Kouamé Y.A.G., Millan M., N'Dri A.B., Charles-Dominique T., Konan M., Bakayoko A., Gignoux J. (2022). Multispecies allometric equations for shrubs and trees biomass prediction in a Guinean savanna (West Africa). Silva Fennica vol. 56 no. 2 article id 10617. https://doi.org/10.14214/sf.10617.

Supplementary file S5

Text 1. Output of the stepwise selection of variables for predicting AGB in both trees and shrubs

```
> model1 <- lm(log(AGB) ~ log(H) + log(rDb2H) + log(S.S) + log(n), data = 
data1)

> summary(model1)

Call:
lm(formula = log(AGB) ~ log(H) + log(rDb2H) + log(S.S) + log(n), 
    data = data1)

Residuals:
     Min       1Q   Median       3Q      Max 
-1.26444 -0.32288  0.01185  0.37849  1.86875 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept) -3.36496    0.19790 -17.003   <2e-16 ***
log(H)       0.01670    0.16424   0.102   0.9191    
log(rDb2H)   0.99936    0.08243  12.124   <2e-16 ***
log(S.S)    -0.07731    0.08705  -0.888   0.3756    
log(n)       0.24651    0.10086   2.444   0.0155 *  
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.5401 on 185 degrees of freedom
Multiple R-squared:  0.9146,	Adjusted R-squared:  0.9127 
F-statistic: 495.3 on 4 and 185 DF,  p-value: < 2.2e-16

> step(model1) -> final.model

Start:  AIC=-229.15
log(AGB) ~ log(H) + log(rDb2H) + log(S.S) + log(n)

             Df Sum of Sq    RSS     AIC
- log(H)      1     0.003 53.967 -231.14
- log(S.S)    1     0.230 54.194 -230.34
<none>                    53.964 -229.15
- log(n)      1     1.743 55.707 -225.12
- log(rDb2H)  1    42.880 96.844 -120.05

Step:  AIC=-231.14
log(AGB) ~ log(rDb2H) + log(S.S) + log(n)

             Df Sum of Sq     RSS     AIC
- log(S.S)    1     0.268  54.236 -232.20
<none>                     53.967 -231.14
- log(n)      1     1.911  55.878 -226.53
- log(rDb2H)  1    91.495 145.463  -44.75

Step:  AIC=-232.2
log(AGB) ~ log(rDb2H) + log(n)
```

```
              Df Sum of Sq    RSS     AIC
<none>                      54.24 -232.20
- log(n)       1      3.52  57.76 -222.25
- log(rDb2H)   1    432.75 486.99  182.83
```

```
> summary(final.model)

Call:
lm(formula = log(AGB) ~ log(rDb2H) + log(n), data = data1)

Residuals:
     Min       1Q   Median       3Q      Max 
-1.27931 -0.33148  0.01142  0.38381  1.83555 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept) -3.50230    0.13703 -25.559  < 2e-16 ***
log(rDb2H)   0.95647    0.02476  38.628  < 2e-16 ***
log(n)       0.16815    0.04826   3.485 0.000614 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
Residual standard error: 0.5385 on 187 degrees of freedom
Multiple R-squared:  0.9142,   Adjusted R-squared:  0.9132 
F-statistic: 995.8 on 2 and 187 DF,  p-value: < 2.2e-16
```

Text 2. Output of the stepwise selection of variables for predicting BGB in both trees and shrubs

```
> model2 <- lm(log(BGB) ~ log(H) + log(rDb2H) + log(S.S) + log(n), data = 
data1)

> summary(model2)

Call:
lm(formula = log(BGB) ~ log(H) + log(rDb2H) + log(S.S) + log(n), 
    data = data1)

Residuals:
     Min       1Q   Median       3Q      Max 
-1.18384 -0.45903 -0.02269  0.41262  2.26860 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept) -2.71614    0.22117 -12.281  < 2e-16 ***
log(H)      -0.18478    0.18355  -1.007 0.315383    
log(rDb2H)   0.87770    0.09212   9.528  < 2e-16 ***
log(S.S)    -0.08398    0.09729  -0.863 0.389168    
log(n)       0.43322    0.11272   3.843 0.000167 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.6036 on 185 degrees of freedom
Multiple R-squared:  0.8319,   Adjusted R-squared:  0.8282 
F-statistic: 228.8 on 4 and 185 DF,  p-value: < 2.2e-16

> step(model2) -> final.model

Start:  AIC=-186.91
log(BGB) ~ log(H) + log(rDb2H) + log(S.S) + log(n)

              Df Sum of Sq    RSS     AIC
- log(S.S)     1     0.271 67.673 -188.14
- log(H)       1     0.369 67.771 -187.87
<none>                     67.402 -186.91
- log(n)       1     5.382 72.784 -174.31
```

```
- log(rDb2H)  1    33.075 100.477 -113.05

Step:  AIC=-188.14
log(BGB) ~ log(H) + log(rDb2H) + log(n)
             Df Sum of Sq     RSS     AIC
- log(H)      1     0.227  67.900 -189.507
<none>                     67.673 -188.144
- log(n)      1    15.070  82.743 -151.944
- log(rDb2H)  1    80.189 147.862  -41.641

Step:  AIC=-189.51
log(BGB) ~ log(rDb2H) + log(n)

             Df Sum of Sq    RSS     AIC
<none>                     67.90 -189.51
- log(n)      1    15.026  82.93 -153.52
- log(rDb2H)  1   285.178 353.08  121.74

> summary(final.model)

Call:
lm(formula = log(BGB) ~ log(rDb2H) + log(n), data = data1)

Residuals:
     Min       1Q   Median       3Q      Max
-1.16474 -0.45081 -0.00847  0.37699  2.25729

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -2.79325    0.15332 -18.218  < 2e-16 ***
log(rDb2H)   0.77644    0.02771  28.025  < 2e-16 ***
log(n)       0.34733    0.05399   6.433 1.02e-09 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6026 on 187 degrees of freedom
Multiple R-squared:  0.8306,   Adjusted R-squared:  0.8288
F-statistic: 458.5 on 2 and 187 DF,  p-value: < 2.2e-16
```

Table 1. Results of ANCOVA test highlighting the influence of the species, of the quantitative explanatory variables ($w = \rho D_b^2 H$ in g cm^{-1} m, n= total number of stems) and their interaction on the estimation of the aboveground and belowground biomass (AGB and BGB) under models fitted in this study from trees and shrubs measurements in the savanna of the Lamto Scientific Reserve. For trees, D_b (cm) corresponds to the stem basal diameter and H (m) represents the total height in the term $\rho D_b^2 H$. For shrubs, the term $D_b^2 H$ corresponds to the sum of $d_i^2 h_i$ (i=1…n) of the n stems, where di (cm) and hi (m) are respectively the basal diameter and the total height of each stem. ρ (g cm^{-3}) is the woody specific density.

		Source of variation	**Mean Sq**	**F value**	**Pr (>F)**
AGB	Trees	Species	1.64	6.62	< 0.001***
		ln(*w*)	285.48	1151.46	< 0.001***
		Species: ln(*w*)	0.89	3.59	< 0.05*
	Shrubs	Species	0.33	4.93	< 0.01**
		ln(*w*)	53.43	800.39	< 0.001***
		ln(n)	11.37	170.26	< 0.001***
		Species: ln(*w*)	0.23	3.45	< 0.05*
		Species: ln(n)	1.16	17.45	< 0.001***
BGB	Trees	Species	3.98	16.15	< 0.001***
		ln(*w*)	158.34	642.04	< 0.001***
		Species: ln(*w*)	0.67	2.72	< 0.05*
	Shrubs	Species	1.18	6.97	< 0.01**
		ln(*w*)	67.51	397.52	< 0.001***
		ln(n)	11.90	70.04	< 0.001***
		Species: ln(*w*)	0.58	3.41	< 0.05*
		Species: ln(n)	0.98	5.78	< 0.01**

Table 2. Results of ANCOVA test highlighting the influence of the growth form and species, on the relation between height (m) and stem basal diameter (D_b, cm).

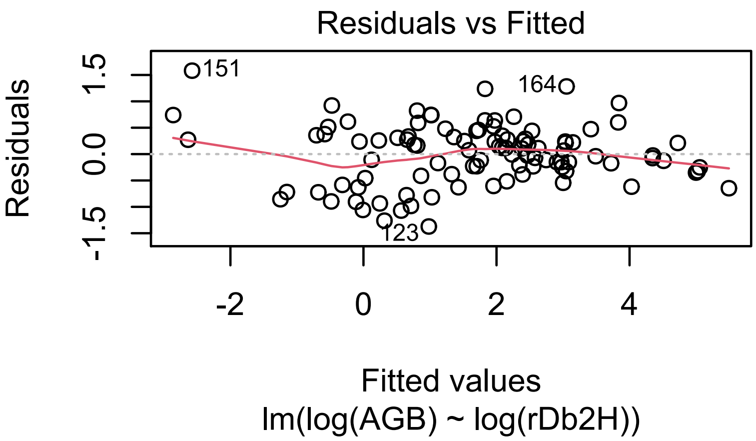
	Dependent variables	Source of variation	Mean Sq	F value	P value
Trees + Shrubs	log (H)	log(D_b)	719.44	2853.56	< 0.001***
		Growth-form	30.72	121.86	< 0.001***
		Species	2.86	11.34	< 0.001***
		D_b: Growth-form	81.60	323.667	< 0.001***
		D_b: Species	3.34	13.24	< 0.001***

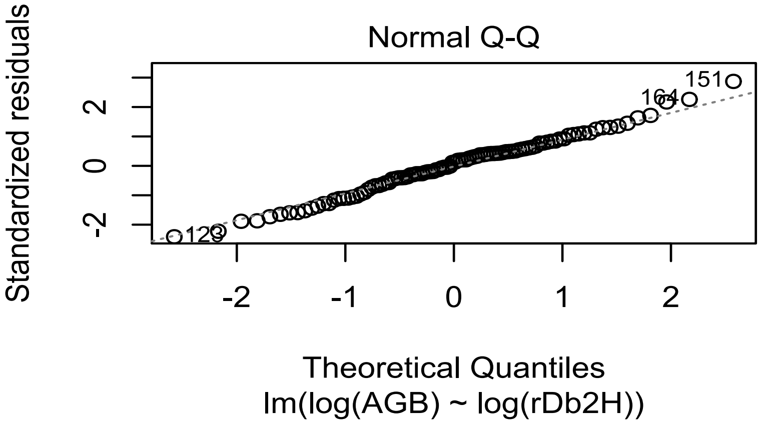
Table 3. Values of the wood specific gravity (g cm^{-3}) of each species in this study and in Ifo et al. (2018) study.

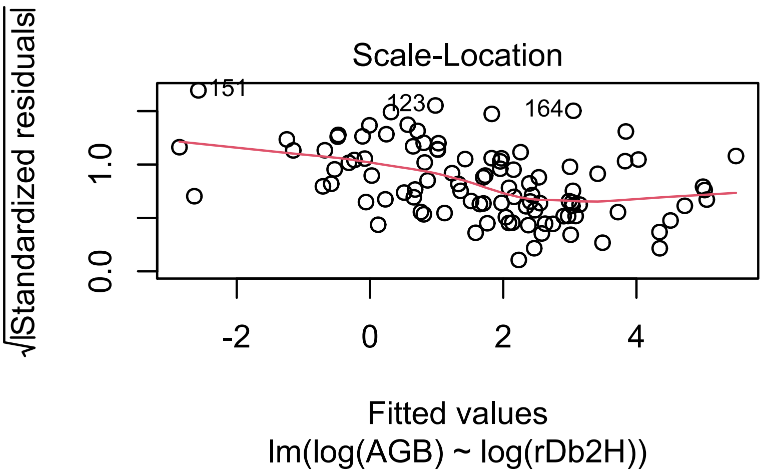
Species	Growth form	Wood specific gravity (g cm^{-3})
Species of this study		
Annona senegalensis	Multistemmed shrub	0.499
Bridelia ferruginea	Single stemmed tree Multistemmed shrub	0.640
Crossopteryx febrifuga	Single stemmed tree	0.724
Cussonia arborea	Single stemmed tree	0.399
Piliostigma thonningii	Single stemmed tree Multistemmed shrub	0.665
Species of Ifo et al. study		
Annona senegalensis	Single stemmed shrub	0.487
Bridelia ferruginea	Single stemmed tree	0.610
Crossopteryx febrifuga	Single stemmed tree	0.579
Hymenocardia acida	Single stemmed tree	0.622
Syzygium guineense	Single stemmed tree	0.600

Fig. 1. Quantiles distributions in AGB predicting model of trees

Normal probability (Q-Q) plot and other quantile distributions that assess goodness of fit of the model predicting the total aboveground biomass (AGB) of trees as a function of variable $w = \rho D_b^2 H$, where ρ (g cm^{-3}) is the specific woody density, D_b (cm) corresponds to the stem basal diameter of one individual or sample, H (m) represents the total height. In case of a good fit, as is the case here, the residual quantiles should be symmetrically distributed (i.e., with equal variance) around an average = 0 and the plot of theoretical quantiles and quantiles from the fitted sample should lie on a line y=x.






Scale-Location
√|Standardized residuals|
0.0
1.0
-2
0
2
4
151
123
164
Fitted values
lm(log(AGB) ~ log(rDb2H))

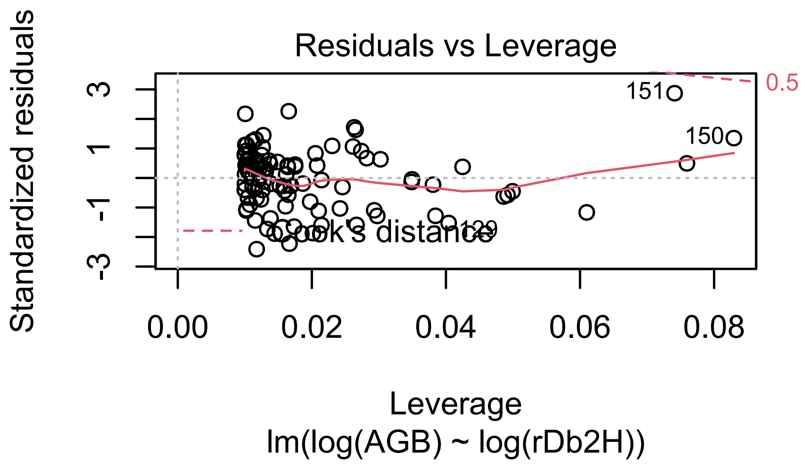
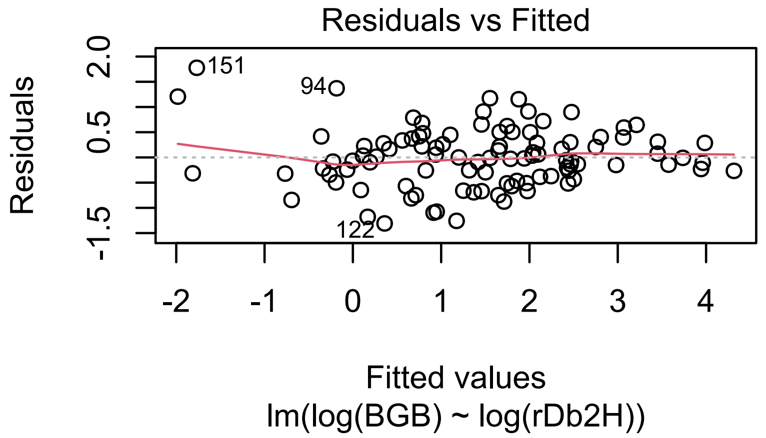
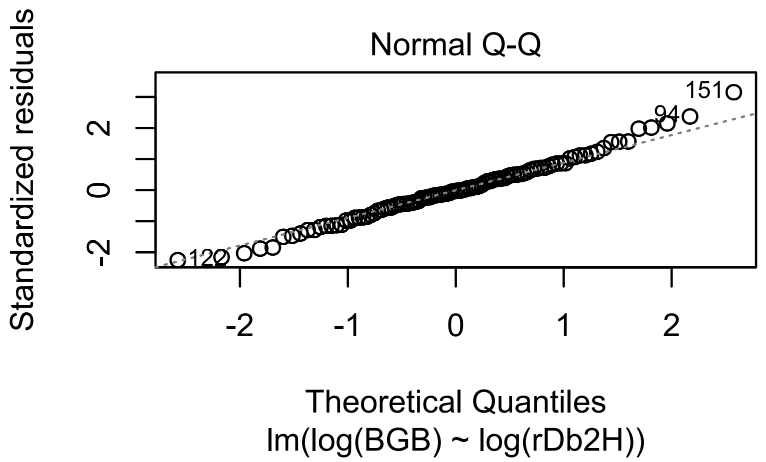
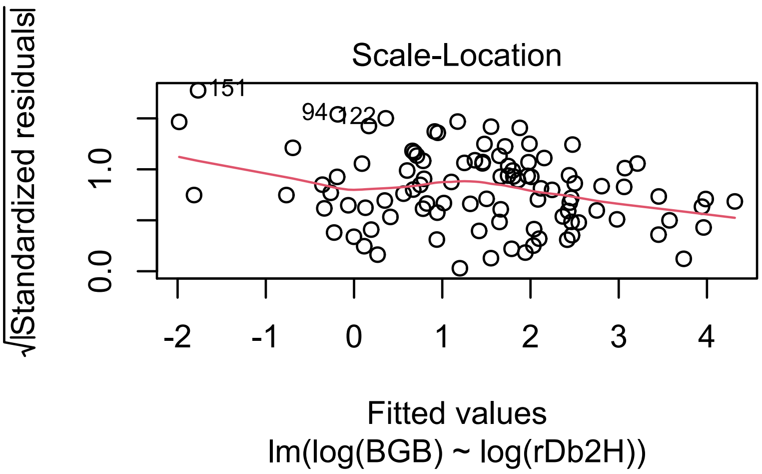

Residuals vs Leverage
Standardized residuals
-3
-1
1
3
0.00
0.02
0.04
0.06
0.08
151
150
129
0.5
Cook's distance
Leverage
lm(log(AGB) ~ log(rDb2H))

Fig. 2. Quantiles distributions in BGB predicting model of trees

Normal probability (Q-Q) plot and other quantile distributions that assess goodness of fit of the model predicting the total aboveground biomass (BGB) of trees as a function of variable $w= \rho D_b^2 H$.






Scale-Location
√|Standardized residuals|
0.0
1.0
151
94
122
-2
-1
0
1
2
3
4
Fitted values
lm(log(BGB) ~ log(rDb2H))

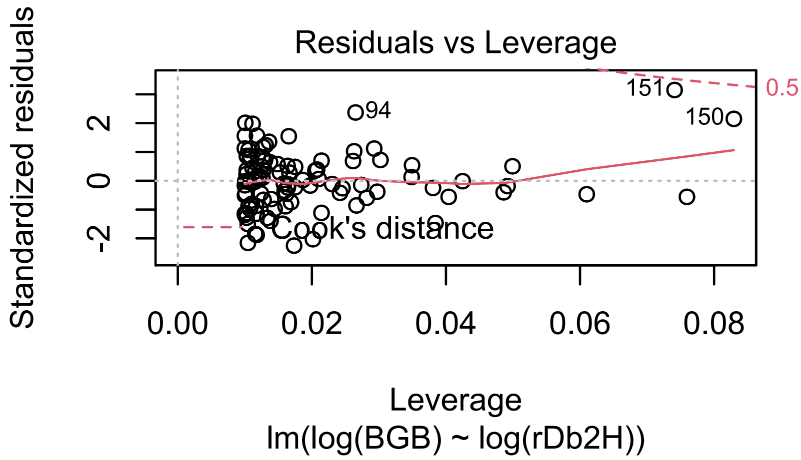
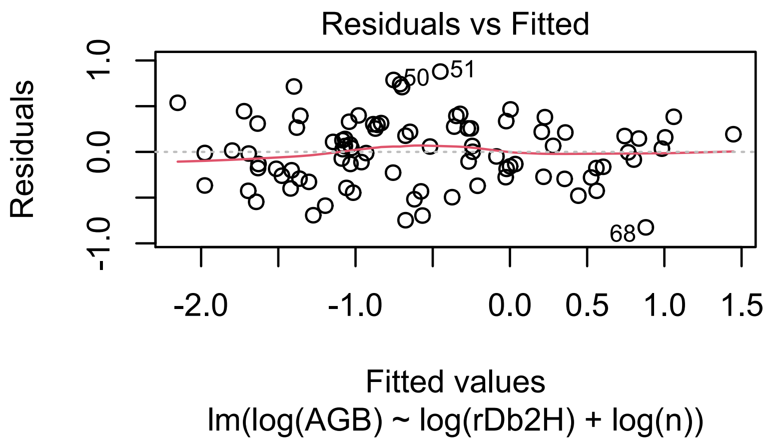
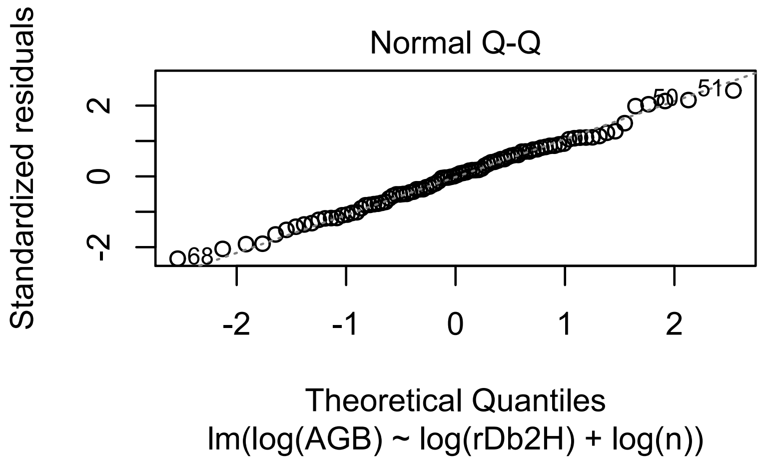
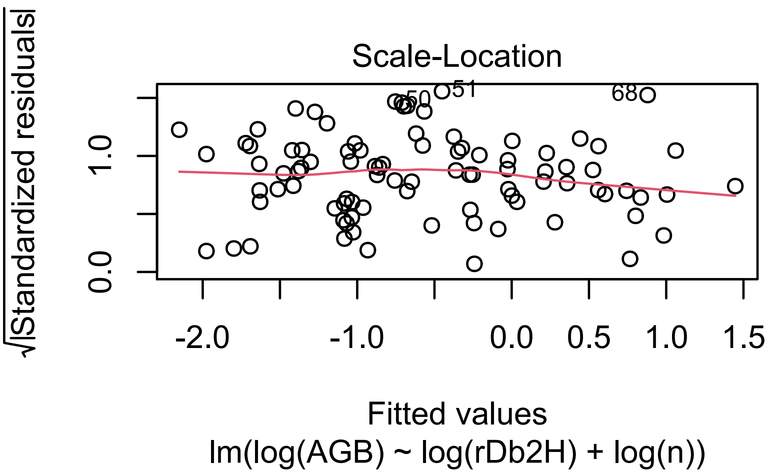

Residuals vs Leverage
Standardized residuals
-2
0
2
151
150
94
0.5
Cook's distance
0.00
0.02
0.04
0.06
0.08
Leverage
lm(log(BGB) ~ log(rDb2H))

Fig. 3. Quantiles distributions in AGB predicting model of shrubs

Normal probability (Q-Q) plot and other quantile distributions that assess goodness of fit of the model predicting the total aboveground biomass (AGB) of shrubs as a function of variable $w = \rho D_b^2 H$ and n= the total number of stems for one shrub. $D_b^2 H$ corresponds to the sum of $d_i^2 h_i$ (i=1…n) of the n stems (with di= basal diameter in cm and hi= total height of each stem in m)






Scale-Location
√|Standardized residuals|
0.0
1.0
50
51
68
-2.0
-1.0
0.0
0.5
1.0
1.5
Fitted values
lm(log(AGB) ~ log(rDb2H) + log(n))

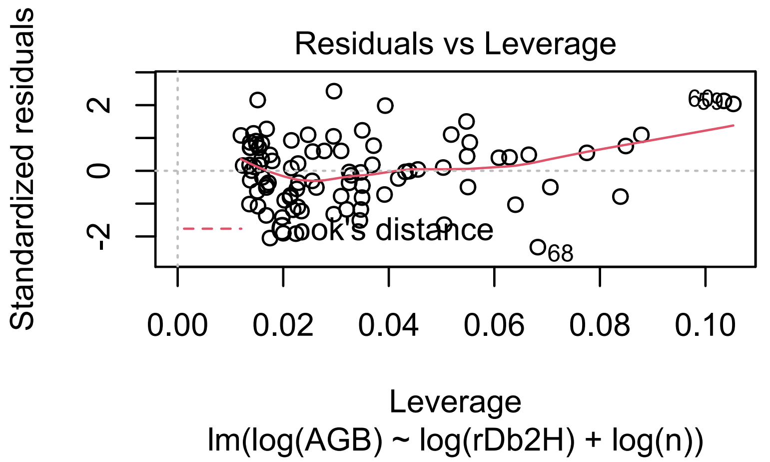
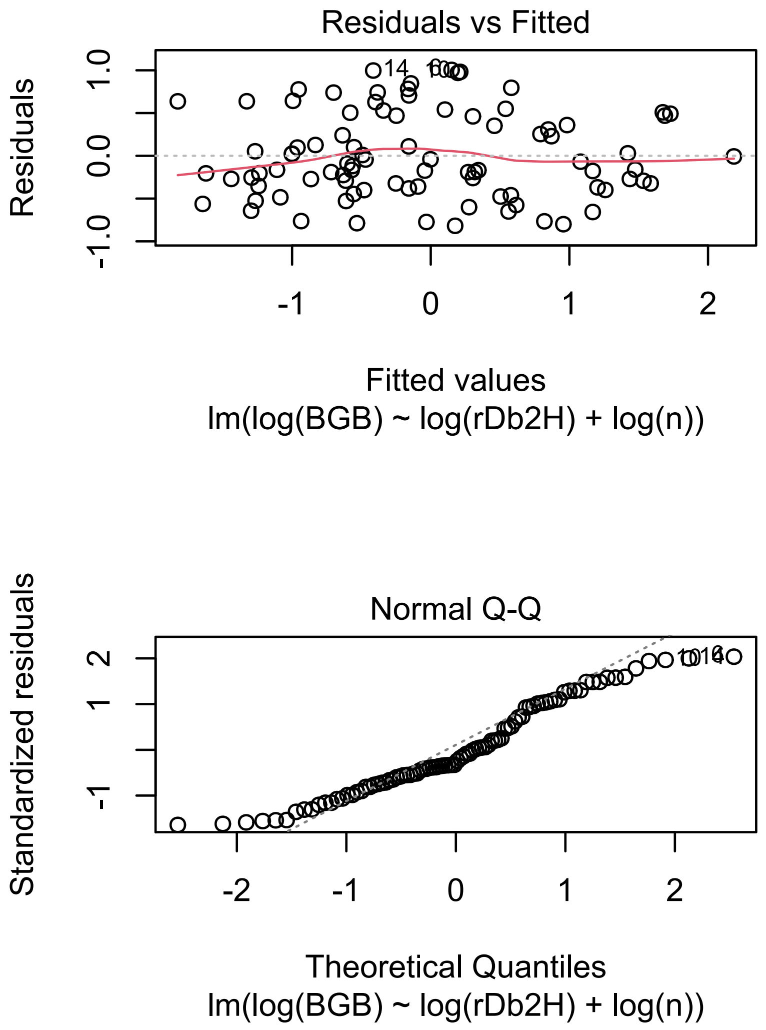
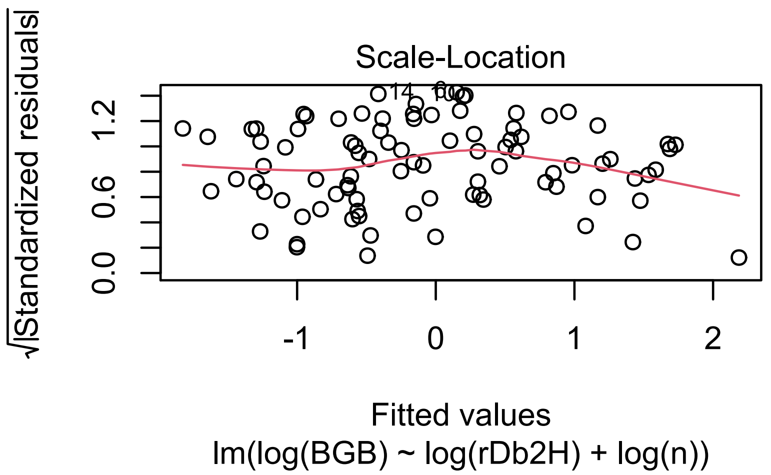
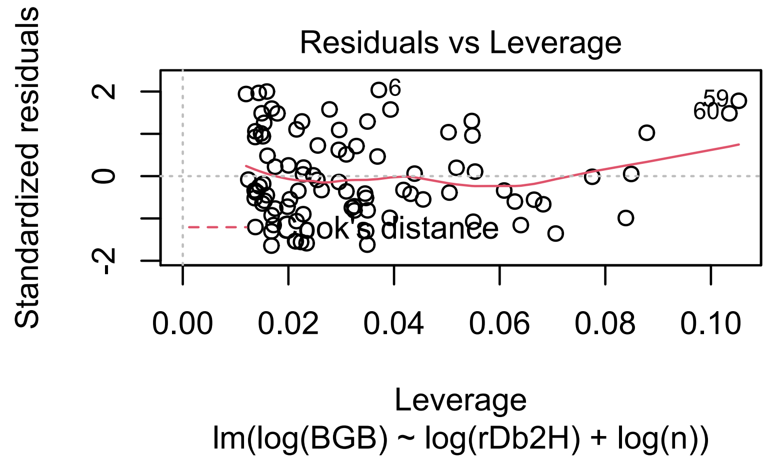

Residuals vs Leverage
Standardized residuals
-2
0
2
Cook's distance
68
0.00
0.02
0.04
0.06
0.08
0.10
Leverage
lm(log(AGB) ~ log(rDb2H) + log(n))

Fig. 4. Quantiles distributions in BGB predicting model of shrubs

Normal probability (Q-Q) plot and other quantile distributions that assess goodness of fit of the model predicting the total aboveground biomass (BGB) of shrubs as a function of variable $w= \rho D_b^2 H$ and n= the total number of stems for one shrub.




Scale-Location
√|Standardized residuals|
0.0
0.6
1.2
14
6
10
-1
0
1
2
Fitted values
lm(log(BGB) ~ log(rDb2H) + log(n))


Residuals vs Leverage
Standardized residuals
-2
0
2
6
59
60
Cook's distance
0.00
0.02
0.04
0.06
0.08
0.10
Leverage
lm(log(BGB) ~ log(rDb2H) + log(n))