

StatEO

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High Resolution Land Degradation Neutrality Monitoring – Achievements of the ESA SEN4LDN Project

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Context – SDG 15.3.1



TARGET 15.3

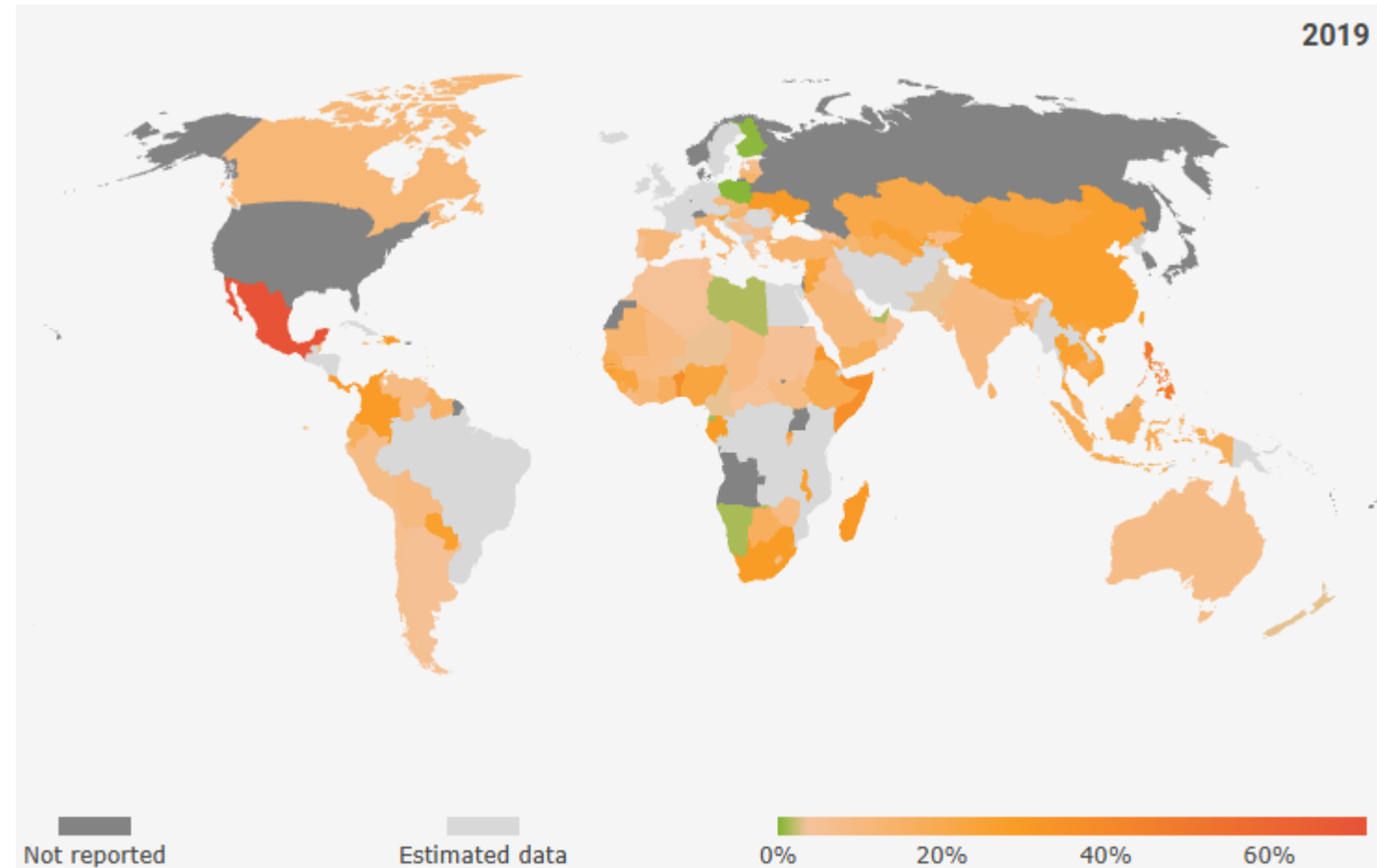
END DESERTIFICATION AND RESTORE DEGRADED LAND



By 2030, combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world.

SDG15.3.1 is mostly based on global datasets with a spatial resolution of 250m – 8km

Proportion of degraded land over total land area

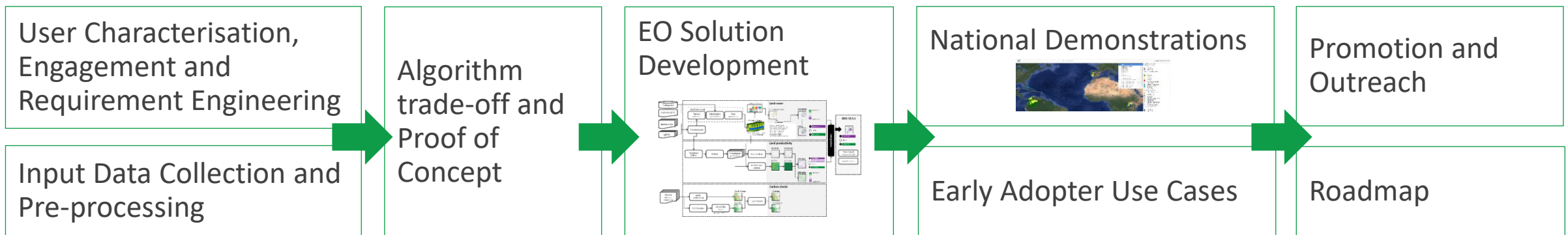


SEN4LDN: High resolution Land Degradation Neutrality Monitoring



SEN4LDN objective

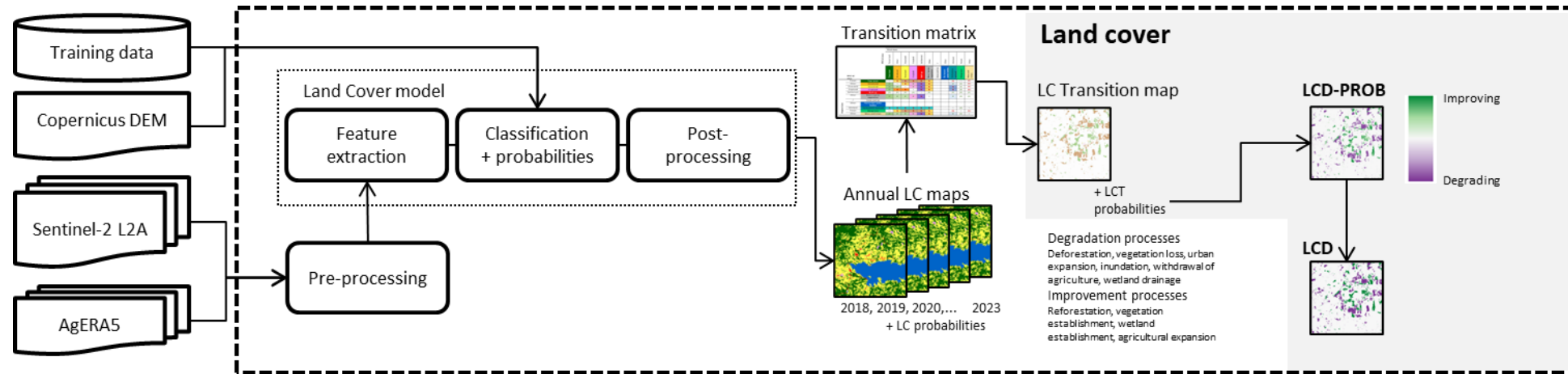
Develop, demonstrate and **validate** a robust and scientifically-sound **EO methodology** that exploits the **high frequency and spatial resolution** of open and free-of-charge satellite imagery to increase **the spatial details of national assessments of land degradation and restoration**, and provide synoptic information for countries to plan LDN interventions at appropriate scales.



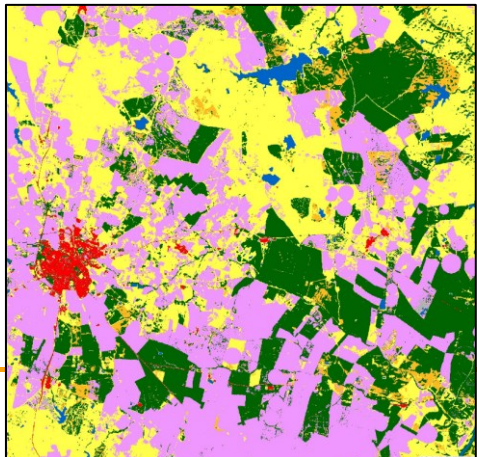
Trends in Land Cover



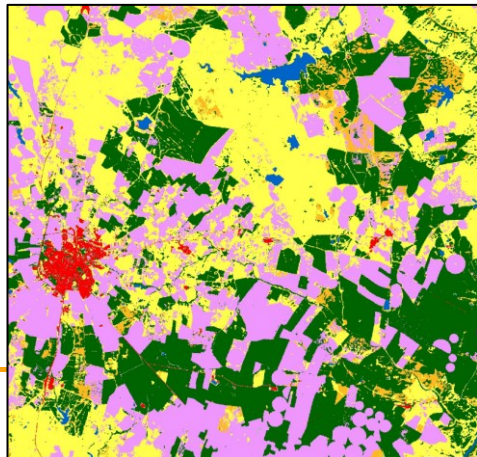
Automated, global land cover change algorithm generating discrete and continuous land cover degradation products at 10m resolution



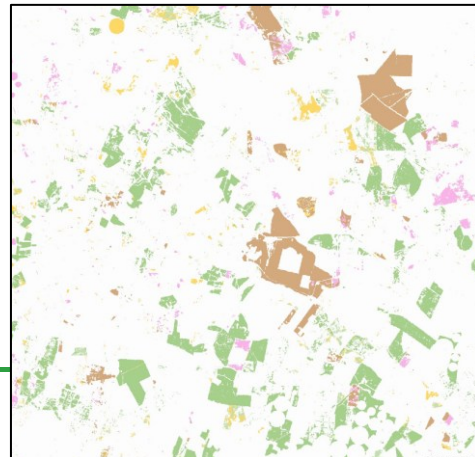
LC 2018



LC 2023



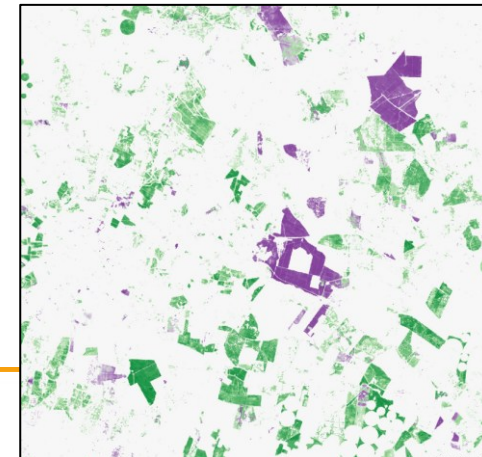
LC Transition



LC Degradation



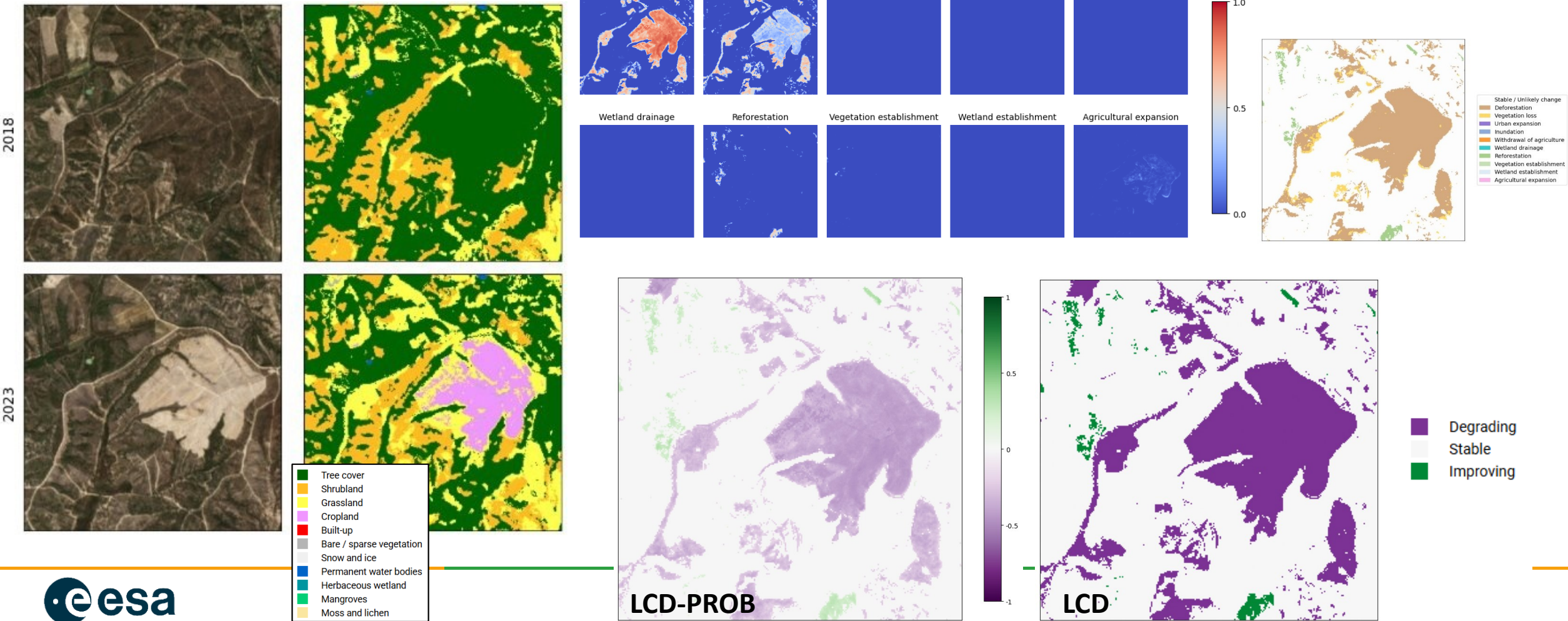
LCD Probabilities*



Trends in Land Cover – Algorithm summary



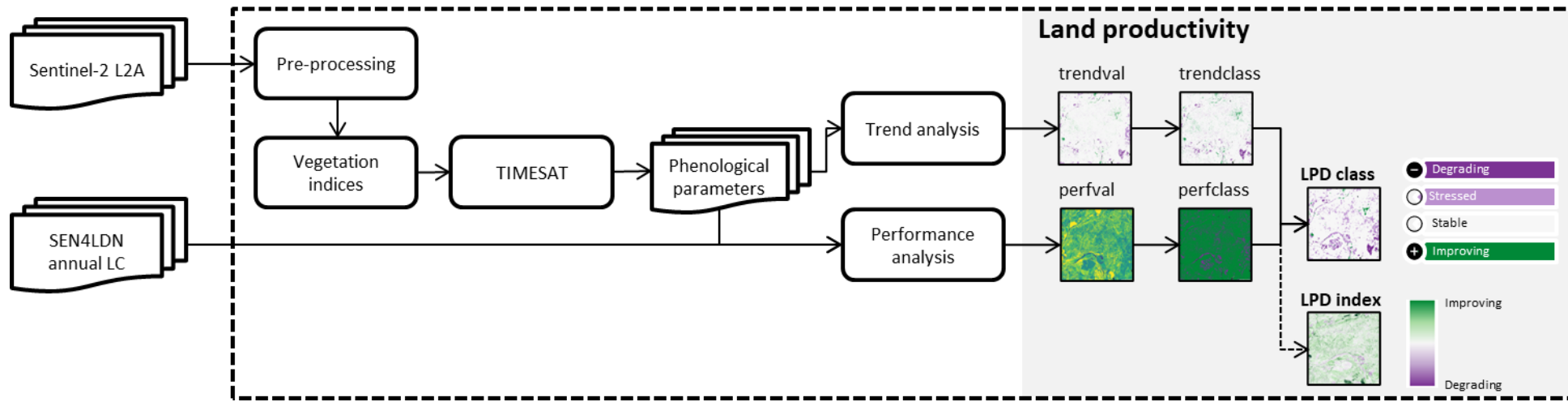
- Customizable transition matrix → Transition probabilities → Discrete transition maps, LCD, LCD-PROB



Trends in Land Productivity



Automated, global algorithm using TIMESAT to generate Land Productivity Degradation classes and continuous values at 10m spatial resolution



Trend value

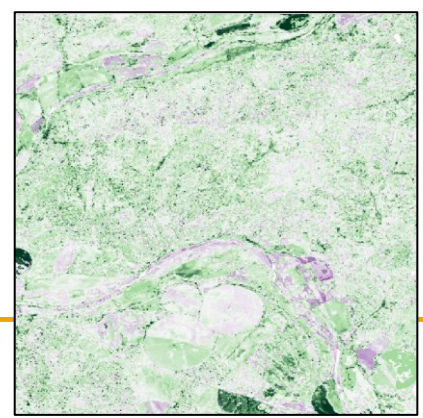
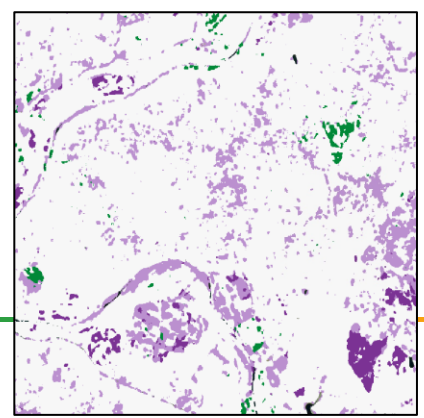
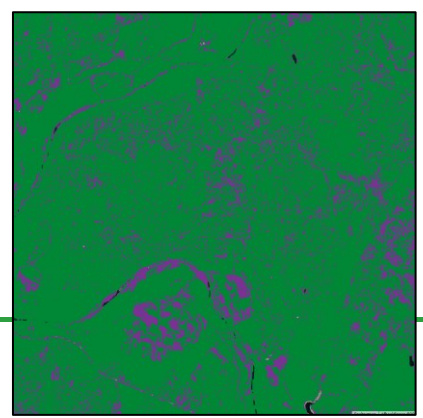
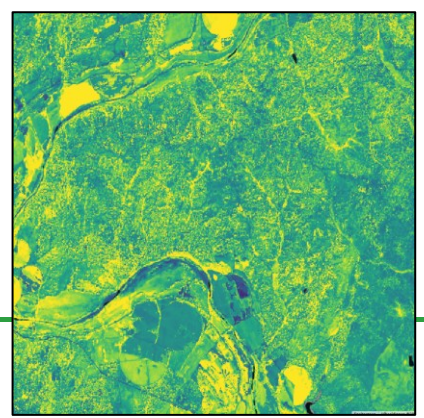
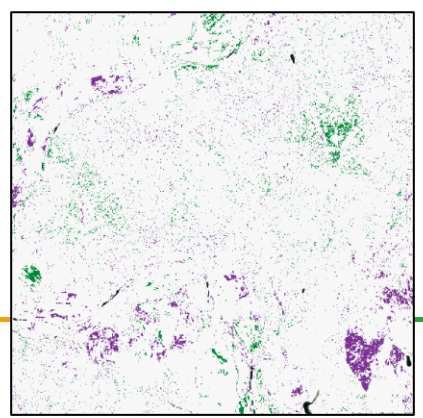
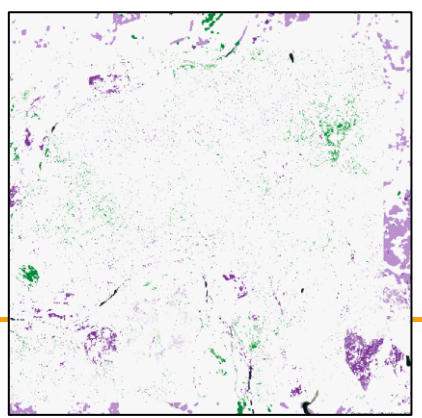
Trend class

Performance value

Performance class

LPD class

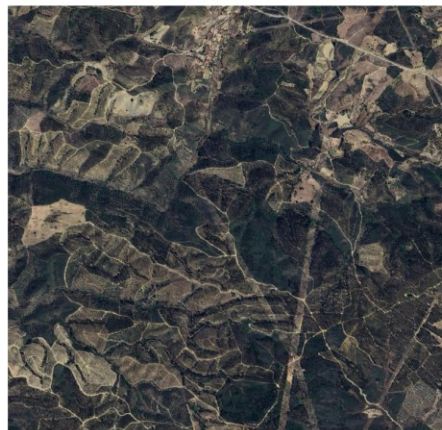
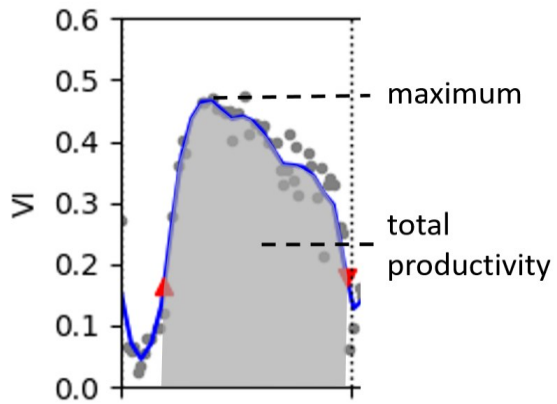
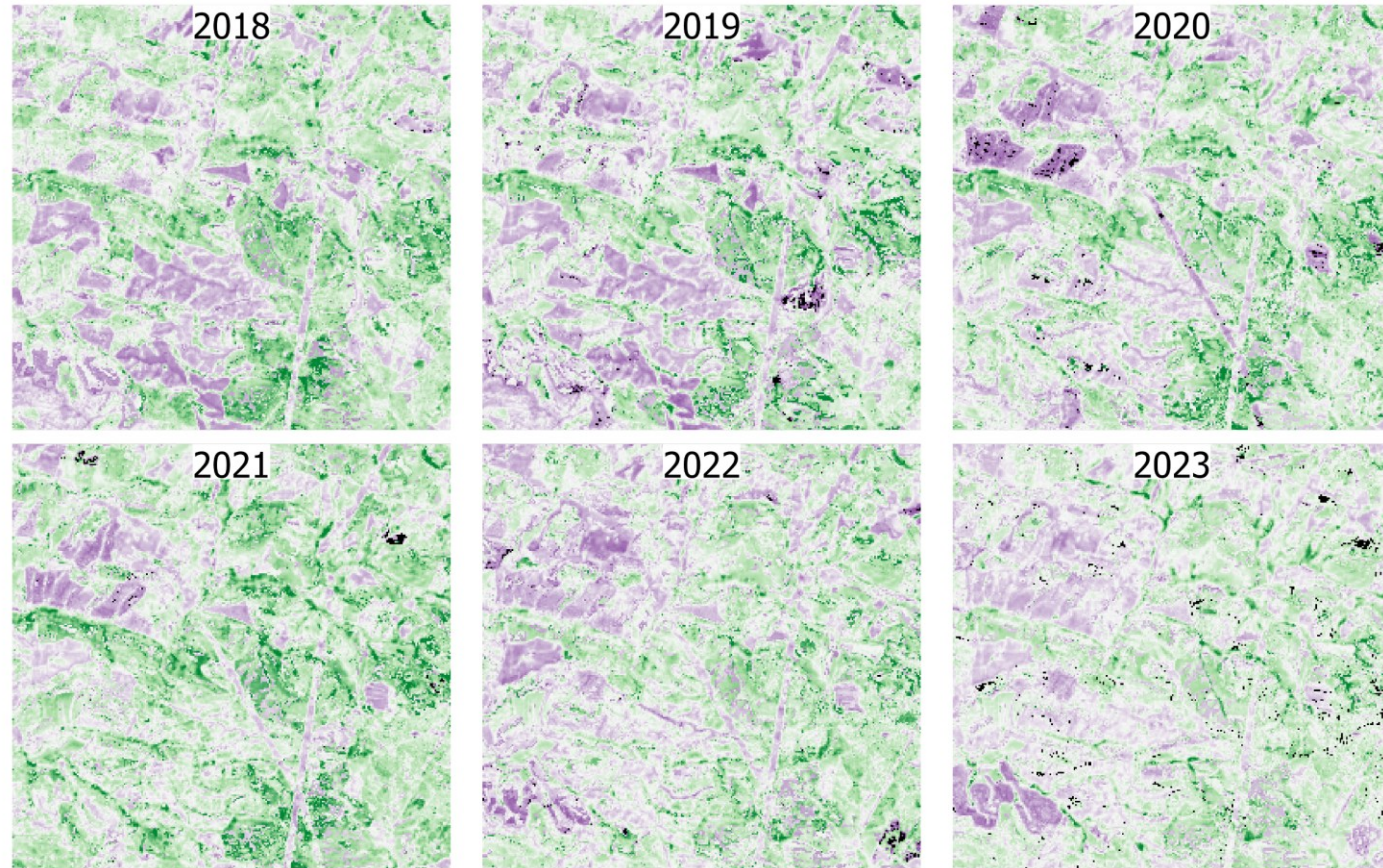
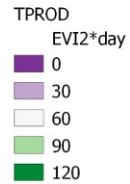
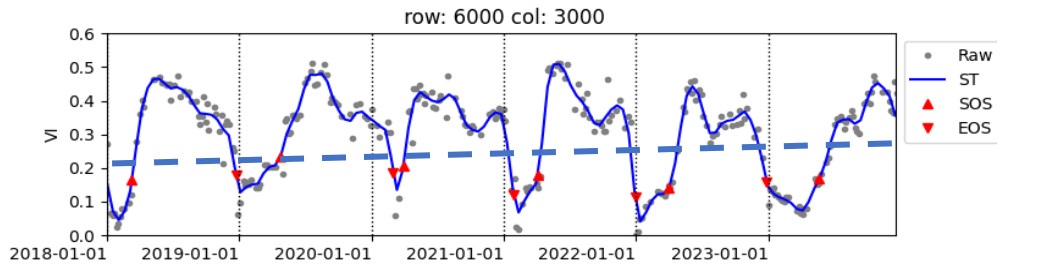
LPD index



Trends in Land Productivity – Algorithm summary



- TIMESAT processing → Seasonal Total Productivity (TPROD) → Trend and Performance estimation → LPD index
 - Based on Daily EVI2 (Smoothing Spline)

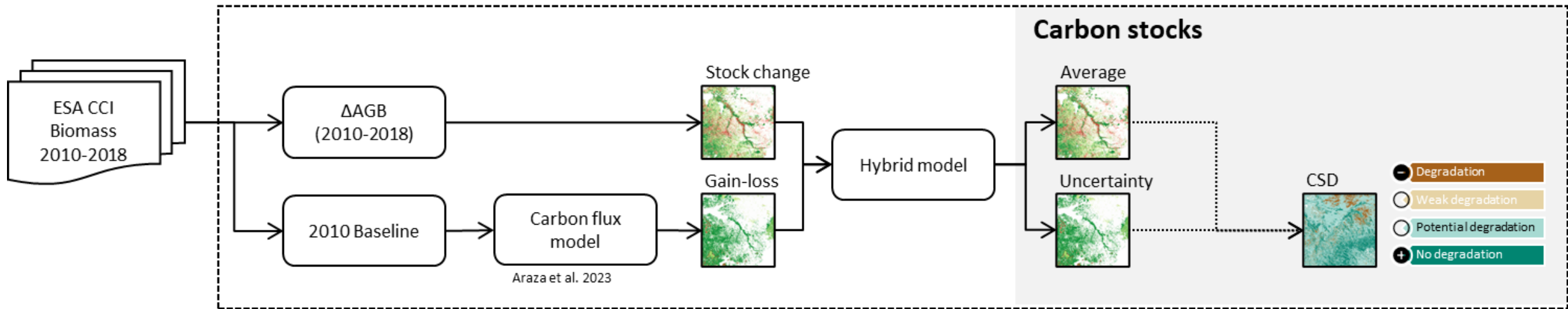


Trends in Carbon Stocks



Focus on above ground carbon stocks

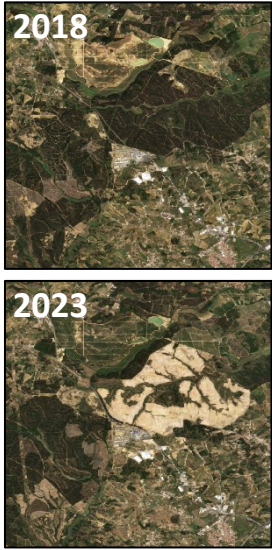
- Hybrid AGB mapping approach was developed as prototype demonstration case, based on two research demonstration models
 - ESA CCI stock change
 - gain-loss WRI flux model [Araza et al. 2023]
- Retrieval uncertainties are given indicating model fidelity
- Net flux estimates provided (country statistics and whether carbon sink or source)



Integration for SDG 15.3.1 indicator on LDN

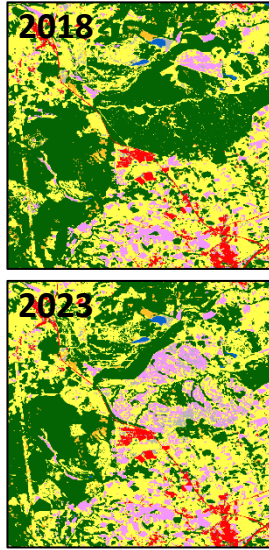


Sentinel-2 composites



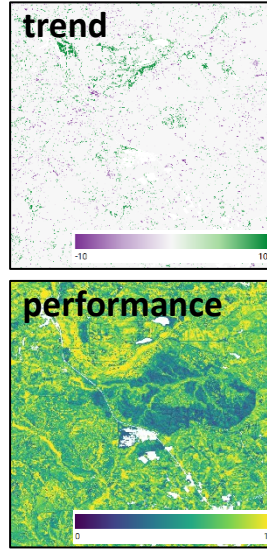
During the installation (2022-2024) of the largest solar photovoltaic plant in Rio Maior and Torre Bela (Portugal) a large area of tree cover was lost. Both the output products on trends in land cover and trends in land productivity show a sharp delineation of these areas.

Trends in Land Cover

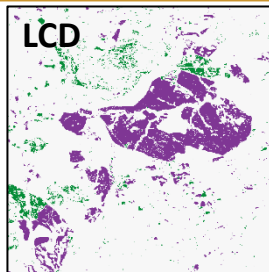


- Tree cover
- Shrubland
- Grassland
- Cropland
- Built-up
- Bare / sparse vegetation
- Snow and ice
- Permanent water bodies
- Herbaceous wetland
- Mangroves
- Moss and lichen

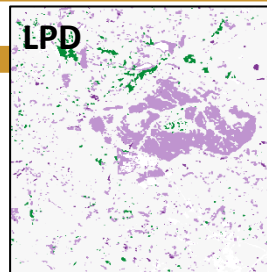
Trends in Land Productivity



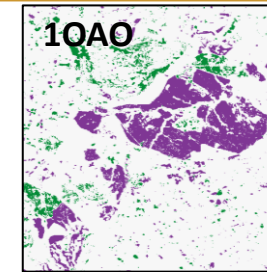
Integrated products for land degradation monitoring



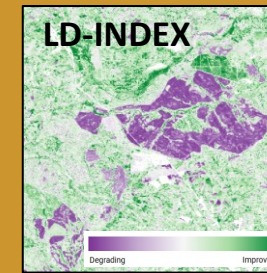
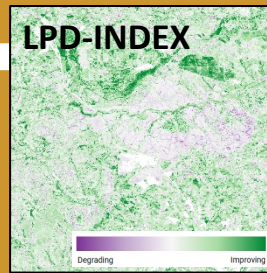
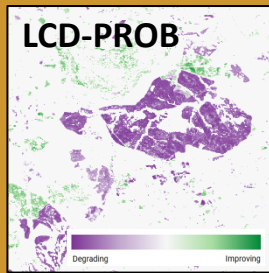
- Degrading
- Stable
- Improving



- Degrading
- Stressed
- Stable
- Improving



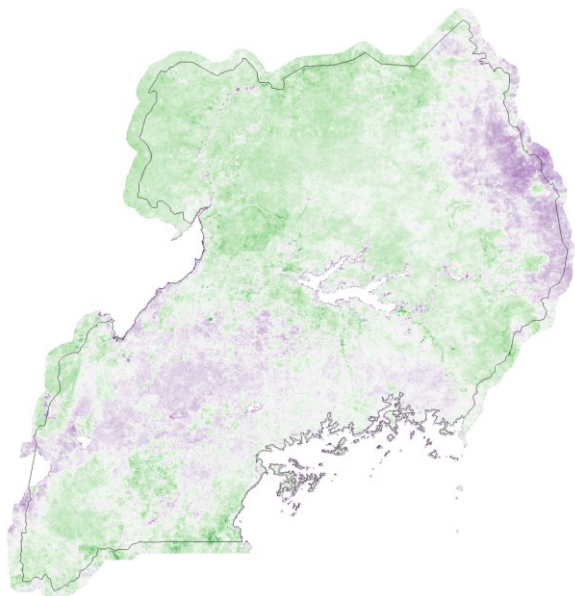
- Degrading
- Stable
- Improving



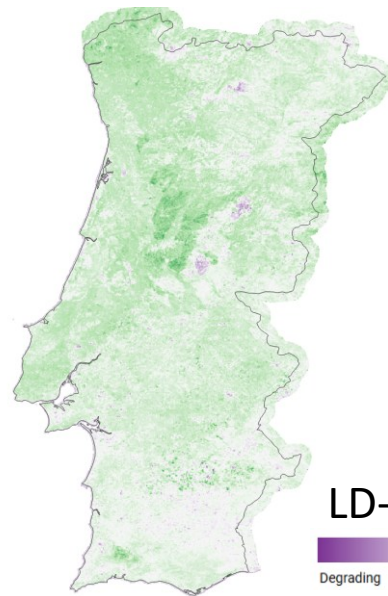
SEN4LDN use cases for Uganda, Portugal and Colombia



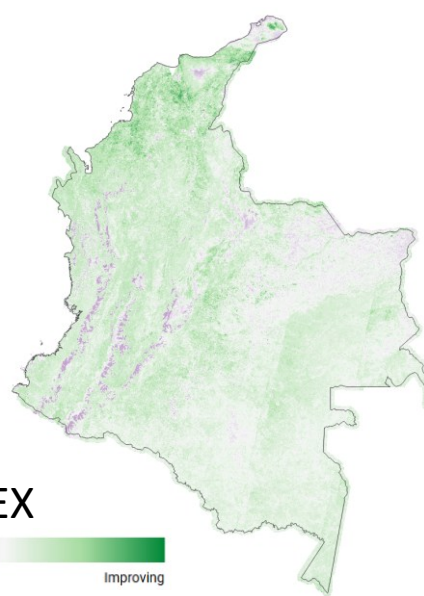
Uganda



Portugal



Colombia



LD-INDEX



Earth Engine Apps

SEN4LDN: High resolution Land Degradation Neutrality Monitoring

This GEE application provides the results of the SEN4LDN national demonstration products that are presented to the Early Adopters at the third round of living labs (November/2024).

Product User Guide V3

Zoom to Area of Interest

Uganda

Portugal

Colombia

Background

Google Satellite

Land Degradation Indicator (10A0)

Stable

Restoration

Degradation

Trends in Land Cover

Land Cover

Tree cover

Shrubland

Grassland

Cropland

<https://vitorsveg.users.earthengine.app/view/sen4ldn>

SEN4LDN Key outcomes



- Advanced monitoring of land degradation and restoration, with methods
 - at **high temporal frequency** (annual) and **high spatial resolution** (10 m)
 - in a more **continuous** way
 - **validated** using ground sampling data and through consistency evaluation
- Algorithm development
 - **Global land cover change** generating **discrete and continuous** land cover degradation products at **10m resolution**
 - **Global land productivity** degradation **classes and continuous values** at **10m spatial resolution**
 - Exploration of the use of **aboveground biomass** for evaluation of trends in carbon stocks
- **Integration for SDG 15.3.1** on LDN: One-Out-All-Out and testing of continuous sub-indicator integration
- **National demonstrations** and use cases in Uganda, Portugal and Colombia

SEN4LDN has provided tangible results to support UNCCD and GEO-LDN in defining the next steps to increase the spatial (and thematic) details of national assessments of land degradation and restoration

- Future work will possibly include
 - Extending high-resolution trends in land cover and land productivity towards the baseline period (2000-2015)
 - Enhanced algorithms allowing local fine tuning, using local reference data
 - Improved algorithms for more thematic details in land cover mapping (e.g. natural forests vs. plantations, natural grasslands vs. managed pastures, etc.)
 - Improved usability in hyper-arid areas, SIDS, mountainous areas
 - Implementation into CDSE/openEO to enhance user uptake
 - ...

Thank you!
Questions?



SEN4LDN

LAND DEGRADATION NEUTRALITY

<https://esa-sen4ldn.org>