Forest Carbon database (ForC-db)

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Database overview:

The Forest C database (**ForC-db**) is an open access global C database that is updated and maintained on Github (https://github.com/forc-db). The database contains data on ground-based measurements of ecosystem-level C stocks and annual fluxes in forests globally, along with site information, disturbance history, and information on methodology. The Tropical Forest C database (**TropForC-db**) is the tropical component of ForC-db, which has been published in the peer-reviewed literature (Anderson-Teixeira et al. 2016). At present, this is the only publicly available portion of ForC-db, but additional data (both tropical and extra-tropical) have been compiled and will eventually be made publicly available (interested users may contact database PI Dr. Kristina Anderson-Teixeira to discuss collaboration). Moreover, we anticipate database growth as other investigators contribute to the database.

The structure of ForC-db is derived from that of BETY-db (www.betydb.org; LeBauer *et al.*, 2010). In brief, the database consists of a series of cross-referenced data tables describing (1) sites, (2) plots and their history, (3) measurements of C cycle variables, (4) variables, (5) disturbance/history event type, (6) plant functional types (PFTs)/ species, (7) methodology, and (8) allometries. Original citations associated with all data are given in the measurements table (3), and a full bibliography may be found in the file "TropForC_bibliography.pdf". Sample R code, showing how to load the data files into R and join the tables, is provided in a separate file, named "TropForC_Rcode.txt".

Throughout the database, missing data were coded to indicate the reason for the missing values (Table 1).

References:

Anderson-Teixeira, K.J. et al. **2016**. Carbon dynamics of mature and regrowth tropical forests derived from a pantropical database (TropForC-db). *Global Change Biology.* doi: 10.1111/gcb.13226

LeBauer D, Dietze M, Kooper R, Long SP, Mulrooney P, Rhode GS, Wang D (2010) Biofuel Ecophysiological Traits and Yields Database (BETYdb). *Energy Biosciences Institute, University of Illinois at Urbana-Champaign.* doi:10.13012/J8H41PB9

Olson DM, Dinerstein E, Wikramanayake ED et al. (2001) Terrestrial Ecoregions of the World: A New Map of Life on Earth. *BioScience*, **51**, 933.

Data Use:

ForC-db is an open access database, and we encourage use of the data for scientific research and educational purposes. All users are responsible to adhere to the data use policy: DATA USE POLICY.md (https://github.com/forc-db/TropForC/blob/master/DATA%20USE%20POLICY.md).

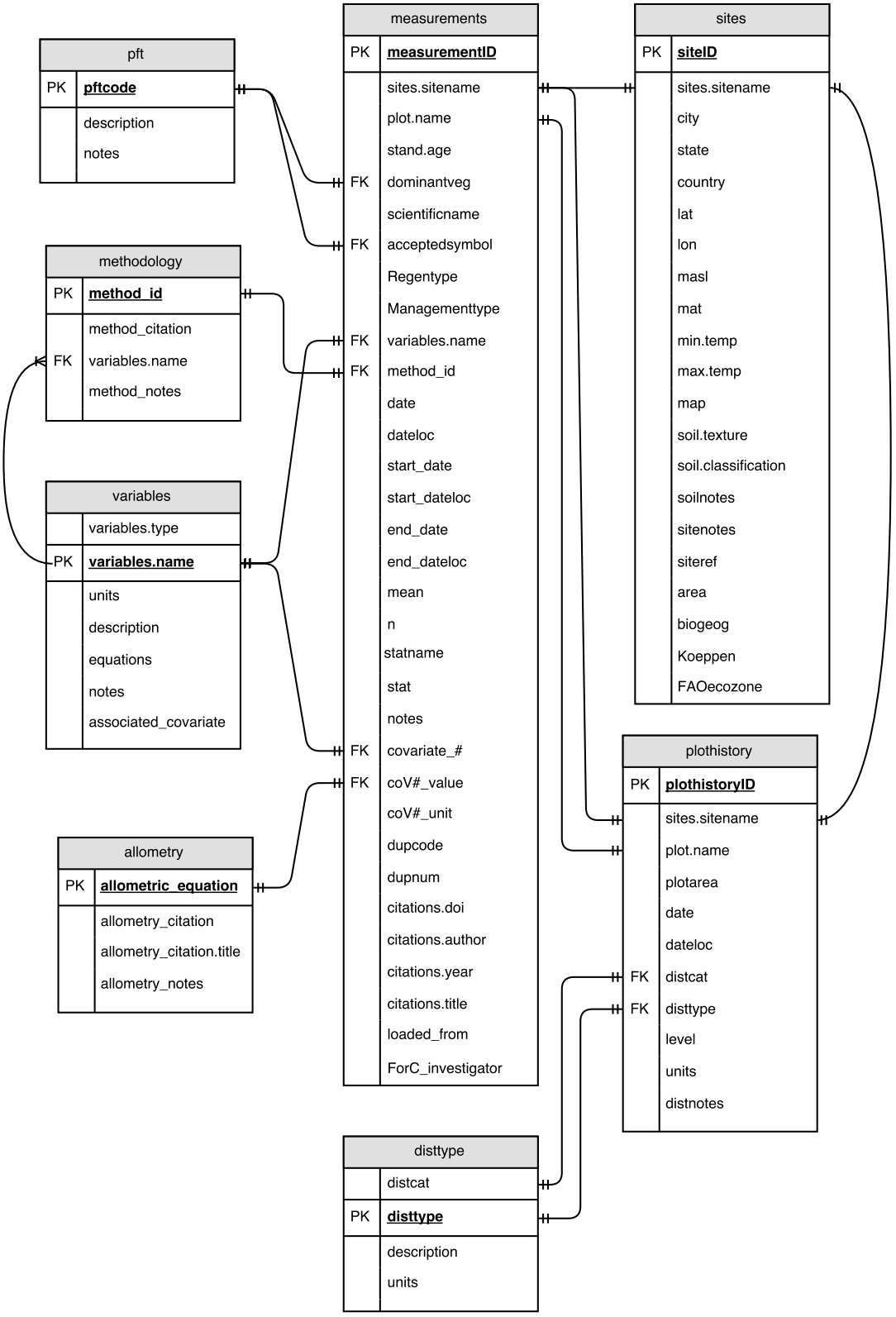
Contributing to the database:

We anticipate that ForC-db will be of great value for various initiatives seeking to understand and manage the role of tropical forests in the global C cycle, and we encourage authors to contribute data. Please see CONTRIBUTING.md(https://github.com/forc-db/TropForC/blob/master/CONTRIBUTING.md).

Overview of database structure and data files:

Data file	Description	Links to other data files
(1) '**sites**' TropForC_sites.csv	Geographic, climatic, and edaphic site data	(2) and (3)
(2) '**plothistory**' TropForC_plothistory.csv	Known history of each plot or set of replicate plots	(1), (3), and (5)
(3) '**measurements**' TropForC_measurements.csv	Records of ecosystem-level measurements relevant to C cycling	(1), (2), (4), and (6)
(4) '**variables**' TropForC_variables.csv	Definitions of C cycle variables and covariates.	Defines codes for columns 'variables.name', 'covariate_1', 'covariate_2', and 'covariate_3' in (3).
(5) '**disttype**' TropForC_disttype.csv	Definition of disturbance, management or regeneration history event types.	Defines codes for column 'disttype' in (2)
(6) '**pft'** TropForC_pft.csv	Definitions of plant functional codes.	Defines codes for columns 'acceptedsymbol' and 'dominantveg' in (3)
(7) '**methodology**' TropForC_methodology.csv	Description of methodologies.	Defines codes for column 'method_id' in (3)
(8) '**allometry'** TropForC_allometry.csv	Sources and description of allometric equations	Defines codes for the covariate 'allometric_equation' in (3)

Entity Relationship Diagram for ForC-db:



Note: Diagram can be edited at the following public link (anyone with the link can edit)
https://drive.google.com/file/d/0B9F3sC2fKyd3WS1lZzcwYXd4UmM/view?usp=sharing

Data File Contents:

(1) TropForC_sites.csv - '**sites**'

Column	Description	Units
siteID	Unique numerical identifier for each record in the sites table.	-
sites.sitename	Site identifier, sufficient to uniquely identify the site within the paper. Links to **plothistory** and **measurements** tables.	-
city	Nearest city	-
state	State	-
country	Country	-
lat	Latitude in decimal form	-
lon	Longitude in decimal form	-
masl	Elevation (meters above sea level) (reported)	m
mat	Mean annual temperature (reported)	°C
min.temp	Mean temperature of the coldest month (reported)	°C
max.temp	Mean temperature of the warmest month (reported)	°C
map	Mean annual precipitation (reported)	mm
soil.texture	Categorical variable describing soil texture, based on % sand-silt-clay. When original publication reports % sand-silt-clay, classification follows USDA soil classification.	-
soil.classification	Soil classification (USDA soil taxonomy or FAO soil classification)	-
soilnotes	Soil details not included above	-
sitenotes	Site details not included above	-
siteref	References—in addition to those associated with measurement data—used to obtain site data. When all site data were obtained from references associated with measurement data, this field is populated with 'NA'.	-
area	Groups sites that are geographically proximate and edaphically similar. Defined as a group of sites where no site is removed from the rest in its group by >0.25 degrees latitude or longitude. Note that groupings are subject to change. As of February 2017, all values were for the set of sites published in Anderson-Teixeira et al. (2016).	-
biogeog	Biogeographical region, extracted from map of Olson *et al.* (2001)	-
Koeppen	Köppen-Geiger classification, extracted from the ESRI Köppen-Geiger map (http://www.arcgis.com/home/item.html?id=7a53584fa55643df969f93cec83788e1).	-
FAOecozone	FAO global ecological zones classification, extracted from FAO's GeoNetwork (http://www.fao.org:80/geonetwork).	-

(2) TropForC_plothistory.csv - '**plothistory**'

Column	Description	Units
plothistoryID	Unique numerical identifier for each record in the history table.	-
sites.sitename	Unique site identifier, sufficient to identify the site within the original publication. Links to **sites** and **measurements** tables.	-
plot.name	Unique plot name, sufficient to identify the plot within the original publication.	-
plotarea	Area of plot or combined area of replicate plots.	ha
date	Date of plot history event.	-
dateloc	Level of confidence in date (codes given in Table 2).	-
distcat	Plot history event categories, namely 'Disturbance' (includes natural and anthropogenic disturbances, management), 'Establishment', 'No.info' (data not available), and 'Regrowth'.	-
disttype	Plot history event types. See **disttype** table for code definitions.	-
level	Intensity/frequency/amount applied of history event type, if available.	-
units	Level units.	-
distnotes	History event details not included above.	-

(3) TropForC_measurements.csv - '**measurements**'

Column	Description	Units
measurementID	Unique identifier for each record in the measurements table.	-
sites.sitename	Unique site identifier name for the site at which the measurement was made. Links to **sites** and **plothistory** tables.	-
plot.name	Unique plot identifier name for the plot in which the measurement was made. Links to **plothistory** table.	-
stand.age	Age of stand in years as reported in the original publication or calculated based on the date of initiation of forest regrowth. When the publication reports a range of ages, the mean is recorded. For primary/old-growth/mature/ intact stands, the stand.age is recorded as "999".	-
dominantveg	Code used to identify plant functional trait of dominant vegetation (≥80% dominance, if given). Identical to **acceptedsymbol** for multi-species forests. For plantations, this is the appropriate **pftcode** based on the planted species.	-
scientificname	Genus and species for single dominant species, if applicable (plantations only).	-
acceptedsymbol	Acronym for plant functional type (pft; multi-species stands) or species listed in scientificname (monospecific stands—i.e., plantations). Plant functional type code, **pftcode**, is as defined in the the **pft** table. For single species, species name acronyms are as listed in the USDA Plants Checklist (http://plants.usda.gov/dl_all.html), or listed as 'nocode' if not available for the species.	-
Regentype	Regeneration type of plot, as follows: natcult – Natural regeneration following cultivation natgrazed – Natural regeneration following grazing natother – Natural regeneration following other forms of disturbance plantation – Plantation/regeneration by planting or sowing nodata – Missing data or none of the above	-
Managementtype	Indicates if the plot is unmanaged ("UM"), managed ("M") or other/unknown ("O").	-
variables.name	Code name for variable sampled. Codes defined in **variables** table.	-
method_id	Code number for methodology. Codes defined in **methodology** table.	-
date	Date on which measurement was made. Usually found as the year of measurement in the methods section, or, when unavailable, approximated as the year before publication.	-
dateloc	Level of confidence in date. See Table 2 for codes behind level of confidence.	-
start_date	Date on which measurements were started.	-
start_dateloc	Level of confidence in date. See Table 2 for codes behind level of confidence.	-
end_date	Date on which measurements ended.	-
end_dateloc	Level of confidence in date. See Table 2 for codes behind level of confidence.	-

Column	Description	Units
mean	Mean value of measurement recorded. Units dependent on **variables.name**. See **variables** table for the associated units.	as defined in variables table
n	Number of experimental replicates used to estimate mean and statistical summary.	-
statname	Name of reported statistic (SE- standard error; SD- standard deviation; 95%CI- 95% confidence interval).	-
stat	Value of reported statistic.	-
notes	Details of study.	-
covariate_#	Code name for covariate associated with the variable being measured. Codes defined in **variables** table.	-
coV#_value	Value of reported covariate.	-
coV#_units	Units of reported covariate.	-
dupcode	Marks entries that meet one of the following criteria: - Duplicate estimates of the same variable but with different values (**code D** for duplicate) - Replicate sampling of the same variables within the same study (**code R** for replicate) - Multiple estimates of the same variables within the same study but using different methods (**code M** for different measurement methods) - Does not have a duplicate (**code 0** for no duplicates)	-
dupnum	Assigns a number to every entry in each set of duplicates/replicates, in chronological order according to the citation.year. If two sources were published in the same year, the primary source (as opposed to a synthesis) comes first.	-
citations.doi	Digital object identifier unique to original data publication, if available. Studies relying on data from ≤20 original publications contained within the database should cite those publications.	-
citations.author	First author's last name of original data publication. Studies relying on data from ≤20 original publications contained within the database should cite those publications.	-
citations.year	Year of original data publication. Studies relying on data from ≤20 original publications contained within the database should cite those publications.	-
citations.title	Complete title of original data publication. Studies relying on data from ≤20 original publications contained within the database should cite those publications.	-
loaded_from	Reference to data compilations from which data and reference to primary source were obtained, if applicable. Studies relying on data from ≤10 previous data compilations contained within the database should cite those publications.	-
ForC_investigator	Name, institution, and email address of the investigator responsible for creating the database record (*i.e.,* the corresponding author for the database record). This is the individual who should be contacted with correspondence regarding that record (*e.g.,* questions, corrections, requests for collaboration).	-

(4) TropForC_variables.csv - '**variables**'

Column	Description	Units
variables.type	Variable type, where "primary" refers to a carbon cycle variable, "secondary" refers to a variable recorded because it can influence carbon cycle variables, and "covariate" refers to a variable required to interpret carbon cycle variables.	-
variables.name	Code name for variable sampled. Used in **measurements** table.	-
units	Units of the variable.	-
description	Definition and notes about the variable.	-
equations	Equations describing relationships among variables. Parentheses indicate variables that are not included in the current database version.	-
notes	Notes of relevance to interpreting variables.	-
associated.covariate	Covariates associated with the variable listed. The codes for these covariates are also defined in this table.	-

(5) TropForC_disttype.csv - '**disttype**'

Column	Description	Units
distcat	Plot history event categories, i.e. Disturbance (includes natural and anthropogenic disturbances, management), Establishment, No.disturbance, No.info (data not available), Regrowth. Used in **plothistory** table.	-
disttype	Code name for plot history event types. Used in **plothistory** table.	-
description	Definition and notes about the disturbance, management, or regeneration type.	-
units	Units of the variable.	-

(6) TropForC_pft.csv - '**pft**'

Column	Description	Units
pftcode	Code name for plant functional traits. Used in **measurements** table. Codes match those in BETY-db (LeBauer *et al.*, 2010).	-
description	Definition of the **pftcode**.	-
notes	Details.	-

(7) TropForC_methodology.csv - '**methodology**'

Column	Description	Units
method_id	Code name for methodology. Used in **measurements** table.	-
method_citation	Reference for the methodology used.	-
variables.name	The type of variable for which the methodology is described. May not exactly correspond to variables.name in **variables** table, as similar variables may be grouped together.	-
method_notes	Description of the methodology used.	-

(8) TropForC_allometry.csv - '**allometry**'

Column	Description	Units
allometric_equation	Code name for allometric equation. Used in **covariate** field in **measurements** table.	-
allometry_citation	Author name and year of publication describing the allometries.	-
allometry_citation.title	Title of reference for the allometries.	-
allometry_notes	Description of the allometries used.	-

Additional Tables:

Table 1. Missing data codes

Code	Definition	Description
NA	Not Applicable	-
NAC	Not Acquired	Information may be available but has not been acquired.
NRA	Not Readily Available	Information was not readily available to the authors (e.g., publication not readily available).
NI	No Information	Publication does not contain the required information.

Table 2. Date level of confidence (**dateloc**) numbering convention, used in **plothistory** and **measurements** tables. Adapted from Table 4 in the BETY-db Data Entry Workflow (available at URL: https://www.authorea.com/users/5574/articles/6800; LeBauer *et al.*, 2010).

Dateloc*	Definition
9	nodata
8	year
7	season
6	month
5	day
4	time of day

* When the dateloc is followed by '.5', it indicates that a range of dates (year/month/day) were given; e.g. "late 1990s" would be given a dateloc of 8.5 for the year "1999".

Database citations:

Anderson-Teixeira, K.J. et al. **2016**. Carbon dynamics of mature and regrowth tropical forests derived from a pantropical database (TropForC-db). *Global Change Biology*. http://dx.doi.org/10.1111/gcb.13226

Anderson-Teixeira, K.J. et al. **2016**. Data from: Carbon dynamics of mature and regrowth tropical forests derived from a pantropical database (TropForC-db). Dryad Digital Repository. http://dx.doi.org/10.5061/dryad.t516f