

Sentinels for Common Agricultural Policy

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

Release of open-source Sen4CAP EO processing system: version 1.0 candidate

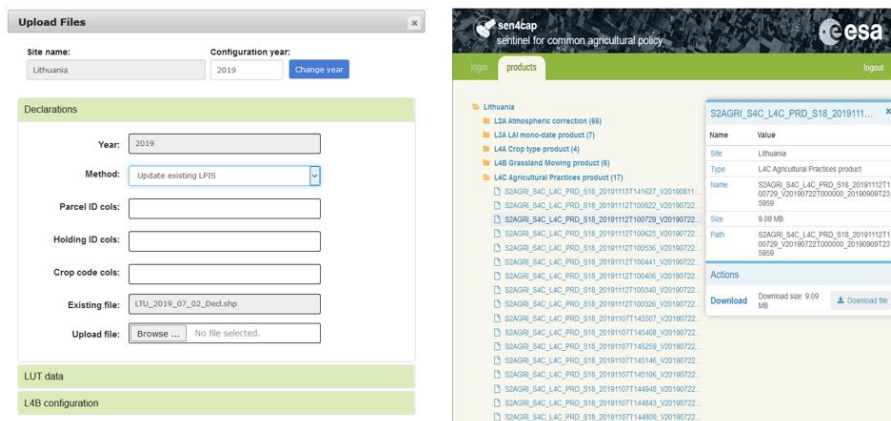
After the release of the Beta version of the Sen4CAP system in July this year, **a new version is made available during the 25th MARS conference**. This new version is accessible **for the whole group of Paying Agencies but also for any other Earth Observation (EO) user** interested in the system, under the GPL v3.0 license.

You can [download the installation package](#) through our website and install it on the computing infrastructure of your choice. The Sen4CAP system source code is also hosted on [GitHub repository](#).

For the mandated Paying Agencies, there is also the possibility to get access to a test virtual machine where the system is already installed and test the system over a small area (contact [Sophie Bontemps](#) or send an email to info@esa-sen4cap.org).

Compared to the Beta version, the **new features and improvements** are:

- additional external sources for an automated retrieval of EO products (in the case of an on-premises installation): Amazon Web Services (S1/S2/L8) and Alaska Satellite Facility (S1),
- failsafe download from external sources for products repetitively not found locally,
- upload and import of LPIS/GSAA data through the User Interface, with monitoring of the progress of the import,
- support for incremental update of LPIS/GSAA data (update of attributes, geometry, parcel addition and parcel removal flags),
- computation of LPIS/GSAA parcels quality indicators (geometry validity, overlaps, shape index, area),
- periodic extraction of reports for level 1 products processing status with e-mail notification about pre-processing issues,
- improved mechanism for automated processing of Biophysical Indicators by daily polling optical level 2A products and checking for unprocessed ones,
- improved parcel selection for crop type classification, classification optimizations and robustness improvements,
- support for parameterization and upload of the configuration of the Grassland Mowing and Agricultural Practices processors from the web interface,
- new interface for downloading final products.



LPIS/GSAA pre-processor and products download interface

A **Sen4CAP hands-on training** is scheduled on the 20 -21 January in Belgium to introduce the Sen4CAP modules and enhance the awareness about the markers and products use for the CAP. This training is **collocated with the Direct Payment Committee**. To attend the training please mail to info@esa-sen4cap.org. More information will be provided shortly on the exact location and agenda.

Crop type monitoring along the year at national scale over 7 countries, to support crop diversification assessment

In 2019, national cultivated crop type maps are being generated on a monthly basis, from May to October, in the 7 pilot countries **covering an area of 635.000 km²**. By the end of the year, **15 million of parcels are being assessed** for cultivated crop type.

Crop type maps are validated at the parcel-level, using parcels from the farmers declarations that have not been used to train the classification algorithm. The comparison between the declared crop type and the crop type predicted with highest confidence level by the algorithm is used to build a confusion matrix and to compute the F-Score of each crop type. From this matrix, several classification performance indicators are calculated. One of the indicators is the **Overall Accuracy**. Compared to the 2018 results, the Overall Accuracy (which essentially tells us out of all of the reference sites what proportion was mapped correctly) has improved significantly for all countries.

The crop type mapping shows quite interesting performance in the seven countries, while the agricultural practices and the agro-ecological conditions vary significantly amongst them (different crop types, practices, parcel size, relief, climate, etc.). The limited impact of the parcels size and shape, already observed in 2018, has been confirmed in 2019.

Country	Total area [km ²]	Total parcels		Parcels not assessed		Overall Accuracy		
		Nr	Area [km ²]	Nr	Area	2018	2019	Progression
Netherlands (full country)	37,380	806,247	18,838	18.82%	5.45%	94.95%	97.39%	+ 2.44%
Czech Republic (full country)	78,873	597,748	34,520	9.22%	0.64%	82.75%	91.14%	+ 8.39%
Lithuania (full country)	64,897	1,185,424	29,299	22.17%	3.43%	78.74%	88.08%	+ 9.34%
Spain (Castilla y León)	94,226	102,897	3,179	19.42%	2.17%	81.83%	84.80%	+ 2.97%
Italy (5 regions)	84,770	5,718,943	27,556	71.14%	18.81%	72.37%	78.90%	+ 6.53%
Romania (full country)	238,369	6,091,197	98,600	35.03%	7.93%	71.16%	74.60%	+ 3.44%
France (2 departments)	35,862	611,074	21,903	12.29%	1.07%	/	81.84%	/

Extent of the crop type identification in 2019 and Overall Accuracy per pilot country in 2018 and 2019.

The **2019 exercise has been conducted in near real time, along the season**, as soon as the farmers declarations were shared by the pilot Paying Agencies. This continuous monitoring has allowed analysing the accuracy evolution along the season. It has also given information about which crop type is already well identified early in the season and which ones need to wait for the end of the summer.

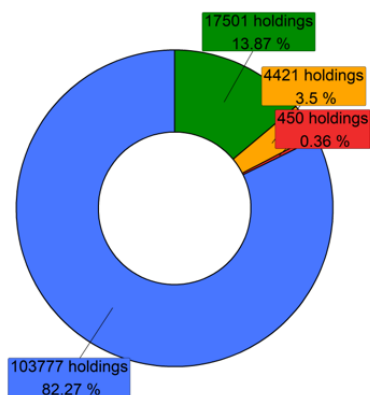
These national crop type maps are used to **support the crop diversification assessment**, which relies on two consecutive steps:

- first, at the parcel-level, we verify that the crop type declared by the farmer is confirmed by the satellite signal and
- at the holding-level, we assess the detected crop types match with the crop diversification rules.

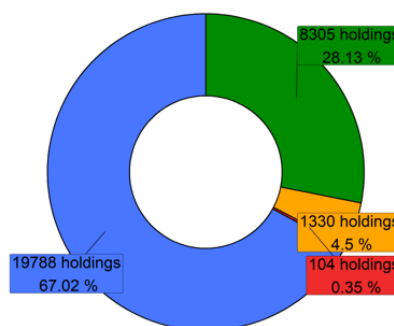
Our crop diversification assessment is based on the **“Worst Case Scenario”** presented by JRC during the last MARS conference, which assumes that the parcels that are not monitorable or not confirmed can be anything and we assign them the crop type label which is the worst for the farmer. We then check if these parcels have an impact at the holding level.

The **percentage of the holdings for which we could not decide on the agreement with the crop diversity rules from EO automated processing** (“missing info holdings”) logically decreases along the season, and **compared to 2018, this percentage is lower** due to the overall improvement of the crop type maps. Comparison of the crop diversification assessment results in season 2019 is presented for the 6 countries interested by this use case. These results correspond to the month when the Overall Accuracy of the crop type identification reached its peak - August for Lithuania and Czech Republic, September for the Netherlands and July for Romania, Italy and France.

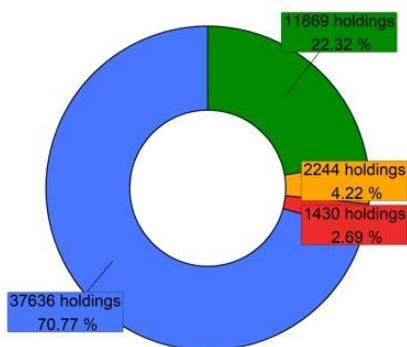
Lithuania



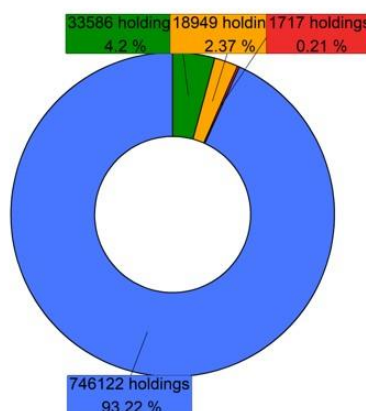
Czech Republic



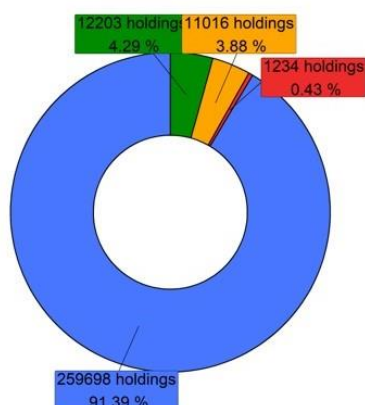
Netherlands



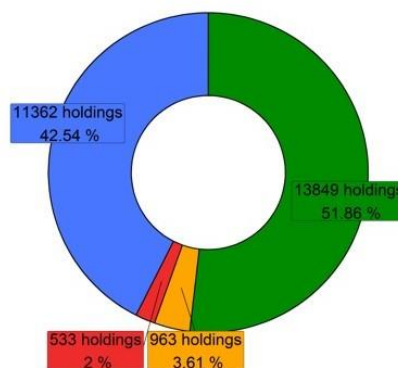
Romania



Italy



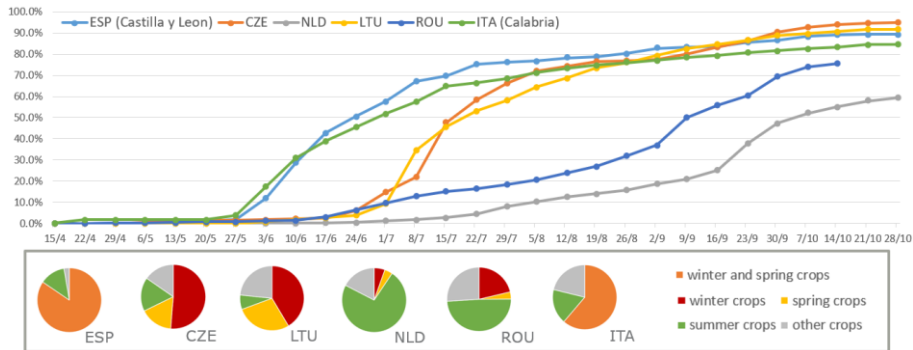
France



Crop diversification assessment results in season 2019 for Lithuania (end of August), Czech Republic (end of August), Netherlands (end of September), Romania (end of July), Italy (end of July) and France (end of July). Blue = holding does not require crop diversification, Green = holding in agreement, Red = holding in disagreement, Orange = not enough information to make an assessment.

Performance of the agricultural practices monitoring

Within Agricultural Practices Monitoring Use Case, detection of agricultural activities evidencing a declared EFA practice (**catch crops, nitrogen-fixing crops or fallow land**) is assessed. In addition to that, harvest/clearance is monitored also on parcels where no agriculture practice has been declared.



Evolution of the percentage of the harvested parcels (confirmed harvest week) in 6 pilot countries in 2019.

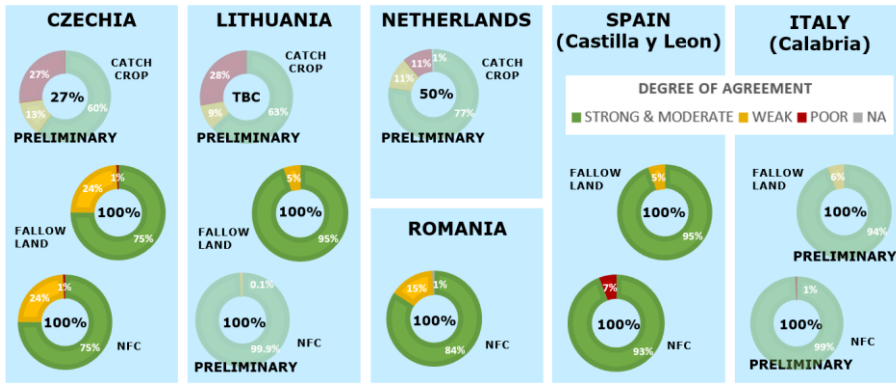
Performance assessment is done by:

- analysing the dense **S1 and S2 time series per parcel**,
- **evaluating relevant markers** (i.e. presence of vegetation, growth of vegetation, no loss of vegetation, harvest/clearance) based on the time series analyses and
- **applying decision trees to confirm or not the declared agricultural practice** using the rules that follow the practice definition in each country.

Most impact on reliability of temporal profile analysis have the following:

- missing data in the EO data time series,
- size and shape of the parcel,
- parcel uniformity in term of cover and activities carried out.

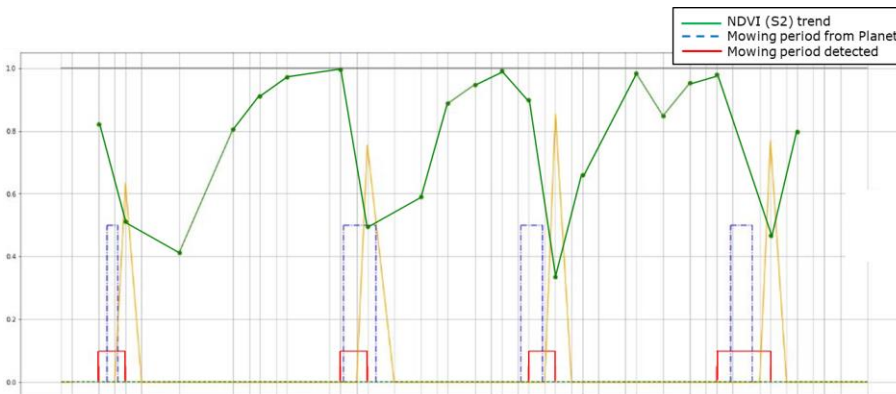
The **performance of the agricultural practices monitoring has been assessed** and presented below **for 6 countries**, for the observation period from 1.1.2019 until the beginning of November 2019. Note that the most relevant results at this point in time are given for practices in countries, where the final assessment was done on 100% of the sample, e.g. fallow land parcels in Lithuania.



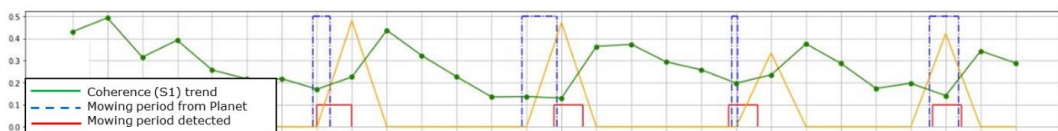
Agricultural practices monitoring performance in 6 pilot countries for the observation period from 1.1.2019 until the beginning of November 2019: % in the circle presents the share of the parcels assessed among all parcels declared for EFA practice. The results which are based only on a part of the sample are presented as preliminary. (NFC=Nitrogen Fixing Crops)

Performance of the grassland mowing detection

The mowing detection algorithm is based on the **identification of sudden decrease of vegetation index** (extracted from S2) **and/or sudden increase of the SAR coherence** (extracted from S1) on the grassland parcel.









Example of mowing detection based on S2 NDVI trend for a grassland parcel in Castilla Y Leon: detected mowing events are indicated in yellow. Planet data was used to visually validate the mowing.



Example of mowing detection based on S1 Coherence trend for a grassland parcel in Netherlands

At the end of the 2019 monitoring season (from 1st April 2019 to 31st October 2019), based on the detection of the mowing events, an assessment is made **whether the grassland parcel was mowed within the period specified by the national regulations or not**. Comparison of the grassland mowing assessment results is presented for 6 countries. It should be clarified that our algorithm only detects mowing events, but not the grazing, which is an alternative practice allowed for the permanent grassland management especially in Spain, Italy and Romania.

Country	Total parcels (n°)	Total area (ha)	Not processed (% n°)	Not processed (% ha)	Detected mowing* (% n°)	Non-detected mowing* (% n°)	Summary (%)
Netherland	501,663	1,020,925	0.16%	0.17%	92.0%	7.9%	
Czech Republic	336,935	1,037,327	0.01%	0.005%	78.9%	21.1%	
Lithuania	532,208	864,349	0.02%	0.003%	75.2%	24.7%	
Castilla Y Leon	11,841	28,901	1.38%	0.07%	48.3%	50.3%	
Romania	1,830,870	2,533,855	0.01%	0.0001%	44.7%	55.3%	
Italy	548,368	413,380	4.15%	0.04%	68.7%	27.1%	

*Mowing assessment statistics at the end of the season (monitoring period from 1st April 2019 – 31st October 2019); * within the regulation period.*

Results from the 2019 processing are being visually **validated with the Planet satellite imagery**. Compared to processing in 2018, early validation results show a meaningful increase of the precision (lower detection of false mowing event – False Positive), which was achievable through slightly decreasing the recall (detection of real mowing event – True Positive).

The main factors that reduce the reliability of the mowing events detection are:

- gaps in the NDVI time profiles due to presence of clouds,
- accuracy of the cloud mask,
- grazing instead of mowing over the parcel (grazing is not detected by our algorithms),
- partial mowing of the parcel.

UPCOMING EVENTS

November 26-28, 2019 - 25th MARS conference in Prague, Czech Republic.

Sen4CAP will be presented on **28 November by Sophie Bontemps** (project manager, UCLouvain).

Pilot paying agencies will also report their **Sen4CAP lessons learned** during the conference throughout oral presentations or informal discussions.

January 20-21, 2020 - Sen4CAP hands-on training, Belgium. The event will be collocated with the Direct Payment Committee (under planning).

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

