

Eoclima for land use and forestry regulation

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 the **land use and forestry regulation** addressing LULUCF and REDD+ activities and supports climate adaptation and mitigation synergies.

eoclima@gmv.com
gmv.com





**ACCELERATE
CLIMATE
ACTION
FOR ALL SDGs**



CHALLENGES

At standing or regrowing stage, forests provide a “carbon sink” that absorbs a net 7.6 billion metric tonnes of CO² per year. The carbon emissions associated with the conversion of forests to other land uses as part of the land use, land use change and forestry (LULUCF) activities, have generated about 40% of historical GHG emissions. To reinforce the role of forests in combating climate change, the United Nations Framework Convention to Combat Climate Change (UNFCCC) developed the REDD+ program, a mechanism to reduce emissions from deforestation, and foster sustainable management of forests, and enhancement of forest carbon stocks. Soils contain about 2,500 billion metric tonnes of carbon, and that is more than four times the amount stored in all living plants. Sustainable land management also helps combat global warming by enhancing the ability of soils to store carbon. Several initiatives driven by UNFCCC are promoting enhanced organic carbon sequestration in soils as a way to mitigate GHG emissions.

SOLUTION

Reducing deforestation and improving land management are the mitigation options with largest and most immediate effect on atmospheric CO² concentration. Meeting these challenges requires consistent observations of forest landscapes and soils around the world, which can only be achieved using **Earth Observation (EO)** measurements.

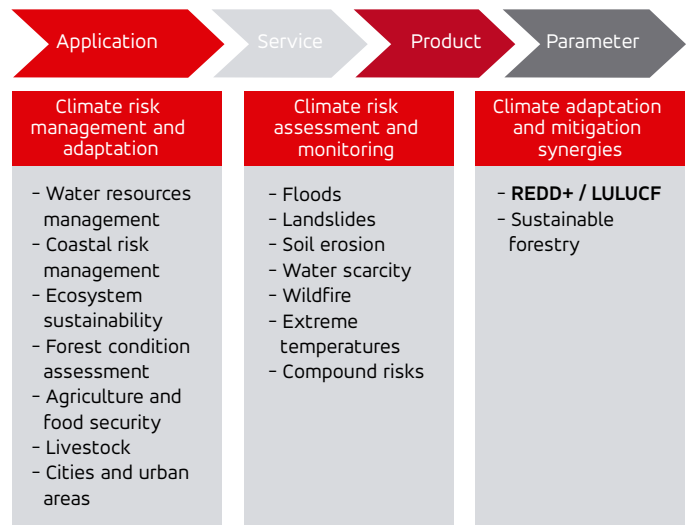
GMV has worked on several projects to integrate EO services into the decision making to contribute to sustainable land use and forestry management practices. As climate finance becomes increasingly aware of the strengths and benefits of EO data, they are being used for an even greater range of problem-solving to help build climate resilience.

Eoclimate 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 Governments.

Eoclimate 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.

Eoclimate SUPPORT FOR CLIMATE POLICY

Eoclimate 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.



Eoclimate land use and forestry regulation service offers the following **products to address REDD+ and LULUCF**:

The **deforestation, afforestation and reforestation** product provides information about the deforestation process, and afforestation and reforestation activities in a region of interest. This product includes time-series forest change detection and quantification, and analysis of land cover dynamics.

The **ecosystems restoration potential** product maps the opportunities for restoration on degraded lands. This product includes analysis of the ecosystem coverage and condition, potential ecosystem coverage under current and future climate, and the human pressure including population density, built-up areas, pasturelands and croplands.

The **carbon stock** product maps the carbon content using EO-based above-ground biomass measurements of forested areas and soil organic carbon estimates as proxy for soil carbon stocks. Biomass estimates are retrieved from Lidar altimetry measurements combined with digital surface models.

The **carbon emission / national GHG inventory** product provides information to support all Tiers of the IPCC’s Guidelines for National GHG Inventories. This product calculates carbon stock changes to retrieve GHG emissions by monitoring changes in land use and estimating multi-source spatial variations on biomass density and soil carbon.



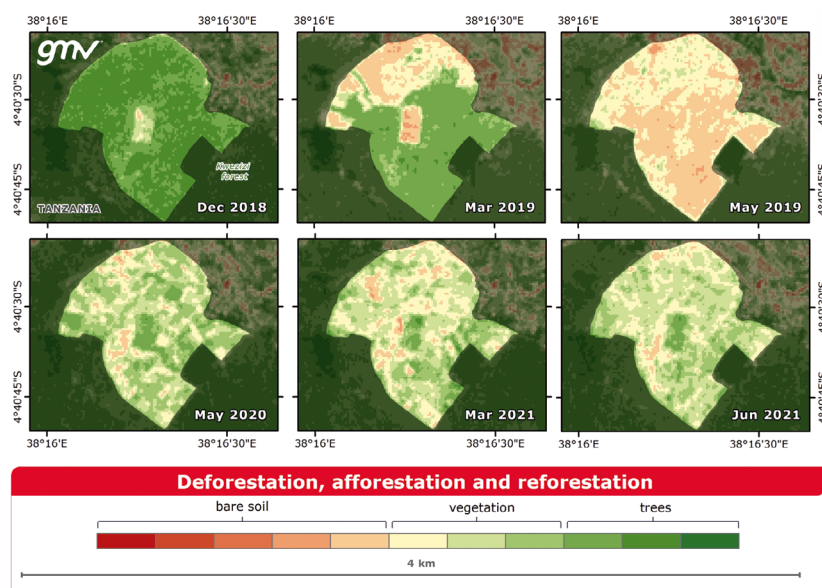
USE CASE: MONITORING REFORESTATION EFFORTS IN NATURE RESERVES IN TANZANIA

Forests and woodlands cover about 55% of the total land area in Tanzania. These forests and woodlands provide wildlife habitat, unique natural ecosystems and biodiversity. The country faces, however, an annual **deforestation** rate of around 469,000 hectares. Between 2001 and 2020, Tanzania lost 2.70 Mha of tree cover, equivalent to a 10% decrease since 2000, and 910 Mt of CO₂ emissions. Deforestation results from heavy pressure from agricultural expansion, livestock grazing, wildfires, overexploitation and unsustainable utilization of wood resources, mainly in unprotected forests. The decline of forest cover and tree root systems eventually decreases soil water retention and lowers the water table. This threatens the region's villagers with water shortages and, ultimately, with the need to migrate into the already overcrowded cities. GMV collaborates with ForestPlanet in Tanzania, an organization that supports large scale, low cost-per-tree reforestation efforts all over the world. GMV supported the ForestPlanet reforestation activities in Kwezizi and Irente forest regions of the Magamba Nature Reserve in Tanzania. The reforestation is later followed by a series of cash and food intercroops, and now trees and crops are now contributing to increase the resilience of local communities against climate change and food insecurity.

Using high and very high resolution satellite data spanning mid-2018 to mid-2021, GMV rebuilt the story of **vegetation cover changes** in the Kwezizi forest. From a dense, mature forest in 2018, through the progressive degradation experience during

2019 -mainly due to excessive cutting and fires originated by a growing population, followed by uncontrolled grazing - to its successful reforestation in 2020 by ForestPlanet and its partners (several corporate donors and a local NGO). The left figure shows how the first effects of the young trees start to be visible on the satellite-derived vegetation indices in June 2021.

Although this change might be caused by different reasons, the sudden decrease of standard deviation indicated that the mosaic of covers is disappearing and a dominant homogenous cover is starting to emerge with high presence of vegetation. GMV analyses were able to prove that the reforestation was successful and that the seedlings were growing following their normal course.

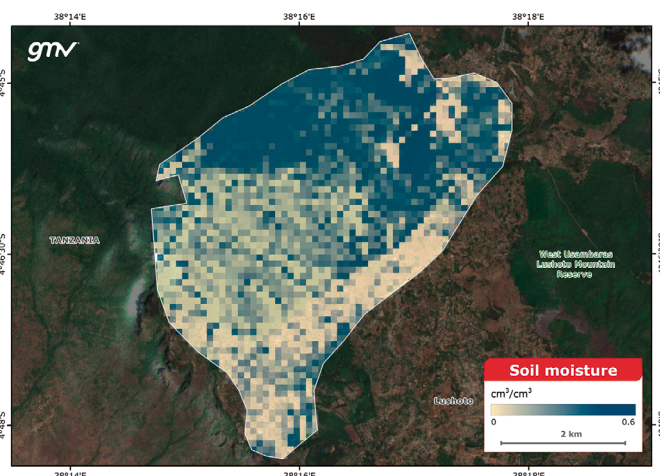


NDVI values close to 0 represent bare soil and values around 1 mean healthy and dense green vegetation.

In Irente (near Lushoto, Tanzania) a forest area of 2,200 hectare located by in the Western Usambara Mountains was also reforested by ForestPlanet and its partners. GMV assessed Irente's forest site condition along summer 2021 using satellite measurements. This date marked the start of the reforestation activities. Now a continuous monitoring of vegetation growth and condition of the newly planting trees is being regularly done.

Together with tree counting estimates and state-of-the-art vegetation indices, high-resolution geospatial soil moisture was derived from combined use of multi-sensor satellite imagery. The **soil moisture** map was obtained for the middle of the dry season to minimize the possibility of water saturated soil. Soil moisture shows a positive correlation with forested areas. This is due to the greater soil water-holding capacity caused by the mechanical action of the tree roots aerating soil, and the greater proportion of organic matter in forest soils.

Satellite-based Earth Observation measurements and monitoring allows accurate and timely assessment of the reforestation efforts in remote locations. The activities performed by GMV, ForestPlanet and collaborating NGOs resulted in an optimized and sustainable tree planting of various native species in previously deforested regions of the Magamba Nature Reserve in Tanzania. A total of 80,000 trees were planted in the 48-hectare Kwezizi region and more than 2 million trees are expected to be planted in the 2,200-hectare Irente site in the near future.



Soil moisture at 100 m derived from SMAP/Sentinel-1/Sentinel-2 data. Higher soil moisture values corresponds to relatively dense and very dense forests.

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:

