FRM4BIOMASS midterm meeting
WP2 - BIOMASS R package
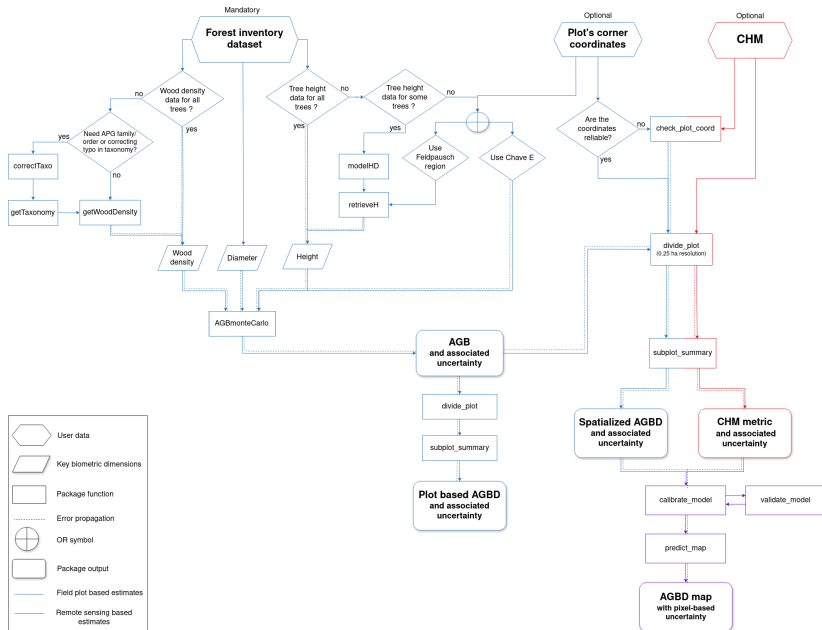
A. Bailly, D. Lamonica, M. Réjou-Méchain

UMR AMAP, IRD

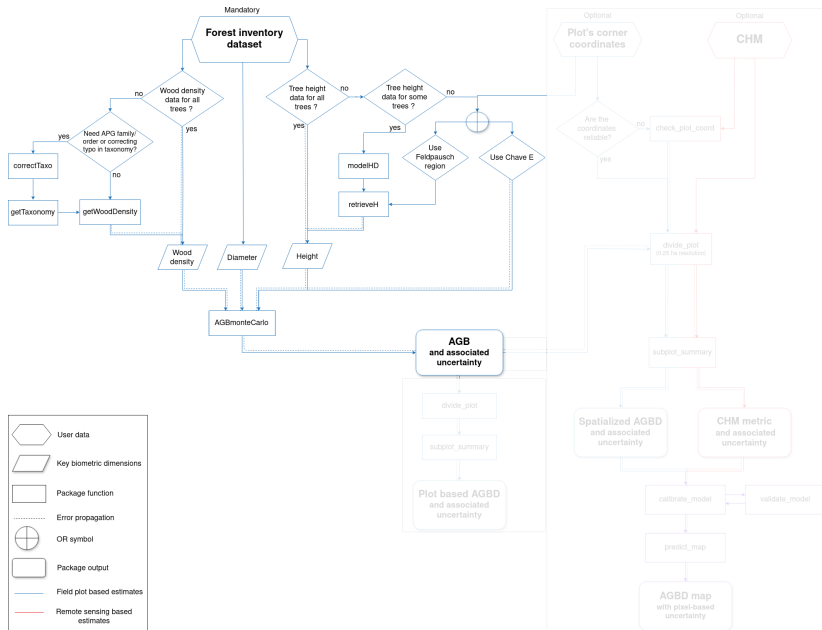2025-06-23

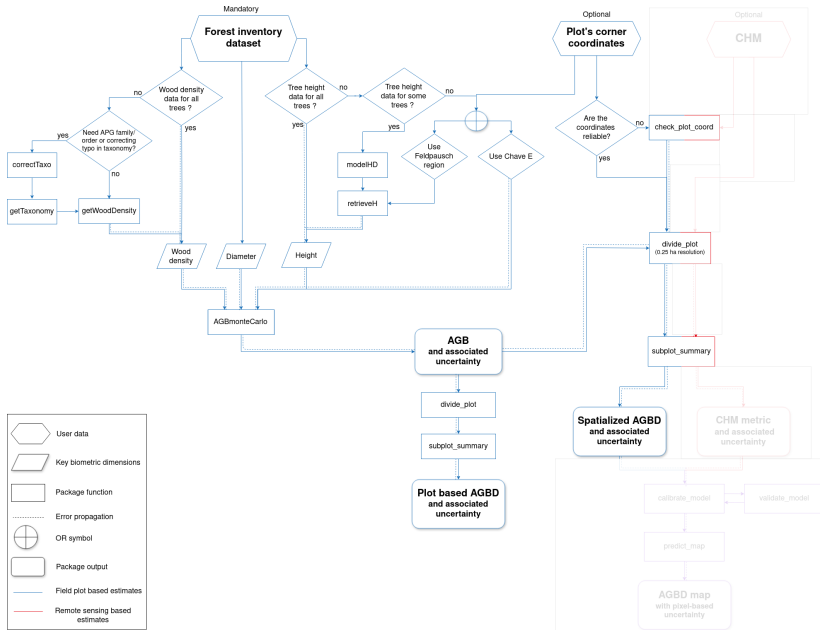# Workflow

FRM4BIOMASS: what has been done & ongoing work

Shiny app for BIOMASS

Spatialization (V2.2)

Spatialization (V2.2.4, CRAN release March 2025)

▶ check plot coordinates

▶ divide plot into subplots

▶ spatialized AGB (*ie* AGBD) products at subplot level

BIOMASS 2.2.4   Articles ▾   Reference

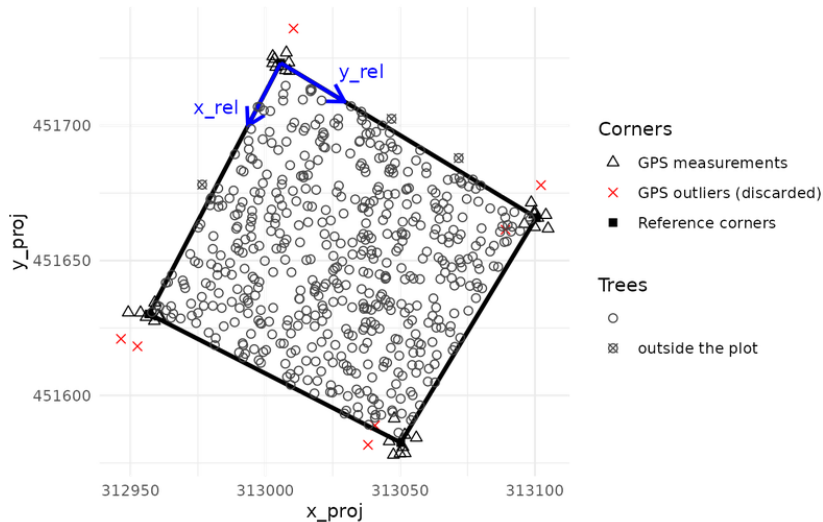# Spatialize trees and forest stand metrics with BIOMASS
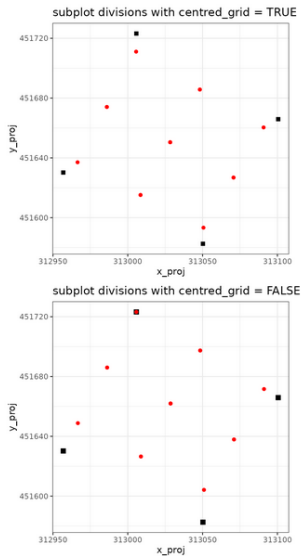
Arthur Bailly

2025-05-22

Source: vignettes/Vignette_spatialized_trees_and_forest_stand_metrics.Rmd
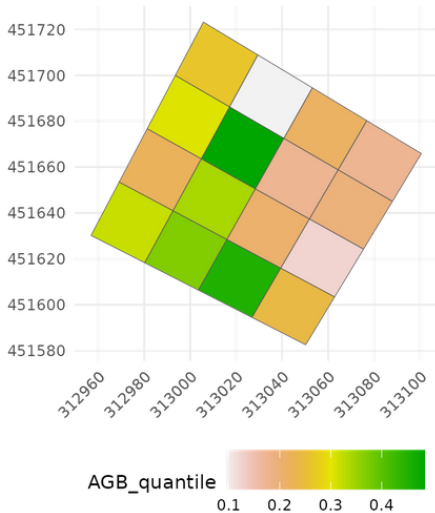
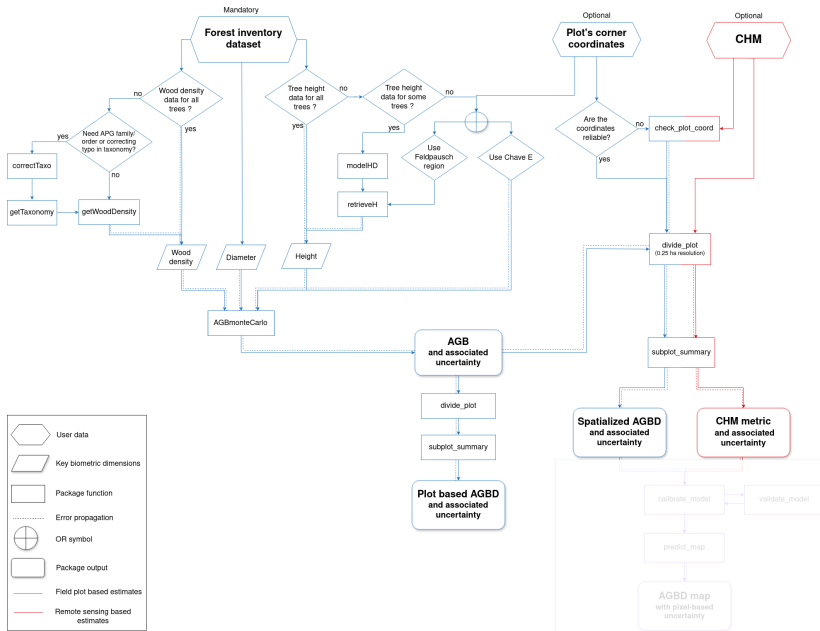# Spatialization (V2.2.4, CRAN release March 2025)

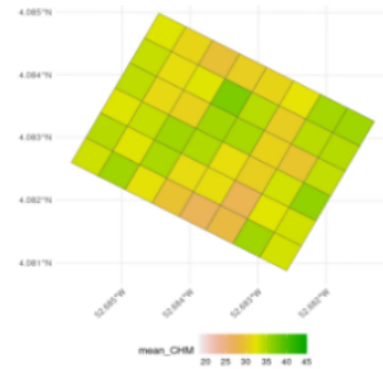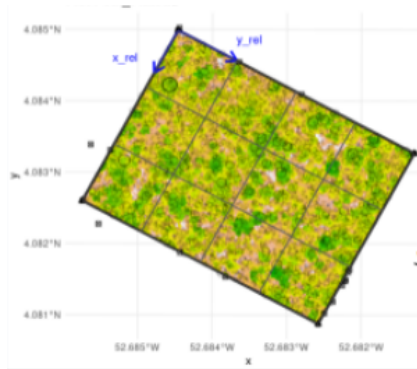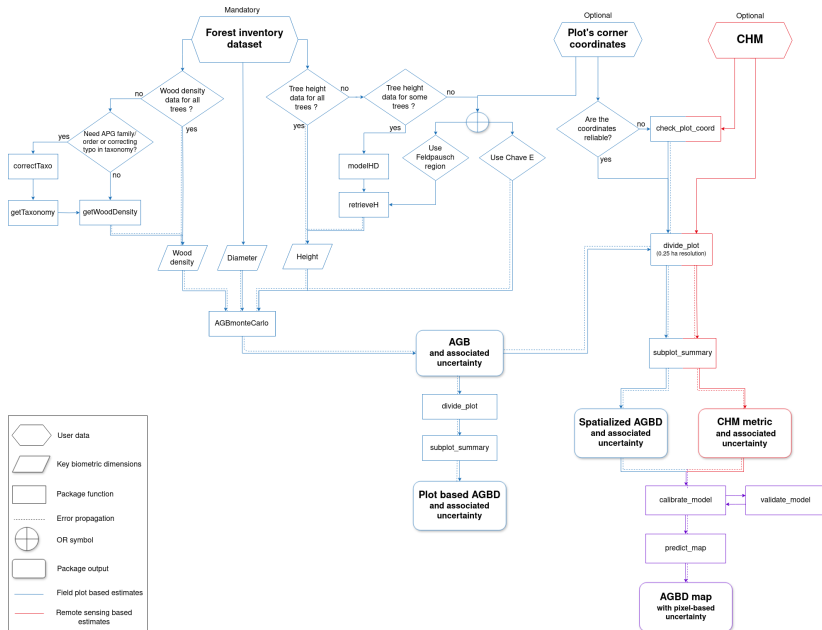# Spatialization (V2.2.4, CRAN release March 2025)

CHM management (V3)

CHM management (V3, implemented but not released yet)

CHM-AGBD model calibration (V3)

CHM-AGBD model calibration: proposed statistical framework

▶ geostatistical model with SPV-I/C (SPatially Varying Intercept/Coefficients) to integrate spatial correlation:

▶ $y(s) = (\alpha + \tilde{\alpha}(s)) + (\beta + \tilde{\beta}(s)) \times x(s) + \epsilon(s)$
with $\tilde{\alpha}(s_1), ..., \tilde{\alpha}(s_n) \sim MVN(0, C_\alpha(s_i, s_j))$

▶ references

Remote Sensing of Environment 169 (2015) 113–127

Contents lists available at ScienceDirect

Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse

ELSEVIER

LiDAR based prediction of forest biomass using hierarchical models with spatially varying coefficients

Chad Babcock [a], Andrew O. Finley [b,*], John B. Bradford [c], Randall Kolka [d], Richard Birdsey [e], Michael G. Ryan [f]

Remote Sensing of Environment 318 (2025) 114557

Contents lists available at ScienceDirect

Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse

ELSEVIER

A geostatistical approach to enhancing national forest biomass assessments with Earth Observation to aid climate policy needs

Neha Hunka [a,*], Paul May [b], Chad Babcock [c], José Armando Alanís de la Rosa [d], María de los Ángeles Soriano-Luna [d], Rafael Mayorga Saucedo [d], John Armston [a], Maurizio Santoro [e], Daniela Requena Suarez [f], Martin Herold [f], Natalia Málaga [f], Sean P. Healey [g], Robert E. Kennedy [h], Andrew T. Hudak [i], Laura Duncanson [a]

CHM-AGBD model calibration: proposed statistical framework

$$y(s) = (\alpha + \tilde{\alpha}(s)) + (\beta + \tilde{\beta}(s)) \times x(s) + \epsilon(s)$$
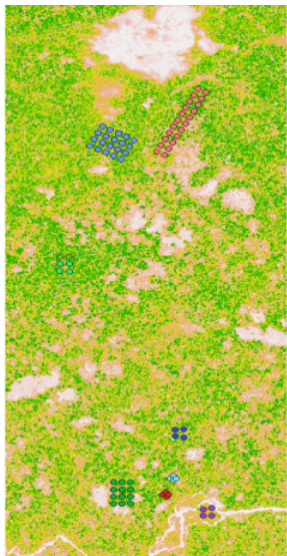
with $\tilde{\alpha}(s_1), ..., \tilde{\alpha}(s_n) \sim MVN(0, C_\alpha(s_i, s_j))$
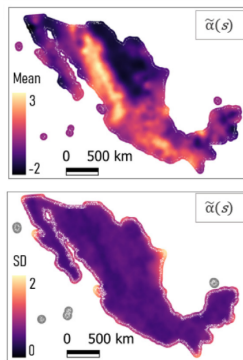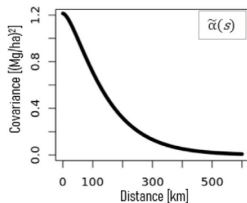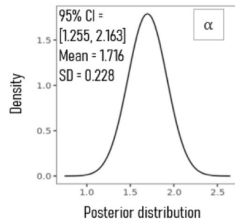
CHM-AGBD model calibration: example with Nouragues data

CHM-AGBD model calibration: implementation possibilities & difficulties

▶ brms package, STAN, geostat module in JAGS

▶ how to propagate AGBD uncertainties, computation wise (eg Monte Carlo procedure, or directly into the model ?)

▶ future statistical development to use all the CHM spatial structure: better use of available information for a more robust & precise full spatial AGBD prediction (for a next major version)

CHM-AGBD model validation

- proposed framework: Ploton et al. (QUEL PAPIER?)
- to be further discussed

Final product: uncertainty sources & how to deal with them

- ▶ wood density, height, diameter
- ▶ plot based AGB prediction: allometric relationship with Monte Carlo procedure
- ▶ plot based AGB density & CHM computation: spatial error with Monte Carlo procedure
- ▶ plot based AGBD-CHM calibration: spatial structure with SPVI/C (Bayesian framework)
- ▶ full spatial AGBD prediction: plot based AGBD uncertainties with Monte Carlo procedure ?

Perspectives

Short term perspectives - with Arthur

▶ Companion paper for V3 BIOMASS R package

▶ Currently under estimation of uncertainties in HD model (only residual error, no parameter uncertainties propagation) → Bayesian inference & propagation (eg, using brms package)

▶ Update wood density database → en attente de Fabian, ce qui nous permettrait d'adopter une approche de propagation d'incertitude plus intégrée

▶ Update taxonomy correction, currently we do not deal with synonymy → en attente de Renato, but his package needs to be on CRAN

▶ Error detection: outliers (diameter, height, wood density)

Long term perspectives - with ?

Temporal BIOMASS

- ▶ propagation des erreurs conjointes sur différentes dates plots & lidar
- ▶ technique pkg implémentation + structure à revoir pour intégrer la dynamique temporelle
- ▶ choix de l'approche allométries/différences de CHM etc

Thank you for your attention