

Eoclima for forest condition assessment

We present **Eoclima**, GMV solution to support climate action through climate-related geo-information products, derived from satellite-based Earth Observation data. We will show how **Eoclima** contributes to **assess forest condition** and to support climate risk management and adaptation solutions.

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**ACCELERATE
CLIMATE
ACTION
FOR ALL SDGs**



CHALLENGES

Forest ecosystems are under increasing pressure from climate change and a growing anthropogenic action. Deforestation and forest degradation are responsible for around 15% of all greenhouse gas emissions. These greenhouse gas emissions contribute to rising temperatures, changes in patterns of weather and water, and an increased frequency of extreme weather events. We need to protect and enhance forests, both in quality and quantity, to reach climate neutrality and a healthy environment.

Forest condition assessment over large areas is a challenging task that requires reliable data on which to ground sound decisions and develop appropriate policies. However, poor temporal availability, low accuracy and inadequate scale resolution of forestry data is an issue. This is partially due to the cost and time inherent to traditional field data collection approaches, especially burdensome when managing large areas.

SOLUTION

Sustainable forest management and forest conservation are key to reduce greenhouse gas emissions. **Earth Observation (EO)** data and services contribute to tackle forest condition assessment challenges by providing customisable outputs, reducing operation costs, enhancing accessibility and usability of data, and enabling management of innovative solutions at large scales.

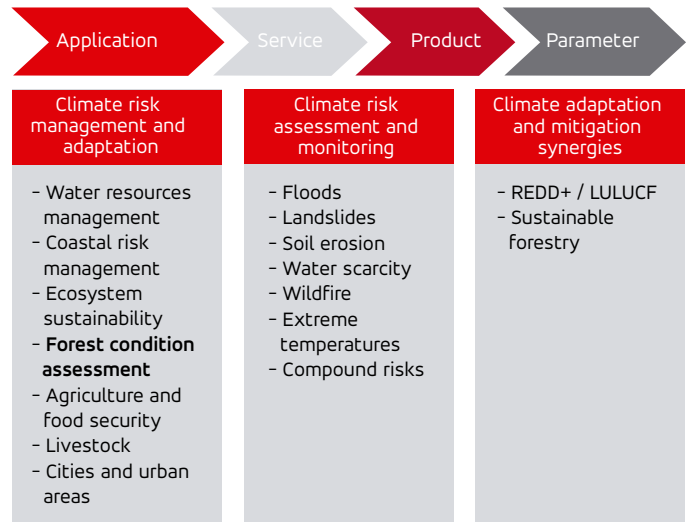
GMV has worked on several projects to integrate EO services into the decision making and design processes to help solve a range of problems for forestry. As climate finance becomes increasingly aware of the strengths and benefits of EO data, satellite observations are being used for an even greater range of problem-solving to help build climate resilience in many different contexts.

Eoclíma is GMV's catalogue of climate-related geo-information products to facilitate the management of environmental resources by organizations involved in the process: NGOs, multilateral climate finance initiatives, International Financial Institutions (IFIs), and environmental and conservation agencies as well as national and local Governments.

Eoclíma meets all currently existing geospatial data standards so, our geospatial products can be downloaded into and/or consumed by any geo-viewer through Open Geospatial Consortium (OGC) standard services.

Eoclíma SUPPORT FOR CLIMATE POLICY

Eoclíma products support the climate resilient pathways through the societal transformational process to achieve long-term emissions reductions and sustainable resilient development. This support is decoupled into main broad applications that lead to climate services tailored into products, here presented, and EO-derived parameters.



Eoclíma forest condition assessment service offers the following **products**:

The **deforestation** product provides the mapping and long-term monitoring of forest covers using satellite-derived forest mask information. The analysis of the forest mask time-series reports the mapping of forest presence, absence and changes, and forest density.

The **forest condition** product characterizes a forested area for a reference period and reports deterioration in the forest health status by assessing the damage caused by forests threats, including forest clearing, extreme drought and insect plagues. Robust statistical algorithms are applied over time-series of vegetation indices to correlate forest health decrease with the intensity of the climate-driven damage.

The **biotic stress** product maps the forest areas affected by biotic stress and provides a qualitative classification of the biotic damage. This technological solution looks for, detects, delimits and estimates woodland plague damage using satellite-based Earth Observation data and machine learning techniques.



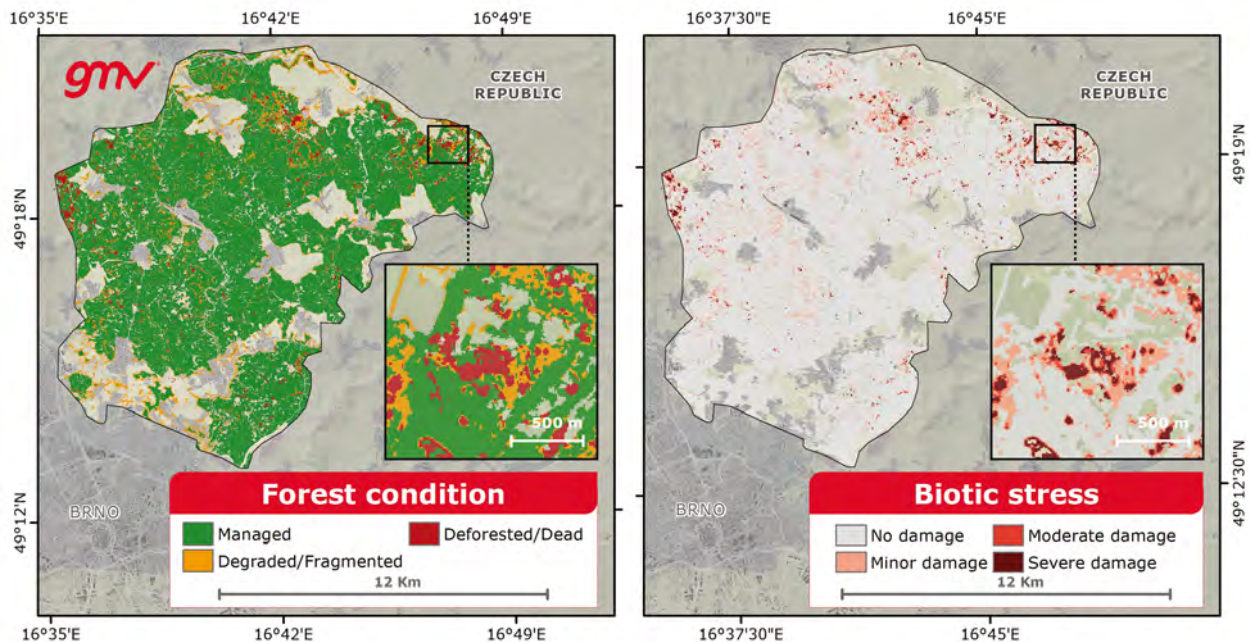
USE CASE: SMALL PEST, BIG PROBLEMS. ASSESSING INCREASING INSECT DAMAGE IN FOREST TRIGGERED BY A CHANGING CLIMATE IN CENTRAL EUROPE

Over the last years, **decrease of forest vitality**, growth under stress, and **greater susceptibility to spruce bark beetle infestation** are being **caused by** global climate change, especially **long-term droughts with extremely high temperatures** in the vegetative period. The accelerated spread of insect pests in woodlands around the world has been of particular concern to forest owners and managers in recent decades. Bark beetles that feed on live tissue are major contributors to global tree mortality and the collapse of the wood market. The bark beetle breeding-cycle is temperature dependent; longer, warmer and dryer summer periods, together with more frequent windstorms, have favoured and multiplied the breeding cycles by a factor of four, boosting the bark beetle population to unknown dynamics.

Since 2003, the Czech Republic has experienced extreme summer weather conditions; the bark beetle pest (*Ips typographus*) has become an emergency across spruce forests (*Picea abies*). During the period 2017-2019, the annual rate of spruce growing stock damaged by bark beetles was around 5 times higher than in 2003-2016. In 2019, the volume of damaged wood reached 23 million m³, leading to a decrease of -16% in the national spruce growing stock from 2014 to 2019. Using Sentinel-2 **satellite images**, **GMV analysed the biotic damages** bark beetle caused on a forestry area (as shown in the picture), just NE to Brno City. The analysis was carried out in the context of the H2020 project MySustainableForest and the area of interest was selected for validation purposes by the University Forest Enterprise Masaryk Forest Krtiny of Mendel University in Brno (UFE).

The Reserve covers 10.228 ha across broken-karstic relief. Natural conditions are most varied in mixed stands, averaging to 38% coniferous and 62% deciduous trees. Dominant conifers are spruce (18.8% stand area), scots pine (8.3%) and larch (8.1%), while deciduous are beech (34.0%), oak (14.7%) and hornbeam (7.9%). The average growing stock reaches 266 m³/ha, the overall current increment of 7.4 m³/ha, the annual harvesting volume of 69.000 m³/ha. UFE forest management is focused on close-to-nature methods, using minimum clear-cuts and a high share of natural regeneration.

Bark beetle damage was mapped using a combination of different machine learning algorithms applied to multi-temporal Sentinel-2 images. Damaged areas characterised by dead trees (red or grey attack) were clearly detected with 92-98% accuracy using machine learning and multi-temporal analysis techniques. This late detection is useful to assess economic and ecological losses caused by the pest in a specific period of time. However, an earlier detection of trees without external signs of infestation (green attack) is needed to avoid pest spread and mitigate potential losses. Therefore, areas with minor damage were also detected to provide information on possible areas in green attack. The final map containing all damage classes was produced at 10 m spatial resolution. In order to provide more information about areas in green attack, GMV carried out a preliminary analysis on early pest detection trying to raise an alert at least 2 months before the first visual signs of tree death. Areas affected by the bark beetle were detected on Sentinel-2 images 70 days before clear signs of decay using Artificial Intelligence, with a final precision of 80% for the infested areas in green attack.



Remote Sensing & Geospatial Analytics

For more information on the products under this service and the parameters included contact us on eoclima@gmv.com!

A product by:



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