

KEEPING WATCH

OVER BRAZIL'S AMAZON FORESTS

Dossier



The federal state of Acre in Brazil's Amazon basin is bordered by Peru and Bolivia. Covering an area of 155,000 sq.km., chiefly forests, its population of no more than 700,000 lives mostly in the eastern corner around Rio Branco, the state capital. The "Estrada do Pacifico", a new highway linking Brazil to the Pacific Ocean via the south of Peru, will soon run through it.

Viewed from the air

Every year during the dry season from June to October, Acre's federal government faces the challenge of monitoring its forests to detect deforestation and illegal logging in an attempt to quantify and ultimately stem this curse. Its task is made more difficult than it first appears by the logistics involved and by the size of deforested areas, increasingly small pockets of no

more than a few hectares, including in indigenous Indian reserves and protected zones. Several thousand such areas are identified each year, so it is impossible for field teams to get to all of them in real time.

Up to 2006, deforestation was monitored essentially by reconnaissance flights using consumer-quality cameras to take pictures while at the same time recording the aircraft's approximate GPS position. Illegal logging statistics were compiled jointly by Acre's environmental agency (SEMA/AC) and non-government organization IMAZON, based in Belem, but only made public several months later.

Viewed from space

This year, encouraged by Acre's Governor, the same partners tested out an innovative method with support from Spot Image and the FORMOSAT-2 satellite. The satellite regularly overflies Rio Branco, so it was able to image the entire Alto and Baixo Acre zone where most illegal logging is concentrated.

Carlos Souza, Executive Director of IMAZON and one of Brazil's most renowned specialists in remote sensing of tropical forests, applied a methodology based on using FORMOSAT-2 to acquire 1 minute 30 seconds of high-spatial-resolution imagery (2 metres) every day. Taiwan's National Space Organization (NSPO) tasked the satellite daily between August and October 2007 to collect coverages of the study area under a virtual data reception agreement between IMAZON and Spot Image. IMAZON also purchased a multi-user licence extended to users at SEMA/AC and other local government offices. Thanks

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▶ IMAZON, the Amazon Institute of People and the Environment, is a non-profit private research institution whose objective is to foster sustainable use of natural resources in the Amazon through scientific studies of its forests. It also supports public policy formulation and concrete local actions aimed at preserving the Amazon environment, while disseminating the knowledge it acquires, for example through training programmes. Founded 17 years ago, under the impetus of top-ranking researchers IMAZON has become one of the main centres providing geoinformation about the Amazon environment, making extensive use of remote sensing. This year, it launched its own geoinformation portal called ImazonGeo.

• www.imazongeo.org.br

AMAZONIA

Amazonia is the largest reserve of biodiversity on the planet, covering an area of nearly five million square kilometres. Its climate is hot and humid, with an average temperature of 26°C. It receives an average 2,100 millimetres of rainfall per year, some areas in the north-west Amazon getting as much as 10,000 millimetres. Preserving nature in the Amazon basin is today a global priority. A range of policies are being applied in an effort to reduce human-induced economic pressures on the Amazon forest. These include the creation of huge natural reserves, logging concessions to keep extraction of precious hardwoods under control, and command-and-control activities such as those described in this article. The deforestation occurring in the Amazon every year makes Brazil the fifth largest emitter of carbon dioxide. As a result, many people believe that stopping deforestation—now a major policy objective of Brazil's federal government—is one of the most effective means to curb the effects of global climate change in the short term.



to close cooperation between Spot Image and NSPO teams, all imagery was delivered through a Web-based interface dubbed MyFormosat-2.

On-line monitoring and tracking

Through this secure portal, IMAZON and SEMA/AC were able to keep track of daily FORMOSAT-2 acquisitions over a three-month period. The portal provided a range of features that users found extremely useful, allowing them to view quicklooks of images and their technical specifications at all times. Other advantages included the ability to view acquisition ground tracks and generate scene production on line.

Armed with these images, teams at IMAZON and SEMA/AC devised a seven-step data production process:

- 1 - FORMOSAT-2's 8-metre multi-spectral band was geolocated using GeoCover.
- 2 - The panchromatic band was co-registered and spectral bands merged.
- 3 - Deforestation masks from previous years, generated by the Brazilian space agency INPE (for the PRODES programme) and by IMAZON for Acre, were overlaid on the imagery.
- 4 - New deforestation polygons were identified and results compiled to yield up-to-date statistics.
- 5 - An attribute was allocated to each polygon containing all required information and a 2007 deforestation polygon database was generated.

6 - Each polygon was compared against the authorized logging mask and in the event of infringements.

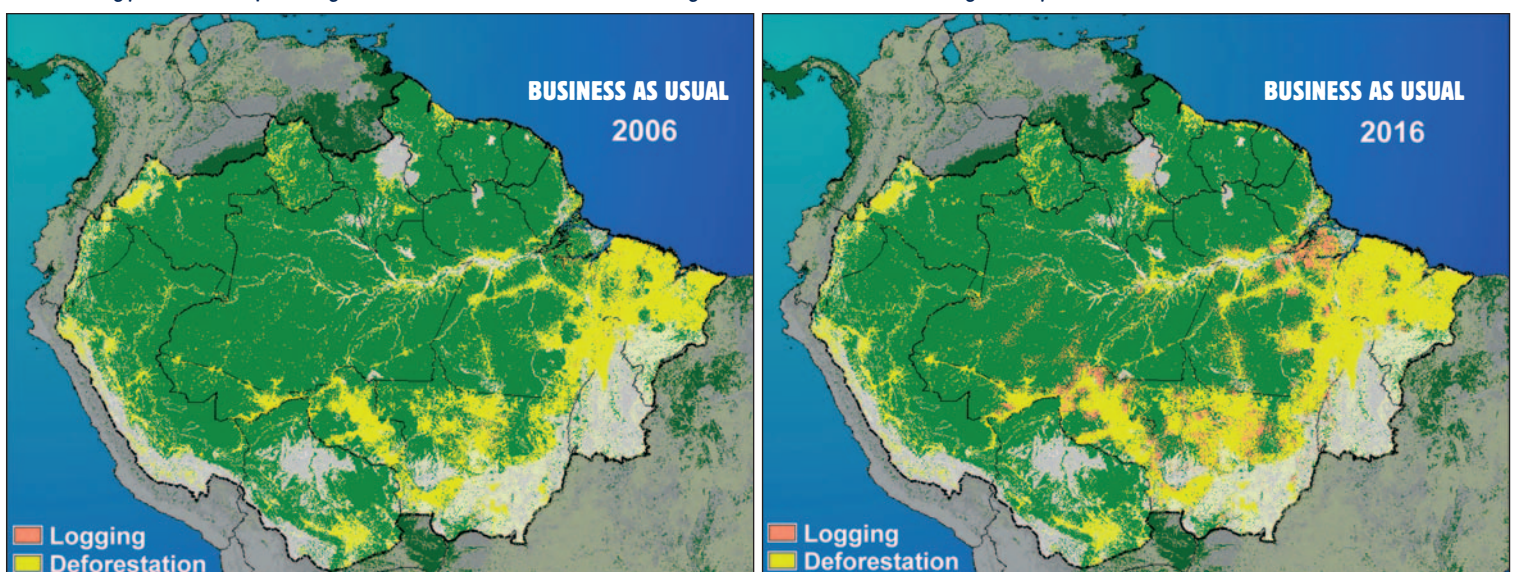
7 - Environmental field enforcement teams from IBAMA and police forces were informed to enable them to intervene.

In total, acquisitions of eight complete coverages of the area of interest were attempted, with significantly worsening weather conditions bringing heavy cloud cover toward the end of the study period. The figure opposite shows image interpretation work progress. The checkerboard appearance is due to the fact that IMAZON and SEMA/AC teams shared image analysis equally between them. This task is still underway and Acre's engineers have already suggested other possible



FUTURE TRENDS IN DEFORESTATION AND LOGGING CAN BE PREDICTED

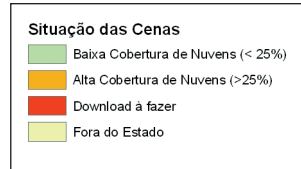
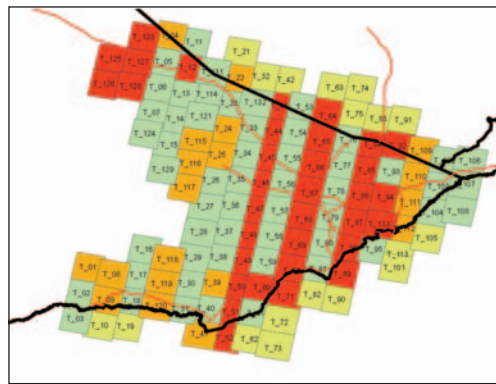
If deforestation continues unchecked, some scientists predict a scenario like the one shown below. However, in the last two years, the Brazilian government, which is strongly committed to preserving the Amazon forest, has succeeded in slowing down the rate of deforestation significantly.





13-23 August coverage

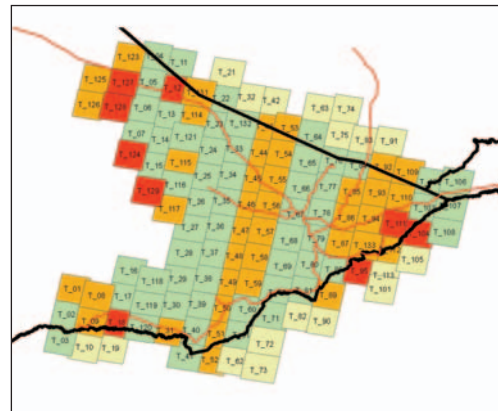
3-11 September coverage



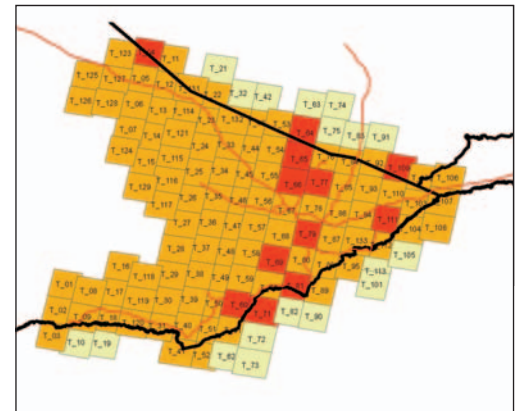
applications of the FORMOSAT-2 imagery such as map updating, land-cover mapping and quantification of biomass.

Daily near-real-time monitoring of deforestation marks a world first

This project is a new experience, so a number of operational improvements will be needed for next year. Given the volume of imagery involved, polygon identification and processing will have to be optimized. Naturally, the value and effectiveness of this operational deforestation monitoring system will ultimately be judged by actions in the field. While the tool proved effective in identifying and quantifying deforested areas of less than a few hectares in near-real time, monitoring and analysis obviously needs to be followed up by police enforcement operations to make the project a success.



23 September - 1 October coverage



23-31 October coverage

Cooperation between Spot Image, NSPO, IMAZON and Acre's federal government enabled daily near-real time monitoring of deforestation in a tropical zone for the first time ever—a result achieved by tasking the FORMOSAT-2 Earth-observation satellite to collect high-resolution images of deforested areas covering less than three hectares. ■

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Source of illustrations: study by Merry, Soares, Nepstad et al. Submitted PNAS: Soares, Nepstad, Curran et al. Nature 2006

