CbM Outreach Kick-Off

Date: Friday, 19th March 2021

Agenda

Session 9:00 - 10:00

- Opening (Wim Devos, JRC)
- CbM outreach 2021 – Overview (Rafal Zielinski, JRC)
- DIAS use for CbM outreach (Guido Lemoine, JRC)

Session 10:00 - 11:15

- Technical questions follow up (Rafal Zielinski, JRC)
- The concept of marker and scenario (Pavel Milenov, JRC)
- Agricultural Activities Detection & Crop Persistence Verification (Daniele Borio, JRC)

Session 11:15 - 12:00

- Discussion and organizational arrangements (Rafal Zielinski, JRC)

A list of subjects/questions discussed during the meeting including the JRC responses

Kick-off meeting agenda

9:00 – 10:00	**Opening** CbM outreach 2021 – Overview DIAS use for CbM outreach
10:00 – 11:15	Technical questions follow up The concept of marker and scenario Agricultural Activities Detection & Crop Persistence Verification
11:15 – 12:00	Discussion and organizational arrangements Closing

Welcome to CbM Outreach KO - participation rules

1. Identify yourself: "MS/INS – Firstname NAME" e.g. "*US – Joe BIDEN*"
2. WEBEX:
   - Unless you take the floor: **mute** microphone and **disable video** to save bandwidth
   - Use the **chat for meeting messages** only: e.g. "*no sound*", "*black screen*"
3. Sli.do: https://app.sli.do/event/yczr8qrf or event code #41613
   - Ask **NAMED** and **targeted** questions: "*From JRC – Wim DEVOS @Philippe: Why sli.do*?"
   - Stay **on topic**: e.g. NOT: *"@theRealDonaldTrump: When will I get my vaccination?"*
   - **"Like"** 👍 earlier questions (anonymously) to prioritize

23rd MARS Conference

Tuesday 28 November 2017

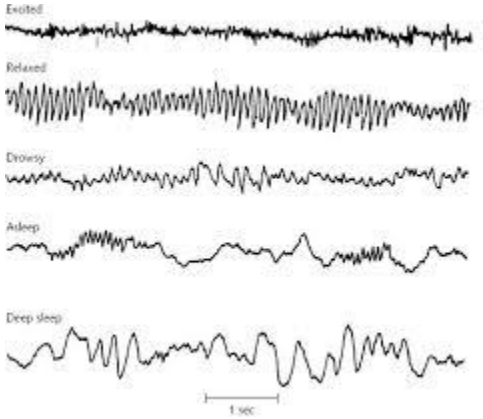
Technical discussion on the introduction of monitoring to substitute OTSC

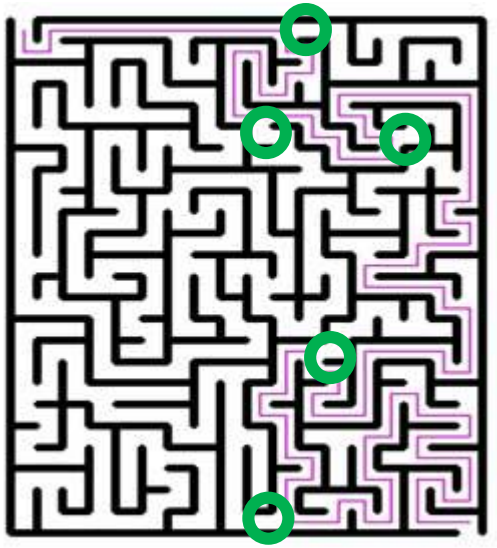
Joint Research Centre – Ispra - Italy

European Commission

Tracking

- Legacy information from previous years
- Initial Application [start]
- Incremental geotagged pictures
- Sentinel data through the use of
  - Marker: *LC observation*
    descriptor of physical state or transition
  - Scenario: *expected impact of LU (activity/practices)*
    - occurrence (of a sequence) of markers for a required/allowed practice/activity
    - absence (of a sequence) of markers for a banned process
- After care





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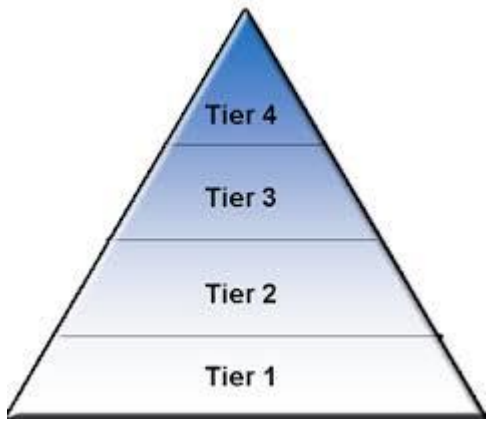
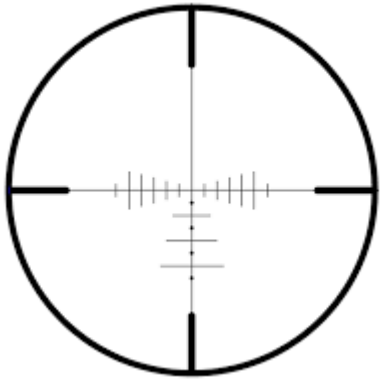
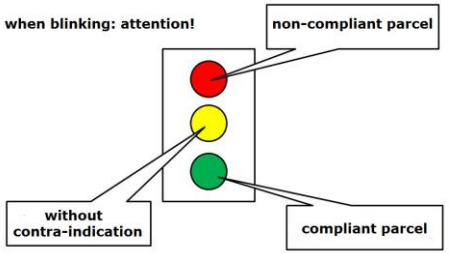
Assessing

- **Tiered**: not a batch processing wave but a controlled breakdown of feasibility / requirements / reliability / timing / interactions
- **Reductive**: an item becomes exempt from further processing when
  - Monitoring provided conclusive evidence
  - The application it belongs to no longer requires evidence

  → use of traffic lights on AP level
- **Targeted**: not a blind classification but search for significant markers







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These remain the driving principles behind this OUTREACH

Checks-by-Monitoring outreach 2021 – Overview

GTCAP
Kick-off meeting , 19 Mar 2021

Kick-off meeting agenda

9:00 – 10:00	Opening **CbM outreach 2021 – Overview** DIAS use for CbM outreach
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Agenda

- What is the outreach initiative?
- Analyses of submitted challenges
- Priority selection for 2021
- Communication and meetings
- Data from Member States

CbM: Outreach 2021 (1/2)

- Rationale
  - To develop best practices for common technical issues linked to detection of agricultural phenomena with Sentinel data
  - To create JRC's Common catalogue of best practices (ECA rec.1.1.)
- Main aims of the support to the Paying Agencies:
  - To provide better understanding of the overall potentials/limits of Copernicus Sentinel satellite data in their landscape via customised extraction of information needed for their CAP processes
  - To lower the technology threshold by offering JRC's publicly available toolkit built on standardized access to data and services

CbM: Outreach 2021 (2/2)

- Initial setup:
  - For Member States willing to take up initiative
  - Up to 3 topical information to be submitted, placed in a specific context (local conditions, schemas, landscapes)
  - Given that this approach is based on bilateral exchanges, Member States could be invited to provide additional input, for example, information on applicable eligibility criteria and/or samples of ancillary data to enable the processing.

Outreach priorities

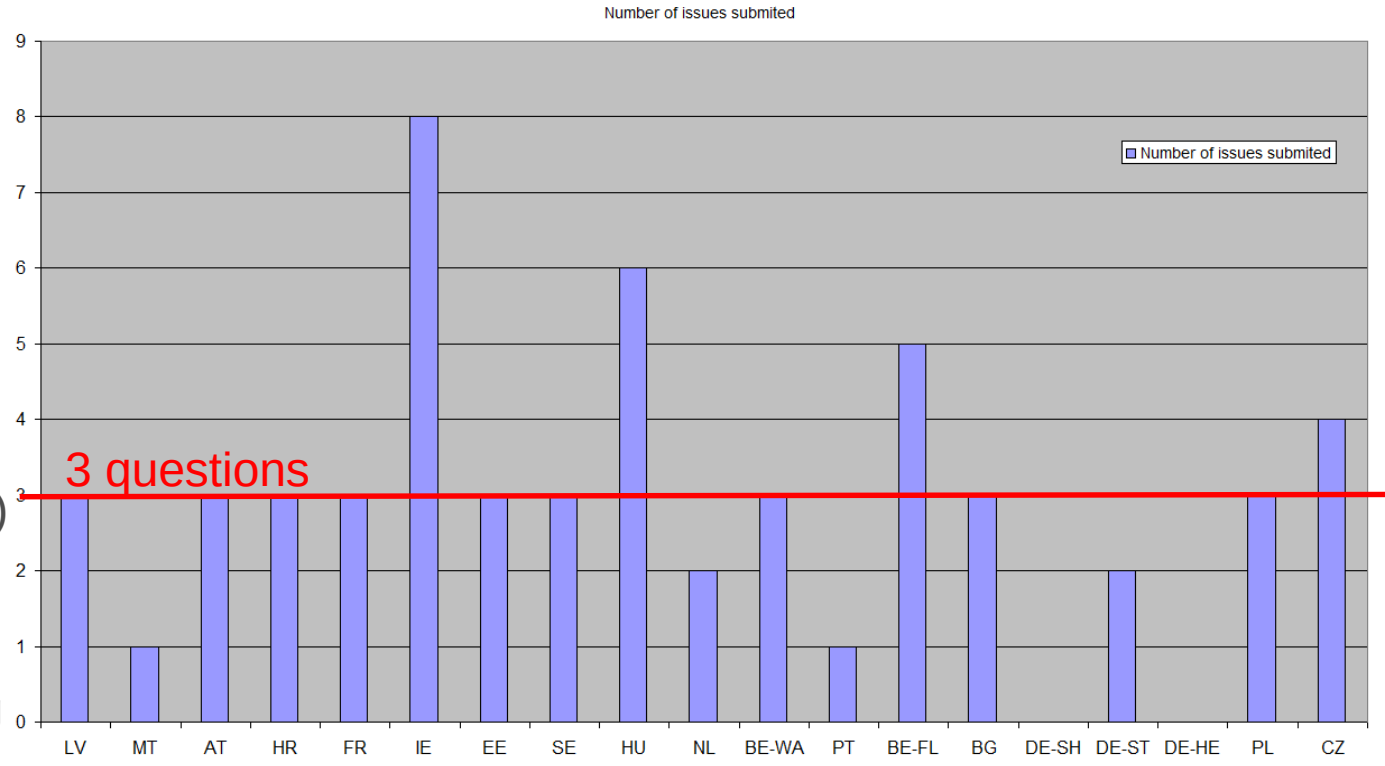
- The overall approach is to start with “**low hanging fruits**” and subsequently elaborate the more challenging topics as experience and expertise grow.

- Collaborative approach (JRC/MS)

- NOT: fillgap / backstop of national pilots!

Submission summary

- **19** replies received
- In total **56 challenges** submitted
- CbM adopters (since 2019):
  BE-FL, MT
- Official CbM 2021:
  PT, LV, HR, BE-WA, IE, DE-ST, DE-SH
- The future adopters, OTSC users
  (AT, FR, EE, HU, NL, BG, PL, CZ, SE, DE-HE)
- Challenging interpretation:
  - Completeness: single sentence **vs** a page long description
  - Complexity: single issue **vs** many issues



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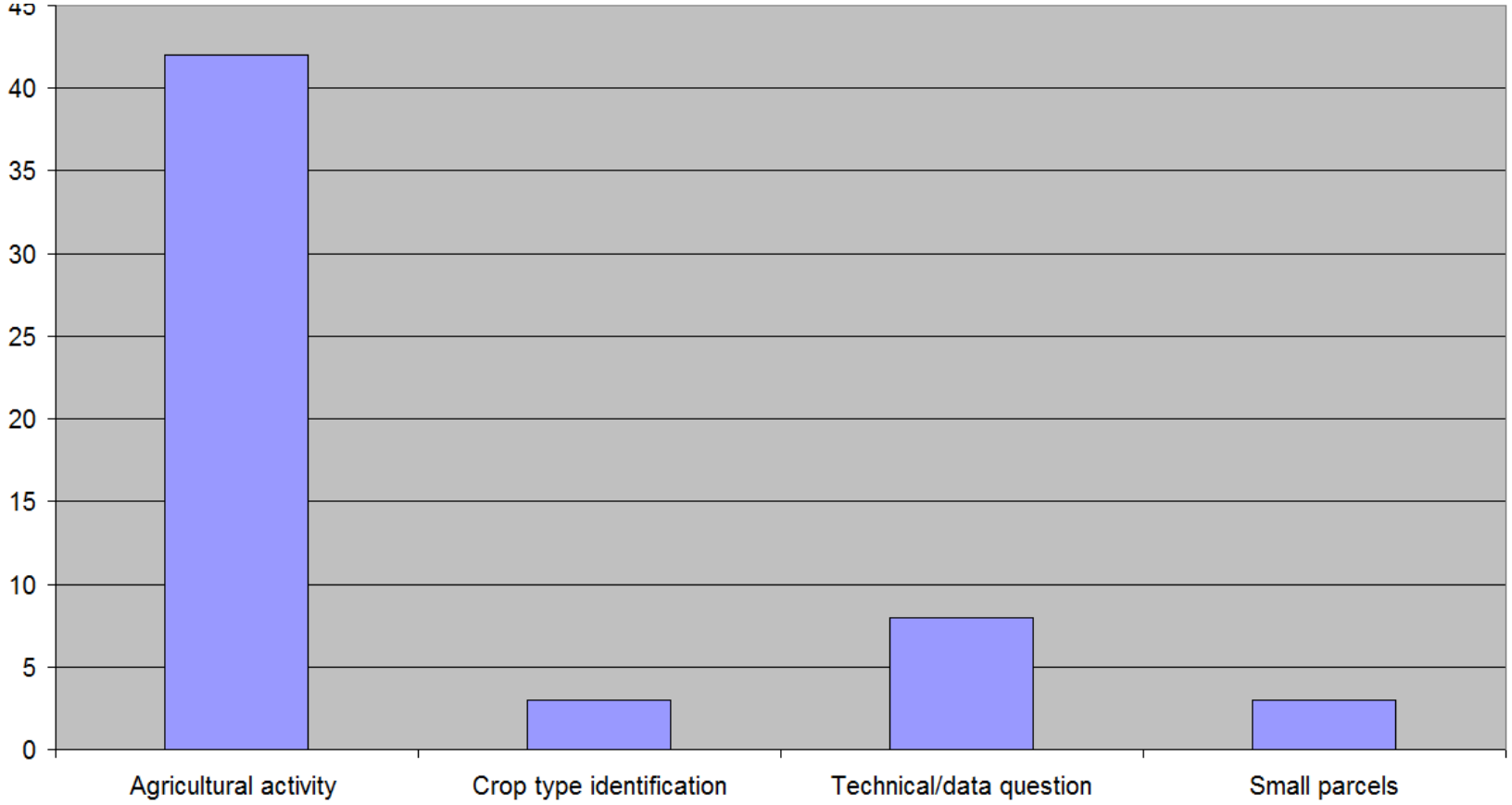
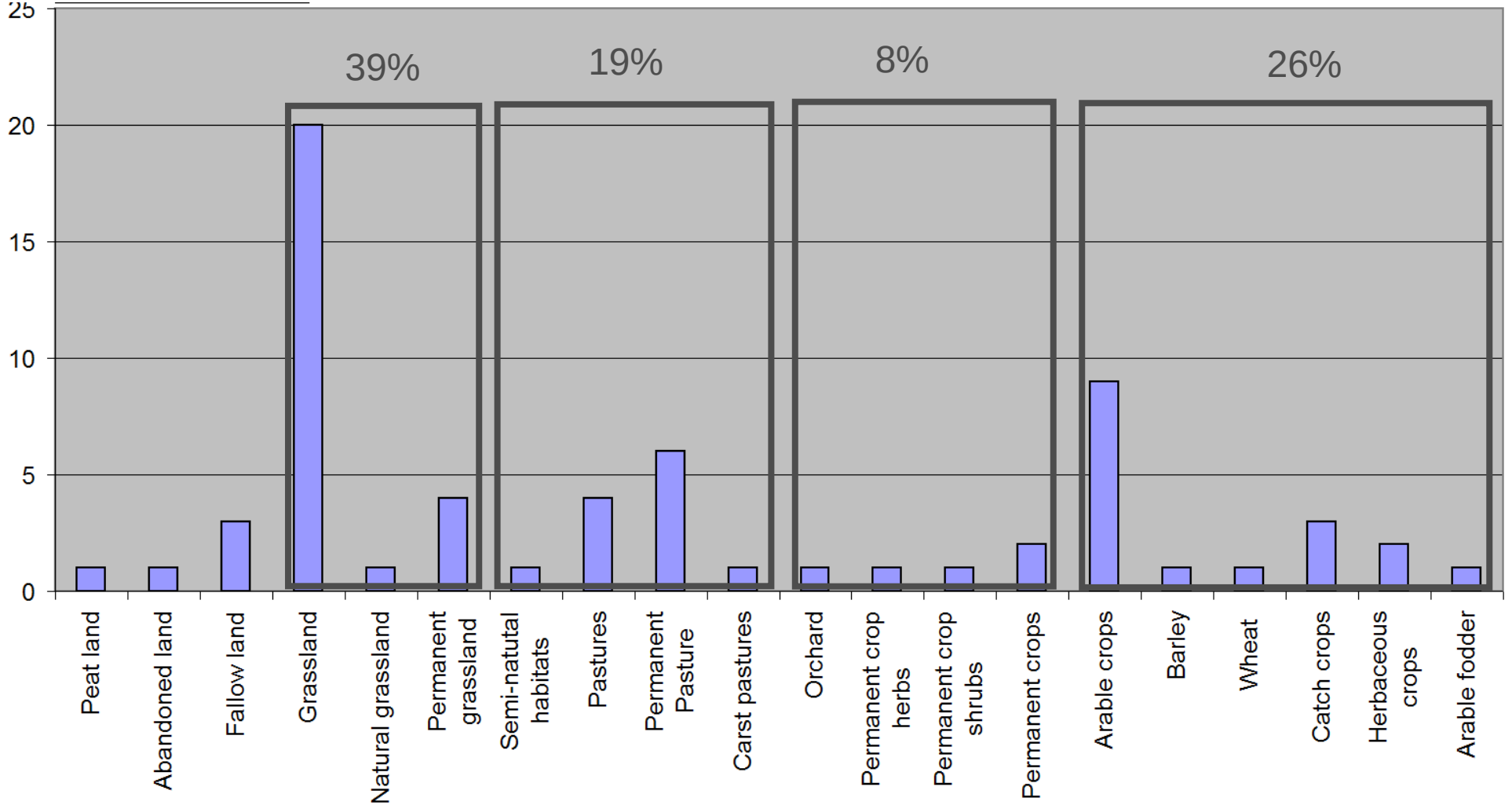
Questions/topics: by the context

- A number of labels/ keywords added – for comparative analyses
- Main focus on:
  - Agricultural activities
- Technical/data questions
  - Sensor/Band
  - Best approach,…
- Small parcel
  - Complex shape
  - Small area



Questions/topics: by the crops as declared

- Grasslands: 39%
- Arable crops 26%
- Pastures: 19%



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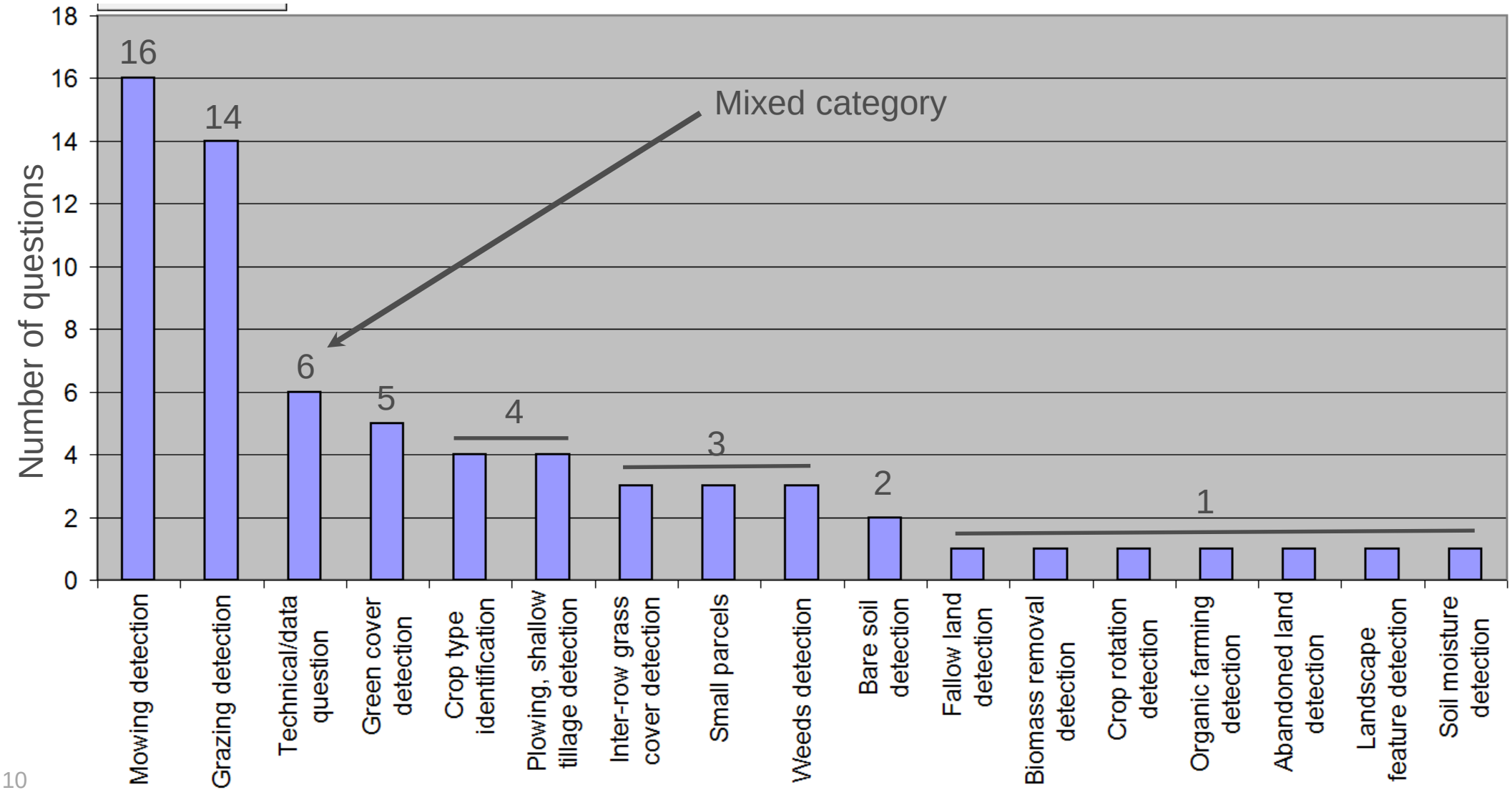
Questions/topics: Agricultural “phenomena” ordered



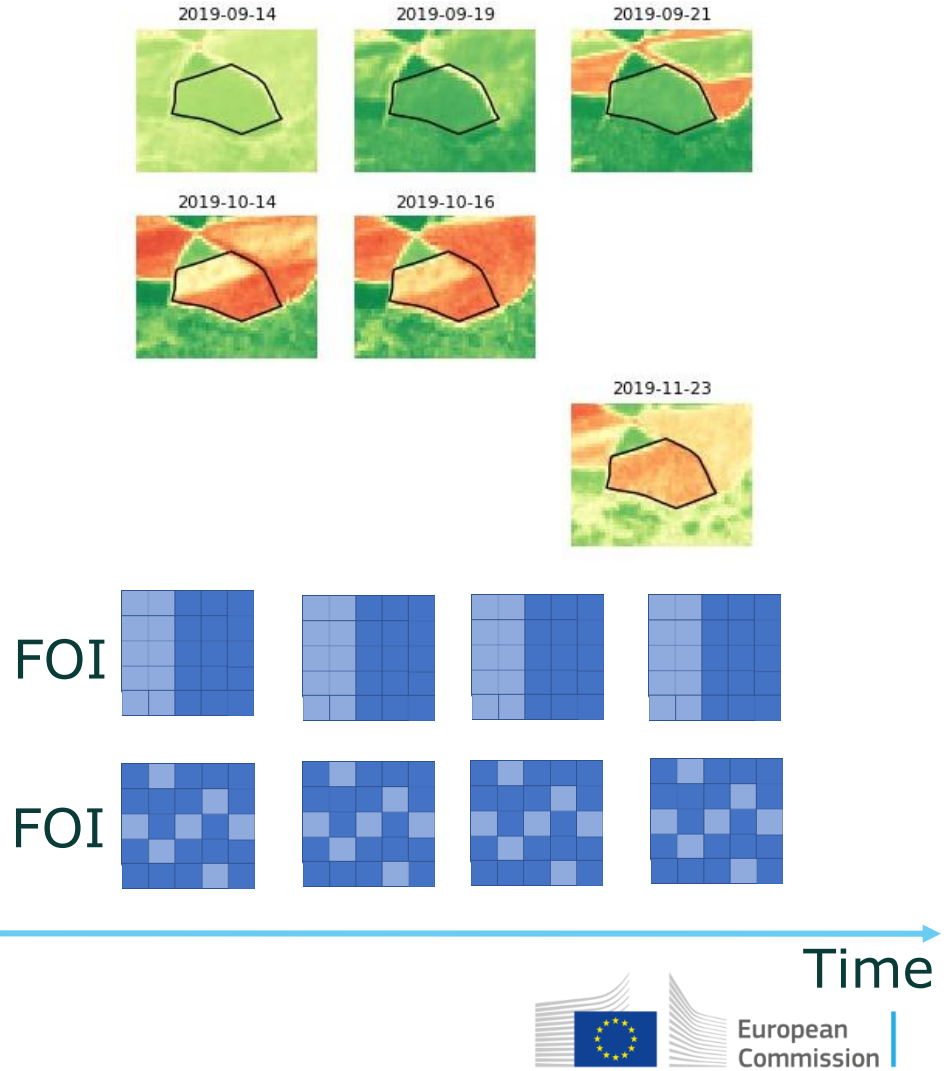
Complexity across one challenge

- **Mowing -** detecting of agricultural activity, crop maintenance, crop status
  - **Crop**: (natural/permanent) grassland, pastures, semi-natural habitats, herbaceous, fodder, open landscape
  - **AOIs**: hilly and sloped areas, Northern territories,
  - **FOI**: complex shape, small area, including trees and bushes
  - **Activity**: throughout season or in a specific period (i.e. autumn, October), one or more occurance during the season, entire FOI at once or partial moving
  - **Other conditions**: removal of biomass
  - **Output**: yes/no, dates of events, confidence value,

(more in Daniele's ppt)

Questions/topics: Additional constrains

- FOI creation and handling
  - Parcel size, narrow parcels
  - Complex shape parcels
- FOI/Sub-FOI analyses
  - Heterogeneity
  - Split/partial agricultural activity detection
  - Selection of representative group of pixels
- Local context and various schemes
  - SPS, Voluntary Coupled Support, Agro-Environmental measures, etc.



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The selection of subjects

1. Technical questions – a set of technical questions /no data processing
2. M…evelopment - **mowing detection**
3. Marker de…t - **grazing detection**
4. Ma…evelopment - **green cover detection**
5. Marker de… - bare soil detection (**soil cover**)

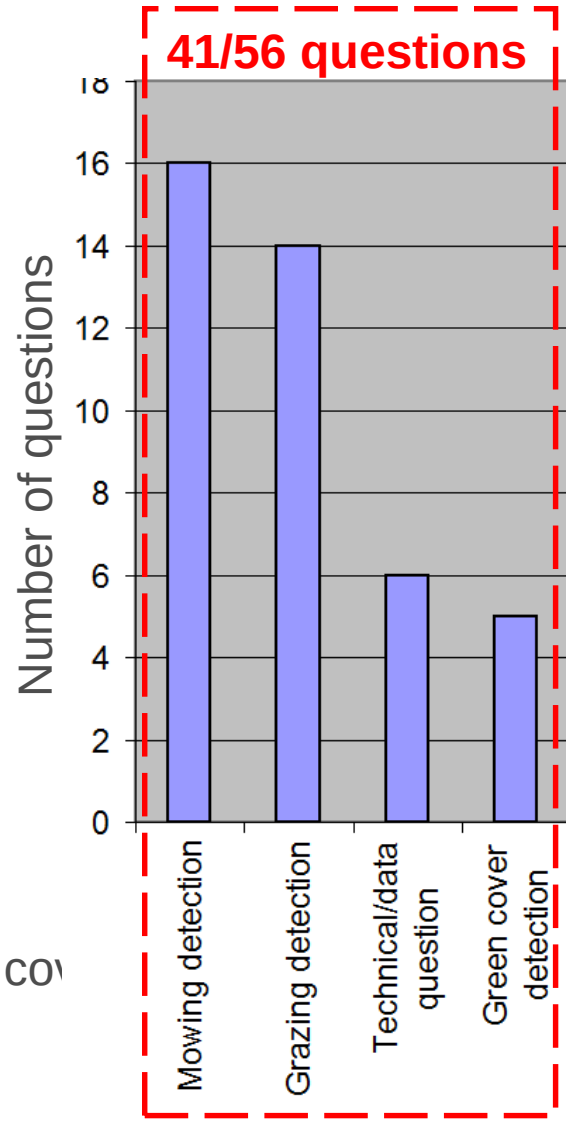
Grassland

Arable land

→ Data required

Collaborative work towards automation

The other challenges, such as: small parcels, crop rotation, ploughing, inter row co… detection and abandoned land will be dealt with, if applicable, under direct CbM support, or, if outreach resources allow, at a later date.



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Communication and meetings

- Kick-off meeting
- Data exchange and verification
- Technical session - to address submitted technical questions
- Within a given subject (x number of subjects)
  - Bi-lateral meetings, per subject, to understand scenario/local condition
  - Common marker definitions + local conditions
  - Small groups + collaborative analytics (PAs/JRC)
  - Technical meeting during the development/validation phase
- Closing meeting

Groups of interest

1. Technical questions:
   EE, IE, HU, HR and PL → 5 PA

2. Marker development - moving detection:
   AT, BE-FL, BE-WA, BG, CZ, EE, IE, LV, NL, and SE (FR, DE-SH) → 12 PA

3. Marker development - grazing detection:
   BE-WA, BG, CZ, DE-ST, EE, IE, LV, HU and SE (FR, DE-SH) → 11 PA

4. Marker development - green cover detection:
   AT, BE-FL HU and IE → 4 PA

5. Marker development - bare soil detection:
   AT and MT → 2 PA

- Small communities created based on common challenges
- Collaborative analytics towards automation

What next?

- [PA] A selection of the representative AOIs
- [PA] Datasets submission (best by the **15/04**)

dreamstime.com

- [JRC] Provision of solutions to the technical questions
- [JRC] Schedule a set of the bi-lateral meetings for the first subject **1. Mowing detection**
- [JRC] Communication of materials for the bi-lateral meetings

- [JRC] Set up of a processing chain preparing and extracting the relevant information from the Sentinel stacks (more in Guido's ppt)

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Data - area of interest

- All data submitted will be used **only in the context of outreach** (method development and validation)
- **Representative areas for a given subject** to get the local variability
  - A spatial subset of your dataset that shows a real picture of the local situation
  - A full spectrum of the cases, not only boundary conditions (the impossible/ difficult one)
- **Complete dataset** with additional observations (i.e. OTSC results)
- A set of min **10.000 parcels/FOIs** for each subjects, bigger dataset to be discussed individually
- Parcel/FOI selection should be clustered geographically (up to one S1 scene 185x185km)
- The **time stamp of the data** (claim year) **can be considered secondary** as the completeness of the dataset has significant importance for the development/validation (**2018**, **2019, 2020**)

Data - type of information

- Information about the scenario and phenomenon

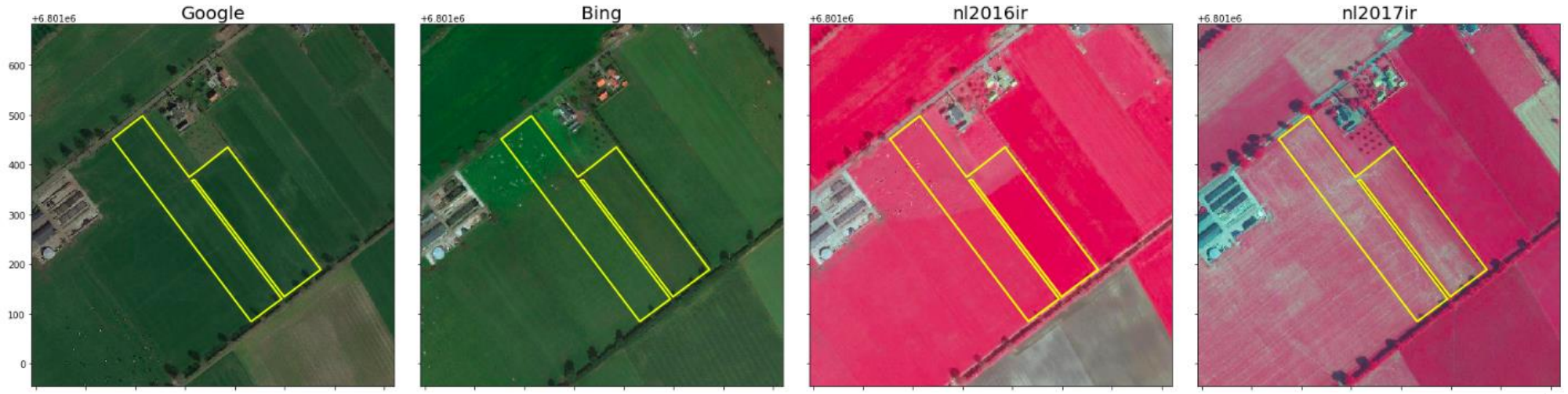
  ← **Bi-lateral meetings**

  - Payment scheme, eligibility criteria, local condition, crop and specific agricultural activities
- GSAA + LPIS
  - **Feature of interest (FOI)**: Geometry and attributes (including: id, area, crop code/name)
  - Information to facilitate understanding of the attributes (EN)
- Other data types
  - Aerial ortho, DTM/DEM, soil data - preferably in WMS
  - OTSC/RFV: 2020, 2019 – along with selected data year
  - Metrological data (Precipitation)
  - Geo-tagged photos, other data that may be useful in the context of a selected subject

Data: Data formats

- GSAA geometries (ESRI .shp format)
  - Topologically sound (cleaned)
- Any supporting information in English (.doc/.xls - or equivalent)
- Image data (Aerial/DEM/…): preferably WMS/WFS services



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Contact persons

- Outreach: Rafal.ZIELINSKI@ec.europa.eu
- DIAS/tools: Guido.LEMOINE@ec.europa.eu

Questions ?

Thank you

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DIAS use for CbM outreach

CbM Outreach Kick-Off meeting, 19 March 2021

JRC D5 – GTCAP Team

Kick-off meeting agenda

9:00 – 10:00	Opening CbM outreach 2021 – Overview **DIAS use for CbM outreach**
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Context

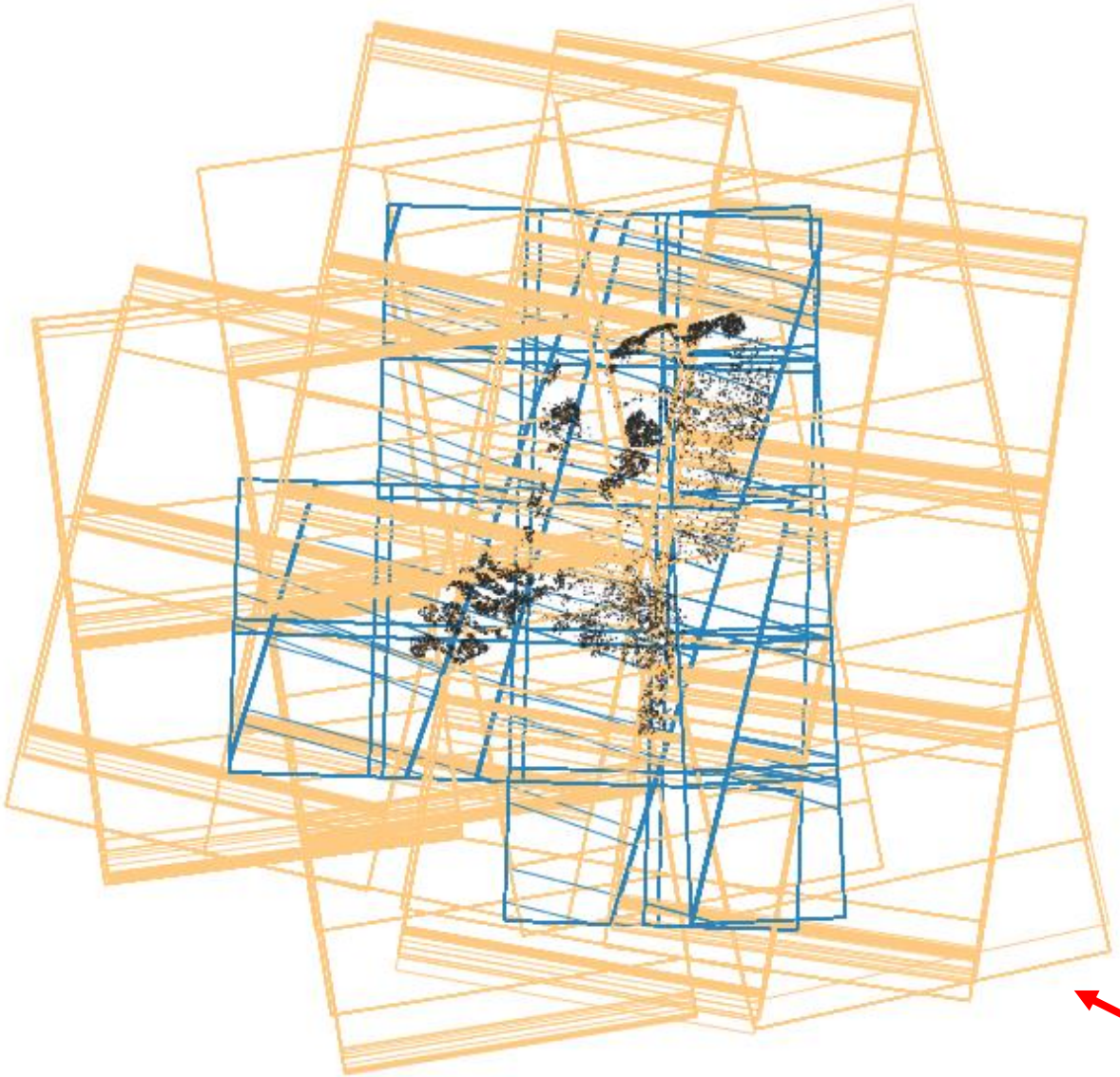
- Checks by Monitoring (CbM) introduces continuous use of Sentinel data streams for 100% of the Member States territory.
- Copernicus DIAS provide cloud-compute solutions, closely coupled to the complete Sentinel archive.
- DG AGRI finances DIAS access for different categories of Paying Agency users.
- DIAS use requires a considerable technical expertise, esp. for full scale use.
- JRC has developed a modular set of tools that address CbM functionalities.
- JRC will “abstract” DIAS use for outreach for all “backend” tasks (single DIAS)
- Outreach participants will access the “frontend”, in a collaborative set up.

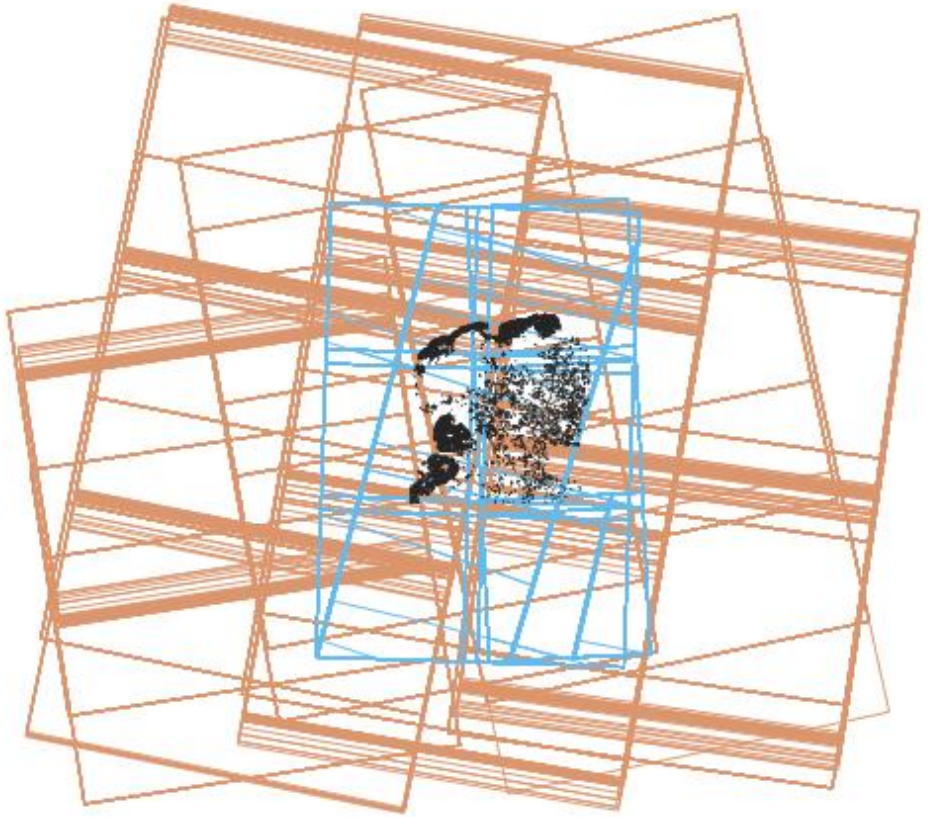
DIAS concepts (JRC view)

- Large volume processing must be fully automatic using a single standard
- Full territory application of CbM implies automated processing at parcel level
- Implies compliant FOI cardinality
- Reduction is an important step, but full traceability to the source data required
- The required functionalities can be implemented on DIAS **backend** (same for any use case, any scale or area of interest)
- **Backend** results are accessible to the **frontend** via server interfaces
- JRC handles the **backend**, Outreach participants will access the **frontend**

DIAS modules (JRC view)

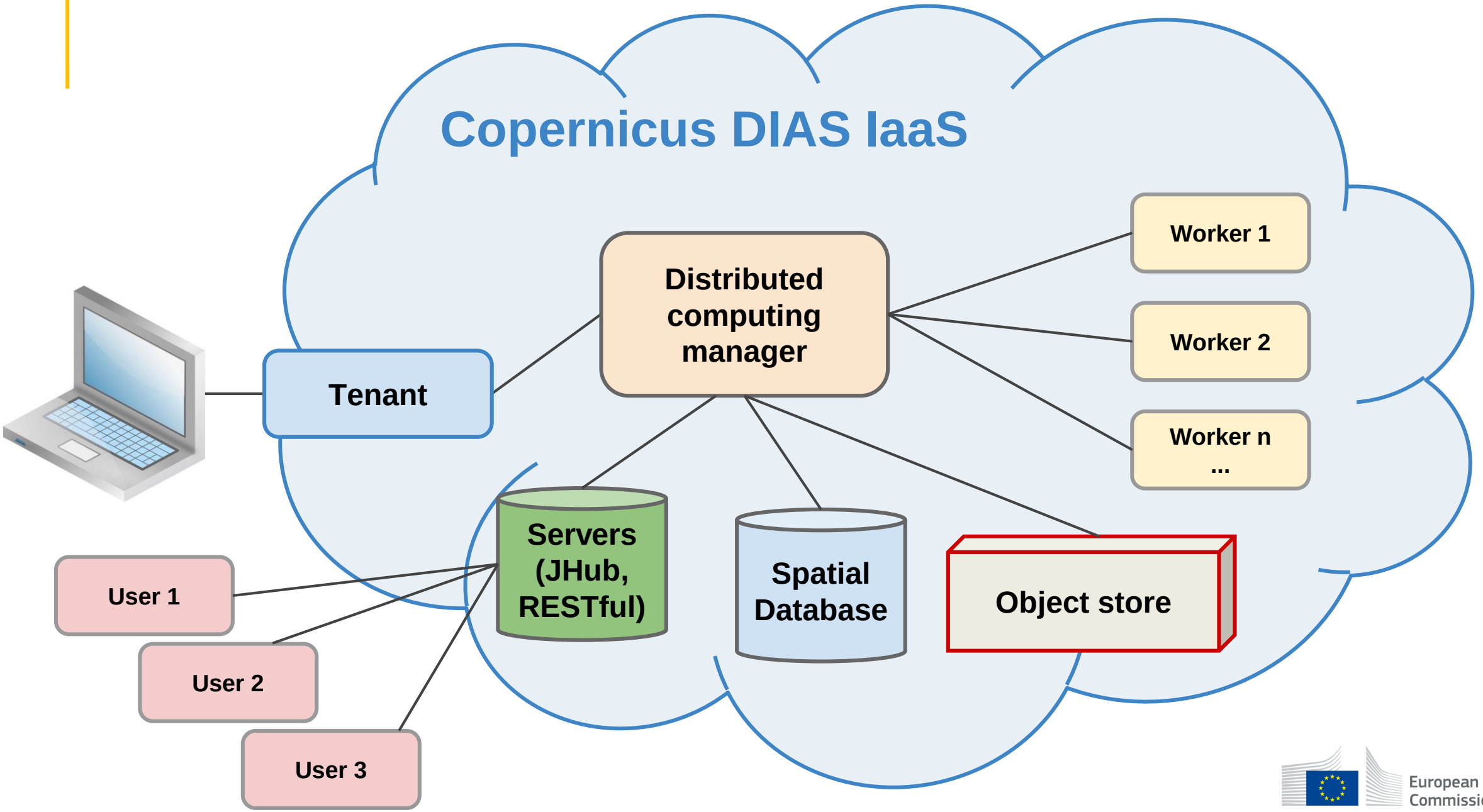
- Sentinel-1 CARD generation (BS, COH-6) for Outreach AOIs
- Automated time series extraction of S1-CARD and S2-Level 2A
- For previous years (2018 ff) and current year, incrementally
- For efficiency reasons, Outreach samples should preferably be clustered
- We use a spatial database server to provide secure access to results
- Combined with user/password protected access to RESTful services
- We can integrate access to National Spatial Data Infrastructure!
- All backend and frontend methods are from/going into github.com/ec-jrc/cbm





10000 potato parcels, clustered
Require 3371 CARD products

10000 potato parcels, not clustered
Require 7474 CARD products



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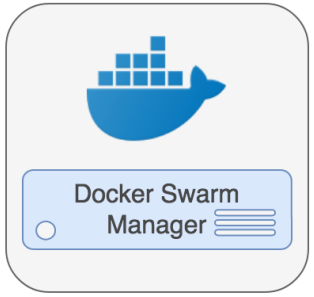
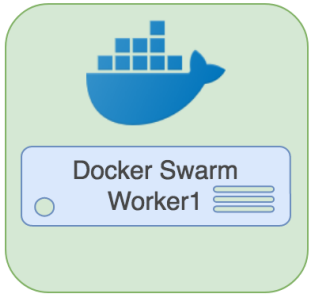
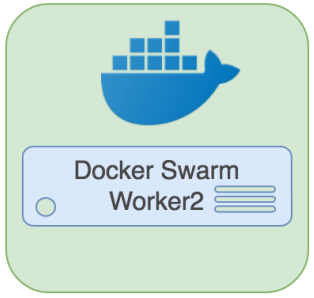
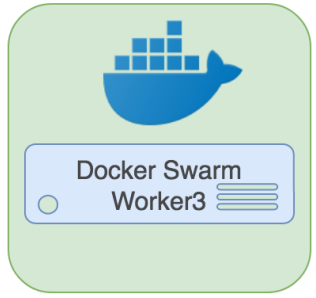
Open Source software components used





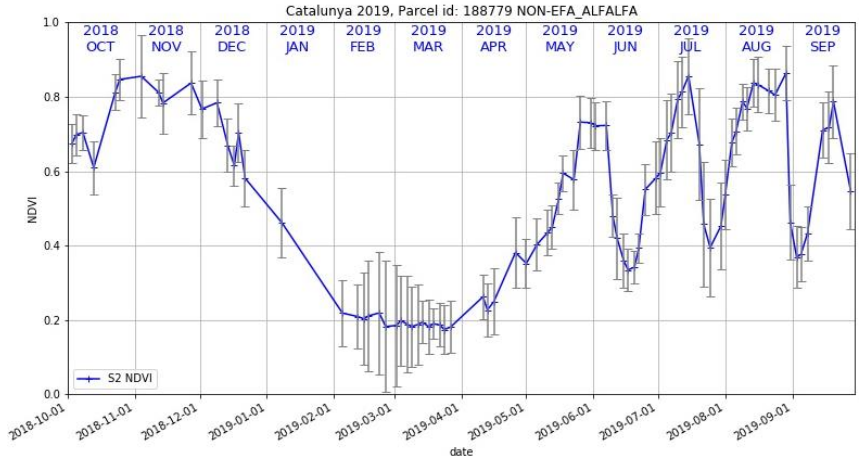




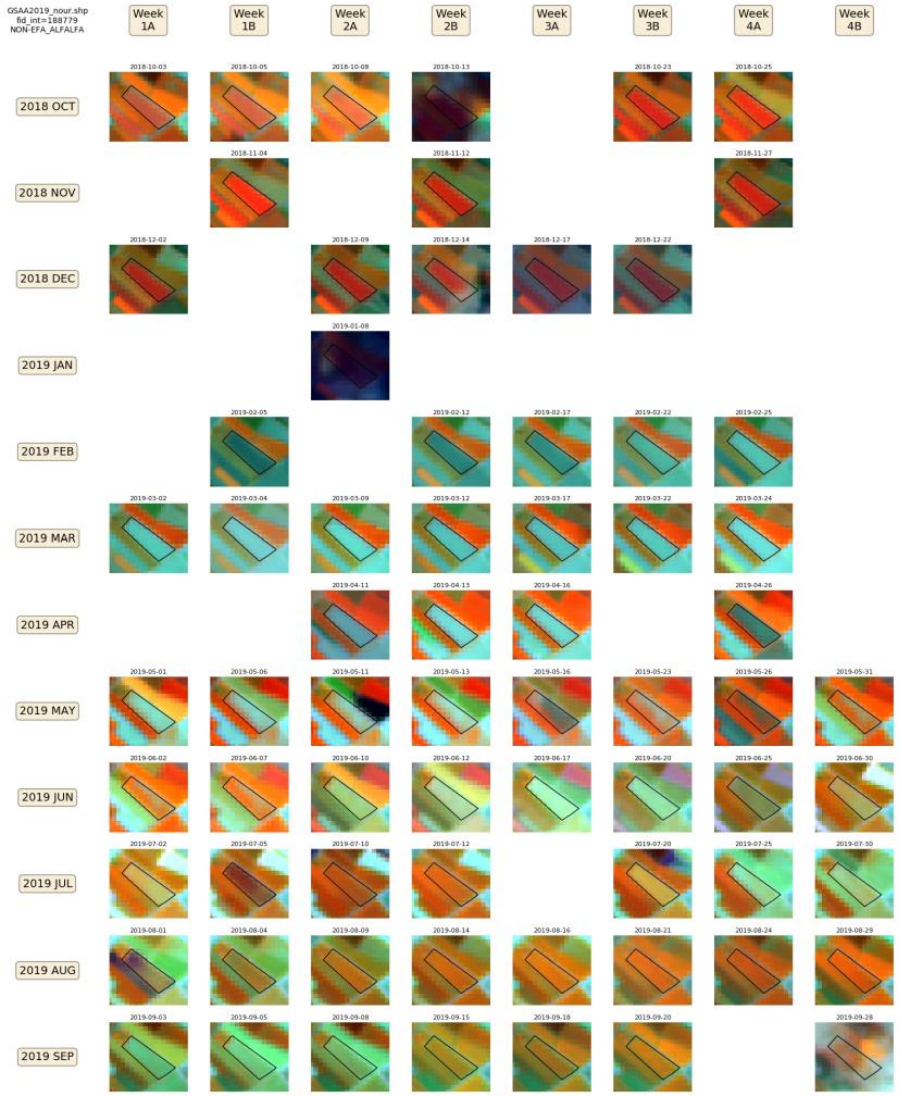
DIAS frontend use

- The **backend** holds the core “reduction” results and CARD data sets
- Data users get access via server interfaces (e.g. RESTful, JHub, map server)
- RESTful supports time series analysis (fast), sub-image selection (slow)
- RESTful can be “consumed” in scripts, automated reports, Jupyter notebooks
- The logic applied to time series and image extracts (“markers”) is applied in the **frontend** (e.g. event detection, outlier analysis, heterogeneity, etc.
- Joint JRC+PA data analytics with knowledge about Outreach contexts
- (some mature **frontend** functionalities may migrate to the **backend**)

Alfalfa parcel



S2 temporal profile



Imagettes display

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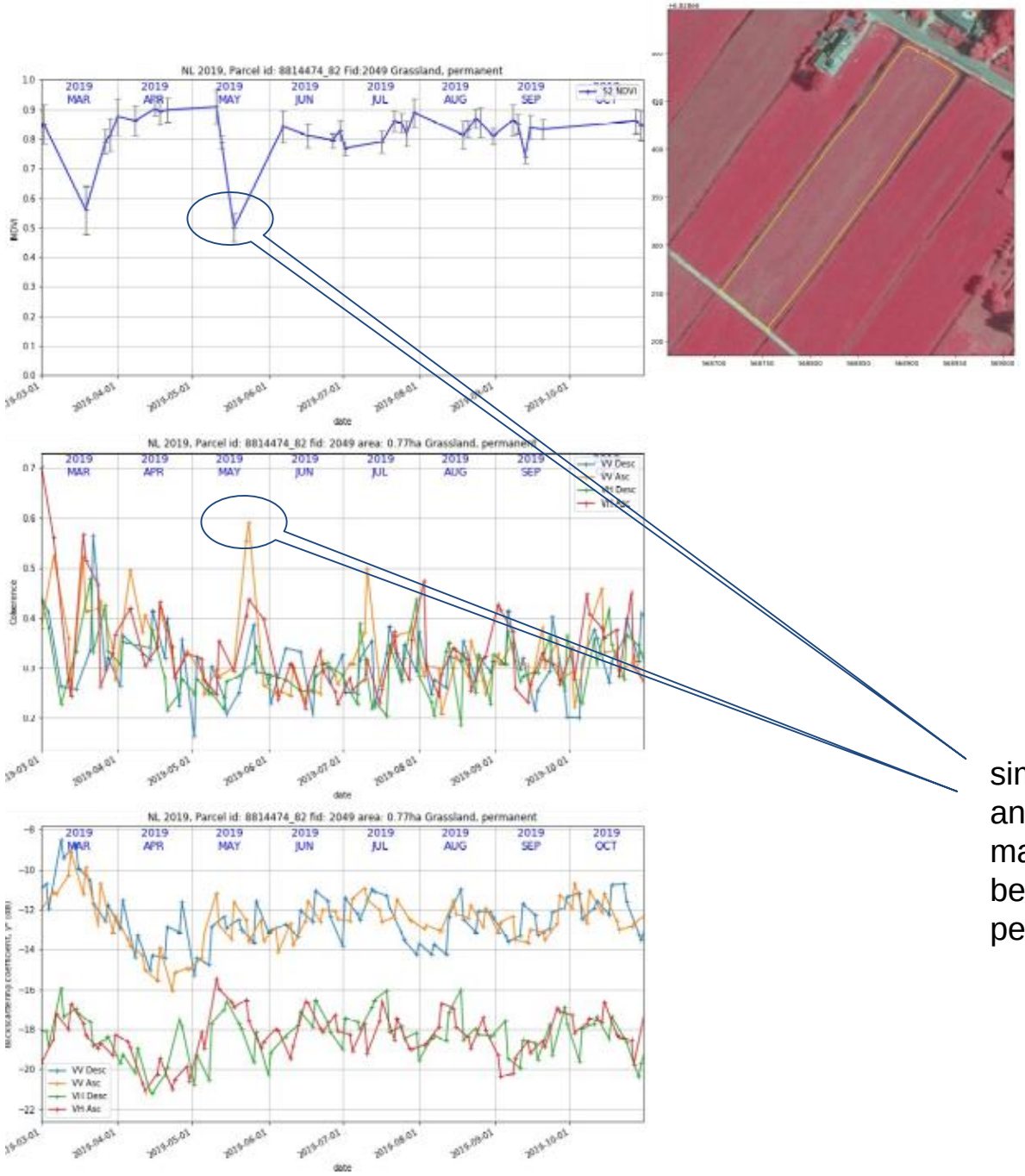
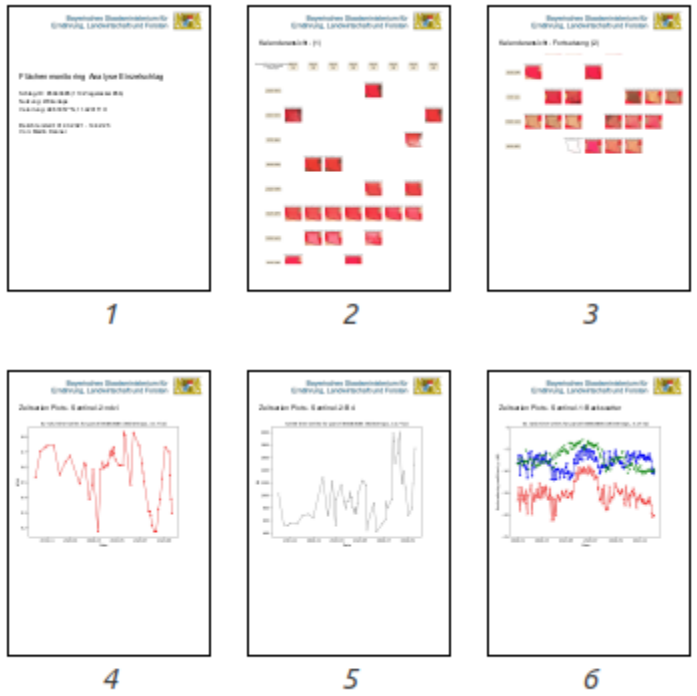


Pseudo-code:

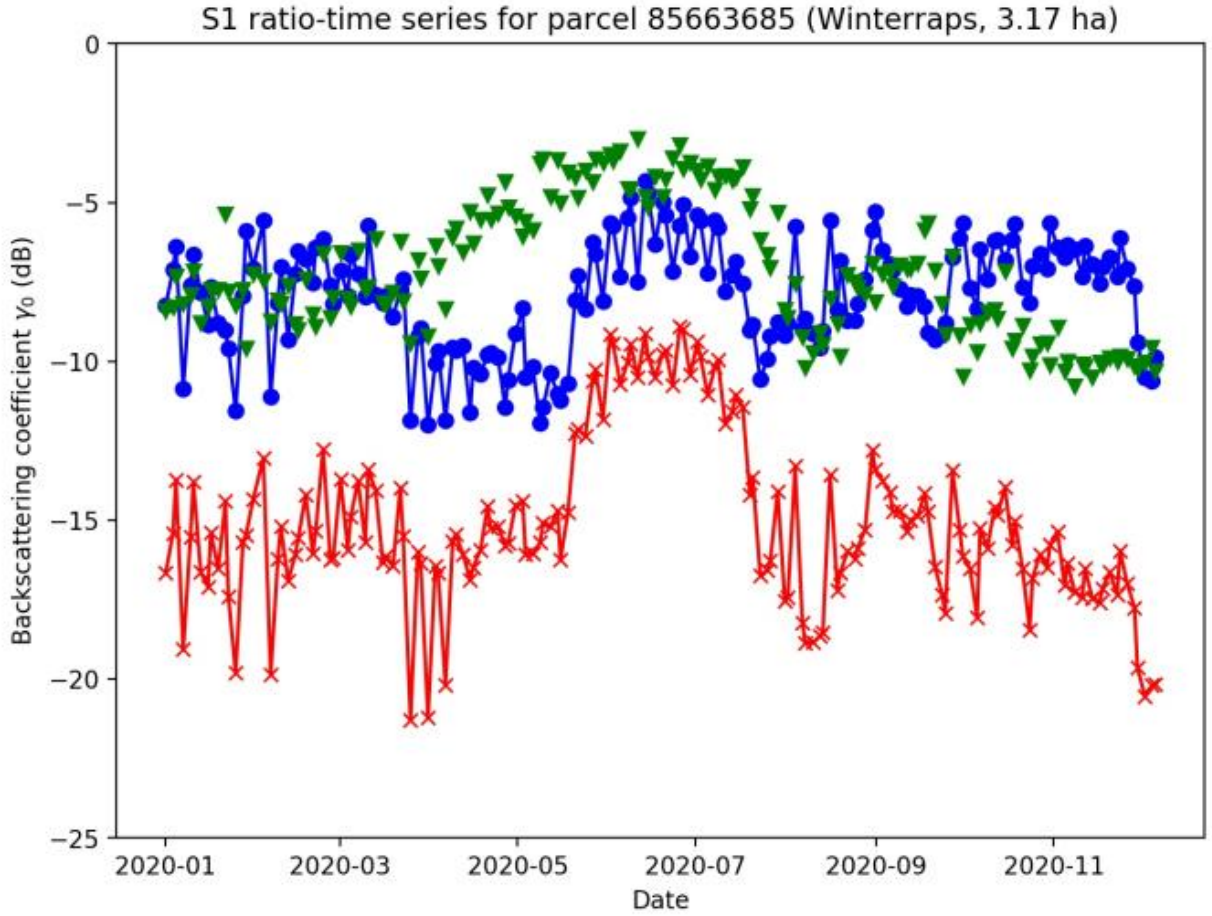
get B4, B8 from RESTful
calculate NDVI
plot
get S1 C6 VV, VH from RESTful
plot
get S1 BS VV, VH from RESTful
plot
getBackground from RESTful
plot
get parcel from RESTful
plot

simultaneous drop in NDVI and jump in coherence mark mark mowing event. Other behavior is typical for permanent grassland.



Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten

Zeitserien Plots - Sentinel-1: Backscatter



Report generation (Bayern PA!)

Pseudo-code:

get timeseries from database
get CalendarView (from WMS)
plot to multipage PDF

Code

Python 3

Data sources: RESTful API for CbM.
Direct access to database and object storage.

RESTful API Settings.

API URL: http://185.178.85.226/ Format: http://0.0.0.0/ or https://0.0.0.0/

API User: EAP

API Passw…

Save

[14]:
```
aoi = 'nld'       # area of interest (str)
year = 2019       # the year of the parcels dataset (int)
pid = 514159      # latitude in decimal degrees (float)
chipsize = 728    # size of the chip in pixels (int)
extend = 364      # size of the chip in meters (float)
# images from tile map servers: Google Bing (list)
tms=['Google', 'Bing', 'nl2016ir', 'nl2017ir','nl2018ir','nl2019ir', 'nl2020ir']
ipycbm.bg_grid(aoi, year, pid, chipsize, extend, tms)
```

Conclusions

- DIAS use in CbM Outreach simplified with JRC backend role
- Allows us to focus on data analytics for the Outreach contexts (see others)

- We hope to benefit from our current open source code base
- And contribute to it with mature and tested practical use cases
- JRC will maintain code base and provide tailored technical support

- We count on active support to data analytics from the participating PAs
- Your knowledge of local context is essential
- Outreach activity serves as your step-up to full DIAS deployment

DIAS documentation and code

- JRC DIAS code repository
- Open Source since late 2020

  https://github.com/ec-jrc/cbm

- Links to documentation at https://jrc-cbm.readthedocs.io/en/latest/

Q&A

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Checks-by-Monitoring outreach 2021 – technical questions

GTCAP
Kick-off meeting , 19 Mar 2021

Kick-off meeting agenda

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Technical questions

- **Technical questions** cover the broad spectrum of categories and **do not require extensive data processing**
- These can be **handled in parallel to the other activities**, to assure that technical issues of data handling, access and understanding are solved without delays. This approach allows for a gradual build up of MS' knowledge.
- Starting point to address submitted questions
  - EE, IE, HU, HR and PL → 5 PA

Example of technical questions (1/2)

- Data availability
  - Minimum number of Sentinel 2 images required in order to accurately use developed tools (decision support tool). Sentinel 2 data availability is limited due to cloud cover.
  - Looking for an alternative data as SENTINEL operates in “sea/ice mode” in Baltic Sea until May.

Cloud cover

Alternatives data sources

Example of technical questions (2/2)

- Data processing
  - What is the sufficient probability of crop identification/classification to make a decision in the CbM process?
  - How can differences in weather conditions and phonological development of crops between different years be handled?
  - Atmospheric conditions (temperature, atmospheric pressure, wind, humidity, precipitation, and cloudiness) and how they affect Sentinel 1 & 2 signals. How to account for these events during data analysis?
  - Solutions for „false peaks“ in NDVI indicators which result with „false positive“ or „false negative“ detection (removal of notices in Sentinel data, and possible implementation of alternative spectral indices)

Crop classification

Atmospheric conditions

Data selection, noise removal

Summary

- Technical issues/question will be tackled in parallel to other activities according to available time and recourses

- Questions and answers will be shortly documented and distributed

- For submission please contact: rafal.zielinski@ec.europa.eu

Thank you

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The concept of marker and scenario

Towards the catalogue of CbM best practices

GTCAP Team

KO meeting - CbM outreach

19th March 2021

European Commission

Kick-off meeting agenda

9:00 – 10:00	Opening CbM outreach 2021 – Overview DIAS use for CbM outreach
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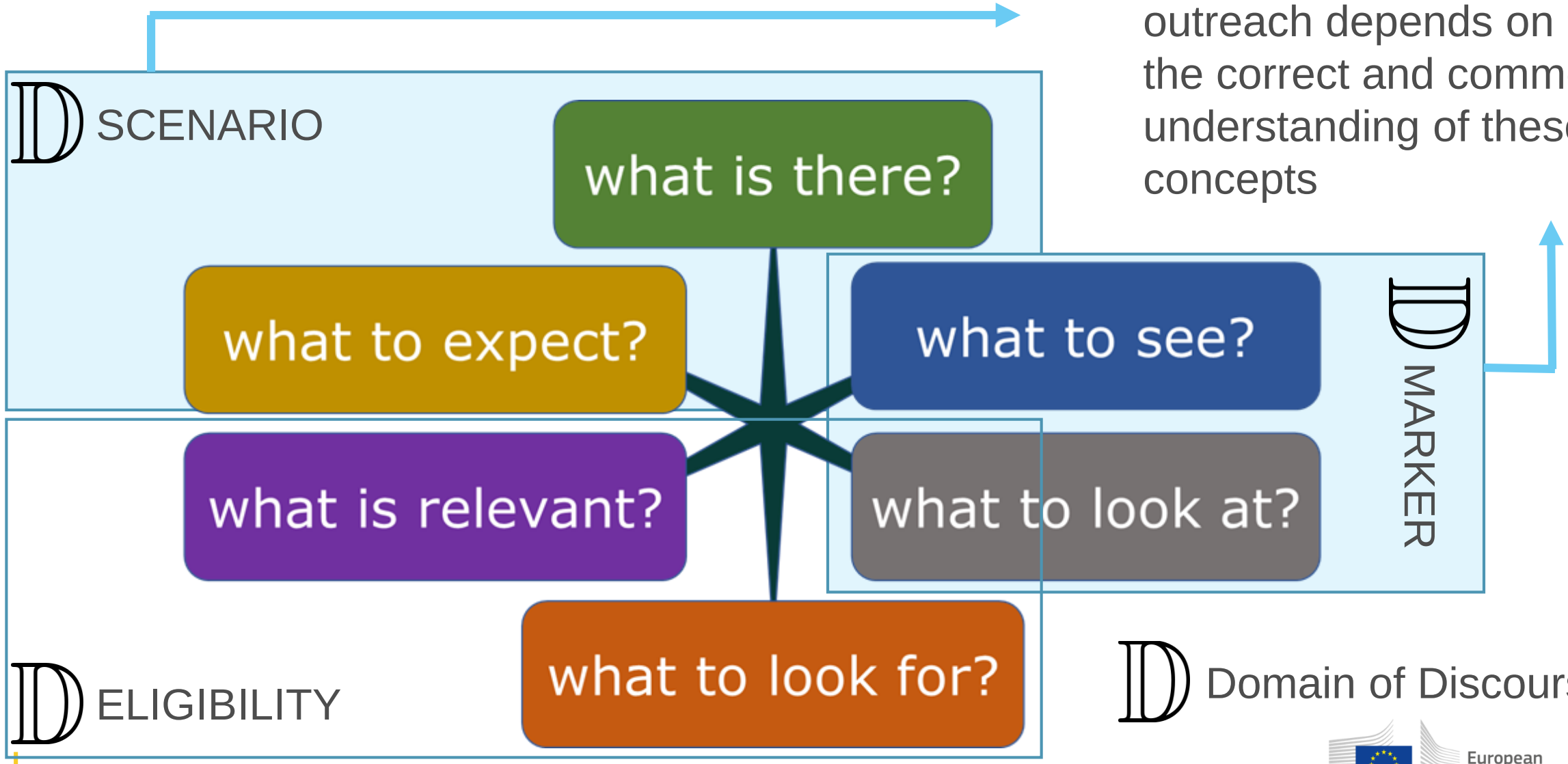
11:15 – 12:00	Discussion and organizational arrangements Closing

Why important for CbM outreach?

- Provides the **reference concepts and vocabulary** of terms to
  - Identify the commonalities in the EU MS needs/challenges
  - Help design the relevant methods for customized extraction of information
  - Set-up a standardized structure for documentation of derived markers
  - Allow for comparison, benchmarking, parametrization and re-use
  - Facilitate the communication and information exchange
- **Concepts need a revisit** due to the evolution of CbM scope/setup

The 6 questions of CbM

The success of CbM outreach depends on the correct and common understanding of these concepts



Domain of Discourse

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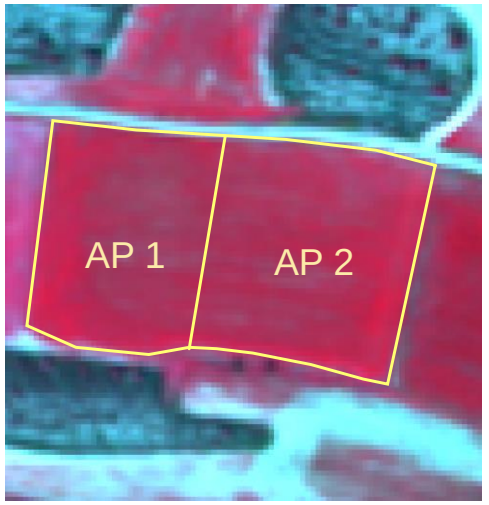
What is there? Feature of interest (FOI)

In GSAA



It is the **spatial "footprint"** of the observed land phenomenon

- Space occupied by the physical object on the ground
- Single unit of agricultural management

Has a **spatial representation in CbM** derived from agricultural parcels (AP) in GSAA

In CbM

<u>CbM monitors the FOI, not directly the AP</u>

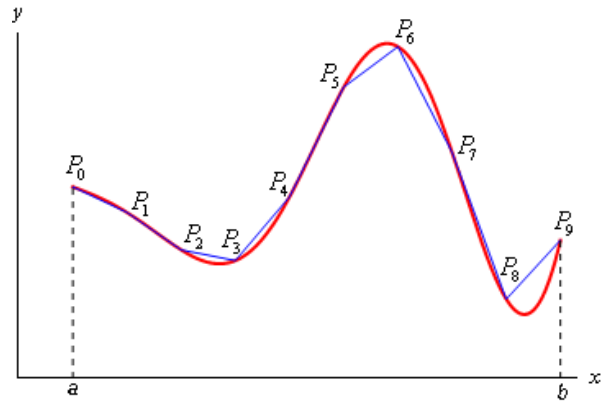
FOI >< GSAA-AP can have many-many cardinality

- Key validity check in CbM

What to see/look at? Marker

Observation record of a “spatio-temporal change”

- revealing a **behaviour** of a property of a feature
- property is primarily related to the “matter” that constitutes the observable feature
- spatial-temporal change could be naturally occurring or anthropogenic
- derived largely (but not exclusively) from EO data

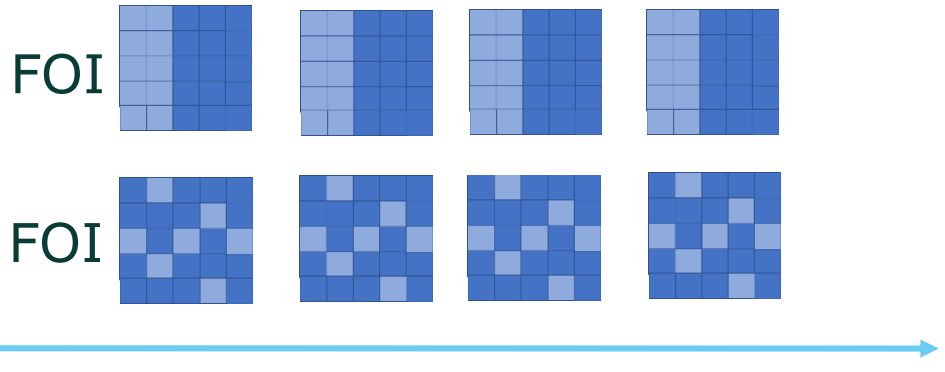


feature = feature of interest (FOI) = land (cover) phenomenon

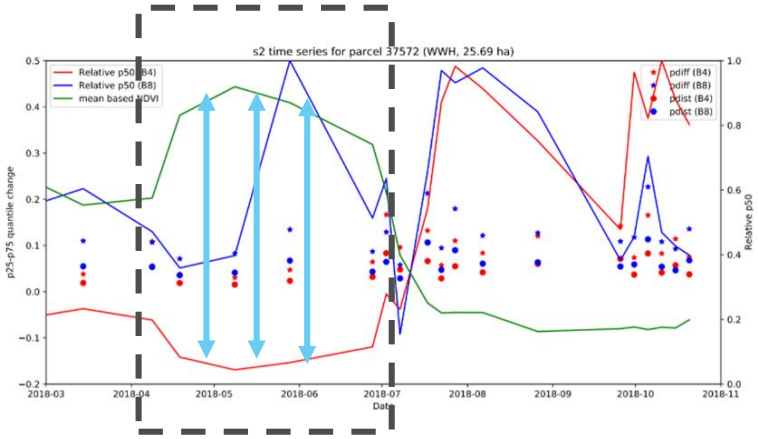
Marker in spatial domain

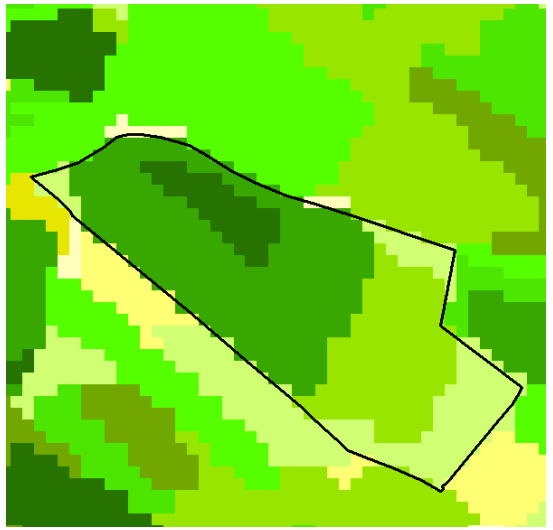
Indicates a presence of **distinct physical entities on different nature** within the FOI representation from GSAA

- Persisting in time (in a given period)
- Different nature = different land cover / land use



Observable period





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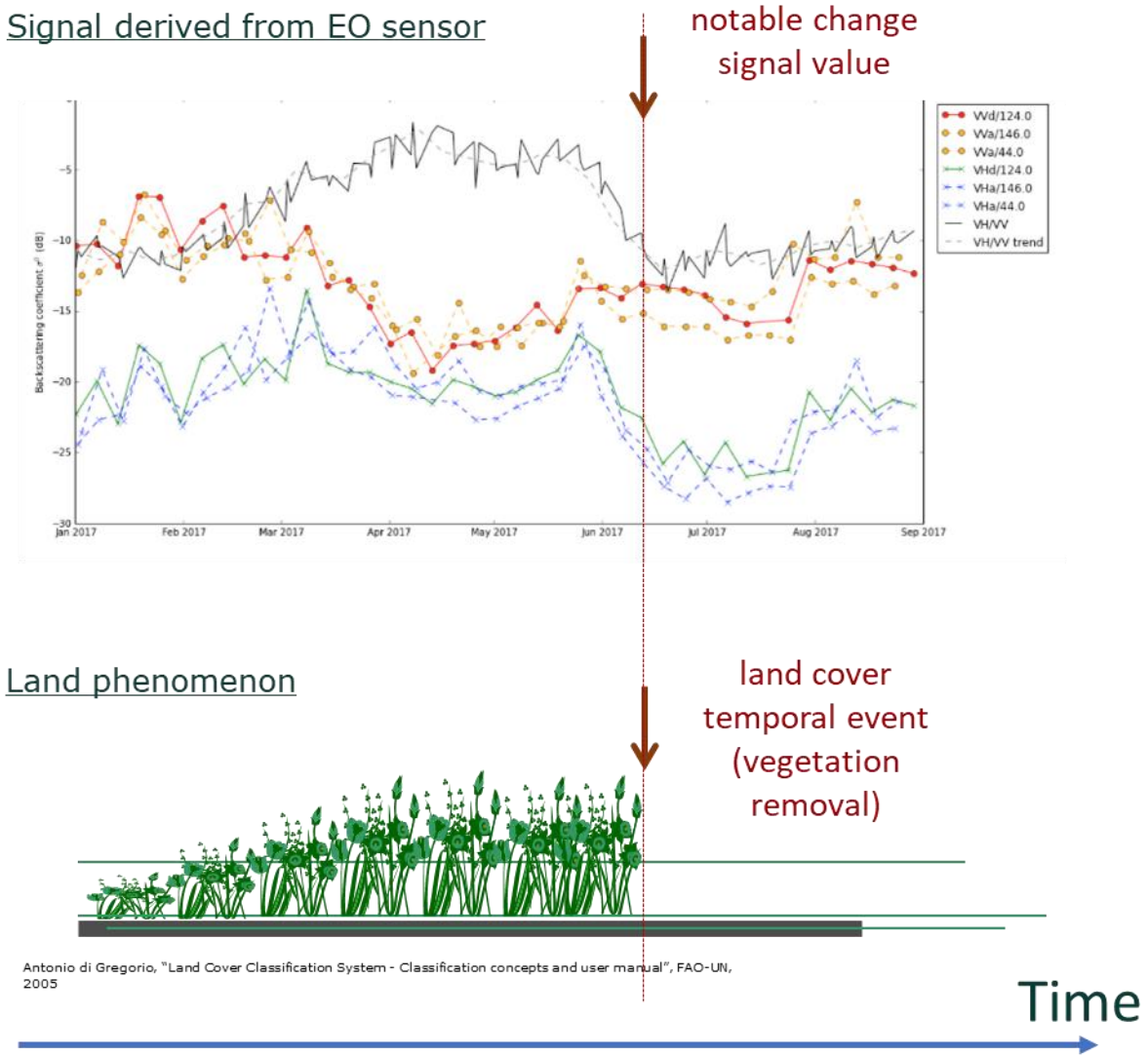
Marker in temporal domain

Indicates an occurrence of **event**

- Instantaneous in temporal granularity of days
  - anthropogenic origin (ploughing, harvest, mowing), or
  - naturally occurring (flooding, snowfall, fire)
- Instantaneous temporal granularity of months/years
  - anthropogenic (grazing, irrigating, mulching)
  - naturally occurring (senescence, flowering, scrub encroachment)



Cloud cover could be considered as an event **affecting** the phenomenon

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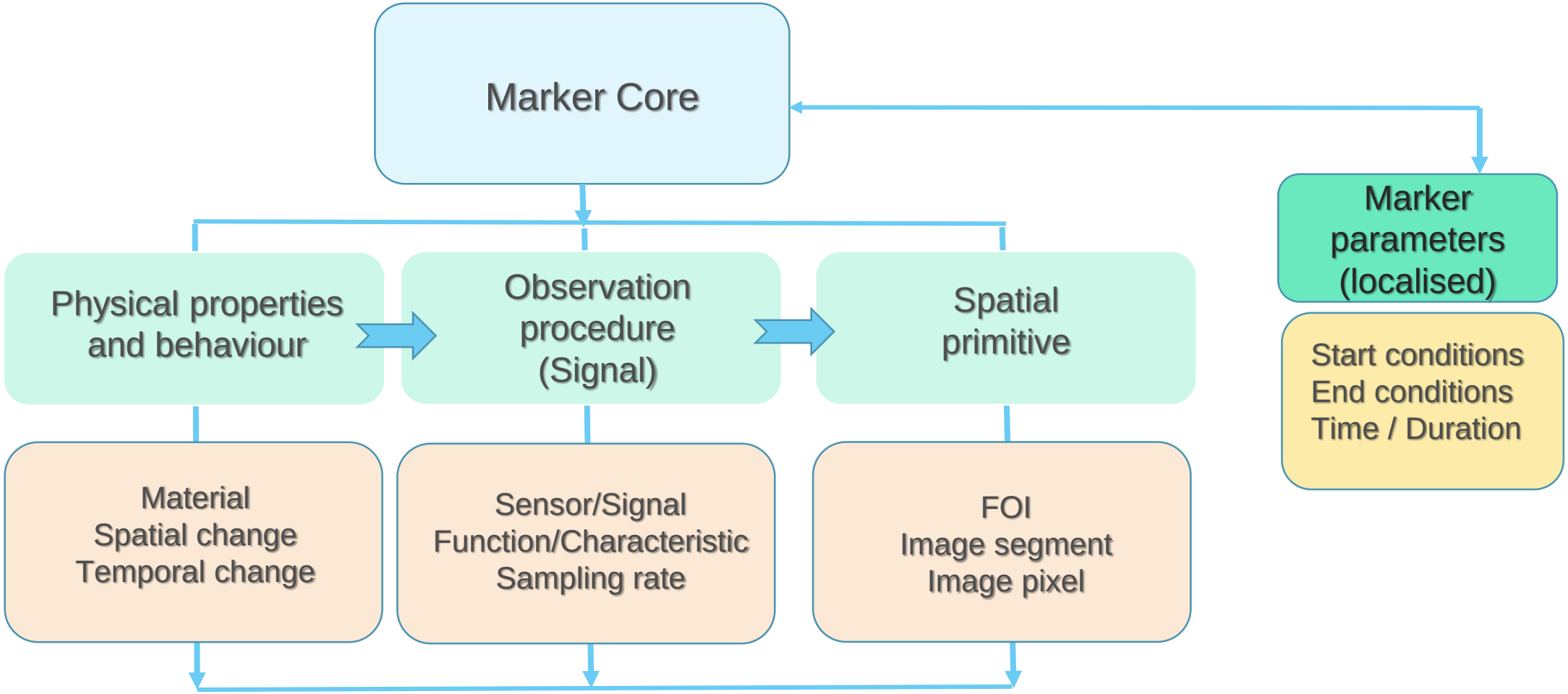
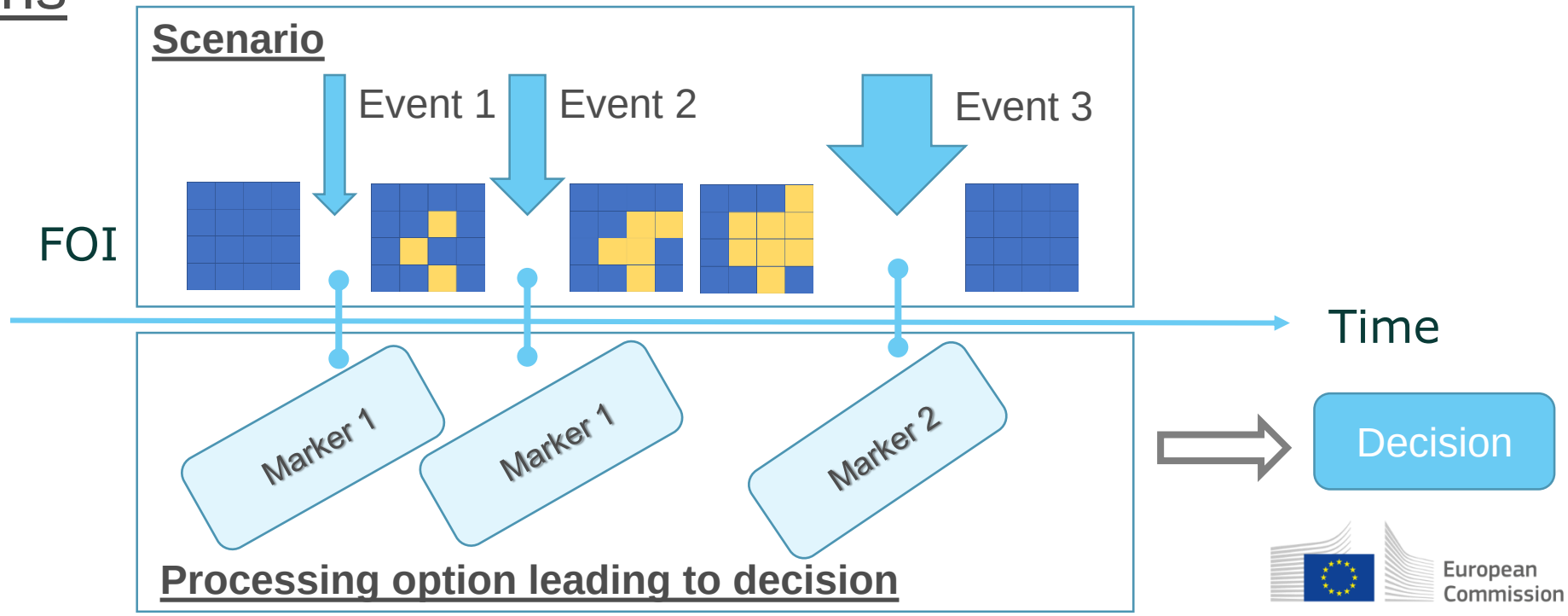
Possible Marker Structure



What to expect? - Scenario

Expected sequence of a “spatio-temporal changes”

- revealing the behaviour of the observed land phenomena
- as defined by the farmer intention and constrained by the local conditions



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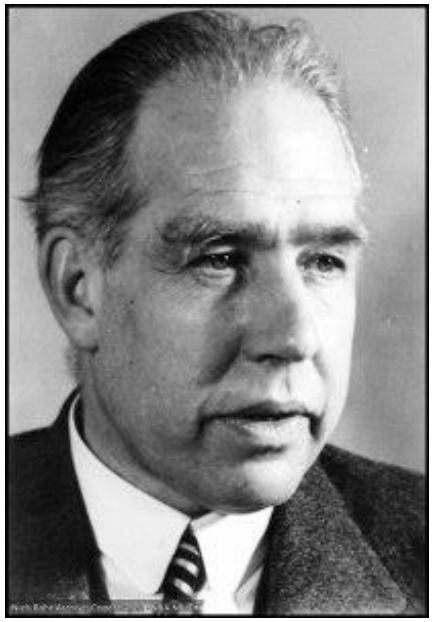
Questions?

Anyone who is not shocked by quantum theory has not understood it.

How wonderful that we have met with a paradox. Now we have some hope of making progress.

Niels Bohr



Agricultural Activities Detection & Crop Persistence Verification

Scenario defintion, context information and data needs

GTCAP Team

KO meeting - CbM outreach,

19th March 2021

European Commission

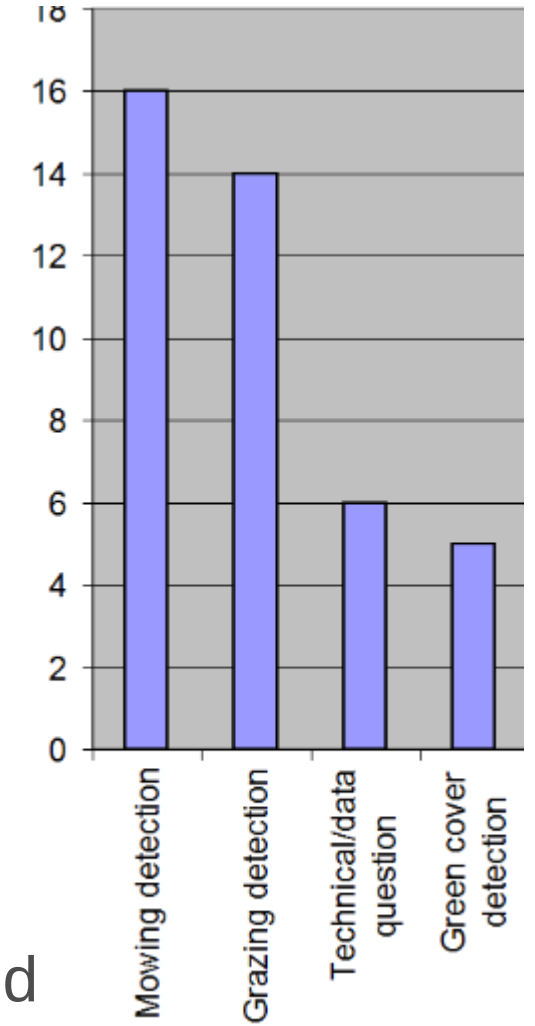
Kick-off meeting agenda

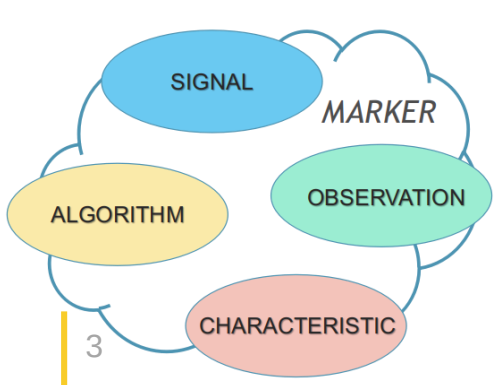
9:00 – 10:00	Opening CbM outreach 2021 – Overview DIAS use for CbM outreach
10:00 – 11:15	Technical questions follow up The concept of marker and scenario **Agricultural Activities Detection & Crop Persistence Verification**
11:15 – 12:00	Discussion and organizational arrangements Closing

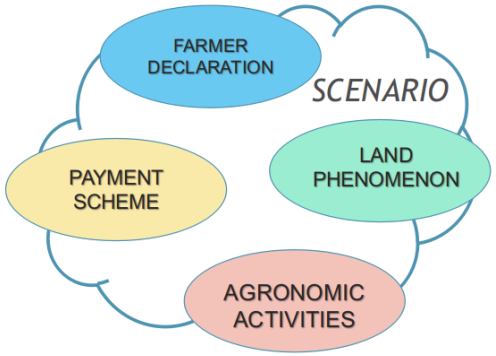
Introduction

Outreach subject selection:

1. Technical questions – a set of technical questions /no data processing
2. Marker development - **mowing detection**
3. Marker development - **grazing detection**
4. Marker development - **green cover detection**
5. Marker development - bare soil detection (soil cover)







Goals:

- 4 markers: introduction and definition
- data requirements

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Mowing as CbM Event

Scenario: **cutting of fresh biomass** (at a given moment of time) and eventual **removal** (within a time period) of herbaceous material

Tell–tale event: Abrupt reduction of green vegetation/vegetation height

Spatial extent: Whole FOI at once / Parts of FOI, intermittently

FOI: Uniform to variable

Duration: from cut until regrowth

Signals: NDVI, SAR coherence...

as for many markers, different '**local declinations**'

Variability of Mowing Scenarios

Wide range of conditions depending on:

- local geographic area (location, weather, ...)
- local practices

e.g./

mowing

drying/turning

windrowing

collection

... and finally **regrowth**

there could be different sequences of events and different field conditions (grass not collected, cut grass rottening, ...)

- egibility conditions (e.g. **date range** for mowing)

Knowledge of the Local Context

Mowing on Different Grassland Types

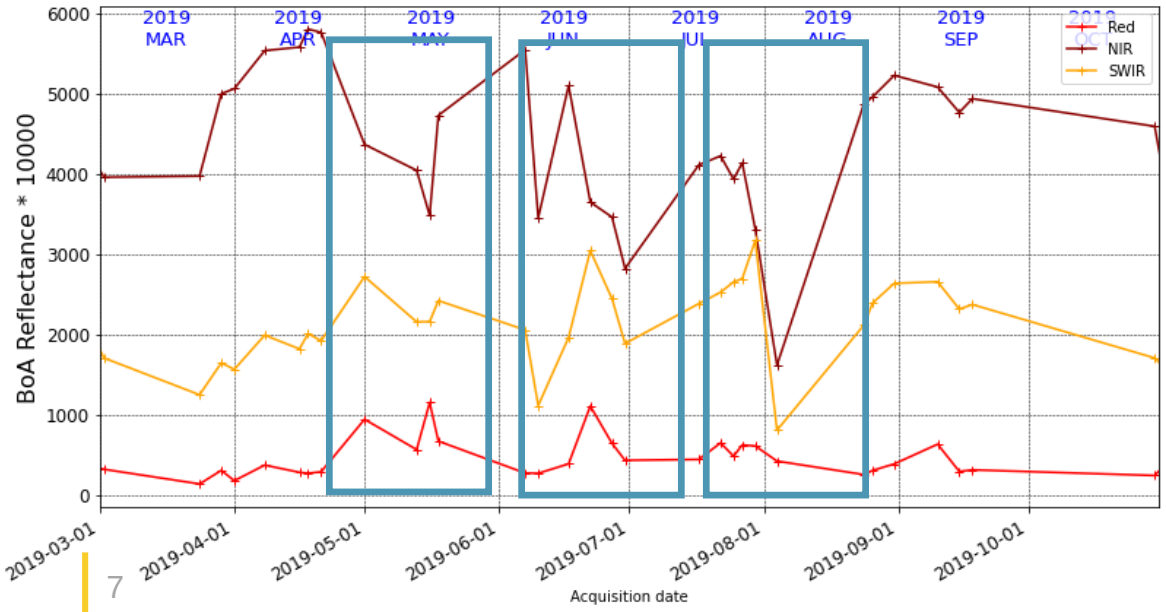
- Grassland, Natural Grassland, Permanent Grassland, ... several definitions (as evident from PAs' questions)
- Different types of covers
- Influence on the signals

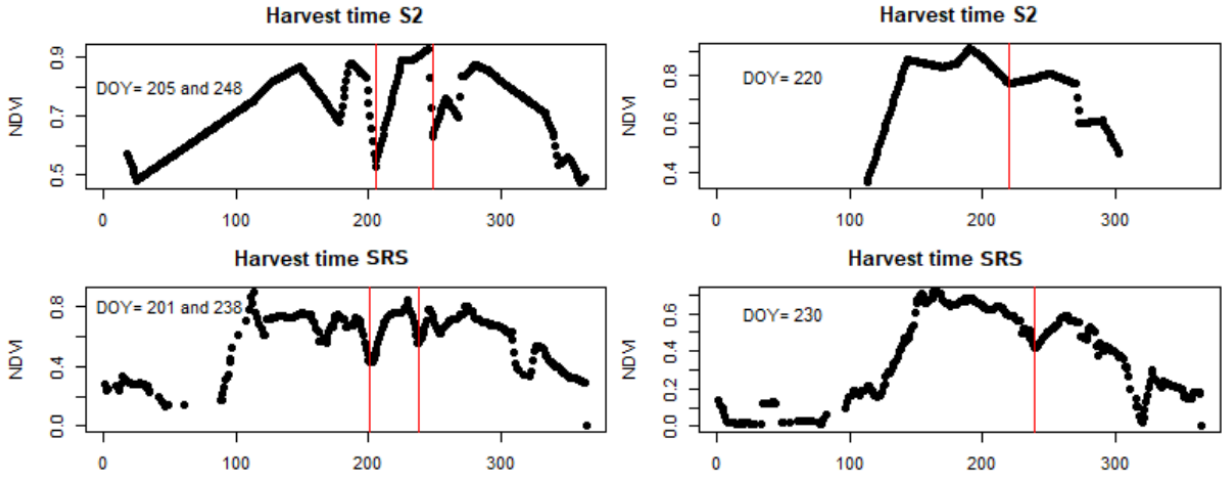
From *Marijke Bekkema and Marieke A. Eleveld* "Mapping Grassland Management Intensity Using Sentinel-2 Satellite Data" *January 2018*

Mowing: Signal Selection and Behaviour - S2

- Mowing implies a **significat reduction of biomass**:

- direct impact on NDVI:
  expected significant drop
  'max-min-max'/'growth-cut-regrowth' **pattern**





NDVI examples from *L. Stendardi et al.* "Exploiting Time Series of Sentinel-1 and Sentinel-2 Imagery to Detect Meadow Phenology in Mountain Regions" *Remote Sensing 2019*

mowing events 'visible' in other S2 signals, including individual events

time and space: both dimensions should be considered

... far from being an exaustive list

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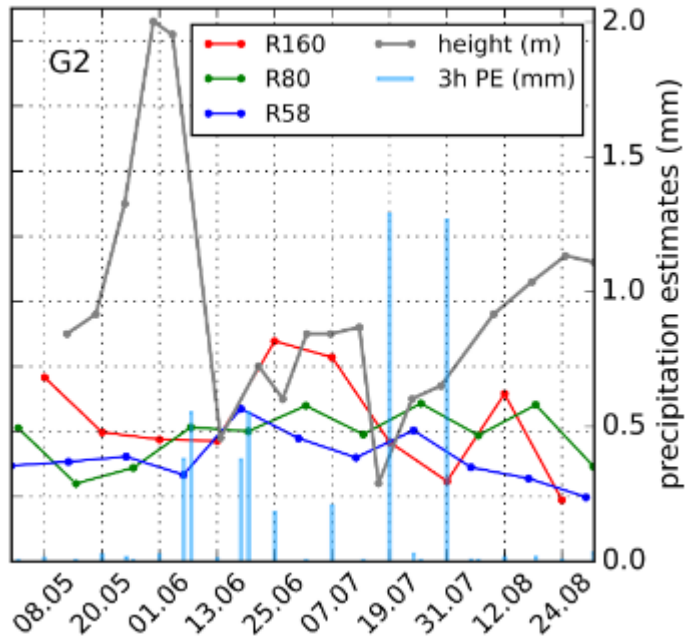
Mowing: Signal Selection and Behaviour - S1

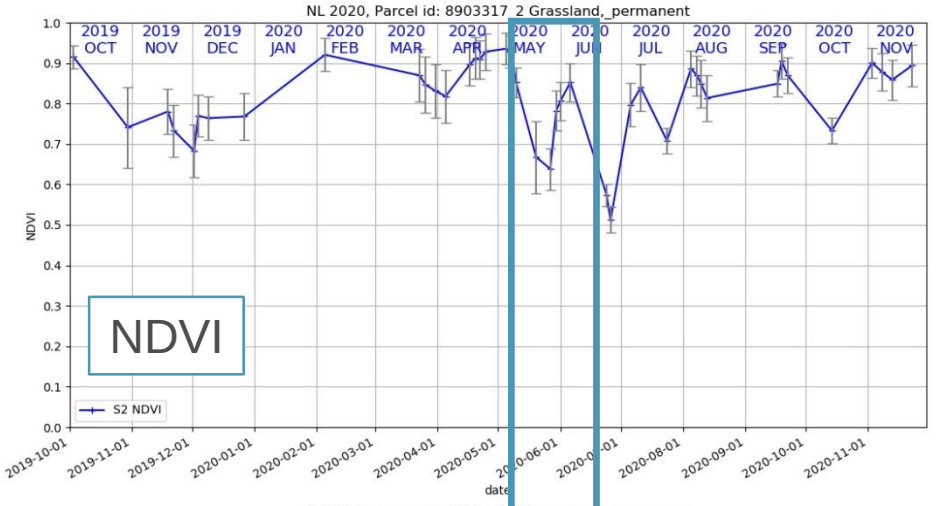
Sentinel-1 Back-scattering and Coherence (COH6) can **reveal mowing events**

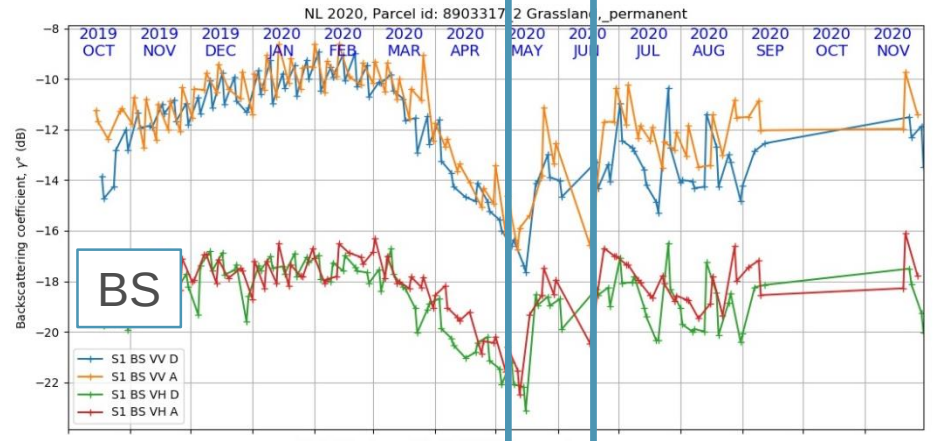
Back-scattering should have a maxima after a mowing event

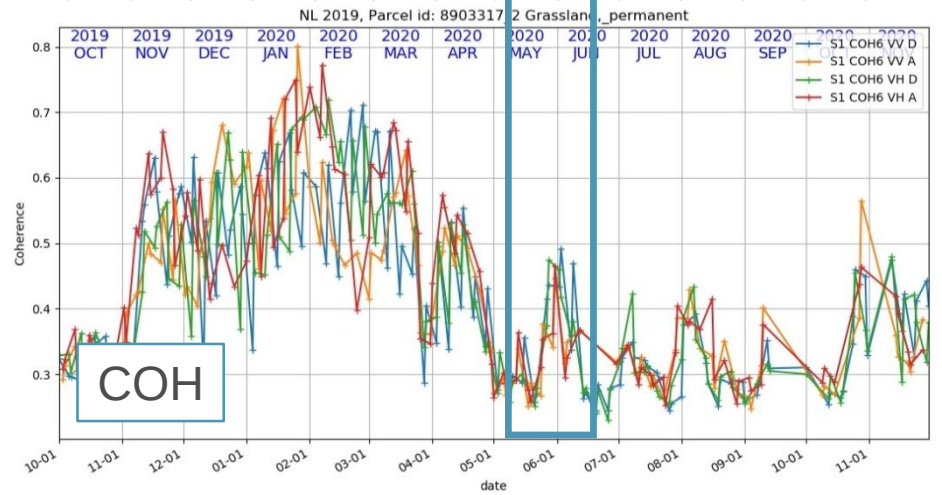
Coherence should increase after a mowing event.
Several approaches available in the literature (for instance Tamm et al. 2016)



coherence example from Tamm et al. “Relating Sentinel-1 Interferometric Coherence to Mowing Events on Grasslands” Remote Sensing, 2016



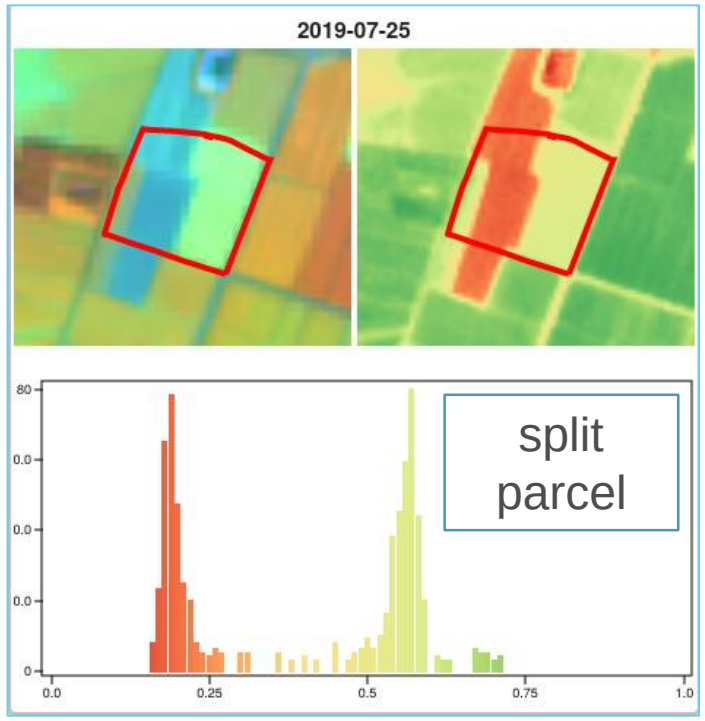


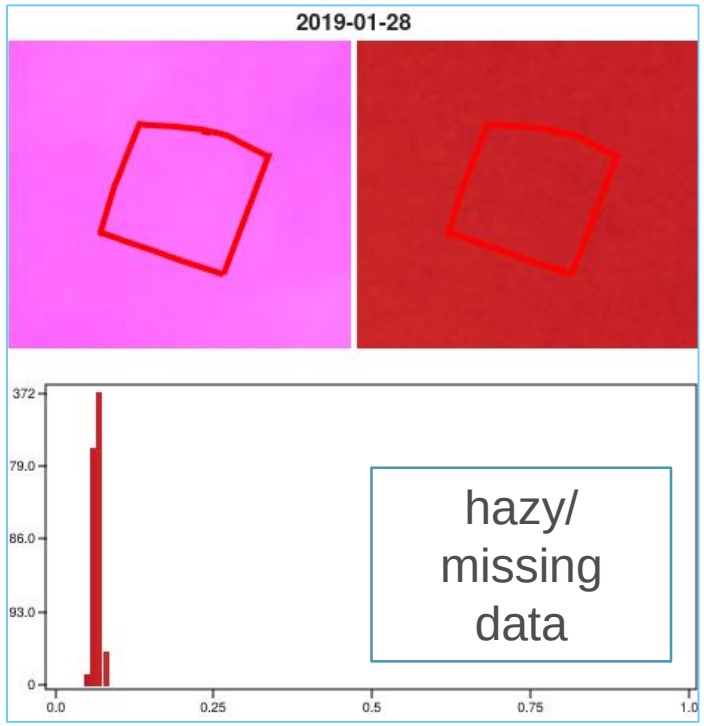


Challenges and Confounding Factors

Several challenges: **signal-related** and **scenario-related** factors

- **Scenario-related:** split parcels (e.g. partial mowing), small parcels, non-agricultural elements on the parcels, limit conditions...





Signal-related: data gaps, irregular sampling, artefact ...

for Sentinel-1 data

- noisy time series
- maxima/minima caused by other factors in addition to mowing

Challenges common to many markes

Limits and Unmonitorable Cases

Limit and **difficult cases**: boundaries of the CbM process

Not all cases can be dealt using Sentinel signals

Need for representative datasets

Screening based on geometric conditions

E.g./

- Contain at least 8 Sentinel-2 full pixels
- Lose less than 60% of the pixels when applying a 5 meter buffer

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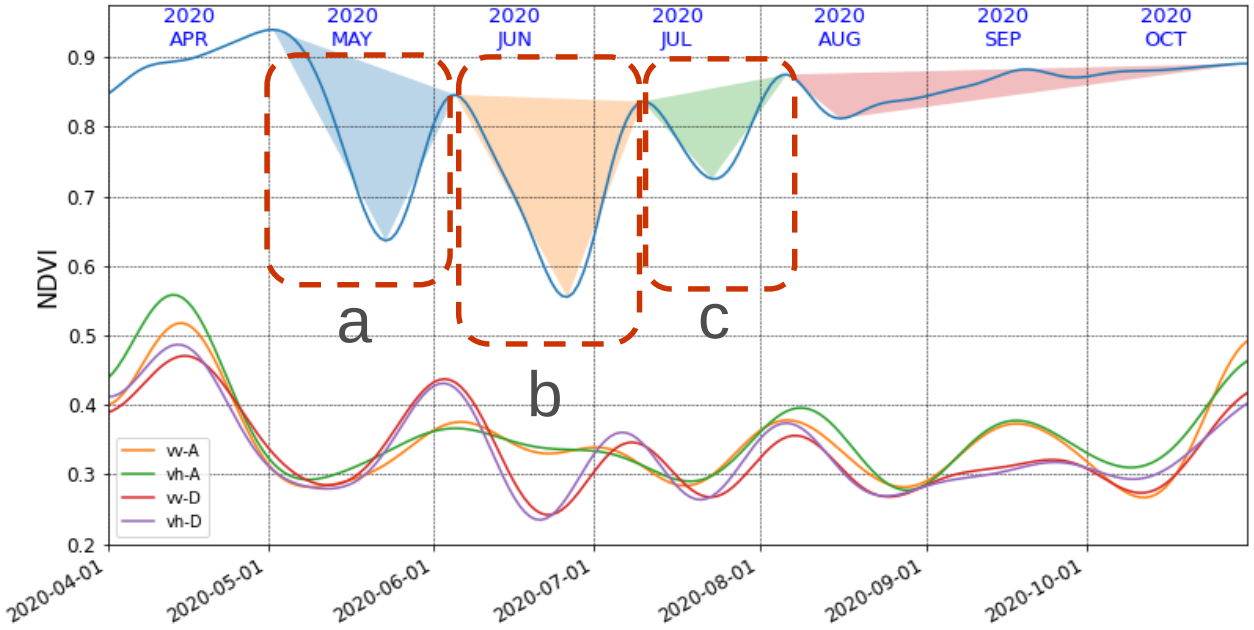
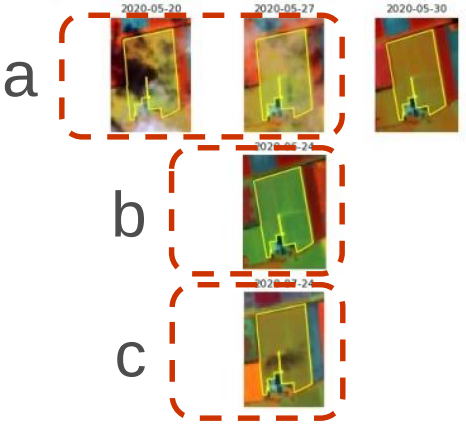
Mowing Detection: an Example

- Mowing marker: identified by the sequence of **state changes** and not only by a single NDVI drop

- Events may occur in sequence or be interleaved with **other markers** (e.g. grazing)





coherence: peaks also due to other phenomena

Grazing as CbM Event

Improved pasture (Hungary). Photo: B. Kosztra (https://land.copernicus.eu/user-corner/technical-library/corine-land-cover-nomenclature-guidelines/html/index-clc-231.html)

Scenario: **removal of fresh grass canopy** by animals that feed on site

Tell–tale event: Gradual reduction of green vegetation/vegetation height

Spatial extent: Whole FOI at once / Parts of FOI, intermittently

FOI: Uniform to variable

Duration: from animal allocation until regrowth

Signals: NDVI, SAR coherence

commonalities between **grazing** and **mowing**

as for many markers, different '**local definitions**'

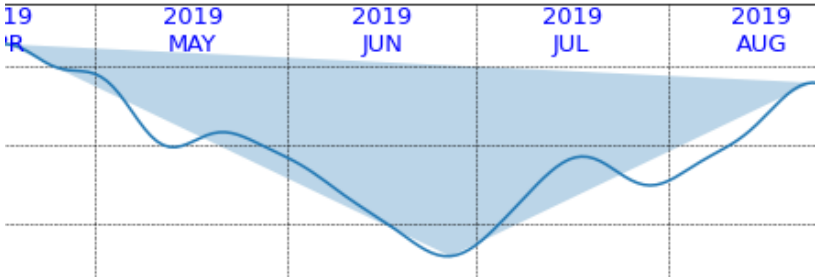
Grazing: Signal Selection

Candidate signals for grazing detection: NDVI, individual S2 bands (NIR, RED, SWIR), backscattering, coherence, ...

Event sharing **several commonalities** with **grazing**: entails removal of grass from the ground

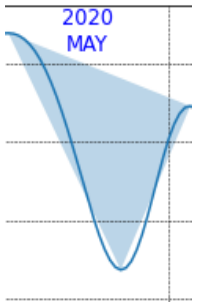
distinguishing **grazing** from **mowing**

NDVI Drop



grazing

vs.



mowing

For grazing:

- longer **event duration**
- depending on the type of animal, **different event intesity**
- longer **regrowth time**
- **irregular patterns** on the field

... distinction not always so easy

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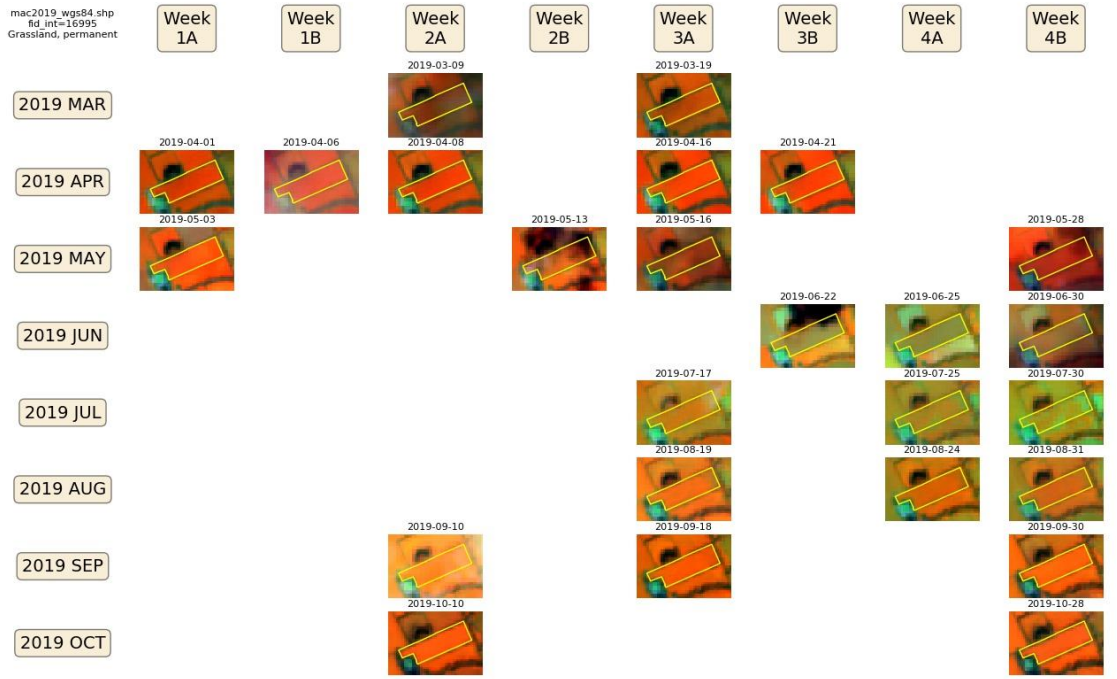
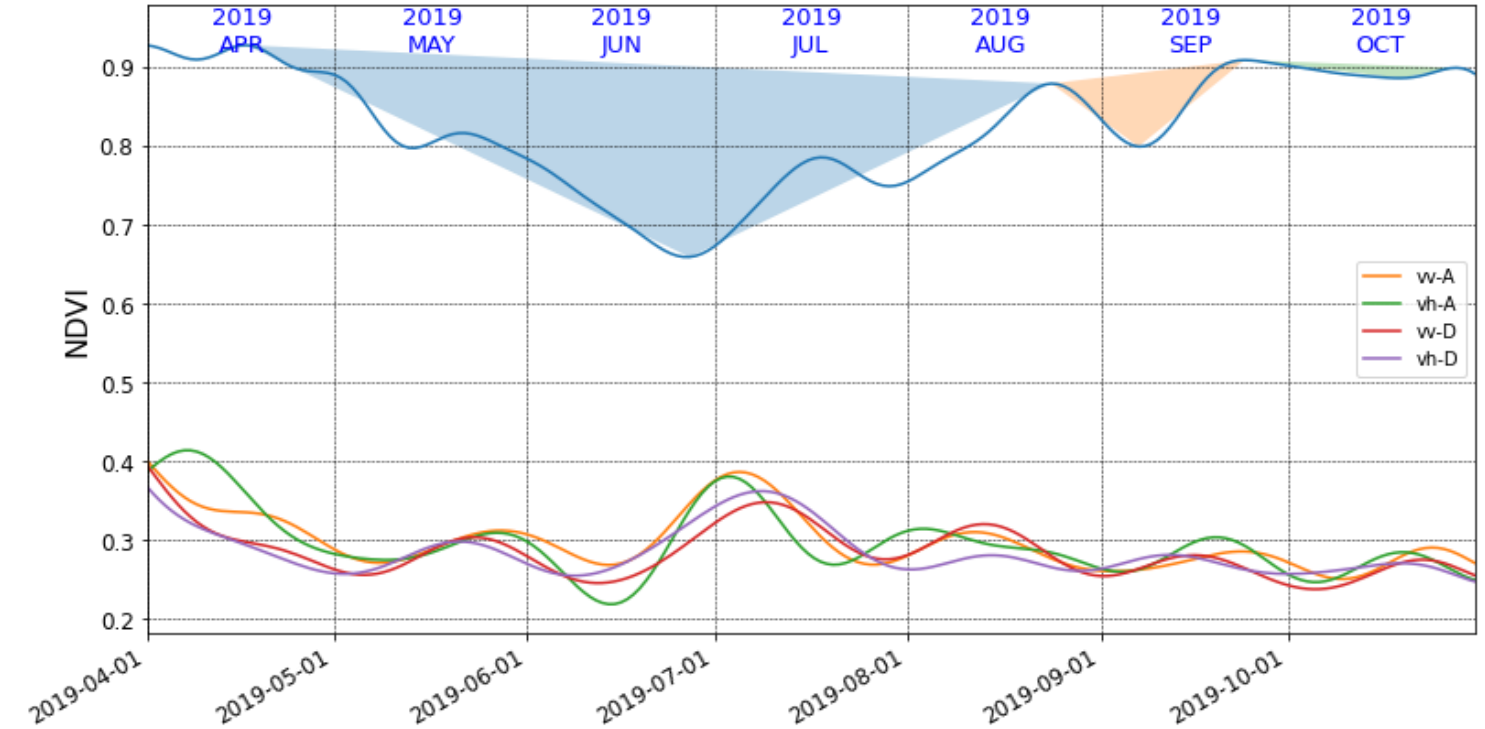
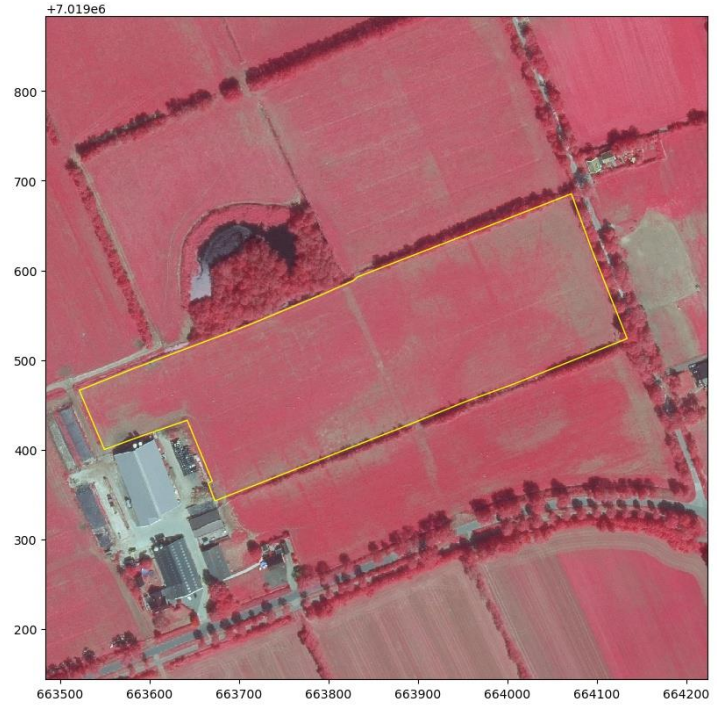
Grazing detection: an Example

- more **gradual changes** than mowing expected (larger event duration)
- gradual change visible in the NDVI (filtered) time series

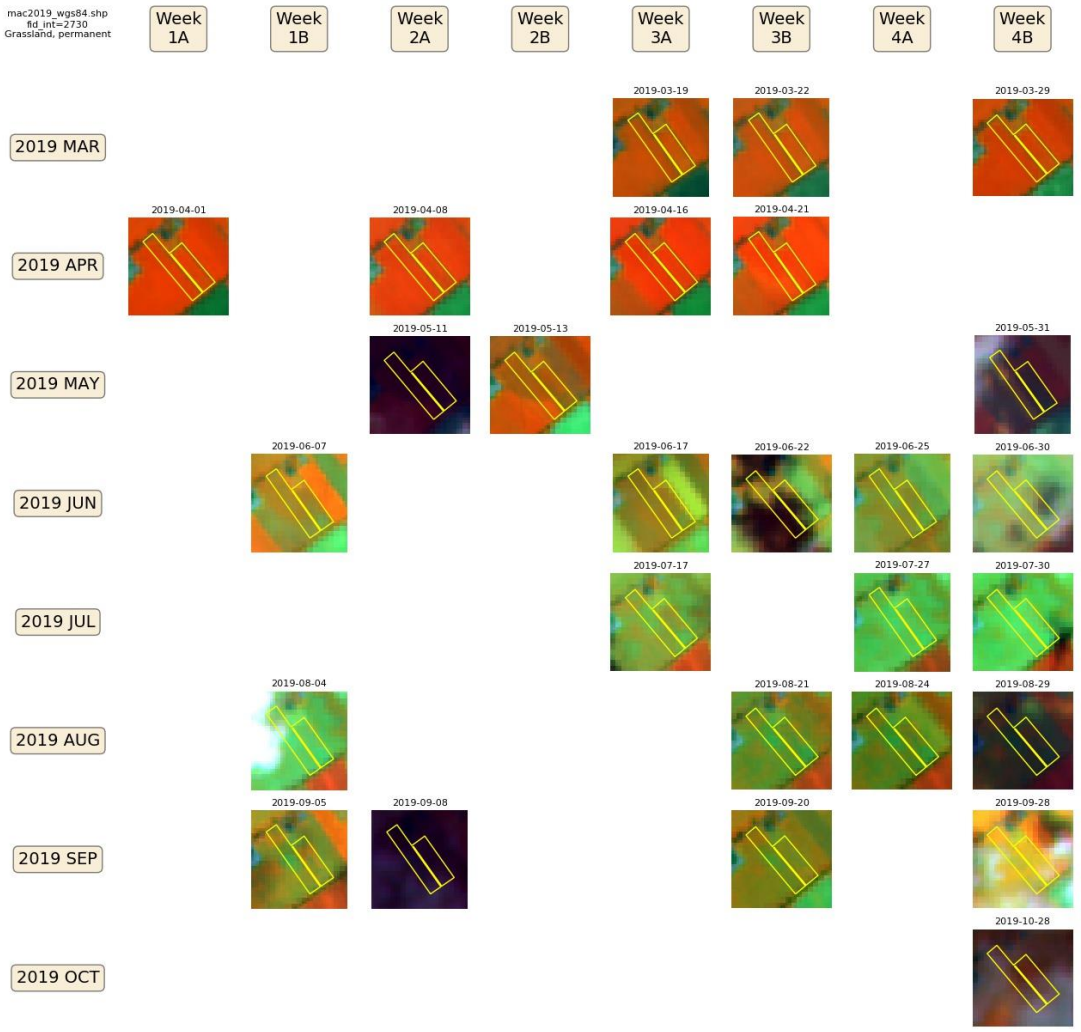


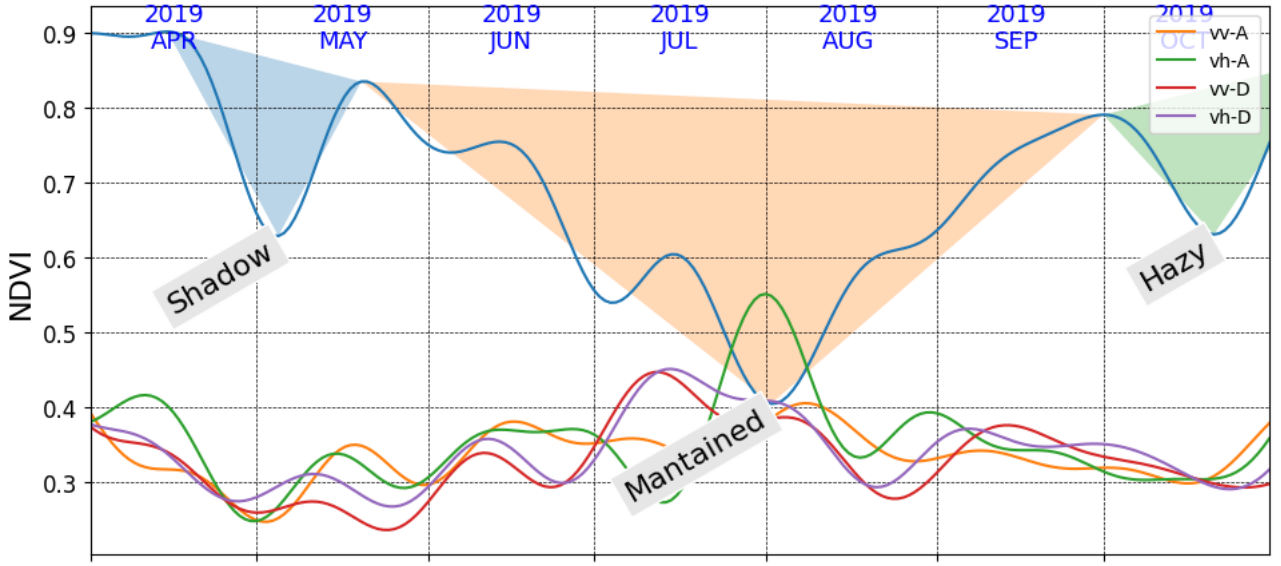


Context information: presence of a nearby farm & local practices

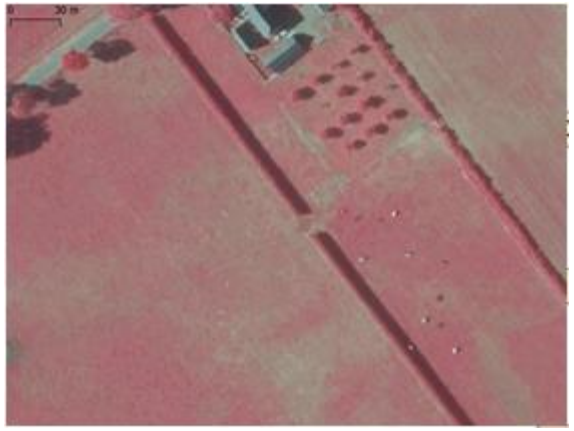


Grazing Detection: a Second Example





grazing confirmed by the presence of animals in orthophotos



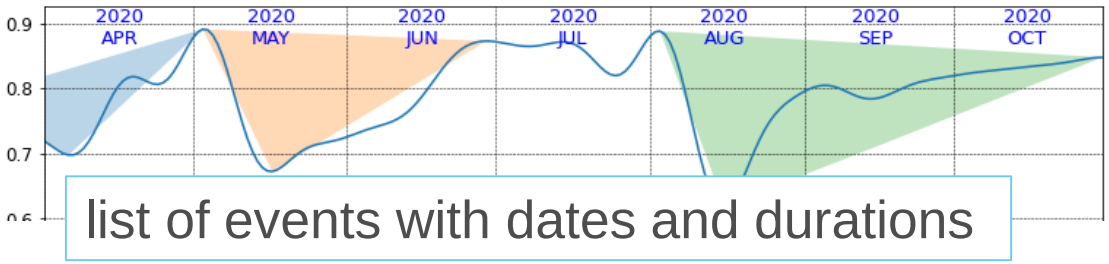
Mowing and Grazing: Data Requirements

- List of parcels with **geometries** (shape file or equivalent) from **GSAA** including unique ID and application ID and **attributes** considered useful for the analysis

- **Ground truth:**
  a significant number of parcels should be accompanied by event information:
  e.g./ **mowed/not mowed** - **grazed/not grazed**

Collaborative nature of the process

ideally:



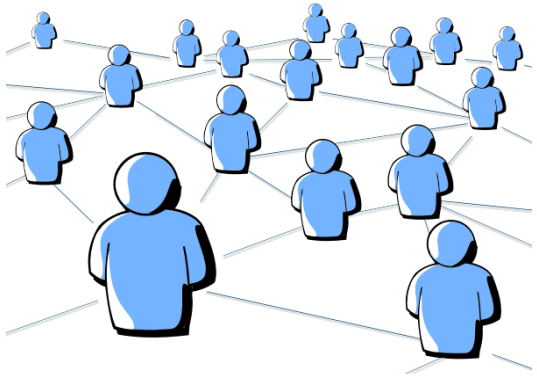
list of events with dates and durations

more realistically: **results from OTSC/RFV**

Additional Information

Clear context:

- **eligibility rules** including **date ranges** for observing the phenomenon
- grassland **typology/farming system**
- relevant weather and climate information
- relevant information on the **local practices**
- exceptions, limit and difficult cases



Let's interact!

- **Representative dataset:** not only the **difficult cases**

- Any additional complementary information:
  e.g. arieal orthophotos, geotagged photos, DEMs, etc.

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Green Cover as CbM Event

Scenario: **presence of green vegetation** within a **given well-defined period**

Tell–tale event: Persistent presence of green vegetation

Spatial extent: Whole FOI at once

FOI: Uniform

Duration: from seeding until removal

Signals: NDVI, individual band signals, other vegetation indexes

different meanings: depending on the payment scheme/measure

- GAEC 4
- Greening

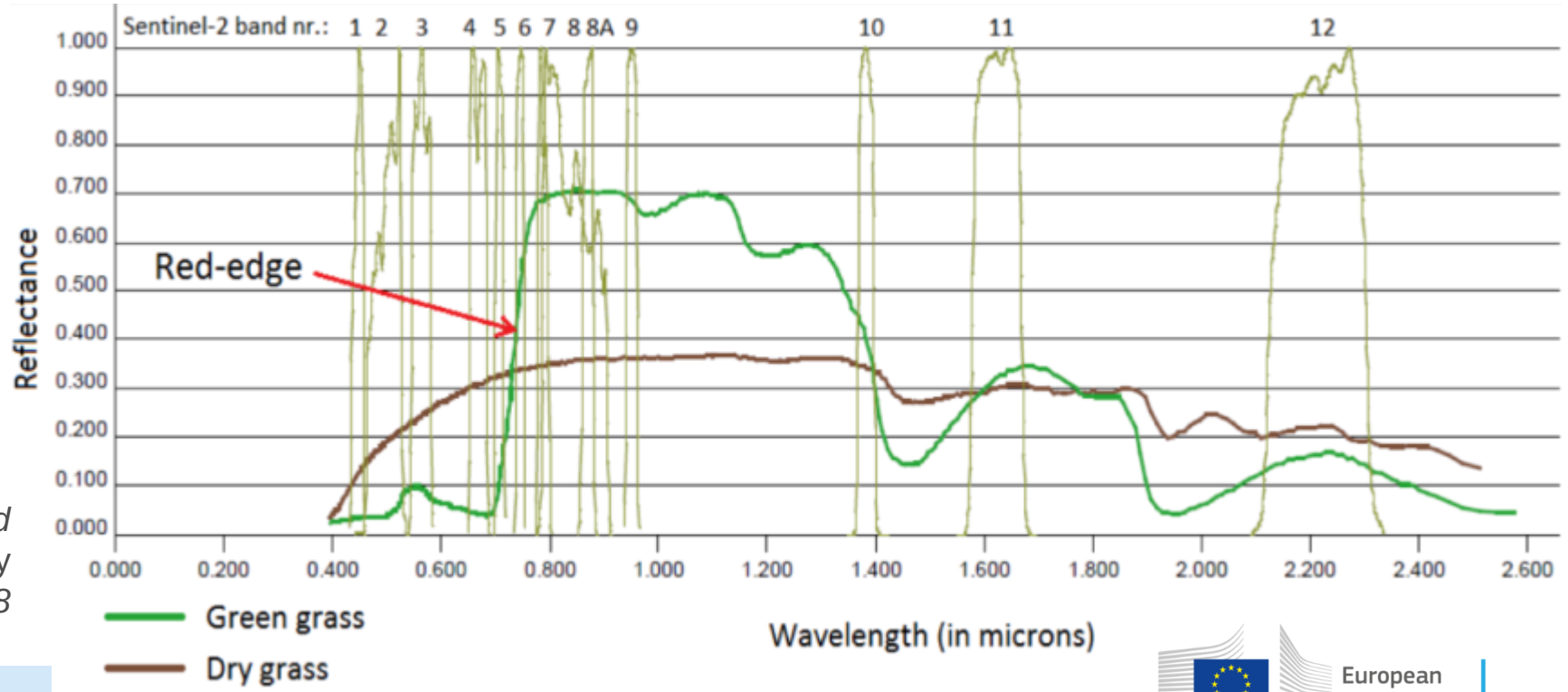
Green Cover Verification: Signal Selection

High NDVI values should be observed in the presence of a green cover
Strong indicator of the green cover presence

State information (spectral signature) from other bands (e.g./ NIR, SWIR and RED)

Potential information from Sentinel-1 to be investigated

e.g./low coherence expected



From *Marijke Bekkema and Marieke A. Eleveld* "Mapping Grassland Management Intensity Using Sentinel-2 Satellite Data" *January 2018*

JRC: work at early stages

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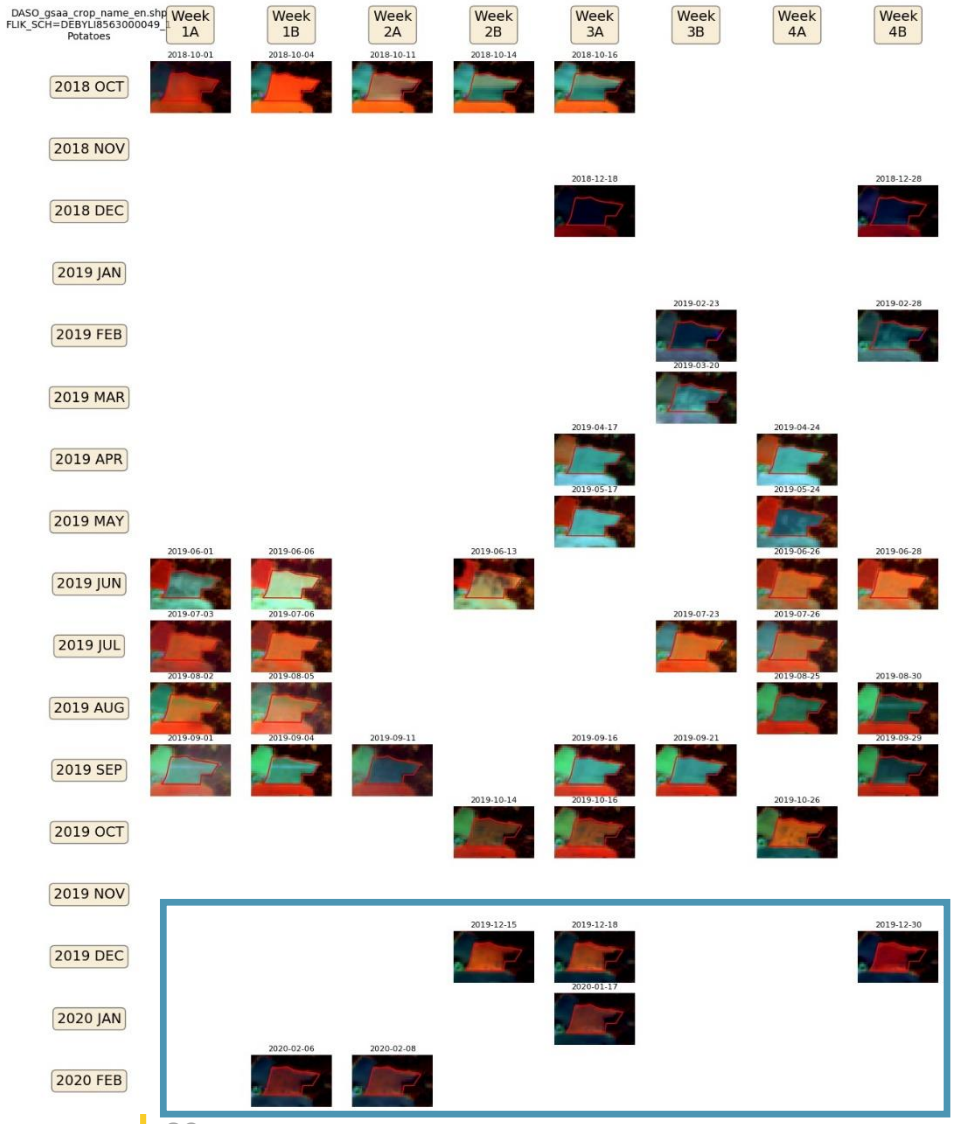
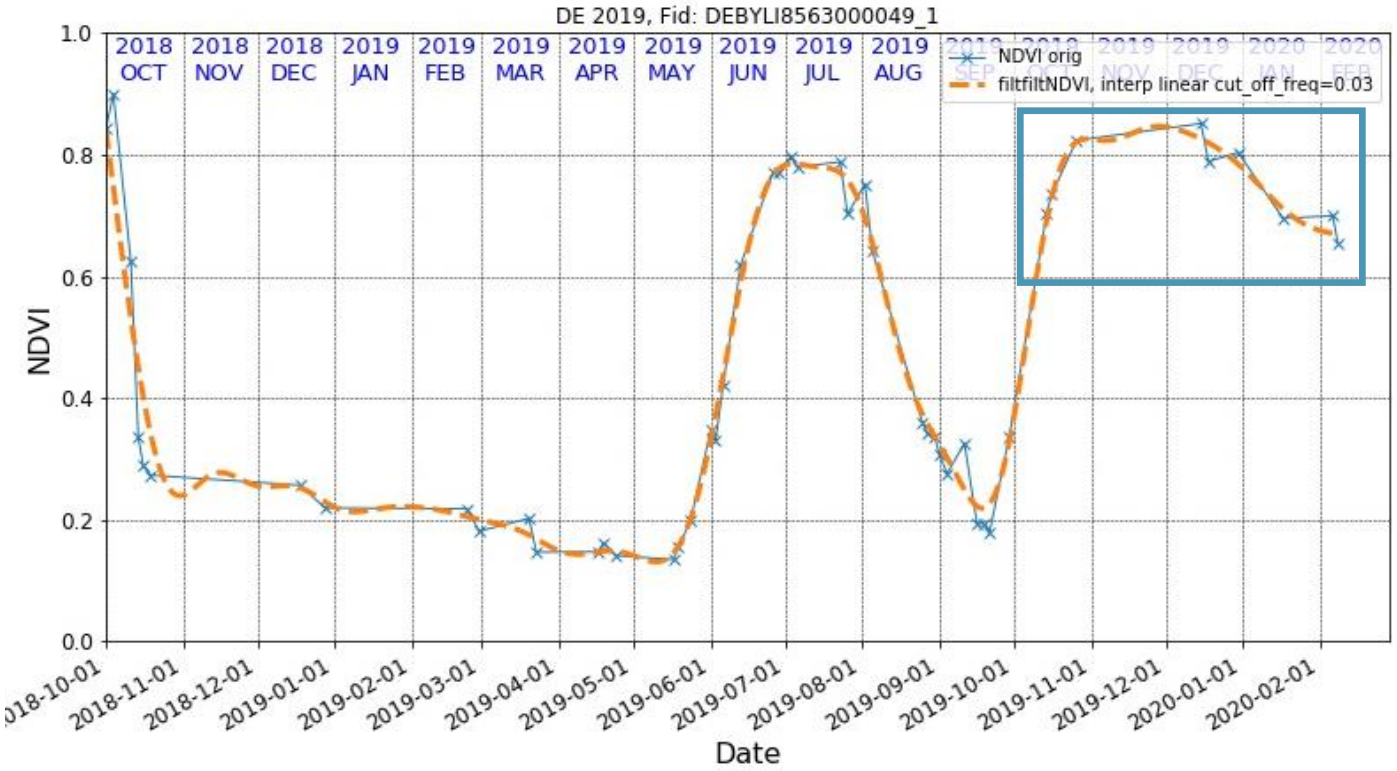
Green Cover Verification: Example





Winter green cover confirmed in the **Nov-Dec 2019** period

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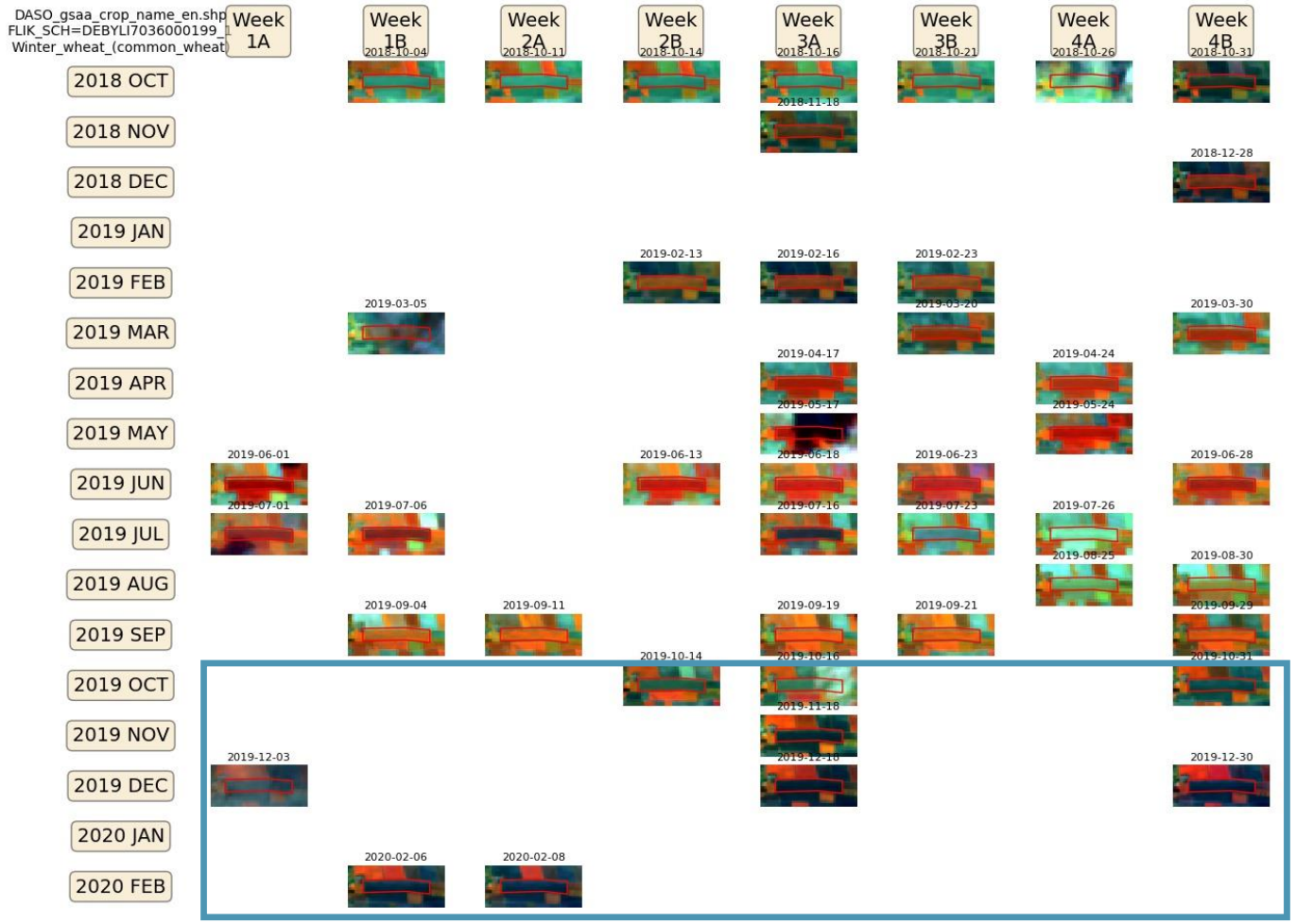
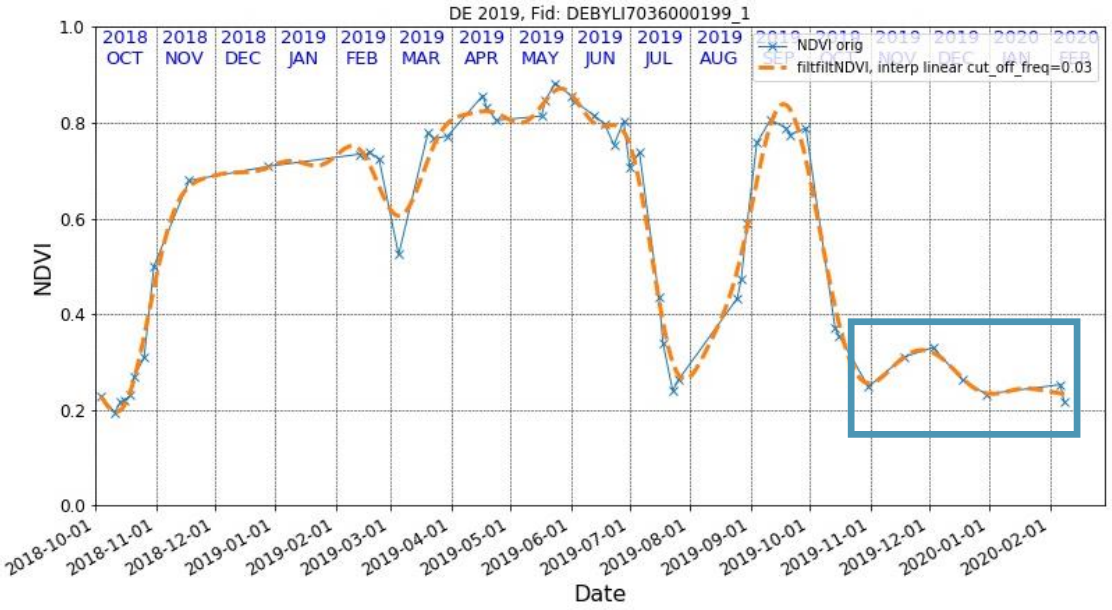
Green Cover: Non-Compliance Detection





Green cover is removed by mid-October

Importance of eligibility requirements: date range where green cover should be present

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Bare Soil as CbM event

Scenario: presence of **bare soil** within a **given well-defined period**

Different from ashes, dead vegetation or residues

Event/Status: Persistent presence of bare soil

Spatial extent: Whole FOI/partial FOI

FOI: Uniform

Duration: in a defined period

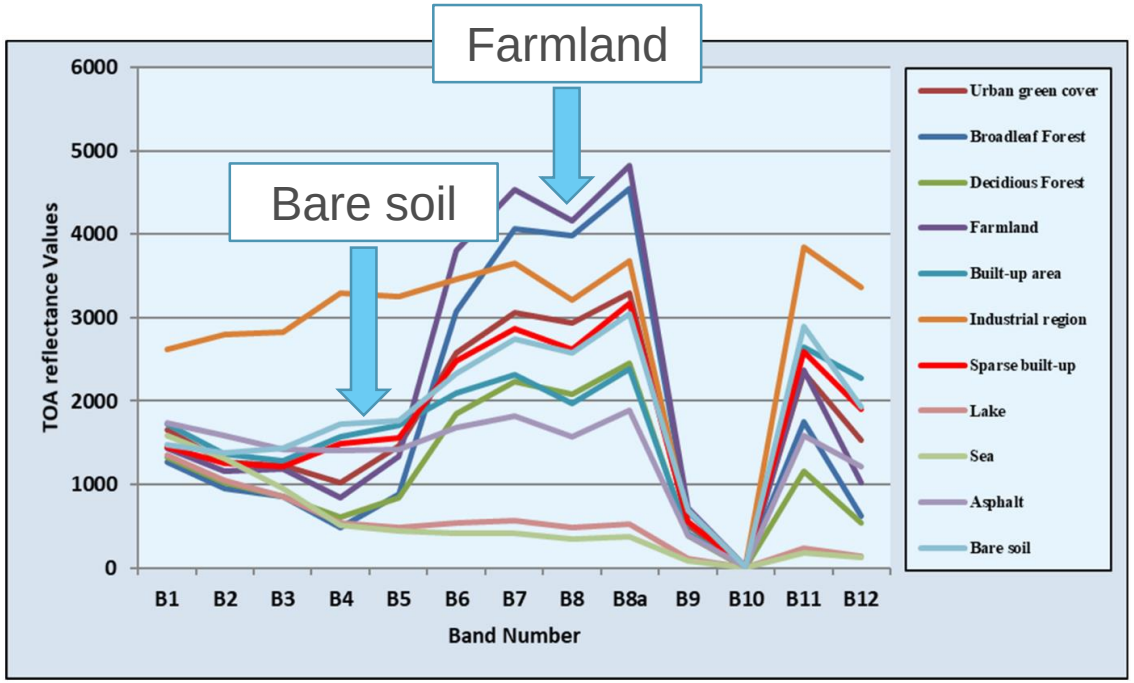
Signals: NDVI, Bare Soil Index, ...

Approached as marker for detecting the period when **exposed bare soil** is present on the FOI

Status verification vs. **event detection**

Bare Soil Verification: Signal Selection

- Each **S2 band** assumes characteristic values for each Land Cover/Use (Paria et al. 2019)
- **Vegetation indeces:** could be more effective in defining the **bare soil marker** (state)
- NDVI is expected to assume **low values** on bare soil
- Other **vegetation indeces**



from *Paria et.* al "Built-Up Areas from Bare Land in Mediterranean Cities Using Sentinel-2A Imagery" *Remote Sensing* 2019

Normalize Difference Tillage Index

$$NDTI = \frac{SWIR_1 - SWIR_2}{SWIR_1 + SWIR_2} = \frac{B_{11} - B_{12}}{B_{11} + B_{12}}$$

Level of tillage of the soil

Note: results based on literature search

Bare Soil Verification: More Candidate Signals

Bare Soil Indeces

$$BSI_1 = \frac{SWIR_1 - RED}{NIR + BLUE} = \frac{B_{11} - B_{04}}{B_{08} + B_{02}}$$

Sinergies “Area Monitoring - Bare Soil Marker”

$$BSI_2 = \frac{(SWIR_1 + RED) - (NIR + BLUE)}{(SWIR_1 + RED) + (NIR + BLUE)}$$

... and many more

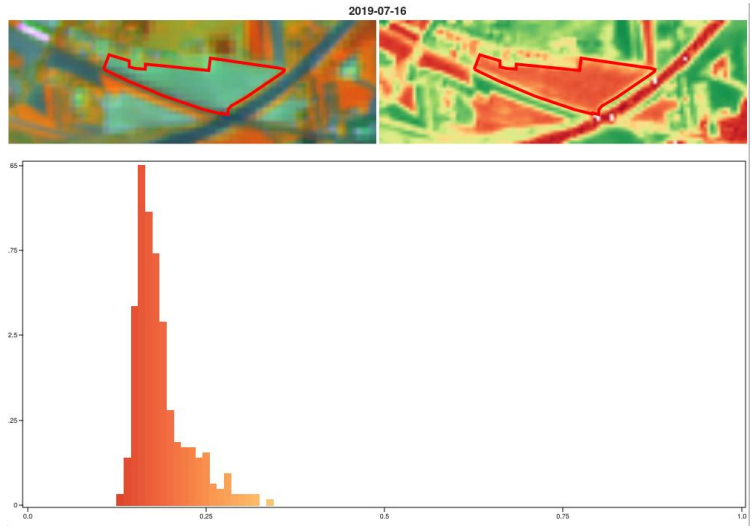
Potential from Sentinel-1:

High **VH/VV ratios** and high **coherence** expected from **bare soil**

Typical approach from the literature

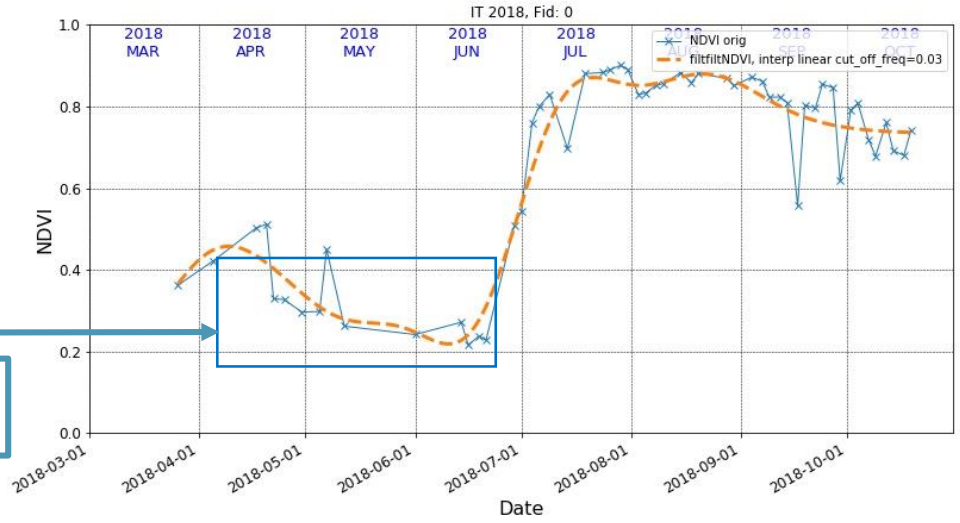
signals and indeces → **Feature vector** → **Classification**

... which can be reduced to a binary hypothesis: bare soil vs. all other cases

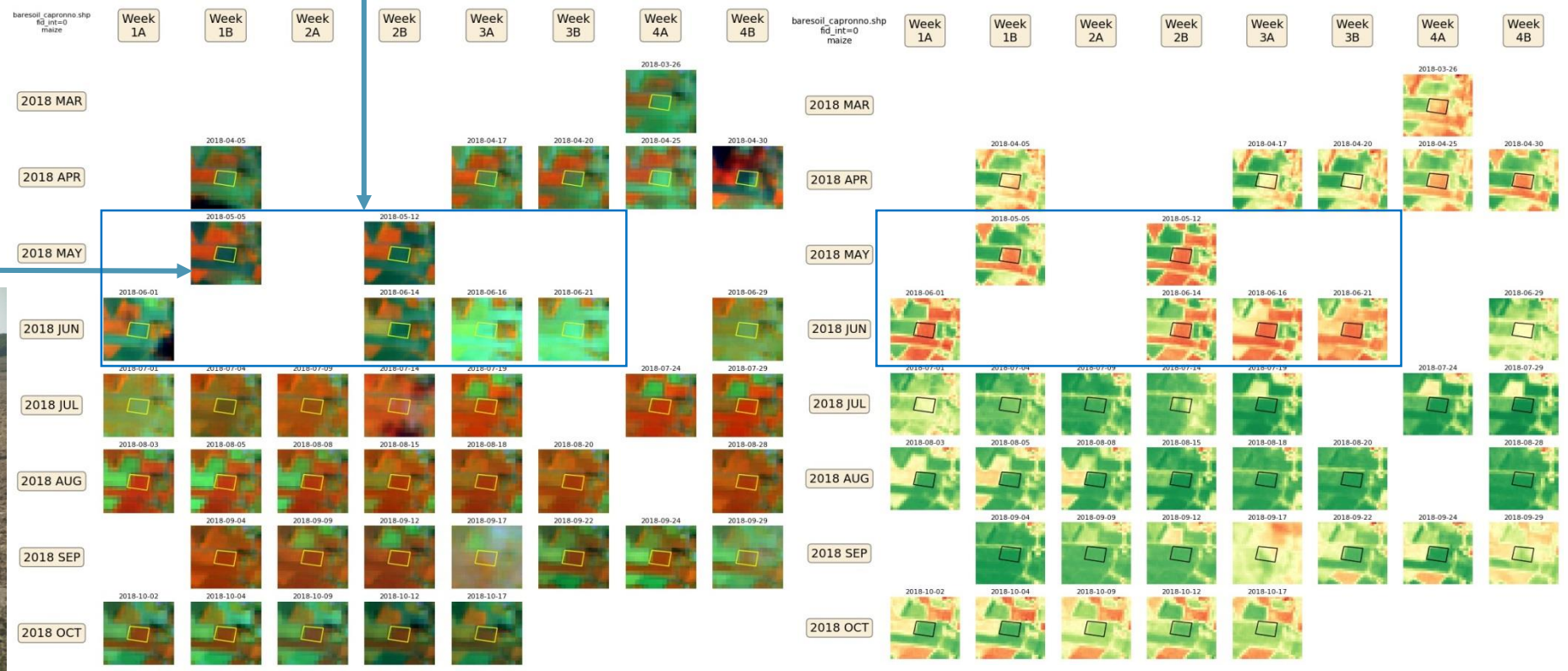


Bare Soil Verification: Example (I/II)

Bare soil signature

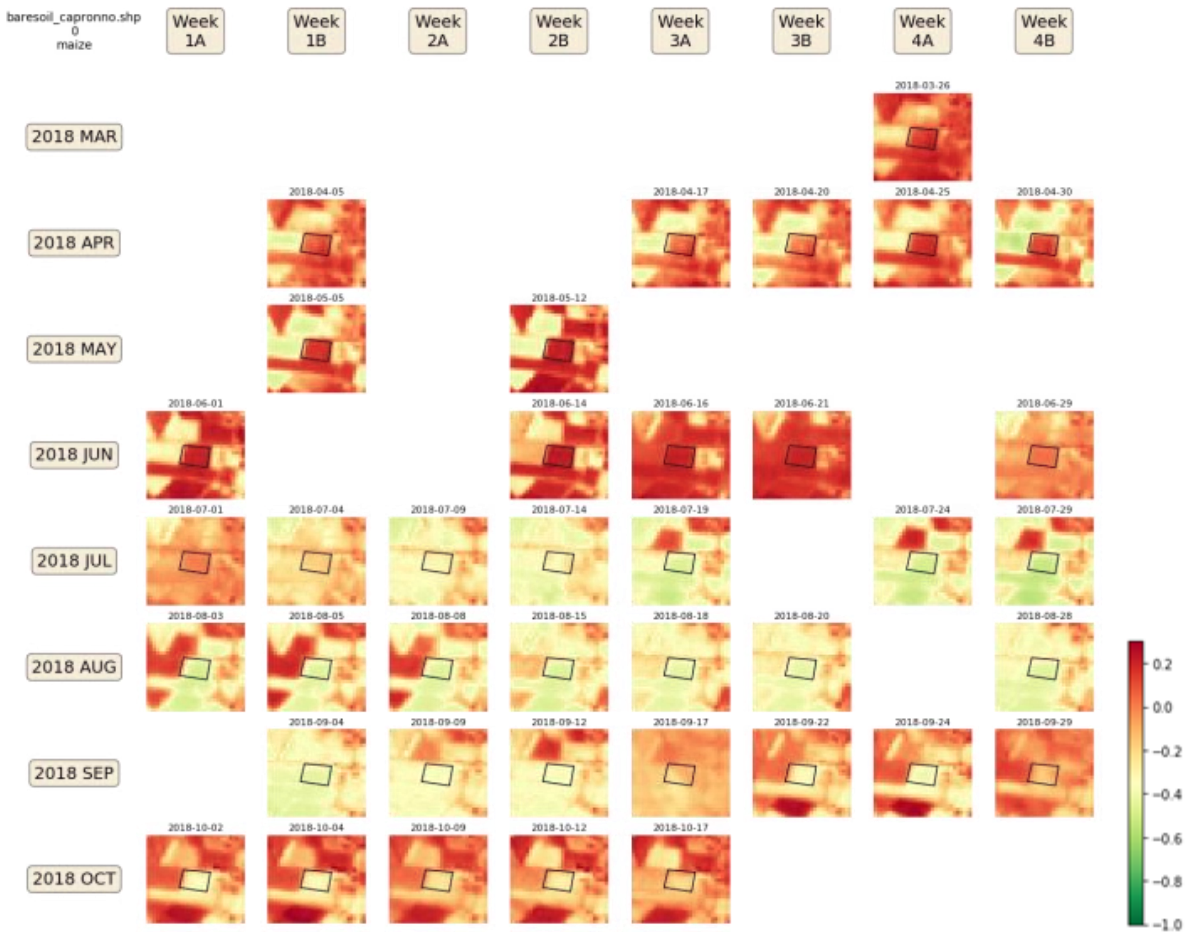


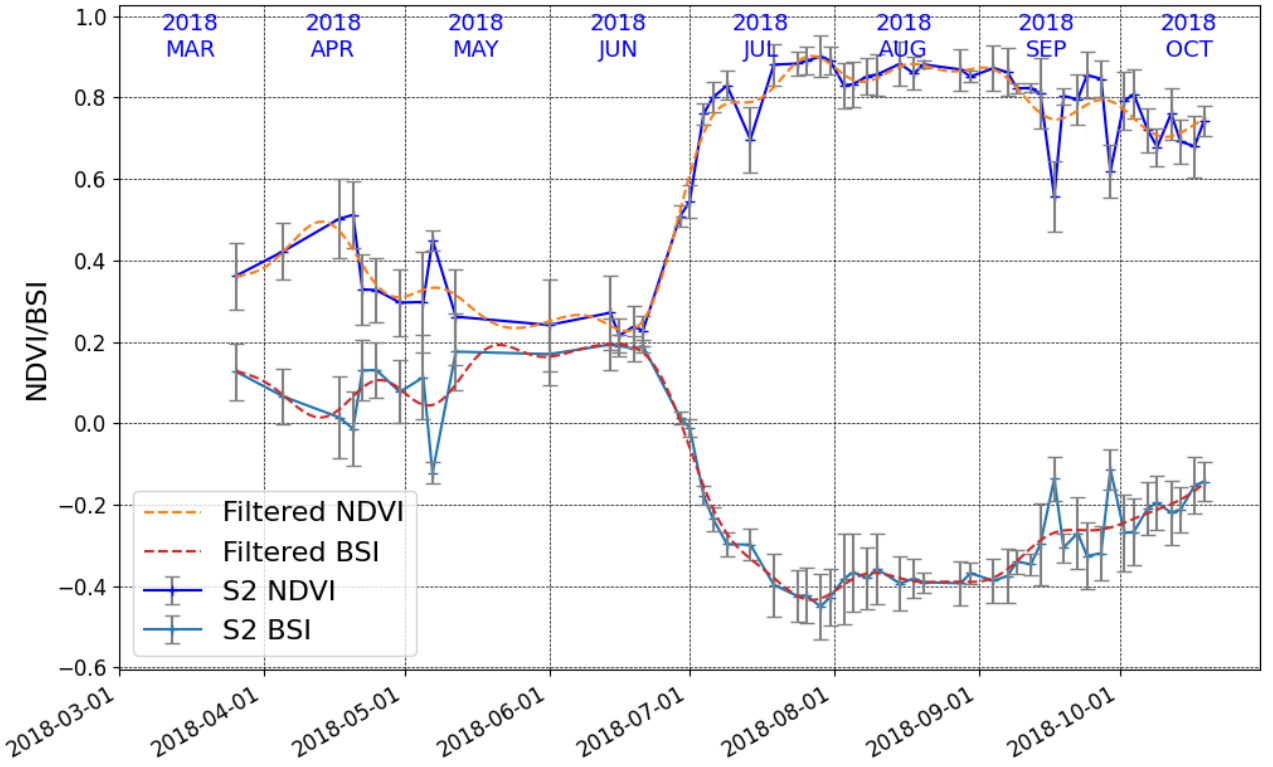
Bare soil in May-June



Bare Soil Verification: Example (II/II)

$$BSI_2 = \frac{(SWIR_1 + RED) - (NIR + BLUE)}{(SWIR_1 + RED) + (NIR + BLUE)}$$

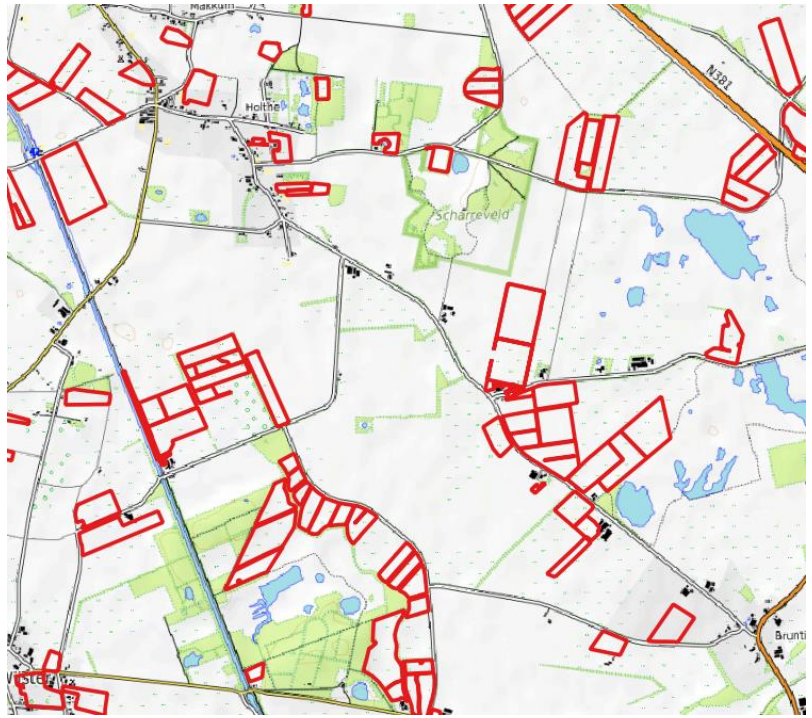




Other indeces (such as BSI) convey similar information as NDVI

European Commission

Data Requirements



- List of parcels with **geometries** (shape file or equivalent) from **GSAA** including unique ID and application ID.
- Include any **attributes** considered useful for the analysis

- **Ground truth:**
  date ranges when green cover/bare soil should be present

- **Context information** (egibility rules, date ranges, etc.)
- **Additional information:** soil maps, DEM, geotagged photos, arial photos, ...

Q&A

Checks by Monitoring Outreach 2021

Kick-off Meeting 19/03/2021

The list of subjects/questions discussed during the meeting including the JRC responses:

1. **Question from PT expert**

   The MS that showed the interest in the outreach effort and were not engaged in any group may now join one of the proposed working groups?

   Answer:

   It is possible to "tune/adjust" your earlier challenges to better fit in the group and so benefit from a higher priority. We assume anyhow that the current priorities are of relevance for all MS, so there's no need to generate new challenges just to be in the group. The term "group" is loosely used because the operations/interactions are bilateral and data remain confidential.

2. **Questions from AT expert**

   Some questions concerning the AoI´s of Austria: we take part in mowing, bare soil and green cover. So I think it's possible to have three different AoI`s.

   Answer:

   It is possible to join bare soil and green cover analyses over one area of interest. The area of interest for mowing should remain separate in your case, thus two AOIs should be sufficient but please consult other conditions as reference dataset/OTSC results availability.

3. **Questions from BE-FL expert**

   Are regular exchanges of progress planned in the course of this project? Because we are also very interested in grazing detection, but are not in that group.

   Answer:

   The regular exchanges are foreseen throughout the project. The JRC will provide dates and organize corresponding meetings. Please be informed that groups were created according to your interest submitted to the outreach initiative.

4. **Question from AT expert**

   Especially concerning green cover and bare soil AT is interested in combining them to the same parcels. Is this possible?

   Answer:

   Yes, it is possible.

5. **Question from CZ expert**

   What work is exactly expected from PA to analyze data via "frontend"?

Answer:

Active participation of the PA is expected that ranges from support to the data analysis with local context information to joint development and testing of code that implements particular markers and evaluate these with the provided data sets. This obviously depends on the level of technical expertise.

6. **Question from AT expert**

Should we exchange at first a test-file per mail to define necessary columns and format with only some parcels inside?

Answer:

It is possible that a Paying Agency will submit the test-files to the JRC in order to define data content and formats. The deadline for the final data submission is 15th of April.

7. **Question from FR expert**

Could we have the presentation in order to reach the url pages?

Answer:

All material presented during the outreach kick-off meeting will be made available online.

8. **Question from AT expert**

Can you submit or clarify the mentioned TileGrid for S1 (185*185 km)? I'm only familiar with the S2 100*100 tile grid.

Answer:

We will provide the Sentinel-2 grid for the sample selection, as it is based on fixed frames of, nominally, 100x100 sqkm. We will ask participants to select their minimum 10000 parcel sample within these 2 adjacent S2 granules. If you would like to provide more than 10000 parcels, this is fine, as long as they are within the 2 adjacent granules. For large MS, we can consider several sets of 2 adjacent granules, after bilateral consultation.

9. **Question from AT expert**

Is it possible to share the results to the other participating MS in the group if the original MS agree? Because I think the results can be interesting for all.

Answer:

In the outreach initiative a collaborative approach was proposed as a form of cooperation between the JRC and the PAs during work in the defined groups. The main principle is that the participants share work and experiences among themselves. The final result of the project will be also available for the public.

10. **Question from EE expert**

The current situation sparseness Sentinel-1 time series in Baltic Sea Region and disables part of the monitoring functionality from March to May. This is particularly a problem for monitoring early season soil preparation.

Answer:

This is an issue for ESA and the Copernicus program (DG DEFIS). The use of the EW imaging mode (which is incompatible with CbM) relates to the need to monitor ice conditions. The Sentinel-1 imaging mode should switch to IW in April. ESA "forgets" to switch for some orbits.

11. Question from DE expert

Regarding Slide #4 : GSAA-Parcels to FOI: Who merges the Geometries?

Answer:

The National Administration merges the geometries, according to a set of rules defined locally. They depend on the particular LPIS design and overall GSAA setup. Some guidance on this data preparation is given in https://marswiki.jrc.ec.europa.eu/wikicap/images/b/b9/JRC112913.pdf (page 30).

12. Question from AT expert

What is the minimum number of parcels which have to be accompanied with in-situ information for mowing?

Answer:

In general, the more the better to support method development and validation procedure.

13. Question from AT expert

Will you also deal with a combination of mowing and grazing at the same parcel, e.g. 1 times mowed and afterwards grazed

Answer:

Yes, the combination of grazing and mowing could be part of one scenario or could be regarded as two different scenarios. This depends on the farmer input in the context of the local eligibility rules for the given schemes. Normally, there would be two separate markers for mowing and grazing, which can be then combined in one single processing option, leading to a decision (for more information see https://marswiki.jrc.ec.europa.eu/wikicap/images/0/0a/TG_CbMQA_1_1.pdf).

14. Question from SE expert

What is the possibility of a marker for extensive surfaces with low animal loads? (moors and other poor lands).

Answer:

The grazing event in this case could be regarded as representing a long-lasting process of gradual transformation of the natural habitat, into semi-natural. Such an event spans over several years, even decades. There might be two options to deal with the detection of such an event in CbM: (1) check with multi-annual data for signs of transition of the area (habitat) from semi-natural to natural. This could be an indication for absence of grazing activities leading to a gradual reversion of the area (habitat) into its natural

ecosystem state; (2) comparison of the behavior of the area in question (supposed being grazed) with similar areas where grazing or other anthropogenic activities, are known being absent.

15. Question from BG expert

When we use the CbM, when should we stop to look at the parcel behavior for the claim year? At the end of the calendar year, financial year, or something else?

Answer:

The behavior of the phenomenon, present on a given parcel and the associated observation period, is defined by the scenario. It is usually within the given agronomic season.

16. Question from BE-FL expert

For bare soil detection, is the accuracy of the bare soil detection in the standard S2 L2A SCL layer known? S1 version seems most interesting.

Answer:

The SCL (Scene CLassifier) layer produced by sen2cor is not very accurate, although it is based on applying a classifier to the band data (this is part of the open source implementation of sen2cor, if details are needed).

17. Question from LV expert

Have you had any success establishing a correlation between S1 backscatter and S2 NDVI? Question from a rather cloudy PA.

Answer:

In general, we are trying to generate markers from signals that are complementary. Since Sentinel-2 reflectance and Sentinel-1 backscattering are linked to different properties of the (agricultural) surface we expect additional information in data combinations. S1 is not sensitive to clouds, so time series are much denser.

18. Question from EE expert

Could it be a solution to correlate RVI (Radar Vegetation Index) to NDVI? Little bit too simple probably to work. Complex machine learning model will be superior.

Answer:

See above. Indices like NDVI and RVI are not always the best choice. Often we prefer to work with the individual channels (which are combined in an index). Machine learning is “neutral” to the information layers that one feeds into it, as long as the information is not too much correlated.

19. Question from DE expert

I have a question regarding the grazing detection: as you mentioned that for grazing it is a long process and how can we detect whether it is grazing or an event caused because of drought? Because drought is also a slow process.

Answer:

We realize that contextual information, like weather parameters, are often relevant to explain trends in the time series. We are working on integrating grid-sampled weather parameters from global models (e.g. ERA-5 or GFS), but if participating MS can provide access to detailed weather station data, such analysis can be further refined. This is also true for other relevant reference data (e.g. DEM, soil data, etc.)

20. Question from BE-FL expert

@LV: A Belgian research Centre has a product that interpolates missing NDVI data with radar: https://blog.vito.be/remotesensing/cropsar2019

Answer:

We are aware of this approach, but have not implemented this for the moment. We are interested in receiving any information on known approaches that MS are aware of and which we could consider for implementation.

21. Question from SE expert

In our tests we see that only 20-30% of all grazing have a clear declining followed by an inclining pattern. Most pastures have different patterns.

Answer:

Indeed, we are aware of this variability. Our aim is to "break down" the problem into smaller parts that are easier to address. For that reason, we decided to start with the more straightforward cases of mowing, applicable for intense (agriculturally improved) grasslands, and then move to the more specific/difficult cases.

22. Question from DE expert

Do you have a special workflow for Coherence calculation or is it the general workflow available in SNAP?

Answer:

Yes, we have provided the SNAP recipes (gpt graphs) to the DIAS providers, who have implemented those in their CARD processing backends. For coherence, there is an additional complexity due the need to combine S1A with 2 S1B frames (and vice versa). We intend to publish the SNAP procedure to our code base.

23. Question from DE expert

Did you calculate the probability of grazing detections? What is an average trust level of detection of this agricultural activity?

Answer:

Markers can provide an indication about what happens to a grassland FOI. Mowing tends to be most distinct, i.e. the marker provides high confidence that a mowing event occurred. Grazing is less distinct and, therefore, provides lower confidence that it may have happened. Confidence levels can only be cross-checked with timely ground truth. In CbM, low confidence cases would lead to a yellow light which either needs to be resolved by RFV, geotagged evidence, cross checks with ortho-imagery and passed on to LPIS update (e.g. if abandonment is suspected) or follow up in the next season.

24. Question from EE expert

@LV: NDVI modelling from S1 is a hot topic, but obviously it is challenging as physically S1 and S2 observe different agri features.

Answer:

see 17 and 18