



In this image of South America, green indicates vegetation that is growing during the dry season. Red and orange indicate "browning down" in the dry season. The boundary of the Amazon rainforest is shown in black. Red areas within the boundary are places where the primary forest has been disturbed.

Amazon Rainforest Greens Up in the Dry Season

By Mari N. Jensen
UA Office of University Communications

The Amazon rainforest puts on its biggest growth spurt during the dry season, according to new research.

The finding surprised the researchers.

"Most of the vegetation around the world follows a general pattern in which plants get green and lush during the rainy season and then during the dry season, leaves fall because there's not enough water in the soil to support plant growth," said lead researcher Alfredo R. Huete, a professor of soil, water and environmental science in the UA College of Agriculture and Life Sciences.

"What we found for a large section of the Amazon is the opposite. As soon as the rains stop and you start to enter a dry period, the Amazon becomes alive. New leaves spring out, there's a flush of green growth and the greening continues as the dry season progresses."

The finding holds true only for the undisturbed portion of the rainforest. Areas where the primary forest has been converted to other uses or disturbed "brown down" in the dry season, said Huete.

Huete suggests the deep roots of trees in the undisturbed forest can reach water even in the dry season, allowing the trees to flourish during the sunnier,

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drier part of the year. In contrast, plants in areas that have been logged or converted to other uses cannot reach deep water in the dry season and therefore either go dormant or die.

Figuring out the metabolism of the Amazon rainforest, the largest old-growth rainforest on the planet, is crucial for understanding how rainforests and other tropical biomes function and how deforestation affects biodiversity and sustainable land use in the tropics. It will also help scientists better understand the global carbon cycle, which affects the natural sequestration and release of carbon dioxide, a major greenhouse gas.

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The research team figured out when the intact forest grows by analyzing five years of satellite images from the MODIS (Moderate Resolution Imaging Spectroradiometer) instrument mounted on NASA's Terra satellite and by cross-checking with information from local sites on the ground. The research was funded by NASA and is part of the Brazilian-led Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA).

Huete's collaborators included Kamel Didan, an assistant research scientist in the UA's department of soil, water and environmental science; Yosio E. Shimabukuro of the Instituto Nacional de Pesquisas Espaciais, São Jose de Campos, Brazil; Piyachat Ratana, a doctoral student in the UA's department of soil, water and environmental science; Scott Saleska, a UA assistant professor of ecology and evolutionary biology; Lucy R. Hutyra of Harvard University; Wenze Yang and Ranga Myneni of Boston University; and Ramakrishna R. Nemani of NASA Ames Research Center in Moffett Field, California.

The MODIS instrument began collecting data in 2000. Once a day, MODIS takes a picture of each spot on the Earth. Each pixel in the images represents a square of about 820 feet (250 meters) on a side. If it's too cloudy

at one spot one day, the next day's picture may be fine. Five years' worth of pictures means the scientists have at least one good image of every spot for every month of the year.

To be able to figure out when the Amazon rainforest is growing, Huete's lab used a new measure, called Enhanced Vegetation Index (EVI), for detecting greenness in MODIS images of very highly vegetated rainforests. Greenness is an indicator of active plant growth.

Plants are green because they contain the photosynthetic pigment chlorophyll. Growing plants generate more chlorophyll and therefore look greener.

The greenness can also be translated to a measure of plant growth called "gross primary productivity." Ecosystems with higher gross primary productivity take up and store more carbon in the form of carbon dioxide, a major greenhouse gas.

"We can look at this increase in greenness as a measure of Amazon health, because in the disturbed areas we don't see the greenness increase during the dry season," Huete said. "A lot of people are interested in the rainforest because of the humongous amount of carbon it stores. A very slight change in the forest's activity will make a tremendous change in the global carbon cycle."

Saleska and his colleagues and other research teams had conducted studies at local sites in the Amazon that suggested the intact rainforest grows more during the dry season. Those studies analyzed data from flux towers, which measure the seasonal gas exchange by vegetation. The new research confirms the local studies and indicates that the greener-in-the-dry-season pattern is basin-wide.

"With the satellite, we can say the whole Amazon basin is doing something," Huete said.

The team's next step, Huete said, is to see if other tropical rainforests behave the same way and how the rainforests behave in El Niño years. He added, "We also want to look harder at the transition zones at the edge of the rainforest to see whether different kinds of disturbance cause different growth patterns." ■

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