WorldForest
Brochure

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WorldForest

esa

Background

Is your country gaining or losing its forests?

It is crucial for countries worldwide to understand whether their forests are expanding, declining or degrading. Forests are essential ecosystems that support biodiversity, climate regulation, livelihoods and economic activity. However, forests are under increasing pressure due to changes in land use, growing demand for food and resources, and the escalating impact of climate change. Although global deforestation rates have slowed, forest loss and degradation persist in many regions. Consequently, international and European policies increasingly require reliable and transparent forest monitoring to support climate action, biodiversity protection and sustainable management.

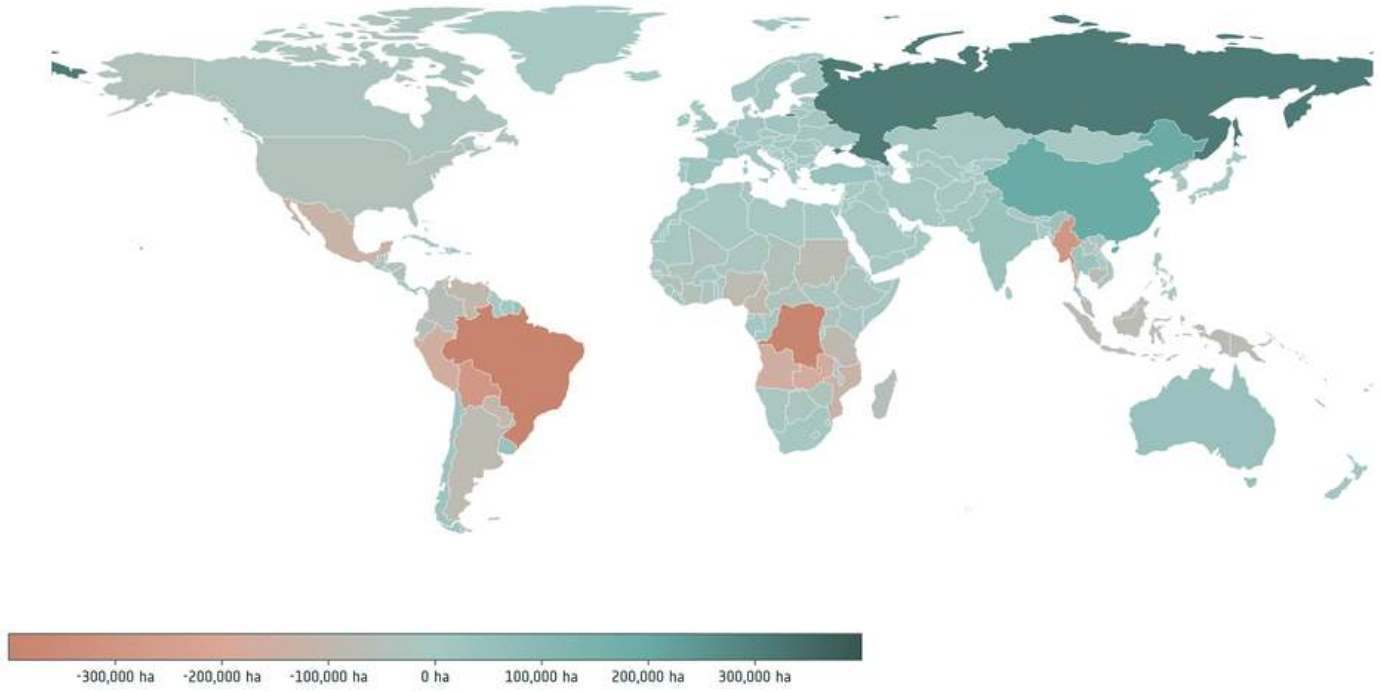


Figure 1: Annual Change in Forest Area 2025 [1]

Do you play a role in how forests are managed and protected?

Forest management and protection involve a wide range of actors operating at different levels:

- **Political institutions** shape and govern forestry, regulations, e.g. the European Commission and UN bodies.
- **Environmental organisations** monitor forest management efforts across regions e.g., WWF.
- **Government agencies** report national forest inventories to international frameworks e.g., forestry ministries.
- **Private companies** invest in forest protection, afforestation, reforestation and carbon initiatives.
- **Local communities** are increasingly participating in community-based projects.

All these stakeholders need reliable forest information. In the WorldForest project, they act as Early Adopters, supporting the co-design and practical application of innovative monitoring solutions.

[1] Food and Agriculture Organization of the United Nations (FAO), 2025. Adapted from OurWorldInData.org/forests-and-deforestation (CC BY). Recoloured for the ESA WorldForest project.

WorldForest

What does WorldForest do?

WorldForest is an ESA-funded initiative, part of ESA's World Series, that develops and demonstrates Earth Observation–based methodologies to support adaptive and sustainable forest management. It builds on existing research and EO data to address information gaps linked to policy requirements and operational needs. The project provides actionable tools and indicators on key forest parameters, such as forest types and structure, disturbance, biomass, fires and vulnerability, aligned with European regulations and global frameworks such as the Paris Agreement and SDG 15. By working directly with selected Early Adopters, WorldForest ensures that these solutions respond to real challenges and can be integrated into decision-making, reporting and forest management practices.

Who are the Consortium members?

WorldForest brings together a consortium of leading European organisations with deep expertise in Earth Observation and forest monitoring. The consortium covers the full technical and thematic range needed to develop innovative EO tools for sustainable forest management.

GAFAG
an e-GEOS (ASI / Telespazio) Company

GFZ
Helmholtz Centre for Geosciences

NMBU
Norwegian University of Life Sciences

vito

DHI

Caribou

What is the World Series?

The World Series is a portfolio of ESA EO4Society projects addressing global environmental challenges through user-driven Earth Observation solutions. These initiatives focus on translating EO data into actionable information for policy and operational decision-making, with real-world demonstrations and international relevance.

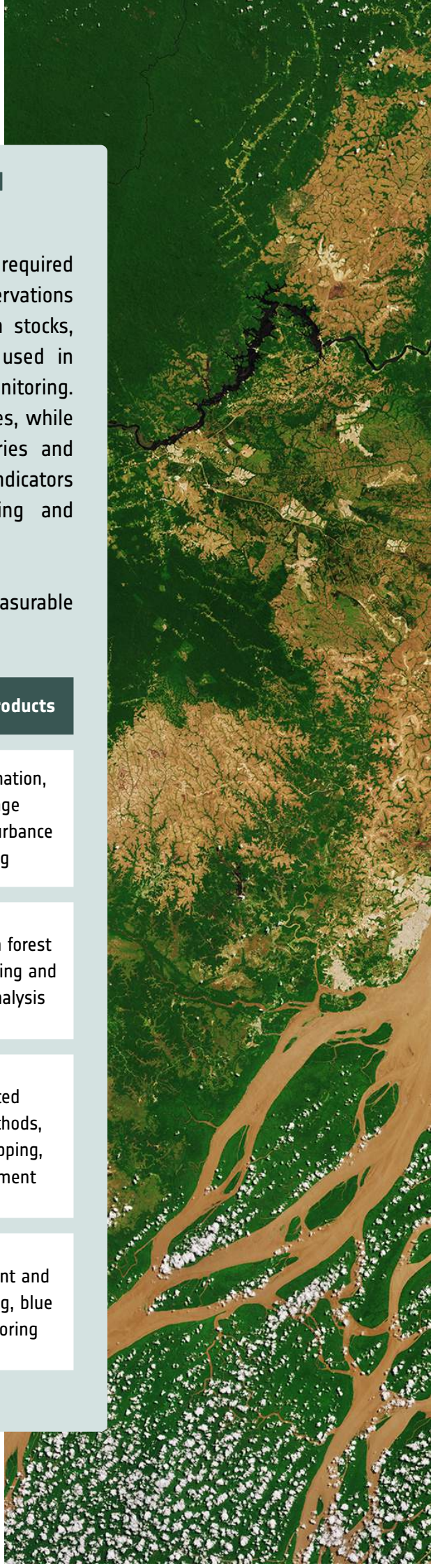
Earth Observation

How does Earth Observation support forest policy and compliance?

Earth Observation provides the measurable data increasingly required under international and European forest policies. Satellite observations deliver consistent information on forest extent, biomass, carbon stocks, disturbance, regrowth and mangrove change – key variables used in climate reporting, biodiversity assessments and deforestation monitoring. Frequent revisit times enable early detection of forest loss and fires, while standardised data products ensure comparability across countries and reporting cycles. As policy commitments translate into specific indicators and compliance obligations, EO supports monitoring, reporting and verification systems with transparent and repeatable evidence.

The table below highlights how policy goals translate into measurable variables monitored via EO technologies

Policy Framework	Policy Requirements	Relevant EO products
Paris Agreement / REDD+	Emissions from deforestation and degradation, FRELs, carbon accounting	Biomass estimation, forest change detection, disturbance monitoring
EU Deforestation Regulation (EUDR)	Verification of deforestation-free commodities and traceability	High-resolution forest change monitoring and geolocation analysis
EU Forest Strategy / Climate Law / SDG 15	Forest extent, structure, biomass and sustainable management indicators	EO-supported inventory methods, structural mapping, stock assessment
Ramsar Convention / Blue Carbon initiatives	Mangrove conservation, coastal resilience and carbon accounting	Mangrove extent and change mapping, blue carbon monitoring



Use Cases

Forest Inventories

What is the challenge?

Policymakers require accurate and up-to-date data on forest extent, structure, biomass and carbon stocks to support greenhouse gas reporting and sustainable forest management. Traditional field-based inventories are resource-intensive, spatially limited and updated infrequently, making it difficult to capture changes consistently across large or remote areas and to ensure comparability over time.

How does EO help?

Satellite data (e.g. radar and optical imagery) provide spatially explicit information on forest area, types, canopy structure, biomass and change dynamics. By integrating EO data with national inventory plots, model-based approaches generate wall-to-wall maps of forest variables such as growing stock, carbon and tree cover density. These datasets support improved stratification, more efficient sampling, and consistent updates, enabling countries to produce harmonised and transparent information for reporting and forest management planning.

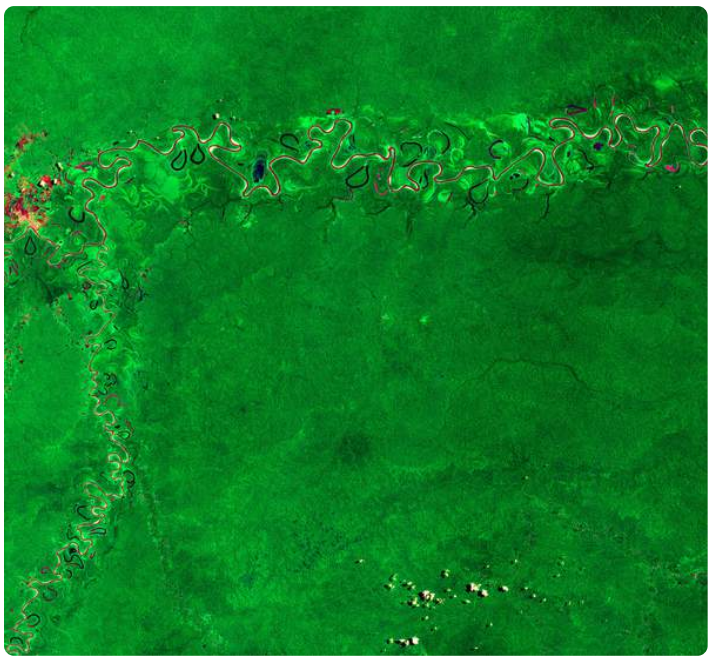


Figure 2: Vegetation Coverage in Amazon Forest [2]

WorldForest in practice - Perù

In Peru, WorldForest supports National Forestry and Wildlife Service of Peru in enhancing national forest inventories by integrating field data with satellite-derived biomass products. This enables consistent, country-wide estimation of biomass and carbon stocks, including in remote areas, while improving data completeness and comparability. The approach strengthens national reporting under REDD+, FRELs and climate commitments, and supports more informed forest management and resource assessment.

[2] Contains modified Copernicus Sentinel data (2019), processed by ESA. https://www.esa.int/ESA_Multimedia/Images/2021/03/Amazon_rainforest

Use Cases

Monitoring Interventions and GHG Emissions

What is the challenge?

Countries shall quantify emissions from deforestation and forest degradation to meet climate reporting requirements and establish Forest Reference Emission Levels (FRELs). This requires consistent time series of forest area change, biomass and carbon estimates, as well as transparent methodologies aligned with international guidance. Data gaps and methodological inconsistencies can undermine the reliability of emission estimates.

How does EO help?

Satellite data provide continuous observations of forest cover, disturbance and recovery, enabling the development of historical baselines and consistent monitoring over time. EO-derived products such as land cover maps, biomass layers and tree cover density support the estimation of activity data and emission factors. Combined with national data, these datasets enable more accurate carbon accounting, improve consistency across reporting cycles and strengthen monitoring, reporting and verification systems.

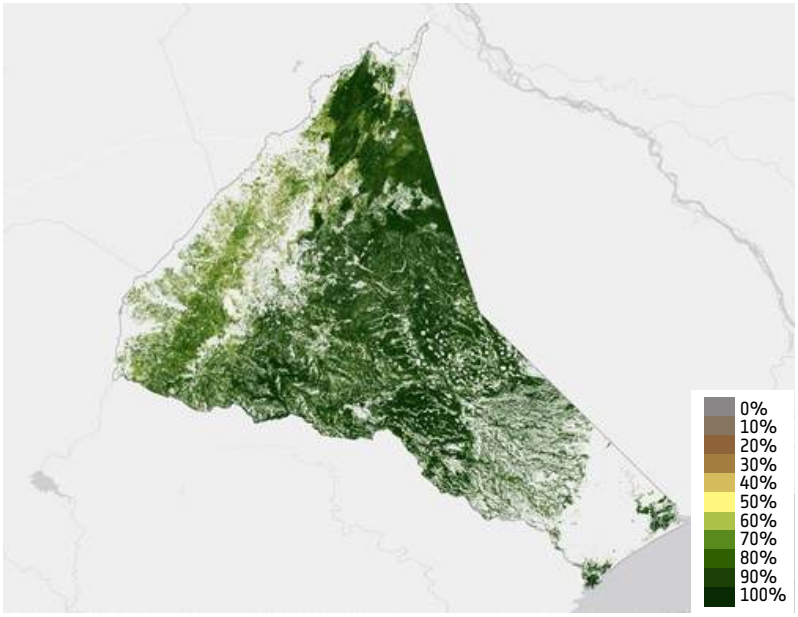


Figure 3: Tree Cover Density Product © GAF AG

WorldForest in practice - Mozambique

In Mozambique, WorldForest collaborates with the National Sustainable Development Fund to strengthen forest monitoring and carbon reporting systems. By combining national inventory data with EO-based biomass estimates, the project enables multi-scale carbon assessment and more accurate emissions reporting. It also improves the detection of forest degradation, including charcoal-related disturbances, supporting REDD+ implementation and national climate reporting.

Use Cases

Deforestation-free supply chains

What is the challenge?

Regulations require companies and authorities to demonstrate that commodities are not associated with recent deforestation. This involves verifying land-use history at plot level, ensuring traceability across supply chains, and monitoring compliance across large and often remote production areas. Limited access to reliable and comparable data makes verification complex and resource-intensive.

How does EO help?

Satellite data provide independent, frequent and high-resolution observations of forest cover and land-use change. EO enables the generation of baseline forest maps, detection of deforestation events and identification of degradation patterns over time. By combining geolocation data with time series analysis, EO supports plot-level verification, risk screening and monitoring of production areas. This enables scalable and transparent compliance assessments aligned with regulatory requirements.

Figure 4: Deforestation in the Amazon Rainforest [3]

WorldForest in practice - Malawi

In Malawi, WorldForest works with Forestry Research Institute of Malawi to improve monitoring of forest disturbance and recovery across northern forest landscapes. Using radar-based EO data, the project enhances detection of tree cover loss and supports the development of consistent forest change datasets. This contributes to national reporting under REDD+, NDCs and restoration initiatives, while strengthening monitoring capacity and data quality.

[3] ESA, The Amazon forest, 2021, https://www.esa.int/ESA_Multimedia/Images/2021/11/The_Amazon_rainforest

Use Cases

Monitoring of Ecologically Vulnerable Areas

What is the challenge?

Mangroves are essential for carbon storage, coastal protection and biodiversity, but are increasingly impacted by land-use change, aquaculture and urban expansion. Policymakers require accurate and timely information to quantify loss, assess ecosystem condition and support conservation and restoration efforts, including blue carbon accounting.

How does EO help?

Satellite data (e.g. Sentinel-1 radar and Sentinel-2 optical imagery) enable consistent mapping of mangrove extent, structure and change at high spatial resolution. Time series analysis supports detection of degradation, land conversion and regrowth, while classification approaches allow differentiation of mangrove types and condition. These datasets support monitoring of coastal ecosystems, carbon stock estimation and informed decision-making for conservation and sustainable management.

Figure 5: Satellite Image of Coastal Mangrove Area © Copernicus Sentinel-2 Satellite 2025

WorldForest in practice - Malaysia

InIn Malaysia, WorldForest partners with Reef Check Malaysia to improve monitoring of coastal ecosystems in Johor. Satellite data are used to generate high-resolution maps of mangrove extent, condition and change, enabling time-series analysis of ecosystem dynamics. This supports conservation planning, blue carbon assessments and evidence-based coastal management aligned with environmental and climate priorities.

Explore ESA WorldForest at https://esa-worldforest.org/