Researchers find satellite measurements of rainforests underestimate carbon storage potential

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The late Dr. Kye Epps teaches Wapichana field researchers how to measure tree diameter, information that can then be used to calculate a tree's biomass and carbon storage. Credit: Han Overman

When it comes to measuring the carbon storage potential of the Amazon forest, indigenous people might outperform sophisticated satellites.

The results from a long-term collaboration between Stanford scientists and indigenous people in Guyana suggests that traditional remote sensing techniques might be undervaluing the region's carbon storage potential by as much as 40 percent. The work could influence how indigenous people in Guyana and elsewhere manage their forests and lead to greater opportunities for these communities to engage in carbon offset programs.

The project, led by Jose Fragoso, a senior scientist in the Department of Biology at Stanford, grew out of his earlier efforts to engage indigenous peoples to gain a better understanding of ecosystems relatively undisturbed by modern civilization.

What is carbon?

The first challenge was teaching people with little to no exposure to the outside world just what carbon is. Co-author Kimberly "Kye" Epps, a postdoctoral scholar in Stanford School of Earth Sciences (who passed away during the project,) developed lesson plans for explaining that all life is based on carbon.

Epps pointed out that the black charcoal from a burnt twig is primarily carbon, and how the carbon-laden smoke enters the atmosphere and ultimately affects the global climate. The plants and trees suck carbon from the atmosphere, she explained, and store it in their trunks and leaves.

"Kye's innovative lessons helped get them to where they not only understand what carbon is, but also understand its global implications and how much they actually hold themselves on their land," said Fragoso, the senior author on the paper. "When they realized its importance, they became very invested in the work."

Next came lessons on establishing survey plots, cataloging plant species and learning how to measure plant trunk circumferences, which is a standard measurement used to calculate biomass and thus how much carbon is contained in the plot.

"The people know the trails really well, and some of them will walk two days to get to their plot and make measurements," Fragoso said. "They can make really good measurements in really isolated areas, where government workers would never get to. Generally, professional scientists will not travel these distances on foot to verify carbon estimates."

Biomass specifics

Whereas satellite observations would most likely have identified each of these plots as "forest" and assigned them a standardized value for carbon storage, Fragoso said that the field workers identified 11 habitat types with trees, each of which requires a different set of calculations for determining its carbon storage potential. Because the researchers could be more specific about the biomass of each vegetation type making up a plot, they were able to calculate that forests in Guyana contain 20 to 40 percent more carbon than previously estimated.

This difference can affect a number of different areas. For one, it means that climate models that include blanket estimations of carbon storage in lands governed by indigenous people might be missing significant data – indigenous people govern about half of all remaining undeveloped land on the planet.

Indigenous lands probably play a much larger role in the global climate than previously assumed, Fragoso said, and indigenous people need to be better represented at global climate talks. These land-owners have more carbon storage at their disposal to sell as carbon credits to governments

and corporations looking to offset their greenhouse gas-producing activities.

"Having a good measurement of carbon storage really helps them to enter into discussions with the national government and surrounding communities," Fragoso said. "This helps them to both prevent global climate change while also benefiting, and that is something that the people we worked with were very interested in."

This is the first model for turning indigenous people into field researchers capable of producing scientifically rigorous calculations for carbon, said Fragoso, who is now planning to share the concept with other indigenous nations around the world.

The paper was published recently in the journal *Forest Ecology and Management*.

More information: Nathalie Butt, Kimberly Epps, Han Overman, Takuya Iwamura, Jose M.V. Fragoso, "Assessing carbon stocks using indigenous peoples' field measurements in Amazonian Guyana," *Forest Ecology and Management*, Volume 338, 15 February 2015, Pages 191-199, ISSN 0378-1127, dx.doi.org/10.1016/j.foreco.2014.11.014.

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