remote sensing

MDPI

Article

SUPPLEMENTARY MATERIAL

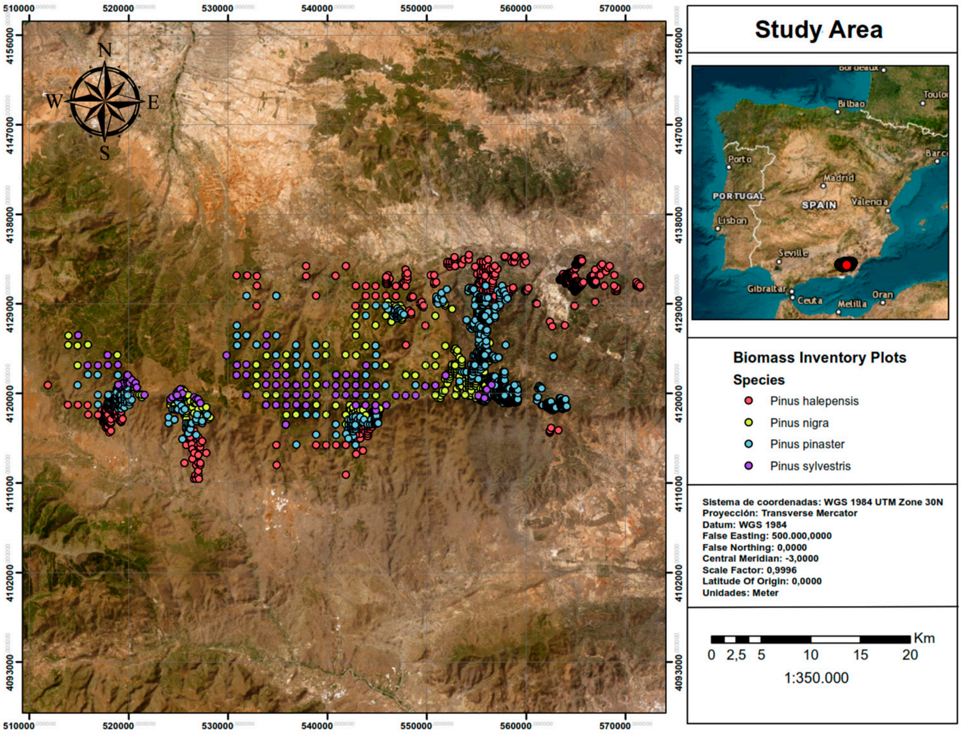


Figure S1. Study area of Pinus spp. plantations in Sierra de los Filabres (Southern Spain) and location of sample plots.

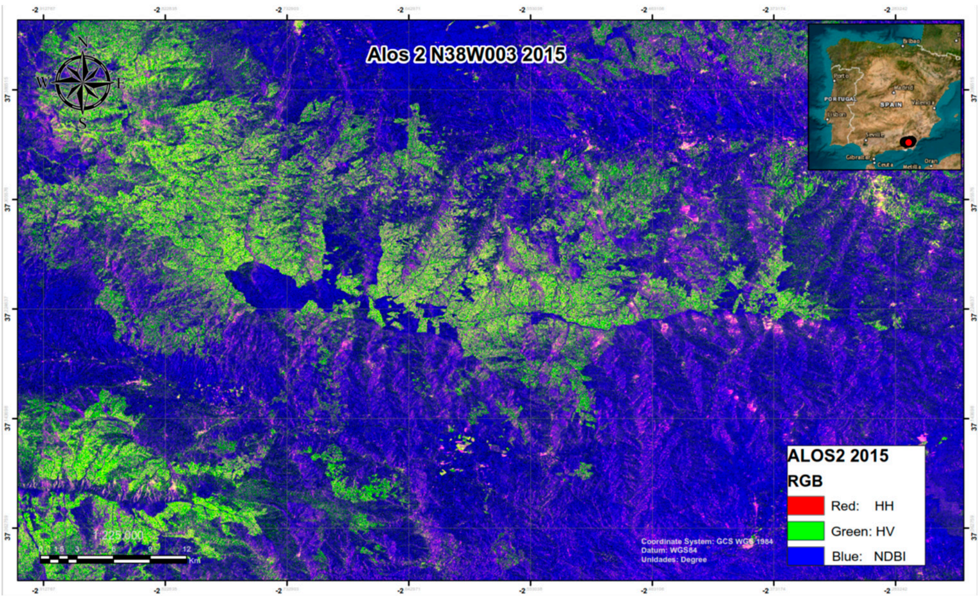


Figure S2. RGB visualization of the ALOS-PALSAR 2 data in the study area, R: HH, G: HV, B: NDBI.

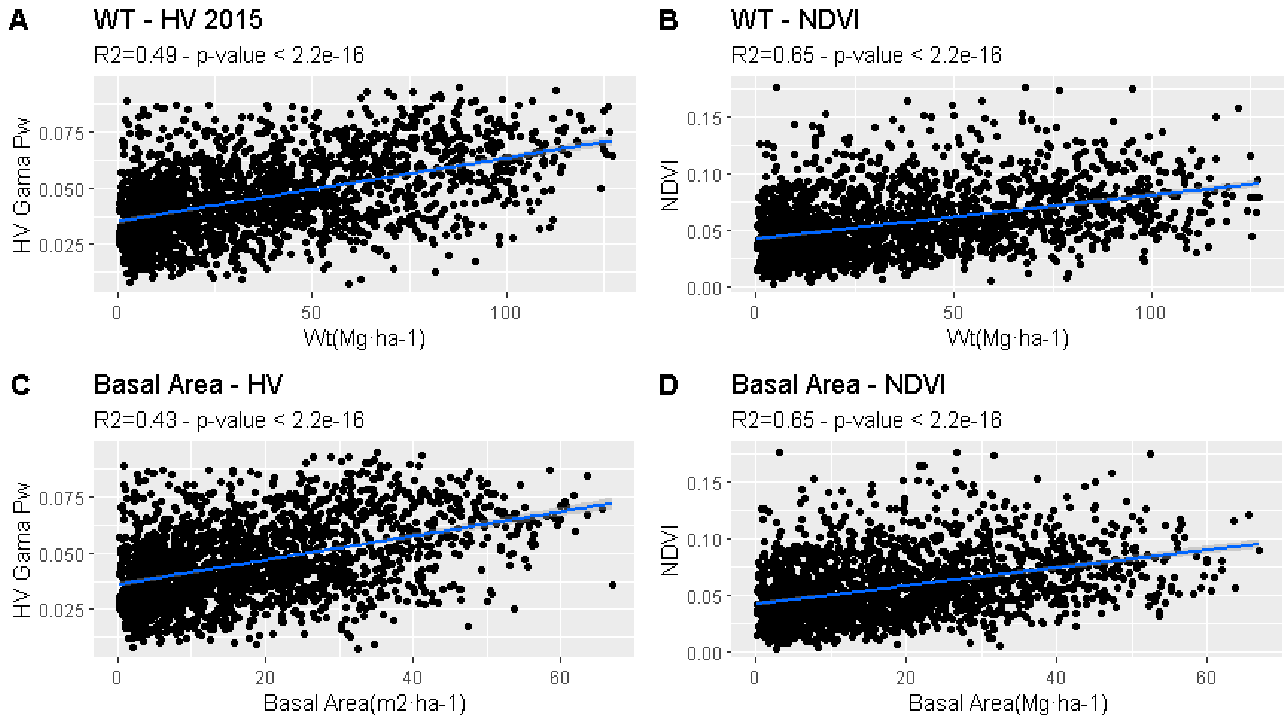


Figure S3. Pearson correlations for NDVI (Landsat 8) and HV (ALOS PALSAR 2) with basal area and biomass of Pinus spp. plantations in Sierra de los Filabres (Southern Spain).

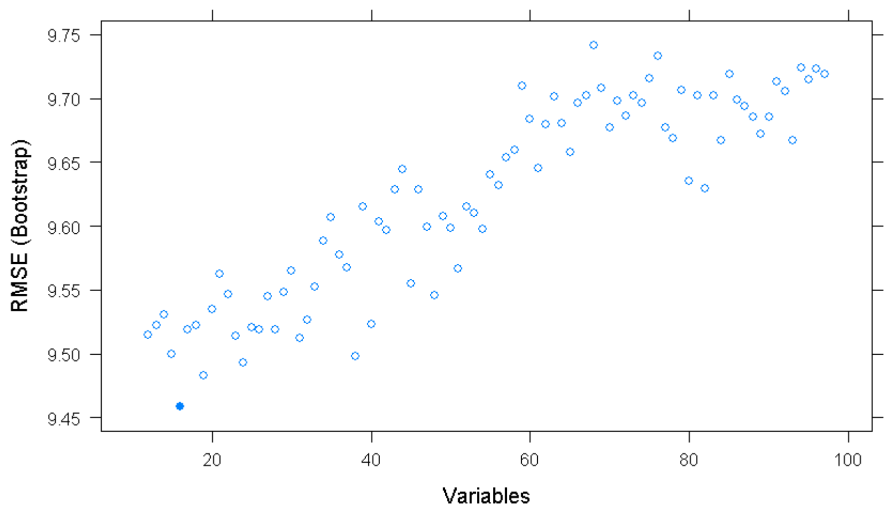


Figure S4. Recursive feature selection, Outer resampling method.

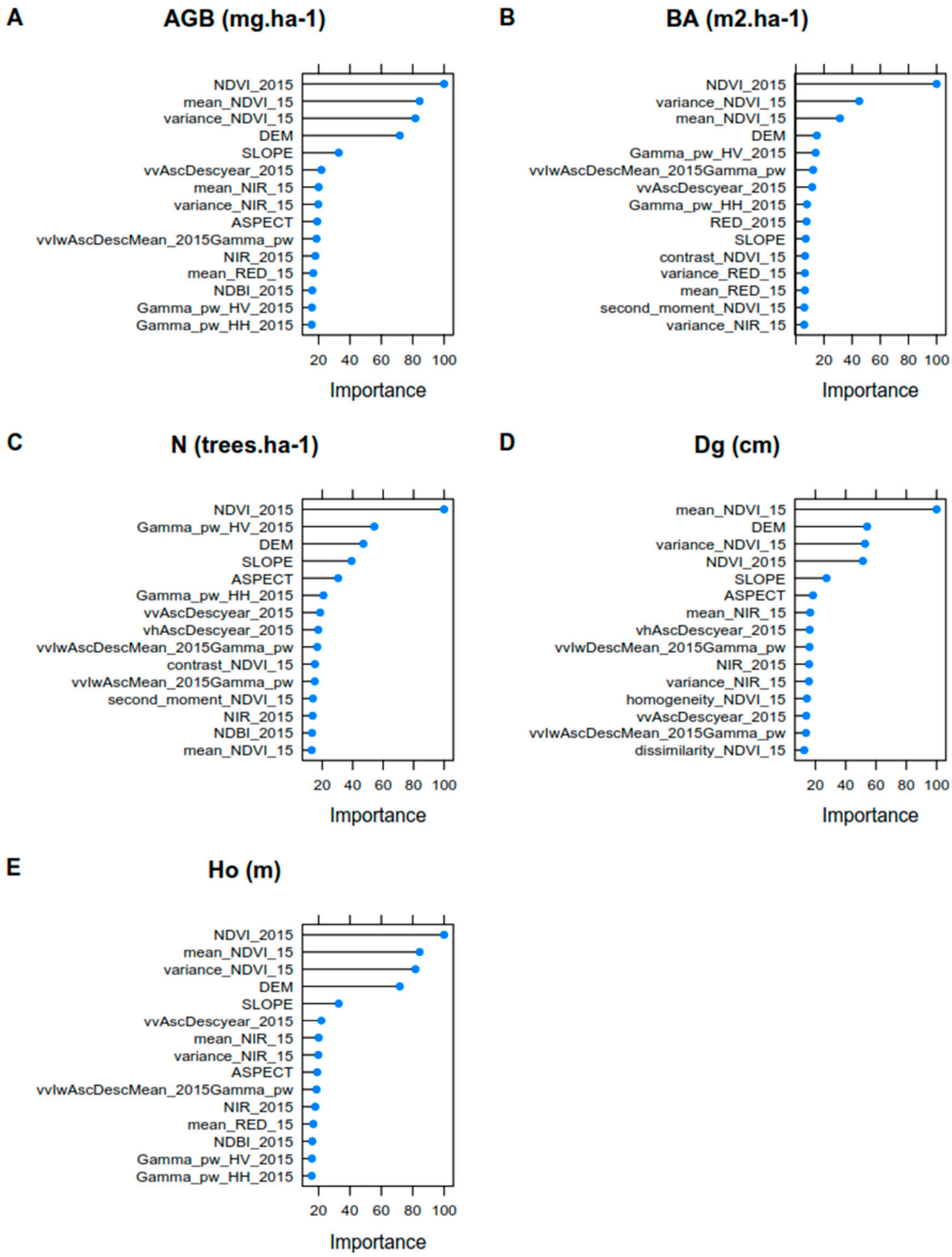


Figure S5. Variance importance ranking predictors in the best fit random forest models for AGB Wt, Basal area BA, N trees per hectare and dimeter of the tree for 2015.

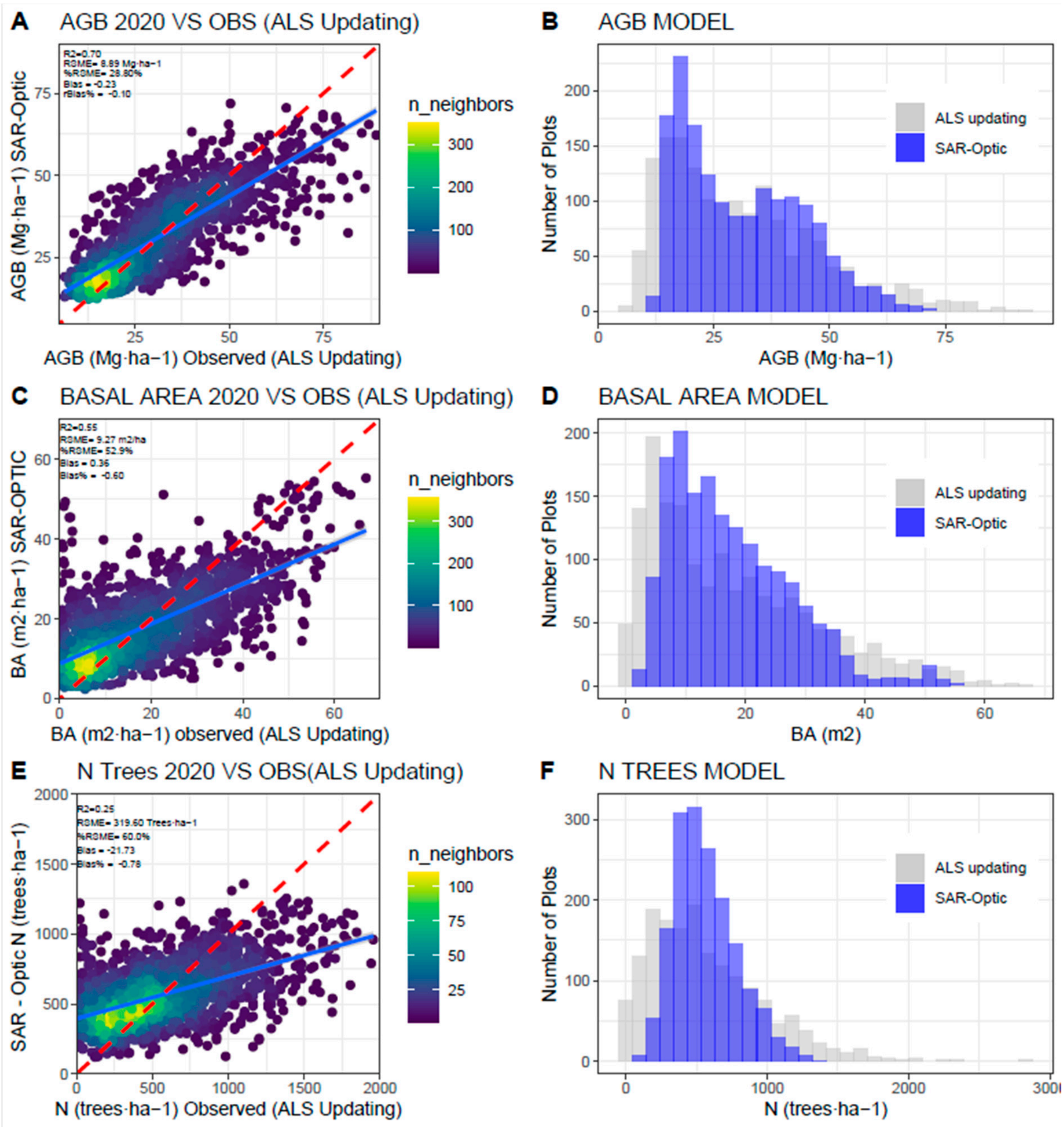


Figure S6. Coefficients of model validation test of the final models ALOS PALSAR 2 – SENTINEL1 - LANDSAT8 for 2015, the red line shows the 1:1-line references, the blue line shows the random forest regression model.

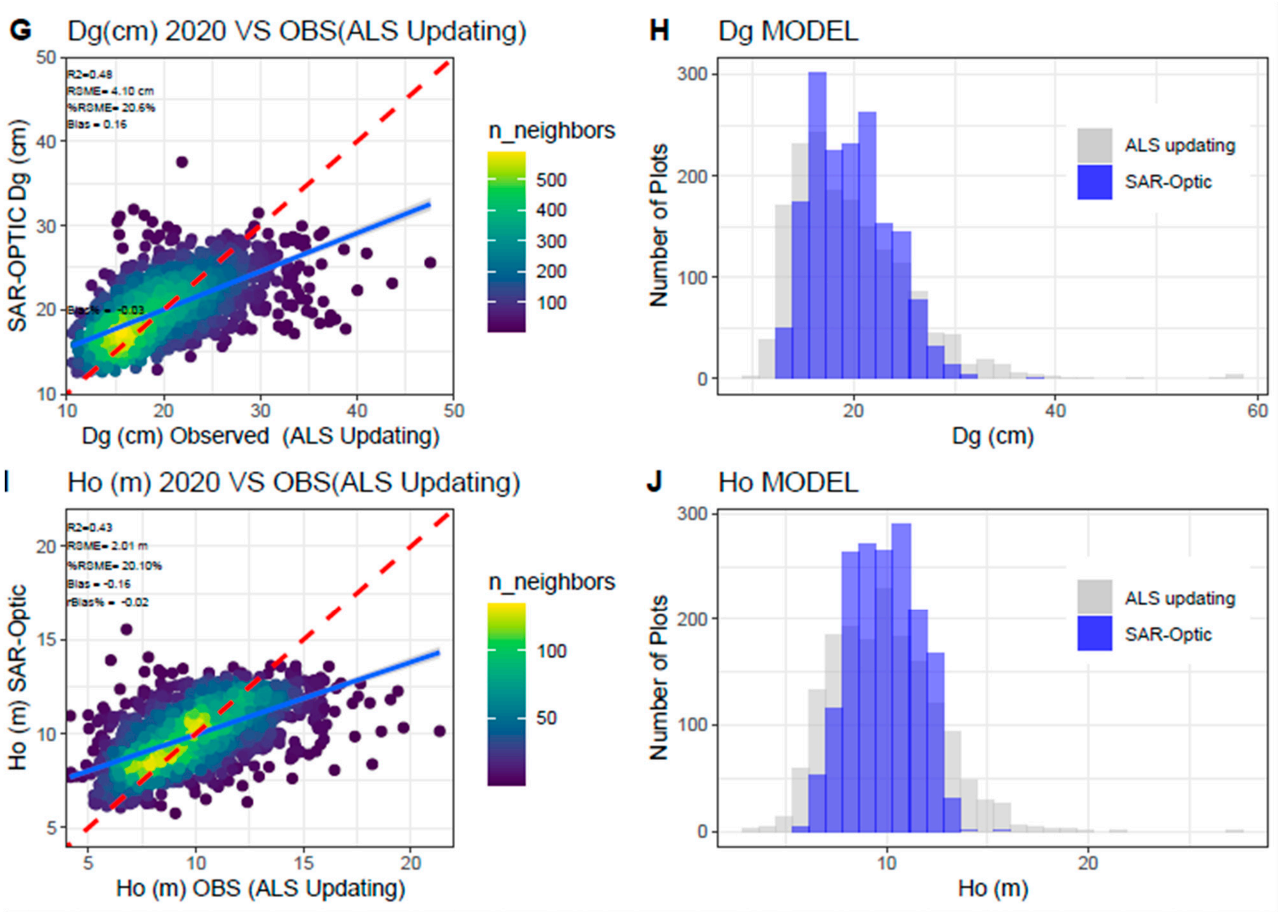


Figure S6. (Continued)

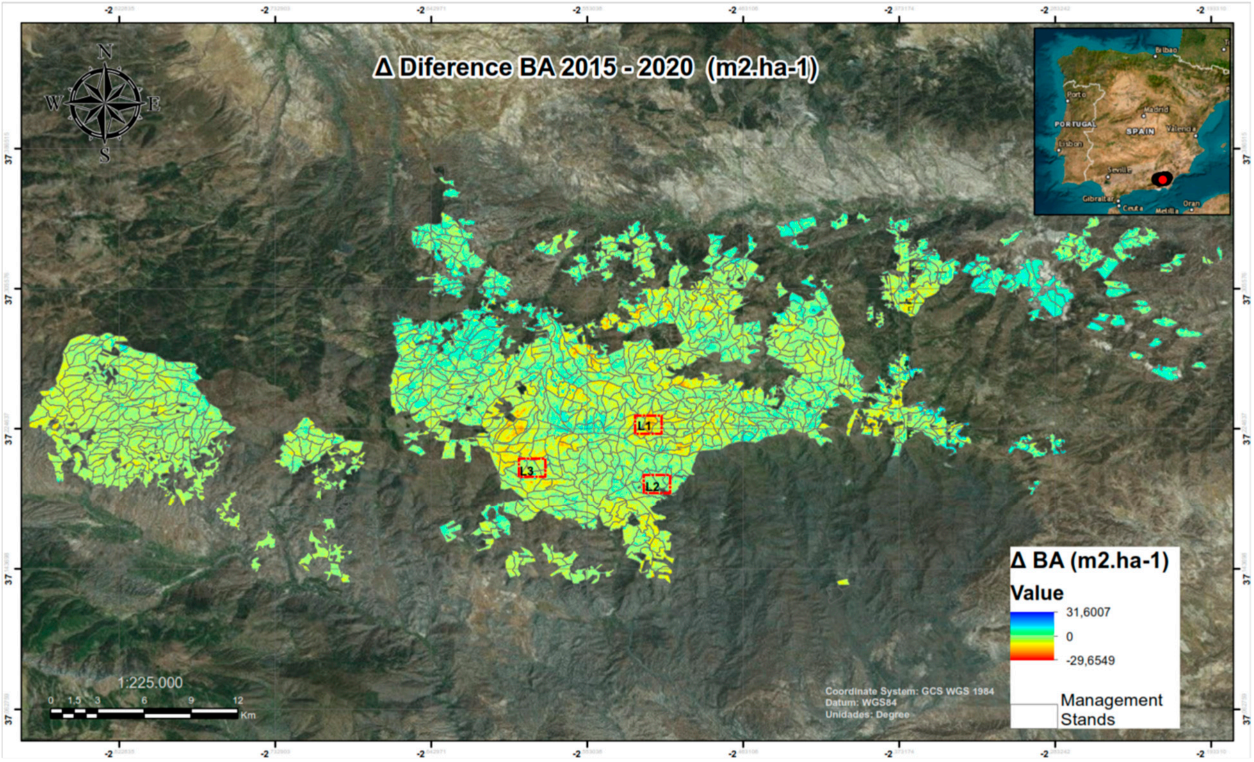


Figure S7. Basal Area (ba) change between 2015 – 2020 using ALOS PALSAR 2- Sentinel 1 -Landsat 8 Random Forest model and textures of second order in *Pinus* spp. plantations in Southern Spain.

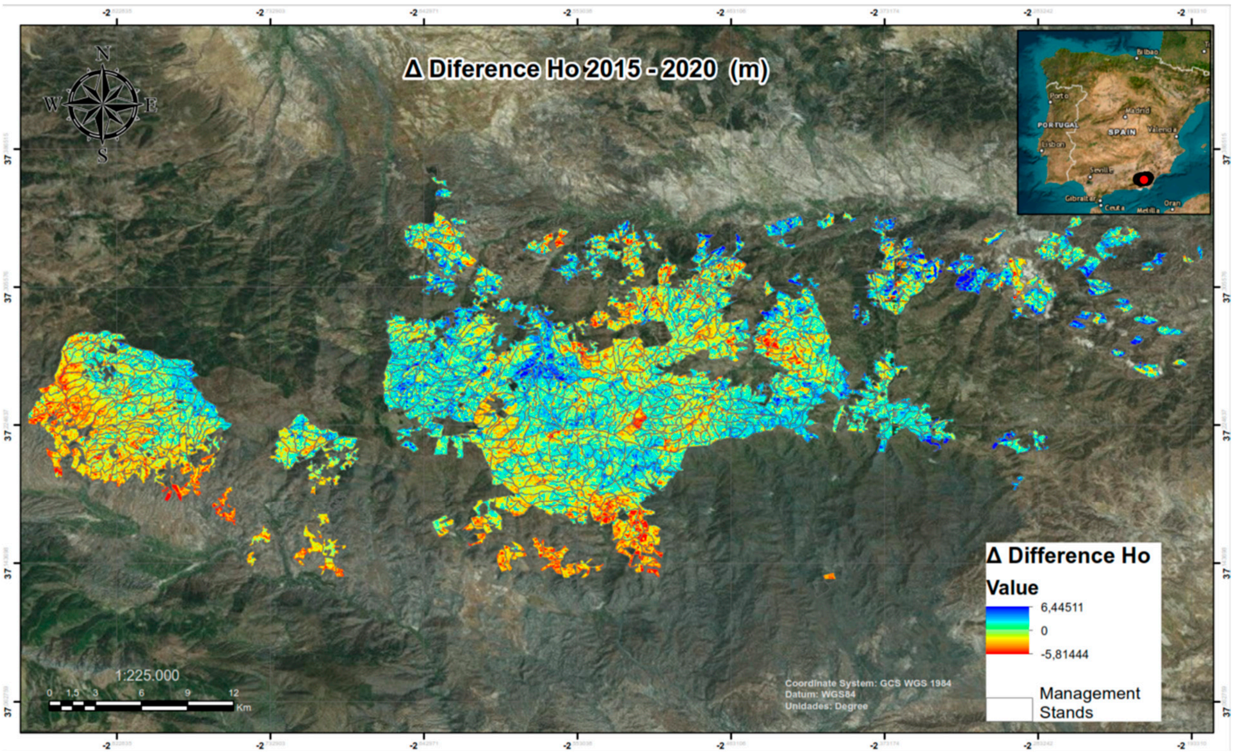


Figure S8. Assman Dominant Height (Ho) change between 2015 – 2020 using ALOS PALSAR 2- Sentinel 1 -Landsat 8 Random Forest model and textures of second order in *Pinus* spp. plantations in Southern Spain.

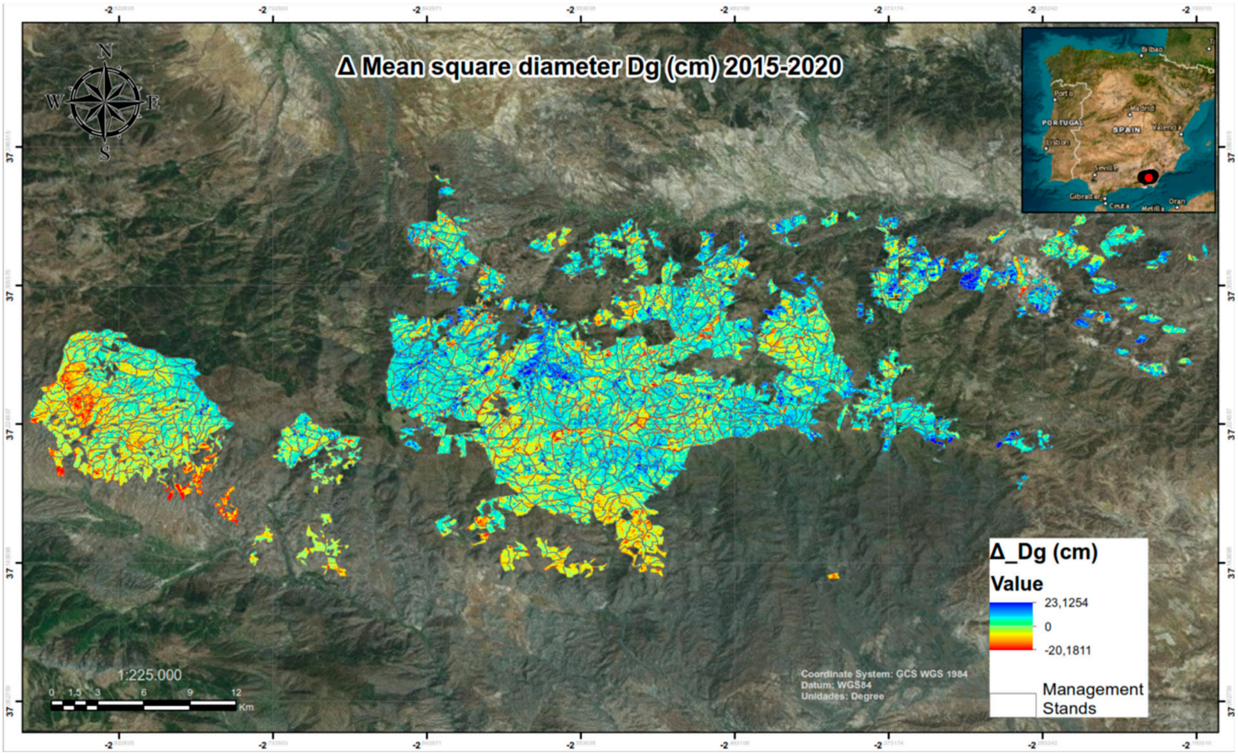


Figure S9. Δ Mean square diameter (Dg) change between 2015 – 2020 using ALOS PALSAR 2- Sentinel 1 -Landsat 8 Random Forest model and textures of second order in *Pinus* spp. plantations in Southern Spain.

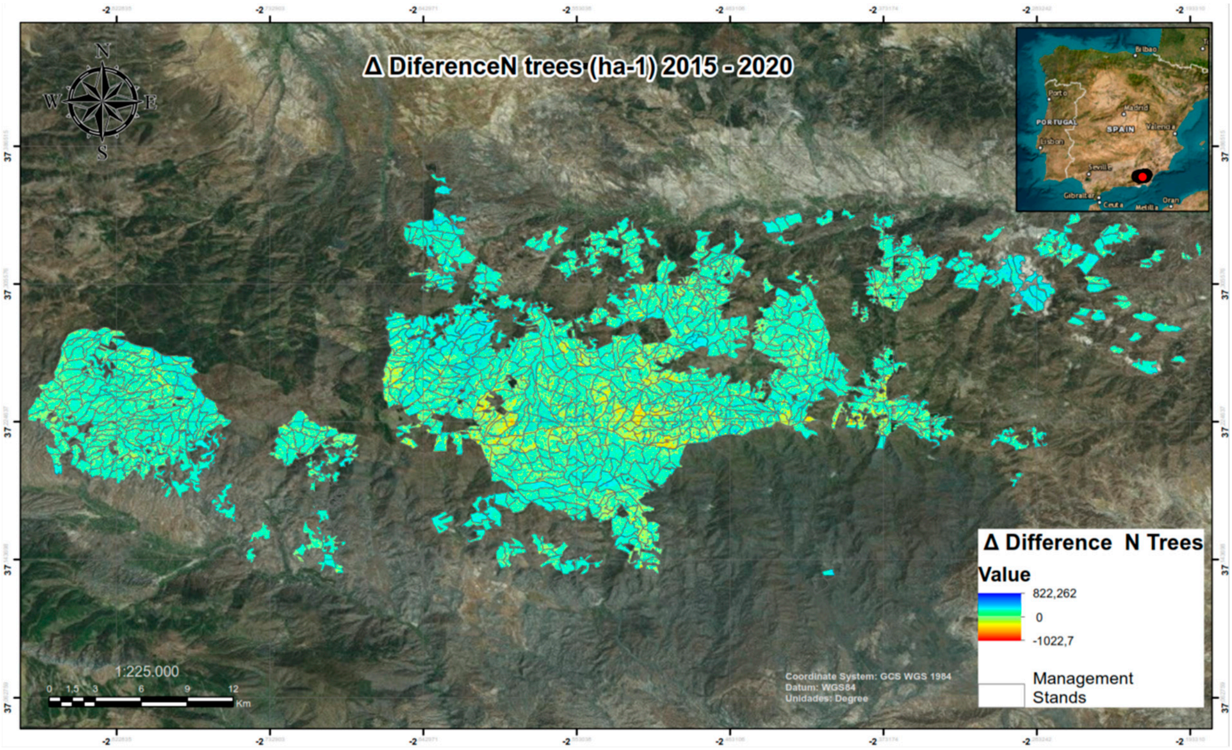
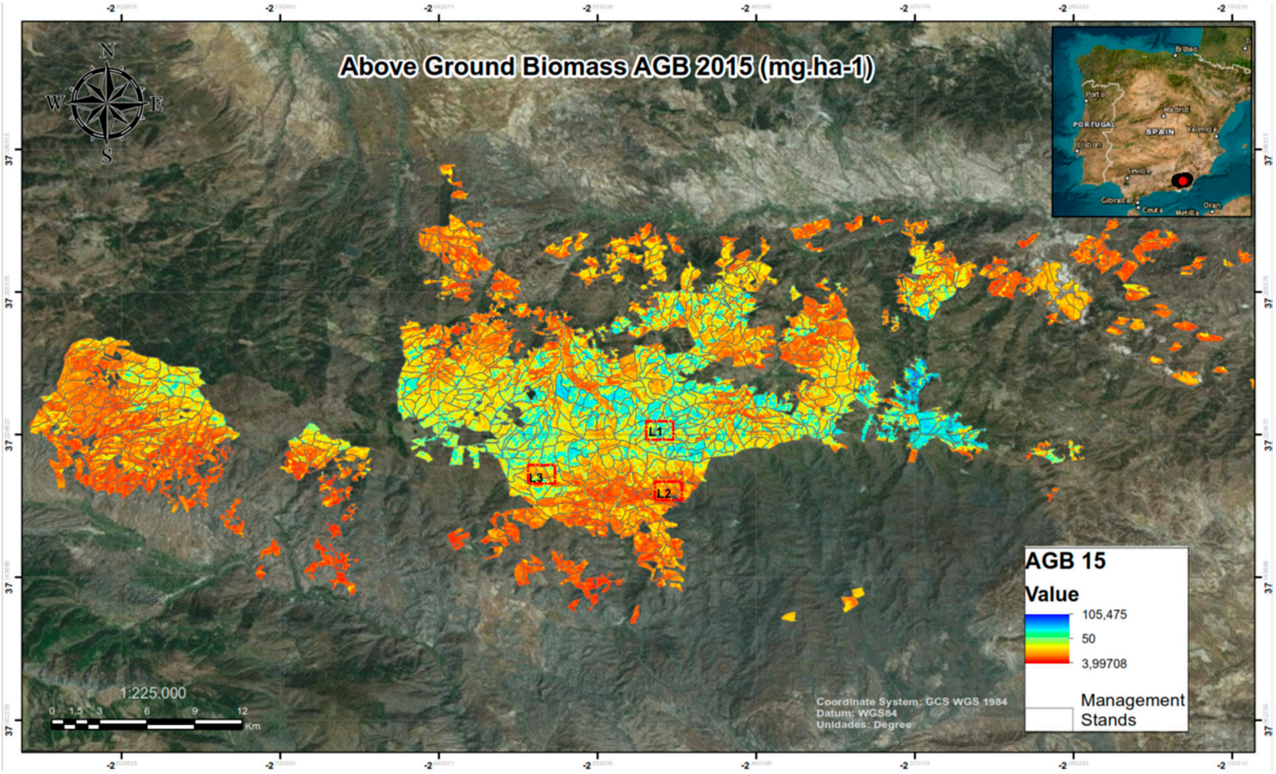
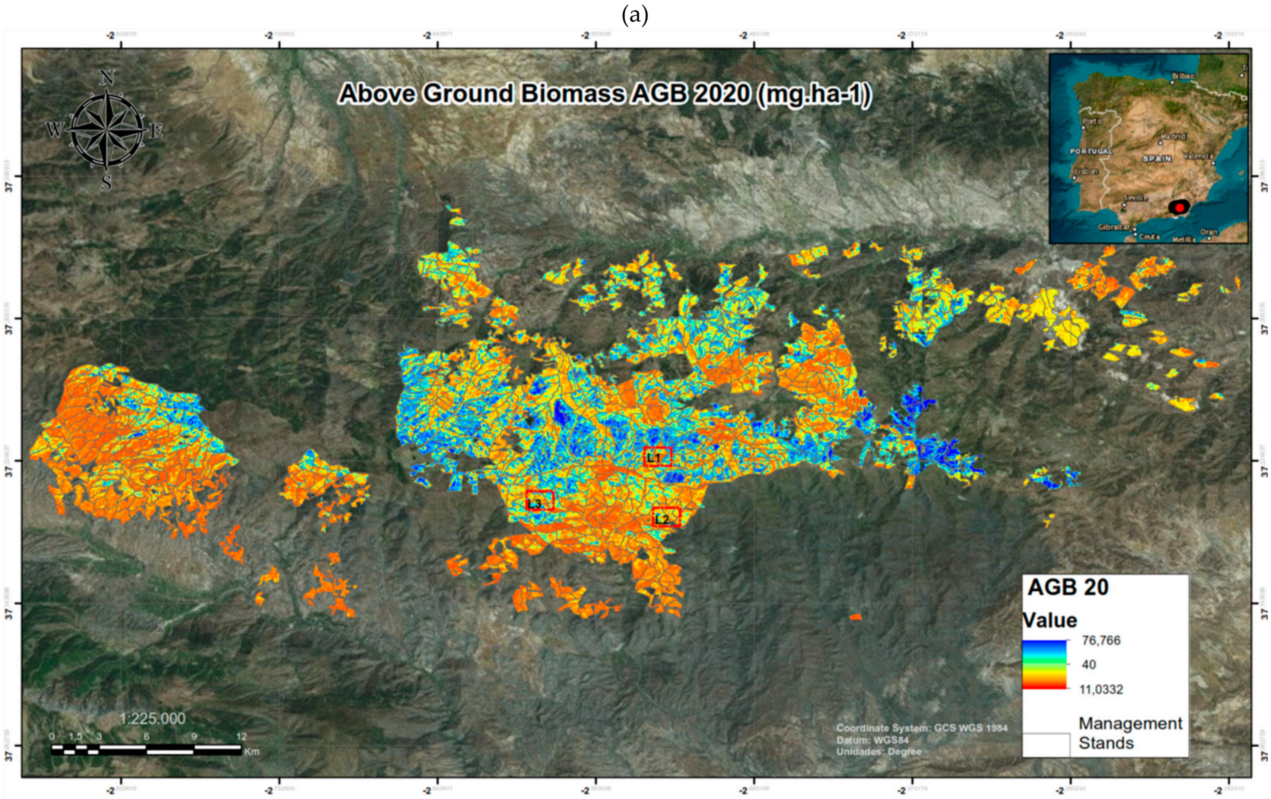


Figure S10. Δ Difference Number of trees (ha-1) change between 2015 – 2020 using ALOS PALSAR 2- Sentinel 1 -Landsat 8 Random Forest model and textures of second order in *Pinus* spp. plantations in Southern Spain.



(a)



(b)

Figure S11. **a.** Map of AGB biomass 2015, **b.** Map of AGB biomass 2020.

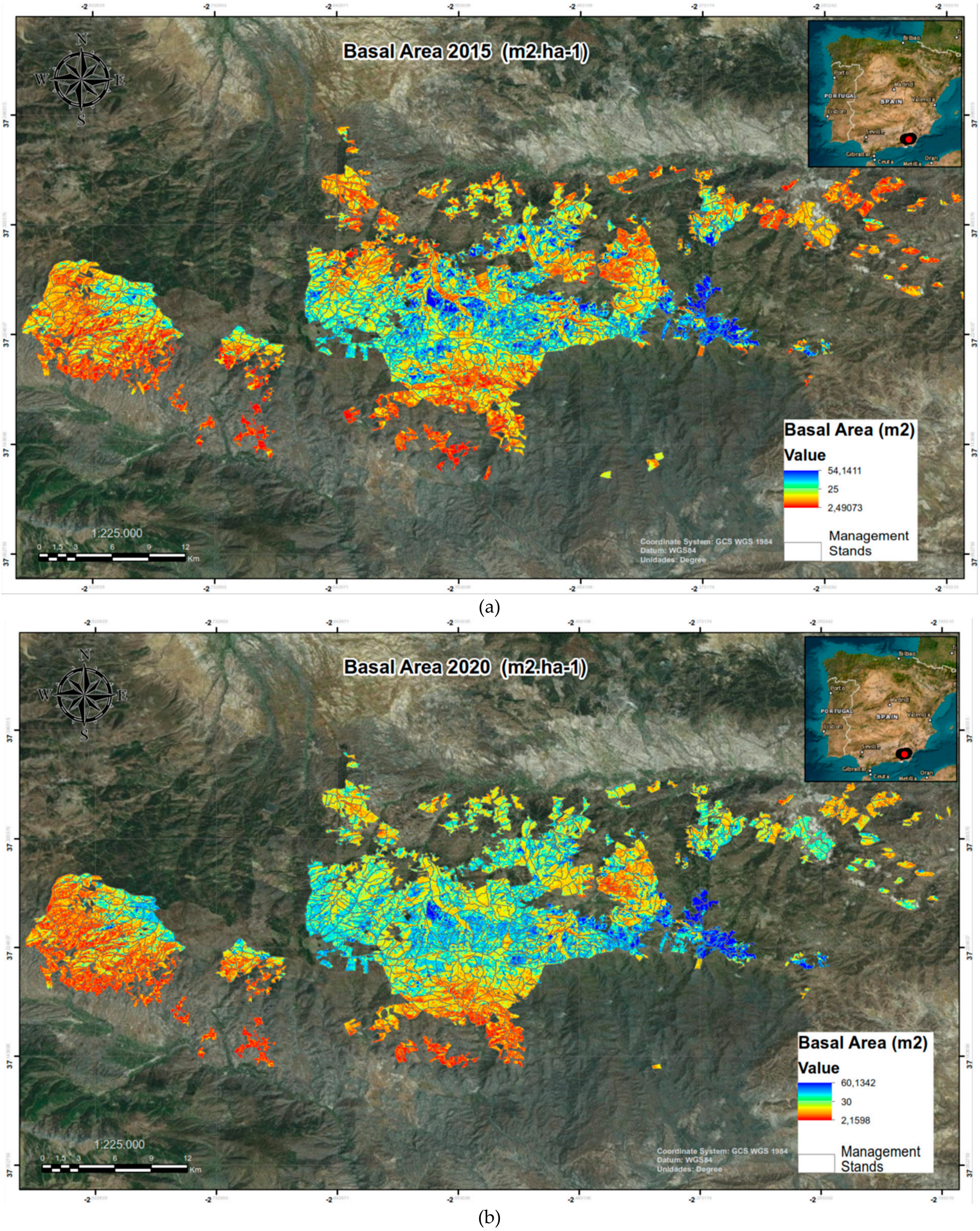
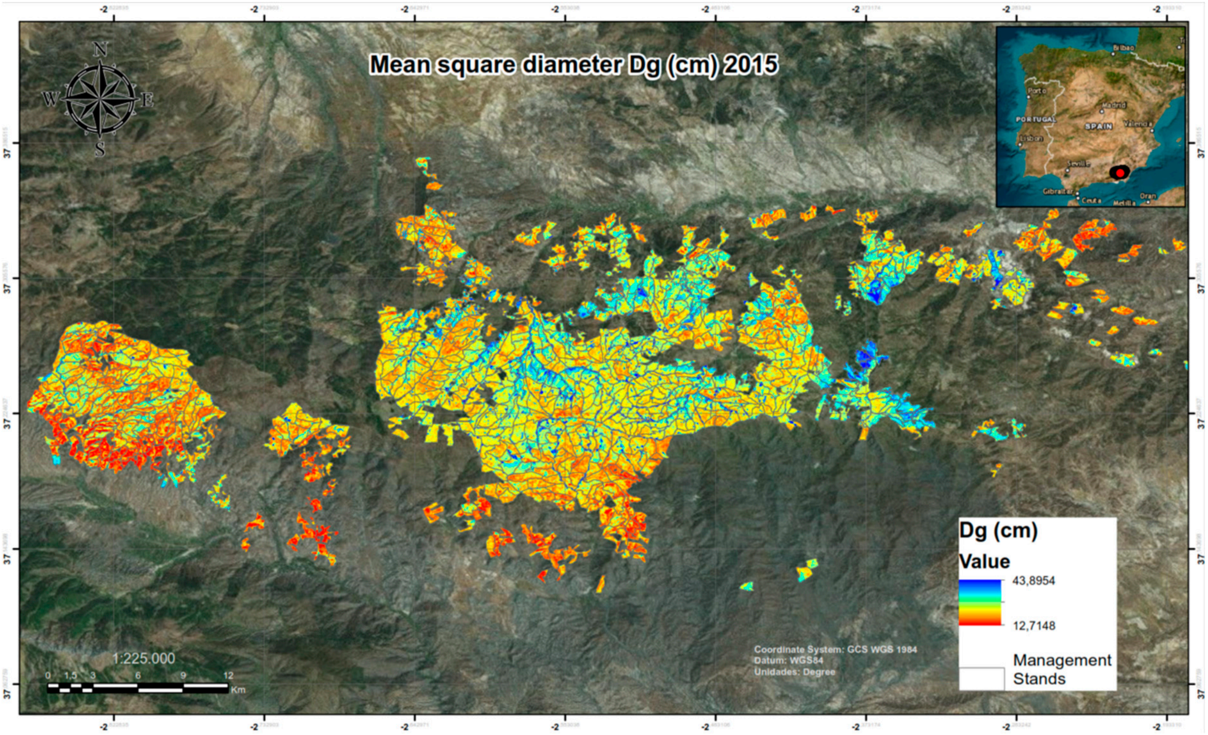
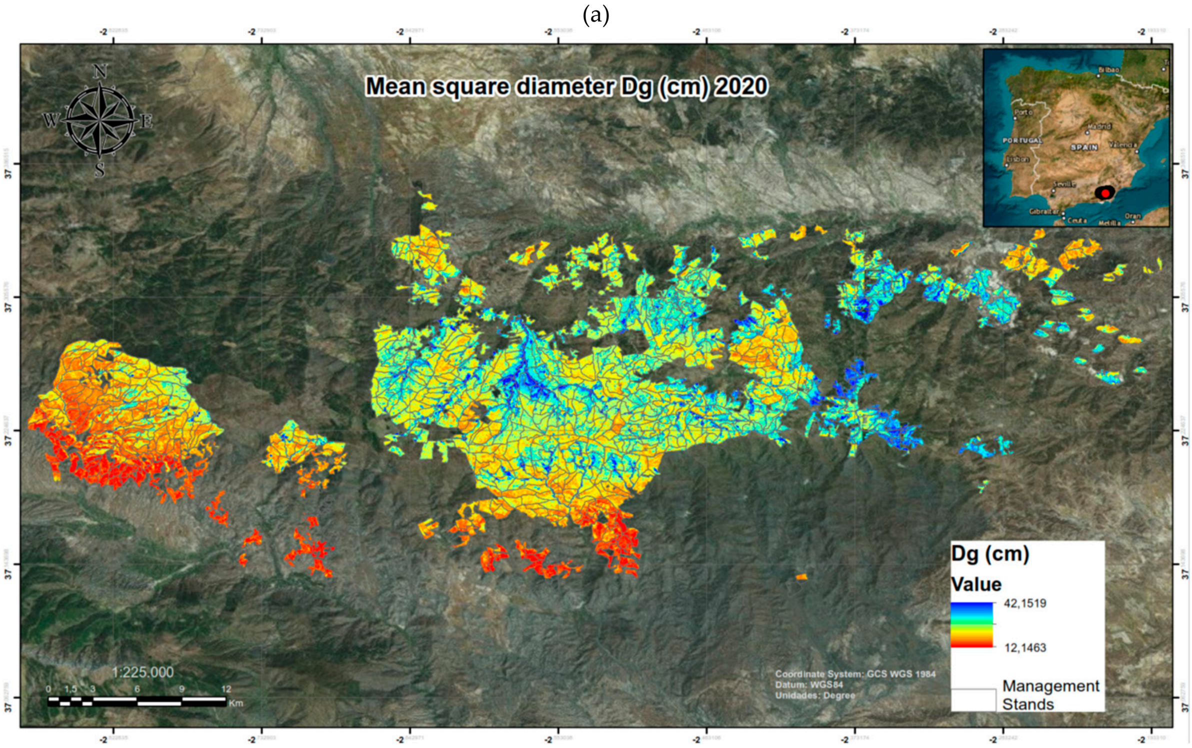


Figure S12. a. Map of Basal Area 2015 **b.** Map of Basal Area 2020.

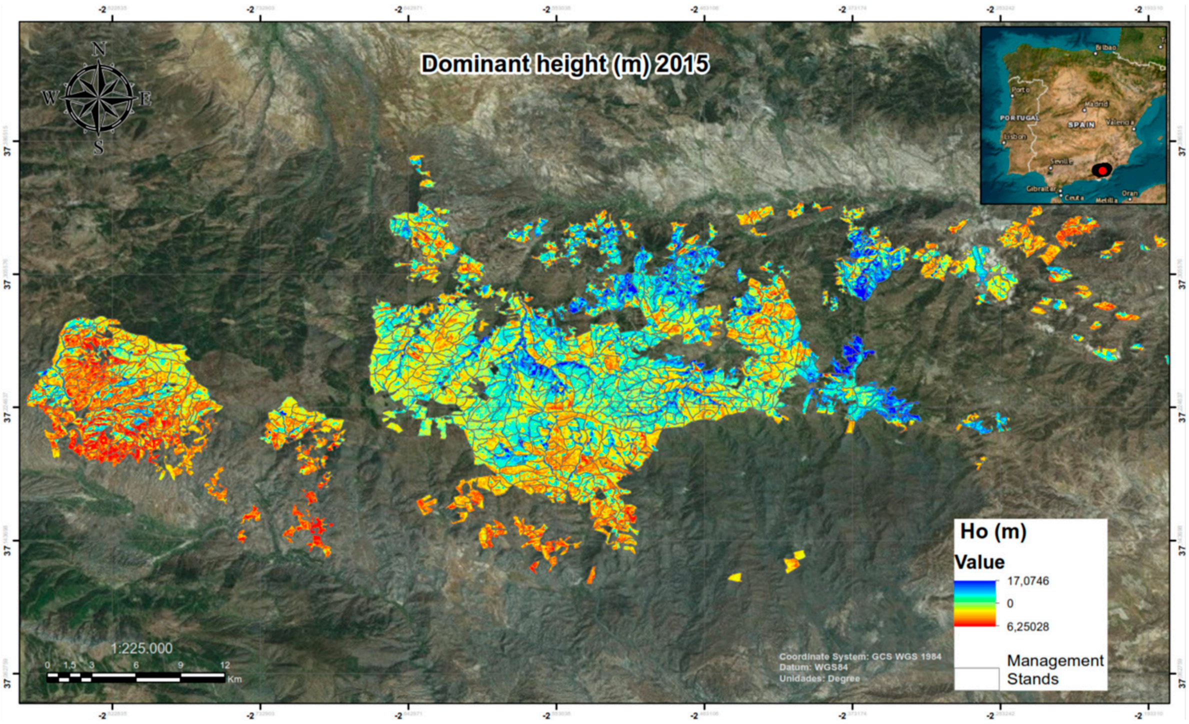


(a)

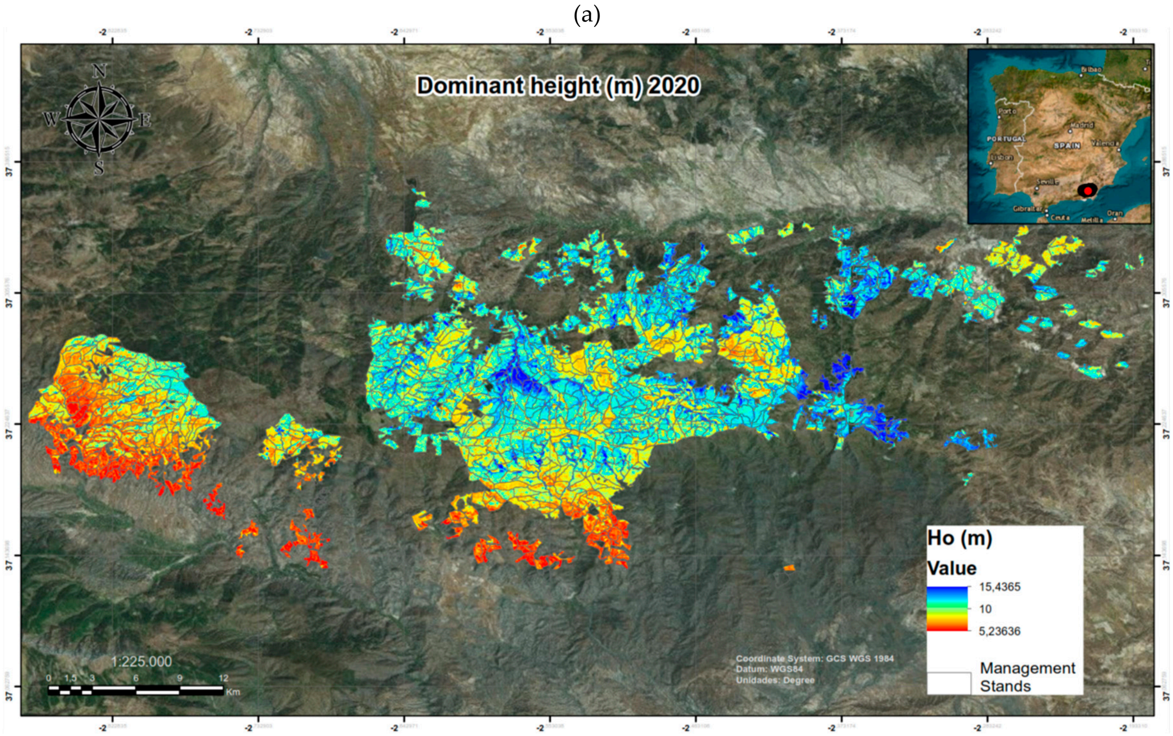


(b)

Figure S13. a. Map of mean square diameter D_g 2015, **b.** Map of mean square diameter D_g 2020.

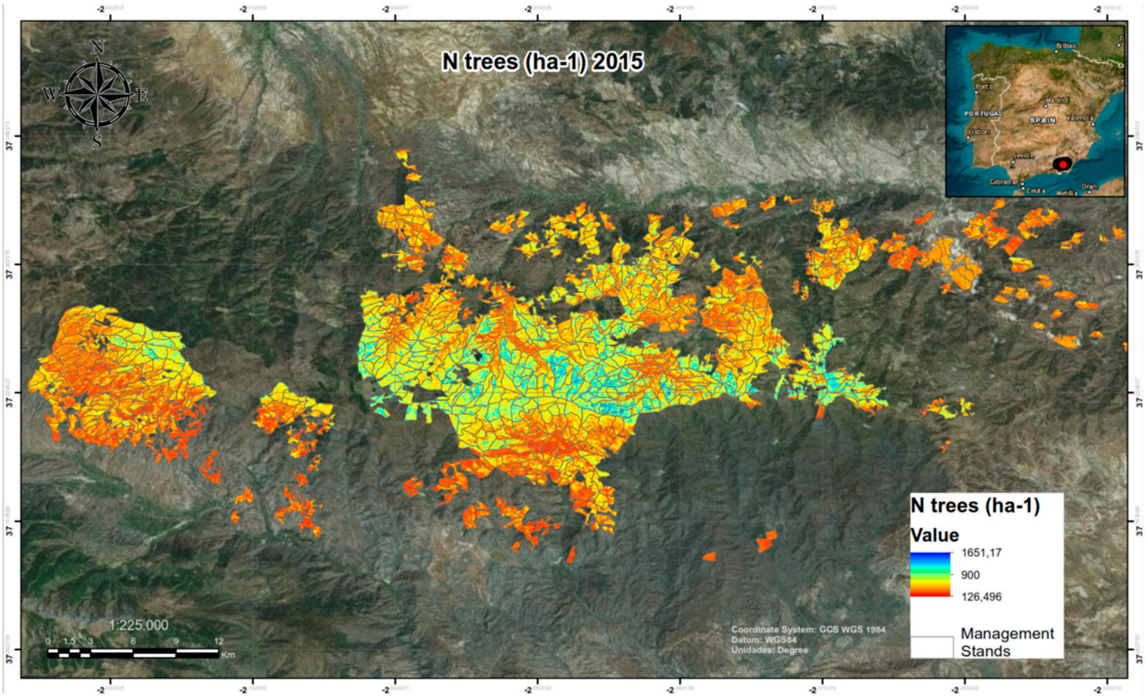


(a)

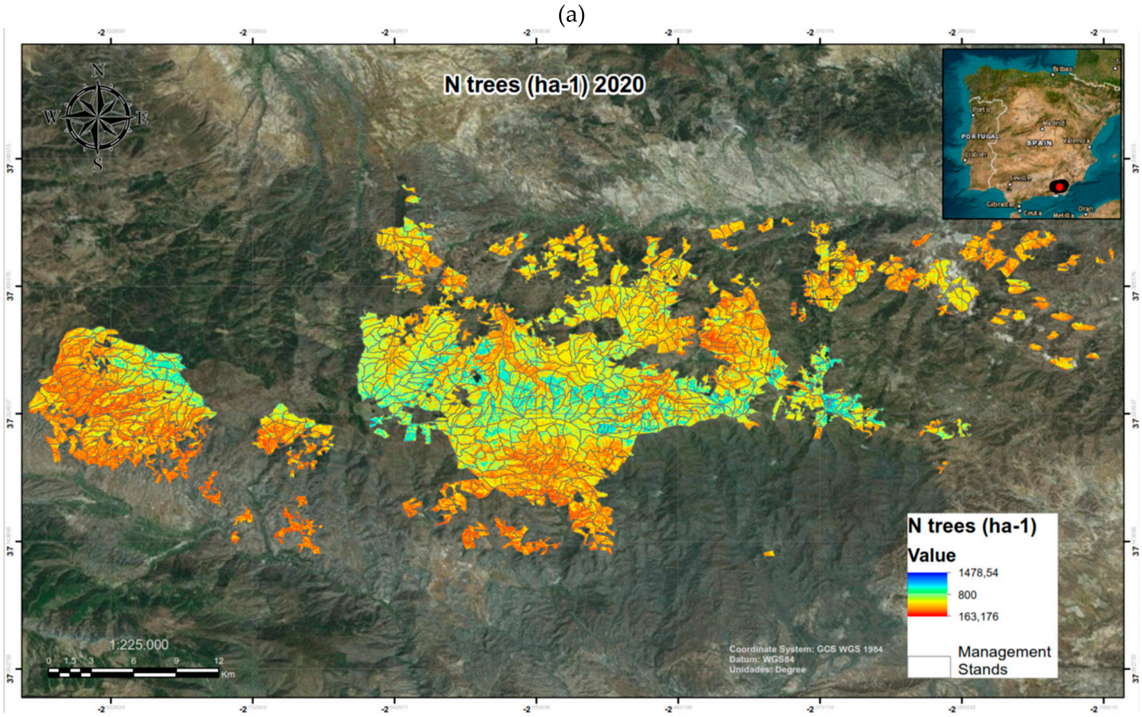


(b)

Figure S14. a. Map of Number of trees per Ha 2015, **b.** Map of Number of trees per Ha 2020.



(a)



(b)

Figure S15. a Map of Number of trees per Ha 2015, **b.** Map of Number of trees per Ha 2020.

Table S1. Height and diameter equations used for inventory data update (Guzmán Álvarez et. al., 2012). Diameter at breast height (D_i, cm), number of stems (N, trees ha^{-1}), height (H_i, m), Site Index (IS) competition index (IC_i) tree age (E_i), biomass fractions (stem W_s, thick branches W_{tkb}, medium branches W_{mb}, thin branches W_{tnb}, roots W_r, thick-medium branches W_{tkmb}).

Species	Equations for inventory data update	Equations for tree age update	Equations for biomass estimation	
			Biomass fraction	Equations
Pinus halepensis	$H_i = e^{-3,7991+0,94876 \cdot ln(Ei)+1,0459 \cdot ln(IS)}$	$H_i = e^{(ln(di)+0,1073*ln(N_i)+0,00046*ln(ICi)-1,4971)/0,9398}$	Stem	$W_s = 0.0139 \cdot d^2 \cdot H$
			Thick branches	For d >27.5 cm $W_{tkb} = 3.926 \cdot (d-27.5)$
	$d_i = e^{1,4971+0,9398 \cdot ln(Hi)-0,1073 \cdot ln(N_i)-0,00046 ln(ICi)}$	$E_i = e^{(ln(Hi)-1,0459*ln(IS)+3,7991)/0,94876}$	Medium branches	$W_{mb} = 4.257+0.00506 \cdot d^2 \cdot H-0.0722 \cdot d \cdot H$
			Thin branches	$W_{tnb} = 6.197 +0.00932 \cdot d^2 \cdot H-0.0686 \cdot d \cdot H$
			Roots	$W_r = 0.0785 \cdot d^2$
Pinus pinaster	$H_i = e^{-3,9777+1,0166 \cdot ln(Ei)+1,0182 \cdot ln(IS)}$	$H_i = e^{(ln(di)+0,0934*ln(N_i)+0,00026*ln(ICi)-1.1049)/1.1004}$	Stem	$W_s = 0.0278 \cdot d^{2.115} \cdot H^{0.618}$
			Thick-medium branches	$W_{tkmb} = 0.000381 \cdot d^{3.141}$
	$d_i = e^{0,8671+1,1349 \cdot ln(Hi)-0,0499 \cdot ln(N_i)-0,000053 ln(ICi)}$	$E_i = e^{(ln(Hi)-1,0182*ln(IS)+3,9777)/1,0166}$	Thin branches	$W_{tnb} = 0.0129 \cdot d^{2.32}$
			Roots	$W_r = 0.00444 \cdot d^{2.804}$
Pinus nigra	$H_i = e^{-4,1267+1,0454 \cdot ln(Ei)+1,0189 \cdot ln(IS)}$	$H_i = e^{(ln(di)+0,0499*ln(N_i)+0,000053*ln(ICi)-0,8671)/1,1349}$	Stem	$W_s = 0.0403 \cdot d^{1.838} \cdot H^{0.945}$
			Thick branches	For d >32.5 cm $W_{tkb} = 0.228 \cdot (d-32.5)^2$
	$d_i = e^{1,1049+1,1004 \cdot ln(Hi)-0,0934 \cdot ln(N_i)-0,00042 \cdot ln(ICi)}$	$E_i = e^{(ln(Hi)-1,0189*ln(IS)+4,1267)/1,0454}$	Medium branches	$W_{mb} = 0.0521 \cdot d^2$
			Thin branches	$W_{tnb} = 0.0720 \cdot d^2$
			Roots	$W_r = 0.0189 \cdot d^{2.445}$

Species	Equations for inventory data update	Equations for tree age update	Equations for biomass estimation	
			Biomass fraction	**Equations**
Pinus sylvestris	$H_i = e^{-4,0619+1,0176 \cdot ln(Ei)+1,0329 \cdot ln(IS)}$	$H_i = e^{(ln(di)+0,1056*ln(N_i)+0,000723*ln(ICi)-1,7441)/0,8306}$	Stem	$W_s = 0.0154 \cdot d^2 \cdot H$
			Thick branches	For d >32.5 cm $W_{tkb} = 0.54 \cdot (d-37.5)^2 - 0.0119 \cdot (d-37.5)^2 \cdot H$
	$d_i = e^{1,7441+0,8306 \cdot ln(Hi)-0,1056 \cdot ln(N_i)-0,000723 \cdot ln(ICi)}$	$E_i = e^{(ln(Hi)-1,0329*ln(IS)+4,0619)/1,0176}$	Medium branches	$W_{mb} = 0.0295 \cdot d^{2.745} \cdot H^{-0.899}$
			Thin branches	$W_{tnb} = 0.53 \cdot d^{2.199} \cdot H^{-1.153}$
			Roots	$W_r = 0.13 \cdot d^2$