EGU24-17582, updated on 20 May 2024
https://doi.org/10.5194/egusphere-egu24-17582
EGU General Assembly 2024

Increasing stem dimensions of European temperate tree species between 1990 and 2015

Vaclav Treml[1], Jan Tumajer[1], Jan Altman[3], Vojtěch Čada[4], Jiří Doležal[3], Pavel Janda[4], Ryszard Kaczka[1], Jakub Kašpar[5], Tomáš Kolář[6], Jiří Mašek[1], Filip Oulehle[7], Michal Rybníček[6], Miloš Rydval[4], Miroslav Svoboda[4], Martin Šenfeldr[6], Pavel Šamonil[5], Ivana Vašíčková[5], and Monika Vejpustková[2]

[1]Charles University, Faculty of Science, Department of Physical Geography and Geoecology, Prague, Czech Republic (vaclav.treml@natur.cuni.cz)

[2]Forestry and Game Management Research Institute, Prague, Czech Republic,

[3]Institute of Botany of the Czech Academy of Sciences, Třeboň, Czech Republic

[4]Department of Forest Ecology, Czech University of Life Sciences, Prague, Czech Republic

[5]Department of Forest Ecology, The Silva Tarouca Research Institute, Brno, Czech Republic

[6]Faculty of Forestry and Wood Technology, Mendel University, Brno, Czech Republic

[7]Czech Geological Survey, Prague, Czech Republic

Increasing forest CO_2 absorption is ensured by enhanced gross primary production (GPP) which exhibited increasing trends as documented by CO_2 flux measurements or by global vegetation models. Considering the simultaneous increase in ecosystem respiration, it is, however, uncertain how the growing GPP imprints in tree stem biomass increase. There is still a certain discrepancy between estimates of forest biomass trends derived from standardized tree-ring series, information acquired from repeated re-measurements of stem biomass at permanent plots, and information derived from vegetation models or flux-tower measurements. Standardization procedures of tree-ring series related to age/size trend removal make this data source unique for the assessment of climate-growth relationships and for climatic reconstruction, however it also increases uncertainty of this data source for biomass trends assessment. Here, we present an approach mimicking repeated data collection at permanent plots based on an extensive data set of tree-ring sites. In this way, we connected two strong benefits of above-mentioned data – reliable age-independent estimates of stem biomass by repeated measurements at permanent plots and a dense network of highly replicated data covering wide environmental gradients provided by tree-ring time series. Our tree-ring network captures core parts of distribution ranges of five main European temperate tree species. Density of tree-ring network is roughly 1 site per 25 km^2 of forested area in Central Europe namely Czech Republic (area of 78 000 km^2) making this tree-ring network probably densest in the world. We first manipulated original tree-ring data sets by their truncation in 1990 (data set mimicking sample collection in 1990) and then adapt the original data set so that it has similar age structure as the 1990 data set mainly by excluding old age classes (data set 2015) assuring age independency of our data. For both data sets and all sites included, we calculated mean stem diameter at breast height (DBH) of average 100-year old tree based on basal area increments. We then tested for differences in DBH between 1990 and 2015.

We found that all species except *Pinus sylvestris* showed a significant increase in stem dimension as indicated by DBH between 1990 and 2015. The highest DBH increase exhibited *Abies alba* (+13.5%), followed by *Fagus sylvatica* (+5.5%), *Quercus* sp.(+5.2%) and *Picea abies* (+4.7%). Differences in DBH between 2015 and 1990 were relatively homogenous across environmental gradients suggesting prevailing influence of large-scale factors independent on local conditions. *Picea abies* and *Fagus sylvatica* exhibited lesser increase in stem dimensions in colder areas. Furthermore, *Picea abies* and *Quercus* sp. showed a significant enhancement of growth at productive sites with fast growing individuals. *Quercus* also significantly enlarged DBH at locations with more positive trends in SPEI, i.e. those experiencing a trend towards wetter climate. Our results corroborate the pervasive growth acceleration in core region of European temperate forests leading to presence of larger canopy-level trees in current forests than in the past. Increasing stem size makes trees more sensitive to disturbances and potentially leads to their shorter life spans as reported in other studies.