OBSERVER: Monitoring the World's Forests with Copernicus Land

COPERNICUS LAND MONITORING SERVICE
*FOREST PRODUCTS*
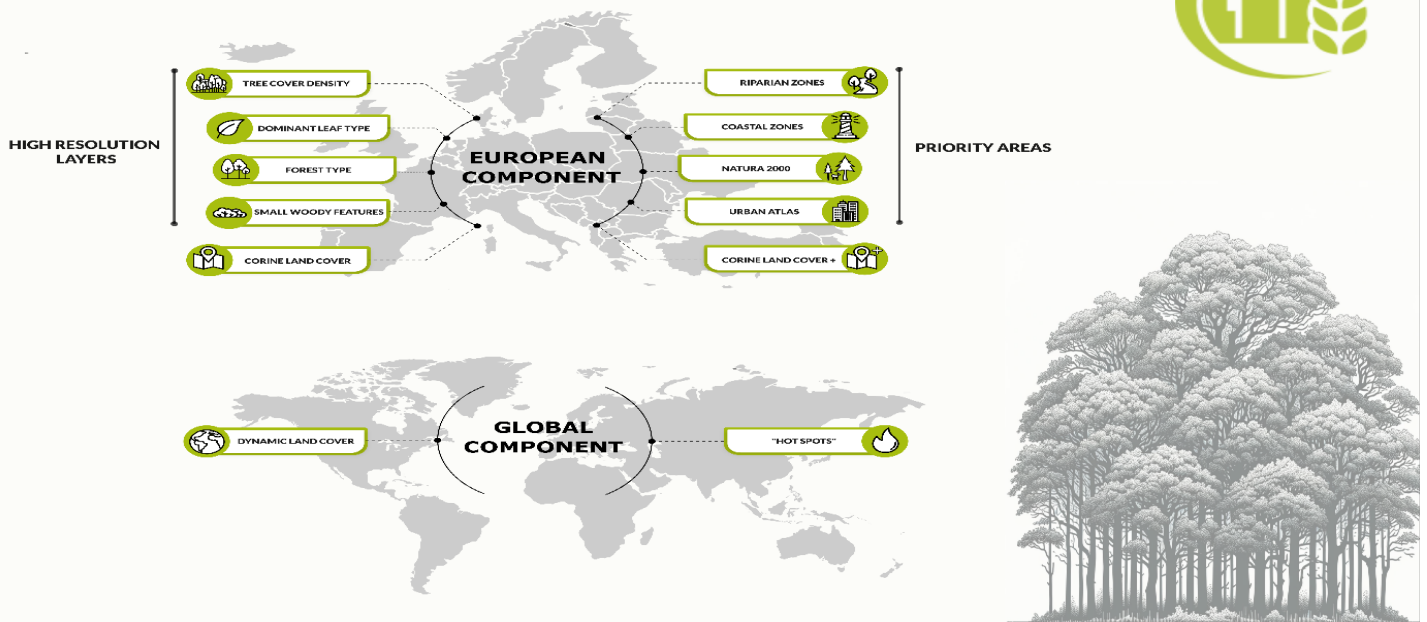
The Siberian Taiga, a vast expanse of old-growth forest in the northern reaches of Asia, stands as a beacon of biodiversity and ecological resilience amidst the global deforestation crisis. While the Taiga remains largely untouched, it serves as a stark contrast to the alarming rate of forest loss experienced worldwide, where the last century alone has seen more trees lost than in the previous 9,000 years combined. This massive decline in global forests underscores the urgent need for effective monitoring and management strategies to preserve our planet's remaining forests. In this context, the Copernicus Land Monitoring Service (CLMS) provides high-quality, open-access datasets that are essential for policymaking and conservation efforts, supporting the EU's ambitious strategies to halt deforestation and promote forest protection. In this week's Observer, we'll delve into the innovative tools and data provided by CLMS, showcasing how it's improving our ability to monitor and manage forests globally, and discussing the implications for future forest-related policies and strategies.

In the northern reaches of Asia lies the world's largest unbroken old growth forest. It is known as the Siberian Taiga, and it extends from the Ural Mountains in the west to the Pacific Ocean in the East, covering an area of just over 12 million square kilometres. Owing to the harsh arctic conditions and the sparsity of human settlements that characterise this region, the Siberian Taiga has remained untouched by human activity, though it has been affected by climate change-induced mega-wildfires.

Sadly, most of the other forests around the world are under threat. In just the last 100 years, the world has lost as many trees as the previous 9,000 years combined. To put in perspective just how much forest has been lost in the last century, it is more than the entire South American continent. Most of this deforestation has been caused by the drive to make room for agricultural fields, the vast majority of which are dedicated to animal grazing or growing crops that become animal feed.

This massive decline in global forests has numerous negative consequences. Forests are, for example, home to 80% of the terrestrial biodiversity on Earth, providing habitats for literally millions of unique species of plants, animals, fungi, and microorganisms. In fact, forest biodiversity is so high that famed British entomologist E.O. Wilson wrote in his book *The Diversity of Life* about an insect collecting trip he took to the Amazon rainforest in which he concluded that there are some beetle

species whose entire population exists on and in single, individual trees.
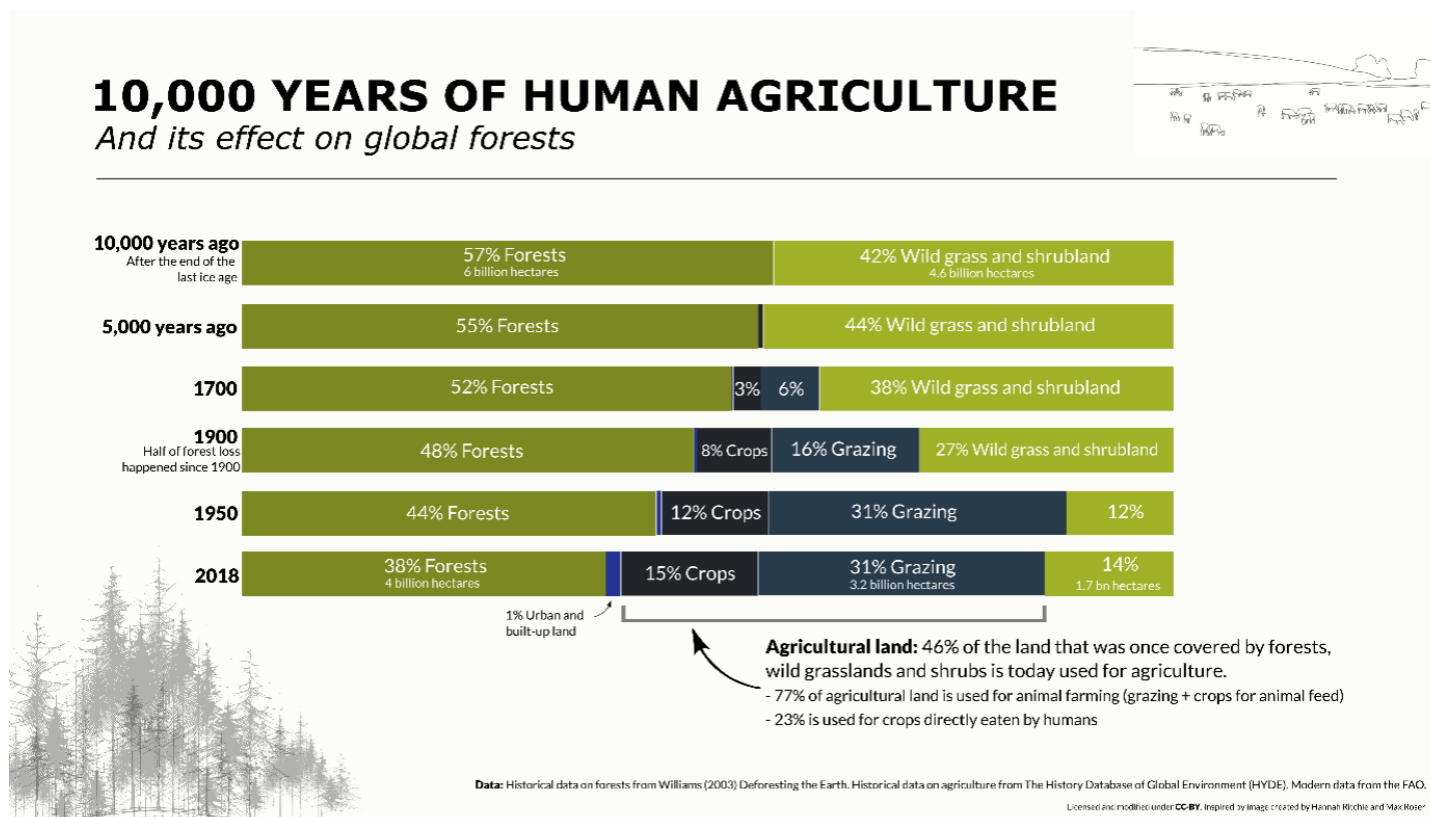
Summary of the historical and current state of global forests, highlighting the outsized impact of animal agriculture. Credit: [Our World in Data, based on historical data from Williams (2003) Deforesting the Earth. Historical data on agriculture from The History Database of the Global Environment (HYDE), Modern data from the FAO. Licensed under CC BY 4.0.](#)

Protecting Forests with Policy

Forests also provide a whole host of environmental services. They play a key role in the water cycle by absorbing rainfall and releasing water vapour into the atmosphere through a process known as transpiration. This process is vital for maintaining both local and global climate stability. Forests also protect soil from erosion by rain and wind and help maintain soil fertility through nutrient cycling. Air quality is also improved by forests. Not only do they filter pollutants and dust from the air, but they also produce around 20% of the world's oxygen.

The European Union (EU) has taken significant steps to address the issue of deforestation and forest degradation, with [the Deforestation Regulation (EUDR)](#) and [the proposed Forest Monitoring Framework](#) being two of the most notable. The EUDR, introduced to curb the EU market's impact on global deforestation and forest degradation, mandates companies trading in commodities such as cattle, cocoa, coffee, oil palm, rubber, soya, and wood to conduct extensive due diligence on their value chain. This ensures that the goods do not result from recent deforestation, forest degradation, or breaches of local environmental and social laws, aligning with the EU's broader strategy to reduce its consumption impact on land and promote the consumption of products from deforestation-free supply chains.

The European Commission proposed a new Forest Monitoring Framework in November 2023. This

framework aims to establish a comprehensive system for monitoring the status and trends of forests across the EU, focusing on specific indicators related to climate change, biodiversity, health, invasive alien species, and forest management. The proposal is part of the EU's efforts to ensure a coordinated EU forest monitoring system, addressing the fragmented and inconsistent information on EU forests, their social and economic value, and the pressures they face. The framework is designed to enable the collection and sharing of timely, reliable, and comparable forest data, building on existing national systems and encouraging Member States to develop integrated long-term forest plans or adapt their existing plans.

In addition, EU has also passed a number of other ambitious and binding policies—such as the [Biodiversity Strategy](#), the [Forest Strategy](#), the [LULUCF Regulation](#), and the [EU Timber Regulation](#) —which aim to halt deforestation and promote protection and restoration of European forests.

CLMS: A Tool for Forest Monitoring

The [Copernicus Land Monitoring Service](#) (CLMS) offers one of the world's most extensive portfolios of high quality, open-access land cover and land use datasets. The service is jointly operated by the [European Environment Agency (EEA)](#), which manages the pan-European component, and the [European Commission's Joint Research Centre (DG JRC)](#), which manages the global component. The synergy between European and global efforts, supported by CLMS, allows for a comprehensive view of forest health and trends at a global level, with a special emphasis on high spatial and temporal resolution for Europe.

Global Component Products

CLMS offers two primary products that can be used to monitor forest cover at the global scale. The first is the 100m [Dynamic Land Cover](#) product, which provides annually updated global land cover maps at 100m spatial resolution. It uses state-of-the-art data analysis techniques to ensure temporal consistency and accuracy, with the latest version achieving 80% accuracy on each continent. This makes this land cover dataset of more than 20 classes a flexible tool for a wide range of applications, including forest monitoring. It is important to note that from 2025 onward, the existing 100m resolution product of the Dynamic Land Cover will be superseded with the global 10m land cover mapping as part of the new [Copernicus Global Land Cover and Tropical Forest Mapping and Monitoring contract](#). This contract will also introduce a specific tropical forest monitoring product at 10m resolution starting with reference year 2020. The tropical forest monitoring product will include information on percentage of tree cover at 10m spatial resolution and annual changes.

The second product capable of monitoring forest cover globally is the [Reference Land Cover and Land Cover Change in selected Hot Spots](#) product. It supports efforts to preserve selected global "hot spots", so named for their rich biodiversity, key landscape area, protected site, as well as cultural significance. There are land cover and land cover change datasets designed to offer high-resolution insights into these global hotspots, many of which are forests, with a specific focus on the African continent.

European Component Products

At the European scale, CLMS offers 10 products that contain detailed information on forests and tree cover. The [Tree Cover Density](#) product provides information on the percentage of tree cover in a given area. Like the other high-resolution layers, these data are updated annually and are available across the [EEA38 area](#) at 10m spatial resolution. [Dominant Leaf Type](#) is produced in parallel with

Tree Cover Density and allows users to identify and track changes in the dominant leaf type of the entire European tree cover. The [Forest Type](#) product is derived from the Tree Cover Density and Dominant Leaf Type products. Together, these represent some of the best publicly available tree cover monitoring data in the world. [Small Woody Features](#) rounds out the set of high-resolution layers by providing information on linear and patchy tree cover such as one might find in a fragmented agricultural landscape.

[CORINE Land Cover](#) (CLC) offers a pan-European land cover and land use inventory with 44 thematic classes, ranging from broad forested areas to individual vineyards, whereas [CLC+ BackBone](#) serves to complement and extend this product by providing higher resolution and detail to certain land cover classes of this flagship product.

The priority area products are designed to provide a higher level of detail for specific areas of interest prone to environmental change. The [Riparian Zones](#) product is focused on the buffer areas between land and waterways, which are characterised by their unique combination of aquatic and terrestrial habitats that are critical for a number of plant and animal species. The [Natura 2000](#) product offers a comprehensive overview of select Natura 2000 sites protected under the European Union's Habitats Directive. The [Coastal Zones](#) product covers the entirety of European coastal areas to an inland depth of 10 kilometres and gives users access to detailed land cover/land use maps of these regions. Finally, the [Urban Atlas](#) provides detailed land cover/land use maps for 788 Functional Urban Areas across Europe, including urban forests.
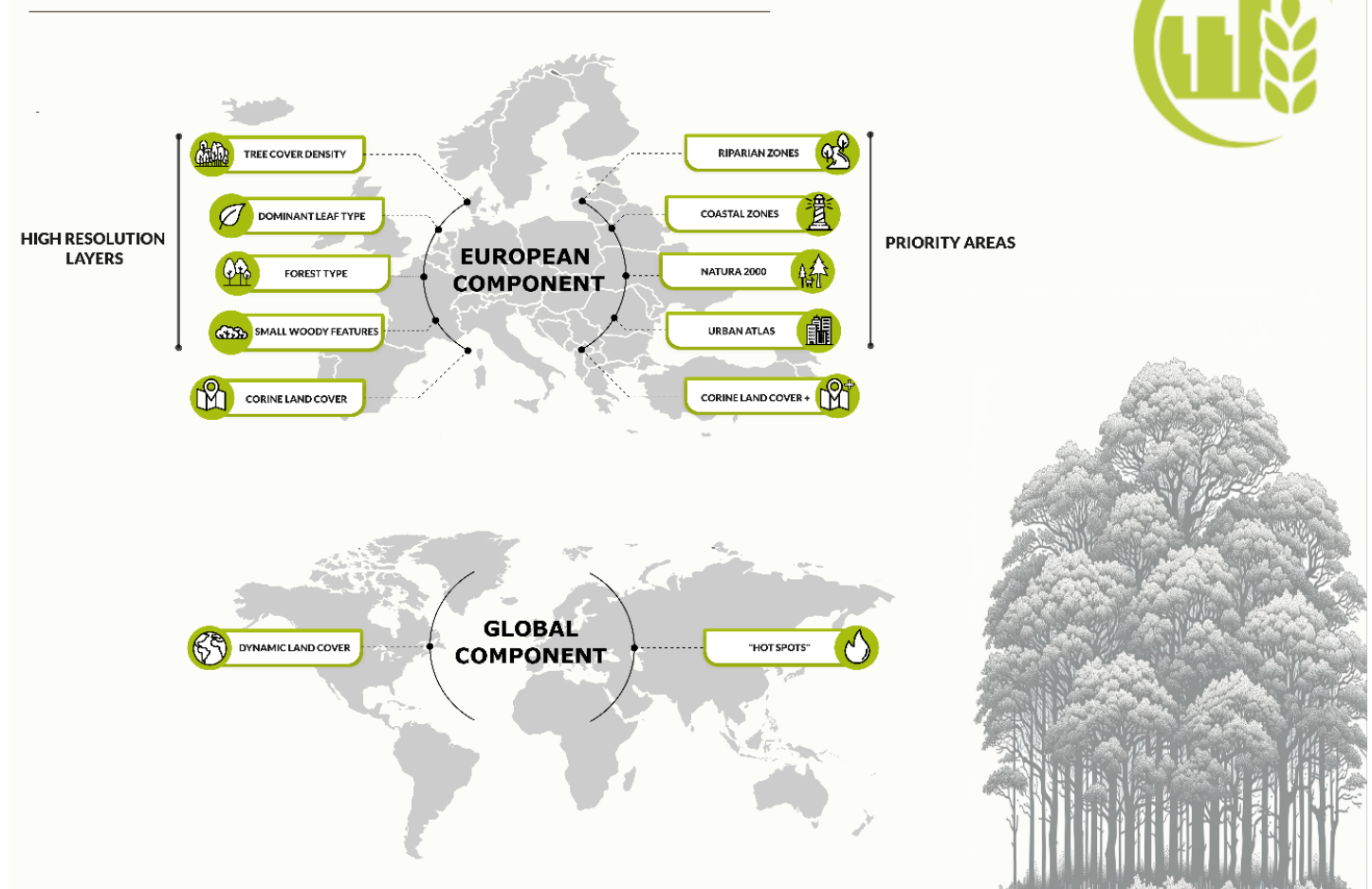
Overview of all CLMS products which feature a land class related to forests. Credit: European Union,

Forest Products in Action

On its website, the European Environment Agency provides a section dedicated to [indicators](#), which are designed to support all phases of environmental policy making from the creation of policy frameworks to target setting. The 2018 high resolution Forest Type status layer, in combination with the 2018 Small Woody Features layer, was used as the basis for the creation of a [Forest Connectivity](#) indicator which represents the level of connectivity between forests in each Member State and Collaborating Sates of EEA. The level of forest connectivity is strongly correlated to the level of biodiversity, with more fragmented and disconnected forests showing lower species diversity compared to well-connected forests. Work such as this helps provide metrics for key forest-related policies such as the EU Forest Strategy for 2030 and the EU Biodiversity Strategy for 2030, which include a pledge to promote forest connectivity by planting at least three billion additional trees by 2030.

[In 2020](#) the Castilla-La Mancha Forest Fires Service (INFOCAM) took advantage of several CLMS [global coverage products](#) to evaluate the susceptibility of Spanish forests to fire risk. As climate change produces more frequent and intense droughts, and a reduction in forest management activities results in a higher fuel load in Spanish forests, fire risk in Spain is higher than ever. As a result, a detailed understanding of vegetation conditions is absolutely essential for fire management services. With publicly available CLMS datasets, INFOCAM is able to produce a set of materials such as vegetation stress risk assessments, fire intensity forecasts, and fire season preparedness estimates, all of which contribute to better forest fire management and increased safety for civilians and firefighting personnel.

The utility of CLMS data in the context of current and future forest-related policies such as the EU Deforestation Regulation, the EU Biodiversity Strategy for 2030, the EU Forest Strategy for 2030, and the proposed Forest Monitoring Law highlights the service's pivotal role in shaping a sustainable future. As we strive to balance human needs with environmental preservation, the importance of technology and policy in driving sustainable forest management and conservation is more important than ever before.

As we move forward, the Copernicus Land Monitoring Service (CLMS) is poised for significant progress in technology and data products, promising to further enhance the capabilities for monitoring and managing forests globally. Innovations in satellite imaging, data processing algorithms, and artificial intelligence are expected to improve the accuracy, resolution, and timeliness of land cover and forest health data. Such progress will enable more precise tracking of deforestation, forest degradation, and reforestation efforts, offering invaluable insights for conservation strategies and policymaking.