ESA DUE GlobBiomass

1st User Workshop

WP 2000
Data Acquisition

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IIASA, Laxenburg
2 February 2016

WP2 Data Acquisition

D4: Ground Data Document

Ground data segment

Aim: Cal/Val of the Global product

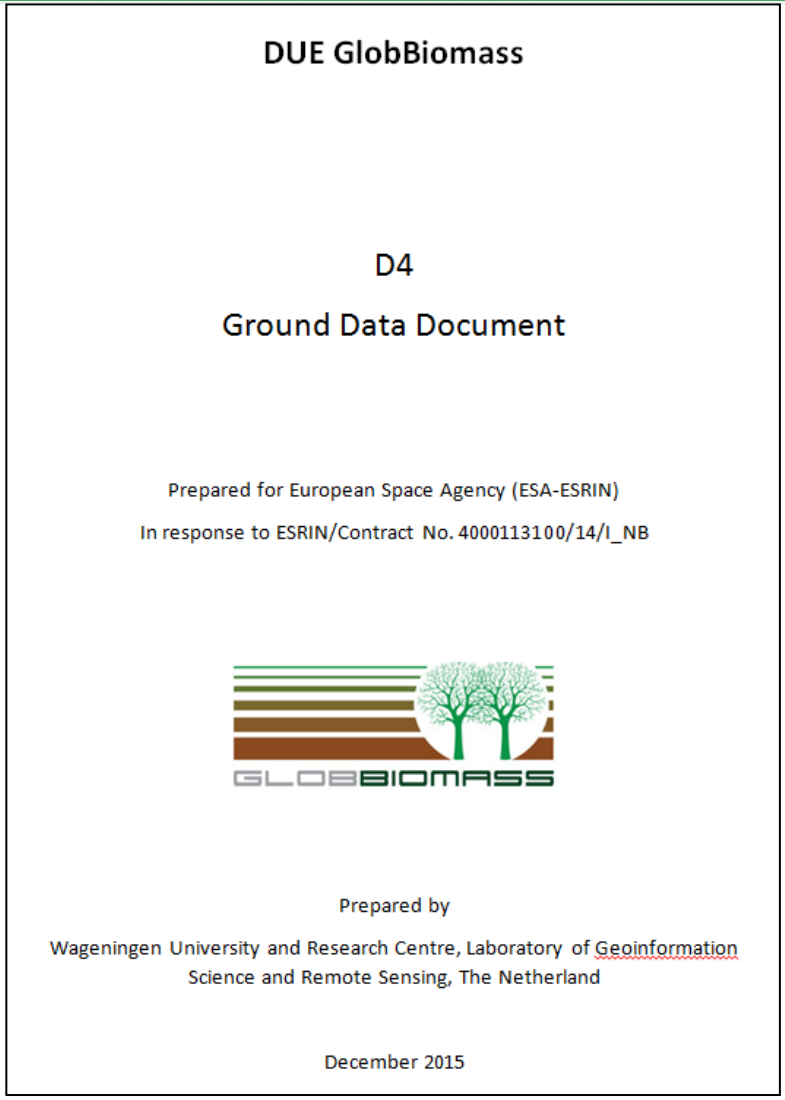
Outputs (D4):

› Ground Data Document

› Ground Database

Three sources of data:

1. Field plots
2. High-resolution maps
3. Sub-national statistics



DUE GlobBiomass

D4

Ground Data Document

Prepared for European Space Agency (ESA-ESRIN)

In response to ESRIN/Contract No. 4000113100/14/I_NB

Prepared by

Wageningen University and Research Centre, Laboratory of Geoinformation Science and Remote Sensing, The Netherland

December 2015

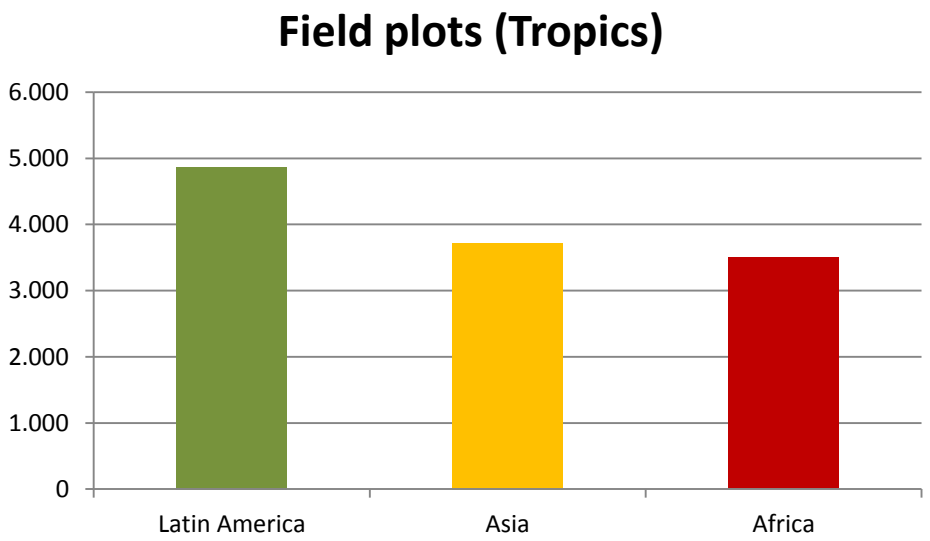
Field plots

Existing data from:

- Research networks (Fluxnet, RAINFOR, GEM, AfriTron, etc.)
- Research projects (Brazil, Indonesia, Ghana, Ethiopia, Laos, Guinea Bissau, etc.)
- National Forest Inventory (Europe, Uganda, Mexico, Guyana, Vietnam)
- Forest concessions (DRC, Sierra Leone)

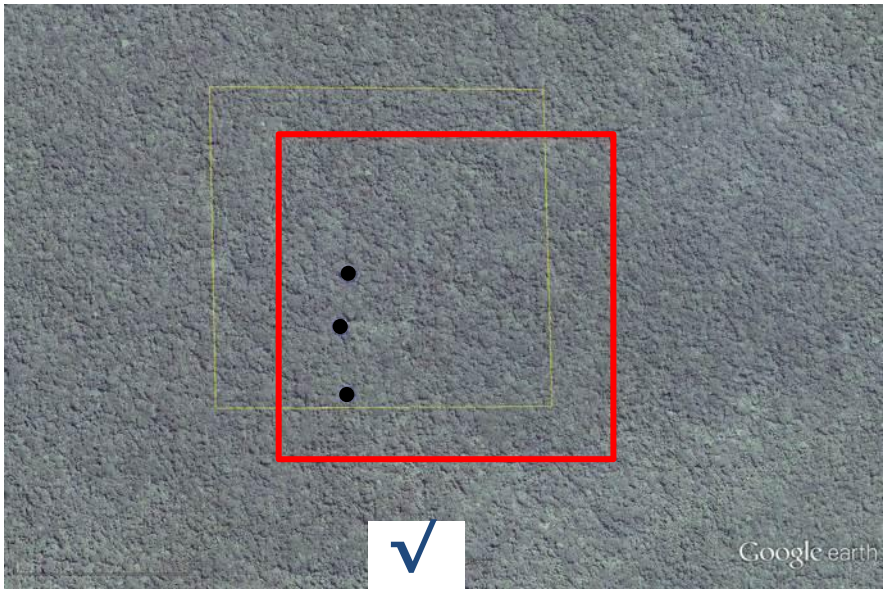
Metadata Quality Criteria:

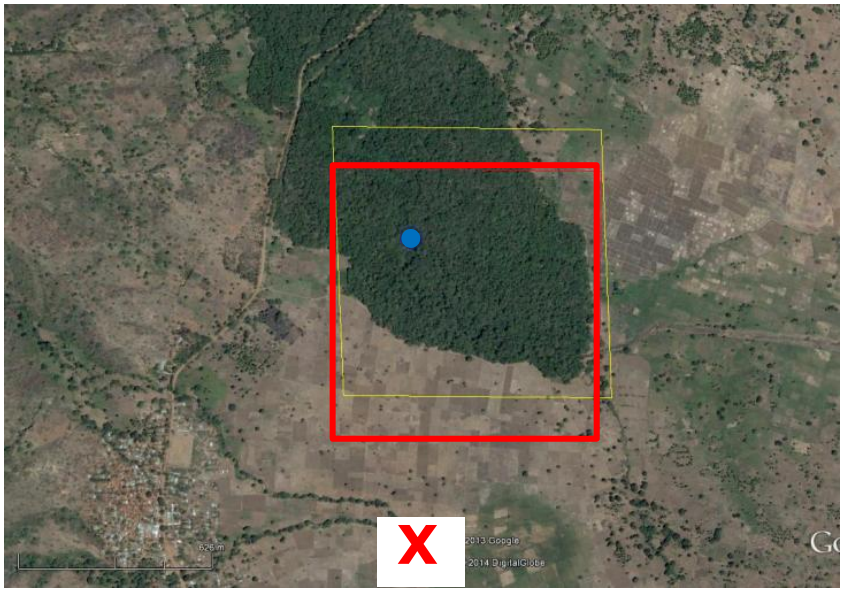
- Plot coordinates acquired with GPS
- Ground measurements from year 2000
- AGB for all living trees with DBH ≥ 0-10 cm
- Appropriate allometric model
- Allometry from Dbh and wood density



Field plots - Tropics

QA/QC	Field plots
1. Pre-Screening	Metadata analysis
2. Upscaling	with Google Earth / Tree Cover (VCF)
3. Aggregation	Average Biomass @ map resolution

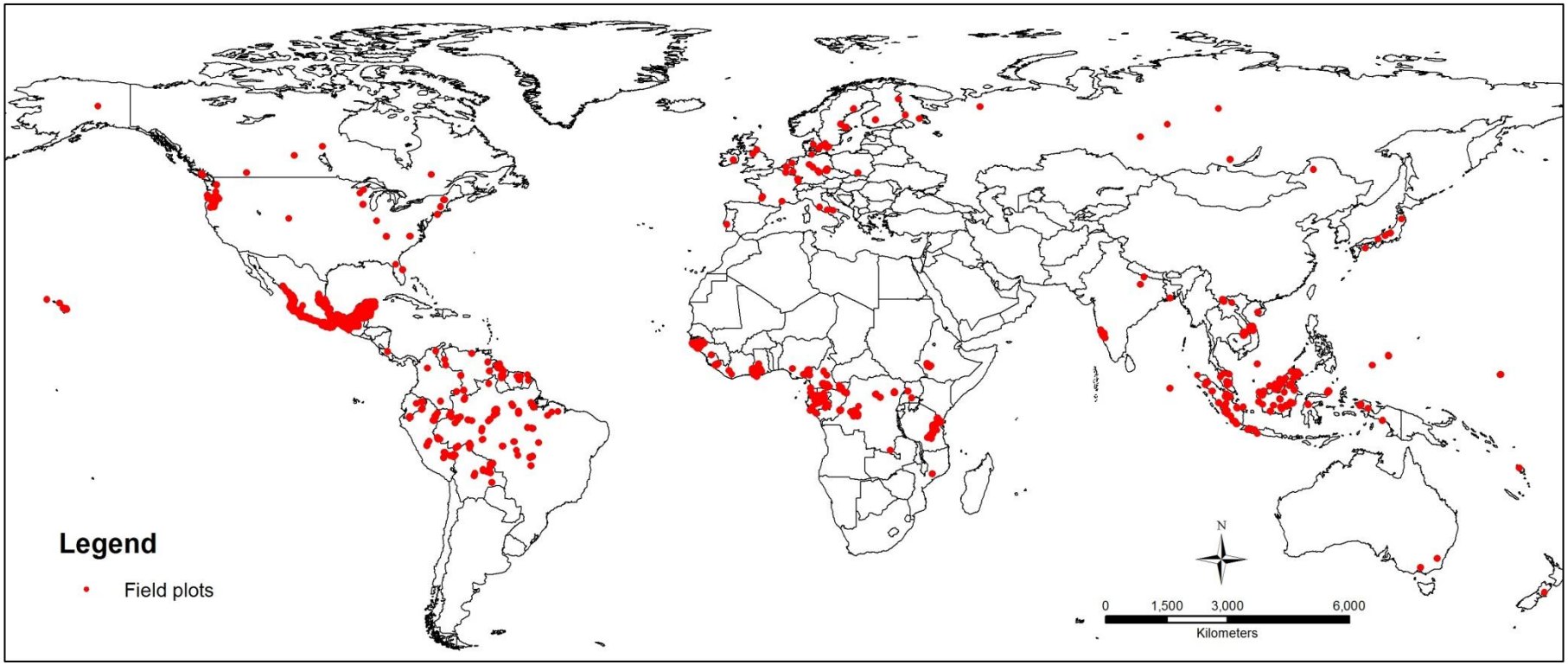




Ground database - v.02

Version 02 (January 2016):

- 28 ground datasets (12,738 reference plots)
- NFI in Europe: acquisition ongoing



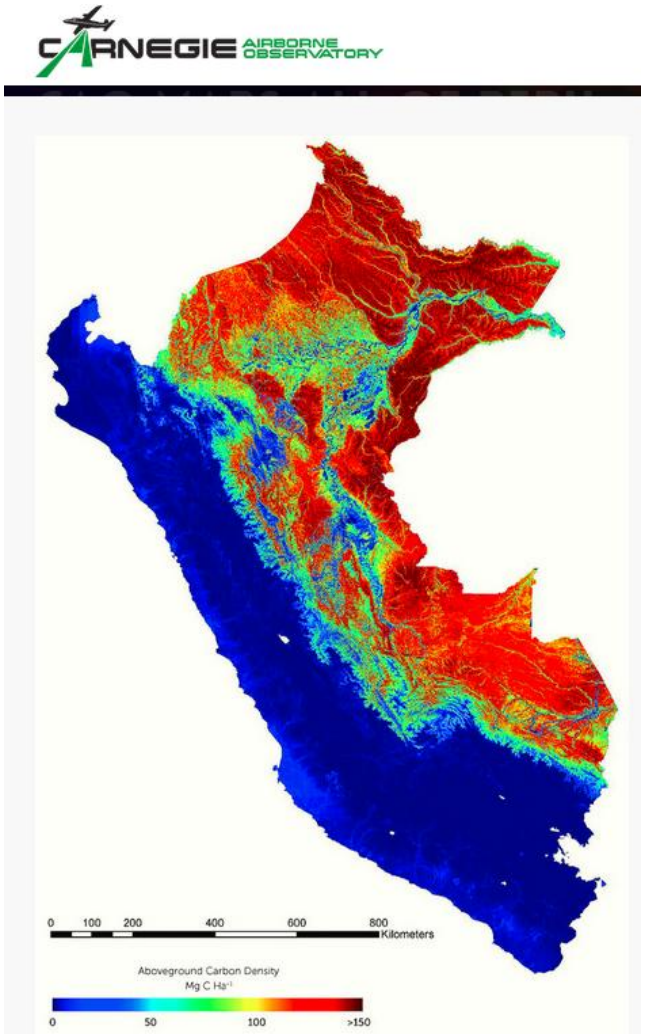
Reference maps

Quality Criteria:

- Locally calibrated, res. ≤ 100m, published, etc.

QA/QC	Biomass maps
1. Pre-Screening	Metadata analysis
2. Upscaling	Aggregation @ map resolution
3. Area selection	Areas with higher confidence

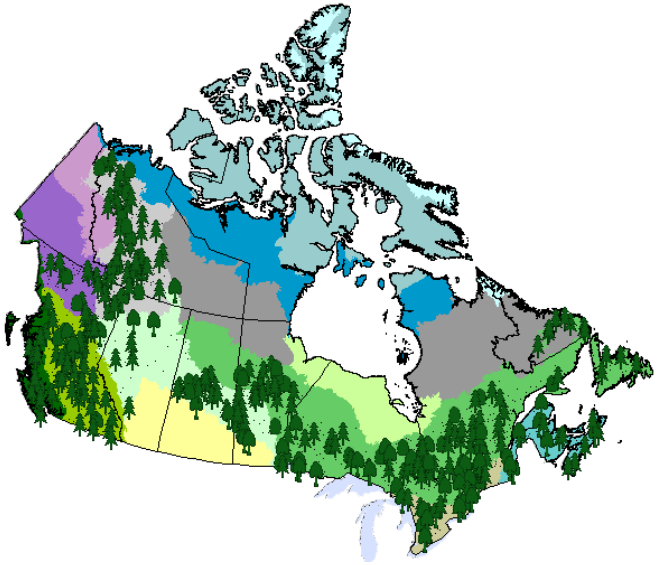
Continent	Country	Extent	Year (map)	Resolution (m)
Africa	Uganda	National	1999-2003	30
Africa	Madagascar	Local	2010	100
Africa	Mozambique	Local	2007	50
Africa	Cameroon	Local	2007	100
Africa	Cameroon	Local	2007-2010	25
Africa	Guinea Bissau	National	2008	50
S. America	Peru	National	NA	100
S. America	Colombia	Sub-nat.	2010	100
C. America	Mexico	National	2007	30
C. America	Panama	National	2008 - 2012	100
Australia	Queensland	Local	2009	50



Sub-national Statistics

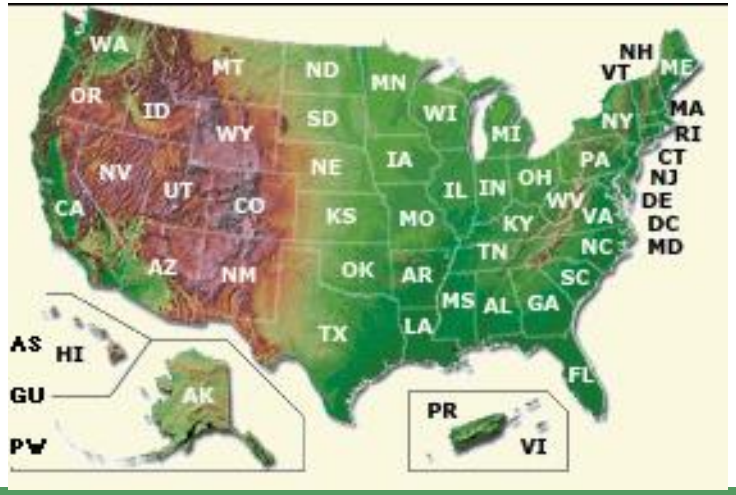
Available:

- Canada
  - NFI (2005) plots not georeferenced (AGB, GSV)
- USA
  - FIA plots with approx. coordinates (AGB, GSV)
- Europe
  - Statistics for counties and provinces



To be acquired:

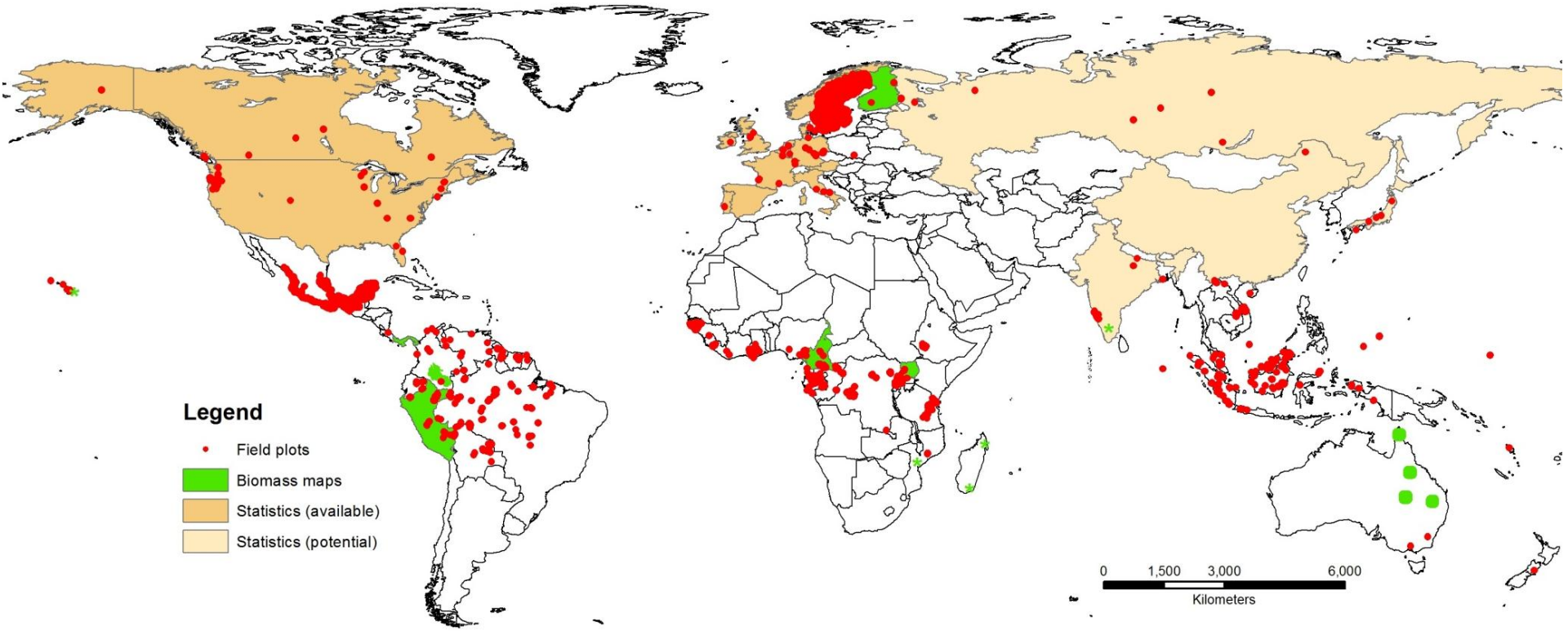
- Russia
- China
- India
- Japan



Ground database - v.02

Version 02 (January 2016):

- 28 ground datasets (12,738 reference plots)
- 14 reference biomass maps



WP2 Data Acquisition

D5: Validation Protocol

Validation approach

CEOS Working Group on Calibration and Validation

Land Product Validation

Subgroup

	Validation Stage - Definition and Current State	Variable
1	Product accuracy is assessed from a small (typically < 30) set of locations and time periods by comparison with in-situ or other suitable reference data.	Fapar Snow Cover Phenology LST & Emissivity Fire Radiative Power
2	Product accuracy is estimated over a significant set of locations and time periods by comparison with reference in situ or other suitable reference data. Spatial and temporal consistency of the product and consistency with similar products has been evaluated over globally representative locations and time periods. Results are published in the peer-reviewed literature.	Leaf Area Index Burned Area
3	Uncertainties in the product and its associated structure are well quantified from comparison with reference in situ or other suitable reference data. Uncertainties are characterized in a statistically rigorous way over multiple locations and time periods representing global conditions. Spatial and temporal consistency of the product and with similar products has been evaluated over globally representative locations and periods. Results are published in the peer-reviewed literature.	Land Cover Albedo Soil Moisture
4	Validation results for stage 3 are systematically updated when new product versions are released and as the time-series expands.	

Stage 1
- Small validation sample

Stage 2
- Significant validation samples
- Spatial/temporal consistency evaluated
- Results published

Stage 3
- Uncertainty fully quantified
- Rigorous sampling

Stage 4
- Systematically updated

http://lpvs.gsfc.nasa.gov/

Validation approach

Uncertainty assessment

Performed by: production teams

Inputs: model and data uncertainties

Outputs: uncertainty metrics and uncertainty maps

Independent validation

Performed by: production teams and independent project partners

Inputs: Validation database and GlobBiomass products

Outputs: error statistics, error analysis

Maps inter-comparison

Performed by: production teams and independent project partners

Inputs : GlobBiomass products + similar existing products

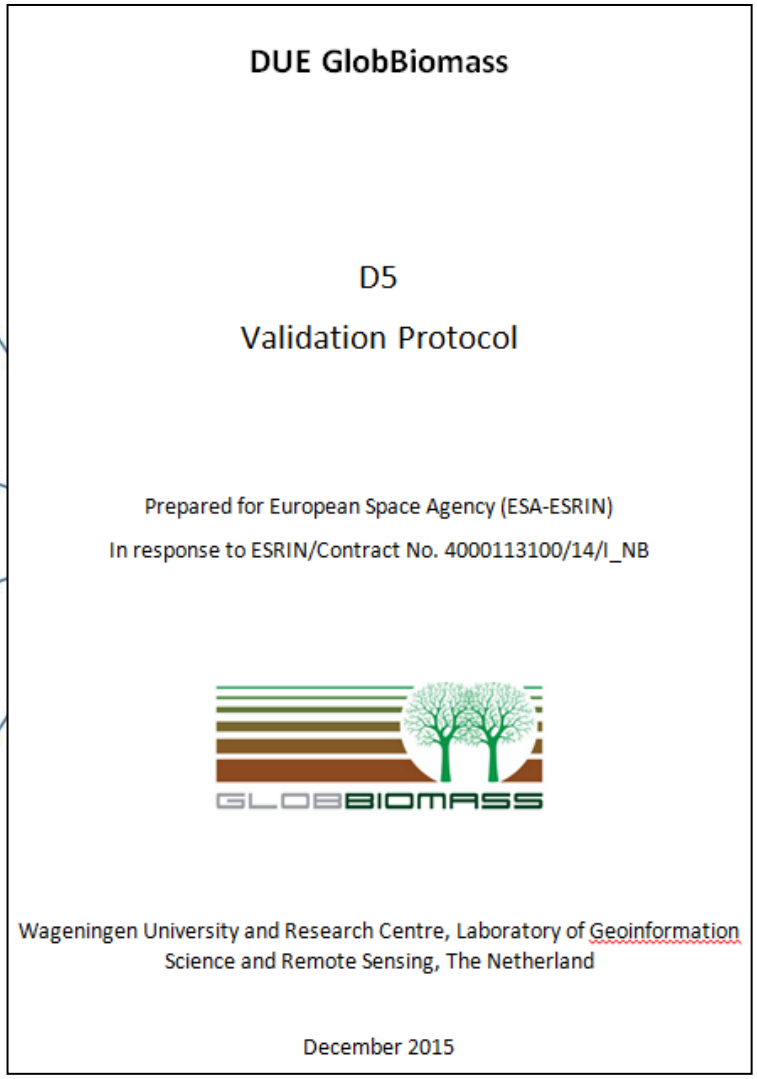
Outputs: discrepancy maps

User assessment

Performed by: user communities

Platforms: Regional teams, Geo-Wiki

Outputs: product assessment and recommendations



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D5

Validation Protocol

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Concepts and definitions

Uncertainty:

› Assess error sources

› Assess model precision / repeatability

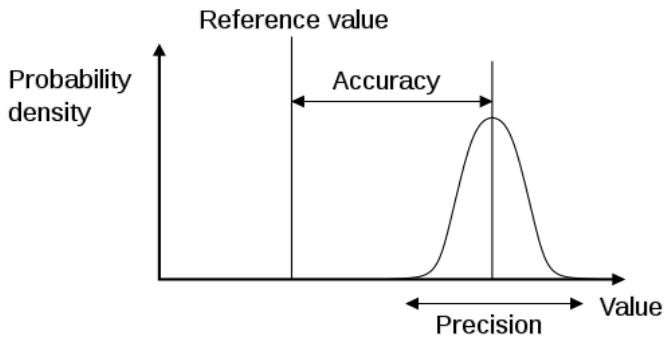
- From multiple model realization (95% Prediction interval, Quality flags)

Accuracy Assessment:

› Compare estimates with reference data

› Output: Error statistics

› Consider bias and precision



Approach: identify optimal (statistical, comprehensive) and reachable targets for assessing biomass products, and future research needs

WP2 Data Acquisition

1. Uncertainty assessment

Uncertainty estimation

Sources of uncertainty:

1. RS data: Technical limitations of remote sensing instruments
2. Additional datasets: Accuracy of input maps, if used
3. Ground data: Amount, distribution and quality of calibration data
4. Model: Uncertainty of models used to transform RS signals in AGB

Approaches for uncertainty estimation:

› Error propagation theory

$$\varepsilon_{AGB} = (\varepsilon^2_{measurement} + \varepsilon^2_{allometry} + \varepsilon^2_{sampling} + \varepsilon^2_{prediction})^{1/2},$$

› Monte-Carlo simulations

Uncertainty estimation

Example: Uncertainty of Reference Data

- Error at tree level
  - Measurement error (Dbh, height, species/wd)
  - Allometry error
- Sampling error
  - Representativeness of plots of AGB of the pixel
  - Representativeness of samples of AGB of the area
- Spatial & temporal mismatch

Define unit of error (or Uncertainty):

- Variance, rel. error, etc.

Define spatial resolution of error

- Compute errors at different resolutions

2. Independent Validation

Validation Data

- Screening for quality criteria
  - Min. plot area, same biomass pool, GPS, ± 1 year or stable area, etc.
- Harmonize
  - Convert to same DBH, use same allometry, etc.
- Aggregation to map resolution

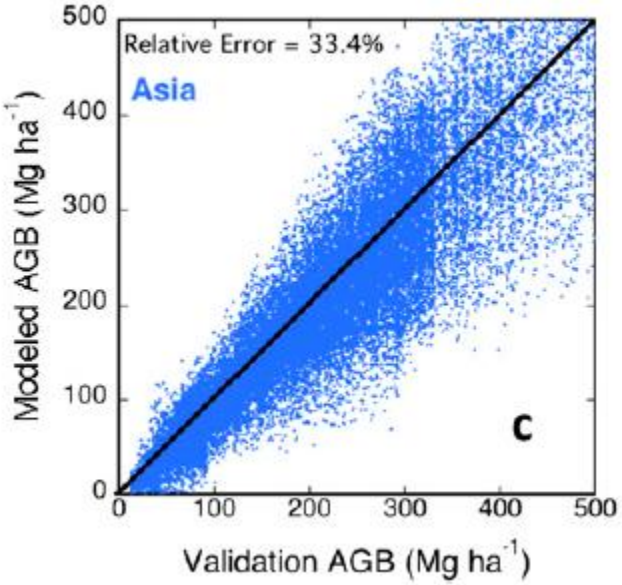
Amount of validation data

- Independent dataset: 10-30% of ground data (random, stratified)
- Cross-validation for very small reference datasets

Validation

Biomass maps

- Accuracy metrics:
  - RMSE
  - Rel. RMSE (%)
  - Bias (mean error)
  - 95% C.I. of the mean (error)
- Compute metrics by biomass class
- Compare histograms/PDF with ref. data
- Include uncertainty of validation data
- Assess representativeness of val. data to biomass distribution



Validation

Biomass change maps

- Validation
  - Use reference data (permanent plots), if available

- Assess consistency
  - Visual analysis of change areas with high-res. images (commission errors)
  - Assess changes on ‘stable areas’ (omission errors)

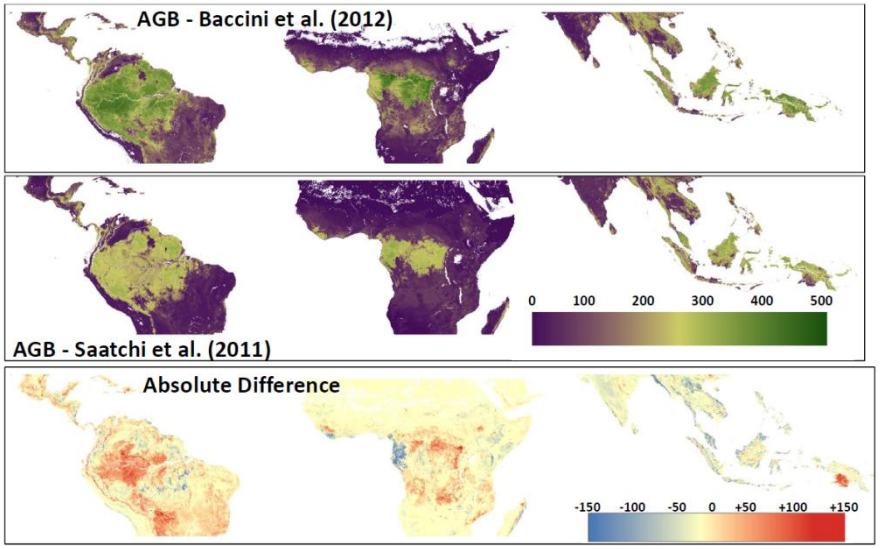
- Assess Uncertainty of change
  - Develop and compare C.I. (Overlapping or separate)

3. Maps inter-comparison

Maps inter-comparison

- Objective:
  - evaluating relative consistency
  - identify areas with higher disagreements
  - assess strengths and weaknesses of different datasets
  - Build confidence in the user communities

- Output:
  - Scale:
    - At pixel level
    - Aggregated resolution
  - Difference metrics:
    - Mean difference, scatterplots, RMSE
  - Difference map
    - Absolute difference
    - Relative difference (%)



4. User assessment

User assessment and feedback

User Assessment is an essential quality control and feedback mechanism

- Objectives:
  - assess the users' acceptance of the products
  - evaluate the quality and limitations from User's perspective
  - obtain recommendations to future improvements
- Metric:
  - Questionnaires
- Output:
  - User survey report

User assessment and feedback

Geo-Wiki