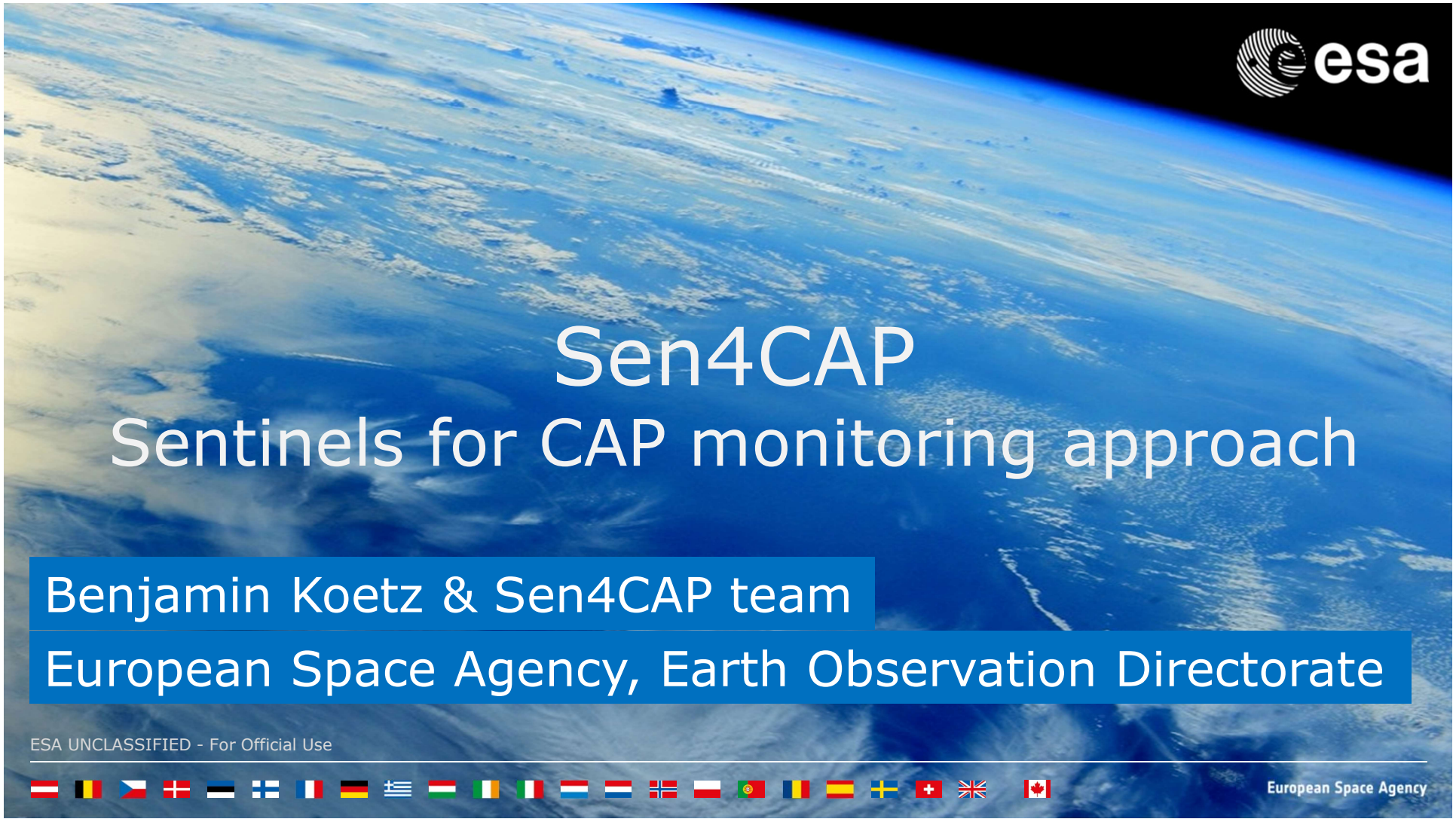
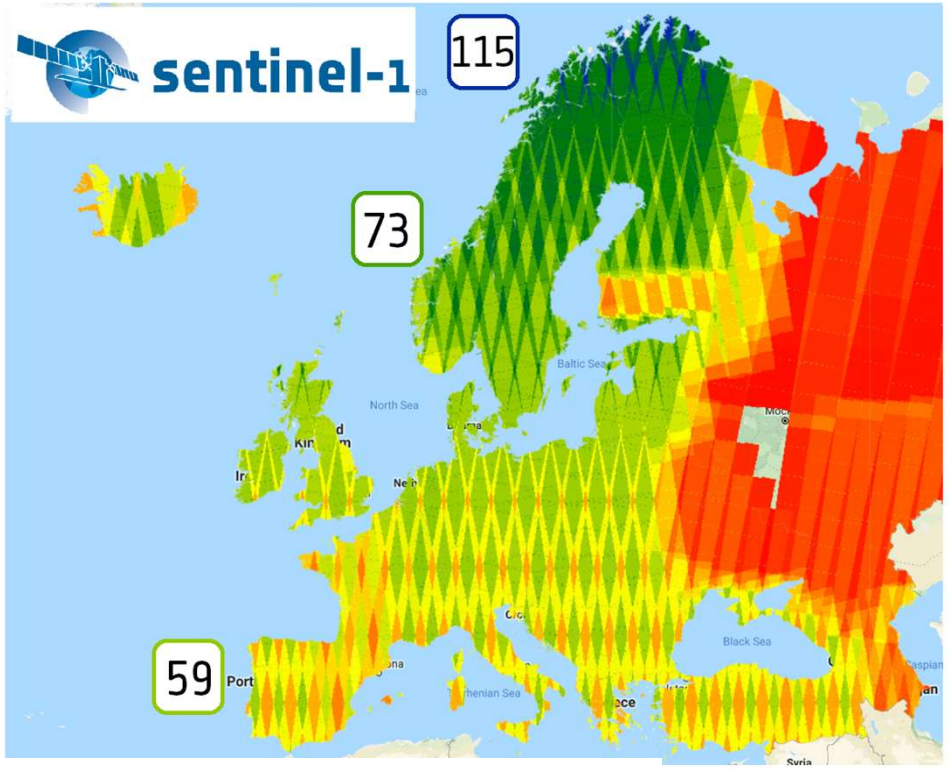

esa
Sen4CAP
Sentinels for CAP monitoring approach
Benjamin Koetz & Sen4CAP team
European Space Agency, Earth Observation Directorate
ESA UNCLASSIFIED - For Official Use
European Space Agency

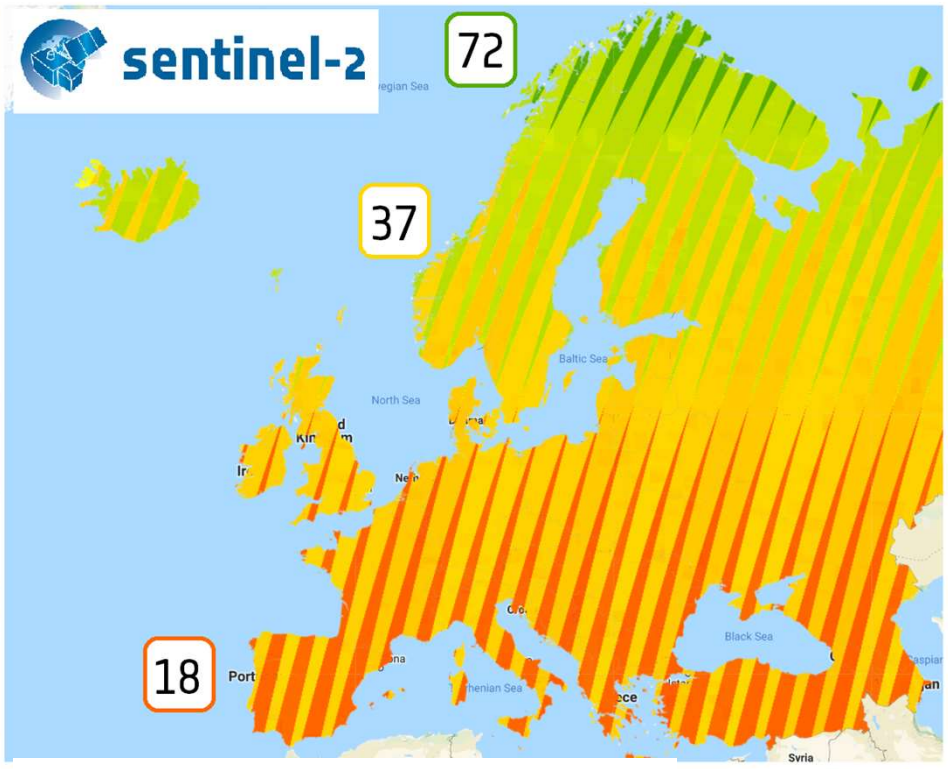
Sentinels for Agricultural Dynamics

Majority of Europe >2 day revisit



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

Majority of Europe >3 day revisit



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

Sen4CAP Evolution

CzechAgri
2015/16

Request
Jan 2017

EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR AGRICULTURE AND RURAL DEVELOPMENT
DIRECTORATE GENERAL FOR INTERNAL MARKET, INDUSTRY, ENTREPRENEURSHIP AND SME'S

Directorate D. Direct support
Space policy, Copernicus and Defence
Directors

Brussels,
D3/BR/cj Ares(2016) 7830056

Subject: Cooperation between the European Commission and the European Space Agency (ESA) on the follow-up of the CzechAgri study

Dear Mr Aschbacher,

Both ESA and the European Commission have an interest in promoting and supporting the development of Earth Observation (EO) use and related capacity in Agriculture.

We have taken great interest in the results of the CzechAgri study that was jointly initiated in December 2015 by ESA, DG JRC and SZIF (Czech Paying Agency) and successfully implemented thanks to ESA funding and a technical steering involving DG AGRI.

Following these promising results, it would be extremely useful to further explore –in close cooperation with the European Commission– the capabilities of the Copernicus Sentinels in view of the current works on the modernisation and simplification of the CAP and the opportunities of EO from space for supporting the Integrated Administration and Control System (IACS). As you may know, technical solutions to improve and to make the IACS more cost efficient are high on the political agenda. A promising way forward is offered by the important potential of Sentinel/Copernicus for administration and control purposes, i.e. in a broader perspective than the current on-the-spot controls using remote sensing. Indeed, the ambition for the next programming period is greater, we also want the IACS to be a key tool in the delivery of enhanced environmental services and public goods.

With this letter, we acknowledge and welcome ESA´s readiness to continue this effort by conducting two or three follow-up pilot studies to the CzechAgri project in preparation of the CAP 2020 reform together with the main stakeholders (DG AGRI, DG GROW and DG JRC) and the national Paying Agencies.

DG-Agri & Grow
Letter

Sen4CAP KO
2017

sen4cap
common agricultural policy

EU Parliament
2017

User Consultation
2017

1st Evidence
March 2018

Checks by Monitoring
May 2018

1st Demonstration Results
November 2018

Use Cases
with Paying Agencies

CAP Monitoring Approach – Technology meets Policy

sen4cap

common agricultural policy

Sen4CAP Objectives:

- **Provide evidence** how Sentinel derived information can support the modernization and simplification of the CAP **in the post 2020 timeframe**
- Provide **validated algorithms**, **products**, **workflows** and **best practices** for agriculture monitoring relevant for the management of the CAP

Sen4CAP – Expertise, Technology & Collaboration

Paying Agencies & Farmers

Steering Committee

DG-Agri, JRC, DG-Grow

EO Experts

UCL Université catholique de Louvain · e-geos · gisat · SINERGISE

Open Source

sen4cap common agricultural policy

Cloud Technology (DIAS)

Continuous Monitoring

Validated Performance

National Demonstration

Innovative Practices

CAP2020 Reform

Sen4CAP Pilot Countries

From Satellites to Compliance - IACS use cases

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

Prototyping – Development & Testing at EU level

Use Cases w/ Paying Agencies

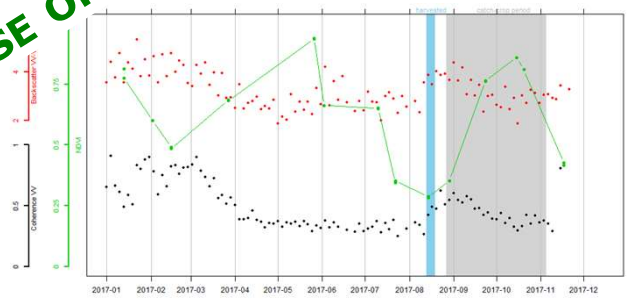
Sentinel-based markers for CAP Monitoring

- Crop type mapping
- Vegetation growing indicator
- Grassland mowing detection
- Agricultural practices monitoring

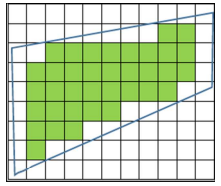
Crop type information & vegetation growing indicators

Number of detected mowing

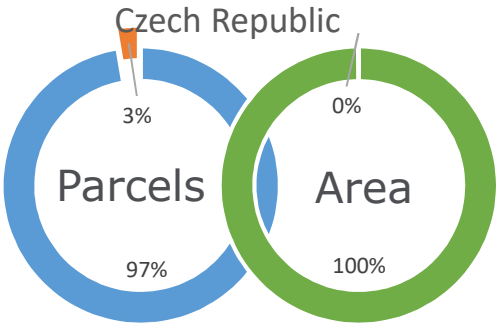
FULL USE OF SENTINEL TIME SERIES

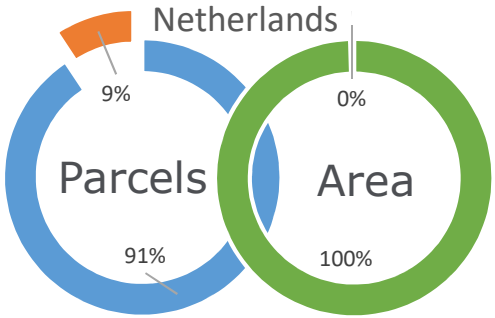


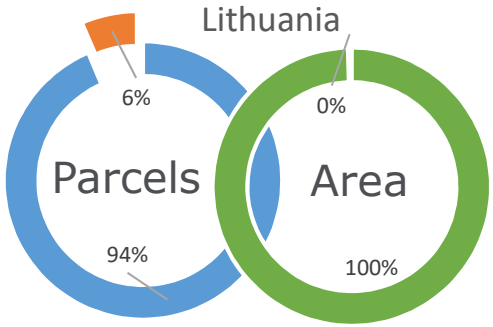
Parcel Level Implementation – New Approach

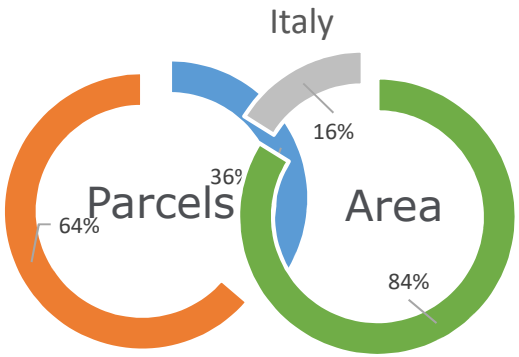


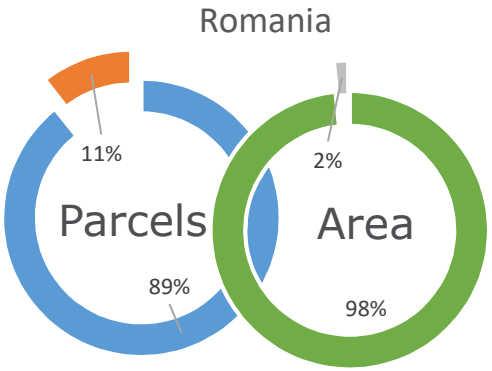
- **5-m inner buffer**
- **Parcels whose centroid is inside**











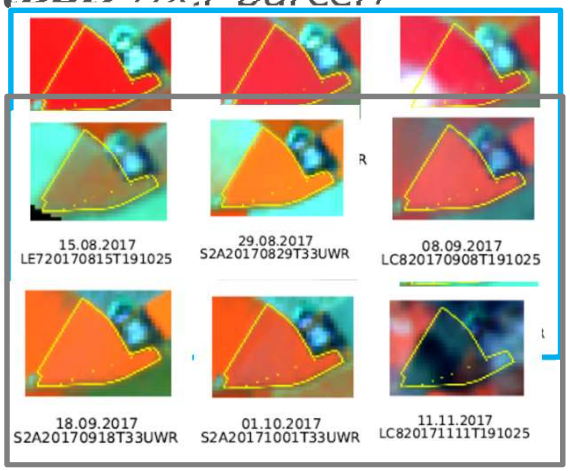
*based on crop diversification use case

Monitoring of Agricultural Practices

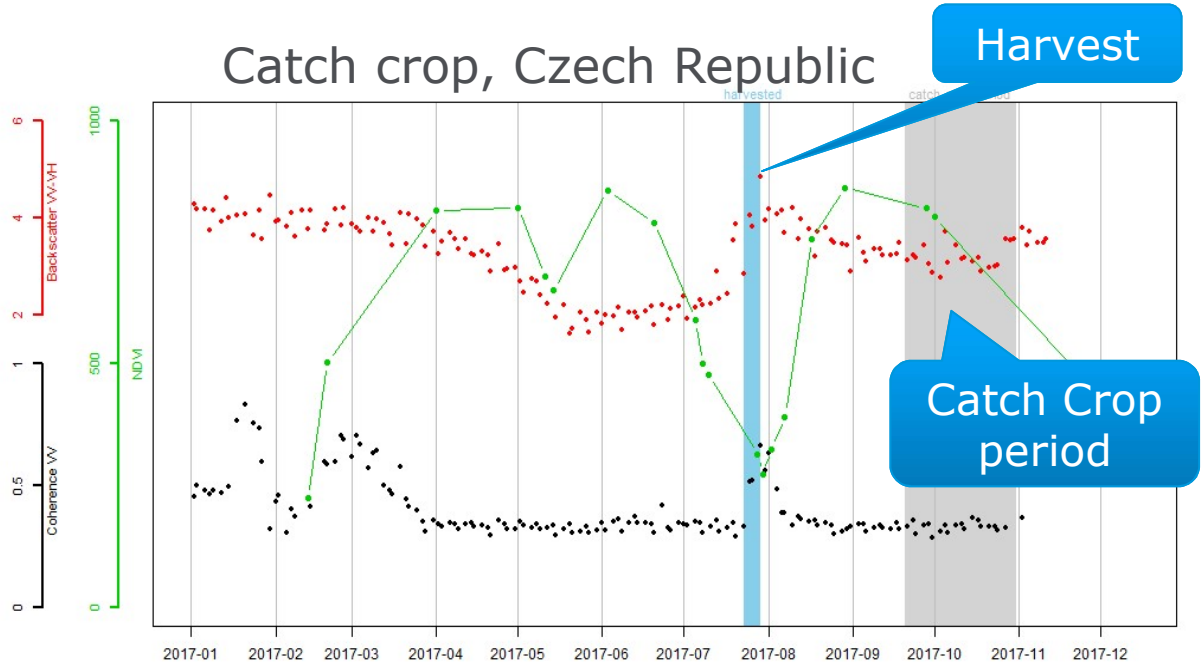
- IACS use case: Ecological Focal Area compliancy (5% area for farms >15ha)
  - based on S1&2 time series – 5 markers tracing crop activities

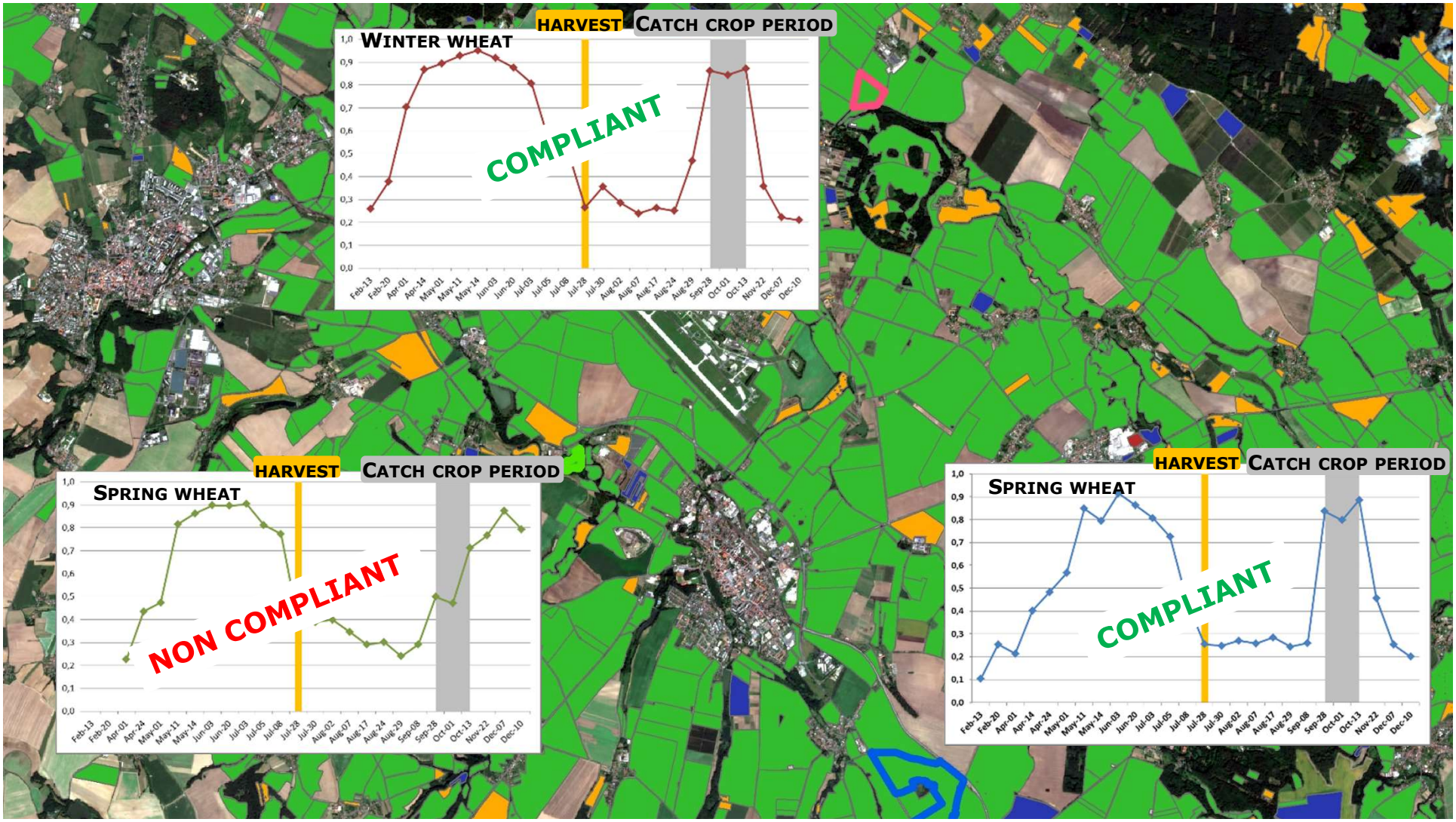
Output: (per parcel)

- Harvest (- Visual check)
-
-
-



Winter Catch Crop – Visual check

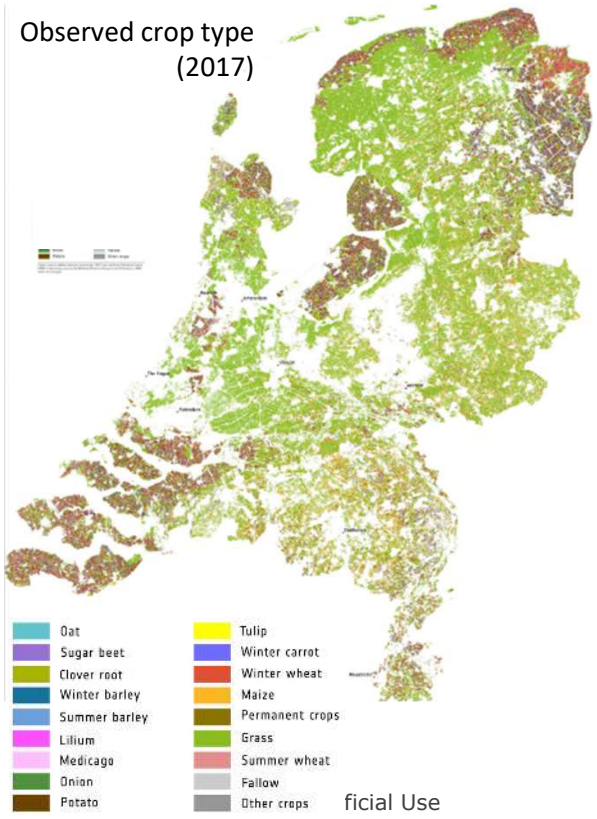


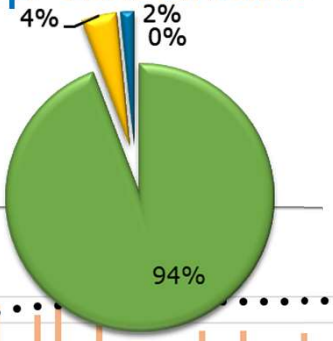

HARVEST
CATCH CROP PERIOD
WINTER WHEAT
COMPLIANT
HARVEST
CATCH CROP PERIOD
SPRING WHEAT
NON COMPLIANT
HARVEST
CATCH CROP PERIOD
SPRING WHEAT
COMPLIANT

Crop type mapping for crop diversification monitoring

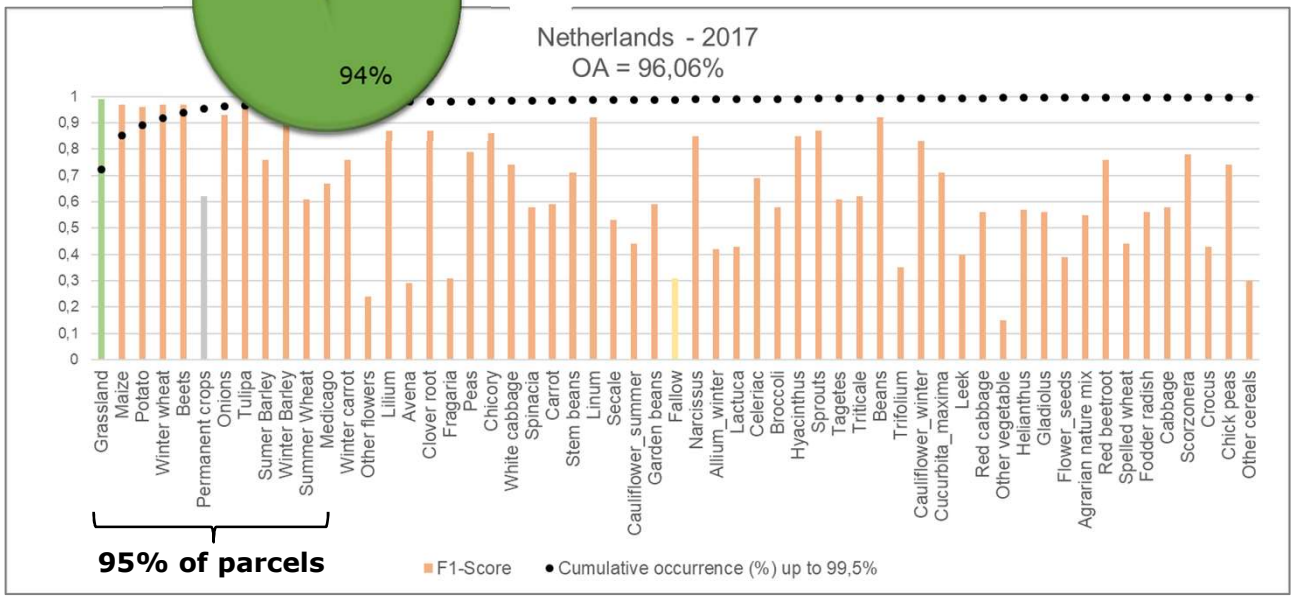
Netherlands - National Scale

Observed crop type (2017)





High confidence in agreement
Average confidence in agreement
Weak confidence in agreement
High confidence in disagreement



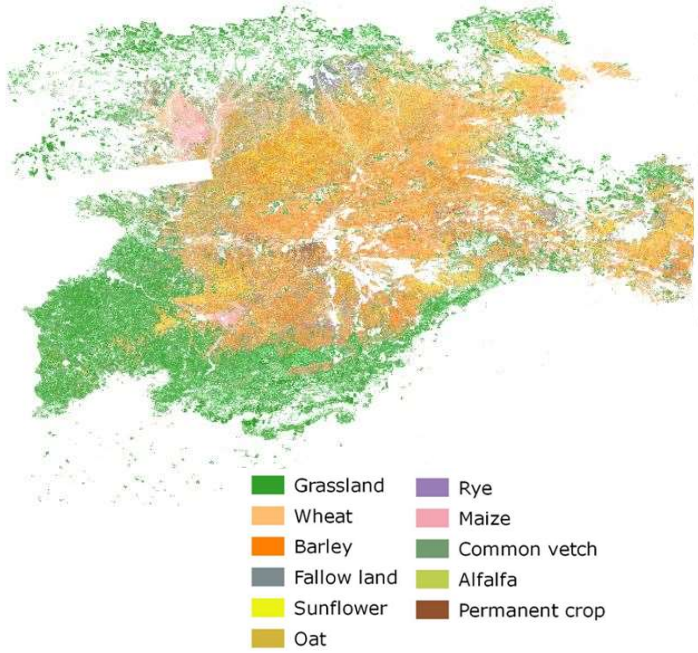
Full Resolution Visualization Online:
http://www.esa.int/spaceinimages/Images/2018/05/Crop_map

ficial Use

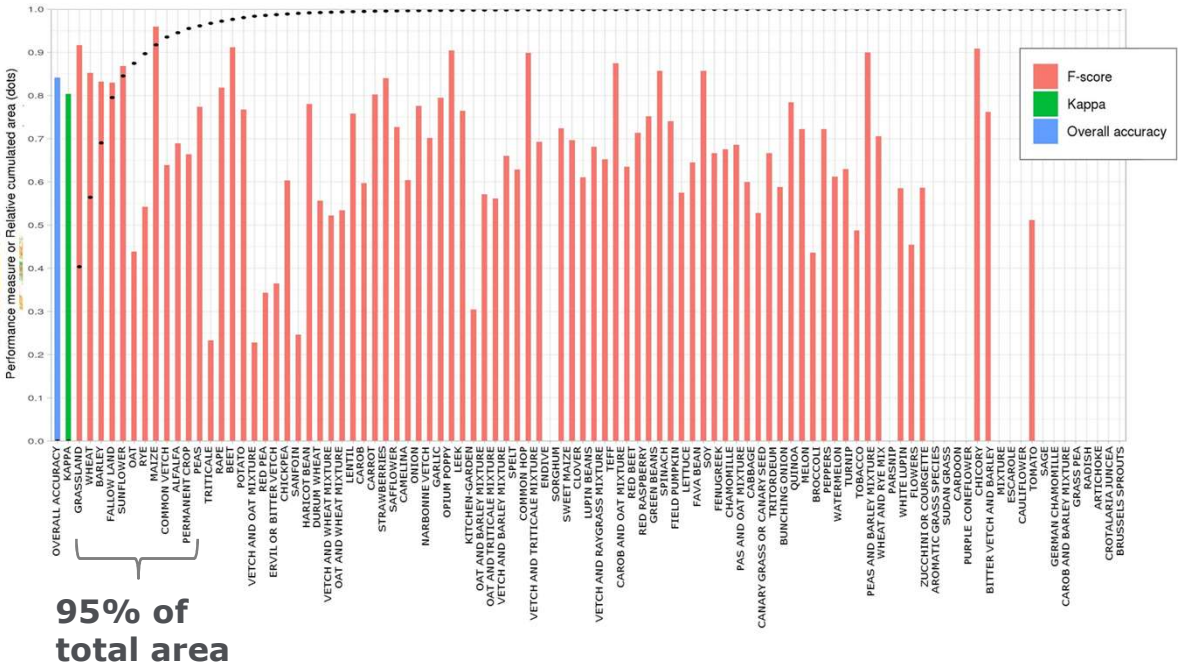
Crop type mapping for crop diversification monitoring

Castilla y Leon – « National Scale »

Observed crop type map (2018)



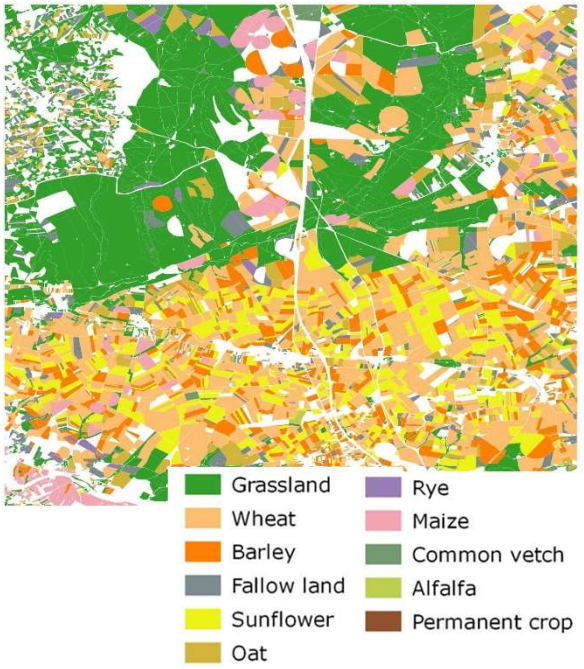
Castilla y Leon - 2018
OA = 84%



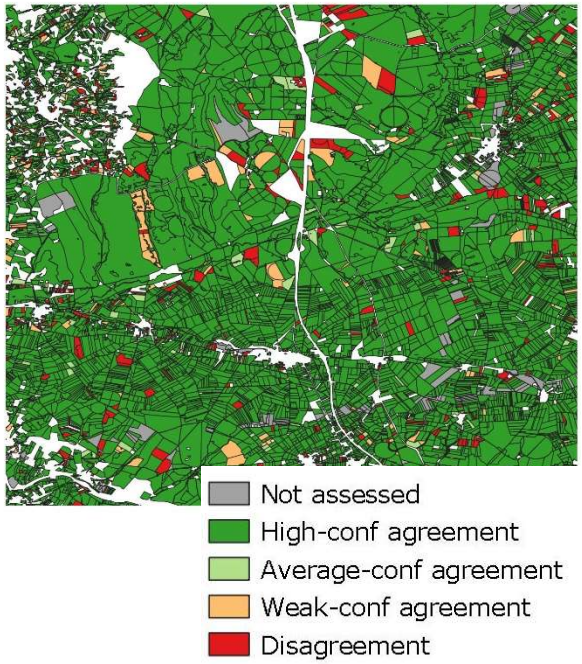
Crop type mapping for crop diversification monitoring

Castilla y Leon – « National Scale »

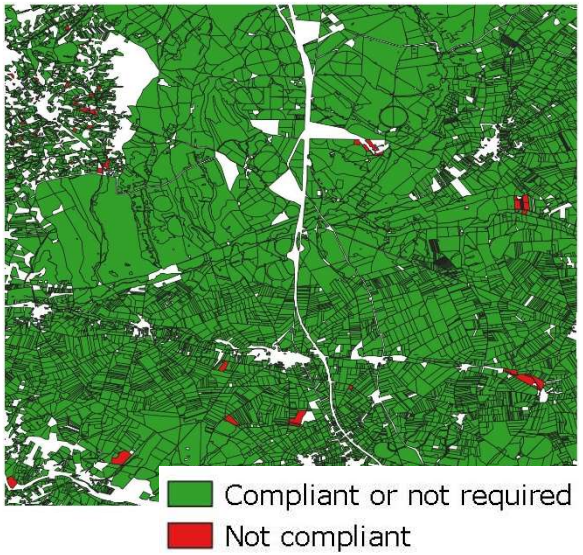
Observed crop type map (2018)



Agreement indicator at the **parcel level**

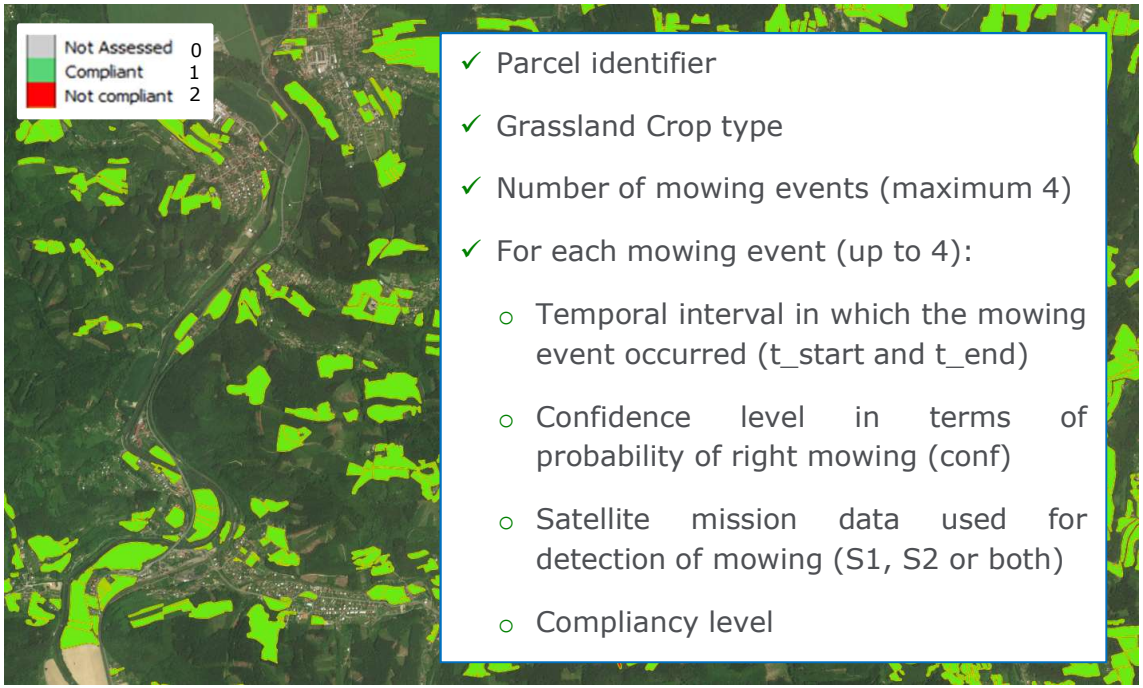


Compliance indicator at the **holding level**

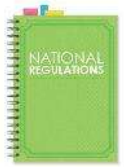


Permanent Grassland Use Case (Czech Republic)

Grassland mowing product consists in the **detection of mowing events** occurred on **grassland parcels** during the period of interest and in the **assessment of their compliancy**, according to the national regulations



- ✓ Parcel identifier
- ✓ Grassland Crop type
- ✓ Number of mowing events (maximum 4)
- ✓ For each mowing event (up to 4):
  - Temporal interval in which the mowing event occurred (t_start and t_end)
  - Confidence level in terms of probability of right mowing (conf)
  - Satellite mission data used for detection of mowing (S1, S2 or both)
  - Compliancy level



National regulations **Czech Republic**

At least **1 mowing** or grazing **within 31st July**

Compliancy level

- 0: Not assessed
- 1: Assessed and compliant because a mowing occurred in the reference period
- 2: Assessed and not compliant because no mowing occurred in the reference period

2018 – Status of production & parcel analysis

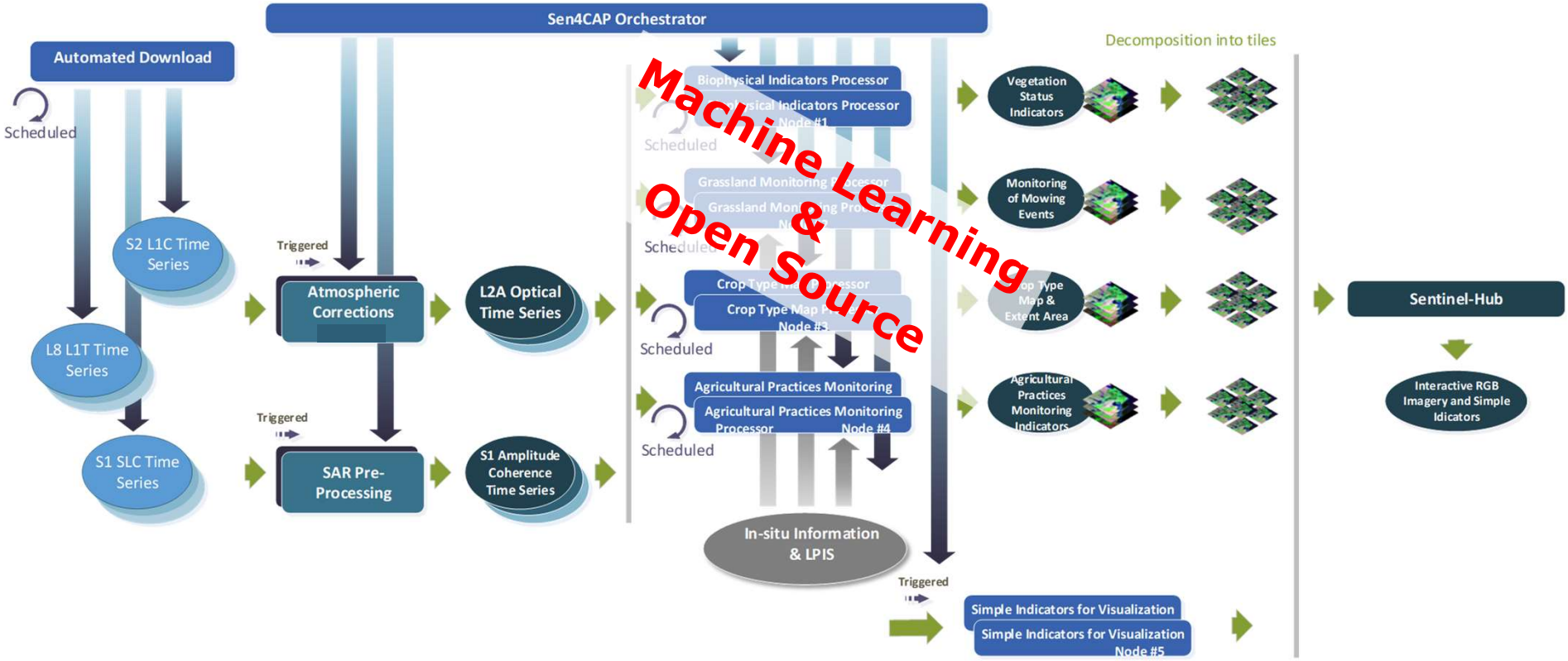
- Evaluation of **impact of parcel size and shape** number of parcels assessed
- Approach adopted: all parcels **having at least 1 pixel whose centroid falls inside 5 meters buffer**
- Performance – preliminary 2018 results for NLD show >80% accuracy (2017 accuracy: NLD 88%, CZE 89%)
- **High heterogeneity** of grassland phenology between different climate zones (e.g. NDL - ESP)

Country	Area Of Interest	EO input up to now	Total Parcels (n°)	Parcels not assessed (%)	Mean parcel area not assessed (ha)	Total AOI area not assessed (%)
NLD*	**100 %** country	**S2**	404.975	0.3 %	0.8 ha	0.1 %
CZE*	**100 %** country	**S2**	323.269	0.03 %	1.3 ha	0.01 %
LTU	**100 %** country	**S2** **S1**	402.160	0.1 %	0.9 ha	0.05 %
ITA*	**100 % of the AOI** (5 Regions)	**S2**	277.603	17 %	0.01 ha	0.2 %
ESP	**100 % of the AOI** (Castilla Y Leon)	in progress	1.273.693			
ROU	**100 %** country	in progress	2.080.995			

** Statistics on NLD, CZE and ITA are based on products generated only on the basis of S2 data. They could be slightly overestimated*

Preliminary 2018 results
Grassland mowing detection - Lithuannia

Design of Sen4CAP processing system

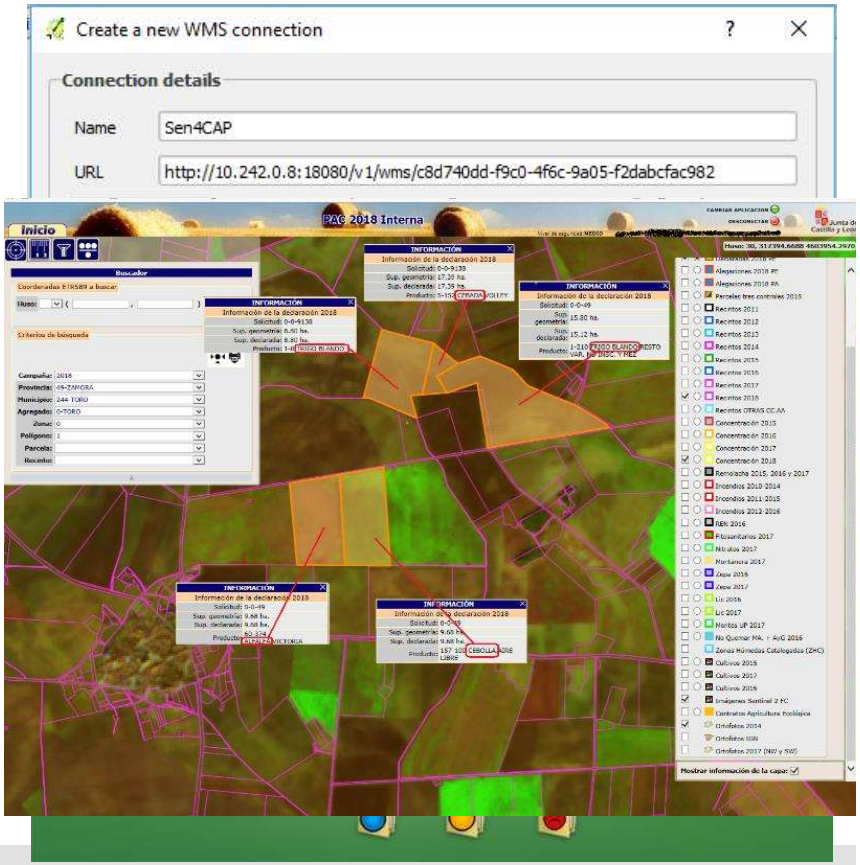


Towards uptake by Paying Agencies

Integration of S1 & S2 images, EO products & markers in PA's environment

WMS providing RGB imagery and simple indicators

- Easily integrated in PAs environment
- S1, S2 & L8 images
- Planet imagery visualization
- Vegetation Indicators (NDVI, LAI, Fcover, FAPAR)
- Time filtering
- Configurable visualization
- Reprojection to local coordinate systems
- Customizable by country



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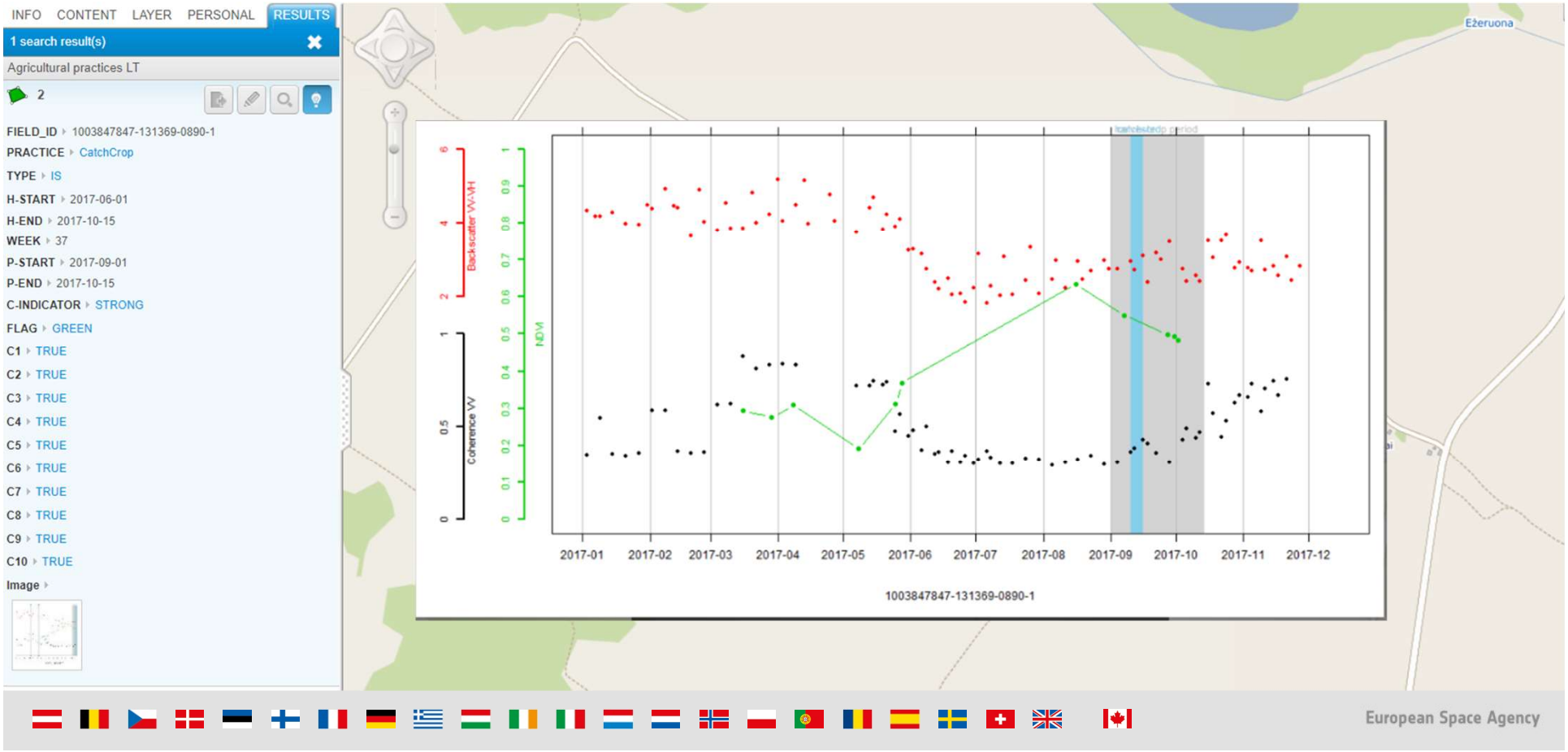
Visualisation tool – Compliancy at parcel/farm level



Validation – performance across EU heterogeneity

- **In-situ data sets** shared by Paying Agencies
  - LPIS/GSAA datasets, subsidy applications, physical inspections, CwRS
- **Dedicated In-situ data sets**
  - farmer interviews – 250 to 500 fields surveyed by practices & country
  - Visual analysis of Planet time series (250-500 fields by practices & country)
- Sampling **heterogeneous EU agricultural landscape**:
  - LPIS types: Cadastral (IT, ES), Physical Block (NL, LI, RO), Farmers Block (CZ)
  - Field sizes: Minimum: RO & IT 72-85% < 1ha, Maximum: CZ 66% > 1ha
  - Landscape & climate: wide geographical range
- **Validation results 2017** (2018 on-going):
  - crop type (OA): CZ 93%, ES 83%, IT 66%, LI 87%, NDL 96%, RO 71%
  - grassland (OA): CZ 89%, NDL 88%

Visual Validation - Grassland Mowing

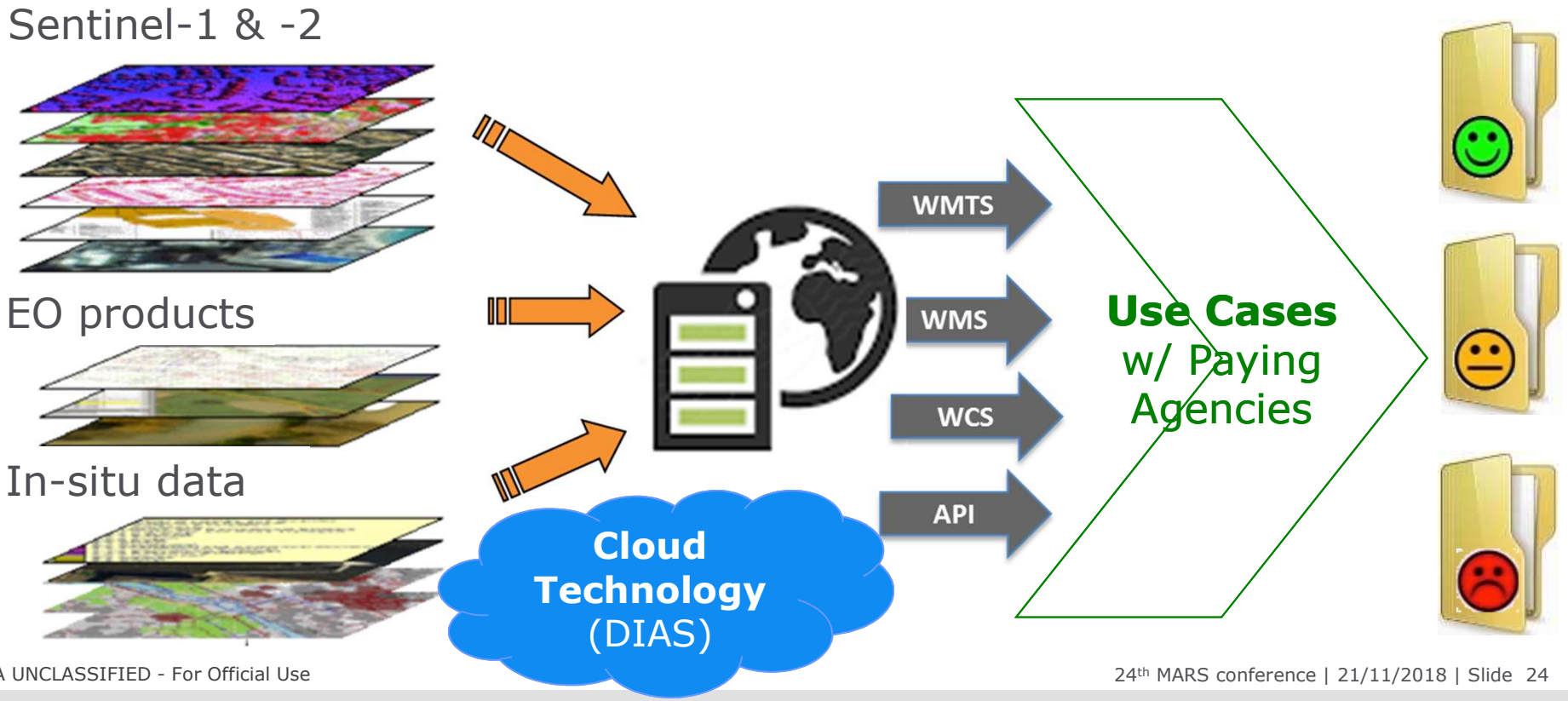
First Mowing Date 1: 07.05.2018

planet.

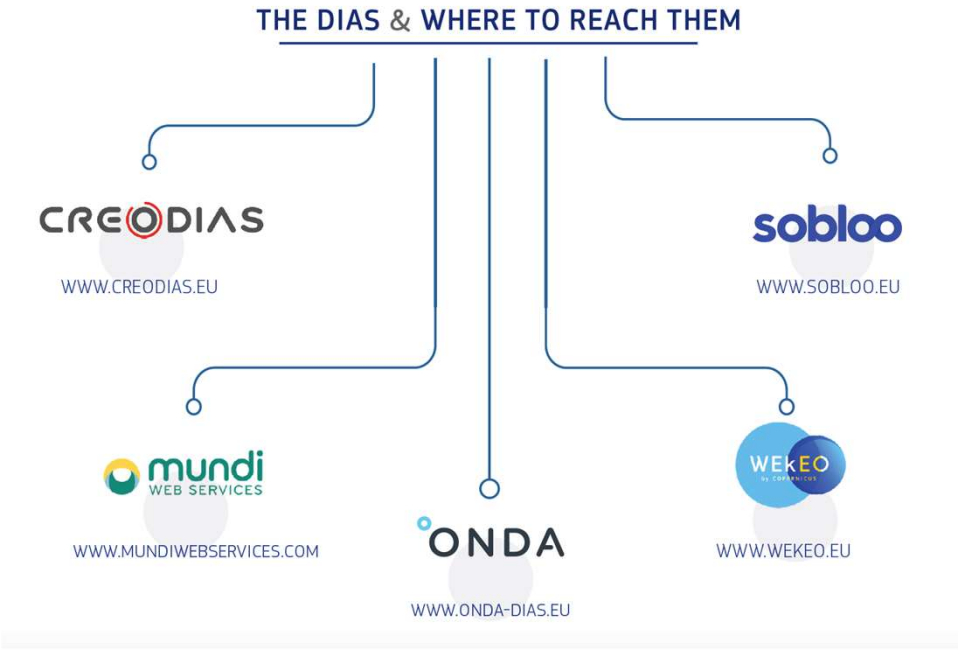
From National to European scale

	Czech Republic	Italy	Europe (indicative)
Input EO data (2018-2019)	28 TB	100 TB	2 PB
Output L2 data (2018-2019)	34 TB	123 TB	2 PB
Output L3 data (2018-2019)	14 TB	50 TB	1 PB
Processing & pre-processing resources (ongoing)	16 cores, 128 GB	32 cores,256 GB	500 cores, 4 TB
Distribution resources (ongoing)	8 cores, 64 GB	16 cores, 96 GB	50 cores, 352 TB

From Satellites to Compliance - Implementation



DIAS assessment and migration plans



DIAS assessment:

- Sen4CAP requirements definition
- RFI document to the 5 DIAS-es
- 2 weeks of services verification
- Results:
  - Data availability/offer
  - Data access reliability
  - ICT performance

Selection in progress
to be ready end of 2018 for
continuous processing in 2019

Sen4CAP: An European Effort to prepare for CAP2020

- Open & operational Sentinel time series enable CAP monitoring approach
- Interaction with PA operations for IACS implementation essential
- Sen4CAP tools support automated, E2E monitoring at large scale
- Cloud computing on DIAS will allow for national to European up-scaling
- Open source approach for direct and customizable uptake & sharing
- Hand in hand demonstration in 2019 together with Paying Agencies

1 million km²
120 TB
Available in 2019

sen4cap

common agricultural policy

2019: National Demonstrations & Training

http://esa-sen4cap.org