EGU21-7207, updated on 07 Dec 2022
https://doi.org/10.5194/egusphere-egu21-7207
EGU General Assembly 2021

Long-term physiological and growth responses of oak trees under climate warming in eastern Asia

Julieta Gabriela Arco Molina[1], Kerstin Treydte[2], Nela Maredova[1,3], Matthias Saurer[2], Jiri Dolezal[1,3], Jong-Suk Song[4], and Jan Altman[1]

[1]Institute of Botany of the CAS, Functional Ecology, 25243 Průhonice, Czech Republic (julieta.arco@ibot.cas.cz)
[2]Research Unit Forest Dynamics, Swiss Federal Institute for Forest, Snow and Landscape Research WSL, CH-8903 Birmensdorf, Switzerland
[3]Faculty of Science, University of South Bohemia, 37005 České Budějovice, Czech Republic
[4]College of Natural Sciences, Andong National University, 760-749 Andong, Republic of Korea

Climate changes and raising atmospheric CO_2 concentrations are expected to influence tree and forest development. However, the direction and intensity of the tree and forest responses are diverse, and long-term studies are scarce. Here, we studied responses of *Quercus mongolica* to climate over the last 117 years based on the tree-ring width, $\delta^{13}C$-derived physiological parameters ($\Delta^{13}C$, C_i and iWUE) and $\delta^{18}O$ in Jeju Island, South Korea. Trend and change point analyses were performed to the radial tree growth, physiology and climate, and tree responses-climate relationships were analysed temporally and spatially. iWUE significantly increased since 1900 but decadal variations were observed in 1950, 1975 and 2010, revealing an evolving physiological response. iWUE was mainly driven by stimulated photosynthesis under no water limitations. This photosynthetic stimulation was driven mainly by the atmospheric CO_2 fertilization, warming and higher radiation, probably through the simultaneous influence on the phenology and physiology of trees. At a local scale, higher radiation combined with less cloudy conditions were the factors with the greatest positive influence on tree growth, while at a regional scale land and sea surface temperatures positively influenced both tree growth and physiology. Moreover, all these responses strongly intensified after the 1970s, showing that tree responses are not temporary stable. Altogether, the present results indicated that the physiology and growth of *Q. mongolica* from eastern Asia are driven by a combination of climatic, ecological and anthropogenic factors. Moreover, the significant, rapid and unprecedented changes in the tree responses indicated that trees may benefit from recent global changes, showing a physiology-driven growth enhancement. This represents a key understanding of trees and forests ecosystems responses to future climate changes, which is relevant to assess and design global change mitigation strategies.