Linking the 3PG model to an individual tree model. Application to the Portuguese production forest

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Summary

✔ Some background

- Some notes on the typology of forest models
- The 3PG model

✔ Adding individual tree diameters to 3PG

- The need for information on individual trees
- Methodology used
- Preliminary results


Warning...

Conferences are a research accelerator

- ✔ Sending abstracts when the research is just starting
  - Some weeks before the meeting, we found out that nothing is done
  - The following weeks we work more than usual
  - At the meeting, the work is not fully completed
- ✔ A few months later a paper is submitted!
- ✔ Every time, I strongly commit myself:
  - “I won’t to do it again!”
- ✔ But… here am I again… things are far from being finished!
- ✔ I will focus mainly on eucalyptus

The 3PG model in Portugal

1980 - Just one yield table built with data from temporary plots

1988 - individual tree model for eucalyptus (Tomé) – later complemented/improved in several works

1998 - stand level model Globulus (Globulus2-2001; Globulus3-2006)

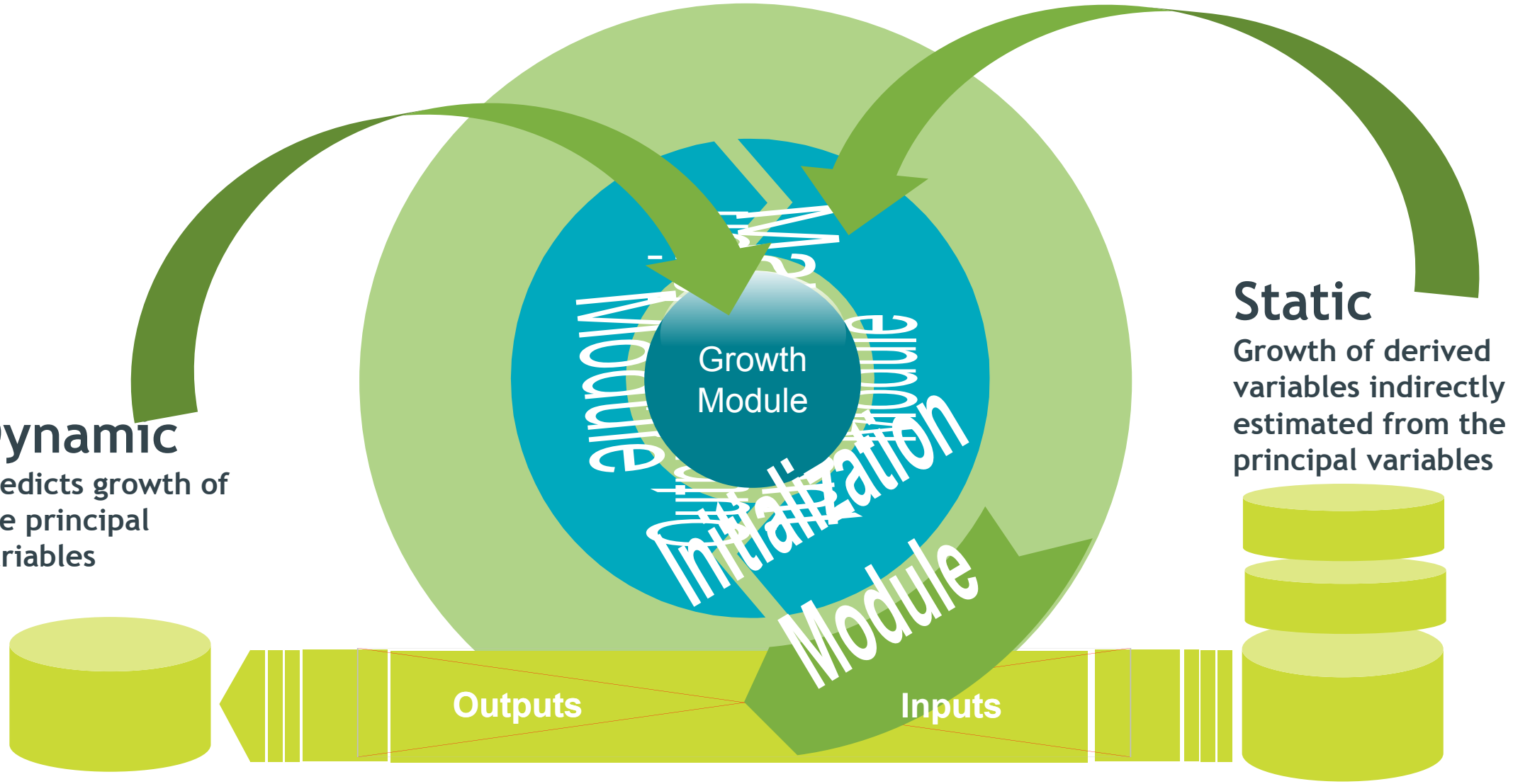
2004 - 1st calibration of the 3PG model (Tomé et al.)

2006 – 1st publication on the calibration of the 3PG model (Fontes et al.)

Why did we start to work with 3PG?

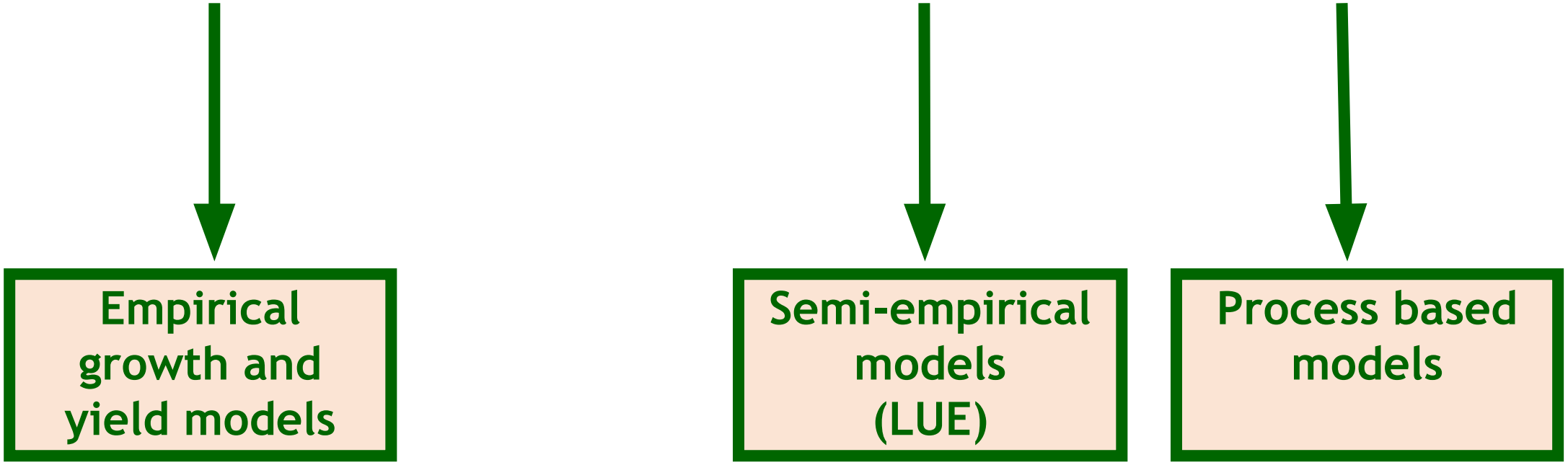
- ✔ By request from one of the Portuguese pulp companies
- ✔ They do forest inventories at 3 and 8 years of age and used the 8 years information as input for the Globulus model in order to predict volume at 10, 11, 12, … years in which they base the harvesting planning
- ✔ But with the recent variability in climate they complained:
  - If there are 1 or 2 years of drought or of over average precipitation, the Globulus predictions are biased…“

Forest model



Forest growth models

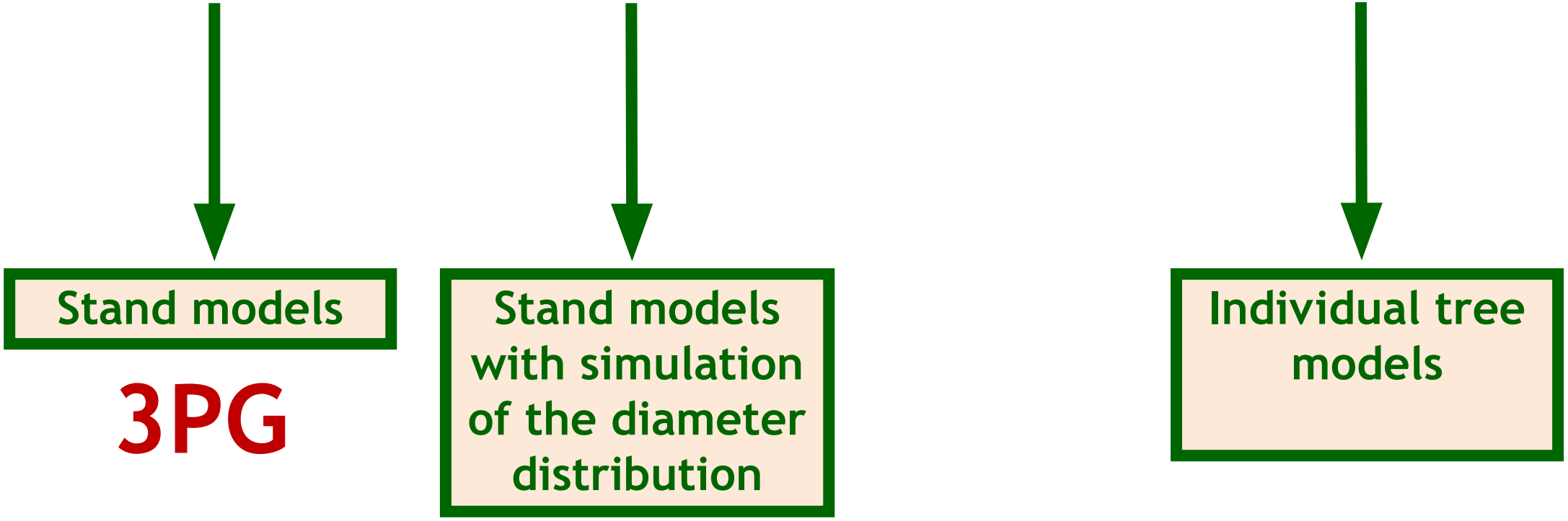
Classification according to the growth module
(to be used in practice all models need a static module)



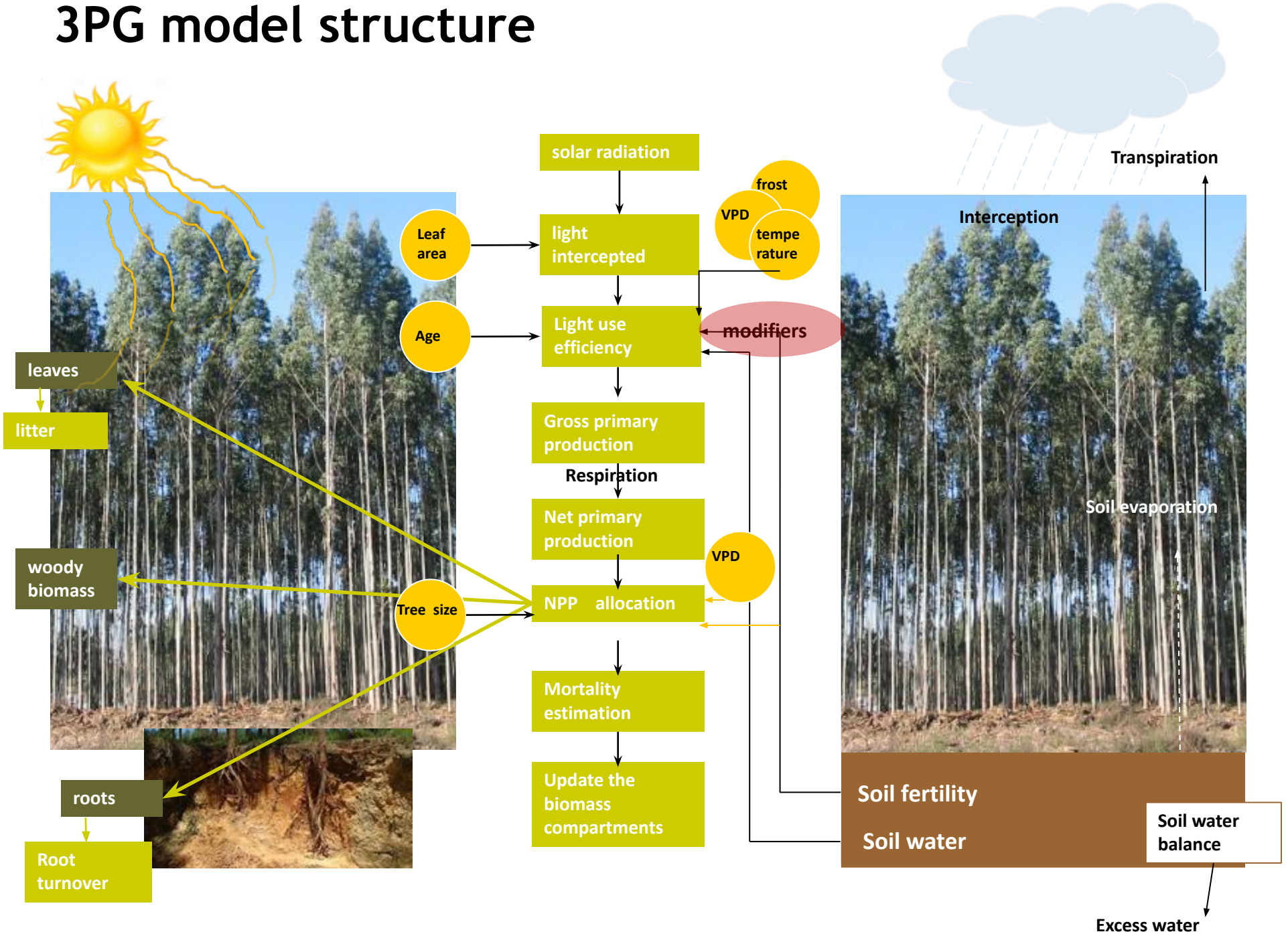
3PG

Forest growth models

Classification according to the unit of simulation (growth module)



3PG model structure



The 3PG model – information for users

✔ **Principal variables** (growth/dynamic module):

- Leaf biomass and leaf area
- Woody biomass (wood + bark + branches)
- Number of trees per ha (self-thinning)

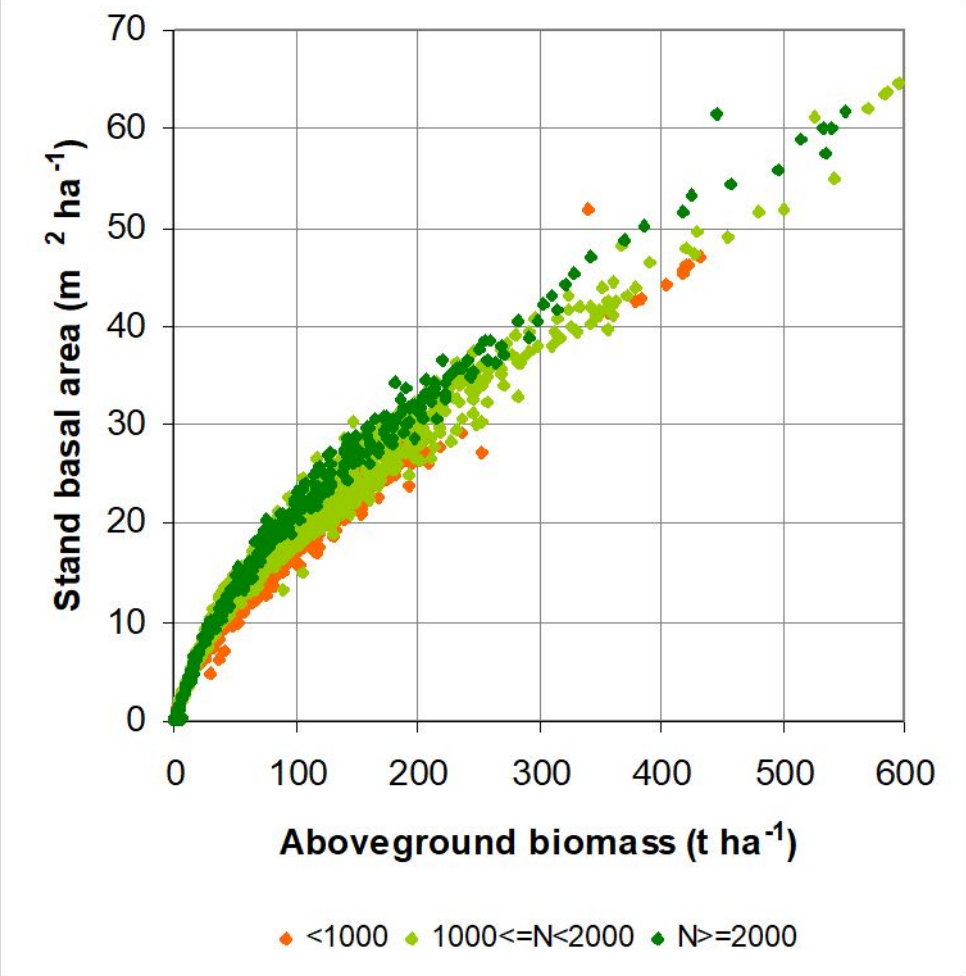
✔ **Derived variables** (static module):

- Basal area
- Stand volume (under bark in our case)

The 3PG model – information for users

- ✔ We used the large data base on eucalyptus growth that we have in Portugal to develop allometric models that use 3PG principal variables as input
  - Basal area

3PG - basal area (G)



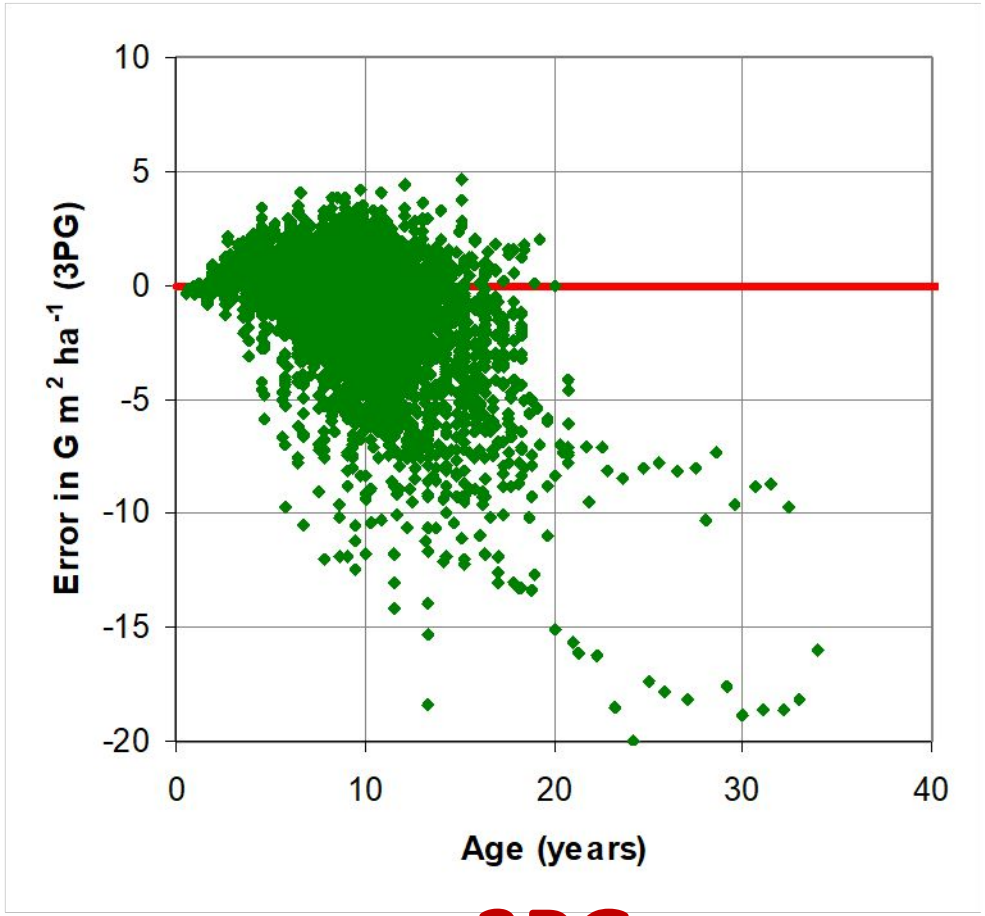
$$G = G_0 + kg \; W^{ag}$$

$$G_0 = \alpha \; \frac{N}{1000}$$

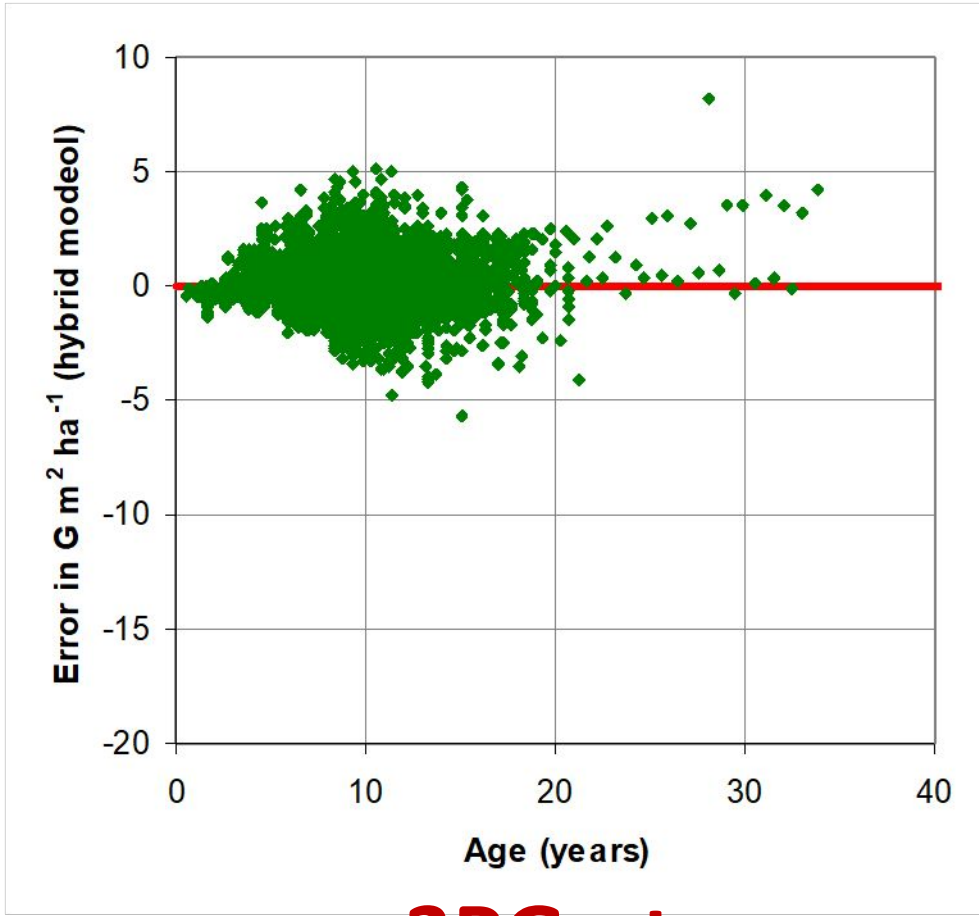
$$kg = \beta 0 + \beta 1 \; \frac{N}{1000}$$

$$ag = \gamma 0 + \gamma 1 \; \frac{N}{1000}$$

3PG - error in G prediction



3PG

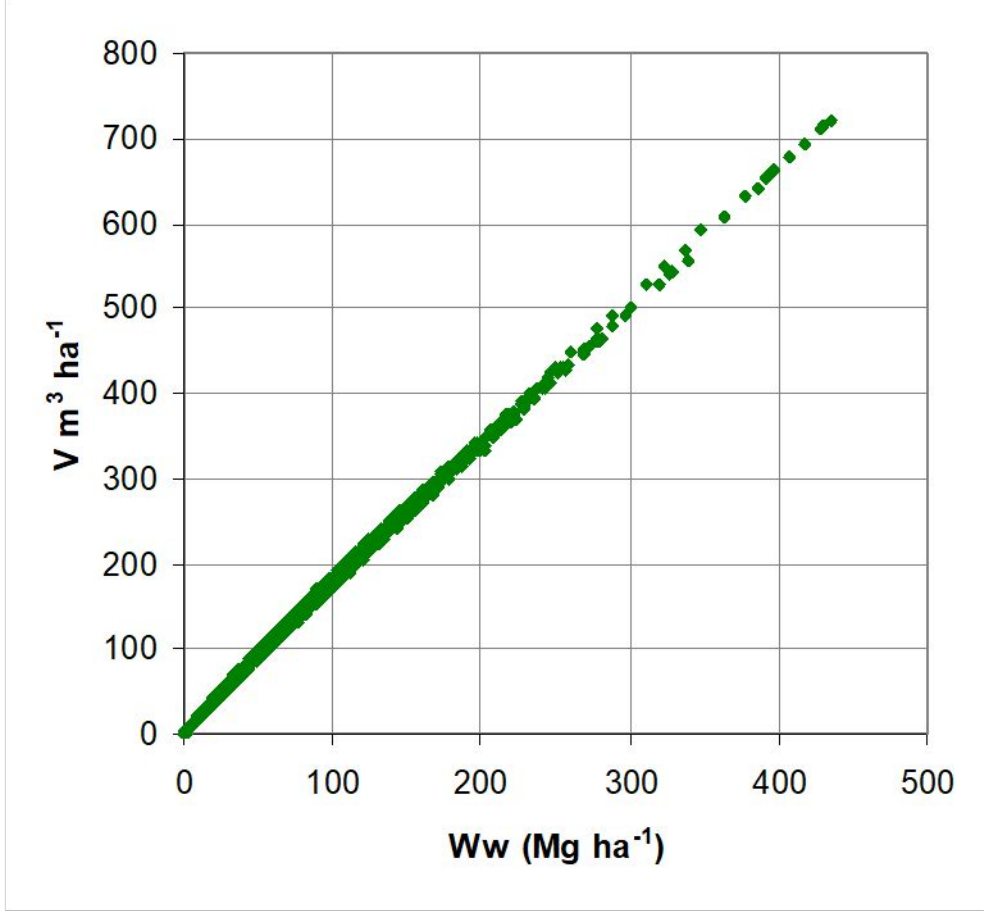


3PG.pt

The 3PG model – information for users

- ✔ We used the large data base on eucalyptus growth that we have in Portugal to develop allometric models that use 3PG principal variables as input
  - Basal area
  - Volume underbark

3PG - volume (Vu)

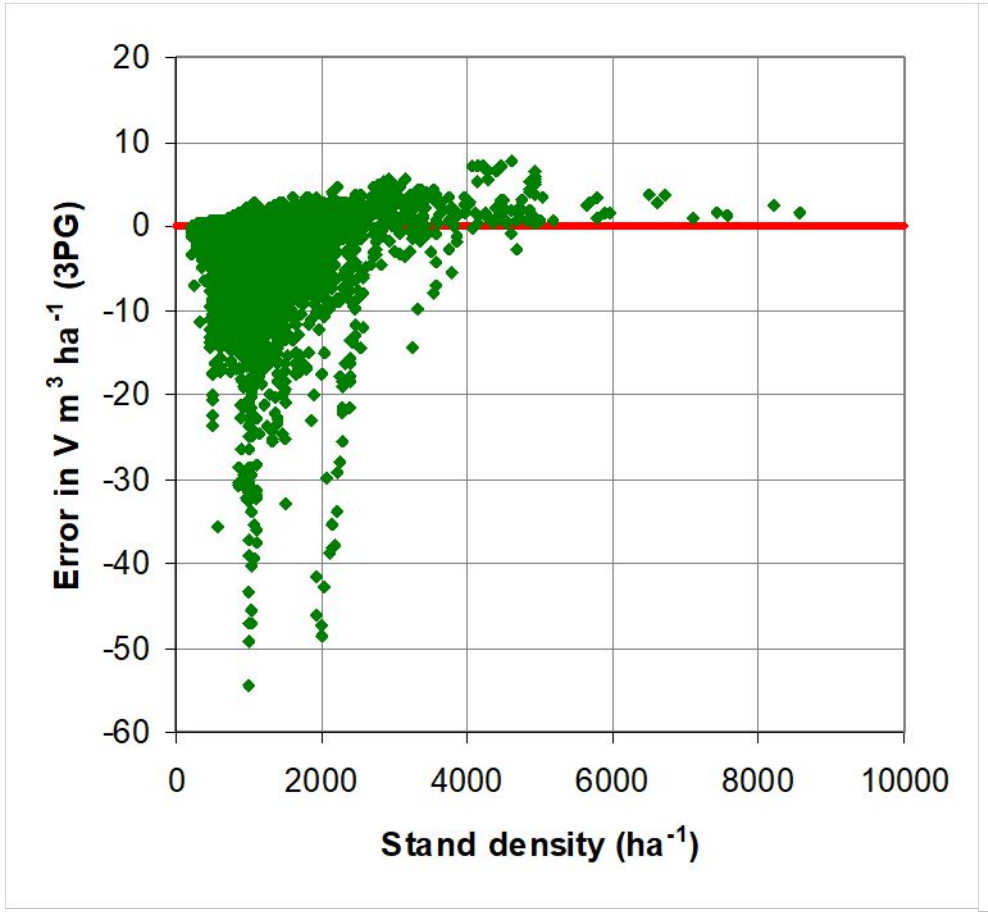


$$Vu = kh \ \ Ww^{ah}$$

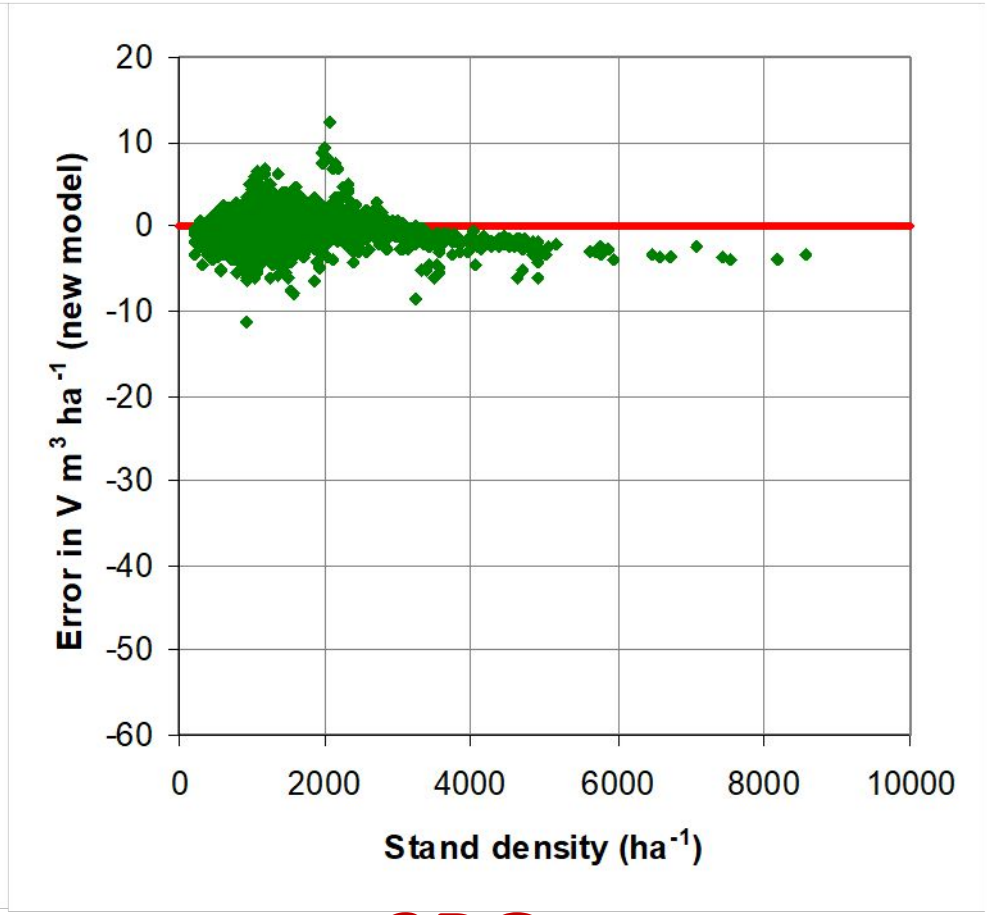
$$kh = \beta 0 + \beta 1 \ \frac{N}{1000}$$

$$ah = \gamma 0 + \gamma 1 \ \frac{N}{1000}$$

3PG - error in Vu prediction



3PG

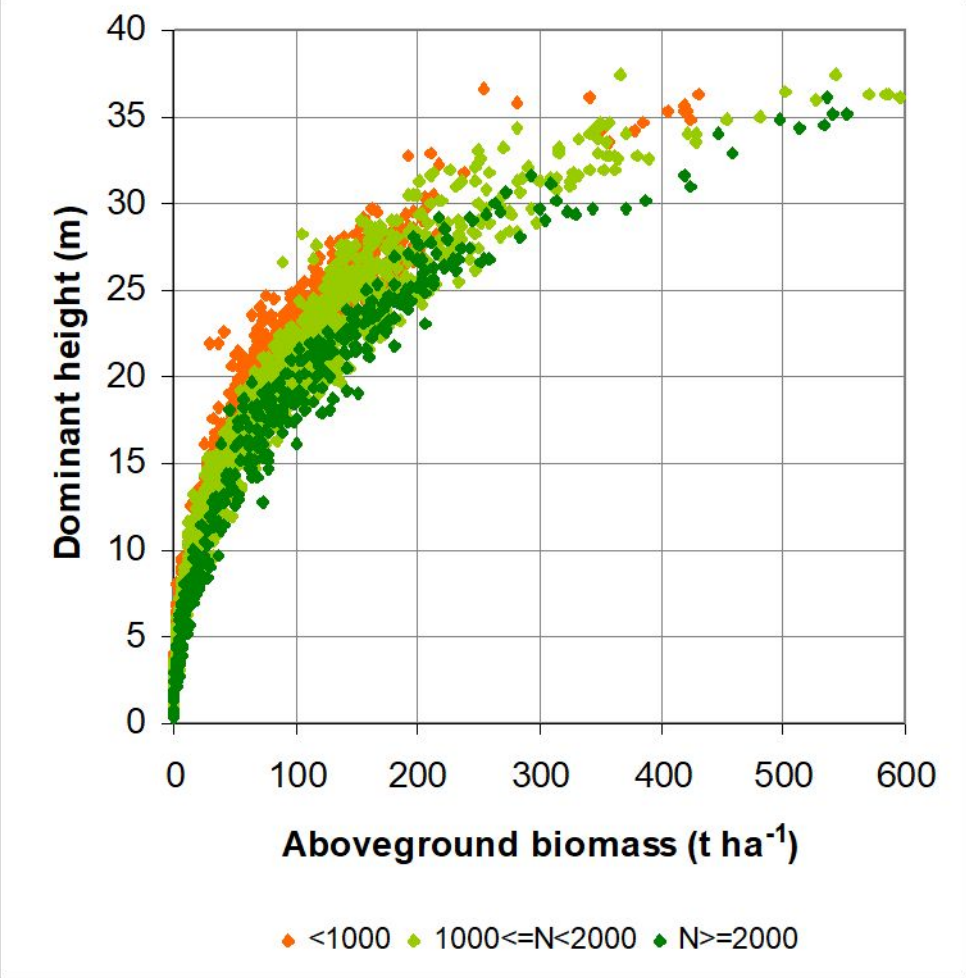


3PG.pt

The 3PG model – information for users

- ✔ We used the large data base on eucalyptus growth that we have in Portugal to develop allometric models that use 3PG principal variables as input
  - Basal area
  - Volume underbark
  - Dominant height (not available in the original 3PG)

3PG - dominant height (hdom)



$$hdom = kh \; W^{ah}$$

$$kh = \beta 0 + \beta 1 \; \frac{N}{1000}$$

$$ah = \gamma 0 + \gamma 1 \; \frac{N}{1000}$$

Adding tree information to the 3PG model

The need for information on individual trees

- ✔ Three main reasons
  - To be able to compute volumes by assortments
  - Implementation of different thinning types
  - Estimation of cork production by cork quality x cork thickness (price) is only possible with the individual trees

Adding individual tree information to 3PG

✔ Methodology applied annually:

- Use an existing individual tree model to estimate basal area of each tree (g_est)
- Compute stand basal area with the estimated g_est (G_est)
- G_est will be different from the basal area estimated by 3PG (G_3PG)
- Apply a “correction” to the g_est values to guarantee that the corrected values reproduce G_3PG

  g_3PG = g_est*G_est/G_3PG

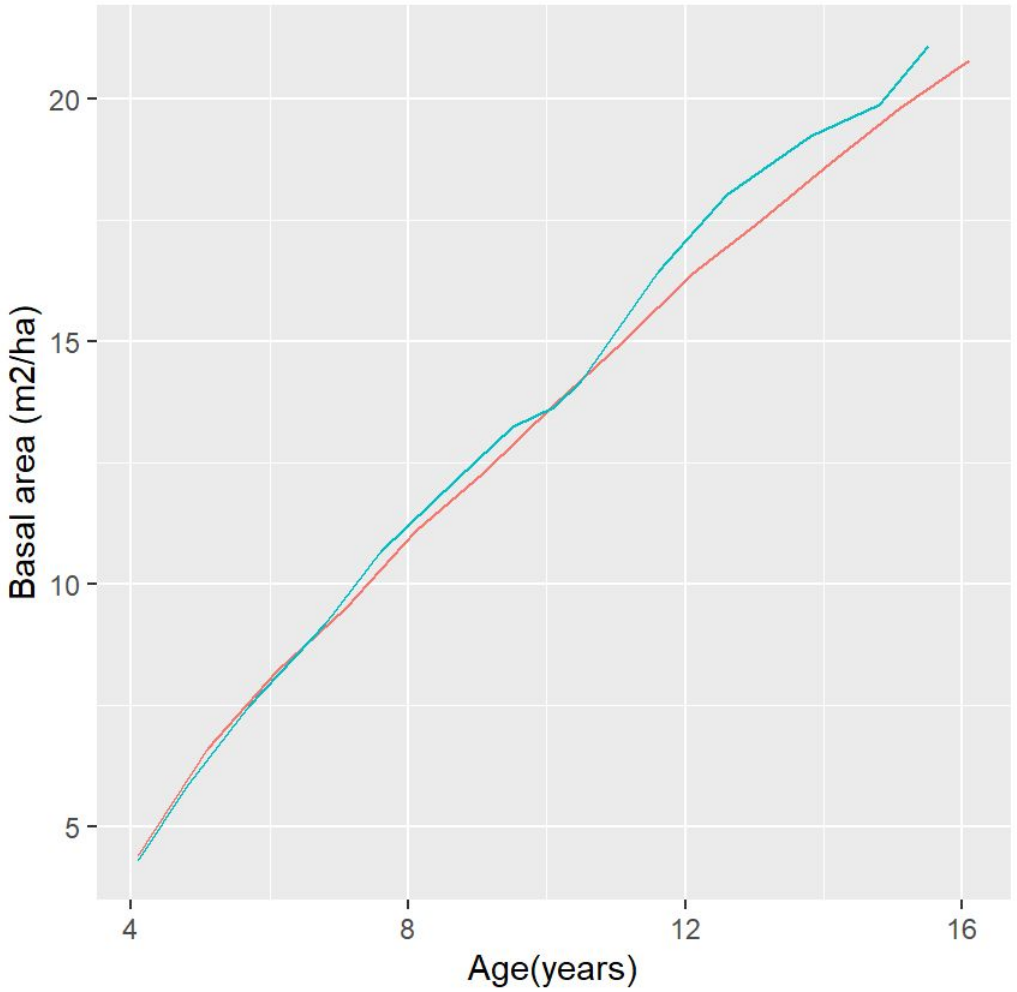
- Compute, for each tree, the d_3PG from the g_3PG

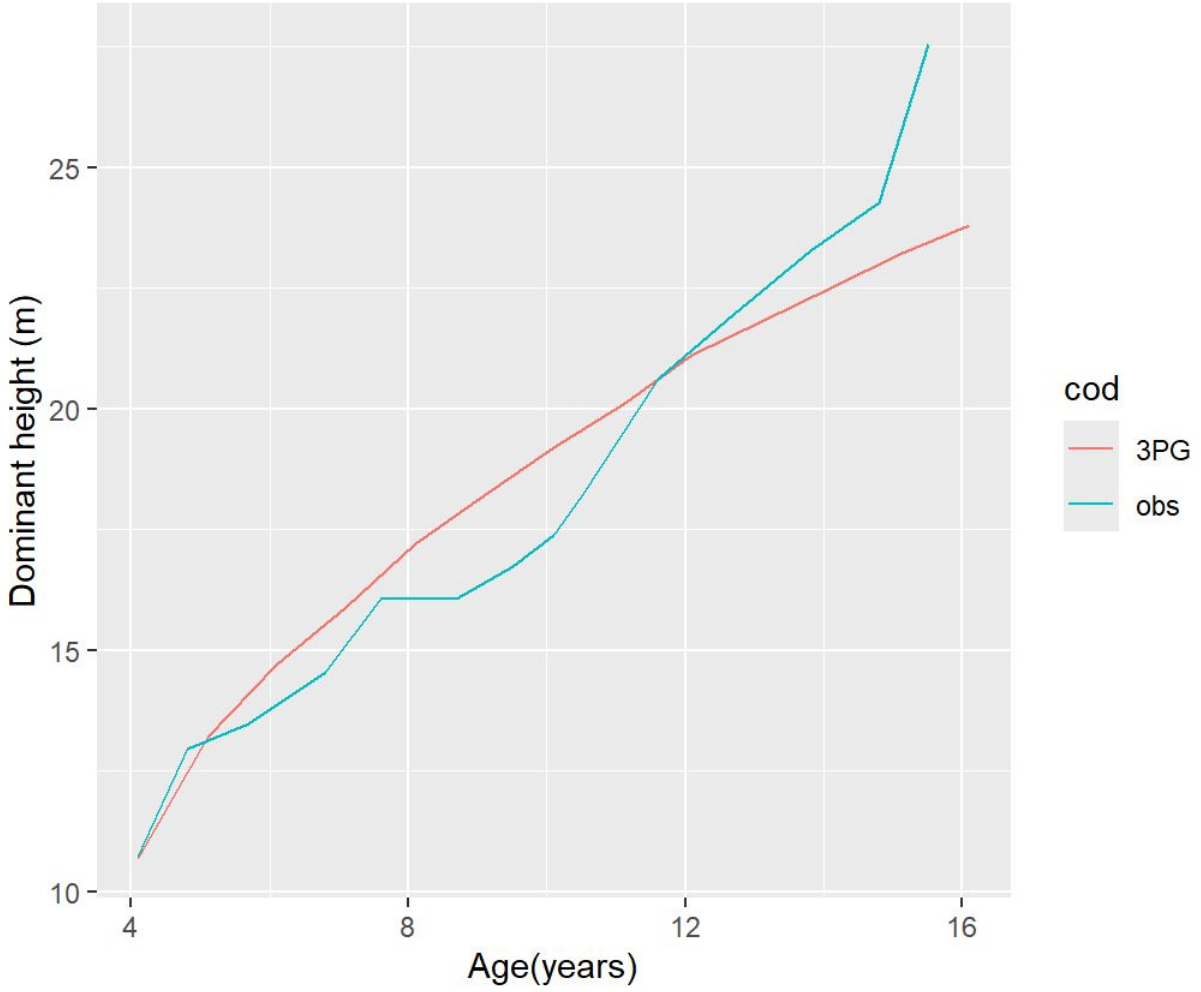
Adding individual tree information to 3PG

- ✔ **We are now ready to realize "operations" with the d_3PG values:**
  - Estimate volumes by assortments
  - Apply thinning algorithms
  - Estimate cork amount per cork quality cork thickness classes
  - Use an equation to estimate the probability of a tree to survive to apply individual tree mortality
- ✔ After the "operations", the principal variables of 3PG might need to be updated before simulating the following years

Preliminary results

Results for a randomly selected plot





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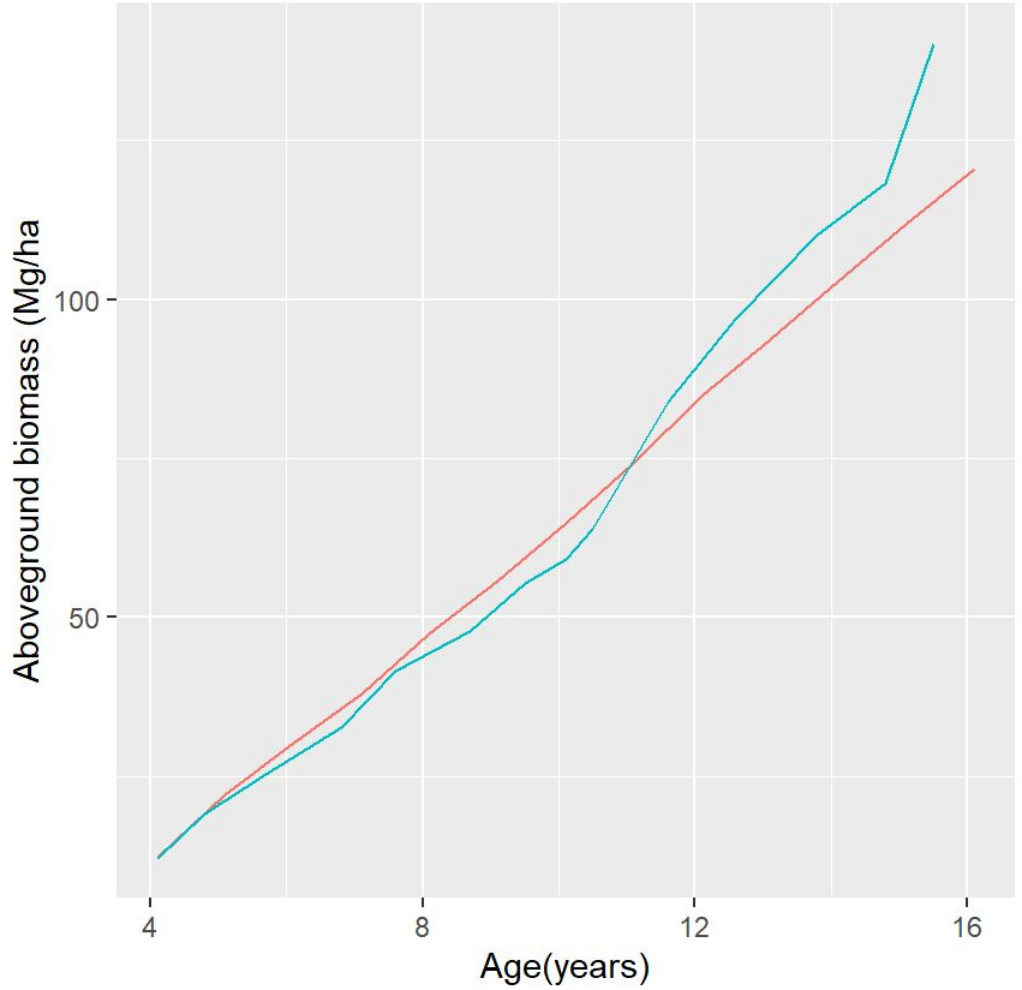

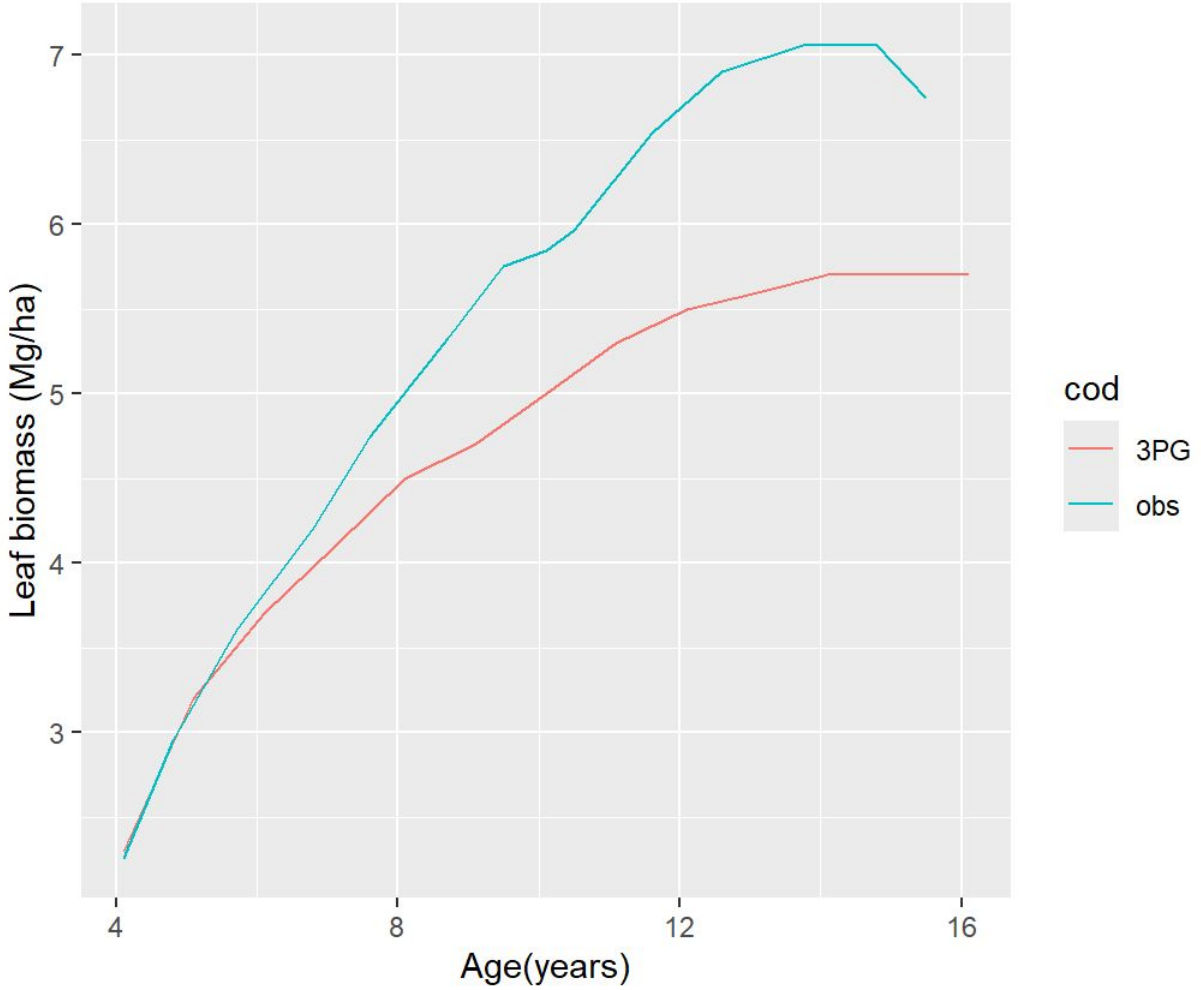

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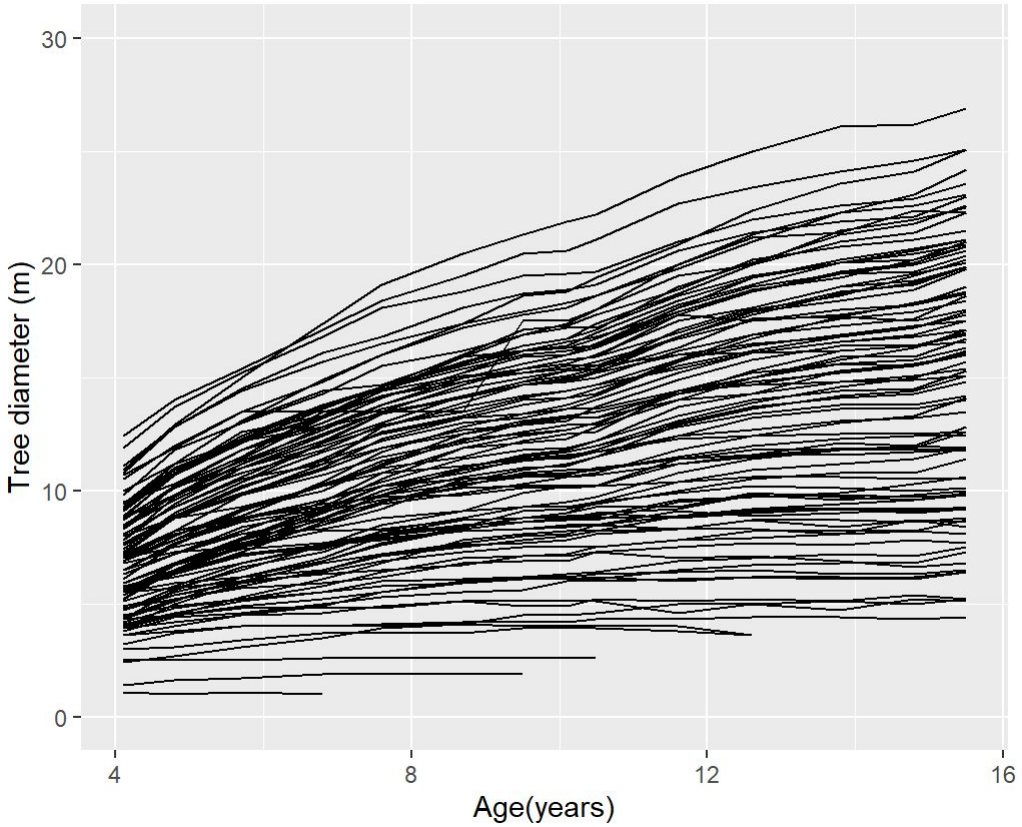

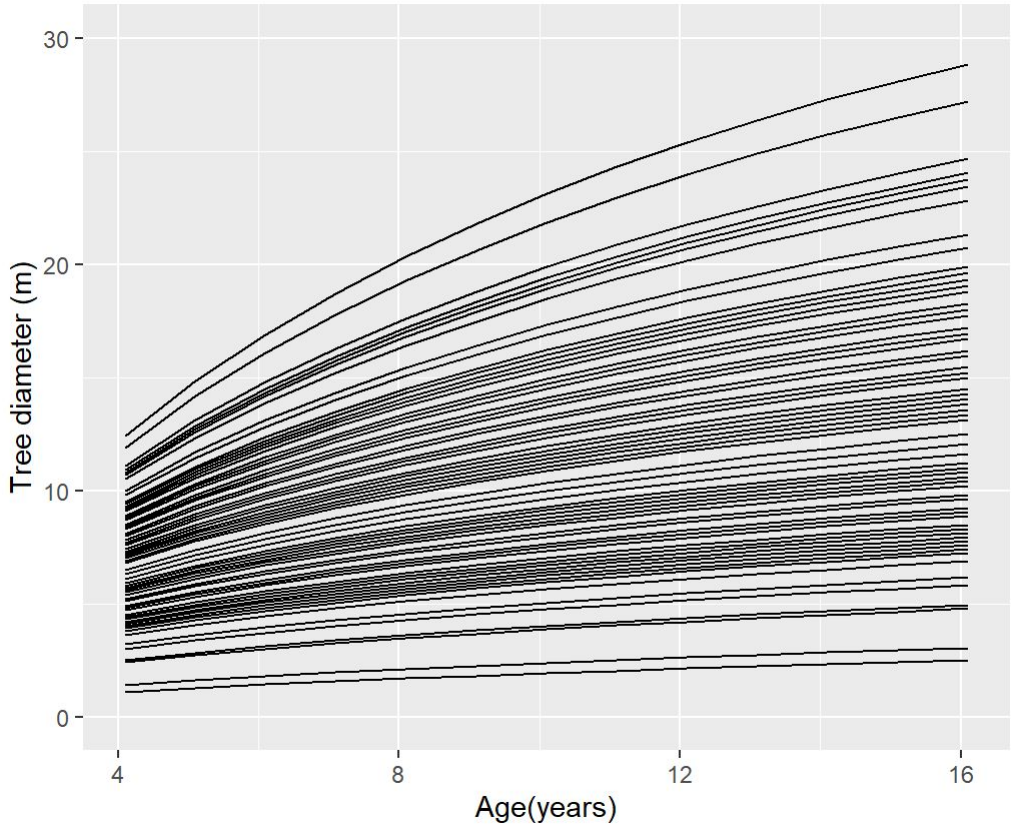


Questions?