

Forestry researcher Steve McNulty with the U.S. Department of Agriculture and his counterparts within NC State's Department of Forestry and Environment Resources don't like to talk about climate change.

It's not that they are ignoring it. Just the opposite. Much of their research focuses on the stress that forest ecosystems face due to climate variability and ways to mitigate and manage that stress. They prefer to avoid the politically charged atmosphere that has stymied effective and important collaborations among landowners, government officials, environmentalists, researchers and the general public. In fact, McNulty and his colleagues work hard to find common ground.

"We work with a lot of different working landowners, some of whom are receptive to the topic of climate effects and some who are not," explains McNulty, who is with the U.S. Forest Service within USDA.

"So if you tell people you're there to fix their climate change problems, that will often be the end of the discussion. From an individual standpoint, they all want the same thing, which is the sustainability of their range, agricultural and forest lands. If we talk to landowners, regardless of their property size, they're going to be receptive if we have something they feel is going to benefit and help them maintain their land — and so that's what we focus on."

EDDY FLUX TOWERS

One way NC State and USDA Forest Service researchers help monitor the effects of climate variability in North Carolina is from towers extending into or above forest canopies in key ecosystems. The towers hold several sensors, including a gas analyzer, hygrometer and thermocouple.

The system allows for continuous monitoring of changes in wind velocity, temperature and water vapor amounts, as well as exchanges of trace gases, such as carbon dioxide.

The data collected from the three towers along North Carolina's coast are combined with a statistical method called eddy covariance or eddy flux. When the results from the towers are analyzed with comparable results from sensors in the ground, such as in the nutrient-rich swampy ecosystems of the Alligator River National Wildlife Refuge near the coast, researchers can better understand forest timber production, carbon sequestration and water yield potential from these similar forests.

Combined with climate data, the results help researchers better understand

how this exchange process works. "The towers help us evaluate the overall performance of an ecosystem," says John King, head of the Tree Physiology and Ecosystem Sciences Laboratory in NC State's College of Natural Resources. "It's both a top-down and bottom-up approach at the same time, allowing us to see if the forest is taking up or giving off CO₂, that is, the next balance with the atmosphere."

NC State and USDA researchers say this information is vital to the region for a number of reasons.

First, North Carolina and other Southern states are highly dependent on forests and trees, especially the loblolly pine or



Saving the Forest for the Trees

MONITORING CLIMATE EFFECTS THROUGH COLLABORATIVE RESEARCH

By Gene Pinder

Pinus taeda L. In some states, such as Alabama, Georgia and North Carolina, about two-thirds or more of their land area is forested, most of which is under private ownership and an important natural resource for the forest products industry.

Second, any long-term climate variability could not only affect sea levels from Cape Cod to the Florida Keys but could also result in a decline in forests' role as a kind of carbon "sink."

Currently the forests store large amounts of carbon, helping remove greenhouse gases from the atmosphere. Research also suggests that climate fluctuations bring on droughts, more pests, and larger

and more dangerous fires as well, all contributing to increased stress on forests.

"It's really risk assessment and putting the probabilities of change in context," King notes.

"We're basically asking — what is the likelihood that a given ecosystem is going to change and to what extent? Society needs to make the best decisions going forward. We want to help by getting this information out to the public. People can see changes now. They can see forests along the coast changing, but they don't know why. We try to help by developing ecosystem models that will provide decision support for future forest management activities."



• FAR LEFT: A 3-D sonic anemometer and open-path CO₂/H₂O analyzer sit atop an eddy flux tower in the Alligator River National Wildlife Refuge. • LEFT: An eddy flux tower rises above the Alligator River refuge canopy. • BOTTOM: John King, left, and Steve McNulty collaborate to identify the effects of climate on Southern forests.



CLIMATE HUBS

The eddy flux towers may be the most visible example of the collaborative work between the USDA Forest Service and NC State researchers, but several other recently launched projects promise to have even greater impact in the field of forest management.

In February 2014, the USDA announced the launch of seven “climate hubs,” officially named Regional Hubs for Risk Adaptation and Mitigation to Climate Change. The Southeast Regional Climate Hub is led by McNulty and located in the USDA Forest Service’s Centennial Campus offices.

The hub has three goals: to deliver

science-based knowledge and practical information to farmers, ranchers and forest landowners that will help them to adapt to climate variability; to act as a repository for the latest climate and working lands science so that it’s readily available to local and regional partners in federal and state agencies, universities, nongovernmental organizations, environmental groups, private companies and tribes; and to learn what information and tools landowners need to maintain and enhance the sustainability of their working lands, then pass this information to USDA leadership as funding priorities in the southeastern United States.

“We’re really excited about the hub and think it’s the best way to get information to and from landowners,” McNulty says.

“In the past, the science being conducted wasn’t always getting to the landowners who might be able to use it. There wasn’t much emphasis on how we make sure the information was actually making a difference. That’s all changing with the hub.”

A good example is the development and implementation of TACCIMO, an online tool for accessing climate change impacts and management options. TACCIMO has a number of features, including a searchable database of various forestry management options that are based on peer-reviewed literature.

There’s also a geospatial mapping application that provides downscaled climate data for most forest ecosystems in the lower 48 states. Visitors to the site can type in their zip code and the map will show how the models predict how the climate will change over time for that zip code. TACCIMO can create climate, planning and literature reports, which can be used by governmental agencies, landowners and other groups.

“It’s a powerful feature,” McNulty explains. “What used to take forest planners three months of study at the library now takes five minutes. Landowners and managers can see a real use for it because it’s very inclusive with the most recent scientific information included, and we’re also adding more literature all the time.”

The tool can be found at www.forest-threats.org/taccimotool.

PROXIMITY PAYS OFF

Whether it’s working on TACCIMO or the eddy flux towers, USDA Forest Service scientists attribute the speed and success of their collaborative efforts with NC State to their proximity.

“We couldn’t do what we do without physically being on campus,” McNulty notes. “You don’t really think about it until you’re on the phone and you have an idea

and need to get together, so we’ll all meet at Hunt Library in an hour. You just can’t do that unless you’re close.”

USDA researchers also appreciate being close to NC State students.

“We have great relationships with graduate and undergraduate interns,” says Jennifer Moore Myers, a resource information specialist with the USDA Forest Service. “They get to work in this professional environment and produce something we use as a pilot for what becomes a larger project, so we benefit tremendously from those interactions. Just being able to participate in other campus activities and the working relationships we have with professors — we definitely enjoy being here.”

NC State researchers share USDA’s enthusiasm for joint efforts.

“Our collaboration with the U.S. Forest Service is crucial,” King adds. “Not only have they historically been a funding source and supporter of our research, but their scientific skills are invaluable. For example, their modelers have really helped us in terms of ecosystems and watersheds. We’ve been able to apply the results of our tower studies across the region using their models.”

Whatever the effects the changing climate will have on natural resources and human communities, researchers from NC State and the U.S. Forest Service agree more funding for research is needed.

“It’s critical that we continue to invest in science, education and the stewardship of our natural resources not only to produce an educated electorate, but to continue to provide answers to some of the most important questions of our time,” King explains.

“These are highly complex problems, the solutions to which will go a long way toward sustaining economic well-being and quality of life for all.”