The role of Earth Observation in tackling Climate Change

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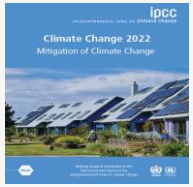
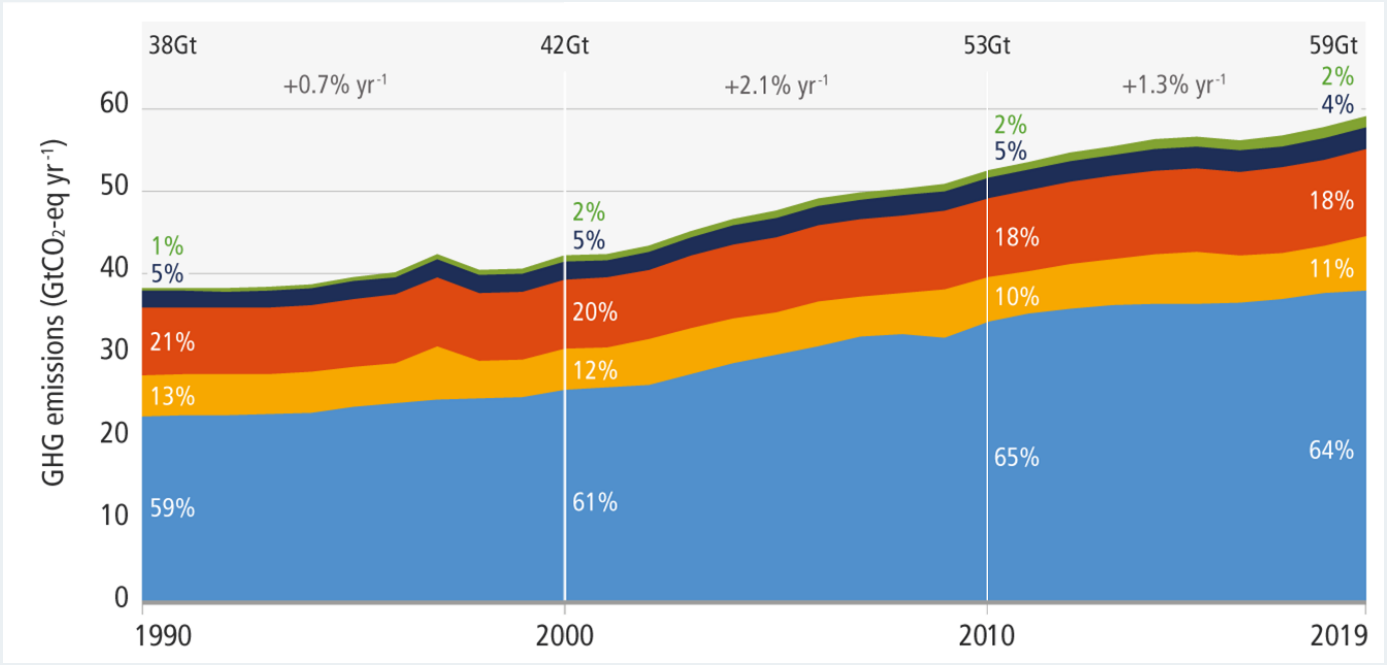
FAO Forestry Division
Forest & Climate Group

ESA-ESRIN, October 2022



IPCC reports 2022

We are not on track to limit warming to 1.5 °C.



Background

Environmental change: climate crisis is here and now (IPCC, 2022): monitoring & forecasting land (cover/use) has become crucial more than ever to

Global scale: variety of data/data sources

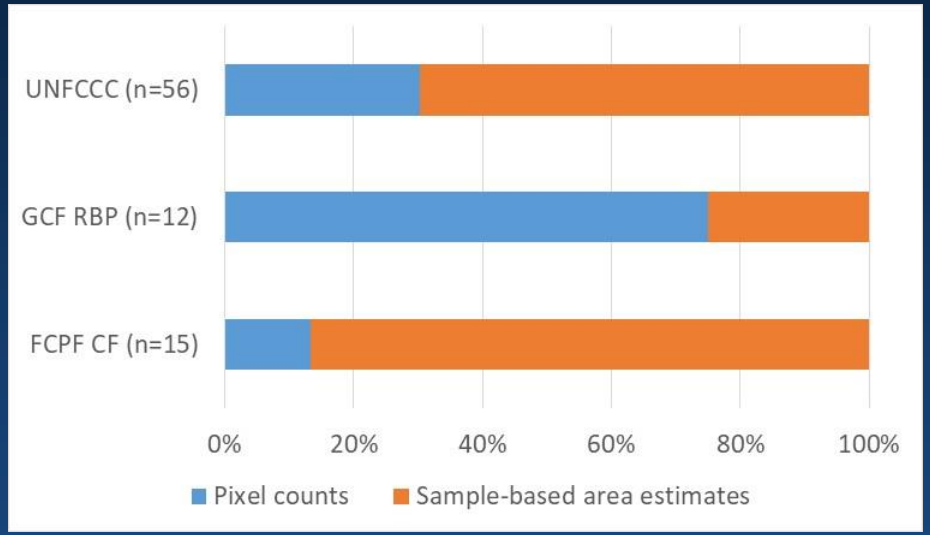
National scale: global data used nationally or national data for different (international) reporting frameworks

FAO in collaboration with ESA, academia and other partners have developed tools to assist countries in measurement, reporting, and verification (MRV)

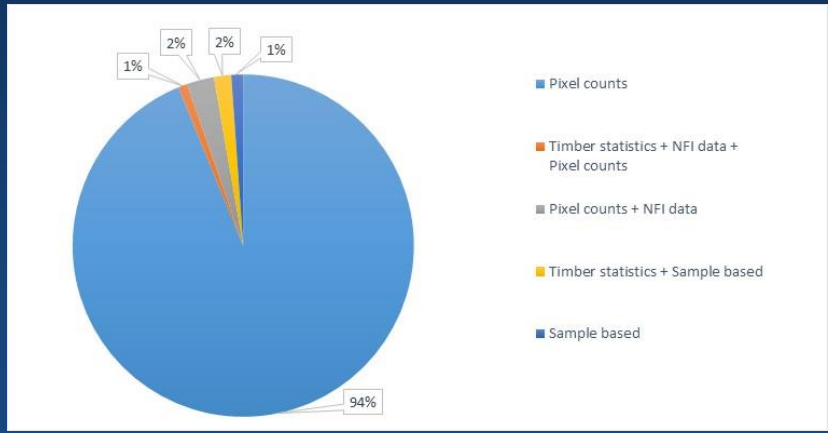
Mitigation: REDD+ reporting to the UNFCCC

Methods AD

Reference levels

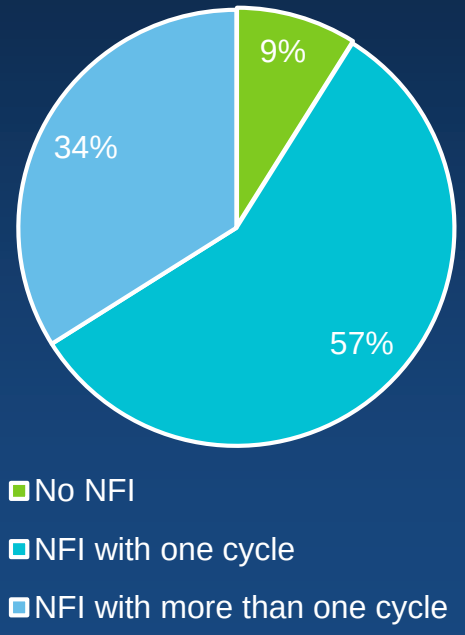


Results reported UNFCCC



Methods EF

56 countries submitting reference level to UNFCCC:



Most countries have NFI or inventory data suitable for deforestation EF

Challenges:

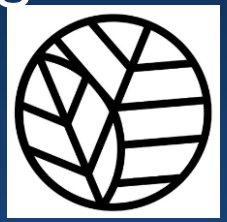
- NFI data for degradation EF
- NFI data for A/R
- Take advantage of multiple cycles

The complicated landscape of carbon finance opportunities

Results-based payments

Compliance markets

Voluntary carbon markets



Monitoring and policy needs (here and now)

- Better data, better decisions? e.g. 10 y UN-REDD
- Need for (better) integration of measurable (hyperspectral) field, airborne and space borne RS parameters with practical (monitoring) solutions and policy implementation
- Support research needed in the domains of agriculture, food security, raw materials, soils, biodiversity, environmental degradation and hazards, inland and coastal waters, and forestry
- **Mitigation** efforts versus **adaptation**: new monitoring field to be explored, f. e. agricultural practices/management through Chl, N in soils, first attempt TOPC-CEOS indicators

FAO Applications and Resources

A short overview

Open Foris initiative

www.openforis.org

Free and open source tools and methods for data collection, analysis and reporting

Arena

Online platform for survey design, data management, utilization and processing

Collect

Easy and flexible survey design and data management

Collect Mobile

Intuitive data collection and validation in the field

Calc

Efficient and collaborative data analysis and results dissemination

Collect Earth

Easy and flexible survey design and data management

Collect Earth Online

Online Land Monitoring tool for crowd-sourcing of augmented visually interpreted data

Earth Map

The power of Google Earth Engine without coding. A user friendly tool for complex land monitoring

SEPAL

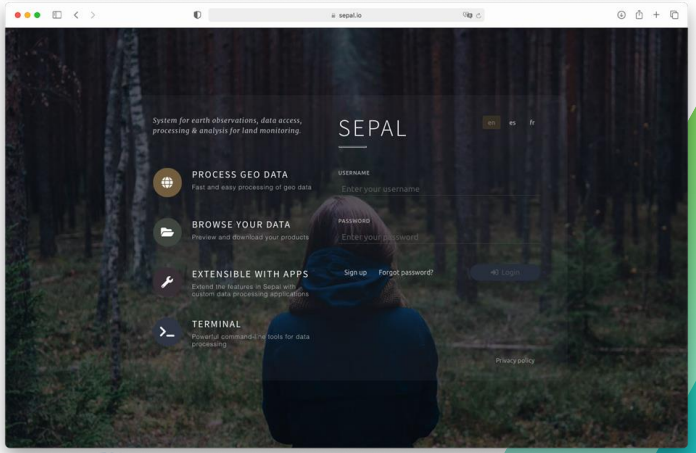
System for earth observation, data access, processing, analysis for land monitoring

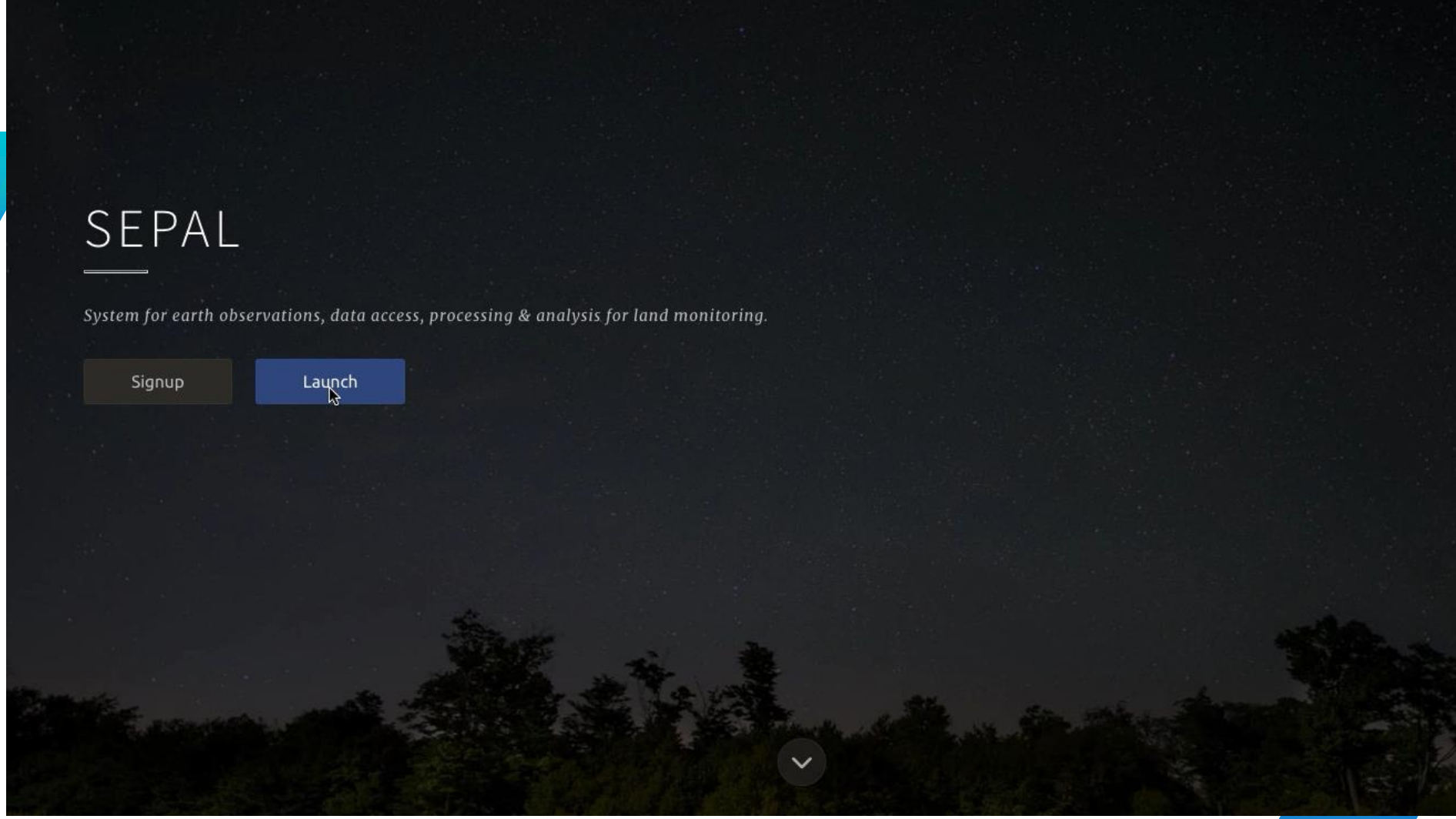
Key principles

- **FAO-led** initiative
- **Free and open source:** approx. 30,000 downloads since 2016; source codes are available in GitHub.
- **Software development:** new and improved versions of the tools are released periodically.
- **Collaboration:** FAO Hand-in-Hand Initiative; private and public partners (e.g. Google, NASA-Servir); academic institutions; projects.
- **Country testing:** OF tools have been used in more than 130 countries.
- **Capacity building:** training sessions on all OF tools in all regions of the world.
- **Implementation:** more than 44 countries have integrated OF tools in their forest monitoring systems.

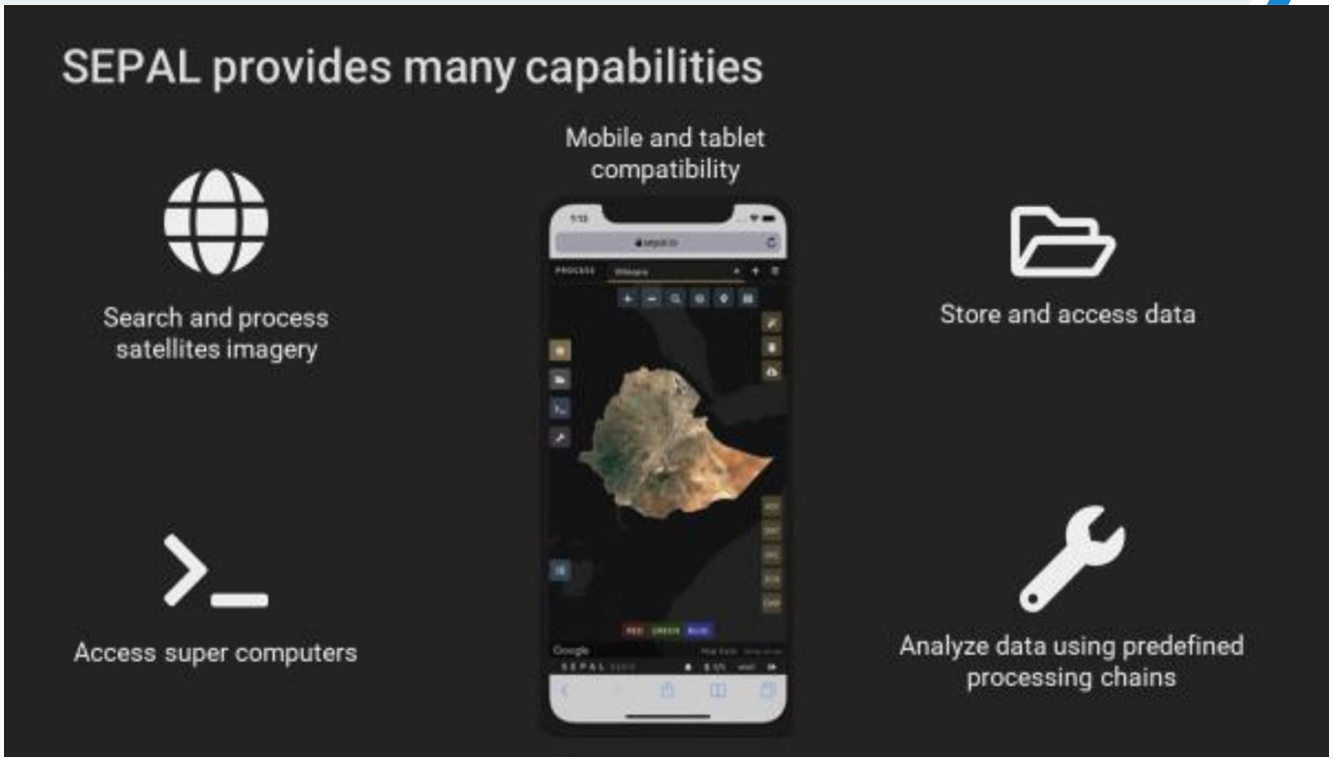
SEPAL: Earth Observation and cloud computing

- SEPAL is a cloud based platform for accessing, processing and analysing geospatial data for land monitoring
- SEPAL is free and open: anyone can register for access to its features: https://sepal.io
- All you need is an Internet connection to access the SEPAL website

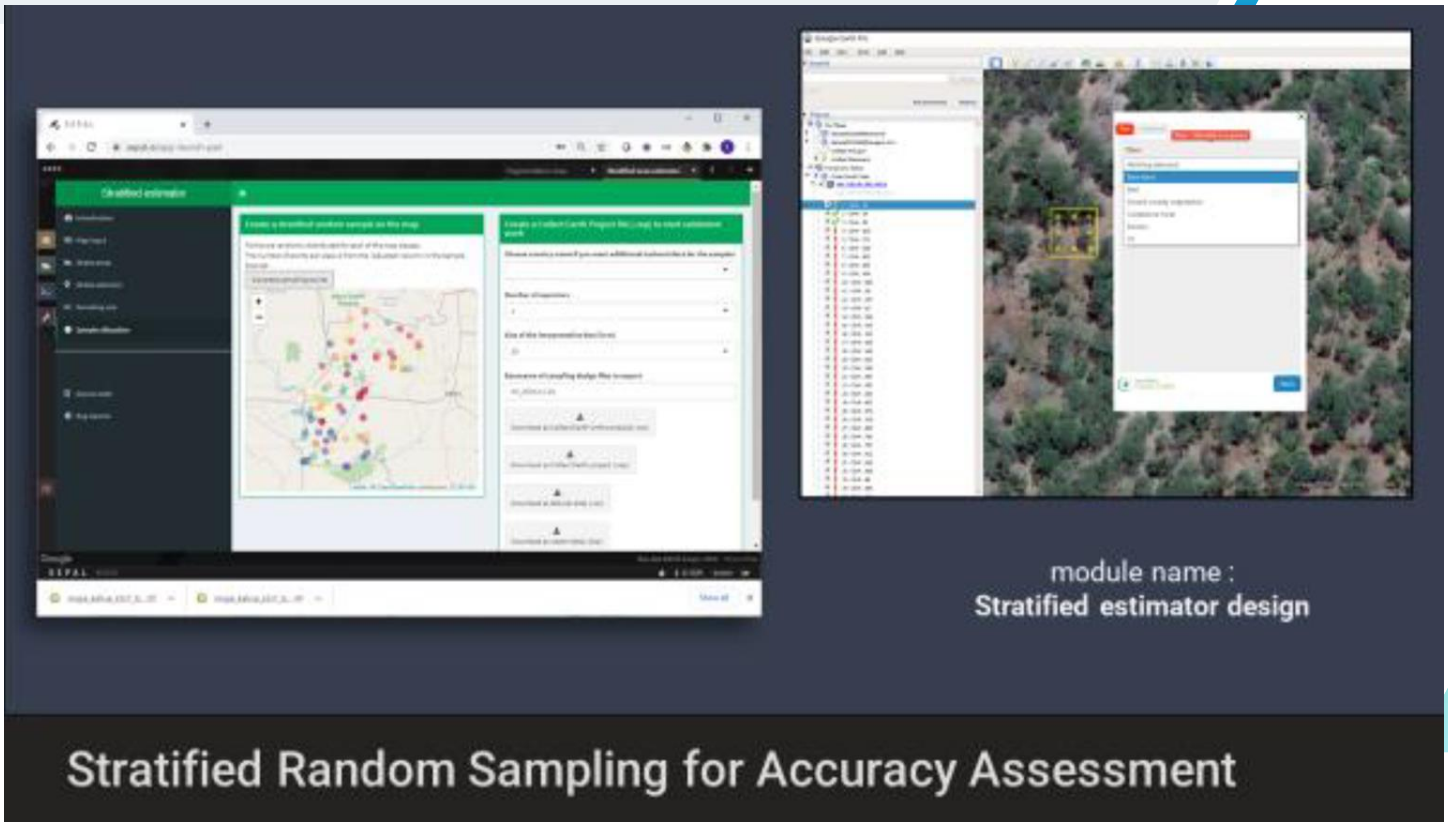



SEPAL
System for earth observations, data access, processing & analysis for land monitoring.
Signup
Launch

SEPAL https://sepal.io



SEPAL -module example

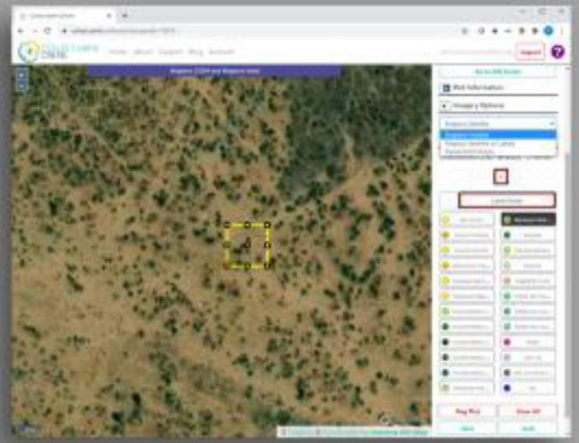


SEPAL

Link to Collect Earth and Collect Earth Online

Collect Earth can be used with Sepal to produce training data.

Follow our tutorials for more information



Collect Earth

Visual interpretation tool for land use/cover classification and change detection with access to high and very high resolution satellite imagery

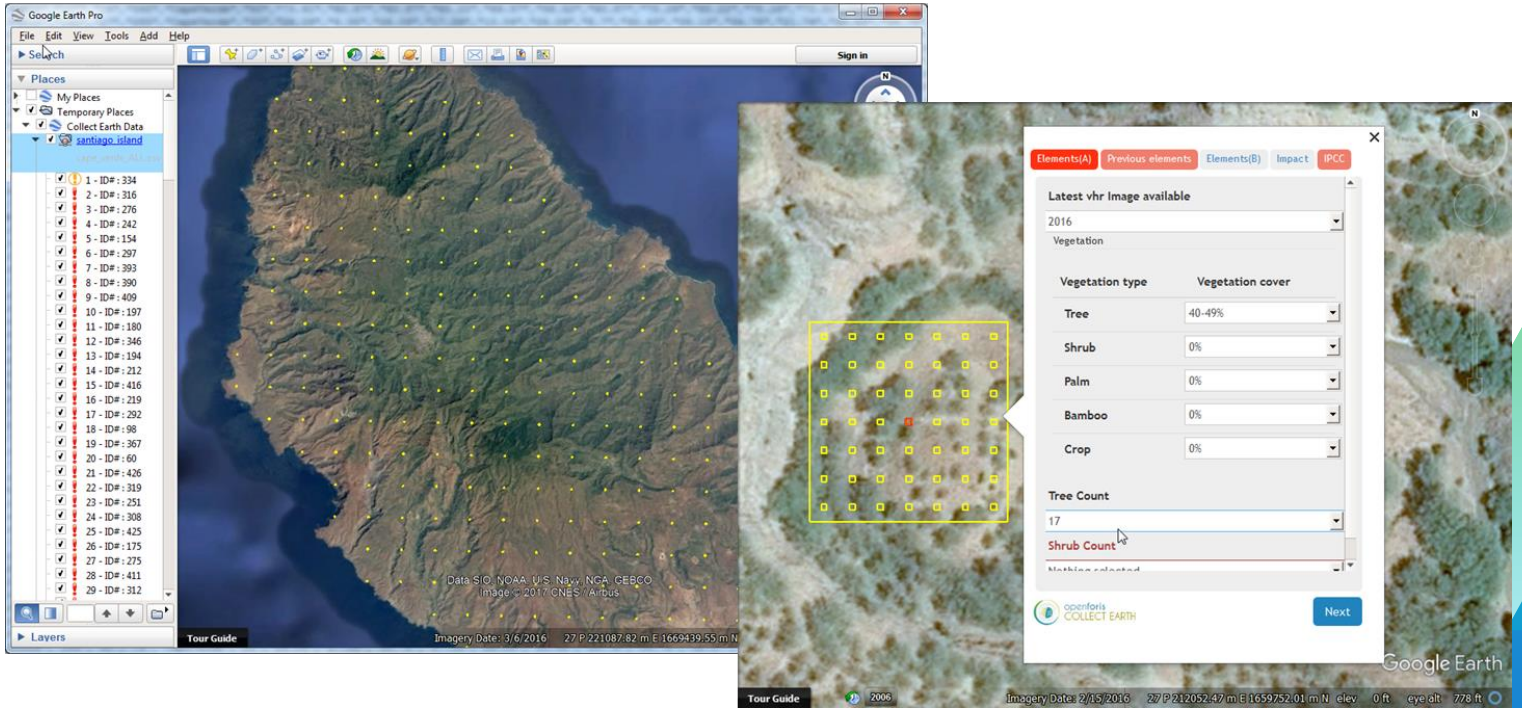
openforis

Augmented Visual Interpretation

Data Collection tool integrated in Google Earth.

Free access to Very High Resolution imagery.

Multitemporal imagery thanks to Google Earth, Bing Maps and High Resolution



Collect Earth Online

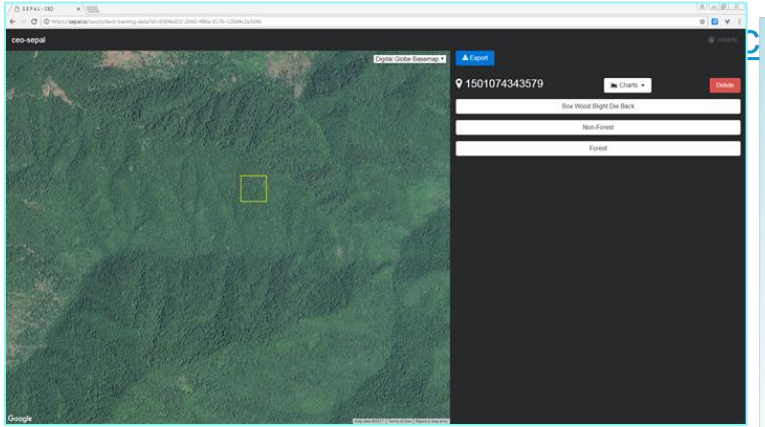
Visual interpretation tool for land use/cover classification and change detection with access to high and very high resolution satellite imagery

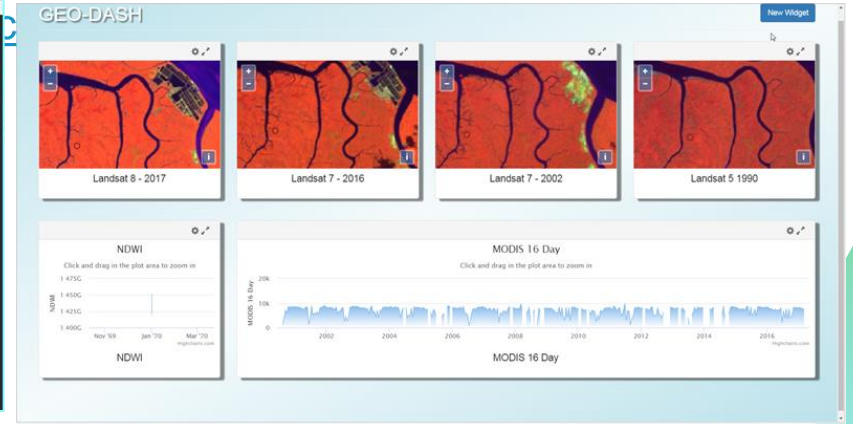
Used globally

openforis

Developed in collaboration with NASA-SERVIR and FAO.

Online application for crowdsourcing and centralized assessments. Multiple users can simultaneously collect information.

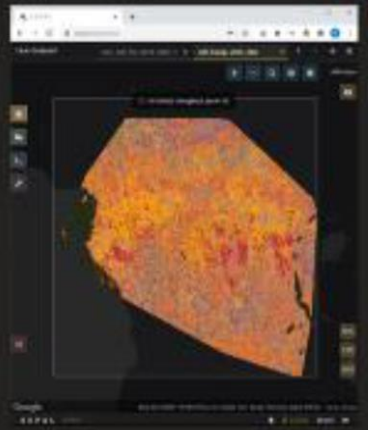




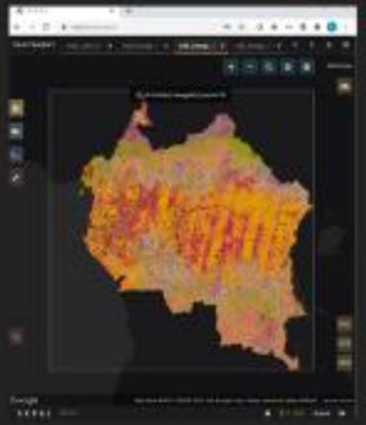
openforis

Fusion Optical and radar data

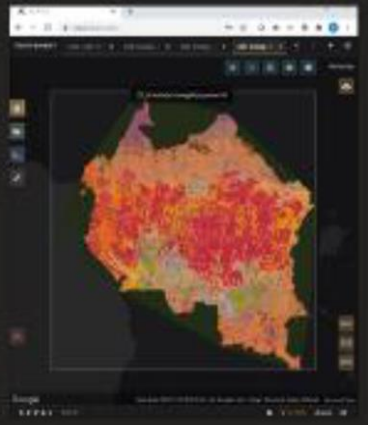
ALOS



LANDSAT 8



ALOS + LANDSAT 8



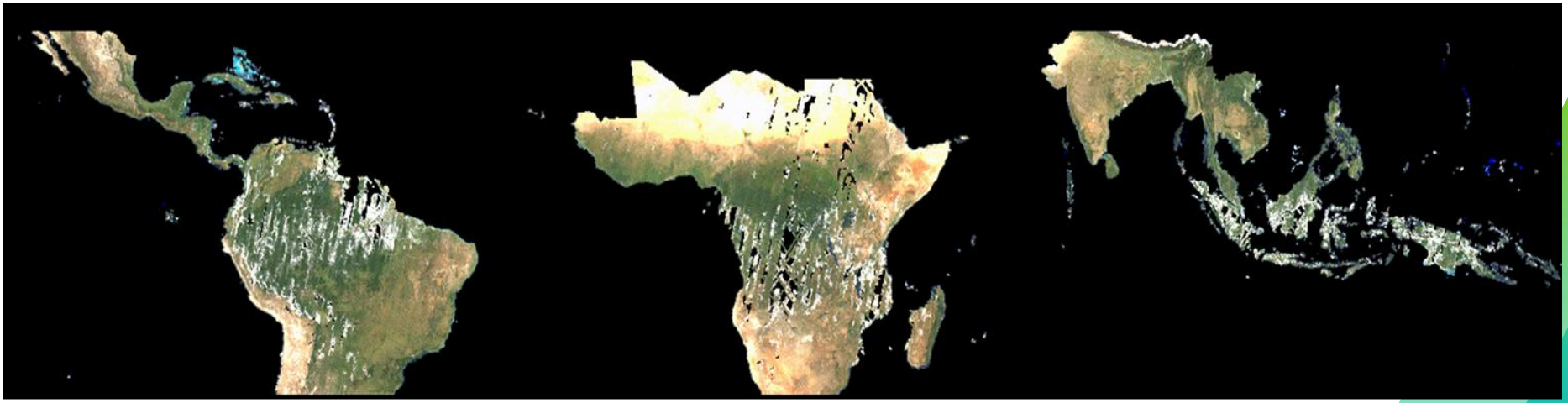
Carrasco, L., O'Neil, A.W., Morton, R.D., Rowland, C.S. Evaluating Combinations of Temporally Aggregated Sentinel-1, Sentinel-2 and Landsat 8 for Land Cover Mapping with Google Earth Engine. *Remote Sens.* 2019, *11*, 288. https://www.mdpi.com/2072-4292/11/3/288

Hirschmugl, M., Sobe, C., Deutscher, J. and Schardt, M., 2018. Combined use of optical and synthetic aperture radar data for REDD+ applications in Malawi. Land, 7(4), p.116.

Joshi, N., Baumann, M., Ehammer, A., Fensholt, R., Grogan, K., Hostert, P., Jepsen, M.R., Kuemmerle, T., Meyfroidt, P., Mitchard, E.T.A., Reiche, J., Ryan, C.M., Waske, B. A Review of the Application of Optical and Radar Remote Sensing Data Fusion to Land Use Mapping and Monitoring. Remote Sens. 2016, 8, 70.

Chang, Chia-Hao & Hsieh, Yi-Te & Wu, Shou-Tsung & Chen, Chaur-Tzuhn & Chen, Jan-Chang. (2015). Applying Image Fusion to Integrate Radar Images and SPOT Multi-spectral Satellite Images for Forest Type Classification. Taiwan Journal of Forest Science. 30. 201-209.

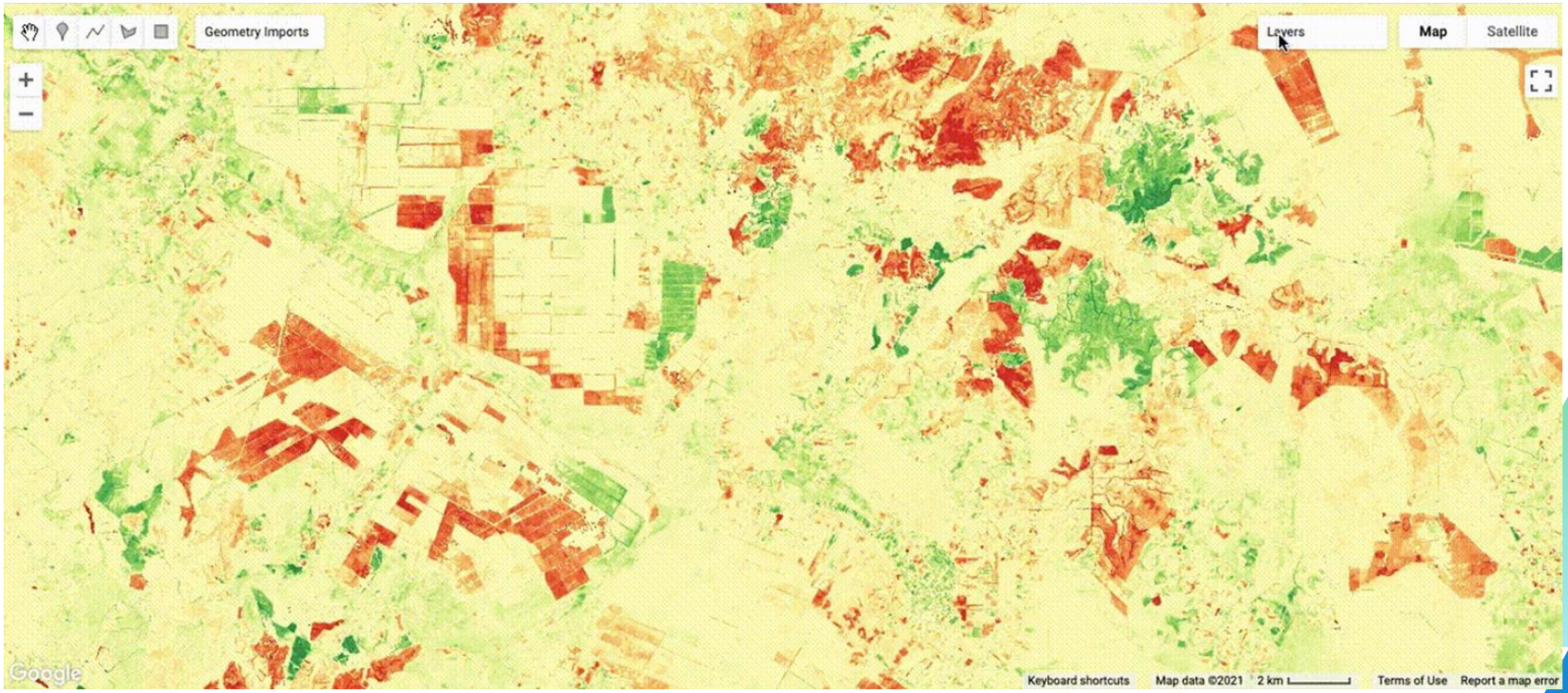
Planet data



Pan-tropical, high-resolution data offer amazing opportunities

(Slides courtesy of R. D'Annunzio)

Land phenology



CAFI validation data

explore the validation data by country, change type driver and view Planet mosaics

Filter Change Type

Select Change Type

- All -

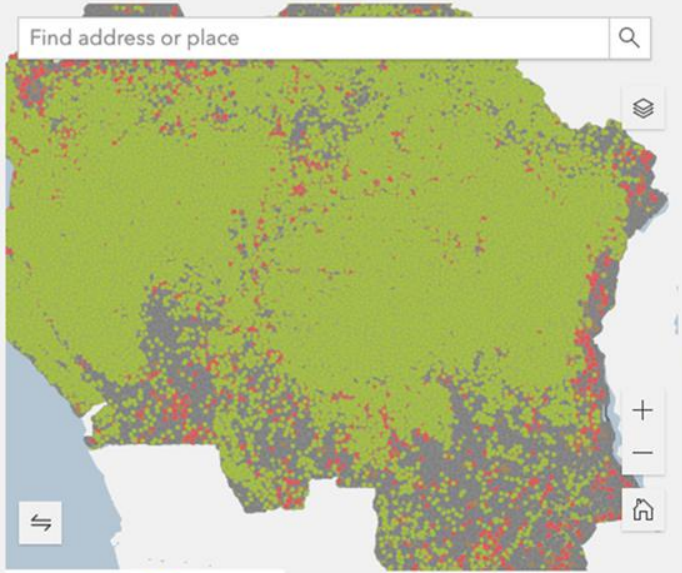
Filter Country

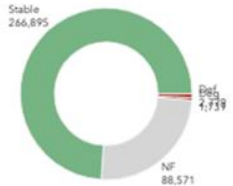
Select Country Code

Select Driver(s)

- Artisanal Agriculture
- Settlements
- Infrastruture
- Artisanal Mine
- Industrial Mine
- Artisanal Forestry
- Industrial Forestry
- Industrial Agriculture
- Other

Total points: 359,978





Add additional information

Comment on validation data

To enter information on a plot, select it in the map

< 1 of 359984 >

Validation Plot: 1

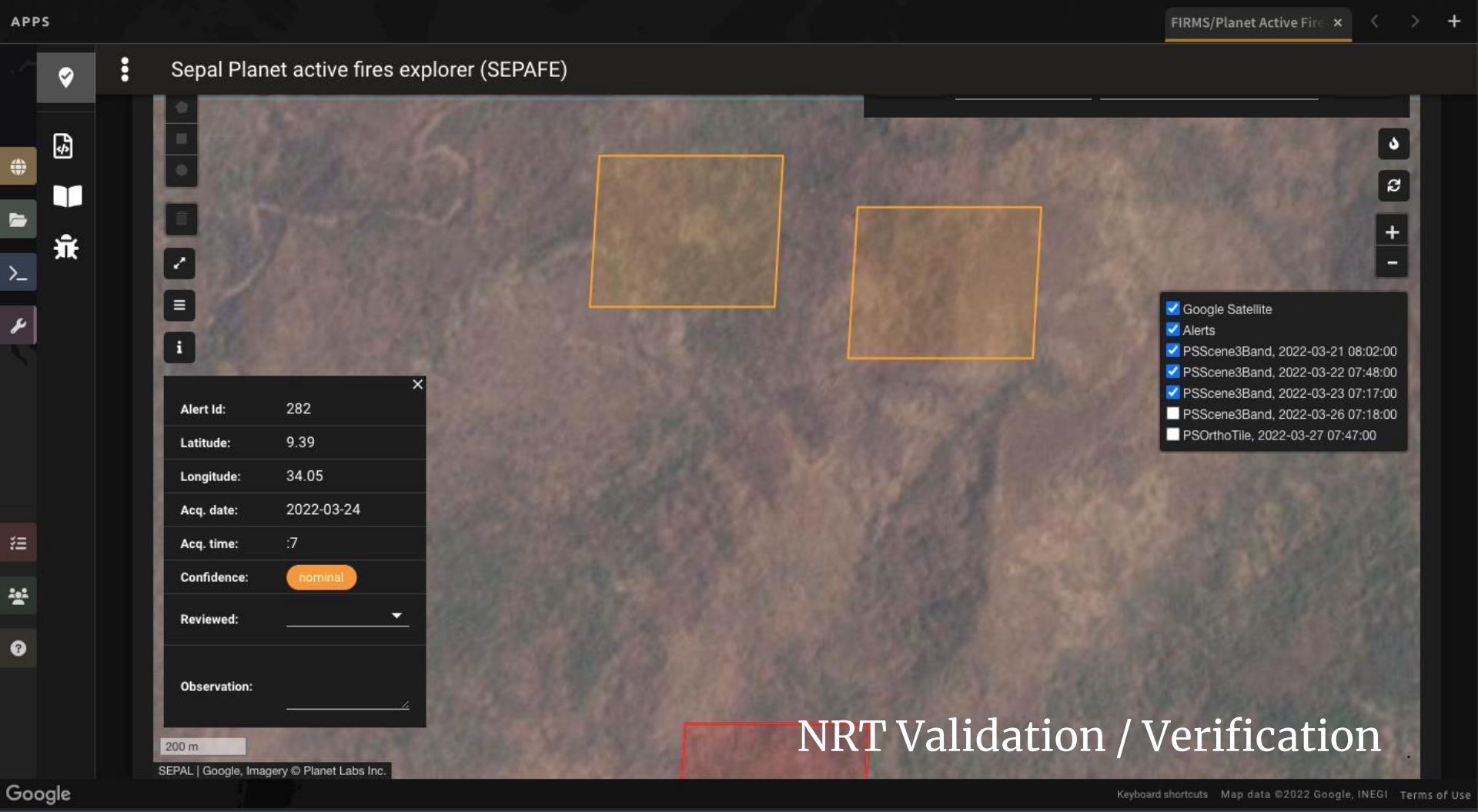
ISO	COG
LON	15.667202
LAT	-0.916955
CUSUM Code	203
CUSUM date	2019.5369873

Validation data

Planet Data

Planet Medres Normalized Analytic 2020-12 Mosaic

Planet Medres Normalized Analytic 2020-11 Mosaic


APPS
FIRMS/Planet Active Fire
Sepal Planet active fires explorer (SEPAFE)
Google Satellite
Alerts
PSScene3Band, 2022-03-21 08:02:00
PSScene3Band, 2022-03-22 07:48:00
PSScene3Band, 2022-03-23 07:17:00
PSScene3Band, 2022-03-26 07:18:00
PSOrthoTile, 2022-03-27 07:47:00
Alert Id: 282
Latitude: 9.39
Longitude: 34.05
Acq. date: 2022-03-24
Acq. time: :7
Confidence: nominal
Reviewed:
Observation:
200 m
SEPAL | Google, Imagery © Planet Labs Inc.
NRT Validation / Verification
Google
Keyboard shortcuts
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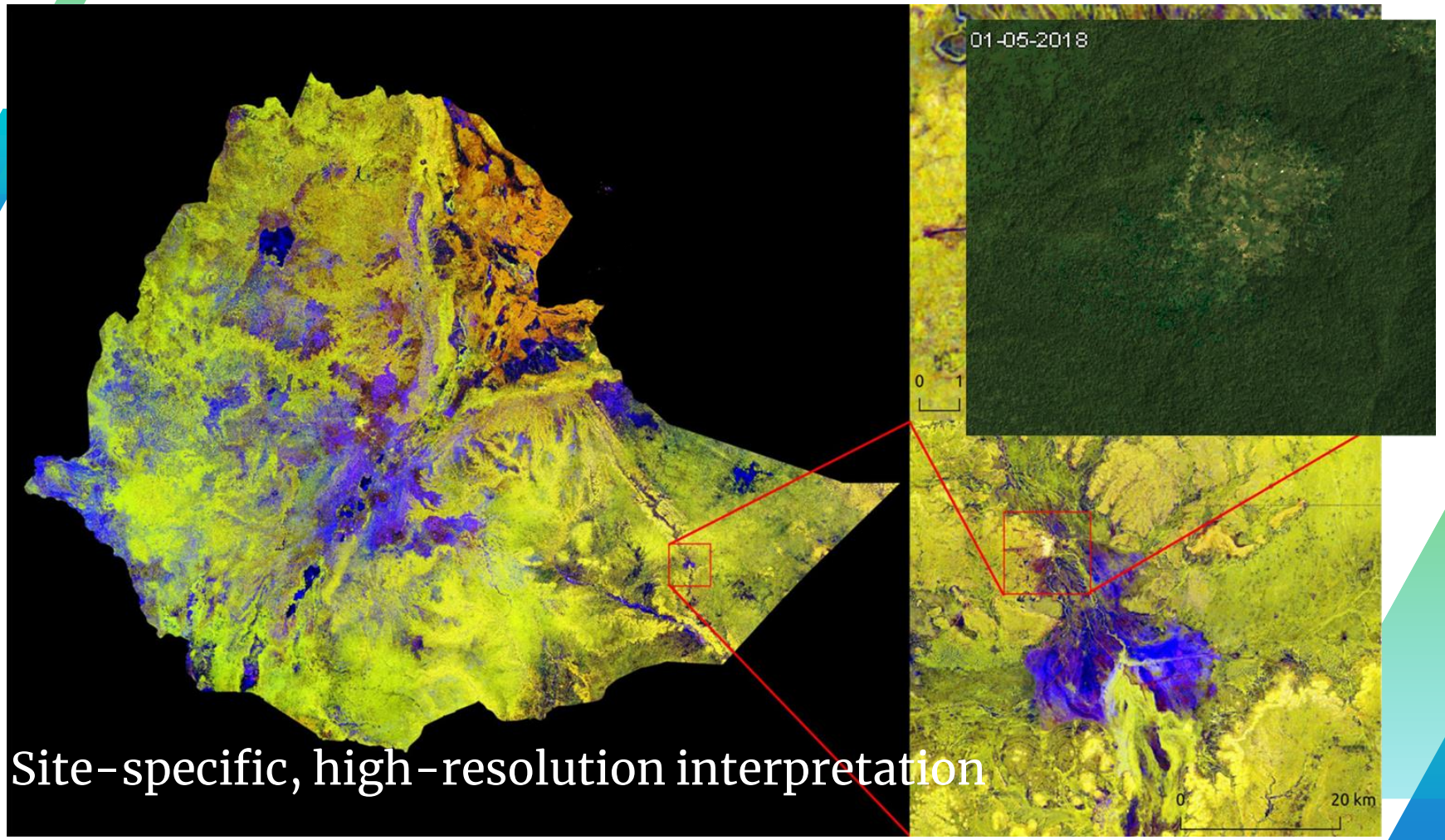
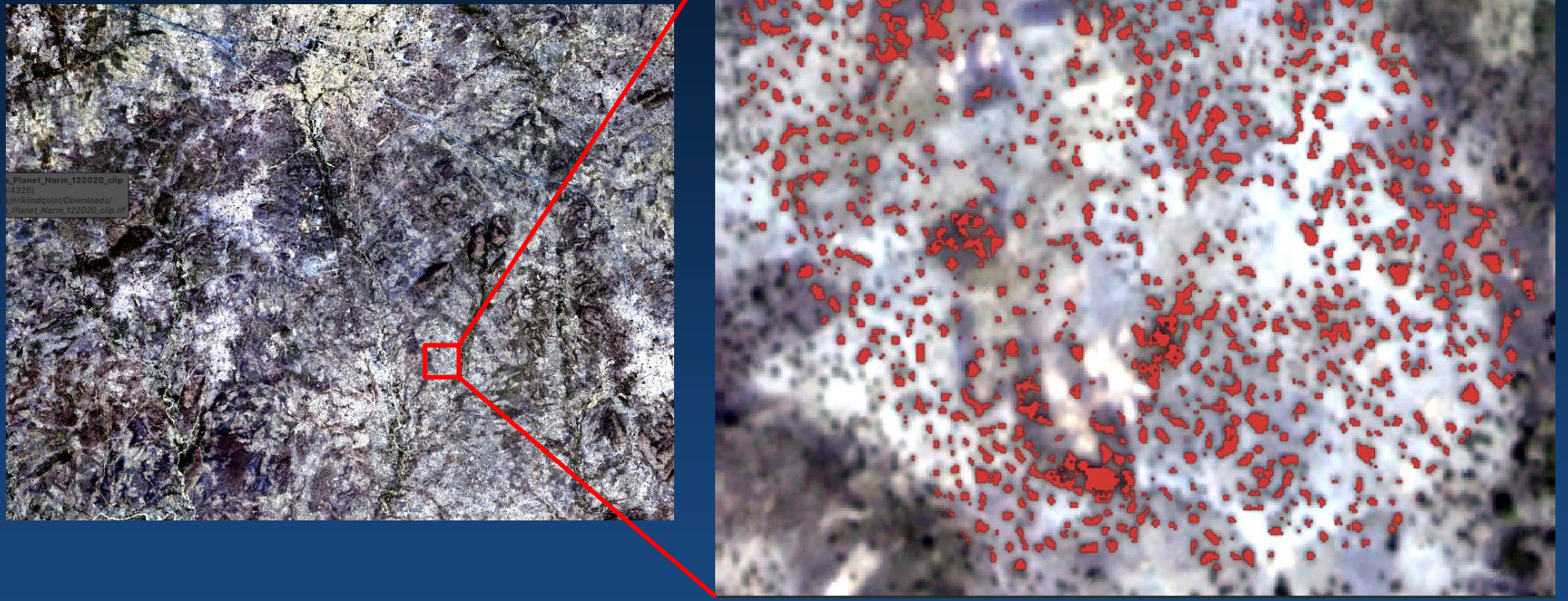


Site-specific, high-resolution interpretation



Tree crown classification

LandTrendr summary

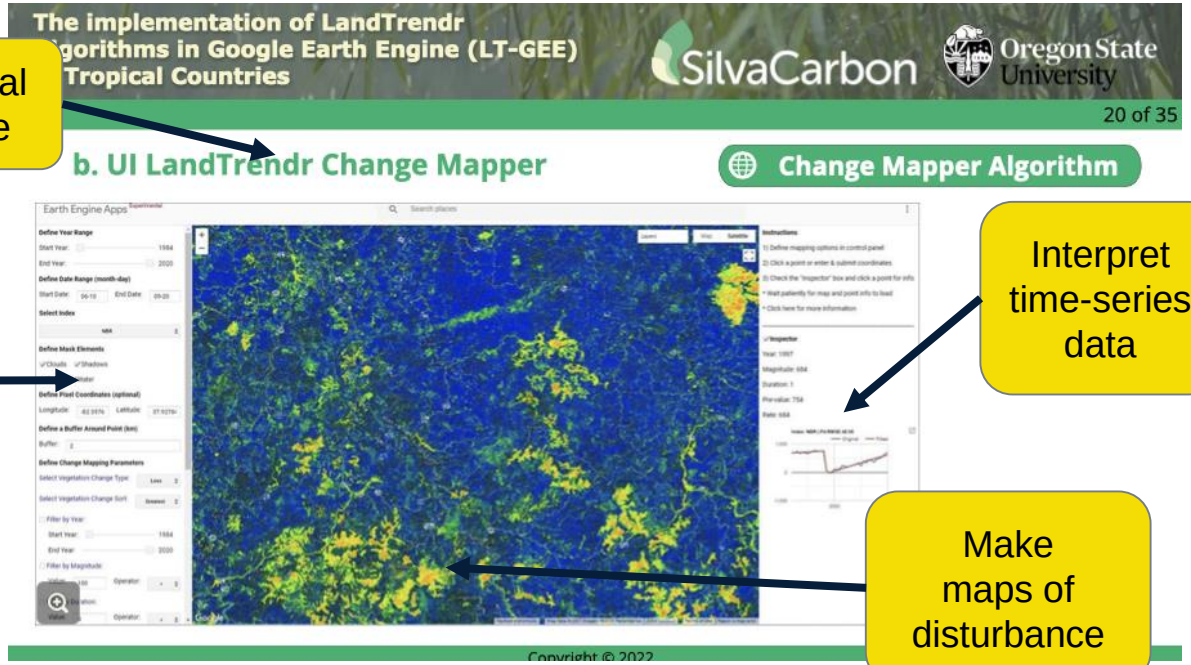
Example: What you'll learn about mapping forest disturbance

Use a graphical user interface

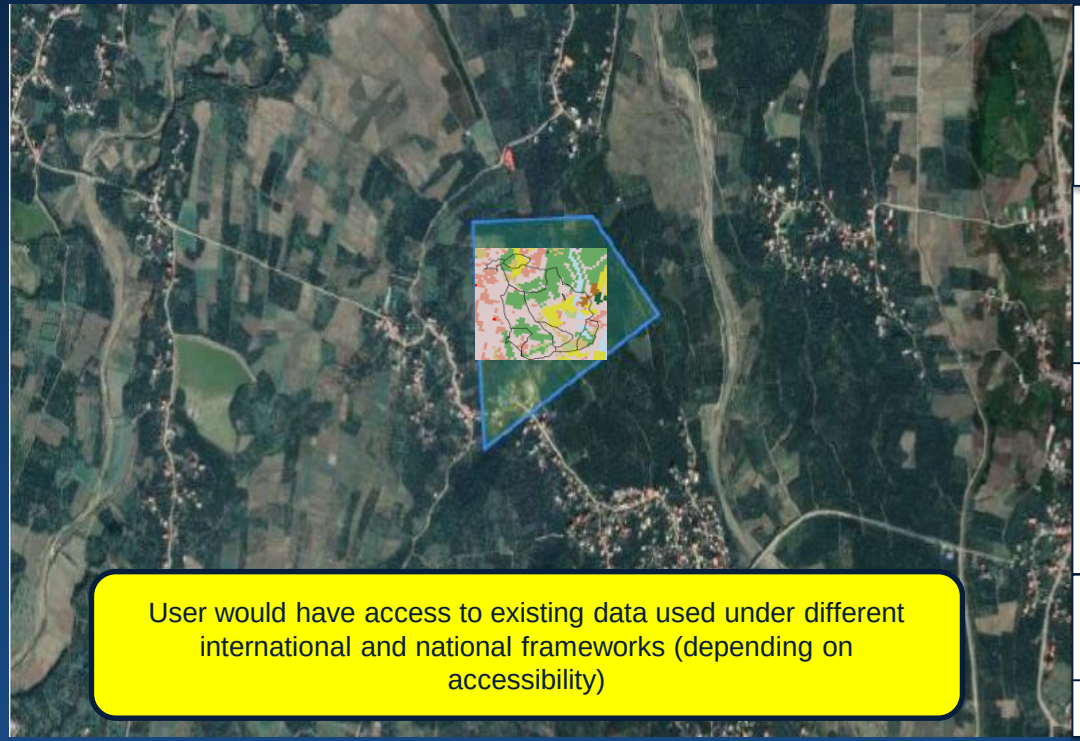
Control algorithm behavior

Interpret time-series data

Make maps of disturbance



ECOCROP: Database of Crop Constraints and Characteristics integrated in the Global Agricultural Ecological zoning (GAEZ) platform



User would have access to existing data used under different international and national frameworks (depending on accessibility)

Area of Interest

- GADM/GAUL
- Upload your AOI
- Design your AOI

Layers by ecosystem components

- Soil
- Water
- Vegetation

Layers by climatic zone

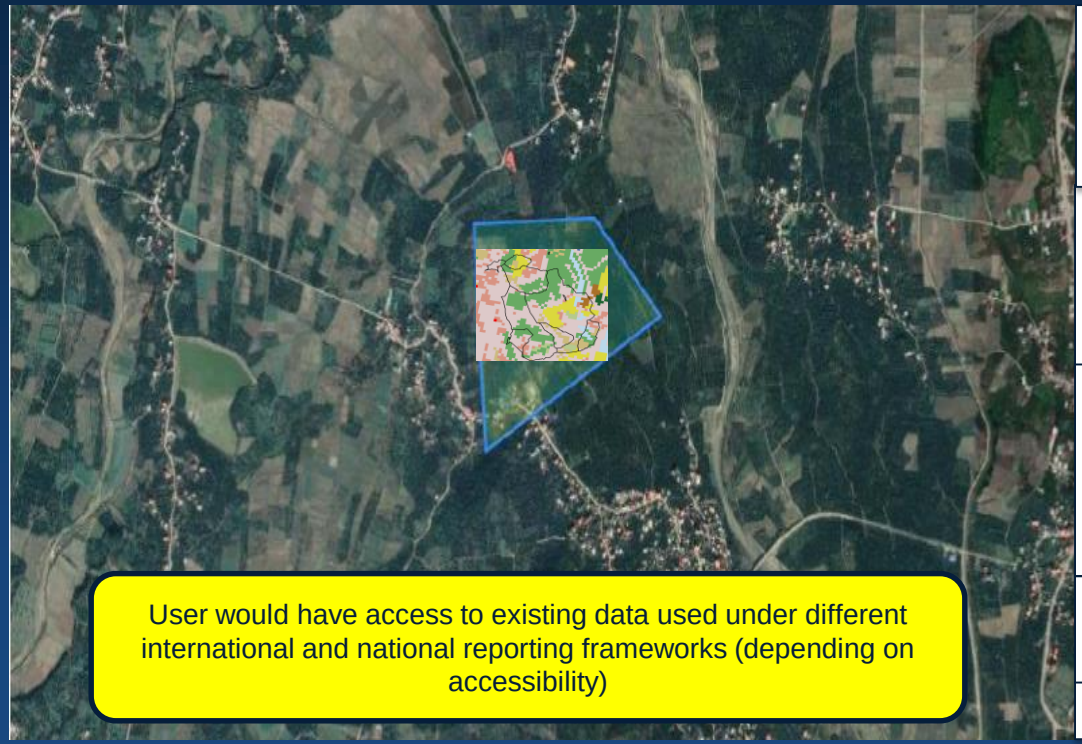
- Subtropical
- Temperate
- Dry
- Tropical

Prepare your indices

- Link to modules in SEPAL

- Download (.shp, .tif, .kml, .xls, etc.)

A FERM Platform for monitoring terrestrial ecosystem restoration



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- Download (.shp, .tif, .kml, .xls, etc.)

Integrating different platforms, data and tools

Layers by ecosystem components

- Soil
- Water
- Vegetation

Layers by climatic zone

- Subtropical
- Temperate
- Dry
- Tropical

Preparation of indices

- Link to modules in SEPAL

Frameworks

Indicators

Platforms

Data

& many others

Data are mapped considering the different indicators, criteria and frameworks
One dataset e.g. Land Cover can be used for various frameworks

Hand in Hand Geospatial Platform

Different frameworks, similar indicators, same data?

Convention on Biological Diversity

United Nations Framework Convention on Climate Change

United Nations Convention to Combat Desertification

United Nations Statistics Division

And others

We map frameworks related to ecosystem restoration and develop a database which contains the data, indicators, criteria, targets, etc.

TAKE HOME MESSAGES and link with EO

-**Agriculture, forestry and other land use** can not only **provide large-scale GHG emissions reductions, but also absorb and store CO2 at scale**. Well-designed measures can benefit biodiversity, help us adapt to climate change, secure livelihoods, improve food security and wood supplies. Agroforestry, reforestation, avoiding deforestation, managing soils and sustainable livestock management can enhance productivity, improve livelihoods and provide renewable energy.

-Positive impacts of certain **international and climate policies** on reducing emissions have been shown as for example deforestation, it argues that it is too early to say whether zero-deforestation pledges from the public and private sectors can be effective.

-- Achieving ambitious climate goals relies on **international cooperation**. Transnational partnerships are playing a growing role as technology, knowledge and experience are shared.

-**Earth Observation with long data records** and data over remote places can help in

- Validation of (climate and other) models
- Monitoring and early warning: imaging spectroscopy!
- Process understanding
- Importance of free and open EO data

Earth Observation: our wish list from policy side to ESA and the Scientific community

- Support in mapping **changes in land cover/land use** and sustainable agricultural practices: ADAPTATION monitoring
- Detect **soil properties** for action on improving soil health
- Support **agriculture** and **forest management** and assessments on biodiversity, ecosystem sustainability and environmental degradation, and to monitor lake and coastal ecosystems including water quality.
- New products asked from end users and services in the domain of agriculture, food security, raw materials, soils, biodiversity, environmental degradation and hazards, inland and coastal waters, and forestry: **distinction private and public end users**

Way forward interlinking end users and Earth Observation scientific community

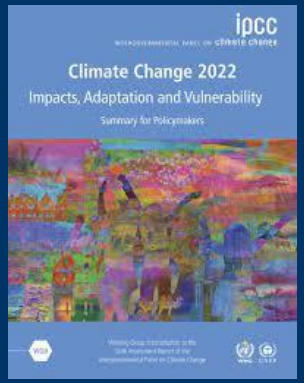
Taking into account **user requirements** in the domains of agricultural services, forestry and sustainable agricultural and forest management

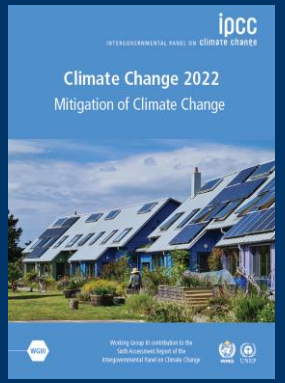
- **User inclusion** from the concrete (project) start with implementing actors/agencies
- **Data ownership** for end users: creating spatially aggregated products for countries need ‘endorsement’ at least
- Important **policy frameworks**, among others

UN SDGs [(Sustainable Development Goals], SDGs 2, 12 and 15], the EU Common Agricultural Policy (CAP), the EU Raw Materials Initiative, the UN Convention for Combating Desertification and Land Degradation, the Soil Thematic Strategy and the Soil Framework Directive, the EU Water Framework Directive and the UN Convention on Biodiversity (Aichi Targets).

Sixth Assessment Report

WORKING GROUP II & III – ADAPTATION & MITIGATION OF CLIMATE CHANGE





“The evidence is clear:
The time for action is now

Thanks for your attention!

More info on www.fao.org

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@FAOClimatechange

inge.Jonckheere@fao.org