Monitoring of tree growth with different types of dendrometers

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Background

Dendrometers are used to continuously monitor tree growth and its intra-annual variation. They capture not only growth processes, but also temporary shrinkage and swelling due to dehydration and subsequent tissue rehydration.

In the Czech Republic continuous monitoring of growth on ICP Forests Level II plots has been established in 2010. **Girth bands** DB20 and **electronic band (circumference) dendrometers** DRL26 (Fig. 1) and DR26 (Fig. 2) manufactured by EMS Brno have been used. Recently low-cost **point dendrometers** D1 – TOMST (Fig. 3) were installed on selected ICP Level I and Level II plots.

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Objective

The aim of the study was to compare the measurements of different types of dendrometers placed on the same tree. Implications for data interpretation and pooling of datasets from different types of dendrometers are discussed.

Fig 1
Girth band DB20 (above) and electronic band dendrometer DRL26 (below)

Fig 2
Electronic band dendrometer DR26

Fig. 3
Point dendrometer D1 - TOMST

Results and discussion

1. GIRTH BANDS versus ELECTRONIC BAND DENDROMETERS

The growth curves from manual and electronic band dendrometers correspond very well, however, after 4-6 years from the beginning of the measurement, the curves start to diverge, with electronic dendrometers recording consistently lower values of radial growth than girth bands (Fig. 4).

Both, manually read permanent girth bands and electronic band dendrometers, can be used for reliable permanent measurement of the annual radial increment. Divergence between the curves from manual and electronic band dendrometers indicates the need for calibration of electronic dendrometers after 4 years at the latest.

Automatic dendrometers, like other electronic devices, are prone to measurement errors e.g. sudden jumps in measurement series, outages in data storage etc. Therefore the girth bands should be installed along with electronical dendrometers to maintain measurement continuity in the event of damage or failure of electronic device.

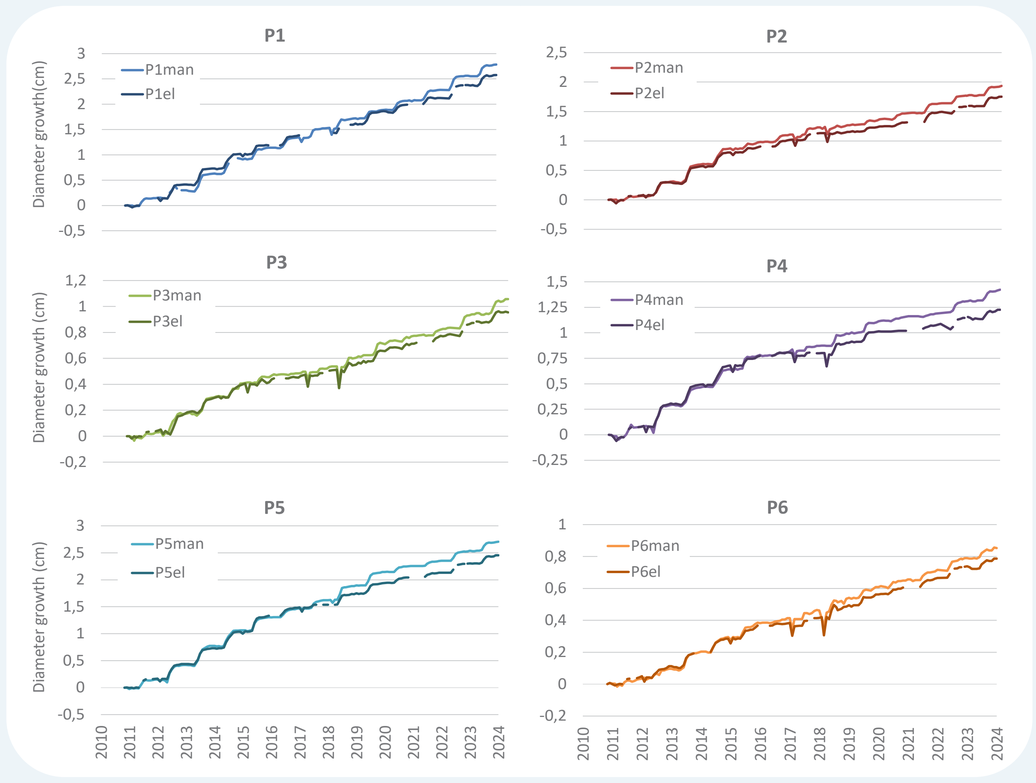

Fig. 4
Diameter growth measured by manually read permanent girth bands (P1man-P6man) and electronic band dendrometers (P1el-P6el) on six beech trees P1-P6 in the period 2010–2024

2. ELECTRONIC BAND DENDROMETERS versus POINT DENDROMETERS

There is a close correlation between the measured series (Fig. 5), however, in absolute values there are significant differences between band and point dendrometers, while the values of radial increment recorded by point dendrometers are several times higher than those from band dendrometers (Fig. 6). Changing the type of dendrometer during long-term monitoring results in inconsistency of time series (Fig. 7). In the case of data pooling, data from different types of dendrometers must be treated separately.

Point dendrometers record clearly diurnal cycle of stem size variation as they are more sensitive to water-related stem size changes. Thus they capture better the physiological response of trees to climatic factors, especially water availability. However they are not suitable for annual radial increment assessment.

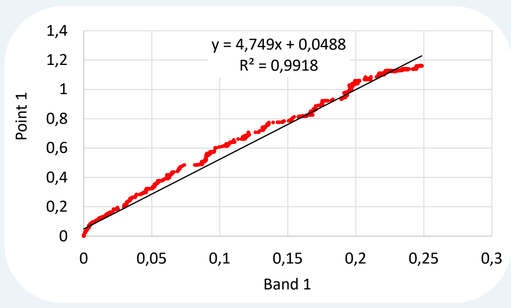

Fig. 5
Relationship between the diameter growth values (cm) measured by electronic band dendrometer DRL26 and point dendrometer D1 on the same tree stem

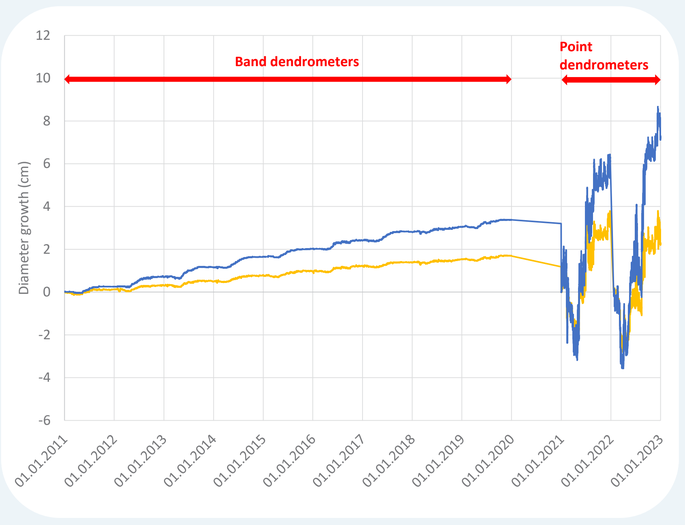

Fig. 7
An example of inconsistent time series when band dendrometers were replaced by point dendrometers in 2021

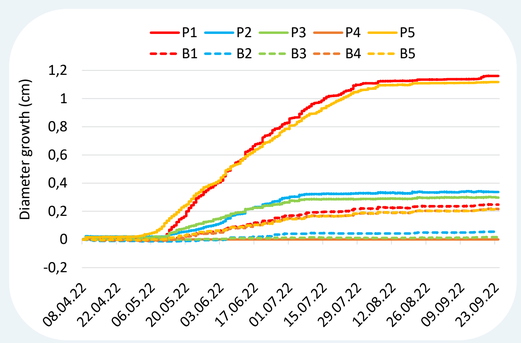

Fig. 6
Comparison of diameter growth of five beech trees simultaneously measured by electronic band dendrometers (B1-B5) and point dendrometers (P1-P5) during the vegetation season 2022

Acknowledgement

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Conclusion

The selection of dendrometer type must be made primarily with regard to the research objective! While band dendrometers reliably record the annual growth, point dendrometers sensitively register water-related stem size changes. Simultaneous measurement by both types of dendrometrs provides comprehensive information about growth processes and physiological response of trees. Pooling different dendrometer datasets must be done with caution.

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