Welcome to the 8th 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
Dominique Laurent from IGN France
Tor Nielsen from Planet

Members of the consortium available to answer your questions
Webinar outline

- Sen4CAP overview
- Sen4CAP evolution
  - Planning for version 3.0
  - Sen4CAP activities continuation in the AVL framework
- NIVA project building on top of Sen4CAP (IGN France)
- Planet Fusion for Checks by Monitoring (Planet)
- Next events
Webinar outline

- **Sen4CAP overview**

- **Sen4CAP evolution**
  - Planning for version 3.0
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- **NIVA project building on top of Sen4CAP (IGN France)**

- **Planet Fusion for Checks by Monitoring (Planet)**

- **Next events**
Sentinel-derived **markers** and **products** assessed through selected **use cases**

- Large dataset of metrics and crop markers from **Sentinel-1, Sentinel-2** and **Landsat8** processed along the season for each parcel and stored in a database
- **Use cases**
  - Crop diversification
  - Perm. grassland monitoring
  - EFA-Land lying fallow
  - EFA-Catch crops
  - EFA-Nitrogen-fixing crops
  - Land abandonment
  - Interactive visualization
  - And many more!

**Products**
- Crop type mapping
- Growing vegetation indicators
- Grassland mowing detection
- Agricultural practices monitoring (+ Tillage detection)
Sen4CAP: from an ESA project to a toolbox

Design and prototyping
2017 – local sites
- Use cases selection
- Products Specifications
- Benchmarked Methods
- Algo & System design
- Prototype products
- Validation

Demonstration and validation
2018 & 2019 – national NRT
- Use cases demonstration
- National scale
- Continuous monitoring
- Validation & Fitness-to-use assessment
- Capacity building and training
- System qualification

User uptake and system evolution
2020, 2021 ...
- 330 downloads and 20+ Paying Agencies testing the system on CREODIAS
- Training with 44 participants from 20 different countries
- Webinars every month
- Support to users
- System evolution
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 2.0 delivered on 8 Feb. 2021
Markers and products assessed through selected use cases but available for many other applications.

Markers DB

- S2 reflectance and VIs
- S2 biophysical indicators
- S1 amplitude
- S1 coherence

Subsidy applications

Crop type map
Grassland mowing product
Agri. Practices monitoring product

New schemes

Markers DB

API interface
Sen4CAP is free and open source
Based on open source existing software

Under GNU-GPL License

Based on **Orfeo ToolBox** framework

Cluster-ready architecture for distributed processing

Integration of **SNAP** tools and processing chains

Operational system required: **CentOS7**
(GNU/LINUX)

**PostgreSQL** and **PostGIS** implementation
Sen4CAP system: simple parametrization and subsidy application upload

- 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

Before the monitoring period

Monitoring period

System initialization

Start of the season

End of the season...

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

Subsidy application

Tables and config files

Upload data
### User community & Support

**370 downloads** since November 2019

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<th>Country</th>
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20+ Paying Agencies accessing test Virtual Machines on CREODIAS

### Online forum

492 posts – 100 users

[https://forum.esa-sen4cap.org/](https://forum.esa-sen4cap.org/)

Webinars and Q&A sessions
Hands-on & online trainings
All ressources online

[http://esa-sen4cap.org/content/presentations](http://esa-sen4cap.org/content/presentations)

AP Webinar, 14 September 2021
Webinar outline

- Sen4CAP overview
- **Sen4CAP evolution**
  - Planning for version 3.0
  - Sen4CAP activities continuation in the AVL framework
- NIVA project building on top of Sen4CAP (IGN France)
- Planet Fusion for Checks by Monitoring (Planet)
- Next events
Version 2.0 released on the 8th February 2021

BETA version
Only available for the PAs

Version 1.0 release candidate
Open-source
Possibility for the PAs to access a test machine with the system

Version 1.1
1st consolidated version
Big evolutions:
- Corrections in the advanced processors
- Sen2Cor L2A compatible
- Move of the system database to a docker container
- ...

Version 1.2
Mainly corrections, adaptations and improvements based on project and user’s experience

Version 1.3
Mainly corrections, adaptations and improvements based on project and user’s experience

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

8th Sen4CAP Webinar, 14 September 2021
Version 3.0 planned for October 2021

- Added
  - **New web interface**
    - Fully implemented in HTML5 and JavaScript (no server-side rendering)
    - Visualization of parcels and markers in the web interface
    - Improved raster visualization in the web interface
    - Web interface configurator
  - **More comprehensive markers DB** - users will have the option to extract also:
    - The reflectance markers for the S2 bands; the bands for which the markers are extracted will be configurable (none by default)
    - The number of valid pixels that were used for computing the mean and stdev for each parcel, for each acquisition
  - **Secured Sen4CAP services** via HTTPS and authentication tokens usage

Version 3.0

Big evolution:
- new web interface
- more comprehensive markers DB
Continuation of Sen4CAP activities within the ESA « Agricultural Virtual Laboratory »

- Continuing Sen4CAP activities funded by ESA:
  1) User Support: website, forum, Q&A sessions when needed, training, webinars
Continuation of Sen4CAP activities within the ESA « Agricultural Virtual Laboratory »

• Continuing Sen4CAP activities funded by ESA:
  1) User Support: website, forum, Q&A sessions when needed, training, webinars
  2) System evolution:
      a) System maintenance and evolution

  - Possibility to compute M1-M5 markers independently from the L4C processor
  - Simplification of the L4C input tables
  - Add more data sources
  - Crop classification possible without a declared crop type
  - System maintenance operation visible in the web interface
  - Maintenance & bug corrections
  - Sen4CAP Services REST API documentation
  - To be continued
Continuation of Sen4CAP activities within the ESA « Agricultural Virtual Laboratory »

- Continuing Sen4CAP activities funded by ESA:
  1) User Support: website, forum, Q&A sessions when needed, training, webinars
  2) System evolution:
     a) System maintenance and evolution
     b) Markers database evolution

- Modification of existing markers and/or addition of new markers based on users’ feedback
- Markers evolution towards the new CAP regulation (from checks/compliance to performance)
  - Call for new use cases in Oct-Nov 2021
    - Supporting the transition towards performance regulations
    - Sharing in situ data to perform R&D
    - Active participation of Paying Agency in assessment
    - R&D and implementation feasible in 6 months
    - Of interest for more than one region / country
  - 3-5 use cases selected by consortium and ESA
  - Benchmarking by consortium with shared in situ data
  - Assessment by consortium + Paying Agency
  - Implementation and documentation in Sen4CAP
Continuation of Sen4CAP activities within the ESA « Agricultural Virtual Laboratory »

- Continuing Sen4CAP activities funded by ESA:
  1) User Support: website, forum, Q&A sessions when needed, training, webinars
  2) System evolution:
     a) System maintenance and evolution
     b) Markers database evolution
     c) Sen4CAP integration in ESA Agricultural Virtual Lab

- Sen4CAP as a standalone toolbox but also as an AVL service
Webinar outline

• Sen4CAP overview

• Sen4CAP evolution
  o Planning for version 3.0
  o Sen4CAP activities continuation in the AVL framework

• **NIVA project building on top of Sen4CAP (IGN France)**

• Planet Fusion for Checks by Monitoring (Planet)

• Next events
NIVA project building on top of Sen4CAP

Sen4CAP webinar – 14/09/2021

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 842009
The NIVA project

- NIVA: New IACS Vision in Action
- H2020 project
- Objectives:
  - To develop e-tools to modernise the CAP
  - To broader reuse of IACS data
- Consortium
  - 9 Paying Agencies
  - technical partners
  - 27 partners
- 3 years project (June 2019 to May 2022)
The NIVA project

WP1: Coordination and Management
WP6: Call for software components and pilot validations
WP7: Ethics requirements
WP2: Large Scale Pilot
WP4: Knowledge Information System
WP3: Harmonisation and Interoperability

(Main) source of today presentation
Data model
Base types for EO monitoring
What is it?

• A conceptual data model in UML (Unified Modeling Language)

• An attempt to provide a structured way to describe EO monitoring processes
  – Present steps and the possible options to be considered
  – No recommendation about a specific method to be chosen

• Model is limited to « Base types »
  – It is not about modelling whole AMS
What are the sources?

- Experiences on EO monitoring
  - Sen4CAP
  - National experimentations (IGN)
  - Various presentations on EO monitoring

- Structuration and modeling work
  - In the NIVA context
How does the model look like?

- The model is composed of 5 packages

- Strategy
- Processes - operations
- Images
- Results
- Crop Classification
To get payment according to a support scheme

One or several eligibility conditions have to be respected

This respect has to be checked through a monitoring process

that may be based on EO process

or on something else
How does the model looks like?

Extracts

It is also useful to define where (in general) this process should occur and when (or how often)
How does the model looks like?

Extracts

Every 6 months during x years

Shall be grass
Shall be "no"
A key information is the algorithm used in the EO monitoring operation.

More detailed information about the method and the tool is also useful.

Code list is not exhaustive. Help welcome
What are the benefits of this model?

• **Internal benefit for NIVA**
  – Use Case (UC1a) about EO monitoring & traffic lights
  – Initial plan was to develop a crop classifier
  – But we discovered in November 2019 that it was already done by Sen4CAP
  – First version of the UML model was designed to help the UC1a team to redesign their plans
    • Avoid duplication of efforts
    • Build something missing or adding value
What are the benefits of this model?

- What NIVA has done to complement Sen4CAP
  - Decision Support System

- Advanced EO tool
  - Specific issues (fallow, Mediterranean grasslands, small parcels ...)
What may be the benefits of this model?

• Contribution to capacity building (PA)
  – Be aware of the various steps and options

• Starting point to document the EO monitoring process

• Contribution to benchmark studies
  – Make clear what is common and what is different between several methods
Where to find this model?

• First official version available on NIVA website
  – [https://www.niva4cap.eu/deliverables/](https://www.niva4cap.eu/deliverables/)
  – Document D3.2 Common semantic model M12

• Current non-official version:
  – Send me an e-mail to get it (dominique.laurent@ign.fr)
  – Comments also welcome (work in progress)

• Final official version will be available on NIVA web site by end of the project (May or November 2022)
  – [https://www.niva4cap.eu/deliverables/](https://www.niva4cap.eu/deliverables/)
  – Document D3.2 Common semantic model M36 (or M42)
Access to EO data
• EO monitoring requires to deal with satellite images (mainly Sentinel)
  – Freely available in theory
  – But whose access and preprocess raise lots of issues in practice

• Lots of discussions within NIVA (and between NIVA and Sen4CAP)
  – Complex issue that no one was fully understanding

• => Something had to be done to improve the situation and get better common understanding
• Deliverable about standardised connections between IACS and other applications (D3.5)
  – Decision to focus on 2 main topics
    • Access to EO data
    • Exchanges between IACS and FMIS
  – Content about EO data
    • Basic knowledge about satellite images and pre-processes
    • Capitalisation of experiences
      – by NIVA project
      – by NIVA partners (at national level)
      – other (conferences ...)
Basic knowledge

• Satellite images main characteristics
  – Optical (Sentinel-2, Landsat-8, HHR)
  – Radar (Sentinel-1)

• Preprocesses, different levels of products, temporal series
  – Optical
  – Radar
Basic knowledge

• Access to EO data
  – Explain the issue:
    • Access through ESA Hub not so easy
    • Need for storage and computation power (big volume of data)
  – Provide an overview of possible solutions
    • Alternative ways to get Sentinel images
    • Possible infrastructures (DIAS, other clouds, in-house ...)


Feed-back from experiences

- **Example 1:** DIAS assessment (e-GEOS)

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<tr>
<th></th>
<th>CREODIAS</th>
<th>Mundi</th>
<th>ONDA</th>
<th>Sobloo</th>
<th>WEKEO</th>
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<tbody>
<tr>
<td><strong>Sentinel 2</strong></td>
<td>L1C: full archive</td>
<td>L1C: last 12 months</td>
<td>L1C: full ESA archive</td>
<td>L1C, L2A: orderable,</td>
<td>L1C: full metadata,</td>
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<td>L2A: Orderable (also non-ESA)</td>
<td>L2A: last 48 months (only Europe data)</td>
<td>L2A: full ESA archive</td>
<td>available last 9 months</td>
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<td><strong>Sentinel 1</strong></td>
<td>SLC: full archive in EU, 5 month worldwide,</td>
<td>Full archive for SLC and GRD. Part of the archive are on cold storage (delayed retrieval available)</td>
<td>SLC, GRD: orderable, available last 9 months</td>
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<td>GRD: full archive</td>
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<td><strong>Landsat 5/7/8</strong></td>
<td>Landsat 5/7/8 full archive over Europe</td>
<td>Landsat 7/8 orderable</td>
<td>Available since 04/2018 (for Europe)</td>
<td>Landsat 8 On-demand</td>
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<tr>
<td><strong>Missing/other data retrieval</strong></td>
<td>Ordering/Caching mechanism available</td>
<td>Missing L2A can be retrieved from ESA or processed if not available</td>
<td>Missing data can be retrieved and hosted in native format. Available HR commercial data (orderable)</td>
<td>Spot sample data available/orderable</td>
<td>Many datasets from Climate/Meteorology</td>
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</table>
Feed-back from experiences

• Example 2: **installing Sen4CAP**

  – Experience by OPEKEPE (Greece)
    • To get the crop classification results necessary for the NIVA Decision Support System
    • First test with CREODIAS virtual machine
    • Second test with local installation

  – Experience by ASP (France)
    • To get NDVI temporal series (for NIVA environmental indicators)
    • Too complex => alternative solution was preferred
• Example 3: developing Open EO API
  
  – The Open EO API standard specifies how to:
    • discover which Earth observation data and processes are available at cloud back-ends
    • build processing graphs (list of jobs)
    • consume such services (run the predefined processing graphs)
  
  – Some **Open EO based micro-services developed by NIVA** on top of Sen4CAP
    • PA installs Sen4CAP
    • The Open EO avoids data file transfer and enables system-to-system data exchange
Feed-back from experiences

• Example 4: quality
  – Temporal series (cloud issues)
    • Document the gaps (NIVA – Copernicus phenology services)
    • Use markers from S2 and from S1 (Sen4CAP)
    • Fill S2 temporal series with S1 (research in IGN)
  – From pixels to parcels
    • Boundary pixels
    • Minimum number of pixels
    • Parcel heterogeneity
Where to find this document?

• Should be available soon on NIVA website
  – https://www.niva4cap.eu/deliverables/
  – Document D3.5 Recommendations for standardised connections between IACS and other applications

• Target readers
  – General chapters (basic knowledge + general recommendations): everyone
  – Feed-back from experiences: more expert or more motivated readers!
Thank you for your attention!

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FUSION

PlanetScope Harmonised to Sentinel 2
For Checks by Monitoring (CbM)
Galicia, Spain
FUSION
PlanetScope Harmonised to Sentinel 2

The Best of Both Worlds

- **Sentinel-2** - Golden Standard data quality
- **PlanetScope** - High spatial and temporal resolution

Harmonisation Process

- Application of CESTEM machine learning process
- Radiometric and Geometric Adjustments
- Atmospheric Corrections and Cloud/Gap Removal

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<td>3-4 days</td>
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A Cubesat enabled Spatio-Temporal Enhancement Method (CESTEM) utilizing Planet, Landsat and MODIS data

Rasmus Houborg, Matthew F. McCabe
**FUSION**

PlanetScope Harmonised to Sentinel 2

**Key Specifications**

- Radiometrically Sentinel-2 comparable
- Analysis Ready Data (ARD)
- Cloud & Gap Free
- 3 meter spatial resolution
- Daily coverage of all EU Member States

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A Cubesat enabled Spatio-Temporal Enhancement Method (CESTEM) utilizing Planet, Landsat and MODIS data

Rasmus Houborg, Matthew F. McCabe
Everyday - Everywhere
Daily Cloud and Gap Free

APRIL 2021
SENTINEL-2
APRIL 2021
PLANETSCOPE

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Everyday - Everywhere
Daily Cloud and Gap Free

APRIL 2021
PLANET FUSION

Peer
Limburg
Belgium
Cloud Removal
Step 1: Identify clouds and cloud shadows
Cloud Removal

Step 2: Apply cloud mask
Cloud Removal

Step 3: Apply predicted values based on most recent observations
DECEMBER 2020
Hechtel-Eksel, Limburg, Belgium
In-Situ Validation

Comparison against Arable Mark Spectrometers

Arable Mark Spectrometers are located in the field to collect ground truth on plant phenology.
PlanetScope Fusion for Inconclusive Parcels

Early Results for Checks by Monitoring (CbM)
Austria has 906,611 small parcels (112,452 ha) that cannot be satisfactorily processed by using Sentinel-2.

Small parcels are (JRC definition) too small to fit 8 Sentinel-2 pixel centres inside with inner 5m buffer and less than 60% pixel loss.

Fusion Pilot on 29,323 representative small parcels with ground truth from year 2020.
Small Parcels in Austria

Applying a crop classification marker

Accuracy & F1-Scores by Crop type - small parcels only

Achieved Crop type prediction quality for Small Parcels with Planet Fusion data enables automated processing within Checks by Monitoring (CbM)
Automated Part of Checks by Monitoring (CbM)

Slovenia has 191,324 small and narrow parcels that cannot be processed by Sentinel-2.

By using PlanetScope Fusion ARKTRP was able to process these claims to the Basic Payment Scheme (BPS) under the automated part of Checks by Monitoring (CbM).

Mid Season (2021) Results

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<th>Vineyards</th>
<th>Hops</th>
<th>Extensive orchards</th>
<th>Arable land</th>
<th>Grassland</th>
<th>Olive trees</th>
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<th>Stock nurseries</th>
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Narrow Parcels in Slovenia

Expert Judgement part of Checks by Monitoring (CbM)

Sentinel-2 Time Series - Not able to identify mowing

Orchard Example
Narrow Parcels in Slovenia

Expert Judgement part of Checks by Monitoring (CbM)

Planet Fusion Time Series - Mowing Identified
THANK YOU FOR LISTENING

Want to learn more?

tor@planet.com
Webinar outline

• Sen4CAP overview

• Sen4CAP evolution
  o Planning for version 3.0
  o Sen4CAP activities continuation in the AVL framework

• NIVA project building on top of Sen4CAP (IGN France)

• Planet Fusion for Checks by Monitoring (Planet)

• Next events
Next events

- **System 3.0** released in October 2021 (you will be informed by email)

- Next **webinar** on **2 November 2021**

- **Your suggestions ???**
Thank you for your attention and your contribution