The TREE4FLUX Project: Monitoring woody productivity and respiration to track Congo Basin Forest Carbon Dynamics

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Tropical forests play a crucial role in the global carbon cycle. Yet, climate change threatens their ability to take up and store carbon. Our understanding of the spatial and temporal carbon distribution in trees and forests remains limited regarding these perturbations, especially in the context of tropical forests of Central Africa. The TREE4FLUX project aims to address these gaps by conducting research at different scales around the CongoFlux tower in the Yangambi Biosphere Reserve (DRC) in the heart of the Congo Basin forests. At the forest ecosystem scale, carbon uptake can be monitored by measurements of CO2 exchanges between the atmosphere and the vegetation using the Eddy Covariance approach. Carbon assessments are also possible through tree-growth measurements within a network of permanent inventory plots. However, refining the carbon cycle at the tree scale requires a detailed study of the numerous metabolic processes that underlie tree growth, e.g. photosynthesis, wood formation, or respiration. Because they are largely controlled by various climatic drivers, it remains challenging to establish climate-growth relationships. The chronology of carbon uptake and attribution to the different mechanisms remain unclear and prevent the grasp of their periodic intra-annual variations. To untangle that problem, monitoring cambial phenology helps characterize the distribution, allocation, and short- and long-term carbon storage in woody material. While tree growth uptakes carbon, respiration and decomposition release carbon back into the atmosphere at various levels. Heterotrophic and autotrophic respirations have therefore a decisive role in the carbon cycle at the forest scale, but face significant misunderstandings in this regard. To enhance our understanding of the carbon dynamic from individual tree to forest scale, we urgently need respiration monitoring in both living and decayed trees. This requires unravelling the metabolic processes driving both autotrophic and heterotrophic respiration, i.e. the tree growth and decayed process, respectively. Characterization of carbon fluxes according to an integrative approach is required to refine forest dynamics models and improve our comprehension of global carbon dynamics.

Keywords

Yangambi, Carbon balance, Rainforest, Congo Basin, Stem respiration, Wood formation