

The AmazonFACE research program: assessing the effects of increasing atmospheric CO₂ on the ecology and resilience of the Amazon forest

David M. Lapola¹, Carlos A. N. Quesada², Richard J. Norby³, Alessandro C. Araújo⁴, Tomas Domingues⁵, Iain Hartley⁶, Bart Kruijt⁷, Keith Lewin⁸, Patrick Meir⁹, Jean P. B. Ometto¹⁰, Anja Rammig¹¹; Anthony Walker³

¹ Universidade Estadual Paulista, Brazil; ² Instituto Nacional de Pesquisas da Amazônia, Brazil; ³ Oak Ridge National Laboratory, USA; ⁴ Empresa Brasileira de Pesquisa Agropecuária, Brazil; ⁵ Universidade de São Paulo, Brazil; ⁶ University of Exeter, UK; ⁷ Wageningen University, Netherlands; ⁸ Brookhaven National Laboratory; ⁹ University of Edinburgh, UK; ¹⁰ Instituto Nacional de Pesquisas Espaciais, Brazil; ¹¹ Potsdam Institute for Climate Change Impact Research, Germany

The existence, magnitude and duration of a supposed “CO₂ fertilization” effect in tropical forests remains largely undetermined, despite being suggested for nearly 20 years as a key knowledge gap for understanding the future resilience of Amazonian forests and its impact on the global carbon cycle. Reducing this uncertainty is critical for assessing the future of the Amazon region as well as its vulnerability to climate change. The AmazonFACE (Free-Air CO₂ Enrichment) research program is an experiment of unprecedented scope in an old-growth Amazon forest near Manaus, Brazil – the first of its kind in tropical forest. The experimental treatment will simulate an atmospheric CO₂ concentration [CO₂] of the future in order to address the question: “*How will rising atmospheric CO₂ affect the resilience of the Amazon forest, the biodiversity it harbors, and the ecosystem services it provides, in light of projected climatic changes?*” AmazonFACE is divided into three phases: (I) pre-experimental ecological characterization of the research site; (II) pilot experiment comprised of two 30-m diameter plots, with one treatment plot maintained at elevated [CO₂] (ambient +200 ppmv), and the other control plot at ambient [CO₂]; and (III) a fully-replicated long-term experiment comprised of four pairs of control/treatment FACE plots maintained for 10 years. A team of scientists from Brazil, USA, Australia and Europe will employ state-of-the-art methods to study the forest inside these plots in terms of carbon metabolism and cycling, water use, nutrient cycling, forest community composition, and interactions with environmental stressors. All project phases also encompass ecosystem-modeling activities in a way such that models provide hypothesis to be verified in the experiment, which in turn will feed models to ultimately produce more accurate projections of the environment. Resulting datasets and analyses will be a valuable resource for a broad community, especially ecosystem and climate modelers, and policy-makers.