

FRM4BIOMASS midterm meeting

WP2 - BIOMASS R package

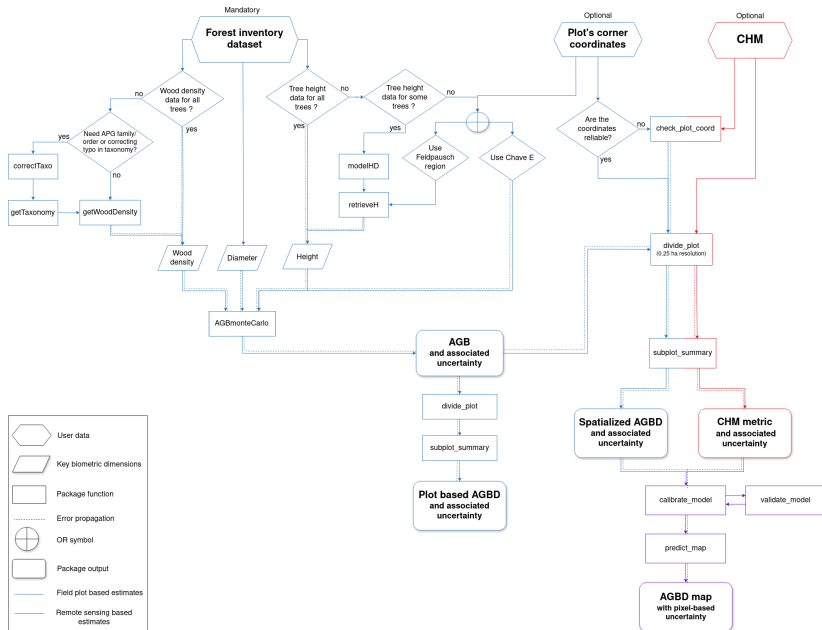
A. Bailly, D. Lamonica, M. Réjou-Méchain

UMR AMAP, IRD

2025-06-23

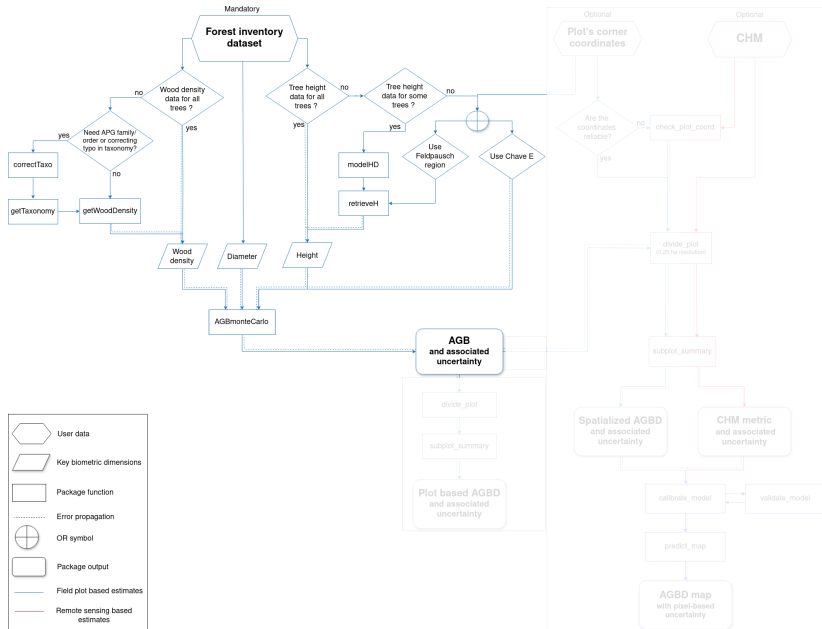


Workflow

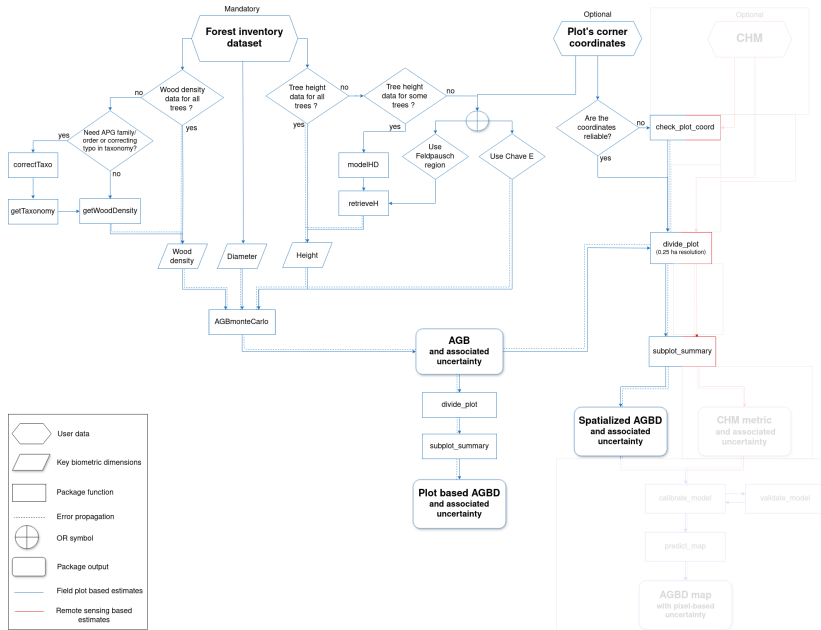


FRM4BIOMASS: what has been done & ongoing work

Shiny app for BIOMASS



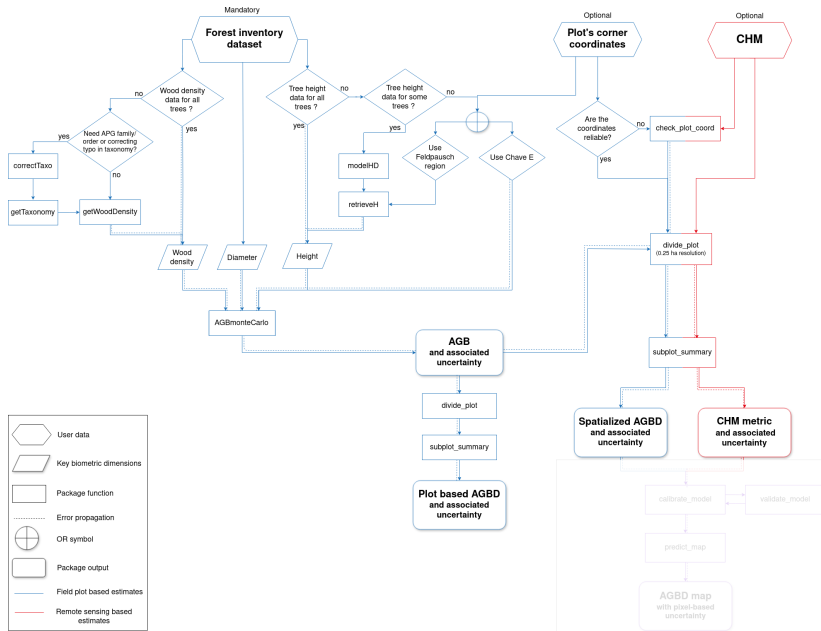
Spatialisation (V2.2)



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- ▶ a bit more details on the features : vignette screen
- ▶ already implemented and published in CRAN V2.2.4 release last March

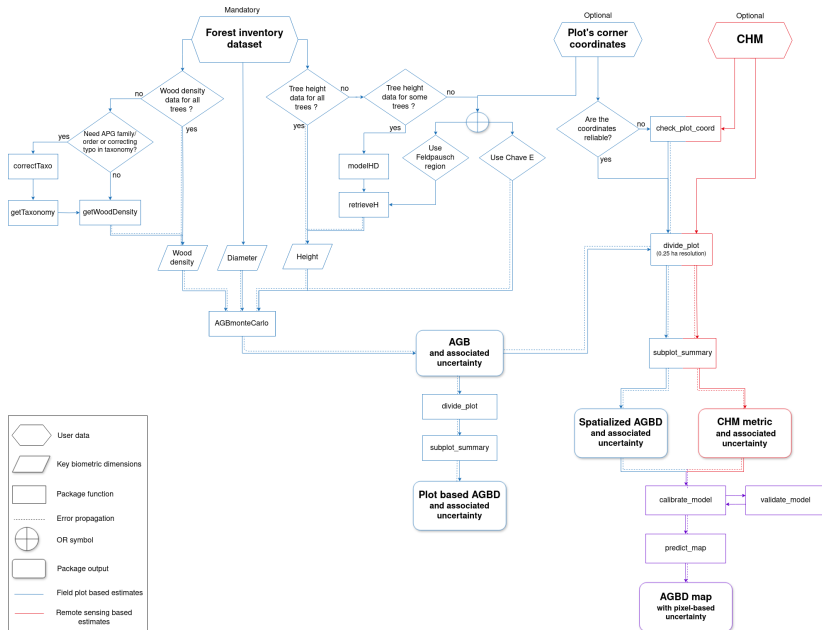
CHM management (V3)



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- ▶ a bit more details on the functions
- ▶ already implemented, not CRAN published 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 $\tilde{\alpha}(s_1), \dots, \tilde{\alpha}(s_n) \sim MVN(0, C_{\alpha}(s_i, s_j))$
- ▶ references



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



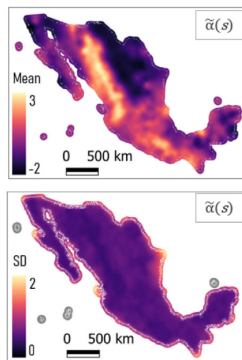
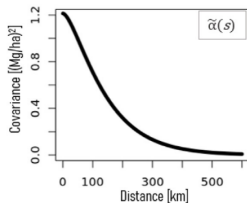
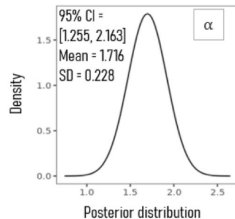
A geostatistical approach to enhancing national forest biomass assessments with Earth Observation to aid climate policy needs

Neha Hunka ^{a,*}, Paul May ^b, Chad Babcock ^c, José Armando Alanís de la Rosa ^d, Maria de los Angeles 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 $\tilde{\alpha}(s_1), \dots, \tilde{\alpha}(s_n) \sim MVN(0, C_{\alpha}(s_i, s_j))$



CHM-AGBD model calibration: example with Nouragues data

first results 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)

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

- ▶ Initiation d'un companion paper sur la V3
- ▶ à l'heure actuelle on sous estime l'incertitude associée au modèle hauteur diamètre car on ne propage pas l'incertitude sur les paramètres d'allométrie -> propagation de toute l'incertitude associée à la hauteur via brms
- ▶ Update de la wood density database -> en attente de Fabian, ce qui nous permettrait d'adopter une approche de propagation d'incertitude plus intégrée
- ▶ Update de la correction taxo -> en attente de Renato : on ne gère pas les synonymes, ce qui est fait par Renato. Par contre tant que le pkg n'est pas sur le CRAN on ne l'intégrera pas
- ▶ Détection d'erreurs dans BIOMASS: outliers du diamètre, hauteur et WD (plus court terme single date)

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