Other uses of Sentinel data in Italy

Livio Rossi

The CAP EU monitoring through Sentinel data-set is going to offer to the entire EU, around the year, many products (or intermediate) in support of many additional territorial necessities

The integration of processed S2 and S1 (**potentially more than 130 acquisitions per year on the same targets**) into the various GIS national systems can really provide continuous maps/alerts/changes, as a multiservice, for many different national/local needs related to **Emergencies, Environment protection and Climate Change effect mitigations**

S2/S1 multi-temporal time series to take advantages from the "monitoring approach"

Automatic satellite time series analysis on the same target (Italy processed more than 300 Sentinel images for Foggia province project in 2018 on 600,000 parcels) =>

This system automatically detects and extracts, besides the CAP, **any territorial alert or change**, in "almost near" real time, like a multiservice for the different national/local needs

17/06/2018

13/05/2018

14/03/2018

11/01/2018

25/10/2017

06/08/2017

Use of Sentinel - summary

- Agro-environment impact mitigation actions, now available
- Copernicus Emergency Mapping services
- Surface, underground water and wetland monitoring/protection
- Maritime and coastline*
- Forest cuts and fire mapping
- Carbon credits support

<div align="center">Conclusion and perspectives</div>

* Not covered in this presentation

A new agro-environmental approach: continuous checks on the same target
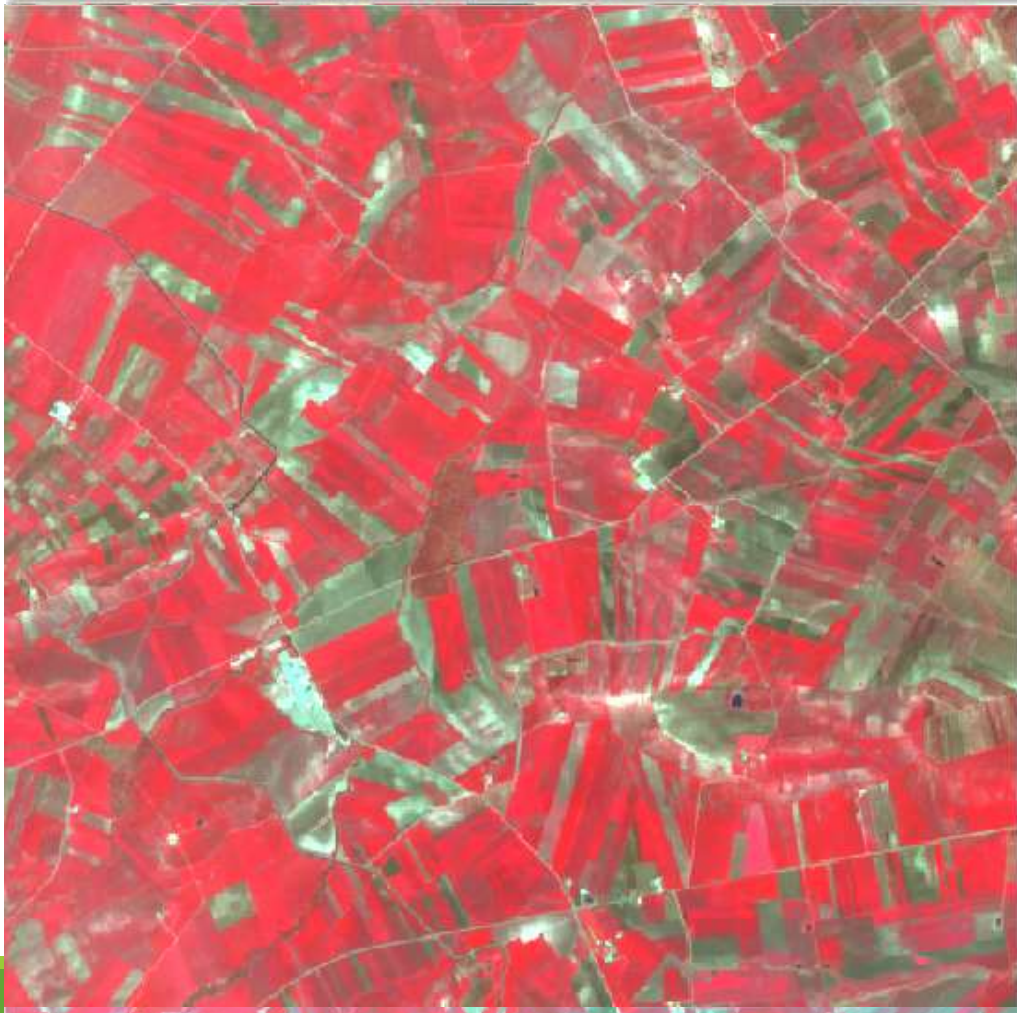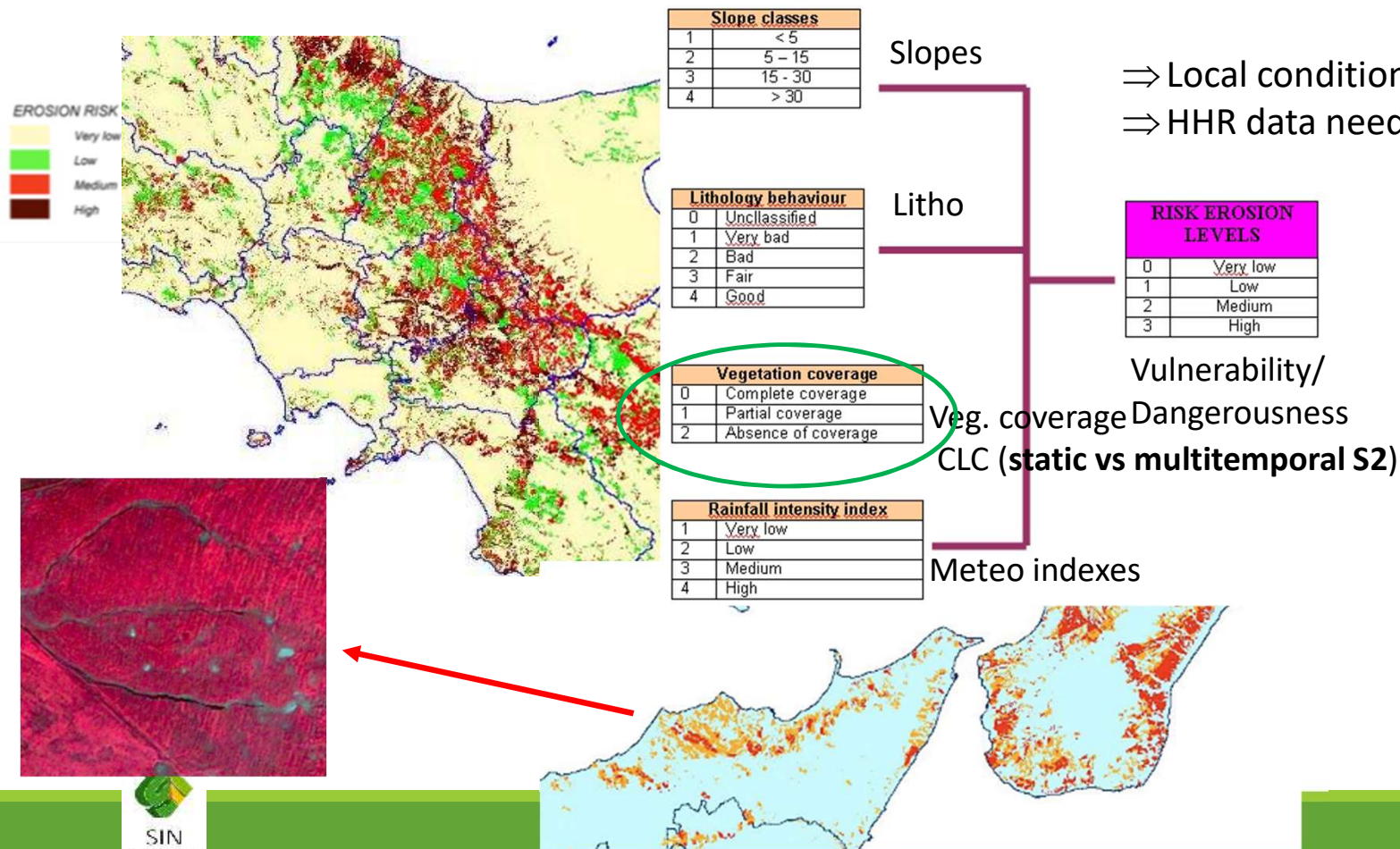
Crop Rotation
alternating growing of crops on a same field: the main real issue for agro-environment sustainability

real advantages: **break weed/pest and disease cycles; improve soil fertility and control insects and diseases; reduce pollution by undue fertilization**

Past: no possibility to check and apply the rule (too expensive)

new CAP: systematic detection capability **by Sentinel**

Propensity-risk to erosion in agro-environment of Italy the dynamic vegetation presence by Sentinel2 improves the index/score quality

Slope classes	
1	< 5
2	5 – 15
3	15 - 30
4	> 30

Slopes

$\Rightarrow$ Local conditionality correct location
$\Rightarrow$ HHR data need indication

Lithology behaviour	
0	Unclassified
1	Very bad
2	Bad
3	Fair
4	Good

Litho

RISK EROSION LEVELS	
0	Very low
1	Low
2	Medium
3	High

Vulnerability/ Dangerousness

Vegetation coverage	
0	Complete coverage
1	Partial coverage
2	Absence of coverage

Veg. coverage
CLC (**static vs multitemporal S2**)

Rainfall intensity index	
1	Very low
2	Low
3	Medium
4	High

Meteo indexes

EROSION RISK
Very low
Low
Medium
High

COPERNICUS
Emergency Mapping Service

Copernicus Emergency Mapping Service (DGgrow-JRC)
2012-in progress, with 100% service reliability
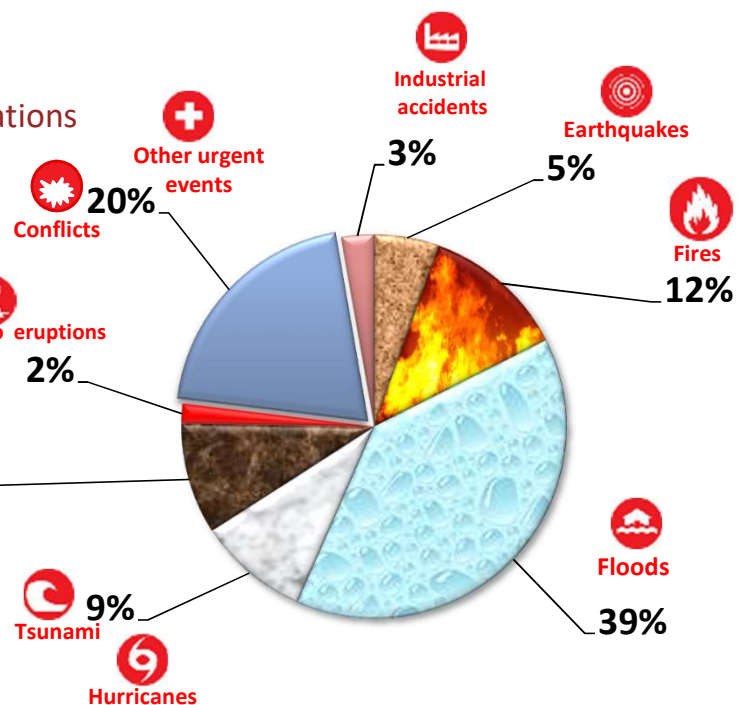
350
rapid mapping activations

50+
Countries worldwide

4.000+
maps

Industrial accidents **3%**

Earthquakes **5%**

Fires **12%**

Other urgent events **20%**

Conflicts

Volcano eruptions **2%**

Landslides **9%**

Tsunami **9%**

Hurricanes

Floods **39%**

Floods are the emergency events for which the EM Service receives more activation requests

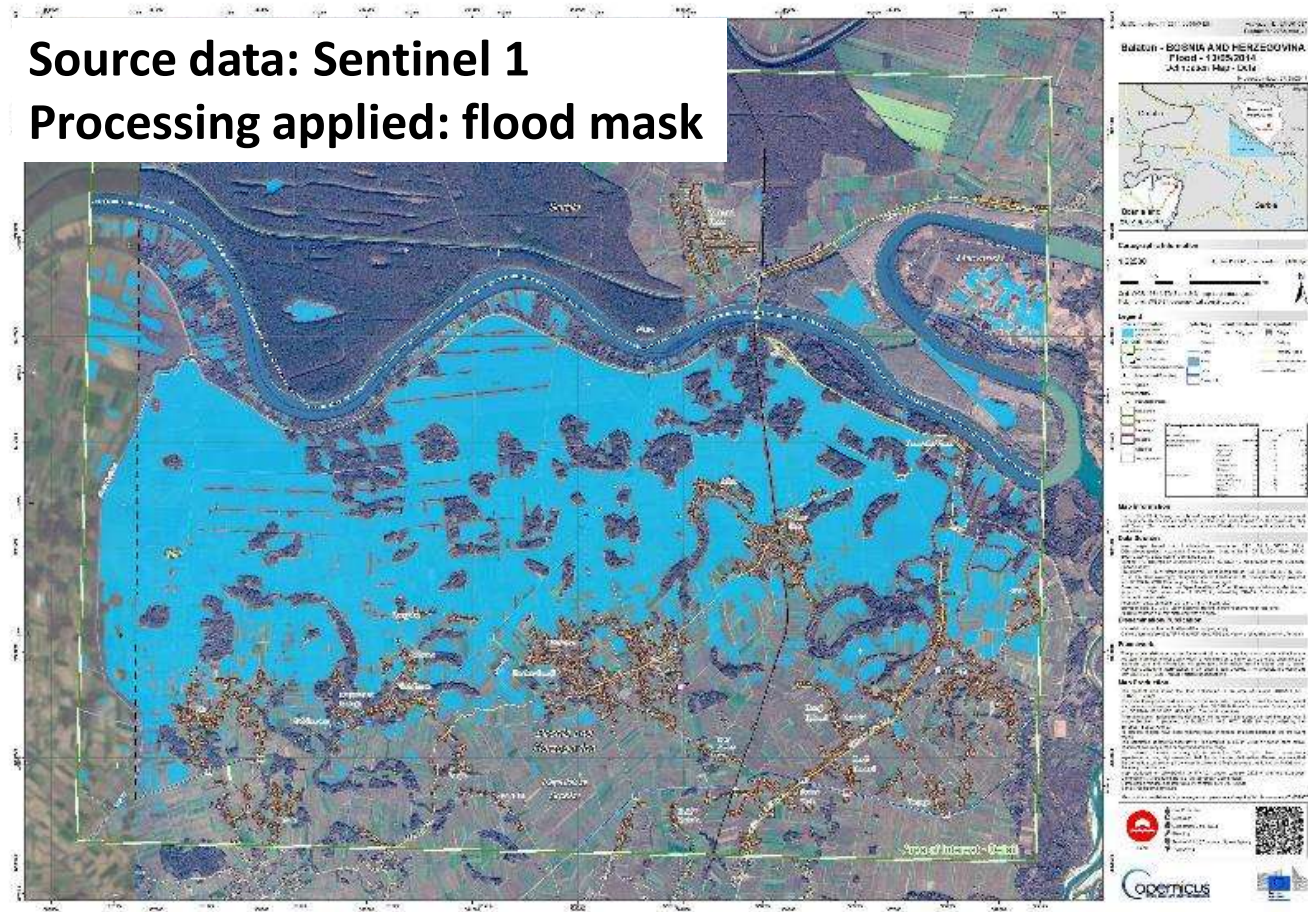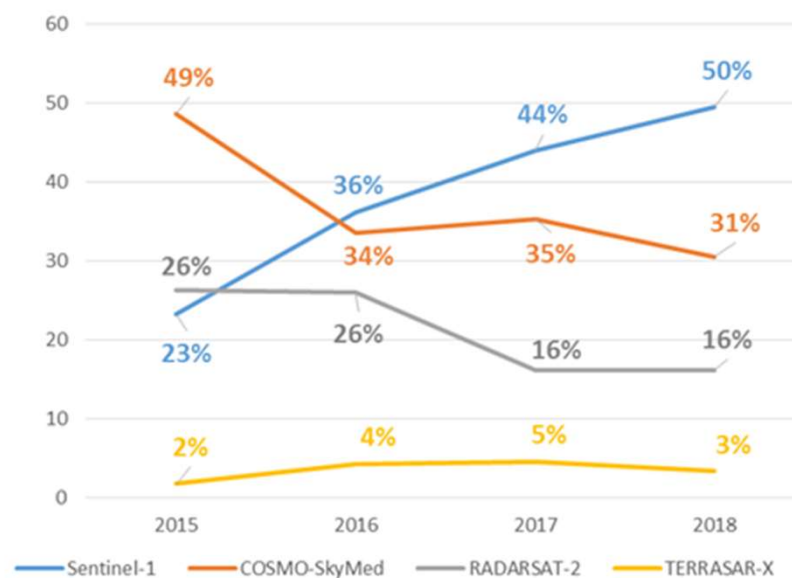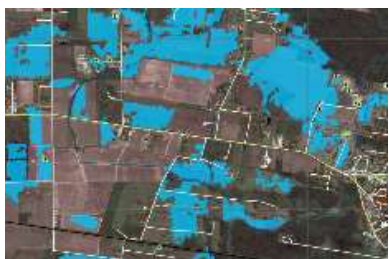# EMS: the growing use of Sentinel in the processing flow

TYPE OF SENSOR USED
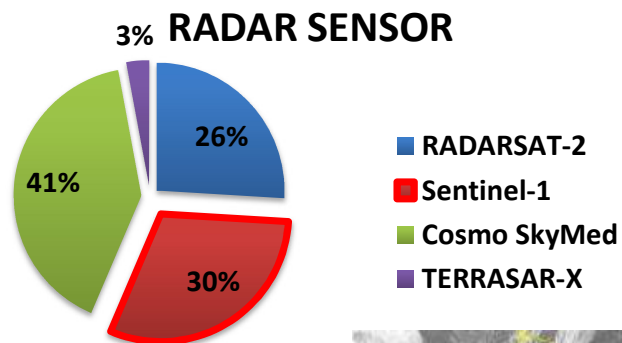

- Optical
- Radar

30%

70%
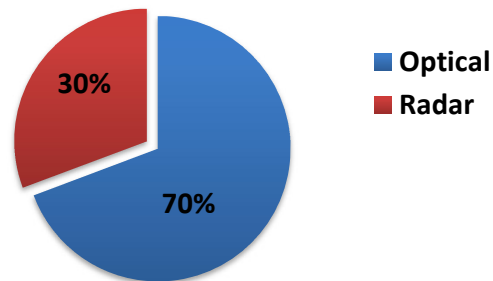
Availability by Matera station:

S1: **0,5 – 3 hours** after acquisition

S2: **3-6 hours**

Source data: Sentinel 1
Processing applied: flood mask

EMS: the growing importance of radar data for meteorological and flood events

RADAR SENSOR

- 26% — RADARSAT-2
- 30% — Sentinel-1
- 41% — Cosmo SkyMed
- 3% — TERRASAR-X

The growing massive use of Sentinel1

EMS wind storm activation in November 2018
Sentinel 2 large use for affected areas definition
=> higher res (Planet, Spot 6-7) for larger scale

PRE-EVENT IMAGERY

POST-EVENT IMAGERY

PREDAZZO

PREDAZZO

Sentinel2 comparison

October 2018   December 2018

11

EMS: Sentinel 2 infrared pre-post event; red circle well delineates the large crash of high valuable forest   **Veneto Region 27-30 October 2018**

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

PRE-EVENT IMAGERY

POST-EVENT IMAGERY

Copernicus Sentinel2 September 21st 2018   Copernicus Sentinel2 October 31st 2018

North East Italy

totally destroyed:

41,314 hectares

8,548,099m3 timber

SLIDE number: N/A

SAN VIGILIO ST VIGIL - ITALY
Storm - Situation as of 17/11/2018
Delineation Map

Po river flooding between Cremona/Mantova Lombardia

Sentinel2 8th November 2018

31st October 2018 – Sentinel2

Bleu: water

Light bleu: muddy water

White: mud and water

Noncello river

Friuli Venezia Giulia Region

Normal condition from archive

EMS: Sentinel2 IRFC contribution even for flooding

Partial cloud free acquisition

Surface, underground water and wetland monitoring/protection
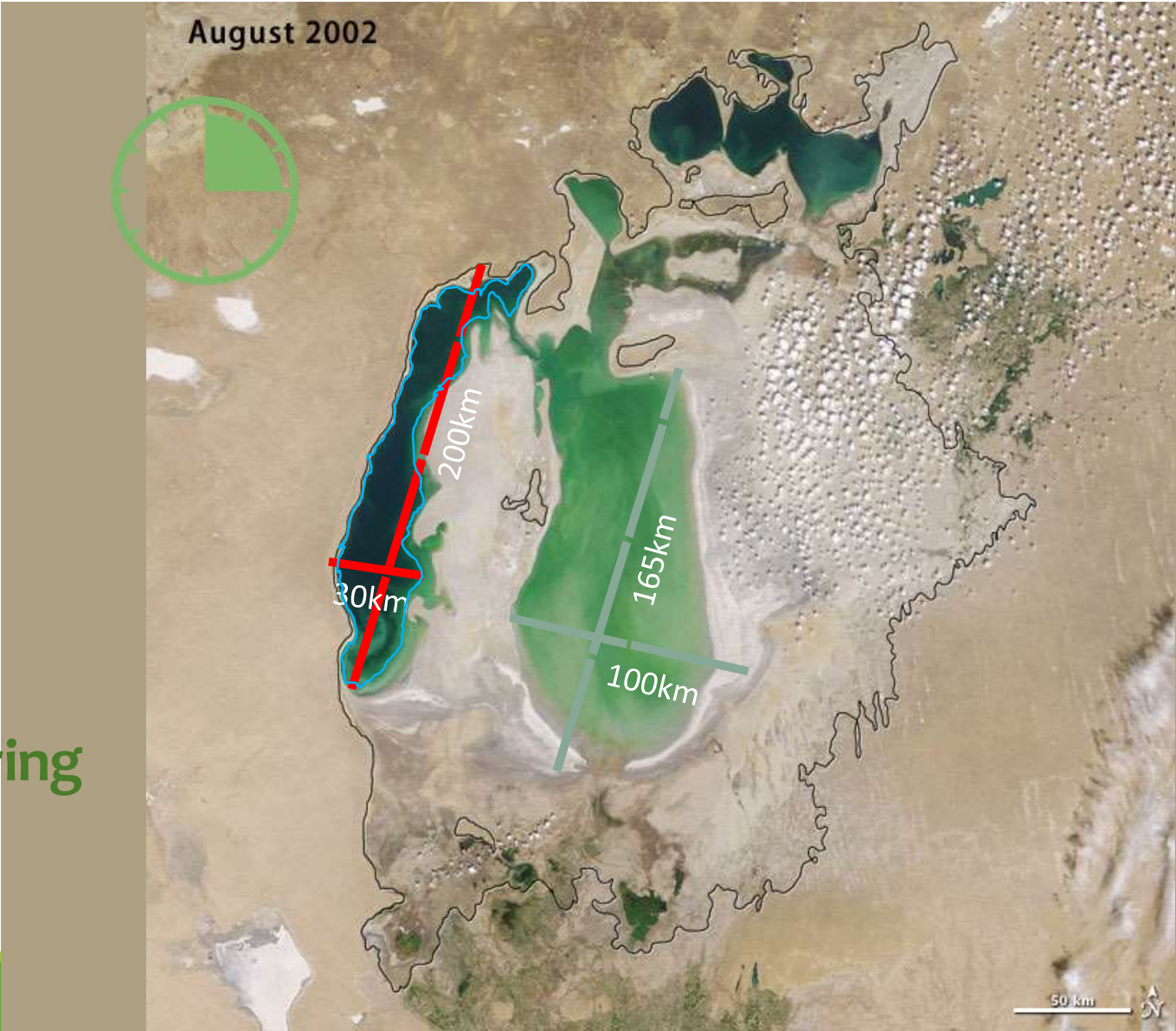
Inland water and wetland Monitoring

Landsat 2

August 1972
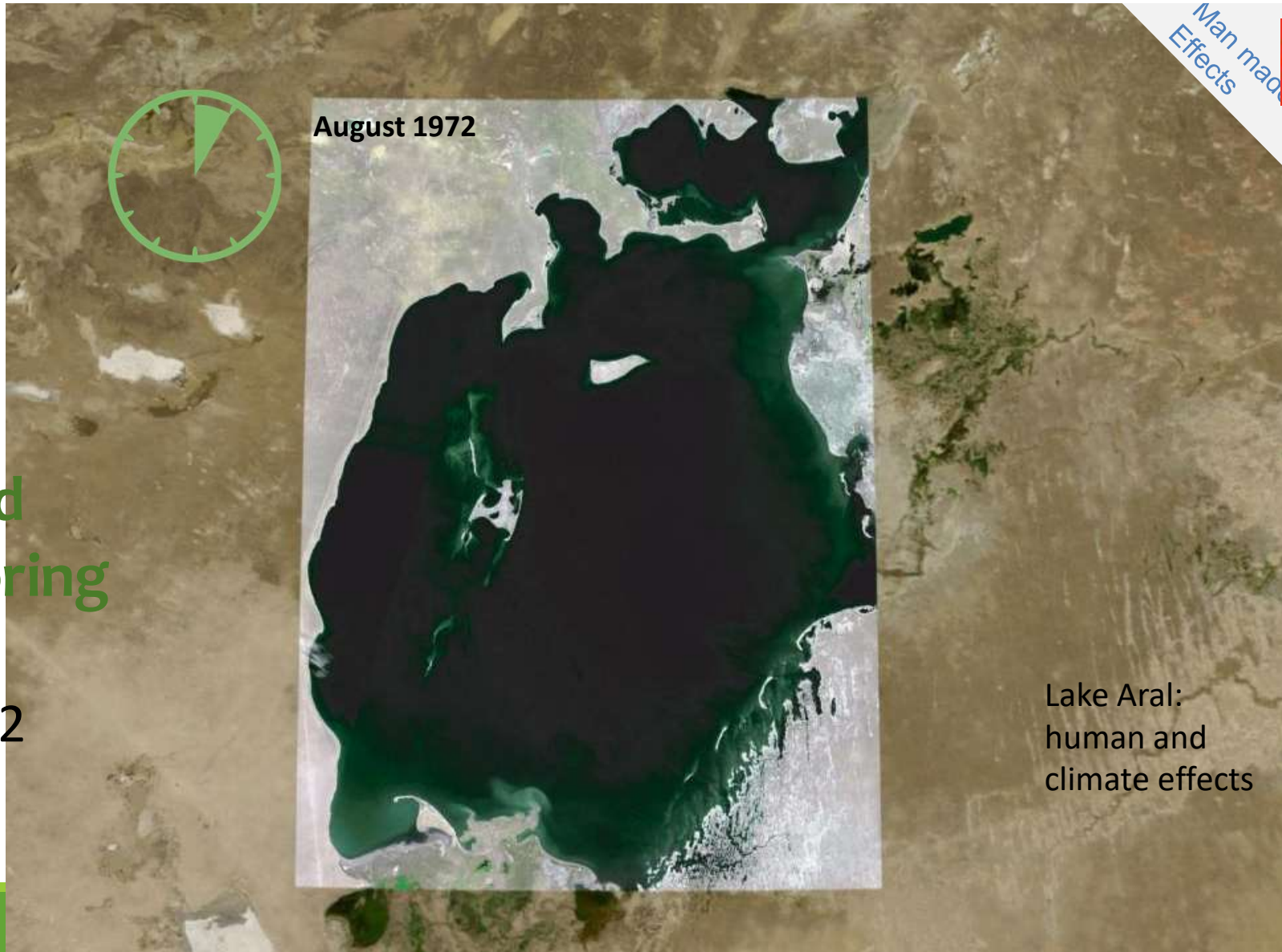
Lake Aral: human and climate effects

Man made Effects

e-geos
AN ASI / TELESPAZIO COMPANY

Inland water and wetland Monitoring

Landsat 5

e-geos AN ASI / TELESPAZIO COMPANY

Inland, wetland and drinking water Monitoring
new by Sentinel2 - 6 revisit per month

Persistent drought
of south Europe in 2017
provoked a lowering
of the water level
and a <u>beach extension
ranging 40-70m</u>, well
measured by S2 passages

Satellite monitoring allowed
a balanced crisis policy for
the **water adduction to Rome**

Advantages:
More beach extension
More rent of sun-umbrellas

2016 August
Sentinel2

2017 August
Sentinel2

70m

Bracciano Lake 30 Km north of Rome

Multitasking use of the same data-set

new by Sentinel2 - 6 revisit per month

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

Unique technology for:
- Water provision
- Ecosystem/climate effect analysis
- Legal/illegal forestry
- Forest fire damages and
administrative land-use of post fire

2016 August

Source of fire investigation ?

recent fire

cleat cut

50m

2017 August
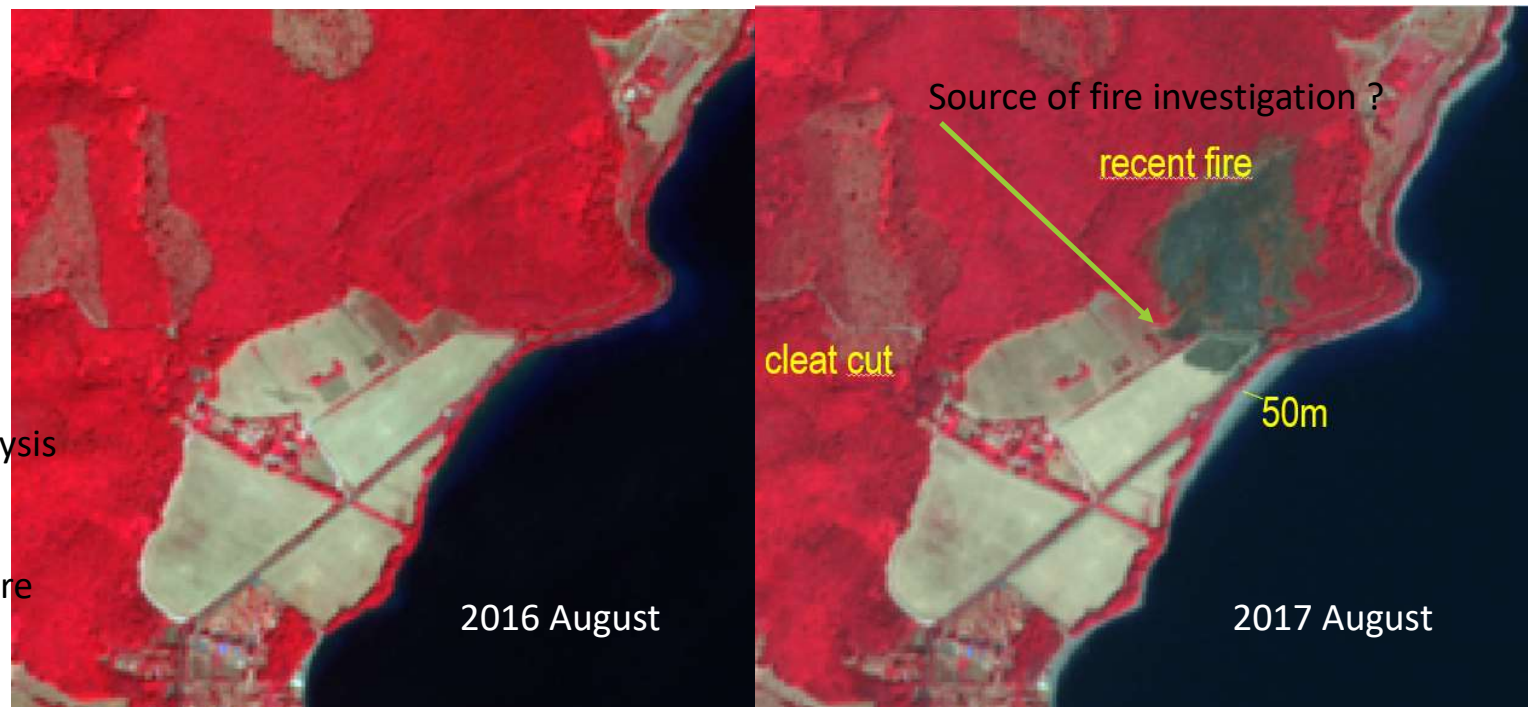
Underground water protection on carsick springs: Water levels and cultivation types modelling for preventing pollution (by fertilizers, manures)
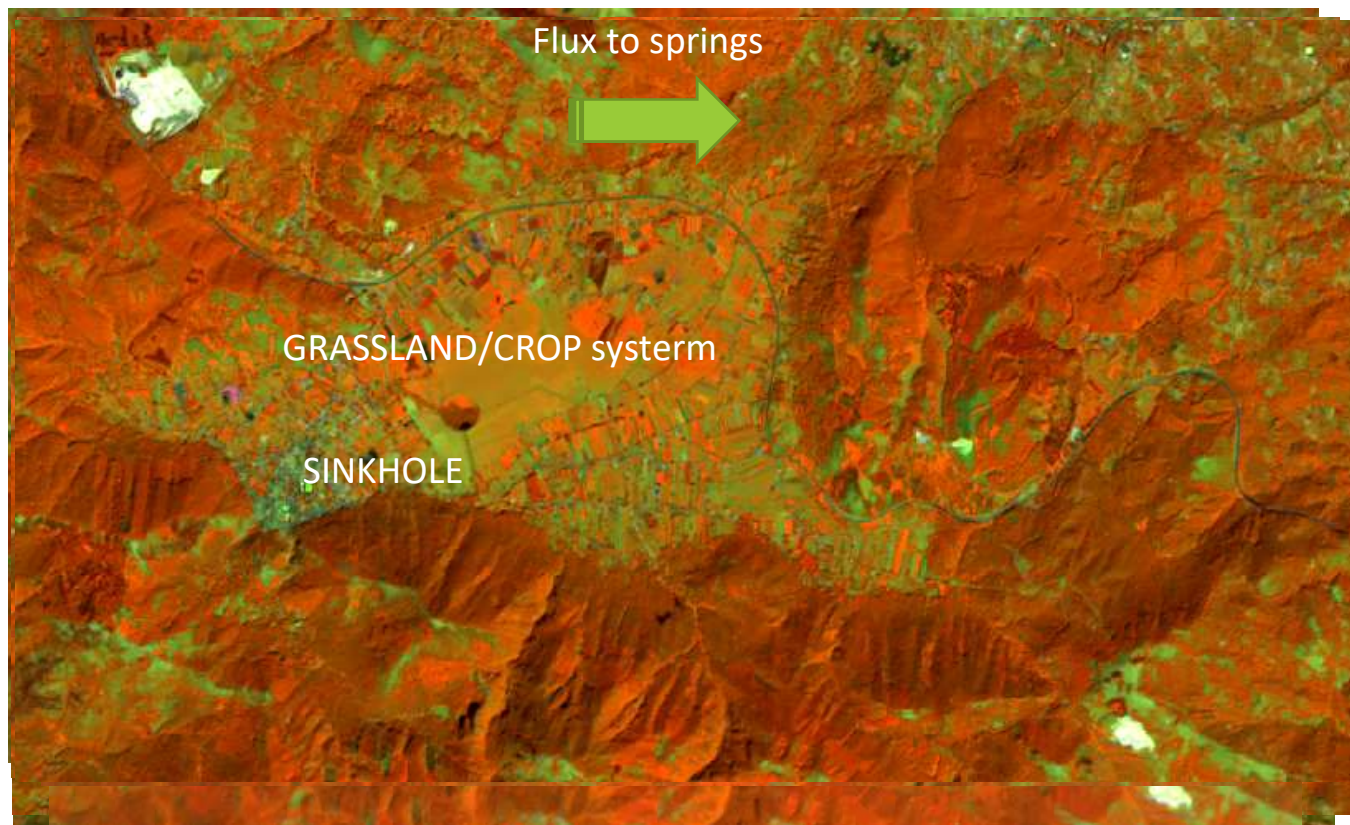
16-09-2015
23-05-2016
12-07-2016
21-08-2016
29-03-2017
07-07-2017
16-08-2017
31-08-2017
08-04-2018

Flux to springs

GRASSLAND/CROP systerm

SINKHOLE

Risk sources detection (point, area) on the idrogeological system, creating a «model» for extracting info by Multitemporal Sentinels (pollution coefficients by crops, grassland, livestoke, grazing) and guiding the in situ measures, both on field and on water

e-geos
AN ASI / TELESPAZIO COMPANY

Water, wetland and underground water Monitoring
new by Sentinel1 - 5 open revisit per month

Subsidence created by water extraction and gas
in Emilia Romagna region (Bologna): SAR interferometric
methods gave the alert for a correct water management plan
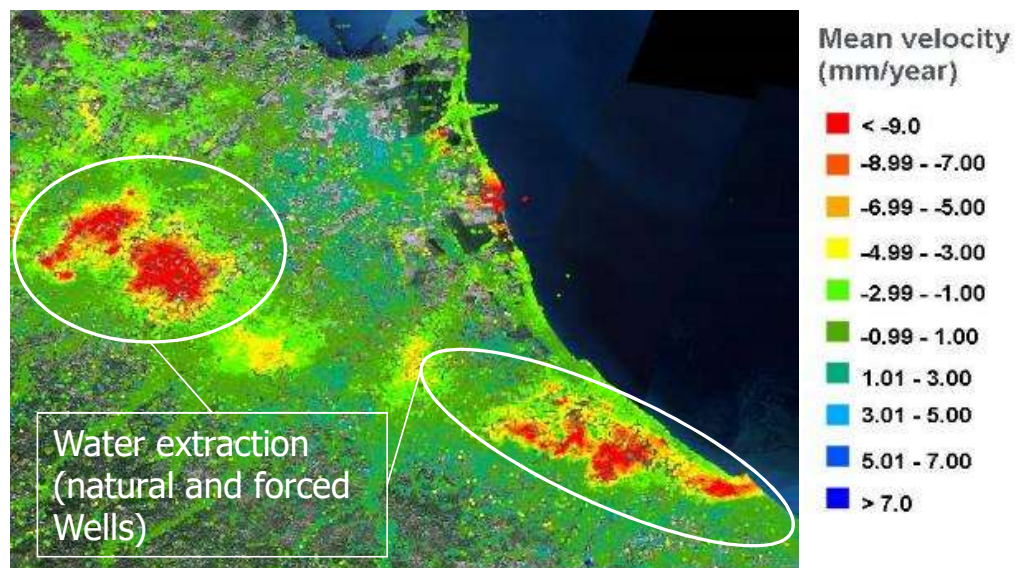
SAR water level lowering of Bracciano lake in 2017
by interferometric acquisitions

Mean velocity (mm/year)

- < -9.0
- -8.99 - -7.00
- -6.99 - -5.00
- -4.99 - -3.00
- -2.99 - -1.00
- -0.99 - 1.00
- 1.01 - 3.00
- 3.01 - 5.00
- 5.01 - 7.00
- > 7.0

Water extraction (natural and forced Wells)

Forest cuts and fire mapping

IRFC Sentinel2 semi automatic land change in forestry

Agea

e-geos
AN ASI / TELESPAZIO COMPANY

Campania region, Italy

Sentinel-2 IRFC 07/07/2017

Yellow areas:
Clear cuts/forest changes up
to 0,5ha (0,2-0,5ha in optimal conditions);
Burnt scar polygons, updated to every
passage, NOT at the end of season
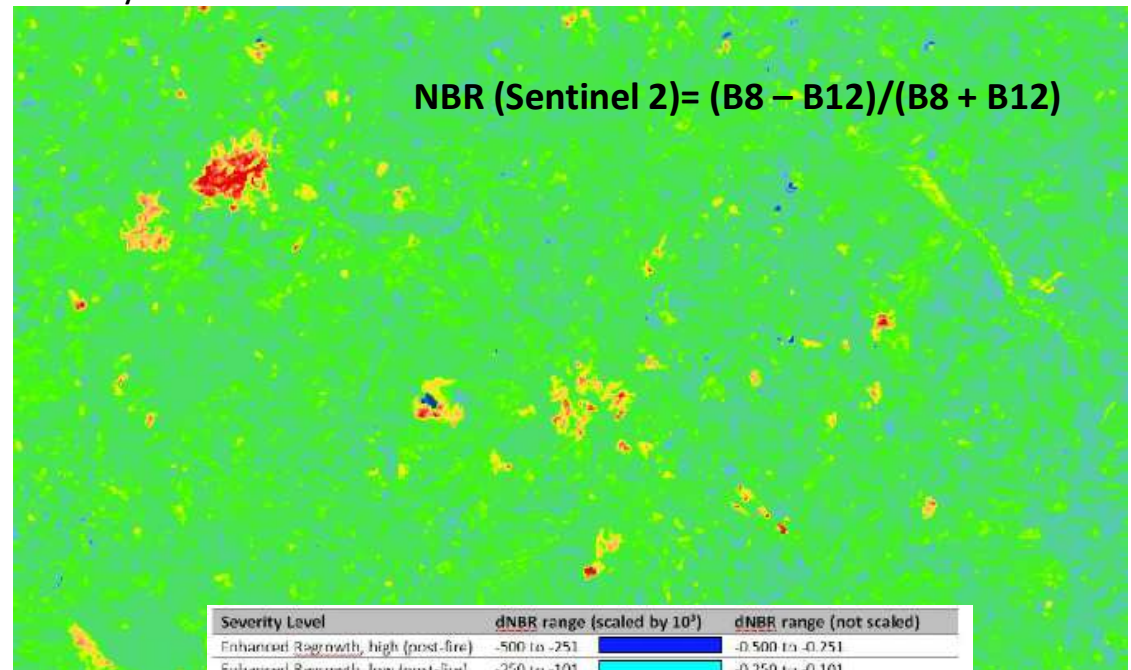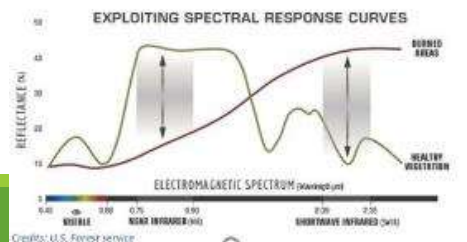
Campania region, Italy

Sentinel-2 IRFC 21/08/2016

Sentinel-2 IRFC 06/08/2017

Clear cut (to verify if legal or illegal) <u>even if «in place»</u>
to eventually block any illegal
CO2 fluxes disturbances for carbon credit

Sentinel-2 IRFC 06/08/2017

University
of Molise

The United States Geological Survey (USGS) classification table for burn severity classification (dNBR).

S2 natural color and shortwave IR band for fire front visibility
Sentinel2 October 2017

NBR (Sentinel 2)= (B8 − B12)/(B8 + B12)

EXPLOITING SPECTRAL RESPONSE CURVES

ELECTROMAGNETIC SPECTRUM

Credits: U.S. Forest service

| Severity Level	dNBR range (scaled by 10³)		dNBR range (not scaled)
Enhanced Regrowth, high (post-fire)	-500 to -251		-0.500 to -0.251
Enhanced Regrowth, low (post-fire)	-250 to -101		-0.250 to -0.101
Unburned	-100 to +99		-0.100 to +0.099
Low Severity	+100 to +269		+0.100 to +0.269
Moderate-low Severity	+270 to +439		+0.270 to +0.439
Moderate-high Severity	+440 to +659		+0.440 to +0.659
High Severity	+660 to +1300		+0.660 to +1.300

Credits: UN-SPYDER Knowledge Portal

University
of Molise

Sentinel 2 contribution for burnt stubbles detection support

Burnt and
ploughed
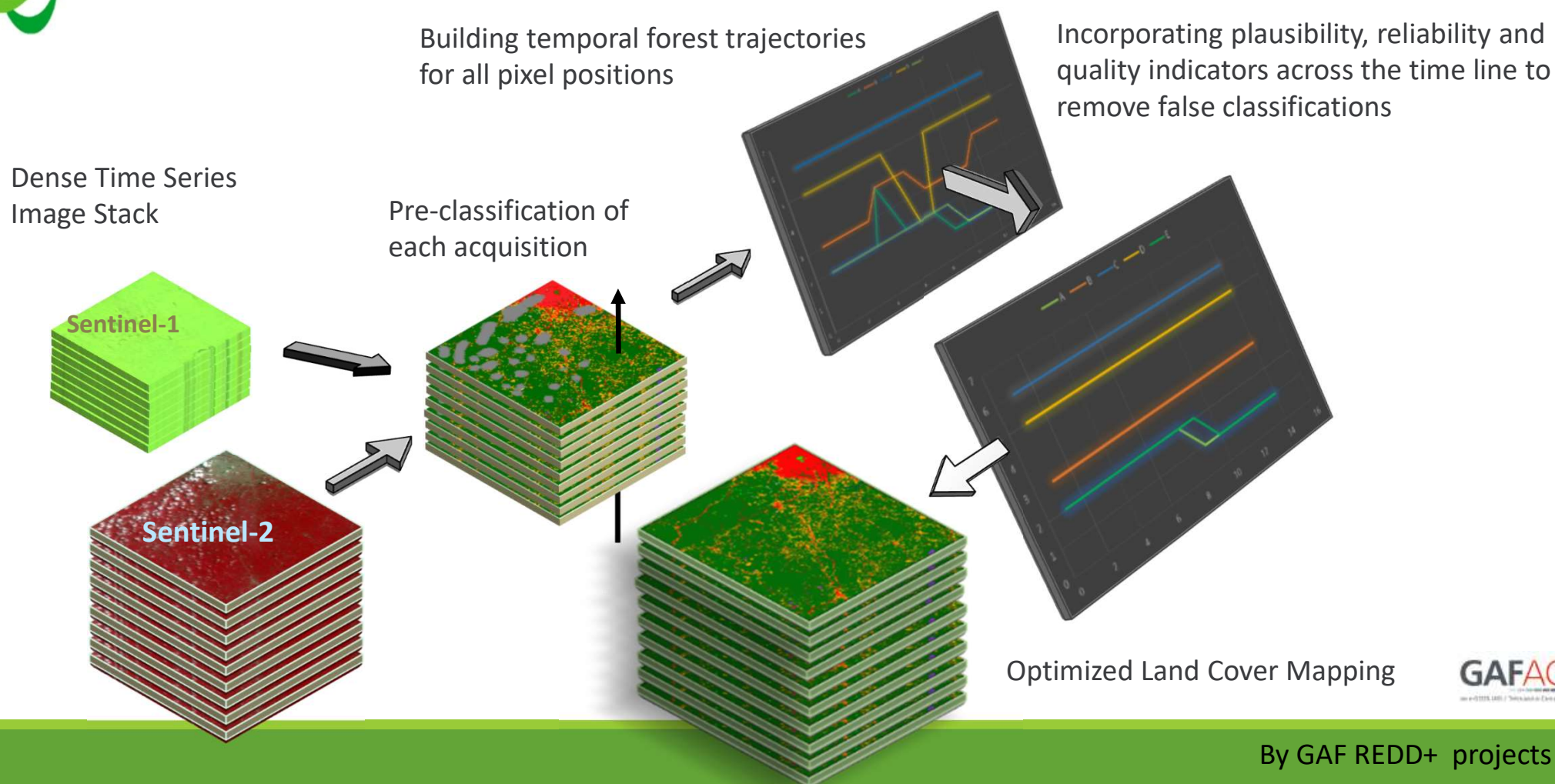
Burnt and not
yet ploughed
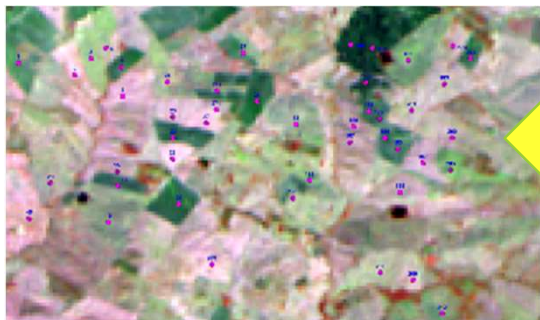
Burnt stubbles dynamic detection
by S2 to avoid:
*loss of organic matter and scattered
fire risk triggering*

"monitoring" provides:
continuous layers available for both
CAP compliance and forest guards
=> alerts and statistics
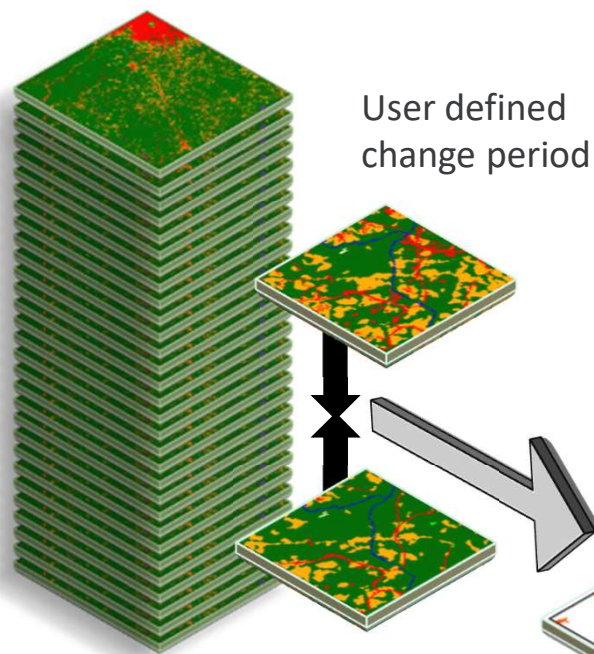
Carbon credits support

Carbon credits – REDD+ projects through Sentinel

Building temporal forest trajectories for all pixel positions

Incorporating plausibility, reliability and quality indicators across the time line to remove false classifications

Dense Time Series Image Stack

Pre-classification of each acquisition

Sentinel-1

Sentinel-2

Optimized Land Cover Mapping

By GAF REDD+ projects

Carbon credits – Worldwide REDD+ with Sentinel => Forest Change Information for disturbances calculation
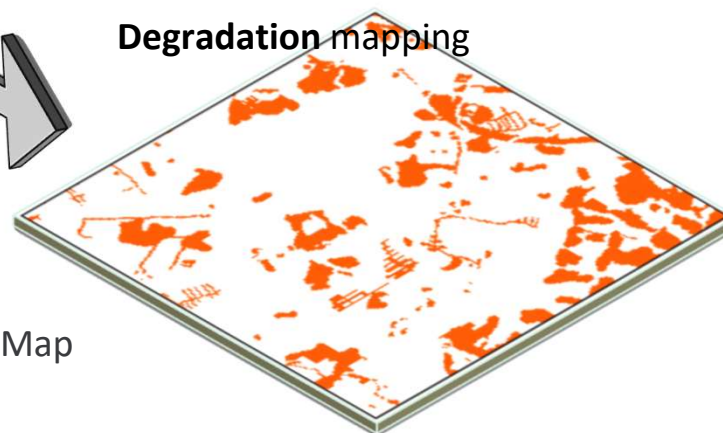
Historical and current forest cover

-Minimum Mapping Unit (MMU) 0.5 – 1.0 ha

-Compliant with national forest definition

-Accuracy >90% (for reporting)

Classification of **deforested** areas and main Land C/U categories

Degradation mapping

User defined change period

Optimized Land Cover sequence

Copernicus user uptake:
TIER 2 = international valorisation
TIER 3 = innovative products/applications

Final Change-Map to be used

Conclusions and perspectives

By non paper DGAgri "Monitoring is thus an information gathering process that delivers data relevant to <u>multiple contexts</u>. Monitoring results can be aggregated over appropriate <u>spatial/ temporal/ administrative</u> domains, in the context of statistical reporting, be used as evidence in <u>decision-making processes</u>, etc.«

Sentinel and the related used ancillary data set from monitoring: **a huge dispenser and a repository of many applications in territorial domains for ALL**

Key words: <u>marginal costs</u>, technology sharing, geoinformation instead of alphanumeric

Detected and proved events (fires, forest, flooded damaged polygons can return in IACS (e.g. for October 2018 storm and flooding in Italy) => LPIS => GSAA=> RD=> for State, Region, RD, Assurance reimbursements – also labelled for next GSAA

Important INFO: **EMS** DGgrow-JRC form must be sent by e-mail to the European Response Coordination Centre (ERCC)
(**echo-ercc@ec.europa.eu**), or by a phone call to ERCC (+32-2-29-21112)