Geospatial Intelligence for Environment Protection against illegal activities

Geospatial Information
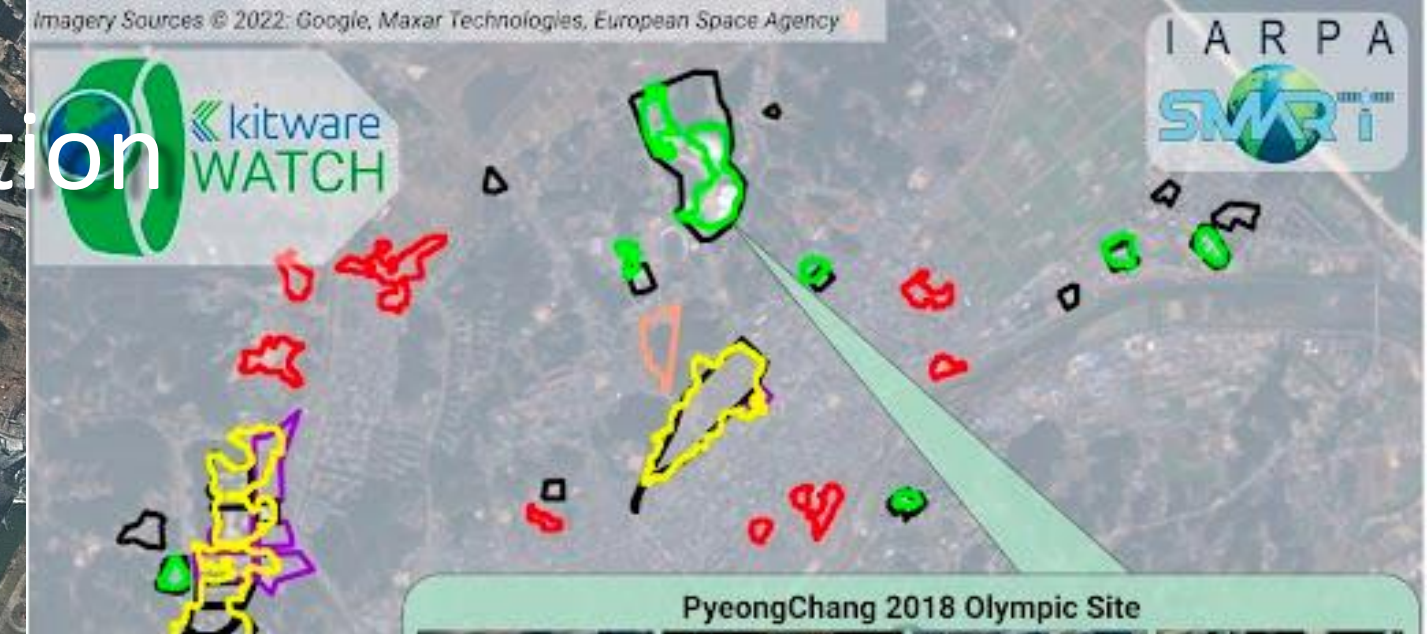
Geospatial Intelligence

"GEOINT encompasses all aspects of imagery and geospatial information and services. It includes, but is not limited to the analysis of literal imagery; geospatial data; and information technically derived from the processing, exploitation, literal, and non-literal analysis of spectral, spatial, and temporal fused products. These types of data can be collected on stationary and moving targets by electro-optical, synthetic aperture radar, related sensor programs, and non-technical means (to include geospatial information acquired by personnel in the field)." Retired Air Force Lt. Gen. James R. Clapper, October 2005

Activity and Objectives

GEOINT4ENV is a FPCUP action supporting the investigation of both public authorities and private entities information needs related to illegal activities affecting the environment such as waste, water, air pollution and forestry as well as the performance of remote sensing and geospatial intelligence (GEOINT) methods to answer those information needs (where, when, what, why, who), taking into account the EU context and actions to improve environmental compliance and governance by

Designing appropriate workflows allowing to collect and process EO space and in-situ data, as needed to produce actionable intelligence to be used in ECA;

Perform the needed data processing and analysis in order to answer the where, when, what, why, who questions

Formulate recommendations supporting the uptake of the services by the relevant users

Top-down activity supported by DG ENV as part of the FPCUP WP 2021

Context

Commission Communication on "**EU actions to improve environmental compliance and governance**" and related green deal acts

Activities developed by the **Environmental Compliance and Governance Forum**

Non-compliance events reported by governmental and EU organisations on waste crime, forest crime, illegal building, air quality, illegal fertilisation, water pollution

Better, open and free geospatial data and **advance in processing and analysis** technology supporting production of actionable intelligence – the GEOINT framework

General approach

Need analysis (types of non compliant events, current knowledge on patterns and features, types of actionable intelligence required)

Investigate **methods and resources** (needed to detect / raise warning, validate, measure / quantify, evaluate / assess in order to produce evidence / actionable intelligence)

Prepare and run **demonstrations** (identify relevant sites / cases, collect data, apply methods using web platforms, other means)

Validate findings (based on dialog with user organisations and relevant parties and relevant OSINT)

Disseminate and report (design and implement the Knowledge–sharing Platform based on selected cases addressed in demonstration activities gathering information on requirements, methods and data, intelligence produced)
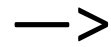
DESIGN   —>   DEMONSTRATE   —>   UPTAKE

Facts & Figures Database

Operation needs

Obstacles &

|

|

Patterns and Features

Evidence needs

Investment need &

|

|

When, what, how to process

Detection & Description

Training needs &

|

|

What and how to validate

Confirmed?

Governance

|

|

What and how to integrate

Quantify & Report

GEOINT User Perception

Permanent dialogue with relevant potential user organisations was established and is maintained towards knowing the operational requirements, defining and running use cases, share results and evaluate perspectives

In Itay, the user uptake is assused by the national user forum and its networks

The Italian Copernicus User Forum

Institutional Representatives

National Representatives into internazionali boards

Relay National Network

National Copernicus Users Forum
(Presidency of the council of Ministers)

Academy National Network

Commercial Representatives

Research Representatives

Air

- Problem: Emissions in the air due to burned waste or burned vegetation, accidental emissions from industrial sources; point sources, mobile sources and surface sources
- Needs: permanent records of measurements allowing production of air quality maps and further modelling towards identification of sources

Water

- Problem: illegal dumping, oil spills, marine litter etc. which result in pollution of the coastal areas; sink and threaten benthic organisms; negative impact on sectors such as fishing and tourism; marine fauna; influence of fresh waters also need to be assessed
- Needs: provide records of all the possible pollutants (marine litter, plastic litter, oil spills); localization of sources (hotspot areas where much litter originates from) in order to identify main polluter countries; localization of (temporal) sinks (accumulation zones such as ocean fronts, eddies, gyres); size and direction of dispersion; spatial and temporal statistics (weekly, monthly, seasonal, yearly statistics);

Construction

- **Problem**: Illegal buildings (or relevant expansion of existing buildings) on unsealed soil (i.e. natural, semi-natural or agricultural land) without the required permissions, or on land where constructions are not allowed;
- **Needs**: location of the possible illegal constructions and an estimate of the extent of the construction area; early detection is desired;

Forest

- **Problem**: forest ecosystems becoming threatened by illegal logging and illegal trade in timber products; forest crime can vary substantially: from subsistence-based activities to operations on industrial scale - taking timber from outside authorised forest concessions or exceeding assigned timber quotas; clearing forest stands for other land uses;
- **Needs**: weekly to monthly monitoring, detection and measurement of not only man-made but also deforestation due to natural factors like wind, fire or specific diseases affecting the forest vegetation in close correlation with the workflows legally established at national level for forest exploitation; min 1-5 Ha

Manure

- **Problem**: common agricultural practice aimed at benefiting the content of nitrogen in soil to improve plant growth; if the applied amount of manure exceeds the nitrogen that the crop can absorb, the phenomenon of nitrate pollution occurs - contamination of surface and groundwater for washout the soil.
- **Needs**: monitoring and control activities during the no-spanning period as required by laws and supporting authorities with a database platform to collect and homogeneously manage the information on manure spreading activities; in areas where farms are present and focusing on arable land

Waste

- **Problem**: Unmanaged or illegal dump sites can vary in size and shape, originate from different sources (e.g. construction waste, household waste, e-waste) and consist of different materials (e.g. plastic, car tyres, metal, bricks, concrete); range from small wild dump sites, which can often be found along roads or rivers to "mountains" of plastic waste;
- **Needs**: Detection of illegal landfills, dump sites, and illegal waste storage facilities including interim ones; monitor correct use (type and quantity) of legal landfills including the closed ones; monitor emissions and impact on environment

Use cases

- follow the general GOINT principles: analysis of imagery and geospatial information to describe, assess, and visually depict physical features and geographically referenced activities on the earth and in the air in relation to identified phenomena
- background knowledge ensured by partners; also based on interaction with relevant organizations as in the case performed by RO authorities in relation with waste sites with the help of European Union's Satellite Centre (SatCen), previous and current national activities
- concepts and methods to be selected based on the characteristics of the observed phenomena
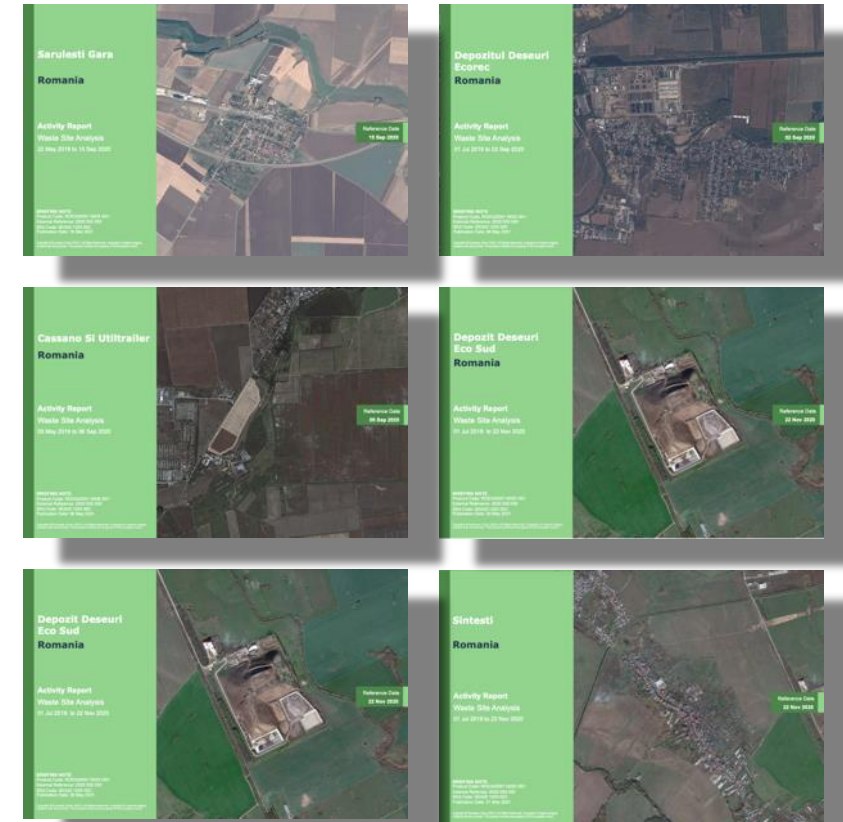
Case studies

- apply the concepts adopted and the knowledge acquired considering local specific conditions and availability of ancillary data & intelligence e.g:
- forest case studies in RO: select AOIs considering available information, on exploitation permits for assessing performance of satellite EO to detect and measure in sites where TLS is also performed
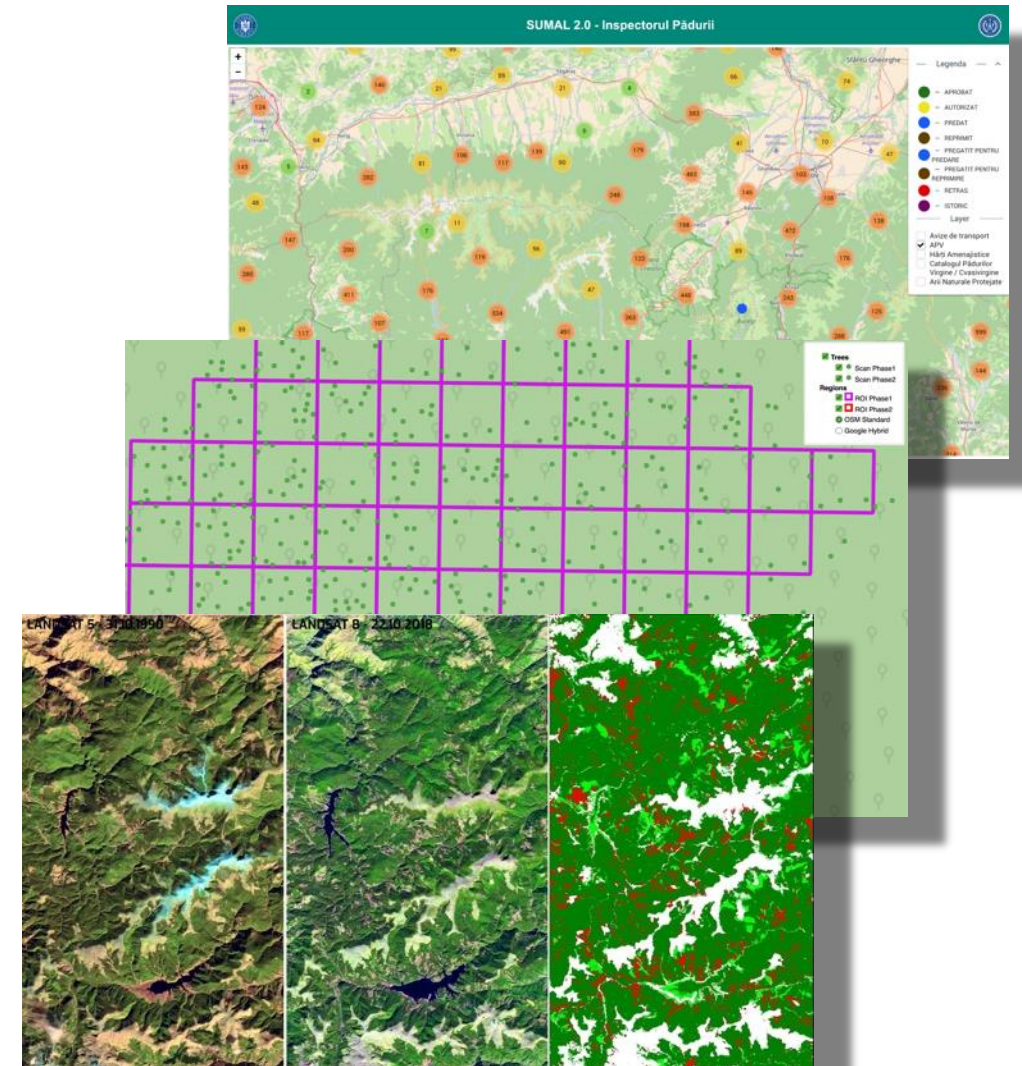
Case studies: illegal logging
Overview Italy

Interaction with users

Addressed these following issues:

- state of the art on current National/Regional regulations and policies;
- technical and administrative elements that hinder the identification/assessment of the investigated topic;
- the identification of criteria to detect the areas where to monitor illegal activities;
- the minimum requirement in term of spatial and temporal monitoring needs;
- the best delivery timeliness of the mapping products;
- any other relevant information needed to monitor the events.

Main obstacles (i.e. technical and administrative elements) that hinder the identification / assessment of illegal logging are:

- having a digital platform for planning and monitoring a forestry management
- general lack of surveillance of the territory
- high fragmentation of competence on permission and control, by different territorial authorities, on forestry authorizations issued
- timing on identification to ascertain the offence

Territorial Authorities	Competence level	Capabilities and Functions
National Park	National	Nature Conservation and Protection
Administrative Region	Regional	Government of the regional territory (i.e. forest management, environmental policies etc.)
Environmental Protection Agency	Regional	Environmental monitoring and verification of the application of environmental legislation

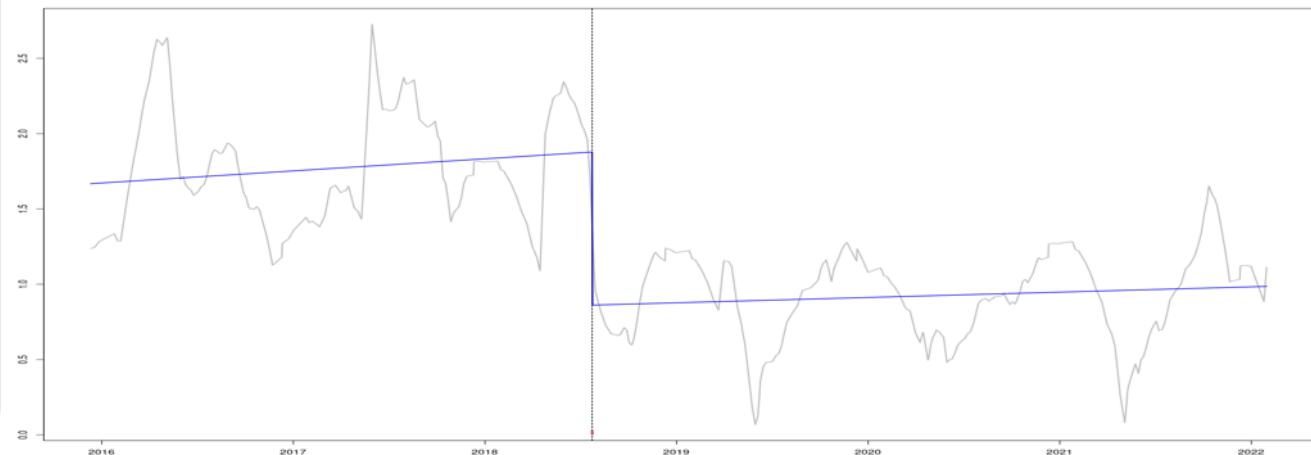# Case studies: illegal logging
Test site: Italy

- Over 30% of user replies indicate illegal logging occurring outside concession boundaries of a forest management plan
- Ancillary information are required to identify illegal logging using satellite Earth Observation, to exclude authorized logging sites or areas of forest loss related to natural factors (i.e. wildfires, insect outbreaks, wind disturbance)
- Required minimum mapping unit: 1 to 5 hectares
- Optimal update frequency: from weekly to monthly
- Earth Observation products support planning of local authorities in-situ checks for the cases where there is really a high risk of infringement

Satellite Earth Observation to identify and characterize illegal logging

- *Data:* Copernicus Sentinel-2 MSI time series (revisit time: 5 days with 2 satellites constellation) + Copernicus Sentinel-1 time series (revisit time: 6 days with 2 satellites constellation)

Spatial resolution: 20 m

Methodology: time series abrupt changes identification, spatio-temporal analysis of changes

Case studies: illegal logging
Test site: Italy

Identification of changes related to forest disturbances

Characterization of changes
(based on spectral and spatio-temporal variability)

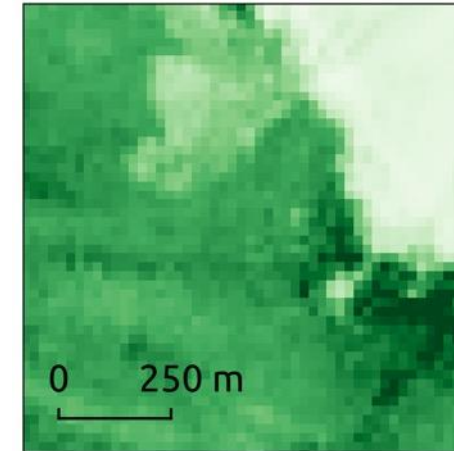Forest logging identification

Comparison with authorized logging sites
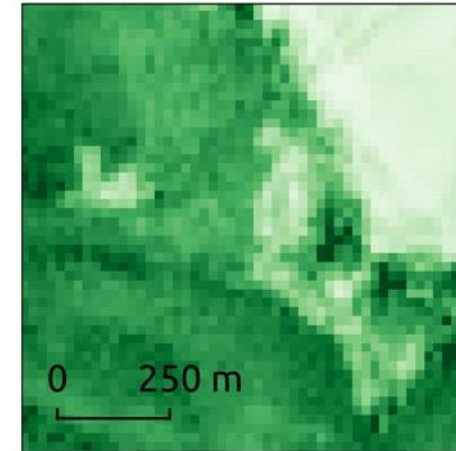
Illegal logging detection

Time series analysis allows to:
- identify logging date
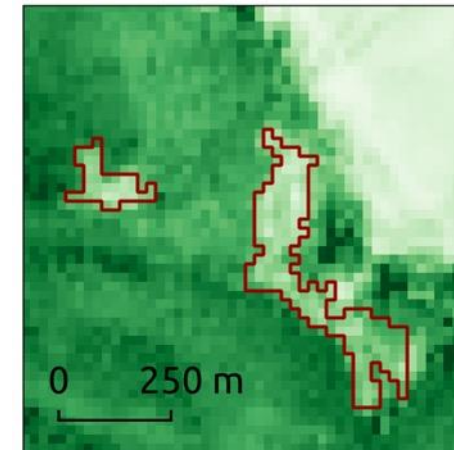- quantify loss in terms of biophysical parameters (i.e. biomass, leaf area index)
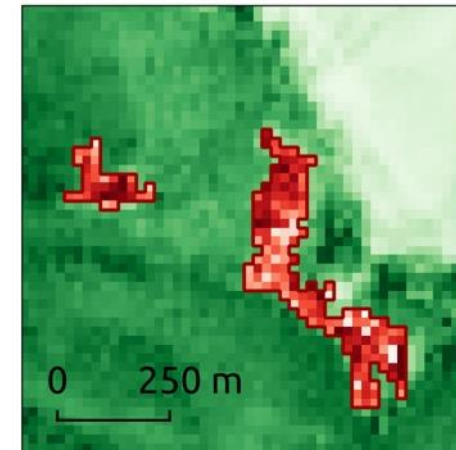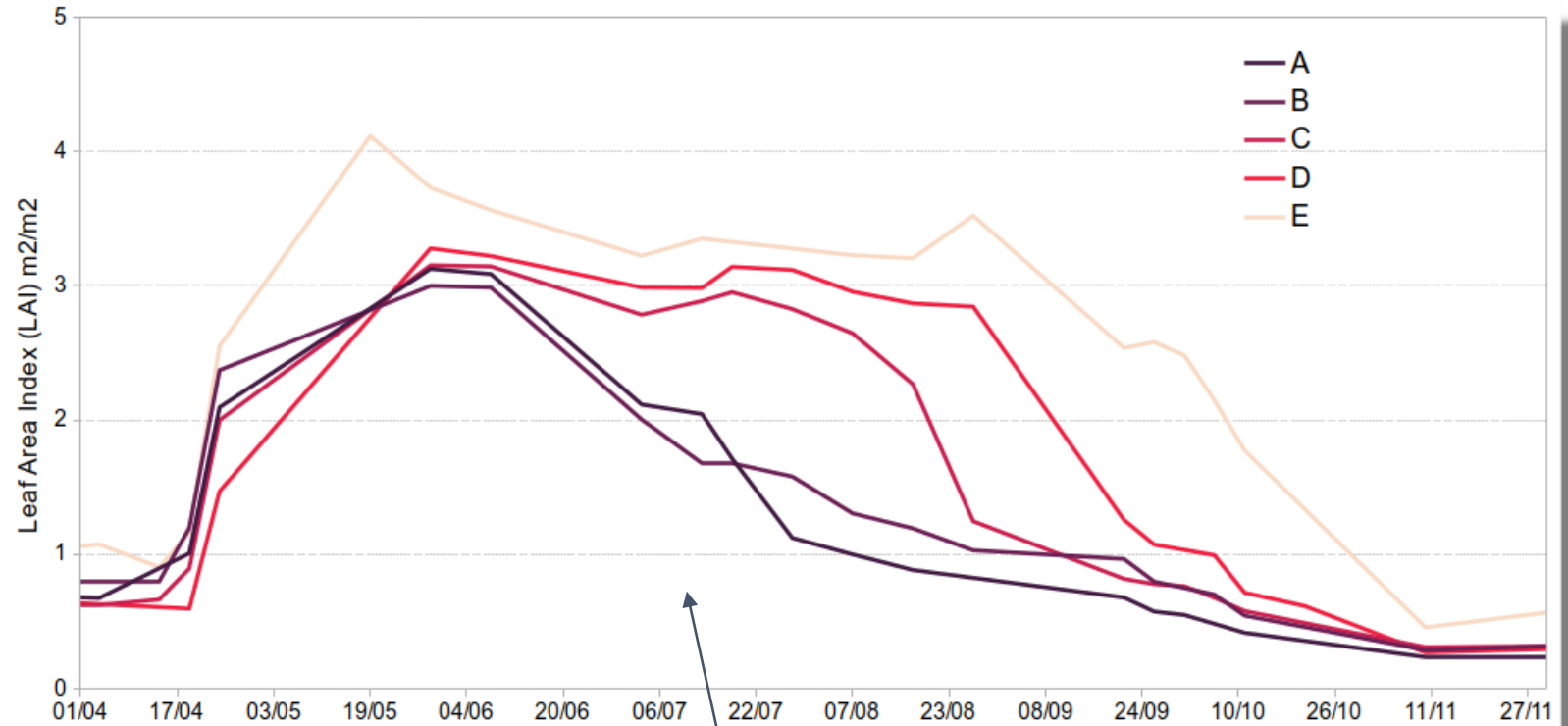

Summer 2017

Summer 2019

0   250 m

0   250 m

Year 2018 logging

LAI difference

0   250 m

0   250 m

-2   0   2   4

Leaf Area Index (LAI) m^2/m^2

Case studies: illegal logging
Test site: Italy

Year 2018 logging date

Day of Year

Leaf Area Index (LAI) m2/m2
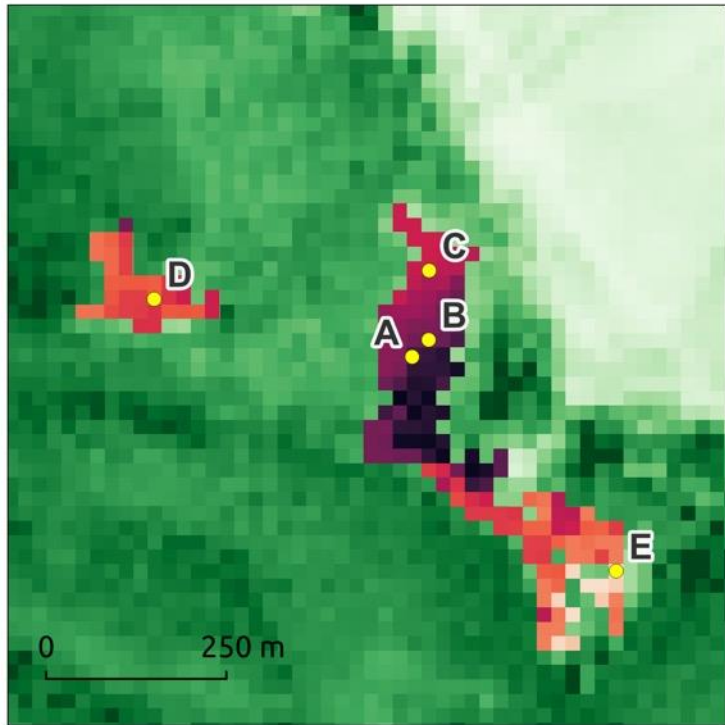
Year 2018
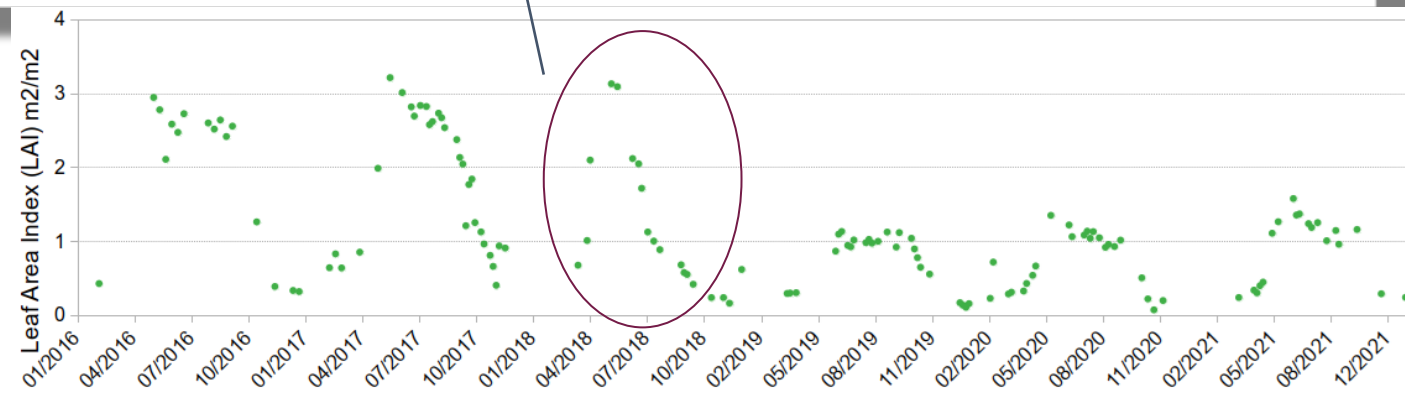
Knowledge Sharing Platform

- registration, visualisation and analysis of showcase related information (maps, charts, animations and reports) and user evaluation and feedback
- support development of a strong, knowledgeable community
- include record of events allowing further analysis and studies toward selecting appropriate EO data sources and methods

BORŞA: Tăiere ilegală şi furt de arbori constatate în zona alpină Strâmtura
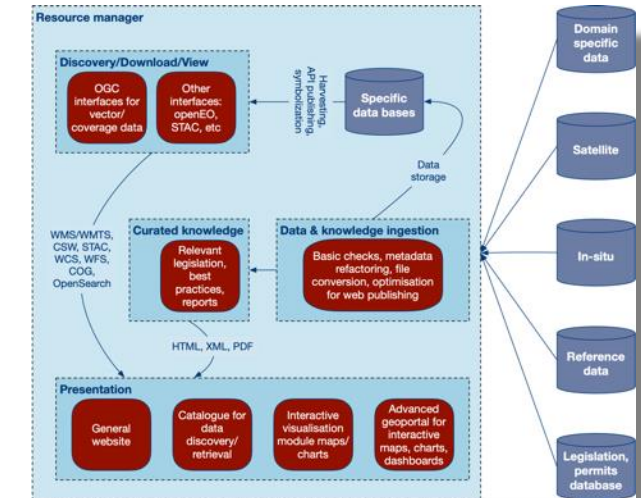
Current Planning & Future Activities

Calendar

Activities / Time	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Requirements analysis	--	--	--	--	--	W1	--	R1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Methods selection	--	--	--	--	--	--	--	—	--	W2	--	R2	--	--	--	--	--	--	--	--	--	--	--	--
Case studies	--	--	--	--	--	--	--	--	--	--	R3	--	--	--	--	R3	--	R4	--	--	--	--		
Uptake planning	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	W3	--	R5	R6	--		

Coordination

Overall coordination: ROSA

Coordination per topic:

Air (METEO)

Forestry (CBK PAN)

Waste (GFZ)

Water (CUT)

Illegal Building (ISPRA)

Illegal Manure Spreading (ISPRA)

Dialogue with users: coordination ISPRA, implementation all partners.

Demonstration products: GFZ

Outcomes

W1: Workshop on user need analysis in M06

R1: report on users profiles, needs and regulatory obstacles (M08)

W2: Workshop on GEOINT methods and tools in M10. Deliverables:

R2: report on recommended IT infrastructure, needed data and analysis tools (M12)

R4: portfolio of demonstration products (INTREPs) in pilot test sites (M20)

R3: knowledge sharing platform (KSP) - software and user manual (M18)

W3: Workshop on workflows and technical and legal barriers in M20

R5: report on possible workflows, technical obstacles and needed investment (M22)

R6: summary of recommendations on workflows, training needs and uptake (M23)

Our team

Topics and contributors

Air pollution: CUT, METEO, ROSA

Illegal construction: ISPRA, ROSA, CBK PAN

Illegal forestry: CBK PAN, ROSA, CUT, ISPRA

Illegal manure spreading: ISPRA, ROSA, METEO

Waste crime: GFZ, ROSA, CBK PAN, CUT

Water pollution: CUT, METEO, GFZ

Organisations and scientists

CBK PAN: Michał Krupiński, Stanisław Lewiński, Marcin Folwarczny

CUT: Thrasos Stylianou, Christiana Papoutsa, Kyriakos Themistocleous

GFZ: Mathias Bochow, Nora Meyer zu Erpen, Tobias Weiß

ISPRA: Luca Congedo, Ines Marinosci, Antonella Tornato, Nico Bonora, Emiliano Agrillo,Federico Filipponi

Meteo RO: Vasile Craciunescu, Anisoara Irimescu

ROSA: Florian Bodescu, Ion Nedelcu

Website: https://www.copernicus-user-uptake.eu/