GlobAllomeTree

Tutorial for the Fantallometrik Software

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Contents

1. Context

Assessment of volume, biomass and carbon stocks for trees and forests is a complex process because of the limited availability of field data and allometric models. Field data relate mostly to temperate forests or forest concessions in tropical forests. National forest inventories exist in tropical zones, but their analysis is hampered by the availability of models and their repeatability by the financial, technical and human capacities. Allometric models allow the estimation of variables that are difficult to measure such as volume or biomass from easy-to-measure parameters such as the diameter or tree height. However, access to the allometric model is limited due to their mode of publication (often in the scientific and grey literature, located in restricted access websites and libraries). Moreover, it appears that the allometric equations are not systematically verified and controlled and that significant errors may be present. It also appears that for a given species or an ecological zone, different equations may be available. It is therefore difficult to identify the most adequate equation to reach the purpose of the inventory and compartments of trees to consider.

2. Objectives

To facilitate the calculations of volume, biomass and carbon stocks, the software Fantallometrik © was developed. This is a flexible software that integrates most of allometric equations and field data to optimize the calculations of forest variables. It allows comparison and selection of allometric equations, make calculations for tree volume, biomass and carbon stocks by compartment and insertion of new equations for updating databases. The input data can be those provided with the software or user-specific.

3. Structure

The software was developed using the deploytool tool[1] made available for noncommercial use by Mathworks. The software Fantallometrik contains three main modules. The first module allows the comparison of allometric equations contained in the database or the default one provided by the user. The selection of equations can be made using a range of filters including the source, geographic location, mathematical forms , sampling (number, species etc..). The second module allows calculation of volume, biomass and carbon stocks using selected allometric equations. It also allows the statistical analysis and comparison of results obtained with the default data proposed by IPCC (2006) [2]. The third module allows the insertion of new allometric equations in existing databases or create new databases for the allometric

[1] http://www.mathworks.it/help/toolbox/compiler/deploytool.html

[2] IPCC, *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, 2006.

equations. The three modules contain functions of quality control to facilitate the selection and verification of the calculations.

The software uses TXT files to avoid problems with different operating systems and software development.

4. Installation

The size of the file Fantallometrik_pkg.exe is less than 200MB. It allows the extraction of three other files. Fantallometrik.exe is the file that allows access to the software. The files Fantallometrik.ctf and MCRInstaller.exe allow the software to work without the installation of MATLAB[3]. To specify the user must also copy the files described in paragraph 0 in the same folder as the software.

At the first use of the software, a window appears to define the dimensions of the screen. The size of software windows will automatically adjust the size of the computer screen.

"Insert width of screen": for example 1280 (pixel)

"Insert height of screen": for example 800 (pixel)

5. Preliminary steps

5.1. The welcome page

In the welcome page you can choose the module you want to use. The three modules are:
1) Comparison of allometric equations
2) Assessment of volume, biomass and carbon stocks
3) Insert new equation into the database

From the menu on the top the user can modify the size screen using «***resize screen size*** » or can automatically connect to the website www.globallometree.org by clicking on «***visit web site***». GlobAllomeTree is an internet platform developed jointly by FAO, UNITUS and CIRAD that provides tree allometric equations databases and facilitates the access to all the information related to tree allometric equation development.

[3] MATLAB (matrix laboratory) is a numerical computing environment and fourth-generation programming language. Developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java, and Fortran.

5.2. Upload the input files

Before doing the calculations relative to the comparison of allometric equations or volume, biomass and carbon stocks assessment, the files containing the databases for the allometric equations, wood density, data for the comparison of input parameters (in the case of the comparison module) and the field data (in the case of the assessment module), must be uploaded into the software.

5.2.1. Upload default allometric equation database

Import the database containing the allometric equations using the function «***import database allometric equation***». Databases containing allometric equations are prepared either by following the protocol developed for this purpose[4], either directly from software's module "Insert new equation". The database contains 72 fields[5]. Some fields are essential to the proper functioning of the software, others are not. The structure is presented in appendix 10. The file is named DB-*.csv (name can be one of the area or continent).

5.2.2. Upload wood density values

Import the database containing the wood densities. The calculation of biomass from volume equations is performed by multiplying the volume (m^3) by the wood density (Mg/m^3). The structure of the file is presented in appendix 11. The file is named WD-*.csv (the name can be e.g. the location, or the continent).

5.2.3. Upload input file (module comparison)

Import database containing information for comparing allometric using different input parameters[6]. The "input data" file is a comparative table that allows the estimate of relevant

[4] Baldasso, M., Birigazzi L., Henry, M. (2012) Tutorial for tree allometric equation database development, version 4, p.27.

[5] ID, Population, Ecosystem, Continent, Country, ID_Location, Group_Location, Location, Latitude, Longitude, Biome_FAO, Biome_UDVARDY, Biome_WWF, Division_BAILEY, Biome_HOLDRIDGE, X, Unit_X, Z, Unit_Z, W, Unit_W, U, Unit_U, V, Unit_V, Min_X, Max_X, Min_Z, Max_Z, Output, Output_TR, Unit_Y, Age, Veg_Component, B, Bd, Bg, Bt, L, Rb, Rf, Rm, S, T, F, ID_Species, Genus, Species, Family, Group_Species, ID_Group, Equation, Sample_size, Top_dob, Stump_height, ID_REF, Label, Author, Year, Reference, R^2, R^2_adjusted, Corrected_for_bias, RMSE, SEE, Bias_correction, Ratio_equation, Segmented_equation, Substitute_equation, IDequation, Contributor, Name_operator

[6] DBH, As, C, BCA, BD, Cb, Cb5, C10, C20, C30, C180, D20, D30, WD, CD, CA, H, Hd, CV, Vs, CH, Ht, Hme, R, CR, Yr, BA, C2, C3_2, C3_8, C5, C50, C6, C_LT_3.2, C_LT_6, DRC.

tree dendrometric variables from the measured tree variables provided by the user in the "field data" file. As the user's field data database contains only dbh (or, alternatively, the other above mentioned mandatory input data) the software may need to convert these variables into others, such as, basal area, circumference or tree height.This information allows application to the inventory data of the equations of which the input variable is different from the ones provided in the field data file. The formulae used to convert those values are presented in appendix 4. If the user wants to use different formulae, or different hypsometric relationships, can develop his own "input data file" while respecting the structure of the original file. The structure is presented in appendix 12. The file is named variables-*.csv (the name can be e.g. the location, or the continent).

5.2.4. Upload input data file (module assessment)

Field data can be uploaded from the software. The software is flexible when considering the structure of the field data. The input variables must necessarily contain the weight (weight: number of individuals for a total area of one hectare), location (Location: Name of the plot), the name of the Genus (Genus), the name of the species (species) and one or more variables dendrometric (DBH: diameter at 1.30m, BA: basal area, C: circumference, CD: crown diameter, H: height). If the height is not specified in the file, it will be automatically calculated using the formula of Brown and Gillesie (1989) [7]. The position of the parameters in the file may vary and the software will automatically identify the variable (the acronyms must be respected). It is important that the user be careful when inserting the scientific names of species measured. Indeed, the identification of wood densities will automatically based on the name of Genus and species. If the species does not have a measured wood density value in the database or if the name is wrong, a default wood density value is assigned. The file structure is presented in appendix 13. The input-file is named input-*.csv (name can be one of the area or continent).

6. Module 1: Comparison of tree allometric equations

The module 1 allows the comparison of allometric equations found in the allometric equation database (section 5.2.1), according to the information provided by the wood density database (see section 5.2.2), and by the input file (see section 5.2.3). Remember that the input file allows the comparison of the input variables.

6.1. Display imported data

[7] S. Brown, A. J. R. Gillespie, and A. E. Lugo, "Biomass estimation methods for tropical forest with application to forest inventory data," *Forest Science*, vol. 35, pp. 881-902, 1989.

Once the data for the database containing the allometric equations, the densities of wood and variable inputs are downloaded by the software, you can start displaying the data and selecting the equations using proposed filters.

After choosing the tree components, information regarding the updated database can be showed using the menu «***show information***». The «***allometric equation database***» allows displaying the allometric equations, «***wood density data***» the wood densities, «***input data***» the input variables.

6.2. Filter and select the equations

The first filter concerns the selection of the tree compartment(s) and is achieved using the menu «***Tree Component***». The user selects the compartment(s) to be analyzed using Figure 1. Once the compartments are selected, it is possible to use the other available filters.

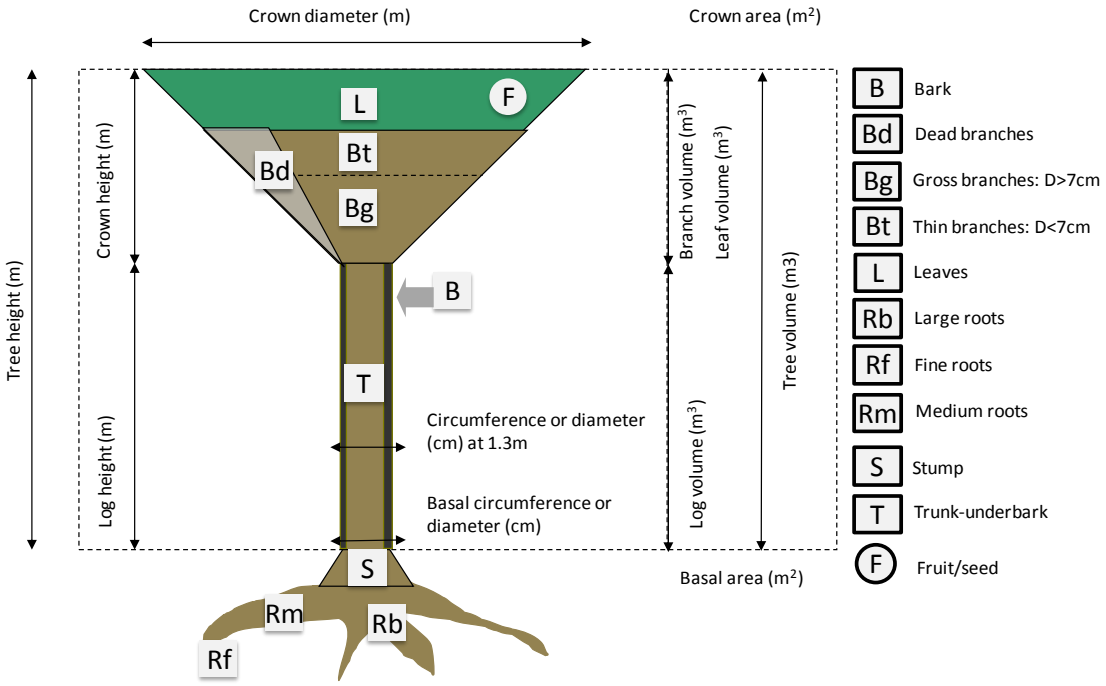


Figure 1: tree components

Other available filters are available by clicking on the menu "***filter database***". The menu contains the following functionalities:

«***Reset filter***»: allows cancelling selected filters;

«***Show filter***»: allows viewing selected filters;

«***ID equation***»: allows selecting the equations based on the ID equation;

«***Population***»: allows selecting the equations based on the population (Tree, Stand, etc…);

«***Ecosystem***»: allows selecting the equations based on the ecosystem (forest, plantation etc…);

«***Geographic***»: allows selecting the equations based on the geographical location (country, locality, locality group, continent) or geographical coordinates (lat / long);

«***Ecological zone***»: allows selecting the equations based on five ecological classification (Udvardy, FAO, WWF (Olson), Bailey, Holdridge). Ecological zones are represented in the Appendix;

«***Input variables***»: allows selecting the equations based on input variables (X, Z, W, U, W);

«***Threshold variables***»: allows selecting the equations based on thresholds of the input variable X, usually the diameter 1.30m or variable Z;

«***Output Equation***»: allows selecting the equations based on output of equation (volume, biomass etc…);

«***Age***»: allows selecting the equations depending on stand age selected to develop the allometric equation. Few equations contain this information;

«***Genus/Species***»: allows selecting the equations depending on the species and genus or group of genus species;

«***Reference***»: allows selecting the equations based on the reference of the original document (author, year);

«***Statistic parameters***»: allows selection according to the sample size < 5, > 10,> 20, > 30, > 100 and the correlation coefficient (R^2);

«***Other***»: allows selection of the equations according to «***top d.o.b***»[8], «***stump height***»[9], «***corrected for bias***»[10], «***ratio equation***»[11], «***segmented equation***»[12].

[8] For equations that include a portion of the merchantable stem, the minimum diameter outside bark (d.o.b.) of the top of the merchantable stem is indicated.

[9] For equations that predict the biomass of any component that includes the tree stem or the stump, this variable corresponds to the estimated or measured stump height.

[10] means that the original authors developed and reported a correction factor to compensate for the potential underestimation resulting from backtransforming logarithmic predictions to arithmetic units.

[11] Some authors presented methods for predicting the biomass of the merchantable stem to a user-defined top diameter. This variable means that a separate ratio equation was presented Table 7

[12] Some authors presented paired equations for the same species such that one equation was applicable at the lower end of the diameter range and a second equation was applicable at the upper end of the range. This variable means that the equation is one-half of a segmented equation; its companion equation for the same species will have the same author and regression statistics but will be applicable over a different diameter range.

6.3. Display graphics and results

In the menu «***plot***» nine functions allows you to do graphics and modify them if necessary.

«***Apply equation***»: performs the graph representing the estimate of the selected variable (biomass default biomass) using the different allometric equations selected. One color is assigned for each curve.

«***Set X Label***»: to change the X axis. You can select the following input variables: DBH, C, H and Crow Diameter.

«***Set Y Label***»: to change the Y axis. You can select the output variables as follows: Volume, Biomass, Carbon, CO2.

«***Set X Limit***»: to change the X axis and zoom in on a particular part of the graph.

«***Set Y Limit***»: to change the Y axis and zoom in on a particular part of the graph.

«***Display results***»: can view the results as a table.

«***Add legend***»: adds the legend indicating the identification number of each equation.

6.4. Verification and quality control

It is possible that the values calculated from allometric equations are not exact[13]. Indeed, some equations may be incorrect or the ranges of validity are not mentioned in the original document. Also, the tool «***Quality control***» eliminates values thought to be impossible:

- When the biomass decreases as the diameter increases (eliminating values below and above the median)

- When biomass is negative

- When the values are twice the average biomass or volume.

«***Show Max/Min***»: displays the minimum and maximum values calculated by the equations.

«***Show Mean***»: displays the average value calculated by equations.

[13] M. Henry, N. Picard, R. Manlay, R. Valentini, M. Bernoux, and L. Saint-André, "Estimating tree biomass of sub-Saharan African forests: a review of available allometric equations," *Silva Fennica Monographs*, vol. 45, pp. 1-94, 2011.

The user can use the function «***display results***» in the menu "***plot***" to view the corrected results.

6.5. Descriptive Statistics

The function «***Descriptive statistics*** » shows the values of some relevant statistic parameters (sample size, minimum and maximum, mean, median, mode, standard deviation and range e range) for Volume, Biomass and Carbon stocks.

6.6. Additional functions

You can right click on a graph to modify it. Right clicking gives the following functionality:

«***Delete line***»: eliminates the curve of the graph

«***Show Information***»: is used to display information about the selected curve

«***Show Values***»: displays the values of the selected curve

«***Change color***»: change the color of the curve

It is also possible to modify the information of the legend by right-clicking on the legend (which appears by using the «**Plot / Add legend**»**).** Right clicking gives the following functionality:

«***Refresh***»: to update the legend;

«***Delete***»: to erase the legend;

«***Color***»: to change the colors of the legend;

«***Edge color***»: to change the color of the legend frame;

«***Line width***»: to change the frame width;

«***Font***»: to change the font characters;

«***Interpreter***»: to select the format latex, tex or none;

«***Location***»: to change the layout of the legend

«***Orientation***»: to change the orientation of the legend

«***Show Property Editor***»: to view the property editing

«***Show M-Code***»: to view the M-Code

6.7. Save the data obtained

Once the results are obtained, it is possible to save them using in the menu «***file***» the functions «***save results***» and «***save plot***». The function «***save results***» allows you to save the selected equations in format .txt. The « ***save plot*** » allows saving the graphics and finalizing their edition.

7. Module 2: Assessment of volume, biomass and carbon stocks

The second module allows the calculation of volume, biomass and carbon stocks from inventory data field. Field data are imported following the instructions given in paragraph 5.2.4.

7.1. Import, view and filter the selected data

Once the files containing the allometric equations, the wood densities and field data are imported, using the indications provided in paragraphs 5.2, it is possible to use the menu and other functions.

The menu «***Display information***» allows viewing of imported data (allometric equations, wood densities, field data and Species Frequency).

The menu «***Tree component***» to select the compartments to be considered in calculations.

The menu «***filter database***» can filter the allometric equations. The functions in this menu are described in Section 6.2 are identical to the menu and comparison of allometric equations.

7.2. Display histograms

The menu «***plot***» contains three functions. The function «***Apply equation***» can view the results as a histogram. Once the histograms are made, it is possible to change the Y axis variable depending on the desired output (volume: m3/ha, biomass: Mg[14]/ ha or carbon stock: Mg / ha). The Y axis can be modified using the function «***set Y label***». The function «***display result***» allows the visualization of results as a table.

[14] Megagrammes ou tones par hectare.

7.3. Quality control

The menu «***quality control***» has two functions. The function «***Apply_QC***» removes the data following the principles described in section 6.4. The function «***IPCC reference values*** » allows the visualization of default data found in the IPCC[15]guidelines. The default data will be selected based on desired classifications and ecological zones.

7.4. Obtain descriptive statistics

The menu «***Descriptive statistics***» provides statistical data and contains four functions. The function «***Volume*** » provides descriptive statistics for the volume. The function «***Biomass***» gives descriptive statistics on biomass. The function «***Carbon***» provides descriptive statistics relating to the carbon stock. The function «***Biodiversity***» assesses the following biodiversity index: S: number of species, Margalef, Shannon, Evenness, Simpson Reciprocal Simpson, Simpson (1-D) Reciprocal Berger Parker.

Number of species:

$$S = \sum_{i=1}^{n} species_i$$

Margalef:

$$D_M = \frac{(S-1)}{\ln(N)}$$

Shannon:

$$H_s = -\sum_{i=1}^{n} (p_i * \ln(p_i))$$

Evenness:

$$E = \frac{H}{\ln(S)}$$

Simpson:

$$D_s = \sum_{i=1}^{n} (p_i)^2$$

Reciprocal Simpson:

[15] IPCC, *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, 2006.

$$D_{rs} = \frac{1}{D_s}$$

Simpson (1-D):

$$D_s(1-D) = 1 - \sum_{i=1}^{n} (p_i)^2$$

Reciprocal Berger Parker:

$$RBP = \left(\frac{N_{\max}}{N} \right)^{-1}$$

7.5. Compare with a new allometric equations

The menu «***Customize***» contains three functions. The function «***Add my Equation***» allows the user to insert a new equation that does not exist in the allometric equation database. The function is described in Module 3 presented in Section 8. The function «***Remove My equation***» eliminates the equation inserted. The function «***Modify Database Information***» allows modifying the equations in the allometric equation database directly.

7.6. Additional functions

You can right click on the histograms to modify them. Right clicking gives the following functionalities:

«***Delete line***»: to eliminate the selected histogram;

«***Show Information***»: to display the information of the histogram;

«***Show values***»: to display the values of the histogram;

«***Change color***»: to change the color of the histogram.

7.7. Save the results obtained

Once the results obtained it is possible to save them using the menu «***file***» functions «***save results***» and «***save plot***». The «***save results***» allows you to save the results in format .txt. The function «***save plot***» allows saving the graphics and finalizing their edition.

8. Module 3: Insert new allometric equations

This module allows the insertion of new equations. First, the user must define the file where to insert the new equation. The .txt file can be the file containing already existing database or a new file. The name of the file must start with DB-*.txt.

A window appears, the left figure shows the fields to be filled and the right figure the data already inserted. "Na" means that the data have not yet been entered. If the user decides to use an existing database, a new identification number is automatically allocated.

Required fields are and their description is available in Appendix 10:

«***Population***»: a drop-down menu allows the user to select sprout, stand, tree. However, the user can create a new field if desired;

«***Ecosystem***»: identifies the type of ecosystem: Forest, plantation, etc. You can add other types of ecosystems;

«***Location***»: to specify the name of the locality or has been performed the allometric equation;

«***Coord. & Ecol. Zone***»: allows the integration of geographic coordinates using the following formats: DMS[16], DDD MM. MMMM[17], Decimal. The software automatically identifies the ecological zone classification for the following: WWF, FAO, Udvardy, Holdridge and Bailey[18] and the country. If the coordinates are wrong, "na" is allocated to the fields of ecological zones and countries. If the coordinates are not available, it is possible to directly identify the ecological area or country. If the user has doubts about the geographical coordinates, we recommend using GoogleEarth ©;

«***Input var and Equation***»: to select the input variables and to insert the equation. The user must select one of the variables and the respective unit previously inserted.

«***Genus/species***»: to identify the species and genus;

«***Reference***»: to identify the original reference of the equation;

«***Age***»: to identify the age of trees used to develop the equation;

«***Statistical parameter***»: to insert the statistical parameters such as number of samples and correlation coefficient;

«***Other***»: correspond other relevant parameters

«***Tree component***»: to identify the tree compartments measured.

[16] Degree, Minute, Second coordinate e.g.: N61° 11' 05.5", W130° 30' 10.0"

[17] Degree, Minute coordinate e.g. N41° 52.736, W087° 38.185.

[18] More information on selected ecological classification are available on the website of the European project Carboafrica http://www.carboafrica.net/data_en.asp

«***ID equation***»: the user can select a equation to database and modify it. New equation have a new ID.

9. Conclusion

The three modules allow the selection of allometric equations, the assessment of the forest variables of interest and insert new equations if necessary. To help improve the performance of calculations and the software, users are encouraged to review the software and contribute to the improvement of databases for allometric equations, but also the wood density and input databases.

10. Appendix 1: description of the structure of the database for allometric equations

N.	FIELD	DESCRITPION	EXAMPLES	Notes
1	ID	Identification number of the allometric equation. Each equation has its own ID reference, two different equations cannot have the same ID.	1188	a. c.
2	Population	Lianas: woody climbing plants mainly of tropical forests; Mangroves: evergreen trees or shrubs of tropical forests, having prop roots and stems and forming dense thickets along tidal shores; Sprout: is a shoot which grows from a bud at the base of a tree or from a shrub or from its roots; Stand: contiguous area that contains a number of trees; Tree: woody plant having a main trunk and usually a distinct crown.	Tree	a.
3	Ecosystem	Forest Plantation	Forest	a.
4	Continent	Name of the continent where the equation was developed	Africa	a.
5	Country	Name of the country using the GAUL nomenclature (Global Administrative Unit Layers, FAO). Write “None” when the allometric equation does not refer to any country.	Burkina Faso	a.
6	ID_Location	Identification number of the location. In the same article for the same location they could be more than one equation.	6772	a. c.

7	Group_Location	Identification number of the group locations. When an allometric equation is valid for a group of locations. Write “None” when the allometric equation does not refer to any group location. Always provide a separate list with the Group_Locations you used in the database, each one with the corresponding ID.	24	c.
8	Location	Location corresponds to the name of the place where the equation was developed It can be a precise location (city, village..) or a geographical area. Search a location as precisely as possible. Write “None” when the allometric equation does not refer to any location.	Laba	a.
9	Latitude	Decimal degrees Write “None” when the allometric equation does not refer to any latitude.	41.899566	b.
10	Longitude	Decimal degrees Write “None” when the allometric equation does not refer to any longitude.	12.515275	b.
11	Biome_FAO	Global Ecological Zones	Tropical dry forest	b.
12	Biome_UDVARDY	Global Ecological Zones	Tropical dry forests / Woodlands	b.
13	Biome_WWF	Global Ecological Zones	Tropical & Subtropical Grasslands, Savannas & Shrublands	b.
14	Division_BAILEY	Global Ecological Zones	SAVANNA DIVISION	b.
15	Biome_HOLDRIDGE	Global Ecological Zones	Tropical dry forest	b.

16	X	Independent variable (see below). e.g.: BA (basal area, the cross-sectional area of the stem at breast height), Bd (diameter at soil), Bd5 (diameter at 5 cm from soil), C (circumference at breast height), Cb (circumference at soil), Cd5 (circumference at 5 cm from soil), D10 (diameter at 10 cm of height from the soil), DBH (diameter of the stem at breast height), H (height), wd (wood density).Look at the end of the tutorial for an exhaustive list of the acronyms to be used.	BA	a.
17	Unit_X	Unit measure (mm, cm, cm2, cm3, dm, gcm-3, m, m2...).Always keep the unit of measurement reported by the author.	cm	a.
18	Z	Independent variable. Cannot be there a second variable. Write “None” when you have not this data.	DBH	
19	Unit_Z	Unit measure Write “None” when you have not this data.	cm	
20	W	Independent variable. Write “None” when you have not this data.	H	
21	Unit_W	Unit measure. Write “None” when you have not this data.	m	
22	U	Independent variable. Write “None” when you have not this data.	-	
23	Unit_U	Unit measure Write “None” when you have not this data.	-	
24	V	Independent variable. Write “None” when you have not this data.	-	
25	Unit_V	Unit measure. Write “None” when you have not this data.	-	
26	Min_X	It is the minimum X value.	10 cm	

		Write “None” when you have not this data.		
27	Max_X	It is the maximum X value. Write “None” when you have not this data.	40 cm	
28	Min_Z	It is the minimum Z value. Write “None” when you have not this data.	3,6 m	
29	Max_Z	It is the maximum Z value. Write “None” when you have not this data.	7,8 m	
30	Output	It is the dependent variable: Y It can express: - Biomass - Volume	biomass	a.
31	Output_TR	The output of the equation can be expressed in the Log(Y) or in the arithmetic value of Y, in which case you don’t specify anything. When the result of the equation is a logarithm you have to specify if it is a natural logarithm (Log) or a logarithm to base b = 10, the common logarithm (Log10). Write “None” if “Y” does not refer to any log.	Log10	a.
32	Unit_Y	Unit measure of Y (e.g. cm3, dm3, m3, m3/ha, g, kg, Mg, kg/ha, Mg/ha...).	kg	a.
33	Age	Age of the population considered in the experiment (years). It can be a precise number (e.g. 20) or a range (e.g. 20-40) or a definition (eg. young...). Write “None” when you have not this data.	20	

34	Veg_Component	They are the vegetation components of the plants considered in the equation (see below). e.g. : Branch biomass Branch biomass without twigs Biomass of roots (RC+RF+RS) Biomass of dead branches Biomass of stem bark Biomass of small roots Biomass of fine roots Crown biomass (BR+FL) Prop roots Stem volume Stem wood biomass Stump biomass Total aboveground biomass Total foliage biomass Total stem biomass (SW+SB) Total tree biomass (AB+RT) Total aboveground biomass without leaves Total aboveground woody biomass	Total stem biomass (SW+SB)	a.
35	B	Bark Write “TRUE “if bark is considered in the output; Write “FALSE “if this component is not considered.	TRUE	a.
36	Bd	Dead branches Write “TRUE “if dead branches are considered in the output; Write “FALSE “if this component is not considered.	-	a.
37	Bg	Gross branches: D>7 cm Write “TRUE “if gross branches are considered in the output; Write “FALSE “if this component is not considered.	-	a.
38	Bt	Thin branches: D<7 cm Write “TRUE” if thin branches are considered in the output; Write “FALSE” if this component is not considered.	-	a.

39	L	Leaves Write “TRUE” if leaves are considered in the output; Write “FALSE” if this component is not considered.	-	a.
40	Rb	Large roots Write “TRUE” if write are considered in the output; Write “FALSE” if this component is not considered.	-	a.
41	Rf	Fine roots Write “TRUE” if fine roots are considered in the output; Write “FALSE” if this component is not considered.	-	a.
42	Rm	Medium roots Write “TRUE” if medium roots are considered in the output; Write “FALSE” if this component is not considered.	-	a.
43	S	Stump Write “TRUE” if stump is considered in the output; Write “FALSE” if this component is not considered.	-	a.
44	T	Trunk-underbark Write “TRUE” if trunk-underbark is considered in the output; Write “FALSE” if this component is not considered.	FALSE	a.
45	F	Fruits Write “TRUE” if fruits are considered in the output; Write “FALSE” if this component is not considered.	-	a.
46	ID_Species	Identification number of the species. Each species has its own ID, two different species cannot have the same ID. Write “1” when the allometric equation does not refer to any particular species.	450	a. c.
47	Genus	It is the name of the genus in the binomial literature in a Latin grammatical forms.	Anogeissus	a.
48	Species	It is the name of the species in the binomial literature in the Latin grammatical form.	leiocarpa	a.

49	Family	It is the name of the Taxonomic family to which belongs the species		a.
50	Group_Species	Write “1” when an allometric eq. refers to a group of species. Write “None” when the equation does not refer to any group of species. Always provide a separate list Group_Species you used in the database, each one with the corresponding ID.	1	a.
51	ID_Group	Identification number of the group species. Each group has its own ID, two different groups cannot have the same ID. Write “None” when the equation does not refer to any group of species.	-	c.
52	Equation	It is the allometric equation.	3.21*X+11.74*X^(2)	a.
53	Sample_size	Number of plants measured to obtain the equation. Write “None” where there is not this data.	32	
54	Top_dob	For equations that include a portion of the merchantable stem. Top d.o.b. describes the minimum diameter in cm, outside bark (d.o.b.) of the top of the merchantable stem. Write “None” where there is not this data.	-	-
55	Stump_height	For equations that predict the biomass of any component that includes the tree stem or the stump, this variable lists (in m.) the estimated or measured stump height. Write “None” where there is not this data.	-	-
56	ID_REF	Identification number of the reference. One reference can correspond to more than one equation. In the case one equation is found in more than one document, the oldest document becomes the reference	579	a. c.
57	Label	Identification number of the pdf/word copy of the article in your library. Hard or soft copies are identified with one label number. One label can correspond to more than one equation. The label can correspond to the ID_REF.	3832	a. c.

58	Author	Author's surname. Write only the first two authors. If there are two authors use "**and"** between the names of the two authors. If more than two authors, write "surname of the first author et al.".	Sawadogo et al.	a.
59	Year	Year of publication of the document. When an author has written more than one work in the same year, use **a**, **b**, etc. to differentiate, e.g. **2000a**, **2000b**. Write "None" where there is not this data.	2010	a.
60	Reference	Authors, year of publication, title of issue, journal, volume number, number of the issue, pages . The reference should be entered in using the Fao bibliography editorial guidelines (look at page 24 for more information).	**Barney, R., Van Cleve, K. & Schlentner, R.** 1978. Biomass Distribution and Crown Characteristics in Two Alaskan Picea Mariana Ecosystems; . *Canadian Journal of Forest Research* (8): 36-41	a.
61	R^2	Coefficient of determination of the equation. Write "None" where there is not this data.	0.878	a.
62	R^2_adjusted	This is an adjustment of the R-squared that penalizes the addition of extraneous predictors to the model. Adjusted R-squared is computed using the formula 1 - ((1 - R^2)((N - 1) /(N - k - 1)) where k is the number of predictors.	0.489	

63	Corrected for bias	A “1” value in this column means that the original author developed and reported a correction factor to compensate for the potential underestimation resulting from backtransforming logarithmic predictions to arithmetic units, as suggested by Baskerville (1972), Beauchamp and Olson (1973), and Sprugel (1983). In many cases where (7) is “yes,” item (8) will list CF, the bias correction factor to be used. In other cases, the authors embedded the correction factor into the equation parameters, or did not publish the value of CF since it can be obtained from the regression statistics. In such cases, the value of CF in the database will be zero even though the authors used the correction factor (Jennifer C. 2004). Write “None” when there is no “corrected for bias”.	-	
64	RMSE	Root-mean-square deviation or error of the equation. Write “None” where there is not this data.	-	a.
65	SEE	Standard error of the mean of the equation. Write “None” where there is not this data.	-	
66	Bias correction (CF)	Value of CF, to correct for potential underestimation resulting from back-transformation of logarithmic predictions to arithmetic units. Write “None” when there is no “CF”.	-	
67	Ratio equation	Some authors present methods for predicting the biomass of the merchantable stem to a user-defined top diameter. A “1” value in this column means that a separate ratio equation was presented by this author. Write “None” when there is no “ratio equation”.	-	
68	Segmented equation	Paired equations for the same species. E.g. one equation was applicable at the lower end of the diameter range and a second equation was applicable at the upper end of the range. A “1” value in this column means that the equation is one-half of a segmented equation. Write “None” when there is not this data.	-	

69	Substitute_equation	Equation as reported in the original source, using the acronyms of the input parameters instead of the common variables X, Z, W. Ex: if the equation is: exp(-9.022+1.904*log(X)+0.765*log(Z)) The substitute equation will be: exp(-9.022+1.904*log(DBH)+0.765*log(H))	1.37+(2.65*log10(DBH))	
70	IDequation	It is the specific number for each equation. Every equation has one and only one IDequation. Because the same equation can appear in more than one row of the database (ID), one IDequation can correspond with more ID, but not vice versa.	1023	
71	Contributor	Name of the institution who worked on entering data in the database.	FAO	
72	Name_operator	Name of the operator who entered the data		

NOTES

a. Very important data
b. Data obtained with other software (see below)
c. Data obtained from pre-existing database (see below)

11. Appendix 2: description of the structure of the database for wood density (non exhaustive list of wood densities)

Number	Family	Binomial	Wood density (g/cm^3), oven dry mass/fresh volume	Region	Reference Number
1	Fabaceae	Abarema jupunba	0.780	South America (tropical)	114
2	Fabaceae	Abarema jupunba	0.660	South America (tropical)	198
3	Fabaceae	Abarema jupunba	0.551	South America (tropical)	52
4	Fabaceae	Abarema jupunba	0.534	South America (tropical)	65
5	Fabaceae	Abarema jupunba	0.551	South America (tropical)	189
6	Fabaceae	Abarema jupunba	0.500	South America (tropical)	204
7	Fabaceae	Abarema jupunba	0.520	South America (tropical)	45
8	Fabaceae	Abarema macradenia	0.438	Central America (tropical)	167
9	Pinaceae	Abies alba	0.353	Europe	28
10	Pinaceae	Abies amabilis	0.400	NorthAmerica	7
11	Pinaceae	Abies arizonica	0.289	NorthAmerica	118
12	Pinaceae	Abies balsamea	0.330	NorthAmerica	7
13	Pinaceae	Abies concolor	0.370	NorthAmerica	7
14	Pinaceae	Abies delavayi	0.400	China	32
15	Pinaceae	Abies ernestii	0.360	China	32
16	Pinaceae	Abies fabri	0.373	China	33
17	Pinaceae	Abies fargesii	0.340	China	32

12. Appendix 3: description of the structure of the file for the input file for the comparison of allometric equations

Acronym	Description	Unit	Population	Formula
BA	stem cross-sectional area at DBH (1m30 height)	cm2	TREE	$\pi * \left(Dbh/2\right)^2$
BA0	basal area	cm2	TREE	$\pi * \left(BD/2\right)^2$
BD	basal diameter	cm	TREE	$Dbh/0.75$
C	circumference at 1.3m	cm	TREE	$\pi * Dbh$
C10	circumference at 10 cm height	cm	TREE	$\frac{C}{0.75} * \frac{120}{130}$
C180	circumference at 180 cm height	cm	TREE	$C * \frac{180}{130}$
C20	circumference at 20 cm height	cm	TREE	$\frac{C}{0.75} * \frac{110}{130}$
C30	circumference at 30 cm height	cm	TREE	$\frac{C}{0.75} * \frac{100}{130}$
C50	circumference at 50 cm height	cm	TREE	$\frac{C}{0.75} * \frac{80}{130}$
CA	crown area	cm2	TREE	$\pi * \left(CD/2\right)^2$

Cb	basal circumference	cm	TREE	$C/0.75$
CD	crown diameter	cm	TREE	$(0.1682 * Dbh) + 0.8282) * 100$ [19]
CH	crown height	cm	TREE	$H * 0.4$
CR	crown radius	cm	TREE	$CD/2$
CV	canopy volume	cm3	TREE	$\pi * \left(\frac{H}{2}\right) * 0.4 * \left(\frac{CD}{2}\right)^2$
D20	diameter at 20cm height	cm	TREE	$C20/\pi$
D30	diameter at 30cm height	cm	TREE	$C30/\pi$
DBH	diameter at breast height	cm	TREE	-
H	height	cm	TREE	$100 * \exp(1.071 + 0.5677 * \ln(Dbh))$ [20]
Hd	stand dominant height	cm	STAND	$H * 0.6$
Hme	merchantable height	cm	TREE	$H * (2/3)$
Ht	height of the trunk	cm	TREE	$H * 0.6$
R	tree ring	nr	TREE	$7.4 + 3.8 * BD$
Vs	volume de la tige	cm3	TREE	$H * \frac{60}{100} * \pi * \left(\frac{Dbh}{2}\right)^2 * Kf$
WD	wood density	g cm-3	TREE	Constant (0.6)
Yr	age of the ecosystem	yr	STAND	Constant

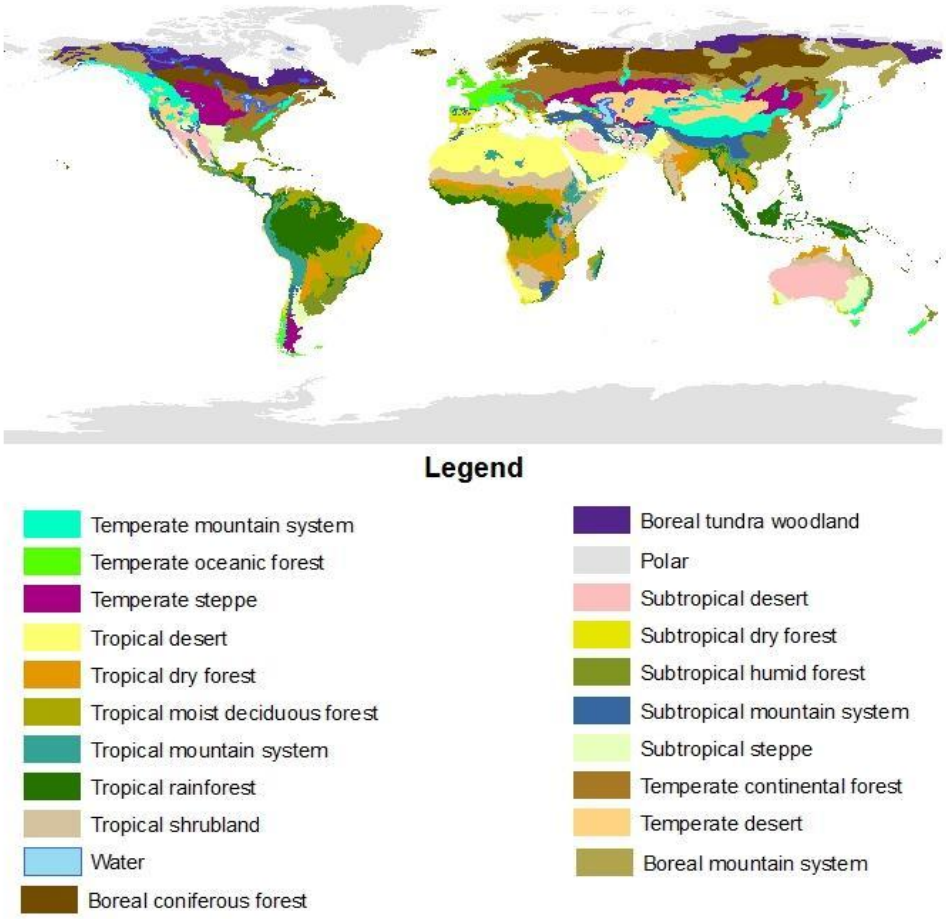
[19] E. G. Foli, D. Alder, H. G. Miller, and M. D. Swaine, "Modelling growing space requirements for some tropical forest tree species," *Forest Ecology and Management*, vol. 173, pp. 79-88, 2003.

[20] S. Brown, A. J. R. Gillespie, and A. E. Lugo, "Biomass estimation methods for tropical forests with applications to forest inventory data," *Forest Science*, vol. 35, pp. 881-902, 1989.

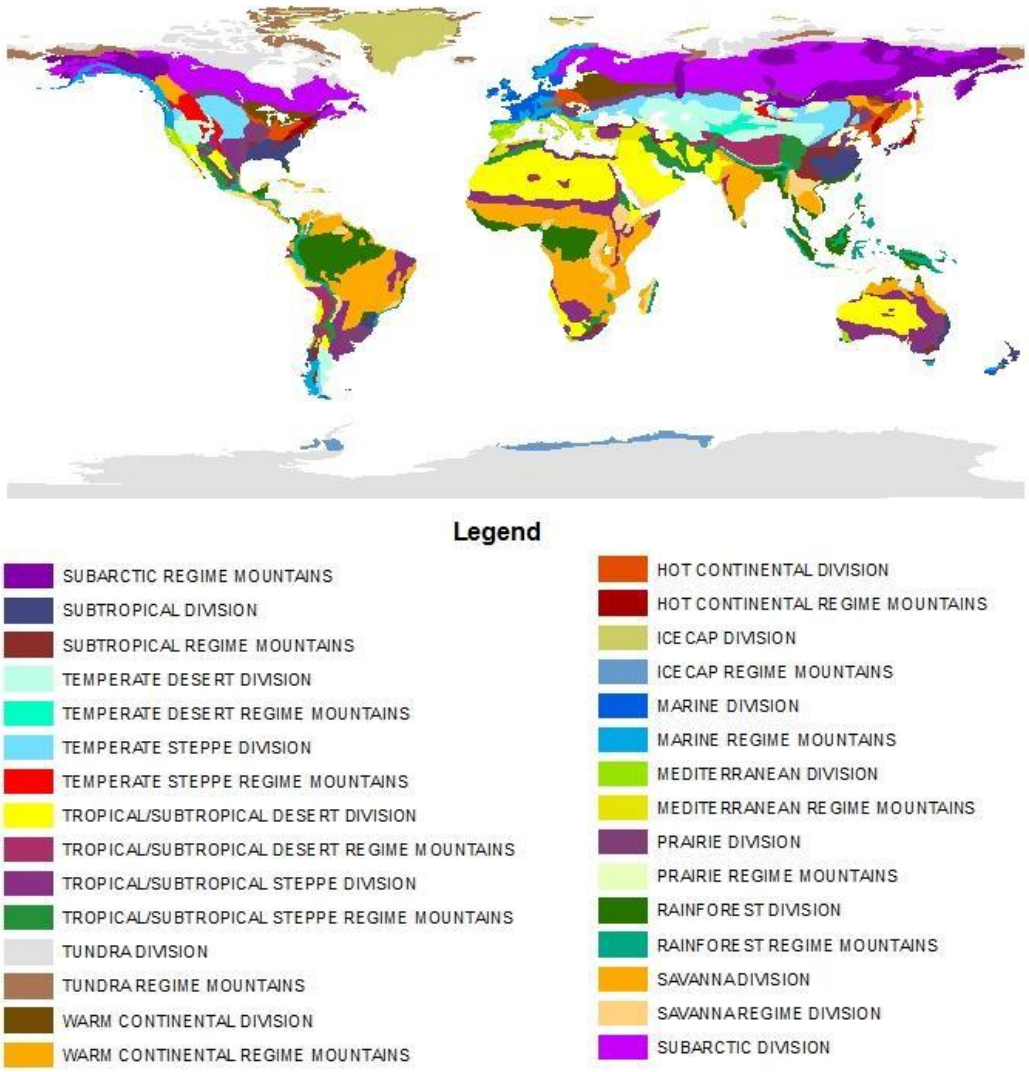
13. Appendix 4: description of the structure of the file for assessment of volume, biomass and carbon stocks

WEIGHT	LOCATION	DBH	H	Genus	Species
#	-	cm	m	-	-
1	BOBIRI	7	9	Cleidion	gabonicum
1	BOBIRI	3	6	Cleidion	gabonicum
4	BOBIRI	21	16	Trichilia	prieuriana
5	BOBIRI	3	5	Microdesmis	puberula
5	BOBIRI	3	6	Bafa	mitiga
5	BOBIRI	3	5	Bafa	mitiga
5	BOBIRI	3	5	Microdesmis	puberula
5	BOBIRI	1	4	Bafa	mitiga
5	BOBIRI	20	16	Microdesmis	puberula
5	BOBIRI	3	5	Celtis	adolfi-friderici
5	BOBIRI	8	10	Hannoa	klaineana
5	BOBIRI	3	6	Celtis	adolfi-friderici
5	BOBIRI	4	7	Nauclea	diderrichii
6	BOBIRI	1	3	Pycnanthus	angolensis
7	BOBIRI	7	8	Cleidion	gabonicum
7	BOBIRI	24	18	Celtis	zenkeri
7	BOBIRI	13	13	Microdesmis	puberula
7	BOBIRI	7	9	Microdesmis	puberula
7	BOBIRI	25	18	Trichilia	prieuriana
7	BOBIRI	6	8	bafa	mitiga
7	BOBIRI	2	5	Napleonaea	leonensis
7	BOBIRI	3	6	Napleonaea	leonensis
7	BOBIRI	2	5	Cleidion	gabonicum
7	BOBIRI	3	5	Cleidion	gabonicum
8	BOBIRI	3	5	bafa	mitiga
8	BOBIRI	120	44	Terminalia	superba
8	BOBIRI	6	8	Sterculia	rhinopetala
9	BOBIRI	3	6	Celtis	zenkeri
10	BOBIRI	2	4	Corynanthe	pachyceras
10	BOBIRI	10	11	Cleidion	gabonicum
10	BOBIRI	10	11	Sterculia	tragacantha
10	BOBIRI	1	3	Celtis	zenkeri

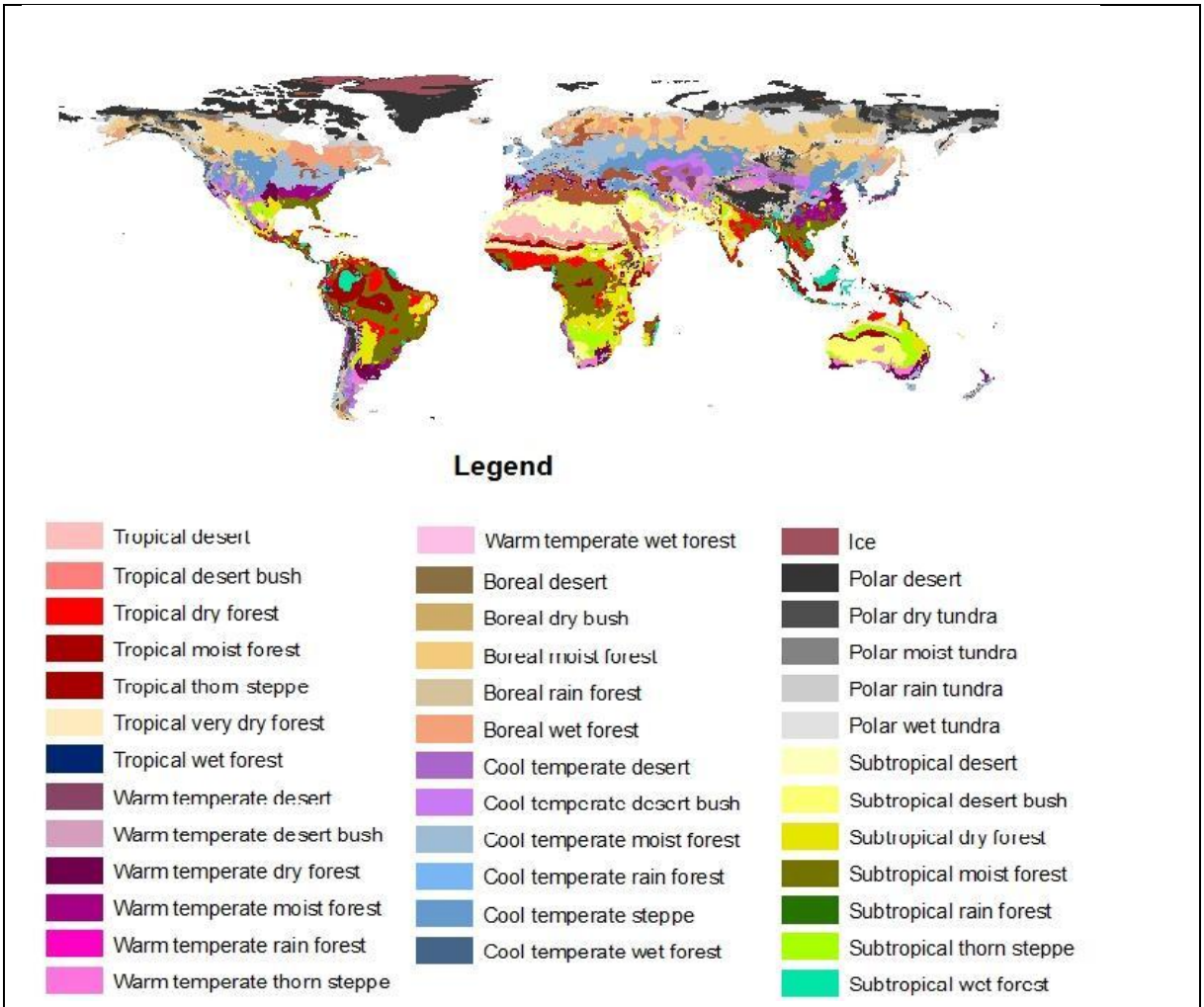
14. Appendix 5: List of the potential ecological zones to be selected



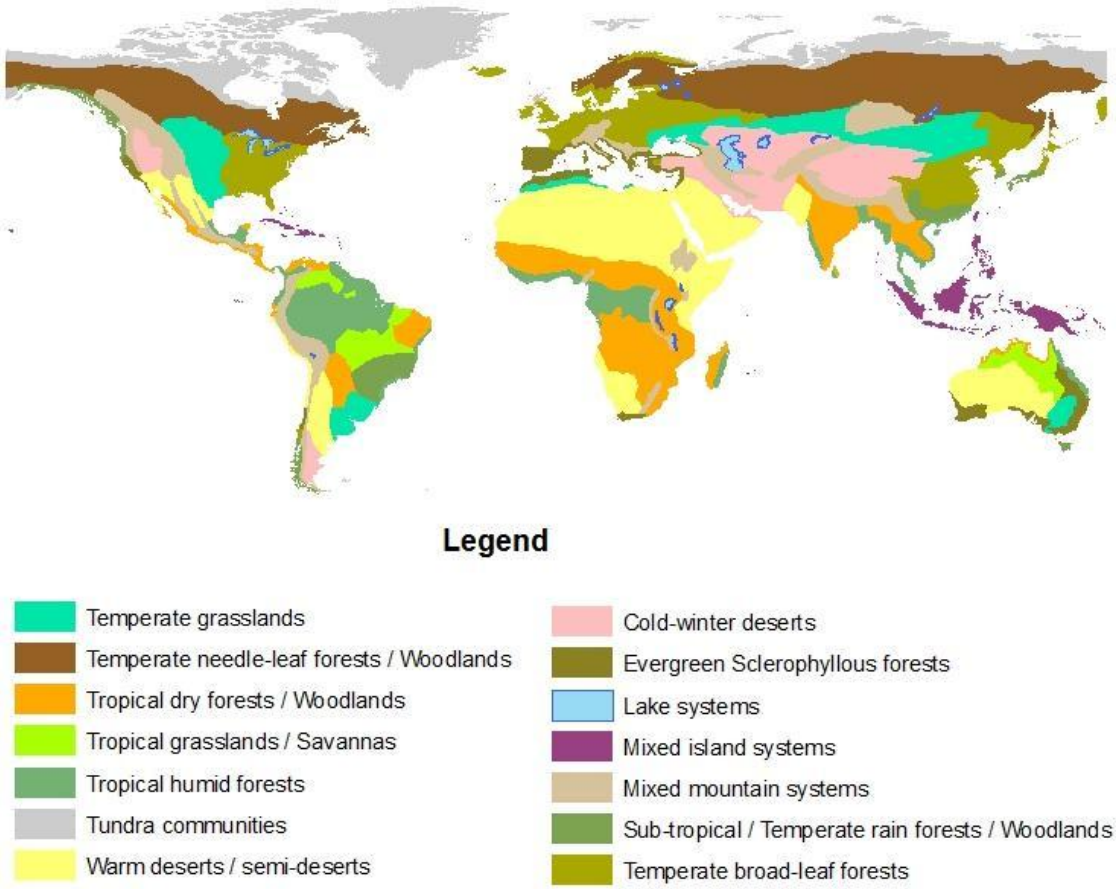
FAO ecological zone classification



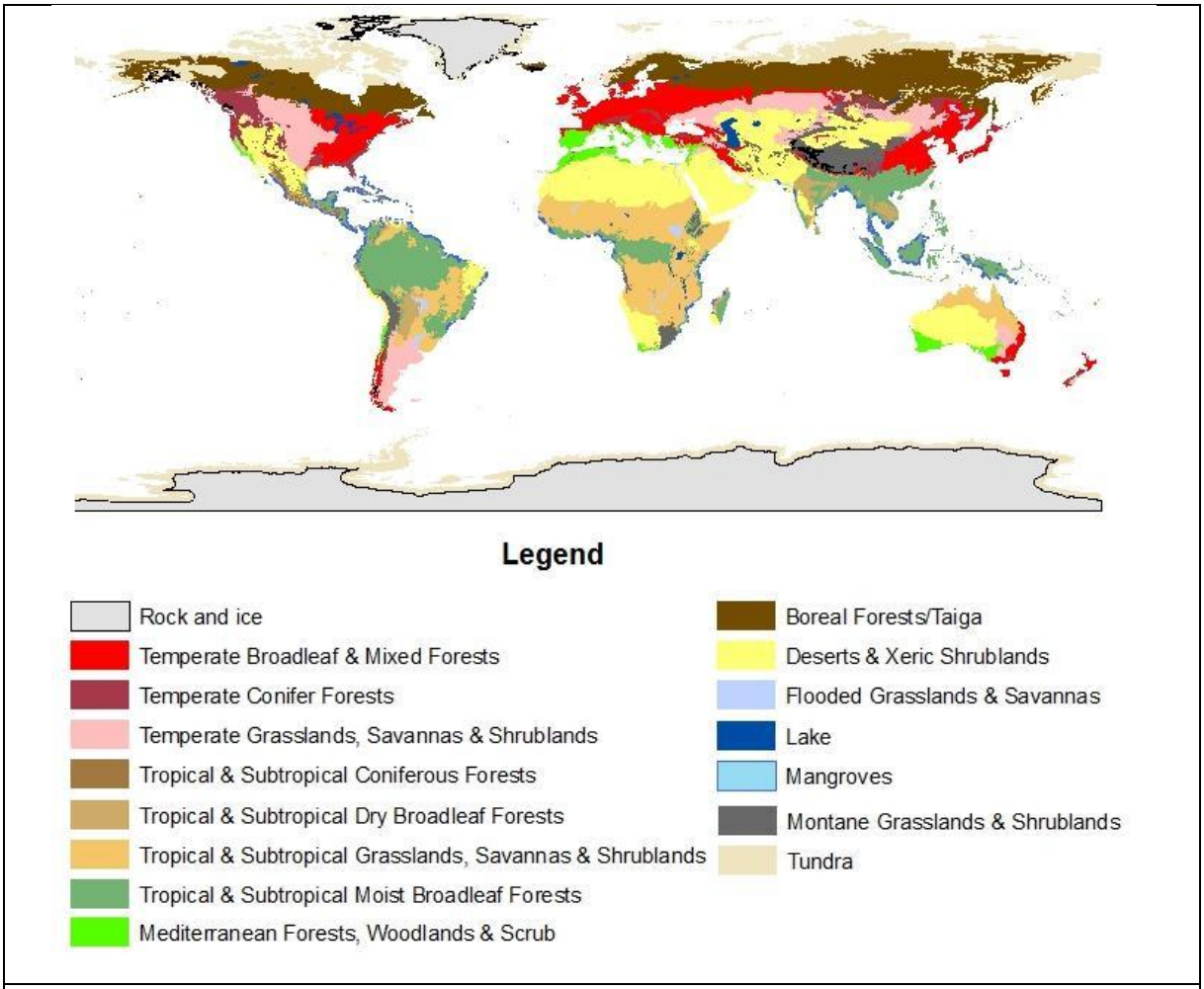
Bailey ecological zone classification



Holdridge ecological zone classification



Udvardy ecological zone classification



WWF ecological zone classification

15. Appendix 6: List of the functions