The European Commission's science and knowledge service

Joint Research Centre

Technical developments

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25th MARS Annual Conference, Prague, CZ, November 26-28 2019

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Challenges

- Land cover conceptualization + markers
- Exploration of spatial/temporal potential of Sentinel-2 data
  - FOI – decision on heterogeneity
  - FOI – estimation of crop area ratios
- Considerations for image content recognition

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Land cover conceptualization + Markers

M.C. Escher's-Metamorphose II
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walldecorationss.com –
Wall's Furniture & Decor

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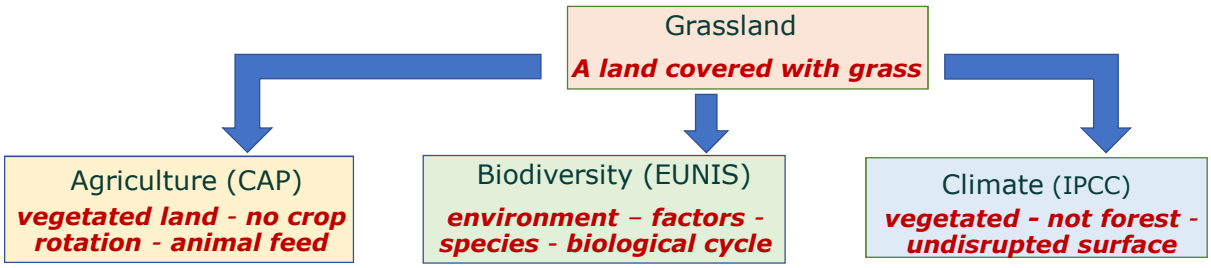
Land cover conceptualization - Context

Future CAP: more transversal and integrated with other policies

- Requires awareness and comprehension of concepts applied



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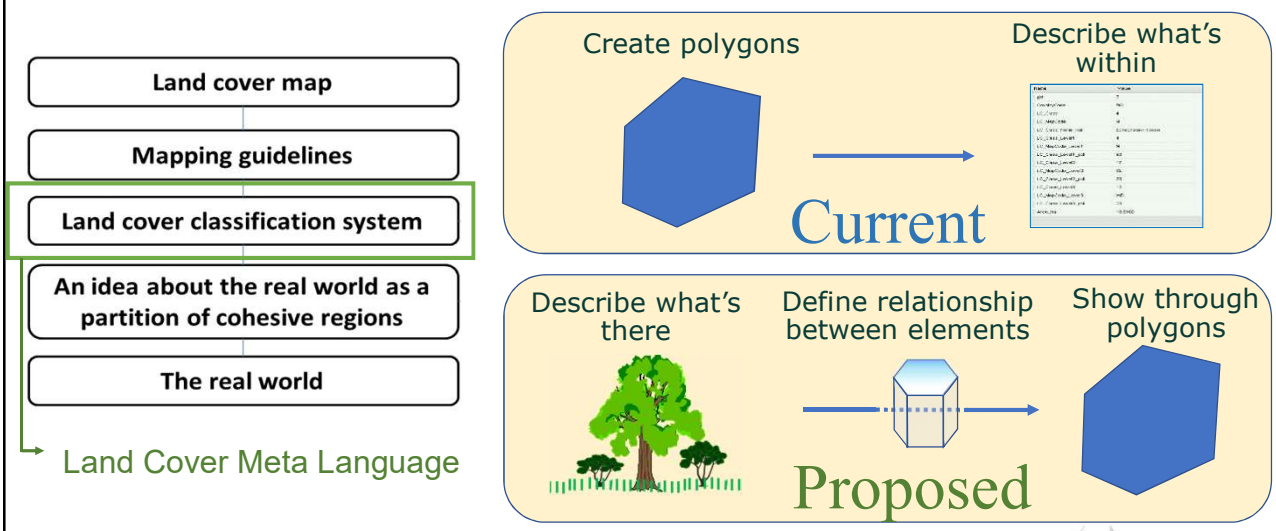
Land cover conceptualization – New approach proposed



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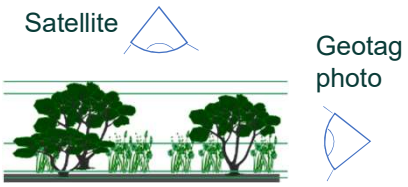
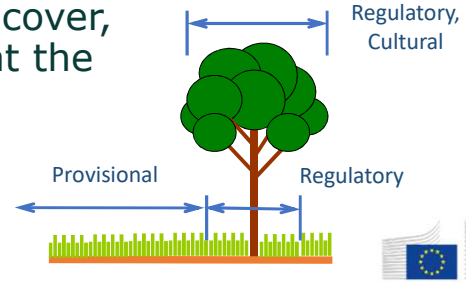
Land cover conceptualization - Key advantages of the proposal

Bridge the gap between existing observation and data capturing methods



Antonio di Gregorio, "Land Cover Classification System - Classification concepts and user manual", FAO-UN, 2005

Enable the link between the land cover, land use and ecosystem service at the level of the feature



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Land cover conceptualization - Future work

JRC concept as proposed item for the revision of Land Cover Meta Language - LCML (ISO 19144-2)

Perspective toward comprehensive method for Land Characterization (incl. Land Use and Ecosystem Function)

Stage 0 Project Team on LCLU

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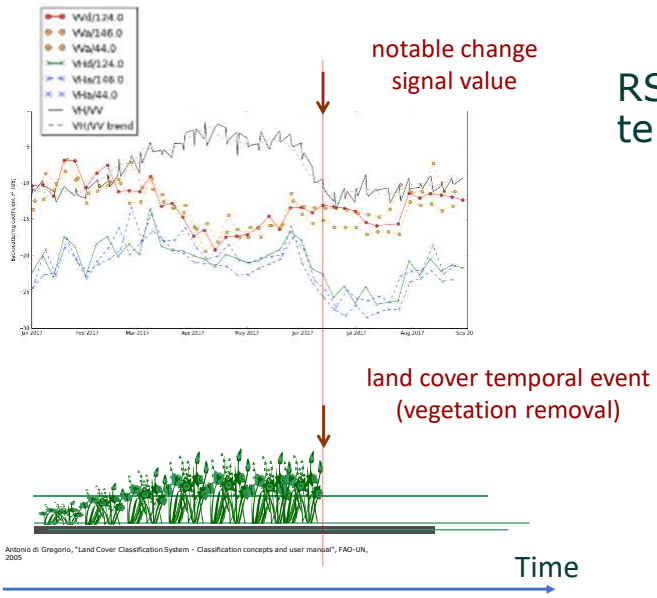
Marker core - Concept



Antonio di Gregorio, "Land Cover Classification System - Classification concepts and user manual", FAO-UN, 2005

RS observation of a "land cover temporal event"

- behaviour of a property of a feature
- property is primarily related to the "material" that constitutes the observable feature

feature = abstraction of real-world phenomenon = FOI

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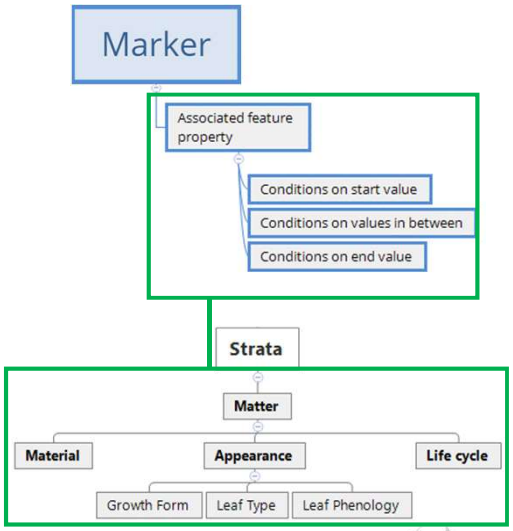
Marker core – Template for register

- Basic elements
  - Property, start-end conditions
- Property-related
- Condition type -related
- Time-related
- Change rate -related

Reuse and extension of existing standards (LCML, observation and measurement)



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Marker core – example (ploughing)

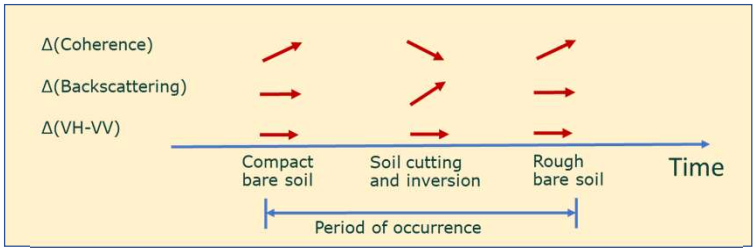
- **Stratum:** 0 (soil)
- **Material:** Abiotic
- **Property:** material appearance (roughness)

- **Condition on start:** smooth
- **Condition on end:** rough
  - **Associated event:** Primary Tillage

- **Signal instantiation:** SAR backscatter with various polarization modes and coherence

Come to the market place:

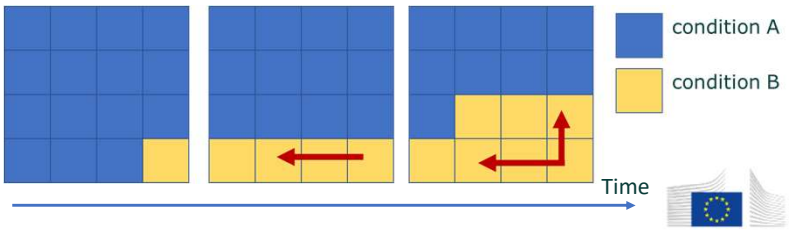
Wed, 15:00 - 16:45



Marker core – Future Developments

- Design and complete the template for event marker cores
- Populate with most matured and proven instances from EU MS
- Work towards:
  - including spatial context (event propagation within FOI)
  - template for non-compliance markers

Spatial propagation of condition change within FOI



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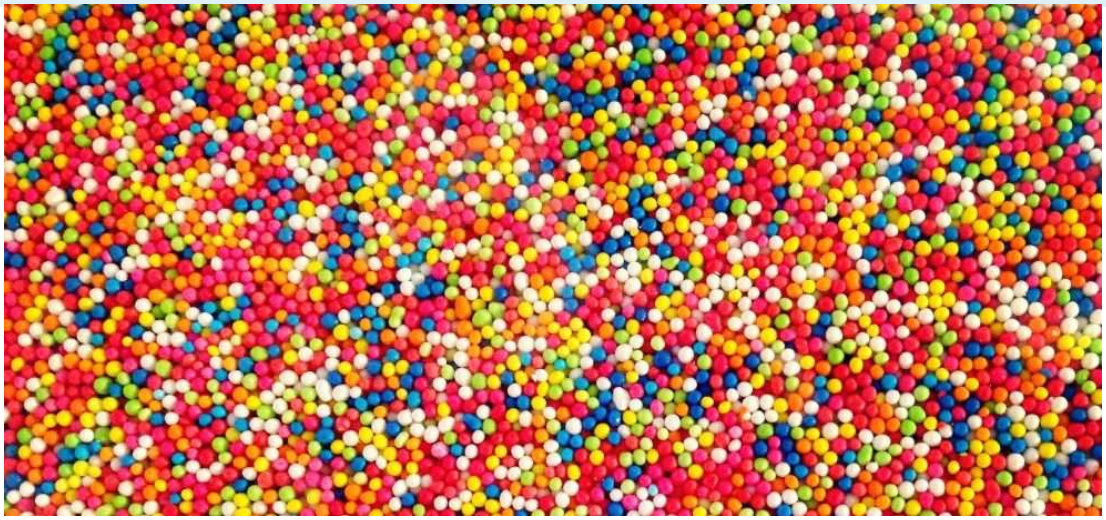
FOI homogeneity analysis



Source: https://www.students4bestevidence.net/blog/2018/11/29/what-is-heterogeneity/

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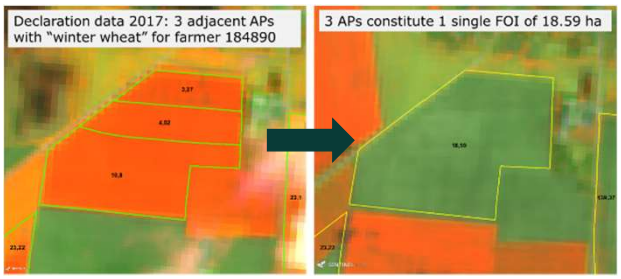
FOI – context

- Homogeneous unit of management
- Detect potential:

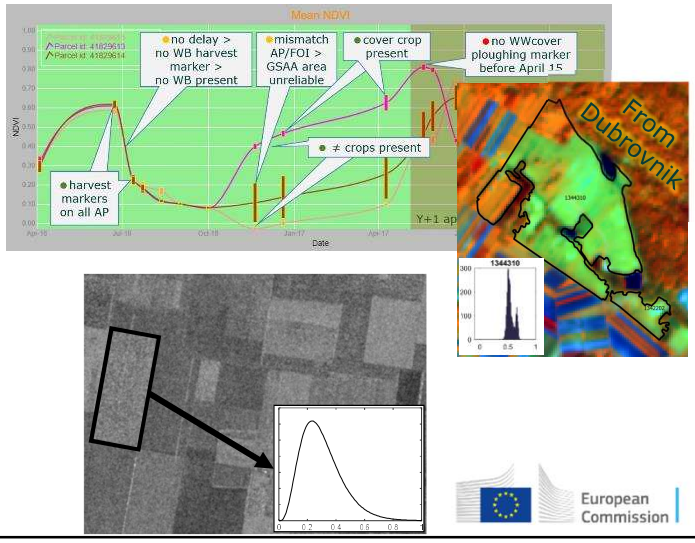
- Sub-parcels
  → need to split

- Bigger parcels
  → need to aggregate



FOI – homogeneity tests

- S2:
  - Threshold on signal-to-noise ratio
  - Histogram analysis
- S1:
  - Analysis of backscattering's speckle noise



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FOI – messages

- Working on tools for automatic and fast detection of heterogeneous parcels
- First steps before more advanced methods (e.g. edge detection → see next section)
- Relevant for classification as well (i.e. clean training data)

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FOI – future steps

- Implementation on portable format (DIAS, python scripts)
- Testing/validation (with MS's feedback)
- Other techniques ? (e.g. deep learning, wavelets)
- Other context ?

→ Heterogeneity = signal ? (e.g. set aside)

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Estimation of crop area ratios

Source: https://libreshot.com/minimalist-colorful-field-photo/

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S2 – crops' area ratio estimation – case study

Context

- In the context of greening requirements (crop diversification)

Goals

- Can multi-temporality of S2 data increase the precision of crops' area ratio estimation?
- Confidence interval of retrieved ratios?
- Factors influencing the accuracy of retrieved ratios?

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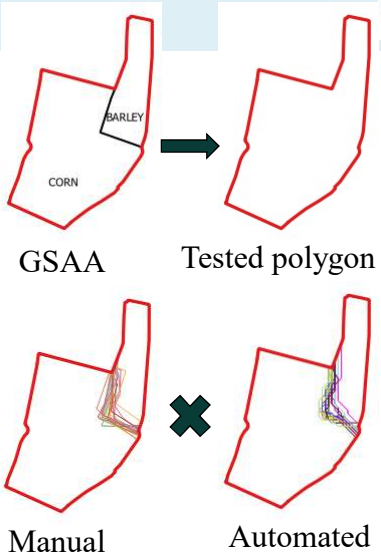
Set up of case study

- ES-Catalunya's GSAA data (crop, area, vector)
- Targeted sample (2crops, various sizes, ratios)
- Manual approach as reference
- Automated approach tested
- Analysis on datasets of area ratios



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Preliminary messages

- Temporal aspect
  - improves the precision of ratios estimation
  - no need of huge number of images, already 3 images gives narrow confidence interval
  - helps to recognize stable edges from temporal features caused by agriculture management routines
- The potential in S2 multi-temporal data – THERE IS!

- The CHALLENGE – find the suitable post-processing procedure at large scale level

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Future

- The workflow for suitable fully automated process needs to be found – if succeeds -> technical guidance

  -> Tests for more crops and larger datasets
- Alternative methods (segmentation..)
- Complement results with S1 data
- Results relevant also to other thematic areas..

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Image content recognition

Source: https://hivelife.com/harnessing-ai-for-agriculture

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Image content recognition

- Geo-tagged photos - confirmation of:
  - crop type,
  - activities,
  - a need of the LPIS update
- Can be sorted automatically with deep learning (DL)
- DL requires large training sets:
  - photos depicting "the object"
  - correct labels

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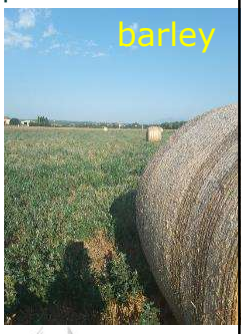
Gathering photos

- Call for images: ES (Catalunia), BG, BE-FL and CZ
  - ~160Gb = 75 000 photos
  - from inspectors and farmers
- LUCAS images

captured for different purposes



- Image screening and label confirmation
  - 60%-85% of images captured by the inspector are usable for classification with DL

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Factors to consider for the DL training set & instructions for farmers

- Phenological development stage
- Orientation of the camera
- Image frame content
- Correct label

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Image content recognition – what next?

- Coming: technical report on geo-tagged photos
- Tools are available:
  - Commercial solutions (platforms, APIs etc)
  - Frameworks and libraries with pre-trained models for in-house developments
- Need for sharing training data?
- Need for sharing codes?
- Need for protocol of data collection?
- Come to the market place and posters!

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Meet us tomorrow, 27.11.2019, 15h00–16h45

Posters:

- Introducing the "marker" concept for near real-time monitoring of farm activities in the context of the European agricultural monitoring
- Precision of estimated crop area ratios based on multi-temporal Sentinel-2 data
- Establishment of a reference data for monitoring the dynamics of permanent grassland with scattered woody vegetation

Market place:

- Prototype ploughing marker and FOI homogeneity analysis
- Considerations for collecting geo-tagged photos
- Copernicus DIAS for CAP's checks by monitoring

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Any questions?

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