EO for Climate Action

Mitigation, REDD+, and the Global Stocktake

Mark Dowell – European Commission, DG JRC

Sara Venturini - GEO

Agenda

1. Introductions – P. Tulkens (European Commission, DG RTD)
2. Earth Observation and Emerging reporting and verification needs under the Paris Agreement (L. Perugini, CMCC)
3. International efforts addressing EO for AFOLU Sector (F-M Seifert, ESA)
4. Progress towards the Copernicus CAMS CO2 service (R. Engelen, ECMWF)
5. EU's Action on the support to REDD+ activities: Copernicus for Forest Monitoring
    - Strong Stakeholder consultation for a Copernicus REDD+ service (M. Herold, Wageningen University)
    - Design of service and transition to operationality (T. Häusler/S. Gomez GAF, M. Massart EC DG DEFIS)
6. Conclusions/Q&A

Focus/Key Messages

GHG Emissions AND AFOLU - systemic approach

Research AND Operations - transitions & feedback

EU AND International - complementarity and synergies

Earth observations and Emerging reporting and verification needs under the Paris Agreement

Lucia Perugini
CMCC, IAFES Division

Centro Euro-Mediterraneo sui Cambiamenti Climatici

Enhanced Transparency Framework of the Paris Agreement

GHG INVENTORIES (Art.13.7.a)

ALL PARTIES

TRACK PROGRESS OF NDCs (Art.13.7.b)

ALL PARTIES

SUPPORT PROVIDED (Art.13.9)

DEVELOPED COUNTRIES

IMPACTS AND ADAPTATION (Art.13.8)

OPTIONAL

Biennial Transparency Report (BTR)

Review (Art.13.11-12)

Technical Expert Review → **COMPLIANCE COMMITEE (Art. 15)**

Facilitative Multilateral Consideration of Progress on Art. 9 (finance)

IPCC2006 For all!

Common global reporting obligation with some flexibilities

To be submitted every 2 yrs from 2024

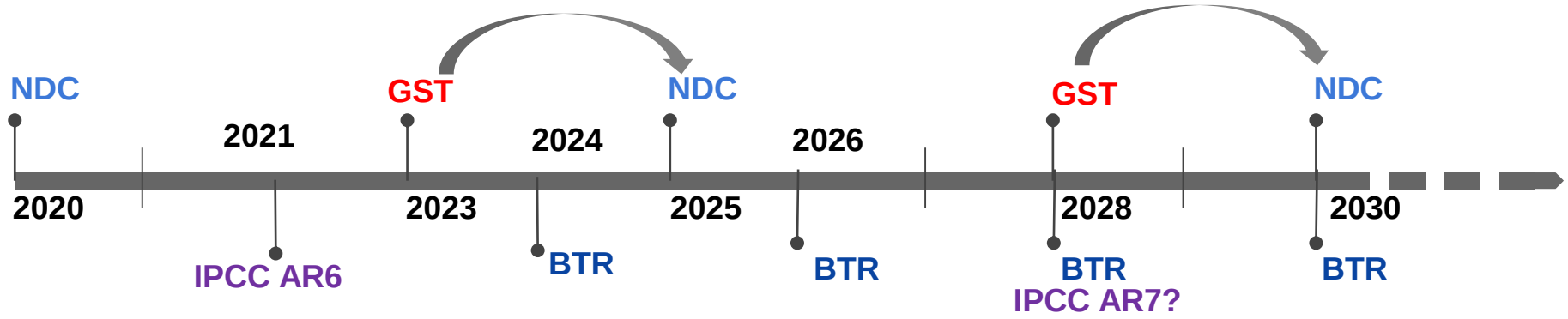
Global Stocktake (GST) process

GST is the main tool for the assessment of the achievement of the global targets of the Paris Agreement

NDC
Focus on Mitigation, Adaptation on voluntary basis (every 5 years)

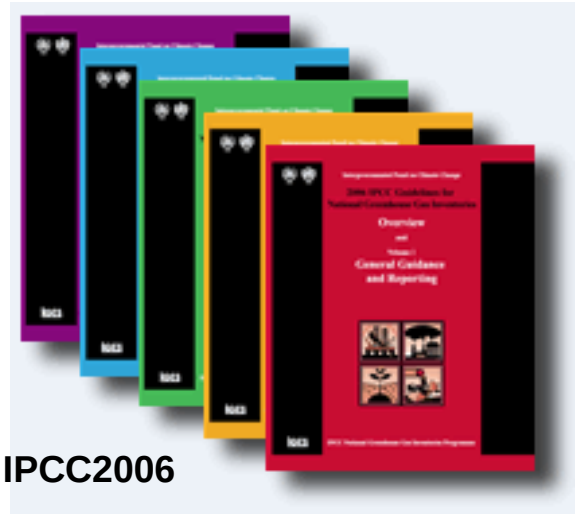
GST
Assess the collective progress against long term targets (every 5 years) – Mitigation, Adaptation and Means of Implementation

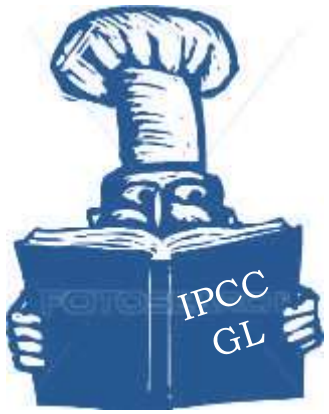
BTR
GHG inventories - Track progress of NDC implementation (mitigation and financial support)



- Two main sources of data of GST:
  - globally aggregated data from the NGHGI reports 13.7(a)) of the PA
  - best available science (art 14.1) such as IPCC.

GHG inventories by countries





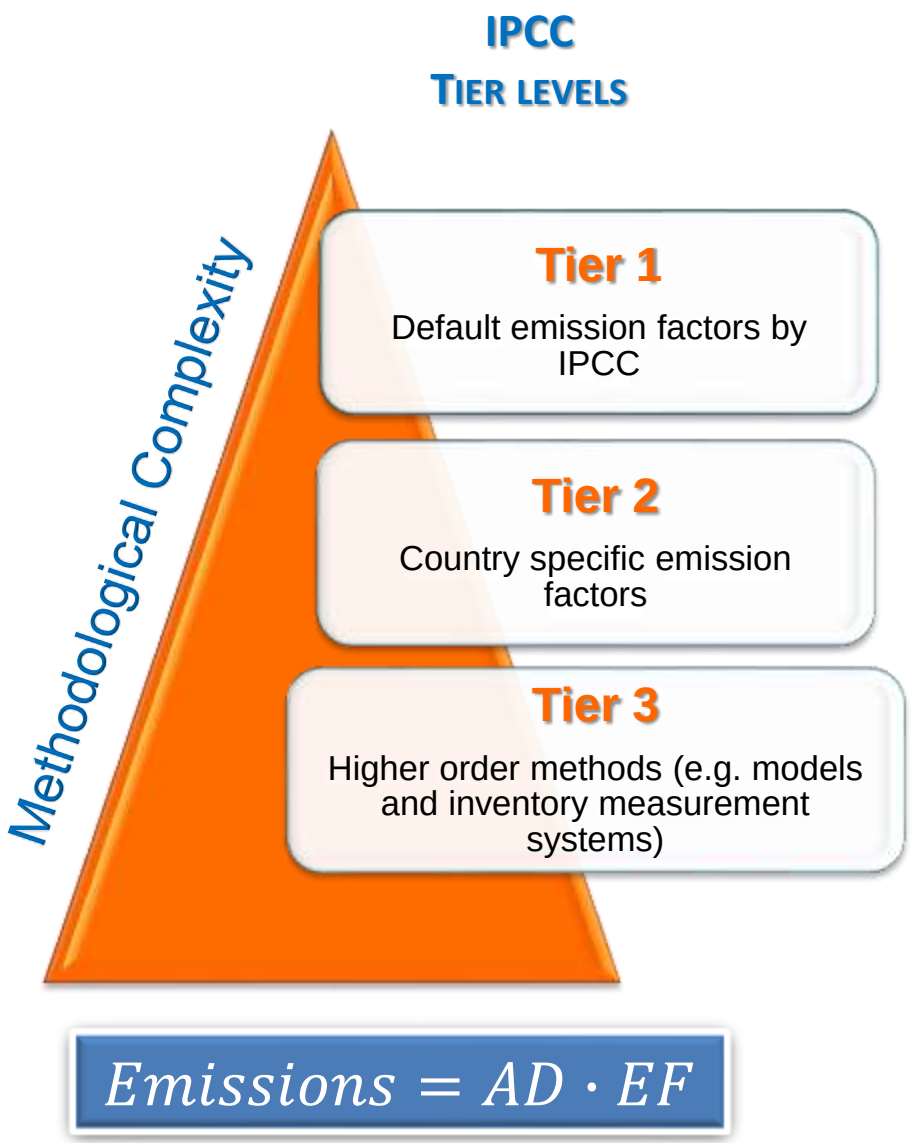
Technical Expert Review

IPCC reporting principles (TCCCA)

- ***Transparent***: fully documented
- ***Complete***: i.e. estimates are reported for all relevant categories of sources and sinks, gases, and relevant geographic areas.
- ***Consistent***: throughout time series → **since 1990!!**
- ***Comparable***: among national inventories
- ***Accurate***: i.e., no over- nor under-estimate

GHG inventories approaches and principles

Technical Expert Review



$$Emissions = AD \cdot EF$$

Scope: **anthropogenic** emissions and removals

GHG: **CO_2; N_2O; CH_4;** PFCs; HCFs; SF_6; NF_3

Scale: **Country level**; **annual basis** (yr-2)

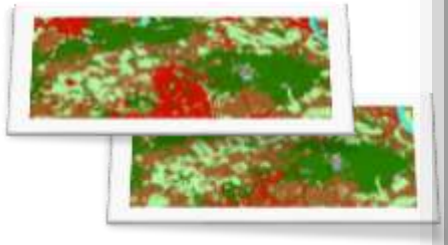
Sectors:

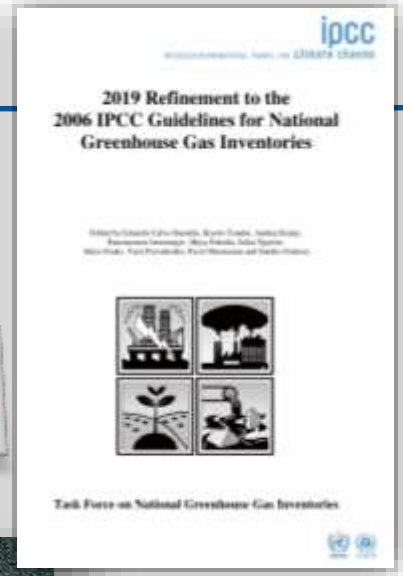
1. **Energy;**
2. **Industrial Processes and Product Use (IPPU);**
3. **Agriculture;**
4. **Land-use, Land-use change and Forestry (LULUCF);**
5. **Waste/Wastewater**

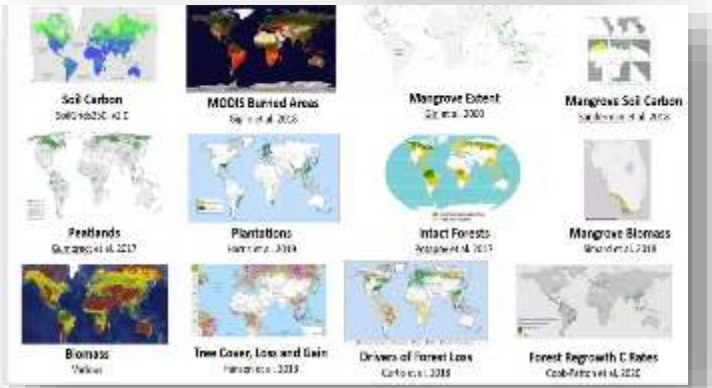
Emissions categories within sectors can be grouped while it is not possible to group between sectors.

EO IN SUPPORT OF INVENTORIES

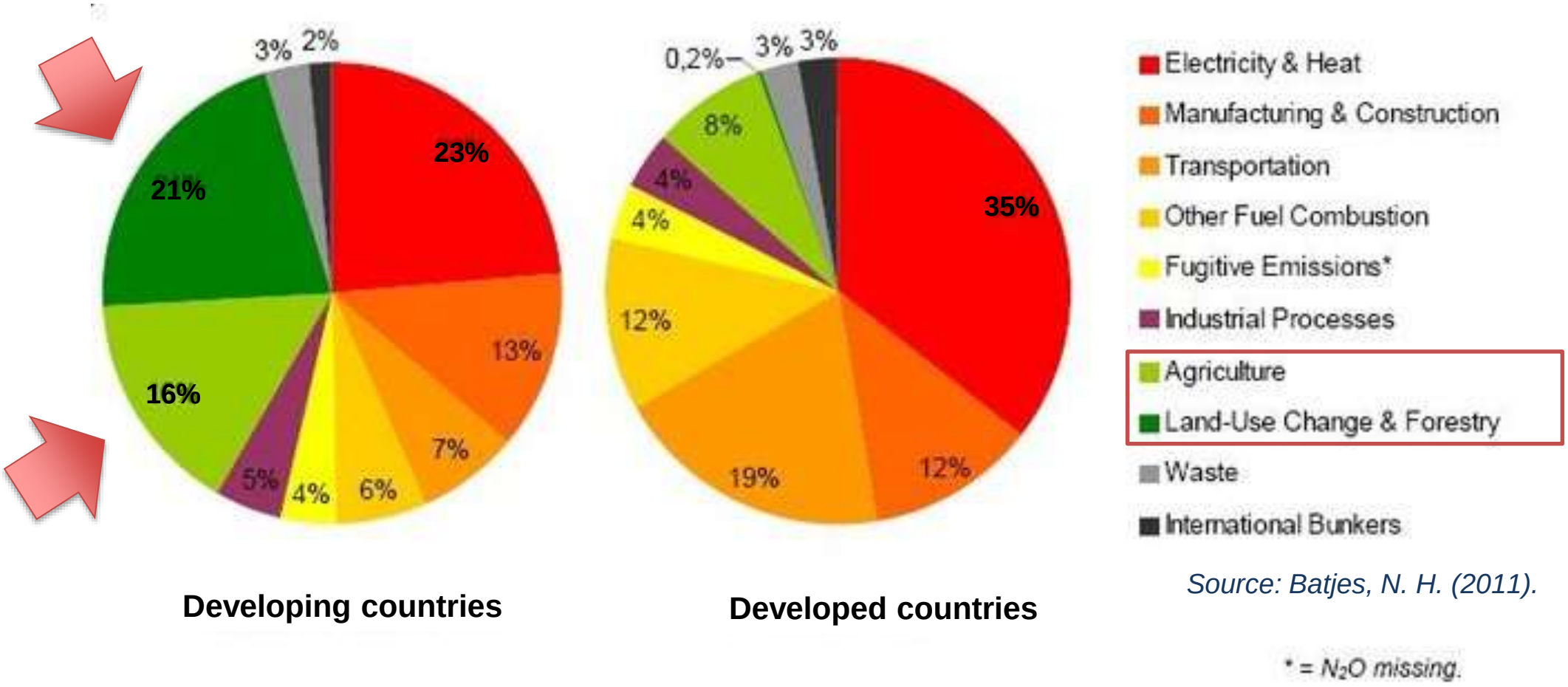
- Identification of **Land cover** elements
- Derivation of **land use** categories from land cover dynamics
- Identification of **LUC** and tracking over time
- Attribute land cover change to specific **disturbances** (e.g. harvesting, fire etc)
- **Stratification** of LU categories into uniform logical units that facilitate the estimation of emissions and removals
- **Biomass density** maps
- **Estimation of uncertainties** of surface data through high resolution satellite including drone surveys
- Support the internal verification process of the inventory **providing independent data** (QA/QC







DEVELOPING COUNTRIES NEEDS



Developing countries

Developed countries

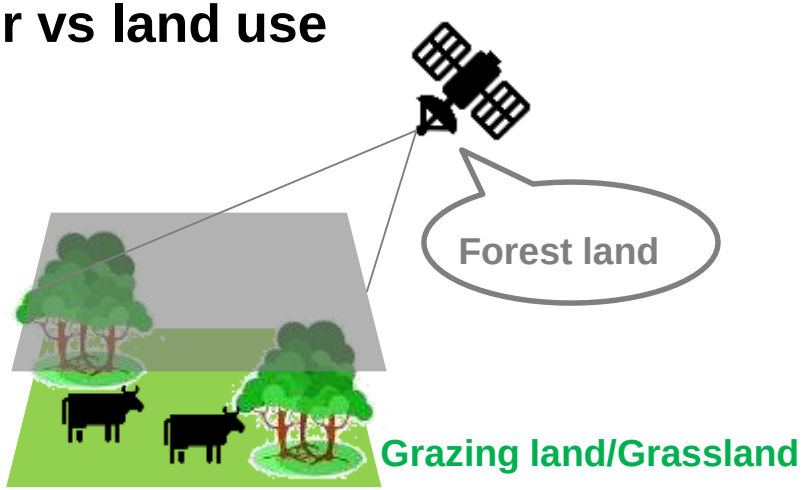
Source: Batjes, N. H. (2011).

** = N_2O missing.*

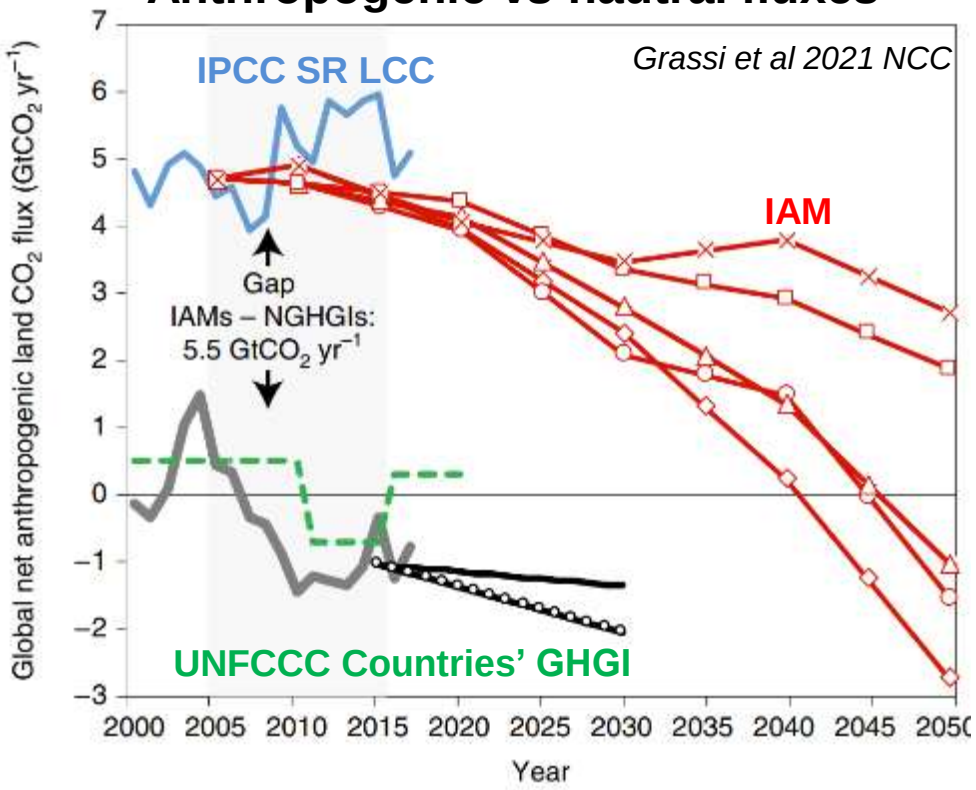
Hey, What's that?
You are not following
the recipe!

EXAMPLES OF DEFINITION AND ATTRIBUTION ISSUES

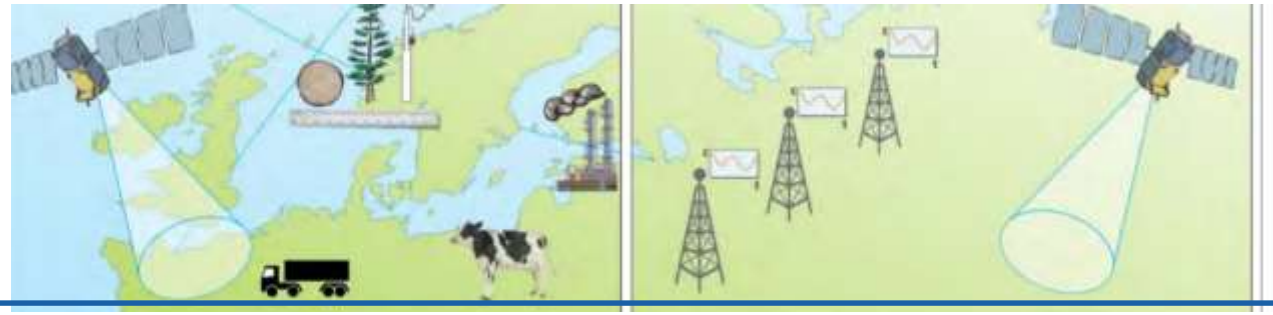
- **Minimum mapping unit** linked with forest definition in GHGI
- **Land cover vs land use**



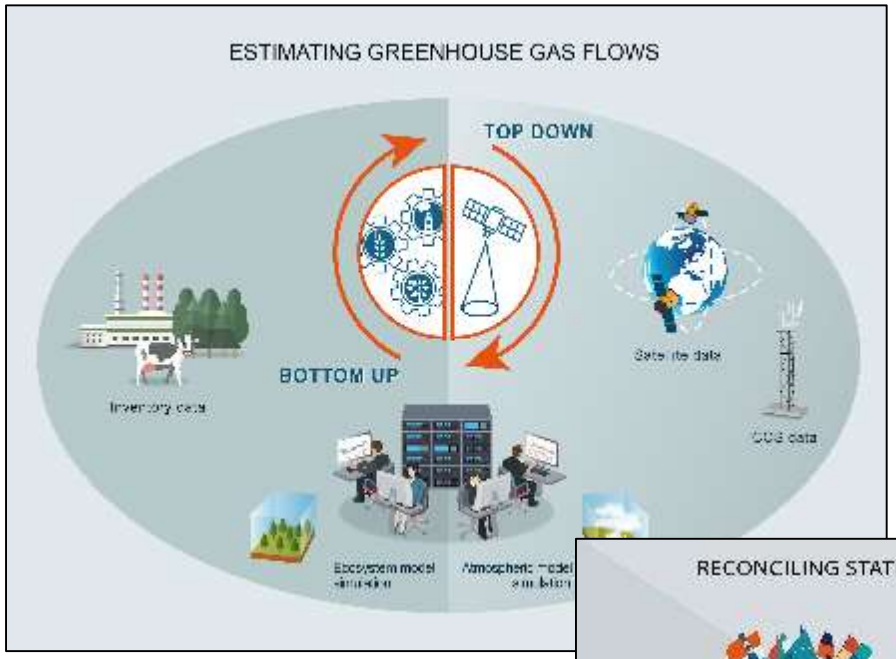
Anthropogenic vs nautral fluxes



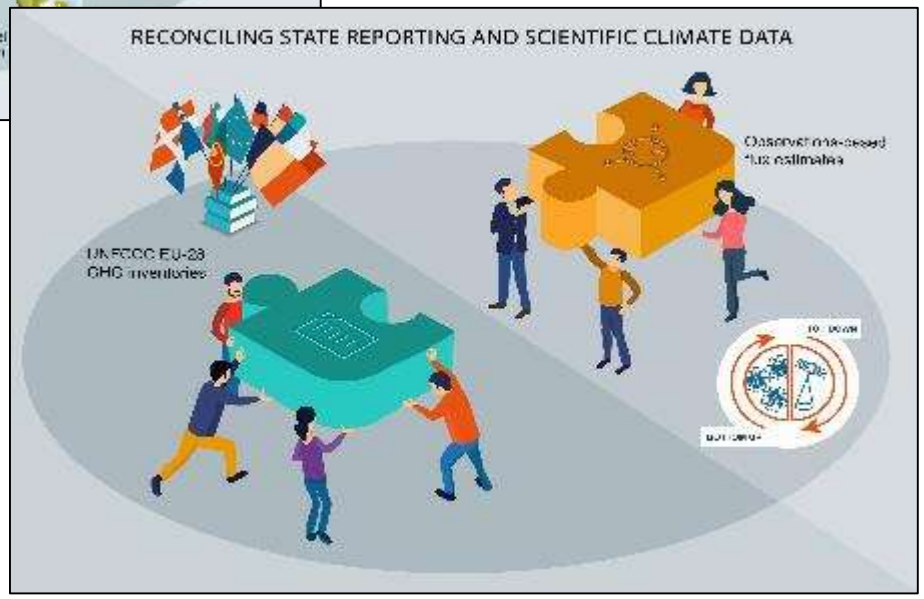
Emission attribution (sector/country)



OBSERVATION-BASED SYSTEM FOR MONITORING AND VERIFICATION OF GHG



Compare observation-based estimates with the **reported fluxes by each country to UNFCCC**



GFOI Global Forest Observations Initiative

GEO GROUP ON EARTH OBSERVATIONS

CoCO2
Prototype system for a Copernicus CO_2 service

Collaboration between GEO and the IPCC Task Force on National GHG Inventories on the topics of land representation for GHG inventories, the role of remote sensing and field measurements, as well as uncertainty.

How can EO support the process?

- **Improve the GHG inventories estimations, verification**
- **Near real time monitoring of mitigation actions**
- Emerging challenges for **developing countries** (methods, protocol, tool and research infrastructure should consider related costs, maintenance effort and knowledge needed)
- Need of full understanding **terms, rules, procedures and guidelines** for relevant inputs
- **Inventory data can offer a good source of data** for modellers to develop tools and methods that can be then used in the GHG inventory.
- Close cooperation with **inventory agencies**
- **Increase awareness** of emerging tools and data

AFOLU Roadmap and GFOI

Frank Martin Seifert (ESA)

EO for Climate Action: Mitigation, REDD+, and the Global Stocktake
EU Pavilion @ COP26
1 November 2021

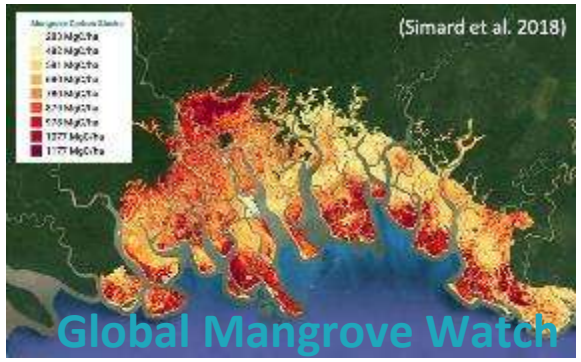
AFOLU

Agriculture, Forestry and Other Land Use (AFOLU) contributes the second largest source of emissions (after fossil fuel use) globally, and is the primary source of emissions in many developing nations

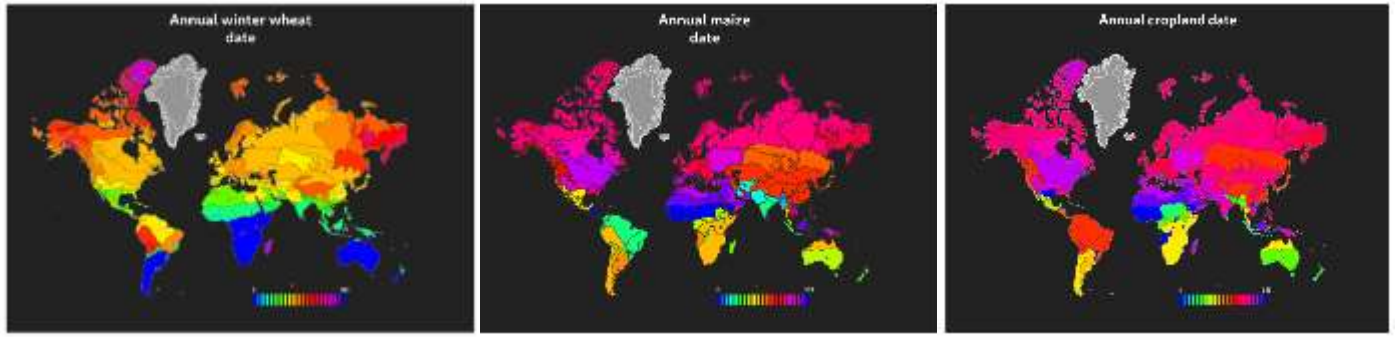
Aboveground Biomass Density (Mg/ha)

Land Cover

Forests



Mangroves



Agriculture

CEOS GST Portal ➔ https://ceos.org/gst/

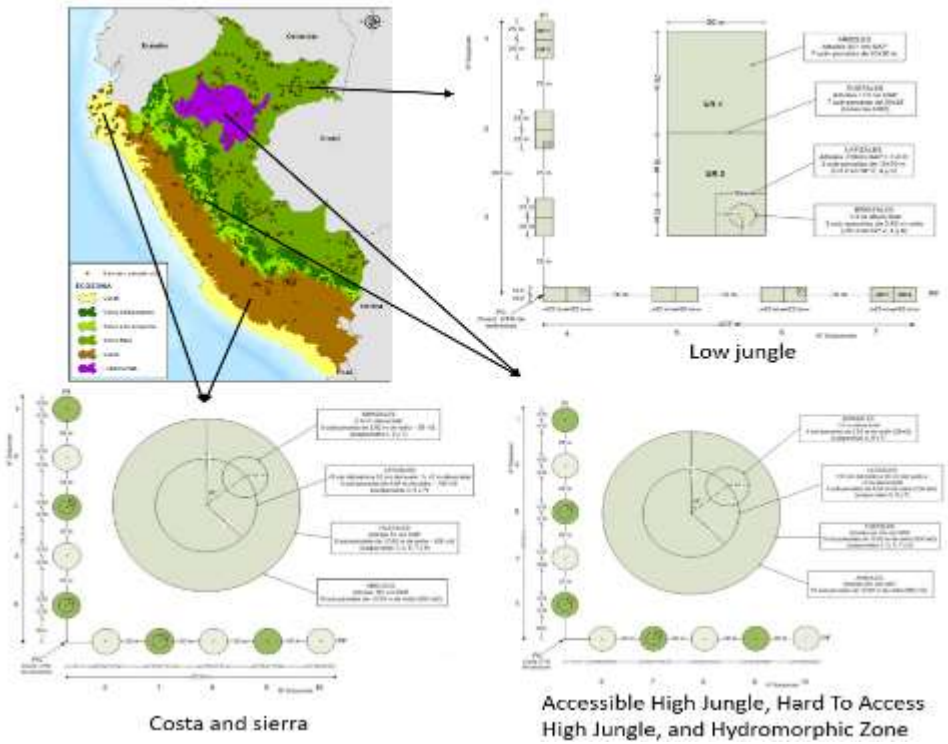
AFOLU for Mitigation

- Earth Observations play a critical role for tracking land use change.
- In the context of the Global Stocktake (GST), AFOLU emissions are estimated from the product of the *Activity Data* (i.e. number of acres of forest converted to agriculture) and an *Emission Factor* (i.e. # of tons of CO_2 released per acre)

Emissions/removals = Activity Data × Emission Factor

- **Activity Data:** Space-based data are a key source of Activity Data
- **Emission Factors:** Above ground biomass measurements and fire radiative power provide insight into forest emission factors
- Only apply to “Managed Land”
  - If another 10 million hectares burn in Siberia, most of these emissions are not counted because they are not on managed land

Biomass – Calibration of Global CCI Biomass Map in Peru

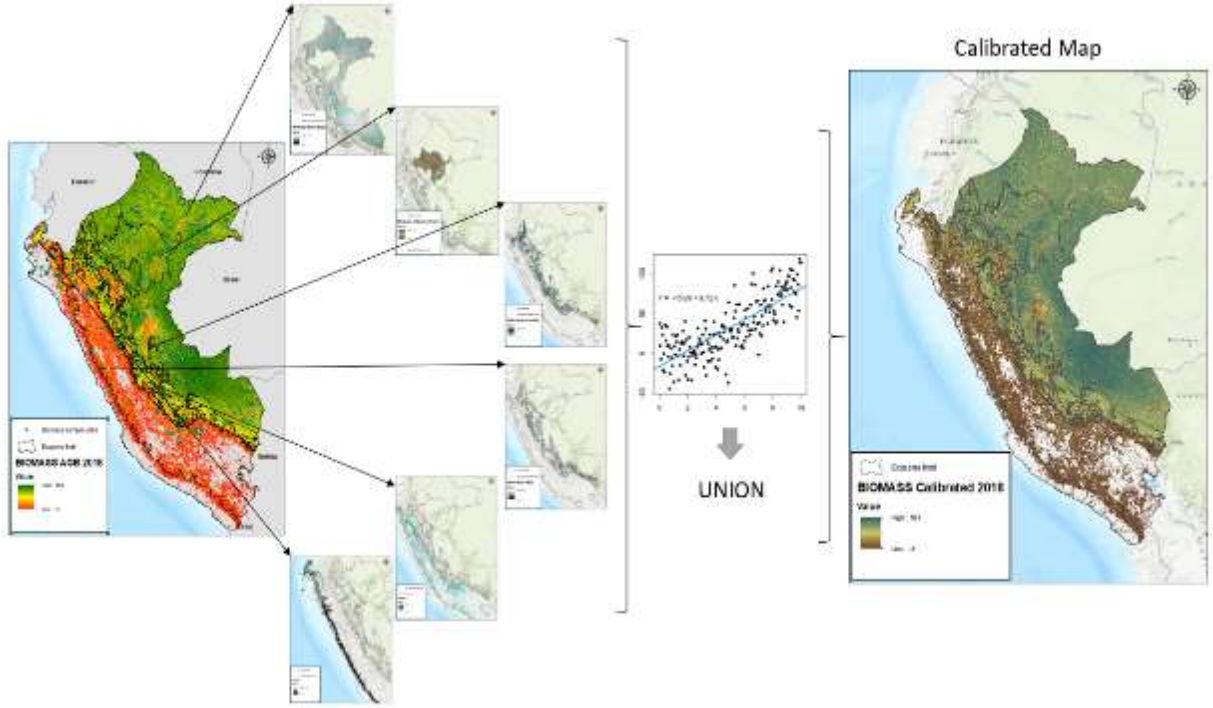


The carbon stored in the forests of Peru is measured from NFI Data by ecozones:

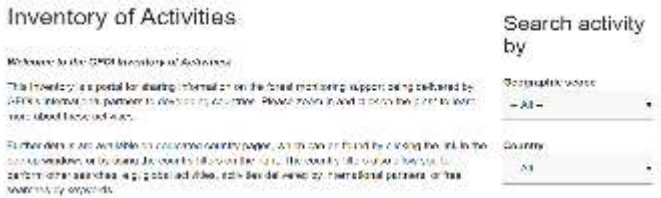
i) Coast,
ii) Highlands
iii) Accessible High Forest
iv) High Forest of Difficult Access
v) Low Forest

Current work:

1. Peru is using the CCI biomass map (AGB) to update ecozone emission factors in the Peruvian Amazon.
2. calibrating these maps using parcel field data to obtain a spatially explicit biomass map for all ecozones in Peru.



GFOI – Interaction with countries



450 activities, **70** partners worldwide

#GFOI2020 Webinar Series

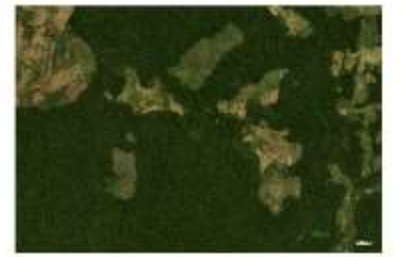
7 Webinars

Guidance used regularly in

50+ countries

NEW V3.0 In EN, FR, ES

10 Online Forestry Courses

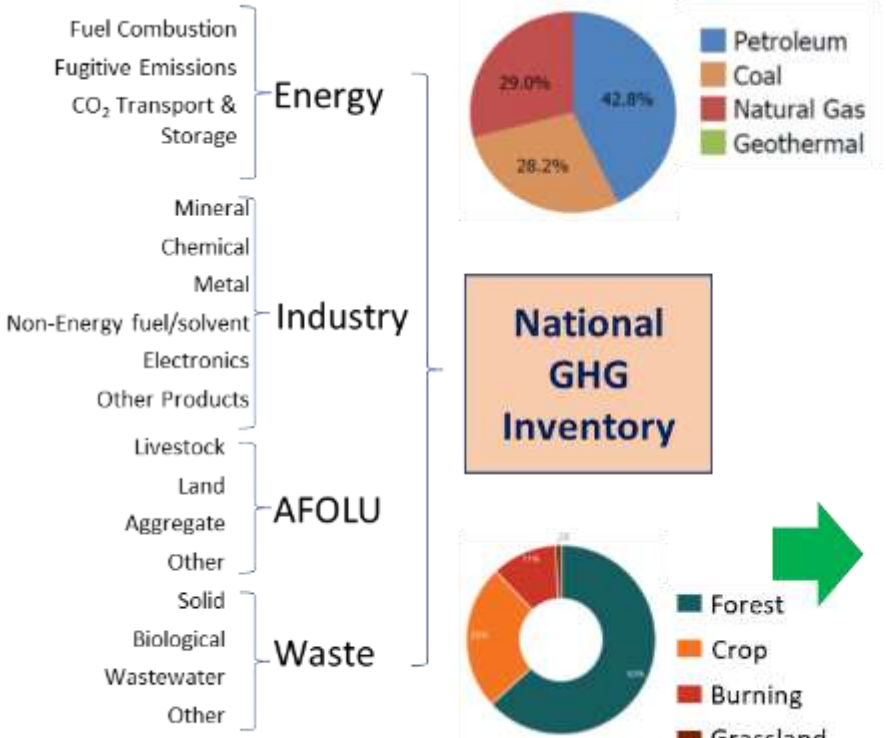


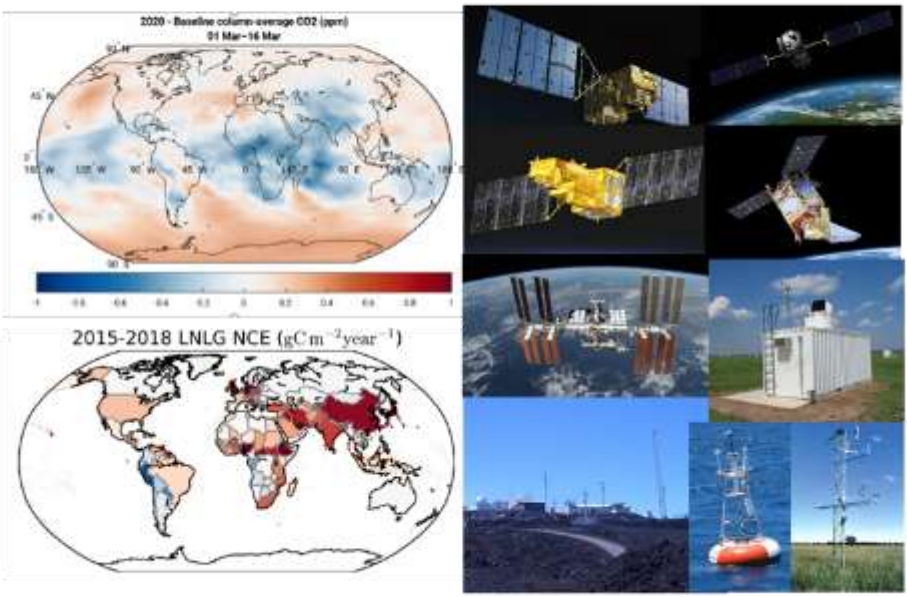
Norway's free satellite data programme now in place to combat deforestation

We are excited to share the news that thanks to the contributions of GFOI leading partner Norway's International Climate and Forests Initiative (NICFI) anyone can now access free high-resolution satellite imagery to support efforts to stop deforestation and save the world's tropical forests. Norway's partnership with Kongsberg Satellite Services (KSAT), Planet and Airbus becomes operational today.
Through this new programme, Planet Basemaps of the full tropical land mass are accessible:

Mitigation – GHG

Bottom-up national GHG inventories can be combined with top-down atmospheric GHG budgets to produce a more complete and transparent Global Stocktake





Bottom-up GHG Inventories

Top-down GHG Budgets

Systematic Observations

United Nations Climate Change

Paris Agreement

PARIS2015 COP21·CMP11

- Adaptation
- Loss & Damage
- Capacity Development / Technology transfer
- National Reporting / Global Stocktake
- Mitigation

Transparency Framework

Global Stocktake

Systematic Observations Community

WORLD METEOROLOGICAL ORGANIZATION

EUROPEAN COMMISSION

CEOS The Committee on Earth Observation Satellites

GCOS GLOBAL CLIMATE OBSERVING SYSTEM

ECMWF

DLR

bc3

EUMETSAT

JAXA

GEO GROUP ON EARTH OBSERVATIONS

esa

NASA

Progress towards the Copernicus CAMS CO_2 service

Atmosphere Monitoring

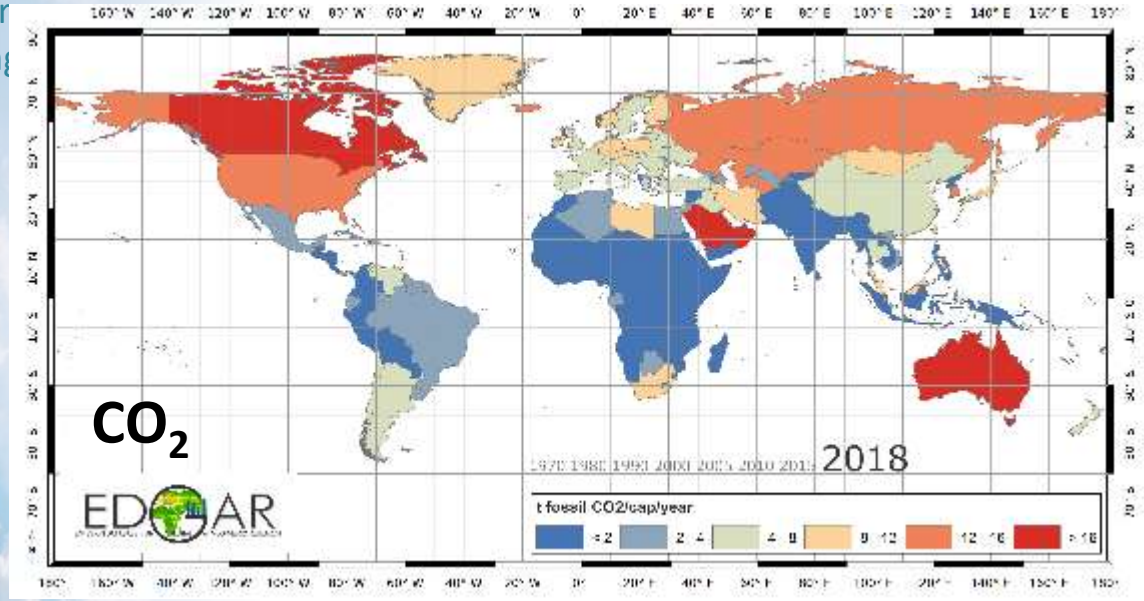
Richard Engelen
Deputy Director of CAMS
Project Coordinator of CoCO2

Copernicus
Europe's eyes on Earth

European Commission

Understanding our emissions and how they change

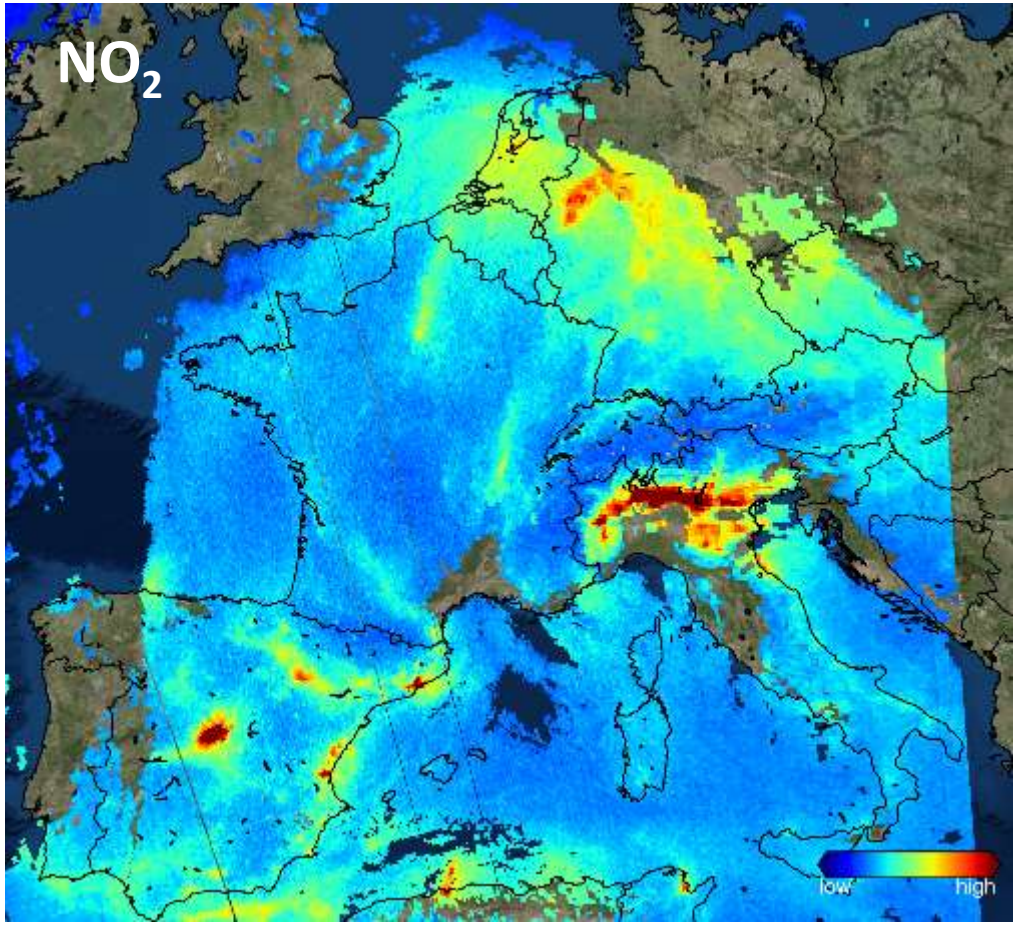
Atmospher
Monitoring



CO_2 emission estimates based on nationally reported data

Observing atmospheric composition from space is a rapidly developing field. Many exciting new instruments, large and small, are being developed and launched.

Can we use Earth observations to improve our knowledge of anthropogenic emissions?



contains modified Copernicus Sentinel data (2017), processed by KNMI/ESA

NO_2 tropospheric columns observed by Sentinel-5p

PARIS2015 UN CLIMATE CHANGE CONFERENCE COP21·CMP11

The European Green Deal

Copernicus Europe's eyes on Earth

European Commission

Atmosphere Monitoring

Is this information sufficient for monitoring our climate goals?

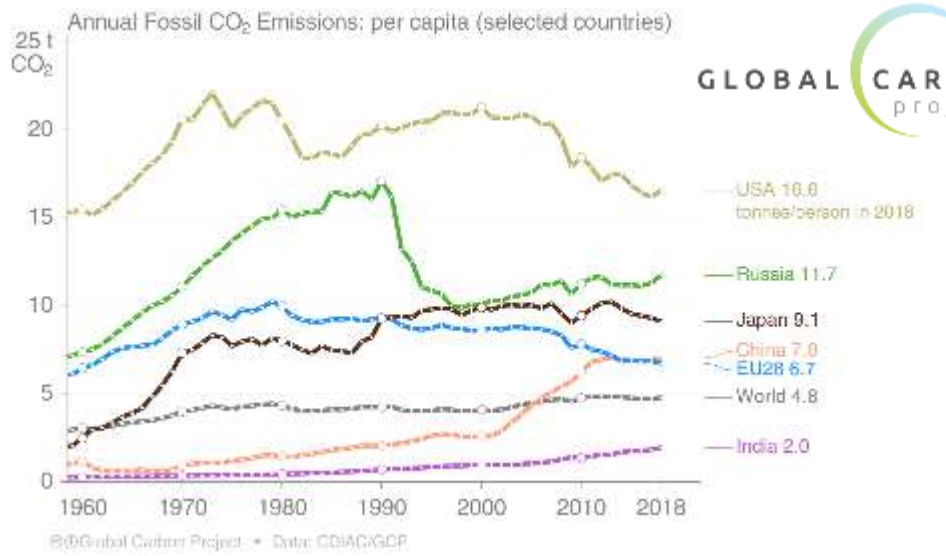
The nationally reported emissions are:

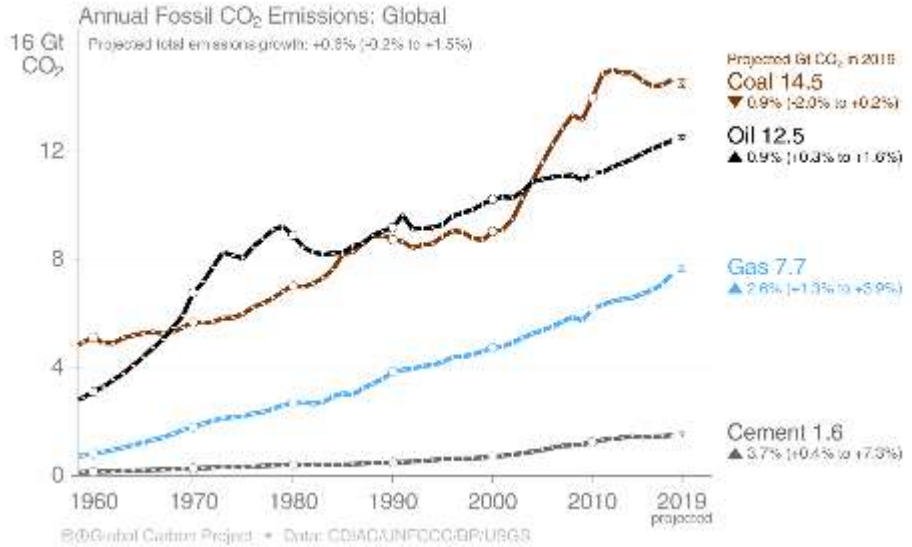
- based on internationally agreed guidelines
- accurate, especially for Annex I countries
- split out by sector

But:

- lag in time (~2 years)
- have no detailed spatial information
- have no detailed temporal information

To achieve a more detailed and timely monitoring of emissions in support of climate mitigation actions, we need additional information.





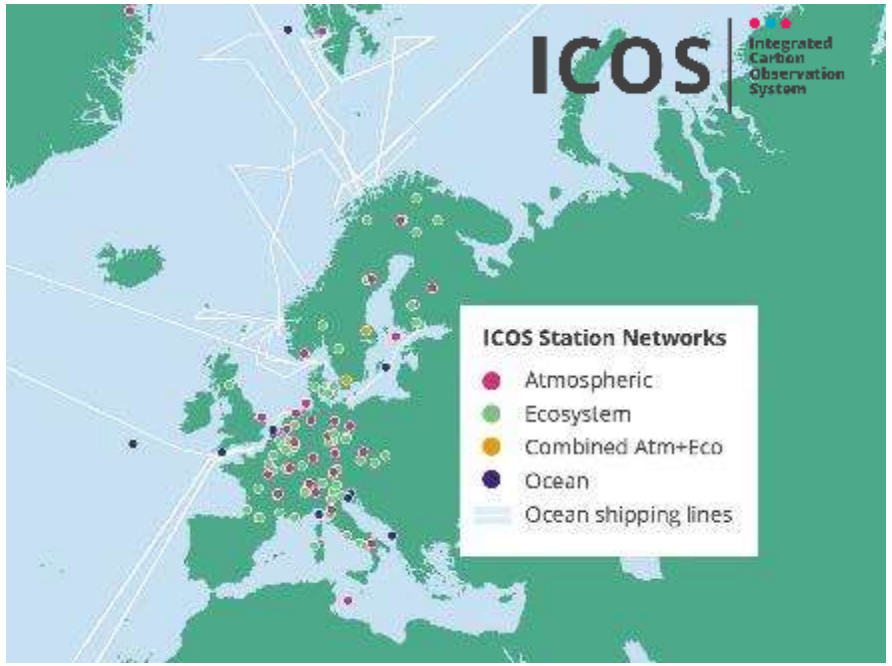
ECMWF Copernicus European Commission

Atmosphere Monitoring

The role of observation-based information

esa EUMETSAT European Commission

Observations provide another source of real-time information on emissions.
While indirect, observations are globally consistent and can often be calibrated against internationally agreed standards.



WORLD METEOROLOGICAL ORGANIZATION
WEATHER. CLIMATE. WATER

IG3IS Integrated Global Greenhouse Gas Information System

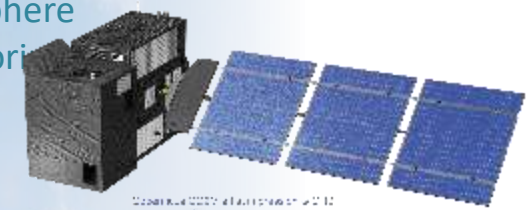
International coordination

CEOS
Committee on Earth Observation Satellites

ECMWF Copernicus European Commission

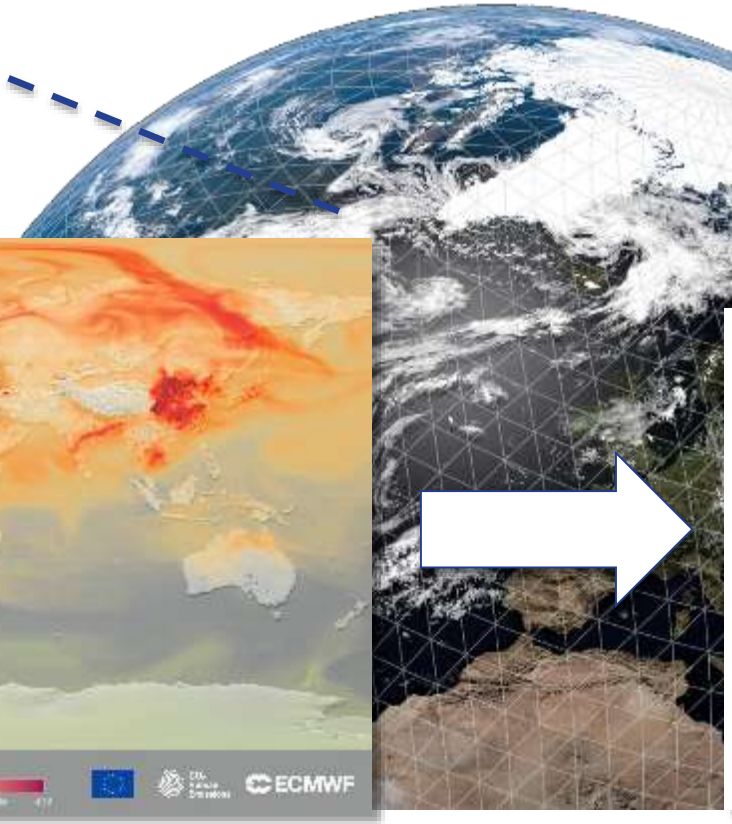
Challenges of observation-based emission monitoring

Atmosphere Monitori

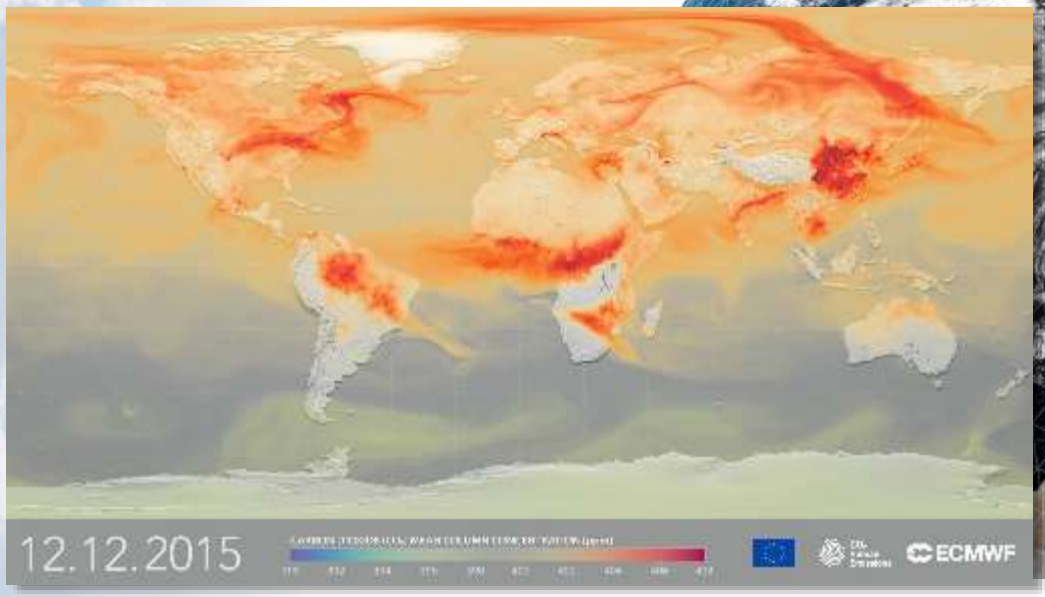


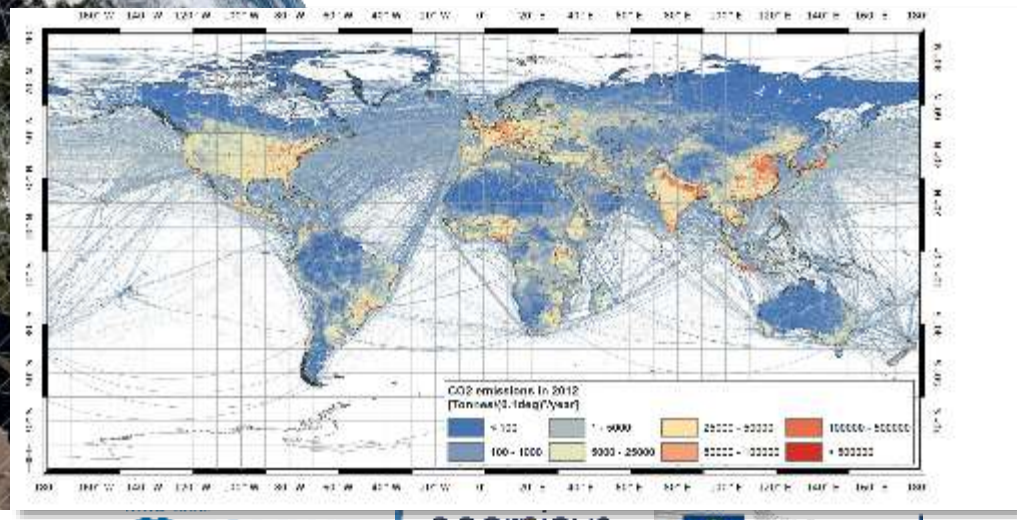
1. Satellites do not measure emissions directly; they measure the impact of emissions on the atmosphere.

2. Satellites see only the total impact of anthropogenic and natural effects.



Earth System models are used to translate the observations into emission estimates.

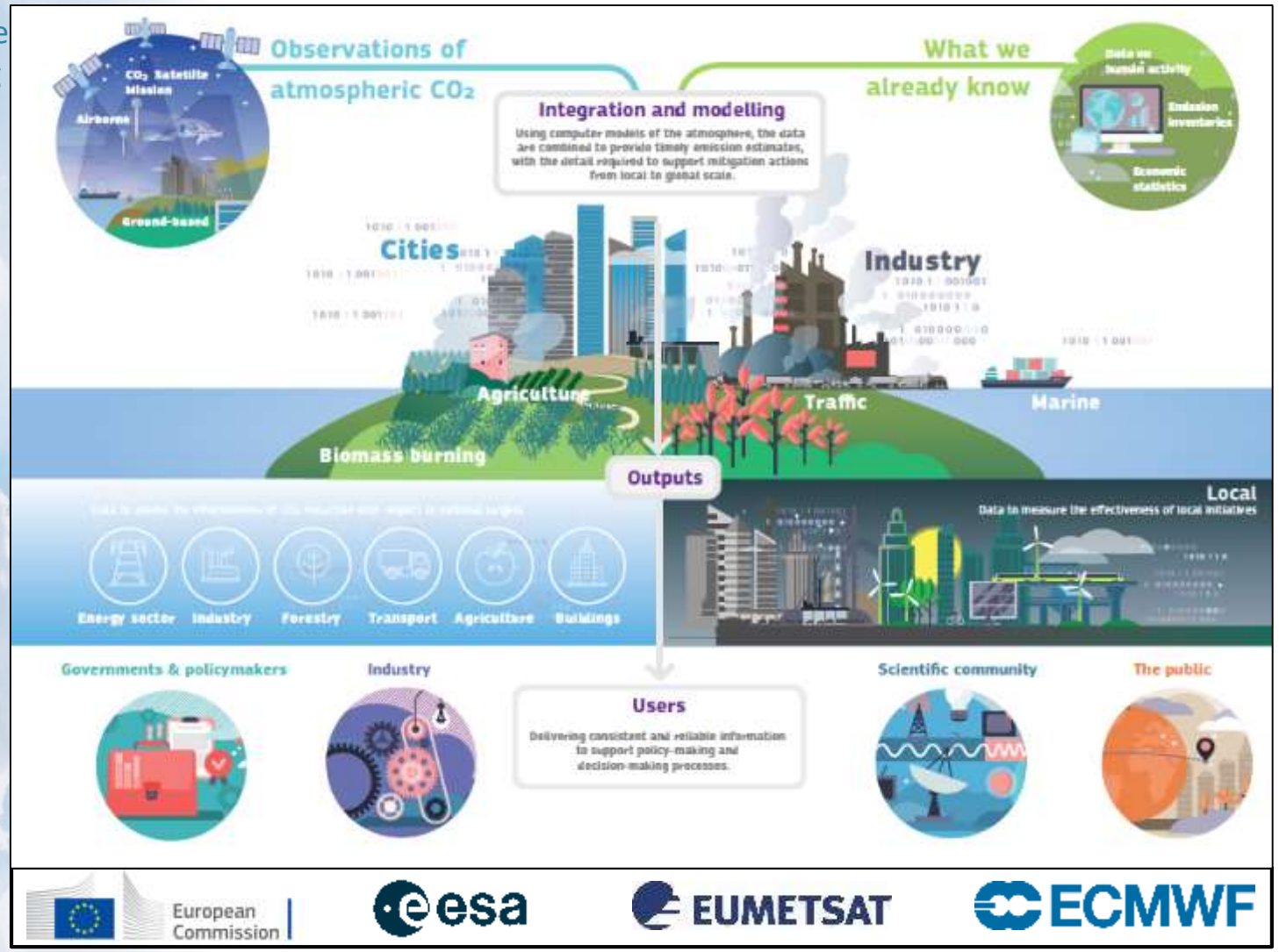




ECMWF opernicus European Commission

Atmosphere Monitoring

Ramping-up of a new Copernicus CO_2 monitoring service



A European contribution to CEOS, GCOS, GEO, and WMO (IG3IS) efforts in support of the Paris Agreement.

Copernicus
Europe's eyes on Earth

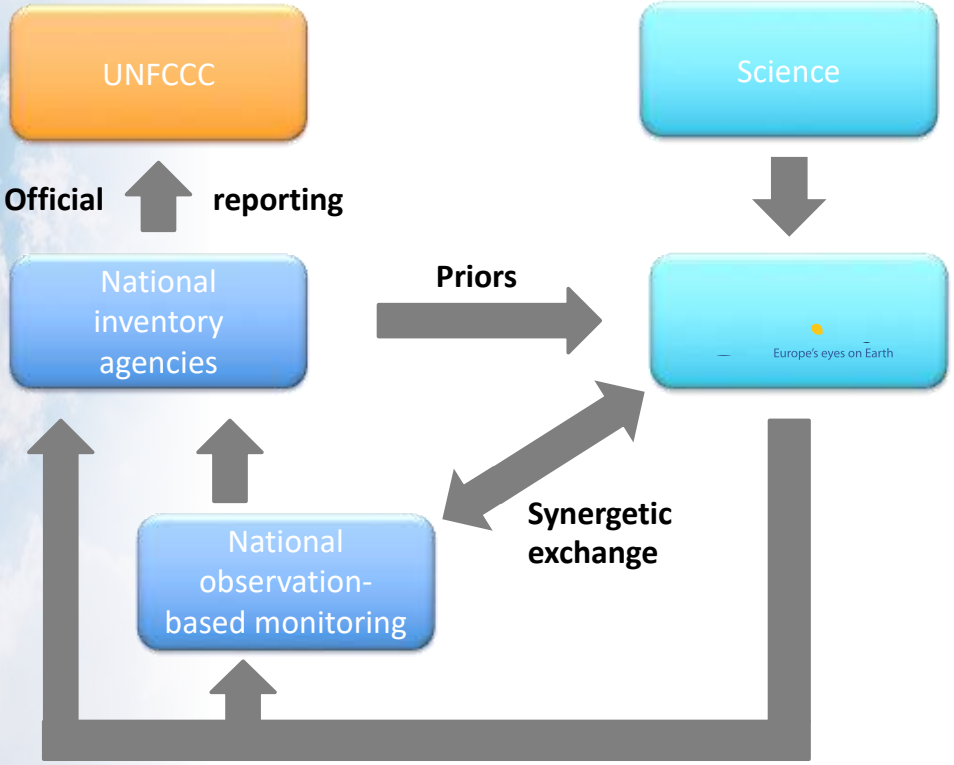
A new European anthropogenic CO_2 emissions monitoring & verification support (CO2MVS) capacity will support countries and regions with observation-based policy-relevant information.

Combining satellite and in-situ observations with Earth system models by expanding the existing Copernicus Atmosphere Monitoring Service's operational infrastructure at ECMWF.

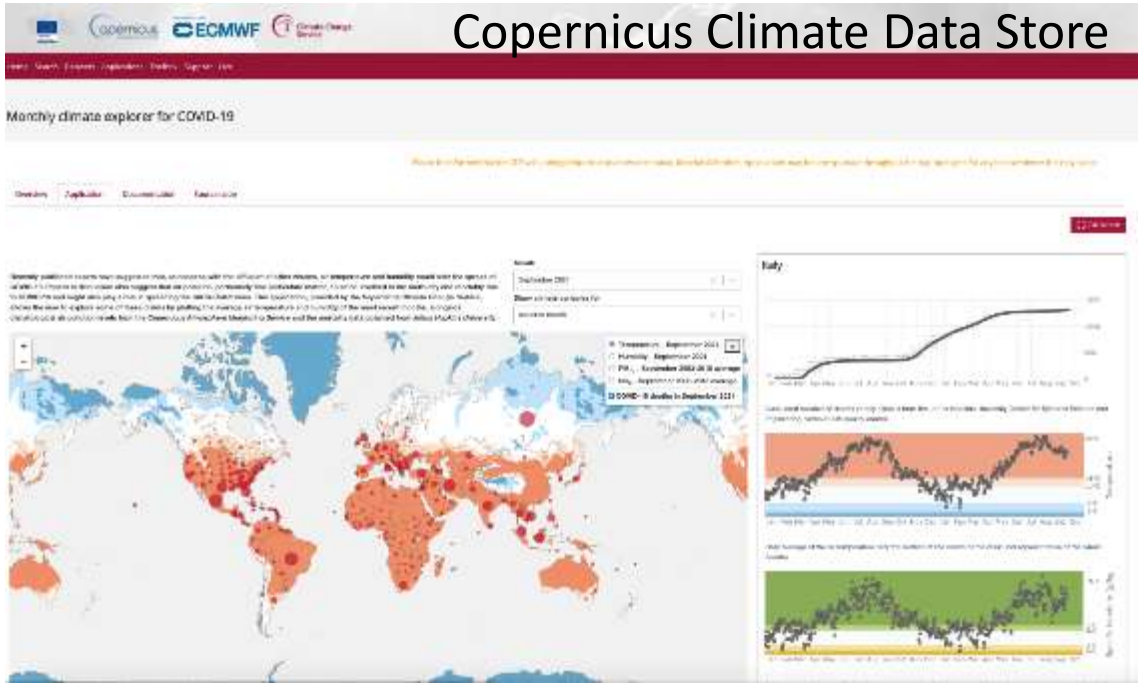
ECMWF Copernicus Europe's eyes on Earth European Commission

User engagement for co-designed user services

Atmosphere Monitoring



Copernicus Climate Data Store



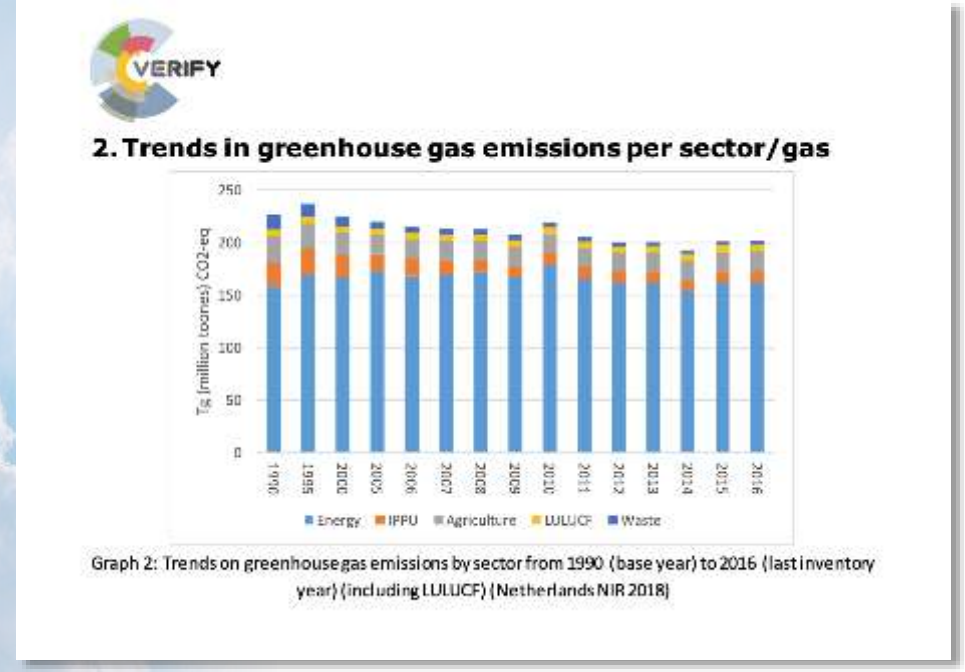
WORLD METEOROLOGICAL ORGANIZATION

International standard for Urban GHG Monitoring and assessment

ECMWF Copernicus Europe's eyes on Earth European Commission

Current examples from CAMS, CoCO2 and VERIFY

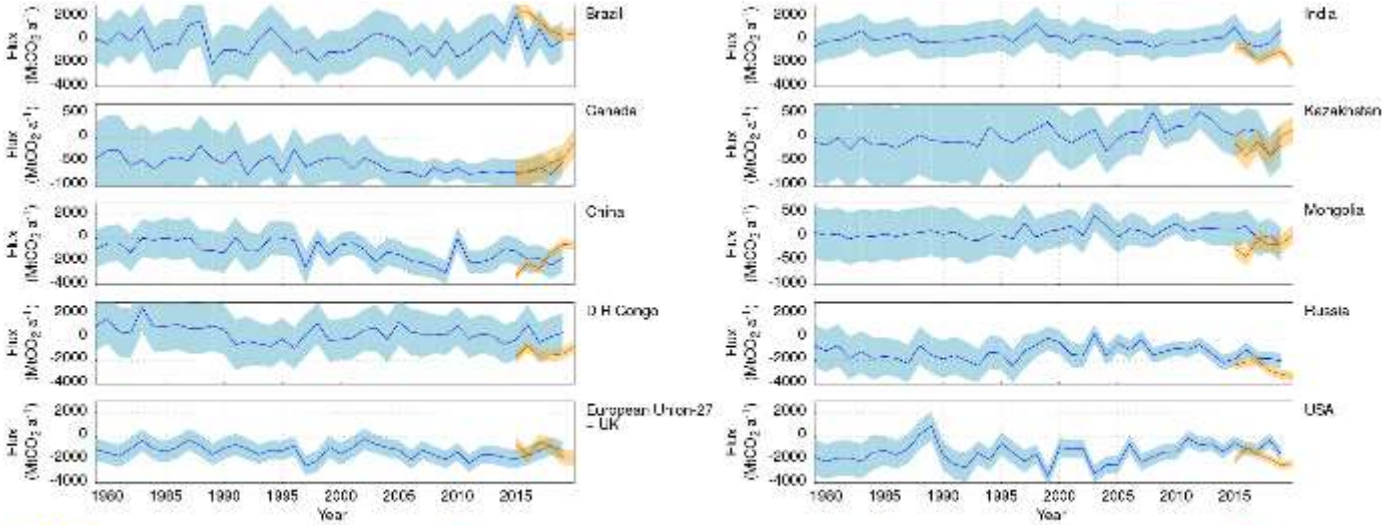
Atmosphere Monitoring



Graph 2: Trends on greenhouse gas emissions by sector from 1990 (base year) to 2016 (last inventory year) (including LULUCF) (Netherlands NIR 2018)

VERIFY has developed an annual synthesis of bottom-up and top-down estimates. This activity will be continued in CoCO2.

Annual CO2 flux from the AFOLU sector in ten large countries or groups of countries estimated by the 1-σ uncertainty envelope of the two CAMS atmospheric inversions (blue for surface air-sample-driven and orange for the satellite-driven). Positive values indicate that the country is a source of CO2 to the atmosphere.



EUROPEAN UNION

Copernicus

ECMWF

VERIFY

CoCO2 Prototype system for a Copernicus CO_2 service

ECMWF

Copernicus Europe's eyes on Earth

European Commission

Capacity for Copernicus REDD+ and Forest Monitoring Services

EU's Action on the Support to REDD+ Activities: Copernicus for Forest Monitoring

REDDCopernicus – EU Side Event, UNFCCC COP 26, Glasgow 01 Nov. 2021

Supported by:

Partners:

This project has received funding from the European Union's Horizon 2020 Work Programme 2018-2020 Leadership in Enabling and Industrial Technologies – Space, Coordinated Support Action under Grant Agreement No 821880.

Objectives of the H2020 Project

The REDD Copernicus Project has the overall aim to define future Global Copernicus REDD+ Service which would be freely available.

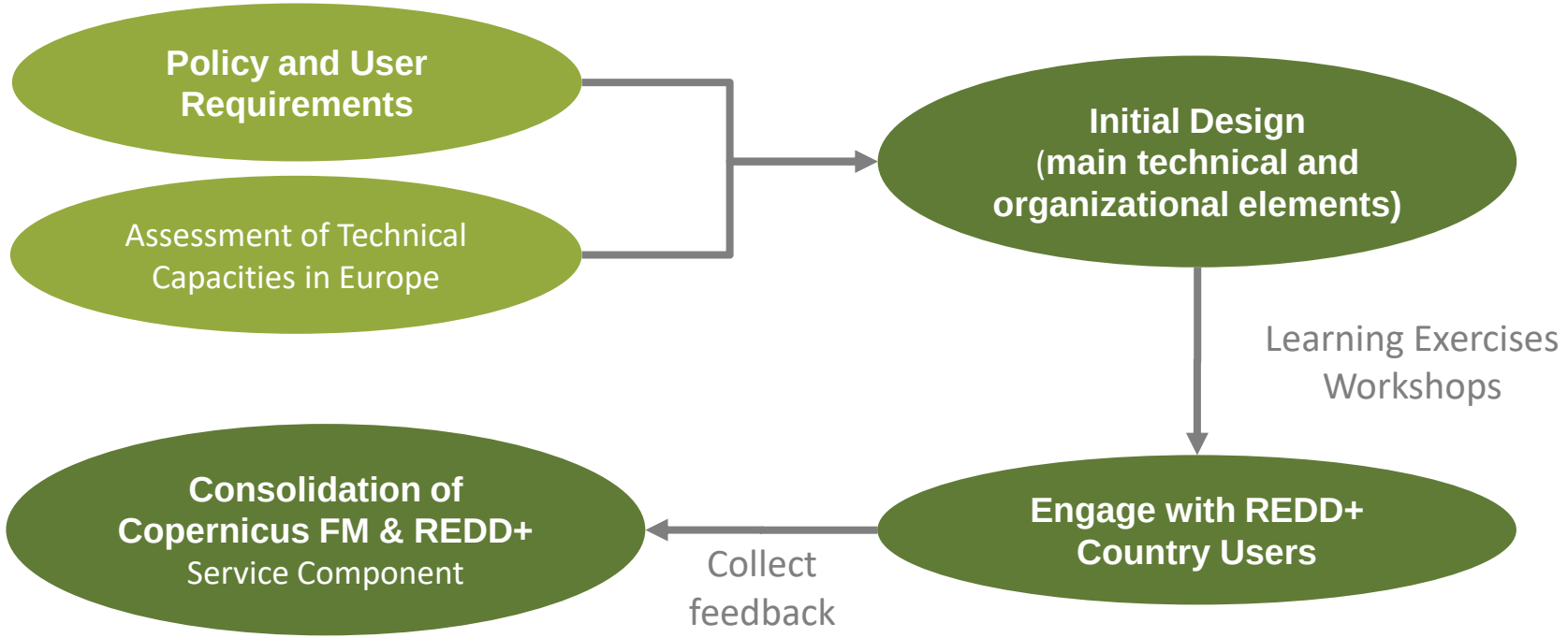
This included:

- Policy requirements review
- Strong stakeholder engagement
- Conceptualisation and design of a Pan-tropical EO Forest service
- Idendifcation of Research & Development gaps in this domain

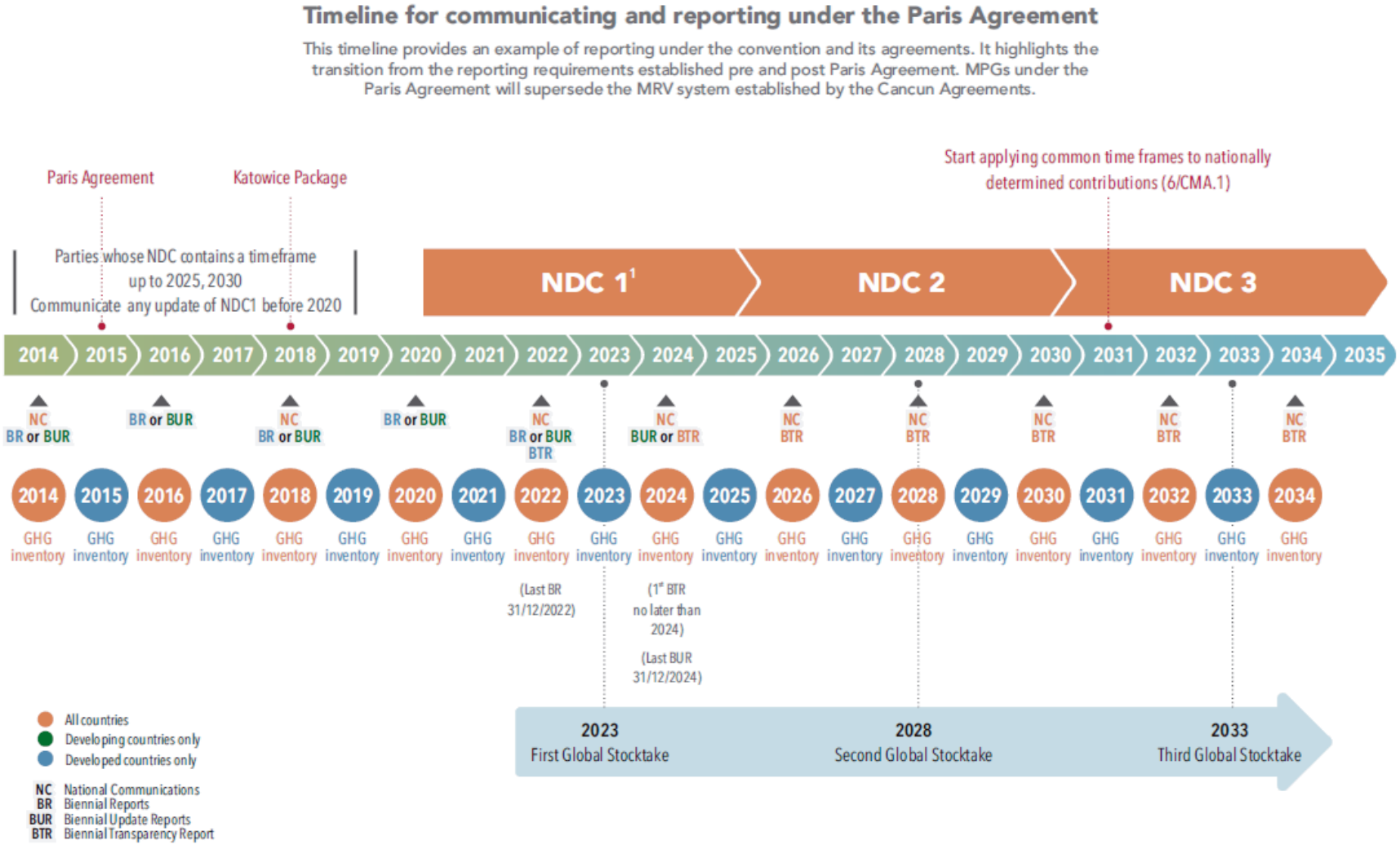
Duration: 2019-2022

Process for Specifications Definition

1. Design and prepare the initial main technical and organizational elements of a Copernicus REDD+ Component
2. Share the design with counterparts in REDD+ countries
3. Consolidate the Specifications



Policy Needs



Stakeholders in User Requirements

Stakeholder groups were consulted for the assessment of user requirements on the future Copernicus REDD+ Service Component through structured interviews, online surveys and user workshops

- EC Services could support and use a potential service
  - DG CLIMA, DG DEVCO, DG ENV, DG GROW (and now DG DEFIS)
- Financiers, Donors and International Development Agencies
- REDD+ Country Users
  - National GHG Inventory Experts, National Policy Makers, Local Forest and Land Managers
- Research and Scientific Community
- International Initiatives and NGOs
- Private Sector Organizations

Stakeholder Workshop, JRC Ispra, 24-25 June 2019

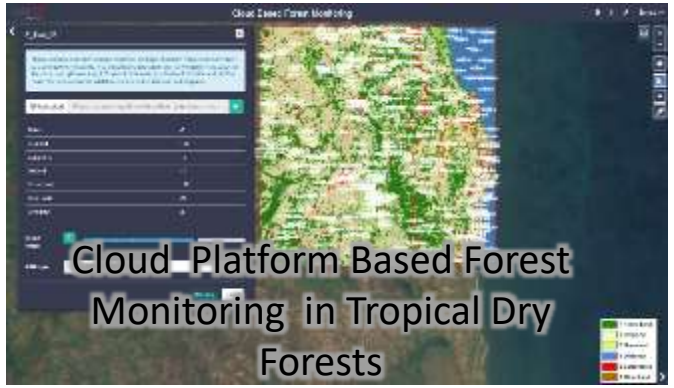
Summary of Findings: User needs

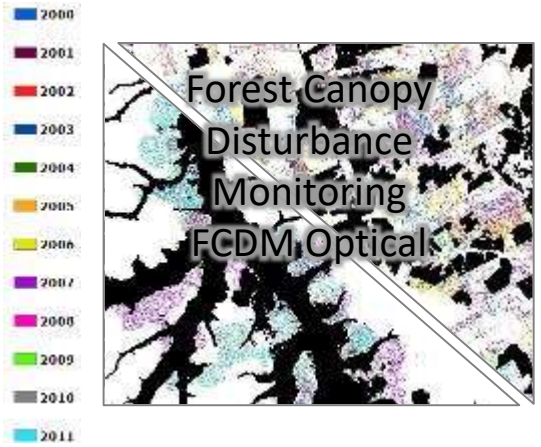
1. **General support/encouragement for a forest monitoring service (i.e. through Copernicus) for:**
   - National reporting and policy processes
   - Global/independent assessments
   - Local implementation and land management
2. **High resolution (i.e. Sentinel data streams) products were requested:**
   - Analysis ready satellite imagery (mosaics) – 87 %
   - Forest/ land cover and change map – 86 %
   - Biomass and change map – 85 %
   - Forest type maps (including plantations) – 85 %
   - Cause of/ driver of deforestation map – 76 %
   - Forest tree cover density and forest mask – 76 %
3. **Long term commitment to provide free, open data with easy access and sufficient user support**

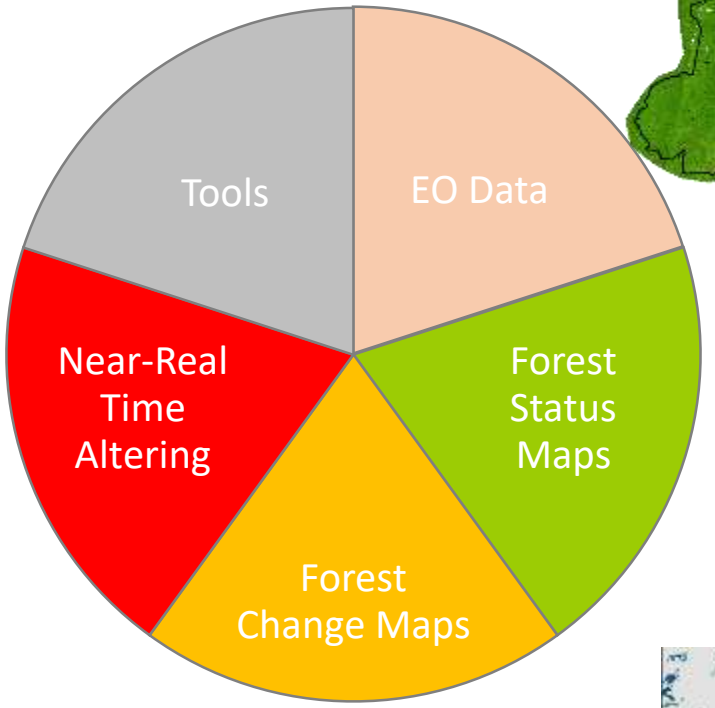
REDDCopernicus - Top five R&D needs

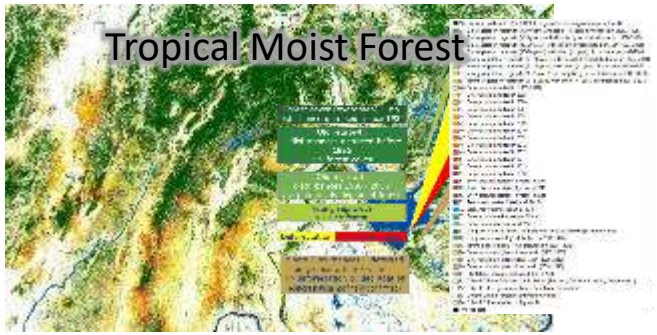
1. Biomass estimation (combining space-based and plot/NFI data)
2. Degradation & Regrowth monitoring
3. Near real time alerting and early warning
4. Uncertainty assessments
5. Land Use change & GHG fluxes

Selected EO Concepts of Relevance for the Design

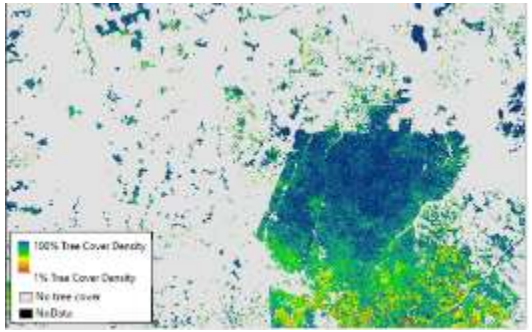




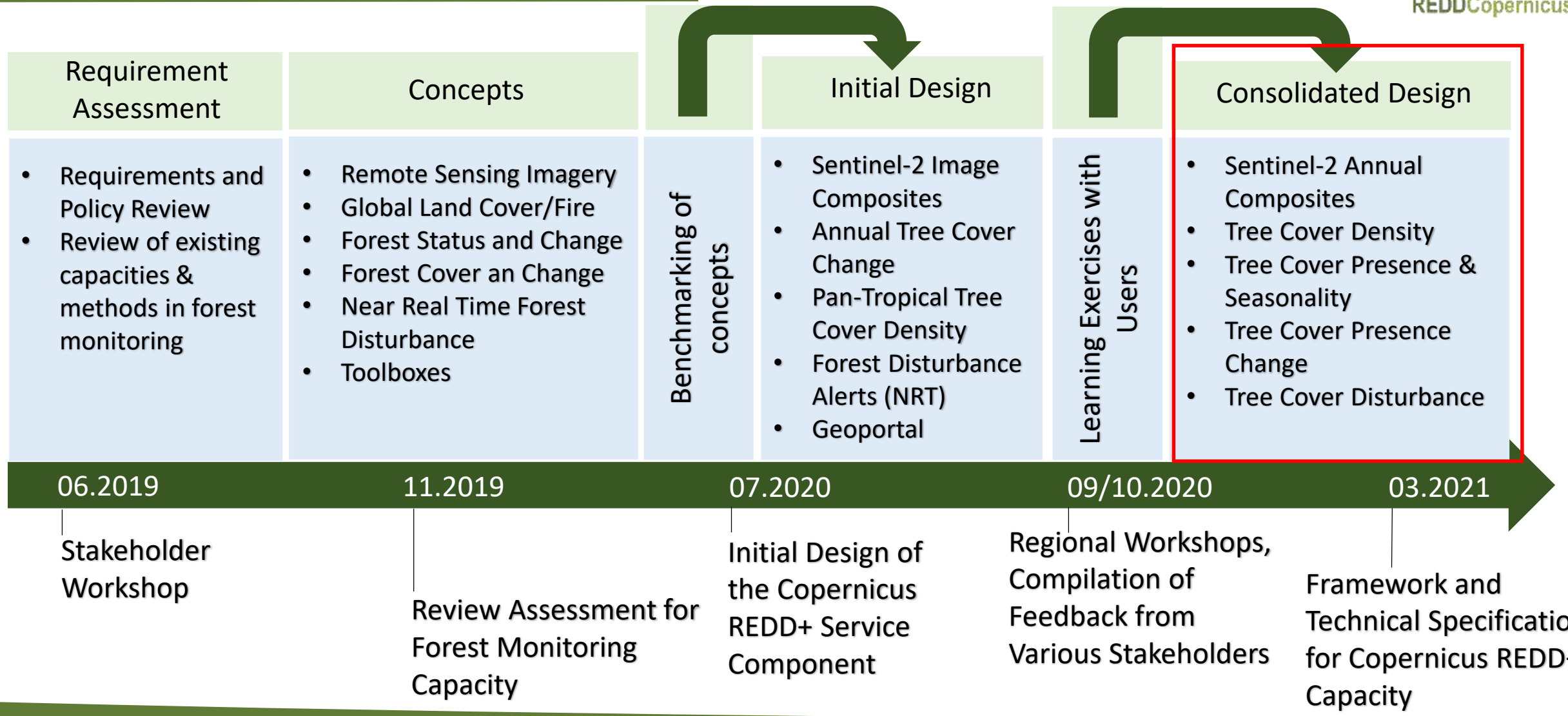




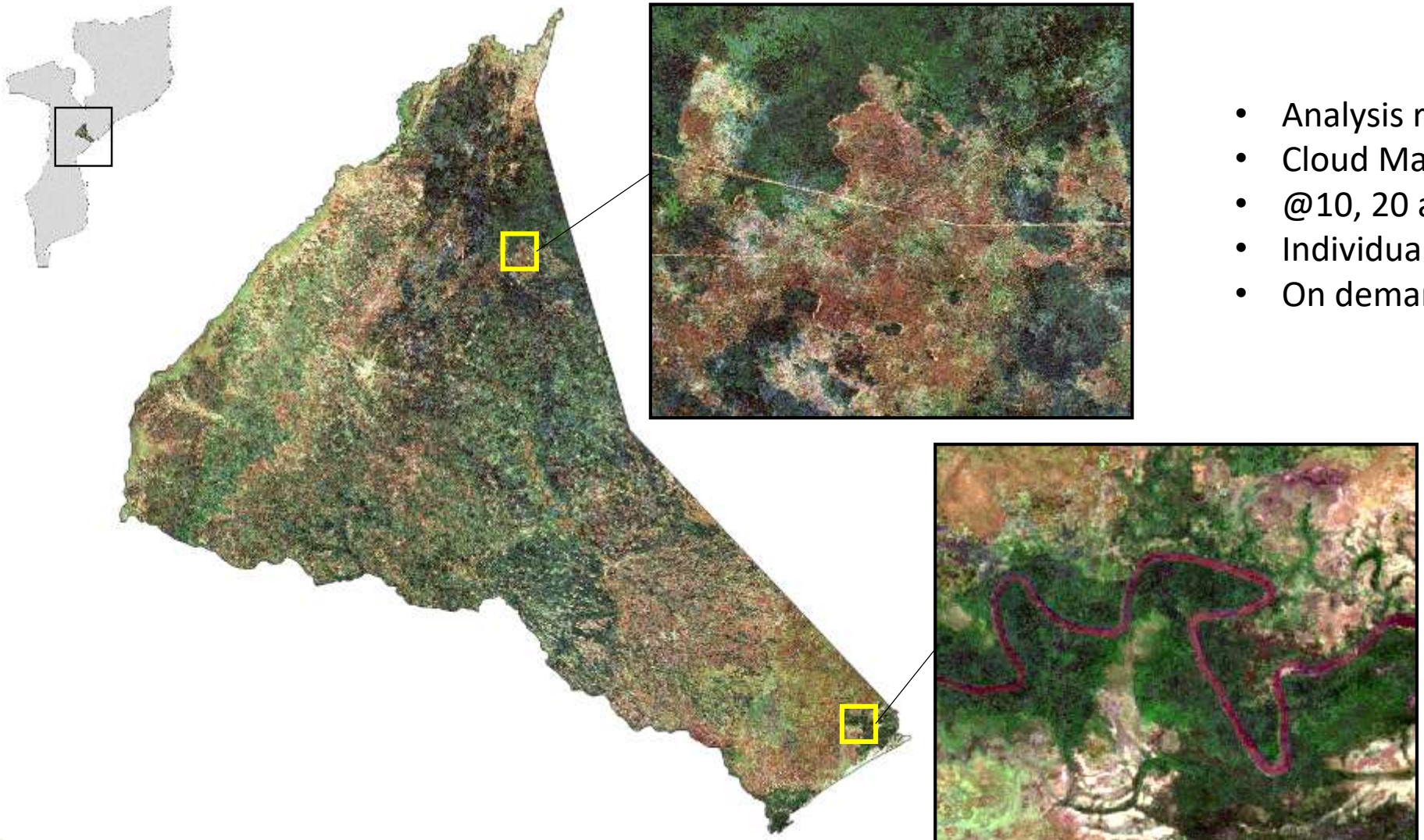
Tree Cover Density



Evolution of Service Specifications

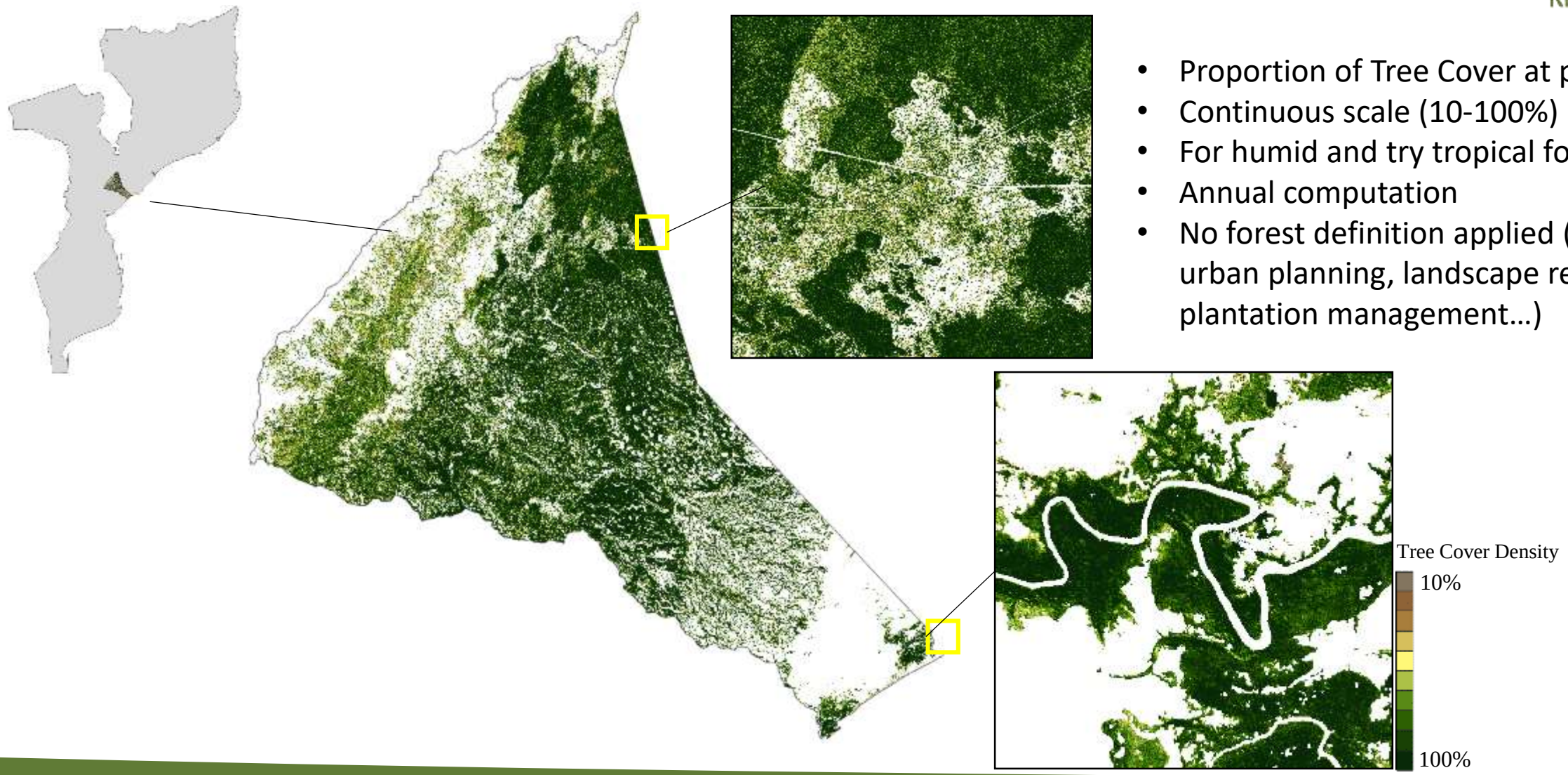


Example Sentinel-2 Annual Composites



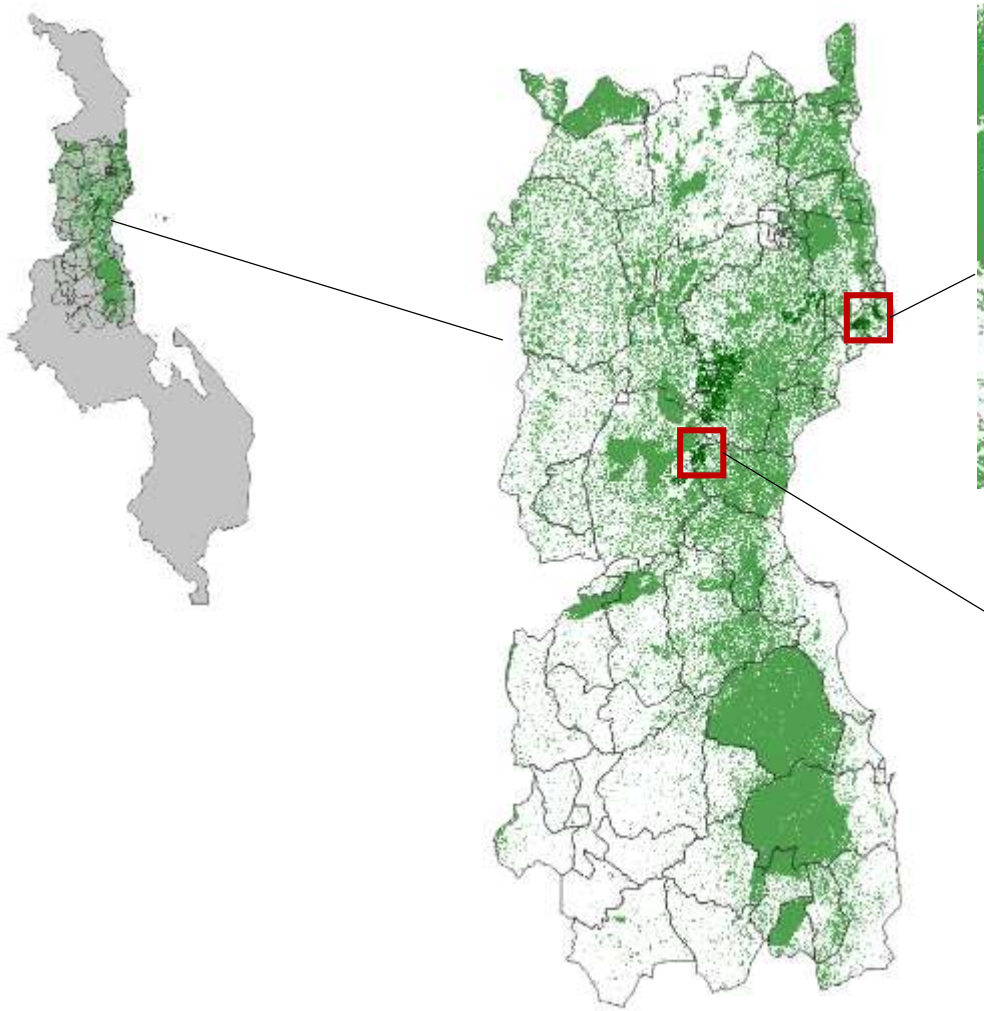
- Analysis ready data
- Cloud Masked
- @10, 20 and 60m spatial resolution
- Individual time periods for compositing
- On demand processing

Example Tree Cover Density



- Proportion of Tree Cover at pixel level
- Continuous scale (10-100%)
- For humid and try tropical forests
- Annual computation
- No forest definition applied (useful for urban planning, landscape restoration, plantation management…)

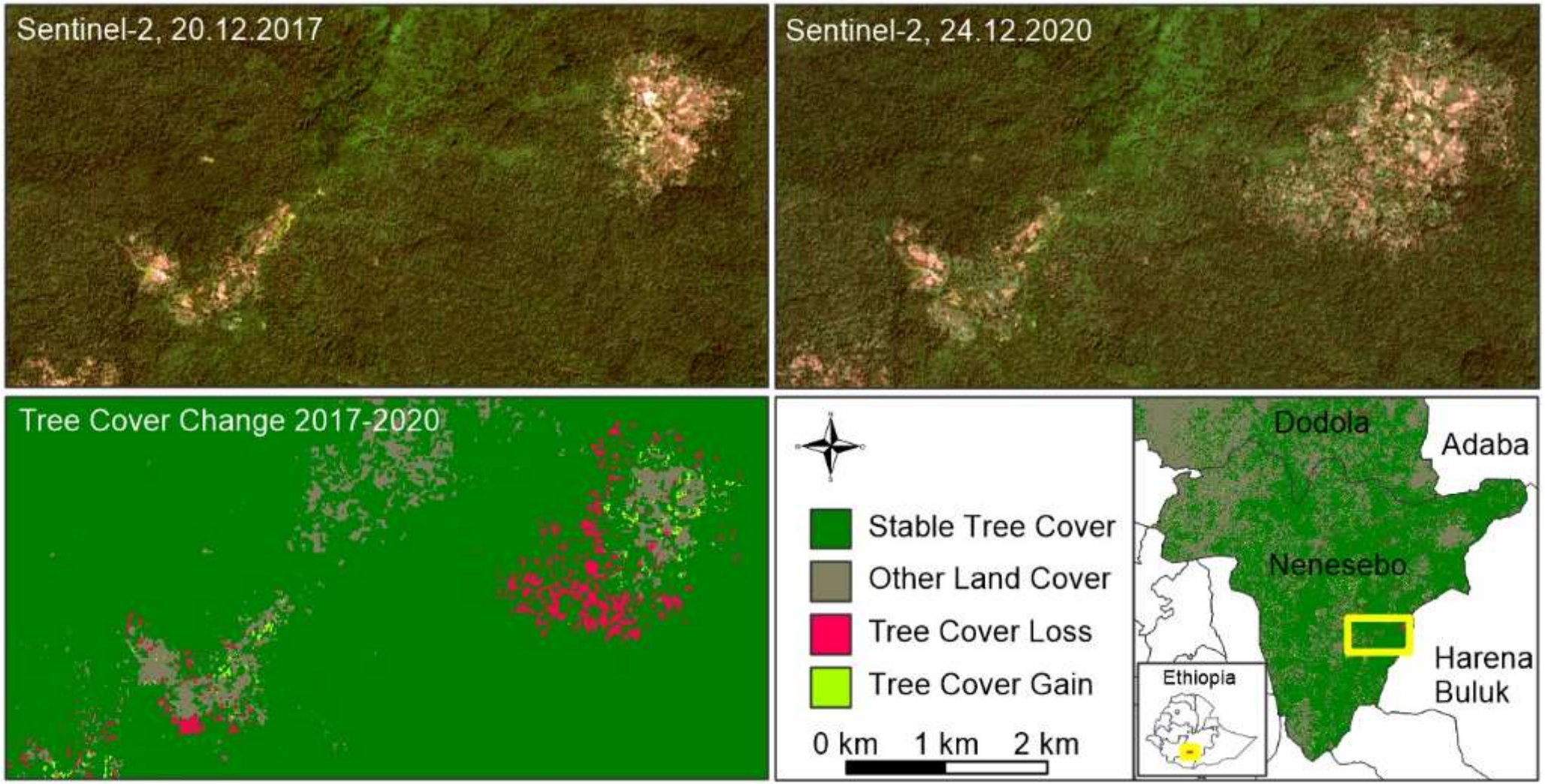
Example Tree Cover Presence & Seasonality



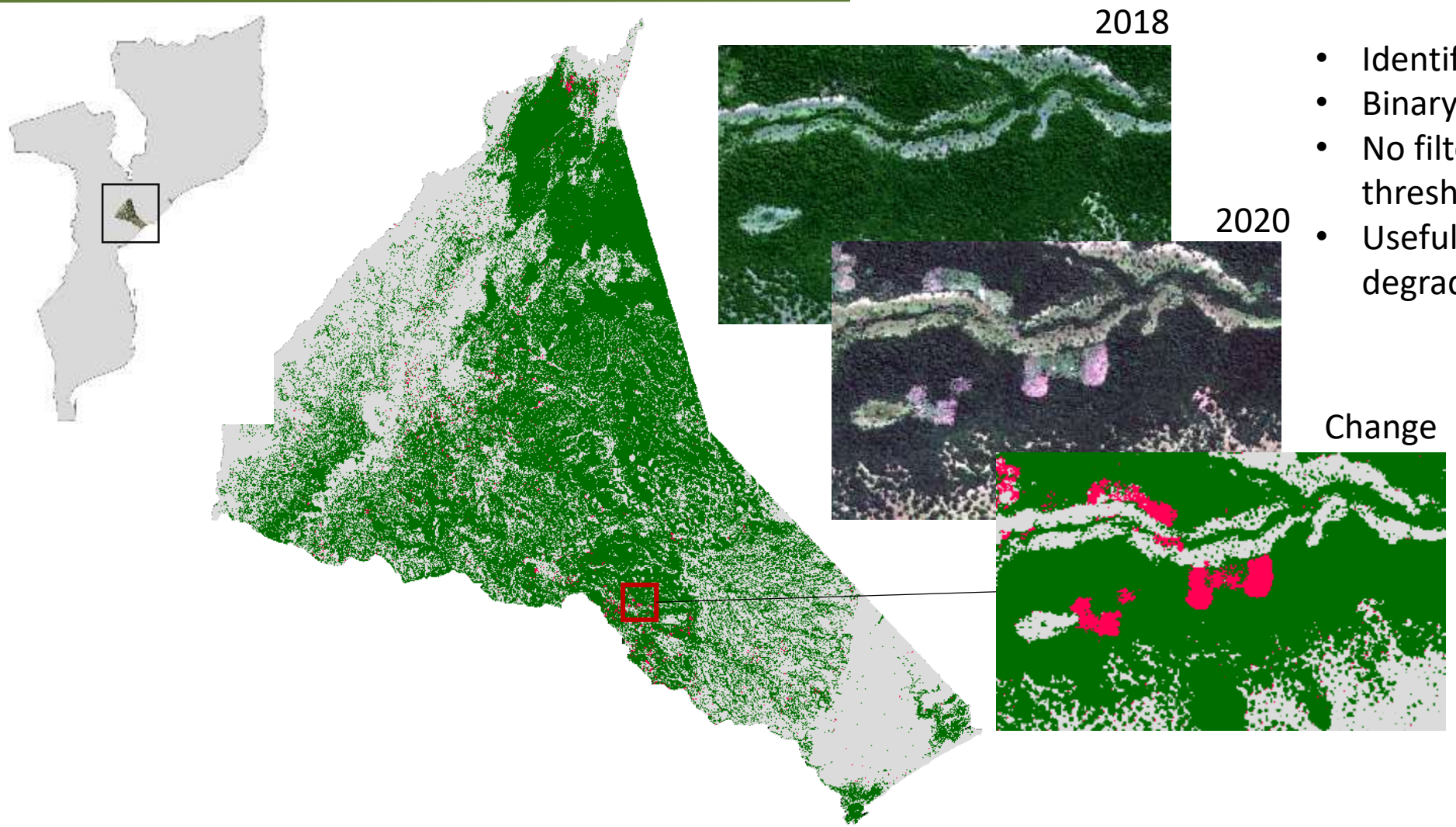
- Evergreen vs. defoliative forests
- Binary information based on Tree Cover Density information and multi-temporal (seasonal) image analysis

Deciduous
Evergreen

Example Tree Cover Presence Change



Example Tree Cover Presence Change

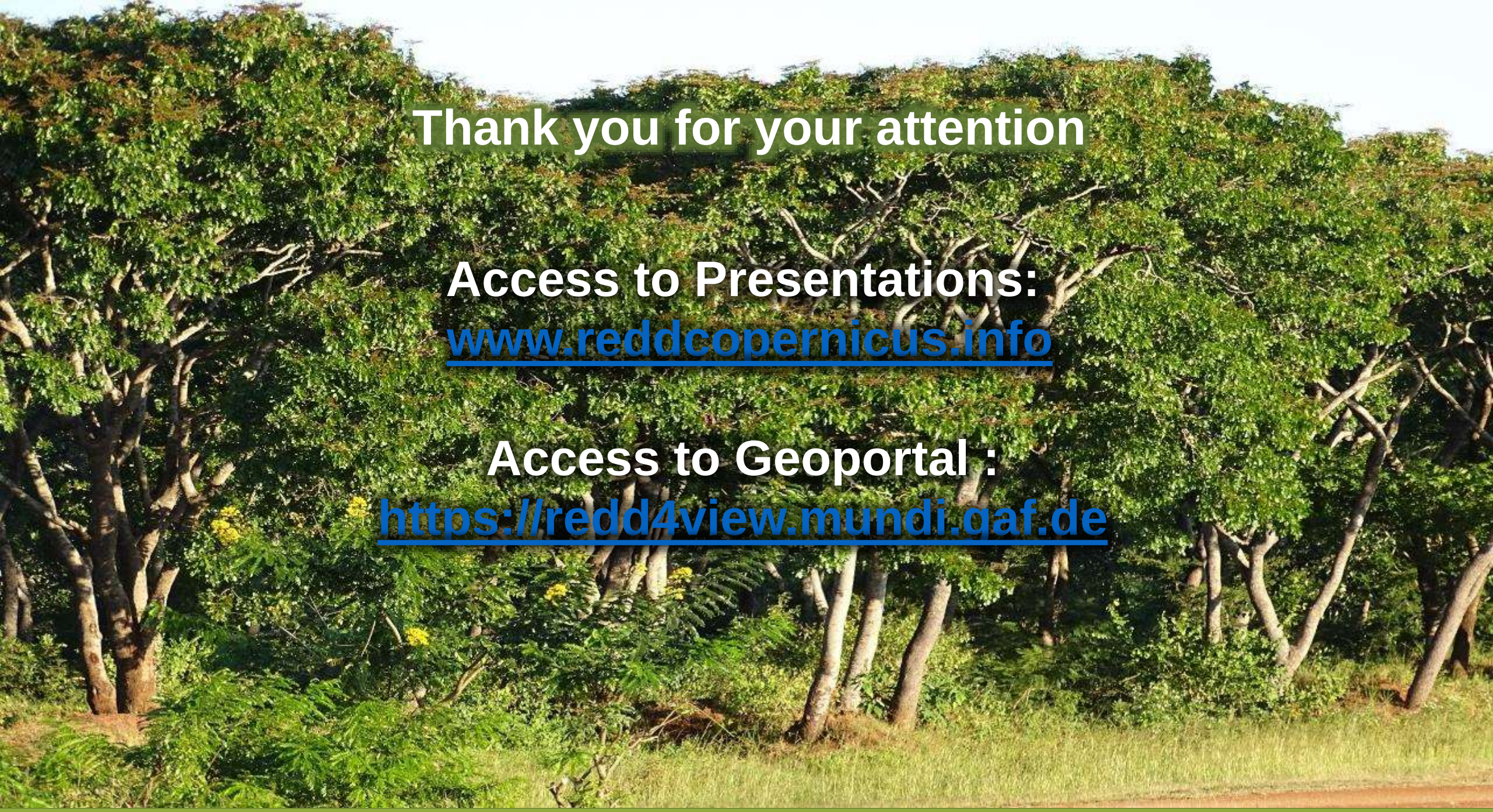


- Identification of Tree Cover Loss
- Binary information at Pixel level
- No filtering or minimum area threshold applied
- Useful for forest definition, forest degradation and change assessment

Example Tree Cover Disturbance

Sentinel-1-based weekly forest disturbance alerts at 10 m resolution for humid tropics (RADD alerts)

Sentinel-1-based weekly alerts, period Jan. 2019 – Dec. 2020, http://radd-alert.wur.nl


Thank you for your attention
Access to Presentations:
www.reddcopernicus.info
Access to Geoportal :
https://redd4view.mundi.gaf.de

Copernicus for Forest Monitoring and REDD+

Land Monitoring

Transition to Operation

Copernicus Europe's eyes on Earth

European Commission

Land Monitoring

Transition to Operation / Copernicus Context

Copernicus is the **Earth Observation and Monitoring Flagship Program** of the European Union

The Copernicus is:

- Fully operational since 2013
- Constellation of **satellites** (RADAR, Optical, Thermal, Altimeter …)
- 6 **Services** (Land, Atmosphere, Marine, Climate, Emergency and Security)
- **Open and free** access data and products
- **Operational & Sustainable**
- User driven
- Support EU policies and EU international commitments

Copernicus Europe's eyes on Earth
European Commission

Land Monitoring

Transition to Operation / Objectives

- A Copernicus REDD+ service component in the Land service is intended to **strengthen forest monitoring systems at global / regional levels** and **at national level** for REDD+ reporting

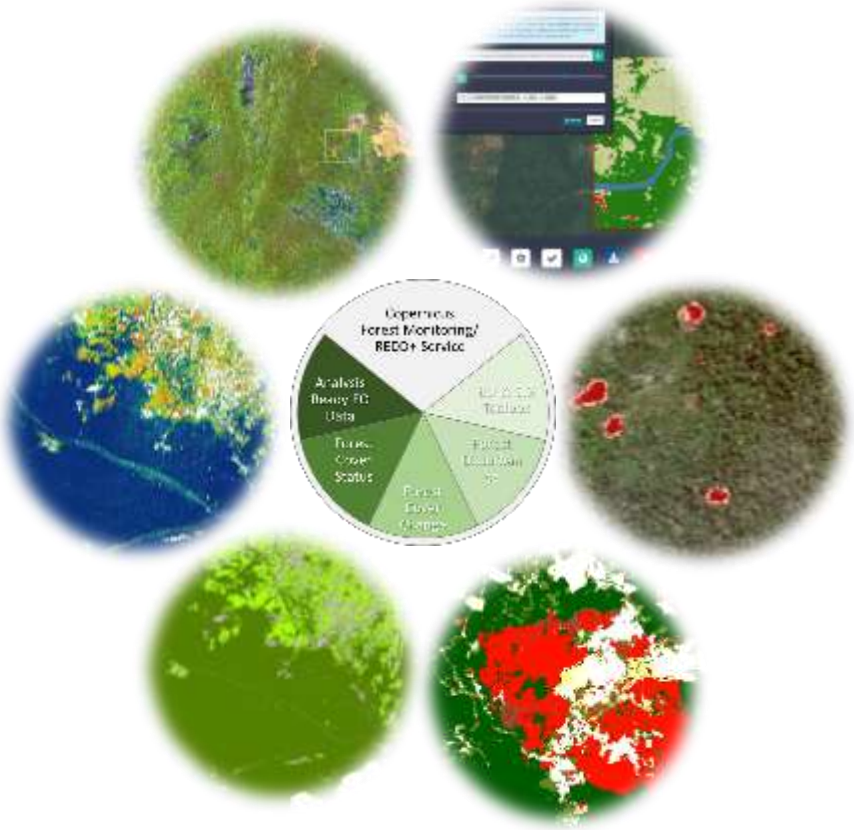
- The Copernicus REDD+ service component will :
  - **Support REDD+ countries**_to achieve their commitment under the Paris Agreement,
  - **Focus on tree cover change**, to allow reporting on deforestation and degradation for REDD+ activities,
  - **Contribute to the European Commission actions** under the Green Deal (including the EU Observatory on deforestation and forest degradation), as well as **Member States actions** to support REDD+ countries

Copernicus Europe's eyes on Earth | European Commission

Land Monitoring

Transition to Operation / Tentative Agenda

- By end 2021: preparation of a Call for launching the Copernicus REDD+ service component
- By mid 2022: Selection of the Consortium and launch of a contract for implementing the Copernicus REDD+ service component
- By early 2023: First product(s) of the Copernicus REDD+ service component

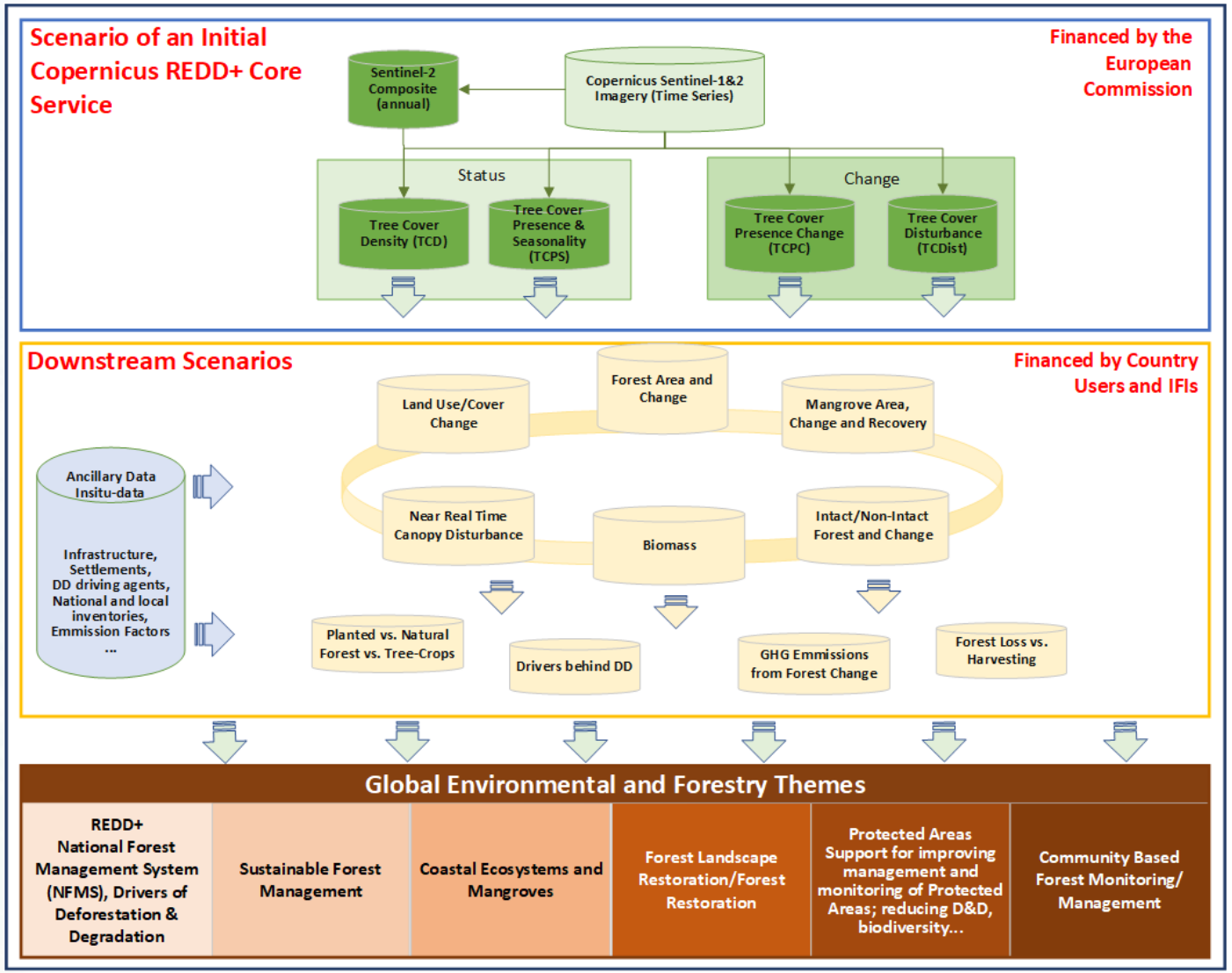


Copernicus Europe's eyes on Earth

European Commission

Land Monitoring

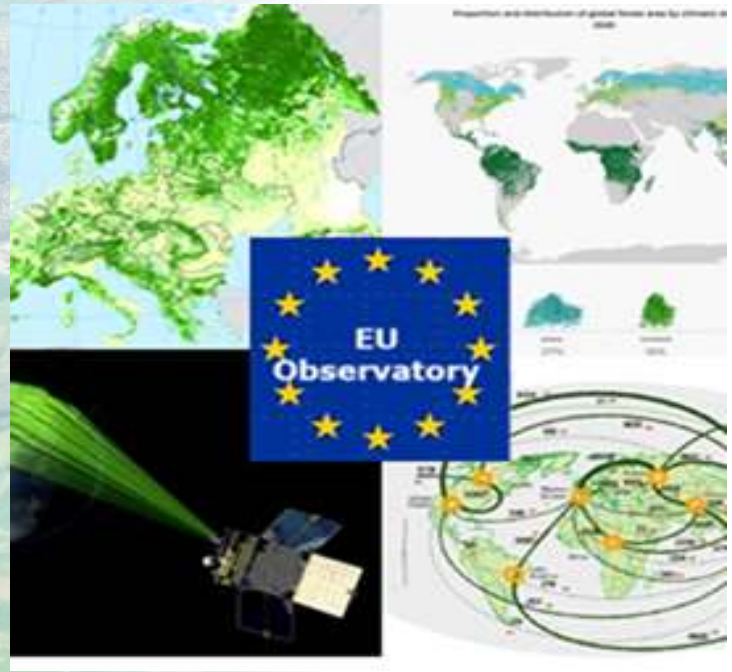
Transition to Operation / Perspectives of Use



Copernicus Europe's eyes on Earth

European Commission

EU Observatory on Deforestation and Forest Degradation



Objective:

- The establishment of this observatory is a key action of the Communication 'Stepping up EU Action to Protect and Restore the world's Forests' and an element of the future regulation on Deforestation-free products

Key activities:

- Monitoring changes in forest cover and forest degradation globally
- Monitoring consumption of commodities and products possibly associated with deforestation and forest degradation
- Feasibility study for an early warning system

Key Outcome:

- Single web based online platform