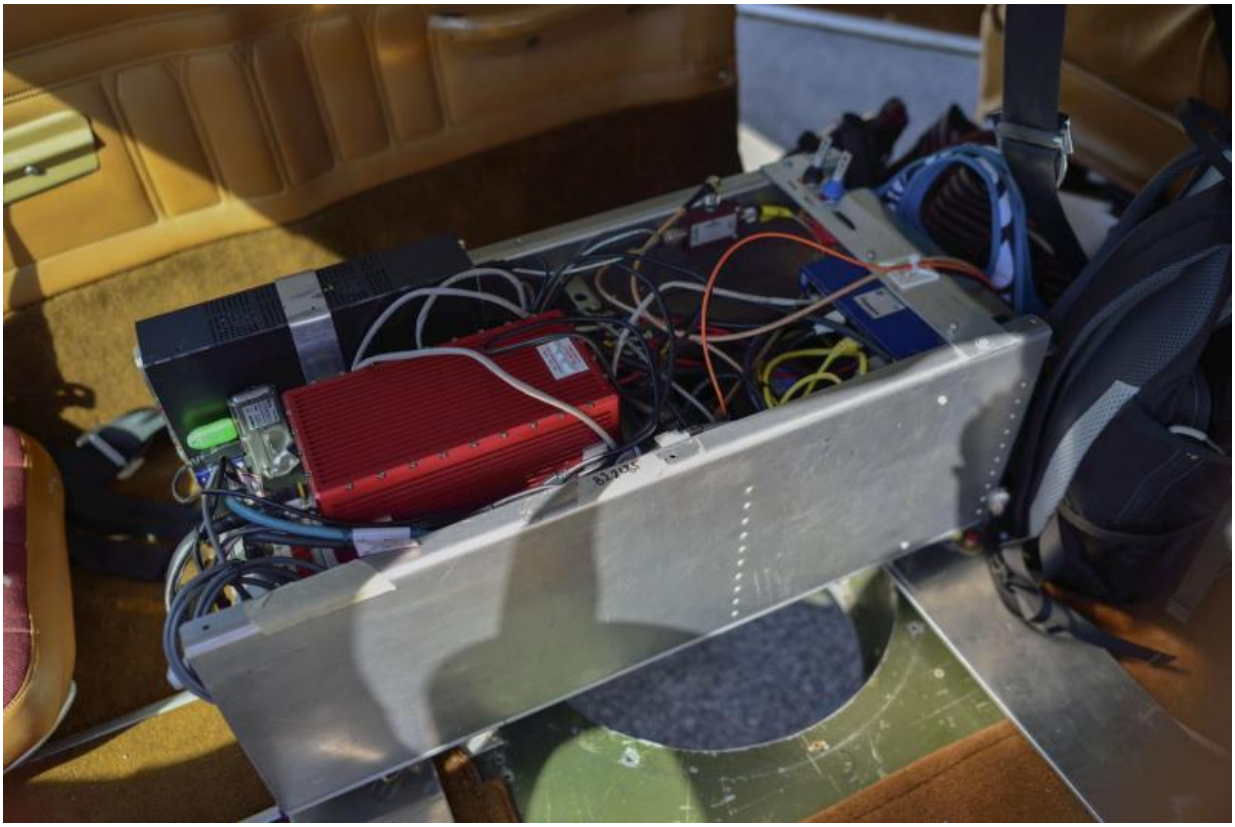
NASA Goddard technology helps fight forest pests

July 31 2015



G-LiHT sits inside the airplane's cockpit, over an open camera port that allows it to look down from about 1,000 feet high and at about 150 mph. Credit: NASA/Goddard Space Flight Center

Northeastern forests in the United States cover more than 165 million

acres, an area almost as big as Texas. Soon, millions of pine and ash trees in those forests could be wiped out, thanks in part to two types of voracious insects—each smaller than a penny.

A joint operation using technology developed at NASA's Goddard Space Flight Center in Greenbelt, Maryland, will help the U.S. Forest Service understand the impacts of these pests on northeastern trees. The collaboration flies a unique airborne instrument known as G-LiHT, or Goddard's LiDAR, Hyperspectral and Thermal imager, on a Forest Service airplane. Using G-LiHT to measure signs and symptoms of forest health, scientists from both agencies flew over forests in Massachusetts, New Hampshire, New York, and Rhode Island this summer.

The southern pine beetle, a lethal predator of pine trees that cost the Southeast's economy 1.5 billion in the early 2000s, already accounts for about 1,000 acres of infestation in New York and has recently been trapped in Connecticut and Massachusetts. The emerald ash borer, considered the worst tree-killer in the United States, has already killed tens of millions of northeastern trees and has been detected in 24 states and two Canadian provinces.

Goddard Earth scientist Bruce Cook said insects like the emerald ash borer will continue their feast for the foreseeable future. "We're probably looking at the eradication of most of the ash trees in the United States and Canada," he said.

Ryan Hanavan, the Forest Service entomologist working with G-LiHT, said these pests pose astronomical damages for the forestry industry in costs for post-infestation control, cleanup and replanting. "It's 900 millions of potential damage for southern pine beetle and 10.5 billions projected for the emerald ash borer," Hanavan said."

Technologies like G-LiHT help the Forest Service monitor insect damage and map areas at risk. G-LiHT uses LiDAR, an airborne device that sends millions of laser photons bouncing off the forest canopy and ground surface. With LiDAR data, Cook and colleagues create detailed 3-D images of each tree in a forest—trunk, branches and leaves included.

Equipped with a special gadget that can see reflected sunlight invisible to the naked eye, G-LiHT reveals information about the species and health of each tree. This gadget, known as an imaging spectrometer, helps scientists detect changes in leaf pigments plants use for photosynthesis. Cook said these pigments are important to measure, since declining photosynthesis indicates sick trees.

G-LiHT also packs a thermal infrared camera. Functioning like night-vision goggles to detect heat, this camera allows scientists to spot infested trees, which appear warmer when insects girdle their trunks and interrupt the natural flow and transpiration of water.

Cook said G-LiHT's multi-sensor system works like a nervous system with different senses. "One sense cannot totally inform you," he said. "A more complete picture of forest composition and health can be obtained with multi-sensor instrument packages."

Hanavan has been on the forefront of the effort to track emerald ash borer and southern pine beetle in New England states. He and Cook teamed up to conduct aerial surveys with G-LiHT and ground observations in Northeastern forests during the summer of 2014 and 2015.

But even with G-LiHT, scientists can't see everything from the air. Cook, Hanavan and their team need firsthand observations from the ground to describe the health of individual trees. Then they use these

notes to interpret how G-LiHT sees infected trees from above.

While slow tree-killers like the emerald ash borer hurt economic stability over several years, southern pine beetle epidemics can abruptly end decades of productive forest growth. "We're literally talking about millions to even billions of dollars in impact to the forestry industry," Cook said. And preventing infestations could save millions of dollars to municipalities and landowners, who could be responsible for disposing of dead trees.

Unhealthy forests can also contribute to biodiversity loss and undermine important water cycle processes. Healthy forests also help offset increasing levels of atmospheric carbon dioxide, a greenhouse gas that contributes to global warming.

NASA and the U.S. Forest Service began using G-LiHT in 2011. Flying more than 1,000 hours in forest health and inventory projects, Cook, Hanavan and colleagues have studied boreal, temperate and tropical forests from Alaska to the Yucatan Peninsula. G-LiHT also fueled collaborations to study croplands, as well as coastal and ocean ecosystems.

Provided by NASA's Goddard Space Flight Center