokanam Pereira[3], Martin De Kauwe[5], Vanessa Ferrer[2], Katrin Fleischer[6], Thorsten Grams[7], Flávia Santana[3], Iain Hartley[8], Bart Kruijt[9], Laynara Lugli[7], Nathielly Martins[4], Richard Norby[10], Bruno Portela[3], Anja Rammig[7], Carlos Quesada[3], David Lapola[11], and the AmazonFACE team[*]

[1]Universidade de São Paulo, FFCLRP, Biology, Ribeirão Preto, Brazil
[2]Ecology Graduate Program, National Institute for Amazonian Research (INPA), Manaus, Brazil
[3]National Institute for Amazonian Research (INPA), Manaus, Brazil
[4]Tropical Forest Sciences Graduate Program, National Institute for Amazonian Research (INPA), Manaus, Brazil
[5]School of Biological Sciences, University of Bristol, Bristol, BS8 1TQ, UK.
[6]Max-Planck-Institute for Biogeochemistry, Jena, Germany.
[7]Technical University of Munich (TUM), School of Life Sciences, Freising, Germany.
[8]Geography, College of Life and Environmental Sciences, University of Exeter, Exeter, UK.
[9]Wageningen University, Water Systems and Global Change, Wageningen, Netherlands.
[10]Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, Tennessee, United States
[11]Center of Meteorological and Climatic Research Applied to Agriculture (CEPAGRI), University of Campinas, Campinas, Brazil.
[*]A full list of authors appears at the end of the abstract

The response of plants to increasing atmospheric $CO_2$ concentration depends on several factors such as life history of specific species, availability of water, nutrients and light, and the ecological context that the plants are found. Although several experiments with elevated $CO_2$ ($eCO_2$) have been done worldwide, none was performed in the Amazon forest understory focusing in a community growing naturally. The understory of the central Amazon is limited by both light and phosphorus. Understanding how such ecosystem responds to $eCO_2$ is important to foresee how the forest will function in the future. Also, quantifying the response of this forest compartment helps to constrain Ecosystem Models that compute carbon and water fluxes.

For this study, we used the open-top chamber (OTC) approach, with a $CO_2$ enrichment of +250 ppm above the ambient concentration. Eight OTC were installed (4 with ambient $CO_2$ and another 4 with $eCO_2$) in the understory of a natural forest in the Central Amazon, approximately 70 km from Manaus city. The eCO2 experiment started in November 2019 and, after 120 days, we quantified the average community response of the following photosynthetic parameters: light saturated carbon assimilation rate ($A_{sat}$), stomatal conductance ($g_s$), transpiration rate ($E$), intrinsic water use efficiency (iWUE), apparent quantum yield ($\Phi$), light compensation point (LCP), maximum carboxylation capacity ($V_{cmax}$), maximum electron transport rate ($J_{max}$). After 240 days of treatment, we quantified mean individual leaf production and accumulated leaf production, leaf area ($Lf_{area}$). After 300 days, we quantified the increment in base diameter (BD), height ($H_t$) and relative growth rate (RGR).

Under $eCO_2$, we observed increases in $A_{sat}$ (67%), $J_{max}$ (19%), $\Phi$ (56%), and iWUE (78%), in agreement with the hypothesis that plants near the light compensation point respond strongly to $eCO_2$. We also detected an increase in $Lf_{area}$ (51%) and BD (65%), indicating that the extra primary productivity was not allocated to growth in height, but to supporting more light intercepting organs (leaf and conducting tissues). No detectable changes were observed for the other variables.

Apart from the expected increase in assimilation rates, understory plants in Central Amazon responded positively to $eCO_2$ by increasing their ability to capture and use light (leaf size, $\Phi$, and $J_{max}$). The increment in leaf area while maintaining E rates signifies that this forest compartment will increase its contribution to the whole forest water fluxes to the atmosphere. That might be related to the prevailing acquisitive strategy necessary for competing for phosphorus brought by water flow through plants. As a possible consequence, this forest might be less resistant to extreme drought associated with El Niño years.

Funding: Coordination for the Improvement of Higher Education Personnel - CAPES (grants 312589/2022-0) and São Paulo Research Foundation-FAPESP processes numbers (2022/07735-5) and (2015/02537-7).

**AmazonFACE team:** Amanda Rayane Damasceno, Sabrina Garcia, Izabela Fonseca Aleixo, Juliane Cristina Gomes Menezes, Iokanam Sales Pereira, Martin Gerard De Kauwe, Vanessa Rodrigues Ferrer, Katrin, Thorsten E. E. Grams, Alacimar Viana Guedes, Iain Paul Hartley, Bart Kruijt, Laynara Figueiredo Lugli, Nathielly Pires Martins, Richard J. Norby, Juliane Stephanie Pires-Santos, Bruno Takeshi Tanaka Portela , Anja Rammig, Leonardo Ramos de Oliveira, Flávia Delgado Santana, Yago Rodrigues Santos, Crisvaldo Cássio Silva de Souza, Gabriela Ushida Neves, David Montenegro Lapola, Carlos Alberto Nobre Quesada and Tomas Ferreira Domingues

**How to cite:** Domingues, T., Damasceno, A., Garcia, S., Aleixo, I., Menezes, J., Pereira, I., De Kauwe, M., Ferrer, V., Fleischer, K., Grams, T., Santana, F., Hartley, I., Kruijt, B., Lugli, L., Martins, N., Norby, R., Portela, B., Rammig, A., Quesada, C., and Lapola, D. and the AmazonFACE team: Amazonian understory response to elevated CO2, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-18954, https://doi.org/10.5194/egusphere-egu24-18954, 2024.