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Seasonal changes in evergreens provide new tool in climate change research

UNL researcher creates optical index of evergreen photosynthetic behavior to study possible effects of climate change.

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Though not apparent to the naked eye, evergreen conifers actually do go dormant in the winter. Researchers recently visualized this dormancy and a spring awakening using newly available satellite data. The discovery could improve scientists' understanding of how conifer photosynthetic activity is changing in a warming climate, and could provide a way to assess evergreen forests' role in the global carbon budget, which so far has been elusive.

MONITORING SEASONAL CHANGES: An international research team that includes UNL's John Gamon has combined satellite data to detect seasonal change in evergreen trees across northern North America. (© Dan Kitwood, Getty Images)

The research conducted largely at the University of Alberta and several other locations in North America shows that pigments in evergreens — both the chlorophylls, or green ones, and the carotenoid, or orange and

yellow ones — undergo a seasonal change in response to changing temperatures. This seasonal response is tied to photosynthetic activity, and these "invisible" patterns of photosynthesis can be detected by satellite remote sensors using these pigment shifts.

Using satellite-collected data, John Gamon, a quantitative remote-sensing scientist now at University of Nebraska-Lincoln, and colleagues created an optical index of evergreen photosynthetic behavior. It combines satellite bands designed for "ocean color" with bands designed for land vegetation and has been dubbed the chlorophyll-carotenoid index. This index provides a new tool in monitoring the changing activity of Northern forests in the face of climate change.

"It is a sharper tool to ask questions about the forests," Gamon says. "It's suddenly made visible, the invisible."

John Gamon is a quantitative remote-sensing scientist at University of Nebraska-Lincoln. (Photo: UNL)

Using this index, Gamon and other scientists are asking whether Northern forests are having an earlier, longer growing season due to climate change, and how this might change photosynthetic activity. This research looks at the possibility that an earlier spring is leading to an increase in photosynthetic activity for Northern forests, as well as whether an earlier growing season is leading to more warming and drought that decreases photosynthesis. Because evergreens, unlike deciduous trees, show no

obvious signs of greening or browning when their photosynthesis ramps up or slows down, the timing of their activation or deactivation has been difficult to assess until now. Scientists hope that this new pigment index will help clarify the exact role of Northern forests in the global carbon cycle.

The research, "A remotely sensed pigment index reveals photosynthetic phenology in evergreen conifers," will be published this week in the Proceedings of the National Academy of Sciences and will be available online at pnas.org .

Gamon conducted this research in collaboration with scientists from the University of Alberta, the University of Toronto, the University of North Carolina, the University of Maryland, Baltimore County, the University of Barcelona, NASA and the U.S. Forest Service.

Gamon is the associate director of the Center for Advanced Land Management Information Technologies based in the School of Natural Resources and is the faculty leader for the center's airborne and field remote-sensing programs. He started in summer 2016. CALMIT's resources, including its plane, and available research funding at Nebraska attracted him to the position. Gamon specializes in airborne collection of data, which is used to verify that collected by satellite or from the ground. At Nebraska, Gamon will continue to study the effects of climate change on Northern forests through the Arctic-Boreal Vulnerability Experiment program, a NASA program."

Source: UNL News