Learning Network Plenary Meeting – Brussels - 18 February 2019

SEN4CAP
Sentinels for CAP monitoring approach

Defourny P., Bontemps S., Bajec K., Cara C., de Vendictis L., Kucera L., Malcorps P., Milcinski G., Nicola L., Rossi L., Sciarretta C., Slacikova J., Tutunaru F., Udroiu C., Zavagli M., Koetz B.

sen4cap
common agricultural policy

UCL Université catholique de Louvain

CS ROMANIA

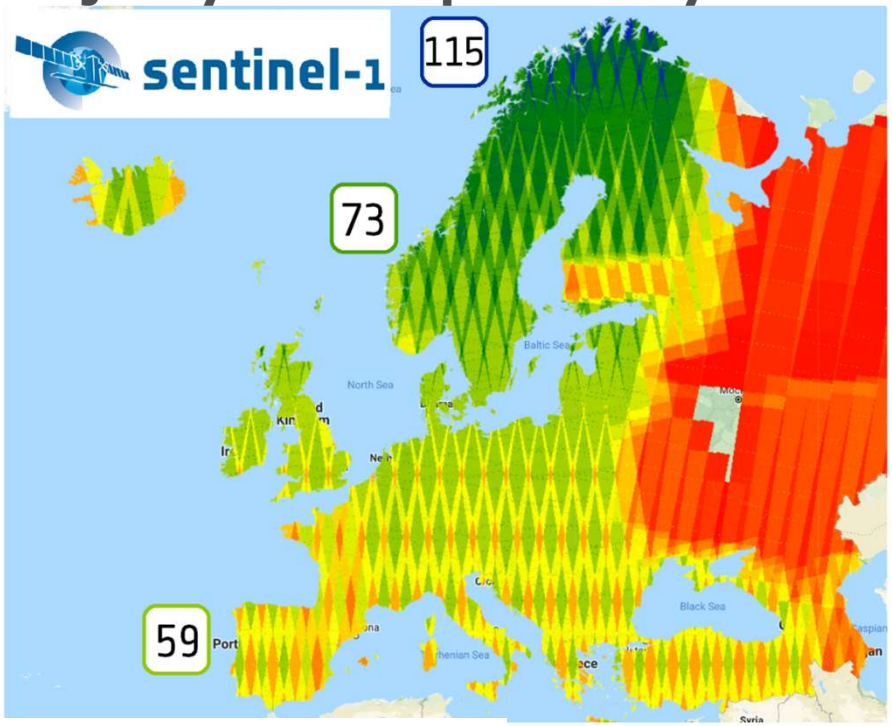
e-geos AN ASI / TELESPAZIO COMPANY

SINERGISE

gisat

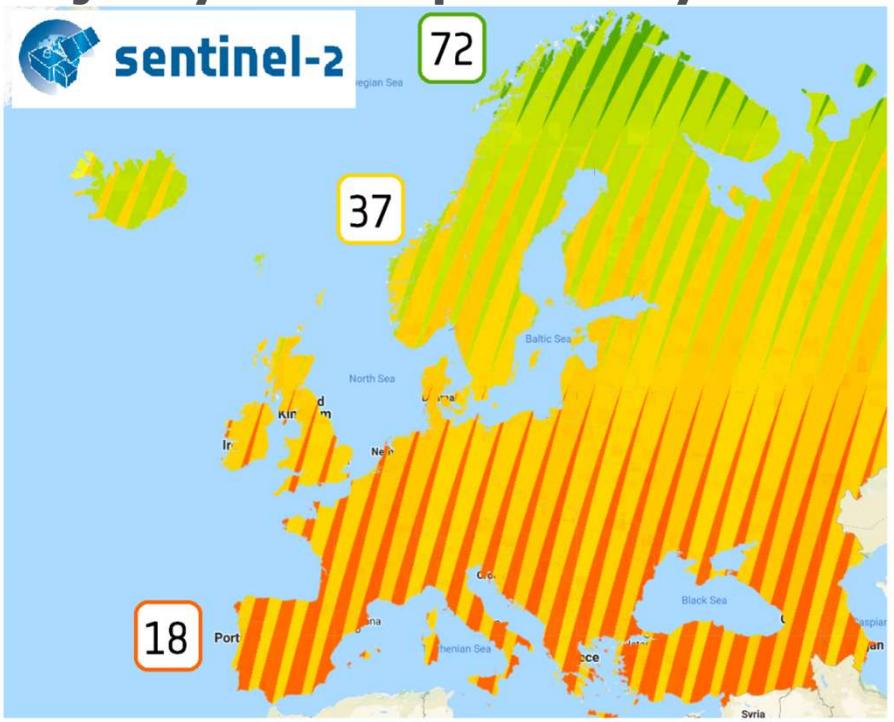
Sentinels for Agricultural Dynamics

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 SMES

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

Brussels,
D3/BR/cj Ares(2016) 7938056

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) and related activity in the CAP.

We have taken great interest in the results of the CzechAgri study, which was initiated in December 2015 by DG AGRI and SZIF (Czech Paying Agency) and successfully implemented by Gisat s.r.o. and a technical steering involving DG AGRI.

Following these promising results, it would be timely and 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

European Commission

Home › News › Modernising the CAP: satellite data authorised to replace on-farm checks

NEWS | 25 May 2018 | Brussels

Modernising the CAP: satellite data authorised to replace on-farm checks

1st Demonstration Results from 2018

CAP monitoring approach – Technology meets Policy

sen4cap

common agricultural policy

esa

European Commission

Copernicus

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

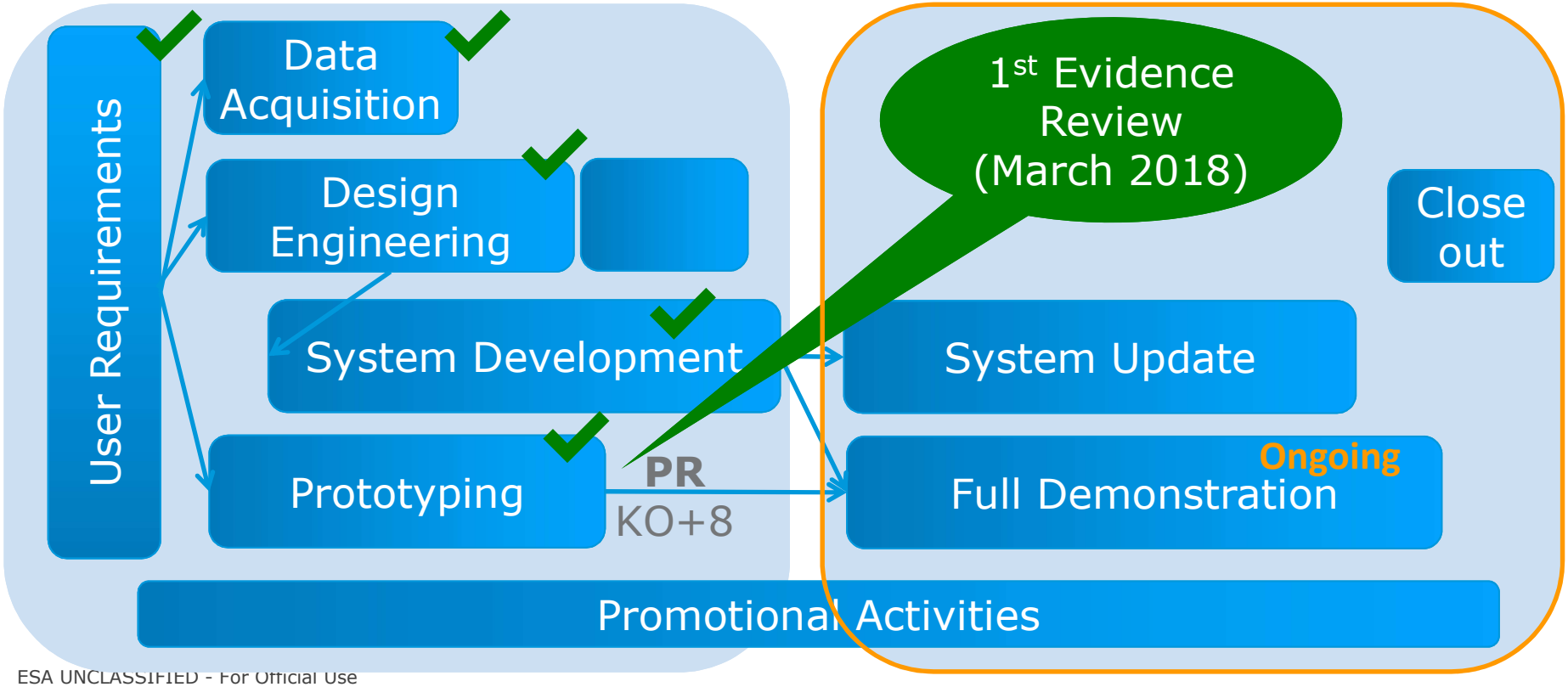
National Demonstration

Innovative Practices

CAP2020 Reform

Sen4CAP Pilot Countries – EU Agricultural Landscape

Sen4CAP – Time Planning & Status



User Requirements in terms of IACS use cases

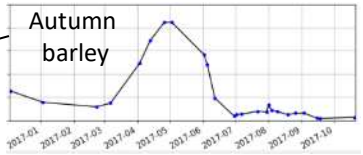
Use case
Crop diversification
Permanent grassland identification
EFA-Land lying fallow
EFA-Catch crops
EFA-Nitrogen-fixing crops
Land abandonment
Interactive visualization
LPIS update
Claimless system

Prototyping – Development & Testing at EU level

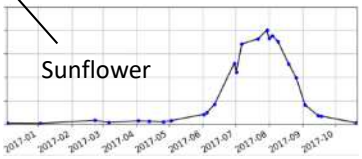
Use Cases w/ Paying Agencies

Sentinel-based markers for CAP Monitoring

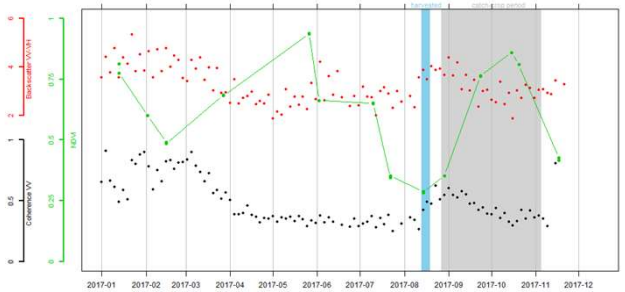
- **Crop type mapping**
- **Vegetation growing indicators**
- **Grassland mowing detection**
- **Agricultural practices monitoring**



Crop type information & vegetation growing indicators



Number of detected mowing events

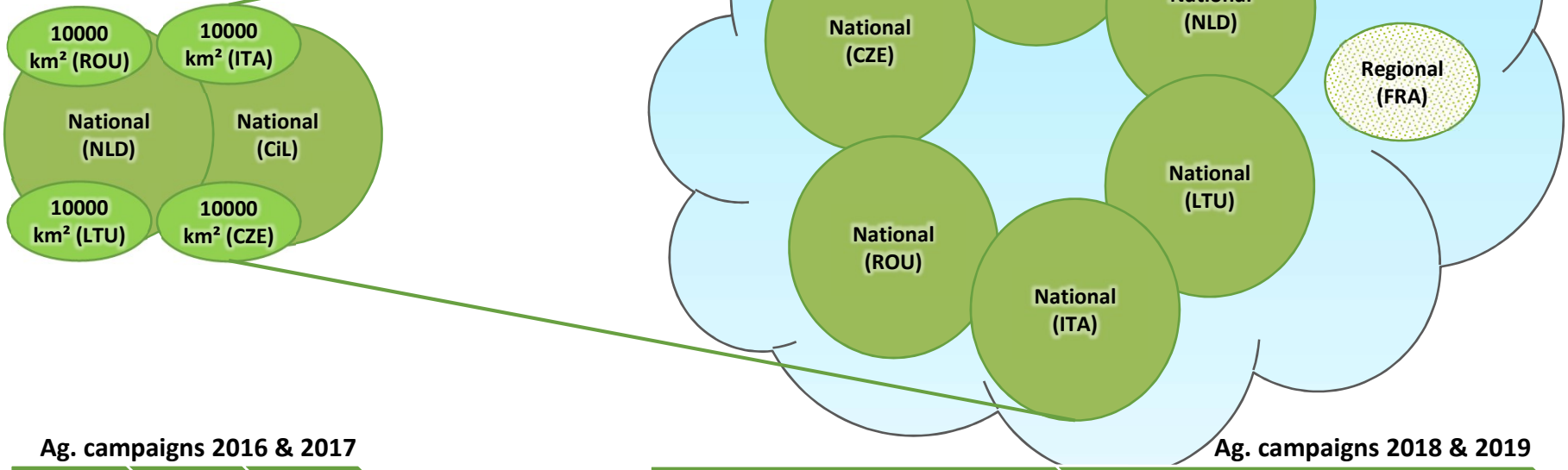


Physical markers to monitor EFA agricultural practices

From prototyping to demonstration

Sampling EU agricultural heterogeneity:

- LPIS types
- Field sizes
- Landscape & climate



Ag. campaigns 2016 & 2017

Algo development → Bench-marking → Validation

Ag. campaigns 2018 & 2019

Use case demonstration → Validation & Assessment

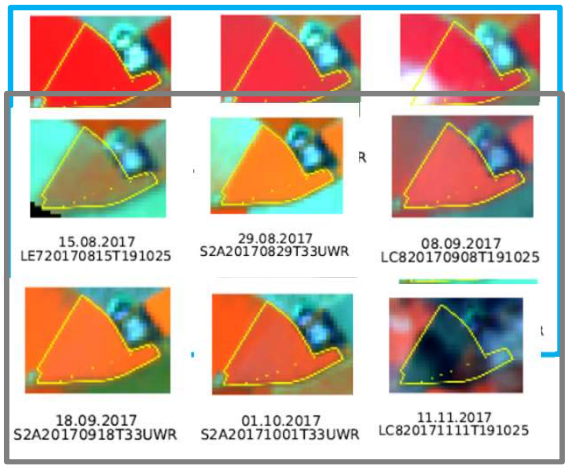
Monitoring of Agri. Practices for EFA compliancy
Czech Republic

- Catch crops based on S1&2

RULE: Winter Catch Crop must be sown before 20 Sept. and must not be harvested before 31 Oct. During this period, crop coverage must not be mechanically or chemically removed or limited in growth.

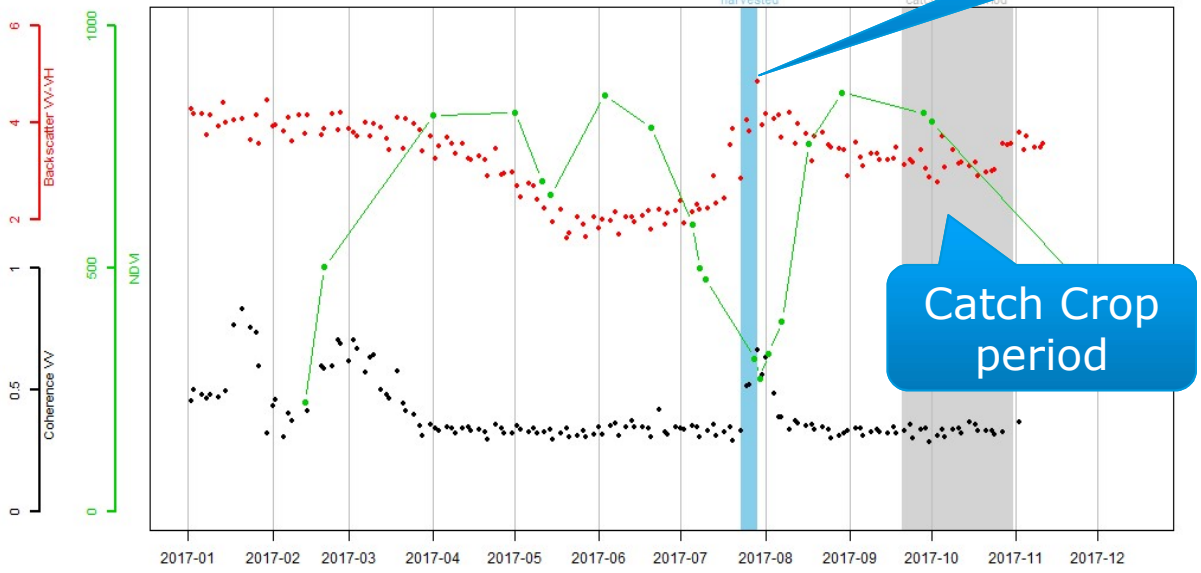
Output: (per parcel)

- Harvest + Visual check
-
-
-

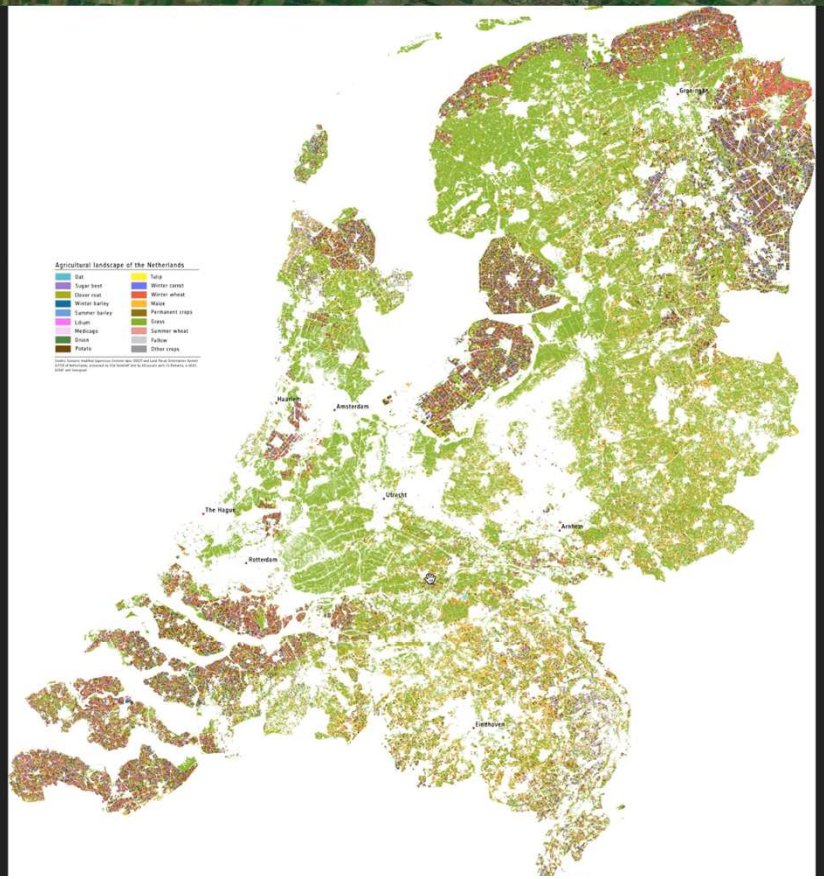


Winter Catch Crop – Visual check

Catch crop



National dynamic crop mapping at field scale



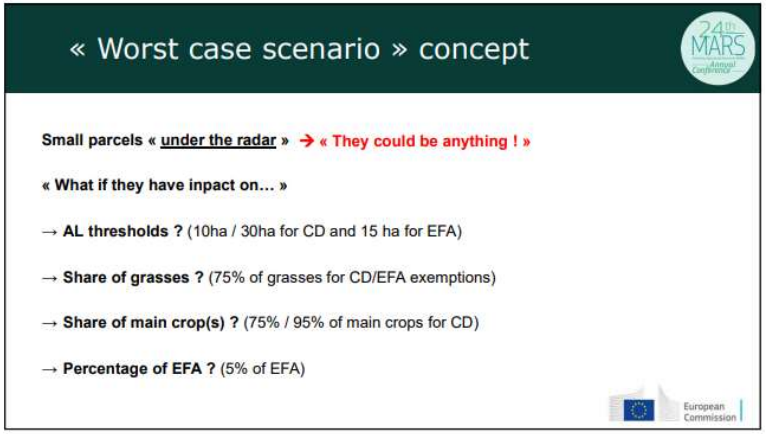
Full Resolution Visualization Online:
http://www.esa.int/spaceinimages/Images/2018/05/Crop_map

Crop diversification monitoring
Combining assessments at parcel- and holding-level

Parcel-level
Assess if the crop type declared by the farmer is confirmed by the satellite signal

Holding-level
Assess the compliancy of the holding with regard to the crop diversification rules

Following the « worst case scenario » approach (presented by JRC – MARS conference, Nov 2018)

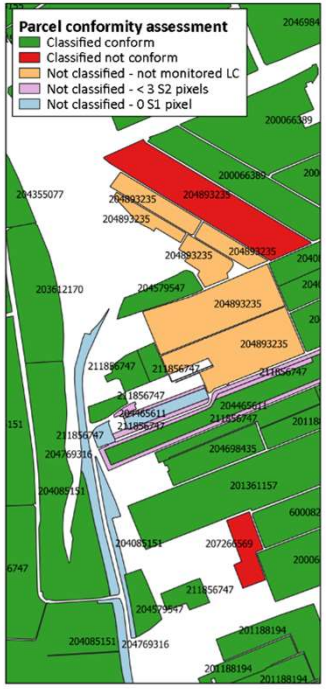


WHEN WE DON'T KNOW:
- **ASSUME THE WORST SCENARIO**
- **CHECK IF IT HAS AN IMPACT**

Crop diversification monitoring
Combining assessments at parcel- and holding-level

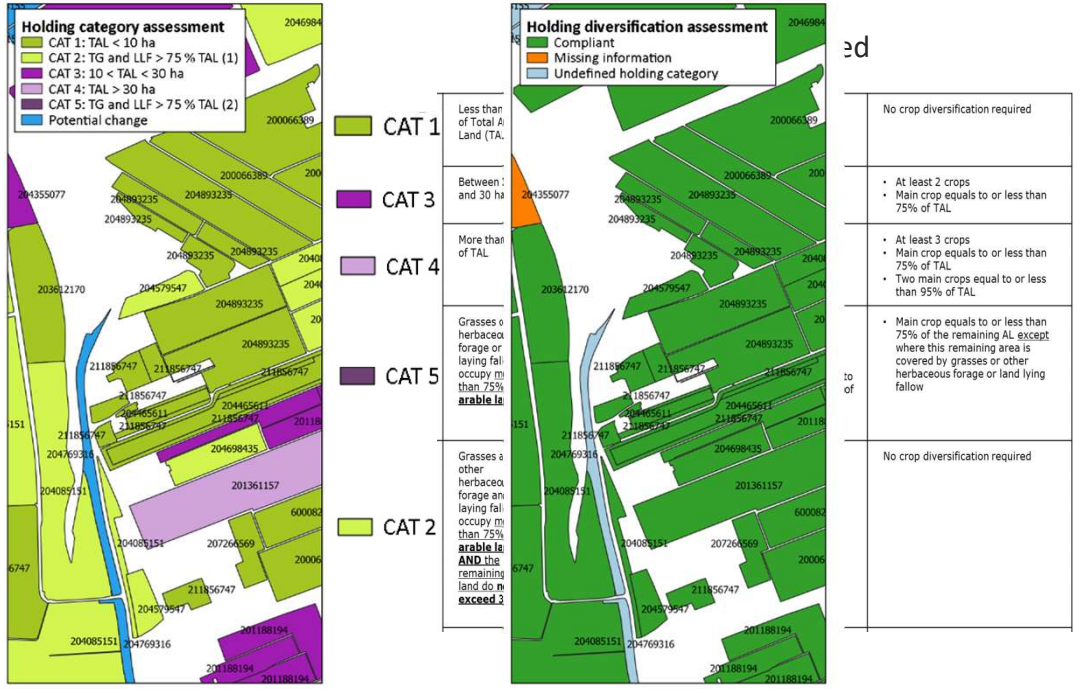
Parcel-level

Assess if the crop type declared by the farmer is confirmed by the satellite signal



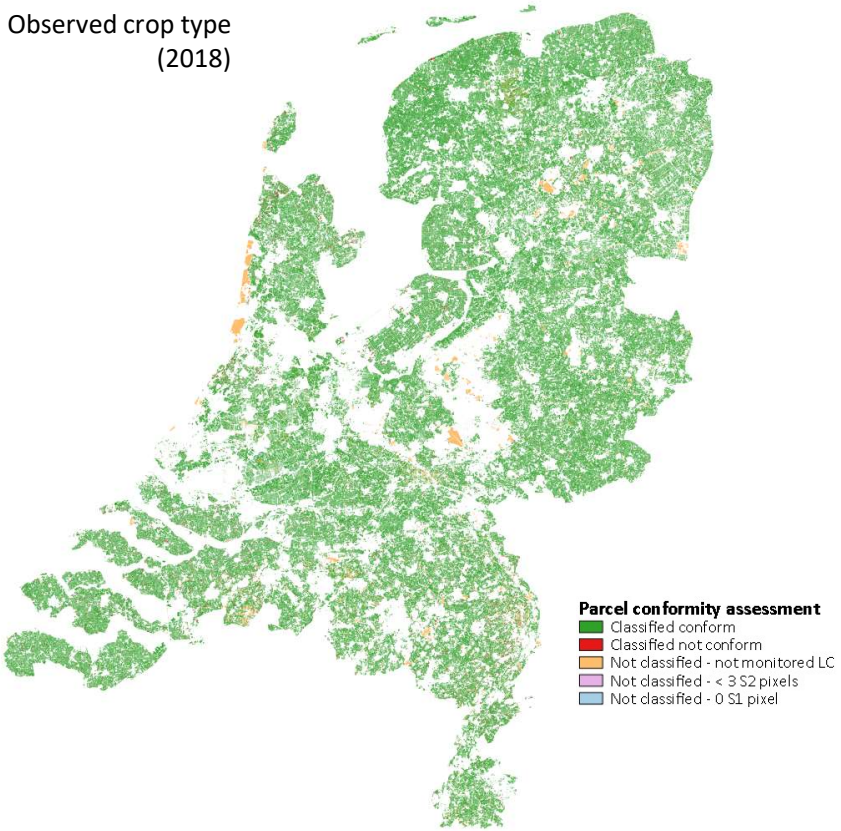
Holding-level

Assess the compliancy of the holding with regard to the crop diversification rules

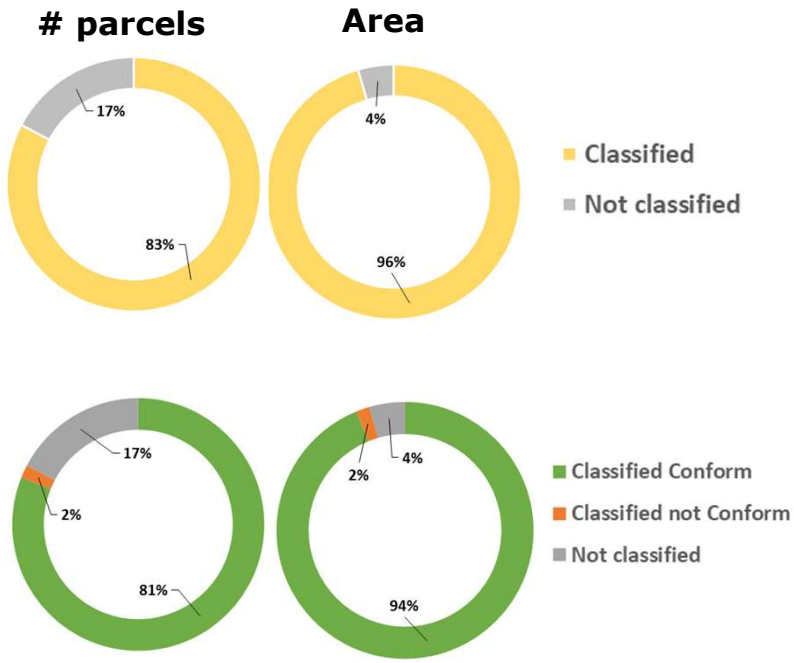


Crop type mapping for crop diversification monitoring
Netherlands

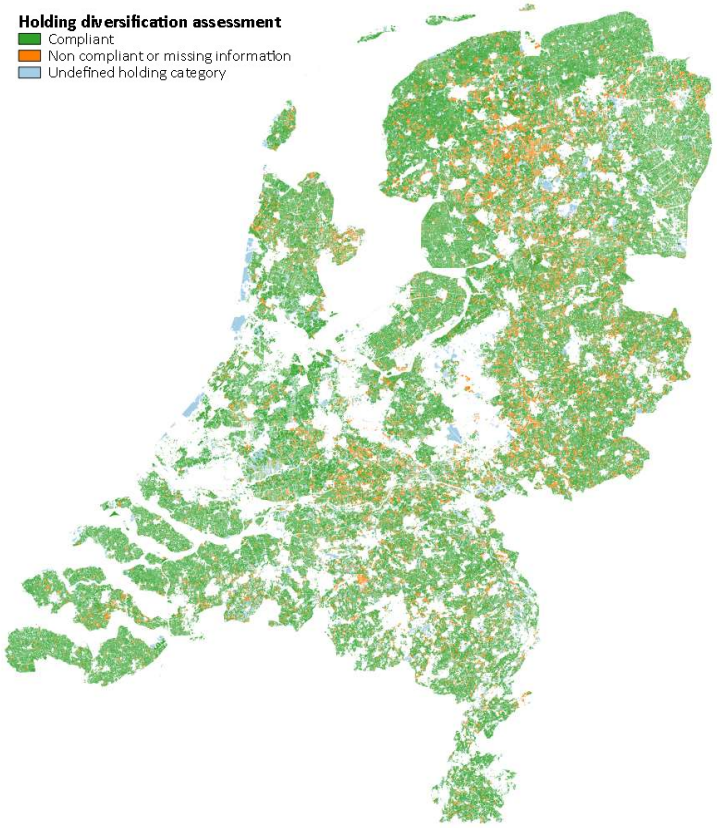
Observed crop type (2018)



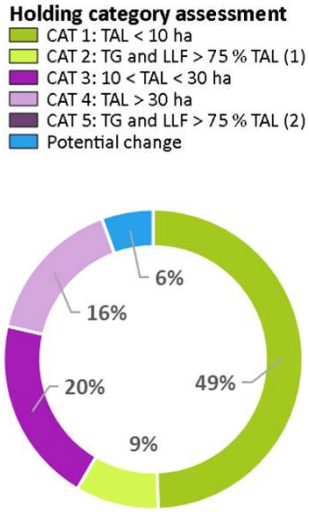
Parcel-level

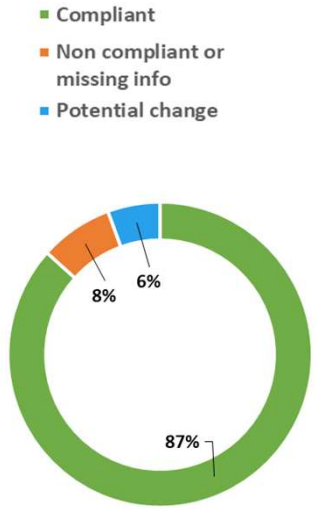


Crop type mapping for crop diversification monitoring
Netherlands



Holding-level

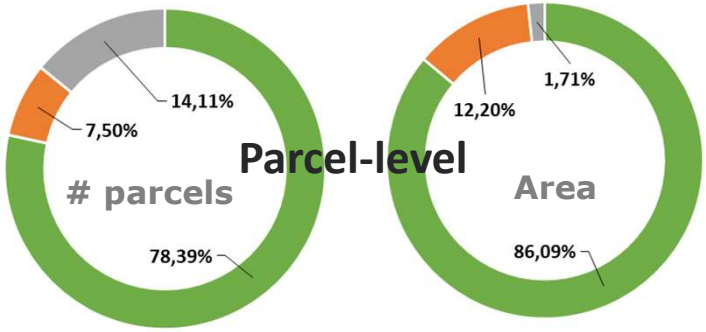




Crop type mapping for crop diversification monitoring

Czech Republic & Lithuania

CZECH REPUBLIC

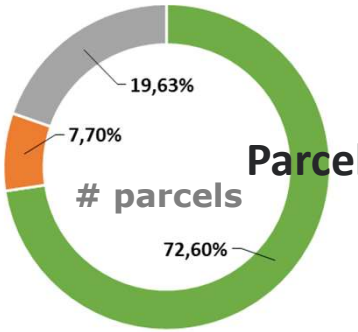


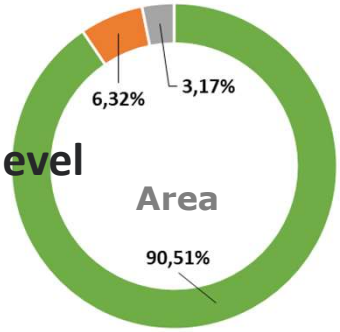
Classified Conform
Classified not Conform
Not classified

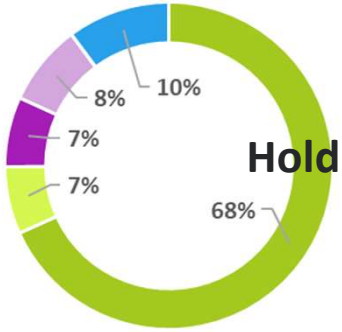
Holding category assessment
CAT 1: TAL < 10 ha
CAT 2: TG and LLF > 75 % TAL (1)
CAT 3: 10 < TAL < 30 ha
CAT 4: TAL > 30 ha
CAT 5: TG and LLF > 75 % TAL (2)
Potential change

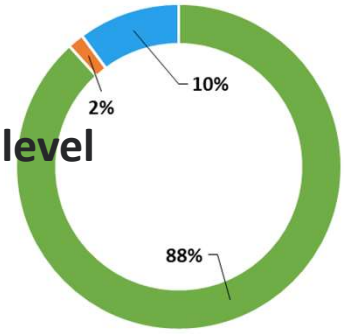
Compliant
Non compliant or missing info
Potential change

LITHUANIA



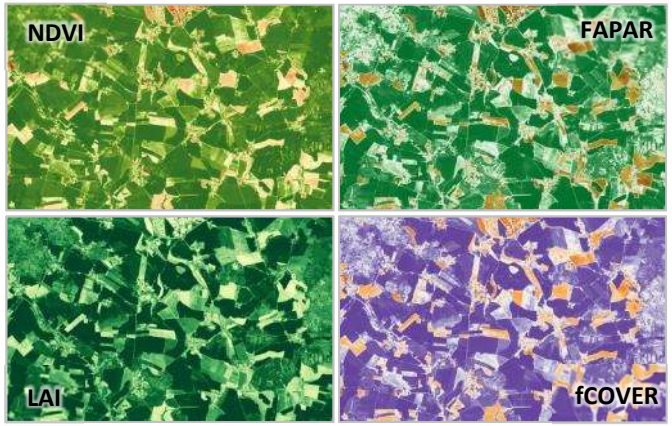




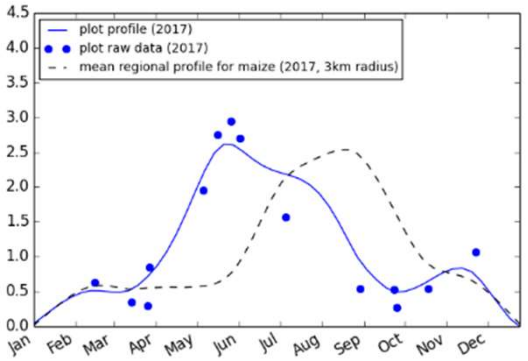


Sentinel-based vegetation indicators as auxiliary data
Czech Republic

4 indicators

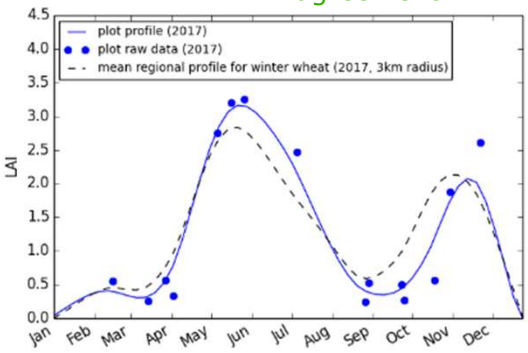


Czech Republic



High confidence in disagreement

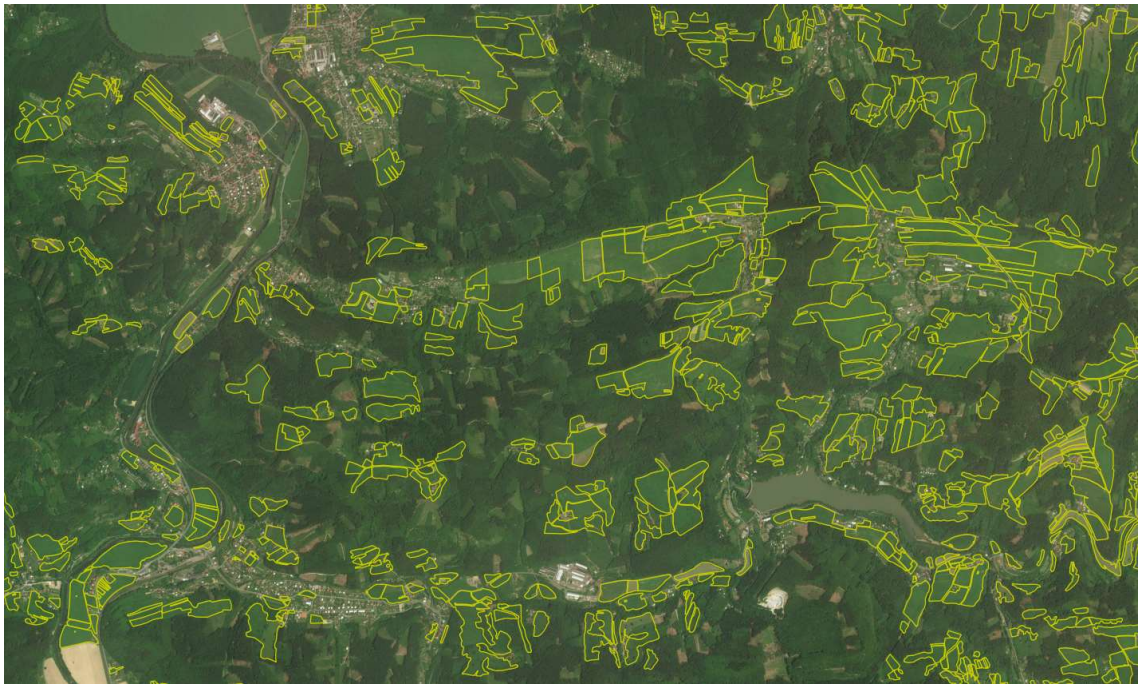
High confidence in agreement

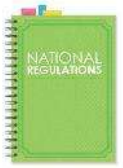


ID	NKOP_DPB	AREA	CONF_IDX	CT_DECL	CT_PRED_1	CT_CONF_1	C_INDIC
5482		23275	0	Maize	Winter rapeseed	0,56	**Additional info required**
6581		18086	1	Winter Wheat	Grassland	0,25	**Additional info required**

Grassland Mowing product

- 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





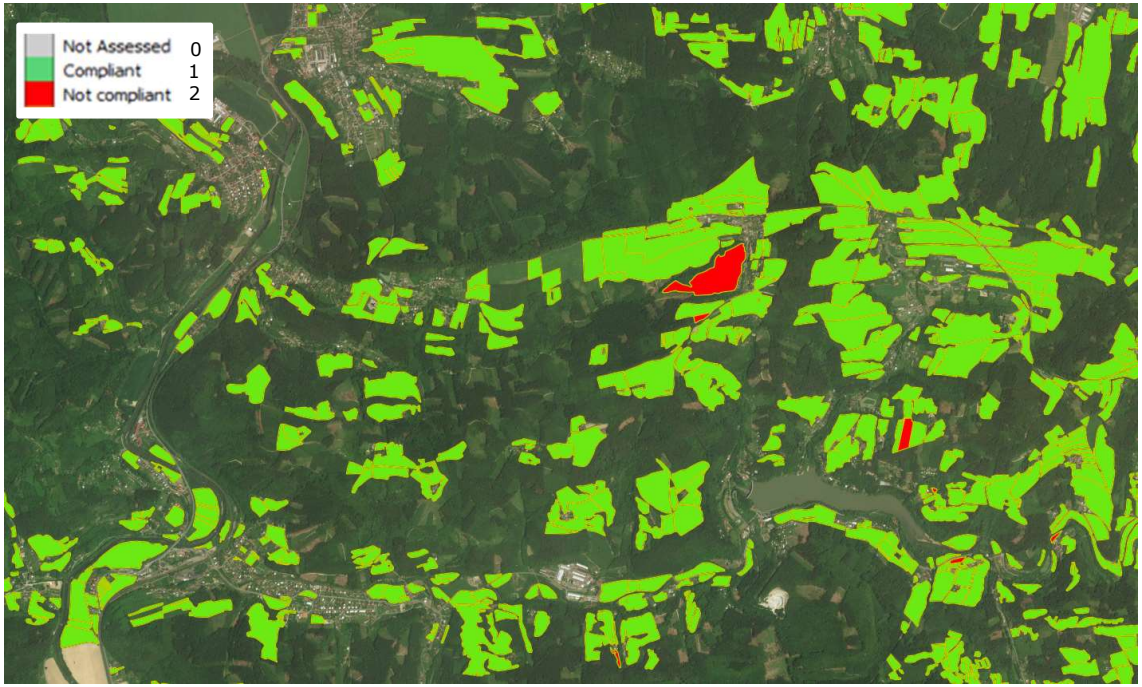
National regulations

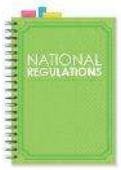
Countries implement different rules to define permanent grasslands, e.g. through:

- the set-up of a **minimum time range of persistence** or
- a reference **date or period for the grassland mowing**

Grassland Mowing product (example on CZE)

- 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





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

Grassland Mowing product - attributes

- Grassland mowing product contains, for each parcel, information about **number and temporal intervals of mowing events** detected

parcel_id	crop_code	mow_n	m1_dstart	m1_dend	m1_conf	m1_mis	m2_dstart	m2_dend	m2_conf	m2_mis	m3_dstart	m3_dend	m3_conf	m3_mis	m4_dstart	m4_dend	m4_conf	m4_mis	compl
31.0000002869728.001	265	3	2018-05-08 00:0...	2018-05-21 00:0...	0.554000...	S2	2018-07-12...	2018-07-20 ...	0.55300...	S2	2018-08-24...	2018-09-18 ...	0.518...	S2	0				
31.0000002869729.001	265	3	2018-05-08 00:0...	2018-05-21 00:0...	0.522000...	S2	2018-07-07...	2018-07-12 ...	0.50200...	S2	2018-08-24...	2018-09-13 ...	0.517...	S2	0				
31.0000002869730.001	265	3	2018-05-08 00:0...	2018-05-21 00:0...	0.519000...	S2	2018-07-07...	2018-07-12 ...	0.50700...	S2	2018-08-24...	2018-09-13 ...	0.517...	S2	0				
31.0000002811919.002	265	3	2018-05-08 00:0...	2018-05-11 00:0...	0.777000...	S2	2018-05-21...	2018-06-20 ...	0.71200...	S2	2018-08-06...	2018-08-26 ...	0.712...	S2	0				
31.0000002869731.001	265	1	2018-09-08 18:0...	2018-09-14 18:0...	0.486000...	S1	0	0	0.00000...	0	0	0	0.000...	0	0				
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31.0000002869732.001	265	0	0	0	0.000000...	0	0	0	0.00000...	0	0	0	0.000...	0	0				
31.0000002812236.002	265	3	2018-05-03 00:0...	2018-05-06 00:0...	0.632000...	S2	2018-06-07...	2018-06-27 ...	0.74700...	S2	2018-08-14...	2018-09-13 ...	0.641...	S2	0				
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31.0000002869736.001	265	0	0	0	0.000000...	0	0	0	0.00000...	0	0	0	0.000...	0	0				
31.0000002813128.002	336	0	0	0	0.000000...	0	0	0	0.00000...	0	0	0	0.000...	0	0				
31.0000002869737.001	265	0	0	0	0.000000...	0	0	0	0.00000...	0	0	0	0.000...	0	0				
31.0000002826797.002	265	4	2018-04-21 00:0...	2018-05-06 00:0...	0.536000...	S2	2018-05-26...	2018-06-07 ...	0.62500...	S2	2018-07-02...	2018-07-12 ...	0.609...	S2	2018-08-				
31.0000002869738.001	331	1	2018-08-09 18:0...	2018-08-15 18:0...	0.171000...	S1	0	0	0.00000...	0	0	0	0.000...	0	0				
31.0000002826801.002	265	3	2018-05-26 00:0...	2018-06-07 00:0...	0.560000...	S2	2018-07-12...	2018-07-15 ...	0.53100...	S2	2018-08-21...	2018-09-13 ...	0.616...	S2	0				
31.0000002869739.001	331	0	0	0	0.000000...	0	0	0	0.00000...	0	0	0	0.000...	0	0				

Product info for each parcel

- ✓ 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 (Si, S2 or both)
  - Compliancy level

Products and use case validation
Specific effort to get validation data

- Farmers interviews conducted by PAs for grassland mowing and EFA practices

ID	Unique parcel ID	Area	MOWING 1										
			Mowing				Extension (parcel area %)	Mowing practice	Additional information				
			FROM	(+/- days)	TO	(+/- days)			Drying	Baling	Bales of hay on the parcel	Removal of bales	Other
1	XXXX												
1	Comment												
2	XXXX												
2	Comment												

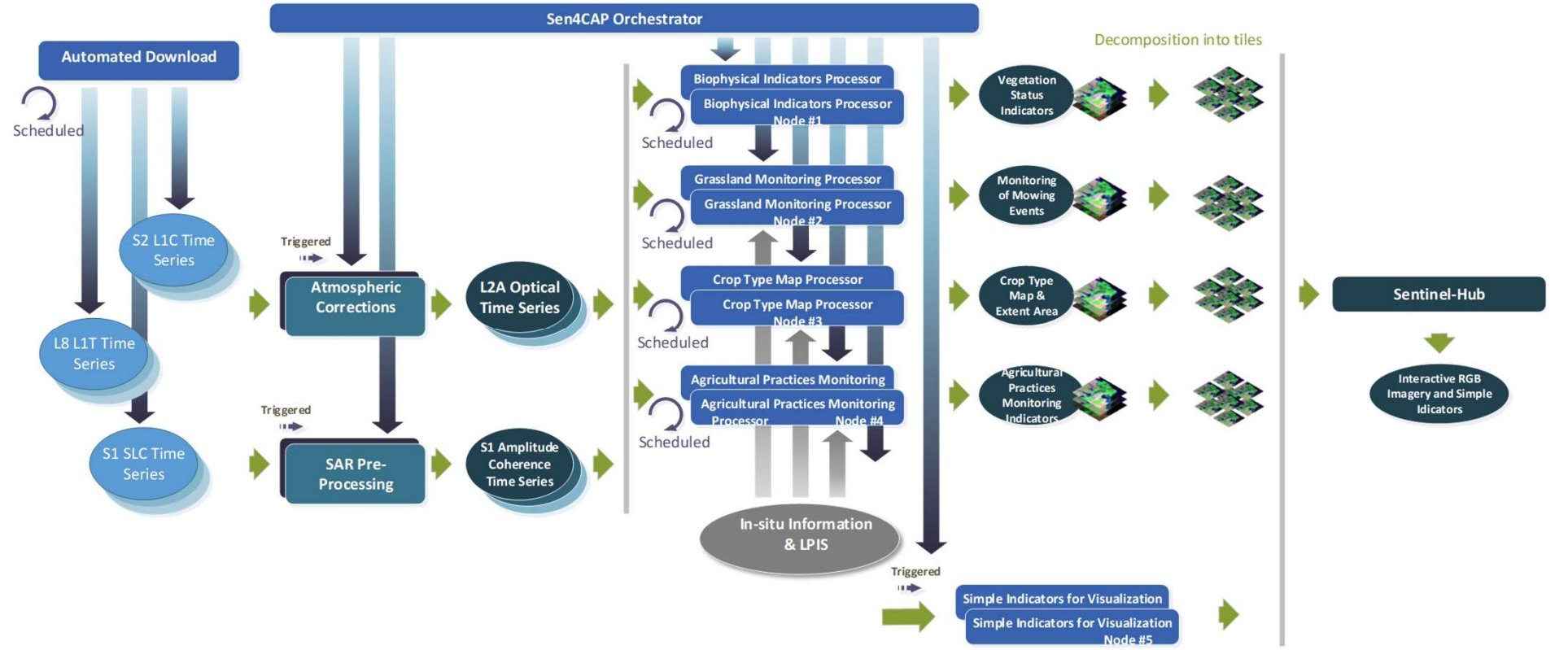
ID	Unique parcel ID	Area	Main crop	EFA type	Seedbed preparation for main crop		Sowing of main crop		Harvest of main crop		Handling of main crop residues	
					FROM	TO	FROM	TO	FROM	TO	FROM	TO
1	XXXX											
1				Comment								
2	XXXX											
2				Comment								

- Access granted to Planet data

7 May 2018 **9 May 2018**

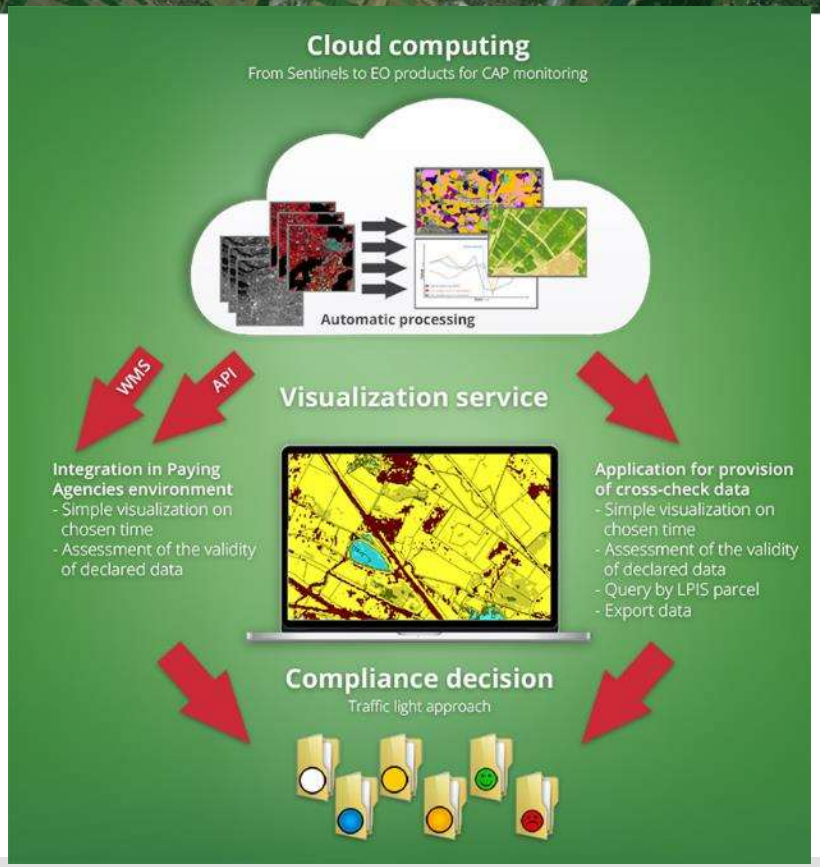
Planet data – very high repetitivity

Development of Sen4CAP processing system



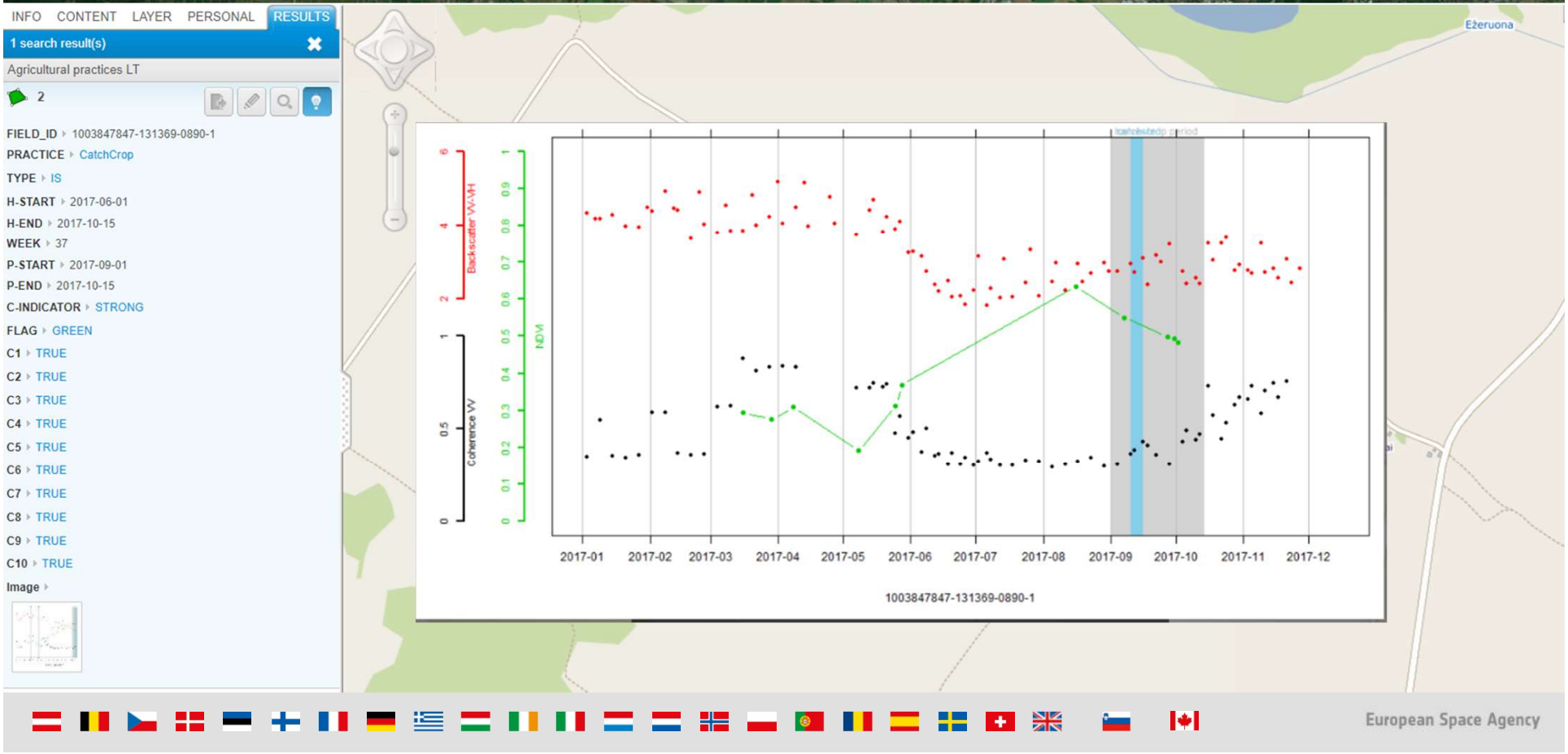
Towards PA's uptake in their environment

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



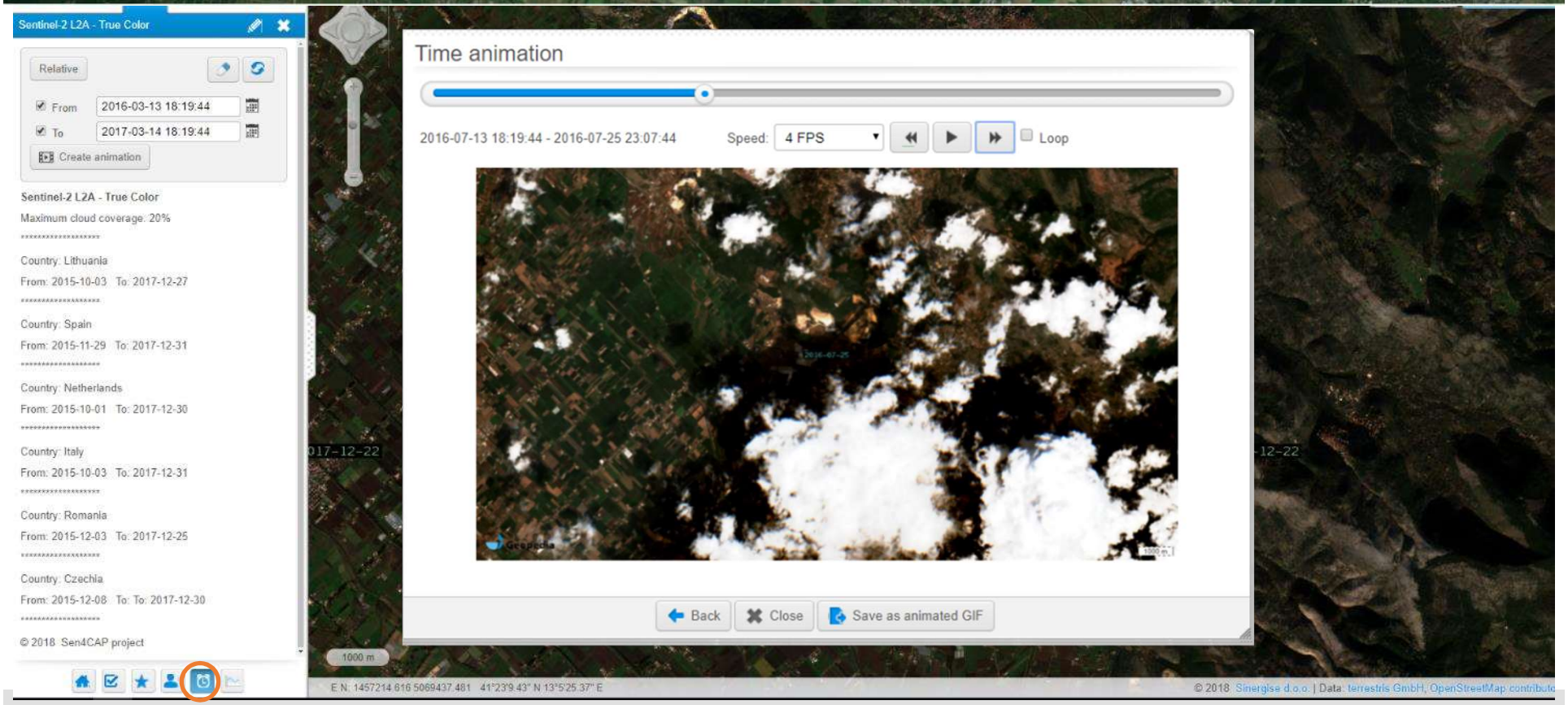
Visualisation tool

Look at all products at the parcel-level



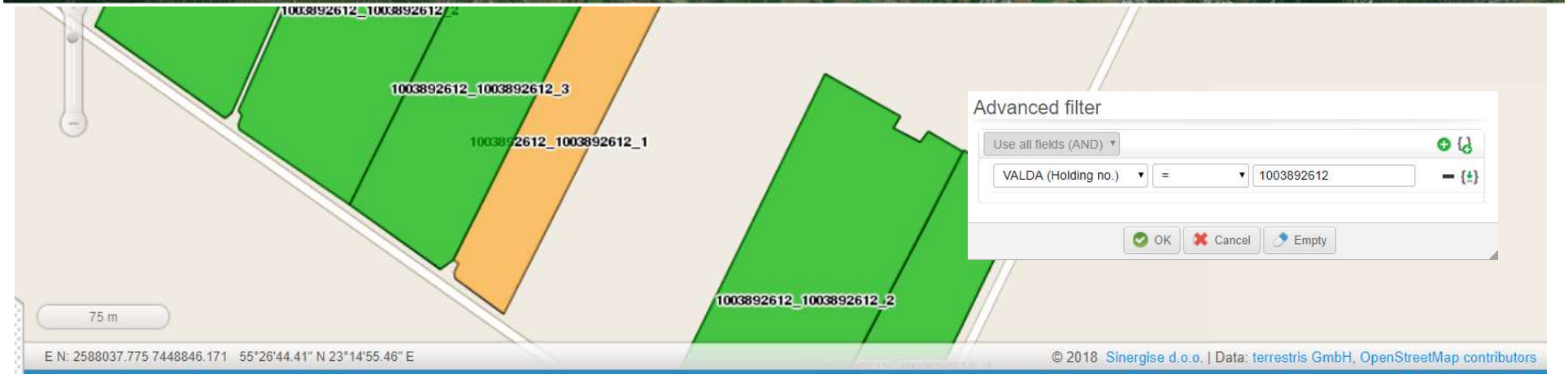
Visualisation tool

Time animation following crop dynamics



Visualisation tool

Checking results at farm level for compliance assessments



Advanced filter

Use all fields (AND)

VALDA (Holding no.) = 1003892612

OK Cancel Empty

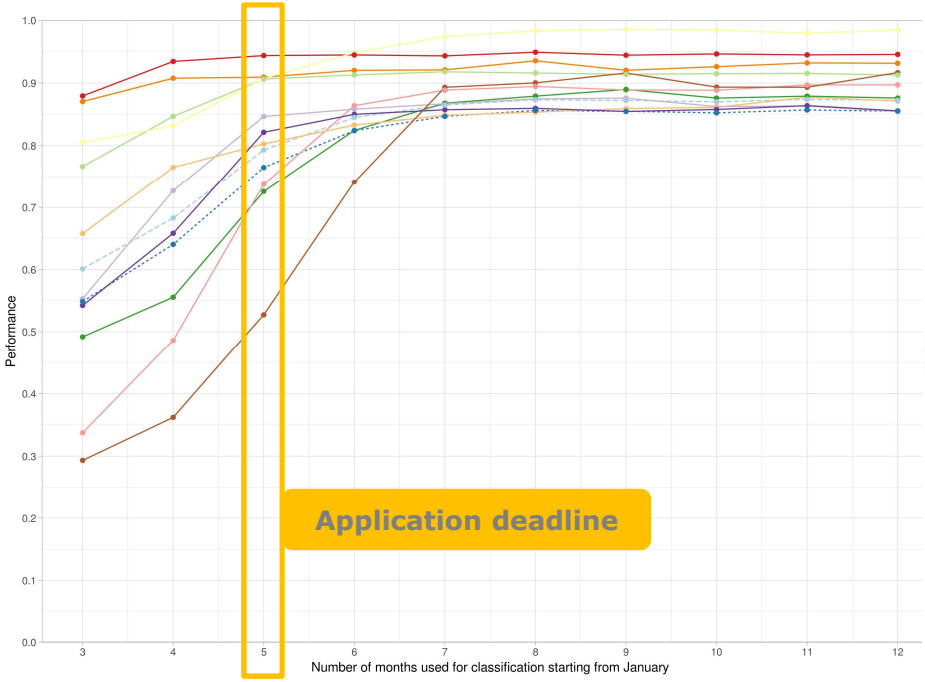
Table of records for layer: **Crop type map LT (Filtered)**

Refresh | Add selection set | Export layer | Filter

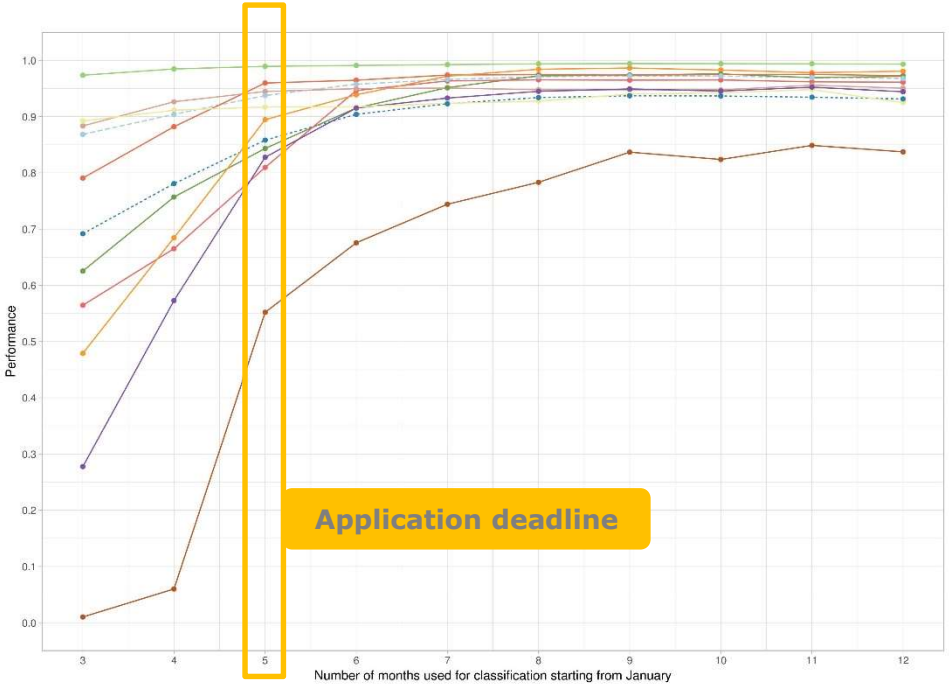
VALDA (Holding no.)	KZS (Block no.)	LAUKO_NR (Field no.)	Area	Conformity	CT_decl	CT_pred_1	CT_conf_1	CT_pred_2	CT_conf_2	Status	C_Indic
1003892612	146452-5589	2	6,398	1.0	MNŠ	MNŠ	0.161	DOB	0.092	Yes	Compliant
1003892612	145452-6380	1	11,004	1.0	MNŠ	MNŠ	0.332	DOB	0.163	Yes	Compliant
1003892612	145451-5152	1	8,550	1.0	NMI	AVI	0.227	KVV	0.117	Yes	Insufficient evidence
1003892612	145451-5768	1	15,131	1.0	KRŽ	KVŽ	0.434	KRŽ	0.19	Yes	Expert-judgement required
1003892612	146452-0763	3	19,083	0.0	MNŠ	MNŠ	0.355	DOB	0.129	Yes	Compliant
1003892612	145452-8265	2	18,000	0.0	MNŠ	MNŠ	0.318	DOB	0.138	Yes	Compliant

Next steps: moving to 2019

- Running a **continuous** monitoring



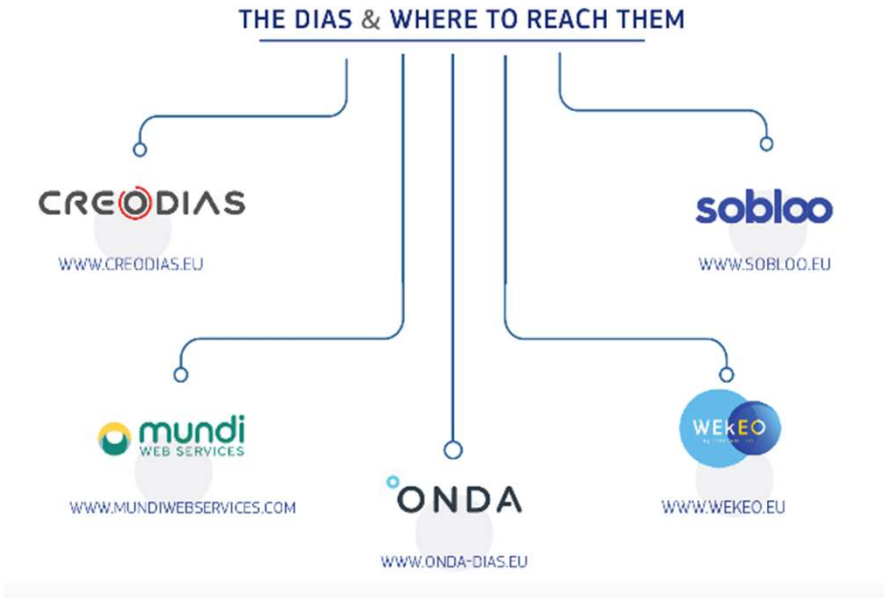
Romania



Netherlands

Next steps: moving to 2019

- Running a continuous monitoring
- Embracing DIAS



	Czech Republic	Italy
Input EO data (2016-2019)	26 TB	128 TB
Output L2 data (2016-2019)	31 TB	137 TB
Output L3 and L4 data (2016-2019)	14 TB	50 TB
Pre-processing resources (ongoing)	16 cores, 90 GB	48 cores, 230 GB
Products & distribution resources (ongoing)	28 cores, 72 GB	62 cores, 144 GB

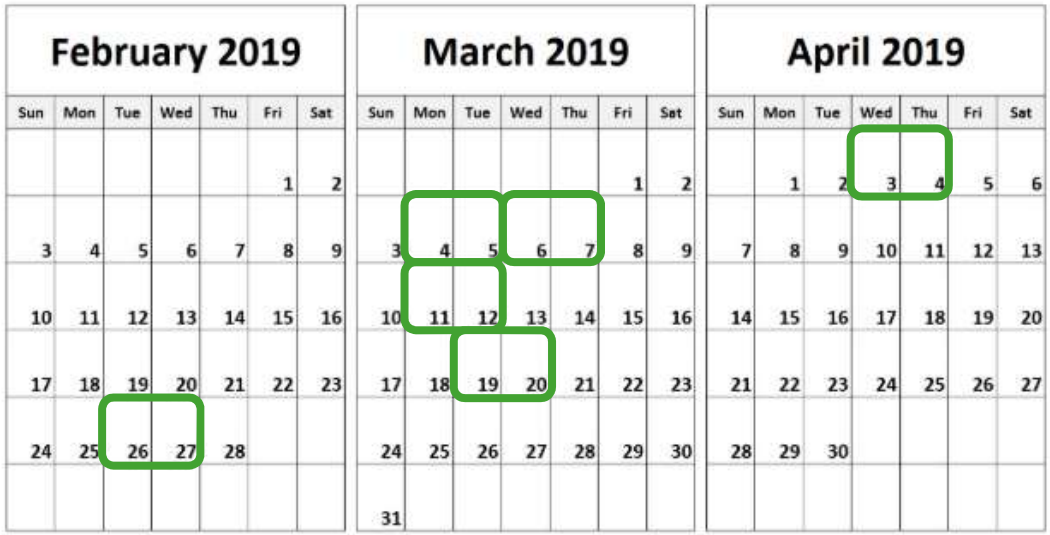
- ✓ Sen4CAP requirements definition
- ✓ RFI document to the 5 DIAS-es
- ✓ Test access

Next steps: moving to 2019

- Running a continuous monitoring
- Embracing DIAS
- Strenghtening interactions with the Sen4CAP Pilot Paying Agencies
  - Feedback needed to improve products and use cases
  - Customizing towards country specificities
  - Trainings on products, use cases and system

Paying Agencies involvement is key

Training planning



Sen4CAP: an European effort to prepare for CAP2020

- Sentinels benefits for CAP monitoring demonstrated with ***prototype*** products
- Moving to national demonstration, wall-to-wall coverage, timely delivery
  - 6 countries (1.2 Mkm²) with diverse cropping systems, LPIS, landscapes, etc.
  - 2018 processing close to its end, including use cases
  - Working hand-to-hand with Paying Agencies, capacity building & training
  - Cloud computing on DIAS for national to European up-scaling
- Operational Sentinel time series enable CAP monitoring approach
- Open source approach for direct and customizable uptake & sharing to all PAs

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common agricultural policy

http://esa-sen4cap.org


Thank you for your attention
and your contribution
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