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Interpreting Stem Diameter Growth during Drought of Scots Pine

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Introduction

- Studies have shown that drought hinders growth within the tree and systematically shuts down biochemical and physiological processes (i.e. net photosynthesis and water potential) in order to maintain basic functions.
- Examining growth from stem diameter changes enables researchers to understand which activities are affected and how these are able to respond to climatic variability.
- The dynamics of diameter changes are explained by the cohesion-tension theory of the xylem and the pressure-flow model of the phloem. These changes within the xylem and phloem thus create reversible and irreversible (growth) changes in the stem diameter.

Study

By observing stem diameter changes, we can recognize the response in Scots Pine and its implications to ecophysiological processes (i.e. photosynthesis, growth, transpiration, and phloem sugar loading and unloading processes).

Furthermore, interpreting stem growth changes allows greater understanding to adaptations to external environmental conditions (i.e. precipitation, soil water potential, and temperature) in response to drought.

Methodology

Stem diameter data of Scots Pine (*Pinus sylvestris* L.) has been collected in the summer of 2006 between April and September from the University's field station in Hyytiälä, Southern Finland.

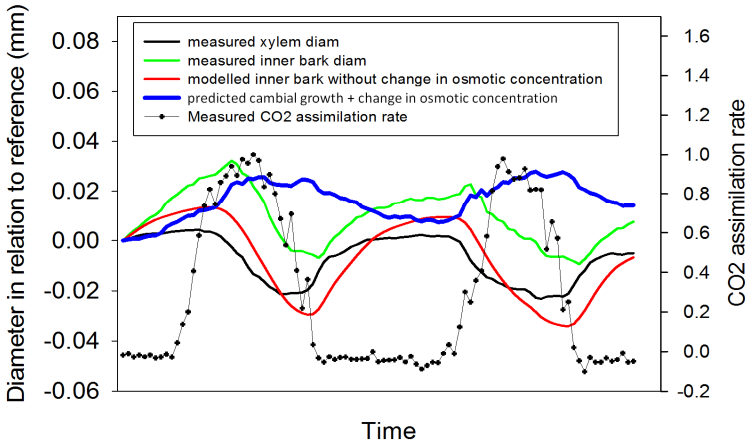
Stem diameter sensor on the frame of tree (left) and sampled Scots Pine in Hyytiälä, Southern Finland (right).

Analysis is done by examining growth using stem diameter data in three different ways:

1. stem diameter change variations
2. simultaneous stem and xylem diameter change variations
3. hydraulic model based on radial water movement between the xylem and inner bark is applied in addition to the measurements.

Measurements will be analyzed with cross—correlation analysis to determine differences in how each of the three different ways reveals growth and to enable exclusion reduction of false positives and negatives. A Gompertz function will be employed as a diameter growth model to determine the relationship between real data collected and the model.

Analyzing the distribution and relatedness of the environmental variables will give a greater understanding of how growth is understood in the field and which processes are affected by drought.



Measurements during Sept. 16-17, 2006 in Hyytiälä, Finland, showing measured xylem (black), inner bark diameter (green) and the modelled inner bark diameter where its osmotic concentration has been assumed constant (red). A change in osmotic concentration including growth (blue) is predicted as an output from the model, and CO2 assimilation rate measured from a cuvette at 15m height. Stem diameter measurements were measured at 10m height.