The Tree Ring Project

What can students do?

In the field: Understand the tree and its environment

Site: Is there anything particular about the site which might influence tree growth?

- In which climate zone are we? In which months of the year are the trees growing? What is limiting tree growth in our region?
- Are we close to the tree line (upper, lower), near the limit of the species' range or at an local extreme site?
- Is the soil rich or poor in nutrients (calcareous, acid)?
- Are the soils wet or dry (geology, groundwater horizon)?
- Is the site sunny or shady (slope exposure and steepness)?
- Is the forest canopy open or closed (competition between trees)? Are there several layers and age classes of trees? Are there one or several tree species in this forest?
- Does the forest type and ground vegetation indicate site conditions?

Tree: What can we tell about the tree?

- Determine the tree species.
- Measure the tree size (tree height, stem diameter/circumference).
- Does the tree look healthy (lots of branches and dense needles/leaves)? Does is show any damages?
- Is it suppressed (understory), part of the top canopy or is it a solitary tree?
- Give an estimate of tree age (rather young or old?).
- In young conifers you can count branch whirls for age estimation.

Basic dendrochronology – explore the tree rings

Tree-ring observation and sampling:

- Observe tree-rings on stumps or the cut surface of felled trees (alternatively on stem discs in the lab or even timber).
- Take a sample with an increment corer:
  Which tree do we choose? Where is the best spot on the tree to extract a core.
  Depending on purpose (maximum number of rings, best climate signal or other?).
- Take a whole tree and cut/core it in different heights above ground (alternative or in addition: branches).

Preparation:

- Mounting cores on laths
- Sanding discs and cores
  (alternative: cut with scalpel/industrial blade and rub with chalk)
  See for example http://web.utk.edu/~grissino/ and http://www.rmtrr.org/.

What do we see on the sample?

- Where is the youngest and oldest ring on the sample (bark, pith).
- Where are broad and narrow rings (biological age trend, abrupt growth changes)?

- Discs: Are the rings concentric?
- Are there any special features?

Age determination and single-year analysis:

- Tree-ring counts on samples: If you know the calendar year of the outermost ring, count from the bark to pith and mark decades and centuries with a pencil. Else count from pith to bark and mark each 10th, 50th and 100th ring.
- Are the rings sensitive or complacent (large/little ring-to-ring variability)?
- Make skeleton plots on graph paper:
    - Mark exteme rings (event years) and abrupt growth changes.
    - Mark other features: faint rings, false rings, wedging rings, frost rings, traumatic resin ducts etc.
- Compare different skeleton plots:
    - plots made from same sample but different persons,
    - plots from different radii within a tree,
    - plots from different trees.

  Do the event years occur simultaneously?
- Cross-dating by pointer years: Combine skeleton plots to master plots showing the main apttern of tree-ring growth with most important diagnostic rings (pointer years). Are there trees which growth obviously deviates from the main pattern – is this due to counting errors, missing/false rings or other factors?
- Is there any relationship between tree age and DBH, height and other tree characteristics?

Collecting time series of tree-rings and climate

Tree-ring width series:

- Measuring ring widths
  (method and resolution depending on wood structure and tools available).
- Comparison of multiple measurement series from the same tree or series from different trees:
    - Do the measurement series run more or less parallel.
    - Do the series cross-date?
    - What happens if we delete one ring or add a false one?
- Averaging measurement series into a tree-ring mean chronology.
- Is this mean chronology representing climate?
- Dealing with non-climatic trends (detrending) and averaging series from trees with different growth rates (standardisation). What statistical tools are available?

Climate data:

- Collect climate data for comparison with the tree-ring data.
    - Are there nearby climate stations?
    - How long are these instrumental series?
    - Which parameters have been measured?
    - Which time resolution is available (monthly values generally sufficient)?

Dendroclimatology

Which is the most important growth limiting factor for your trees?

- What do the pointer years tell?
- What can we read from the time series?
- Can we compute statistical measures for the observed relationship?
- Is this climate-growth relationship stabile in time?

Climate reconstruction:

- Do we meet the required preconditions
    - chronology length,
    - climate signal and
    - statistical tools?

Other excercises:

Tree species:

- What does the wood of various tree species look like (macroscopically and microscopically)?
    - Differences between conifers and broadleaved trees.
    - Ringporous and diffuse porous broadleaved trees.
    - What about shrubs?
- Differences in ages?
- Do they differ in climate response?

Site conditions: How do trees grow and react to climate in different environments, e.g., on

- dry versus wet soils and
- north-facing versus south-facing slopes?

Tree-ages: Do young trees react to climate in the same way as old trees do?

Recent decades: Is there something special about tree growth and climate during the recent decades? Any sign of the ”divergence problem”?

Stand dynamics:

- Map trees and determine their ages in a forest.
- Are there distinct age classes / regeneration phases?
- Observe how trees increase growth after, e.g., thinning.

Dead trees :

- If you can find trees which recently died, can you determine the year of death and tell something about cause of death? Is there anything particular about the last rings before death?

Dendrochronology:

- Dating of stumps of known/unknown felling date and recently died trees.
- Dating of timber buildings of known timber species and provenance. Preconditions: Suffient chronology length, known species and origin of timber, sufficient number of rings, bark/waney edge, dating object not too old.