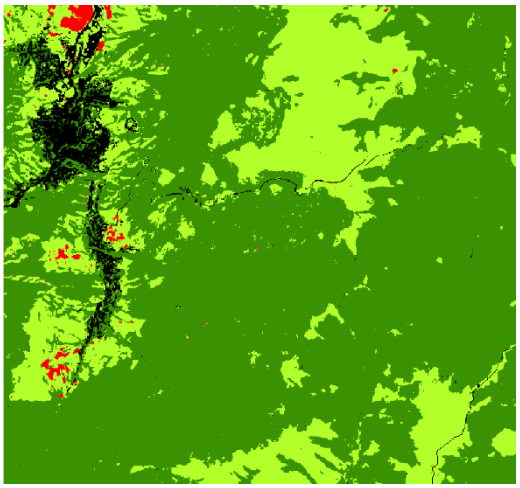
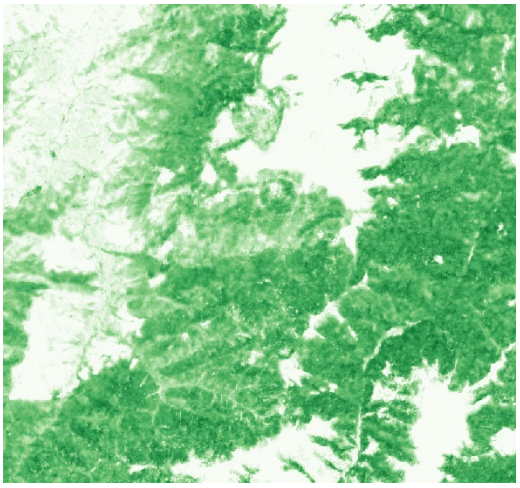
Estimating areal vegetation cover in Armenia based on remote sensing products

Forest Restoration and Climate Change in Armenia (FORACCA)





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Executive Summary

One of the major challenges for forest restoration and protection efforts in Armenia is the lack of precise information about the country's current forest and vegetation coverage. No full forest inventory has been conducted since 1989 and reliable data on forest coverage is sparse. Many areas that have officially been designated as forested areas by the state may no longer consist predominantly of forests while new forests may in turn have grown in areas that are not designated as forested areas.

Remote sensing data may offer valuable insights to overcome this knowledge gap. This analysis compared a time series of well-established global land cover products providing information on the development of vegetation cover in Armenia during the past 30 years. We also calculated a vegetation cover height model based on Sentinel-2 data covering the years 2017 – 2025. Though these products assess the proportion of the land covered in trees, which may include trees in urban areas and parks rather than exclusively forests, they represent a good starting point for assessing the state and development of forest areas.

The analysis compared four high-resolution land cover products, all with a spatial resolution of 10 meters, and three products that are only available in coarser resolutions but go back further in time.

Product (Acronym)	Spatial Resolution	Temporal Coverage
Global Dynamic Land Cover (GDLC)	10m	2015-2020
WorldCover (WC)	10m	2020-2021
Dynamic World (DW)	10m	2015-2025
Sentinel-2 10-Meter Land Cover (ESRI LC)	10m	2017-2025
Global Land Cover and Land Use (LCLU)	30m	2000-2020
Climate Change Initiative Land Cover (CCI LC)	300m	1992-2022
MODIS (MCD12Q1)	500m	2001-2024

Table 1: Comparison of global land cover products

To compare these products, the categories they used were harmonized to the classification scheme of GDLC and WC as this represented a good compromise between products with more detailed and broader categories.

The four high-resolution products all show similar overall land cover distributions between the different categories. However, analyzing the maps themselves quickly shows that GDLC and WC include a higher level of spatial detail. Among the lower resolution product, LCLU still displays similar levels of spatial details as the high-resolution products. However, CCI LC and MCD12Q1 are strikingly less detailed. Detailed analysis of specific parts of the country also reveals clear misclassifications by CCI LC and MCD12Q1. As such, the analysis of long-term developments based on these two products may not be completely reliable, but LCLU offers a good alternative.

All seven global land cover products show similar areal extents for vegetation with tree cover. Especially the four high-resolution products only deviated slightly from each other, indicating around 4000 km^2 of tree cover existed in Armenia in the year 2020.

As for the temporal evolution, all three low-resolution products show stable “Tree cover” area until 2015. After 2015, all three products show a slight increase, with CCI LC and MDC12Q1 estimating a slightly stronger increase than LULC.

The Sentinel-2 based Vegetation Height Model (S2-VHM) developed by WSL with Swiss reference data and applied to Armenia for the period 2017 – 2025 proved to be a good alternative to the high-resolution global land cover products. The forest masks, derived by applying a vegetation height threshold on each year, also show an areal extent of around 4000 km^2, depending on the height threshold applied. S2-VHM shows a slight increase of tree cover area from 2017 until 2024, though it is not statistically significant. This development also reverses after 2024, further supporting our initial conclusion that the observed slight changes in tree cover area were not significant and overall tree cover remained the same from 2017 until 2025.

The benefits of using S2-VHMs are the added information content of vegetation height compared to simple land cover class, the flexibility of the forest mask definition, and the timeliness of the information.

Links & Disclaimers

The S2-VHMs can be obtained from ENVIDAT through the following DOI:

https://www.doi.org/10.16904/envidat.690

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