First satellite measurement of water volume in Amazon floodplain

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For the first time, scientists have been able to measure the amount of water that rises and falls annually in the Amazon River floodplain.

The result -- 285 billion metric tons, or 285 cubic kilometers of water by volume -- sounds like a lot. That amount is over half the volume of Lake Erie, which is the world's 15th largest lake.

But it accounts for only 5 percent of the water flowing through the Amazon River every year, and it is a much smaller amount than researchers were expecting to find in the largest drainage basin in the world.

Doug Alsdorf, associate professor of earth sciences at Ohio State University, and his colleagues report their study online in the journal *Remote Sensing of Environment*, in a paper to appear in a future print edition.

Until now, researchers could only estimate the amount of water in the Amazon floodplain using a few sporadic field studies and crude assumptions about water flow. In fact, water volumes on any floodplain are poorly known, if at all. Yet this information is critical to predicting the floods and droughts that could accompany global climate change, explained Alsdorf.

Much of Earth's available fresh water resides in remote rivers, lakes and wetlands, and also underground.

"Nobody knows exactly how much water there is on the planet," he said. "We need to understand how our water supply will change as the climate changes, and the first step is getting a handle on how much water we actually have."

Alsdorf and his team have made it their mission to find ways to measure water from space.

"Satellite observations are the only reliable option for places like the Amazon and especially the Congo Basin, where in-person measurements are near-impossible. Just getting there is a serious challenge," he said.

For this study, the researchers were interested only in the amount of water that flowed into and out of the floodplain -- that is, the amount of water that spilled onto land when the Amazon River overflowed its banks during the rainy season.

Alsdorf and his team used four satellites -- three NASA satellites and one from the Japan Aerospace Exploration Agency -- to get the first direct measure of water in the floodplain.

They combined data from the Gravity Recovery and Climate Experiment, the Global Precipitation Climatology Project, the Shuttle Radar Topography Mission, and the Japanese Earth Resources Satellite. They focused on measuring water level changes during the wet and dry seasons between 2003 and 2006.

Taken together, these satellites gave a picture of how the Amazon landscape changed as highland rains surged through the river's many tributaries and the resulting overflow spilled into the lowland jungle. After the water receded, they calculated the change in volume along the floodplain.

These calculations haven't been made before, in part due to the immense difficulty of combining different kinds of data in a reliable way. The researchers had to meld gravity readings -- a measure of the flood water's mass -- with radar and optical measurements of the water level and extent of the floodplain.

The measurements added up to an average of 285 cubic kilometers (285 billion metric tons) of water stored and emptied from the floodplain in a year.

At the height of the rainy season, water flowed into various locations on the Amazon floodplain at a rate of 5,500 cubic meters (5,500 metric tons) per second, and during the dry season, it drained away into the Amazon River -- and, ultimately, into the Atlantic Ocean - at a rate of 7,500 cubic meters (7,500 metric tons) per second.

The floodplain total, however large, represents only 5 percent of the amount that scientists believe is emptying from the Amazon River into the ocean every year.

To Alsdorf, the finding begs the question of exactly how much water is flowing through the Amazon system, and it underscores the many unknowns that scientists must confront as they work to understand climate change.

The Amazon, however grand in size, is just one river basin among countless basins around the planet -- each vital to the soil quality and water quality of its surroundings, he said.

Future measurements should be easier with the Surface Water and Ocean Topography (SWOT) mission, which aims to take stock of all the world's water. Alsdorf co-leads the science team for the SWOT satellite, which NASA has set to launch in 2020.

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