Main aims

- Get the best picture of knot (*define*) …

- pith parameters (origin and angle to vertical) and mean radial growth rate …

- in a cylindrical coordinate system …

- from external measurements
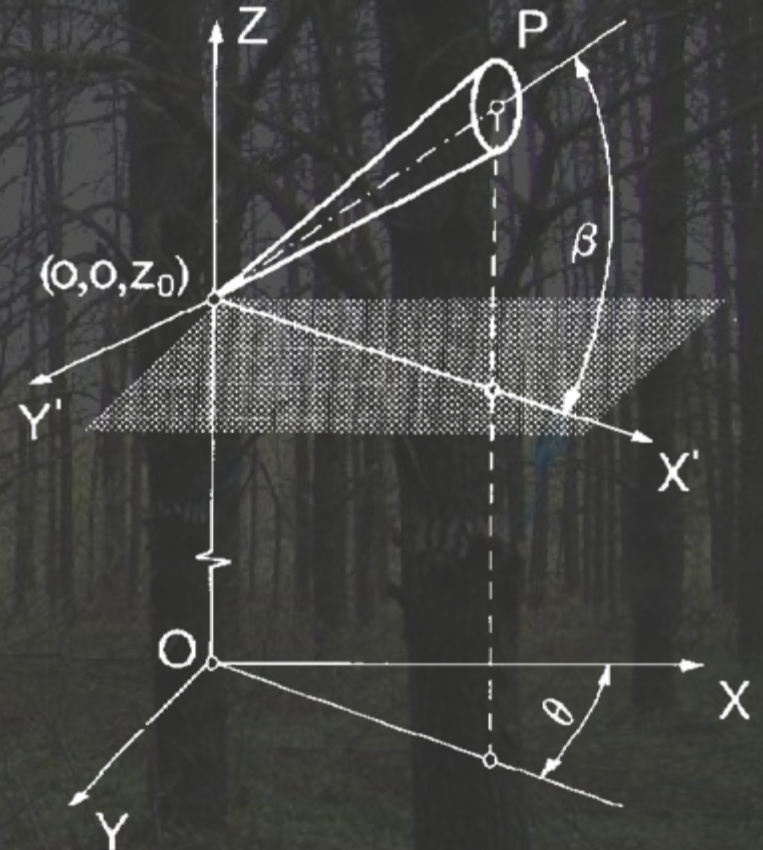
(Samson, 1993)

Equipment

- Tree level
  - Vertex hypsometer
  - Corer
- Whorl/branch level
  - Diameter tape (1 mm)
  - *Electronic* caliper (1 mm)
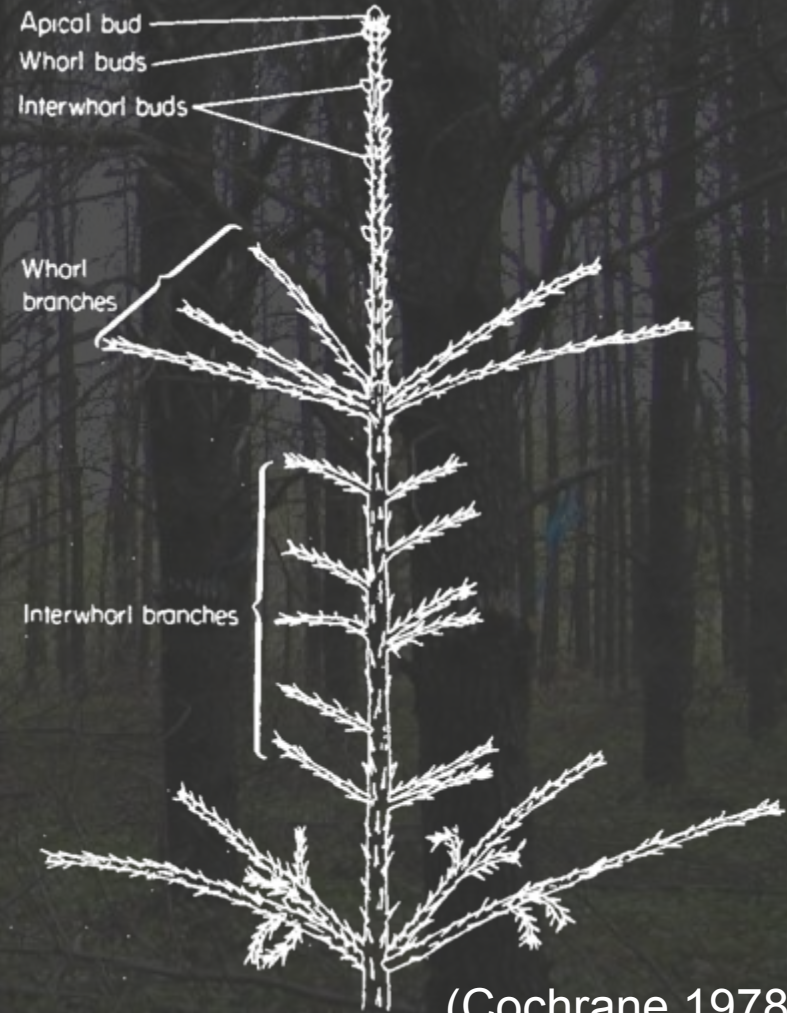 - Protractor (1°)

Field – tree level

- Tree age

- Tree height (1 cm)

- Height to crown base (1 cm)
  - lowest live nodal whorl (containing at least one live branch)

- DBH (1 mm)

Field – whorl/branch level

- Whorl types

Apical bud
Whorl buds
Interwhorl buds

Whorl branches

Interwhorl branches

(Cochrane,1978)

Field – whorl/branch level

- For all whorls
  - Whorl type (binary)
  - Height (1 cm)
  - Branches within whorl
    - state (dead or alive)
      - supporting needles or not
    - diameter (1 mm)
    - insertion angle (5°)

Field – whorl/branch level

- For nodal whorls only
  - Stem diameter (1 mm precision)
  - Distance from magnetic North clockwards→azimuth (5 mm)
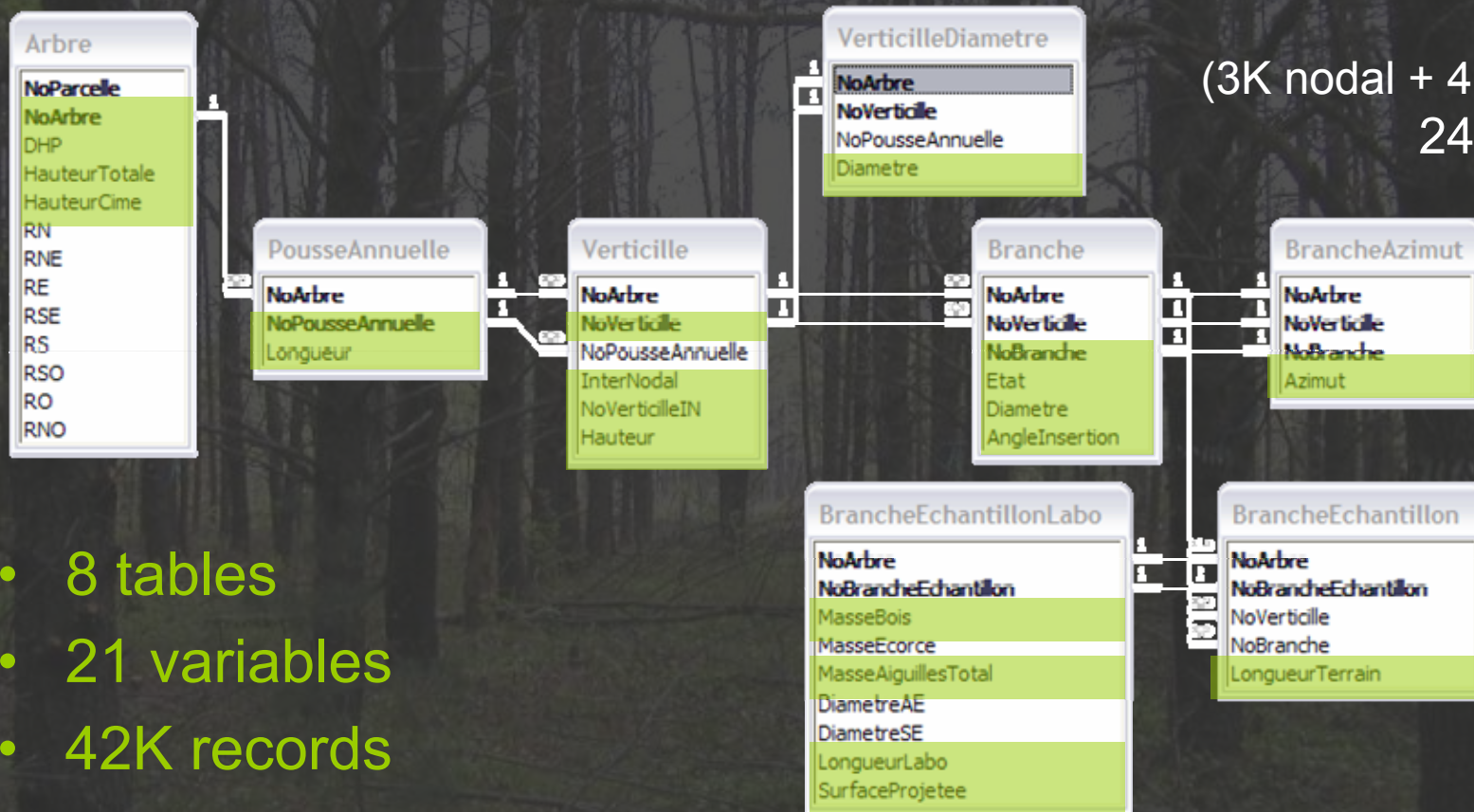- For sample branches only
  - Length (1 cm)

Laboratory

- For stem analysis disks
  - Radial increments with WinDENDRO
- For sample branches only
  - Branch length (1 cm)
  - Branchwood and foliage biomass (1 mg)
  - Foliage projected area with WinSEEDLE

Main calculations

- Stem analysis (Carmean, 1972)
- Annual shoot length
- Number of branches per annual shoot
- Distance from magnetic North into azimuth
  - Divide by (π x stem diameter)
  - Convert length into degrees
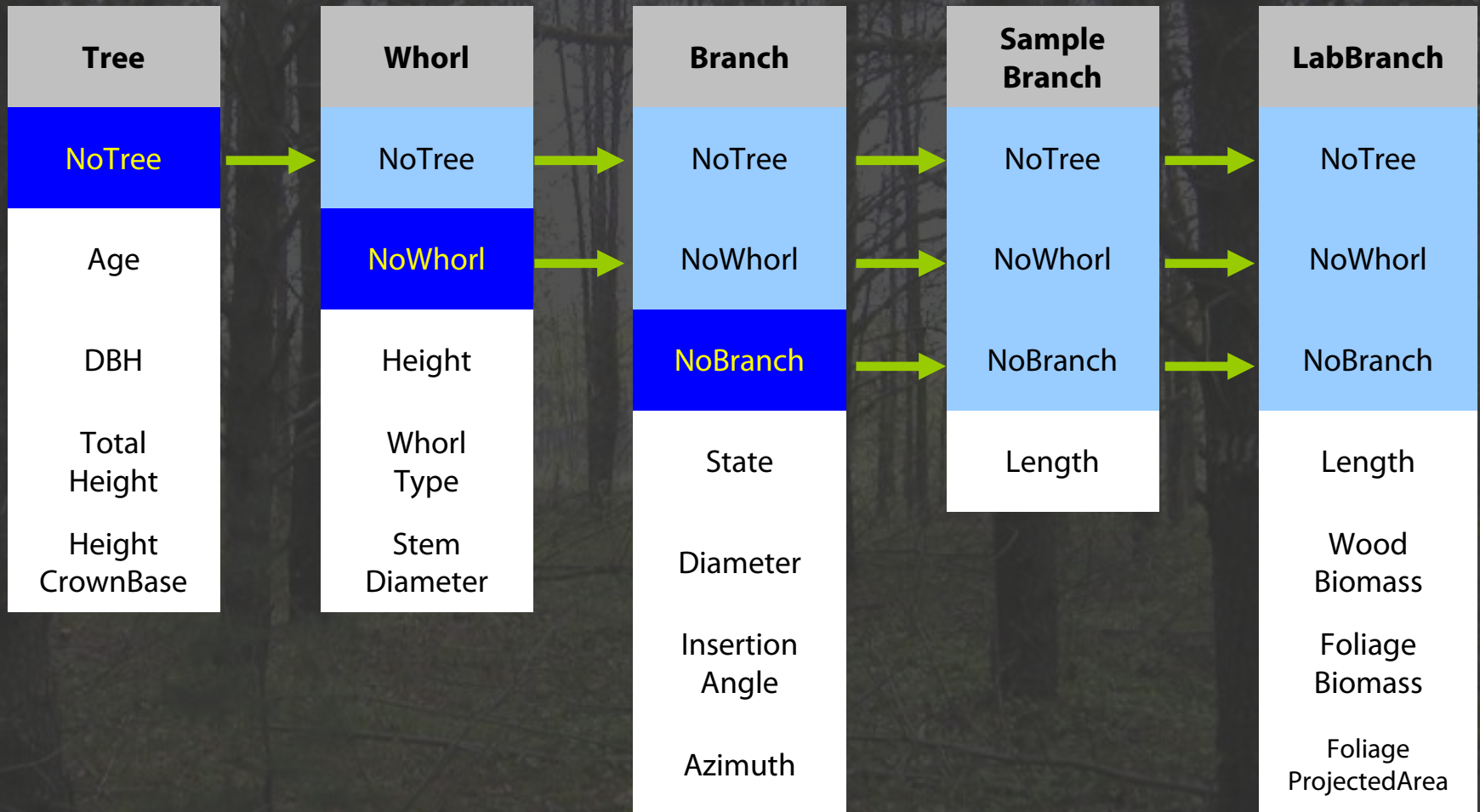 - Remove magnetic declination

Database

85 trees
3K annual shoot (years)
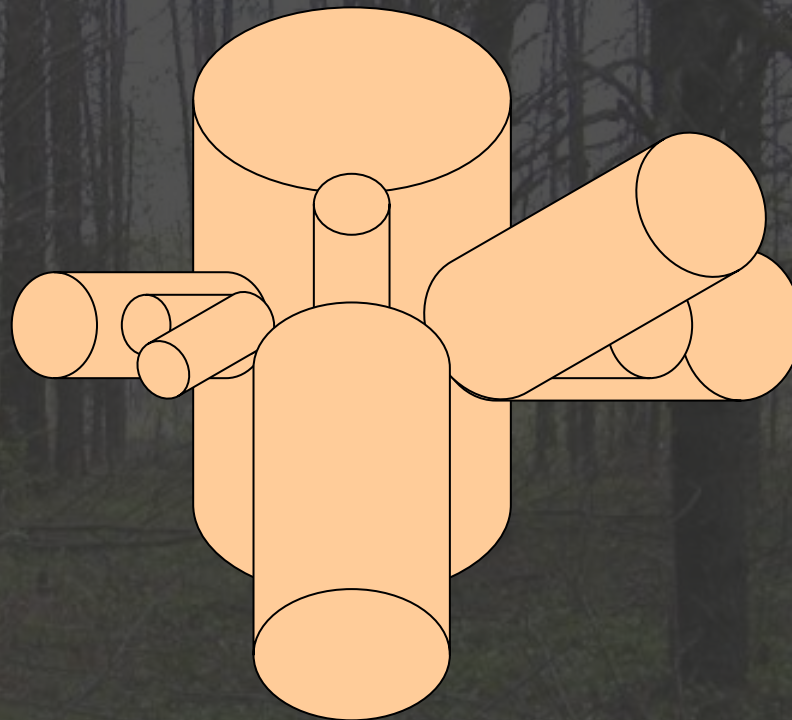7K whorls
(3K nodal + 4K internodal)
24K branches

- 8 tables
- 21 variables
- 42K records
- 142K data entries !!!

Simplified Database

Tree	Whorl	Branch	Sample Branch	LabBranch
NoTree	NoTree	NoTree	NoTree	NoTree
Age	**NoWhorl**	NoWhorl	NoWhorl	NoWhorl
DBH	Height	**NoBranch**	NoBranch	NoBranch
Total Height	Whorl Type	State	Length	Length
Height CrownBase	Stem Diameter	Diameter		Wood Biomass
		Insertion Angle		Foliage Biomass
		Azimuth		Foliage ProjectedArea

Branch module

Branch relationships

- Number of (nodal) branches
  - Previous year annual shoot length
  - Normally distributed random variable

- Azimuth
  - Assumed regularly spaced
  - Shift of 30° of the first branch of the next year

Branch relationships

- Diameter
  - Establish a random diameter with the mean branch diameter from the total branch basal area divided by the number of branches
  - Subsequent annual growth (proportions) function of the sum of total branch basal area above

Branch relationships

- Insertion angle
  - Always function of branch diameter
  - Normally distributed random variable

- Death
  - Probability of a branch to be alive
    - branch age
    - relative branch diameter

Beware of …

1. Database construction
2. Whorl type
3. Azimuth
4. Young trees

Time and labor

- Last summer fieldwork (June 2007)
- Including site selection (6), competitor inventory (including coring), felling, branch measurements, and sample branches and disk collection
- 18 trees (70 years old) with 4 people in 10 days
  - 1 day for site selection (2 people)
  - 30% the time for competitor inventory and felling
  - 60% for branch measurements (2 trees per team [1 secretary and 1 measurer] per day)
  - 10% for sample collection

Ways of accelerating fieldwork ?

- Teams of three people

- Ignore whorl type on the field

- Ignore azimuth and assume branches within whorls to be regularly spaced

Measurer (downwards)   **Secretary**

Measurer (upwards)

Chaire en productivité forestière

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