

Taper and total aerial volumes

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1. Taper volume

In tree sample...

- trees j , where c, h, h_{dec} are measured

$$V_{\text{bole}}(j) = f_{III}(c, h, h_{\text{dec}})$$

- *simplified* or *remeasured* trees i , where c is measured

$$\cancel{V_{\text{bole}}(i) = V_{\text{bole}}(j)} \rightarrow \cancel{V_{\text{bole}}(i) = V_{\text{bole}}(j) \frac{c(i)}{c(j)}} \rightarrow V_{\text{bole}}(i) = V_{\text{bole}}(j) \frac{f_I(c(i))}{f_I(c(j))}$$

- Data sets source
- Linear models
- Transformations

$$\begin{cases} V_{\text{bole}} = \frac{c^2 h}{4\pi \left(1 - \frac{1,3}{h}\right)^2} f_{\text{new}} \\ f_{\text{new}} = f_{III}(c, h, h_{\text{dec}}) \end{cases}$$

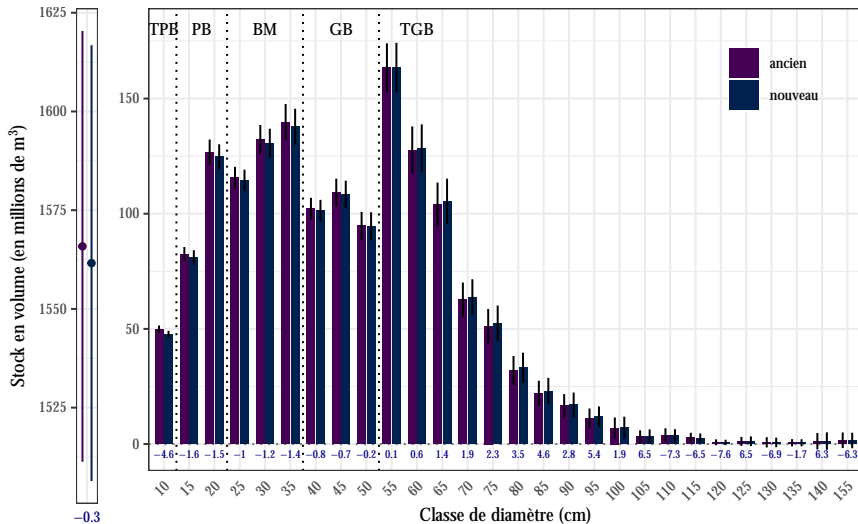
$$\ln(V_{\text{bole}}) = f_I(\ln(c))$$

- Explanatory variables
 - ▶ h_{dec} turns into h'_{dec}
 - ▶ variables are shared by every species
 - ▶ $f(g)$ is dropped
- Parameters
 - ▶ the three-variable model is no longer cut-specific

$$f_{\text{new}} = \alpha + \beta c + \gamma \frac{\sqrt{c}}{h'_{\text{dec}}} + \delta \frac{\sqrt{h'_{\text{dec}}}}{c^2 h} + \eta \left(1 - \frac{h'_{\text{dec}}}{h} \right)$$

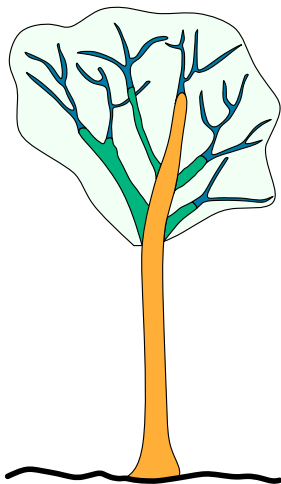
$$V_{\text{bole},I} = e^{\alpha + \beta \ln(c) + \gamma \ln(c)^2 + \frac{\sigma^2}{2}}$$

Performances similar to current models



2. Total aerial volume

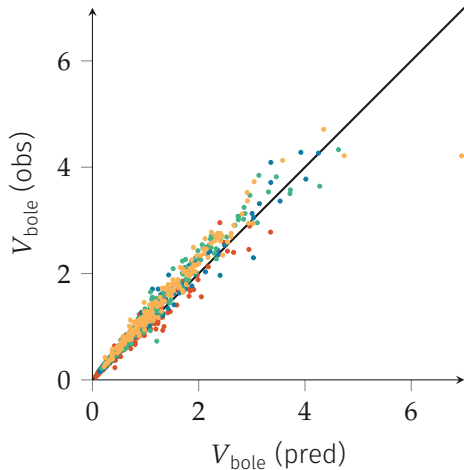
A tree in Emerge data



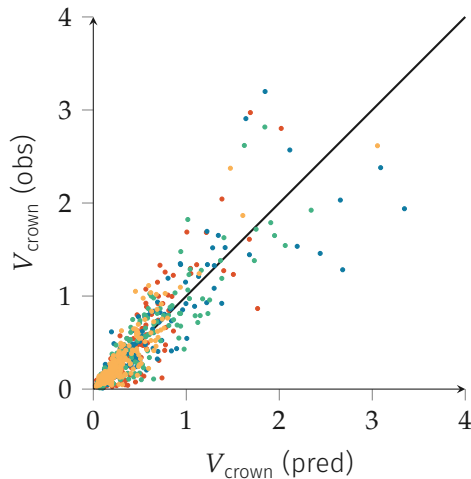
- Bole volume
- Large branches
- Small branches

1. Bole volume (Florence) and independent crown model
2. Multivariate model for both bole and crown volumes
3. Model on the ratio between bole and total volumes

Independent crown model – 1

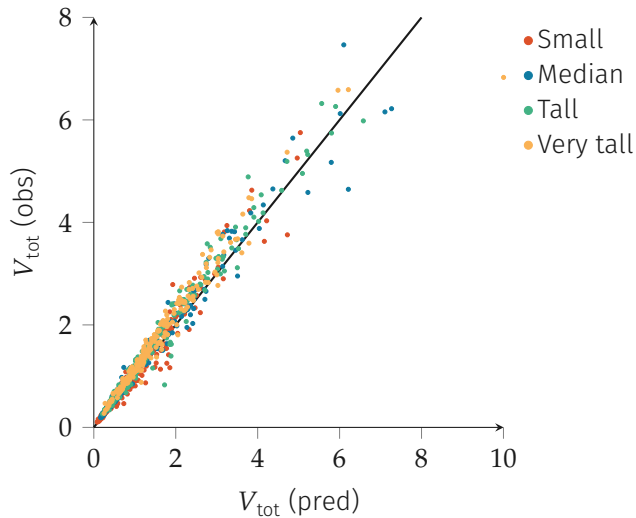


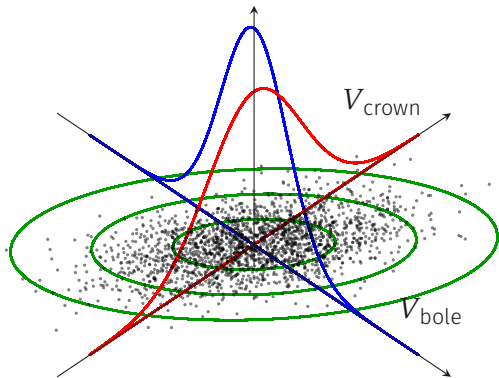
● Small ● Median ● Tall ● Very tall



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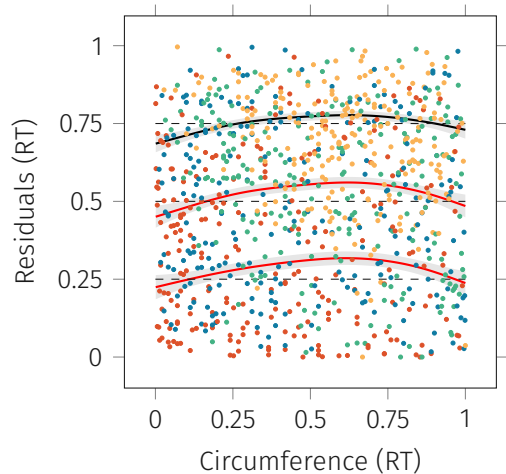
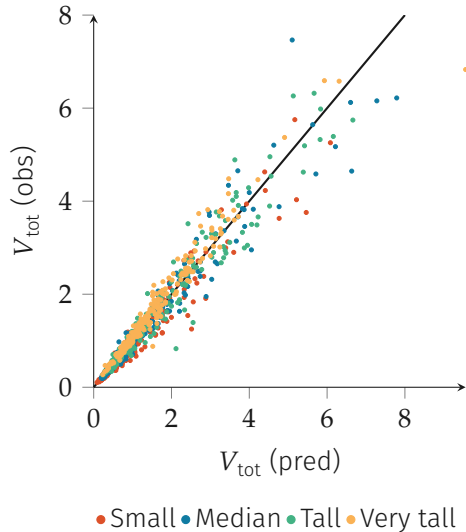
Independent crown model – 2



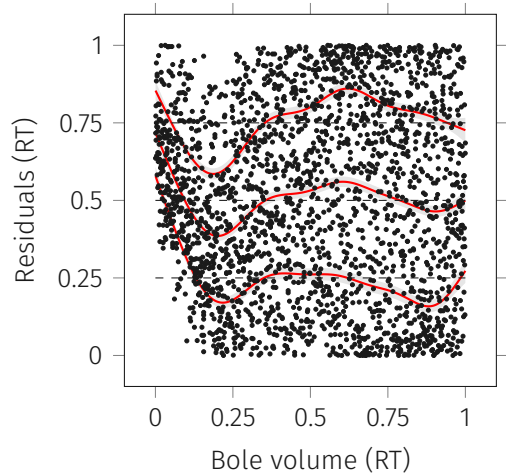
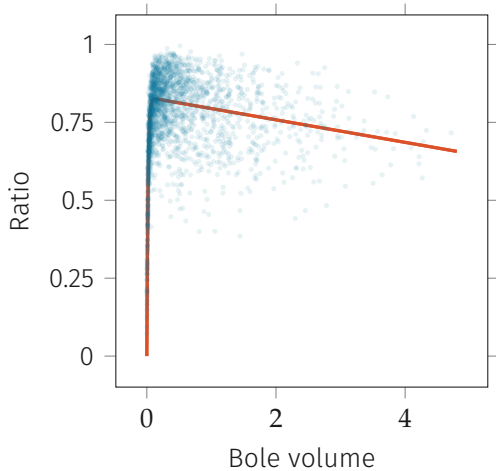


$$\begin{pmatrix} \log(V_{\text{bole}}) \\ \log(V_{\text{crown}}) \end{pmatrix} \sim \text{MVN} \left\{ \begin{pmatrix} f(c, h; \boldsymbol{\theta}) \\ g(c, h; \boldsymbol{\theta}) \end{pmatrix}, \boldsymbol{\Sigma} \right\}$$

Multivariate model – 2



Ratio model



3. Conclusion

Emerge & NFI



Volumes

Density

Biomass

Carbon

XyloDensMap

