Welcome to the 11th 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 from UCLouvain
Laurentiu Nicola from CS GROUP - ROMANIA

Members of the consortium available to answer your questions
Webinar outline

• Sen4CAP overview
• System evolution
  o New version 3.1 – Support for MAJA 4.5.4
  o Next version 3.2
• New use cases for 2022
  o Test sites
  o Parcels heterogeneity
  o Bare soil detection
• Next events
Webinar outline

- **Sen4CAP overview**
- **System evolution**
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Sen4CAP system

Funded by European Space Agency

eesa

EO Experts

UCLouvain

GISAT

SINERGISE

e-geos

ES

ROMANIA

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

User group:
6+1 Paying Agencies

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.
Sen4CAP – An open-source system

- 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

Version 3.1 delivered on 20 Jul 2022
Sen4CAP system: simple parametrization and subsidy application upload

**Sen4CAP system: main parameters settings**

- **Area of Interest**: Shapefile to be uploaded
- **Monitoring period**: Start and end dates to be defined
- **S1+S2 / S1+S2+L8**: L8 to be selected

**Sen4CAP system: data from PA**

- **Subsidy application (shp)**: Subsidy application layer (shapefile)
- **Tables and config files (csv)**:
  - L4A crop code LUT
  - L4B config file
  - L4C config file + agri practices tables

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**System initialization**

Before the monitoring period  Monitoring period

Start of the season  End of the season...

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**Subsidy application**

Upload data

Tables and config files
Demonstration & Validation in 2018, 2019 & 2020
Checks by Monitoring (CbM) and Area Monitoring System - as a Service
An open-source collaborative ICT system for EO agriculture scientists

Agriculture Virtual Laboratory (AVL)

- Base solution on proven and well-established technologies
- Focus on seamless integration rather than on re-inventing wheels

1. Common components
2. Thematic processing subsystem
3. Exploitation subsystem

Technology

- TAO, SNAP, xcube, geoDB, cate, Sentinel Hub, Python stack, OTB, R, GDAP, Sen2-Agri, Sen4CAP, Sen4Stat, SenET, etc.

Approach

- Tailored Data cube generation and visualization // GeoDB
- Interactive programming environment
- Web toolbox

- Xcube Generator, Cube Viewer, GeoDB
- Jupyter Notebooks
- Cate

https://agriculturevlab.eu/

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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
1st consolidated version
Big evolutions:
- Corrections in the advanced processors
- Sen2Cor L2A compatible
- Move of the system database to a docker container
- ...

Version 2.0
Big evolutions:
- Markers database
- Tillage processor
- Dockerization
- ...

Version 2.0
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Version 3.0
Big evolutions:
- Web interface (system configuration)
- Products visualization
- Additions in MDB
- Secured services
- Dockerization
- ...

Version 3.1
Big evolution:
- Support for MAJA 4.5.4
Version 3.1 supports MAJA 4.5.4

- MAJA 4.5.4 has **support for the ESA's recent changes in the Sentinel-2 products format**

- MAJA 4.5.4 other improvement:
  - MAJA version 4 was a complete recoding of MAJA version 3’s internal scheduler -> one bug in the aerosol estimation method
  - In the case of rare images, high optical thicknesses and low surface reflectance values appeared -> propagated to the next images, as the method is multi-temporal
  - Not existing if using CAMS

Example of MAJA v3 L2A

Same product as (left) with MAJA v4 before bugfix. After bugfix, both images are identical.
1. New installation:

   ```bash
   # open a terminal -- go into /install_script folder:
   cd /path/to/Sen4CAPDistribution/install_script
   # Run the install script
   sudo ./sen4capPlatformInstallAndConfig.sh
   ```

2. Update your previous version:

   ```bash
   cd /path/to/Sen4CAPDistribution/install_script
   sudo ./update.sh
   ```

3. Don’t forget to also update the GIPP files

4. The full time series must be pre-processed with the same algorithm (MAJA or Sen2COR) – **don’t change within the season**
Next version 3.2 to come

- Possibility of using FMask
- Updates for collection 2 of USGS (some changes in the L1T products structure)
- Some corrections for past seasons executions
- Possibility to cut S1 AP/COHE by S2 tiles (optional)
- Try to determine dynamically the interval for computing the Coherence (6 days if S1A and S1B or 12 days if only S1A)
- More comprehensive markers Database:
  - New signal statistics & markers: median, p25 & p75
  - Jupyter Notebook (python) to easily access the MDB and create new indices based on existing “signal statistics”
- Other corrections
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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
New uses cases of 2022

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

**Bare soil markers**

**Change of cover from year to year**

- New Optical & SAR variables – all year round
- Multi-annual analysis

MILENOV Pavel et al., 2021, JRC
Sub-parcel heterogeneity detection

Benchmarking of 3 approaches

- Clustering by tile
- Coefficient of variation at the parcel-level
- Statistical distribution check at the parcel-level
Selected methodology and workflow

All images S2 of 1 month

- L2A – 10m
- L2A – 10m
- L2A – 10m
- B2, B3, B4, B8

- L3B – 10m
- L3B – 10m
- NDVI

- BCK Ratio
- BCK VV
- BCK VH
- COHE VV
- COHE VH

Crop Mask

Clustering (MiniBatchKmeans)

Remove isolated pixel

Raster of Clusters

Analysis at the parcel level

Monthly S2 result

Parcel declaration

Monthly S1 result

Clustering (MiniBatchKmeans)

Remove isolated pixel

Raster of Clusters

Analysis at the parcel level
Preliminary results – Wallonia (Belgium)

S2 clustering - October

Clusters

NDVI
Preliminary results - Wallonia (Belgium)

S1 clustering - October

Clusters

Coherence VV
Preliminary results – Saxony (Germany)
Preliminary results – Saxony (Germany)

Clustering – S2 - June

S2 (NDVI) – 09/06/2021

S2 (NDVI) – 19/06/2021
Preliminary results - Denmark

Maximum difference of NDVI between 2 clusters: **0.151**

Maximum difference of NDVI between 2 clusters: **0.100**

Maximum difference of NDVI between 2 clusters: **0.074**
Bare soil detection

Challenges

- In « summer », corresponding to the main crop harvesting
- But also in « winter » to monitor the period of green cover
- Sentinel-2 and Sentinel-1, combining different ratios and features related to bare soil
- Distinguishing between bare soil and scenic vegetation
Selected methodology and workflow

- **S2** L2A & New Variables
- **S1** BCK, VV, VH, Ratio & COHE
- **Calibration dataset**: BS (Bare Soil) & Vegetation
- **RF model S2**: S2 Bare Soil detection
- **RF model S1**: S1 Bare Soil detection

Model applied every 10 days on each parcel
Bare Soil calibration dataset based on S2

Expert based Thresholds

Calibration Dataset

- BSI
- NDVI
- NDTI

Bare Soil in situ - Wallonia

![Graph showing relationship between NDVI and vegetation ratio]

BS | Vegetation
Preliminary results in Luxembourg

Vegetation detected

- conf : 0.986
- conf : 0.974
- conf : 0.982

Bare soil detected

- conf : 1

Parcel of Maize
→ destruction of the cover crop
Multi-year rotation

- Arable Land
- Perennial Crop
- Permanent Grassland

Y1, Y2, Y3, Y4
Next steps

- Finalization of the R&D for the 2 first use cases and implementation in the system
- Conducting the R&D for the last use case
- Validation with users and algos adjustments
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Next events

- **Forum** for your questions about the system 3.1 (and other)
- **Workshop with pilot countries** for use cases 2022
  - Hosted by Czech State Agricultural Intervention Fund
  - On 24 November in Prague
  - Feedback will be shared with the whole community
- Next version **Sen4CAP 3.2**: end of November 2022
- Next webinar **13 December 2022**

- **Your questions ???**
Thank you for your attention and your contribution.