Aimed to provide validated algorithms, products, workflows and best practices for generating satellite-derived markers and information relevant for the CAP monitoring.

Release of the beta version of the open-source Sen4CAP Earth Observation processing system

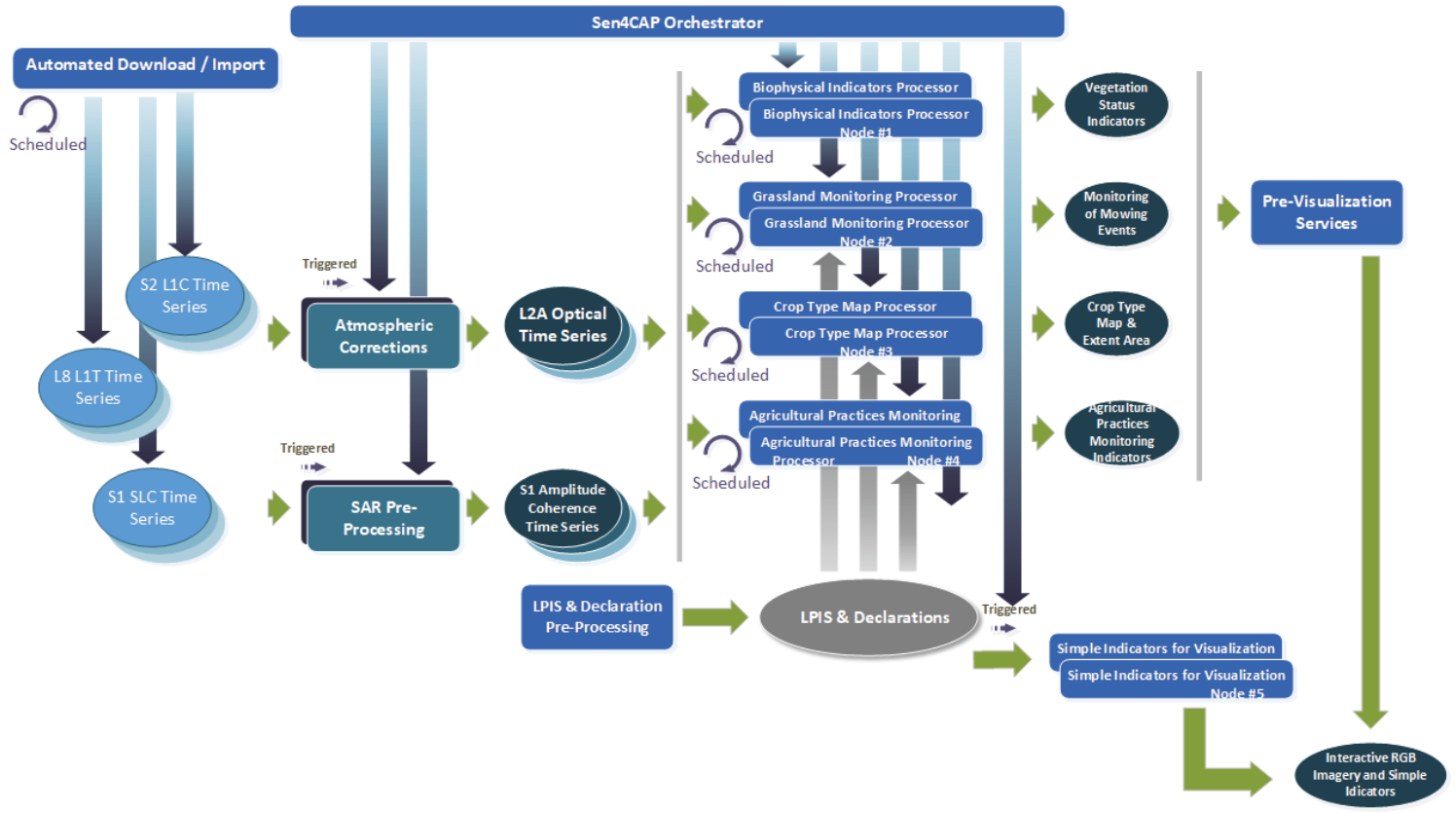
The **Beta version of the Sen4CAP** system is now available for the **whole group of Paying Agencies**.
If you are interested to access and test this open-source system, you can contact **Sophie Bontemps** or send an email to **info@esa-sen4cap.org**.
Two options are proposed. The first one is to **access a virtual machine** where the system is already installed and to test it over a small area. The second one is to **download the installation package and to install it** on the computing infrastructure of your choice.
Once the Sen4CAP EO processing system is fully qualified, it will eventually be made available beyond the CAP community as an open-source system under the GPL v3.0 license.
A general awareness training intended for all Paying Agencies is being planned with DG-Agri and is under preparation. More information will be communicated later.
The open-source Sen4CAP system is a standalone processing toolbox and data management system which generates a set of markers and products for CAP monitoring from Sentinel-2 L1C, Sentinel 1 Single Look Complex and Landsat 8 L1T time series. These features and markers corresponding to each LPIS parcel can be produced in near real time for monitoring and compliance analysis. They also corresponds to a set of products:

- cultivated crop type maps, generated regularly along the agricultural season;

- biophysical vegetation status indicators (NDVI, LAI, fAPAR and FCover) describing the vegetative development of crops;

- grassland mowing product, generated at regular intervals during the agricultural season;

- agricultural practices monitoring product, generated at regular intervals during the agricultural season (with a main timestep at the end of the period of required compliancy according to the national Ecological Focus Area definition).



Logical data flow of the Sen4CAP Earth Observation processing system.

Successful hands-on trainings at the premises of our six pilot Paying Agencies

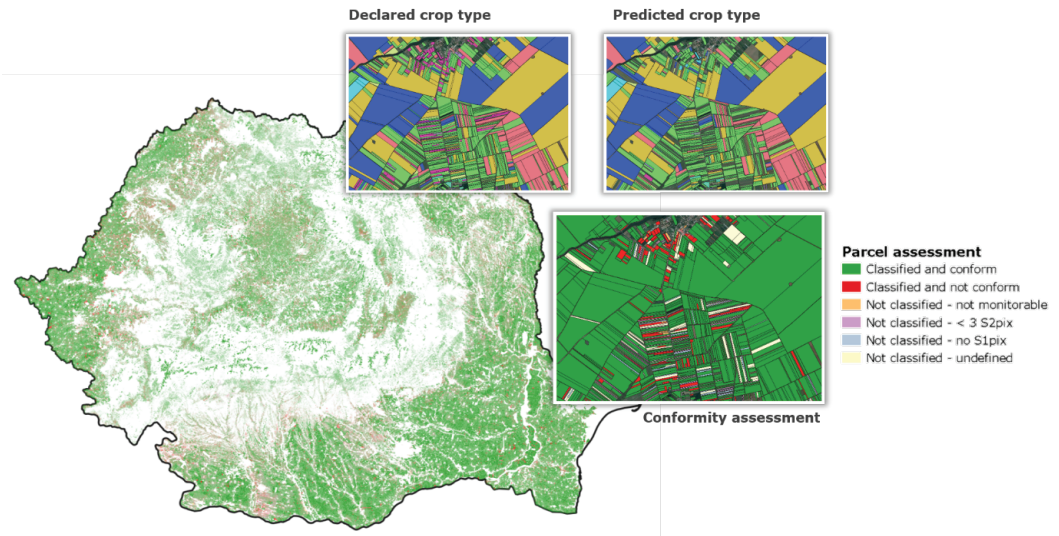
From February to April 2019, we have visited the six pilot Paying Agencies during 2 days, **to present the Sen4CAP demonstration products** for the year 2018, to discuss their respective **accuracy**, **performance** and **relevance** in the context of the **new CAP monitoring approach**. We also had a live demonstration and a hands-on training session allowing each paying agency to run for the first time the Sen4CAP system. A Virtual Machine on CREODIAS, with Sen4CAP already installed, was made available for each of them for the training and continues to run for testing during the full year 2019.

In each country, we had the possibility to discuss with 5 to 10 persons from the Paying Agency, with different background (from field visits to remote sensing). The relevance of the Sen4CAP system and products was clearly expressed by each Paying Agency, even if each of them was more specifically interested in some products or processing chains. It was a great opportunity to **prioritize further improvements** and allowing to focus on key elements. We also agreed to concentrate on the **validation of the 2018 products**, both in terms of **quantitative accuracy** coming from the comparison with independent datasets and in terms of **usefulness to support the payment decision** at the end of the workflow. It was also decided to work in **near-real life conditions during the year 2019**, i.e. to monitor all agricultural parcels continuously along the year as soon as the farmer declarations are available.

Hands-on trainings at the premises of pilot PAs

National crop type mapping over 6 countries to support Crop Diversification assessment

In the “Greening context”, farmers have to diversify their crops within farms. For example, farmers with over 10 ha and up to 30 ha of arable land have to grow at least 2 crops and the main crop cannot cover more than 75% of the land. Paying Agencies have to assess this diversification in each holding and we have evaluated how Sentinel-based national crop type maps can support this assessment. National crop type maps were generated over the six pilot countries, with **overall accuracies ranging from 71% to 95%**. Interestingly, we have observed the limited impact of parcel size and shape on the assessed areas (0,3 % to 8 % depending on the country). The crop diversification monitoring approach relies on two consecutive assessments: first, at the **parcel-level**, to verify that the crop type declared by the farmer is confirmed by the satellite signal and second, **at the holding-level**, to assess the compliancy with regard to the crop diversification rules.



Crop type mapping in Romania (January - August 2018) and parcel-level assessment comparing the farmers declarations and the satellite signal.

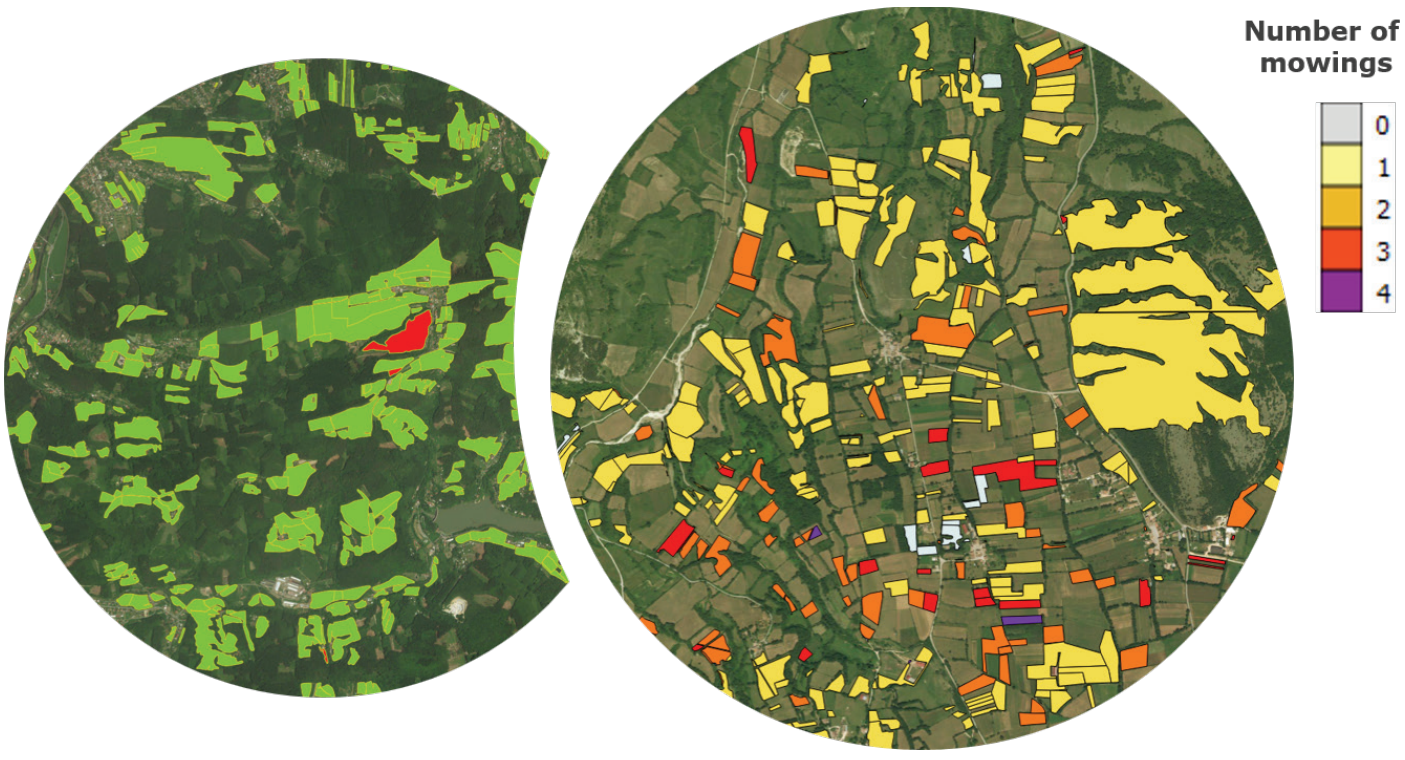
During the holding-level assessment, the rules to apply to each holding were checked and consolidated according to the interpretation of the national regulations. This assessment is based on the “**Worst Case Scenario”** presented by JRC during the 25th MARS conference. This scenario assumes that the parcels that are not monitorable or assessed as non-conform can be anything and we checked if these parcels from which we do not know anything have an impact at the holding level.

From Crop Type mapping to crop diversification: assessments at parcel- and holding-level in Romania, at the end of season 2018.

Depending on the country, the proportion of holdings for which no decision was possible ranges from 17% (Castilla y León) to 4% (Lithuania). These results are to be understood as preliminary, since the crop type maps were generated without any country-specific tuning. Significant improvements are expected from appropriate crop types grouping, stratification of the country or better calibration datasets for instance.

Grassland Mowing Detection Use Case

In most countries, permanent grasslands are defined through the set-up of a minimum time range of persistence (e.g. 5 years). Many countries (but not Italy and Spain, which are two of our pilot countries) also define a reference date or period for the mowing of these permanent grasslands. A specific satellite-derived marker has been developed to inform about mowing events over each LPIS or GSAA polygons declared by the farmers as permanent grassland. During the first year of the project, the six pilot Paying Agencies provided their national definition of Permanent Grassland. When mowing events were part of the definition, they specified the reference or mandatory periods (e.g. according to Single Area Payment Scheme) during which these events should be observed. The developed **methodology relies on the analysis of dense Sentinel-1 and Sentinel-2 temporal profiles** over the grassland parcels. The Sentinel-1 markers are based on **backscatter amplitude and coherence at 20 meters**, from ascending and descending orbits and for VV and VH polarizations. The optical-based indicators include three **vegetation indicators at 10 meters: NDVI, Leaf Area Index and fAPAR**. Grassland mowing is expected to cause a decrease of the Vegetation indices value and a sudden increase of coherence. The compliancy assessment identifies if (i) mowing occurred within the reference period, (ii) no mowing occurred within the reference period or (iii) mowing occurred within but also outside the reference period. For each mowing detected by the algorithm, the period of the detection is recorded as well as a confidence indicator of the detection.



Grassland mowing detection in Czech Republic (April - October 2018),
with information about number of mowing observed over each grassland parcel and compliancy assessment with respect to the reference period in the national regulations.

A dedicated tool for visualisation of Sentinel data and Sen4CAP markers and products

A WebGIS application has been set up to **demonstrate how satellite imagery used within Sen4CAP system can be integrated into standard GIS environment** and to provide an easy option to **analyze the Sentinel-derived markers and products generated within the project**, together with the **input datasets provided by the Paying Agencies**. During the first year of the project, each pilot Paying Agency got a separate account with an access to their own data. Within the WebGIS application, it is possible to:

- visualize S2 and L8 data by getting a list of dates of available satellite images within a specified period and display a sequence of the satellite images for a chosen period;

- view the EO markers and products generated in the project at the LPIS/GSAA parcel level: declared crop type compared to the crop type observed by remote sensing, number of mowing events, markers related to agricultural practices, together with easily accessible metadata of each product;

- view results at a farm level for compliance assessments;

- query over multiple fields within the same layer;

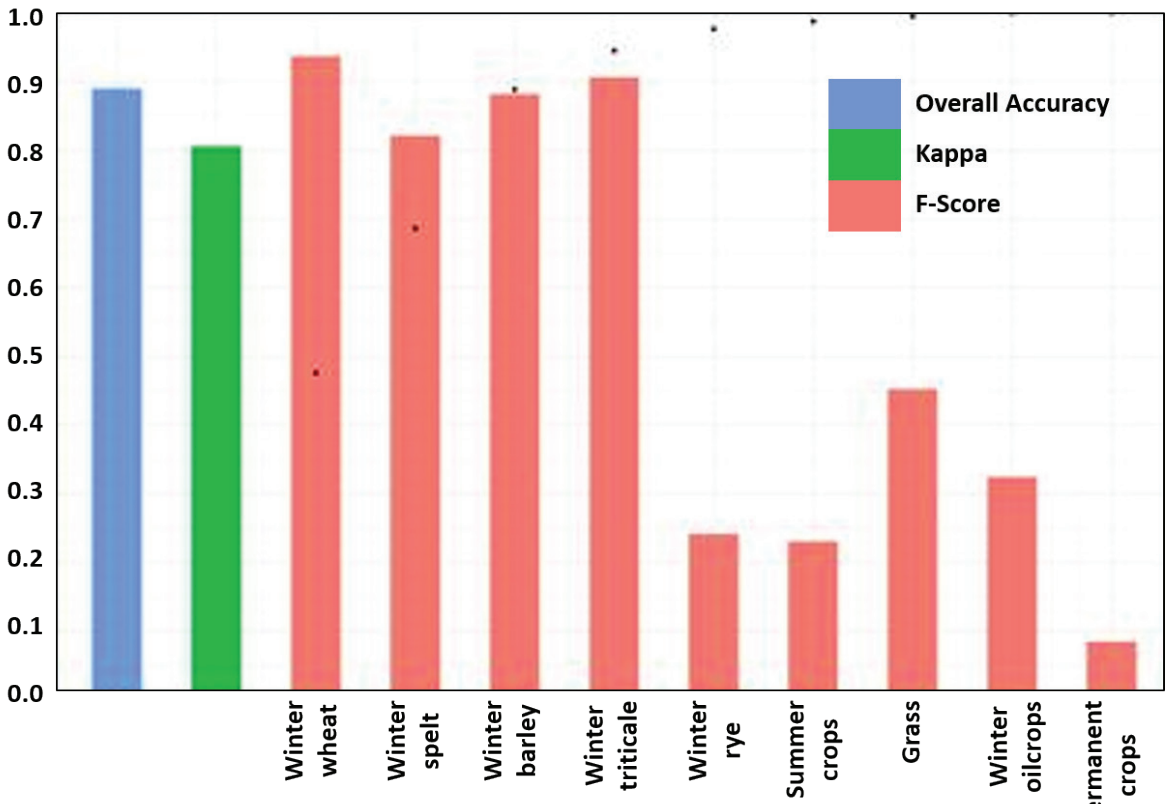
- get the graphical presentation of the vegetation status indicators' values averaged at the parcel level.

Crop type mapping results as shown in the visualisation tool.

Read more in the Visualisation Tool Quick User Guide.
- http://esa-sen4cap.org/sites/default/files/sen4cap_quickuserguide_visualisationtool.pdf

2019 season monitoring is ongoing

For 2019, the objective of the project is to **monitor the 6 countries continuously and in near-real life conditions.** Sentinel-1 and -2 as well as the suite of Sen4CAP Earth Observation markers are continuously processed since early 2019 and we aim at generating the varying products as the declarations' datasets are made available by the pilot Paying Agencies. **In 2019, the project will also work in France**, including the monitoring of 2 departments.



Accuracy of the crop type mapping from 15 May 2019 in Lithuania.
At this point of time in the season, only winter cereals are accurately discriminated.
The accuracy of the other crop types is expected to improved from June.

UPCOMING EVENTS

October 16-18, 2019 - 56th Panta Rhei conference in Dubrovnik, Croatia.
Sen4CAP will be presented by Sophie Bontemps to the whole group of Paying Agencies.

Autumn 2019 (date TBD) - A general awareness training in Brussels, Belgium.
The event is being planned with DG-Agri and is intended for all Paying Agencies. The exact date will be communicated by email.

Please do not hesitate to send us any feedback to info@esa-sen4cap.org. You can also meet us in person at the upcoming events. We look forward to hearing from you.

The Sen4CAP team