Welcome to your Sen4CAP training

The training session will last around 1h30

The slides will be made available on the Sen4CAP website after the training

Presenters:
Sophie Bontemps, Philippe Malcorps and Diane Heymans from UCLouvain
Sophie.Bontemps@uclouvain.be  Philippe.Malcorps@uclouvain.be

Website: http://esa-sen4cap.org/
Overview of the session

1) What is Sen4CAP?
   - Sen4CAP system and visualization tool
   - Subsidy application and auxiliary information preparation

2) System operation: first steps with the system (presentation and hands-on training using the system web interface)
   - Launch a site in the automatic mode
   - Prepare and upload parcels information
   - Launch additional jobs
   - Access system database

3) System installation: ICT requirements and procedure

4) Questions and answers
Overview of the session

1) What is Sen4CAP?
   - Sen4CAP system and visualization tool
   - Subsidy application and auxiliary information preparation

2) System operation: first steps with the system (presentation and hands-on training using the system web interface)
   - Launch a site in the automatic mode
   - Prepare and upload parcels information
   - Launch additional jobs
   - Access system database

3) System installation: ICT requirements and procedure

4) Questions and answers
Sen4CAP Objectives

- **Provide evidence** how Sentinel derived information can support the modernization and simplification of the CAP **in the post 2020 timeframe**
- **Provide validated algorithms, products, workflows** and **best practices** for agriculture monitoring relevant for the management of the CAP

---

**2017 ag. season – local sites**
- Use cases & Algorithm development
- Benchmarking
- Validation

**2018 ag. season – 6 national cases**
- Use case demo & training

**2019 ag. season – 6 NRT national demo**
- Validation & Assessment
From prototyping to NRT national demonstrations

Design and prototyping

2017 agri season – local sites

Demonstration and validation

2018 & 2019 agri seasons – national NRT

Use cases selection

Products Specifications

Benchmarked Methods

Algo & System design

Prototype products

Validation
Use Cases: Sentinels to support payment decisions

Use case

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

Use Cases w/ Paying Agencies
Use Cases: Sentinels to support payment decisions

Use case

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

Use Cases w/ Paying Agencies

- Crop type mapping
- Growing vegetation indicators
- Grassland mowing detection
- Agricultural practices monitoring (EFA)
From prototyping to NRT national demonstrations

**Design and prototyping**

*2017 agri season – local sites*

- Use cases selection
- Products Specifications
- Benchmarked Methods
- Algo & System design
- Prototype products
- Validation

**Demonstration and validation**

*2018 & 2019 agri seasons – national NRT*

- Use cases demonstration
- National scale
- Continuous monitoring
- Validation & Fitness-to-use assessment
- Capacity building and training
- System qualification

Sen4CAP online training, April 2020

ESA UNCLASSIFIED - For Official Use
Automated and modular system ingesting S1 and S2 time series, demonstrated at national scale for NRT or off-line production, locally or on the cloud.
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
Open source Sen4CAP system (v1.0)

**Automated** mode: generate markers and products at the parcel-level along the season as Sentinel-1 and Sentinel-2 images are ingested => **Orchestrator concept**

- **High modularity**: software components that can be used separately
Sen4CAP system – S1/S2 ingestion and pre-processing
Sentinel-2 pre-processing

- Correcting single-date Level-1C products from the effects of the atmosphere that reduce the quality of the images

- Level-2A products are systematically generated at the ground segment over Europe since March 2018 using Sen2COR processor

- Sen4CAP reads L2A Sen2COR products, but also proposes MAJA as alternative L2A pre-processing module

https://earth.esa.int/web/sentinel/user-guides/sentinel-2-msi/product-types/level-2a
S1 pre-processing: backscatter and coherence from S1 SLC Interferometric Wide images

- **SAR backscatter (after calibration, sigma nought $\sigma_0$)**

The **SAR backscattering** is a measure of the **outgoing radar signal that the target redirects directly back towards the radar antenna**. It is a measure of the reflective strength of a target. The normalised measure of the radar return from a distributed target is called the backscatter coefficient, or **sigma nought ($\sigma_0$)**, and is defined as per unit area on the ground. In general, due to the high dynamic of the SAR backscatter coefficient, **the amplitude** = $\sqrt{\sigma_0}$ is preferred for visualization purposes.

- **SAR Coherence**

The coherence, which assume values in the range [0.0, 1.0], gives an **estimation of changes in the scene taking into account variation of the phase of the backscattered radar signal**: high coherence (close to 1.0) implies that the scene is steady (e.g. urban areas, bare soil, rocks and so on), low coherence indicates changes between the two acquisition dates.

The coherence is **calculated from a couple of SAR images acquired from the same orbit** (in order to have significant coherence values the images must be acquired with similar sight of view). The high revisit time of Sentinel-1 mission allows to calculate **short term coherence** from couples of images acquired one **6 days** from the other.

[https://earth.esa.int/handbooks/asar/CNTR5-2.html](https://earth.esa.int/handbooks/asar/CNTR5-2.html)
Sentinel-1 time series

Sentinel-1 backscatter in VV and VH polarization (weekly mosaics)
Large dataset of markers from S1 & S2 for a national coverage

Sen4CAP system to process in near-real time S1 and S2 full time series

Metrics / markers stored for each LPIS/GSAA parcel
Crop type map – Fine-tuned Random Forest

- Optimized parcels selection for calibration
- Focus on minor crops
- Stratification
- 1st and 2nd most probable crop types
- Independent validation

Crop type classification

http://esa-sen4cap.org/content/technical-documents
Sentinel-2

- Temporal resampling, with gap filling (every 10-day)
- 8 spectral values
  - 10m: green (B3), red (b4), NIR (B8)
  - 20m: red-edge (B5-6-7), SWIR1 (B11) and SWIR2 (B12)
- Computation of 3 spectral indices: NDVI, NDWI, brightness
- For all spectral bands and spectral indices: mean and standard deviation at the parcel-level

-> 22 metrics by parcel every 10 days

Sentinel-1

- 10 indices every 6 days
  - coherence / amplitude in VV / VH + amplitude ratio
  - ascending / descending
- For these 10 indices: mean and standard deviation at the parcel-level
- Computation of temporal indicators
  - Whole period, 2 months, 1 month
  - Coefficient of variation
  - Quantile 10

-> 20 metrics by parcel every 6 days + temporal markers
2019 Ain crop type map – End of July

Declared crop type

1st prediction and confidence level

2nd prediction and confidence level

<table>
<thead>
<tr>
<th>CT_decl</th>
<th>CT_pred_1</th>
<th>CT_conf_1</th>
<th>CT_pred_2</th>
<th>CT_conf_2</th>
</tr>
</thead>
<tbody>
<tr>
<td>180</td>
<td>180</td>
<td>0.924</td>
<td>36</td>
<td>0.018</td>
</tr>
<tr>
<td>36</td>
<td>36</td>
<td>0.719</td>
<td>256</td>
<td>0.119</td>
</tr>
<tr>
<td>3000</td>
<td>3000</td>
<td>0.874</td>
<td>151</td>
<td>0.037</td>
</tr>
<tr>
<td>180</td>
<td>180</td>
<td>0.482</td>
<td>3000</td>
<td>0.090</td>
</tr>
<tr>
<td>236</td>
<td>236</td>
<td>0.611</td>
<td>180</td>
<td>0.132</td>
</tr>
<tr>
<td>NULL</td>
<td>NULL</td>
<td>0.806</td>
<td>NULL</td>
<td>0.057</td>
</tr>
<tr>
<td>149</td>
<td>149</td>
<td>0.806</td>
<td>NULL</td>
<td>0.057</td>
</tr>
<tr>
<td>180</td>
<td>180</td>
<td>0.957</td>
<td>36</td>
<td>0.009</td>
</tr>
</tbody>
</table>

ESA UNCLASSIFIED - For Official Use

Sen4CAP online training, April 2020
Biophysical indicators – LAI, FAPAR, FCover retrieval using BV-Net approach

4 indicators about the evolution of the green vegetation corresponding to the vegetative development of the crop

**NDVI**

**LAI**

**FAPAR**

**fCOVER**
Biophysical indicators – LAI, FAPAR, FCover retrieval using BV-Net approach

4 indicators about the evolution of the green vegetation corresponding to the vegetative development of the crop

• Optical pre-processing for S2 (and L8)
• All spectral bands are used, except the blue one
• Acquisition of the geometry (sun zenith angle, view zenith angle, relative azimuth angle)
• BV-Net approach developed by Weiss et al. (2002) from INRA
  o PROSPECT&SAIL Radiative Transfer Model are used to simulate surface reflectance for a wide range of soils and vegetation
  o The simulations are used to train a Artificial Neural Network for each of the 3 targeted biophysical variables
  o The Neural Network is applied to real Sentinel-2 acquisitions
  o It does not require in situ data for calibration
LAI time series at 10-m

Belgium
30 fields (wheat and potatoes)

PCC = 0.96
RMSE = 1.01
MAE = 0.76
N = 30

6 Apr 18
21 Apr 18
14 May 18
3 Jul 18
28 Jul 18
22 Aug 18

6057.56 5736.96 2420.71
6000 5000 4000

Autumn barley
Sunflower
Grassland mowing detection from S1 and S2

Input data

- LPIS or GSAA

S1 time series
- Time data preparation
- S1 coherence (VV, VH)

S2 time series
- Optical data preparation
- NDVI

S2 and S1 Detection algorithm

1.1 SAR feature extraction
- Last 3 acquisitions
- S1 coherence pre-processing
- Segmentation

1.2 Optical feature extraction
- S2 records, pre-processed
- Segmentation

2.1 SAR mowing detection
- Preprocessed overlay segmented patches
- SAR mowing level detection
- Output overlaid patches with SAR mowing

2.2 Optical mowing detection
- Preprocessed overlay segmented patches
- Land cover
- Output overlaid patches with optical mowing

S1 mowing detection
- + Probability of false alarm (PFA)

S2 detection
- Standard deviation
- Movement confidence

Detection fusion and compliance assessment
- Standard deviation
- Moving detection
- Moving detection confidence

Compliance analysis
- Mowing detection
- + Confidence level

Detection fusion
- country regulations
- Moving detection
- Moving detection confidence

Output
- Mowing detection
- + Confidence level

European Space Agency

ESA UNCLASSIFIED - For Official Use

Sen4CAP online training, April 2020
S1 & S2 time series analysis

**S2**

NDVI, LAI, FAPAR

**S1**

Coherence

http://esa-sen4cap.org/content/technical-documents
Grassland mowing product contains, for each parcel, information about number and temporal intervals of mowing events detected.
Agricultural practices monitoring from Sentinel-1 and Sentinel-2 markers analysis

- Analysing the dense S1 and S2/L8 time series per parcel

- Applying decision trees to determine the degree of compliance of the declared agricultural practice

Data extraction:

- SAR Coherence data extraction
- SAR Backscatter data extraction
- Optical NDVI data extraction

Time-series analysis: Markers

- Calculate weekly values or averages
- Apply time-series analysis, trend analysis, decision tree, and thresholds
- Check if predefined conditions are met

Input LPIS/GSAA

CSV File

SAR Coherence

SAR Backscatter

Optical NDVI

NDVI

VV-VH Backscatter

VV Coherence

http://esa-sen4cap.org/content/technical-documents
Markers

- Related to vegetation state or vegetation change on a parcel

<table>
<thead>
<tr>
<th>MARKERS FOR HARVEST</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M1</strong> M1: Presence of vegetation in the main vegetation season (pre-requisite)</td>
<td>High values of NDVI</td>
</tr>
<tr>
<td><strong>M2</strong> M2: Loss of vegetation</td>
<td>Break in NDVI (decrease)</td>
</tr>
<tr>
<td><strong>M3</strong> Loss of vegetation</td>
<td>Break in backscatter ratio (increase)</td>
</tr>
<tr>
<td><strong>M4</strong> Low/no vegetation</td>
<td>High values of backscatter ratio</td>
</tr>
<tr>
<td><strong>M5</strong> Low/no vegetation (stable conditions)</td>
<td>Break in VV Coherence (increase) or high values of VV Coherence</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MARKERS FOR DECLARED PRACTICES</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M6</strong> Presence of vegetation</td>
<td>High values of NDVI</td>
</tr>
<tr>
<td><strong>M7</strong> Growth of vegetation</td>
<td>Break in NDVI (increase)</td>
</tr>
<tr>
<td><strong>M8</strong> No loss of vegetation</td>
<td>No break in NDVI (decrease)</td>
</tr>
<tr>
<td><strong>M9</strong> No loss of vegetation</td>
<td>No increase of the backscatter ratio</td>
</tr>
<tr>
<td><strong>M10</strong> Presence of vegetation (dynamic conditions)</td>
<td>No Break in VV Coherence (increase) and no high values of VV Coherence</td>
</tr>
</tbody>
</table>
Monitoring of harvest/clearance of a parcel with winter wheat + catch crop (NLD)

Catch crop in the period from 29.7.2019 to 29.9.2019

Area: 2.5 ha
Visualization tool to access all markers and products at parcel-level (Web application)

Cloud Optimised GeoTIFFs

VM1

Weekly, bi-weekly or monthly export

VM2

FTP:
• Crop type map shp
• Grassland mowing shp
• EFA & harvest shp

Cloud (CREODIAS)

WMS

Import

Geopedia servers

Geopedia client

Weekly, bi-weekly or monthly export

Cloud Optimised GeoTIFFs

FTP:
• Crop type map shp
• Grassland mowing shp
• EFA & harvest shp
Exploring the products in Qgis

FTP:
- Crop type map shp
- Grassland mowing shp
- EFA & harvest shp

Weekly, bi-weekly or monthly export

Cloud Optimised GeoTIFFs

Cloud (CREODIAS)

WMS

Transfer to local disk

VM1
Overview of the session

1) What is Sen4CAP?
   - Sen4CAP system and visualization tool
   - Subsidy application and auxiliary information preparation

2) System operation: first steps with the system (presentation and hands-on training using the system web interface)
   - Launch a site in the automatic mode
   - Prepare and upload parcels information
   - Launch additional jobs
   - Access system database

3) System installation: ICT requirements and procedure

4) Questions and answers
Subsidy applications layer and auxiliary information preparation

1) System operation: continuous monitoring
2) List of files to upload
3) Area of interest (AOI)
4) Subsidy applications layer (parcels)
5) L4A crop type (LUT)
6) L4B grassland mowing detection (configuration file)
7) L4C agricultural practices monitoring (configuration file and practice table)

⇒ We are still working to better document some of these files
⇒ Examples of all these files are given on the website: http://esa-sen4cap.org/content/data
Subsidy applications layer and auxiliary information preparation

1) **System operation: continuous monitoring**

2) List of files to upload

3) Area of interest (AOI)

4) Subsidy applications layer (parcels)

5) L4A crop type (LUT)

6) L4B grassland mowing detection (configuration file)

7) L4C agricultural practices monitoring (configuration file and practice table)
System operation: continuous monitoring

- **System designed to run in continuous mode** -> **continuous monitoring**

- **At the beginning of the season:**
  - No parcel with declaration: crop type, practice, etc.
  - **BUT, it is important to launch the preprocessing of the EO data** (S1, S2 and L8), which represents the highest part of the processing time

- **When the first version of the subsidy applications layer (parcels) is available:**
  - Upload in the system
  - **+ upload of needed auxiliary information** for the use of the advanced processors (L4A crop type, L4B grassland mowing detection and L4C agricultural practices monitoring)
System operation: continuous monitoring

At the beginning of the season: System initialization

Sen4CAP system: main parameters settings

<table>
<thead>
<tr>
<th>Area of Interest (AOI)</th>
<th>Shapefile to be uploaded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring period</td>
<td>Start, mid- and end dates to be defined</td>
</tr>
<tr>
<td>S1+S2 / S1+S2+L8</td>
<td>L8 to be selected</td>
</tr>
</tbody>
</table>

Start of the monitoring period

When launched, the system will begin to:

- **Download/access** the low-level products (S1, S2 and L8 Level-1 data)
- **Preprocess** these data:
  - S2 and L8: atmospheric correction and cloud detection
  - S1: backscattering and weekly coherence computation (VV & VH)
- **Generate biophysical indicators** from S2 and L8 cloud-free observations (if activated)
System operation: continuous monitoring

During of the monitoring period

**Before the generation of advanced products (L4x processors):**

Subsidy applications layer and auxiliary information upload

<table>
<thead>
<tr>
<th>Sen4CAP system : auxiliary information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parcels (shp)</td>
</tr>
<tr>
<td>Tables and config files (cfg and csv)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
System operation: continuous monitoring

S1 pre-processing (backscattering and weekly coherence, VV & VH)

S2 and L8 pre-processing (atmospheric correction and cloud detection)

Biophysical indicators generation from S2 and L8 cloud-free observations (NDVI, LAI, FAPAR, FCover)

Markers extraction over each parcel

Monthly crop type map every month

Grassland mowing detection every 2 weeks

Harvest and EFA practices monitoring on a weekly basis
System operation: continuous monitoring

- 2 operating modes:

**Automated mode through the web interface**
- a) Based on the Orchestrator with by-default parameterization, automatic data download/access and processing until the end of the season, on-time delivery => operational scenarios
- b) Processor execution on user request, with by-default parameterization, with the Scheduled job approach

**Manual mode**: to run processors independently, with custom parameters
- a) Through the web interface, with the Custom job approach
- b) In command lines through a Linux console
Subsidy applications layer and auxiliary information preparation

1) System operation: continuous monitoring

2) **List of files to upload**

3) Area of interest (AOI)

4) Subsidy applications layer (parcels)

5) L4A crop type (LUT)

6) L4B grassland mowing detection (configuration file)

7) L4C agricultural practices monitoring (configuration file and practice table)
List of files to upload

- At the beginning of the monitoring period:
  - Area of Interest (AOI)
  - Before the generation of advanced products (L4x processors):
    - Subsidy applications layer (parcels)
    - L4A crop type: crop code Look-Up-Table (LUT)
    - L4B grassland mowing detection: configuration file
    - L4C agricultural practices monitoring:
      - Configuration file
      - 1 table by monitored practice

1 shapefile
1 shapefile
1 csv table
1 cfg file
1 cfg file
Potentially 4 csv tables
Subsidy applications layer and auxiliary information preparation

1) System operation: continuous monitoring
2) List of files to upload
3) **Area of interest (AOI)**
4) Subsidy applications layer (parcels)
5) L4A crop type (LUT)
6) L4B grassland mowing detection (configuration file)
7) L4C agricultural practices monitoring (configuration file and practice table)
Area of interest (AOI)

- **FORMAT:** *zip file*, containing a shapefile
  - Mandatory files: .dbf, .prj, .shp, .shx
- **PROJECTION:** *WGS84/UTMzoneXXX*
- Will only be used to define the area where the system will look at S1, S2 and L8 data

Example: Wallonia (BE)
1) System operation: continuous monitoring
2) List of files to upload
3) Area of interest (AOI)
4) **Subsidy applications layer (parcels)**
5) L4A crop type (LUT)
6) L4B grassland mowing detection (configuration file)
7) L4C agricultural practices monitoring (configuration file and practice table)
Subsidy applications layer (parcels)

- **FORMAT**: zip file, containing a shapefile
  - Mandatory files: .dbf, .prj, .shp, .shx
- **PROJECTION**: any projection
  - This projection will be used as the projection of the advanced products
- Must contain **3 INFORMATION** (in the attribute fields table):
  - **Unique id of the parcel** (txt or num): can be contained in one attribute field or via the concatenation of several attribute fields
  - **Holding id of the parcel** (txt or num):
    - Only used for the crop diversification use case
    - If not interested, create one field with a unique value
  - **Crop code of the parcel** (txt or num): code used to defined the crop type
Subsidy applications layer (parcels)

Example from the Netherlands
Subsidy applications layer and auxiliary information preparation

1) System operation: continuous monitoring
2) List of files to upload
3) Area of interest (AOI)
4) Subsidy applications layer (parcels)
5) **L4A crop type (LUT)**
6) L4B grassland mowing detection (configuration file)
7) L4C agricultural practices monitoring (configuration file and practice table)
L4A crop type LUT

- **FORMAT**: csv file
- **CONTENT**: for each crop type
  - List of all the original crop code from the subsidy applications layer (parcels)
  - Definition of the high-level land cover category
    - 1 = Annual crop
    - 2 = Permanent crop
    - 3 = Grassland
    - 4 = Fallow land
    - 5 = Greenhouse and nursery
    - 0 = Other natural areas
  - Definition of the groups for the classification
  - Information for the crop diversification use case
## L4A crop type LUT

### Original crop code list

<table>
<thead>
<tr>
<th>Crop type name</th>
<th>New sequential number</th>
<th>High-level land cover category</th>
<th>Crop code for classification (and name)</th>
<th>Crop code for crop diversification use case (and name)</th>
<th>Crop diversification use case related information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flower seeds open ground</td>
<td>174</td>
<td>1</td>
<td>54</td>
<td>Flower_seeds</td>
<td>44 Flower_seeds</td>
</tr>
<tr>
<td>Wheat winter-</td>
<td>233</td>
<td>1</td>
<td>1</td>
<td>51</td>
<td>Winter wheat</td>
</tr>
<tr>
<td>Wheat summer-</td>
<td>234</td>
<td>1</td>
<td>1</td>
<td>42</td>
<td>Triticum_summer</td>
</tr>
<tr>
<td>Barley winter</td>
<td>235</td>
<td>1</td>
<td>1</td>
<td>88</td>
<td>Hordeum_winter</td>
</tr>
<tr>
<td>Barley summer-</td>
<td>236</td>
<td>1</td>
<td>1</td>
<td>89</td>
<td>Hordeum_summer</td>
</tr>
<tr>
<td>Rye (not cut corn)</td>
<td>237</td>
<td>1</td>
<td>1</td>
<td>126</td>
<td>Secale</td>
</tr>
<tr>
<td>Oats</td>
<td>238</td>
<td>1</td>
<td>1</td>
<td>11</td>
<td>Avena</td>
</tr>
<tr>
<td>Chick peas (and gray peas)</td>
<td>241</td>
<td>1</td>
<td>1</td>
<td>37</td>
<td>Chick peas</td>
</tr>
<tr>
<td>Peas</td>
<td>242</td>
<td>1</td>
<td>1</td>
<td>12</td>
<td>Pisum</td>
</tr>
</tbody>
</table>

**Notes:**
- **Ori_crap**: Original crop code.
- **CTnum**: New sequential number.
- **CT**: Crop type name.
- **LC**: Land cover category.
- **CTnumL4A**: Crop code for classification.
- **CT4A**: Crop code for crop diversification use case.
- **CTnumDIV**: Crop code for crop diversification use case.
- **CTDIV**: Crop diversification use case related information.
- **EAA**: Effort area.
- **AL**: Area loss.
- **PGrass**: Percentage of grass.
- **TGrass**: Total grass.
- **Fallow**: Fallow area.
- **Cwater**: Cwater area.

---

**Source:**
Sen4CAP online training, April 2020
Subsidy applications layer and auxiliary information preparation

1) System operation: continuous monitoring
2) List of files to upload
3) Area of interest (AOI)
4) Subsidy applications layer (parcels)
5) L4A crop type (LUT)
6) **L4B grassland mowing detection (configuration file)**
7) L4C agricultural practices monitoring (configuration file and practice table)
L4B grassland mowing detection (configuration file)

- **FORMAT**: *cfg file* (can be adapted using any notepad)
- **CONTENT**:
  - Algorithm parameters

```
; Netherlands
prod_type_list = SNDVI
sc_fact = 1000
corrupted_th = 0.1
invalid_data = -10000
decreasing_abs_th = 0.12
decreasing_rate_th = -0.000001
increasing_rate_th = 0.9
high_abs_th = 0.75
low_abs_th = 0.5
```

These parameters can be adapted to better fit with the region specificities in terms of grassland growing conditions and agricultural practices

Ex. from the 7 pilot countries
L4B grassland mowing detection (configuration file)

- **FORMAT:** *cfg file* (can be adapted using any notepad)
- **CONTENT:**
  - Algorithm parameters
  - Rules corresponding to each grassland type

It defines the monitoring periods during which a grassland mowing event must be observed, to be compliant.

```plaintext
; Netherlands
crop_codes = 265, 331, 336, 266, 332, 33
crop_time_intervals = ('01/04/2019', '31/04/2019', '31/10/2019'), ('01/04/2019', '31/10/2019'), ('01/04/2019', '31/10/2019')
crop_rule = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
```
1) System operation: continuous monitoring
2) List of files to upload
3) Area of interest (AOI)
4) Subsidy applications layer (parcels)
5) L4A crop type (LUT)
6) L4B grassland mowing detection (configuration file)
7) L4C agricultural practices monitoring (configuration file and practice table)
L4C agricultural practices monitoring (configuration file)

- **FORMAT:** *cfg file* (can be adapted using any notepad)
- **CONTENT:**
  - Algorithm parameters corresponding to each marker

```plaintext
[DEFAULT_TIME_SERIES_ANALYSIS_PARAMS]
# IMPORTANT: Please do not remove any of these keys from this section

# OPTHRVECYCLE - Used in Marker 1 as NDVI presence threshold for def
OPTHRVECYCLE=350
# NDVIDW - Used in Marker 2 as the Lower limit of the NDVI loss thesh
NDVIDW=380
# NDVIUP - Used in Marker 2 as the Upper limit of the NDVI loss thesh
NDVIUP=350
# NDVISTEP - Used in Marker 2, 7 and 8 as the Value to which the comp
NDVISTEP=5
# OPTTHRMIN - Used in Marker 2 as the Minimum NDVI threshold
OPTTHRMIN=100

# COHTHRBASE - Used in Marker 1 as percentage of the presence thr
# COHTHRBASE=0.05
# COHTHRMAX - Used in Marker 1 as percentage of the presence thr
# COHTHRMAX=0.95

# M4 - Loss of vegetation (high/lower/medium) - Threshold levels for
# Marker 1. Break in NDVI (increased) in high values of NDVI
M1 = Presence of vegetation (in the main vegetation season)
M2 = Loss of vegetation
M3 = Loss of vegetation
M4 = Loss of vegetation
M5 = Loss of vegetation

# M6 - Presence of vegetation (stable conditions)
M6 = Presence of vegetation
M7 = Presence of vegetation
M8 = No loss of vegetation
M9 = No loss of vegetation
M10 = Presence of vegetation (dynamic conditions)
```

These parameters can be adapted to better fit with the region specificities in terms of crop growing conditions and agricultural practices

Ex. from the 7 pilot countries
L4C agricultural practices monitoring (configuration file)

- **FORMAT:** file (can be adapted using any notepad)
- **CONTENT:**
  - Algorithm parameters corresponding to each marker
  - Corrections for each monitored practice

```plaintext
[CC_TIME_SERIES_ANALYSIS_PARAMS]
CC_CATCHMAIN="CatchCrop_3"
CC_CATCHPERIODSTART="${YEAR}-07-15"
CC_NDVIUP=500
CC_AMPTHRMIN=0.2
CC_CONTHRBASE=0.1
CC_CONTHRABS=0.7
CC_EFAAMPTHR=0.03
CC_AMPTHRBREAKDEN=3
CC_AMPTHRVALDEN=3

[FL_TIME_SERIES_ANALYSIS_PARAMS]
# Section not used

[NFC_TIME_SERIES_ANALYSIS_PARAMS]
# Section not used

[NA_TIME_SERIES_ANALYSIS_PARAMS]
NA_NDVIUP=500
NA_AMPTHRMIN=0.2
NA_CONTHRBASE=0.1
```

NA = Harvest
CC = Catch Crop
FL = Fallow Land
NFC = Nitrogen Fixing Crop
L4C agricultural practices monitoring (practice table)

- **FORMAT:** csv files (1 for each monitored practice)
- **CONTENT:** for each monitored practice
  - List of parcels to be monitored and associated practice
  - Time ranges of monitored practices

Ex. of catch crop table

<p>| | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
<td>G</td>
<td>H</td>
<td>I</td>
</tr>
<tr>
<td>---</td>
<td>----</td>
<td>---</td>
<td>-----</td>
<td>----</td>
<td>-------------------</td>
<td>---</td>
<td>---</td>
<td>----</td>
</tr>
<tr>
<td>1</td>
<td>FIELD_ID</td>
<td>MAIN_CROP</td>
<td>VEG_START</td>
<td>H_START</td>
<td>H_END</td>
<td>PRACTICE</td>
<td>P_TYPE</td>
<td>P_START</td>
</tr>
<tr>
<td>2</td>
<td>id36</td>
<td>233</td>
<td>20-05-19</td>
<td>15-07-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop_3</td>
<td>15-10-19</td>
</tr>
<tr>
<td>3</td>
<td>id46</td>
<td>233</td>
<td>20-05-19</td>
<td>15-07-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop_1</td>
<td>15-10-19</td>
</tr>
<tr>
<td>4</td>
<td>id56</td>
<td>2708</td>
<td>20-05-19</td>
<td>03-06-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop_1</td>
<td>15-10-19</td>
</tr>
<tr>
<td>5</td>
<td>id66</td>
<td>1044</td>
<td>20-05-19</td>
<td>03-06-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop_1</td>
<td>15-10-19</td>
</tr>
<tr>
<td>6</td>
<td>id76</td>
<td>2014</td>
<td>20-05-19</td>
<td>10-06-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop_1</td>
<td>15-10-19</td>
</tr>
<tr>
<td>9</td>
<td>id106</td>
<td>233</td>
<td>20-05-19</td>
<td>15-07-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop</td>
<td>CatchCrop</td>
</tr>
<tr>
<td>10</td>
<td>id116</td>
<td>854</td>
<td>20-05-19</td>
<td>02-06-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop</td>
<td>CatchCrop</td>
</tr>
</tbody>
</table>
L4C agricultural practices monitoring (practice table)

⇒ VEG_START to H_END = vegetation period (crop growing period)
⇒ H_START to H_END = harvest period (period when the harvest must be observed)
⇒ P_START to P_END = practice period (period when the agricultural practice (catch crop) must be observed)

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FIELD_ID</td>
<td>MAIN_CROP</td>
<td>VEG_START</td>
<td>H_START</td>
<td>H_END</td>
<td>PRACTICE</td>
<td>P_TYPE</td>
<td>P_START</td>
</tr>
<tr>
<td>2</td>
<td>id36</td>
<td>233</td>
<td>20-05-19</td>
<td>15-07-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop_3</td>
<td>15-10-19</td>
</tr>
<tr>
<td>3</td>
<td>id46</td>
<td>233</td>
<td>20-05-19</td>
<td>15-07-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop_1</td>
<td>15-10-19</td>
</tr>
<tr>
<td>4</td>
<td>id56</td>
<td>2708</td>
<td>20-05-19</td>
<td>03-06-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop_1</td>
<td>15-10-19</td>
</tr>
<tr>
<td>5</td>
<td>id66</td>
<td>1044</td>
<td>20-05-19</td>
<td>15-10-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop_1</td>
<td>15-10-19</td>
</tr>
<tr>
<td>6</td>
<td>id76</td>
<td>2014</td>
<td>20-05-19</td>
<td>10-06-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop_1</td>
<td>15-10-19</td>
</tr>
<tr>
<td>7</td>
<td>id86</td>
<td>3804</td>
<td>20-05-19</td>
<td>15-10-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop_1</td>
<td>15-10-19</td>
</tr>
<tr>
<td>8</td>
<td>id96</td>
<td>372</td>
<td>20-05-19</td>
<td>15-10-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop_1</td>
<td>15-10-19</td>
</tr>
<tr>
<td>9</td>
<td>id106</td>
<td>233</td>
<td>20-05-19</td>
<td>15-10-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop_1</td>
<td>15-10-19</td>
</tr>
<tr>
<td>10</td>
<td>id116</td>
<td>854</td>
<td>20-05-19</td>
<td>02-06-19</td>
<td>15-10-19</td>
<td>CatchCrop</td>
<td>CatchCrop_1</td>
<td>15-10-19</td>
</tr>
</tbody>
</table>

Ex. of catch crop table
Subsidy applications layer and auxiliary information preparation

1) System operation: continuous monitoring
2) List of files to upload
3) Area of interest (AOI)
4) Subsidy applications layer (parcels)
5) L4A crop type (LUT)
6) L4B grassland mowing detection (configuration file)
7) L4C agricultural practices monitoring (configuration file and practice table)