

Webinar

A new Common Agricultural Policy (CAP) based on Copernicus programme and EO4GEO tools

April 28th, 2021

10:00 a.m.

Online event

Livio Rossi, e-geos, AIT President

- **Index**

- What is the EU Common Agriculture Policy CAP and its achievements along the time
- EO data/products used for the PAC controls and their evolution
- The Land Parcel Identification System and the CAP controls through EO
- The Copernicus Sentinel constellations
- The new "Checks by Monitoring" on the EU territory: the wall to wall monitoring opportunity
- The GeoTag in situ photo APP on mobile phones
- Additional targets: land sustainability and climate changes effect limitations: what advantages for the EU citizens
- Point of strength/weakness and perspectives of technical jobs in this sector
- The EO4GEO tools and the opportunity of free training resources.

The Common Agricultural Policy - CAP

The CAP started at the end of 1970 for the European organization of the agro-market, but since 1992 became geographical-based, through the support of **satellite data**.

It currently consists of around **40 Billion euros** of annual subsidies distributed to 8 million of European farmers and has really been promoting the EO Agricultural sector in Europe.

The in act modernization of the CAP is successfully including the opportunities offered by the **Copernicus** programme, such as EO*GI solutions and each EU farmer (also through associations, agencies, etc) is stimulated to improve his/her **“e-governance”**.

CAP Main tasks: after specific analyses/controls at national and regional level, well supported by satellite and geomatic services, (nowadays by Copernicus) , EU DGAgri officers **authorize the final funds transferring** to each EU Member States and then to each single farmer/beneficiary.

CAP objectives

The CAP purposes:

- ensure a stable and affordable **food supply** promoting the local and EU own food production: **OK**
- reduce the **import** of primary goods: **OK**
- enable “productive” farmers to obtain a **stable living**: **OK**
- support the rural economy and the **sustainable use** of resources: **OK/Partial**
- maintain rural landscapes and improve the environmental safeguard, particularly for the **climate changes** fighting: **Partial**

Anyway: EU CAP legislation and related subsidies achieved in EU a 20% reduction of the **agro-carbon footprint** since 1990 (unique economic sector in the world)

The CAP main working tasks

In summary:

- **integrate and update** rural cartographic, cadastral and alphanumeric data
- plan and acquire **aerial and satellite** data for the agronomic mapping, both “wall to wall” and at sampling level (LPIS, controls)
- organize digital and geo-referenced 'annual “**aid applications**’ for the farmers’ declaration
- **check, through remote sensing**, the accuracy of the declarations and the applied environmental protection measures, based on national sampling
- calculate the **premiums to be paid** to each farmer, according to deadlines set by the EU

The CAP rules vs the technology updating along the last decades

The CAP



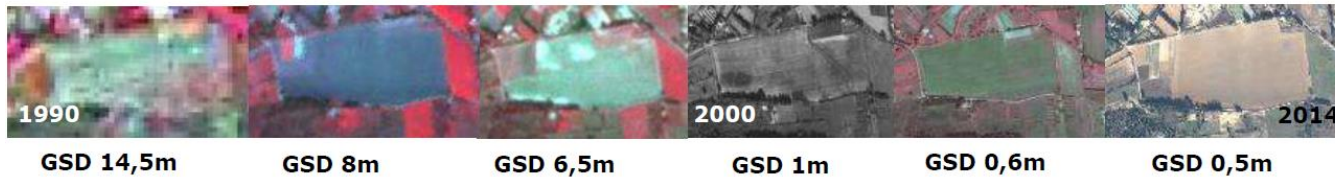
Objectives unchanged: ... check all conditions for which aid is granted



But conditions constantly evolve



Technology is also evolving



→ Methods constantly need update if not upgrade

JRC- by Philippe Loudjani

Example of initial used technologies (satellite + SW)(in the 90's)

Orthophoto B/N (01/05/1998)

Landsat-TM (04/07/1998)

Spot-XS (29/10/1997)

Rejected after satellite checks

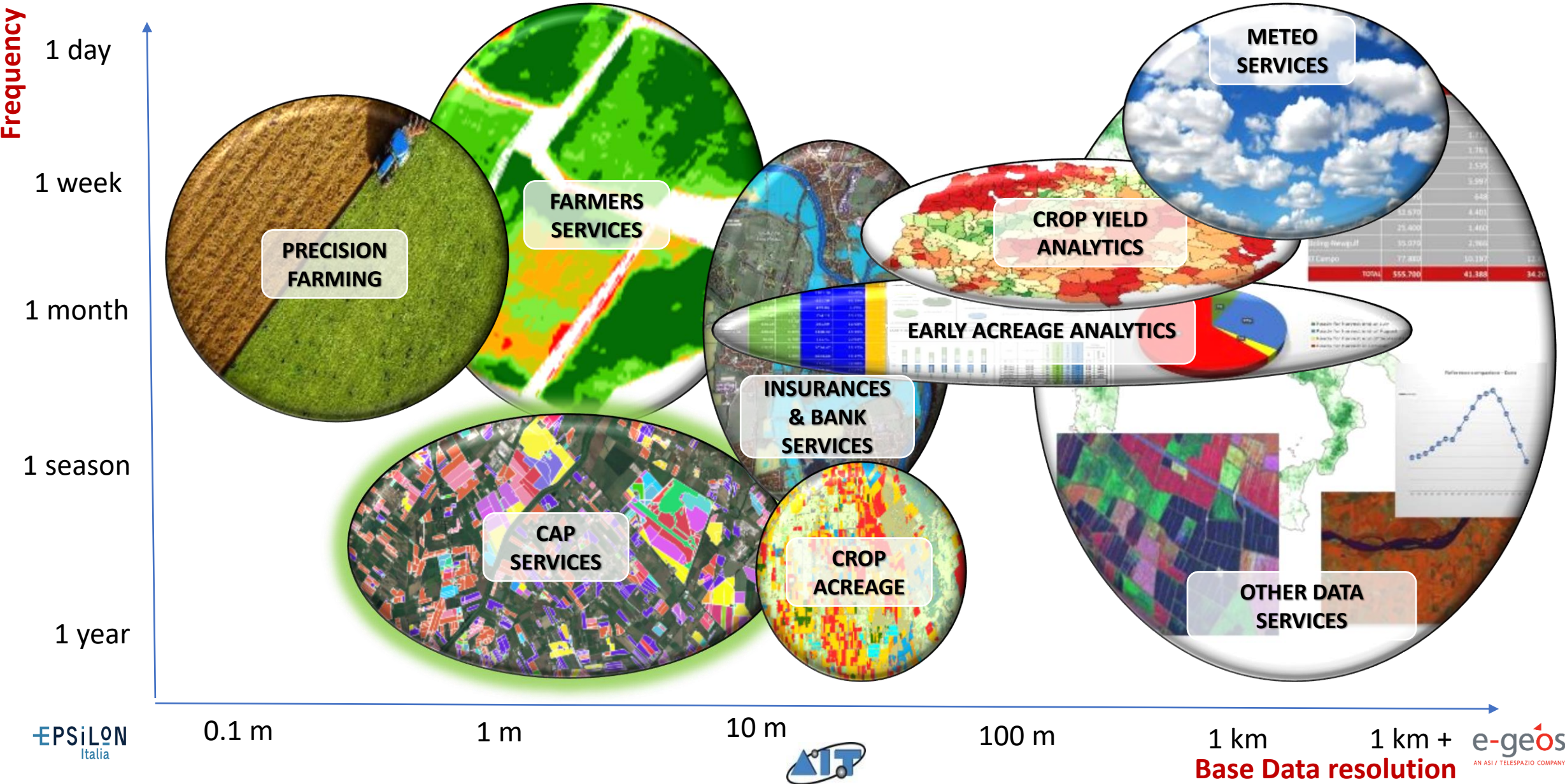
GSD 10 m

COLTURA	DICH.	ACC.	DIFF
Mais			
Frumento duro			
Altri cereali			
Soia	3,55		-10C
Girasole			
Colza e ravizzone			
Piante proteiche			
Colture			
Superfici messe a			
Altri utilizzi	0,27		-10C
IN			
TOTALE	Ettari	3,82	3,84

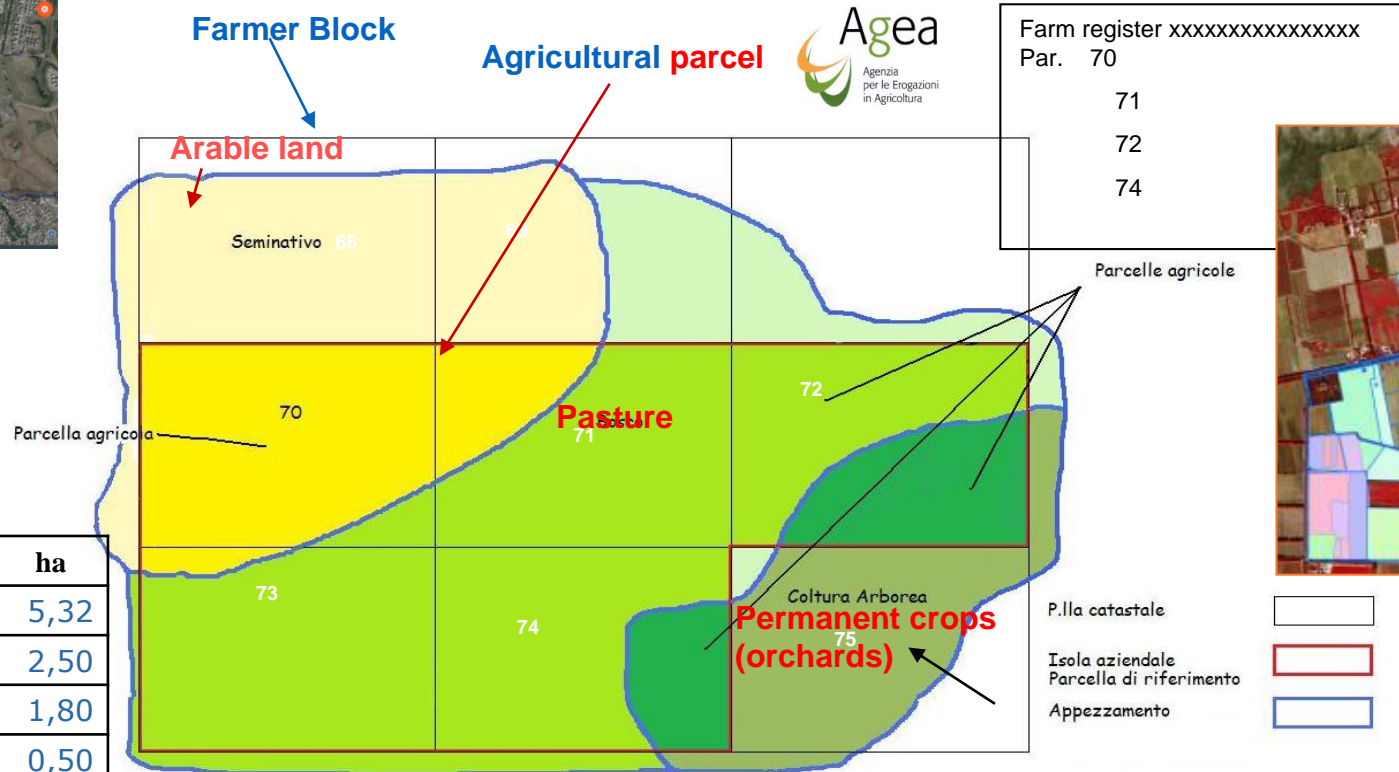
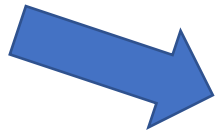
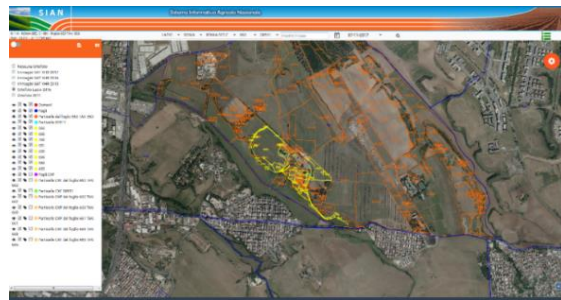
Provincia: Mantova
Comune: Medole
Foglio: 0007
Particella: 00088 ha: 3,84

Consorzio ITA

Earth Observation: what agriculture services for what revisit and spatial resolution?



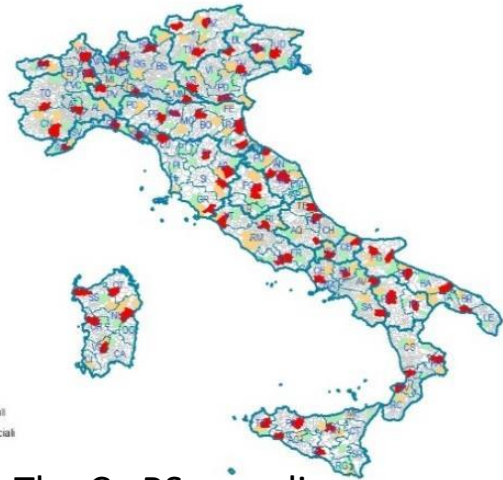
The **Land Integrated Parcel System LPIS**, mandatory for each nation, synergistically manages and updates the entire agronomic multi-annual data base of each EU nation: (satellite, air photos, cartography/cadaster, land and agronomic registers, GNSS surveys, farms' information)



Cod.	Land use	ha
040	Arable land	5,32
120	Nut trees	2,50
160	Olive trees	1,80
360	Other orchards	0,50
920	Not cultivated uses	0,37

property, reference parcels, land use at very large scale for the **maximum possible amount of subsidies calculation**

The annual CAP **Controls with Remote Sensing CwRS**, through a risk based sampling on declared areas: scattered” acquisitions over Europe of Very High Resolution VHR satellite, processing, interpretation and ground visits before the CAP payments at the end of the year



Legenda
 Limiti regionali
 Limiti provinciali
 Siti 2020
 Siti 2019
 Siti 2018
 Limiti comunali

The CwRS sampling frame on Italy: 30,000 sqkm



The CwRS sampling frame on Europe > 500,000 sqkm altogether



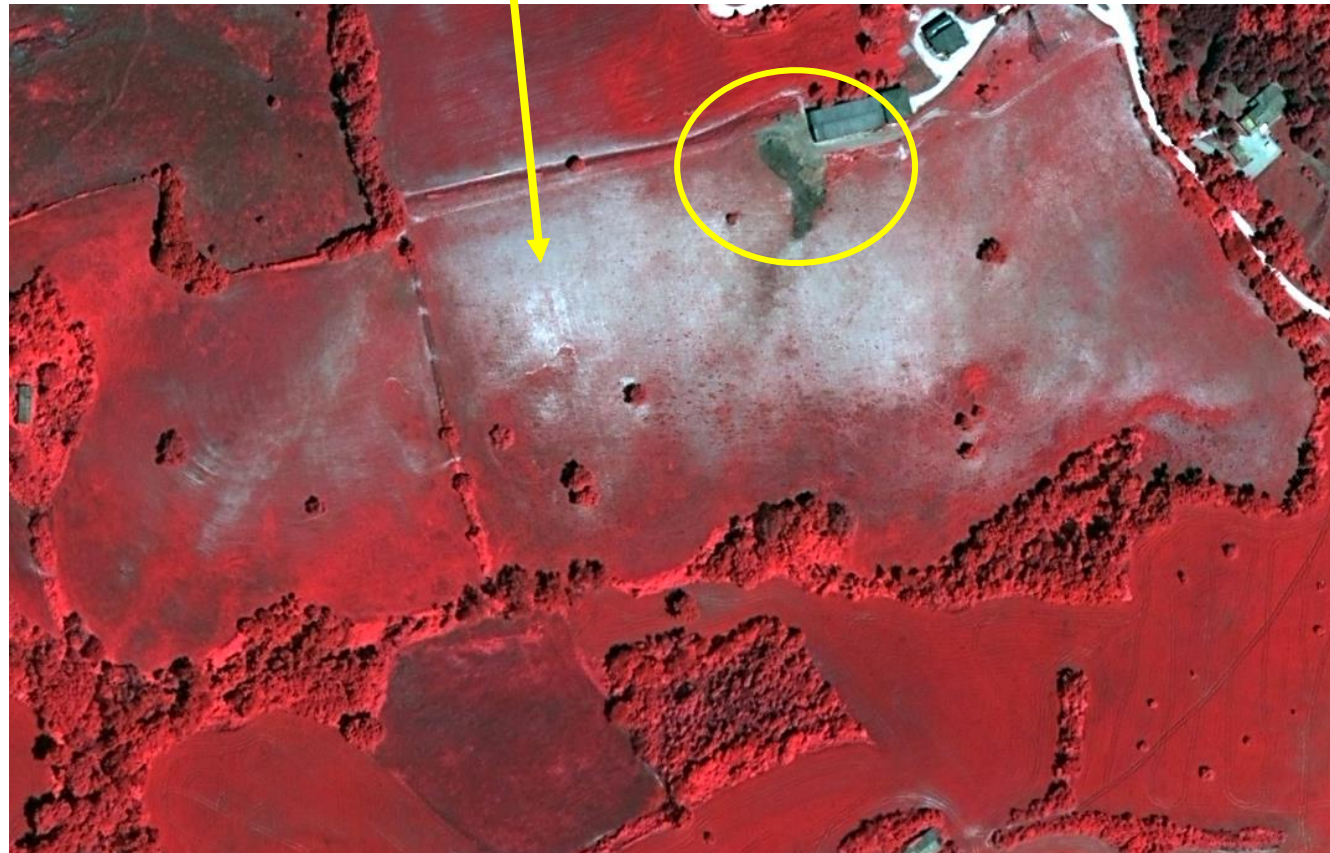
VHR satellite: Geoeye, Worldview, Kompsat at 0,5m resolution acquired on a sample base over the entire EU, previously selected by MS;
 Data, after professional data processing are submitted to expert interpreters for 5% of declaration compliances and ground survey for doubtful cases

only after this verification: farmers can be payed

EU JRC and DGAgri usually verify the correctness by annual Audits

The CwRS controls for the **agro-environmental protection** requested measures: CAP Good Agricultural Environmental Conditions -**GAEC** to be verified through very high resolution satellite

example of overgrazing and livestock waste disposal: a non compliant behaviour by farmer detected by VHR sat

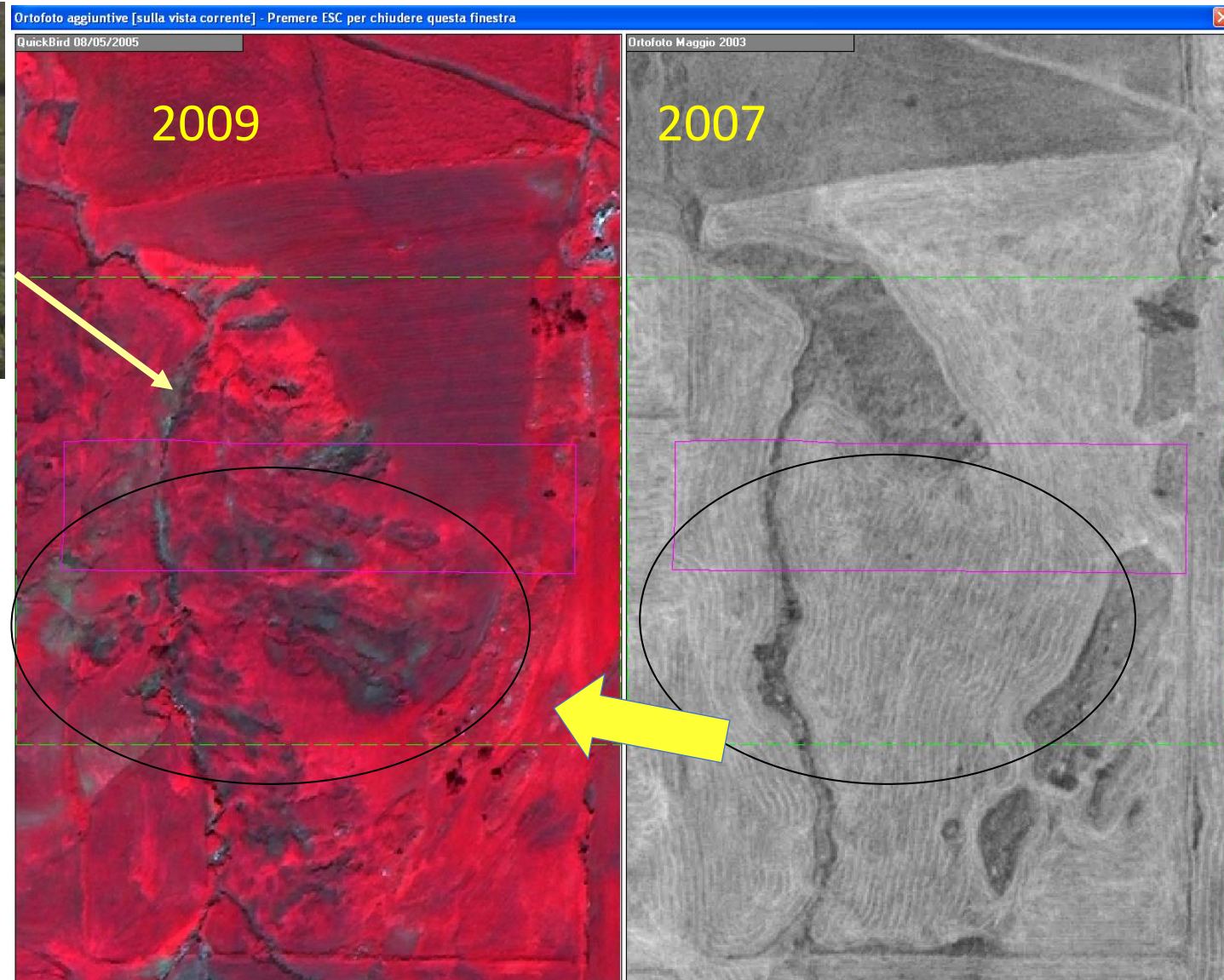


Lack of agro-soil maintenance/interventions in the last decades is destroying the local potential productivities, creating serious loss of fertile soil



Consequences

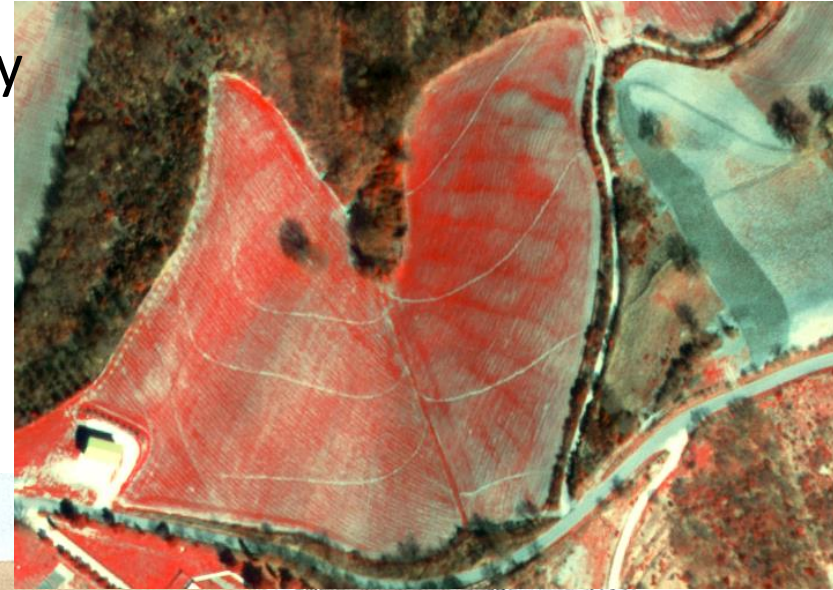
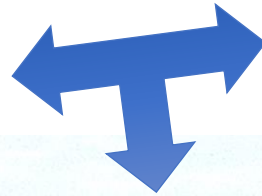
erosion,
landslides,
organic matter loss,
higher flooding
intensity and
frequency,
and
then irreversible loss
of agricultural surfaces



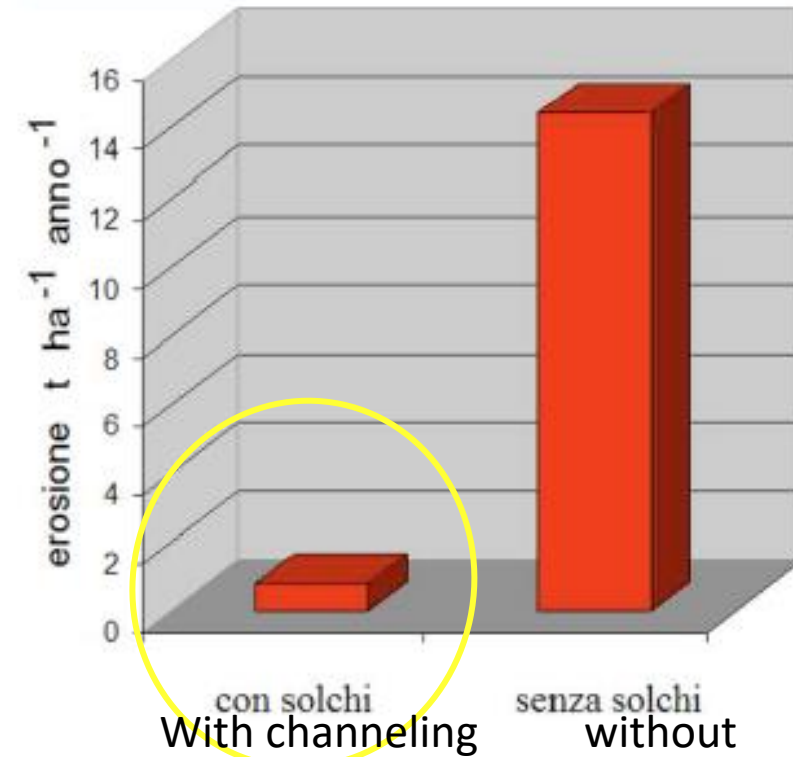
GAEC - Possible remediation: temporary and stable channeling on slopes – EO has been using for addressing the corrective measures and controlling the benefits ex post



Control's capability
through
VHR sat imagery



GAEC rules and results: the temporary channeling on slope, to save water and soil appears efficacy if well applied



Efficond project
By CREA (It. Centre of
Research in Agri.)



Edge- tree/rows for water, soil and
biodiversity protection

From GMES to Copernicus programme

COPERNICUS SERVICES: a strong contribution to the CAP programme



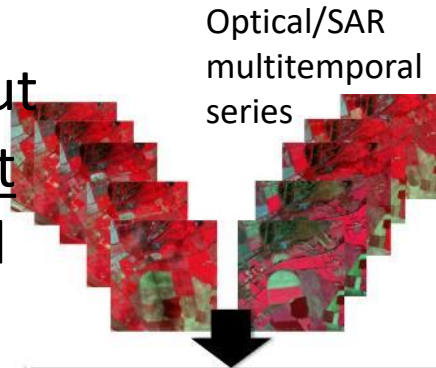
A new enabling structure

The new Monitoring approach: Copernicus Sentinel capability => Checks by Monitoring - CbM

CbM:

More democracy in controlling, instead of the 5% of sampling only (leaving 95% out of controls) and create a positive deterrent for avoiding fraudulent/inaccurate CAP aid declarations

In addition it offers to Administrations and citizens a complete and continuous national/local **land monitoring** for the environmental controls, providing additional services, **beyond the CAP** and the Agro sector



1 parcel= 1 field
Multitemporal indexes analysis and automatic traffic lights for direct payments

Crop confidence level **98%**

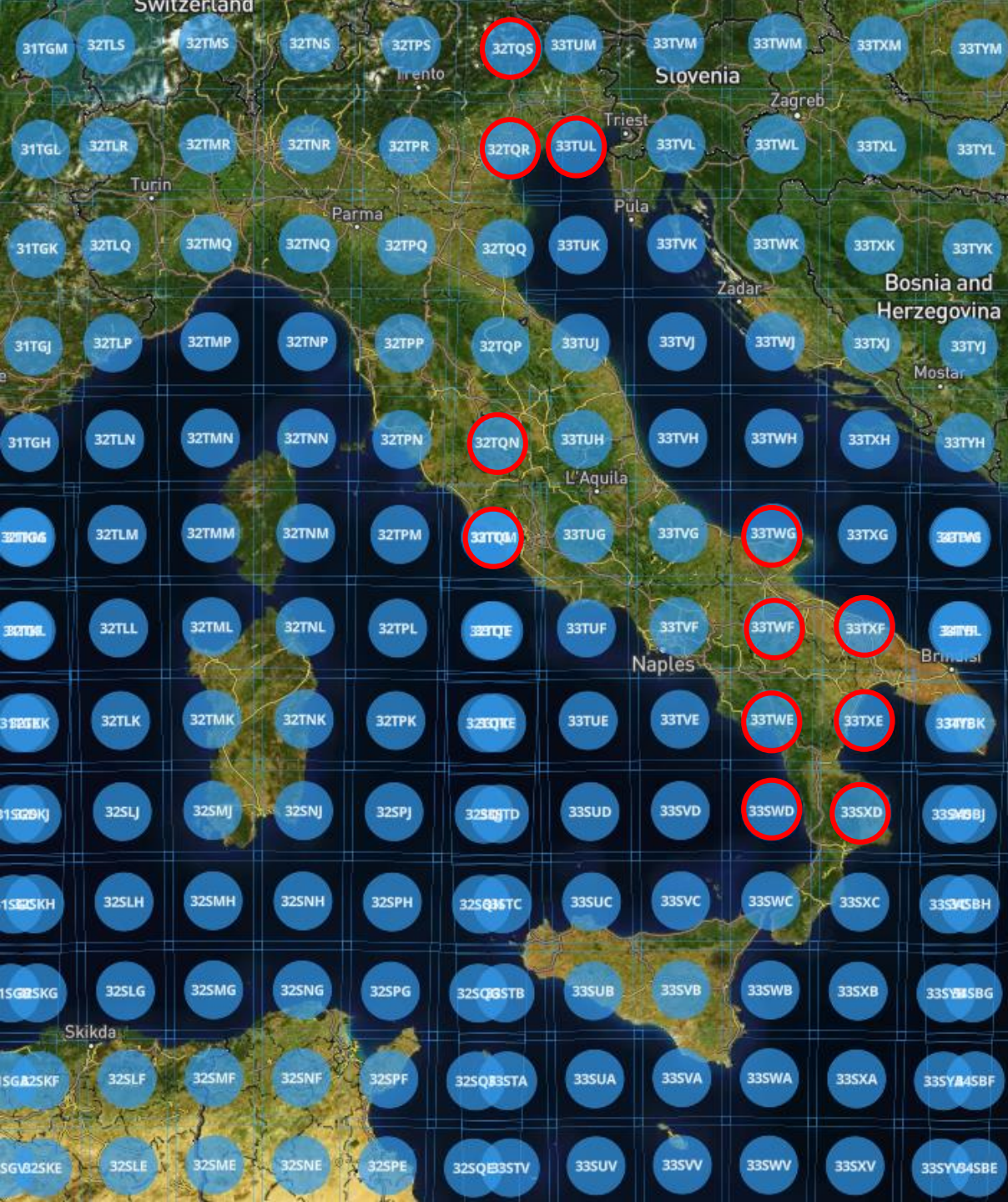
€€€
PAYMENTS



intra-parcel indexes



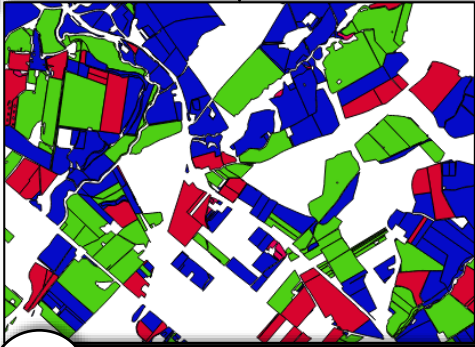
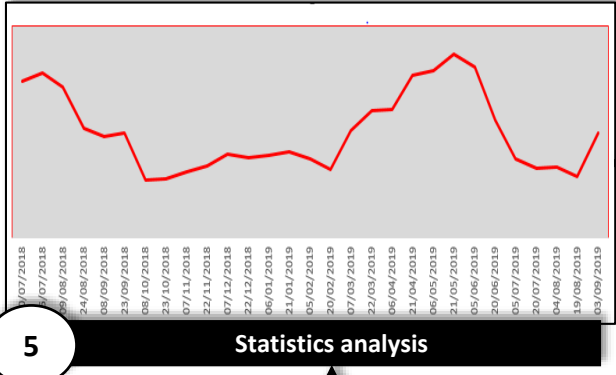
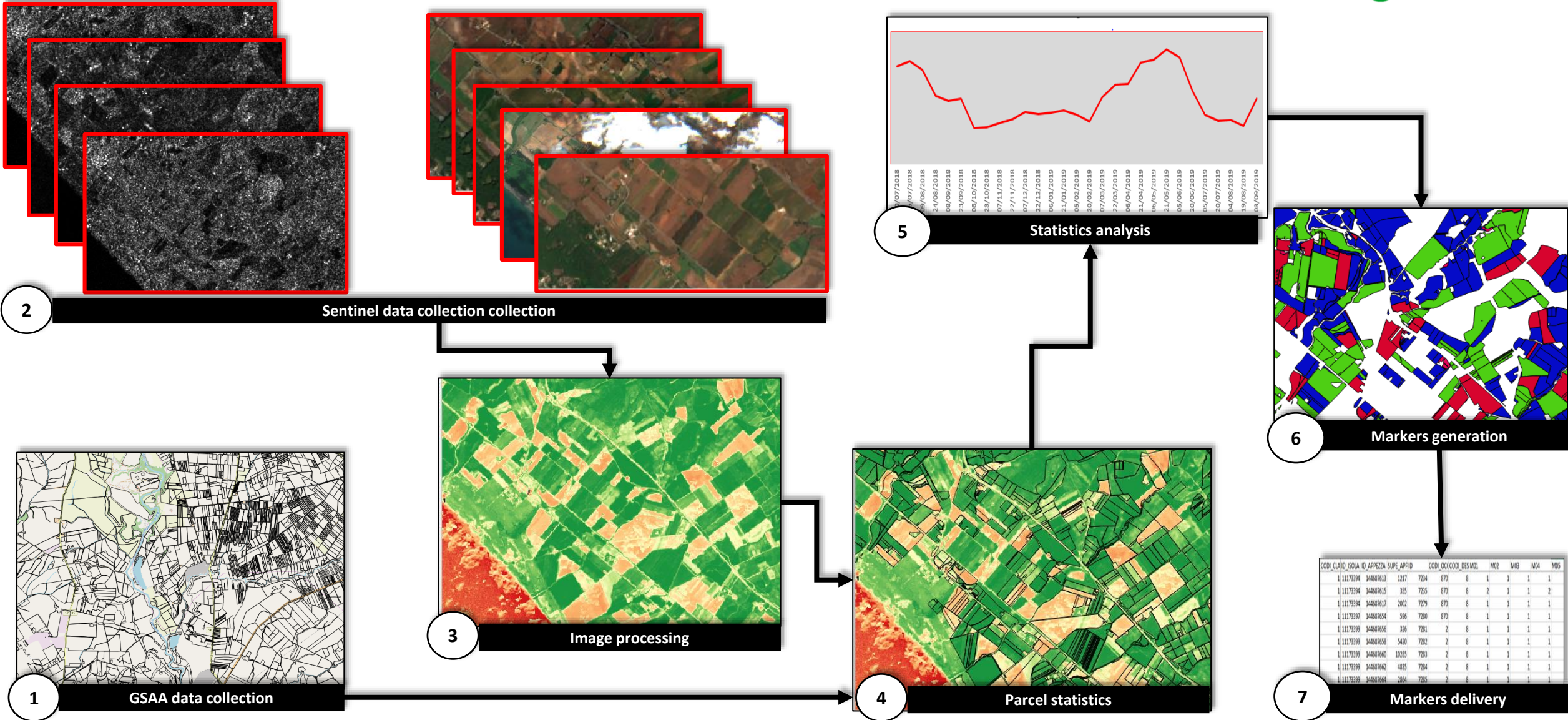
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119	124	130	136	138	140	150	150	151	152	153	150	136	121	119	118	118	118	118	116	122	128	133	138	143	137	130	124	118	111	105					
134	136	138	140	139	138	145	144	144	143	142	128	125	122	120	126	132	134	136	139	135	131	133	135	138	134	131	127	124	120	117					
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Sentinel-2 data availability and collection example for CbM

- ESA Sentinel-2 tiles «granules» extraction
- Selection criteria: cloud cover < 90%
- Example of starting date in collection (Italy): 15 July of the previous year
- Example of ending date (Italy): 15 November of the Administrative CbM year
- Used S2 «granules» for CbM monitoring: potentially up to 100 per Tile per year for a mediterranean agronomic season
- NB: **SAR S1** collection and processing helps to replace optical in cloud cover persistent cases and to improve grassland mowing detection events

Checks by Monitoring CbM: how to work the **workflow** applied for the Italian Paying Agency AGEA



CCODI	CLA_ID	ESOLA_ID	APPEZZA	SUPE	APPID	CCODI	CCODI	DES	M01	M02	M03	M04	M05
1	11173394	144687613	1217	7234	870	8	1	1	1	1	1	1	1
1	11173394	144687615	355	7235	870	8	2	1	1	1	1	1	2
1	11173394	144687617	2002	7239	870	8	1	1	1	1	1	1	1
1	11173397	144687654	596	7280	870	8	1	1	1	1	1	1	1
1	11173399	144687656	326	7281	2	8	1	1	1	1	1	1	1
1	11173399	144687658	5420	7282	2	8	1	1	1	1	1	1	1
1	11173399	144687660	10205	7283	2	8	1	1	1	1	1	1	1
1	11173399	144687662	4835	7284	2	8	1	1	1	1	1	1	1
1	11173399	144687664	2864	7285	2	8	1	1	1	1	1	1	1

CbM: example of **markers extraction** by Sentinel, at parcel's level

After a «crop grouping» of the declared parcels (same phenology), one or more markers must be automatically extracted on each parcel, such as:

- *Ploughed*: ploughed terrain before seeding
- *Growth*: parcel with growing vegetation (gradient ratio calculation)
- *Vegetation presence*: parcel with vegetation (threshold's verification)
- *Harvested*: parcel harvested
- *Mowed*: grassland mowed and timing
- *Grubbed*: grubbing of permanent cultivations

Contextually, different **timing scenarios** must be individuated and selected, considering :

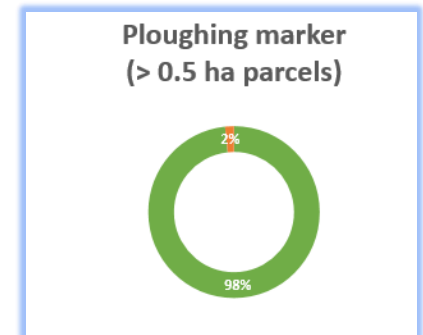
- *Type of crops*: activities carried out in different periods of the year (i.e.: harvesting or ploughing times for winter or summer crops, etc.)
- *Geographic location*: crop calendars can be different even at national/regional level, depending on the region (climate, altitude, latitude, local traditions)
- *Regulations*: some activities are ruled and performed or not performed according to specific periods (grass mowing, land lying fallow cleaning, etc)

CbM- Geo Spatial Aid Application -GSAA; CAP declared parcels by farmers collection – green (aid request); white (not declared areas) -example in Puglia Region





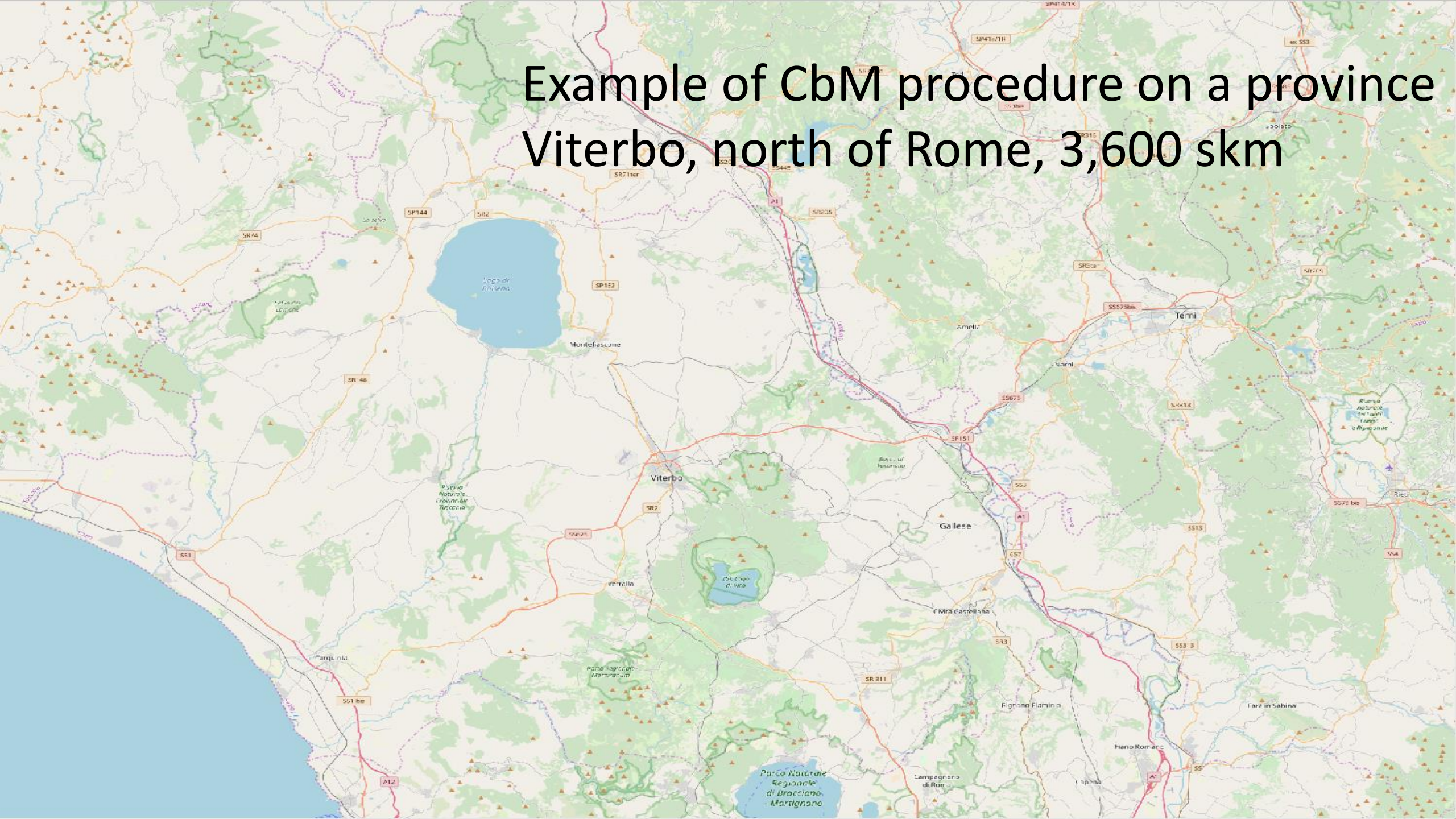
Green: marker detected
Orange: not detected

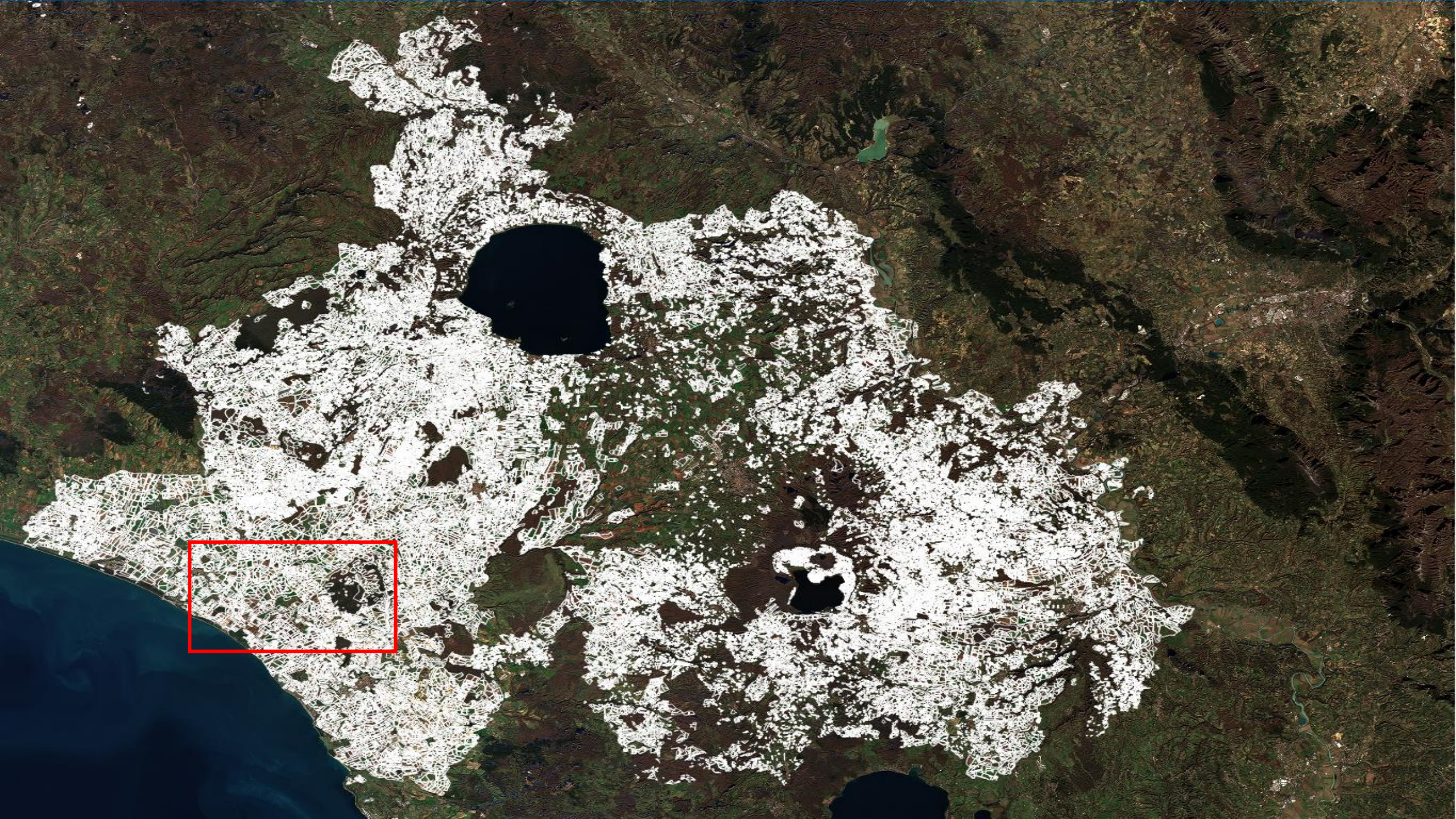


Ploughing marker details and analytics



Example of CbM procedure on a province Viterbo, north of Rome, 3,600 skm







Sentinel2 natural
colors

27/12/2018



Merging GSAA and
satellite data

27/12/2018



S2

27/12/2018

Winter crops GSAA
and satellite data



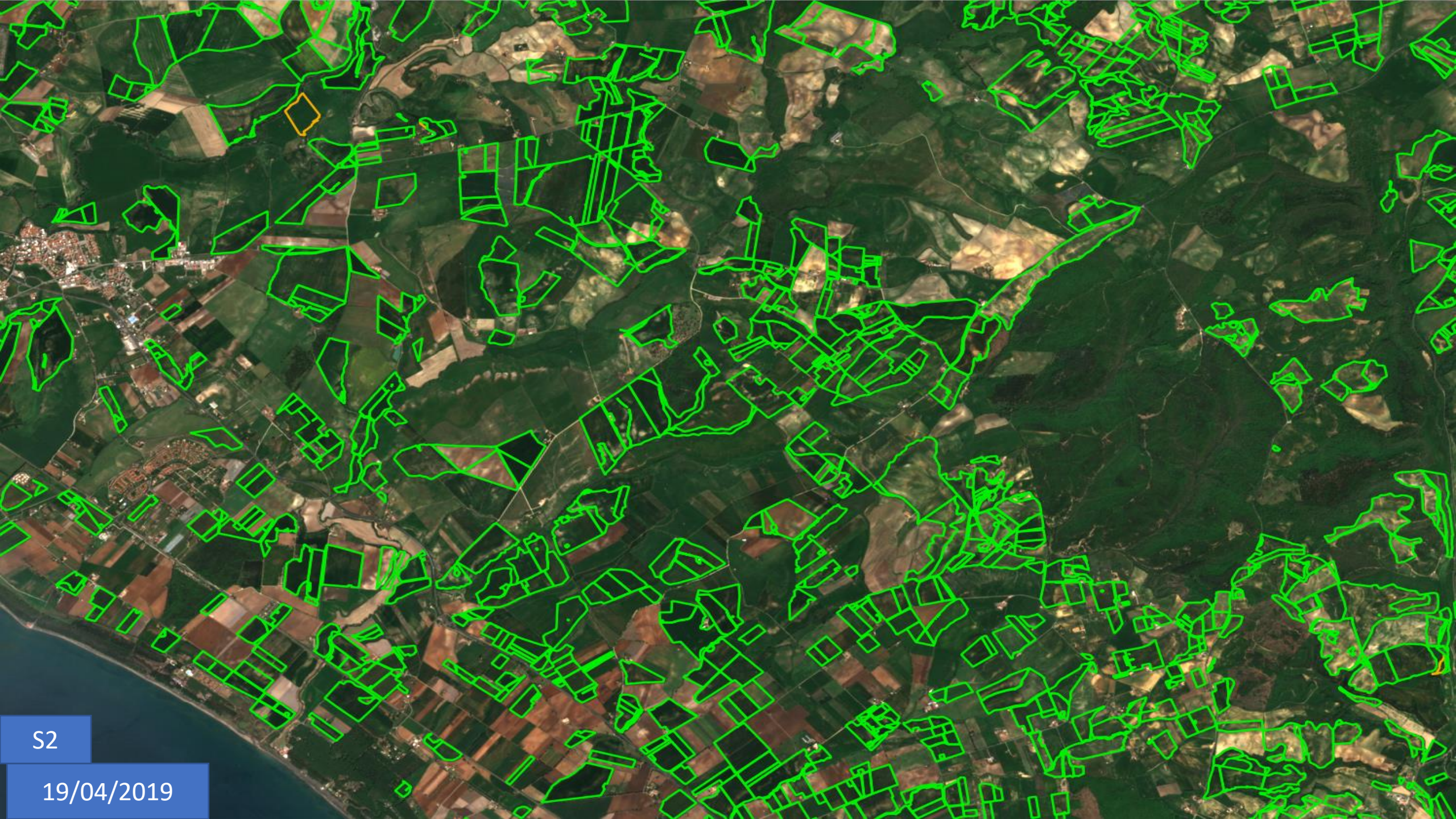
S2

26/01/2019



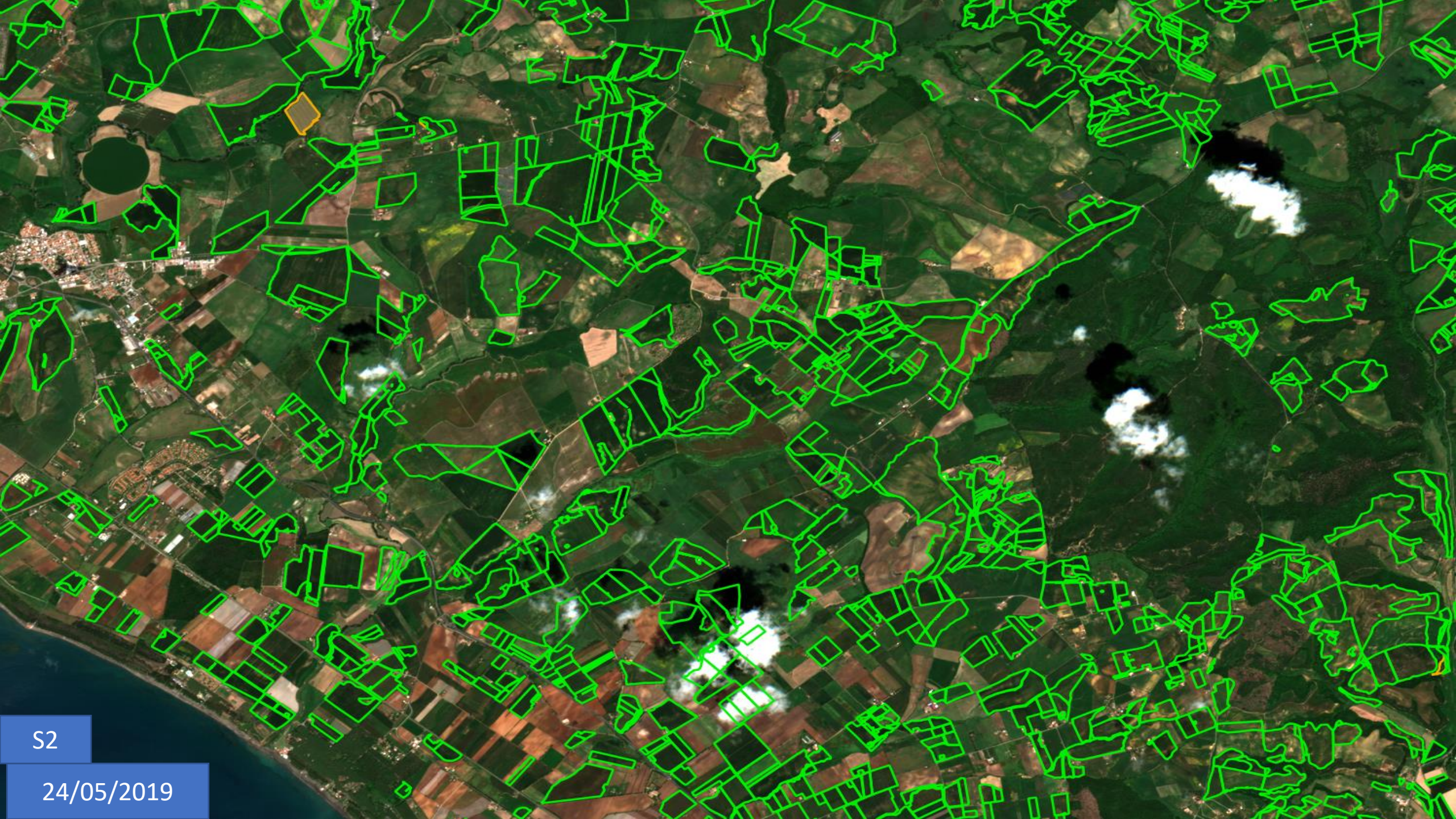
S2

28/02/2019



S2

19/04/2019



S2

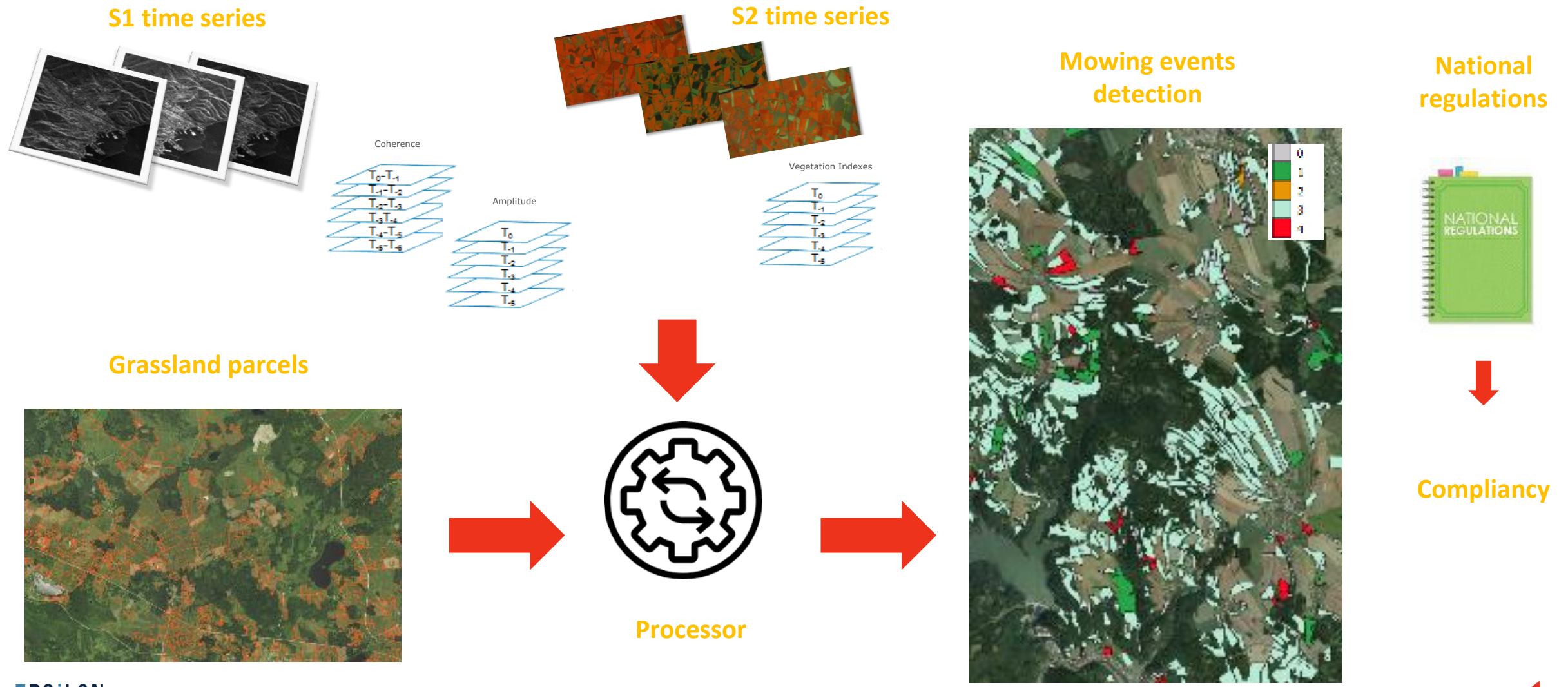
24/05/2019



S2

18/06/2019

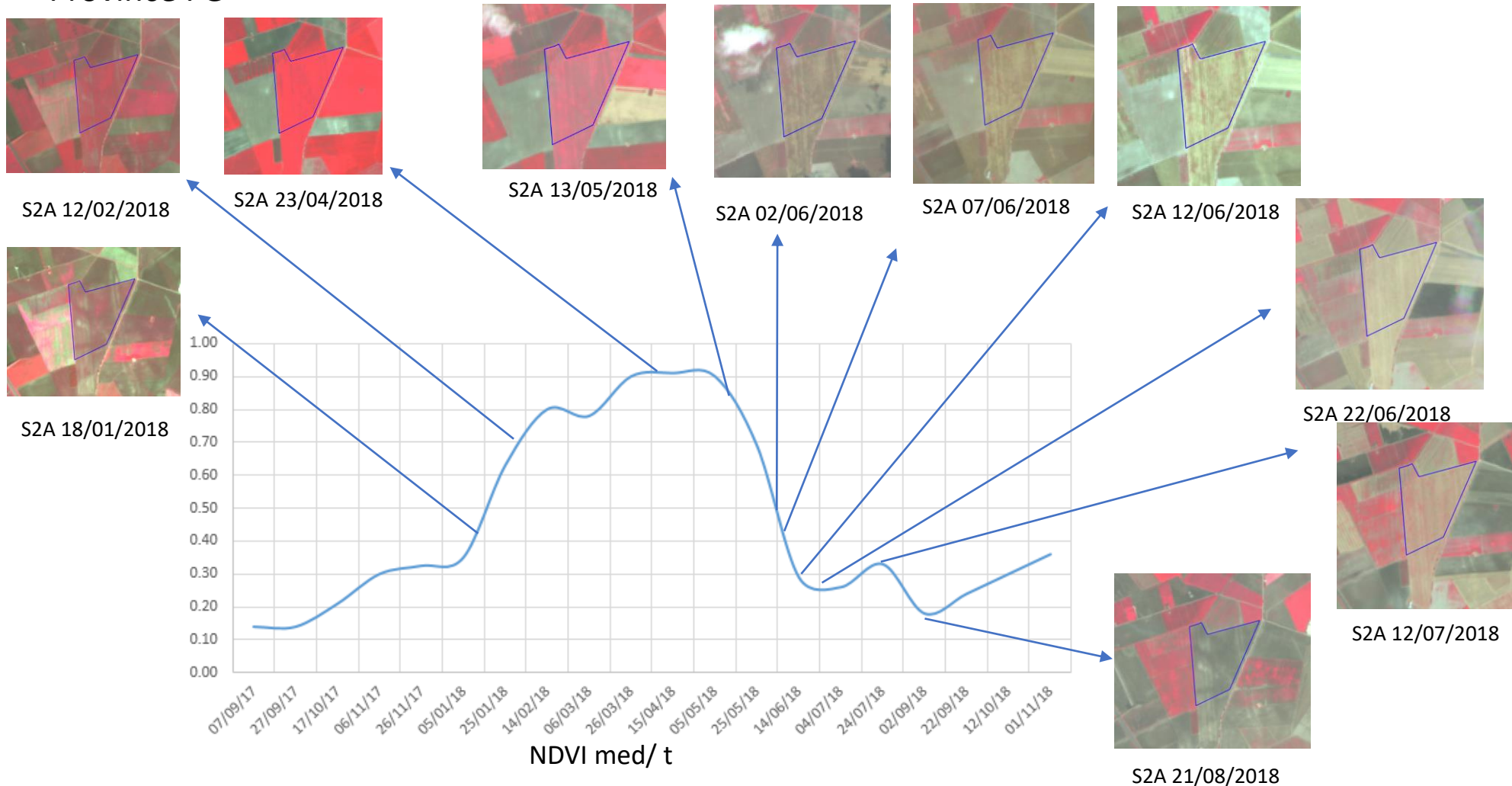
CbM: specific processing for detecting events of grassland mowing through Sentinel 2 and SAR Sentinel 1



Use cases of CbM: operational examples in Italy

POSITIVE and eligible parcel by CbM - Barley: entire phases' evaluation

870 cod barley – arable
 parcel ID: 199218200
 Area 25 ha
 Province FG



CAP CbM output, at administrative level

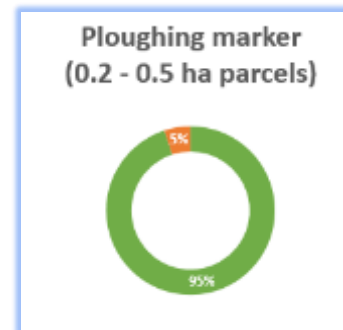
winter crops example: the ploughing «marker» detection

PARCELS numbers STATISTICS of a province

ARABLE LAND : AUTUMN-WINTER CROPS

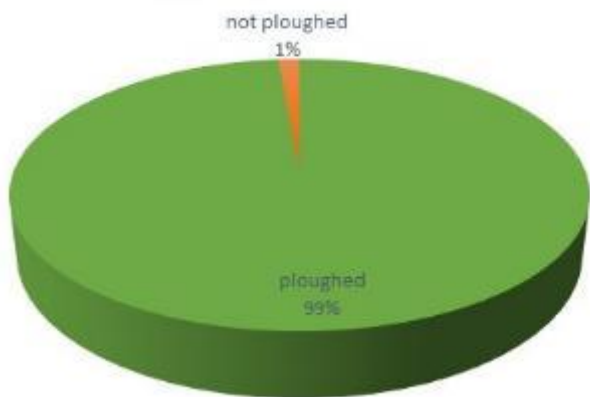
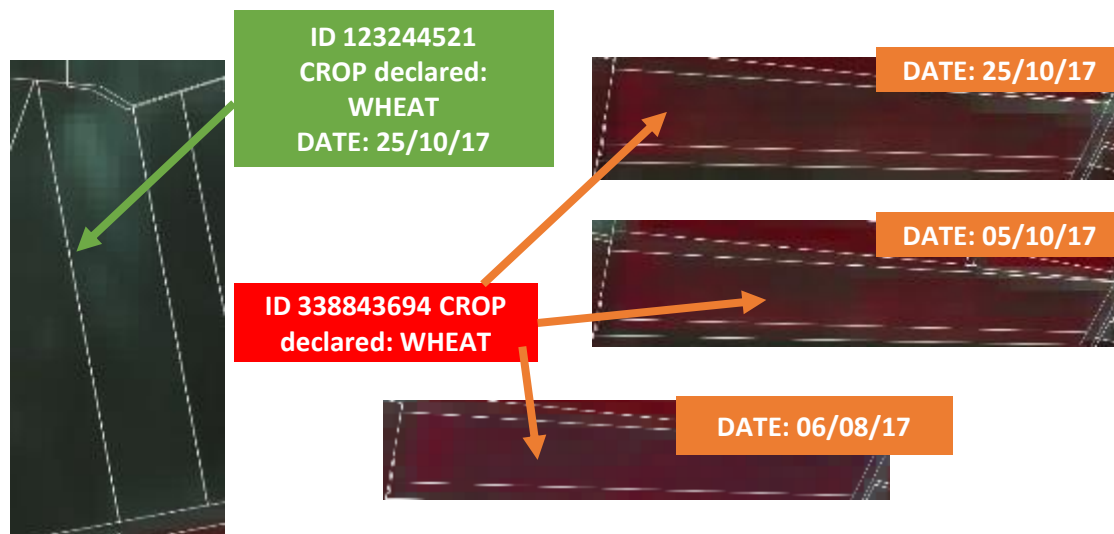
MARKER M01 - Ploughed (period 15/7/2017 - 30/10/2017)

	PLOUGHED	NOT PLOUGHED	NOT MEASURABLE	% OVER TOTAL
< 0,2 ha	19487	3418	7577	26%
0,2 - 0,5 ha	16961	899	0	15%
> 0,5 ha	67927	1153	0	59%
TOTAL	104375	5470	7577	100%



Declared AREA STATS

Ploughing marker - Area

ID 123244521
 CROP declared: WHEAT
 DATE: 25/10/17

ID 338843694 CROP declared: WHEAT

DATE: 25/10/17

DATE: 05/10/17

DATE: 06/08/17

Example of correct (green) and not correct (red) declaration by automatic analysis

CAP CbM output at administrative level

autumn-winter crops example: the harvest «marker»

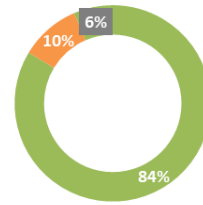
PARCELS STATS

ARABLE LAND : AUTUMN-WINTER CROPS

MARKER M05 - Harvested (period 1/5/2017 - 31/7/2018)

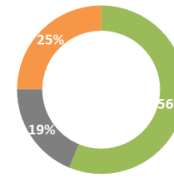
	HARVESTED	NOT HARVESTED	NOT MEASURABLE	% OVER TOTAL
< 0,2 ha	17131	5774	7577	26%
0,2 - 0,5 ha	15532	2328	0	15%
> 0,5 ha	65559	3521	0	59%
TOTAL	98222	11623	7577	100%

Harvested
(100% parcels)



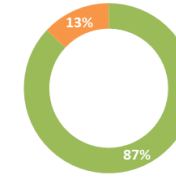
■ HARVESTED ■ NOT HARVESTED ■ NOT MEASURABLE

Harvested
(< 0.2 ha parcels)



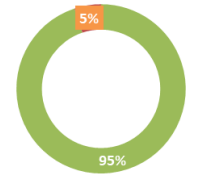
■ HARVESTED ■ NOT HARVESTED ■ NOT MEASURABLE

Harvested
(0.2 - 0.5 ha parcels)



■ HARVESTED ■ NOT HARVESTED

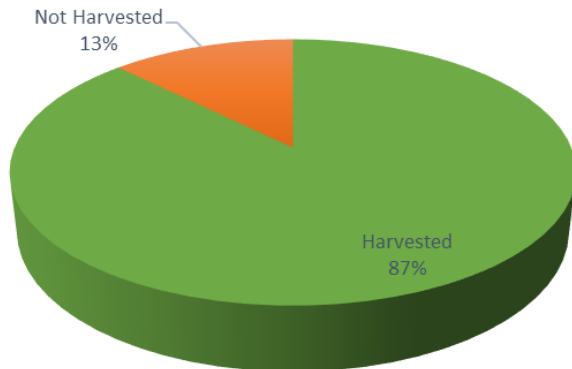
Harvested
(> 0.5 ha parcels)



■ HARVESTED ■ NOT HARVESTED

AREA STATS

Harvested marker - Area



CAP CbM output at administrative level

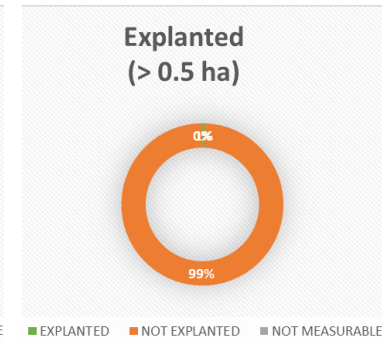
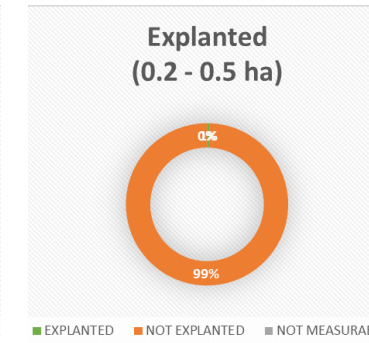
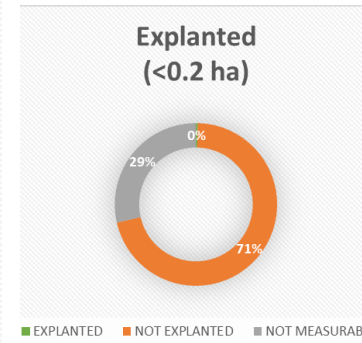
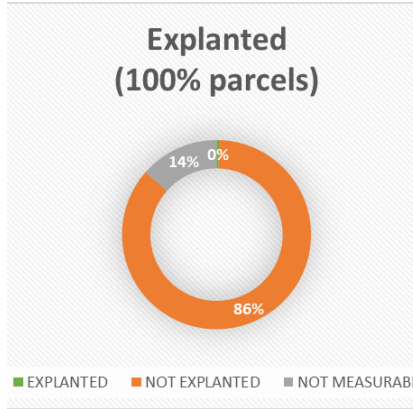
permanent crops example –vineyards: grubbing detection

PARCELS STATS

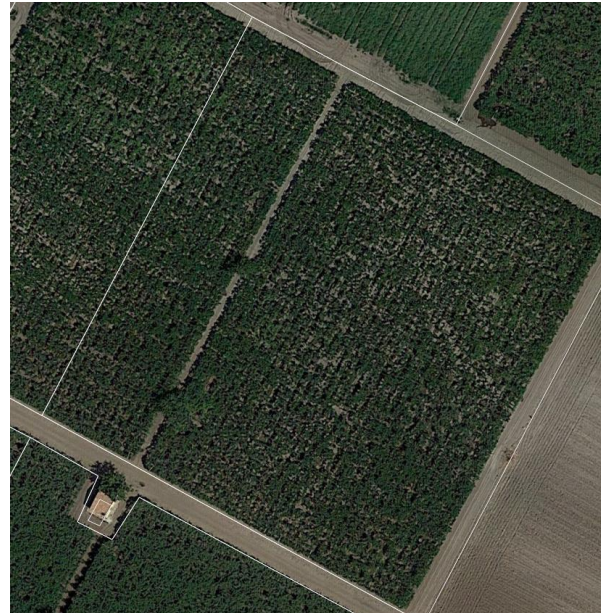
PERMANENT CROPS - VINEYARDS

MARKER M62 - Explanted (period 1/1/2018 - 6/11/2018)

	EXPLANTED	NOT EXPLANTED	NOT MEASURABLE	% OVER TOTAL
< 0,2 ha	66	13113	5276	47%
0,2 - 0,5 ha	40	7438	0	19%
> 0,5 ha	67	13088	0	34%
TOTAL	173	33639	5276	100%



ID 349914344
Area: 1,23 ha



Verified by VHR satellite and ground surveys

Follow-up and administrative procedure, after CbM automatic satellite “flag generation”

- The CbM periodic and systematic automatic procedure from **Sentinel Copernicus** often does not conclude the analysis
- For these cases **Follow-up** activities are necessary, to finalize the subsidies admissibility (especially for small, strange shapes, hilly-mountain parcels);
- **A Back Office (B-0)** activity must therefore perform additional analyses and /or through farmers information to finalize the decisions, by SW for rapid Satellite multitemporal visual analysis, georeferenced GEOTAG photos in field, documents exchanging , etc

FROM FLAGS (satellite) to final **TRAFFIC LIGHT** (administration + B-O) for paying each single farmer and rejecting frauds: **the workflow**



1° STEP

2° STEP

3° STEP

SATELLITE
MARKERS/SCENARIOS
EVALUATION

FLAGS
GENERATION

PARCELS/ FARMS
ECONOMIC
IMPACTS

EXPERT
SURVEYORS
INTERVENTION

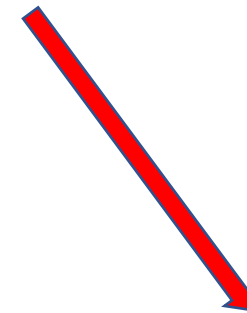
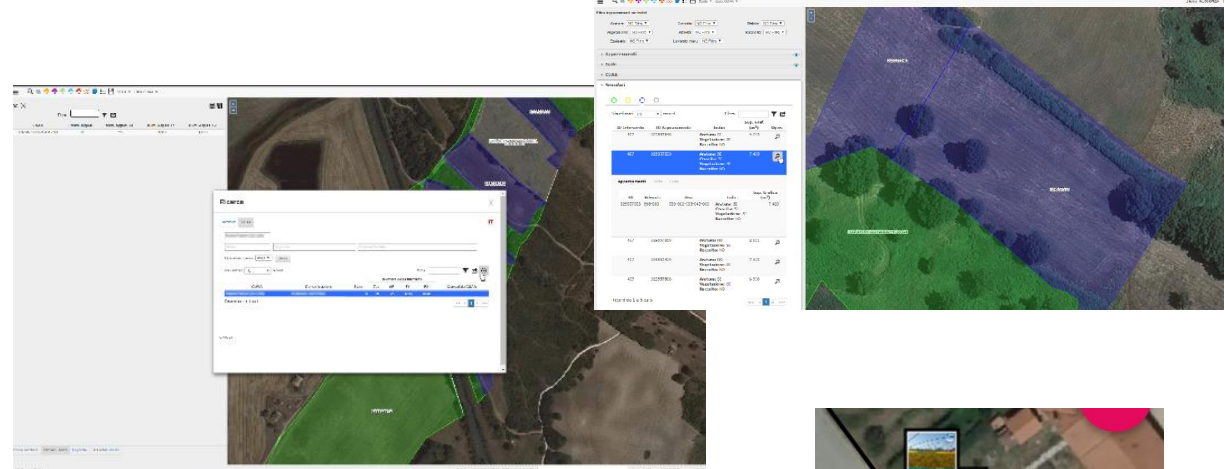
FOLLOW-UP

TRAFFIC
LIGHTS
OUTPUTS

PAYMENTS
PROCEDURES

The AGEA Back-Office (B-O) for CAP Checks by Monitoring how to work

- When Sentinel or other remote ancillary information **do not give conclusive** answers (yellow flags), B-O expert operators must go in detail through visual interpretation or can ask to surveyors or to farmers to acquire specific **geo-tagged photos** to provide a correct ground proof
- Users (farmers or surveyors) can be guided by the APP both in reaching the parcel and in the correct **taking of the photographs**
- The APP GEOTAG of AGEA is connected to the Public Agency server and through this tool, CbM can be concluded via a final **“traffic light”** for payable farms or rejected (green or red)



« Geotag App » on phone mobile

Operational photo cones acquired



Secure, protected and guaranteed “in-field” photos

Needs

Secure tool to avoid frauds or manipulations, through a low cost device for precise and verified **in-field proofs**

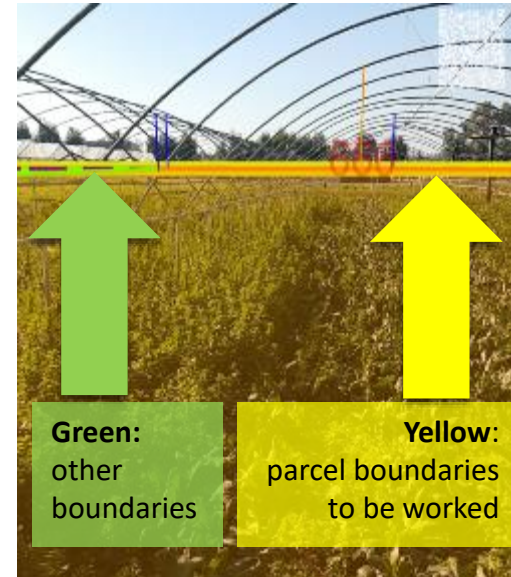
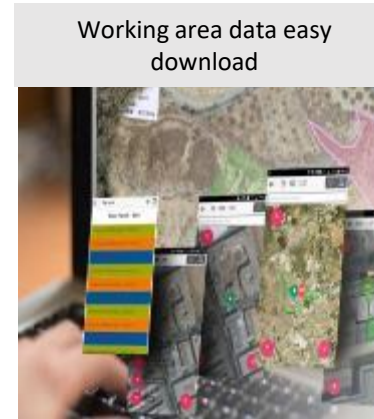
Applications

App for both surveyors and/or farmers

- **Time and date** from satellite, not only by device
- **On-line and off-line** capability (matching through sequential codes)
- **GNSS tracking capability** in different modes, including “walking”
- **High accuracy in positioning through Galileo EGNSS4CAP by GSA**

Availability

- Operational activities since 2018 for CbM; open in Italy through AGEA for Paying Agencies

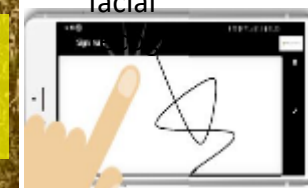


Green:
other
boundaries

Yellow:
parcel boundaries
to be worked

Easy tracking
inside the
field

Digital
signature &
facial



Copernicus Checks by Monitoring CbM: operational considerations

- Monitoring of arable land parcels **worked properly**
- **Parcels less 0.2 ha** are however problematic to managed by Sentinel only (10m pixel S2 and around 20m S1)
- Permanent crops, pasture pro-rata (not mowed) are more suitable through a **systematic analysis through Land Parcel Identification System**
- Follow-up (doubtful parcels) need firstly **Back-Office photo-interpretation** to reduce expensive and time consuming investigations in situ
- Dissemination/learning to farmers of CbM methods improve their **pro-active involvement**, allowing to receive digital documentation and/or geo-tagged photos, speeding up the overall project cycle, **reducing errors and frauds**

New targets addressed to **farmers and EU citizens** by the next CAP :

- **Precision and organic farming expansion**
- **CO₂ > absorption/ carbon footprint reduction**
- **Improve the recovery of biodiversity (improve natural elements)**
- **Push remote and proximal EO sensing towards a «soil/water/food chain» health**

What does this new goal need?

A continuous **mutual support and interaction** among:

- **Public Institutions** (P. Agencies, EU DGs, JRC, ESA, GSA)
- **Scientific** entities and their achievements
- **Industry** and their challenging propositions

The next **new scenario**, leveraging on a complete EO agro-monitoring by the CAP

- **Expand a > benefit/costs EO agro-services to:**

medium-small farms, insurances and local professionals

- **Offer, at marginal costs, further geoinformation tools** (also by intermediate products) for:

CO2 adsorption fluxes calculation and

- **ecosystem** status
- **forest fires**
- legal/illegal **clear cuts**
- flooding
- **water** provision
- **disaster** management

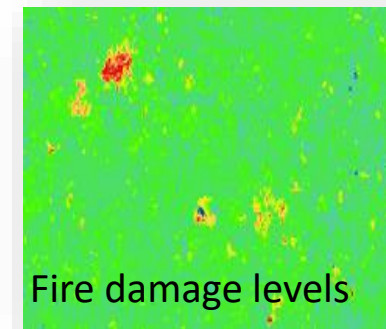
In synthesis...”to **deny an oxymoron**”:

*safeguard both the vital-healthy **agronomic business** and our living environment*

Flooding monitoring by Sentinel

Bleu: water

Light blu: muddy water



Forest monitoring by Sentinel

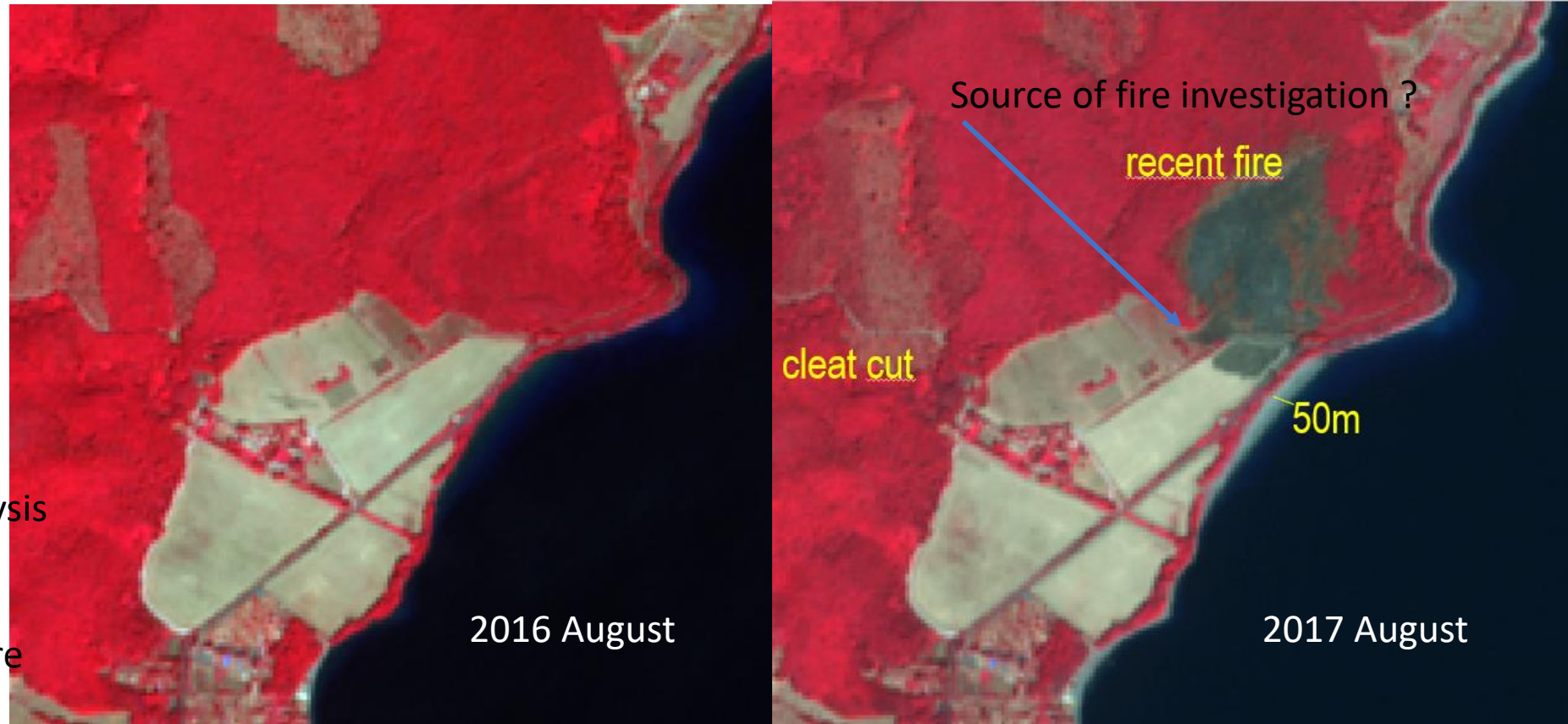
Multitasking use of the same CbM data-set

operational examples

- Forest **clear cut** dynamic checks
- Burnt scar** mapping not only at the end of the season

Info layer for:

- Water availability
- Ecosystem/climate effect analysis
- Legal/illegal forestry
- Wild fire damages and administrative land-use of post fire



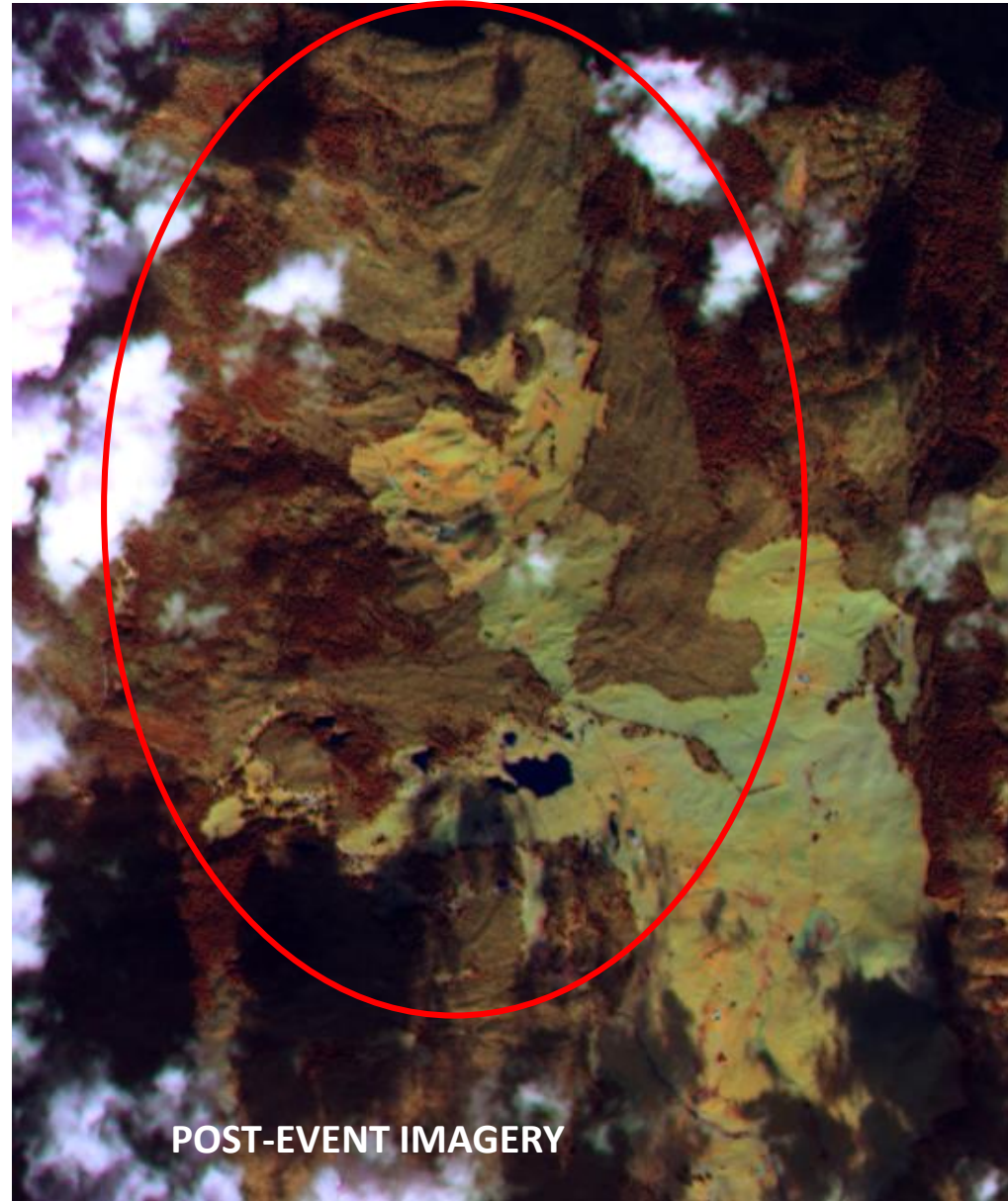
Emergency Mapping Services EMS Sentinel 2; red circle well delineates the large crash of high valuable forest

Veneto 27-30 October 2018

EMS standard legend, reference map, and statistics on any affected area

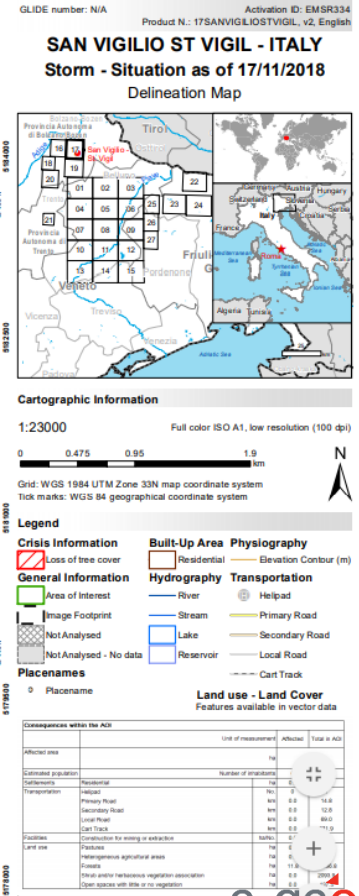
PRE-EVENT IMAGERY

Copernicus Sentinel2 September 21st 2018



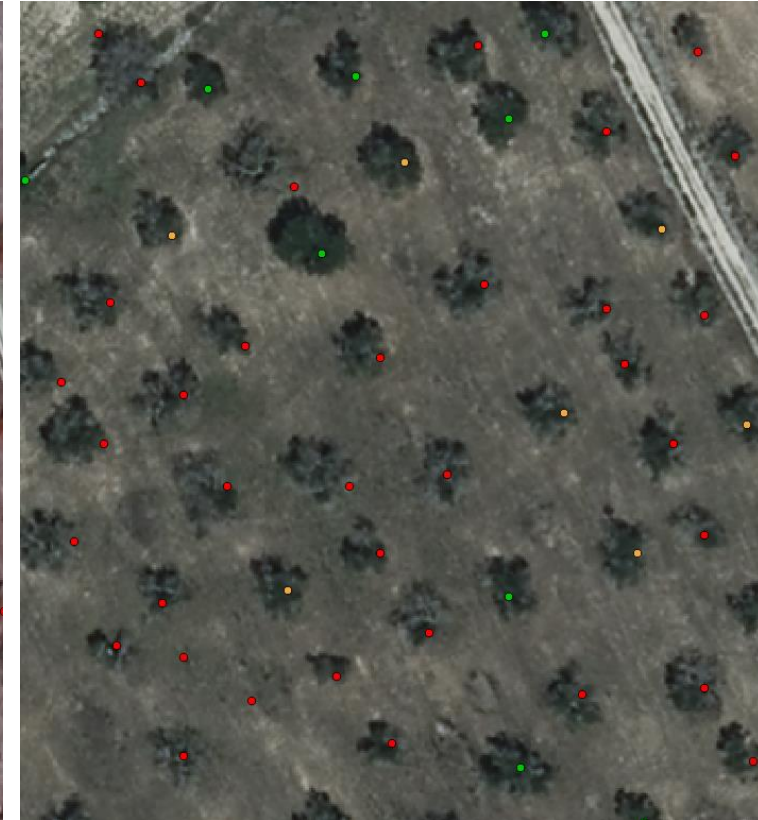
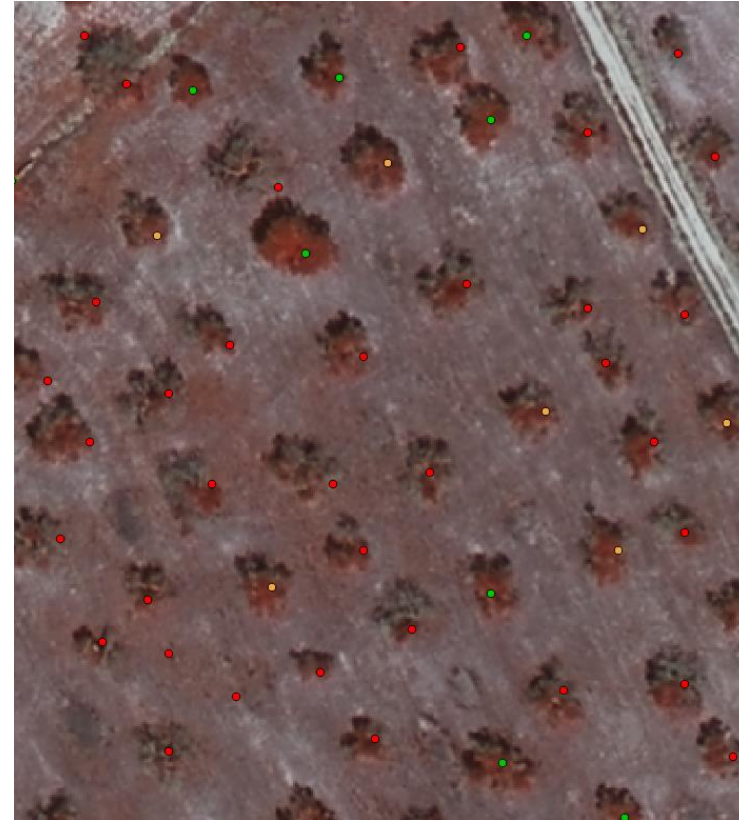
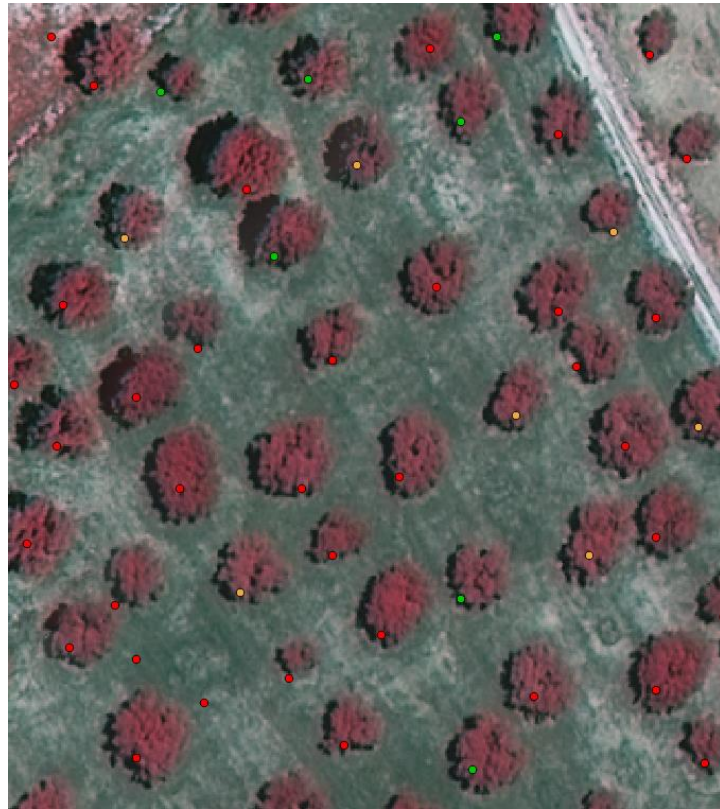
Copernicus Sentinel2 October 31st 2018

North East Italy
totally destroyed:
41,314 hectares
8,548,099m3 timber



Going in depth: use of **airborne and drones** for local targets: Xylella disease on Olive groves management starting from the CAP LPIS

measurable decreasing vigor on olives through the airborne acquisition cycles: the role of drones



- Sana
- Malata
- Severamente malata

2016

2019

Italy, Puglia region

Comments/perspectives- 1

The induction of the Agriculture sector in **Copernicus**' community of users / providers is simplifying and improving responses to the needs, giving the opportunity to **provide new and previously unthinkable “wall to wall” services** as well as information of public interest.

The availability of **Galileo** signals opens the way to more mass market applications, providing easy-to-use positioning solutions in the sector

In this innovative context, the **Geomatic Community** must have the role of “**digital transformation facilitator**” of the whole system, also beyond the CAP

Comments/perspectives- 2

CAP and Crop monitoring applications with Sentinel data **are raising worldwide** through commercial and ad hoc **platforms**

Digital technologies (Analytics, Cloud, super Computer), if applied to EO and GNSS, can provide lower cost systems

The single national Land Parcel Identification Systems **LPIS** (existing in all EU) can be updated using new cost effective **systems of Artificial Intelligence**

Copernicus EO and GNSS services can really speed **up new valuable jobs**, among:

EU/MS public administrations (national/local Paying Agencies/local assistance centers): new graphic declarations, **open GIS expert on semi-natural resources**,

Industry : **experts on AI and cloud systems management**

SME/scientific bodies: **experts in EO innovative indexes extraction and new figures as “data scientists”**