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AmazonFACE – Assessing the response of Amazon rainforest functioning to elevated atmospheric carbon dioxide concentrations

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The rapid rise in atmospheric CO_2 concentration over the past century is unprecedented. It has unambiguously influenced Earth's climate system and terrestrial ecosystems. Elevated atmospheric CO_2 concentrations (eCO_2) have induced an increase in biomass and thus, a carbon sink in forests worldwide. It is assumed that eCO_2 stimulates photosynthesis and plant productivity and enhances water-use efficiency – the so-called CO_2-fertilization effect, which may provide an important buffering effect for plants during adverse climate conditions. For these reasons, current global climate simulations consistently predict that tropical forests will continue to sequester more carbon in aboveground biomass, partially compensating human emissions and decelerating climate change by acting as a carbon sink. In contrast to model simulations, several lines of evidence point towards a decreasing carbon sink strength of the Amazon rainforest. Reliable predictions of eCO_2 effects in the Amazon rainforest are hindered by a lack of process-based information gained from ecosystem scale eCO_2 experiments. Here we report on baseline measurements from the Amazon Free Air CO_2 Enrichment (AmazonFACE) experiment and preliminary results from open-top chamber (OTC) experiments with eCO_2. After three months of eCO_2, we find that understory saplings increased carbon assimilation by 17% (under light saturated conditions) and water use efficiency by 39% in the OTC experiment. We present our main hypotheses for the FACE experiment, and discuss our expectations on the potential driving processes for limiting or stimulating the Amazon rainforest carbon sink under eCO_2. We focus on possible effects of eCO_2 on carbon uptake and allocation, nutrient cycling, water-use and plant-

herbivore interactions, which need to be implemented in dynamic vegetation models to estimate future changes of the Amazon carbon sink.