Study incorporates ecological processes into Earth system models

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One component of the US Department of Agriculture-funded study is to better understand how forest management influences climate, including cloud cover. Credit: VT News

A professor in Virginia Tech's College of Natural Resources and Environment is launching a new project to enable scientists to look many decades ahead and predict the effectiveness of land management practices in agriculture and forestry to mitigate climate change.

"The project is focused on predicting how forest and agriculture management can be used to meet demands for food and fiber while having positive benefits on climate," said Quinn Thomas, assistant professor of forest dynamics and ecosystem modeling in the Department of Forest Resources and Environmental Conservation.

Thomas is leading the $2.6 million, five-year project funded by the U.S. Department of Agriculture's National Institute of Food and Agriculture. Research partners include geophysical and biological scientists from multiple institutions.

"Biological predictions and land management in climate models, more broadly called Earth system models, are largely unexplored," he said. "By viewing climate as part of the Earth system, predictions of future climate fundamentally depend on the interaction of physical, chemical, and biological processes, including human society.

"Our research addresses the need to improve predictions of biological services in the Earth system with a focus on agricultural and forest sustainability," he continued.

One example of coupled climate-biological-land management prediction is determining how decisions about the timing of crop or forest harvest rotations influence patterns of temperature and precipitation.

"Our aim is to study how agricultural and forestry practices that provide food and timber can alter climate by modifying the energy, water, and greenhouse gases in the atmosphere," Thomas explained.

Uncertainty in climate prediction can be substantial when considering the chaotic nature of the atmosphere and the challenges of predicting future human behavior, as well as the influence of land-use and land-cover change on carbon and energy cycles, he said.

"Presently, society needs climate predictions from climate models at the 10- to 50-year time scale," Thomas said. "It is on this time horizon that we hypothesize biological services associated with land management, such as carbon storage, may have an important influence on prediction. This project focuses on testing this hypothesis by improving the representation of biological processes and land management in Earth system models."

The project will use field data to better understand key ecological processes and integrate these findings into a state-of-the-art Earth system model that contributes to the goals of the Intergovernmental Panel on Climate Change. The model runs on one of the nation's most powerful supercomputers, located at the National Center for Atmospheric Research-Wyoming Supercomputing Center in Cheyenne, Wyoming.

"Contributions from the ecological, environmental, and agricultural sciences are needed to resolve discrepancies among models in ecosystem responses to and feedbacks with climate change and to rigorously evaluate the biology in the models," said Gordon Bonan, a senior scientist at the National Center for Atmospheric Research and partner on

project.

Additional project partners are Christine Goodale and Jed Sparks, professors in the ecology and evolutionary biology department at Cornell University; Jeffrey Dukes, professor of forestry, natural resources, and biological sciences at Purdue University; Stuart Grandy and Serita Frey, professors in the natural resources and the environment department at the University of New Hampshire; and Professor Thomas Fox, University Distinguished Professor Harold Burkhart, and forestry doctoral student Benjamin Ahlswede of Newport, Virginia, in Virginia Tech's Department of Forest Resources and Environmental Conservation.

The project, titled "Decadal prediction of sustainable agricultural and forest management—Earth system prediction differs from climate prediction," also will expand the education and research opportunities of students in natural resources and ecological fields by enabling them to work directly with the nation's leading climate scientists.

Provided by Virginia Tech