Potential and limitations of permanent stem circumference measurements on level II plots

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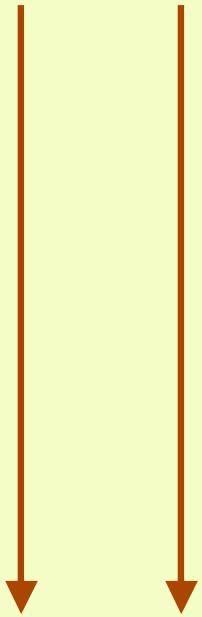
Measurements of Stem Growth

Non-destructive

- Repeated stem diameter measurements (time scale usually > 1 year)
- Permanent manual girth bands (scale annual to bi-weekly)
- Electronic dendrometer (point or bands; scale: hourly or less)

Increasing Resolution



Destructive

- Tree cores or stem discs (resolution annual, time covered: > decades; little to total destructive)
- Micro cores or puncher data (intra-annual, weekly; medium destructive)
- Pinning (intra-annual, weekly; total destructive)

Increasing Costs

Non-destructive Growth Measures

- Stem diameter (mm) with circumference tapes, tree height (dm) and height-to-crown base (dm) on all numbered trees on the plot every 5 years
  - > growth / ha for each plot
- Stem diameter (1/10th of mm) with fixed circumference tapes every year on 10 stratified randomly selected trees per main species on the subplots (used for crown condition ass.)
  - > inter-annual growth differences
- Hourly electronically recorded circumference measures on selected trees in selected plots
  - > intra-annual growth differences

Destructive Growth Measures

- Normal Tree Cores in the buffer zone on few dominant trees at the establishment and closing of the plot
  - > plot history, growth-climate signal, inter-annual differences
- Stem disks only following thinning operations or disturbance (storm, …)
  - > plot documentation, special studies (RECOGNITION)
- Micro cores or pinning on few selected trees in buffer zone in selected years every one or two weeks.
  - > intra-annual growth

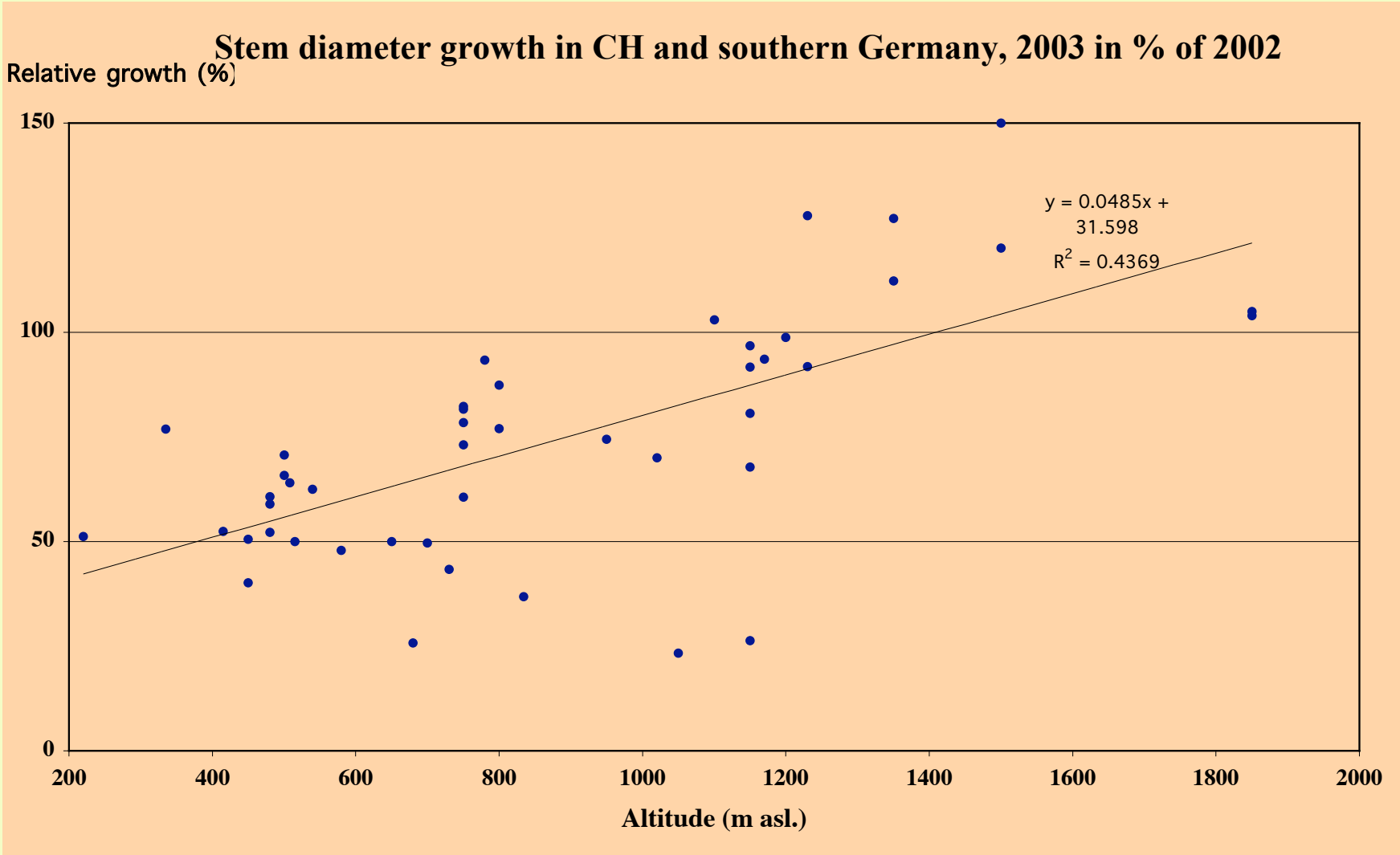
Advantages and disadvantages of permanent stem measures

- Advantages
  - Fixed = same tree height => less error
  - Higher time resolution (annual, interannual, hourly...)
  - Automatic recording possible
- Disadvantages
  - Needs time to adjust to stem
  - Reading needs training
  - Conversion volt to mm needs known calibration coefficients
  - Material may be influenced by temperature ...

Need for higher time resolution

- Five-year measurements
  - => miss annual extrem events (climatic, biotic..)
  - => do not allow to gain understanding of underlying processes

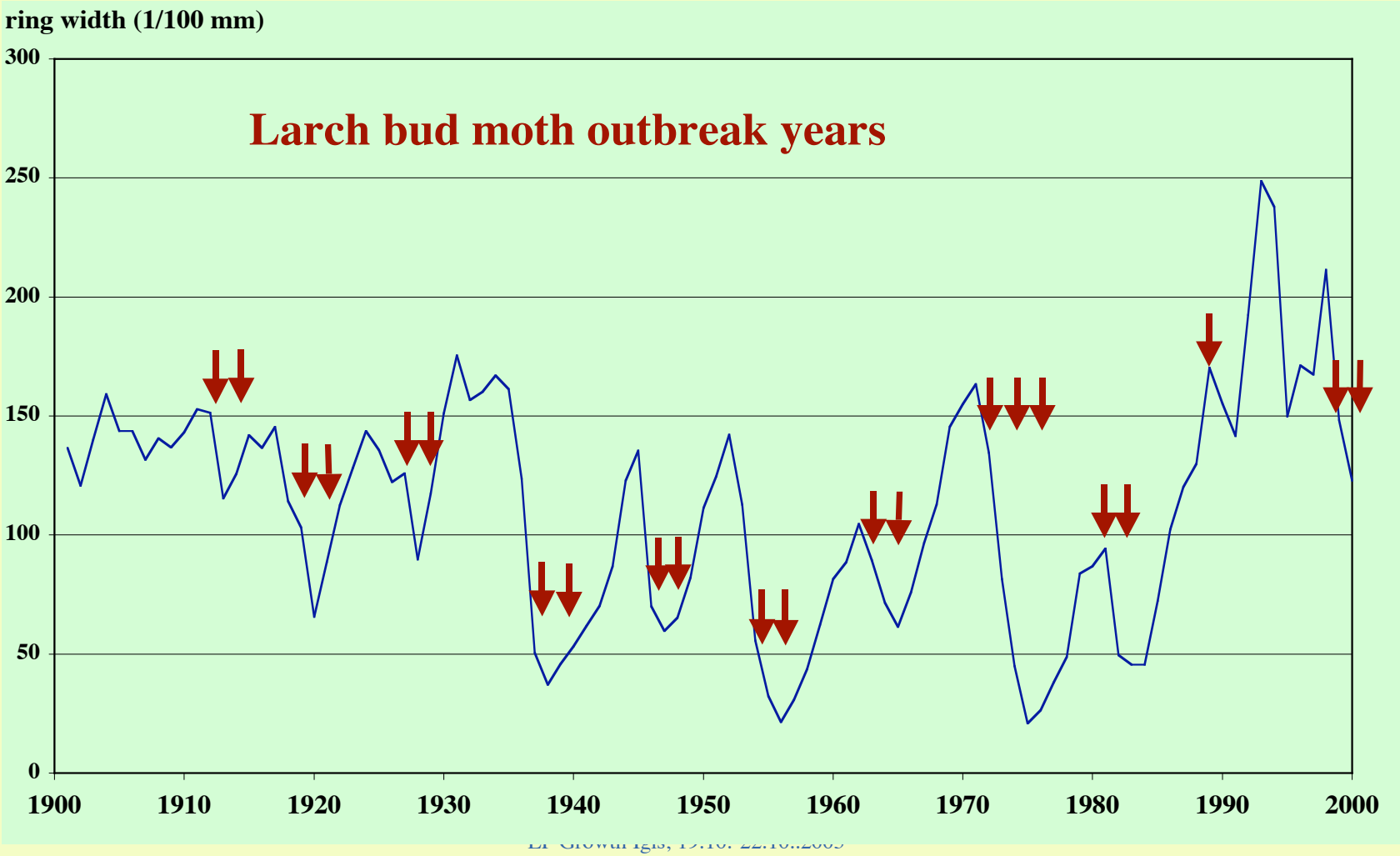
Example 1: Drought 2003



Growth reduction in CH in 2003 below 1200 m a.s.l.

Altitude	N	Growth -% of year 2002	
		2003	2004
≥ 1200 m	4	110 %	95 %
< 1200 m	11	63 %	92 %

Example 2: Insect Defoliation



Example 2: Insect Defoliation

Larch budmoth outbreaks usually last 2 to 3 years and occur every 7 -10 years and effect current and next years growth:

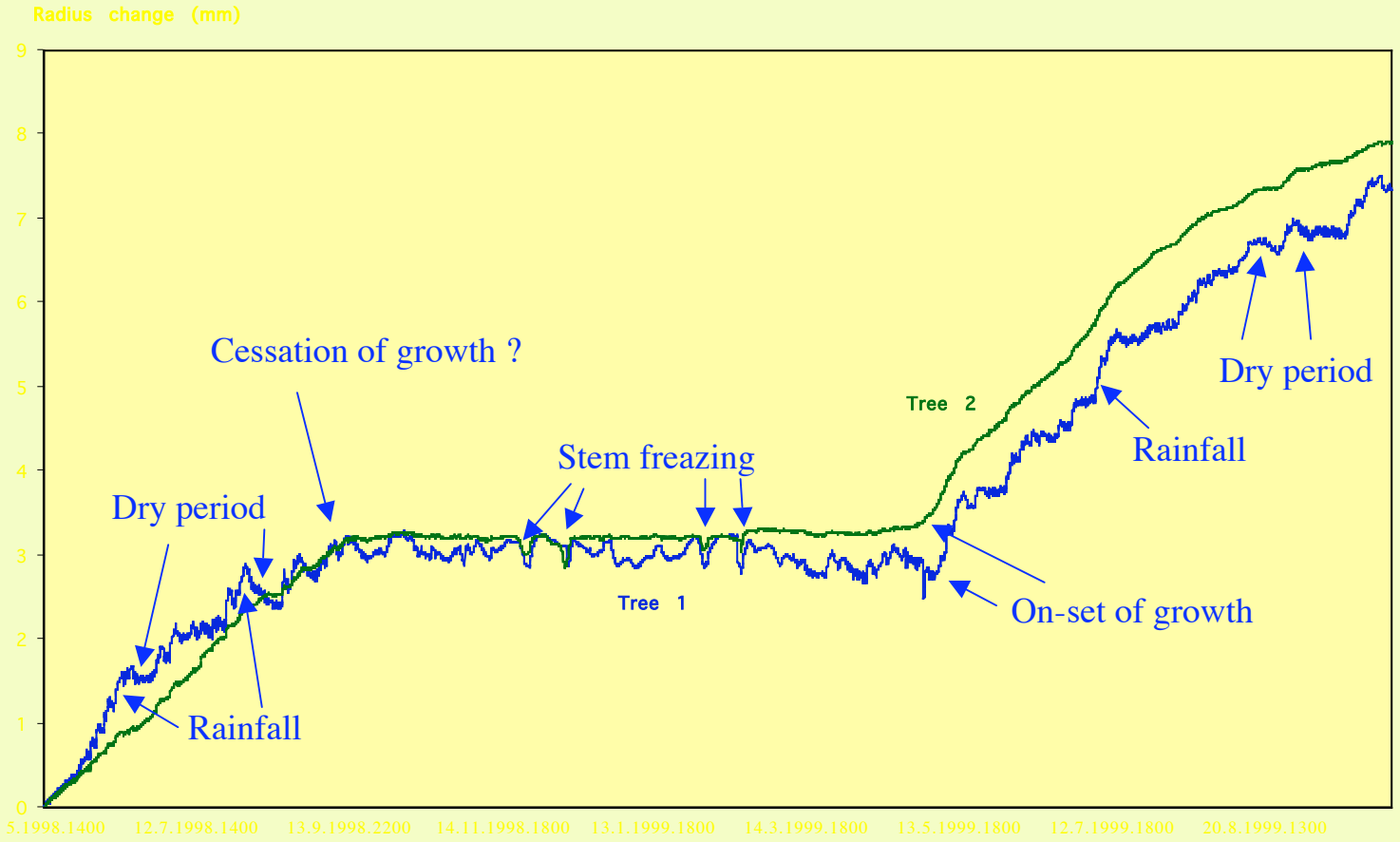
Last outbreak in the Engadin (CH) was 1999-2000 =>
affected growth periods 1995-1999 and 2000-2004

Next expected outbreak is 2006-2007:
will mainly affect the 2005-2009 growth period.

Dendrometers for Understanding

- Growth processes, phenology
- Climatic influences (rain, drought, frost) on tree physiology
- Carbon allocation

Dendrometer Bands - Not only for growth



Hypothesis

- Automatic and manual dendrometer readings can be used on level II plots,

  => but need carefull evaluation and interpretation
- Dendrometer band readings need to be used in conjunction with other growth measurements and additional climatic and perhaps physiological measurements.