Welcome to the 4th webinar

The webinar will last around 1h

The slides will be available on the Sen4CAP website in the coming 48 hrs (http://esa-sen4cap.org/)

Presenters:

Sophie Bontemps & Philippe Malcorps from *UCLouvain*
Laurentiu Nicola from *CS Romania*

Members of the consortium available to answer your questions

Webinar outline

- Sen4CAP overview
- System evolution
    - Version 1.2
    - Markers database
- RACE Covid 19: Sen4CAP to monitor the harvest of winter cereals in Spain
- Next events // Questions & Answers

Webinar outline

- **Sen4CAP overview**
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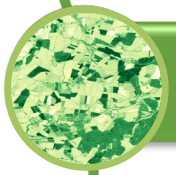
Use Cases: Sentinels to support payment decisions


Crop type mapping


Growing vegetation indicators


Grassland mowing detection


Agricultural practices monitoring (EFA)

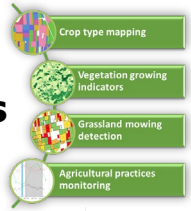
Use Cases w/ Paying Agencies

Use case
Crop diversification
Permanent grassland identification
EFA-Land lying fallow
EFA-Catch crops
EFA-Nitrogen-fixing crops
Interactive visualization
Land abandonment
LPIS update
Claimless system

From prototyping to NRT national demonstrations

Design and prototyping
2017 agri season – local sites

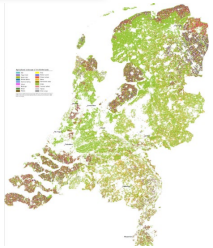
Use cases selection



Products Specifications

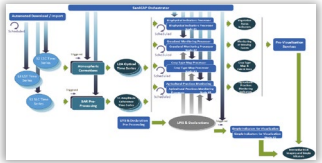
Benchmarked Methods

Algo & System design



Prototype products

Validation



Demonstration and validation
2018 & 2019 agri seasons – national NRT

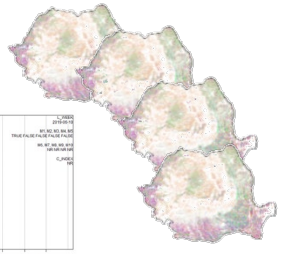
Use cases demonstration

National scale

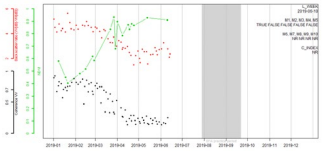
Continuous monitoring

Validation & Fitness-to-use assessment

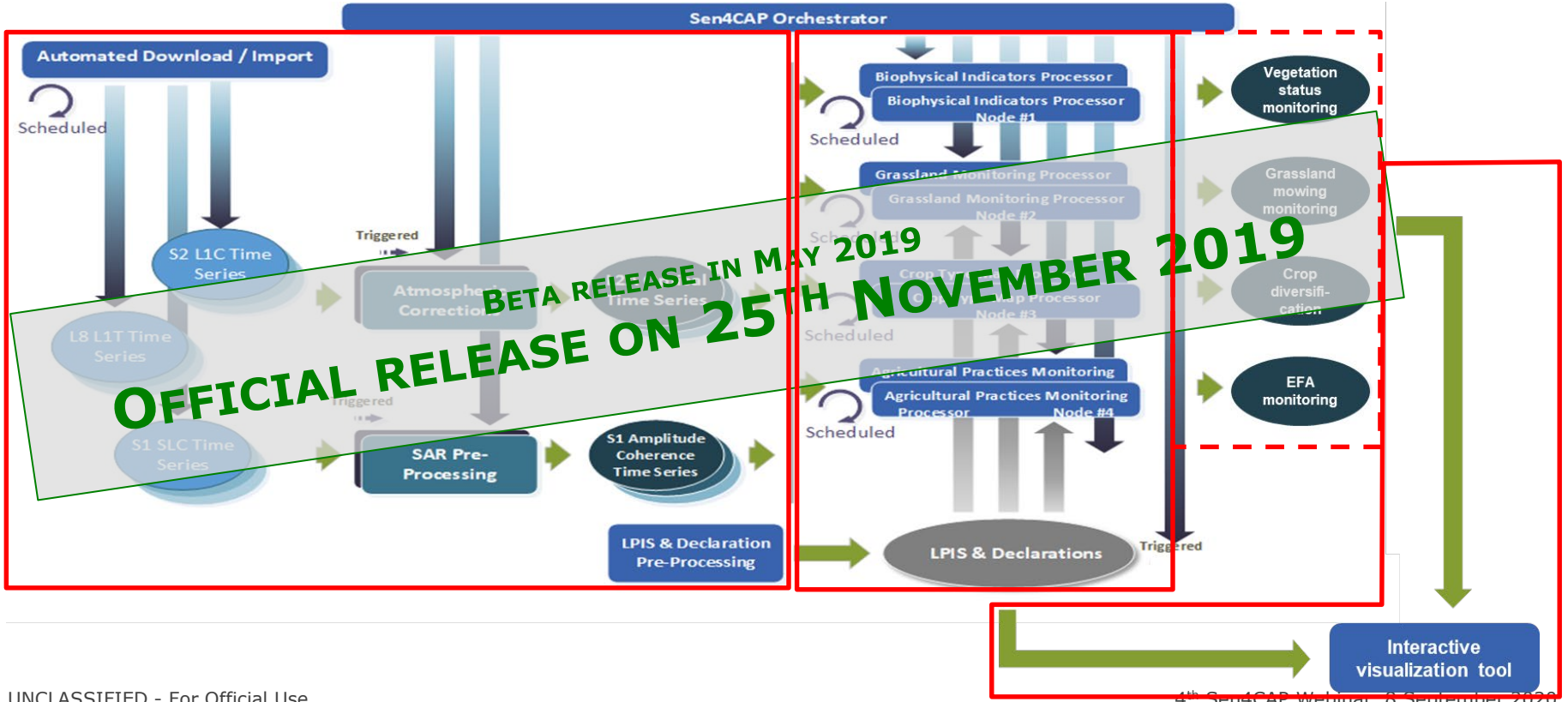
Capacity building and training



System qualification

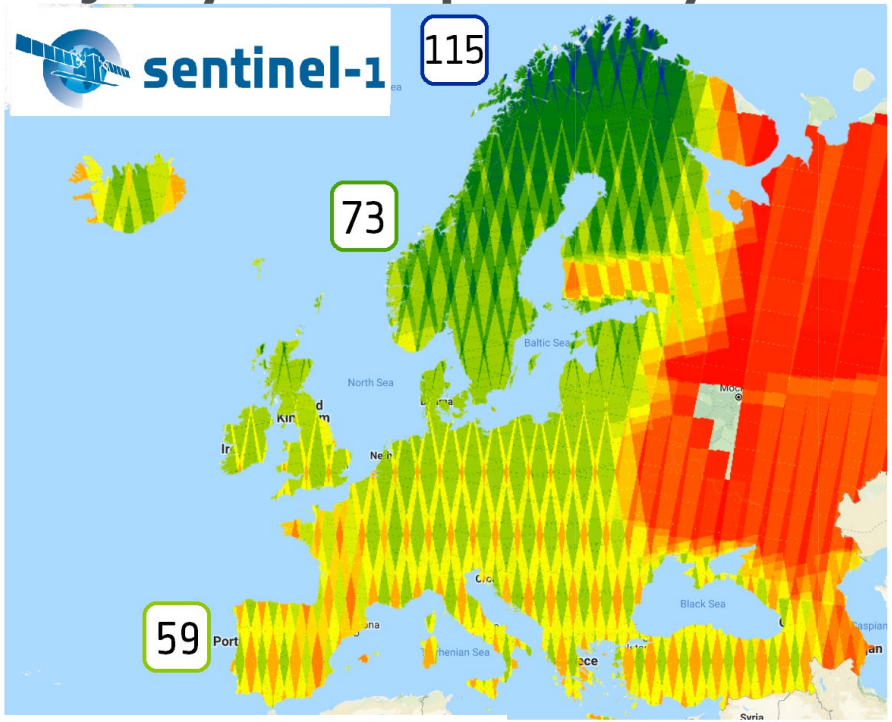


Sen4CAP system (v1.0)



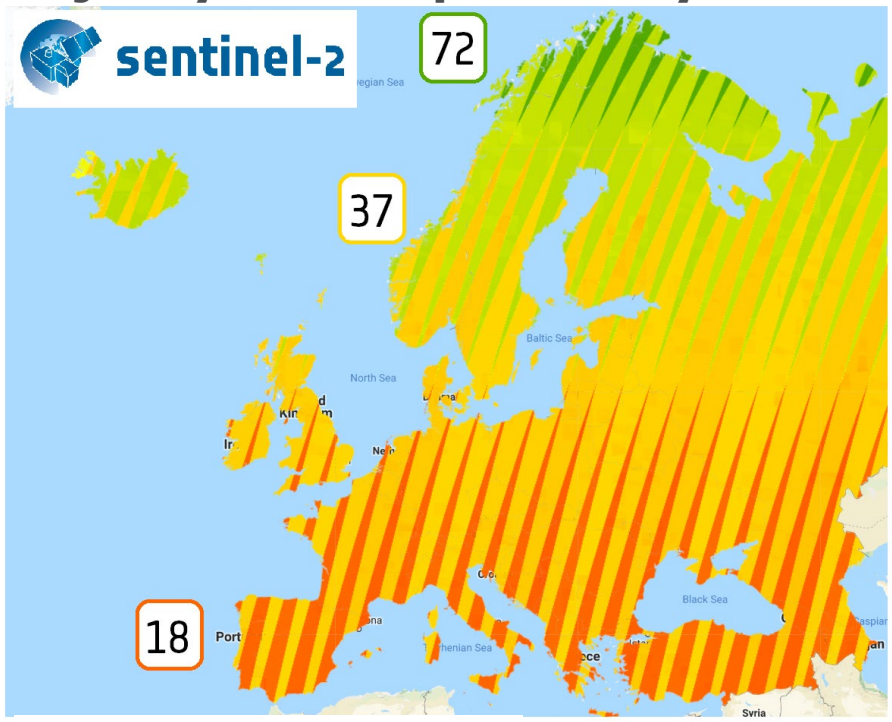
Input EO time series

Majority of Europe >2 day revisit



S-1A & -1B (July-Sept 2018)

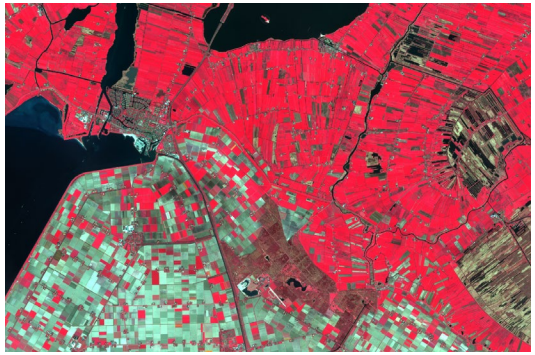
Majority of Europe >3 day revisit

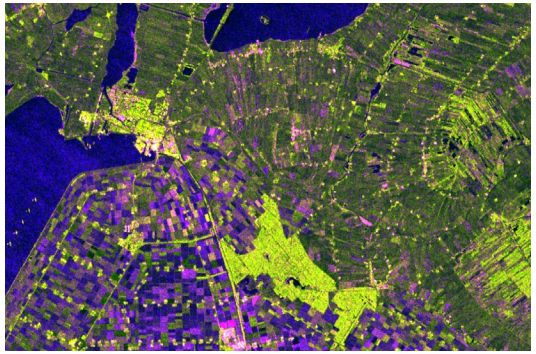


S-2A & -2B (July-Sept 2018)

Large dataset of markers from S1 & S2 for a national coverage

Sen4CAP system to process in near-real time full time series locally or on the cloud





Metrics / markers stored for each LPIS/GSAA parcel

- Crop type mapping
- Growing vegetation indicators
- Grassland mowing detection
- Agricultural practices monitoring

Sen4CAP system : simple parametrization and subsidy application upload

Before the monitoring period | Monitoring period

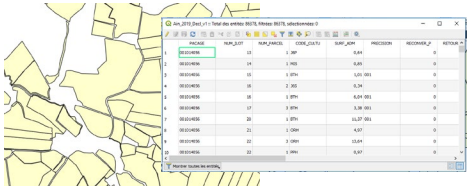
System initialization

Start of the season → End of the season...

Sen4CAP system : main parameters settings

Area of Interest	Shapefile to be uploaded
Monitoring period	Start and end dates to be defined
S1+S2 / S1+S2+L8	L8 to be selected

Subsidy application

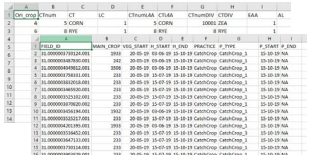


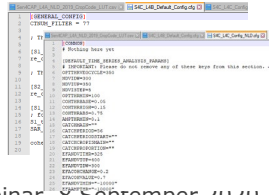
Upload data

Sen4CAP system : data from PA

Subsidy application (shp)	Subsidy application layer (shapefile)
Tables and config files (csv)	L4A crop code LUT L4B config file L4C config file + agri practices tables

Tables and config files





Sen4CAP is free and open source
Based on open source existing software

Under GNU-GPL License

Based on **Orfeo ToolBox** framework

Cluster-ready architecture for distributed processing

Integration of **SNAP** tools and processing chains

Operational system required : **CentOS7** (GNU/LINUX)

PostgreSQL and **PostGIS** implementation

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- RACE Covid 19: Sen4CAP to monitor the harvest of winter cereals in Spain
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Version 1.2 released on the 16th of July 2020

May 2019

BETA version

Only available for the PAs

25th of Nov 2019

Version 1.0 release candidate

Open-source

Possibility for the PAs to access a test machine with the system

29th of May 2020

Version 1.1

1st consolidated version

Big evolutions:

- Corrections in the advanced processors
- Sen2Cor L2A compatible
- Move of the system database to a docker container
- … => 2 Q&A sessions organized end of June

16th of July 2020

Version 1.2

Mainly corrections and adaptations based on project and user's experience

What are the **changes** in version 1.2?

=> Added, changed and fixed features specific to each version are listed in change log file

- Added
  - Mechanism for **dynamic timeout computation when performing queries on SciHub** => due to large delays in S1 queries experienced during maintenance activities
  - Added **configuration keys** (in config table: downloader.s1.query.days.back, downloader.s2.query.days.back and downloader.l8.query.days.back) **to force queries in the past on SciHub** => because some products are sometimes available with a delay of a few days
- Changed
  - **Processors jobs are stopped (and fail) if one of the steps is failing**
- Fixed
  - **Needed corrections to L4A crop type processor**, due to the move of the system database to container and the use of another gdal version
  - If missing, **php-pgsql package installed again** => because, when upgrading from version 1.0 to version 1.1, it happened that this package was uninstalled by mistake, causing login fail to web interface

1. It is my first installation of the system

- ✓ Download the Sen4CAP distribution, SRTM and SWBD datasets and GIPP files, from the Sen4CAP website
- ✓ Follow the installation procedure described in the System User Manual (section 3) or in the « System installation » presentation:
  - Create user accounts on the data provider platforms
  - System download
  - MAJA download and installation
  - System installation
  - Configure data provider accounts
  - Configure data sources

2. I have already installed my system

- ✓ Download only the Sen4CAP distribution, from the Sen4CAP website
- ✓ Follow the steps described in the System User Manual (section 3.3.2):
  - Copy the Sen4CAP distribution on the machine where the system is installed
  - Run the « update.sh » script

NOTE: you can update your system even if you have already processed or are still processing data for a site and season:

- Data download and S1/S2/L8 preprocessing will be stopped during the update but triggered again when it is finished – everything is automatic
- L3B and L4x processors will be stopped during the update but not triggered again when it is finished. **You will have to relaunch them** manually after the update

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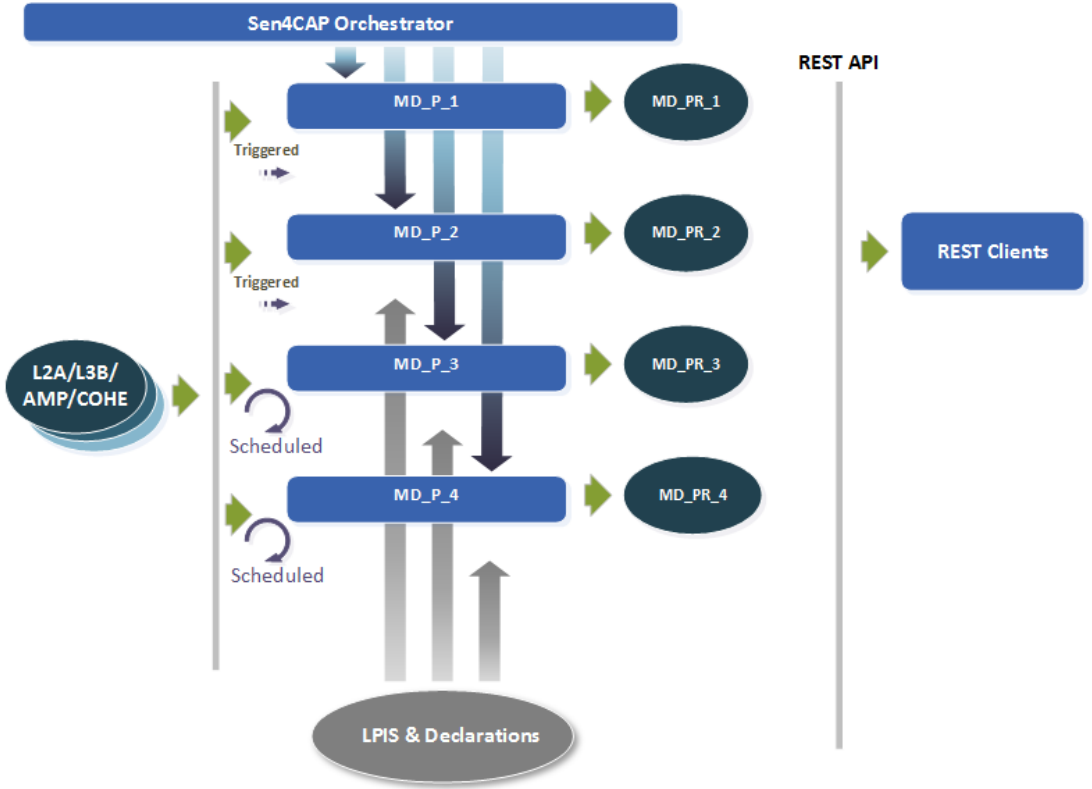
Markers Database - Overview



Markers Database - Preliminary design

- **Products -** New types of products will be added in the system:
  - ✓ MD_PR_1 - mean and standard deviation for L3B/AMP/COHE rasters
  - ✓ MD_PR_2 - Mean Ampl Ratio for ASC VH/VV and DESC VH/VV
  - ✓ MD_PR_3 - mean and standard deviation for NDWI, B3, B4, B8, B5 etc.
  - ✓ MD_PR_4 - mean\coefficient of variation AMP (ASC VV, ASC VH etc.)

- **Orchestrator**
  - ✓ Processors implemented as OTB application or python scripts
  - ✓ New processors will be added each type of products that will be triggered on each product occurrence for MD_PR_1 and MD_PR_2 and on a scheduling base (periodically) for the others.

- **System database updates**
  - ✓ New product types and processors will be added
  - ✓ An entry will be inserted into "Product" table corresponding to each markers product (each product containing the markers information for the parcels in files on disk).

Markers Database - Preliminary design

- **Internal physical products format**
  - ✓ Current format for markers generated internally by the processors is csv with some disadvantages”
    - ❑ large size
    - ❑ slow I/O speed
    - ❑ no random access
    - ❑ only some of them are indexed
  - ✓ A new feature data format will be used for the internal storage - Apache Arrow
  - ✓ Advantages:
    - ❑ Faster access than CSV files
    - ❑ Wide support (C, C++, Java, Python, R)
    - ❑ Smaller disk size
    - ❑ An index can be added for faster access
    - ❑ If needed, these products can be downloaded via the current API and custom user applications can read directly these files

Markers Database - Preliminary design

- **Sen4CAP services updates** – REST API adding endpoints for :
  - ✓ Retrieve a parcel properties from the LPIS
  - ✓ Retrieve time series markers for one or more parcels

- **Examples :**

Query for available markers:

```
GET https://<host_or_ip>/markers/names?site=<short_name>&productType=<product_code>&year=<yyyy>
```

Example:

```
GET https://<host_or_ip>/markers/names?site=ROU&productType=L4A&year=2019
```

Response:

```
[ "s2_mean_b3", "s2_mean_b4", "s2_mean_b8", "s2_dev_b3", "s2_dev_b4", "s2_dev_b8", "s2_dev_ndvi"
"s2_dev_ndwi", "s2_dev_brightness" ]
```

Markers Database - Preliminary design

- **Query for marker values:**

```
GET https://<host_or_ip>/markers?site=<short_name>&[year=<yyyy>|[&from=<yyyy-MM-dd>&to=<yyyy-MM-dd>]][[&roi=<WKT>]|[&parcels=<pid1,pid2,..>]][&markers=<mid1,mid2,...>]
```

Example:

```
GET https://<host_or_ip>/markers?site=ROU&from=2019-01-01&to=2019-01-21&parcels=227595
```

NOTE:

- **Can be provided either an interval (from the same year) or a year (ex. 2019)**
- **« roi » and « parcels fields are exclusive (either « roi », or « parcels » could be used)**
- **« roi|parcels » and « markers » are optional fields**

Markers Database - Preliminary design

- **Response of the query for marker values:**


```
{
    "dates": ["2019-01-01", "2019-01-11", "2019-01-21"],
    "parcels": [{
        "id": 227595,
        "markers": {
            "s2_mean_b3": [6006.72, 6006.72, 4230.36],          "s2_mean_b4": [6352.99, 6352.99, 4553.35],
            "s2_mean_b8": [6415.76, 6415.76, 4827.74],          "s2_mean_b11": [1078.1, 1078.1, 1619.92],
            "s2_mean_b5": [6460.45, 6460.45, 4697.3],           "s2_mean_b6": [6579.59, 6579.59, 4854.9],
            "s2_mean_b7": [6494.34, 6494.34, 4842.68],          "s2_mean_b8a": [6534.22, 6534.22, 4959.05],
            "s2_mean_ndvi": [0.00511983, 0.00511983, 0.0295513],"s2_mean_ndwi": [-0.7111, -0.7111, -0.495788],
            "s2_mean_brightness": [10898.9, 10898.9, 8035.52],  "s2_dev_b3": [575.387, 575.387, 403.817],
            "s2_dev_b4": [663.69, 663.69, 471.184],             "s2_dev_b8": [647.827, 647.827, 473.842],
            "s2_dev_b11": [61.1683, 61.1683, 86.1375],          "s2_dev_b5": [581.583, 581.583, 410.277],
            "s2_dev_b6": [594.346, 594.346, 423.862],           "s2_dev_b7": [580.628, 580.628, 417.358],
            "s2_dev_b8a": [573.228, 573.228, 414.97],           "s2_dev_ndvi": [0.0100915, 0.0100915, 0.0101097],
            "s2_dev_ndwi": [0.0155391, 0.0155391, 0.0250613],   "s2_dev_brightness": [1082.19, 1082.19, 772.629]
        }
    }]
}
```

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RACE initiative from EC and ESA

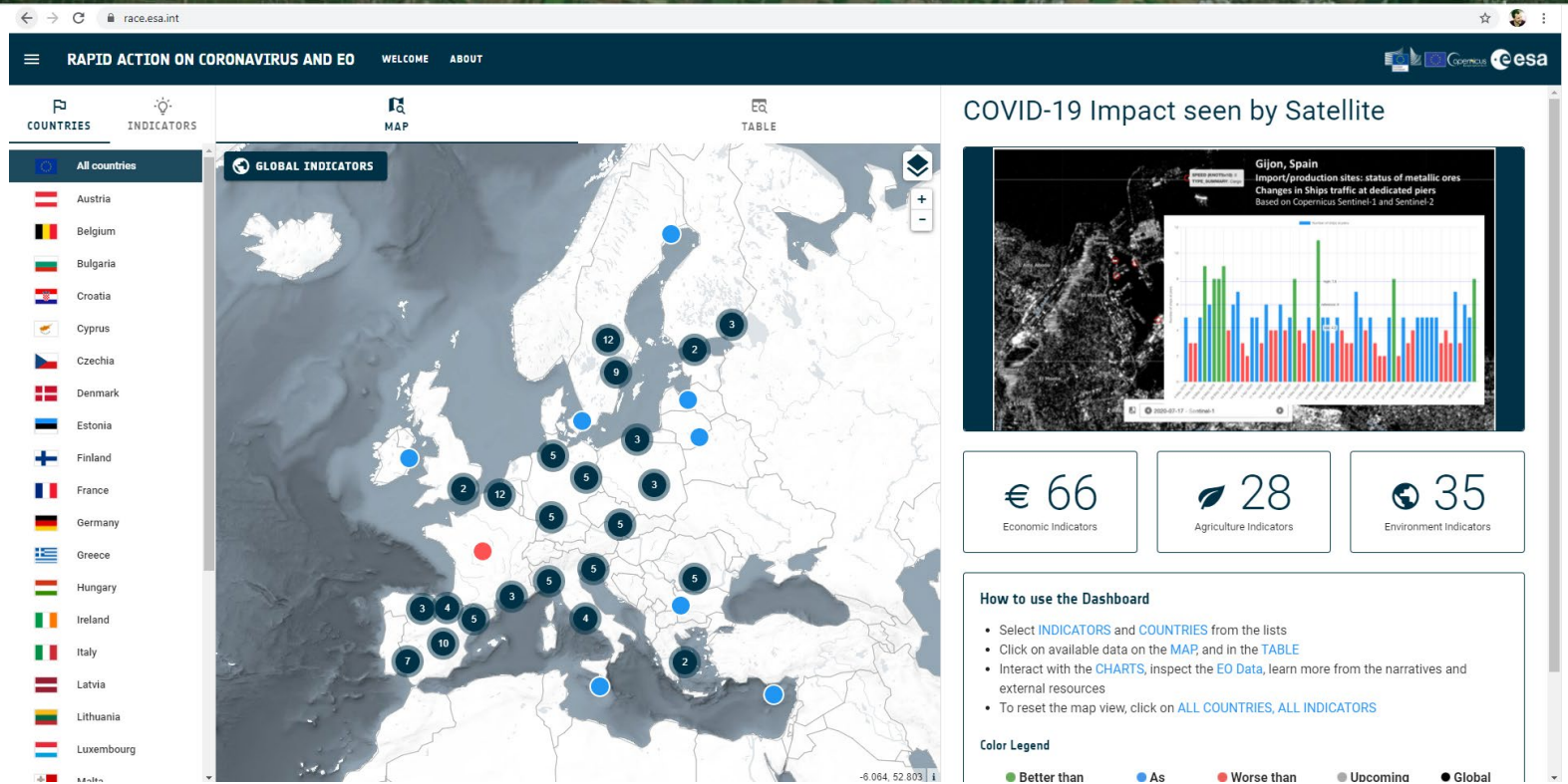
Rapid Action Coronavirus Earth observation dashboard platform

https://race.esa.int/

https://www.copernicus.eu/en/events/events/european-commission-esa-press-conference-race-initiative

- Using EO satellite data to measure the impact of the coronavirus lockdown and monitor post-lockdown recovery
- First demonstration of EO data ingestion supporting decision-making
- Public information – transparency

RACE platform

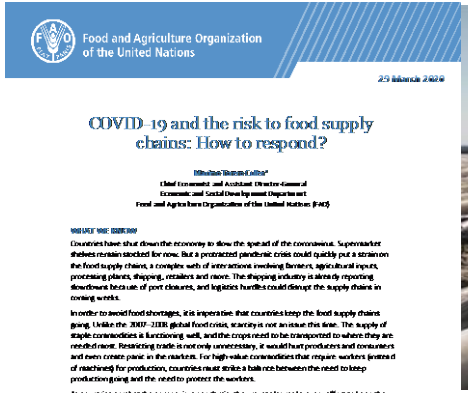


COVID19 Impact on agricultural production in Europe

1. Impact on labour intensive harvesting of **vegetables & fruits**
   a) Asparagus harvest in Germany, Brandenburg
   b) Strawberry harvest in Spain, Huelva province
2. **Verification of delay or disruption of winter cereals harvesting in Spain**

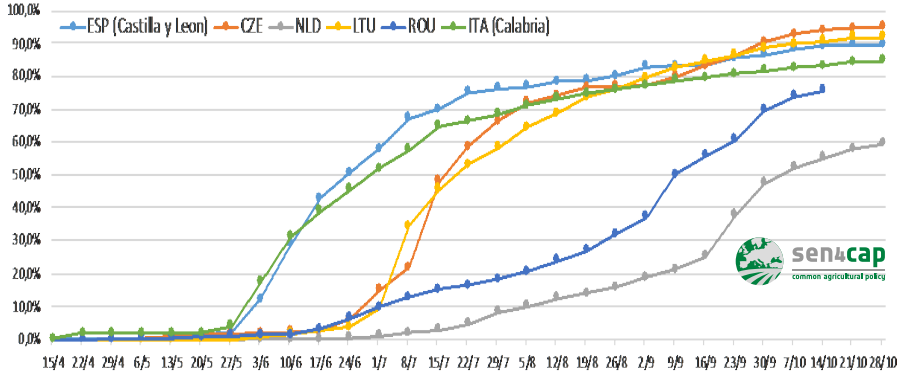
   That could be due to shortages of inputs such as fertilizers or lack of labor and spare parts in case of farm equipment problems

=> Goal: Monitoring the impact of lock-down, border closures & transport restriction on food production and supply chains


Food and Agriculture Organization of the United Nations

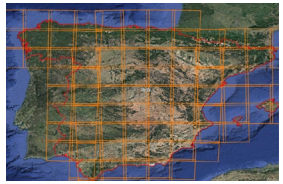
COVID-19 and the risk to food supply chains: How to respond?

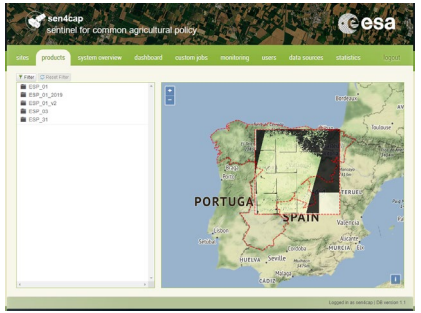
Evolution of harvest detection in 2019



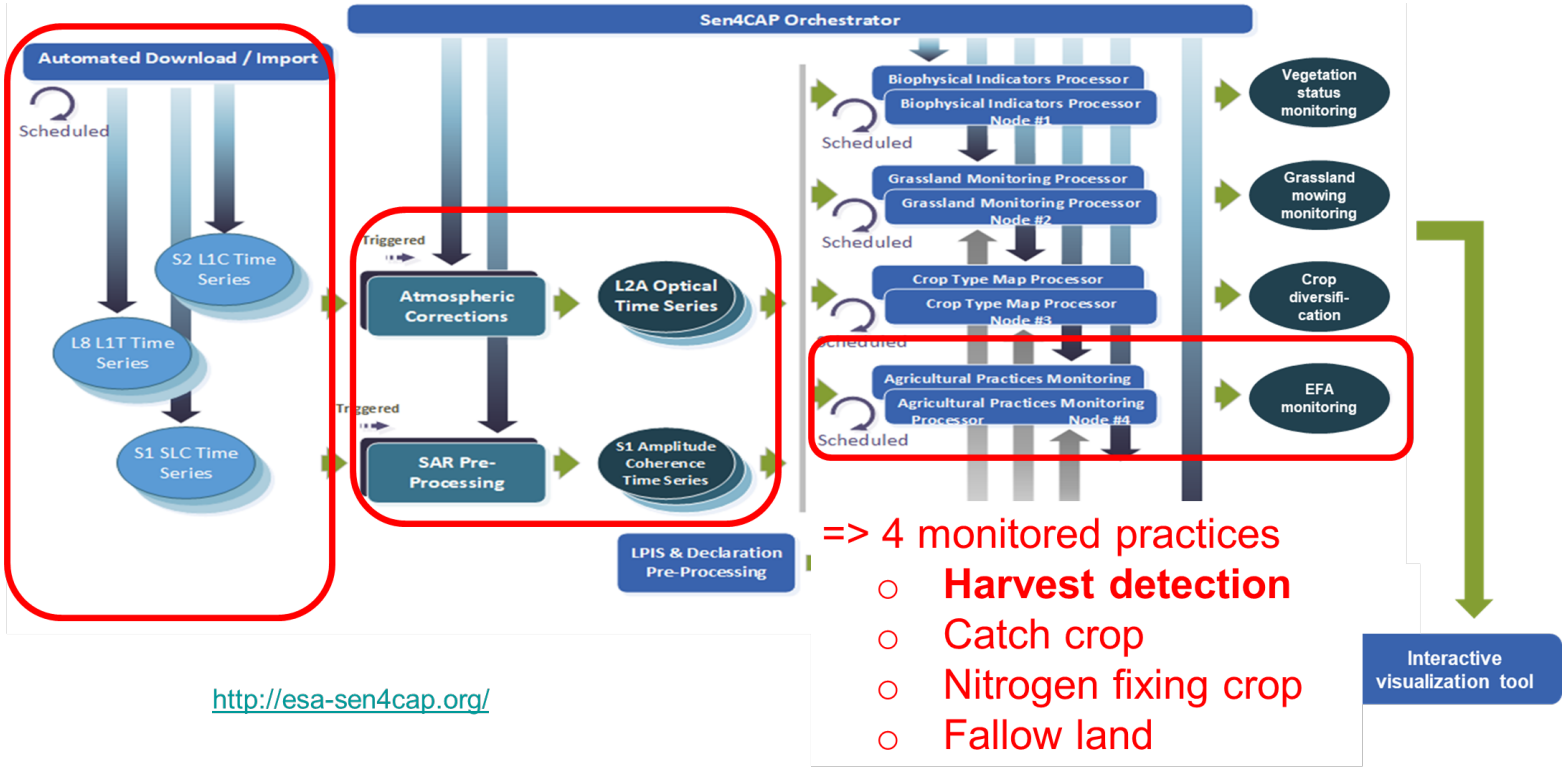
Verification of delay or disruption of winter crops harvesting in Spain

- **OBJECTIVE**: to monitor 2020 winter cereals harvest progress, and comparison with 2019
- **STUDY AREA**: Spain (whole country)
- **METHOD**: using Sen4CAP system
  - S1 and S2 preprocessing -> to provide S1 ampl and cohe, and S2 NDVI time-series
  - Harvest detection using the L4C agricultural practices monitoring processor
- **INFRASTRUCTURE**: 4 CreoDIAS VMs -> 16 cores, 128 Gb
  - 2020 N and S
  - 2019 N and S





L4C agricultural practices processor

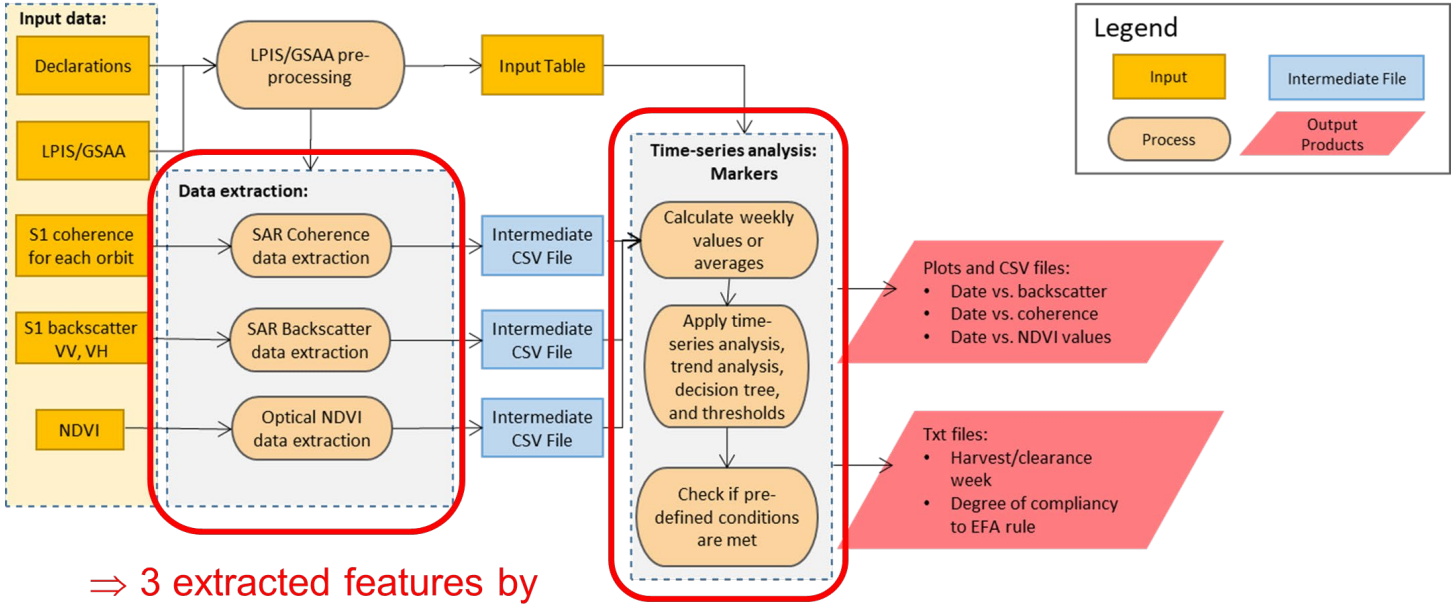


http://esa-sen4cap.org/

=> 4 monitored practices

- **Harvest detection**
- Catch crop
- Nitrogen fixing crop
- Fallow land

L4C agricultural practices processor



⇒ 3 extracted features by parcel

- NDVI
- SAR backscatter ratio VV/VH
- SAR coherence (6 days, VV)

⇒ 5 markers evaluation (weekly) for harvest detection

Time-series analysis: markers extraction

MARKERS FOR HARVEST		
M1	M1: Presence of vegetation in the main vegetation season (pre-requisite)	High values of NDVI
M2	M2: Loss of vegetation	Break in NDVI (decrease)
M3	Loss of vegetation	Break in backscatter ratio (increase)
M4	Low/no vegetation	High values of backscatter ratio
M5	Low/no vegetation (stable conditions)	Break in VV Coherence (increase) or high values of VV Coherence

- **Weekly monitoring**

-> evaluation of markers

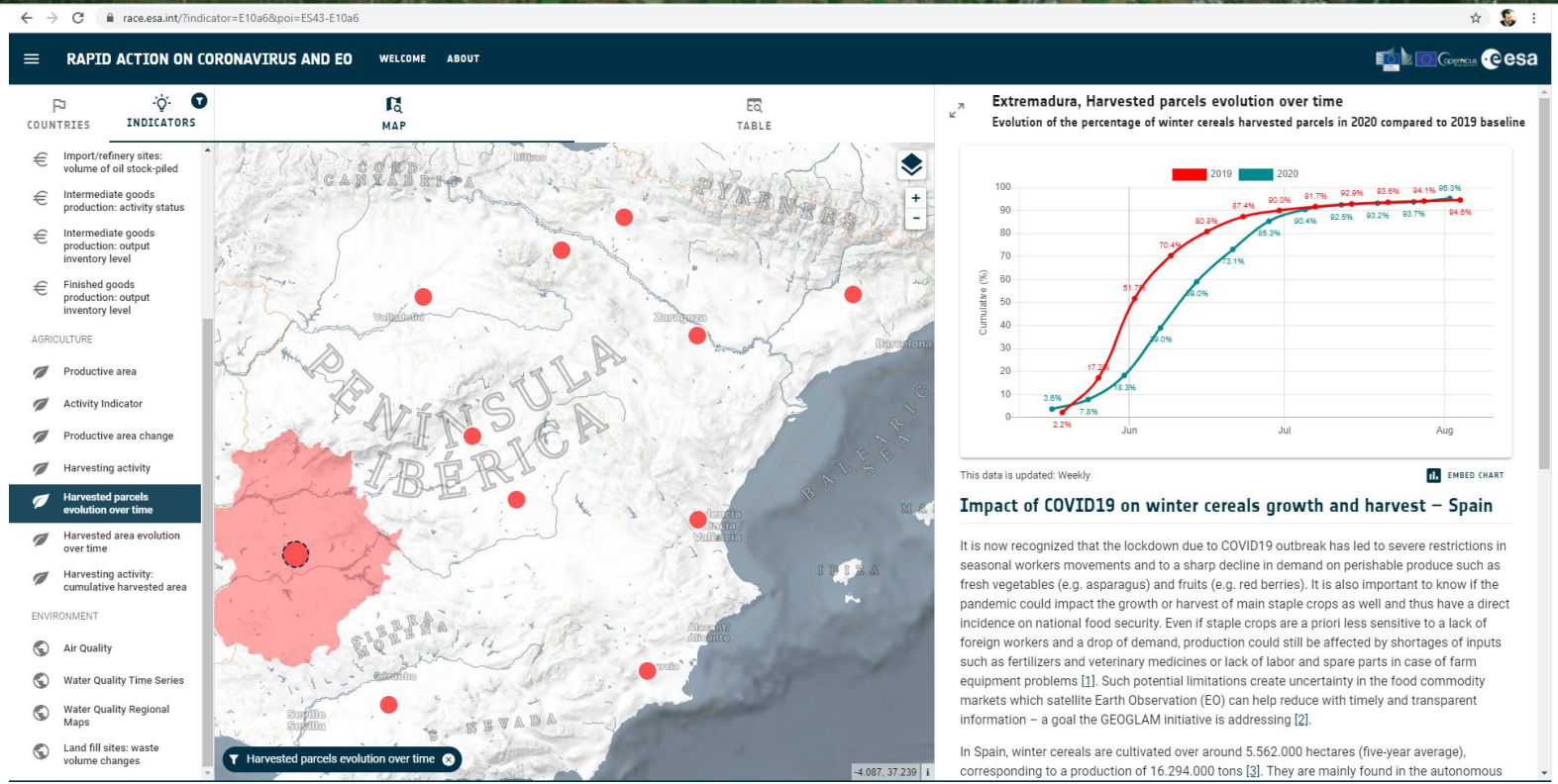
- **Harvest detection**

-> all markers (M1 – M5) are TRUE

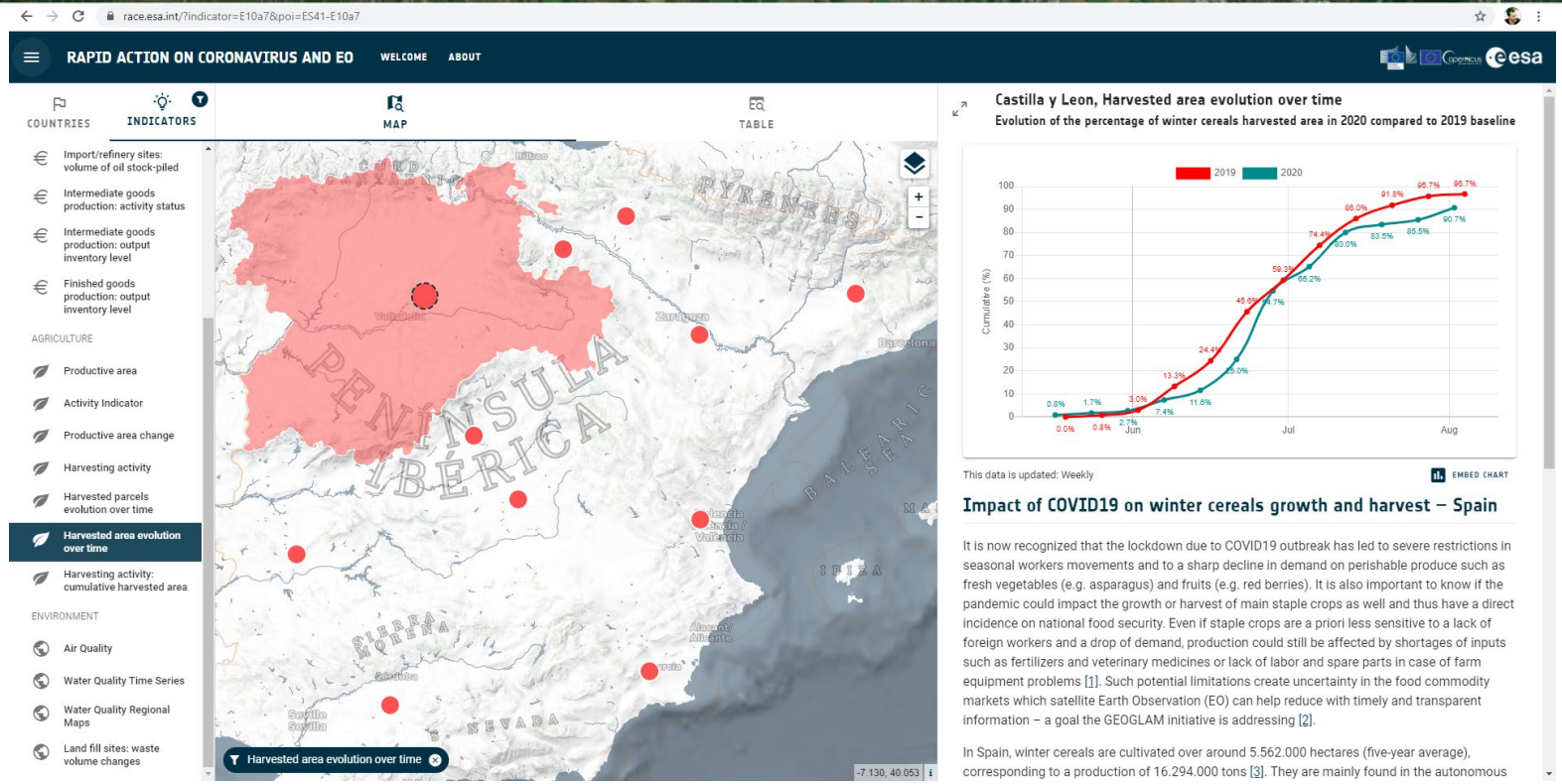
- **Preliminary detection**

-> only S1 based markers (M3 – M5)

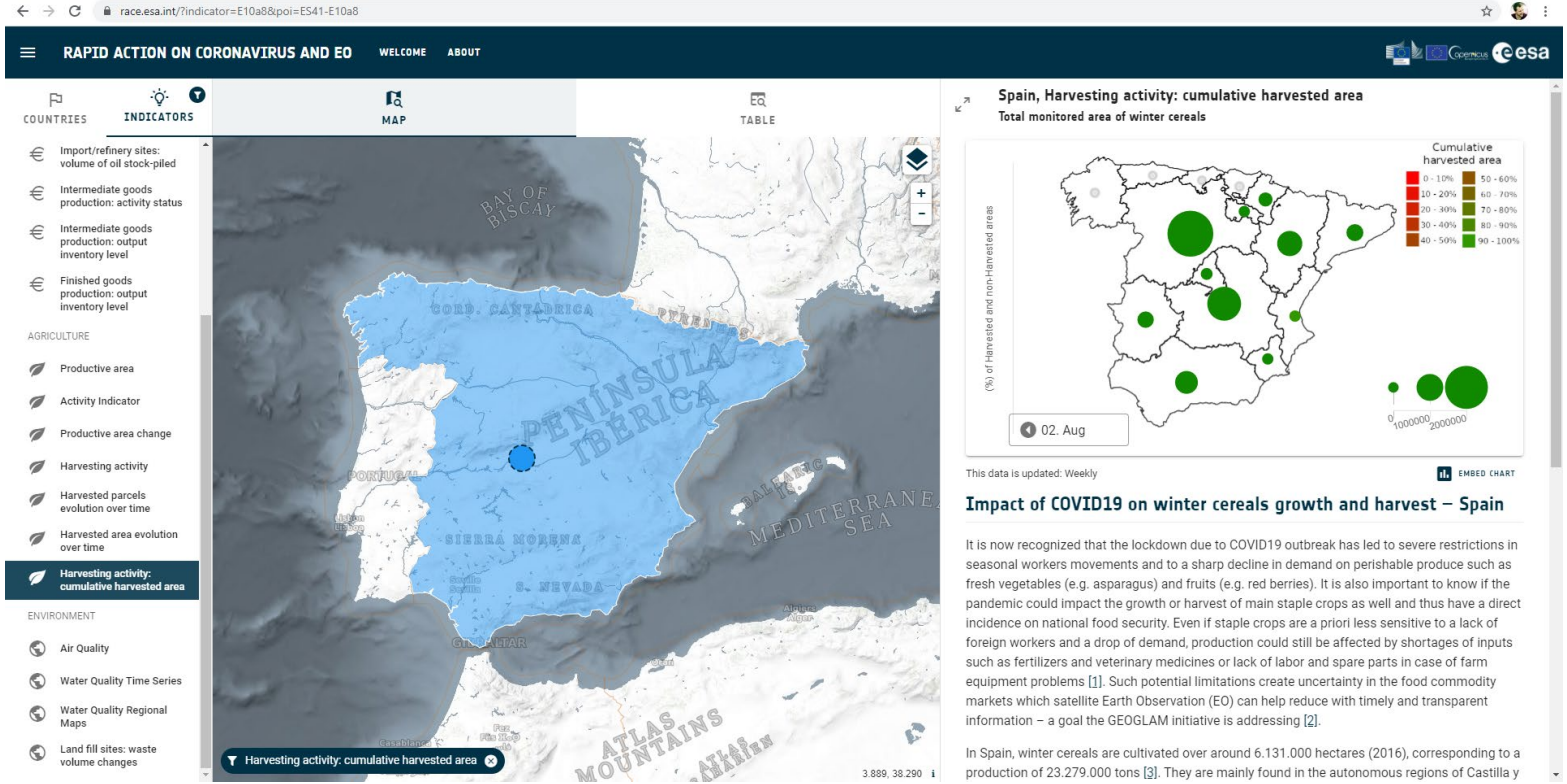
OUTPUT: Harvested parcels evolution over time



OUTPUT: Harvested area evolution over time



OUTPUT: Harvesting activity: cumulated harvested area



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Next events

- Next webinar will be on **3rd November**
  - New processor on tillage detection
  - Other specific topic?

- Do you need online Q&A sessions in October?

- **Your questions ???**


Thank you for your attention
and your contribution
sen4cap
common agricultural policy