Abstract

Because tropical and temperate forests together encompass an estimated 38% of terrestrial carbon pools and 48% of terrestrial net primary production, knowledge of their carbon budgets and of how these budgets respond to natural and anthropogenic global change is key to understanding the global carbon cycle today and in the future. Regrettably, there are still large gaps in our understanding of forest carbon pools, short- and long-term carbon fluxes, the mechanisms underlying these fluxes, and the likely impacts of global change – especially for tropical forests. The new CTFS Global Forest Research Initiative aims to fill these gaps through research quantifying the sizes of forest carbon pools and fluxes, their spatial and temporal variation, and the drivers of this variation at multiple tropical and temperate forest sites around the globe.

CTFS has a 25-year history of forest dynamics research monitoring growth and mortality of >3 million trees of >2000 species (10% of the world’s trees) and >100,000 individual trees. Building on this work, we are now censusizing carbon pools in soils, fine roots, coarse woody debris, and lianas as well as trees. We are measuring tree growth, tree mortality, litterfall, and soil respiration annually or subannually in order to estimate interannual variation in associated carbon fluxes. We will analyze the relationship of spatial and temporal variation in these carbon pools and fluxes to climate and chemical drivers in order to test hypotheses regarding the effects of global change on forests, and develop a better basis for predicting future forest carbon budgets.

Objective 1: Quantify current forest carbon pools

In order to enhance understanding of spatial variation in these pools, enable more accurate valuation of forest carbon pools today and establish a baseline for detecting future change.

Tree trunks and branches ~ 40-50% of tropical forest carbon pools

We will improve estimates of carbon pools in tree trunks and branches by collecting additional species- and site-specific data on wood specific gravity and tree height.

Soil and fine roots ~ 30-40% of tropical forest carbon pools

Soil samples will be taken in every ha of each plot (1-13 samples per ha, depending on depth), with 1 sample per ha to the maximum depth possible. Fine root and soil C will be analyzed for samples pooled by ha and by depth class (10-20, 20-50, 50-100, 100-200, >200 cm). The red subsoil, which extends > 5.5 m below the surface, has a low carbon concentration but its large volume means that it adds substantially to the total carbon.

Woody necromass ~ 5-10% of tropical forest carbon pools

We will use line transects (25 km per plot) to estimate the volume of fallen woody debris, conduct plot censuses of standing dead trees to estimate their volume, and collect and analyze wood samples from a subset of all these to convert volumes to mass of carbon.

Lianas ~ 1-3% of tropical forest carbon pools

At those sites without previous liana inventories, we will census lianas using a spatially- and size-stratified design.

Soil respiration measurements to estimate below-ground production and allocation

We plan to install 25-100 soil respiration sampling points per plot, with respiration measured at least monthly.

Objective 2: Quantify major forest carbon fluxes

And their interannual variation in order to improve understanding of spatiotemporal variation, analyze the influences of climate and other factors on these fluxes and establish a baseline for detecting fugure change.

Annual tree diameter measurements to measure wood production and loss

We are installing dendrometers on 2000 trees per plot, stratified across 5 size classes and 100 subplot, to be remeasured at least 2 per year.

Litter trapping to measure leaf, fruit, flower production

We are installing 100 litter traps per plot, with litter collected biweekly, oven-dried, sorted to leaves, woody, reproductive, and other, and weighed.

Repeated censuses of necromass to assess carbon fluxes in and out of this pool

We will be conducting repeated censuses of standing dead trees and fallen trees and branches to investigate rates of input via mortality and branchfall, and rates of output via decomposition.

Objective 3: Investigate the mechanisms

That drive spatial and temporal variation in forest carbon pools and fluxes and test related hypotheses in order to develop a better basis for predicting future forest carbon budgets.

Role of plant functional types

Global change can affect forest carbon budgets not only through direct physiological mechanisms, but also by changing the relative competitive ability of different plant functional types differing in their influences on carbon pools and fluxes.

Spatiotemporal variation in carbon budgets

We will analyze the relationship of spatial and temporal variation in carbon pools and fluxes to variation in topography, climate, and soils.

Literature Cited


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