# FORESTS 2020

A GLOBAL INITIATIVE TO USE SATELLITE-DERIVED DATA TO CONSERVE TROPICAL FORESTS IS ALREADY YIELDING EXCITING RESULTS. **RICHARD TIPPER** LOOKS AT THE BREAKTHROUGHS ACHIEVED IN THE FIRST 18 MONTHS

Tropical forests represent a vital resource, underpinning the livelihoods of billions of people, storing and cycling large amounts of carbon dioxide and water and hosting a large proportion of global biodiversity.

Recent research by climate experts has noted the essential role of tropical forest carbon sinks in preventing the world tipping into a 'hothouse state', where runaway global warming would take the Earth towards a much higher equilibrium temperature, submerging most coastal cities over the course of two centuries. It is therefore critical that we understand what is happening to forests and whether efforts to preserve them are succeeding.

Forests 2020 is the UK Space Agency's flagship project to improve the monitoring of tropical forests. It involves a £14.2 million UK investment, matched by resources from partner countries Brazil, Indonesia, Colombia, Mexico, Ghana and Kenya. Led by Ecometrica, it involves more than 20 international partner organisations.

During its first 18 months, Forests 2020 has achieved notable advances in terms of developing and testing new and improved ways of monitoring forest changes.

Early achievements include:

• Leicester University has developed and published automated forest-loss detection processing chains using Sentinel 2 (optical) data. They can be used to provide ongoing monitoring of areas subject to deforestation, so that responses can be mounted earlier. Ecometrica has developed a similar process using Sentinel 1 (radar) methods, which have the advantage of being able to penetrate cloud cover, which is frequently a problem for optical sensing in the tropics.

• Partners in Indonesia have automated several processing steps for Landsat data that were previously handled through laborious manual processes, accelerating the production of national forest maps and providing better information to national policy makers.

• A team at the University of Edinburgh has developed improved methods of assessing the risk of forest fires that can be delivered as a monthly 'data layer', adding to locally available information. Forest fires are one of the main factors in forest degradation, and improved fire management regimes, including controlled burning of dead wood and fire breaks, are likely to be an essential component of climate change resilience strategies.

• El Colegio de la Frontera Sur, a federal research agency in Mexico, has developed new methods for generating high-resolution thematic land-use maps using semi-automated processing and machine learning. These maps are already being used to better understand land-use change processes at the regional level.

Land-use map of the Cerrado biome in Brazil. This map was developed under the Terraclass Cerrado 2013 project, which aimed to map the land-use and vegetation cover of the Cerrado biome. The map was developed by the Brazilian Ministry of the Environment, Embrapa, INPE, Ibama, UFG and UFU

• Carbomap, a specialist start-up company working on signal processing from LiDAR surveys, is working with Ecometrica and partners in Ghana to apply drone-borne LiDAR to detect the presence of cocoa cultivation within forest reserves. This is a technique takes advantage of the capability of LiDAR sensors to gather data on the vegetation structure below the forest canopy.
• In Brazil, new mapping techniques are being used to monitor the sustainability of agriculture in the Cerrado biome, which contains the largest forest extent in south America outside the Amazon.

Across the project, Ecometrica has used a cloud-based mapping system to enable the participating research, government organisations and companies to organise, publish, compare and analyse the outputs of regional earth observation processes.

## A worldwide effort

The advantage of a large-scale, multi-partner project of this type is that we can invest efforts advancing a range of solutions that can be applied to various issues across multiple countries. We can encourage learning between countries, and there is even some healthy competition to push developments into working systems, adopted by national and sub-national agencies.

Working at scale delivers multiple benefits of cross-fertilisation and efficiency that would not be possible for a project focused on a specific area or a single technology.

With our ambitious goals, it is important to have effective processes to monitor progress and measure the impacts. About 10% of the project's budget is invested in monitoring, evaluation and learning. The tools used for this include:

Sun-drying cocoa beans after they have been fermented in Ghana. © Lewis Rattray

• Processes for monitoring the advancement of earth observation methods and techniques from the lab to implementation at regional and national levels. The development of technical innovations is tracked using a number of criteria, so that potential users are aware of how much additional R&D would be needed before a process can be adopted as operational.
• Statistical techniques to assess the effectiveness of different forest change detection methods in different regions and landscapes. These accuracy-assessment methods involve the collection of either ground data or very high-resolution optical data for specific areas where change is being monitored. These are used to identify the relative accuracies of different forest-change methods (for example, Sentinel 1 radar time series versus Sentinel 2 optical time series), comparing errors of omission and commission in different forest types.
• A method, known as the Hectares Indicator, which compares actual forest loss for forests in different risk categories relative to an agreed reference level, to estimate the success of the project in contributing to avoided deforestation.

The monitoring, evaluation and learning component of the Forests 2020 project is essential to the project's success. It is vital to understand early on what technologies work in different conditions and situations as it is widely recognised that no single earth observing technique can solve all forest monitoring problems.

Looking to the future, the partners hope to develop a business case for addressing the more challenging aspects of forest monitoring such as degradation. Degradation is the loss of forest quality – usually resulting in lower biomass, biodiversity and productivity on land that still remains classified as forest. The extent and severity of degradation in tropical forests is still uncertain but is generally reckoned to be at least as extensive as deforestation.

Forest resources are vital for the future of the planet. Given the scale of the monitoring challenge, satellite constellations, supplemented by UAV and in-situ measurements, are the only realistic approach to providing the information needed to underpin sustainable management and protection. With its internationally collaborative approach, Forests 2020 is laying the groundwork for this space-based solution to a major problem on Earth.

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Risk of deforestation in 2017 across Indonesia using Ecometrica's Hectares Indicator methodology. The map was developed by Daemeter for the first year of reporting for Forests 2020.