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Satellite Study Raises Estimates of Forest Degradation, Carbon Dioxide Emissions in the Brazilian Amazon

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DURHAM, N.H. -- A new study published in the Oct. 21 issue of *Science* shows that selective logging activity in the Brazilian Amazon region covers an area nearly equal to the annual area deforested, thereby doubling the area of forest degradation. Moreover, based on this area estimate, the authors calculate that logging adds 25 percent to the gross carbon dioxide emissions from the Brazilian Amazon from forest degradation.

The study by Greg Asner of the Carnegie Institution of Washington, Michael Keller of the USDA Forest Service and the University of New Hampshire, Natalino Silva of Brazil's Agricultural Research Enterprise (EMBRAPA) and other colleagues, used data from NASA's Landsat satellite and a new computationally intensive method backed by extensive fieldwork.

"Our results show that the geographic area of the Brazilian Amazon subjected to selective logging matches and even exceeds the area that is deforested," Asner says.

Adds Keller, an affiliate professor at the UNH Institute for the Study or Earth, Oceans, and Space (EOS), "This is a brute force study in that it was hard to do because we had to calculate from hundreds of images and do extensive field studies to make sure what we were looking at. The analytical technique itself is elegant."

Previous satellite interpretations were able to detect only areas where all forest cover was removed entirely. But by using a pattern recognition technique developed by Asner that "masked out" any natural disturbance from the clear, linear patterns created by logging trucks, skidders, etc., the researchers found that selective logging covered an area of 12,135 to 20,651 square kilometers per year – an area the size of Connecticut – from 1999 through 2002.

Compared to previous satellite images of the region, Keller says, "We're seeing something totally different. Other imagery identifies where all the trees are removed, swept down to grass or bare ground or soybeans, and what we're seeing is this much more subtle canopy disturbance," which shows up as the "linear" patterns of roads and snaking paths where trees are hauled out of the forest. "We've mapped more than 10 million acres of these linear features and it's very detailed – down to a meter. We know exactly where every trail is."

Because the new technique clearly identifies the subtle features of logging, it could enable law enforcement agencies and forest managers in Brazil and other tropical forest countries to monitor logging economically in their extensive frontier regions. As Keller points out, the researchers' imagery of the Brazilian Amazon's numerous "reserve" regions revealed that some illegal logging was occurring but that in such a vast frontier there can't be a "cop on every corner," and the technology could provide an sharp eye in the sky for monitoring and management.

"Illegal logging creates a disincentive for producers to adopt good management practices because legal timber cannot compete with illegally produced ones," says co-author Natalino Silva. "Therefore this new technique can help increase interest in good management if illegal logging operations are reduced or eliminated."

With respect to the bigger-picture issues of climate change and global warming, Keller notes that the study shows that the "forest degradation process is contributing a substantial amount of carbon, in a gross sense, to the atmosphere." The additional 25 percent in gross carbon dioxide emissions the researchers estimated will be offset to some extent by the rapid regrowth that occurs in the tropical environment. But that, Keller says, "isn't in our study and the rate at which this regrowth occurs is relatively unknown. That's our future research – measuring the net" increase in carbon dioxide emissions.