Welcome to the 13th 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, Diane Heymans & Maxime Troiani from *UCLouvain*

Cosmin Udroiu & Laurentiu Nicola from *CS Romania*

Members of the consortium available to answer your questions

Webinar outline

- Sen4CAP overview
- New use cases and processors
  - Parcels heterogeneity
  - Bare soil detection
  - Change of land category
- System evolution
  - New version 4.0
- Conclusions and next steps

Webinar outline

- **Sen4CAP overview**
- New use cases and processors
  - Parcels heterogeneity
  - Bare soil detection
  - Change of land category
- System evolution
  - New version 4.0
- Conclusions and next steps

sen4cap
common agricultural policy

Funded by European Space Agency

esa

EO Experts

UCLouvain gisat SINERGISE e-geos AN ASI / TELESPAZIO COMPANY ROMÂNIA

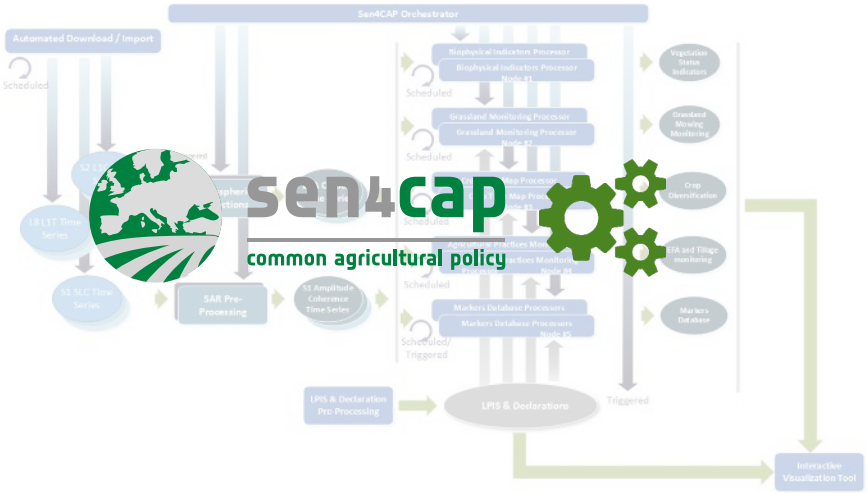
Sen4CAP system

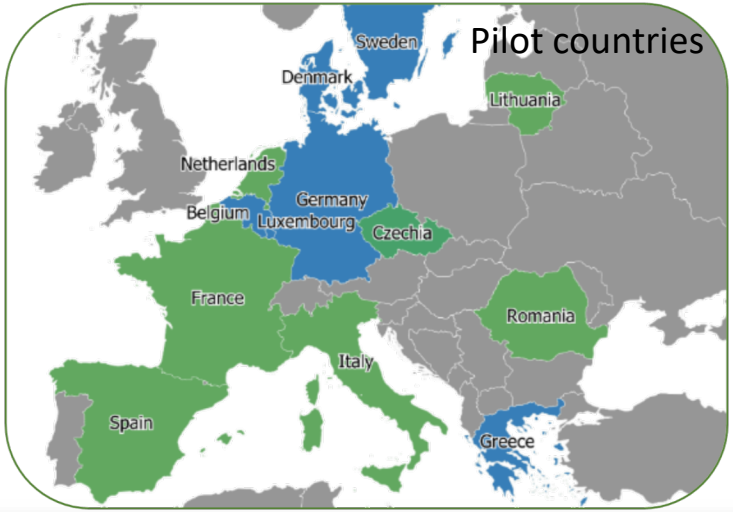
User group: 6+1 Paying Agencies

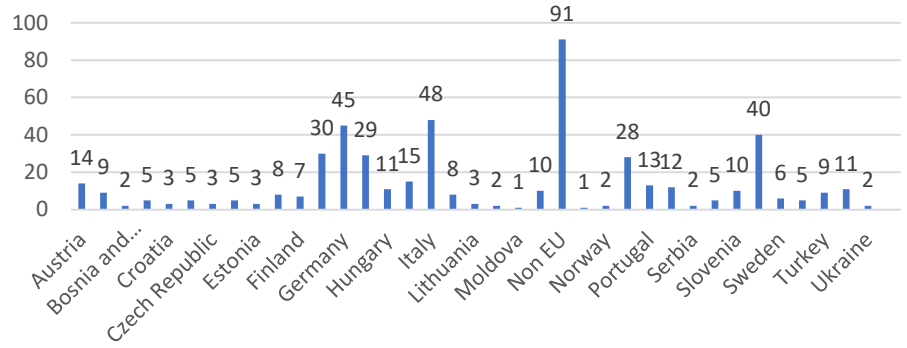
Guidance by DG-Agri, JRC, DG-Grow.

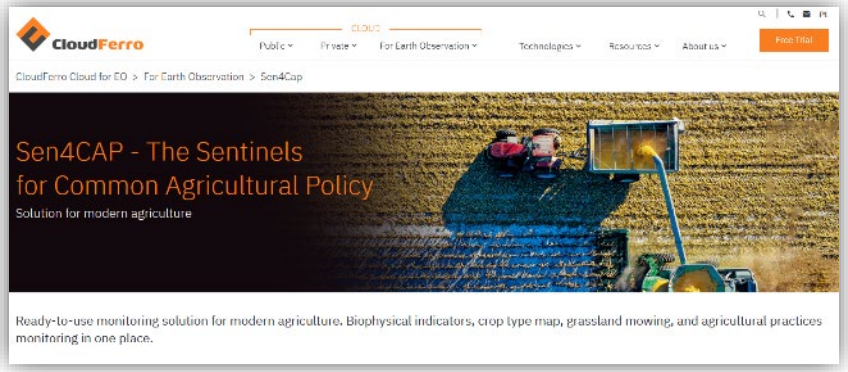
From an ESA project …

…to an open source system uptaken by the CAP community

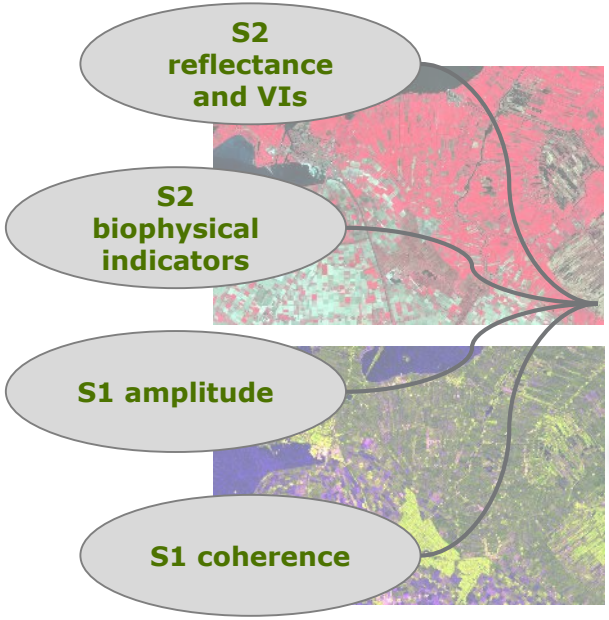


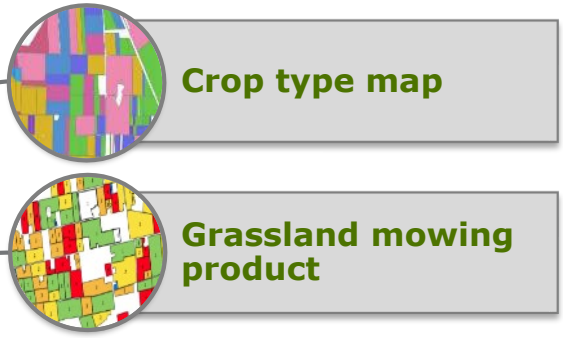




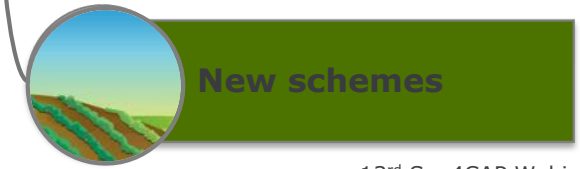


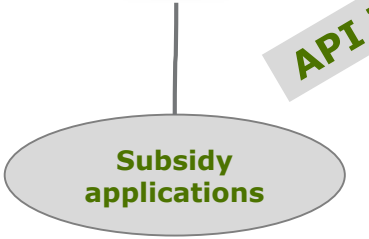
Markers and products assessed through selected use cases but available for many other applications





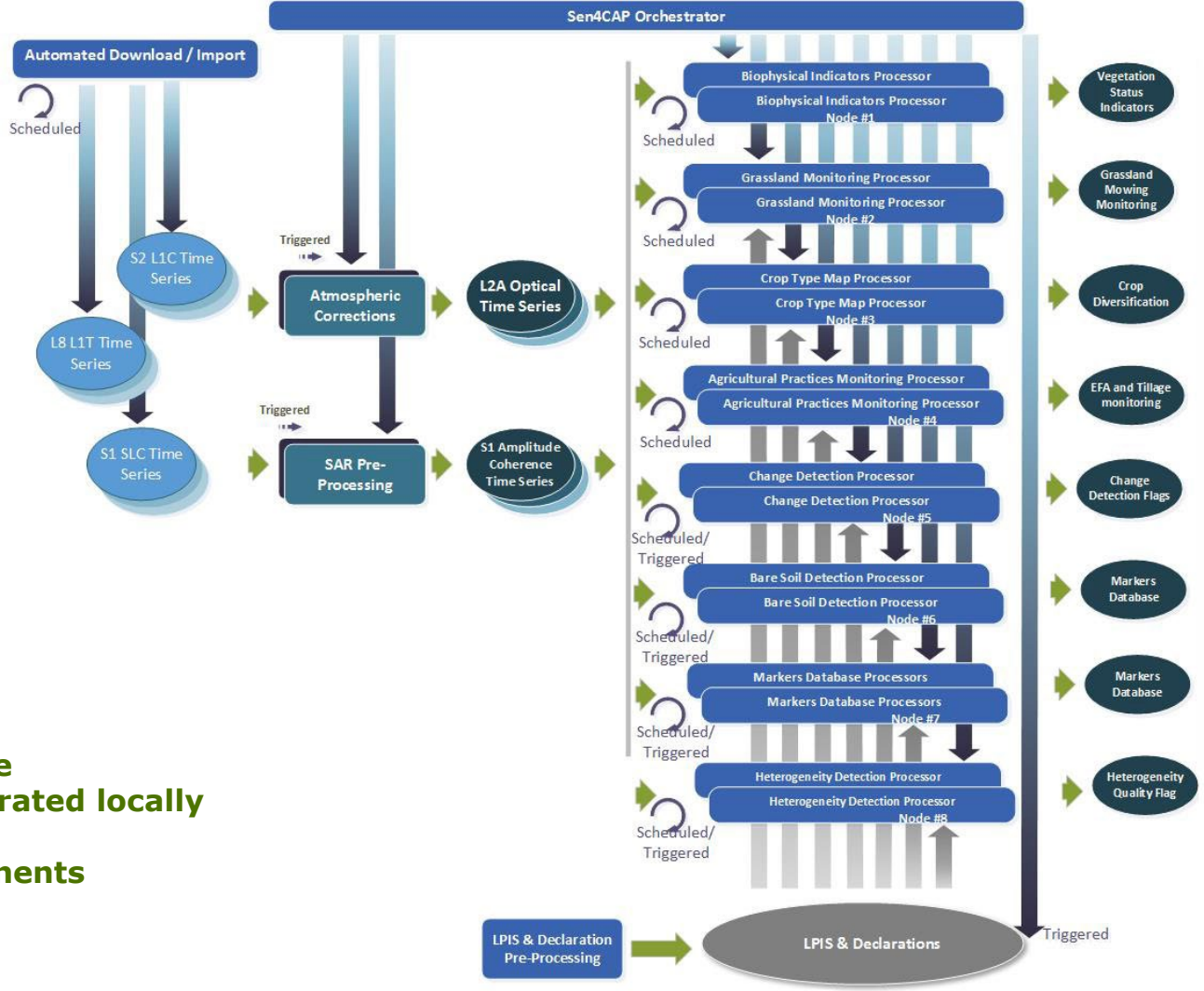
API interface



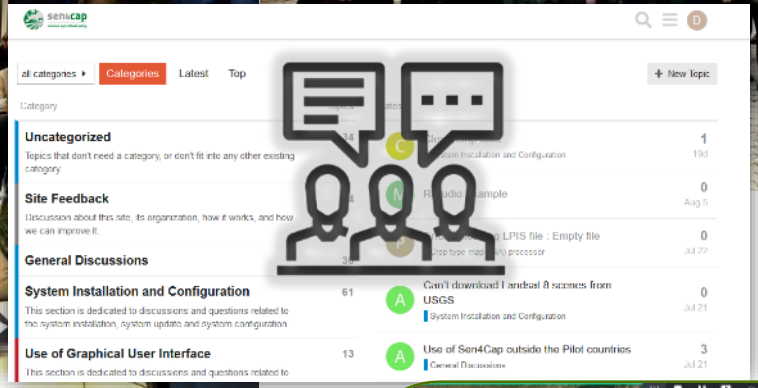


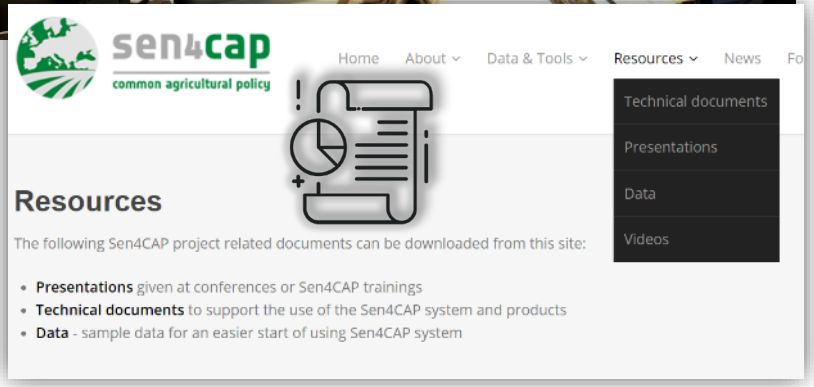
Sen4CAP
Open-source system

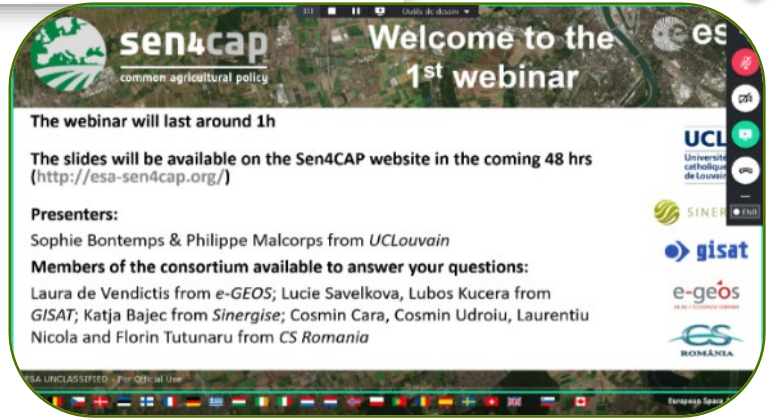
Version 4.0 delivered today



- **Sentinel-1 & -2**
- **Automated and modular**
- **For NRT or off-line production**
- **Demonstrated at national scale**
- **Portable on all DIAS-es or operated locally**
- **User-friendly & API interfaces**
- **Dockerization for main components**


sen4cap
all categories
Categories
Latest
Top
+ New Topic
Category
Uncategorized
Topics that don't need a category, or don't fit into any other existing category
Site Feedback
Discussion about this site, its organization, how it works, and how we can improve it.
General Discussions
System Installation and Configuration
This section is dedicated to discussions and questions related to the system installation, system update and system configuration
61
Use of Graphical User Interface
This section is dedicated to discussions and questions related to
13
Can't download Landsat 8 scenes from USGS
System Installation and Configuration
Use of Sen4Cap outside the Pilot countries
General Discussions


sen4cap
common agricultural policy
Home
About
Data & Tools
Resources
News
Technical documents
Presentations
Data
Videos
Resources
The following Sen4CAP project related documents can be downloaded from this site:
Presentations given at conferences or Sen4CAP trainings
Technical documents to support the use of the Sen4CAP system and products
Data - sample data for an easier start of using Sen4CAP system

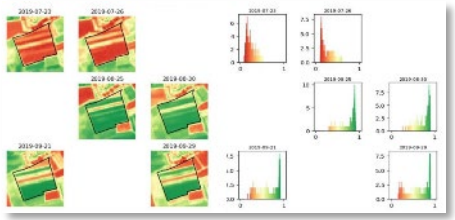

sen4cap
common agricultural policy
Welcome to the 1st webinar
The webinar will last around 1h
The slides will be available on the Sen4CAP website in the coming 48 hrs (http://esa-sen4cap.org/)
Presenters:
Sophie Bontemps & Philippe Malcorps from UCLouvain
Members of the consortium available to answer your questions:
Laura de Vendictis from e-GEOS; Lucie Savelkova, Lubos Kucera from GISAT; Katja Bajec from Sinergise; Cosmin Cara, Cosmin Udroiu, Laurentiu Nicola and Florin Tutunaru from CS Romania
gisat
e-geos
ROMÂNIA

Webinar outline

- Sen4CAP overview
- **New use cases and processors**
  - **Parcels heterogeneity**
  - **Bare soil detection**
  - **Change of land category**
- System evolution
  - New version 4.0
- Conclusions and next steps

New uses cases

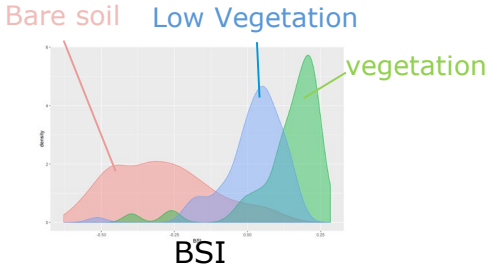
Sub-parcel **heterogeneity** marker(s)



MILENOV Pavel *et al.*, 2021, JRC

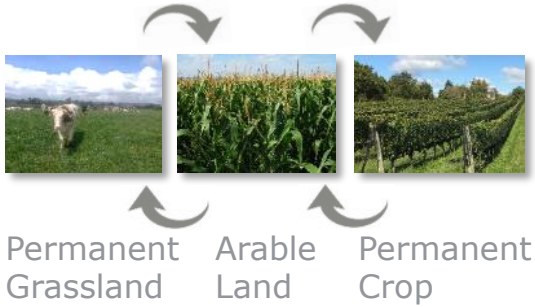
Per pixel analysis

Bare soil markers

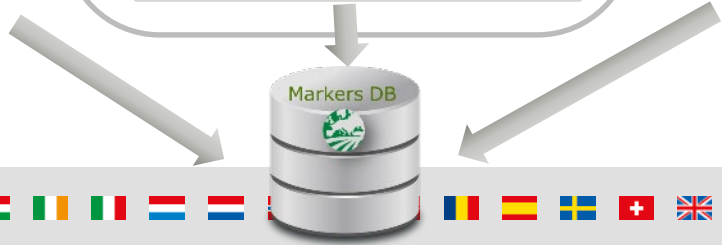


New Optical & SAR variables – all year round

Change of cover from year to year

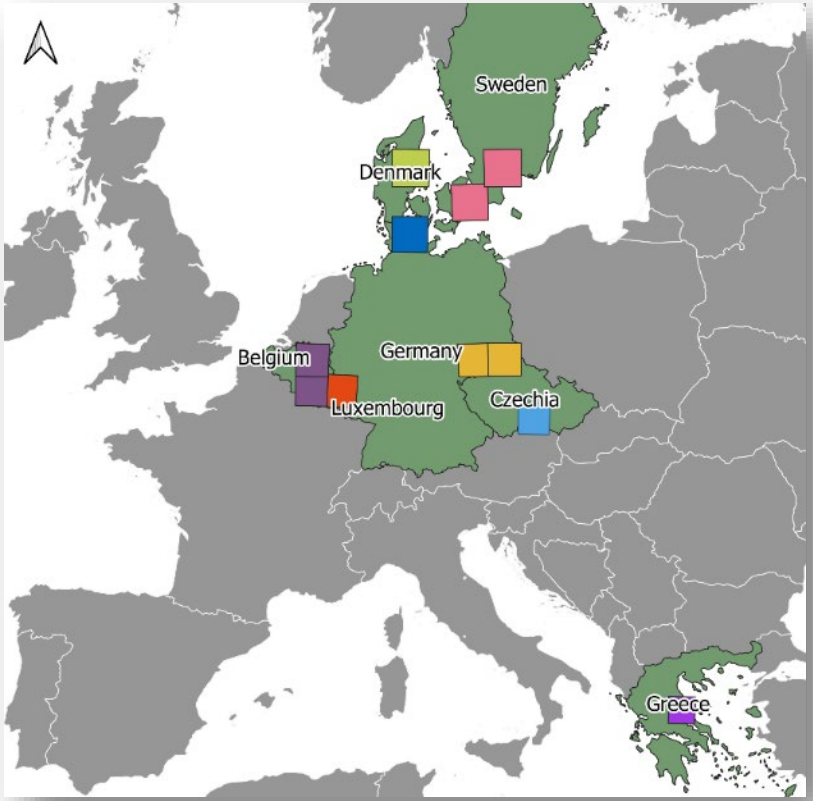


Multi-annual analysis



R&D with 7 pilot countries (8 Paying Agencies), sharing calibration and validation data

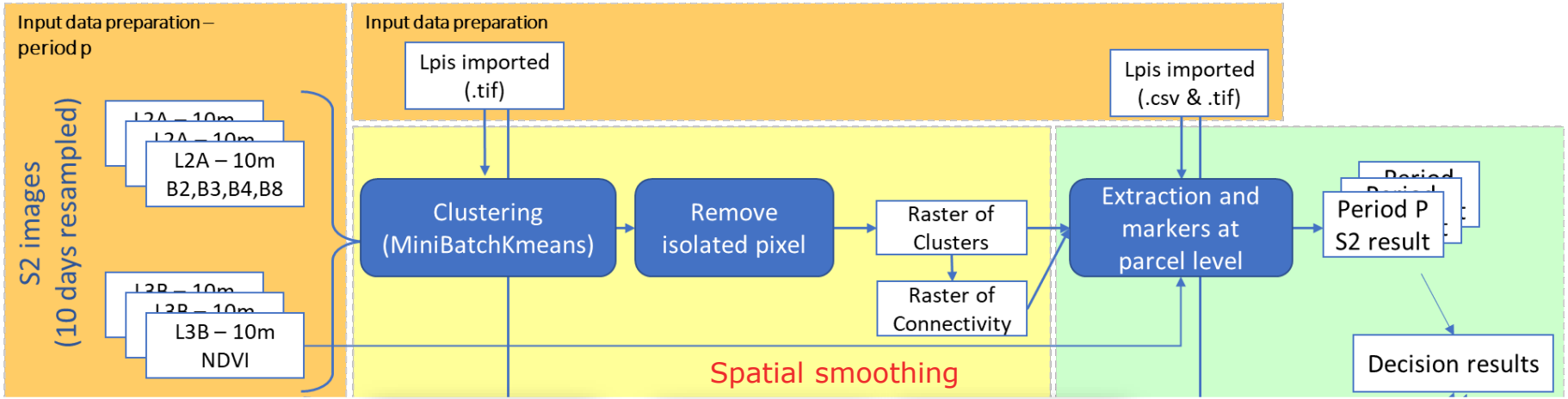
- 1 or 2 S2 tiles
- 1 or 2 years (2020-**2021**)
- All Sentinel-1 and Sentinel-2 preprocessed

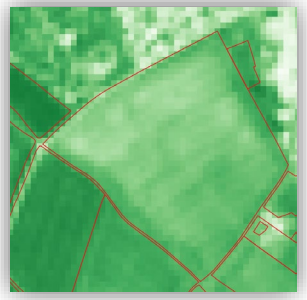


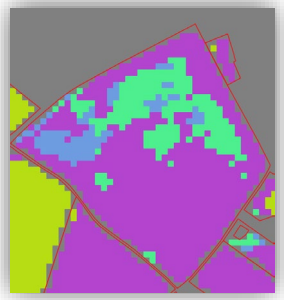
Sites list

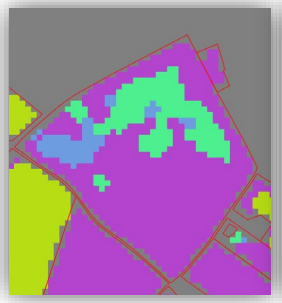
Site name	Short name	Seasons			
		Season name	Season start	Season mid	Season end
Czechia	czechia	2020	2020-01-01	2020-07-03	2020-12-31
		2021	2021-01-01	2021-07-03	2021-12-31
Danish	danish	2021	2021-01-01	2021-07-03	2021-12-31
Greece	greece	2021	2021-01-01	2021-07-03	2021-12-31
Luxembourg	luxembourg	2020	2020-01-01	2020-07-03	2020-12-31
		2021	2021-01-01	2021-07-03	2021-12-31
Saxony	saxony	2021	2021-01-01	2021-07-03	2021-12-31
SaxonyV2	saxonyv2	2020	2020-01-01	2020-07-03	2020-12-31
		2021	2021-01-01	2021-07-03	2021-12-31
Schleswig	schleswig	2021	2021-01-01	2021-07-03	2021-12-31
Sweden	sweden	2021	2021-01-01	2021-07-03	2021-12-31
SwedenV2	swedenv2	2021	2021-01-01	2021-06-03	2021-12-31
Wallonie	wallonie	2020	2020-01-01	2020-07-03	2020-12-31
		2021	2021-01-01	2021-07-03	2021-12-31

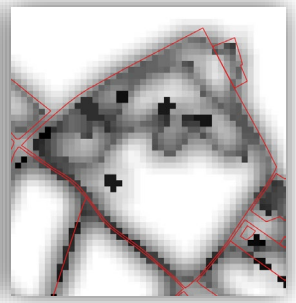
Heterogeneity Workflow





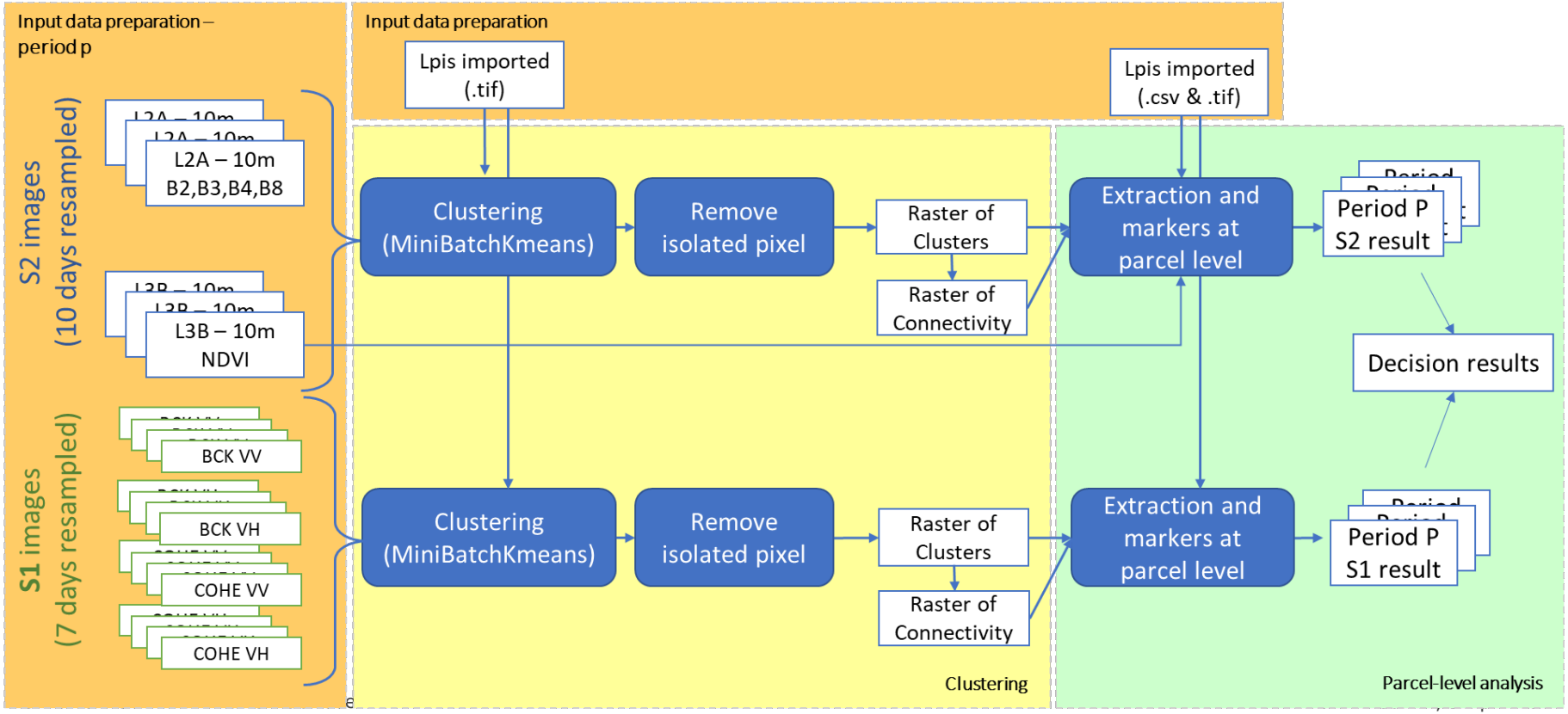






- Number & size of clusters ?
- Difference of NDVI between clusters ?
- Are the clusters compact ?

Heterogeneity Workflow



Heterogeneity – Markers S2 & S1

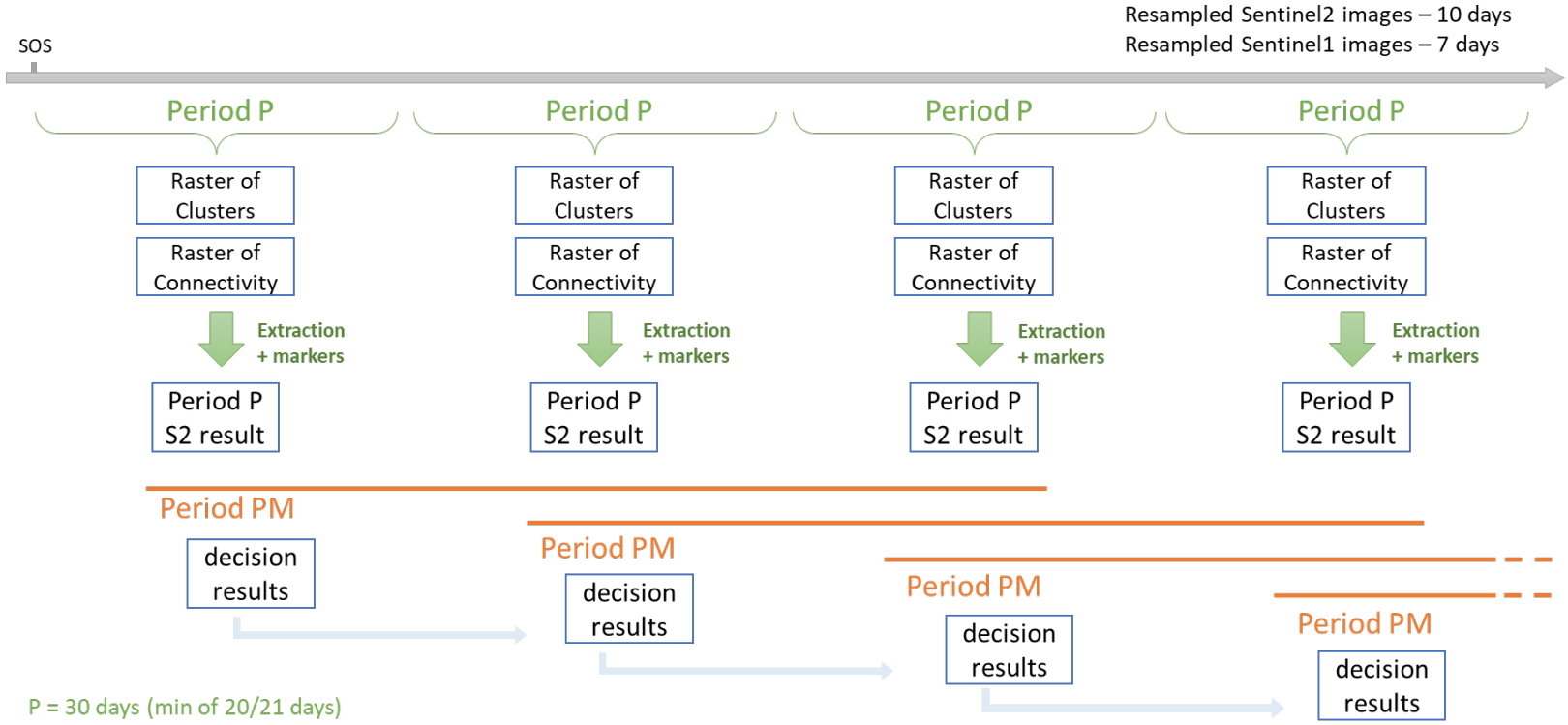
Marker	Description	Possible Value at each period P
M1	**More than one big cluster (>*PerHetero* % of the parcel) with S2**	**1 / 0 / NA**
M2	**At least 2 clusters with more than *NPixClS2* & M1 =1**	**1 / 0 / NA**
M3	**DistNDVI > *ThrdNDVIdist***	**1 / 0 / NA**
M4	**Compact S2 > *ThrdCompactS2***	**1 / 0 / NA**

S2 Markers

Parameters :

- PerHetero = Percentage of the biggest cluster in the parcel (default = 90%)
- NPixClS2 = Number of S2 pixel needed to determine if a cluster can be big enough (default = 20)
- NPixClS1 = Number of S1 pixel needed to determine if a cluster can be big enough
- ThrdNDVIdist = difference of NDVI needed for heterogeneity
- ThrdCompactS2 = Threshold of compactness (varies according to the radiusC - see connectivity raster)
  (Saxony – radius = 3, thrdcompacts2 = 3 VS Greece – radius = 2, thrdcompacts2 = 1.7)

Heterogeneity – decision period



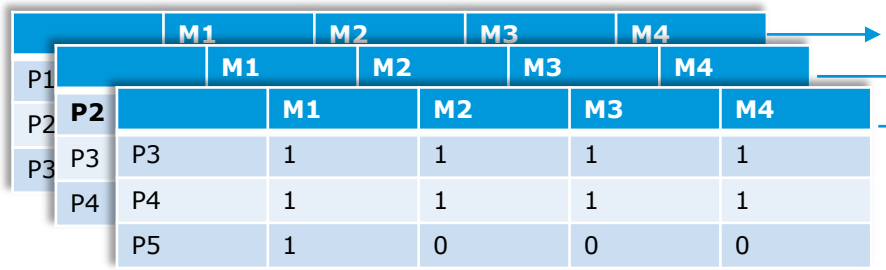
Heterogeneity – C_INDEX decision

STRONG: All (3) periods with all markers = 1

MODERATE: At least 1 period with all markers = 1

WEAK: One marker missing each period

POOR: Half of the markers = 1



	M1	M2	M3	M4
P1				
P2				
P3				

	M1	M2	M3	M4
P2				
P3	P3	1	1	1	1
P4	P4	1	1	1	1
P5	P5	1	0	0	0

P_Hete_L = 1 & C_INDEX = MODERATE

P_Hete_L = 2 & C_INDEX = STRONG

P_Hete_L = 2 & C_INDEX = STRONG

P_Hete_L = Last confirmed period with best detection

S1 as support for S2 detection & when not available

Heterogeneity – C_INDEX decision

STRONG: All periods with all markers = 1

MODERATE: At least 1 period with all markers = 1

WEAK: One marker missing each period

POOR: Half of the markers = 1

Saxony Results: **27,5%** with a detection

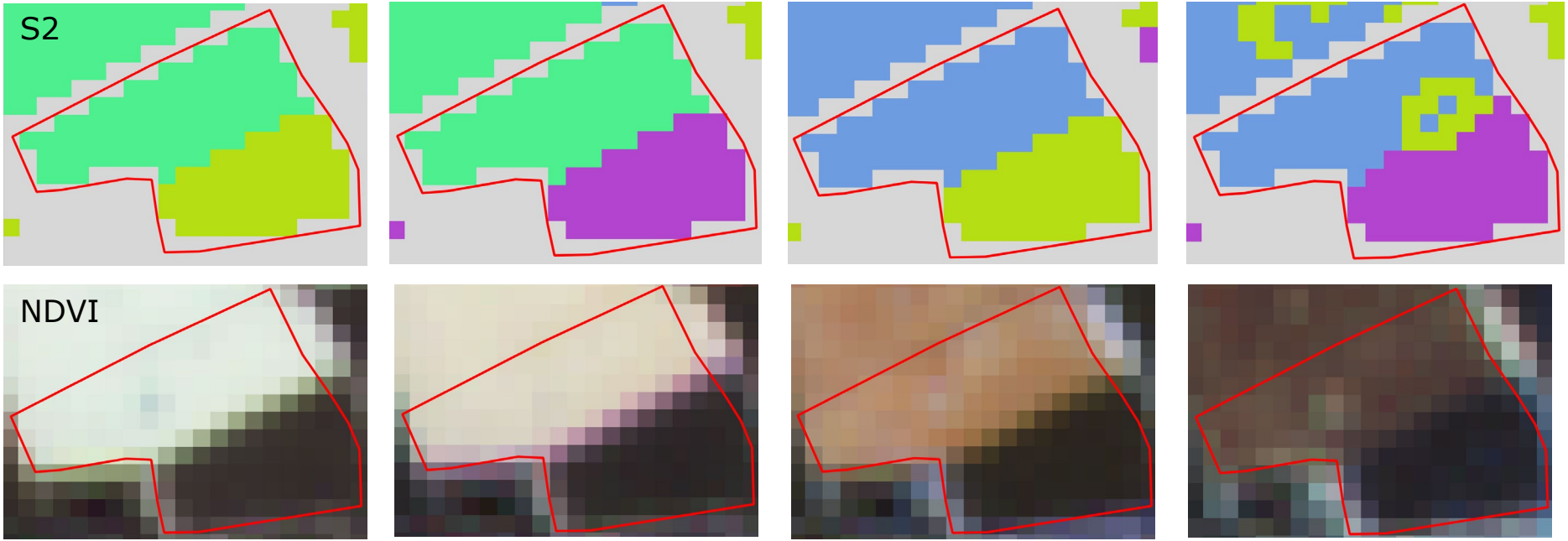
→ POOR: 71%
→ WEAK: 27%
→ MODERATE: 1%
→ STRONG: 1%

Greece Results: **8,5%** with a detection

→ POOR: 68,5%
→ WEAK: 29,5%
→ MODERATE: 1%
→ STRONG: 1%

Heterogeneity – Example in Greece

Last confirmed detection – p6 | Detection – p7 | Detection – p8 | No Compacity – p9

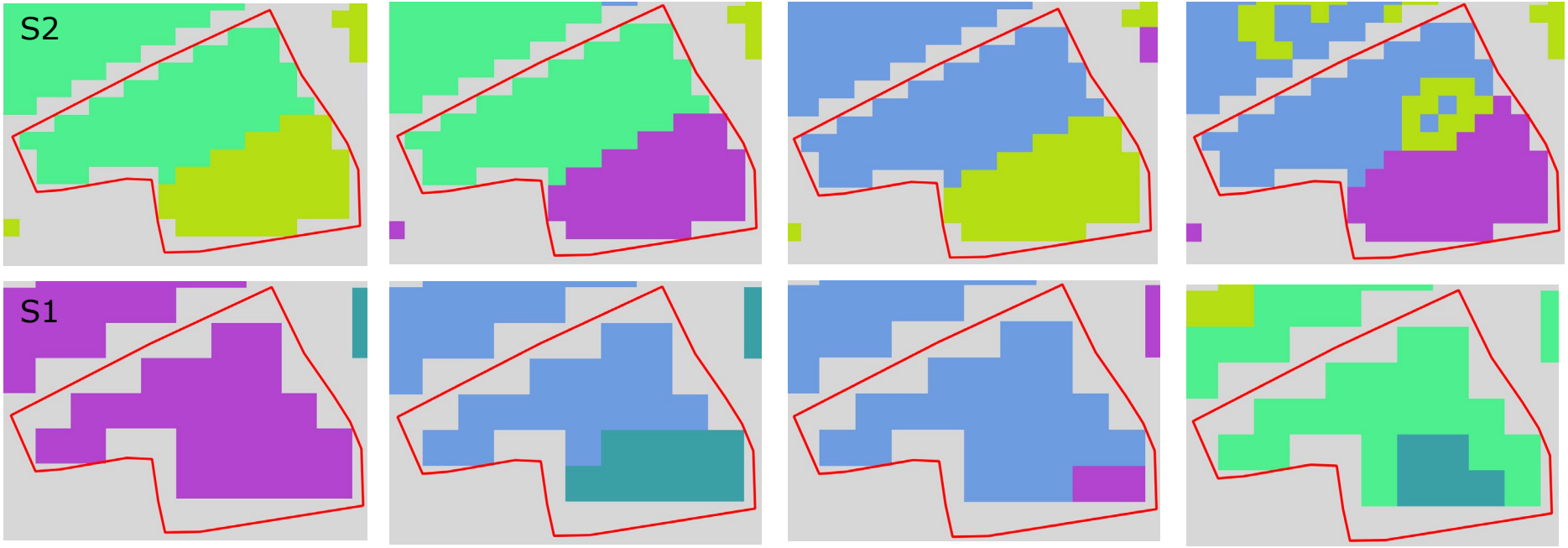


Id = 626

STRONG detection with S2

Heterogeneity – Example in Greece

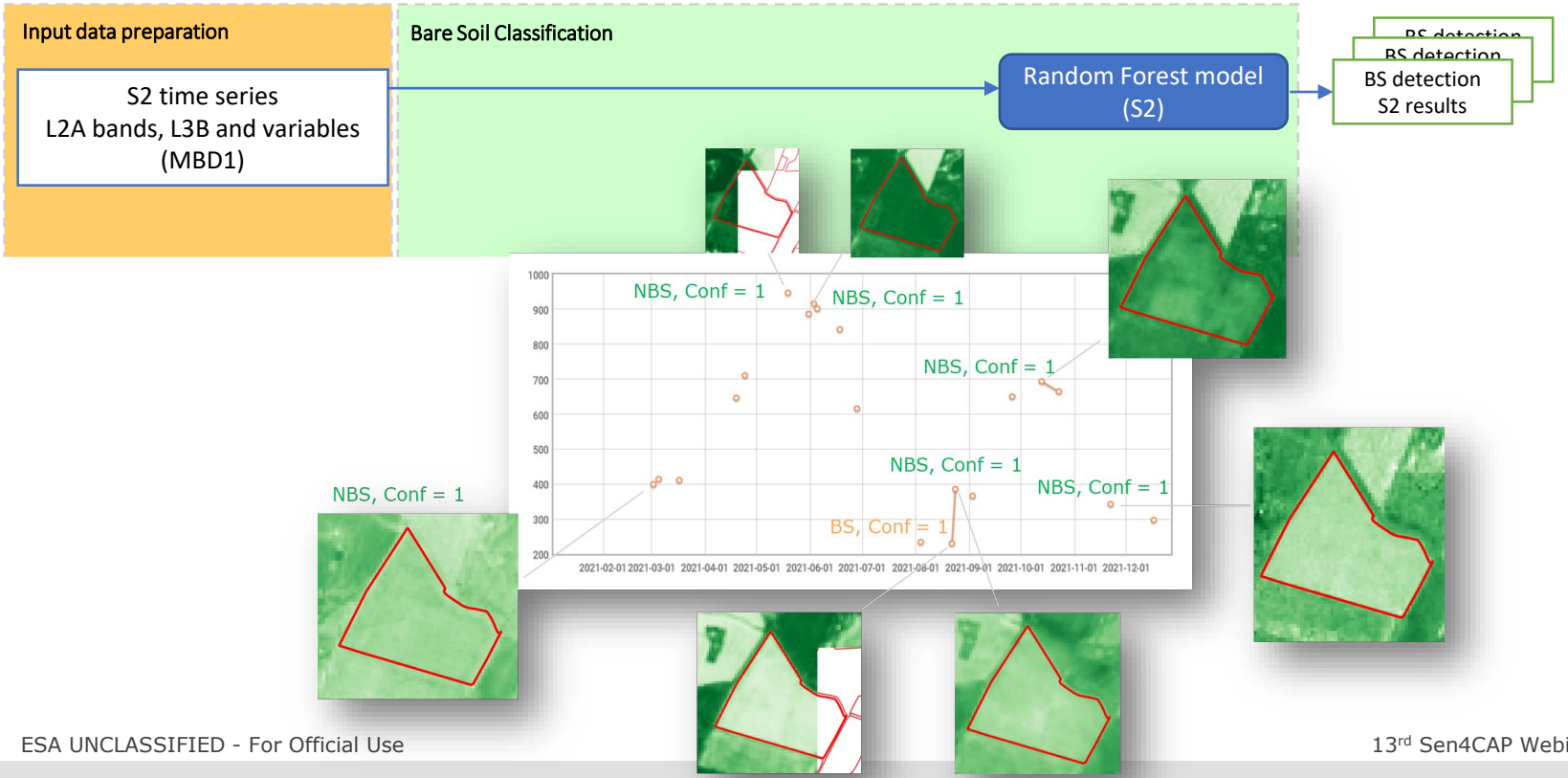
Last confirmed detection – p6 | Detection – p7 | Detection – p8 | No Compacity – p9



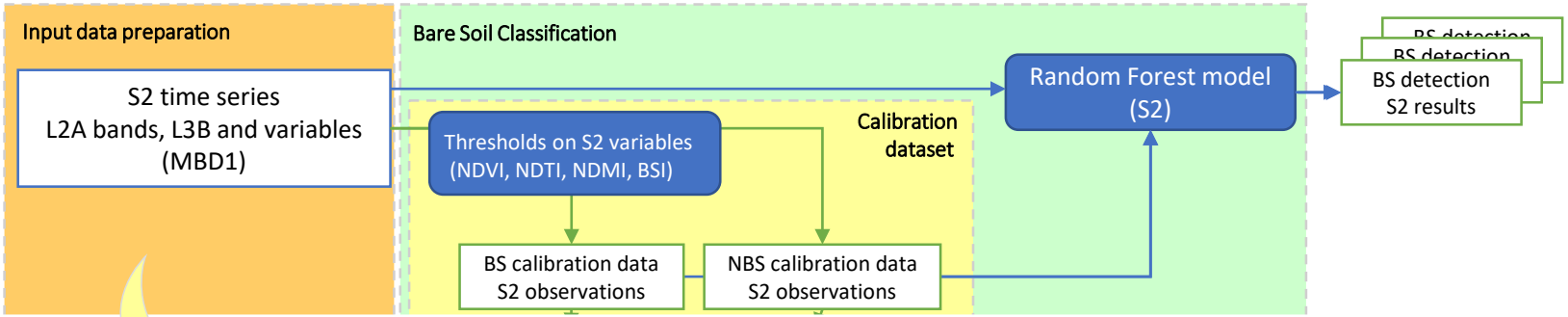
Id = 626

STRONG detection

Bare Soil : Classification



Bare Soil : Calibration dataset with S2

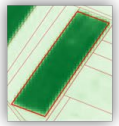


*For each parcels and at each date during **the period of training***

→ *Looks if NDVI, NDTI, BSI, NDMI < BS_threshold* BS

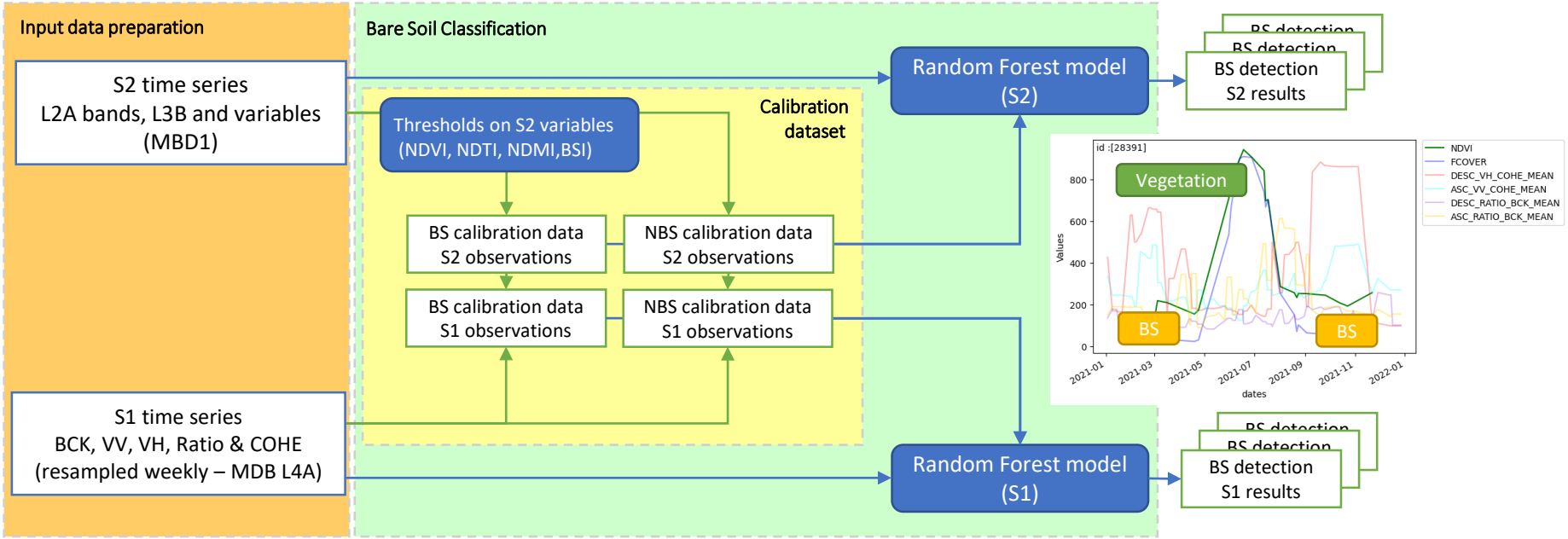
✓ *The date and parcel goes to the calibration dataset as bare soil*

→ *Looks if NDVI, NDTI, BSI, NDMI > NBS_threshold* Vegetation

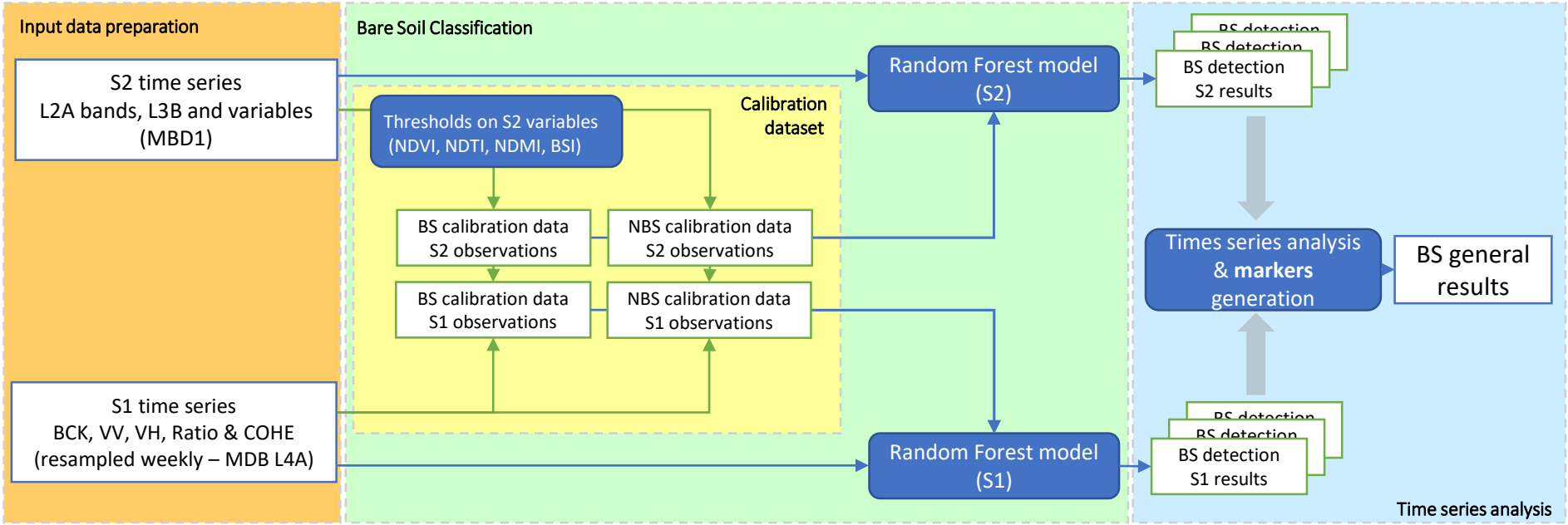


✓ *The date and parcel goes to the calibration dataset as vegetation*

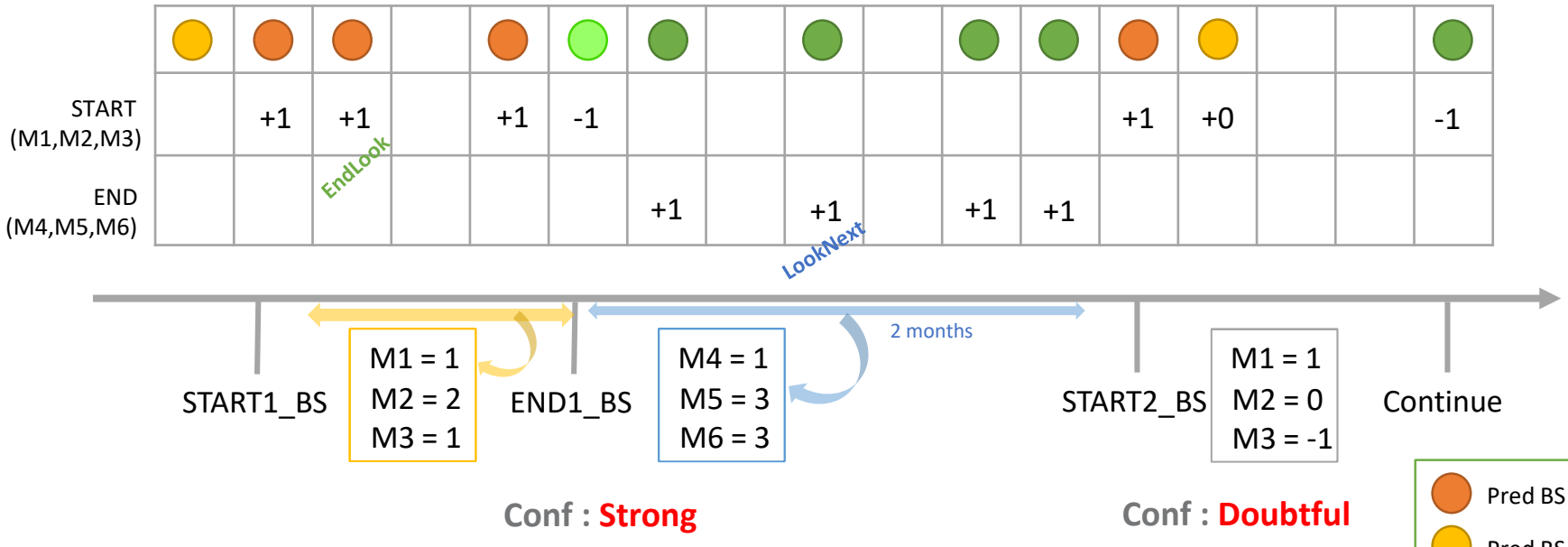
Bare Soil Classification S1 & S2



Bare Soil : Complete workflow



Time Series Analysis & Markers



Example

Time Series Analysis & Markers

	Description	Values possible
M1	First observation of BS with conf > *thr_bs* → **Allow to set the *START_BS_S2***	0 / 1
M2	Observation of BS in conf > *thr_bs* → **+1** → 1st confirmation → **LookEnd** = True (look for the end of the BS period) → Allow to see **number of strong BS in the BS period**	0 / 1+ / NA
M3	Observation of BS in conf > thr_bs → +2, BS in conf < thr_bs → +1 & NBS in any conf → -1 → Number of strong observation – number of noise in the BS period	-1 / 0 / 1+ /NA
M4	Observation of NBS with conf > *thr_nbs* → **Allow to set the END_*BS_S2***	0 / 1
M5	Observation of NBS in conf > *thr_nbs* → +1 → Allow to see **number of strong NBS in the Plong period (2 months) after the BS period**	0 / 1+ / NA
M6	Observation of NBS in conf > thr_nbs → +2, NBS in conf < thr_nbs → +1 & BS in any conf → -1 → Number of strong observation – number of noise	-1 / 0 / 1+ / NA

Parameters:

- *Thr_bs* : Threshod of BS that indicate the minimum confidence level in the **BS prediction** to be consider as a **strong detection**.
- *Thr_nbs* : Threshod of NBS that indicate the minimum confidence level in the **NBS prediction** to be consider as a **strong detection**.
- *Pshort* : 1. As the maximum number of days after after the START_BS where if the END_BS is not found, the ENDS_BS is equal to the START_BS.
  2. to see if there a strong detection of BS after the set of the ENDS_BS. When it happens two times, the END_BS is restarted.
- *Plong* : Long period that is used as the duration to look for vegetation (NBS) after the END_BS. It has an impact on the M5 and M6.

Confidence level in the detection

Strong : M2 >= 3, M3 > = 2 and M6 >= 0

Good : M2 > 0, M3 >= 0 and M5 > 0

Medium : M2 > 0 and M3 >= 0

Poor : M2 >= 0 and M3 < 0

Doubtful : only M1 = 1 (only one strong BS)

Results & use of S1 as confirmation of S2

Czechia :
52,5% of the parcels with a detected bare soil (M1_S2)

Confidence	S2	
Doubtful	19.07%	17.30%
With S1 conf		**1.78%**
Poor	6.34%	4.75%
With S1 conf		**1.59%**
Medium	18.49%	13.91%
With S1 conf		**4.58%**
Good	25.92%	16.64%
With S1 conf		**9.28%**
Strong	30.17%	11.51%
With S1 conf		**18.66%**

→ **36%** of the parcels with a detection with a S1 confirmation

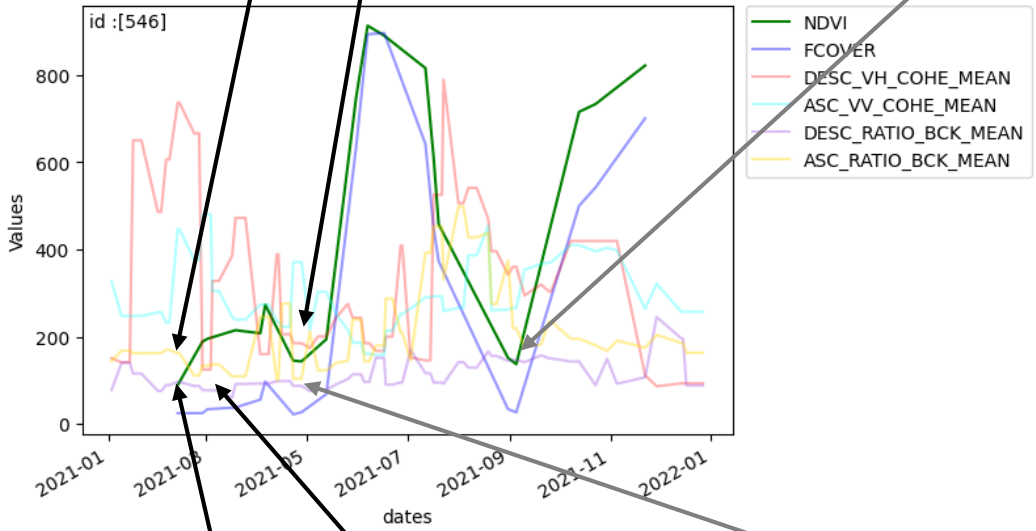
Sweden :
32,7% of the parcels with a detected bare soil (M1_S2)

Confidence	S2	
Doubtful	32.66%	29.41%
With S1 conf		3.25%
Poor	6.52%	5.77%
With S1 conf		0.75%
Medium	13.07%	11.76%
With S1 conf		1.32%
Good	12.50%	10.63%
With S1 conf		1.88%
Strong	35.24%	17.62%
With S1 conf		17.62%

→ 25% of the parcels with a detection with a S1 confirmation

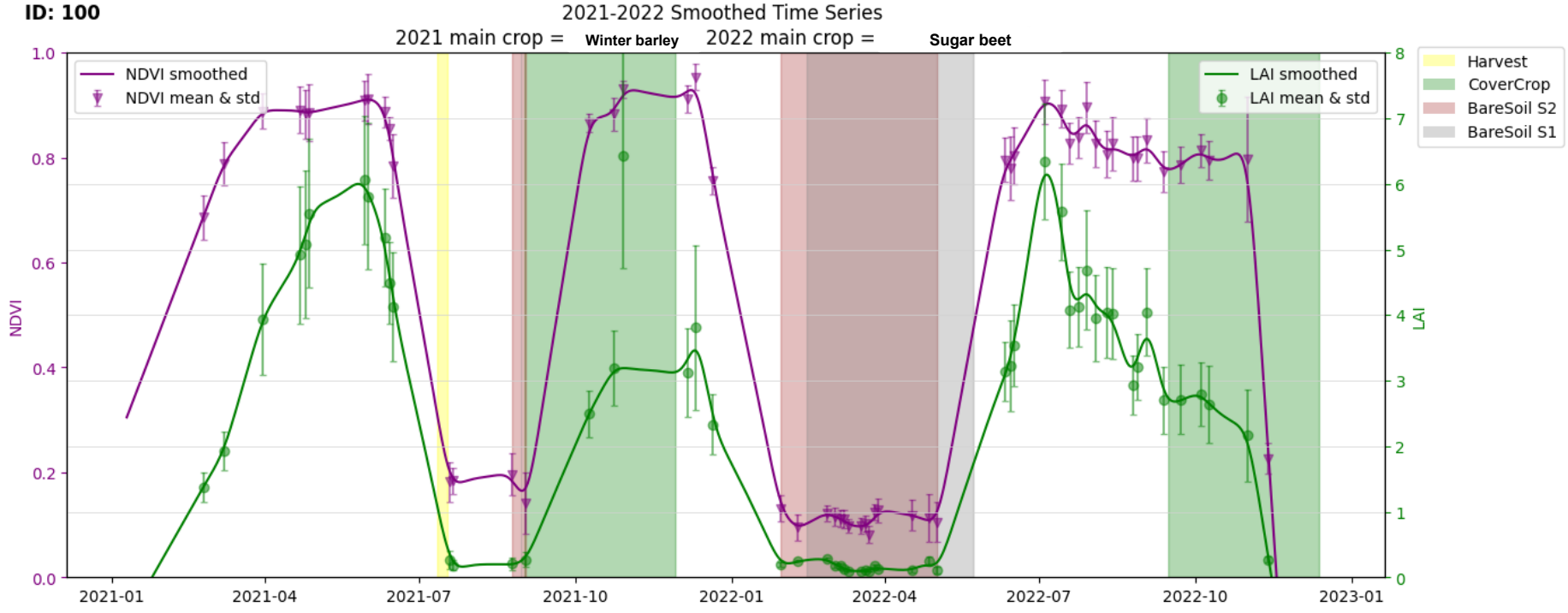
Bare Soil – Example in Sweden

NewID	M1_S2	M2_S2	M3_S2	M4_S2	M5_S2	M6_S2	START1_BS_S2	END1_BS_S2	Conf1_S2	Nbr1S2	Look_nextS2	START2_BS_S2	END2_BS_S2	Conf2_S2	Nbr2S2
546	1	1	0	1	2	2	12-02-21	13-05-21	Strong+_S1	9	VRAI	31-08-21	05-09-21	Good	2

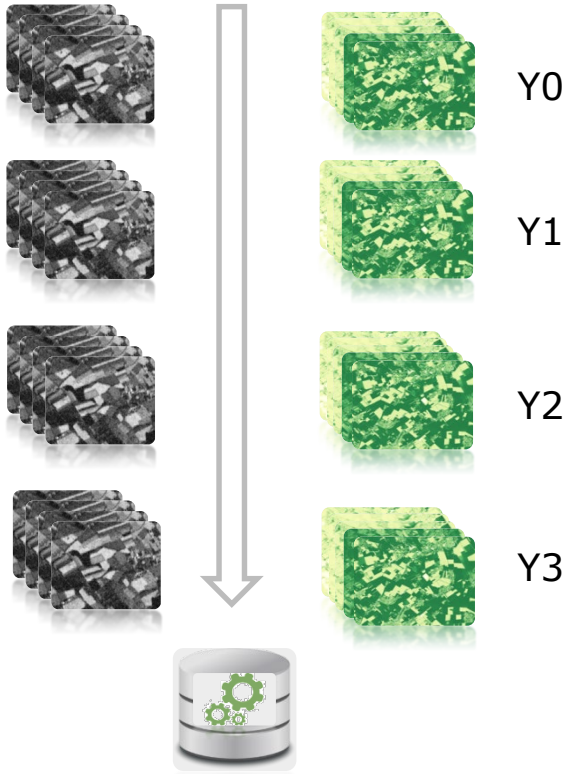


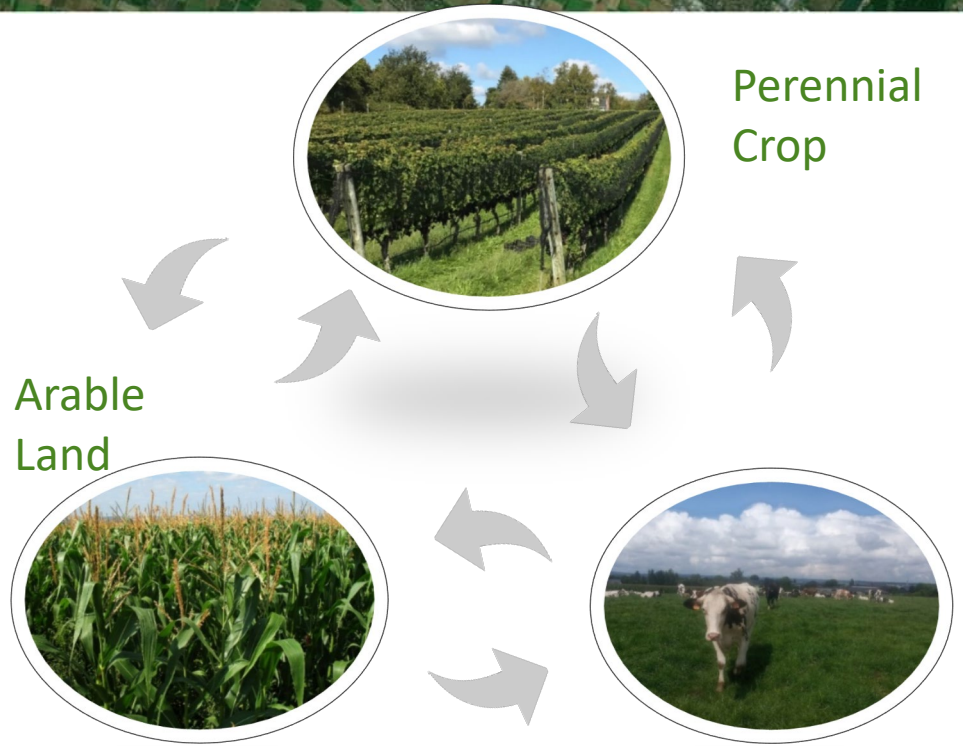
M1_S1	M2_S1	M3_S1	M4_S1	M5_S1	M6_S1	START1_BS_S1	Conf1_STARTS1	END1_BS_S1	Nbr_S1	Look_nex	START2_BS_S1	Conf2_STARTS1	END2_BS_S1	Nbr_S1
1	0	-3				08-02-21	01-03-21	Strong	4	VRAI	26-04-21	26-04-21	Doubtful	4

Bare Soil – Example in Belgium

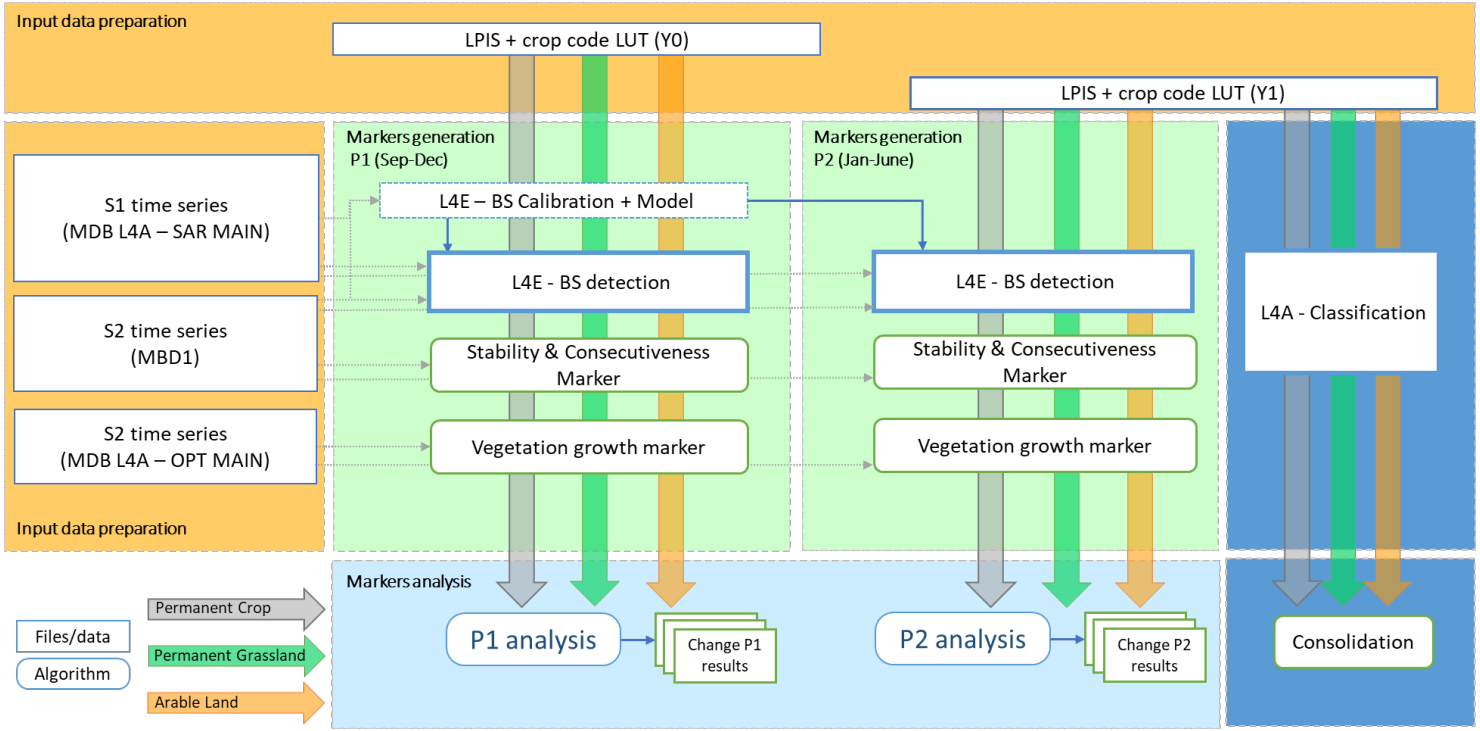


Change of Agricultural Category



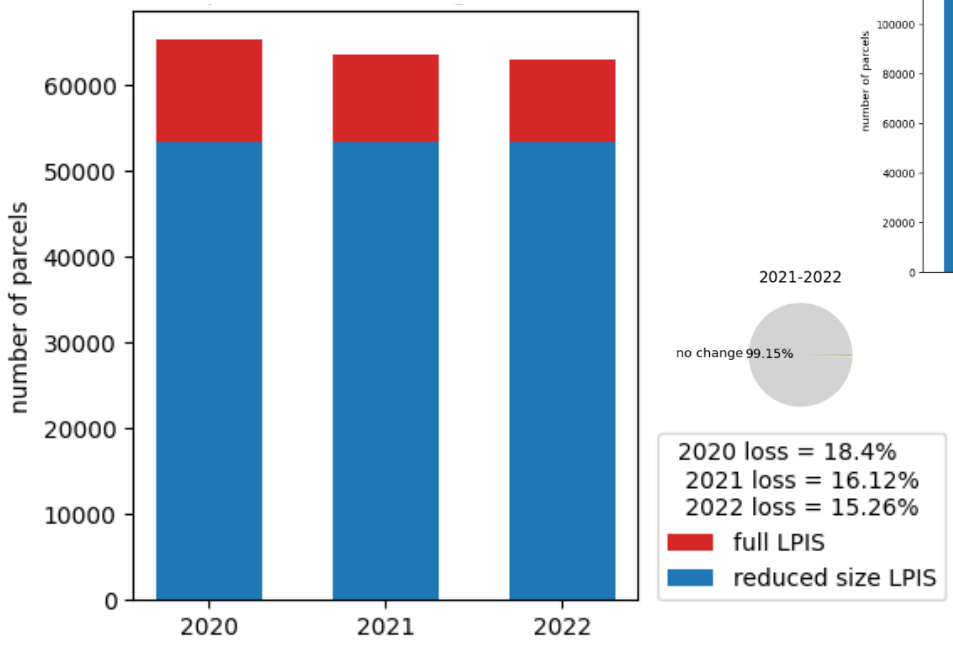


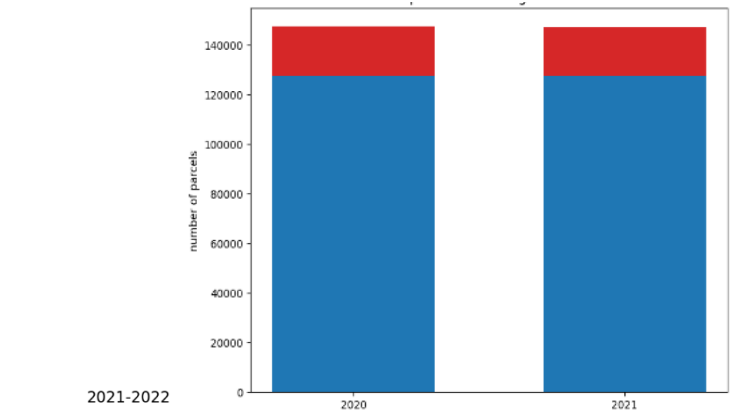
Change of Agricultural Category - Workflow



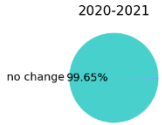
Change of Agricultural Category – LPIS/GSAA standardization

Luxembourg

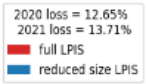


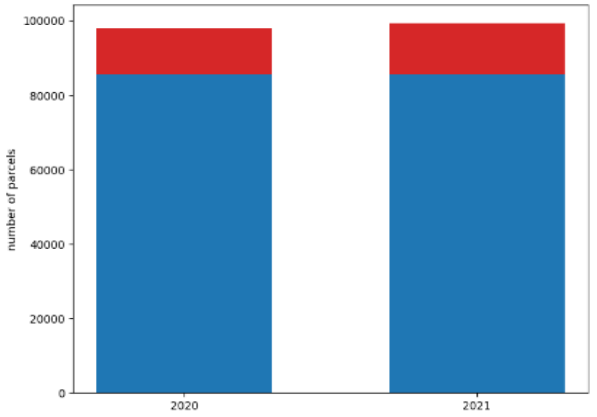


Saxony

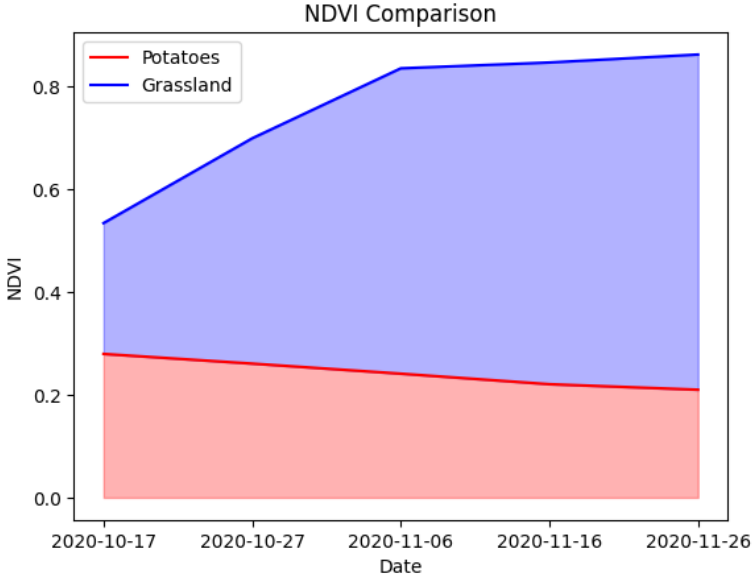


Czechia

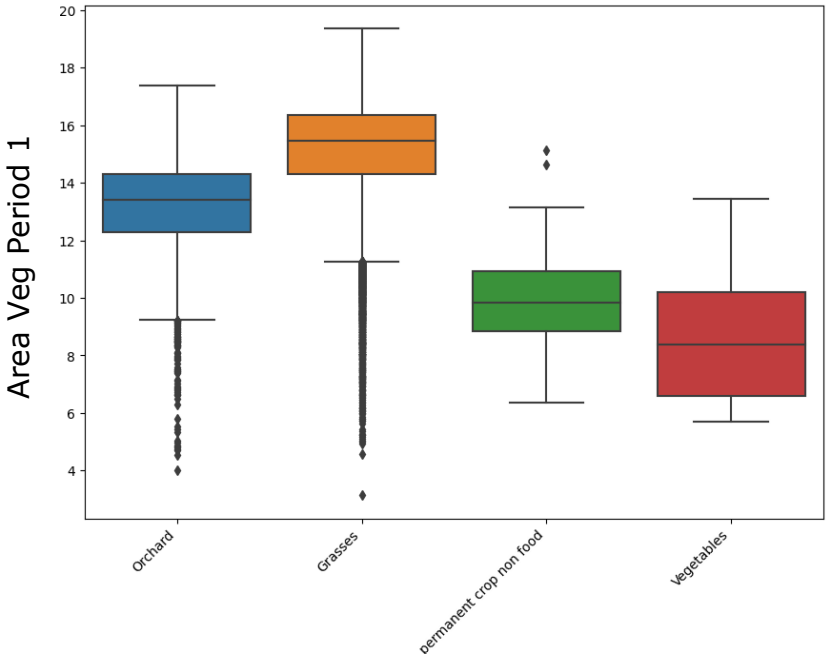




Change of Agricultural Category – Vegetation Growth

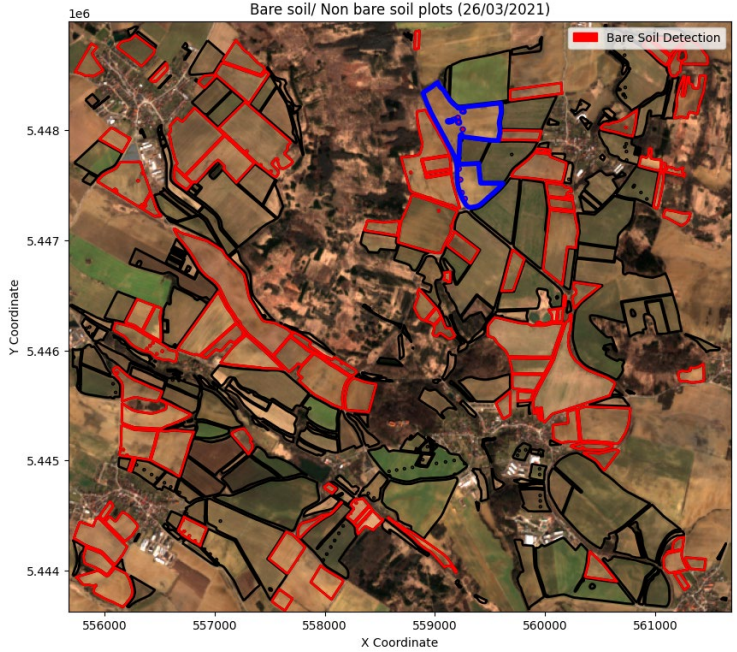


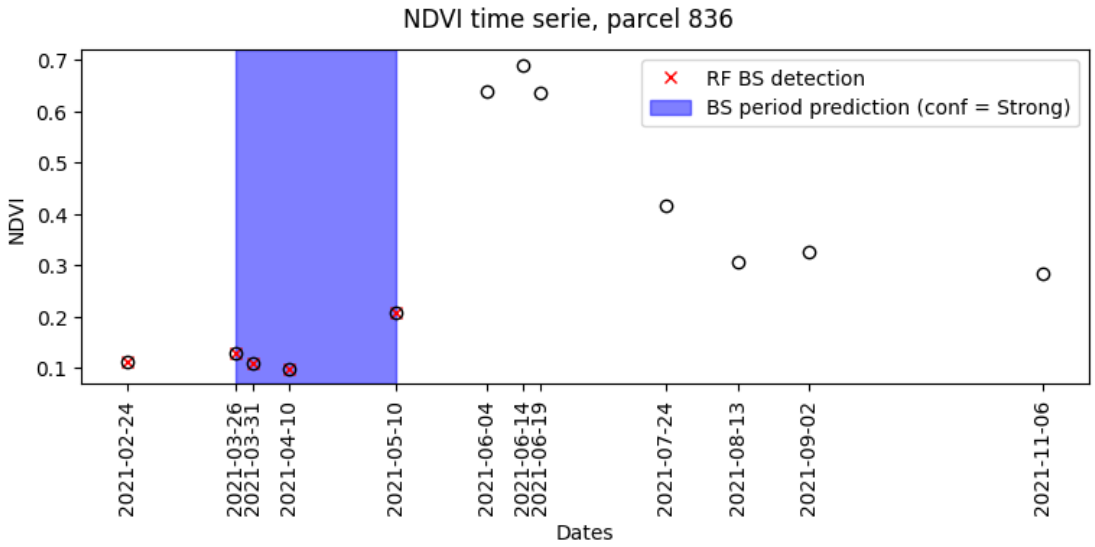
Period 1



Wallonia (Belgium)

Change of Agricultural Category – Bare soil

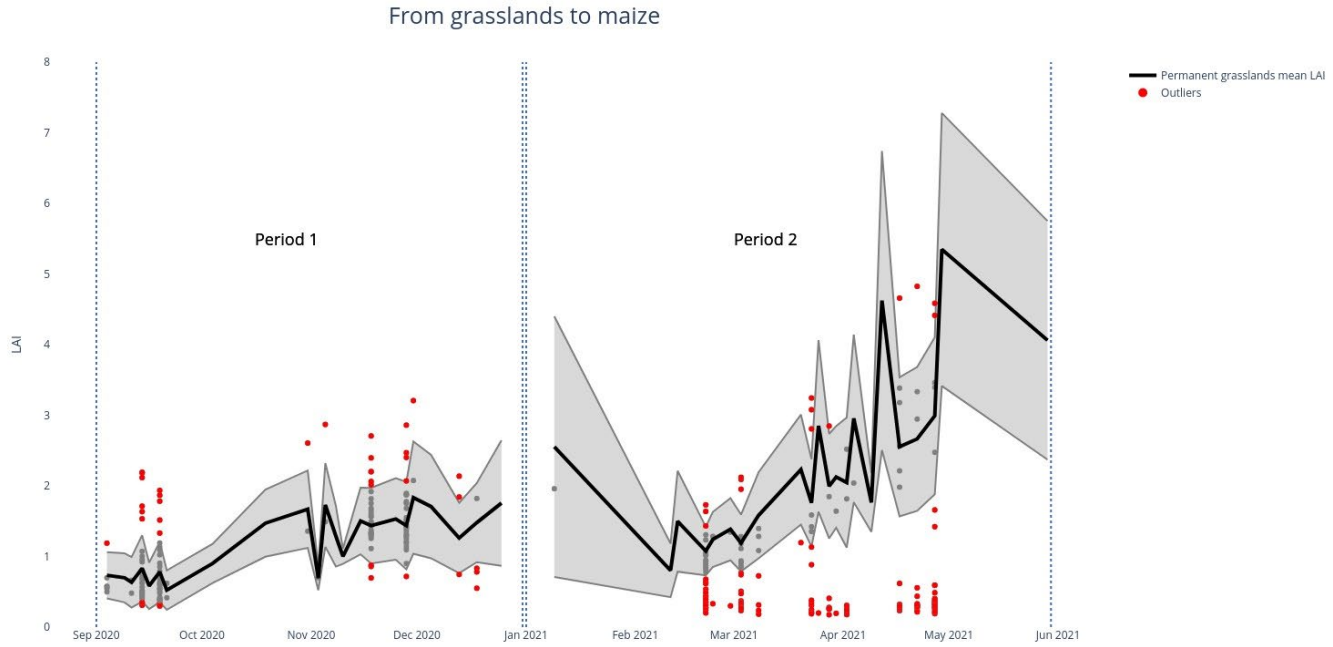




Period 1

Czechia

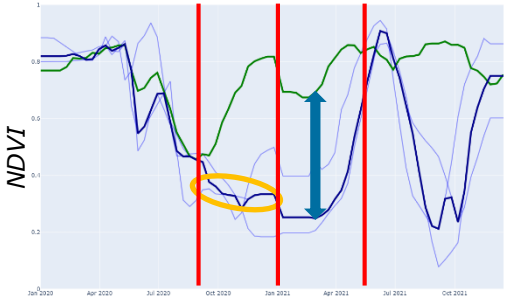
Change of Agricultural Category – Vegetation stability & outlier consecutiveness



Luxembourg

Change of Agricultural Category – Markers analysis

Period 1



Period 2

Change score computation : Tresholds values Period 1

	Marker	Tresholds	Change score value
Grassland	TTdaysS2	TTdaysS2 > 0	+2
	Ratio_stability	0 < Ratio_stability < 50 Ratio_stability > 50	+1 +1.5
	Consec_stability	Consec_stability > 0	+1
Permanent crop	TTdaysS2	TTdaysS2 > 0	+3
	AreaVeg	AreaVeg> 50	+1
	Ratio_stability	Ratio_stability > 20	+1
Annual crop	TTdaysS2	TTdaysS2 > 0	+1
	AreaVeg	AreaVeg > 50	+1,5

X >Change score treshold P1

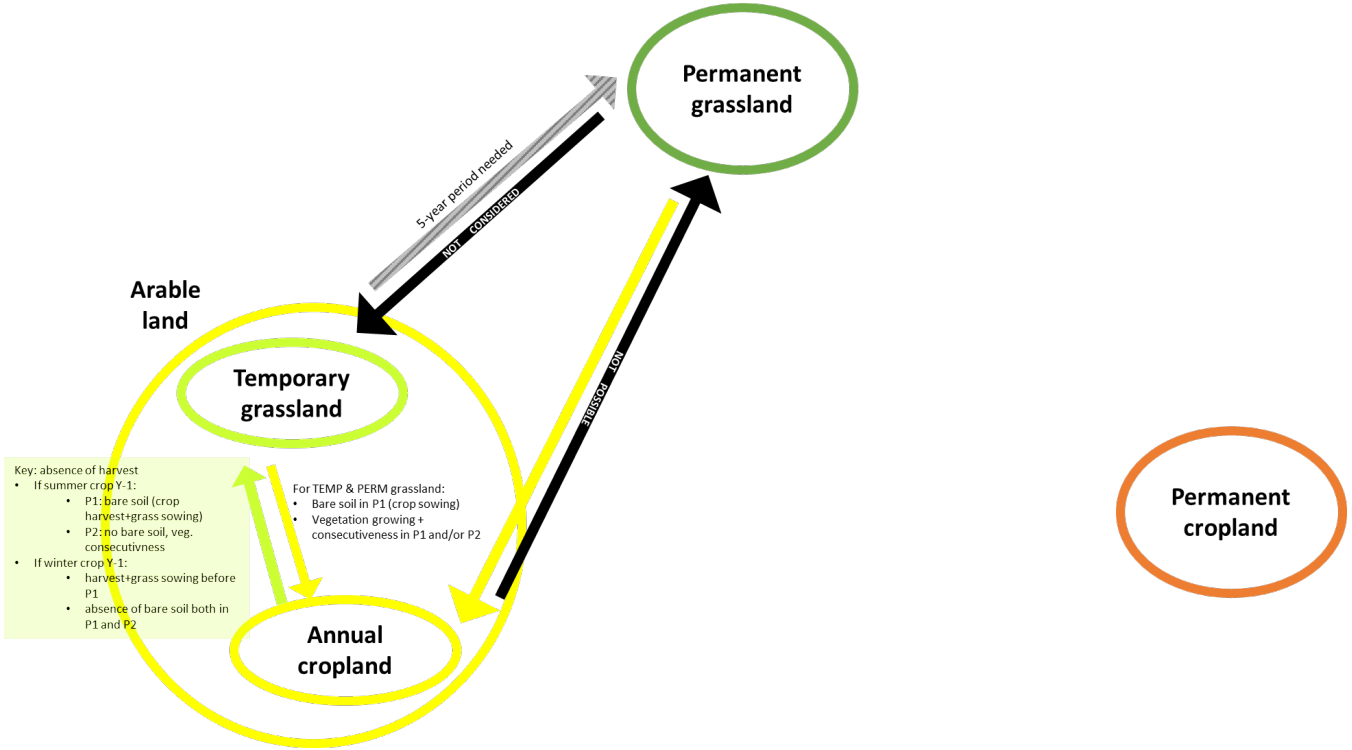
Change score computation : Tresholds values Period 2

	Marker	Tresholds	Change score value
Grassland	TTdaysS2	TTdaysS2 > 0	+2
	Ratio_stability	0 < Ratio_stability < 25 Ratio_stability > 25	+1 +1.5
	Consec_stability	Consec_stability > 1	+1
Permanent crop	TTdaysS2	TTdaysS2 > 0	+3
	AreaVeg	AreaVeg> 25	+1
	Ratio_stability	Ratio_stability > 20	+1
Annual crop	TTdaysS2	TTdaysS2 > 0	+1
	AreaVeg	0 < AreaVeg < 50 AreaVeg > 50	+0,5 +1.5

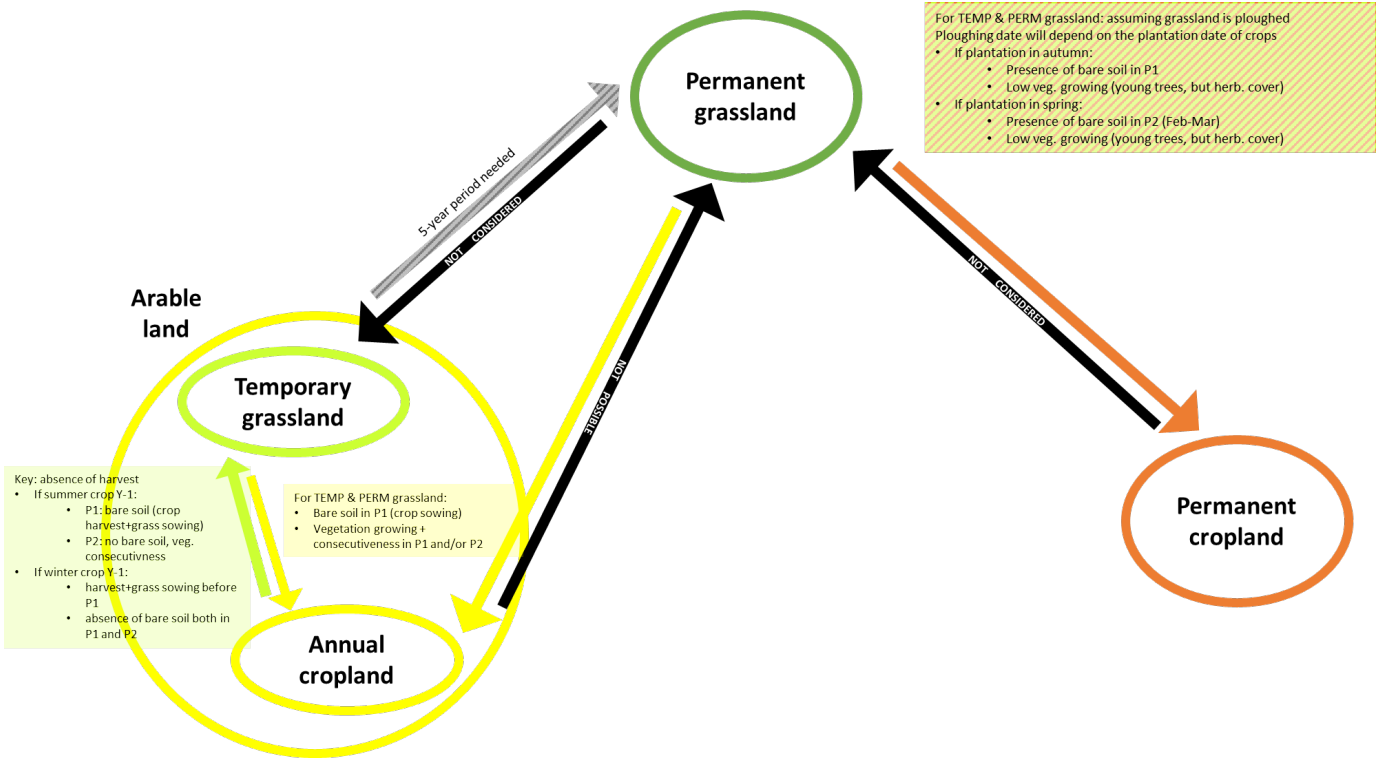
X >Change score treshold P2

Agricultural category change prediction

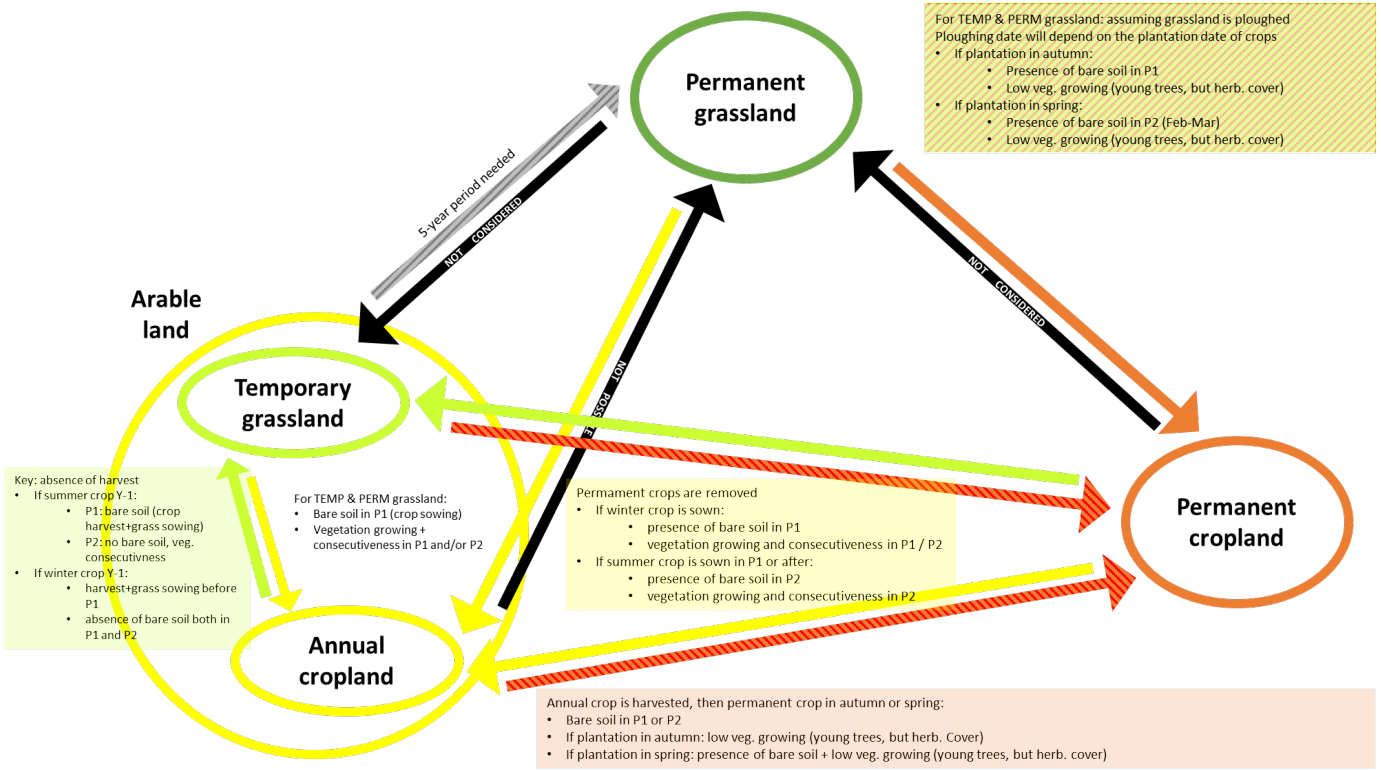
Change of Agricultural Category – interpretation grid



Change of Agricultural Category – interpretation grid



Change of Agricultural Category – interpretation grid



Webinar outline

- Sen4CAP overview
- New use cases and processors
  - Parcels heterogeneity
  - Bare soil detection
  - Change of land category
- **System evolution**
  - **New version 4.0**
- Conclusions and next steps

Sen4CAP versions

Version 1.0 release candidate

Open-source

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

Version 1.1, 1.2, 1.3

Version 2.0

Markers database

Tillage processor

Dockerization

…

Version 3.0

Web interface

Products visualization

Additions in MDB

Secured services

Dockerization

…

Version 3.1

Support for MAJA 4.5.4

Version 3.2

Updates for the Creodias datasources

Updates for USGS datasources

New markers in MDB1

…

Version 4

Bare soil processor

Change detection processor

Heterogeneity processor

Copernicus DAS data source

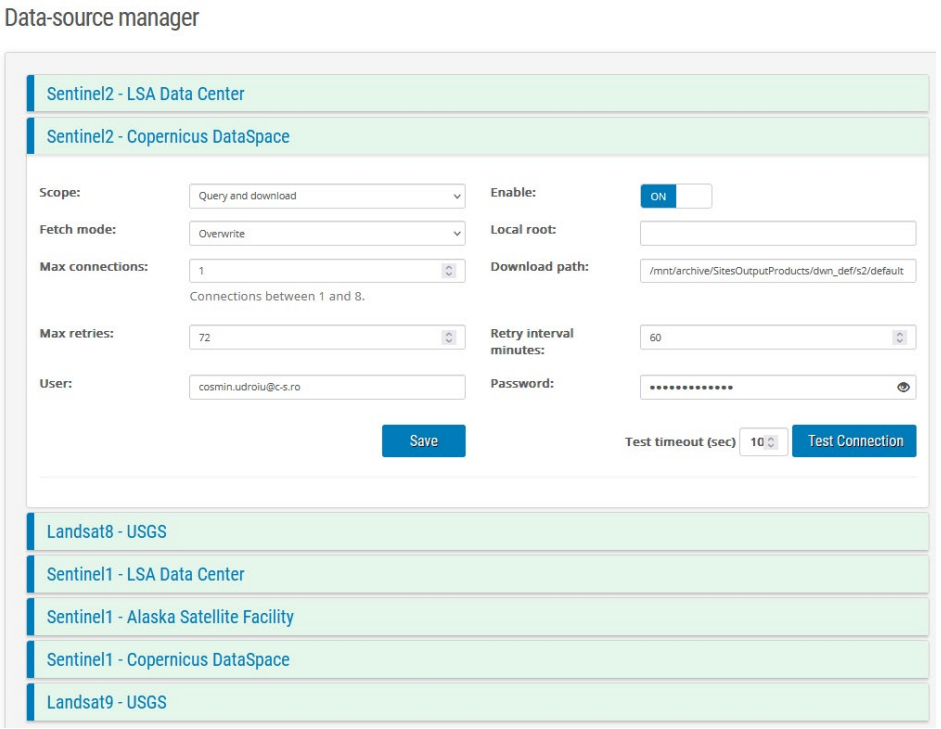
…

Version 4 new features

- **System evolution – New version 4.0**
  - New Postgis 16-3.4 version for new installations
  - New Copernicus Data Space Ecosystem (DAS), LSA and ASF data source
  - Removed the SciHub data source
  - Added Bare soil processor
  - Added Change detection processor
  - Added Heterogeneity processor

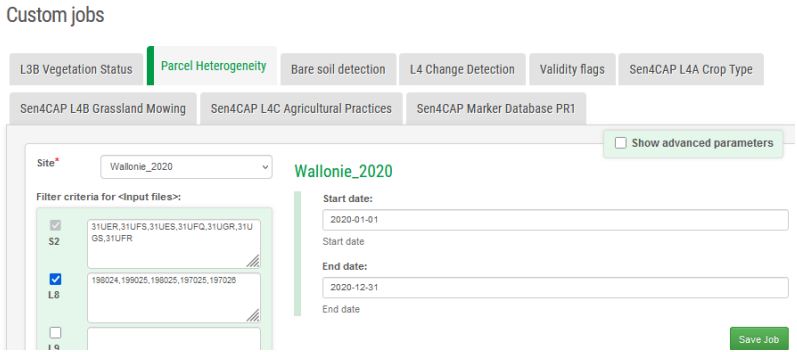
Version 4 new features

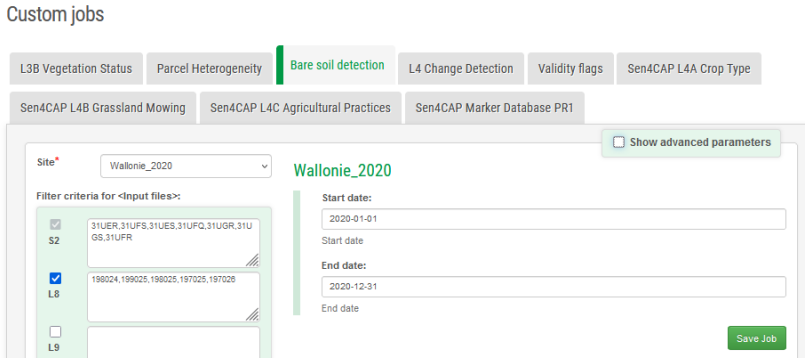
- **New Copernicus DAS data source**
  - New account needs to be created
  - Local root not supported yet
    - In the next future to support the access to EO data via S3 API
- **New LSA data source**
- **New ASF data source**



Version 4 new features

- **Bare soil processor**
  - **Inputs** :
    - ✓ MDB 1
    - ✓ MDBL4A_SAR_Main
  - Simple start/end dates selection

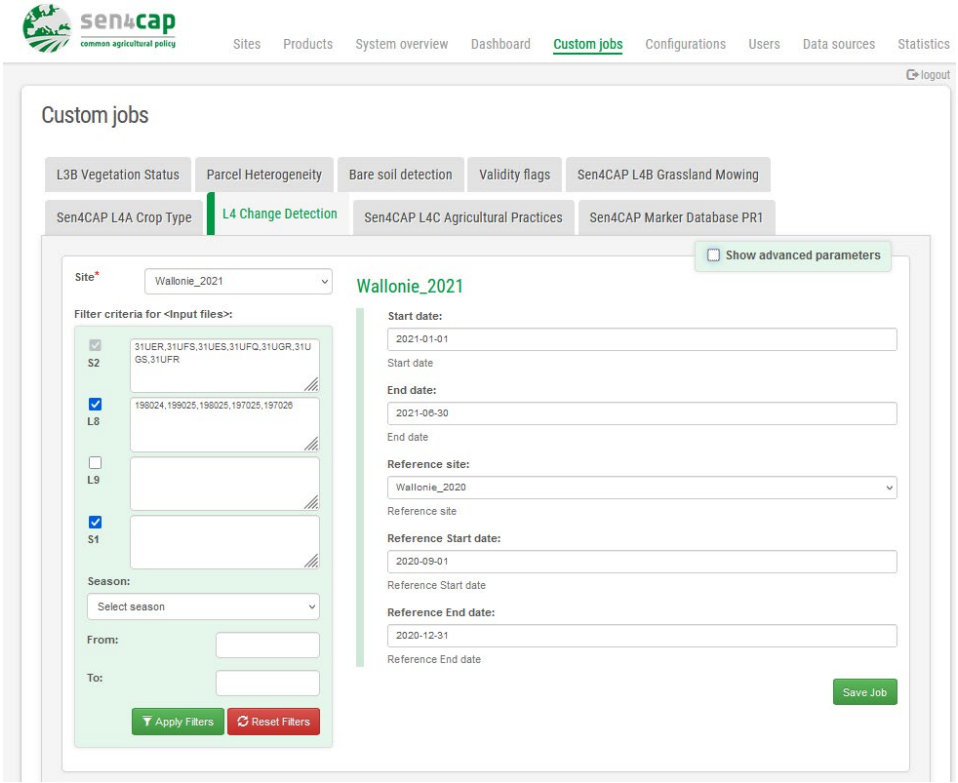




- **Heterogeneity processor**
  - **Inputs**
    - ✓ L3B (NDVI only)
    - ✓ S1 weekly temporal resampled rasters
      - ❖ CropType processor is launched automatically inside
    - ✓ L2A with validity masks

Version 4 new features

- **Change detection processor**
  - **Inputs** :
    - ✓ MDB1
    - ✓ MDB L4A Optical Main
    - ✓ Bare soil products
  - Two sites are involved
    - ✓ Main site
    - ✓ Reference site
  - Start and end dates to be provided for both reference and main site



Webinar outline

- Sen4CAP overview
- New use cases and processors
  - Parcels heterogeneity
  - Bare soil detection
  - Change of land category
- System evolution
  - New version 4.0
- **Conclusions and next steps**

Next events

- **Forum** for your questions about the system 4.0 (and other)

- **ESA ITT** about **« Sen4CAP cloudification »**

SEN4CAP – future developments & opportunities

- While after several years of funding and contract changes, the SEN4CAP project comes to an end, ESA intends to initiate a long-term perspective with a dedicated Invitation to Tender

- Cloud readiness:
  - Transform SEN4CAP key functionality into modular cloud-based services and deploy e.g. in CDSE
  - Implementation to follow a cloud native approach and expose functionality via API and python libraries

- Open-Source readiness:
  - Ensure and prepare resulting source code for community contributions and engage with relevant initiatives

- Basic scientific enhancements:
  - Not the focus of this ITT, but selected critical CAP related enhancements to be implemented as well

INFORMATION-AS-A-SERVICE PATHFINDER: SEN4CAP

Evolve existing SEN4CAP algorithms to cloud-based on-demand services

- open-source consolidation
- ready for community maintenance & evolution
- modular functionality via client libraries and APIs
- datacube-centric refactoring

Call for Proposals, Q2

~ 400-600K, one pathfinder

interested? ➔ Patrick.griffith@esa.int

Next events

- **Forum** for your questions about the system 4.0 (and other)
- **ESA ITT** about **« Sen4CAP cloudification »**
- **Your questions ???**


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