Photoperiod and temperature prove secondary growth resumption in Northern Hemisphere conifers

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Ecologists from the South China Botanical Garden of the Chinese Academy of Sciences have identified multiple exogenous factors that can affect the onset of wood formation and quantified the key drivers for secondary growth resumption in Northern Hemisphere conifers. Credit: Huang Jianguo

Forest trees play a critical role in regulating global carbon, water and energy cycles and mitigating global warming. The phenology of trees is a key to understanding the feedbacks between terrestrial vegetation and Earth's climate. Recent climate warming has changed the seasonal timing of the primary (e.g., budburst, leaf unfolding and flowering) and secondary (e.g., cambial activity, xylem tissue formation and phloem formation) growth of trees.

However, the environmental factors triggering the onset of wood formation in springtime and its underlying cellular mechanisms have been poorly understood, and this hampers an effective assessment of terrestrial forest productivity and the carbon budget under global warming.

Ecologists from the South China Botanical Garden of the Chinese Academy of Sciences have identified multiple exogenous factors that can affect the onset of wood formation and quantified the key drivers for secondary growth resumption in Northern Hemisphere conifers.

The scientists used a unique collection of extensive datasets of wood formation for 21 coniferous species distributed over 79 sites spanning from 23°N to 67°N across subtropical to boreal biomes in the Northern Hemisphere.

They quantitatively demonstrated that the onset of xylem tissue formation in conifers of the Northern Hemisphere is primarily driven by photoperiod and mean annual temperature (MAT), and only secondarily by spring forcing, winter chilling and moisture availability. Photoperiod interacts with MAT and plays the dominant role in regulating the onset of secondary meristem growth, contrary to its as yet unquantified role in affecting the springtime phenology of primary meristems.

"These results provide unique and insightful evidence of how wood formation in Northern Hemisphere conifers is regulated by exogenous factors, which can be incorporated into state-of-the-art Earth models, improving prediction of terrestrial carbon, water and energy cycles under global change scenarios, and enforcing ground and remote sensing data," said Prof. Huang Jianguo, first author of the study.

"Overall, this study offers a deeper understanding of how forest ecosystems respond and adapt to climate warming through phenological changes within the context of global change and mitigating atmospheric CO_2. Future studies that determine how exogenous factors regulate the other phases of wood formation may generate a deeper understanding of acclimation mechanisms in forests and trees," said Prof. Huang.

More information: Jian-Guo Huang el al., "Photoperiod and temperature as dominant environmental drivers triggering secondary growth resumption in Northern Hemisphere conifers," *PNAS* (2020). www.pnas.org/cgi/doi/10.1073/pnas.2007058117

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