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AfriSAR

NASA science mission
measures changes in
the Gabon environment



Cover

The Okoumé tree is large, as compared to a hand seen in the bottom right portion of the image by Carla Thomas, AFRC2016-0054-086. The Mondah National Park is one of the field research sites for NASA's AfriSAR campaign.

Above, a breath-taking view is shown of the Mondah National Park.

AFRC2016-0054-307

NASA/Carla Thomas



AFRC2016-0054-218

NASA/Carla Thomas

A member of the Gabon National Parks Agency Ecoguard discussed with Lola Fatoyinbo, Marc Simard and Laura Duncanson the next research destination.

AfriSAR

Mission reveals clues about global changes

By Maria-José Viñas
NASA's Earth Science News Team

Gabon, a Central African country slightly smaller than the state of Colorado, is home to one of the most pristine rainforests on the planet. During the two-week-long NASA campaign, a collaboration with a European Space Agency (ESA) mission called AfriSAR, researchers collected measurements of plant mass, distribution of trees, shrubs and ground cover, and diversity of plant and animal species – not only from Gabon's rainforest but also from the country's wetlands, mangrove forests and savanna.

ESA launched the first part of the AfriSAR field campaign in Gabon in July 2015, when teams led by the French National Aerospace Research Center collected radar and field measurements of the country's forests. NASA and the German Aerospace Center (DLR) joined the second

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AFRC2016-0054-327

NASA/Carla Thomas

Marc Simard of the Jet Propulsion Laboratory installs a gauge that will record water level changes in the Pongara Mangrove.

leg of the campaign.

The data will help prepare for and calibrate four current and upcoming spaceborne missions for NASA, ESA and DLR that aim to, among other goals, better gauge the role of forests in Earth's carbon cycle.

“One of the questions we're really interested in at NASA is balancing



AfriSAR team members Sassan Saatchi (left) from NASA's Jet Propulsion Laboratory and Laura Duncanson from NASA's Goddard Space Flight Center take measurements of trees in the rainforest in the Mondah National Park, Gabon, Africa.

AFRC2016-0054-096
NASA/Carla Thomas



AFRC2016-0054-139

NASA/Carla Thomas

Tanguy Gabouma Bekale, director general of the Gabonese Space Agency, talks to media about the AfriSAR mission.



AFRC2016-0054-190

NASA/Carla Thomas

During an education outreach event in Gabon, Africa, students and educators, look at the German Aerospace Center Dornier DO-228 twin-engine turboprop aircraft that assisted the AfriSAR mission.



Sam Choi and Naiara Pinto observe near real time imaging from the synthetic aperture radar aboard the C-20A aircraft that is overlaid on Google Earth images.

AFRC2016-0054-528

NASA/Carla Thomas

Armstrong pilots David Fedors and Stu Broce are at the controls of the C-20A as it carries a synthetic aperture radar over areas of interest in the AfriSAR mission based in Gabon, Africa.



AFRC2016-0054-539

NASA/Carla Thomas



AFRC2016-0054-609

NASA/Carla Thomas

NASA's C-20A takes off from Libreville International Airport in Gabon, Africa, in support of the AfriSAR campaign.



AFRC2016-0054-307

NASA/Carla Thomas

Goddard Space Center's Laura Duncanson records global positioning satellite coordinates of the Pongara Mangrove and tree heights and diameters.



AFRC2016-0054-105

NASA/Carla Thomas

NASA researchers walk through the Mondah rainforest to collect tree and flora measurements and other data as part of the AfriSAR mission.

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the global carbon budget," said Lola Fatoyinbo, a research scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, and lead of NASA's contribution to the AfriSAR campaign. "We know how much carbon dioxide is being emitted into the atmosphere by fossil fuel emissions, but we don't have a good estimate of how much carbon is being taken up from the atmosphere and where it's stored – we think that forests absorb about a quarter of all these emissions, but we need better studies of forest biomass to confirm this.

"With AfriSAR, we're getting very accurate measurements of the 3-D structure of an ecosystem that is representative of the larger Congo Basin rainforest and of tropical forests in general, and this is going to allow us to get a better grip on how much carbon is stored in these ecosystems," Fatoyinbo said.

Gabon's forest is part of the Congolian tropical forests, altogether the second largest rainforest in the world after the Amazon. About 85 percent of the country's land is forest: only about 1.5 million people live there.

"The forests in Gabon are special: they are rich in plants and animals, but empty of people and intact in most places," said Sassan Saatchi, a senior scientist from NASA's Jet Propulsion Laboratory in Pasadena, California. He is part of the NASA AfriSAR team that operates the Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR). More information on UAVSAR is located at: <http://uavsar.jpl.nasa.gov>. The other NASA group participating in AfriSAR, led by Goddard scientist Bryan Blair, is in charge of the Land, Vegetation, and Ice Sensor (LVIS) instrument.

During the AfriSAR campaign, the UAVSAR system that is mounted in a pod beneath a C-20A aircraft from NASA Armstrong, flies at about 40,000 feet altitude. LVIS flies at 28,000 feet onboard a B-200 airplane from NASA's Langley Research Center in Hampton, Virginia. Both systems send out a series of radio or light wave pulses and record the time and strength of the reflected signals. LVIS, which points directly below the aircraft, is able to determine the height of the canopy and ground and the 3-D canopy structure by measuring how long it takes the signals to bounce back. UAVSAR looks to the left side of the aircraft and uses data from two or more specially designed flight paths separated by 60 feet to 600 feet to extract canopy 3-D structure and ground topography.

"LVIS studies the vertical structure of the forests by measuring the elevation of everything the photons hit: the top of the canopy, all of the leaves and branches and finally the ground" said Blair, principal investigator and developer of LVIS. "In tropical forests, the challenge is to get the laser pulse all the way to the ground because the whole canopy is closed; there are very few holes for the photons to get through."

The data collected by LVIS will help calibrate and validate the information gathered by UAVSAR over the same targets, and vice versa. The two datasets will also be compared to the airborne radar measurements that ESA and DLR are compiling during their current campaigns in Gabon.

"Whenever you are studying a complex system like a tropical forest no one instrument provides all the information needed to understand it," said Scott Hensley, a senior research specialist at JPL. "Collecting data from multiple sensors allows for the extraction of complementary information and to cross calibrate various data products obtained from the instruments."

Finally, AfriSAR's ground teams from Goddard and JPL are collecting several types of field measurements, such as tree width, forest structure and soil moisture, which will complement and refine the data gathered from the air.

Both NASA airborne instruments are test beds for future space missions. LVIS is the precursor to the Global Ecosystem Dynamics Investigation lidar (GEDI), a powerful laser altimeter that will be installed on the International

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AFRC2016-0054-110

NASA/Carla Thomas

The Okoumé tree grows tall above the other flora to reach for the sun's energy.

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Space Station in the near future to measure forests in 3-D. UAVSAR will help develop the NASA-ISRO Synthetic Aperture Radar, or NISAR, a joint U.S. and Indian radar-based satellite mission set to launch in 2020. In turn, the European space agencies' radar measurements in Gabon are aimed to prepare for ESA's BIOMASS satellite mission, which will deploy in 2020. DLR will also compare the data to the measurements collected by its TanDEM-X satellite constellation, launched in 2010.

Furthermore, the forest data gathered in Gabon might help to inform policymakers working on climate mitigation and forest conservation policies, Saatchi said.

AfriSAR is NASA's first collaboration with Gabon's young space agency, AGEOS, and also is one of the few large international campaigns in Africa since NASA's participation in a hydrological study of the Sahel in the 1990s.

For more on NASA's Airborne Science program:
<https://airbornescience.nasa.gov>



AFRC2016-0054-211

NASA/Carla Thomas

Members of the AfriSAR team standing by the C-20A in Gabon, Africa, which is usually based at NASA Armstrong Flight Research Center in California include, from left, John McGrath, Carlos Meza, Stu Broce, Samuel Choi, David Fedors, Naiara Pinto, Mark Scherer, Marc Simard, Vincent Moreno, Chuck Irving and Kean Tham.



AFRC2016-0054-163

NASA/Carla Thomas

The NASA Langley Research Center-based B-200 in Gabon, Africa, was visited by three representatives of the Gabon Ministry of the Numerical Economy (the three women seen in the middle). In the photo from left are Bryan Blair, Rick Yasky, the three Gabon representatives, Alan Barringer and Lola Fatoyinbo.



2016-0054-651 NASA/Carla Thomas

C-20A crew chief Vince Moreno inspects the aircraft.



2016-0054-642 NASA/Carla Thomas

Mark Scherer prepares the C-20A for the AfriSAR mission.

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