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CARING FOR THE PLANET'S LUNGS

A SIXTH OF THE EARTH'S FOREST COVER IS IN AFRICA AND SAFEGUARDING IT IS A VITAL TASK. JUDITH METSCHIES LOOKS AT HOW SATELLITE IMAGERY IS BEING USED TO ENSURE FORESTRY IS MANAGED SUSTAINABLY ON THE CONTINENT

The world's forests are vital. Covering nearly 30% of the land and home to a huge number of animal and plant species, they are also the planet's lungs – carbon sinks that provide valuable services for regulating the climate and controlling the water cycle. In Africa in particular, they occupy an estimated 650 million ha. This is over a fifth of the land area of Africa and a sixth of the world's total forest cover.

More than 1.5bn people's livelihoods depend on forestry resources and the constantly rising pressure from human activities is now being monitored. Regulatory frameworks are being implemented to reconcile economic growth, social development and environmental protection: the sustainable management of forestry ecosystems is being strongly encouraged, including financially, for example by means of new mechanisms for monetising ecosystems, such as REDD+.

Satellite imaging plays a vital support role in this. More than 30 years of data archives are available, covering all points on the globe, making it possible to produce reference maps and study the various changes that have occurred over the passing years. Satellite technology has continued to improve and today provides high-resolution images, be they spectral, spatial or geometrical, enhancing the level of detail in the studies carried out further still and meeting the growing need for precision and forward planning. Furthermore, access to optical and radar data, which can be merged and compared, makes it possible to extract even more information from each scene acquired, whether to combine the data or to circumvent the problem of persistent cloud cover.

Understanding, monitoring and mitigating the risks of degradation of the resource, while securing financing, are the real challenges for the space industry in general and the providers of satellite images in particular. For nearly a decade now, Airbus Defence and Space has been developing and participating in operational projects, more specifically through the OSFT (Space Observatory for Tropical Forests) project, which is working on detailed mapping of the Congo River basin and its forests, in order to improve our understanding of it and encourage improved management along with specific protection measures. Monitoring and ensuring that sustainable practices are in place for the long

term are part of the service mission of the Airbus Defence and Space's GO Monitor Forest solution, which in particular helped with the eco-certification of a forestry operation in Cameroon. Finally, when disastrous practices have damaged vast areas, only satellite imaging is capable of rapidly and objectively providing a precise picture of the situation, as was the case with the forests of Ghana.

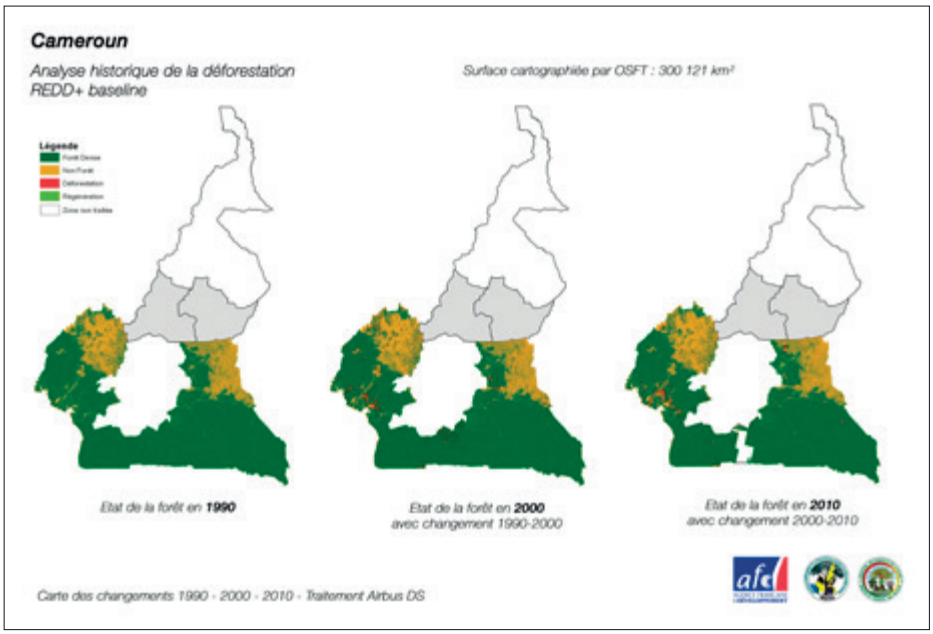
National REDD+ strategies

The forests of the Congo basin, the second largest forestry basin after the Amazon, are shrinking by more than 1% every year. This represents a very real threat, both for these ecosystems and for the climate as a whole.

A highly ambitious French initiative is under way in this region. It began in 2009 when France took the decision to provide the countries of the Congo Basin with the 'best space technology' to enable them to join REDD+. One year later, the French Development Agency and Airbus Defence and Space signed a framework agreement to supply satellite images and forestry maps to stakeholders in the region in charge of forestry resources and their exploitation. The OSFT programme, which is integral to reducing emissions linked to deforestation and forest degradation (REDD+), was then launched in 2010, to finish early next year.

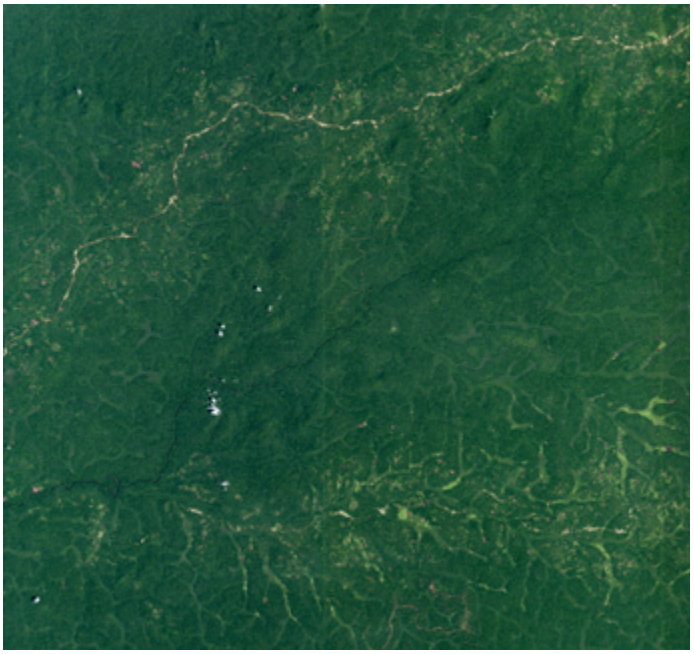
The goal is to provide detailed mapping of the Congo basin to gain a clearer understanding of its forests and help improve management of its resources through pertinent and targeted measures for each of the areas making up the 3 x 106 km² of this region. To do this, archive satellite images acquired before 2010 by Airbus Defence and Space's SPOT 4 and SPOT 5 satellites and more recently SPOT 6 and SPOT 7 were supplied to administrations, public institutions and NGOs working in the sustainable management of forests in the Congo basin. These images were used to produce the first bases for characterising land cover and above all classifying the vegetation cover. These maps thus enabled the reference scenario to be produced, which is essential for any stakeholder wishing to be a part of the REDD mechanism.

The earlier SPOT images had a resolution of 20m, while the latest imagery acquired by SPOT 6 and SPOT 7, now offer 1.5m resolution

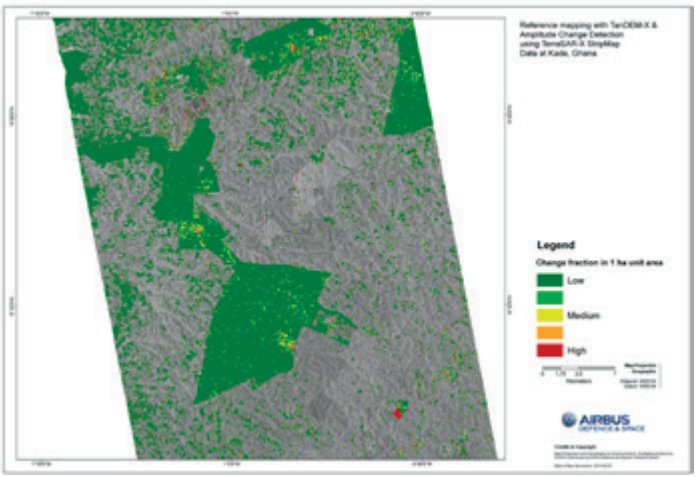


A baseline map of Cameroon showing forest evolution from 1990 to 2000 and from 2000 to 2010, as part of the OSFT project

Congo SPOT 6 image acquired 19 May 2013 © Airbus DS



Congo SPOT 6 image acquired 05 March 2013 © Airbus DS



Change fraction in 1ha grid cells showing degradation pattern (forest remains forest but loses biomass) © DLR eV and Airbus DS Geo GmbH

and deliver very high levels of detail. The SPOT satellites offer far better definition of contours and allow clearer identification of the plots, however small, while providing extensive coverage thanks to its 60km swath. Improved discrimination of the land cover classes and more detailed mapping of soil usage are thus possible.

With the help of multi-date analyses, it is possible to evaluate areas that have undergone change, to identify the nature of the change, but also to calculate the surface area of the zones concerned. In particular, the resolution of the SPOT 6 images, combined with 12-byte data coding, offers high analysis capacity, even in shadow areas, thanks to greater contrast. It has thus been possible to detect illicit logging in forestry concessions of several thousand hectares, and to estimate the ratio of deforestation to new agricultural and residential land that has appeared to the detriment of the forest. This all plays a part in calculating the carbon reserves either lost or gained.

However, the project does not stop with the supply of satellite images and land cover maps. It goes much further and provides remote sensing and GIS training for local stakeholders in charge of managing forestry resources. It is essential for the beneficiaries of the projects to appropriate these techniques to guarantee the success of such a project and enable these countries to deploy effective monitoring methodologies across their territory and reinforce their forestry mapping expertise. This contributes to an understanding of the deforestation mechanisms in order to establish national climate plans for the preservation of the forests.

Eco-certification

One of the main levers for responsible and sustainable management of forestry resources is eco-certification. This guarantees that any wood extracted complies with precise specifications and that an environmentally-friendly process has been implemented. Here again, satellite images provide solutions, thanks to their objective ability to observe and image the various areas and the information contained in each of the pixels making up the images.

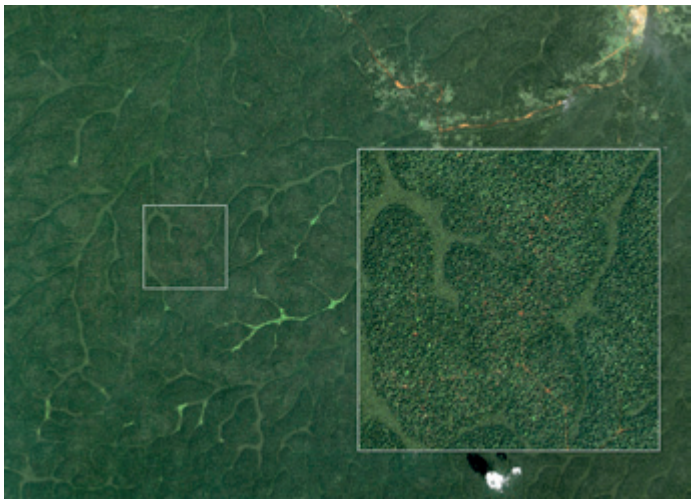
In partnership with ONF International, Airbus Defence and Space has set up an operational service for all forestry project surveillance and monitoring needs, regardless of their nature. To do this, images are regularly acquired, at a frequency linked to the type of project concerned. Diachronic analyses highlight all the differences between acquisitions. Thus deforestation or forest degradation, tracks and forestry infrastructures, accompanied by sophisticated and detailed analysis, are mapped and reports produced.

A concrete example of the application of this service can be found in Cameroon and concerns the forestry certification in which an increasing number of forestry operators are engaging. The Kribi Forestry Company and WIJMA Cameroon obtained FSC certification for an area of 612km^2. They were also looking to intensify low environmental impact practices in order to consolidate the forestry eco-certification of the concession. They called on the GO Monitor Forest service in 2013 for a summary of these low environmental impact practices and to provide WIJMA with the means of monitoring the integrity of the concession and the potential pressure from human activities, which is an obligation with regard to the certification agency.

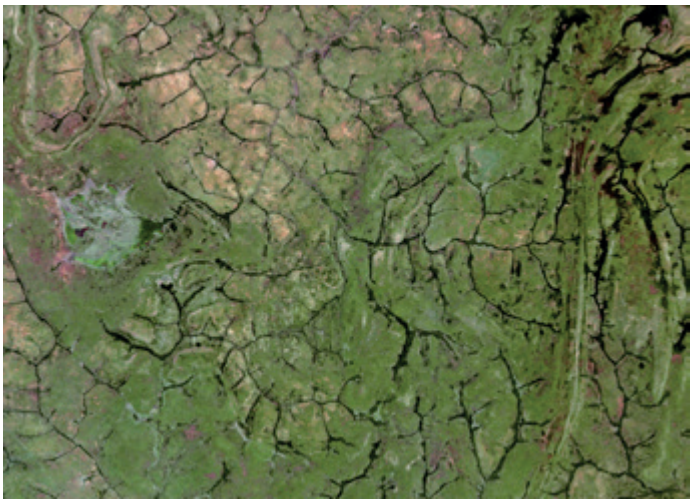
A forestry management analysis was thus performed using a SPOT 6 image on the 2011-2012 felling allowance. The Annual Allowable Cut (AAC) is the area that is scheduled to be exploited annually by the annual operations plan. It is defined by a development plan for the Forest Management Unit (FMU) which is established by the company and validated by the Ministry of Forests and Fauna. The AAC 2011 and 2012 in the investigated area were analysed with a view to improving operating practices.

Thanks to the SPOT 6 image it was possible to establish that:

- Forest tracks represent an average of 16.5% of the deforested areas and are on average 7m wide (roadway surface), a width that corresponds to the recommendations of the Regional Code for Reduced Impact Forest Harvesting of the FAO (dating from 2003).
- Canopy bridges were maintained over these tracks to assist the passage of primates and thus preserve biodiversity.



SPOT 6 image of Cameroon © Airbus DS



SPOT 6 image of the Central African Republic © Airbus DS

- The footprint of the lumber yards in which the trees are skidded then hauled after felling should be limited. The analyses showed that the average surface area of these yards is 1,550m^2, well above the 1,000m^2 recommended for a rotation of 50 trees/day.

The SPOT 6 image demonstrated the best practices employed by the forestry company. However, it also revealed the impact of certain practices by the neighbouring populations, which were highly detrimental and accelerated deforestation.

The SPOT 6 image revealed the existence of a road which was not referenced on the maps of Cameroon. This north-south road was built by the state to the east of the FMU between 2010 and 2013. It passes through the concession and has accelerated the process of degradation and the change in soil occupancy. The footprint of the road sometimes exceeds a width of 80m and slash and burn agriculture was observed in the vicinity. This is linked to plantations of maize, manioc, ground-nuts and bananas on the concession, indicating uncontrolled anthropogenic pressure.

Unfortunately, the current population dynamics in the area are accelerating the degradation and deforestation and the long-term future of the FMU cannot be guaranteed. The significant change in the allocation of the ground between 2010 and 2013 requires immediate action by the authorities and continued long-term monitoring.

Forest degradation

Radar satellite data can be particularly useful in areas with dense cloud cover. But in addition, the various polarisation modes offered by the TerraSAR-X satellite provide information directly linked to the texture of the vegetation, which can support the improvement of the forest cover classification.

According to the World Wildlife Fund (WWF), the Republic of Ghana has lost 90% of its tropical forests over the past 50 years and the remaining areas are threatened. The Ghanaian government has therefore decided to launch a national plan to combat deforestation and forest degradation. It was also a candidate to take part in the United Nations collaborative programme in 2010 to reduce emissions linked to deforestation and degradation in the developing nations (REDD).

In 2011, Airbus Defence and Space joined forces with the German International Cooperation Agency (GIZ) to support, during 18 months, this national forest monitoring project. Thanks to the TerraSAR-X StripMap data, it was possible to detect subtle changes in the vegetation over very large areas. Those newly acquired 3m resolution images were compared with archive data and were used to fine-tune the search for small-scale variations. Thanks to a specific amplitude change detection process it was possible to gain a good indication of selective deforestation, or of any other source of degradation. The radar signal from an intact forest remains relatively stable over a period of time, while the appearance of clearings or the logging of a given species of tree disrupts the backscatter signal.

The changes detected were then validated by field campaigns carried out by Ghanaian forestry commission teams. The project highlighted the numerous advantages and the effectiveness of the TerraSAR-X data for the surveillance of tropical forests, no matter how remote and inaccessible. It also helped support the deployment of long-term, efficient teams in the country for sustainable management of their forests.

Conclusion

Monitoring forests and providing decision support for forest managers is a crucial challenge for which satellite imaging provides a highly effective solution. Whether for the generation of forest inventories, for reporting in the frame of international conventions or activity monitoring, the pertinence of optical and radar satellite data has been clearly proven. The implementation of increasingly numerous national MRV systems as part of REDD+ is today inconceivable without images from satellites such as SPOT 6 & 7 and TerraSAR-X. Through these projects, but also other initiatives such as SPOT World Heritage or KIC Forest, Airbus Defence and Space contributes to a responsible and accountable management of our natural resources worldwide.

MONITORING FORESTS AND PROVIDING DECISION SUPPORT FOR FOREST MANAGERS IS A CRUCIAL CHALLENGE FOR WHICH SATELLITE IMAGING PROVIDES A HIGHLY EFFECTIVE SOLUTION

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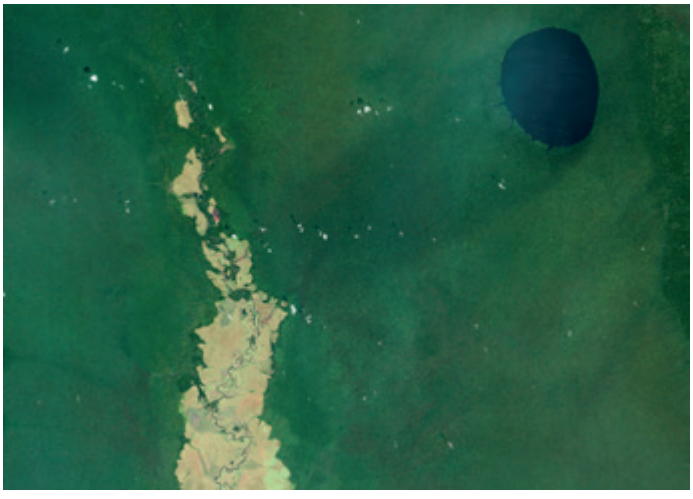

SPOT 6 image of the Democratic Republic of Congo © Airbus DS