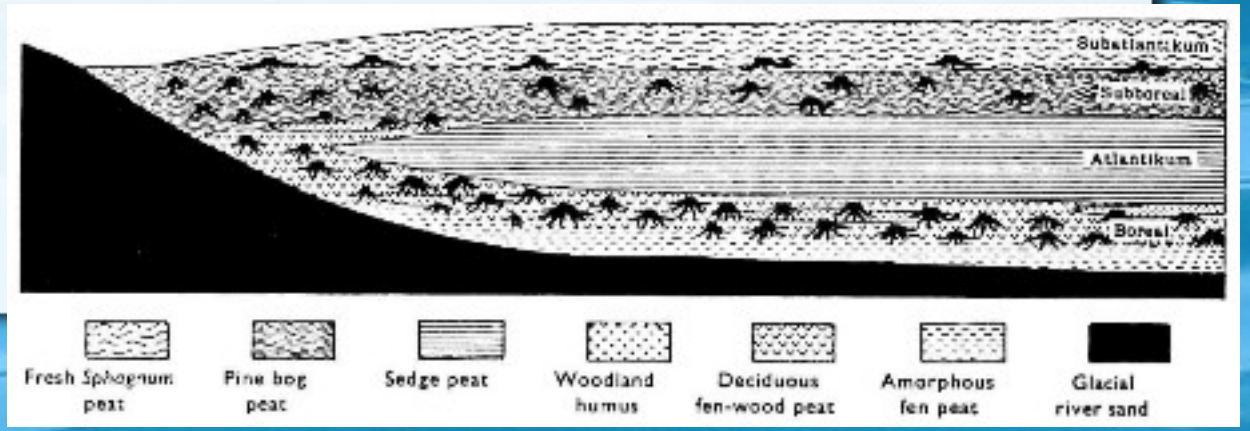
# Basic age-models

# History dating

- Pre $^{14}C$ dating (relative dating)
  - Peat layers (Sernander 1866-1944) & pollen
  - Link pollen with archaeology (bronze age etc.)
  - Link with Swedish varve chronology (de Geer)
  - (Sub) millennial precision




Von Post 1946

# History dating

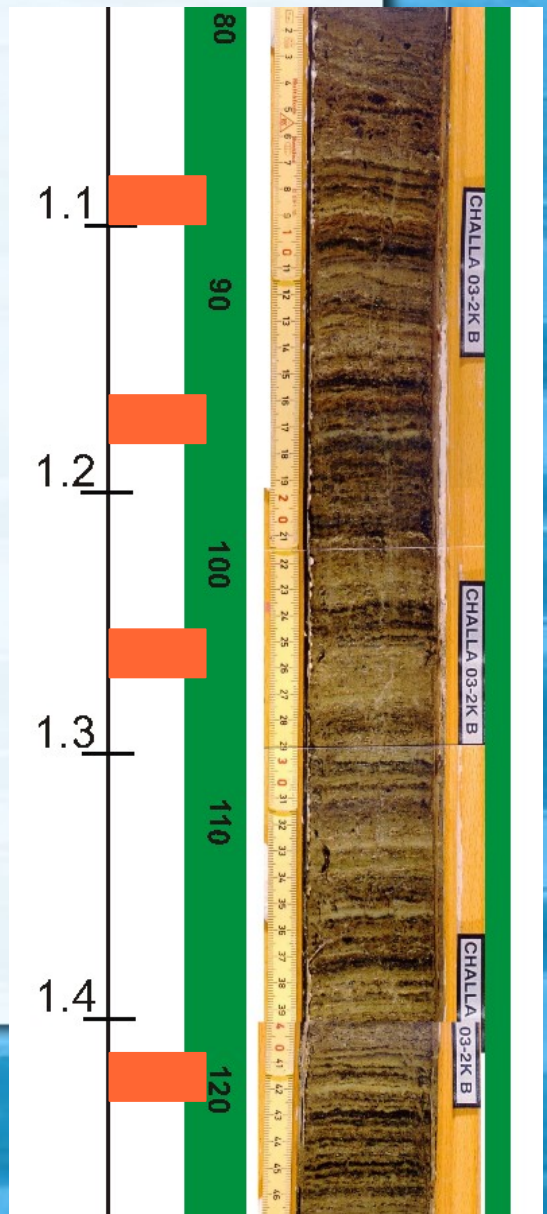
- Carbon dating → 'absolute', independent dates
  - Smith & Pilcher 1973: $^{14}C$ dating *vs.* pollen zones
- $^{14}C$ date depths along peat core
  - At levels with major proxy changes
  - At regular intervals
- Assume linear accumulation between dated levels
  - e.g.: Aaby 1976, van Geel 1978

# History dating

- High-resolution $^{14}C$ dating
  - wiggle-match dating (van Geel&Mook 1989)
  - Bayesian (e.g., Blaauw&Christen 2005)
  - post-bomb dating (e.g., van der Linden et al. 2008)
- Tephra (e.g., Pilcher et al. 1995, Davies et al. 2003)
- $^{210}Pb$ dating (e.g., Turetsky et al. 2004)
- All form age estimates for *age-depth models*
  - The estimates and models are uncertain

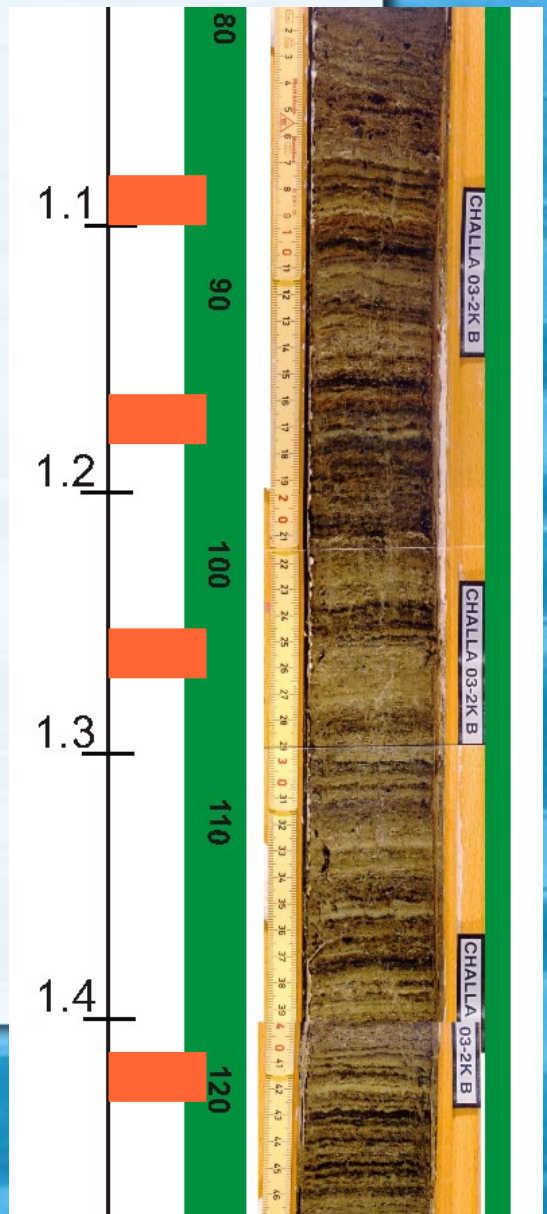
# Age-depth modelling

- So now we have dates... what's next?
- Estimate ages of non-dated levels
  - *and* of dated levels!
- Use available information
  - all dates
  - environmental settings site
  - other comparable archives

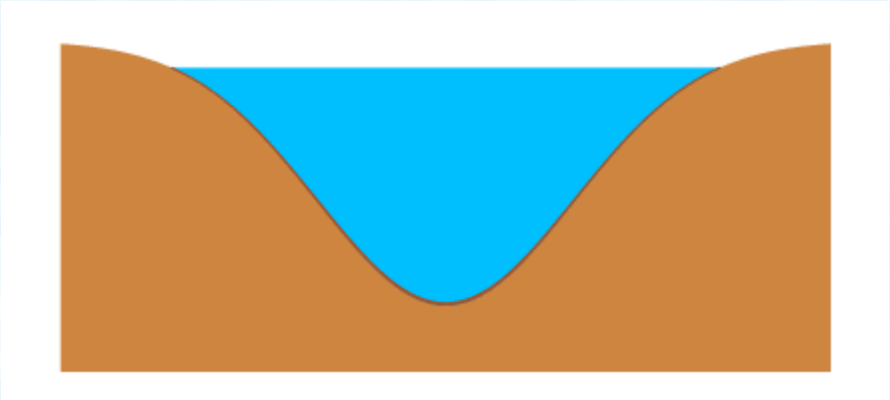


# Age-depth modelling

- $^{14}C$ and other dates
- Basic age-modelling techniques
  - interpolation, regression, spline, ...
- Bayesian approaches
  - chron. ordering, wiggle-match dating
- Compare multiple archives
  - tuning, eye-balling, Bayesian



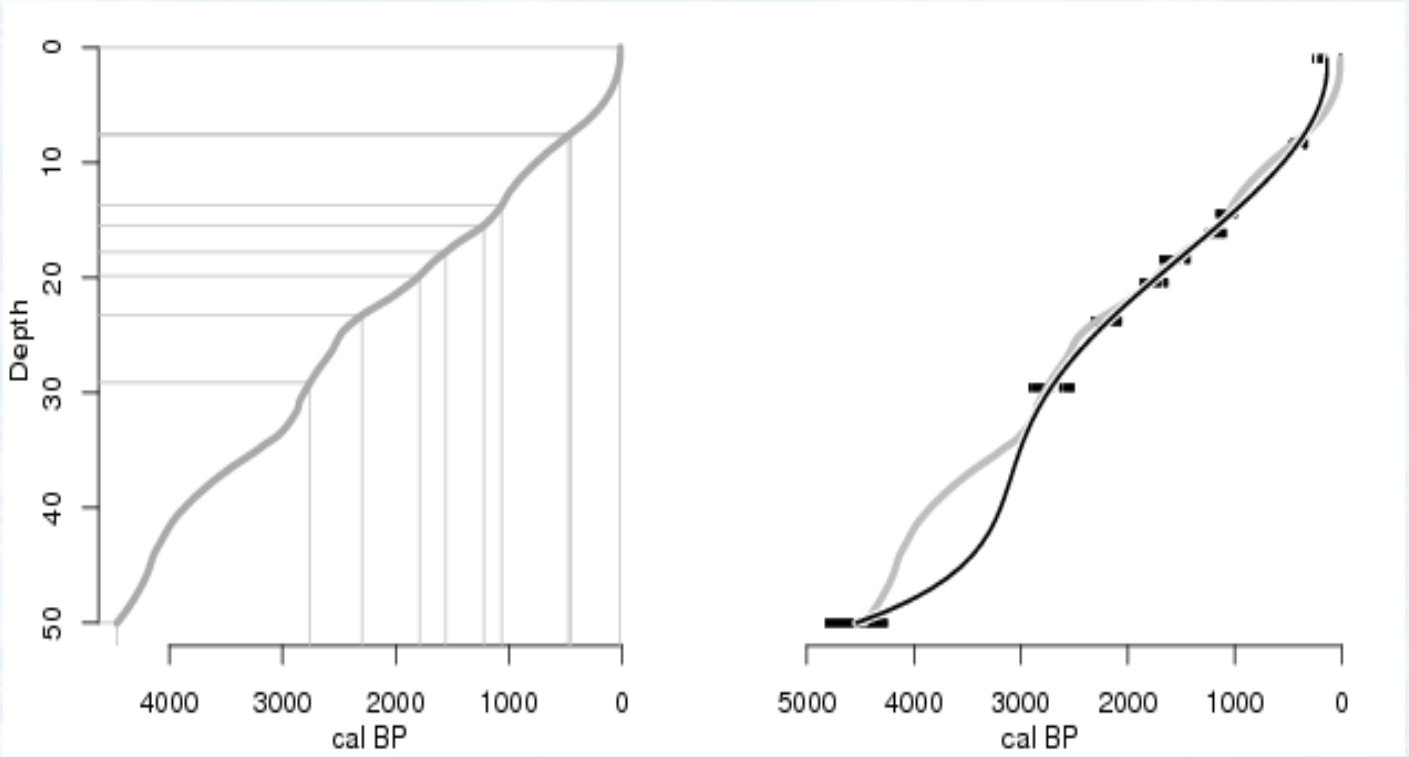
# Age-depth modelling



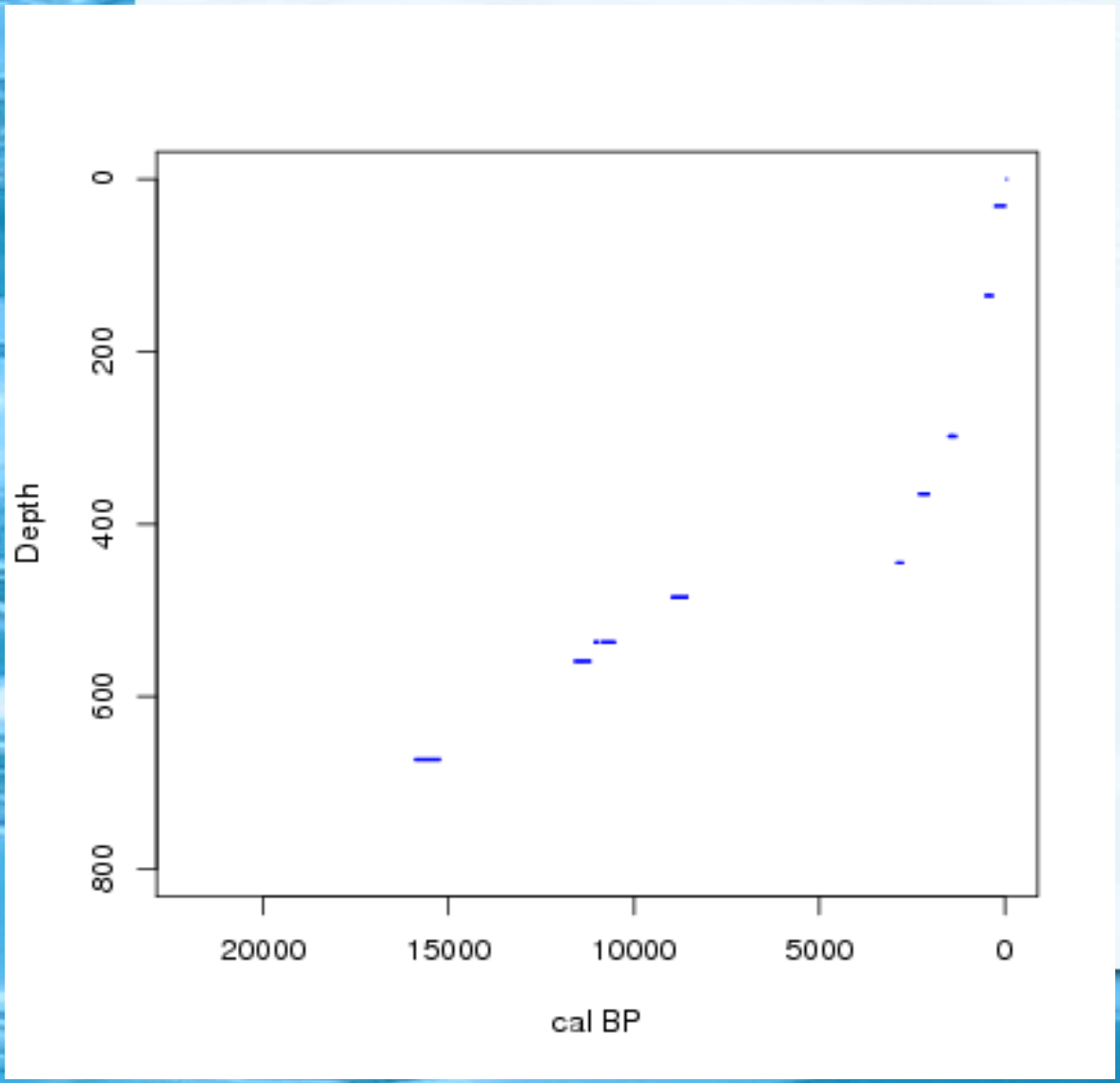
# Age-depth modelling

# Many date$

# Few dates


Depth
0
10
20
30
40
50
4000
3000
2000
1000
0
cal BP
5000
4000
3000
2000
1000
0
cal BP

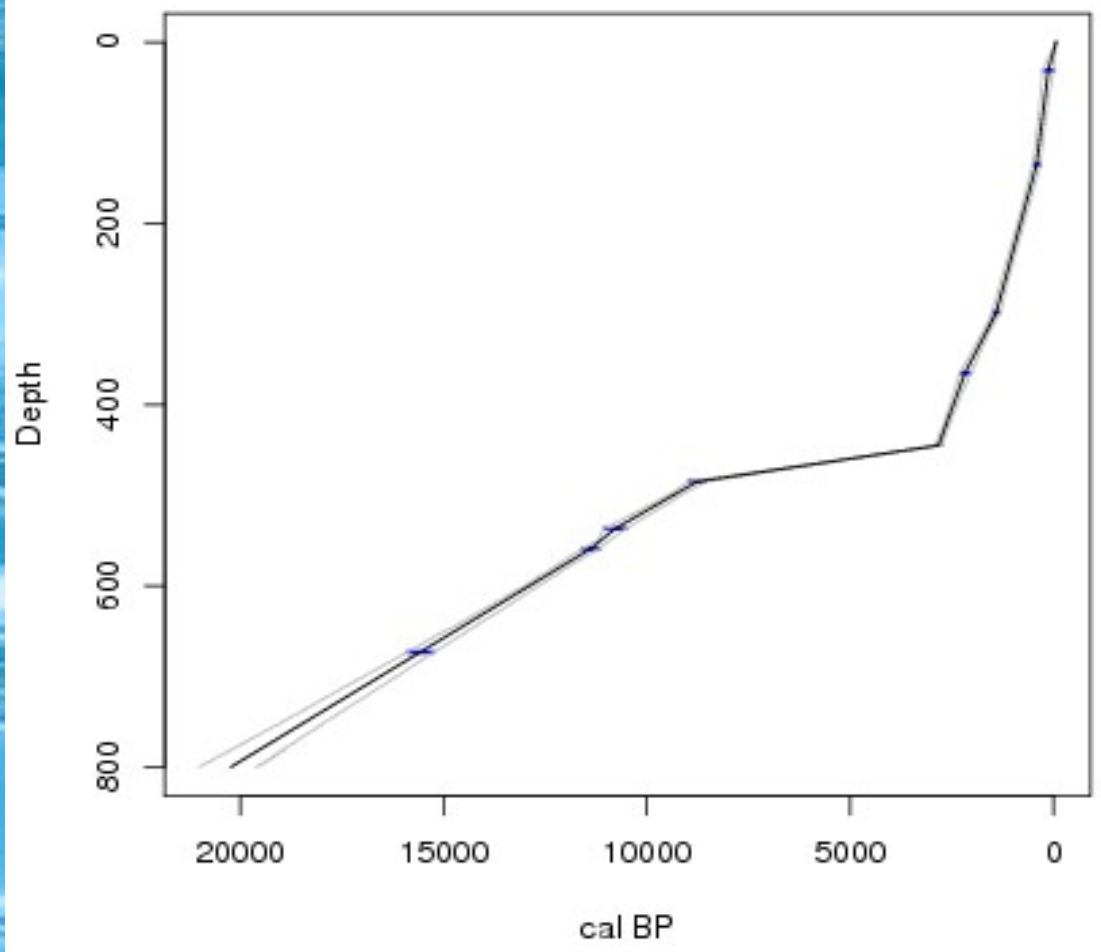
# Which age-depth model?




800 cm core

9 $^{14}$C dates

surface = recent



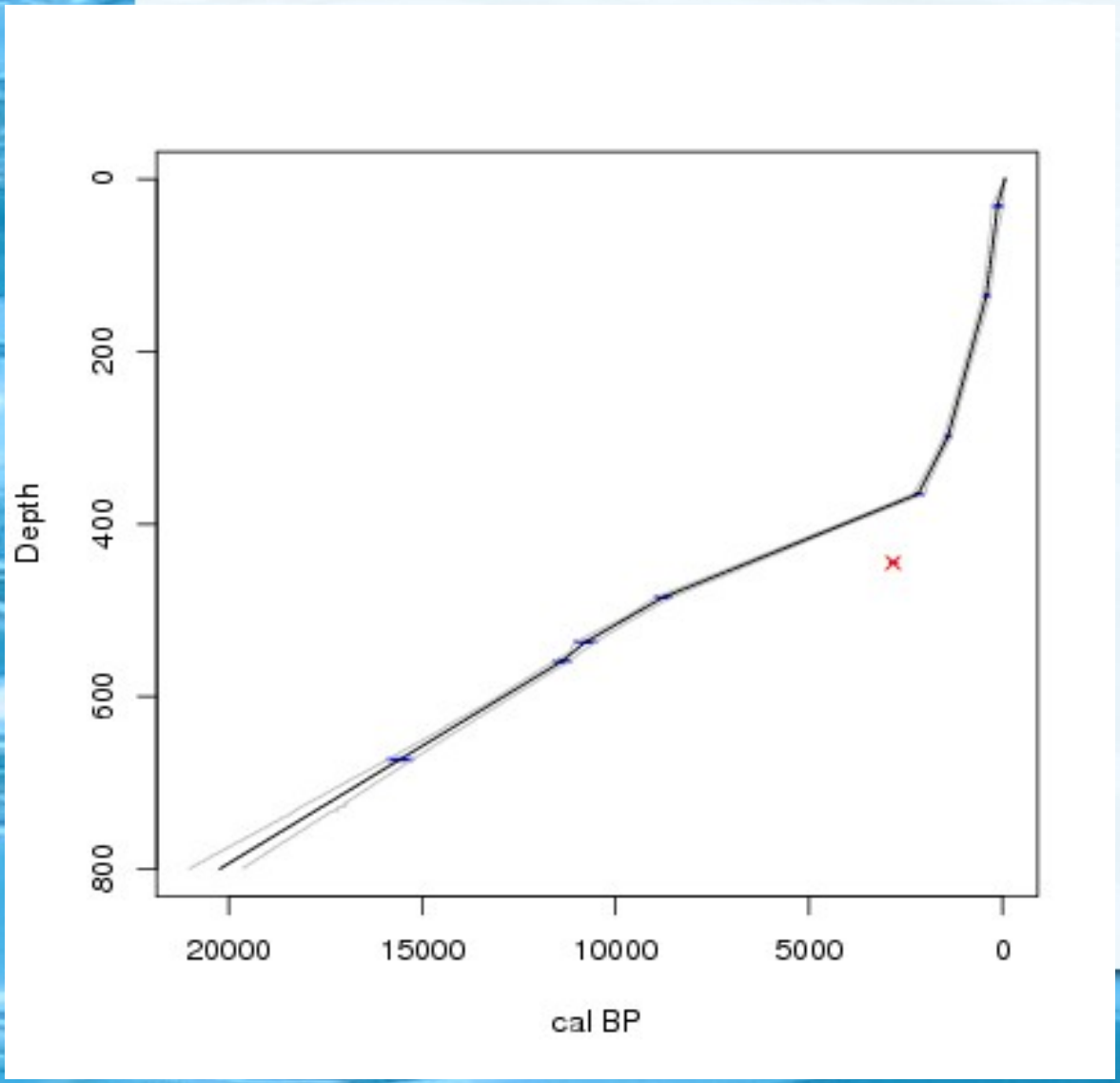

800 cm core

9 $^{14}$C dates

surface = recent

**Linear interpol.**

**Too much weight on individual dates?**



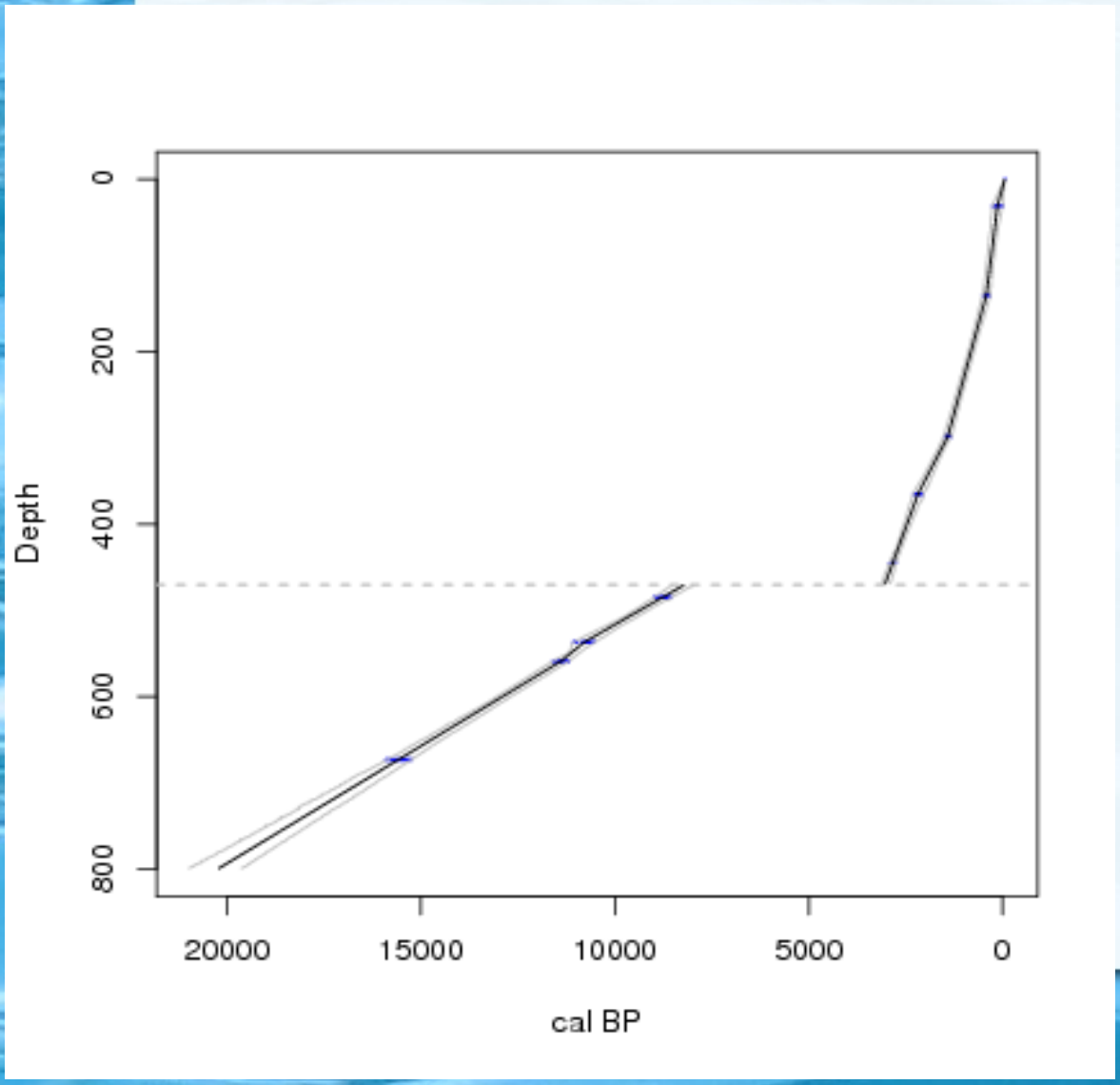

800 cm core

9 $^{14}$C dates

surface = recent

**Linear interpol.**

- **date 6 = outlier**



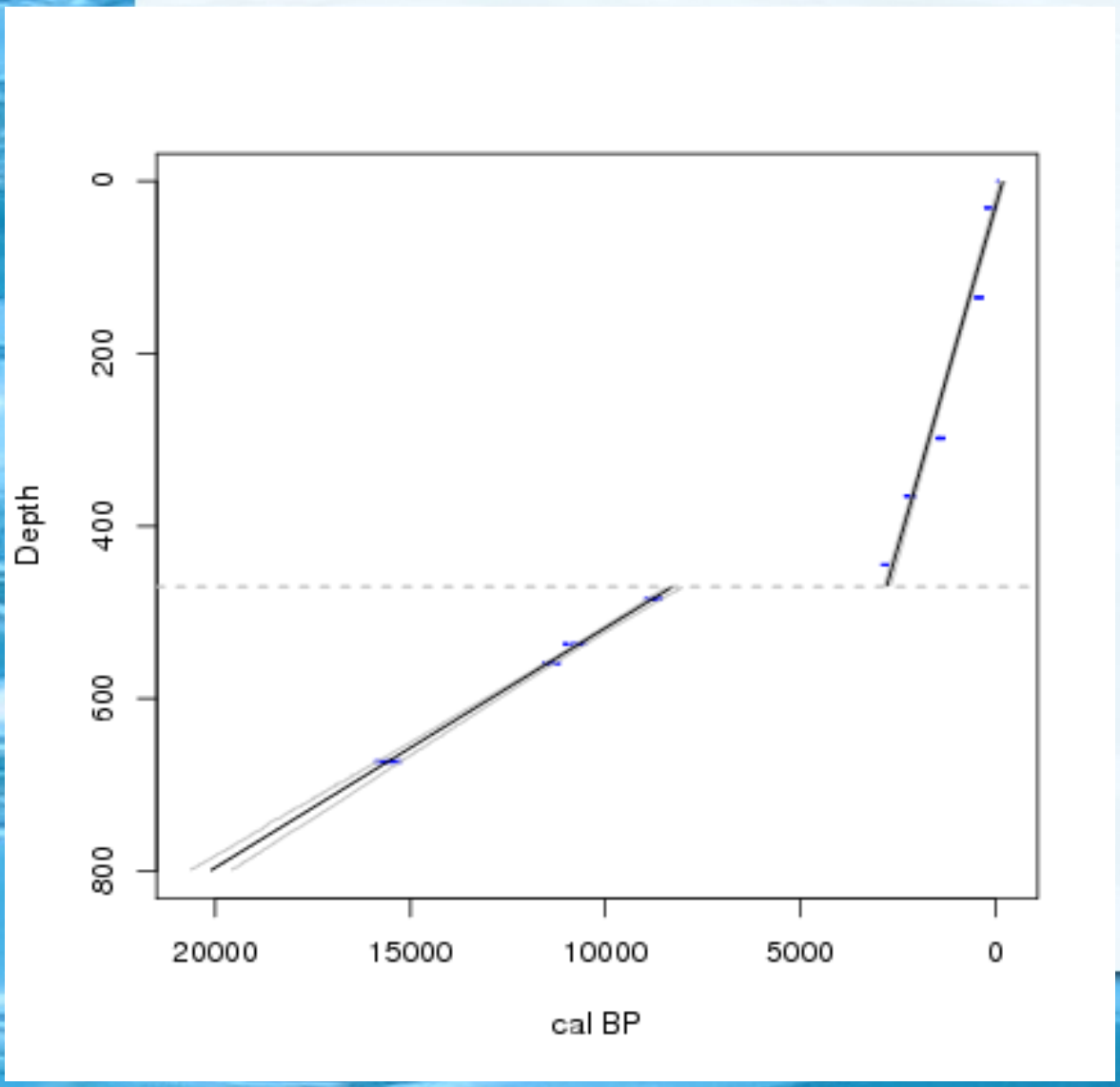

800 cm core

9 $^{14}$C dates

surface = recent

**Linear interpol.**

- **470 cm = hiatus**




800 cm core

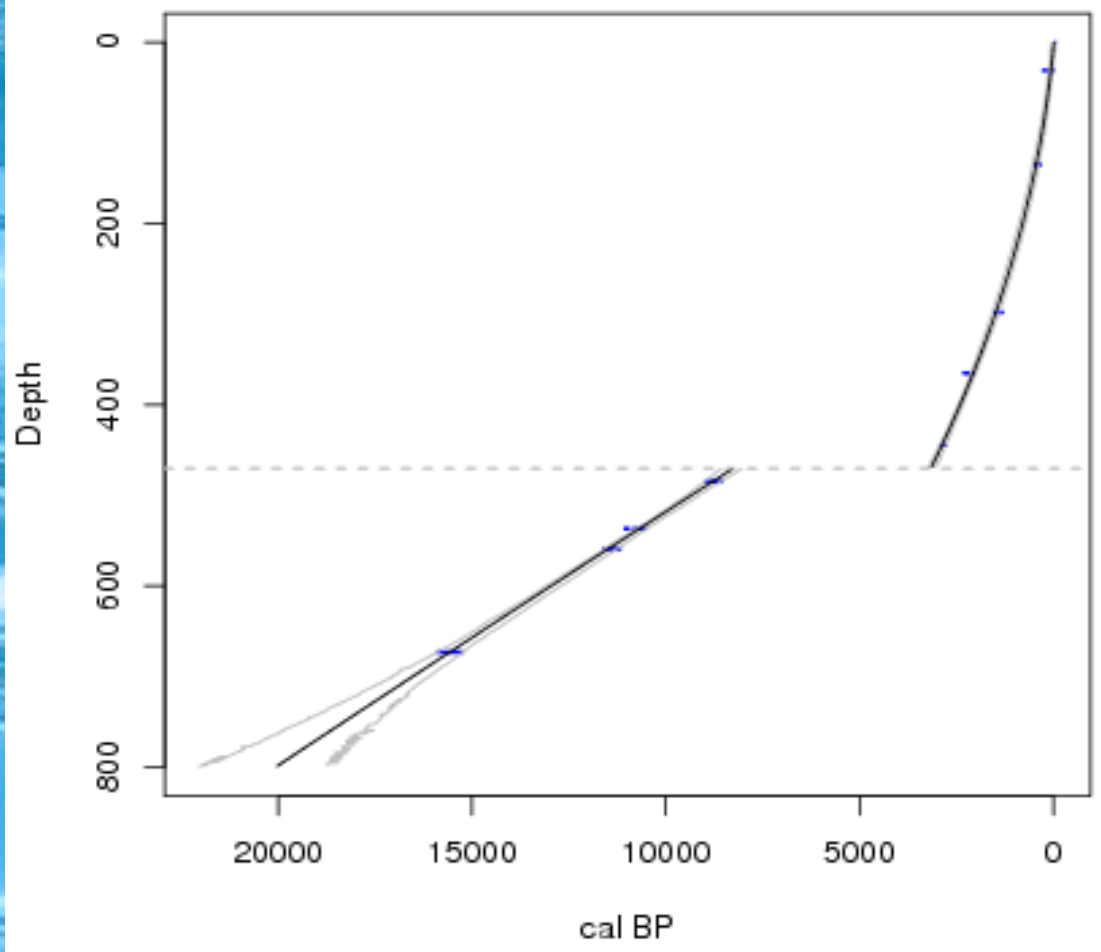
9 $^{14}$C dates

surface = recent

**Linear regression**

- **470 cm = hiatus**

**Too narrow error ranges?**




800 cm core

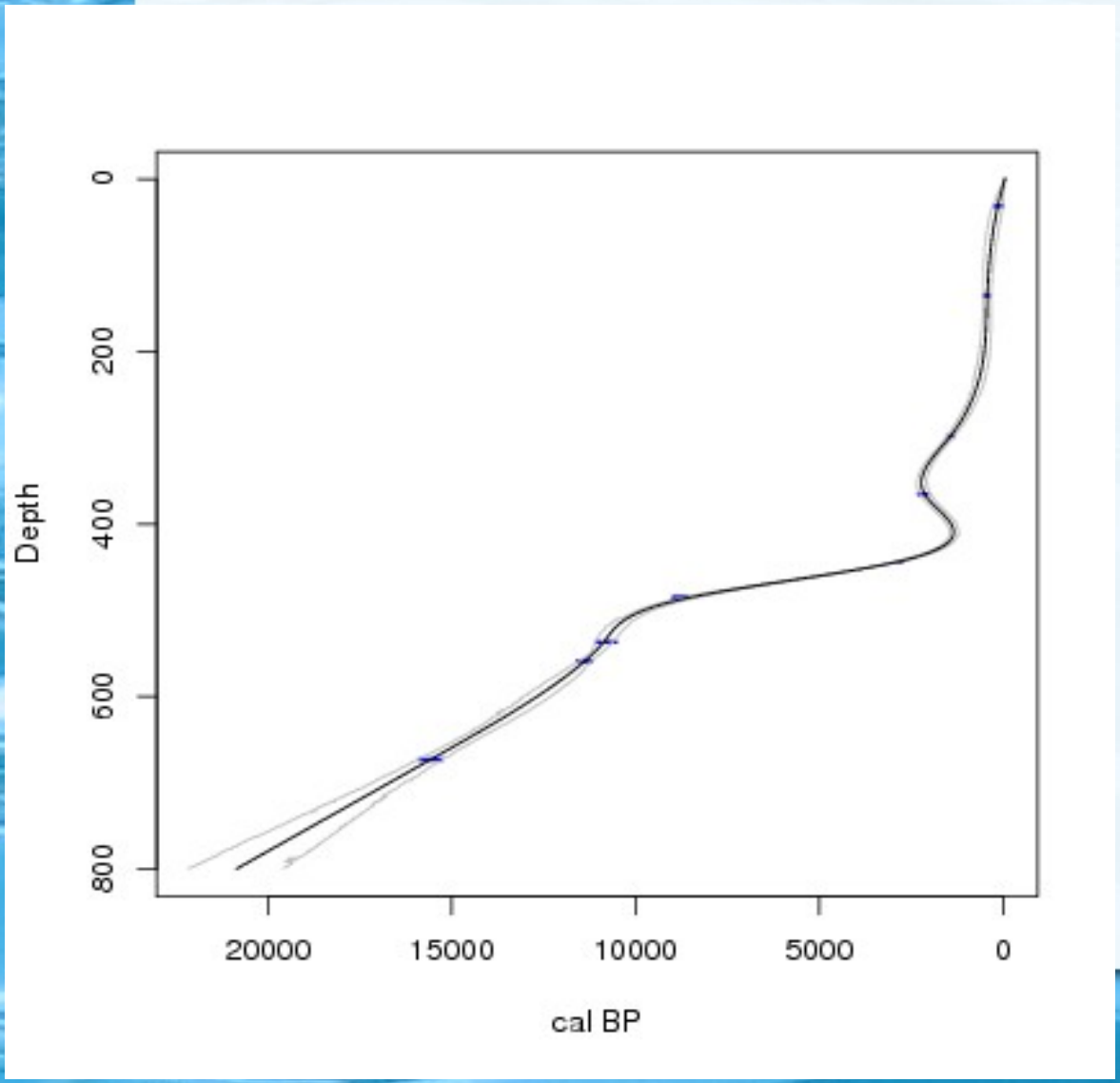
9 $^{14}$C dates

surface = recent

**Polyn. regression**

- **470 cm = hiatus**
- **second degree**

**wide uncertainties when extrapolating!**

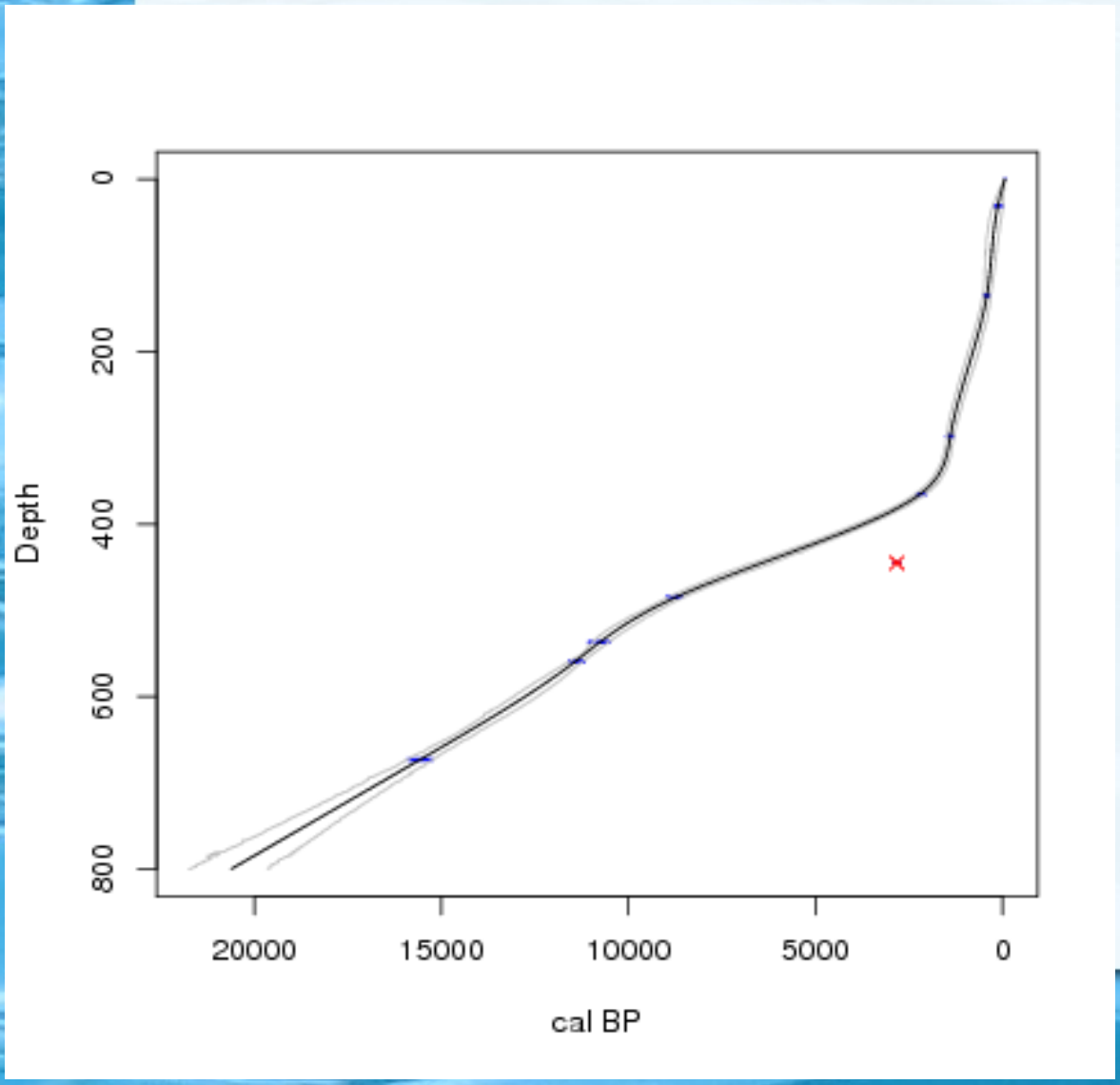



800 cm core

9 $^{14}$C dates

surface = recent

**Smooth spline**



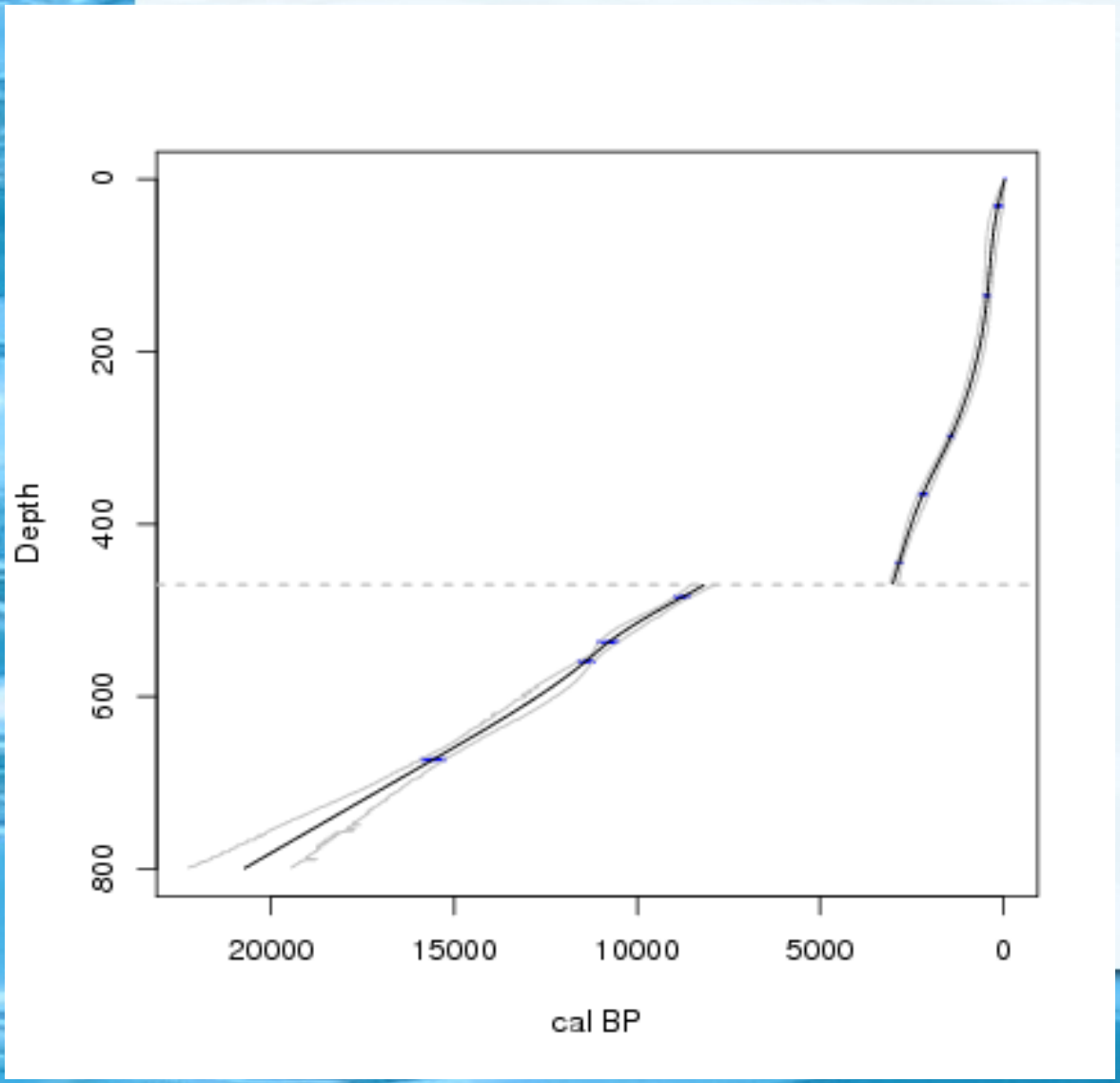

800 cm core

9 $^{14}$C dates

surface = recent

**Smooth spline**

- **date 6 = outlier**



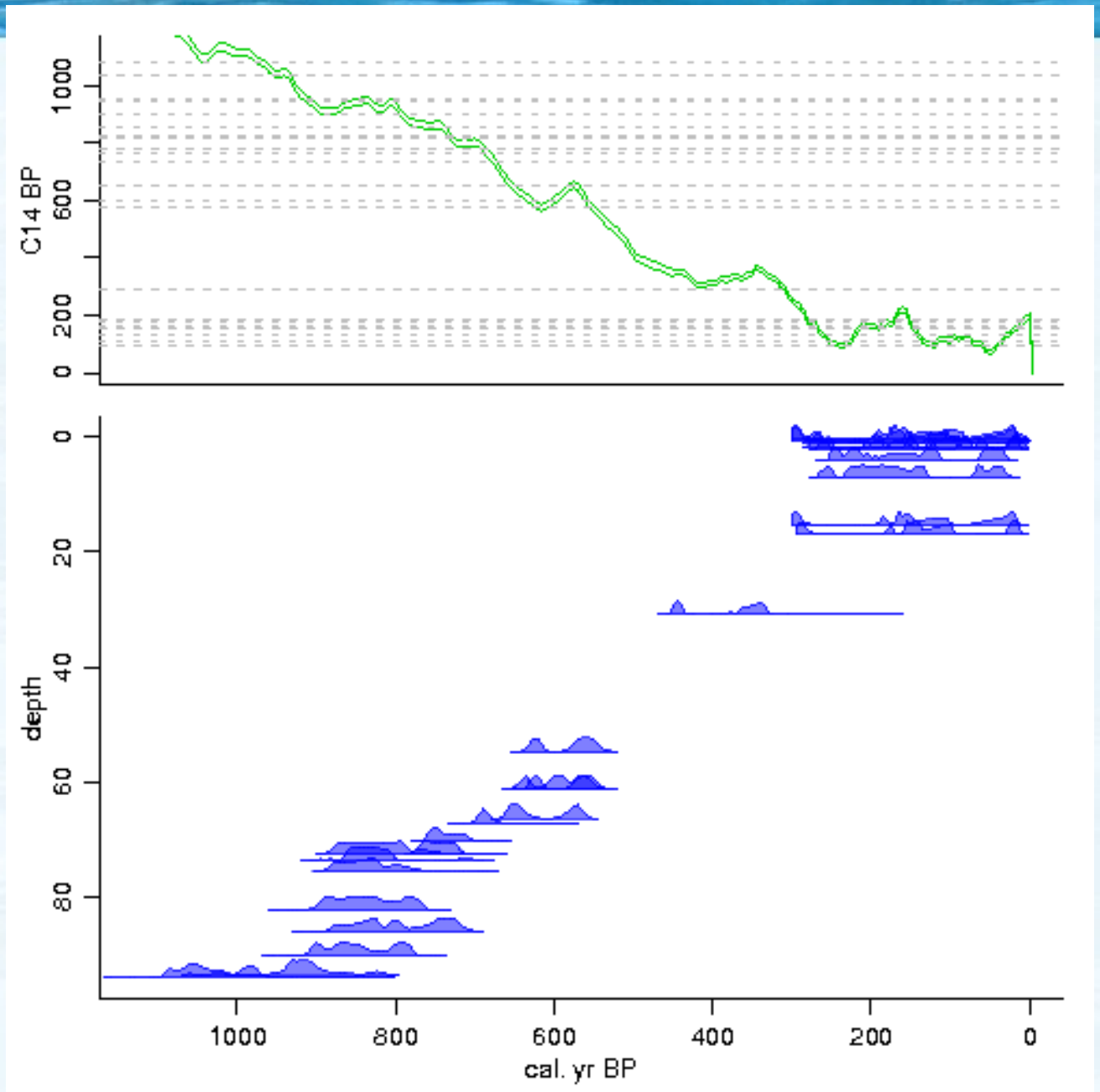

800 cm core

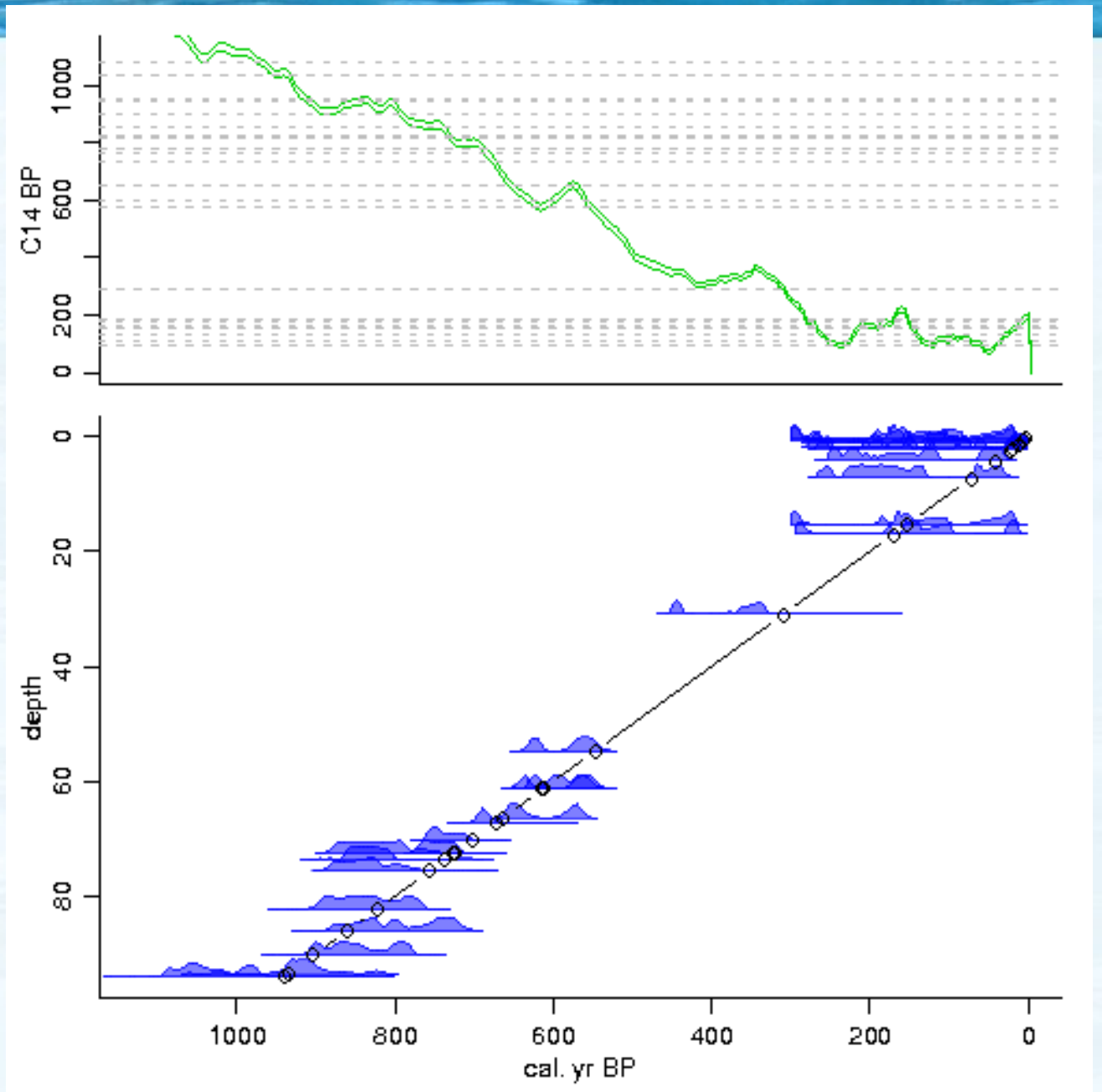
9 $^{14}$C dates

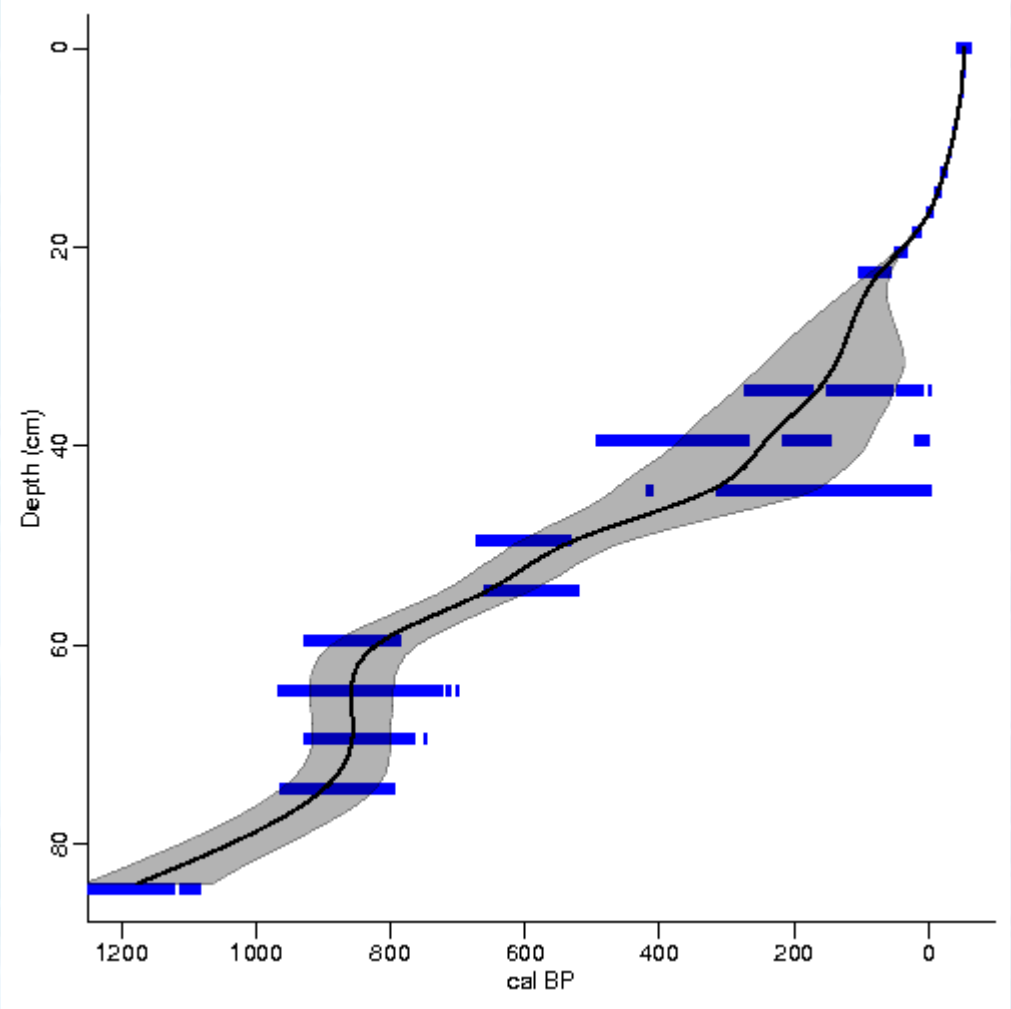
surface = recent

**Smooth spline**

- **470 cm = hiatus**


C14 BP
0
200
600
1000
depth
0
20
40
60
80
1000
800
600
400
200
0
cal. yr BP


C14 BP
0
200
600
1000
depth
0
20
40
60
80
1000
800
600
400
200
0
cal. yr BP


Depth (cm)
0
20
40
60
80
1200
1000
800
600
400
200
0
cal BP

# Age-depth modelling

- How did sediment accumulate over time?
  - Constant? Varying? Pulses? Hiatuses? Site specific
  - Should we try to fit a line through all dates?
    - Balance belief in dates and belief in model
  - Use stratigraphic information
- How many dates do I need?
  - The more, the better? The more problems?
  - Depends on your questions
    - “is my sediment Holocene?” “early 8.2 k event?”

File Edit View Go Help

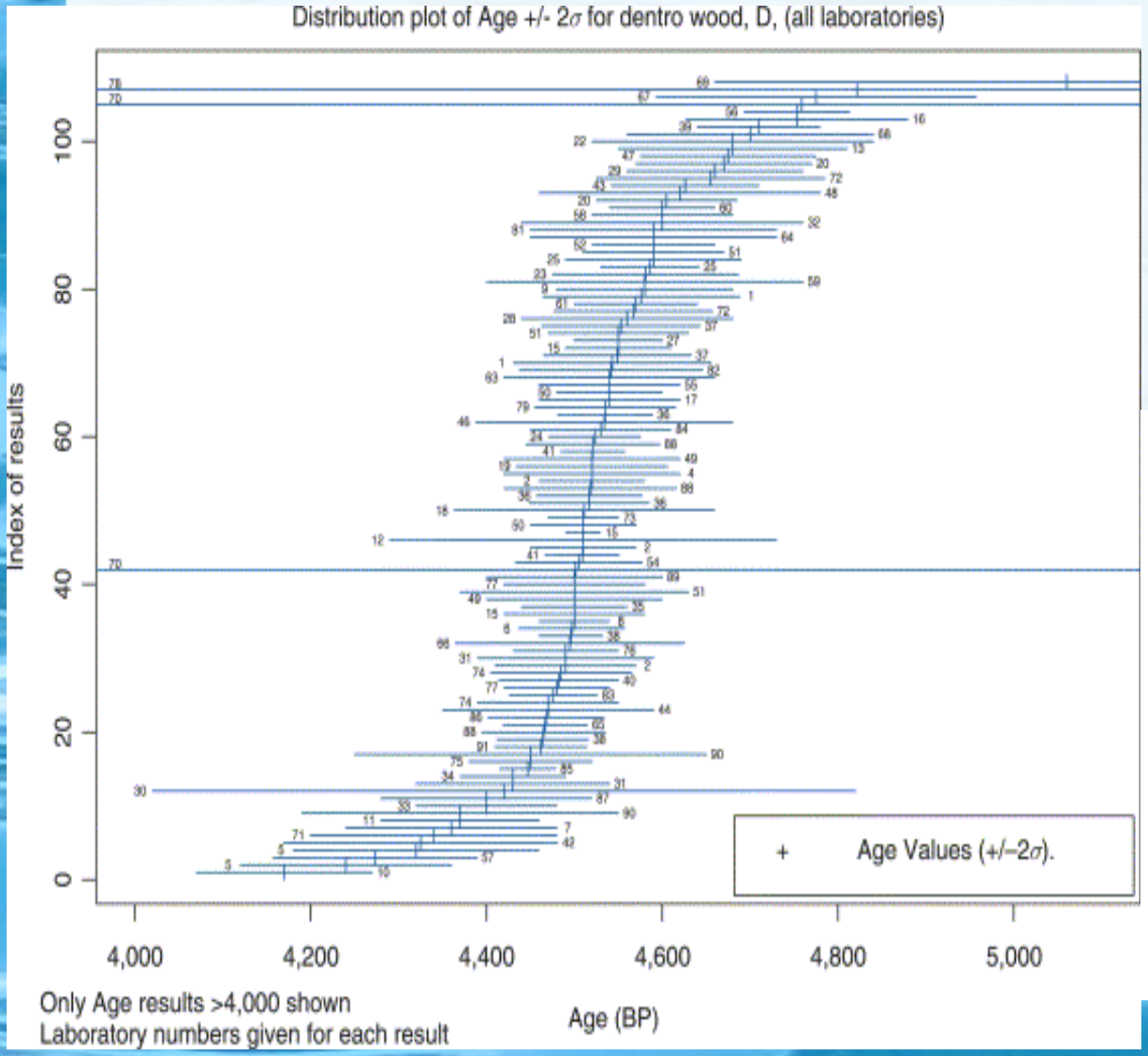
Previous Next 2 of 7 100%

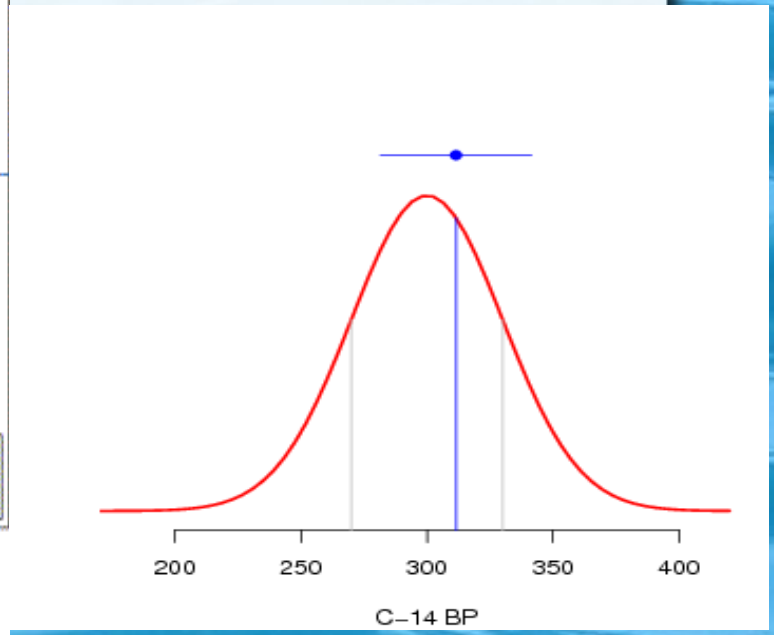


**Table 1**
Literature analysis of primary literature reporting age–depth models, published in 2008 in Quaternary Geochronology (2 papers), Quaternary Science Reviews (40), Quaternary Research (10), Journal of Quaternary Science (13) and The Holocene (28). Publications citing previously published age–depth models were not taken into account. As several papers applied a number of age–depth models and types of dates, the numbers do not always add up. 17 papers mentioned the removal of dates identified as outlying.

| Dates | Point estimate | Model | Model error | Age-model software |
|---|---|---|---|---|
| $^{14}$C (82) | Not specified (60) | Linear interpolation (31) | Not specified (65) | Not specified (71) |
| Tephra (11) | Full distribution (13) | Not specified (18) | 2 sd error (17) | Oxcal (6) |
| $^{210}$Pb/Cs (9) | Mid (5) | Linear regression (13) | 1 sd error (6) | Bpeat (4) |
| U/Th (8) | Median (4) | Bayesian (11) | | Mixed-effect (3) |
| OSL (5) | Intercept (3) | Linear regression (5) | | Bchron (1) |
| Tuning (4) | Mean (1) | Spline (4) | | psimpoll + BCal (1) |
| Varves (2) | Weighted mean (1) | Mixed-effect (3) | | Other (2) |
| | Mid of most probable range (1) | CRS (2) | | |
| | | Other (2) | | |

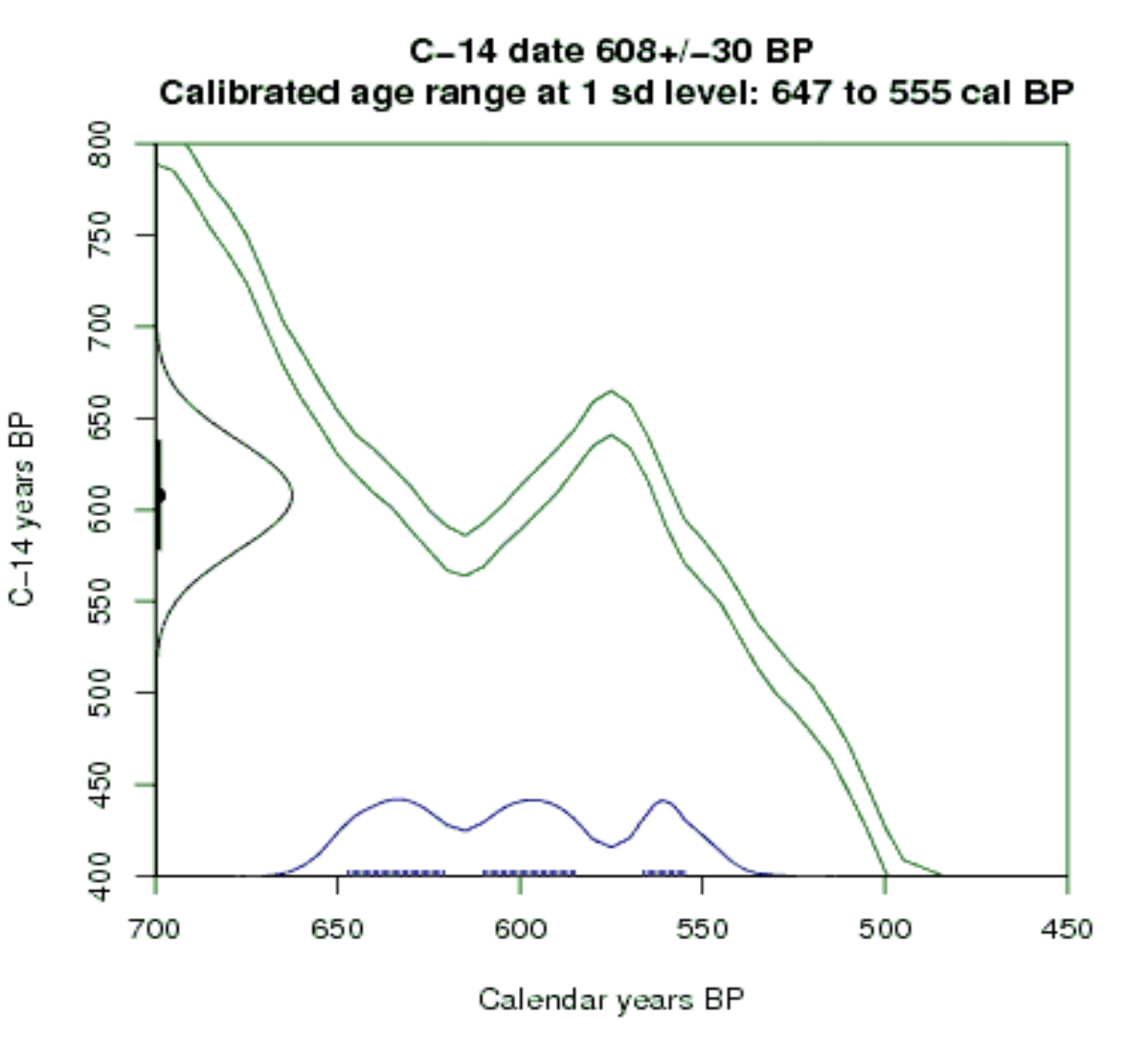
# Dating uncertainties




Scott, 2007. Sources of Errors. *Encyclopedia of Quaternary Science*

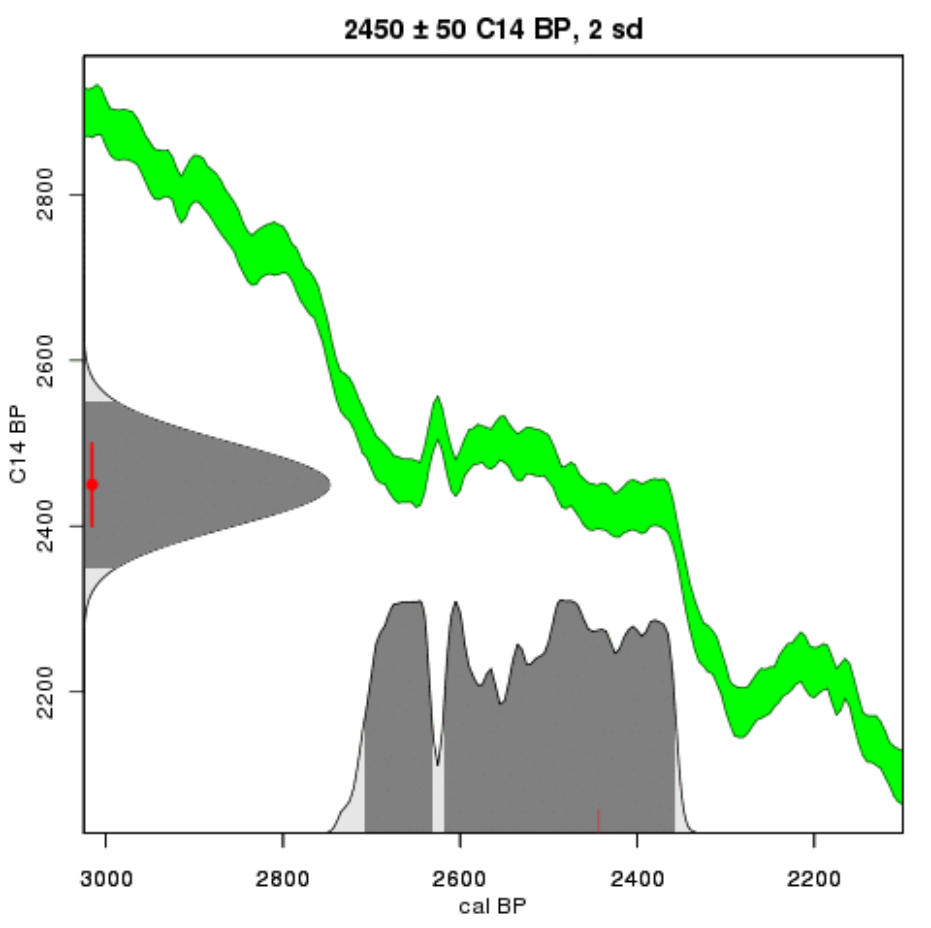
# $^{14}C$ dating


C–14 date 608+/–30 BP
Calibrated age range at 1 sd level: 647 to 555 cal BP
C–14 years BP
800
750
700
650
600
550
500
450
400
700
650
600
550
500
450
Calendar years BP

# Point estimates

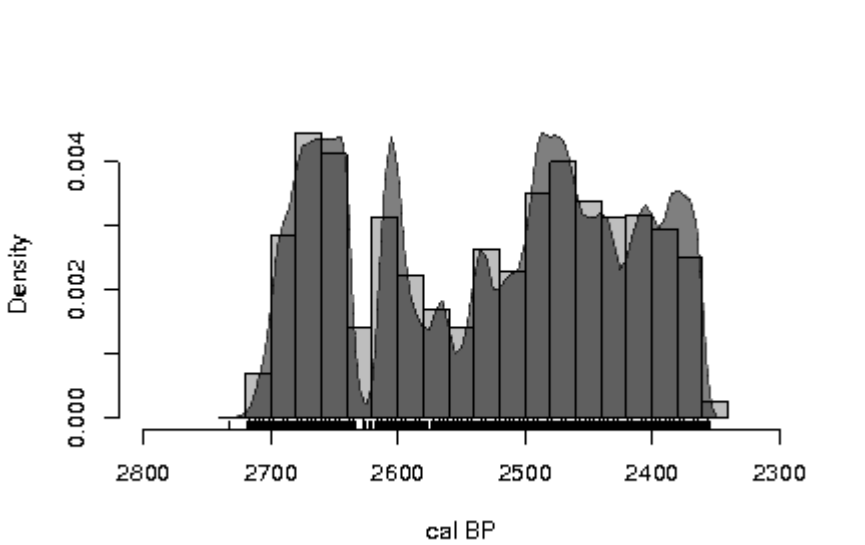
- Cal yr of maximum calibrated distribution
- Midpoint calibrated ranges
- Midpoint of 'best' / most likely calibrated range
- Weighted mean
- Randomly drawn from distribution

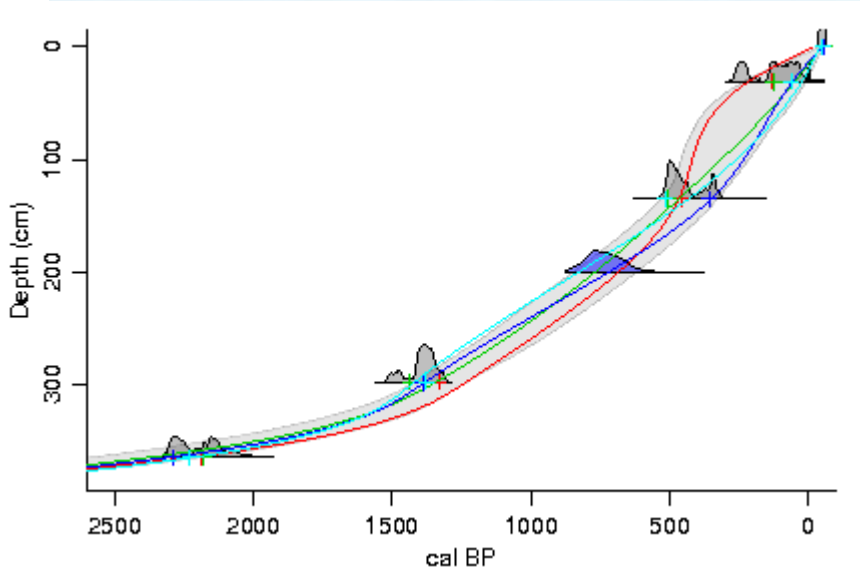
# Sample from calibrated date



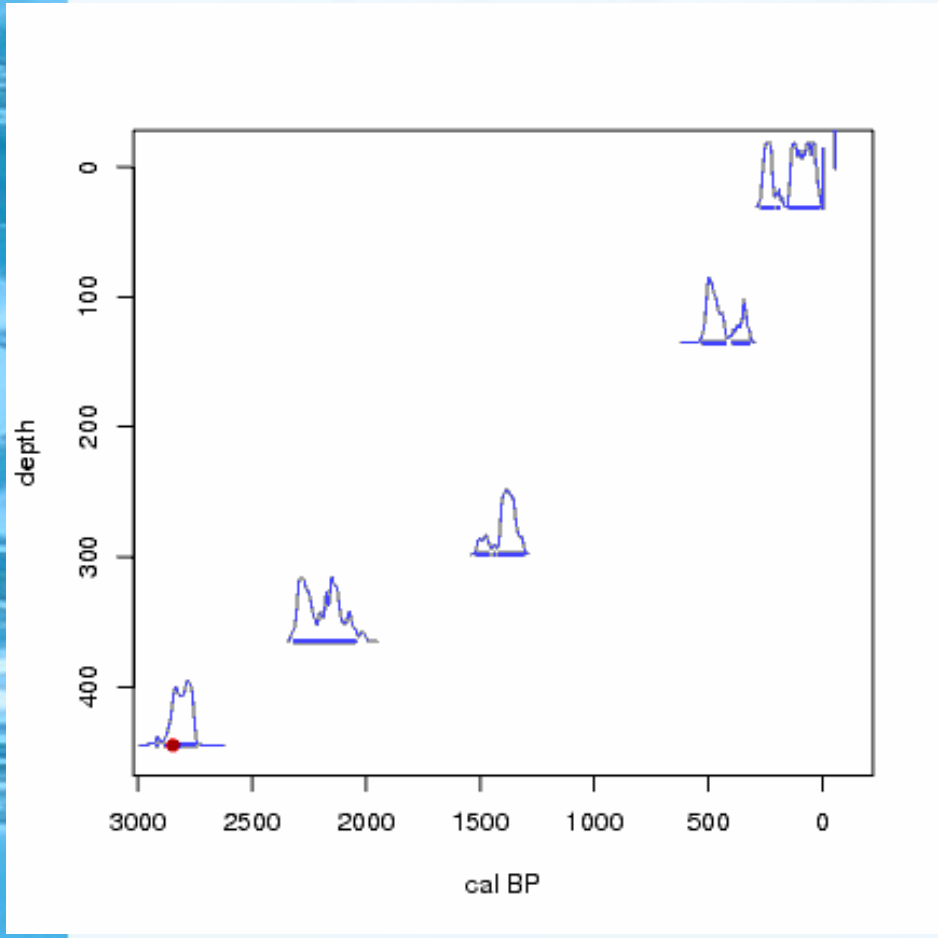

- Sample from calibrated distribution
- Years with higher probability are more likely to be sampled
- Will reproduce distribution after many iterations

# Sample from calibrated date



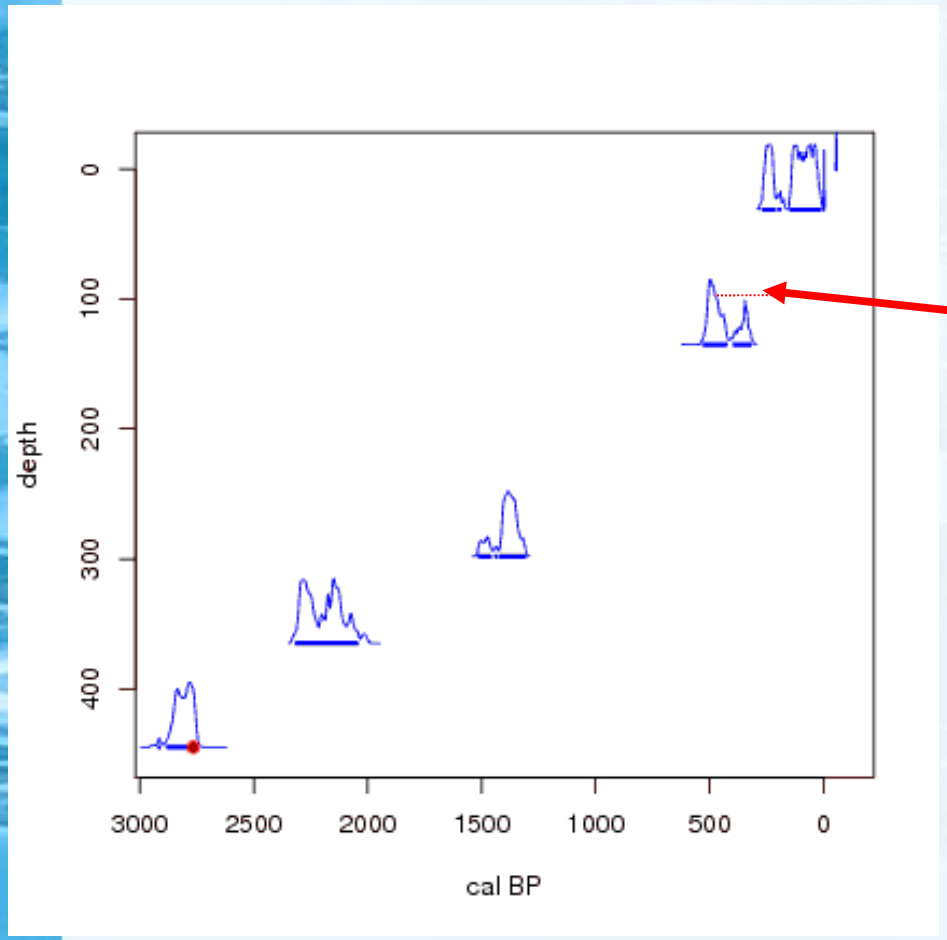



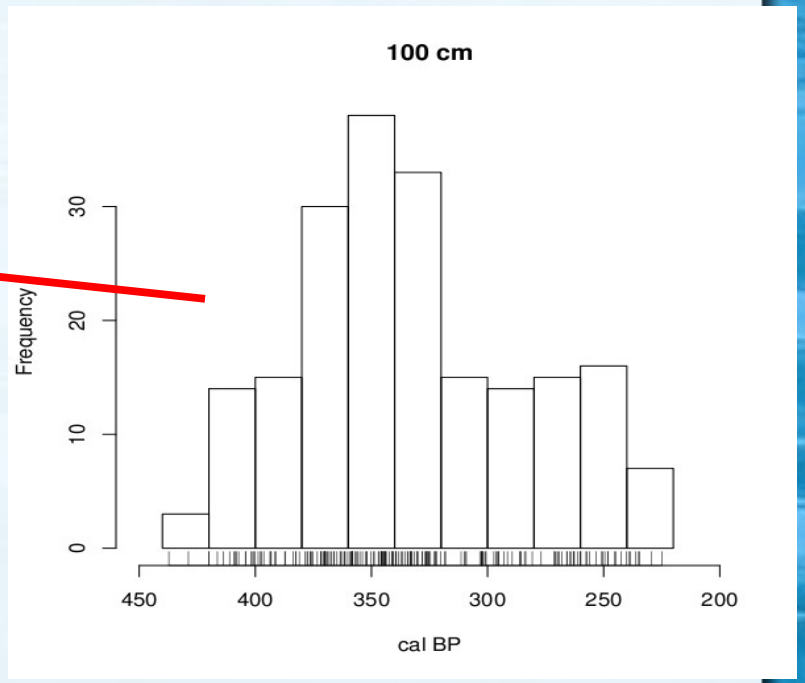
# Uncertainties dates

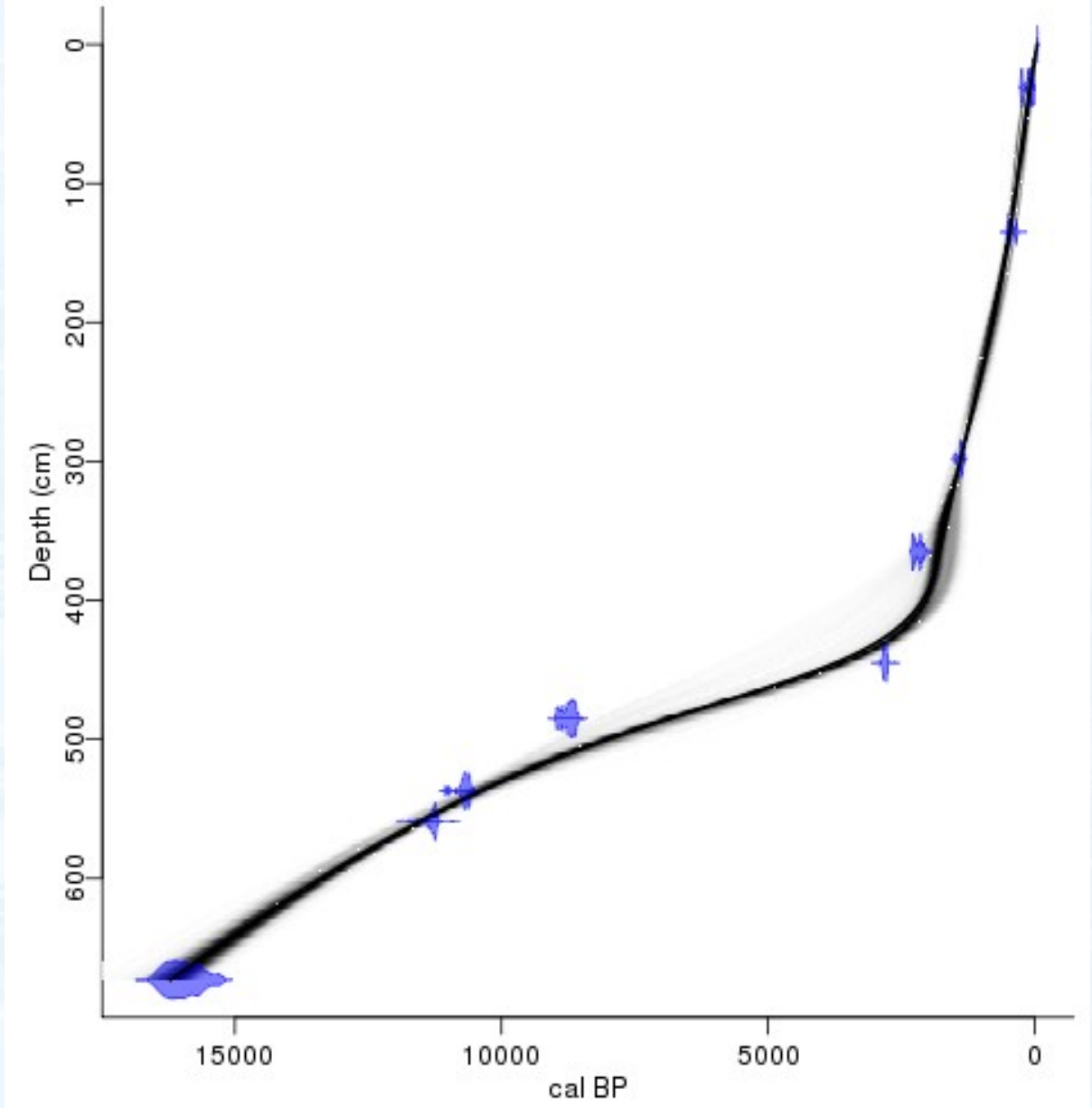



- 5 calibrated dates
- surface = recent
- simulate yr every date
- draw age-model
  - **linear interpolation**
- repeat

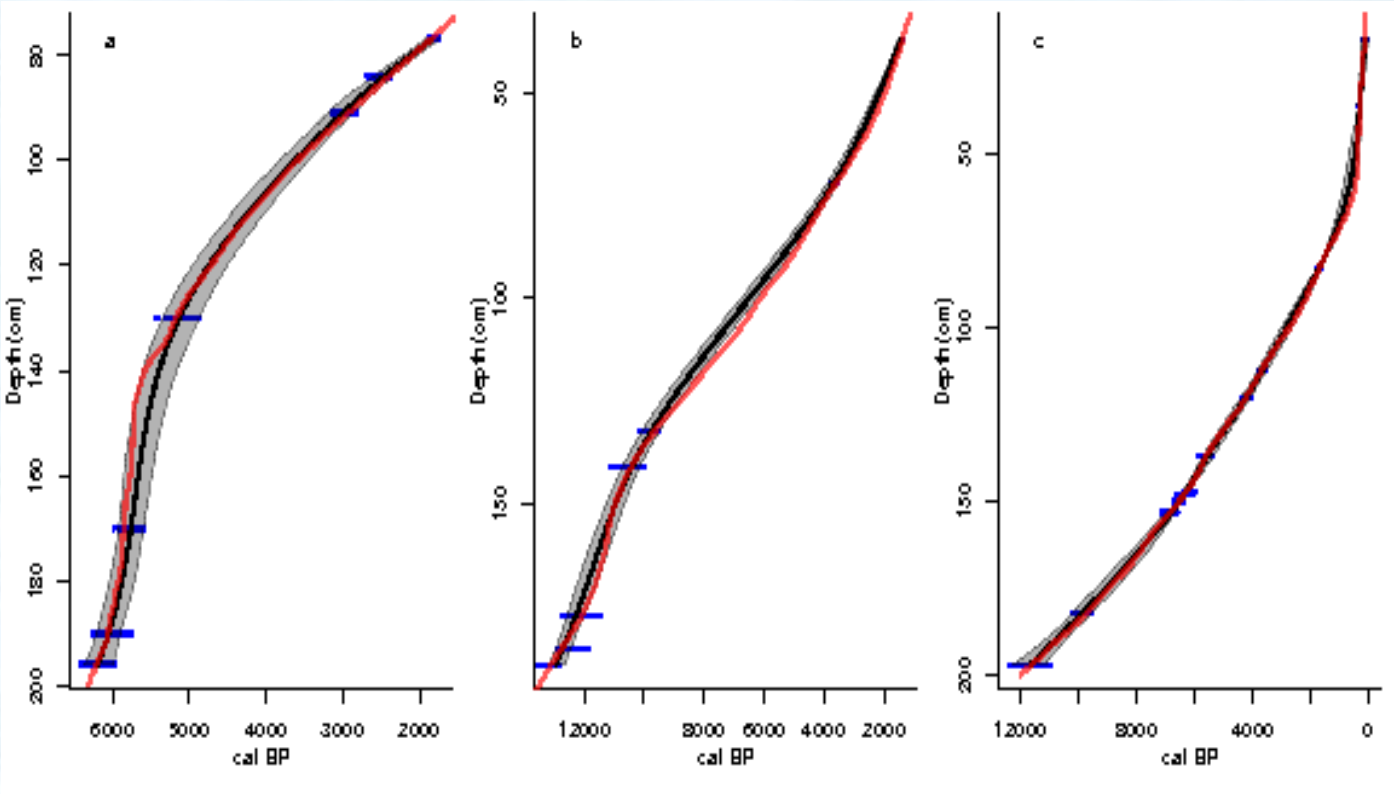
# Uncertainties dates

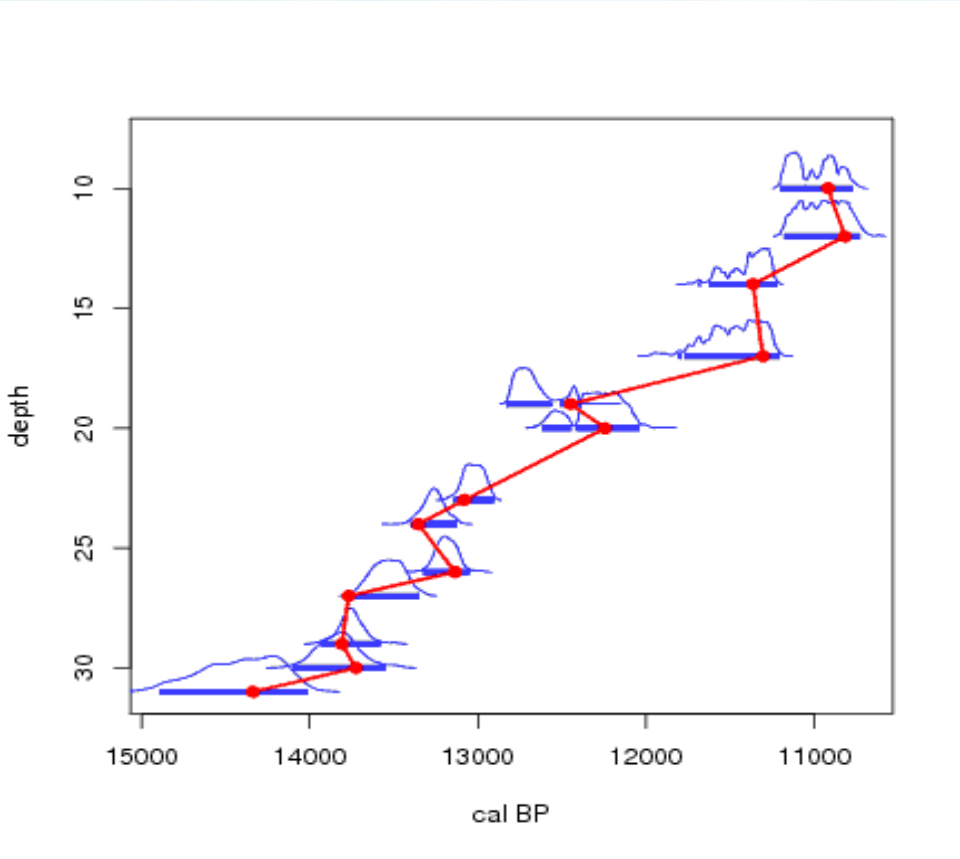


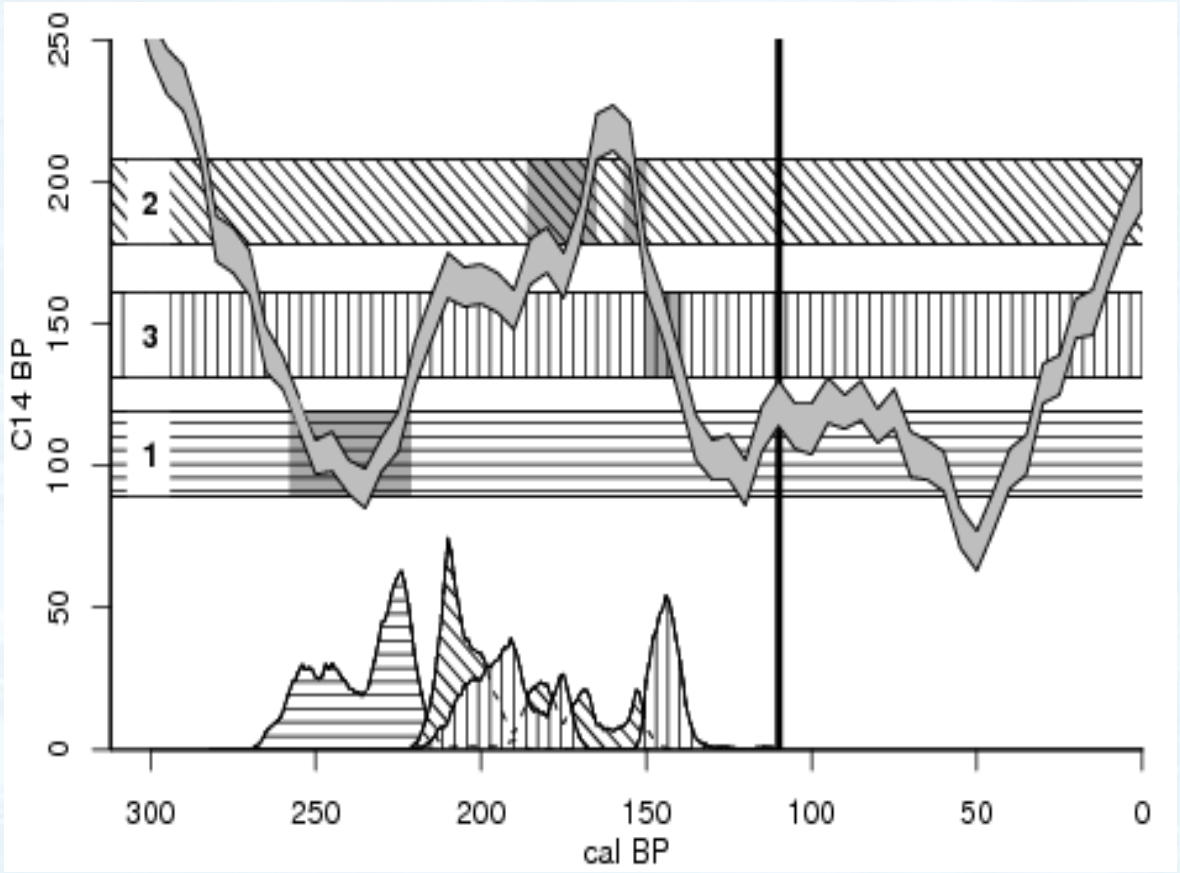

Depth (cm)
0
100
200
300
400
500
600
15000
10000
5000
0
cal BP

# How well does this work?






**http:///www.chrono.qub.ac.uk/blaauw/**




Blaauw and Heegaard, in press

# Basic age-modelling

- Choose which one looks nicest... No transparent process
- How treat point estimates? (mid/max, multimodal)
  - Why just one curve?
- Not much literature
  - Bennett 1994, Bennett and Fuller 2002, The Holocene, Telford et al. 2004, QSR
- Software
  - Calib + Excel, psimpoll, Tilia
  - clam, Blaauw in press (Quaternary Geochronology)