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Climate conditions impact on annual growth of *Pinus sylvestris* L. in the Aukštaitija National Park (Lithuania)

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Introduction

- **Scots pine** (*Pinus sylvestris* L.) is widely distributed in boreal and temperate climatic zones and, therefore, predominantly serves as a species for the investigation of various environmental effects and influences of climatic conditions on different ecosystems

- **The main objectives:**

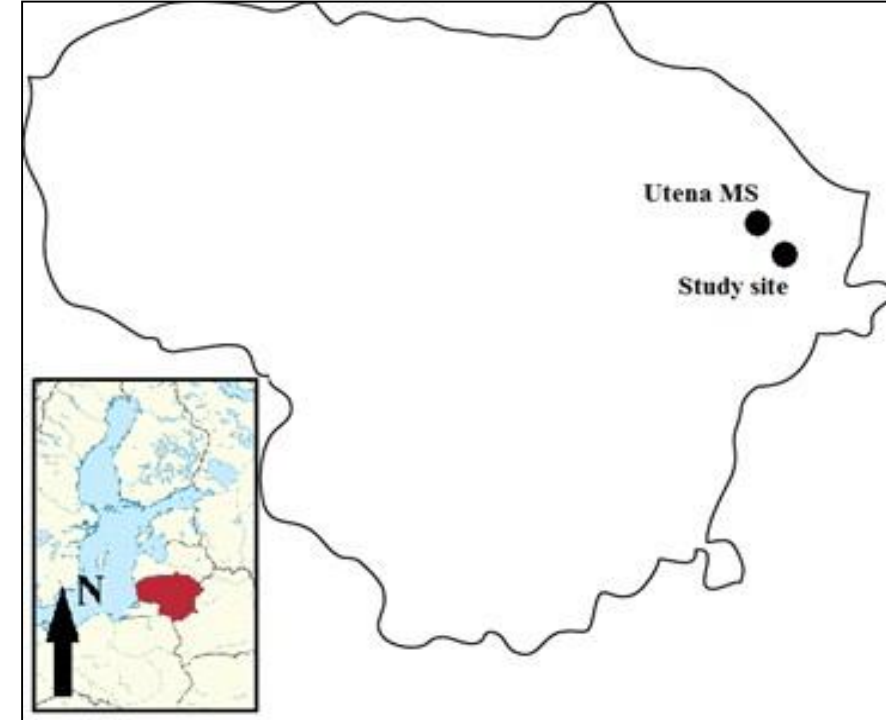
1. to evaluate the intra-annual tree-diameter growth during period from May to August;
2. to assess the short-term effects of air temperature and rainfall on tree-diameter growth; and
3. to determine tree-diameter growth trends in the study area



Scots pine
(*Pinus sylvestris* L.)

Data and methods

- **Research object:** tree-diameter measurements using band dendrometers
- **Research period:** 1976-2017 (42 years)
- **Dendrometers data:** the median of 20 trees growth (May 1 – August 31), residuals from the ARIMA(1, 1, 1) model
- **Meteorological data:** daily and monthly mean, maximum, minimum air temperatures and precipitation totals (Utena MS)
- **Research methodology:** correlation between tree-diameter growth and weather conditions (Spearman coefficient), a slope of linear regression of growth tendencies (Mann-Kendall test), daily radial tree growth rate changes (Mann–Whitney U-test)



Research area: Aukštaitija National Park, Lithuania, 55°26'N 26°02'E, 160 m a.s.l.



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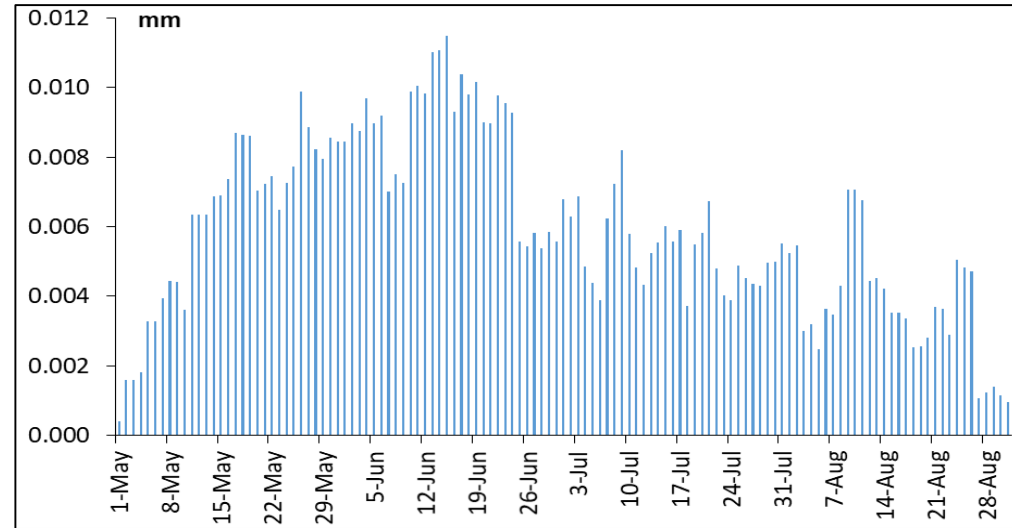


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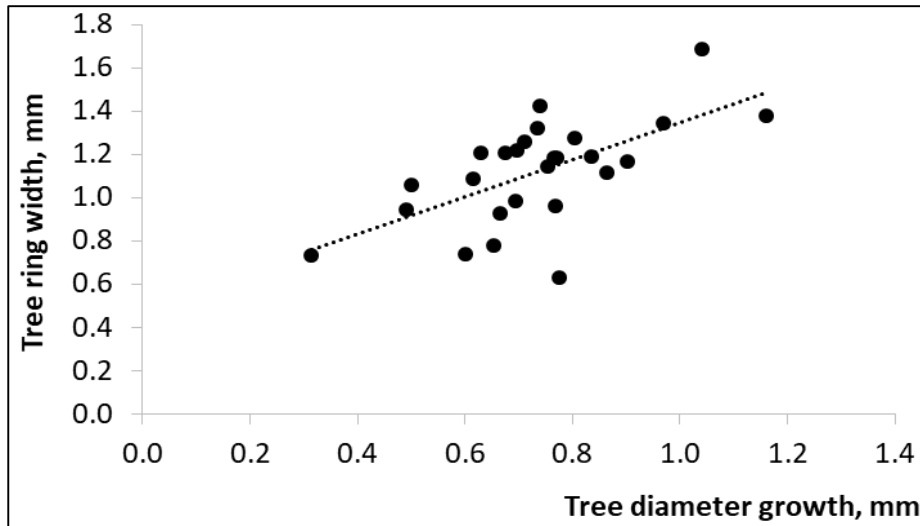
Manual band dendromete

Intra-annual growth dynamics of tree diameter

- On average, 53% of the total annual increase in tree diameter recorded during period from May 11 to June 24
- The averaged diameter growth rate drops significantly after June 24.



Median (mm) daily increase in tree radius from May to August 1976–2017

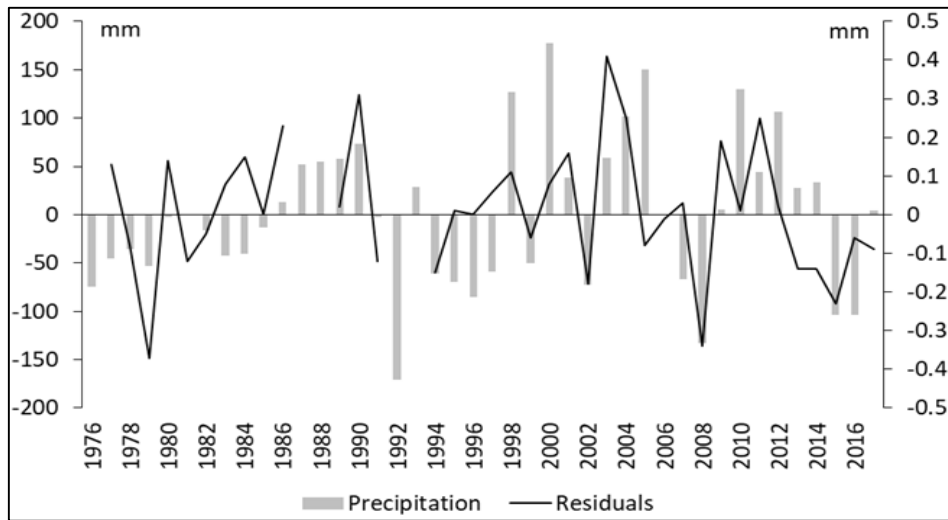


The relationship between annual tree-diameter growth and tree-ring width in 1976–2003

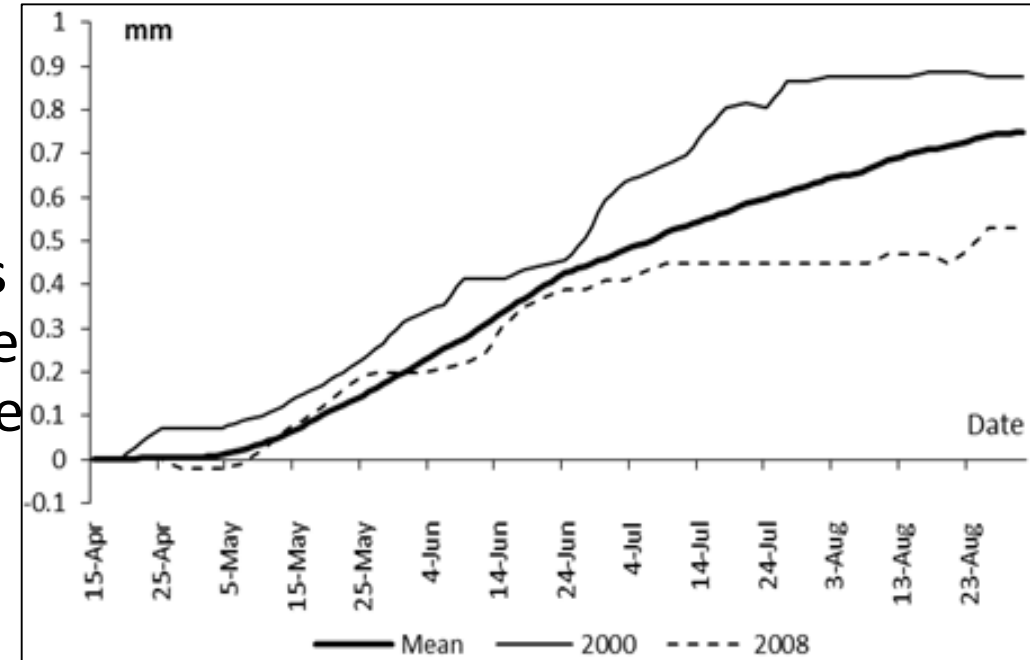
- We found the photoperiodic response of the maximum diameter-growth rate of Scots pine in a temperate climate
- The sharp transition to slower rates of diameter growth after summer solstice suggests a slowdown of several processes of wood formation

Effects of meteorological conditions on tree-diameter growth

- The onset of radial tree growth is triggered by an increase in temperature
- The tree-diameter growth in May the thermal conditions of the entire spring season have the largest impact, while the amount of precipitation is less important because the ground is usually saturated with water after snowmelt



Precipitation amount and annual tree-radial growth residuals in May–August in 1976–2017

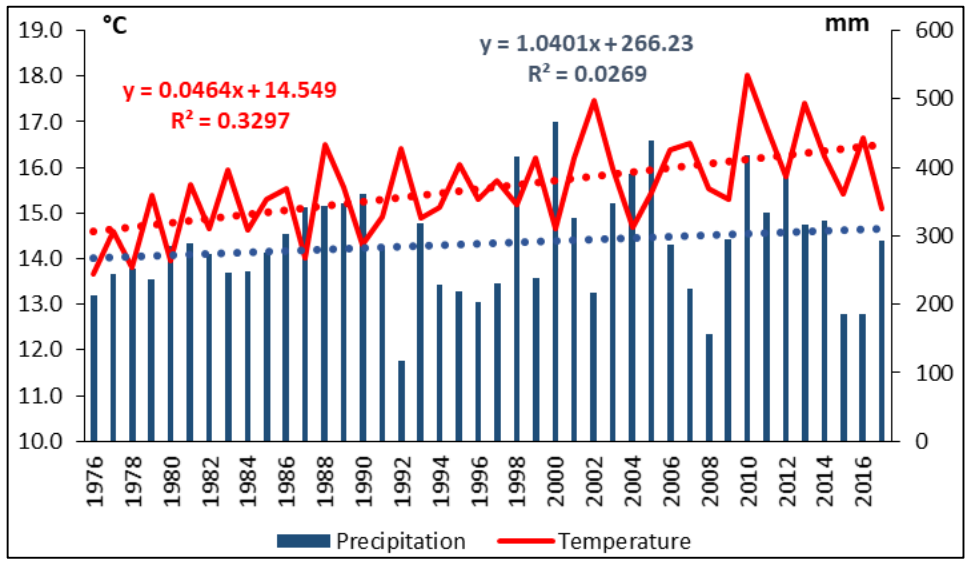


Tree diameter growth dynamic during the driest (2008; 221 mm) and the wettest (2000; 508 mm) years the mean tree diameter growth during the whole investigation period (1976–2017)

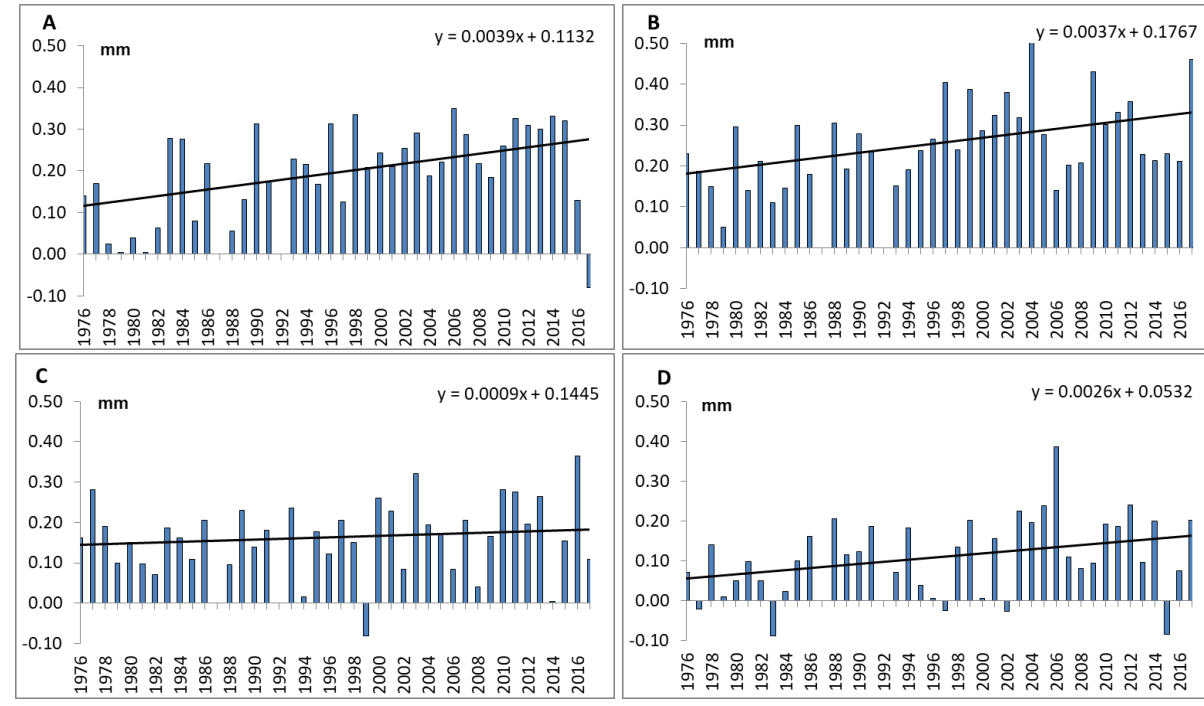
- Heavy precipitation events and prolonged dry periods have the largest impact on short-term tree-diameter fluctuations (swelling and shrinking)

Long-term growth-rate changes in tree diameter

- The positive tree-diameter growth trends in May–August during the period from 1976 to 2017 were found



May-August air temperature and precipitation amount changes in Utena MS



Tree growth dynamics in 1976–2017 :
May (A), June (B), July (C) and August (D)

- It can be linked to current climate change tendencies in the region