

STARION

Helping to Protect
Our Forests



It is estimated that 80% of the world's ancient forests have been destroyed or irreparably degraded, predominantly by human activity. The price for this destruction is escalating climate change, biodiversity loss, diminishing habitat for endemic species and community displacement. Klaus Scipal, the European Space Agency's (ESA's) Mission Manager for Biomass, and Starion's Michele Caccia, Biomass Payload Data Ground Segment Instrument Engineer, explain how the Biomass satellite will provide critical information to researchers and governments to help protect and expand our remaining forests.

The world's ancient forests are critical ecosystems for fighting climate change, supporting livelihoods and protecting biodiversity. Forests across the globe are being destroyed every day by industrial scale logging operations, many of which are illegal, as well as land grabbers chopping trees for palm oil manufacturing and clearing ground for illegal mining and livestock farming.

According to data from the University of Maryland on the World Resources Institute Global Forest Watch platform¹, in 2022 the Tropics lost an estimated 4.1 million hectares of primary rainforest: the equivalent of 11 football fields of forest every minute, and 10% more primary rainforest than was lost in 2021. All this forest loss produced 2.7 gigatonnes of carbon dioxide emissions, which is equivalent to India's annual fossil fuel emissions.

The destruction of these forests is pushing many indigenous species – such as the orangutan in Malaysia and the jaguar and tapir in the Amazon Basin – towards the brink of extinction, as well as devastating local communities. It is estimated that 1.6 billion people, including nearly 70 million indigenous people, rely on forest resources for their livelihoods. Deforestation, especially in the Tropics, impacts local temperatures and rainfall in ways that can compound the effects of global climate change, with consequences for human health and agricultural productivity.



Why do forests matter?

We know that humankind is facing a 'final warning' on the climate crisis, and that reducing deforestation is one of the most cost-effective and important landbased measures we can implement to mitigate climate change. Forests are both a source and a sink for carbon, removing carbon dioxide from the air when standing or regrowing and emitting it when cleared or degraded.

Tackling deforestation has wider benefits beyond ensuring biodiversity and fighting climate change. Forests harbour the most biodiversity of any ecosystem on Earth. The Kunming-Montreal Global Biodiversity Framework² adopted in 2022 at the United Nations (UN) Biodiversity Conference of the Parties, COP15, set out an ambitious pathway to reach the global vision of a world living in harmony with nature by 2050.

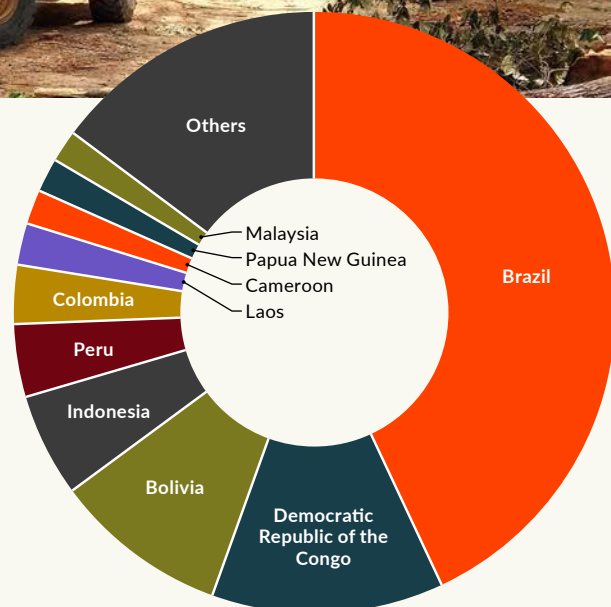


Separately, at the 2021 UN Climate Change Conference, COP26, which took place in Glasgow, UK, heads of 145 countries voted in the Glasgow Climate Pact to halt and reverse forest loss by 2030, in recognition of the important role of forests in combating climate change and biodiversity loss. However, the trend is still moving in the wrong direction, and the consistent decline in primary forest loss continues.

In addition to exacerbating global warming, scientists have warned that deforestation heightens the risk of global pandemics. It is suggested that deforestation and forest degradation may have played a critical role in triggering the COVID-19 pandemic. According to a study in Nature³, the populations of animals hosting zoonotic diseases, like the coronavirus, are up to 2.5 times higher in degraded places.

How space is helping

Space is playing a major role in helping to identify and tackle deforestation. Satellites have been used for decades to monitor the loss of ancient forests using



Top countries for primary forest loss by area in 2022.

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space-based technologies, helping inform and provide researchers, governments, farmers and industry with the information they need to act more effectively in tackling this crisis.

A UK Government survey found that monitoring illegal logging with satellites could be up to 12 times more cost effective than traditional measures⁴. Satellite technology

offers near real-time monitoring of largescale illegal deforestation operations. This allows for the kind of rapid response capability that the fight against global deforestation desperately needs, and enables pressure and policy to be applied in a targeted and more effective and efficient manner.

Since 2017, satellite technology has been used to track and halt cases of deforestation in Malaysia, in a way that is being used as a blueprint for easing deforestation in the Amazon Basin. Local efforts in Malaysia have helped mitigate deforestation for palm oil, which has plummeted from around 4,000 square kilometres per year to less than 1,000 square kilometres.

More recently, the Malaysian Government has been actively supporting efforts to tackle deforestation through Malaysia Sustainable Palm Oil (MSPO) – the world's first national mandatory sustainable certification scheme, which now encompasses 87% of the national palm oil industry. In December 2020, the Malaysian Government declared its aim was to achieve 100% traceability at farm level by publishing palm oil concession satellite maps.

The power of Copernicus

Many satellites have been launched by ESA, NASA, national agencies and commercial operators to look at different aspects of our Earth. For example, the European Copernicus programme includes Sentinel-1: a pair of satellites that each carry a synthetic aperture radar (SAR) instrument to provide all-weather, dayand- night imagery of the Earth's surface, thus providing historical information on forest locations. Sentinel-2 also consists of two identical satellites that deliver high-resolution imagery with 13 spectral bands to give an overview of land and vegetation variants.

These satellites have provided data to show how forests have diminished over time. However, none of their instruments can penetrate the forest canopies to give us a true understanding of the health and biomass of the tropical forests.

Forest destruction accounts for around 20% of global carbon emissions – more than the world's entire transport sector.



Introducing Biomass

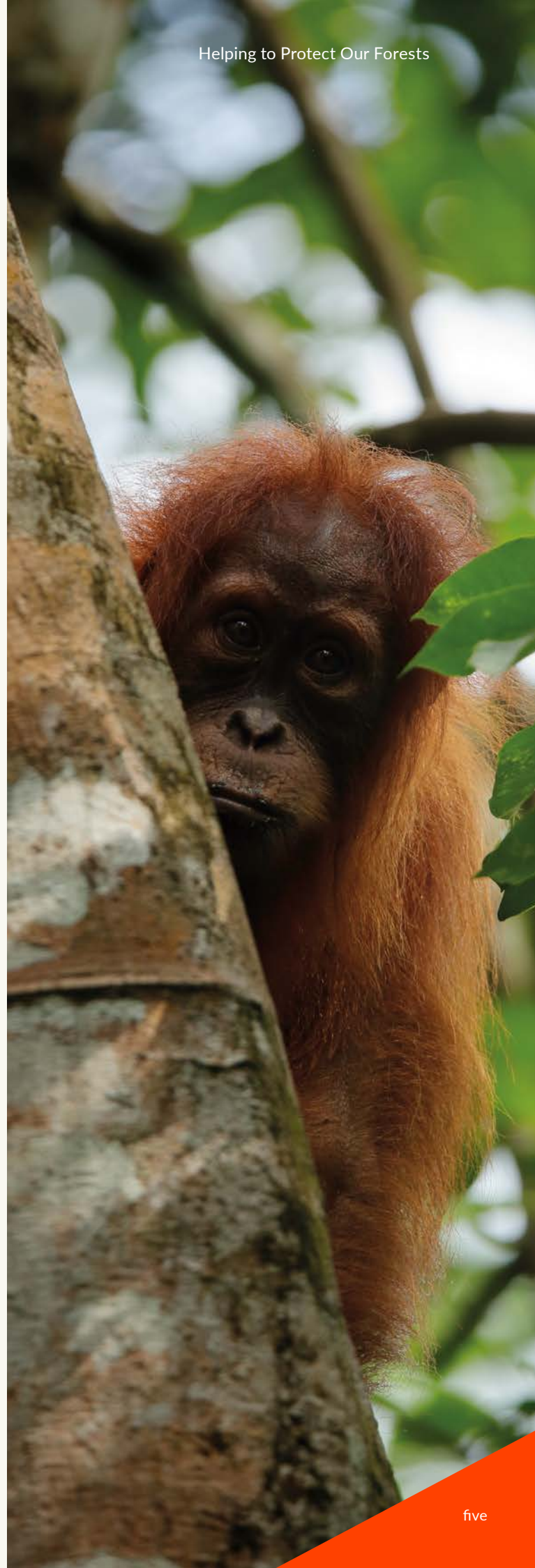
As part of the Earth Explorer programme, ESA is launching an innovative new satellite called Biomass that will provide crucial information about the state of forests and further our knowledge of the role forests play in the carbon cycle.

Michele Caccia, Biomass Payload Data Ground Segment Instrument Engineer at Starion, explains: "Biomass is a unique, groundbreaking satellite that will provide important information regarding the overall health of our tropical forests.

"Existing Copernicus missions, such as Sentinel-1, which uses advanced radar instruments to supply imagery of the Earth, and Sentinel-2, where the two satellites each carry an innovative, wide swath, high resolution multispectral imager, are already helping us identify where the deforestation and degradation has taken place since they were launched in 2014 and 2015 respectively.

"However, Biomass is the first satellite to use P-band radar in space. By using novel measuring techniques, it can look into the canopy and see the structure of trees with their trunks and branches, and the forest terrain. This is a real game-changer. Information from the Biomass mission will lead to a better understanding of the state of Earth's forests and how they are changing over time, and advance our knowledge of the carbon cycle."

ESA's Mission Manager for Biomass and SMOS, Klaus Scipal, advises: "The Biomass satellite is a scientific mission looking at the Earth in a way that no one else has looked at it before. We want to answer new science questions and Biomass will contribute to what we know least and fill the biggest knowledge gaps. By taking observations and measuring forest structure and how it changes over time, Biomass will help us to better understand the role forests play in the carbon cycle, especially of tropical forests, which are the most diverse and important ones in this respect in the world. "One of the challenges today is we do not know a lot about the biomass of forest ecosystems. Forests are very effective in fighting climate change; they are the most effective natural way to extract or absorb carbon from the atmosphere. But we do not exactly know how this works and especially how this works with the changing climate.



“Biomass is not designed to measure plant health as such. Observations from Biomass will lead to better insight into the rate of habitat loss and the impact this may be having on biodiversity in the forest environment. In addition, the mission will offer the opportunity to map subsurface geology in deserts, the ice structure of ice sheets and the topography of forest floors.”

Monitoring the carbon cycle

When explaining the importance of measuring carbon, Klaus Scipal says: “Forests play a very important role

in climate change and they do this in two ways. Fifty percent of a tree is carbon; if you cut down the tree or if it burns, all that carbon is moved into the atmosphere and contributes to global warming. At the same time, trees soak up a tremendous amount of carbon from the atmosphere. They are so effective that they are one of the main mitigation aspects in the fight against climate change.”

Forests are estimated to absorb around 8 gigatonnes of atmospheric carbon dioxide every year, playing a crucial role in the carbon cycle and climate system. However, forest degradation is causing much of this stored carbon to be released back into the atmosphere, exacerbating climate change.

Klaus Scipal continues: “Biomass will help researchers quantify the global carbon cycle, which is essential to understanding the rapid changes that forests are undergoing and the subsequent implications for our climate. Measurements of forest biomass can be used as a proxy for stored carbon – but this is currently poorly quantified for the majority of forests around the world. Data from the Biomass mission will reduce major uncertainties in calculations of carbon stocks and fluxes on land, including carbon fluxes associated with land use change, forest degradation and forest regrowth.”

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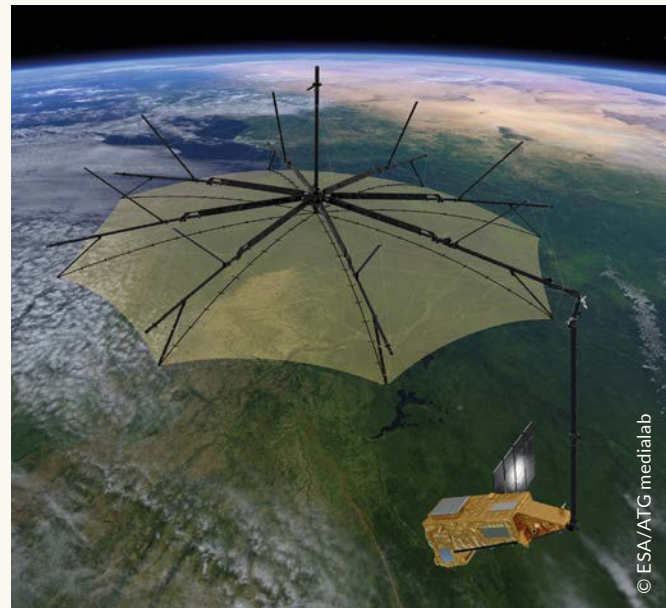
“Interestingly, new research based on data from ESA’s Soil Moisture and Ocean Salinity (SMOS) mission, which was launched 14 years ago, suggests that young trees in boreal forests are champions at carbon capture, which is a surprise. To better understand the complexities of our climate system and predict the effects of change, scientists need to be able to account for carbon storage. However, their efforts have been foiled by uncertainty when it comes to the carbon contained in vegetation on land, making it difficult to estimate the global carbon balance. When Biomass launches in 2025, it will help with this.

“A paper published recently in the journal Nature Geosciences describes how ESA-funded scientists have directly observed how terrestrial carbon stocks have changed at regional and global scales using observations from ESA’s SMOS satellite. This is very exciting and Biomass will definitely help to provide further evidence.”

Data usage

The main users for the information gained from Biomass will be the scientific community, especially those studying forest ecology and the carbon cycle. The data will also contribute to societal needs. Governments have agreed to take action against climate change and deforestation and give financial incentives to developing countries. Biomass will provide essential data to see if these actions are effective.


Data gained from Biomass, and from all ESA, NASA and most Earth observation satellites, is open source and therefore accessible by anyone, enabling every country to access it. Reliable knowledge of forest biomass will underpin the implementation of the UN Reducing Emissions from Deforestation and Forest Degradation (REDD+) initiative – an international effort to reduce carbon emissions from deforestation and land degradation in developing countries.



The novel P-band SAR instrument on ESA’s Biomass satellite will deliver new information on forest height and biomass.

Coming together

In 2021, there was criticism of the COP26 pledge by world leaders on an overarching goal of ceasing the reversal of forest loss and land degradation by 2030 – the COP26 Declaration on Forests and Land Use – due to its lack of detail on enforcement and implementation plans. While there is some evidence of progress, deforestation globally is still happening at an alarming rate and it is unclear how some countries plan to implement this declaration.

Many are calling for governments to regulate and legislate with a greater sense of urgency because tackling deforestation is no longer an option, but a necessity – not just for the continued health of the planet or the global economy, but for survival of everyone, everywhere. Evidence provided by space data and satellites such as Biomass will be central to such efforts across the globe. 

Sources

1. wri.org/initiatives/global-forest-watch
2. cbd.int/gbf/
3. Nature; Zoonotic host diversity increases in human-dominated ecosystems; August 2020
4. UK Space Agency; International Partnership Programme: A Summary of the IPP Midline Evaluation; August 2020



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