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## Amazon Carbon Balance affected by human activities and Climate change

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Amazon is the major tropical land region, with critical processes, such as the carbon cycle, not yet fully understood. Only very few long-term greenhouse gas measurements regionally represented is available in the tropics. The Amazon accounts for 50% of Earth's tropical rainforests hosting the largest carbon pool in vegetation and soils (~200 PgC). The net carbon exchange between tropical land and the atmosphere is critically important because the stability of carbon in forests and soils can be disrupted in short time-scales. The main processes releasing C to the atmosphere are deforestation, degradation, fires and changes in growing conditions due to increased temperatures and droughts. Such changes may thus cause feedbacks on global climate.

In the last 40 years, Amazon mean temperature increased by 1.1°C. The length and intensity of the dry season is also increasing, causing a strong stress each year higher to the forest.

We observed a reduction of 17% in precipitation during dry season and the transition dry to wet season during this same period. This reduction in precipitation and the increase in temperature during the dry season exacerbate vegetation water stress, with consequences for carbon balance.

To understand the consequences of human-driven and climate changes on the C budget of Amazonia, we put in place the first program with regional representativeness, from 2010 onwards, aiming to quantify greenhouse gases based on extensive collection of vertical profiles of CO<sub>2</sub> and CO. Regular vertical profiles from the ground up to 4.5 km height were performed at four sites along the main air-stream over the Amazon. Along this period from 2010 to 2018, we performed 669 vertical profiles, over four strategic regions that represent fluxes over the entire Amazon region.

The observed variability of carbon fluxes during these 9 years is correlated with climate variability (Temperature, precipitation, GRACE, EVI) and human-driven changes (Biomass Burning). The correlations were performed inside each influenced area for each studied site and show how high temperature and water stress during dry season are affecting the Amazon Carbon Balance. At Southeast of Amazon these extreme conditions are dominating the annual balance. Fire emission is the main source of carbon to the atmosphere, which is not compensated by the C removal from old-growth Amazon forest. The west Amazon almost compensates the east carbon source. During wet/normal years Amazon Carbon Balance is around neutral, but during dry years the uptake capacity is very compromised.