Sentinels Looking after Agriculture
Sentinel-2: key revisit and spatial resolution

Majority of Europe
>3 day revisit


S2 10 meters

L8 30 meters
Sentinel-1: Dense time series for crop stages monitoring

 Majority of Europe >2 day revisit

 S-1A & -1B (July-Sept 2017)
Uptake of Copernicus within the CAP 2020

1th of July: Modernizing and simplifying the Common Agricultural Policy
Commissioner Phil Hogan, DG-Agri (25th of May, Press release):
“This new satellite technology will significantly reduce the number of field inspections, removing the climate of fear, which causes significant stress for farmers. It will also benefit public administrations, by reducing the costs of administering controls and checks. It is thus a win-win for farmers and administrators.”
Sen4CAP: R&D for Common Agricultural Policy

• Sen4CAP Implementation:
  o Responding to the request from DG-AGRI & DG-GROW
  o Collaboration with DG-AGRI, DG-GROW, DG-JRC
    and national Paying Agencies

• Sen4CAP Objectives:
  o Provide evidence how Sentinel derived information can support the
    modernization and simplification of the CAP in the post 2020
    timeframe
  o Provide validated algorithms, products, workflows and best
    practices for agriculture monitoring relevant for the management of the
    CAP
Sen4CAP – Expertise, Technology & Collaboration

Paying Agencies & Farmers
DG-Agri, JRC, DG-Grow
EO Experts

Cloud Technology (DIAS)
Continuous Monitoring
Validated Performance
National Demonstration
Innovative Practices

CAP2020 Reform
Sen4CAP Pilot Countries – EU Agricultural Landscape
1. Analysis existing **recommendations** coming from the **CzechAgri pilot study** and the different **PA workshops** from the last months
2. Design of a **questionnaire** dedicated to the PAs formally involved in the project + **interview** of these PAs
3. Organize a **User Requirement Workshop** in which the user requirements were discussed actively with all bodies involved
User Requirements in terms of IACS use cases

Use case

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

Use Cases w/ Paying Agencies

Prototyping & Testing at EU level
Identify Sentinel-based markers for CAP Monitoring

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

Crop type information & vegetation growing indicators

Number of detected mowing events

Physical markers to monitor EFA agricultural practices
Prototyping - Developing & Testing at EU level

- 2 “national” coverage (NLD + CyL) + 10,000 km² test sites
- In-situ data sets shared by Paying Agencies
  - LPIS/GSAA datasets, subsidy applications, physical inspections, CwRS
- Sampling heterogeneous EU agricultural landscape:
  - LPIS types: Cadastral (IT, ES), Physical Block (NL, LI, RO), Farmers Block (CZ)
  - Field sizes: Minimum: RO & IT 72-85% < 1ha, Maximum: CZ 66% > 1ha
  - Landscape & climate: wide geographical range

➡ Algorithm Development, Benchmarking & 1st Validation
Monitoring of Agri. Practices for EFA compliancy
Czech Republic

- Catch crops, based on S1&2 time series – 5 markers tracing crop activities

Harvest – Visual check

Catch crop

Winter Catch Crop – Visual check
Monitoring of Agri. Practices for EFA compliancy
Czech Republic

- Catch crops, based on S1&2 time series – 5 markers tracing crop activities

**Output:** (per parcel)
- Harvest detection
- Harvest week
- Catch crop detection
- Confidence level for compliancy
National dynamic crop mapping at field scale

Full Resolution Visualization Online: [http://www.esa.int/spaceinimages/Images/2018/05/Crop_map](http://www.esa.int/spaceinimages/Images/2018/05/Crop_map)
Crop type mapping for crop diversification monitoring
Netherlands

Observed crop type
(2017)

95% of parcels
Crop type mapping for crop diversification monitoring
Netherlands

Observed crop type (2017)

Confidence indicator of agreement (2017)

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

Percentage of high confidence in agreement: 94%
Percentage of other confidence levels: 6%
Crop type mapping for crop diversification monitoring - Lithuania

Available information:
- Total area of arable land at the farm-level
- Number of crops at the farm-level
- Proportions of the main crops

Compliance indicator of agreement at parcel-level:
- High confidence in agreement
- Average confidence in agreement
- Weak confidence in agreement
- High confidence in disagreement

Compliant at holding-level:
- 56.6 ha
- 4 crops

Compliant at holding-level:
- Total area of arable land at the farm-level
- Number of crops at the farm-level
- Proportions of the main crops
Sentinel-based vegetation indicator as auxiliary data
Czech Republic

4 indicators

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<th>ID</th>
<th>NKOP_DPB</th>
<th>AREA</th>
<th>CONF_IDX</th>
<th>CTDECL</th>
<th>CT_PRED_1</th>
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<td>Wheat</td>
<td>Grassland</td>
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Czech Republic

Low confidence in agreement

High confidence in agreement
Design of Sen4CAP processing system
Towards PA’s uptake in their environment

- Integration of S1 & S2 images, EO products & markers in PA’s environment
- WMS providing RGB imagery and simple indicators
  - Easily integrated in PAs environment
  - S1, S2 & L8 images
  - Vegetation Indicators (NDVI, LAI, Fcover, FAPAR)
  - Time filtering
  - Configurable visualization
  - Reprojection to local coordinate systems
  - Customizable by country
Visualisation tool – Implementation by country
Visualisation tool – view attributes of the parcel related to the selected layer
Visualisation tool – viewing results at farm level for compliance assessments
Visualisation tool – Time animation following crop dynamics
Visualisation tool – products metadata

Product description
- Year
- Type of agricultural practice
- Regulation
- Interpretation of regulation
- Description of fields

Legends

Codelists with descriptions
Prototypes for proof of concept

- 2016 & 2017
- 10.000 km² test site + national coverage (NLD and Castilla i Leòn)

Full scale demonstration

- 2018 & 2019
- National coverages for all six countries
- Near-real time processing (2019) and timely delivery
- Operational environment of pilot PAs
- Capacity building and training
Methodological developments

- Algorithms improvements and refinements based on PA’s feedback
  - Crop type legend: are all the crop classes needed? How to merge? BPS vs crop diversification use cases
  - Better understanding and integration of EFA regulations
  - Better integration of S1 & S2 for grassland monitoring
- Selection of « monitorable » parcels
  - Prototyping: 0.5 – 1ha threshold; inner buffers
  - No more thresholds but considering only inner pixels
- Continuous monitoring
Continuous monitoring

**Romania**

- Classes:
  - Overall accuracy
  - Kappa
  - Autumn Common wheat
  - Corn
  - Sunflower
  - Autumn rape
  - Alfalfa
  - GRASSLAND
  - Bean peas
  - Autumn Barley
  - Rice
  - Soy

- Metrics:
  - F-score
  - Kappa
  - Overall accuracy

**Netherlands**

- Classes:
  - Overall accuracy
  - Kappa
  - GRASSLAND
  - Zea
  - Solanum tuberosum
  - Winter wheat
  - Beets
  - Tulipa
  - Onions
  - PERMANENT CROPS
  - Winter carrot
EO data timely processing

• S1 and S2 data, since the 1st January 2018 continuously processed
2018 in situ data collection

- Subsidy applications for 2018

- On-The-Spot-Check (OTSC) data

- Farmers interview for grassland mowing and agri. practices
  - Interactions by e-mails
  - 250 to 500 fields surveyed by practice (grassland, crop harvest, catch crops, nitrogen fixing crops, fallow land)
<table>
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<tr>
<th></th>
<th>Czech Republic</th>
<th>Italy</th>
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<tbody>
<tr>
<td>Output L2 data (2016-2019)</td>
<td>31 TB</td>
<td>137 TB</td>
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<tr>
<td>Output L3 and L4 data (2016-2019)</td>
<td>14 TB</td>
<td>50 TB</td>
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<tr>
<td>Pre-processing resources (ongoing)</td>
<td>16 cores, 90 GB</td>
<td>48 cores, 230 GB</td>
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<tr>
<td>Products &amp; distribution resources (ongoing)</td>
<td>28 cores, 72 GB</td>
<td>62 cores, 144 GB</td>
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*Average LPIS database volume: 0.1-10 GB*
Embracing DIAS

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

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

- Sentinels benefits for CAP monitoring demonstrated with *prototype* products
  - For IACS use cases: crop diversification, permanent grassland and EFA
  - Under specific assumptions in terms of parcels size, parcels geometry, etc.
  - Several ways identified to increase relevance of Sentinels markers

- Moving to national demonstration, wall-to-wall coverage, timely delivery
  - Wall-to-wall coverage over 6 countries (1.2 Mkm²) with diverse cropping systems, LPIS, landscape, etc.
  - 2018 processing ongoing: in-situ and EO data (S1 + S2 pre-processing, markers)
  - Tacking national-scale methodological issues
  - Going to use cases
  - Moving to DIAS
  - Capacity building & training