Berkeley lab scientists search Amazon for clues to impacts of climate change, drought

June 17 2015, by Jeremy Thomas, Contra Costa Times

For several days at a time each week, Lawrence Berkeley lab scientist Kolby Jardine rambles along slippery, oft-muddy roads for miles into the heart of the Central Amazon, braving jaguars and snakes to study more than 500 species of trees. His goal is to assess the impact of climate change in some of the most lush, diverse and undisturbed jungle on the planet, and perhaps gain a better understanding of California's drought.

Using mass spectrometers and other sensors from 150-foot towers high above the forest canopy, Jardine and a small group of Brazilian and U.S. researchers are measuring emissions from the forest. Plants emit smells (compounds) that can prevent stress, protect the canopy from extreme heat, and also play an important role in cloud formation and precipitation.

"It's really about studying the feedback of the atmosphere back into the forest and what biological processes are happening," Jardine said. "In terms of the discovery science that's possible, it's incredible because almost none of this has been done before."

By peering deeply into the Amazon, which has experienced two "megadroughts" in the past decade, scientists may be able to better predict the impact of climate change globally, Jardine said, and also collect clues about how California's vegetation might be affected by drought in the coming years, such as if and when trees might start dying off en masse.

"There are a lot of great parallels to (California); a lot of what we learn in the Amazon can be applied to the Sierras, for example," said Jardine. "There are fundamental processes that happen to all plants, and when we understand those, we can use that information for any other plants."

Jardine is one of more than a dozen scientists from Lawrence Berkeley Lab who are working to develop a better understanding of how trees interact with Earth's climate - and vice versa.

Over the next 10 years, researchers will create an unprecedented ecosystem model under the new Next Generation Ecosystem Experiments-Tropics (NGEE-Tropics) project, funded by the U.S. Department of Energy. The collaboration is headed at the Berkeley lab but includes the Brookhaven, Los Alamos, Oak Ridge and Pacific Northwest national laboratories, as well as other federal and international agencies.

The goal of the $100 million study is to allow scientists to explore how rising temperatures, shifting precipitation patterns, rising greenhouse gas levels and other changes affect the tropics' influence on climate.

"Ultimately, it's about understanding how the climate is going to change over the next 100 years," said Jeff Chambers, a Berkeley ecologist and project director for NGEE-Tropics. "If you want to understand the climate system, you have to understand all the main pieces of it, and those pieces aren't necessarily in North America."

The first phase is a three-year pilot study at sites in Brazil, Panama and Puerto Rico, where scientists will assess what's already known about tropical ecosystems and how well the knowledge is represented in existing models.

For the Amazon site, Chambers and his team built a sophisticated lab

and sent the equipment to Manaus, Brazil, where Jardine has been living and working for the past two years.

In Puerto Rico, researchers will look at soil fertility and the effects of soil variations on the regrowth of forests. With airborne-sensing technology from NASA, they'll measure the forest's structure and the chemistry of the canopy. And in Panama, scientists will examine the characteristics that enable some plant species to thrive under warmer or drier conditions, while others die off.

Once data is collected, the researchers will combine their work with more intensive field investigations in subsequent phases to build a new rainforest model using supercomputers such as the National Energy Research Scientific Computing Center (NERSC) in Oakland.

"What we're really trying to understand is whether these ecosystems will continue to be a sponge for atmospheric (carbon dioxide) or whether that sponge will cease to take up carbon dioxide," said Lara Kueppers, NGEE-Tropics' deputy project director. "That has implications for every part of the planet. ... We'll be pushing these ecosystems outside of their current temperature envelope, and we just don't know well how they'll respond."

Kueppers, a Berkeley research scientist, said she's most intrigued by the challenge of projecting what forests will look like in the coming decades and centuries.

"Tropical forests are the most diverse ecosystems on the planet, so it's like the hardest problem you could possibly throw your mind at," Kueppers said. "It's about understanding how they're going to react to a global scale experiment that's unprecedented in human history."

More than just interesting science, Kueppers said designing more precise predictive models could have implications on public policy that could

help forestall the worst effects of global warming, such as initiatives aimed at increasing renewable energy use or further reducing greenhouse gases.

"I would hope it would help us make better-informed choices," Kueppers said. "I think there's a misconception that it's a future problem, but a lot of places are already feeling the impacts. They're small right now, but they're going to get bigger."