GlobBiomass: Algorithm Development Overview

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Inputs from the whole team

Regional and global products

GlobBiomass has produced regional and global maps of biomass, together with products indicating the accuracy of these maps.

- The **regional** maps are produced independently by the regional teams for the 2005, 2010 and 2015 epochs, and represent the **best biomass estimates** they can make using whatever data are available. Biomass change maps are also produced.
- The **global** biomass map (for 2010 only) is produced in a consistent way from available global datasets of relevant variables. It aims to be better than any of the existing continental scale maps.

The Algorithm Theoretical Basis Document (ATBD)

The fundamental description of how the biomass products are produced in GlobBiomass is the ATBD. The functions of the ATBD are:

- **Concise** description of the data and methods used to produce the various maps and accuracy products;
- To provide enough detail to allow **replication**;
- To give **reasons** for selecting these data and methods (and not selecting others).

Structure of the ATBD: regional

Regional biomass maps (Poland, Sweden, Kalimantan, Mexico, S. Africa):

a. General description of regions
b. Datasets: input, training, accuracy assessment, validation
c. Methods: pre-processing, biomass estimation, training, assigning accuracy, testing accuracy
d. Products
e. Properties of the regional products
f. Methods to calculate regional biomass change
g. Relation of regional methods and maps to global product

Structure of the ATBD: global

Global biomass map:

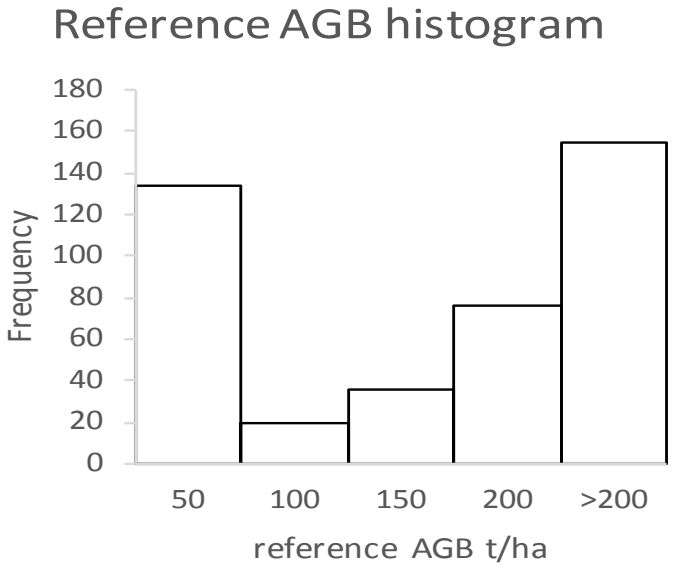
a. Datasets for input, training, validation, accuracy assessment; Rationale for using these datasets
b. Methods: pre-processing, biomass estimation, assigning accuracy)
   - Several candidate methods: comparison and combination
   - Converting Growing Stock Volume to Above-Ground Biomass
c. Products

Regional comparison: biomass ranges

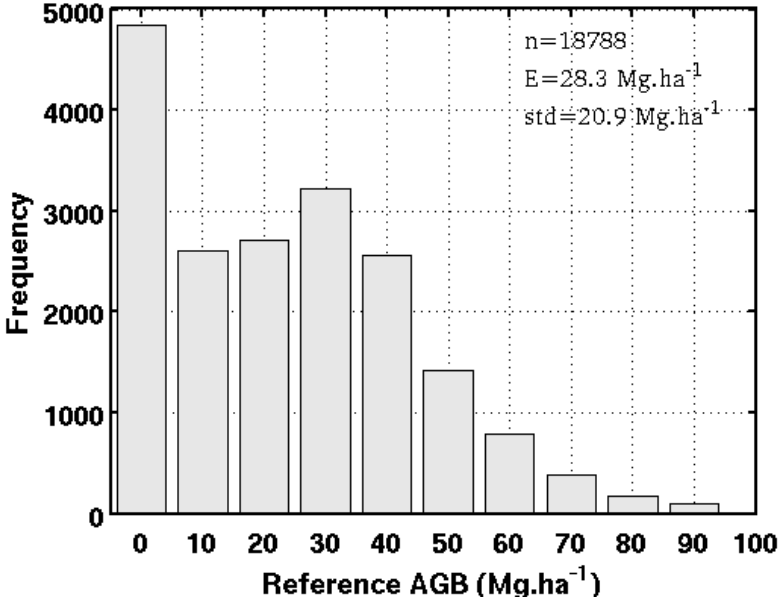
Region	Biomass Range (t/ha) (reference data)
Poland	0 – 300 t/ha, roughly uniform distribution
Sweden	0 – 250 t/ha, roughly uniform distribution up to 75 t/ha, then declining in frequency
Indonesia	0 - 400 t/ha, dominated by AGD > 200 t/ha
Mexico	Mostly < 150 t/ha, steady decline in frequency with AGB
South Africa	Mostly < 80 t/ha, largest class is 0 - 10 t/ha, decline in frequency after 40 t/ha

Biomass ranges

Kalimantan



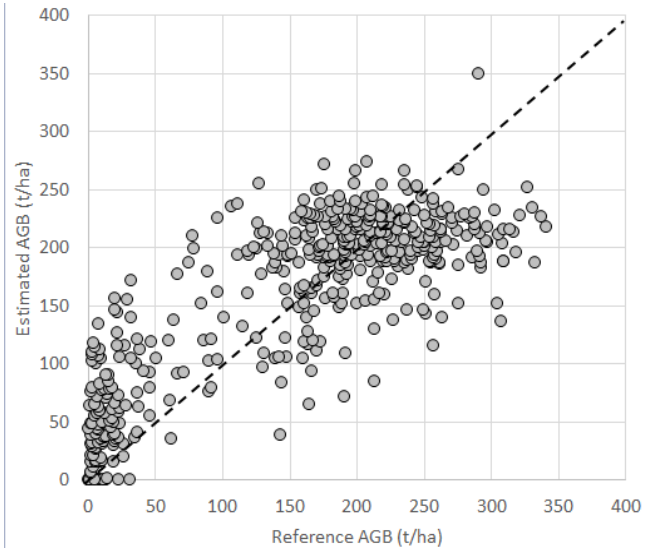
S. Africa



Regional comparison: methods

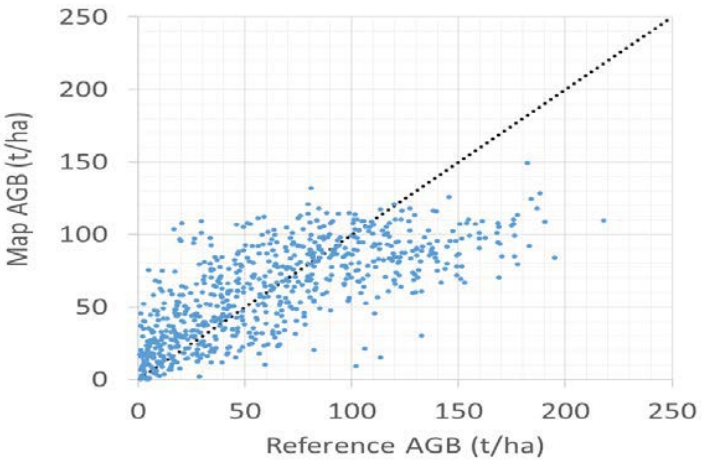
Region	Primary Data	Primary Method	Reference Data
Poland	PALSAR 25m HH+HV mosaics	RandomForest	Plot data
Sweden	Spot 4/5, PALSAR strips	kNN with Spot 4/5 and NFI data + BIOMASAR approach with multi-temporal PALSAR data.	National Forest Inventory (NFI) plots. Lidar
Indonesia	PALSAR 25m HH+HV mosaics	Regression models including ratio and texture values	Plots + lidar
Mexico	PALSAR 25m HH+HV mosaics, Landsat and DEM	Maximum Entropy	Plots from the Mexican NFI
South Africa	PALSAR 25m HH+HV mosaics	Bayesian approach using the water cloud model	Lidar + plots

Accuracy assessment: Indonesia 2010



AGB classes (t/ha)	n	Average estimated AGB (t/ha)	Average reference AGB (t/ha)	RMSE (t/ha)	R^2	SD (error) (t/ha)	Bias (t/ha)
0-50	141	50	13	54	0.23	39	37
50-100	21	130	78	71	0.07	50	52
100-150	38	171	132	66	0.08	54	39
150-200	117	194	178	42	0.07	39	16
>200	184	207	247	60	0.01	44	-40
Overall	**501**	**154**	**149**	**55**	**0.69**	**55**	**4**

Accuracy assessment: Mexico 2010



Site	AGB classes (t/ha)	n	Average estimated AGB (t/ha)	Average reference AGB (t/ha)	RMSE (t/ha)	SD(error) (t/ha)	R^2	Bias (t/ha)
Both sites	0-30	213	30.7	13.6	26.6	20.4	0.15	17.1
	30-60	159	55.0	44.1	26.6	24.3	0.03	10.9
	60-90	140	74.4	74.7	22.3	22.3	0.12	-0.3
	90-120	98	85.2	104.6	29.6	22.4	0.00	-19.4
	>120	99	91.8	146.5	58.7	21.3	0.16	-54.7
	Overall	**709**	**60.8**	**63.6**	**32.8**	**32.7**	**0.51**	**-2.8**

Regional accuracy: general features

All regional data analysis exhibits:

- Overestimation at low biomass
- Underestimation at high biomass (not S Africa)
- Roughly constant residual error (after correcting for bias) across all biomass ranges
    - Poland & Mexico ~20-25 t/ha; Sweden, 25-35 t/ha;
    - Indonesia, ~65 t/ha; South Africa, ~14-21 t/ha

Global accuracy

Estimated using error propagation taking account of:

- radar backscatter measurement errors
- errors in the terms going into the model-based inversion
- geocoding and resampling

Checked against Growing Stock Volume at several sites.