Spring may come earlier to North American forests, research says

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(Phys.org)—Trees in the continental U.S. could send out new spring leaves up to 17 days earlier in the coming century than they did before global temperatures started to rise, according to a new study by Princeton University researchers. These climate-driven changes could lead to changes in the composition of northeastern forests and give a boost to their ability to take up carbon dioxide.

Trees play an important role in taking up carbon dioxide from the atmosphere, so researchers led by David Medvigy, assistant professor in Princeton's department of geosciences, wanted to evaluate predictions of spring budburst—when deciduous trees push out new growth after months of winter dormancy—from models that predict how carbon emissions will impact global temperatures.

The date of budburst affects how much carbon dioxide is taken up each year, yet most climate models have used overly simplistic schemes for representing spring budburst, modeling for example a single species of tree to represent all the trees in a geographic region.

In 2012, the Princeton team published a new model that relied on warming temperatures and the waning number of cold days to predict spring budburst. The model, which was published in the Journal of Geophysical Research, proved accurate when compared to data on actual budburst in the northeastern United States.

In the current paper published online in Geophysical Research Letters, Medvigy and his colleagues tested the model against a broader set of observations collected by the USA National Phenology Network, a nation-wide tree ecology monitoring network consisting of federal agencies, educational institutions and citizen scientists. The team incorporated the 2012 model into predictions of future budburst based on four possible climate scenarios used in planning exercises by the Intergovernmental Panel on Climate Change.

The researchers included Su-Jong Jeong, a postdoctoral research associate in Geosciences, along with Elena Shevliakova, a senior climate modeler, and Sergey Malyshev, a professional specialist, both in the Department of Ecology and Evolutionary Biology and associated with the U.S. National Oceanic and Atmospheric Administration's Geophysical Fluid Dynamics Laboratory.

The team estimated that, compared to the late 20th century, red maple budburst will occur 8 to 40 days earlier, depending on the part of the country, by the year 2100. They found that the northern parts of the United States will have more pronounced changes than the southern parts, with the largest changes occurring in Maine, New York, Michigan, and Wisconsin.

The researchers also evaluated how warming temperatures could affect the budburst date of different species of tree. They found that budburst shifted to earlier in the year in both early-budding trees such as common aspen (*Populus tremuloides*) and late-budding trees such as red maple (*Acer rubrum*), but that the effect was greater in the late-budding trees and that over time the differences in budding dates narrowed.

The researchers noted that early budburst may give deciduous trees, such as oaks and maples, a competitive advantage over evergreen trees such as pines and hemlocks. With deciduous trees growing for longer periods of the year, they may begin to outstrip growth of evergreens, leading to lasting changes in forest make-up.

The researchers further predicted that warming will trigger a speed-up of the spring "greenwave," or budburst that moves from south to north across the continent during the spring.

The finding is also interesting from the standpoint of future changes in springtime weather, said Medvigy, because budburst causes an abrupt change in how quickly energy, water and pollutants are exchanged between the land and the atmosphere. Once the leaves come out, energy from the sun is increasingly used to evaporate water from the leaves rather than to heat up the surface. This can lead to changes in daily temperature ranges, surface humidity, streamflow, and even nutrient loss from ecosystems, according to Medvigy.

More information: Jeong, Su-Jong, David Medvigy, Elena Shevliakova, and Sergey Malyshev. 2013. Predicting changes in temperate forest budburst using continental-scale observations and models. *Geophysical Research Letters*, Article first published online: Jan. 25, 2013. DOI: 10.1029/2012GL054431

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