**SUPPLEMENTARY INFORMATION**

**CTFS-ForestGEO: A worldwide network monitoring forests in an era of global change**

Anderson-Teixeira *et al.* (2014), *Global Change Biology*

**CONTENTS**

## Appendix S1. Data sources and analysis methods

### *1. Climate and atmospheric deposition data*

#### *CGIAR-CSI Climate Data*

In order to obtain standardized climate data for all sites, global climate data with 0.5 degree spatial resolution were downloaded from the CGIAR-CSI database (http://www.cgiar-csi.org/data) in January 2014. Specifically, we retrieved monthly data for 1951 – 2012 for ten variables: daily mean temperature (°C), monthly average daily minimum temperature (°C), monthly average daily maximum temperature (°C), diurnal temperature range (°C), frost day frequency (days), precipitation (mm), wet day frequency (days), cloud cover (%), and vapour pressure (hecta-Pascals) from the CRU-TS v3.10.01 Historic Climate Database for GIS (http://www.cgiar-csi.org/data/uea-cru-ts-v3-10-01-historic-climate-database). In addition, potential evapotranspiration (PET; mm day$^{-1}$) estimates were obtained from the Global Potential Evapo-Transpiration (Global-PET) dataset (http://www.cgiar-csi.org/data/global-aridity-and-pet-database; Zomer, 2007; Zomer *et al.*, 2008). Data for each CTFS-ForestGEO site was extracted and is available online (www.ctfs.si.edu/Data).

Monthly data were used to calculate the annual values. Annual values were averaged over 1980-2012 to obtain climatic averages (Table S2). Recent change (Fig. 4, Table S3) was calculated as the difference between 2008-2012 and 1951-1980 average.

*Note: Comparison of available local weather station data (Table 2) to CRU data revealed close correlation for MAT ($R^2$ >94%). However, CRU data tended to systematically underestimate MAP at sites with high MAP, particularly those receiving >3000* *mm yr$^{-1}$* (e.g., Korup, Kuala Belalong, Sinharaja, Fushan, La Planada). *Thus, CRU precipitation values for high precipitation sites should be considered probable underestimates.*

*WorldClim current and projected climate data*

Current and projected future climate data (Fig. 2; Table S4) were downloaded from WorldClim (http://www.worldclim.org; Hijmans *et al.*, 2005) in November 2013 at the highest available spatial resolution (30 arc-seconds for current climate; 30 seconds for future climate). Current climate is based on an interpolation of observed data, representative of 1950-2000 (v. 1.4). Future projections are based on predictions of the *HadGEM2-ES* model as part of the $CMIP_5$ (IPPC Fifth Assessment) for the year 2050 (2041-2060 climatic average) under the lowest and highest emissions scenarios (RCP 2.6 and RCP 8.5, respectively). These data have been downscaled and calibrated using WorldClim's current climate (v. 1.4) as a baseline, which makes it appropriate to compare current and future climate data from these sources (e.g., Fig. 2).

*Note: Comparison of available local weather station data (Table 2) to WorldClim data revealed close correlation for MAT ($R^2$ >97%). However, WorldClim data tended to systematically underestimate MAP at sites with high MAP, particularly those receiving >3000 mm yr$^{-1}$* (e.g., Korup, Kuala Belalong, Sinharaja, Fushan, La Planada). *Thus, WorldClim precipitation values for high precipitation sites should be considered probable underestimates.*

*Atmospheric deposition*

Data on deposition of nitrogen ($NO_y$ and $NH_x$) and sulfur ($SO_x$) were obtained from the data set of N Dentener *et al.* (2006) (F. Dentener, personal communication). These data are estimates for the year 2000 and have one-degree resolution.

*2. Multivariate spatial clustering analysis*

Multivariate Spatio-Temporal Clustering (MSTC) (Hoffman & Hargrove, 1999; Hargrove & Hoffman, 2004; Hoffman *et al.*, 2008; Kumar *et al.*, 2011) and network representativeness analysis (Hargrove *et al.*, 2003; Hoffman *et al.*, 2013) were used to calculate representativeness for the CTFS-ForestGEO network in forested and non-forested areas. These analyses require continuous grids of each variable for the extent of the study area. The data used for both the MSTC and for the subsequent representativeness analysis of the CTFS-ForestGEO network were 17 variables on a 4 km grid comprised of 13,719,022 map cells of global land area (Baker *et al.*, 2010). The 17 variables in the dataset were: (1) precipitation during the hottest quarter (mm); (2) precipitation during the coldest quarter (mm); (3) precipitation during the driest quarter (mm); (4) precipitation during the wettest quarter (mm); (5) ratio of precipitation to potential evapotranspiration (unitless); (6) temperature during the coldest quarter (°C); (7) temperature during the hottest quarter (°C); (8) day/night diurnal temperature difference (°C); (9) sum of monthly $T_{avg}$ where $T_{avg} \geq 5$°C (°C); (10) integer number of consecutive months where $T_{avg} \geq 5$°C (unitless); (11) available water holding capacity of soil (unitless); (12) bulk density of soil (g/cm$^3$); (13) carbon content of soil (g/cm$^2$); (14) nitrogen content of soil (g/cm$^2$); (15) compound topographic index (relative wetness; unitless); (16) solar interception (kW/m$^2$); (17) elevation (m).

Fifty ecoregions were delineated using MSTC (Kumar *et al.*, 2011). The regions produced by this unsupervised classification method were then labeled with ecoregion or land cover type names derived from a suite of expert maps compared with the spatial clusters using the Mapcurves algorithm developed by Hargrove *et al.* (2006). Forested areas were then extracted and combined to derive the global forested area delineated in Figure 1. Representativeness analysis provided a quantitative "dissimilarity score" for each of the CTFS-ForestGEO 59 sites using the Euclidean distance in 17-dimensional data space between each site and every other cell in the map. The 59 individual site maps were then combined to create a single map by selecting the minimum value for each grid cell from the collection of 59 individual dissimilarity scores. The final map is the minimum representativeness surface for the entire network.

For a high resolution version of Figure 1 and additional figures and information from the MSTC analysis, Mapcurves analysis, and representativeness analysis see Maddalena *et al.* (2014).

*3. Analysis of forest degradation, loss, and fragmentation*

To evaluate forest degradation, loss, and fragmentation surrounding CTFS-ForestGEO plots, we performed a spatial and temporal analysis using global data on deforestation and forest cover and change with 30m resolution (Hansen *et al.* 2013, data downloaded February 2014 from http://earthenginepartners.appspot.com/science-2013-global-forest). Raw raster data was downloaded for: (a) Tree canopy cover, defined as 'canopy closure for all vegetation taller than 5 m in height', in the year 2000 (%); (b) pixels converted from forest to other land uses between 2000 and 2012; and (c) areas of no data, mapped land surface, and permanent water bodies. A separate raster of forest area was calculated from the tree canopy cover raster using a threshold function that defined terrestrial land surface pixels having greater than 10% canopy cover as forest, following the definition used by FAO (2000). To define areas of original forest cover surrounding each site, a global raster map of original pre-human modification forest cover produced by UNEP-WCMC was downloaded April 2014 from http://www.unep-wcmc.org/generalised-original-and-current-forests-1998_718.html. Only four sites had less than 100% original forest coverage within 50km. All spatial statistics were limited to terrestrial land areas of original forest cover.

Spatial analyses were performed in R (R Core Team, 2013) using the raster, geosphere, and rgdal packages using parallel processing via the foreach and dosnow packages. The land surrounding each CTFS-ForestGEO plot was buffered into five distinct spatial zones: (i) within the plot (but not including the entire plot; calculated as a circle originating at the plot center with a radius of half the smaller plot dimension); (ii) from the plot to 1 km distance; (iii) from 1-5 km; (iv) from 5-25 km; and (v) from 25-50 km. Three core metrics were calculated: (a) percentage tree cover in 2012; (b) percentage of tree cover present in 2000 that was lost by 2012, and (c) forest fragmentation, defined as the length of forest edge adjacent to a deforested area (i.e., an area of original forest no longer forest) per unit forest area (units: km $km^{-2}$).

An index of forest degradation was calculated for the purpose of comparing the severity of forest degradation and loss across sites (e.g., Fig. 3). Specifically, the index is the average of eight numbers: % reduction in tree cover relative to plot (calculated from ‘a’ above) and % forest loss from 2000-2012 (‘b’ above), each at the four distance zones outside of the plot (ii-v above). Thus, the index integrates forest loss across a range of distances from the plot, giving more weight (on a per-area basis) to the area immediately surrounding the plot. It combines historical (pre-2000) and recent (2000-2012) forest loss, giving more weight to recent forest loss.

It is important to note that the Hansen *et al.* (2013) dataset does not distinguish between natural forest and agroforestry areas; agroforestry areas with greater than 10% canopy cover and vegetation taller than 5 m in height are included in this definition of “forest”. Thus, “forest cover” in the surrounding landscapes is not necessarily primary or natural forest, and “forest loss” may include cutting of agroforestry plantations (i.e., as part of a rotation cycle). For example, at Pasoh (Malaysia), oil palm and rubber plantations are a feature of the landscape around the reserve, and “forest loss” from 2000-2012 adjacent to the reserve is attributable to the oil palm rotation, not to original forest loss. Moreover, the dataset does not distinguish between natural disturbance and deforestation; rather, “forest loss” implies either a stand-clearing disturbance or deforestation.

Selected results are provided in Table S5; full data are available for download at www.ctfs.si.edu/Data. Copies of R scripts used in the above analyses are available for download from the Harvard Dataverse Network at http://thedata.harvard.edu/dvn/dv/eben.

**Appendix S2. CTFS-ForestGEO measurement protocols**

This section describes the CTFS-ForestGEO core census and other protocols applied at five or more sites across the network (Table 3).

*1. Plants*

*1.1. Core census*

Protocols for the tree core census are described in detail by Condit (1998). In brief, every free-standing woody stem>1cm DBH consist is identified to species, mapped, and tagged when it first enters the census within a plot. On each stem, diameter is measured at breast height (1.3 m) or above stem irregularities (Manokaran *et al.*, 1990; Condit, 1998). The census is typically repeated every five years. Database standards and management practices are described in Condit *et al.* (2014). Analysis of CTFS-ForestGEO census data is commonly conducted using the CTFS R package, which includes functions to analyze tree abundance, growth, mortality and recruitment rates, biomass, and demographic changes (downloadable at http://ctfs.arnarb.harvard.edu/Public/CTFSRPackage/).

*1.2. Lianas*

Lianas (woody vines) are inventoried as part of the core census at some sites. Lianas are mapped, identified to species, and measured at breast height (1.3m) according to the protocols detailed in Gerwing *et al.* (2006) and Schnitzer *et al* (2008).

*1.3. Functional Traits*

Detailed methods for functional trait measurements are publicly available at www.ctfs.si.edu/group/Plant+Functional+Traits/Protocols. Below is a summary:

*1.3.1. Wood density (WD)*

Wood density is measured for trees and lianas. Methods for collection may differ across sites, but processing methods are identical, following Cornelissen *et al* (2003). At sites where wood collection is prohibited due to the destructive nature of the method (e.g., BCI), samples are collected opportunistically from outside the permanent plot. Wood samples are collected with an increment borer for trees larger than 10 cm DBH, and a 10-cm long, 1-cm diameter stem segment is taken from lianas and shrubs. In some cases, 1-cm diameter branch samples are used in place of cores. Wood specific gravity is measured using the water displacement method to determine fresh volume. Samples are then dried in a convection oven (at 60°C) to finally calculate oven dried wood specific gravity (i.e., density).

*1.3.2. Height (H)*

Tree height is measured either (1) on a size-stratified sample of trees (e.g., Bohlman & O'Brien, 2006) or (2) on the largest-diameter individuals in the plot for the purpose of estimating maximum tree height (Wright *et al.*, 2010). Methods for measuring tree height are described online (http://www.ctfs.si.edu/data///documents/Crown_traits_draft.pdf) and in Larjavaara & Muller-Landau (2013); the CTFS-ForestGEO standard is to use what Larjavaara & Muller-Landau refer to as the sine method.

*1.3.3. Crown traits (C)*

Crown traits measured across the network include crown diameter and crown exposure index. To estimate crown diameter (m), the crown radius is measured from the center to the edge of the crown in eight cardinal directions, then averaged. A qualitative crown exposure index serves as a proxy for light availability is recorded following a procedure adapted from Clark & Clark (1992). Full details are available online at http://www.ctfs.si.edu/data///documents/Crown_traits_draft.pdf.

*1.3.4. Leaf traits (L)*

Six leaf traits are measured following the procedures of Cornelissen *et al* (2003): lamina size ($mm^2$); specific leaf area ($m^2$ $kg^{-1}$); leaf thickness (µm); N concentration (mg $g^{-1}$); P concentration (mg $g^{-1}$); and dry matter content (mg $g^{-1}$). The most recent tree census is used to randomly select 5-6 of the largest and smallest individuals of each tree species for sampling. Two to five leaves are measured for each individual. Fresh mass is recorded upon leaf removal and dry mass after drying at 60° C for 72 hrs.

*1.3.5. Reproductive traits (R)*

Four reproductive traits are measured: dispersal mode (categorical), diaspore shape (unitless), diaspore mass (mg), and seed mass (mg). Diaspores are the unit that is dispersed by explosive force, by wind or by animals. Diaspores are dissected to isolate the embryo plus endosperms (i.e., seed). Collection of plant reproductive parts happens opportunistically and varies across sites subject to plant phenology. We attempt to collect five mature fruits from five individuals of each species, although for rare species or for those from which fruits rarely fall we collect single fruits or diaspores. Dispersal mode and shape classification follows Cornelissen *et al* (2003).

*1.4. High-precision diameter growth*

*1.4.1. Infrequent (<1 measurement/month) dendrometer band measurements (P1)*

Metal or plastic dendrometer bands are installed on trees to obtain precise estimates of diameter growth. Bands are fixed to a stratified random subset of trees (n= 225 - 3,000; varies by site) and are measured one to four times per year using precision digital calipers. In temperate regions, measurements are made at the beginning and end of the growing season. Crown exposure index, crown condition (completeness), and sometimes liana coverage of the crown are also judged on a 5-point scale at every recensus. Protocols for construction, materials and installation of metal and plastic bands are available at http://www.ctfs.si.edu/group/Carbon/Protocol+Documents.

*1.4.2. Frequent dendrometer (≥1 measurement /month) band measurements (P2)*

To resolve seasonal growth patterns, dendrometer bands installed on a subset of trees are measured at least once a month (commonly every two weeks) during the growing season. A workflow for optimizing the fit and interpretation of intra-annual growth measurements in a seasonal forest (SERC) is detailed in McMahon & Parker (2014). This paper outlines methods for fitting growth models to intra-annual measurements using R (R Core Team, 2013).

*1.5. Flower and seed production*

Flower and seed production of trees and lianas is monitored using flower/seed traps (n=60-336; varies by site). Each flower trap has a surface area of 0.5 $m^2$ and is elevated off the ground to reduce risk of seed predation. Traps are located randomly within plots (to represent different habitat types), or in a stratified random design at 4-13 m intervals on alternating sides of pre-existing trails. Specimens are collected weekly to bimonthly. All plant reproductive parts are identified to species, seed and fruits are counted and flowers recorded on a qualitative logarithmic scale. Details for trap construction and methods are available online (http://www.ctfs.si.edu/floss/page/methods/).

*1.6. Seedling performance*

To monitor the establishment, growth, and survival of seedlings, three 1-$m^2$ seedling plots are installed in association with each flower/seed trap (n≤1,008 seedling plots associated with ≤336 seed traps; n varies by site). Woody seedlings are identified, measured (height and number of leaves), and permanently tagged. They are monitored annually (quarterly at some sites) from germination until plants reach 1 cm DBH and enter the core census. Canopy photographs are taken over each seedling plot annually to assess light availability. The proximity of seed traps and seedling plots enables an evaluation of the seed-to-seedling transition through comparisons of seed inputs and seedling recruitment.

*1.7. DNA barcoding of plants*

DNA sequences are being captured at multiple genetic loci for all tree species in the CTFS-ForestGEO network, with nearly 3,000 plant species sequenced to date (http://www.ctfs.si.edu/group/Science+Initiatives/DNA+Barcoding). Collection of plant samples for DNA barcode data begins with proper taxonomic identification of individual species from which a reference voucher and tissue sample are collected (see Kress *et al.*, 2012 for workflow). Ideally, 4-5 individuals are sampled per species. Field collected samples consist of 0.1-0.5 grams of green leaf tissue that are placed in silica gel desiccant. Only 0.01 gram of tissue is used in DNA extraction for plants where PCR and sequencing follows Fazekas *et al.* (2012; see also http://ccdb.ca/resources.php). Sequence data are cleaned and aligned into a multi-gene sequence matrix using Geneious (version 7.0, Biomatters), and then used in maximum-likelihood based phylogentic reconstruction following Kress *et al.* (2009) to generate phylogenetic trees. Quantitative assessment of phylogenetic diversity metrics are conducted in R using the Picante package (see Swenson, 2012; picante.r-forge.r-project.org/). DNA barcode data are included in the BOLD database (e.g., Wabikon, USA: dx.doi.org/10.5883/DS-WABLK).

*2. Animals*

*2.1. Arthropods*

Multi-taxon censuses are being conducted at five tropical sites (Table S6-S7), focusing on a target set of assemblages chosen for their ecological relevance, taxonomic tractability and ease of sampling (Table S7; http://www.ctfs.si.edu/group/arthropod%20monitoring/).

*2.1.1. Light traps*

We use 10 W black light traps (automatic bucket-type model) fitted with intercept panes and a roof protecting catches from rain (Kitching *et al.*, 2001). Traps are filled with crumpled paper to provide surface to hold moths and other insects so that they do not loose most of their scales. Plastic, open egg trays separate larger insects from more fragile specimens. Insects are collected dry and killed by five strips of DDVP insecticide dispensed in the trap. The attraction range of one trap is < 50m (Baker & Sadovy, 1978).

*2.1.2. Winkler*

To concentrate and extract litter ants, mini-Winkler eclectors (Besuchet *et al.*, 1987; Agosti, 2000) are used from a 0.25 $m^2$ sample of leaf litter. The litter is picked up from within a 0.25$m^2$ frame, concentrated with a litter sifter and stored into a cloth bag. Each replicate (sample) is calibrated with a 400ml cylinder randomly scooped up and hung in a mini-Winkler. The extraction of material lasts for 72 hours. Ants are collected in ethanol and then processed as required.

*2.1.3. McPhail traps*

McPhail traps (International Atomic Energy Agency, 2003; model from Biobest, www.biobest.be), baited with methyleugenol and cuelure are used to attract tephritid flies. The traps are running for a week and are set up in the vegetation, not in direct sunlight, at 3-4 m height. Attraction range of baits is < 100-200m (Cunningham & Couey, 1986).

*2.1.4. Butterfly transects*

Walking transects of 500 m, timed to about 30 minutes (similar to Caldas & Robbins, 2003) are established to observe and catch butterflies. The observer restricts his/her attention to a 2 m wide strip across the transect and up to 5m height. For each transect, air temperature, relative humidity (%), and wind speed are also recorded. Cloudiness (%) is estimated visually. A full description of the protocol and how to implement it practically (establishment of local reference collection, etc.) is detailed in (Basset *et al.*, 2013).

*2.1.5. Termite transects*

Termite sampling transects are destructive (wood fragmentation, soil disturbance, etc.) and therefore are performed outside the permanent plots. Each year, we sample one transect of 400m, including 1 quadrat of $5m^2$ searched for 30 minutes by one person, every 10m (total 40 samples; Roisin *et al.*, 2006). This include 4 different operations: (a) inspection of all trunks and branches for termite galleries up to 2m in height; (b) breaking any dead logs and branches; (c) scooping 6 smaller soil samples of ca. 15x15x10 cm; and (d) stirring and inspecting most of litter within the quadrat.

*2.1.6. Bee baits*

Cineole baits are used to attract euglossine bees traps (Ackerman *et al.*, 1982; Roubik, 2001), dispensed in McPhail traps (see item 3). The traps are baited with 7ml cineole and 100ml of commercial ethyleneglycol (car coolant) and run for a week.

*2.1.7. Interaction studies: seed predation*

Non-rotting fruit and seeds from focal plant families are collected from inside and outside the plots. Fruits/seeds are processed as soon as possible after collection and placed in suitable rearing containers covered with black mesh and lined with tissue paper. Fruits of different species, tree individuals, collection sites, stage of maturity, size, and collection date are stored in separate rearing containers. Containers are checked a minimum of two times per week for emerging seed predators and parasitoids. Fruit/seeds are kept in a rearing shed for a period of three months. After this period, fruits/seeds are dissected before being discarded. In cases where developing larvae are encountered during dissection, fruits/seeds are returned to the rearing shed to allow for continued development of immature individuals. The protocol was adapted from (Janzen, 1980).

*2.1.8. DNA barcoding of arthropods*

Field arthropod samples are collected by placing a leg of each individual into vells of a microplate filled with 95% ethanol. The voucher specimen is dry mounted, pictured and preserved in a local reference collection. Vouchers are later transferred into collections of national importance in the host country. Sample preparation and DNA sequencing for arthropods are detailed in Wilson (2012; see also http://ccdb.ca/resources.php). Sequences and voucher pictures are gradually becoming all public at http://www.boldsystems.org/.

*2.2. Vertebrates*

The vertebrate program (http://www.ctfs.si.edu/group/vertebrates) is collecting data on vertebrates in selected sites across the ForestGEO network. To date, the focus is on ground-dwelling mammals, which are monitored using standardized camera trapping procedures.

*2.2.1. Camera trapping: TEAM Protocol (P1)*

Terrestrial mammals are monitored following the terrestrial vertebrate monitoring protocol implemented by the Tropical Ecology Assessment and Monitoring Network (TEAM Network, 2011; see also http://www.teamnetwork.org). This protocol uses digital camera traps (60-90 camera traps points) at a density of 1 camera every 2 km² to monitor the status of species and changes in the community. Photographs are processed with an application called DeskTEAM (Fegraus *et al.*, 2011). The data product is used to build annual occupancy and spatial occurrence models through sites. Protocols are available at http://www.teamnetwork.org/protocols/bio/terrestrial-vertebrate.

*2.2.2. Camera trapping: CTFS-ForestGEO Protocol (P2)*

Terrestrial mammals are monitored using camera traps deployed at points in a 1-km² grid centered on each plot at a density of 1 camera trap / 2 ha (one hundred times more dense than TEAM protocol). The rates at which species pass in front of the cameras and are photographed are used as proxy for their abundance and can be compared between survey years and across plots. Photographs are securely stored and processed with custom-made database and processing tools (Kays *et al.*, 2009). Protocols are at http://www.ctfs.si.edu/group/vertebrates.

*3. Ecosystem and Environmental Variables*

*3.1. Aboveground biomass*

*3.1.1. Ground based estimates*

Biomass is estimated from tree diameter, height, and wood density data (when available) using the best available allometric equations. In the tropics, calculations rely on standard allometric equations (e.g., Chave *et al.*, 2005). In the temperate and boreal regions, species- and even site-specific allometric equations are sometimes available (e.g., Yosemite; Lutz *et al.*, 2012), and generic allometries (e.g., Jenkins *et al.*, 2003) are used when these are not available.

Aboveground biomass (AGB) based on general allometric equations (currently Chave *et al.*, 2005) can be calculated using the CTFS R package available at http://ctfs.arnarb.harvard.edu/Public/CTFSRPackage/index.php/web/tutorials/biomass/index. This code will soon be updated to take advantage of the newest tropical forest allometries (Chave et al. 2014).

### *3.1.2. Airborne LiDAR estimates*

Airborne LiDAR measurements have been made following a variety of protocols (e.g., Lefsky *et al.*, 1999; Parker *et al.*, 2004; Weishampel *et al.*, 2007; Mascaro *et al.*, 2011). There is not a specific CTFS-ForestGEO protocol.

## *3.2. Dead Wood/ Coarse Woody Debris (CWD)*

Two alternative sets of protocols for measuring necromass have each been implemented at multiple CTFS-ForestGEO sites. The CTFS Forest Carbon Research Initiative methods include CWD long transect, and fallen and standing CWD dynamics (P1-P3 below). An alternative method that has been employed at several temperate sites involves comprehensive inventories of all woody debris within the plot perimeter (P4 below). These methods are described below.

### *3.2.1. CWD long transect (P1)*

Dry mass of fallen woody debris per area is quantified using line-intersect surveys following Warren & Olsen (1964). An inventory of fallen coarse pieces (or CWD, >200 mm in diameter) is performed on the entire transect, and fine woody debris (or FWD, 20-200mm in diameter) on 10% of the transect (2 m of every 20 m). The diameter of each piece intersecting a transect is measured to enable estimation of the average volume of woody debris on the plot as a whole and its confidence limits. Where permitted, a sample is also taken from each piece to enable estimation of the dry mass of woody debris per unit area on the plot as a whole, with its confidence limits (Larjavaara & Muller-Landau, 2011). Where sampling on the plot is not allowed, other data on the wood density of woody debris are used instead. Hardness of coarse pieces is in all cases recorded using a penetrometer, and these values can be used as a basis for assigning wood densities (Larjavaara & Muller-Landau, 2010). The protocol is described in detail at http://www.ctfs.si.edu/group/Carbon/Protocol+Document.

*3.2.2. Fallen CWD dynamics (P2)*

Fallen coarse woody debris (CWD; >200 mm diameter) is quantified using a repeated inventory of line transects. Transects are 20-m long within typically one hundred 40 m x40 m subplots (same subplots used for the standing CWD and the stratified sample of dendrometers). More details can be found in the online protocol document (http://www.ctfs.si.edu/group/Carbon/Protocol+Documents).

*3.2.3. Standing CWD dynamics (P3)*

Standing dead trees are inventoried within 40 m x 40 m sub-plots. Standing CWD (>200 mm) are censused throughout the whole subplot, while standing FWD (20-199 mm) are censused only in the central area with a radius of 5 m. For each standing dead tree greater than 200 mm in diameter, dbh (or diameter above buttress), height, and hardness (using a penetrometer) are measured. In addition, the proportion of branches remaining is categorized. More details can be found in the online protocol document (http://www.ctfs.si.edu/group/Carbon/Protocol+Documents).

*3.2.4. CWD comprehensive (P4)*

This alternative method of inventorying woody debris includes all deadwood objects within a plot perimeter (at some sites, only trees >100 mm dbh are measured). All pieces are outlined as vectors on a site local map, which allows posterior calculation of length and orientation plus local coordinates. Objects are sorted by two binary classifications into a "standing/lying" and "whole/broken" class. According to their combination and height attributes six deadwood types are defined: whole dead standing tree, broken dead standing stem (snag), whole dead lying tree, base part of dead lying stem, further parts of dead lying stem, and stump. Volume is calculated using DBH allometric equations (truncated cones for stem parts). A decomposition class (hardwood, touchwood, and disintegrated) is assigned to each piece to track tree individuals until their final decomposition (Král *et al.*, 2014).

*3.3. Soil Carbon and Fine Root Biomass*

Soil samples are systematically taken from around the center 20 x 20 m quadrat in every hectare at each plot. Soil is sampled to 3 m in the center of the quadrat, with additional samples taken to 1 m (x4) and 10 cm (x9) around the quadrat. Roots are separated by hand into fine roots < 2 mm and coarse roots > 2 mm diameter, dried at 60°C, and weighed. The soils are air-dried, sieved (<2 mm) and a subsample ground for analysis. Soil carbon concentration is determined by combustion and gas chromatography using a Thermo Flash EA 1112 Elemental Analyzer (for details, http://www.ctfs.si.edu/group/Carbon/Protocol+Documents)

*3.4. Soil Nutrients*

*3.4.1. Soil nutrient mapping (P1)*

Soils are sampled using a regular grid of points every 50 m within sites. Each alternate grid point is paired with an additional sample point to capture variation in soil properties. 50 g of topsoil (0- to 10-cm depth) is collected at each sample point, and available cations and P are extracted using the Mehlich-3 extractant solution. N mineralization rates are measure on site using 3-inch diameter pipes 15 cm into the ground and incubated for 28 days (in-field incubation). Maps of estimated soil resource availability at the 10 x 10 m scale for each plot are then generated following John *et al.* (2007).

*3.4.2. Soil nutrient mapping-Turner protocol (P2)*

More recent nutrient mapping has used Bray-1 solution to determine available phosphorus and 0.1 M BaCl2 to determine exchangeable base cations and extractable Al and Mn. The latter is preferred to the Mehlich extraction because it yields measures of effective cation exchange capacity, base saturation, and the potential toxins Al and Mn. It does not, however, provide extractable micronutrient data. Soil pH is determined in deionized water, 0.01 M $CaCl_2$ and 0.1 M $BaCl_2$.

*3.4.3. Soil nutrient mapping-Turner protocol (P3)*

This method follows same steps as P2 above for cations but includes measurements of N mineralization ($NH_4$ and $NO_3$) using in-field resin bags. Briefly, mixed ion exchange resins are sealed in mesh bags and placed in the upper 10 cm of soil at the same sample locations as in P1 above. After three weeks, resin bags are removed, cleaned, and extracted in 0.5 M HCl. In addition to nitrogen, the extracts are also analyzed for P and base cations.

*3.5. Litterfall*

Litter production of the stand, including trees and lianas of all species combined, is monitored using a set of aboveground and ground litter traps (n=100 pairs). Traps are located systematically or randomly within plots. Each aboveground litter trap has a surface area of 0.5 $m^2$ and is elevated off the ground to reduce risk of seed predation. Ground traps are next to the aboveground trap and are used to monitor palm fronds and branchfalls of material that is too large to be captured in the aboveground traps. The traps are censused on a weekly to monthly basis. Trap contents are oven-dried at 65 C, then sorted into leaves, reproductive parts (flowers, seeds, fruits), fine woody material, and other. These fractions are weighed for each trap. Details of trap construction and methods are available online at http://www.ctfs.si.edu/group/Carbon/Protocol+Documents.

*3.6. Bio-micrometeorology*

At or adjacent to 15 sites, ecosystem-atmosphere gas exchange has been measured using the eddy-covariance technique (e.g., Barford *et al.*, 2001; Kume *et al.*, 2011; Thomas *et al.*, 2011; Kosugi *et al.*, 2012; Soderberg *et al.*, 2012; Wharton *et al.*, 2012; Zhang *et al.*, 2012). There is not a specific CTFS-ForestGEO protocol. While integration between flux measurements and core tree census data remains limited, these co-located measurements represent an important opportunity to link the growth and water use of individual trees to whole-ecosystem carbon cycling and evapotranspiration.

*3.7. Micrometeorology*

Meteorological stations vary by site. At sites with meteorological stations installed as part of the CTFS Carbon Program (BCI, SCBI, Huai Kha Khaeng, Khao Chong, and Pasoh), a standardized meteorological station installed within or adjacent to the plot. The stations include several sensors recorded automatically by a CR1000 datalogger (Campbell Scientific) at a 5-minute interval. These sensors include: 1) an aspirated and shield temperature and a relative humidity sensor plus an additional secondary temperature sensor (MetOne Instruments); 2) a 2-D sonic anemometer WS425 (Vaisala); 3) a tipping rain bucket TB4-L (Campbell Scientific); and 4) a solar radiometer CMSP2 (Kipp & Zonen), plus a secondary radiometer LI-290 (LiCOR biogeoscience).

In addition to meteorological data, some sites monitor soil temperature, moisture, and/or snow presence (e.g., Raleigh *et al.*, 2013).

**Table S1. Geographic coordinates, elevation data, and references to site descriptions for all CTFS-ForestGEO sites.**

| # | Site | Latitude | Longitude | Elevation-min (m) | Elevation-max (m) | Topographic relief (m) | Site Description |
|---|---|---|---|---|---|---|---|
| 1 | Korup | 5.07389 | 8.85472 | 150 | 240 | 90 | Thomas *et al.*, 2003, 2015; Chuyong *et al.*, 2004 |
| 2 | Ituri (Edoro and Lenda)* | 1.4368 | 28.5826 | 700 | 850 | 150 | Makana *et al.*, 2004 |
| 3 | Rabi | -1.9246 | 9.88004 | 28 | 54 | 26 | |
| 4 | Mpala | 0.2918 | 36.8809 | 1660 | 1800 | 140 | Georgiadis, 2011 |
| 5 | Wanang | -5.25 | 145.267 | 90 | 190 | 100 | |
| 6 | Kuala Belalong | 4.5384 | 115.154 | 160 | 320 | 160 | |
| 7 | Dinghushan | 23.1695 | 112.511 | 230 | 470 | 240 | Pei *et al.*, 2011 |
| 8 | Heishiding | 23.27 | 111.53 | 435 | 698 | 263 | Yin & He, 2014 |
| 9 | Hong Kong | 22.4263 | 114.181 | 145 | 257 | 112 | |
| 10 | Jianfengling | 18.7308 | 108.905 | 866 | 1017 | 151 | |
| 11 | Nonggang | 22.4333 | 106.95 | 370 | 180 | 190 | Wang *et al.*, 2014 |
| 12 | Xishuangbanna | 21.6117 | 101.574 | 709 | 869 | 160 | Cao *et al.*, 2008 |
| 13 | Mudumalai | 11.5989 | 76.5338 | 980 | 1120 | 140 | Sukumar *et al.*, 2004 |
| 14 | Danum Valley | 5.10189 | 117.688 | | | | |
| 15 | Lambir | 4.1865 | 114.017 | 104 | 244 | 140 | Lee *et al.*, 2003, 2004 |
| 16 | Pasoh | 2.982 | 102.313 | 70 | 90 | 20 | Manokaran *et al.*, 2004 |
| 17 | Palanan | 17.0402 | 122.388 | 72 | 122 | 50 | Co *et al.*, 2004 |
| 18 | Bukit Timah | 1.35 | 103.78 | 74 | 124 | 50 | Lum *et al.*, 2004; LaFrankie *et al.*, 2005 |
| 19 | Sinharaja | 6.4023 | 80.4023 | 424 | 575 | 151 | Gunatilleke *et al.*, 2004 |
| 20 | Fushan | 24.7614 | 121.555 | 600 | 733 | 133 | Su *et al.*, 2007 |
| 21 | Kenting | 21.98 | 120.7969 | 250 | 300 | 50 | Lin *et al.*, 2011; Wu *et al.*, 2011 |

| # | Site | Latitude | Longitude | Elevation-min (m) | Elevation-max (m) | Topographic relief (m) | Site Description |
|---|---|---|---|---|---|---|---|
| 22 | Lienhuachih | 23.9136 | 120.879 | 667 | 841 | 174 | Lin *et al.*, 2011; Chang *et al.*, 2012 |
| 23 | Nanjenshan | 22.059 | 120.854 | 300 | 340 | 40 | Sun & Hsieh, 2004 |
| 24 | Zenlun | 23.4247 | 120.5509 | | | | |
| 25 | Doi Inthanon | 18.5833 | 98.4333 | 1630 | 1710 | 80 | Kanzaki *et al.*, 2004 |
| 26 | Huai Kha Khaeng | 15.6324 | 99.217 | 549 | 638 | 89 | Bunyavejchewin *et al.*, 2004, 2009 |
| 27 | Khao Chong | 7.54347 | 99.798 | 110 | 360 | 250 | |
| 28 | Mo Singto | 14.4333 | 101.35 | 725 | 815 | 90 | Brockelman *et al.*, 2011; Chanthorn *et al.*, 2013 |
| 29 | Haliburton | 45.2901 | -78.6377 | 412.5 | 454.4 | 41.9 | |
| 30 | Scotty Creek | 61.3 | -121.3 | 258 | 274 | 16 | Chasmer *et al.*, 2014 |
| 31 | Harvard Forest | 42.5388 | -72.1755 | 340 | 368 | 28 | Motzkin *et al.*, 1999 |
| 32 | Lilly Dickey Woods | 39.2359 | -86.2181 | 230 | 303 | 73 | |
| 33 | Santa Cruz | 37.0124 | -122.075 | 314 | 332 | 18 | Gilbert *et al.*, 2010 |
| 34 | SCBI | 38.8935 | -78.1454 | 273 | 338 | 65 | Bourg *et al.*, 2013 |
| 35 | SERC | 38.8891 | -76.5594 | 6 | 10 | 4 | McMahon & Parker, 2014 |
| 36 | Tyson Research Center | 38.5178 | -90.5575 | 172 | 233 | 61 | |
| 37 | Wabikon | 45.5546 | -88.7945 | | | | |
| 38 | Wind River | 45.8197 | -121.9558 | 352.4 | 384.7 | 32.3 | Lutz *et al.*, 2013 |
| 39 | Yosemite National Park | 37.7662 | -119.819 | 1774.1 | 1911.3 | 137.2 | Lutz *et al.*, 2012 |
| 40 | Ilha do Cardoso | -25.0955 | -47.9573 | 3 | 8 | 5 | de Oliveira *et al.*, 2014 |
| 41 | Manaus | -2.4417 | -59.7858 | 40 | 80 | 40 | Gomes *et al.*, 2013 |
| 42 | Amacayacu | -3.8091 | -70.2678 | | | | Arias Garcia *et al.*, 2009 |
| 43 | La Planada | 1.1558 | -77.9935 | 1796 | 1840 | 44 | Vallejo *et al.*, 2004 |

| # | Site | Latitude | Longitude | Elevation-min (m) | Elevation-max (m) | Topographic relief (m) | Site Description |
|---|---|---|---|---|---|---|---|
| 44 | Yasuni | -0.6859 | -76.397 | 215 | 245 | 30 | Valencia *et al.*, 2004 |
| 45 | Barro Colorado Island | 9.1543 | -79.8461 | 120 | 160 | 40 | Hubbell, 1979; Condit, 1998; Leigh *et al.*, 2004 |
| 46 | Cocoli | 8.9877 | -79.6166 | | | | Condit *et al.*, 2004 |
| 47 | San Lorenzo/ Sherman | 9.2815 | -79.974 | | | | Condit *et al.*, 2004 |
| 48 | Luquillo | 18.3262 | -65.816 | 333 | 428 | 95 | Thompson *et al.*, 2002; Thompson *et al.*, 2004 |
| 49 | Laupahoehoe | 19.9301 | -155.287 | 1150 | 1170 | 20 | Ostertag *et al.*, 2014 |
| 50 | Palamanui | 19.7394 | -155.994 | 255 | 275 | 20 | Ostertag *et al.*, 2014 |
| 51 | Badagongshan | 29.46 | 110.52 | 1470 | 1369 | 101 | Wang *et al.*, 2014 |
| 52 | Baotianman | 33.4956 | 111.9397 | | | 241 | |
| 53 | Changbaishan | 42.3833 | 128.083 | 792 | 810 | 18 | Wang *et al.*, 2009 |
| 54 | Donglingshan | 39.9566 | 115.425 | 1290 | 1509 | 219 | Liu *et al.*, 2011 |
| 55 | Gutianshan | 29.25 | 118.117 | 446 | 715 | 269 | Lai *et al.*, 2009; Ma *et al.*, 2009; Lin *et al.*, 2012 |
| 56 | Tiantongshan | 29.8116 | 121.783 | 304 | 602 | 298 | Yang *et al.*, 2011 |
| 57 | Zofin | 48.6638 | 14.7073 | 735 | 825 | 90 | Král *et al.*, 2010; Šamonil *et al.*, 2011 |
| 58 | Speulderbos | 52.253 | 5.702 | 49 | 63 | 14 | Wijdeven, 2003 |
| 59 | Wytham Woods | 51.7743 | -1.3379 | 104 | 163 | 59 | Butt *et al.*, 2009; Thomas *et al.*, 2011b |

[*] Ituri has four plots at two locations (Edoro and Lenda). Geographic coordinates are the midpoint value.

**Table S2. Climate data for all CTFS-ForestGEO sites: average for 1980-2012 from CGIAR-CSI climate data.** Additional climate data are available online (www.ctfs.si.edu/Data). *Note:* These values do not correspond exactly to values in Table 2 (most of which come from local weather stations measured over a range of time frames) or Figure 2 (which come from the WorldClim database). For high precipitation-sites within the CTFS-ForestGEO network, values from the CRU-TS v3.10.01 Historic Climate Database tend to underestimate MAP, dramatically so at some sites (e.g., Korup, Kuala Belalong, Sinharaja, Fushan, La Planada; see Appendix S1).

| # | Site | Annual temperature (°C) | January temperature (°C) | July temperature (°C) | Frost days (days/yr) | Annual PET (mm/yr) | MAP (mm/yr) | Months with PPT<PET | Precipitation Seasonality (CV; %) | Precipitation days (days/yr) | Cloud Cover (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Korup | 26.4 | 26.2 | 25.0 | 0.0 | 1050 | 2440 | 4.0 | 77 | 172 | 84 |
| 2 | Ituri (Edoro and Lenda) | 24.2 | 24.1 | 23.2 | 0.0 | 1168 | 1430 | 4.2 | 43 | 137 | 69 |
| 3 | Rabi | 26.1 | 27.3 | 23.6 | 0.0 | 956 | 1943 | 4.3 | 85 | 139 | 90 |
| 4 | Mpala | 17.7 | 16.4 | 16.9 | 2.3 | 1280 | 773 | 10.0 | 71 | 116 | 69 |
| 5 | Wanang | 26.5 | 26.8 | 25.8 | 0.0 | 1183 | 3366 | 0.6 | 44 | 278 | 75 |
| 6 | Kuala Belalong | 26.6 | 26.2 | 26.6 | 0.0 | 1164 | 3757 | 0.8 | 47 | 276 | 69 |
| 7 | Dinghushan | 22.0 | 13.4 | 28.8 | 0.5 | 1065 | 1870 | 4.2 | 86 | 148 | 70 |
| 8 | Heishiding | 21.5 | 12.6 | 28.4 | 1.5 | 1022 | 1719 | 4.4 | 83 | 155 | 72 |
| 9 | Hong Kong | 23.0 | 15.7 | 28.6 | 0.0 | - | 2334 | - | 99 | 158 | 66 |
| 10 | Jianfengling | 24.9 | 19.7 | 28.5 | 0.0 | 1197 | 2102 | 4.9 | 89 | 110 | 69 |
| 11 | Nonggang | 22.5 | 14.2 | 28.5 | 0.2 | 1066 | 1345 | 6.0 | 86 | 156 | 73 |
| 12 | Xishuangbanna | 21.1 | 16.2 | 24.0 | 0.2 | 1054 | 1423 | 5.9 | 91 | 203 | 63 |
| 13 | Mudumalai | 24.3 | 22.6 | 23.6 | 0.0 | 1498 | 1079 | 7.6 | 89 | 60 | 51 |
| 14 | Danum Valley | 25.6 | 25.3 | 25.4 | 0.0 | 1104 | 2724 | 1.2 | 49 | 253 | 70 |
| 15 | Lambir | 26.3 | 25.7 | 26.5 | 0.0 | 1114 | 3249 | 1.0 | 50 | 284 | 71 |
| 16 | Pasoh | 26.3 | 25.7 | 26.4 | 0.0 | 1120 | 1896 | 2.5 | 47 | 240 | 74 |
| 17 | Palanan | 25.1 | 22.5 | 26.6 | 0.0 | 1238 | 2724 | 3.2 | 73 | 172 | 65 |
| 18 | Bukit Timah | 27.5 | 26.6 | 27.7 | 0.0 | 1172 | 2301 | 2.5 | 52 | 264 | 74 |
| 19 | Sinharaja | 26.9 | 26.2 | 27.0 | 0.0 | 1384 | 2533 | 3.3 | 64 | 130 | 65 |

| # | Site | Annual temperature (°C) | January temperature (°C) | July temperature (°C) | Frost days (days/yr) | Annual PET (mm/yr) | MAP (mm/yr) | Months with PPT<PET | Precipitation Seasonality (CV; %) | Precipitation days (days/yr) | Cloud Cover (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | Fushan | 21.4 | 15.3 | 27.3 | 0.0 | 1085 | 2121 | 2.8 | 66 | 205 | 73 |
| 21 | Kenting | 23.5 | 18.4 | 27.7 | 0.0 | - | 2207 | - | 85 | 175 | 68 |
| 22 | Lienhuachih | 16.7 | 11.8 | 21.2 | 3.1 | 908 | 1958 | 3.6 | 84 | 187 | 71 |
| 23 | Nanjenshan | 23.3 | 18.7 | 26.8 | 0.0 | 1255 | 2157 | 5.4 | 99 | 144 | 67 |
| 24 | Zenlun | 17.4 | 12.8 | 21.5 | 1.6 | 943 | 2031 | 3.8 | 88 | 179 | 71 |
| 25 | Doi Inthanon | 23.1 | 19.4 | 23.8 | 0.0 | 1135 | 1201 | 6.3 | 97 | 159 | 55 |
| 26 | Huai Kha Khaeng | 25.1 | 22.6 | 25.6 | 0.0 | 1202 | 1448 | 5.9 | 92 | 154 | 58 |
| 27 | Khao Chong | 27.1 | 26.3 | 27.2 | 0.0 | 1208 | 2331 | 3.4 | 67 | 174 | 72 |
| 28 | Mo Singto | 27.4 | 25.6 | 27.8 | 0.0 | 1300 | 1672 | 5.9 | 94 | 141 | 62 |
| 29 | Haliburton | 4.8 | -11.2 | 18.8 | 186.2 | 653 | 1176 | 2.7 | 34 | 172 | 63 |
| 30 | Scotty Creek | -2.7 | -23.5 | 16.8 | 231.0 | 511 | 380 | 6.0 | 72 | 100 | 61 |
| 31 | Harvard Forest | 8.8 | -5.0 | 21.6 | 157.0 | 910 | 1150 | 4.4 | 47 | 135 | 66 |
| 32 | Lilly Dickey Woods | 11.9 | -1.8 | 24.4 | 115.3 | 981 | 1130 | 4.9 | 52 | 126 | 66 |
| 33 | Santa Cruz | 14.6 | 10.3 | 18.1 | 9.6 | 1084 | 664 | 8.2 | 134 | 42 | 48 |
| 34 | SCBI | 12.8 | 1.0 | 24.3 | 110.1 | 1003 | 1029 | 5.9 | 52 | 133 | 66 |
| 35 | SERC | 14.1 | 1.8 | 26.1 | 82.3 | 1111 | 1128 | 5.8 | 52 | 119 | 61 |
| 36 | Tyson Research Center | 13.6 | -0.5 | 26.6 | 99.6 | 1138 | 992 | 7.3 | 59 | 117 | 61 |
| 37 | Wabikon | 4.2 | -11.4 | 18.4 | 199.2 | 684 | 748 | 5.4 | 64 | 130 | 68 |
| 38 | Wind River | 8.3 | 0.6 | 17.9 | 141.9 | 770 | 1893 | 4.3 | 86 | 129 | 71 |
| 39 | Yosemite National Park | 10.8 | 2.6 | 21.3 | 154.3 | 1293 | 960 | 7.5 | 120 | 44 | 49 |
| 40 | Ilha do Cardoso | 21.2 | 24.8 | 17.3 | 0.0 | - | 2265 | - | 60 | 227 | 65 |
| 41 | Manaus | 27.3 | 26.8 | 27.0 | 0.0 | 1166 | 2177 | 3.3 | 58 | 249 | 82 |
| 42 | Amacayacu | 25.8 | 25.8 | 25.3 | 0.0 | 1010 | 2623 | 0.8 | 41 | 337 | 82 |
| 43 | La Planada | 16.1 | 15.8 | 16.1 | 0.0 | 920 | 1612 | 3.5 | 59 | 197 | 81 |
| 44 | Yasuni | 25.9 | 26.3 | 24.8 | 0.0 | 1380 | 3270 | 1.0 | 42 | 300 | 83 |
| 45 | Barro Colorado Island | 26.3 | 25.7 | 26.9 | 0.0 | 1311 | 3025 | 4.0 | 76 | 218 | 58 |

| # | Site | Annual temperature (°C) | January temperature (°C) | July temperature (°C) | Frost days (days/yr) | Annual PET (mm/yr) | MAP (mm/yr) | Months with PPT<PET | Precipitation Seasonality (CV; %) | Precipitation days (days/yr) | Cloud Cover (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 46 | Cocoli | 26.6 | 26.2 | 27.2 | 0.0 | 1385 | 1709 | 4.6 | 75 | 217 | 56 |
| 47 | San Lorenzo/ Sherman | 26.3 | 25.7 | 26.9 | 0.0 | 1311 | 3025 | 4.0 | 76 | 218 | 58 |
| 48 | Luquillo | 25.6 | 23.4 | 27.0 | 0.0 | 1219 | 2363 | 2.8 | 61 | 201 | 61 |
| 49 | Laupahoehoe | 18.8 | 17.1 | 20.3 | 0.0 | 1091 | 2041 | 3.3 | 64 | 246 | 69 |
| 50 | Palamanui | 17.6 | 15.9 | 19.1 | 0.0 | 1052 | 1587 | 4.3 | 56 | 246 | 68 |
| 51 | Badagongshan | 14.0 | 2.8 | 24.3 | 55.0 | 821 | 1250 | 3.9 | 67 | 177 | 75 |
| 52 | Baotianman | 14.3 | 1.6 | 25.8 | 82.0 | 959 | 781 | 8.6 | 88 | 93 | 63 |
| 53 | Changbaishan | 1.3 | -18.6 | 17.8 | 215.9 | 762 | 877 | 7.8 | 112 | 109 | 53 |
| 54 | Donglingshan | 8.1 | -8.7 | 22.7 | 160.3 | 1057 | 461 | 10.8 | 117 | 69 | 44 |
| 55 | Gutianshan | 15.9 | 4.0 | 26.8 | 48.3 | 934 | 1637 | 3.3 | 66 | 153 | 66 |
| 56 | Tiantongshan | 16.8 | 5.9 | 27.9 | 28.3 | 906 | 1430 | 3.1 | 63 | 163 | 68 |
| 57 | Zofin | 8.5 | -1.5 | 18.3 | 123.1 | 704 | 726 | 5.3 | 57 | 166 | 66 |
| 58 | Speulderbos | 10.0 | 2.8 | 17.6 | 78.4 | 619 | 802 | 4.7 | 50 | 192 | 77 |
| 59 | Wytham Woods | 10.3 | 4.5 | 17.2 | 64.7 | 637 | 681 | 5.3 | 52 | 156 | 77 |

**Table S3. Recent climate change at CTFS-ForestGEO sites (difference between 2008-2012 and 1951-1980 average) calculated from CGIAR-CSI climate data.**
Additional climate data are available online (www.ctfs.si.edu/Data). *Note:* For high precipitation-sites, values from the CRU-TS v3.10.01 Historic Climate Database tend to underestimate MAP, dramatically so at some sites (e.g., Korup, Kuala Belalong, Sinharaja, Fushan, La Planada; see Appendix S1).

| # | Site | Δ MAT(°C) | Δ January T (°C) | Δ July T (°C) | Δ Frost days (days/yr) | Δ Annual PET (%) | Δ MAP (%) | Δ Months PPT<PET (months/yr) | Δ Precipitation Seasonality (%) | Δ Precipitation days (days/yr) | Δ Cloud Cover (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Korup | 0.74 | 0.50 | 0.66 | 0.0 | 1.56 | -6.7 | 0.7 | 7.2 | -2.1 | 0.4 |
| 2 | Ituri (Edoro and Lenda) | 1.28 | 1.26 | 1.29 | 0.0 | 3.20 | 3.5 | -0.9 | -22.1 | 4.7 | -1.2 |
| 3 | Rabi | 0.31 | 0.08 | 0.31 | 0.0 | 0.55 | 3.3 | -0.2 | -11.5 | 4.0 | 0.1 |
| 4 | Mpala | 1.01 | 1.08 | 1.03 | -2.1 | 3.75 | -5.3 | 0.9 | -27.9 | -31.5 | -1.3 |
| 5 | Wanang | 0.19 | 0.20 | 0.20 | 0.0 | 0.63 | 4.4 | -0.8 | -15.6 | 10.9 | 1.2 |
| 6 | Kuala Belalong | 0.28 | 0.27 | -0.04 | 0.0 | -1.80 | 21.8 | -0.3 | 5.9 | 23.2 | 1.5 |
| 7 | Dinghushan | 0.27 | -1.19 | 0.58 | -0.1 | 8.15 | 7.6 | -0.5 | -3.4 | 3.1 | -2.3 |
| 8 | Heishiding | 0.05 | -1.39 | 0.36 | 0.5 | 6.93 | 3.1 | -0.7 | -9.5 | 3.0 | -2.4 |
| 9 | Hong Kong | -0.10 | -0.73 | -0.42 | 0.0 |  | -5.2 |  | -8.3 | -3.0 | -1.0 |
| 10 | Jianfengling | 0.27 | -0.38 | 0.22 | 0.0 | 4.05 | 24.5 | -1.4 | -17.9 | 0.2 | 1.7 |
| 11 | Nonggang | 0.13 | -1.31 | 0.25 | 0.1 | 5.89 | -1.1 | -0.2 | -12.7 | -11.5 | -2.7 |
| 12 | Xishuangbanna | 1.23 | 1.43 | 1.00 | -1.6 | 7.73 | 6.5 | -0.3 | -6.2 | -4.9 | -6.2 |
| 13 | Mudumalai | 0.90 | 1.24 | 0.80 | 0.0 | 0.80 | -1.0 | -0.6 | -14.9 | 6.3 | 3.8 |
| 14 | Danum Valley | 0.60 | 0.77 | 0.36 | 0.0 | -0.87 | 22.2 | -0.5 | -1.4 | 16.3 | 0.9 |
| 15 | Lambir | 0.08 | -0.05 | -0.24 | 0.0 | -3.08 | 18.9 | -0.2 | 18.7 | 20.4 | 1.9 |
| 16 | Pasoh | 1.18 | 0.92 | 1.30 | 0.0 | 2.02 | 5.3 | -1.7 | -33.5 | 13.2 | 0.5 |
| 17 | Palanan | 0.52 | 0.34 | 0.18 | 0.0 | 2.06 | 16.9 | -0.6 | 7.5 | -10.9 | -0.9 |
| 18 | Bukit Timah | 0.95 | 0.63 | 1.20 | 0.0 | 2.04 | 12.0 | -0.2 | -0.9 | 8.9 | -0.2 |
| 19 | Sinharaja | 0.66 | 0.58 | 0.72 | 0.0 | 0.22 | -10.5 | -0.6 | -9.0 | 14.2 | 1.9 |

| # | Site | Δ MAT(°C) | Δ January T (°C) | Δ July T (°C) | Δ Frost days (days/yr) | Δ Annual PET (%) | Δ MAP (%) | Δ Months PPT<PET (months/yr) | Δ Precipitation Seasonality (%) | Δ Precipitation days (days/yr) | Δ Cloud Cover (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | Fushan | 0.58 | 0.41 | 0.40 | 0.0 | 10.73 | 12.4 | -0.3 | -20.0 | 7.4 | 3.6 |
| 21 | Kenting | 0.46 | 0.26 | 0.25 | 0.0 | | -2.7 | | -25.4 | -0.7 | 3.5 |
| 22 | Lienhuachih | 0.65 | 0.46 | 0.53 | -2.7 | 12.17 | 7.2 | -1.3 | -19.0 | 5.7 | 5.6 |
| 23 | Nanjenshan | 0.53 | 0.35 | 0.34 | 0.0 | 6.14 | -0.3 | -1.0 | -8.0 | 0.8 | 4.2 |
| 24 | Zenlun | 0.63 | 0.41 | 0.50 | -1.6 | 11.26 | 5.7 | -1.1 | -11.8 | 4.4 | 5.1 |
| 25 | Doi Inthanon | 0.85 | 1.99 | 0.37 | -0.3 | 2.74 | -6.3 | 0.2 | -1.2 | -0.5 | -2.6 |
| 26 | Huai Kha Khaeng | 0.22 | 0.56 | -0.14 | 0.0 | -2.48 | 17.7 | -0.3 | -1.1 | 5.7 | 3.2 |
| 27 | Khao Chong | 0.69 | 0.90 | 0.60 | 0.0 | -0.79 | 13.0 | -0.5 | -12.5 | 0.7 | 4.8 |
| 28 | Mo Singto | 0.52 | 0.87 | 0.19 | 0.0 | -2.05 | 22.2 | -1.3 | -4.2 | 1.6 | 5.4 |
| 29 | Haliburton | 1.22 | 1.31 | 0.90 | -11.3 | 1.02 | 7.4 | -0.7 | -22.7 | 7.9 | 3.3 |
| 30 | Scotty Creek | 0.99 | 2.83 | 1.04 | -7.3 | 6.12 | 9.2 | 0.3 | -25.2 | -25.5 | 0.4 |
| 31 | Harvard Forest | 1.23 | 0.76 | 1.05 | -14.5 | 7.33 | 19.9 | -0.2 | 8.4 | 6.8 | 4.4 |
| 32 | Lilly Dickey Woods | 1.25 | 0.27 | 1.55 | -21.1 | 9.29 | 15.4 | -0.7 | 14.3 | 5.7 | 6.6 |
| 33 | Santa Cruz | 0.58 | 1.15 | 0.20 | -8.7 | -2.16 | -0.7 | -0.1 | 5.0 | 1.0 | 8.7 |
| 34 | SCBI | 0.28 | -0.06 | 0.52 | -8.0 | 1.67 | 2.7 | -0.9 | -22.4 | 8.5 | 5.5 |
| 35 | SERC | 0.90 | 0.35 | 1.29 | -11.4 | 10.14 | 6.8 | -0.1 | -3.5 | 8.0 | 4.8 |
| 36 | Tyson Research Center | 1.29 | 1.42 | 1.39 | -14.5 | 8.07 | 26.3 | -0.8 | 4.4 | 18.0 | 5.4 |
| 37 | Wabikon | 0.55 | 0.17 | 0.70 | -6.4 | -5.30 | -0.9 | 0.4 | 5.4 | -5.8 | 6.6 |
| 38 | Wind River | -0.06 | 1.20 | 0.17 | -5.5 | -3.69 | 1.8 | -1.1 | -15.0 | 8.2 | 3.5 |
| 39 | Yosemite National Park | 1.58 | 1.97 | 2.05 | -39.0 | 0.75 | -18.7 | 0.1 | 10.6 | -0.5 | 18.7 |
| 40 | Ilha do Cardoso | 1.09 | 0.65 | 1.16 | 0.0 | | 29.5 | | -4.7 | 15.5 | -0.5 |
| 41 | Manaus | 0.77 | 0.32 | 0.84 | 0.0 | 2.46 | 9.5 | -0.2 | 5.2 | -10.7 | -0.4 |
| 42 | Amacayacu | 0.25 | -0.05 | 0.44 | 0.0 | -1.57 | -7.8 | 0.4 | 14.2 | -8.1 | 0.3 |
| 43 | La Planada | -0.01 | -0.27 | 0.22 | 0.0 | -12.70 | 2.4 | -0.3 | 10.2 | 3.0 | 5.8 |
| 44 | Yasuni | -0.02 | -0.30 | 0.35 | 0.0 | -7.30 | 8.4 | 0.2 | 25.8 | 5.2 | 4.8 |

| # | Site | Δ MAT(°C) | Δ January T (°C) | Δ July T (°C) | Δ Frost days (days/yr) | Δ Annual PET (%) | Δ MAP (%) | Δ Months PPT<PET (months/yr) | Δ Precipitation Seasonality (%) | Δ Precipitation days (days/yr) | Δ Cloud Cover (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 45 | Barro Colorado Island | 0.36 | 0.46 | 0.44 | 0.0 | -3.31 | 17.9 | 0.1 | 9.2 | 13.3 | 2.7 |
| 46 | Cocoli | 0.33 | 0.41 | 0.41 | 0.0 | -3.01 | 11.2 | -0.5 | 3.9 | 11.2 | 1.8 |
| 47 | San Lorenzo/ Sherman | 0.36 | 0.46 | 0.44 | 0.0 | -3.31 | 17.9 | 0.1 | 9.2 | 13.3 | 2.7 |
| 48 | Luquillo | 0.34 | 0.08 | 0.60 | 0.0 | -0.16 | 29.0 | -0.6 | 2.9 | 11.4 | 1.2 |
| 49 | Laupahoehoe | -0.04 | 0.03 | 0.01 | 0.0 | -7.27 | -20.7 | 1.3 | 18.2 | 4.7 | 2.6 |
| 50 | Palamanui | 0.07 | 0.13 | 0.11 | 0.0 | -7.21 | -28.4 | 2.8 | -4.2 | -3.4 | 3.0 |
| 51 | Badagongshan | 0.29 | -0.79 | 0.13 | -5.6 | 0.67 | -5.6 | 1.2 | -6.8 | -3.1 | 6.8 |
| 52 | Baotianman | 0.90 | 0.10 | 0.55 | -15.0 | 4.55 | -1.7 | 0.4 | -3.9 | -1.6 | 5.8 |
| 53 | Changbaishan | 0.71 | 0.87 | 0.02 | -9.7 | 4.67 | 0.2 | -0.3 | 2.7 | -9.9 | -6.0 |
| 54 | Donglingshan | 1.51 | 0.80 | 1.73 | -16.8 | 11.70 | 2.8 | 0.3 | -10.7 | 0.5 | -2.1 |
| 55 | Gutianshan | 0.25 | -0.87 | 0.17 | 0.1 | 10.96 | 3.0 | 0.2 | -15.7 | 2.0 | -0.8 |
| 56 | Tiantongshan | 0.29 | -0.58 | 0.35 | -2.5 | 3.91 | 10.6 | -0.4 | -2.7 | 6.0 | 1.7 |
| 57 | Zofin | 1.32 | 1.82 | 1.26 | -17.4 | 9.01 | 4.8 | 0.0 | -4.1 | 1.2 | -5.6 |
| 58 | Speulderbos | 0.99 | 0.95 | 1.30 | -14.7 | 16.24 | 6.7 | 0.3 | 6.1 | 3.3 | -4.0 |
| 59 | Wytham Woods | 0.75 | 0.65 | 0.61 | -15.1 | 6.51 | 3.3 | 1.1 | -12.1 | -17.2 | 2.8 |

**Table S4. Climate Change Projections for CTFS-ForestGEO sites.**
Recent climate ('R'; 1950-2000 average; source: WorldClim) and future- HADGEM2-ES model Climate Change Projections for 2050 (2041-2060 average) under two emissions scenarios: RCP 2.6 (IPCC's most optimistic scenario, with emissions going to zero by 2070) and RCP 8.5 (IPCC's most pessimistic emissions scenario). Full data on climate change projections are available online (www.ctfs.si.edu/Data). *Note:* These values do not correspond exactly to values in Table 2 (most of which come from local weather stations measured over a range of time frames). For high precipitation-sites within the CTFS-ForestGEO network, values from the WorldClim Database tend to underestimate MAP, dramatically so at some sites (e.g., Korup, Kuala Belalong, Sinharaja, Fushan, La Planada; see Appendix S1).

| | | Mean Annual Temperature (°C) | | | Max T of warmest month (°C) | | | Min T of coldest month (°C) | | | Mean Annual Precipitation (mm $yr^{-1}$) | | | Precipitation of wettest month (mm $mo^{-1}$) | | | Precipitation of driest month (mm $mo^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **#** | **Site** | **R** | **RCP 2.6** | **RCP 8.5** | **R** | **RCP 2.6** | **RCP 8.5** | **R** | **RCP 2.6** | **RCP 8.5** | **R** | **RCP 2.6** | **RCP 8.5** | **R** | **RCP 2.6** | **RCP 8.5** | **R** | **RCP 2.6** | **RCP 8.5** |
| 1 | Korup | 26.6 | 28.3 | 29.3 | 32.5 | 34.1 | 35 | 22 | 23.9 | 24.9 | 2680 | 2763 | 2762 | 411 | 426 | 408 | 29 | 32 | 31 |
| 2 | Ituri (Edoro and Lenda) | 24.3 | 26.3 | 27.5 | 31.3 | 33.1 | 34.6 | 17.9 | 20 | 21.2 | 1750 | 1775 | 1818 | 198 | 198 | 200 | 67 | 84 | 77 |
| 3 | Rabi | 25.6 | 27.3 | 28.2 | 32.3 | 33.9 | 34.9 | 18.5 | 20.6 | 22 | 1970 | 2026 | 2002 | 371 | 398 | 423 | 2 | 2 | 3 |
| 4 | Mpala | 17.9 | 20 | 21.1 | 28 | 29.7 | 30.8 | 8.1 | 10.7 | 12.1 | 709 | 648 | 662 | 133 | 125 | 142 | 21 | 17 | 17 |
| 5 | Wanang | 26.2 | 27.8 | 28.6 | 30.9 | 32.5 | 33.4 | 21.4 | 23 | 24 | 3764 | 4006 | 4074 | 430 | 516 | 539 | 180 | 143 | 134 |
| 6 | Kuala Belalong | 26.5 | 27.9 | 28.8 | 30.4 | 31.9 | 33 | 23 | 24.5 | 25.3 | 3767 | 3890 | 4061 | 370 | 391 | 441 | 247 | 252 | 248 |
| 7 | Dinghushan | 19.7 | 21.8 | 22.7 | 30.1 | 31.8 | 32.8 | 7.1 | 9.8 | 10.8 | 1735 | 1829 | 1847 | 283 | 318 | 339 | 33 | 31 | 30 |
| 8 | Heishiding | 22 | 24.2 | 25.1 | 33.5 | 35.3 | 36.2 | 8.9 | 11.5 | 12.4 | 1440 | 1507 | 1506 | 245 | 254 | 263 | 33 | 34 | 33 |
| 9 | Hong Kong | 21.9 | 24 | 24.8 | 30.5 | 32.1 | 33 | 11.3 | 13.9 | 14.6 | 2286 | 2312 | 2280 | 415 | 451 | 452 | 28 | 26 | 25 |
| 10 | Jianfengling | 20.4 | 22.1 | 22.8 | 27.4 | 28.9 | 30 | 10.9 | 13 | 13.6 | 1657 | 1569 | 1355 | 318 | 310 | 349 | 17 | 18 | 17 |
| 11 | Nonggang | 22.5 | 24.8 | 25.8 | 32.6 | 34.8 | 36.3 | 10.2 | 12.6 | 13.5 | 1376 | 1356 | 1343 | 240 | 228 | 246 | 24 | 29 | 24 |
| 12 | Xishuangbanna | 21.3 | 23.1 | 24.4 | 30.4 | 32.9 | 34.5 | 9 | 10.6 | 12.2 | 1611 | 1641 | 1579 | 290 | 289 | 288 | 21 | 25 | 22 |
| 13 | Mudumalai | 22.3 | 24 | 25 | 30.1 | 31.9 | 32.8 | 14.9 | 16.4 | 17.6 | 1480 | 1658 | 1582 | 409 | 410 | 392 | 2 | 1 | 1 |
| 14 | Danum Valley | 25.9 | 27.3 | 28.2 | 30.5 | 32.1 | 33.1 | 21.8 | 23.3 | 24.2 | 2466 | 2412 | 2525 | 275 | 261 | 294 | 147 | 130 | 111 |
| 15 | Lambir | 26.5 | 27.8 | 28.6 | 30.8 | 32.1 | 33 | 22.5 | 24 | 24.7 | 2929 | 3076 | 3234 | 347 | 350 | 395 | 170 | 170 | 173 |
| 16 | Pasoh | 26.4 | 28 | 28.9 | 32.1 | 33.9 | 34.9 | 21 | 22.6 | 23.5 | 1975 | 1861 | 1975 | 254 | 209 | 239 | 103 | 112 | 101 |
| 17 | Palanan | 26.5 | 27.9 | 28.6 | 33.4 | 35.1 | 36 | 19.5 | 20.7 | 21.3 | 2644 | 2724 | 2707 | 558 | 573 | 594 | 79 | 70 | 65 |
| 18 | Bukit Timah | 26.9 | 28.1 | 28.9 | 31.5 | 32.9 | 33.6 | 22.1 | 23.4 | 24 | 2371 | 2374 | 2367 | 301 | 284 | 287 | 153 | 162 | 158 |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19 | Sinharaja | 23.6 | 25 | 25.8 | 29.1 | 30.8 | 31.7 | 18.7 | 19.8 | 20.6 | 3442 | 3716 | 3556 | 434 | 607 | 529 | 162 | 115 | 119 |
| 20 | Fushan | 19.3 | 21.1 | 21.7 | 28.1 | 29.8 | 30.3 | 10.1 | 12 | 12.8 | 3189 | 3018 | 3139 | 461 | 482 | 513 | 125 | 107 | 106 |
| 21 | Kenting | 24.4 | 25.8 | 26.3 | 30.6 | 32 | 32.6 | 16.6 | 18.2 | 18.6 | 2470 | 2401 | 2468 | 565 | 568 | 551 | 30 | 25 | 25 |
| 22 | Lienhuachih | 19.3 | 21.1 | 21.7 | 27 | 28.7 | 29.2 | 10.3 | 12.1 | 12.9 | 2345 | 2313 | 2437 | 488 | 602 | 551 | 25 | 19 | 18 |
| 23 | Nanjenshan | 22.9 | 24.3 | 24.8 | 29.1 | 30.5 | 31.1 | 15.1 | 16.6 | 17.1 | 3034 | 2901 | 2986 | 703 | 662 | 696 | 54 | 45 | 45 |
| 24 | Zenlun | 22.7 | 24.3 | 24.9 | 30.9 | 32.5 | 33 | 12.9 | 14.7 | 15.4 | 2620 | 2591 | 2780 | 613 | 600 | 655 | 16 | 12 | 12 |
| 25 | Doi Inthanon | 19.7 | 21.7 | 22.9 | 30.6 | 32.5 | 33.4 | 7.1 | 9.5 | 11 | 1057 | 1080 | 992 | 195 | 220 | 202 | 10 | 11 | 12 |
| 26 | Huai Kha Khaeng | 24.8 | 26.7 | 27.8 | 34.3 | 35.9 | 36.9 | 14.3 | 16.6 | 17.9 | 1347 | 1327 | 1224 | 257 | 254 | 257 | 3 | 4 | 4 |
| 27 | Khao Chong | 26.9 | 28.2 | 29.1 | 34 | 35.8 | 36.8 | 21 | 22.4 | 23.2 | 2114 | 2243 | 2211 | 324 | 342 | 372 | 38 | 43 | 33 |
| 28 | Mo Singto | 23.5 | 25.6 | 26.8 | 31.6 | 33.8 | 35.1 | 13.2 | 15.9 | 17.2 | 1098 | 1083 | 975 | 236 | 226 | 229 | 6 | 6 | 8 |
| 29 | Haliburton | 4.2 | 7.3 | 8.6 | 24.5 | 27.3 | 29.6 | -16.9 | -13.1 | -12.3 | 962 | 1064 | 1048 | 94 | 110 | 115 | 62 | 69 | 67 |
| 30 | Scotty Creek | -3.5 | 0.1 | 2.2 | 23 | 25.4 | 26.8 | -30.5 | -26.3 | -22.7 | 372 | 411 | 418 | 59 | 64 | 60 | 18 | 20 | 20 |
| 31 | Harvard Forest | 6.7 | 9.6 | 10.7 | 26 | 28.7 | 30.4 | -12.8 | -8.8 | -8.4 | 1151 | 1267 | 1288 | 106 | 122 | 126 | 82 | 90 | 82 |
| 32 | Lilly Dickey Woods | 11.4 | 14.1 | 15.5 | 29.7 | 33.4 | 36.9 | -7.1 | -4.7 | -3.3 | 1088 | 1158 | 1087 | 120 | 133 | 120 | 69 | 61 | 61 |
| 33 | Santa Cruz | 13.2 | 15.1 | 16 | 24.7 | 26.6 | 27.7 | 3.4 | 5.3 | 5.9 | 899 | 1006 | 1007 | 193 | 230 | 239 | 2 | 2 | 2 |
| 34 | SCBI | 11.2 | 13.8 | 15 | 29.2 | 32 | 34.9 | -7.1 | -4.6 | -3.7 | 1011 | 1055 | 1033 | 102 | 108 | 101 | 64 | 64 | 60 |
| 35 | SERC | 13.2 | 15.8 | 16.9 | 30.4 | 33 | 35.5 | -3.8 | -1.2 | -0.4 | 1068 | 1135 | 1093 | 112 | 117 | 114 | 71 | 71 | 74 |
| 36 | Tyson Research Center | 12.4 | 15.1 | 16.4 | 31.5 | 35.3 | 37.7 | -7.7 | -5.3 | -3.8 | 999 | 1048 | 1014 | 107 | 122 | 120 | 51 | 61 | 64 |
| 37 | Wabikon | 4.2 | 7.3 | 8.6 | 25.4 | 28.5 | 29.9 | -17.9 | -13.9 | -12 | 803 | 799 | 826 | 106 | 99 | 101 | 24 | 28 | 27 |
| 38 | Wind River | 9.4 | 11.9 | 13 | 25.3 | 28.6 | 30.5 | -1.6 | 0.3 | 1.2 | 2565 | 2602 | 2447 | 458 | 487 | 490 | 22 | 22 | 22 |
| 39 | Yosemite National Park | 7.4 | 9.7 | 10.8 | 25.1 | 27.6 | 28.9 | -5.1 | -3.4 | -2.5 | 1034 | 1081 | 1076 | 184 | 210 | 214 | 7 | 7 | 7 |
| 40 | Ilha do Cardoso | 22.5 | 23.7 | 24.4 | 30.9 | 32.3 | 33 | 13.8 | 14.8 | 15.6 | 2479 | 2549 | 2605 | 377 | 332 | 359 | 85 | 90 | 96 |
| 41 | Manaus | 26.7 | 28.8 | 30.2 | 32.3 | 34.4 | 36.1 | 22 | 23.7 | 24.9 | 2404 | 2213 | 2122 | 314 | 320 | 313 | 110 | 100 | 102 |
| 42 | Amacayacu | 25.9 | 27.7 | 28.9 | 31.2 | 33.2 | 34.5 | 20.2 | 22.2 | 23.3 | 2790 | 2635 | 2758 | 317 | 321 | 332 | 150 | 140 | 148 |
| 43 | La Planada | 17.8 | 19.4 | 20.4 | 23.7 | 25.4 | 26.5 | 12.3 | 13.9 | 14.9 | 1716 | 1872 | 1765 | 214 | 270 | 252 | 40 | 42 | 42 |
| 44 | Yasuni | 25.1 | 26.8 | 27.9 | 30.9 | 32.6 | 33.6 | 19.7 | 21.4 | 22.4 | 3115 | 3208 | 3236 | 329 | 351 | 364 | 197 | 210 | 208 |
| 45 | Barro Colorado Island | 25.9 | 27.5 | 28.3 | 30.8 | 32.2 | 33.1 | 21.6 | 23.4 | 24.2 | 2635 | 2999 | 3006 | 386 | 446 | 463 | 26 | 35 | 32 |
| 46 | Cocoli | 26.6 | 28.2 | 29.1 | 32.2 | 33.5 | 34.5 | 21.9 | 23.7 | 24.5 | 2018 | 2211 | 2242 | 317 | 306 | 328 | 11 | 15 | 14 |
| 47 | San Lorenzo/ Sherman | 26.2 | 27.8 | 28.6 | 30.4 | 31.9 | 32.7 | 22.3 | 23.8 | 24.6 | 3188 | 3723 | 3702 | 501 | 575 | 591 | 48 | 61 | 49 |
| 48 | Luquillo | 22.6 | 24.1 | 24.7 | 28.6 | 30 | 30.7 | 16 | 17.6 | 18.3 | 3015 | 3019 | 2686 | 336 | 434 | 384 | 129 | 145 | 132 |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 49 | Laupahoehoe | 16.2 | 18 | 18.7 | 22.7 | 24.8 | 25.5 | 10.1 | 11.8 | 12.5 | 1937 | 1890 | 1921 | 255 | 334 | 334 | 43 | 42 | 48 |
| 50 | Palamanui | 22.2 | 24.1 | 24.8 | 28 | 30.2 | 31 | 16.3 | 18 | 18.7 | 1177 | 1246 | 1303 | 124 | 176 | 172 | 71 | 57 | 40 |
| 51 | Badagongshan | 15.9 | 18.1 | 19.1 | 31.2 | 33.4 | 34.9 | 0.8 | 3.3 | 4.3 | 1410 | 1678 | 1566 | 229 | 291 | 252 | 33 | 36 | 36 |
| 52 | Baotianman | 8.1 | 10.3 | 11.4 | 23.9 | 25.9 | 27.2 | -9.4 | -7.1 | -6.3 | 950 | 1067 | 1013 | 192 | 219 | 224 | 15 | 18 | 18 |
| 53 | Changbaishan | 2.3 | 4.7 | 5.8 | 24.5 | 26.5 | 27.3 | -24.3 | -20.7 | -19.4 | 693 | 769 | 788 | 163 | 194 | 193 | 7 | 9 | 11 |
| 54 | Donglingshan | 4.7 | 6.9 | 8.1 | 24.6 | 26.3 | 27.3 | -18.3 | -15.2 | -13.7 | 519 | 616 | 614 | 148 | 191 | 182 | 4 | 4 | 4 |
| 55 | Gutianshan | 15.4 | 17.9 | 18.8 | 30.6 | 33.6 | 34.6 | -0.3 | 2.3 | 3.3 | 1860 | 1917 | 1934 | 317 | 343 | 332 | 51 | 51 | 53 |
| 56 | Tiantongshan | 14.4 | 16.8 | 17.6 | 28.5 | 31.2 | 31.8 | 0.1 | 2.6 | 3.5 | 1480 | 1476 | 1514 | 204 | 222 | 223 | 52 | 48 | 49 |
| 57 | Zofin | 5.7 | 8.7 | 9.9 | 20.7 | 25.4 | 28.2 | -7.2 | -3.9 | -2.6 | 949 | 931 | 912 | 122 | 118 | 104 | 55 | 55 | 63 |
| 58 | Speulderbos | 9 | 11.3 | 12.2 | 21 | 24.5 | 26 | -1 | 0.7 | 2 | 803 | 794 | 764 | 78 | 84 | 88 | 49 | 51 | 42 |
| 59 | Wytham Woods | 9.3 | 11.5 | 12.4 | 20.7 | 24.7 | 26.6 | 0 | 1.3 | 2.3 | 657 | 656 | 626 | 65 | 68 | 73 | 39 | 43 | 30 |

**Table S5. Atmospheric deposition; forest degradation, loss, and fragmentation; and local anthropogenic disturbances at CTFS-ForestGEO sites.**
Atmospheric deposition data in year 2000 estimated from Dentener *et al.* (2006). Statistics on tree cover, recent forest loss, forest fragmentation, and forest degradation calculated from the data of Hansen *et al.* (2013) as described in Appendix S1. Note that in this analysis, "forest" can include agroforestry areas. Local anthropogenic disturbances refer to perturbations within the plots. Complete data are available online (www.ctfs.si.edu/Data).

| # | Site | *NOy deposition* (g N $m^{-2}$ $yr^{-1}$) | *NHx deposition* (g N $m^{-2}$ $yr^{-1}$) | *SOx deposition* (g S $m^{-2}$ $yr^{-1}$) | *Tree cover in originally forested land area relative to tree cover in plot (%)* | | | | *Percent of 2000 forest area lost by 2012* | | | | *Forest fragmentation index (edge km / area km2) in 2012* | | | | *Degradation Index* | *Anthropogenic Disturbance-Past*† | *Anthropogenic Disturbance-Ongoing** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | <1 km | 1-5 km | 5-25 km | 25-50 km | <1 km | 1-5 km | 5-25 km | 25-50 km | <1 km | 1-5 km | 5-25 km | 25-50 km | | | |
| 1 | Korup | 0.45 | 0.54 | 0.17 | 99 | 101 | 99 | 90 | 0.1 | 0.1 | 0.7 | 1.1 | 0.2 | 0.2 | 0.5 | 0.8 | 2 | f, e, h | - |
| 2 | Ituri (Edoro and Lenda)‡ | 0.46 | 0.48 | 0.14 | 100 | 100 | 99 | 99 | 0.0 | 0.0 | 1.1 | 0.9 | 0.0 | 0.0 | 0.4 | 0.4 | 1 | - | h |
| 3 | Rabi | 0.31 | 0.20 | 0.11 | 99 | 95 | 99 | 98 | 0.2 | 0.9 | 0.7 | 0.7 | 0.3 | 1.2 | 0.5 | 0.5 | 1 | W | w |
| 4 | Mpala§ | 0.16 | 0.39 | 0.08 | >100 | >100 | >100 | >100 | 0.0 | 0.0 | 0.0 | 0.4 | - | - | - | - | 0 | P, A, W,E,H | P, A, I |
| 5 | Wanang | 0.06 | 0.11 | 0.79 | 129 | 136 | 142 | 141 | 6.5 | 3.2 | 2.9 | 2.8 | 5.8 | 3.5 | 2.5 | 2.6 | 2 | H | H |
| 6 | Kuala Belalong | 0.18 | 0.19 | 0.18 | 100 | 99 | 91 | 83 | 0.0 | 0.9 | 3.6 | 6.0 | 0.0 | 0.6 | 3.2 | 4.2 | 5 | h | - |
| 7 | Dinghushan | 0.67 | 2.16 | 1.85 | 92 | 76 | 46 | 39 | 0.0 | 8.3 | 8.8 | 13.0 | 3.0 | 6.6 | 13.5 | 20.3 | 22 | | |
| 8 | Heishiding | 0.63 | 2.25 | 1.60 | 35 | 17 | 63 | 73 | 14.2 | 30.0 | 16.9 | 14.8 | 33.4 | 47.1 | 19.9 | 16.2 | 36 | | |
| 9 | Hong Kong | 0.65 | 1.18 | 1.79 | 93 | 51 | 40 | 22 | 0.3 | 0.4 | 1.1 | 8.1 | 1.0 | 8.1 | 11.9 | 17.6 | 25 | F, W, B, H, E | e |
| 10 | Jianfengling | 0.35 | 0.79 | 0.71 | 102 | 93 | 51 | 39 | 0.1 | 0.5 | 6.0 | 8.8 | 0.1 | 2.2 | 7.7 | 12.8 | 16 | | |
| 11 | Nonggang | 0.45 | 2.00 | 0.81 | 99 | 110 | 62 | 59 | 0.3 | 1.2 | 1.9 | 5.2 | 4.6 | 3.8 | 12.5 | 13.1 | 11 | - | - |
| 12 | Xishuangbanna | 0.39 | 1.26 | 0.43 | 79 | 74 | 76 | 75 | 1.1 | 5.4 | 4.2 | 6.1 | 5.3 | 6.5 | 5.5 | 5.9 | 14 | H | |
| 13 | Mudumalai | 0.38 | 0.95 | 0.79 | 106 | 95 | 66 | 54 | 0.0 | 0.0 | 0.7 | 0.8 | 0.2 | 2.0 | 7.1 | 9.0 | 11 | W, H | h |
| 14 | Danum Valley | 0.14 | 0.13 | 0.17 | 102 | 103 | 90 | 79 | 0.2 | 0.5 | 6.8 | 13.9 | 0.3 | 0.6 | 4.4 | 6.8 | 7 | | |
| 15 | Lambir | 0.18 | 0.16 | 0.18 | 97 | 82 | 45 | 57 | 1.2 | 7.1 | 44.0 | 31.7 | 0.7 | 5.2 | 14.1 | 9.6 | 25 | H, e | H |
| 16 | Pasoh | 0.32 | 0.41 | 0.41 | 99 | 53 | 52 | 61 | 0.1 | 44.0 | 32.9 | 24.1 | 0.1 | 5.2 | 12.8 | 10.0 | 30 | | h, e |
| 17 | Palanan | 0.15 | 0.30 | 0.35 | 99 | 67 | 94 | 71 | 0.8 | 2.6 | 1.2 | 3.8 | 0.8 | 6.9 | 2.0 | 6.2 | 10 | H, w, e | - |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | Bukit Timah | 0.32 | 0.25 | 0.49 | 70 | 37 | 22 | 50 | 0.3 | 2.3 | 17.2 | 28.0 | 7.3 | 17.4 | 24.3 | 13.9 | 34 | F, CC | |
| 19 | Sinharaja | 0.20 | 0.47 | 0.36 | 98 | 93 | 82 | 68 | 0.1 | 0.5 | 1.2 | 1.9 | 0.1 | 1.1 | 4.1 | 8.4 | 8 | | e |
| 20 | Fushan | 0.52 | 0.54 | 1.47 | 102 | 101 | 81 | 69 | 0.0 | 0.0 | 0.3 | 0.7 | 0.0 | 0.1 | 3.0 | 5.0 | 6 | | h |
| 21 | Kenting | 0.35 | 0.34 | 0.81 | 84 | 68 | 79 | 90 | 1.7 | 1.7 | 2.0 | 3.1 | 4.2 | 8.0 | 5.4 | 4.2 | 11 | F, e | e |
| 22 | Lienhuachih | 0.49 | 0.92 | 1.21 | 94 | 84 | 71 | 61 | 0.8 | 1.4 | 1.1 | 0.6 | 2.5 | 4.7 | 5.9 | 4.9 | 12 | H, F | h |
| 23 | Nanjenshan | 0.44 | 0.63 | 1.07 | 97 | 80 | 70 | 75 | 1.3 | 1.6 | 2.3 | 3.4 | 1.1 | 5.0 | 4.9 | 5.0 | 11 | - | - |
| 24 | Zenlun | 0.49 | 0.92 | 1.21 | 114 | 95 | 82 | 88 | 8.0 | 4.5 | 1.3 | 1.6 | 11.4 | 10.0 | 5.5 | 5.8 | 6 | W | W |
| 25 | Doi Inthanon | 0.46 | 0.92 | 0.36 | 97 | 85 | 61 | 51 | 0.0 | 0.6 | 3.9 | 3.3 | 0.4 | 6.0 | 5.8 | 7.8 | 14 | - | - |
| 26 | Huai Kha Khaeng | 0.45 | 0.65 | 0.43 | 96 | 98 | 83 | 64 | 0.1 | 0.0 | 0.3 | 0.5 | 0.1 | 0.0 | 1.0 | 2.5 | 7 | - | h |
| 27 | Khao Chong | 0.23 | 0.28 | 0.27 | 98 | 92 | 57 | 47 | 0.0 | 2.1 | 12.0 | 14.2 | 0.3 | 2.4 | 12.8 | 15.5 | 17 | | |
| 28 | Mo Singto | 0.49 | 0.63 | 0.54 | 102 | 97 | 68 | 24 | 0.1 | 0.1 | 0.8 | 1.5 | 0.1 | 1.0 | 5.5 | 16.7 | 14 | | |
| 29 | Haliburton Forest | 0.51 | 0.31 | 0.87 | 100 | 98 | 97 | 95 | 0.1 | 0.6 | 0.4 | 0.6 | 0.4 | 1.1 | 1.4 | 1.9 | 1 | | |
| 30 | Scotty Creek Forest Dynamics Plot[**] | 0.03 | 0.02 | 0.74 | 138 | 139 | 184 | 177 | 0.0 | 0.0 | 0.1 | 0.3 | - | - | - | - | 0 | | |
| 31 | Harvard Forest | 0.94 | 0.27 | 1.16 | 98 | 92 | 88 | 78 | 3.7 | 1.7 | 2.0 | 2.2 | 1.1 | 3.3 | 4.2 | 6.3 | 7 | P, W,I | I |
| 32 | Lilly Dickey Woods | 0.99 | 0.59 | 1.73 | 99 | 82 | 67 | 29 | 0.1 | 0.2 | 0.4 | 0.5 | 0.4 | 4.4 | 6.1 | 13.3 | 15 | W, b, h | b, h, i |
| 33 | Santa Cruz | 0.27 | 0.13 | 0.15 | 84 | 71 | 77 | 31 | 0.9 | 1.1 | 3.0 | 1.6 | 5.0 | 6.5 | 4.0 | 13.6 | 18 | w | I |
| 34 | SCBI | 0.99 | 0.38 | 1.60 | 87 | 69 | 57 | 51 | 0.0 | 1.9 | 1.3 | 2.0 | 2.1 | 7.3 | 8.3 | 9.9 | 18 | P, I | I |
| 35 | SERC | 1.07 | 0.32 | 1.51 | 78 | 53 | 49 | 37 | 4.3 | 1.3 | 2.3 | 3.7 | 7.0 | 13.9 | 13.5 | 16.4 | 24 | | |
| 36 | Tyson Research Center | 0.84 | 0.65 | 1.36 | 87 | 69 | 43 | 33 | 0.0 | 2.1 | 1.8 | 1.6 | 2.4 | 6.8 | 13.5 | 14.8 | 22 | H, W, p, i | i, h |
| 37 | Wabikon Lake Forest | 0.40 | 0.34 | 0.59 | 95 | 93 | 83 | 81 | 1.5 | 0.8 | 2.8 | 3.4 | 0.6 | 1.8 | 4.3 | 3.9 | 7 | W, h | h |
| 38 | Wind River | 0.18 | 0.19 | 0.21 | 81 | 93 | 89 | 71 | 0.0 | 1.3 | 2.1 | 8.8 | 2.9 | 1.6 | 1.9 | 5.7 | 10 | I | I |
| 39 | Yosemite National Park | 0.26 | 0.10 | 0.14 | 92 | 85 | 56 | 32 | 4.0 | 7.6 | 6.0 | 5.8 | 2.7 | 5.0 | 6.9 | 12.0 | 20 | I | I |
| 40 | Ilha do Cardoso | 0.29 | 0.44 | 0.26 | 100 | 95 | 92 | 88 | 0.4 | 0.0 | 0.3 | 1.4 | 0.4 | 1.6 | 2.2 | 3.2 | 3 | | |
| 41 | Manaus | 0.24 | 0.22 | 0.11 | 100 | 100 | 98 | 96 | 0.0 | 0.1 | 0.9 | 2.1 | 0.0 | 0.0 | 0.6 | 1.4 | 1 | | |
| 42 | Amacayacu | 0.20 | 0.10 | 0.09 | 100 | 95 | 95 | 96 | 0.0 | 1.4 | 1.7 | 2.1 | 0.0 | 1.8 | 1.3 | 1.0 | 2 | | |
| 43 | La Planada | 0.20 | 0.35 | 0.49 | 99 | 93 | 88 | 74 | 0.0 | 1.1 | 1.3 | 2.3 | 0.0 | 1.6 | 2.2 | 5.3 | 7 | P | E |
| 44 | Yasuni | 0.19 | 0.28 | 0.30 | 99 | 98 | 99 | 97 | 0.0 | 0.2 | 0.1 | 1.8 | 0.1 | 0.7 | 0.2 | 0.8 | 1 | cc | e, h |
| 45 | Barro Colorado Island | 0.20 | 0.20 | 0.23 | 101 | 100 | 69 | 63 | 0.1 | 0.1 | 4.3 | 6.7 | 0.1 | 0.4 | 8.4 | 11.4 | 10 | w, f | - |
| 46 | Cocoli | 0.21 | 0.22 | 0.25 | 87 | 72 | 55 | 60 | 4.9 | 4.4 | 3.9 | 4.4 | 3.8 | 7.1 | 10.2 | 9.8 | 18 | | |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 47 | San Lorenzo/ Sherman | 0.20 | 0.20 | 0.23 | 101 | 99 | 79 | 65 | 0.3 | 0.7 | 4.8 | 7.5 | 0.4 | 1.2 | 7.2 | 11.3 | 9 | | |
| 48 | Luquillo | 0.09 | 0.07 | 0.13 | 99 | 83 | 49 | 54 | 0.3 | 1.4 | 2.8 | 2.3 | 0.5 | 5.7 | 15.3 | 12.6 | 15 | CC, F | |
| 49 | Laupahoehoe | 0.04 | 0.04 | 0.12 | 100 | 95 | 42 | 33 | 0.0 | 0.1 | 0.5 | 0.9 | 0.0 | 0.7 | 6.7 | 8.4 | 16 | I, A | I, H |
| 50 | Palamanui | 0.04 | 0.04 | 0.12 | 105 | 68 | 68 | 64 | 6.9 | 2.2 | 0.9 | 0.5 | 20.0 | 16.2 | 15.6 | 13.3 | 14 | I, A | I |
| 51 | Badagongshan | 0.73 | 3.05 | 2.34 | 104 | 103 | 103 | 95 | 0.3 | 0.1 | 0.4 | 0.8 | 9.4 | 9.8 | 9.2 | 11.3 | 1 | e | |
| 52 | Baotianman | 0.83 | 1.84 | 2.83 | 94 | 91 | 74 | 46 | 0.6 | 0.3 | 0.6 | 0.9 | 1.1 | 1.4 | 5.5 | 8.9 | 12 | | |
| 53 | Changbaishan | 0.38 | 0.74 | 0.84 | 101 | 95 | 95 | 87 | 0.0 | 0.6 | 0.9 | 1.0 | 0.2 | 2.2 | 3.0 | 4.7 | 3 | w | - |
| 54 | Donglingshan | 0.64 | 0.81 | 2.18 | 78 | 35 | 28 | 18 | 0.0 | 0.2 | 0.2 | 0.5 | 6.3 | 19.9 | 22.5 | 26.5 | 30 | CC | |
| 55 | Gutianshan | 0.94 | 2.02 | 2.93 | 95 | 87 | 74 | 71 | 0.1 | 0.2 | 4.1 | 3.2 | 0.3 | 2.4 | 6.3 | 5.8 | 10 | w, b, H | - |
| 56 | Tiantongshan | 0.81 | 1.13 | 3.14 | 104 | 86 | 30 | 37 | 0.0 | 0.4 | 0.7 | 0.9 | 1.7 | 4.9 | 12.0 | 13.0 | 19 | | |
| 57 | Zofin | 0.76 | 1.09 | 1.08 | 90 | 80 | 50 | 45 | 8.8 | 11.3 | 4.6 | 5.0 | 7.1 | 9.5 | 13.2 | 13.7 | 21 | w, h | - |
| 58 | Speulderbos | 0.82 | 1.48 | 1.00 | 80 | 61 | 38 | 20 | 1.2 | 3.0 | 5.1 | 2.8 | 4.9 | 9.3 | 17.1 | 29.0 | 27 | | |
| 59 | Wytham Woods | 0.73 | 0.97 | 0.96 | 60 | 7 | 5 | 8 | 0.0 | 0.7 | 2.0 | 1.7 | 7.2 | 48.3 | 47.1 | 40.2 | 40 | P, W, h, I | I |

[†] Codes are as follows: F-farming; P-pasture; W-wood harvesting; CC-clear cut/ complete clearing; B-burn; H-hunting; E-extraction of NTFP (non-timber forest products); I-invasive species; '-' no significant disturbances. Capital letters denote strong pressure; lowercase denote mild pressure.

[‡] Forest cover/ loss/ fragmentation/ degradation are average values for four plots.

[§] Tree cover at this savanna site falls below the 10% tree cover threshold used to classify forest. Therefore, calculations were not limited to areas originally classified as forest. Forest fragmentation index was unreliable due to low-density tree cover and therefore is not reported.

[**] Forest fragmentation index was unreliable due to low-density tree cover and therefore is not reported.

**Table S6. Record of supplementary measurements made at CTFS-ForestGEO sites.**
Coded as follows: P(#): measured using standardized CTFS-ForestGEO protocol outlined in Appendix S2 (numbers differentiate multiple protocols in the same category); 'N'- Will be measured by NEON (see NEON, 2011); '+' measured (any protocol); '-' not measured or no information; * in progress; (f)-planned for near future, with funding. Other codes explained in footnotes.

| # | Site | N tree censuses‡‡ | Lianas | Functional Traits§§ | Dendrometer Bands | Flower & Seed Production | Seedling Performance | DNA barcoding*** | Arthropods††† | Vertebrates | Airborne LiDAR | Dead Wood/ CWD | Fine Roots | Soil C | Soil Nutrients | Litterfall | Eddy Covariance‡‡‡ | Weather station§§§ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Korup | 3 | P | L; SM; H; WD | - | - | - | P(p)* | - | P1 | - | - | - | P | P1 | - | - | A |
| 2 | Ituri (Edoro and Lenda) | 3 | P | + | - | - | - | - | - | + | - | - | - | - | + | - | - | |
| 3 | Rabi | 1 | - | - | - | - | - | P(p)* | - | - | - | - | - | - | - | - | - | A |
| 4 | Mpala | 1* | - | + | - | - | - | P(p)* | - | + | - | - | - | - | +; P2(f) | - | + | A |
| 5 | Wanang | 1 | - | + | - | - | - | P(a) | P | - | - | - | - | - | P3 | - | - | |
| 6 | Kuala Belalong | 1* | - | - | - | - | - | - | - | - | - | - | - | - | * | - | - | |
| 7 | Dinghushan | 2 | - | L; SM; H; WD | P1 | P | P | P(p) | - | P2 | - | - | - | - | + | P | - | + |
| 8 | Heishiding | 1 | P | L; SM; H; WD | - | + | + | - | - | - | - | - | - | - | - | - | - | |
| 9 | Hong Kong | 1* | - | - | - | - | - | P(p)* | P* | - | - | - | - | - | - | - | - | A, C |
| 10 | Jianfengling | 1 | - | L; SM; H; WD | * | P | P | P(p) | - | - | - | - | - | + | + | P | + | A |
| 11 | Nonggang | 1* | - | L; SM; H; WD | - | - | - | - | - | P2 | - | - | - | - | - | - | - | B |
| 12 | Xishuangbanna | 1 | + | L; SM; H; WD | P1 | P | P | P(p) | - | P2 | - | - | - | - | + | - | - | - |
| 13 | Mudumalai | 4 | - | L; SM; H; WD | P1 | - | - | - | - | + | - | P1 | - | - | - | P | - | A |
| 14 | Danum Valley | 1* | - | SM | - | - | - | P(p)* | - | + | - | - | - | + | P1 | - | - | A |
| 15 | Lambir | 4 | - | L; SM; H; WD | P1 | - | - | - | - | + | - | P1 | P* | P* | + | P | + | A |
| 16 | Pasoh | 6 | + | L; SM; H; WD | P1 | P | P | - | - | P1 | - | P1; P2; P3 | P | P | +; P1 | P | + | A |

| # | Site | N tree censuses[‡‡] | Lianas | Functional Traits[§§] | Dendrometer Bands | Flower & Seed Production | Seedling Performance | DNA barcoding[***] | Arthropods[†††] | Vertebrates | Airborne LiDAR | Dead Wood/ CWD | Fine Roots | Soil C | Soil Nutrients | Litterfall | Eddy Covariance[‡‡‡] | Weather station[§§§] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | Palanan | 3.5 | - | L; H(f) | - | * | * | P(p) | + | + | - | - | - | - | - | * | - | (f) |
| 18 | Bukit Timah | 6 | - | - | P1 | - | - | P(p) | - | - | - | P1; P3; P4 | P | P | P2 | P | - | A |
| 19 | Sinharaja | 3 | - | - | - | + | - | - | - | + | - | - | - | - | +; P1 | - | - | |
| 20 | Fushan | 3 | - | H; L; WD | P1 | P | P | P(p) | + | + | + | P1; P2; P3 | - | - | + | P | - | A |
| 21 | Kenting | 3 | - | H; C; L; SM | P1 | P | P | P(p) | - | + | - | - | - | - | - | - | - | C |
| 22 | Lienhuachih | 1 | - | L; SM; H; WD | P1 | P | P | P(p) | - | - | - | P1; P2; P3 | - | - | + | P | - | A |
| 23 | Nanjenshan | 3 | - | L | - | - | + | P(p) | - | - | - | P1; P2; P3 | - | - | - | - | - | A |
| 24 | Zenlun | 2 | - | - | - | P | P | - | + | + | - | - | - | - | - | - | - | A |
| 25 | Doi Inthanon | 4 | - | WD; H | - | - | - | + | - | - | - | - | - | - | - | - | - | C |
| 26 | HKK | 4 | - | - | P1 | + | - | - | - | + | - | P1; P2 | P(f) | P(f) | +; P | P | - | A |
| 27 | Khao Chong | 3 | - | - | P1 | + | + | P(a) | P | - | - | P1 | P(f) | P(f) | +*; P1; P3 | P | - | A |
| 28 | Mo Singto | 2.5 | P | - | P1 | - | - | - | - | + | - | P1; P2 | - | - | - | P | - | |
| 29 | Haliburton Forest | 1*(3) | - | L; SM; H; C; WD; O | - | P | - | P(p) | - | + | + | + | - | P | P2 | P | + | A, B |
| 30 | Scotty Creek | 1 | n/a | C; WD | P1 | - | - | P(a) | - | - | + | - | P(f) | P(f) | - | P(f) | + | A |
| 31 | Harvard Forest | 1 | - | N | P1; P2 | - | - | - | N | N | +; N | N | N | N | N | +; N | +; N | A; N |
| 32 | Lilly Dickey | 1 | - | - | P1 | - | - | - | - | - | - | - | - | P* | +; P2* | - | - | A |
| 33 | Santa Cruz | 2 | + | H; C; L; WD(f) | - | P | - | P(p) | - | + | + | - | - | - | + | - | - | A |
| 34 | SCBI | 2 | + | L; H; C; O | P1; P2 | P | P | P(p) | +; N | +; P2; N | +; N | P1; P3; P4; N | P; N | P; N | +; P2; N | P; N | N | A, N |
| 35 | SERC | 1 | P | N | P1; P2 | + | + | P(p) | N | +; P2*; N | +; N | P4; N | P; N | P; N | +; P3; N | N | +; N | A, N |
| 36 | Tyson | 1(4) | - | L; WD; O | * | + | * | - | - | * | - | P4 | - | - | +; P2 | + | - | A |

| # | Site | N tree censuses[‡‡] | Lianas | Functional Traits[§§] | Dendrometer Bands | Flower & Seed Production | Seedling Performance | DNA barcoding[***] | Arthropods[†††] | Vertebrates | Airborne LiDAR | Dead Wood/ CWD | Fine Roots | Soil C | Soil Nutrients | Litterfall | Eddy Covariance[‡‡‡] | Weather station[§§§] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37 | Wabikon Lake Forest | 2 | - | - | P1 | + | + | P(p) | - | + | - | - | - | - | - | - | - | |
| 38 | Wind River | 1(2) | n/a | N | P1 | + | - | - | N | N | +; N | +; N | N | N | P2(f); N | N | +; N | A; N |
| 39 | Yosemite | 2* | n/a | - | P1 | - | - | - | - | - | + | + | - | - | - | - | - | A |
| 40 | Ilha do Cardoso | 1 | - | + | - | P | - | - | - | - | - | - | - | - | P1/ P2/ + | - | - | |
| 41 | Manaus | 1 | P | - | - | - | - | P(p) | - | P1 | - | - | - | - | - | - | - | + |
| 42 | Amacayacu | 1 | - | L; SM; H; WD | P1 | - | - | - | - | - | - | P1; P2; P3 | P | P | P2 | P | +(f) | |
| 43 | La Planada | 2 | - | - | - | - | - | - | - | - | - | - | - | - | P1 | - | - | |
| 44 | Yasuni | 3 | + | L; SM; H; WD | P1 | P | P | - | P | P1 | + | P1; P2; P3 | P | P | P1; P2 | P | - | A |
| 45 | BCI | 7 | P; + | L; SM; H; C; WD; O | P1 | P | P | P(p); P(a) | P | +; P1; P2 | + | P1; P2; P3 | P | P | P1 | P | + | A |
| 46 | Cocoli | 3 | + | - | - | - | - | - | - | - | - | - | - | - | - | - | - | C |
| 47 | San Lorenzo | 1 | + | L; SM; H; WD | P1 | P | P | - | - | - | + | - | - | P | P2 | - | - | C |
| 48 | Luquillo | 5 | + | L; SM; H; WD, C | P1 | P | P | P(p) | + | + | - | +; P | P | P | P2 | P | - | A |
| 49 | Laupahoehoe | 1 | - | - | - | P | P | P(p)* | - | - | + | - | - | - | - | + | - | A |
| 50 | Palamanui | 2* | - | - | - | P | P | P(p)* | - | - | - | - | - | - | - | + | - | A |
| 51 | Badagongshan | 1* | - | - | P1 | P | P | - | - | P2 | - | - | - | - | - | P | - | |
| 52 | Baotianman | 1 | - | - | - | P | P | - | - | P2 | - | - | - | - | - | - | - | |
| 53 | Changbaishan | 2 | - | L; SM; H; WD | P1 | P | P | P(p) | - | P1; P2 | - | - | - | - | + | P | - | + |
| 54 | Donglingshan | 1* | - | L; SM; H; WD | - | P | P | - | - | - | - | P1; P2; P3; P4 | - | - | - | - | - | |
| 55 | Gutianshan | 2 | - | L; SM; H; WD | P1 | P | P | P(p) | - | + | - | P1; P2; P3 | - | - | + | P | - | B |
| 56 | Tiantongshan | 1 | - | L; SM; H; WD | - | P | P | - | - | - | - | - | - | - | - | - | - | |

| # | Site | N tree censuses‡‡ | Lianas | Functional Traits§§ | Dendrometer Bands | Flower & Seed Production | Seedling Performance | DNA barcoding*** | Arthropods††† | Vertebrates | Airborne LiDAR | Dead Wood/ CWD | Fine Roots | Soil C | Soil Nutrients | Litterfall | Eddy Covariance‡‡‡ | Weather station§§§ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 57 | Zofin | 1(4) | - | + | - | - | + | P(p)* | - | - | + | P4 | - | + | + | - | - | A |
| 58 | Speulderbos | 1 | n/a | - | + | - | - | - | - | P2* | - | - | - | - | - | - | - | B |
| 59 | Wytham Woods | 2 | - | + | + | - | + | - | - | + | + | P1; P2; P3 | + | + | + | + | + | A |

‡‡ Number of censuses as of May 2014. Numbers in parentheses indicate total number of censuses including those prior to the sites adoption of the CTFS-ForestGEO core tree census protocol (i.e., censuses with any DBH cutoff and/or smaller plots). These include any in-progress survey.
§§ H: tree height; C: crown dimensions; L: leaf traits; SM: seed mass; WD: wood density; O: other
*** p- plants; a- arthropods
††† Arthropod measurements made using standardized CTFS-ForestGEO protocol are detailed in Table S7.
‡‡‡ Measured onsite or at a similar site within 10 km.
§§§ A- onsite or a similar site within 10 km that is believed to have similar climate; B- nearby (within 50km), believed to have similar climate (e.g., similar elevation, distance from coast); C- nearby (within 50km), believed to have dissimilar climate (e.g., dissimilar elevation, distance from coast); '-' no known weather station within 50km; N-NEON (future). P denotes CTFS-ForestGEO protocols described in Appendix S2.

**Table S7. Record of arthropod sampling at CTFS-ForestGEO sites.**
Entries below are no. of individuals/no. of species / no. of DNA sequences / taxonomic knowledge (coded as follows: 1 = work needed; 2 = reasonable; 3 = checklist complete or nearly so) as of November 2013.

| Protocol | Target taxa (order) | Guild | BCI | Khao Chong | Wanang | Yasuni | Hong Kong |
|---|---|---|---|---|---|---|---|
| Light traps | Passalidae (Coleoptera) | Wood eaters | 510 / 13 / 51 / 3 | - | - | - | - |
| | Platypodinae (Coleoptera) | Wood eaters | 662 / 19 / 56 / 2 | 959 / 24 / 0 / 1 | - | - | - |
| | Dynastinae (Coleoptera) | Scavengers | 1,556 / 24 / 52 / 2 | - | - | - | - |
| | Isoptera | Scavengers | 14,289 / 30 / 62** / 2 | 4,896 / 4 / 0 / 1 | - | - | - |
| | Flatidae (Hemiptera) | Sap-suckers | 1,855 / 28 / 97 / 3 | 311 / 20 / 0 / 1 | - | - | - |
| | Reduviidae (Hemiptera) | Predators | 971 / 51 / 65 / 1 | 100 / 6 / 0 / 1 | - | - | - |
| | Saturniidae (Lepidoptera) | Chewers (leaves) | 34 / 714 / 168 / 3 | - | - | - | - |
| | Geometridae (Lepidoptera) | Chewers (leaves) | 6,673 / 229 / 961 / 2 | 6,220 / 396 / 409 / 2 | - | - | Planned starting 2014 |
| | Arctiinae (Lepidoptera) | Chewers (leaves) | 8,875 / 160 / 812 / 2 | 4,394 / 174 / 34 / 1 | - | - | Planned starting 2014 |
| | Pyraloidea (Lepidoptera) | Chewers (leaves) | 11,253 / 339 / 832 / 1 | 7,412 / 445 / 103 / 1 | - | - | Planned starting 2014 |
| | Ecitoninae - alates (Hymenoptera) | Predators | 4,416 / 16 / 67 / 1 | - | - | - | - |
| | Apidae + Halictidae - nocturnal (Hymenoptera) | Pollinators | 2,904 / 23 / x / 2 | 140 / 5 / 0 / 2 | - | - | - |
| Winkler | Formicidae - litter (Hymenoptera) | Varia | 11,945 / 133 / 957 / 3 | 10,929 / 134 / 0 / 1 | Planned starting 2014 | 2,500/100/0/ 1 | - |
| McPhail traps | Tephritidae (Diptera) | Chewers (fruits) | - | 17,945 / 83 / 93 / 2 | Planned starting 2014 | - | - |
| Butterfly transects | Papilonoidea+Hesper | Chewers | 8,772 / 350 / | 3,567 / 280 / | 3,371 / 134 / | - | 73 / 28 / 0 / 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | iidae (Lepidoptera) | (leaves) | 1,282 / 3 | 404 / 2 | 651 / 2 | | |
| Termite transects | Isoptera | Scavengers | 2,598 / 13 / 62** / 2 | 2,268 / 35 / 0 / 2 | Planned starting 2014 | Planned starting 2015? | Planned starting 2015? |
| Bee baits | Apidae Euglossini (Hymenoptera) | Pollinators | 19,020 / 26 / 96 / 3 | - | - | - | - |
| Seed predation | Various in Lepidoptera, Coleoptera and Hymenoptera | Seed predators | 24,000 / ? / 1,148 / 1 | 1,373 / 90 / 0 / 1 | 4,626 / 23 / 0 / 1 | - | - |

** Total number of sequences for all Isoptera

**Table S8. Site-specific acknowledgments for selected CTFS-ForestGEO sites.**

| Site | Acknowledgements |
|---|---|
| Amacayacu | We thank the Staff of the National Natural Park of Amacayacu and the National System of Protected Areas of Colombia. |
| Badagongshan | Work at Badagongshan was supported by the National Natural Science Foundation of China (31270562) and the Chinese Forest Biodiversity Monitoring Network (29200931131101919). |
| Baotianman | The 25 ha Baotianman forest dynamics plot was funded by National Science and Technology Support Plan (2008BAC39B02), State Key Laboratory of Vegetation and Environmental Change (LVEC2011zyts01), the Natural Science Foundation of China (31070554, 31270642, 31370586), and Biodiversity Committee, Chinese Academy of Sciences. Thanks to hundreds of college students, graduate students, local workers, and researchers for their hard works. Thanks to State Key Laboratory of Vegetation and Environmental Change, Institute of Botany, the Chinese Academy of Sciences, Chinese Forest Biodiversity Monitoring Network, Henan Agricultural University, Nanyang Normal University, China University of Mining & Technology (Beijing), Pingdingshan University, and Baotianman National Nature Reserve for their cooperation and kind support. |
| Barro Colorado Island | The BCI forest dynamics research project was founded by S.P. Hubbell and R.B. Foster and is now managed by R. Condit, S. Lao, and R. Perez under the Center for Tropical Forest Science and the Smithsonian Tropical Research Institute in Panama. Numerous organizations have provided funding, principally the U.S. National Science Foundation, and hundreds of field workers have contributed. |
| Danum | The Danum plot is a core project of the Southeast Asia Rain Forest Research Programme (SEARRP). We thank SEARRP partners especially Yayasan Sabah for their support, and HSBC Malaysia and the University of Zurich for funding. We are grateful to the research assistants who are conducting the census, in particular the team leader Alex Karolus, and to Mike Bernados and Bill McDonald for species identifications. We thank Stuart Davies and Shameema Esufali for advice and training. |
| Harvard Forest | Funding for the Harvard ForestGEO Forest Dynamics plot was provided by the Center for Tropical Forest Science and Smithsonian Institute's Forest Global Earth Observatory (CTFS-ForestGEO), the National Science Foundation's LTER program (DEB 06-20443 and DEB 12-37491) and Harvard University. Thanks to many field technicians who helped census the plot. Jason Aylward was instrumental as a field supervisor and with data screening and database management. Thanks to John Wisnewski and the woods crew at HF for providing materials, supplies, and invaluable field assistance with plot logistics. Joel Botti and Frank Schiappa provided survey expertise to establish the 35-ha plot. Special thanks to Stuart Davies and Rick Condit for field training, database assistance, and plot advice. Sean McMahon and Suzanne Lao were extremely helpful with field planning, data questions, and many plot logistics. Thanks to Jeannette Bowlen for administrative assistance and |

| Site | Acknowledgements |
|---|---|
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