A global map to understand changing forests

May 16 2019, by Brian Wallheimer

The Global Forest Biodiversity Initiative developed the first map of global tree symbioses. The map will help answer questions about environmental impacts associated with forest changes, forest management and biological conservation. Credit: Leonhard Steinacker

An international collaboration of hundreds of scientists—led in part by the Forest Advanced Computing and Artificial Intelligence (FACAI)

Laboratory in Purdue's Department of Forestry and Natural Resources—has developed the world's first global map of tree symbioses. The map is key to understanding how forests are changing and the role climate plays in these shifts.

The findings, reported today in the journal *Nature*, come from the Global Forest Biodiversity Initiative (GFBI), a consortium of forest scientists and practitioners of which the FACAI Lab is a key hub and global center. Jingjing Liang, a Purdue University assistant professor of quantitative forest ecology, is co-supervisor the FACAI Lab, coordinator and cofounder of the GFBI and co-lead author of the paper. Mo Zhou, a Purdue assistant professor of forest economics and management, is a senior author of the paper, co-supervisor of the FACAI lab and lead economist of the GFBI.

Purdue's FACAI lab employs artificial intelligence and machine learning to study global, regional and local forest resource management and biodiversity conservation. For this research, FACAI compiled species abundance data from 55 million tree records in 1.2 million forest sample plots spanning 110 countries. The organization of the data was integral to developing the global map.

"The map and underlying global forest inventory database will serve as the foundation for research on the environmental impacts of forest changes, biological conservation and forest management," Liang said.

The map identifies the types of mycorrhizal fungi associated with trees in a particular forest. These fungi attach to tree roots, extending a tree's ability to reach water and nutrients while the tree provides carbon necessary for the fungi's survival. The two most common types of mycorrhizae are arbuscular, which grow inside the tissues of tree roots and are associated with tree species such as maple, ash and yellow poplar, and ectomycorrhizal, which live on the outside of roots and are associated with tree species such as pine, oak, hickory and beech.

Those associations are important because the mycorrhizae affects the trees' ability to access nutrients, sequester carbon and withstand the effects of climate change.

"Managing forests for climate change mitigation and sustainable development, therefore, should go well beyond managing only trees," Zhou said.

The authors found that climate is the most significant factor affecting the distribution of mycorrhizae. A warming climate is reducing the abundance of ectomycorrhizal tree species by as much as 10 percent. That change is altering forests' ecological and economic footprints, especially along the boreal-temperate ecotone, the border areas between colder and warmer forest. Losses to ectomycorrhizal species have implications for climate change since these fungi increase the amount of carbon stored in soil.

"Knowing the species composition in the forested area across the world is an important start," Liang said. "There are many fundamental and socioeconomic questions we can answer now with GFBI data and cutting-edge machine learning techniques."

The FACAI lab is currently developing collaborations to explore questions about ecology and economics, including self-learning forest models, innovative approaches to biodiversity valuation, locating unknown forest resources and space exploration.

More information: Data from this research can be downloaded at ag.purdue.edu/facai/data/ .

Climatic controls of decomposition drive the global biogeography of

forest-tree symbioses, *Nature* (2019). DOI: 10.1038/s41586-019-1128-0
, www.nature.com/articles/s41586-019-1128-0

Provided by Purdue University