NIVA
NEW IACS VISION IN ACTION

U C 1a: Earth Observation Monitoring & Traffic Lights

UC1a Leader:

PAYMENT AND CONTROL AGENCY
FOR GUIDANCE AND GUARANTEE COMMUNITY AIDS
(O.P.E.K.E.P.E)

UC1a Partner:

NEUROPUBLIC
Information Systems & Technologies

Webinar – 21/05/2020

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General objectives and status of the UC –
Eligibility Criteria
Efi Kyrodimou

Main Concept

UC1a's main objective is to demonstrate how the "monitoring" can be implemented and deployed.

To develop Smart Monitoring approach of the CAP, at parcel level that will:

➢ Provide Eligibility Criteria for: **Basic Payment Scheme**, **Voluntary Coupled Schemes** & **Crop Specific Payment for Cotton** based on EO Classification Engines Output

➢ Provide Decision Support System (NIVA-DSS) based on these Schemes that will conclude in a traffic light system at parcel level.

   This DSS will incorporate input from:

   ➢ At least 2 EO Classification engines:

   a) Sen4CAP and b) the new Subcontracting EO Classification.

   ➢ Secondary sources to deal with yellows (FMIS and Geo-tagged)

Flow of Events – Basic Path

| Flow of Events – Basic Path	
Step 1 (A+B)	A. Selection of the eligibility criteria that may be (reasonably) checked with the EO monitoring method and coded as computing algorithms. B. Evaluation and improvement /customization of suitable EO processing algorithms (Subcontracting)
Step 2	Extraction of key info from farmer declaration (e.g. Declared crops, Parcel geo-characteristics: size, location, farmer's identification number)
Step 3	Definition of relevant markers and optimum assesment period of time per identified eligibility criteria
Step 4	Train, "run" and deliver outcome from different Earth Observation Classification Engines
Step 5	Import data to Desicion Support System (DSS)
Step 6	Run Eligibility Criteria Engine on Desicion Support System (DSS)
Step 7	Generation of traffic lights outcome based on identified eligibility criteria
Step 8	Summary and publication: The results may be stored for review and/or use by the PA. These results can later be accessed through: an export process to appropriate geospatial files (e.g. in GML format), 1. Visualisation of the obtained results to a web-based interface: a view service for the concluded eligibility status (traffic light), Visual representation of traffic light results on sentinel images, metadata about the monitoring process (assessment date, concerned Sentinel images, …) and summary of features if possible.
Step 9	Incorporation of additional secondary data sources (e.g. geotagged photos, farmer's e-calendar activities) in order to enhance decision concerning eligibility criteria in case of inconclusive evidence
Step 10	Summary and publication: The results may be stored for review and/or use by the PA. These results can later be accessed through: 1. an export process to appropriate geospatial files (e.g. in GML format), Visualisation of the obtained results to a web-based interface: a view service for the concluded eligibility status (traffic light), Visual representation of traffic light results on sentinel images, metadata about the monitoring process (assessment date, concerned Sentinel images, …) and summary of features if possible.
Flow of Events – Alternative Paths	
Step 4	After testing and benchmarking, the best Earth Observation Classification Engine will be chosen according to eligibility criteria under inspection.

Logical Workflow
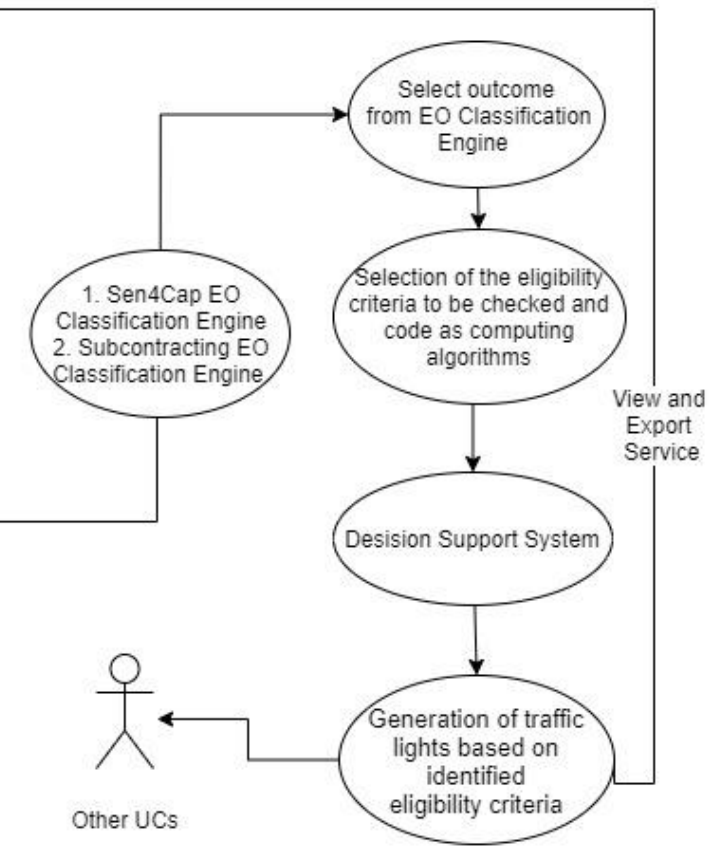
Eligibility Criteria

❑ <u>Eligibility criterion 1:</u> Distinction/classification between arable land (AL), permanent crops (PC) and permanent grassland (PG) (three types of land cover).

• *<u>Objective:</u>* **To assess eligibility at parcel level for BPS**.

❑ <u>Eligibility criterion 2:</u> Crop classification by categorizing Cotton.

• *<u>Objective:</u>* ***To assess eligibility at parcel level for Crop Specific Payment for Cotton***.

❑ <u>Eligibility criterion 3:</u> Crop classification by categorizing main permanent crops and main arable crops.

• *<u>Objective:</u>* ***To assess eligibility at parcel level for VCS schemes***.

Eligibility Criteria – Expected assessed output

TYPE	USING: SEN4CAP	USING: EO CLASSIFICATION ENGINE PRODUCED BY SUBCONTRACTING	COMMENTS
Arable Land (AL)	Yes (to be checked)	Yes (higher confidence /to be checked)	Also fallow land & green houses - **BPS**
Perm. Crops (PC)	Yes (to be checked)	Yes (higher confidence /to be checked)	**BPS**
Perm. Grassland (PG)	Not possible	Yes (to be checked)	**BPS**
Cotton	Yes (to be checked)	Yes (higher confidence /to be checked)	**Cotton Scheme**
Oranges	Yes (to be checked)	Yes (higher confidence /to be checked)	Permanent Crops - **VCS**
Peaches	Yes (to be checked)	Yes (higher confidence /to be checked)	Permanent Crops- **VCS**
Nuts	Yes (to be checked)	Yes (higher confidence /to be checked)	Permanent Crops- **VCS**
Grapes	Yes (to be checked)	Yes (higher confidence /to be checked)	Permanent Crops- **VCS**
Apples	Yes (to be checked)	Yes (higher confidence /to be checked)	Permanent Crops- **VCS**
Rice	Yes (to be checked)	Yes (higher confidence /to be checked)	Arable Land- **VCS**
Durum Wheat	Yes (to be checked)	Yes (higher confidence /to be checked)	Arable Land- **VCS**
Industrial Tomatoe	Yes (to be checked)	Yes (higher confidence /to be checked)	Arable Land- **VCS**
Pulses	Yes (to be checked)	Yes (higher confidence /to be checked)	Arable Land- **VCS**
Protein/Legum LSto	Yes (to be checked)	Yes (higher confidence /to be checked)	Arable Land- **VCS**
Seeds	Yes (to be checked)	Yes (higher confidence /to be checked)	Arable Land- **VCS**
Asparagus	Yes (to be checked)	Yes (higher confidence /to be checked)	Arable Land- **VCS**
Sugar beets	Yes (to be checked)	Yes (higher confidence /to be checked)	Arable Land- **VCS**
Protein/Legum Hay	Yes (to be checked)	Yes (higher confidence /to be checked)	Arable Land- **VCS**

Eligibility Criteria – Decision Trees
(indicative based on Sen4CAP output in Greece for Eligibility Criterion 1)
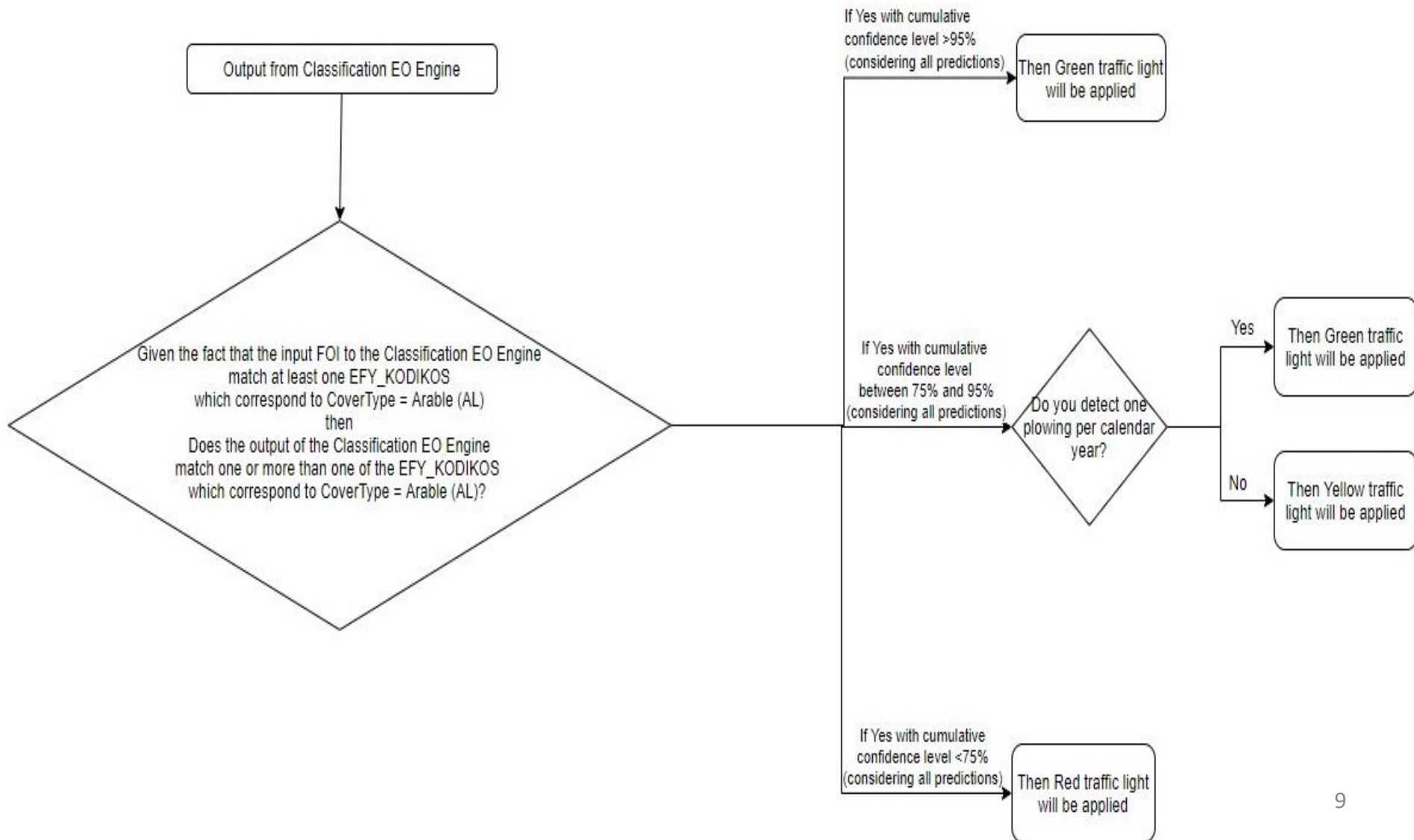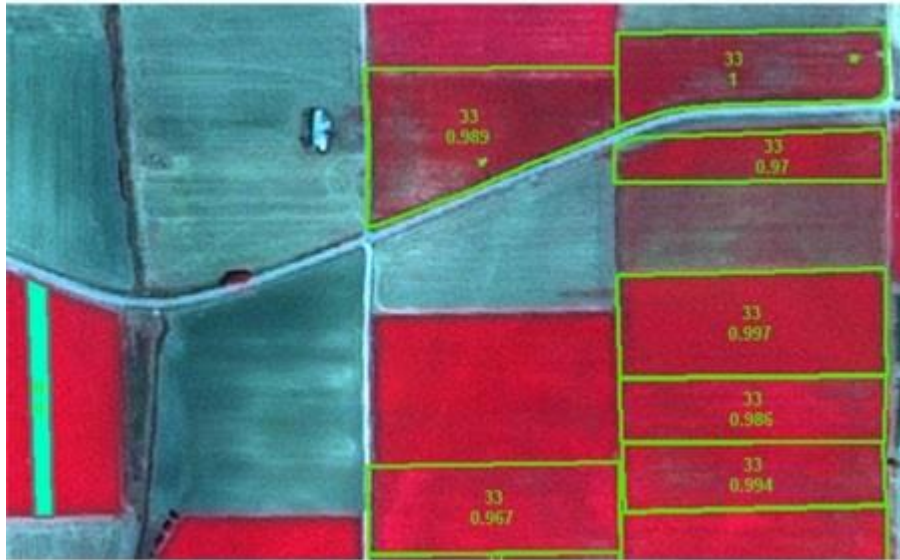
UC1a – Sen4CAP EO Classification Engine – Testing – First Experiments

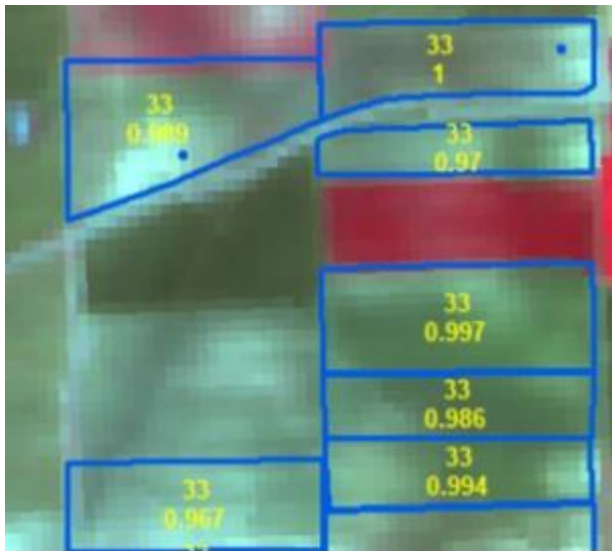**Maria Papaefthymiou**
Dimitrios Sykas
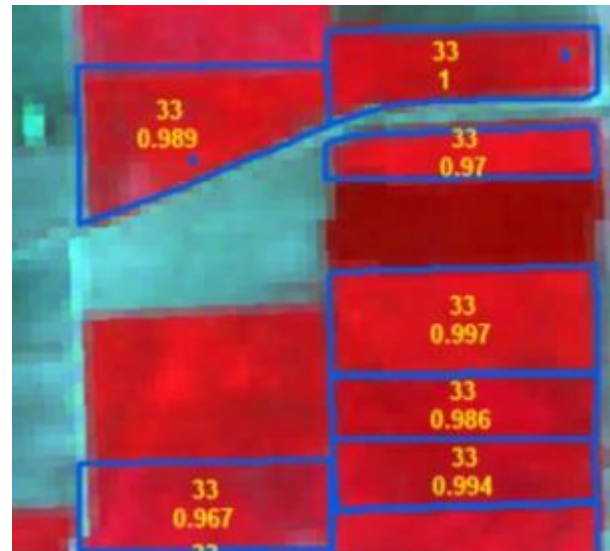
Sen4CAP – outputs (cotton : green traffic light)

Declared : cotton
1st prediction : cotton
All with conf > 95%

Strips : ??? problem need to be solved
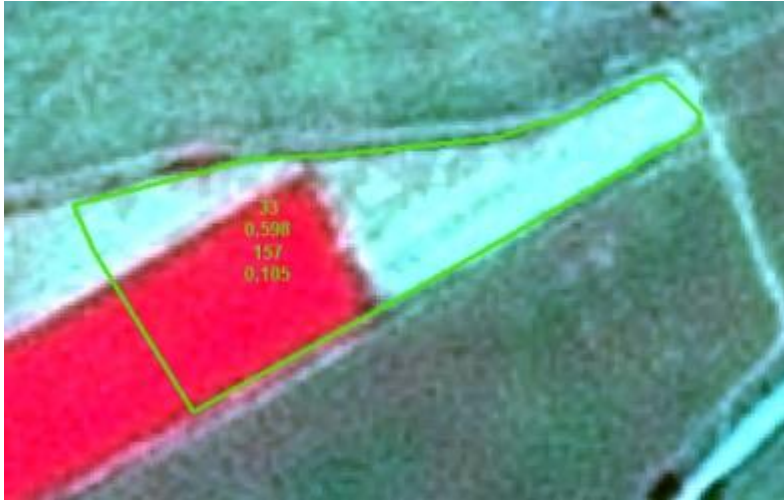
HHR acq date 02/09

S2 acq date 08/06

S2 acq date 07/08

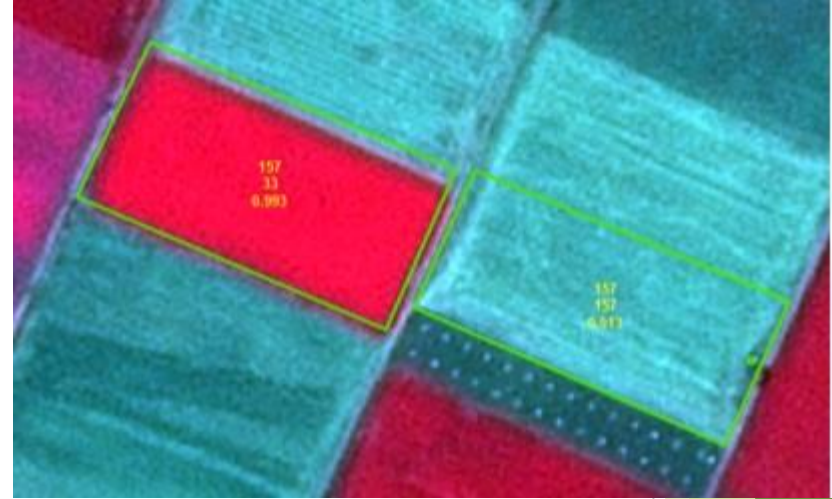# Sen4CAP – outputs (cotton , wheat : yellow, red traffic lights)

HHR acq date 01/08

Declared : cotton
1st prediction : cotton with conf 59.8%

wrong declaration /digitization

Red (or yellow) traffic light
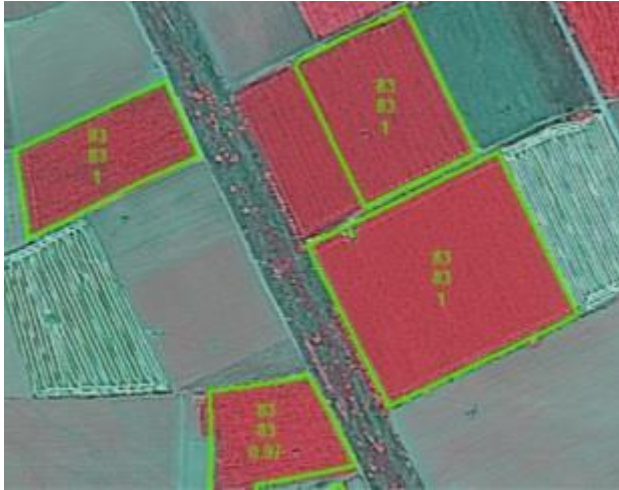
Declared : wheat
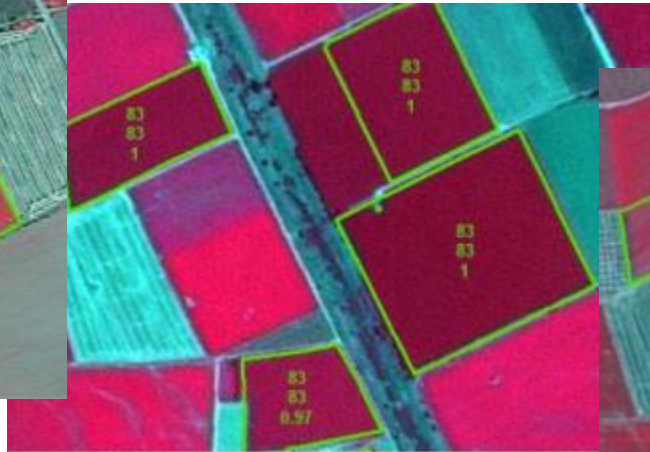1st prediction : cotton with conf 99.3%

wrong declaration / wrong crop type

Red traffic light

Do we need additional evidence? Do we need farmer's input?
Only request a correction in the declaration.

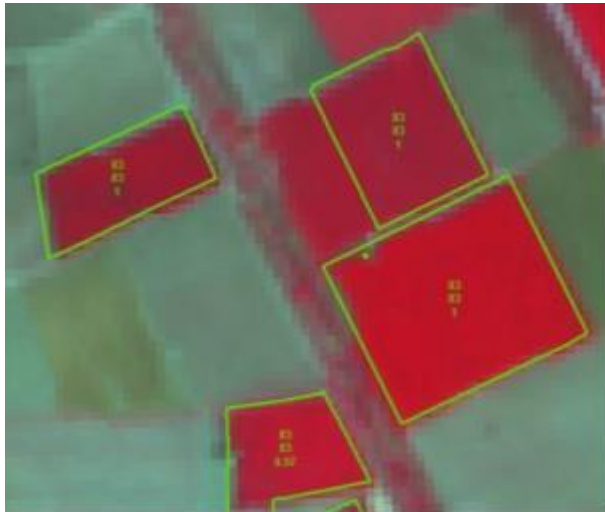# Sen4CAP – outputs (maize : green traffic light)

VHR acq date 19/06

HHR acq date 01/08

HHR acq date 02/09

S2 acq date 08/06

Declared : maize
1st prediction : maize with conf > 95%

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Summer crops : distinction cotton-maize (compliance rule -marker)

"For a voluntary coupled payment, all necessary markers to identify the crop (i.e. discriminate from all other potential crops) would be needed in the rule" (JRC112913)
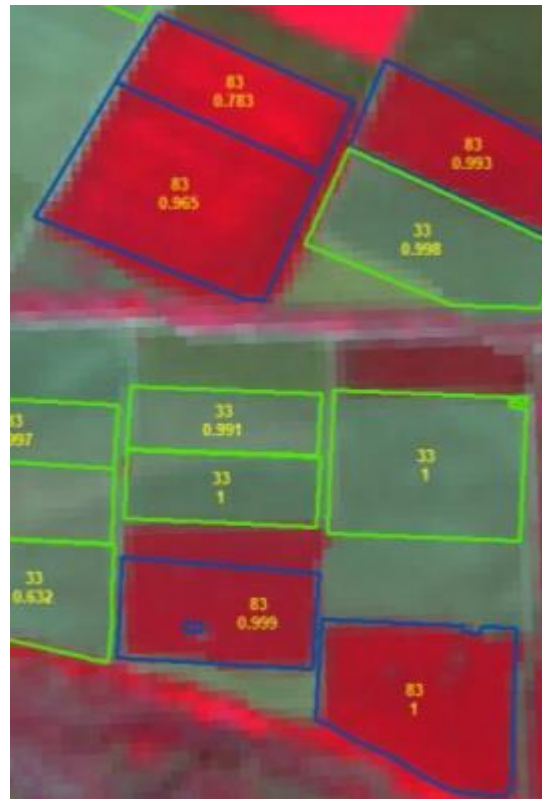
Early June
maize : we detect the growth of the cultivation
cotton : the growth is not detected yet

Clear distinction

Green parcels : cotton
Blue parcels :maize

S2 acq date 08/06   HHR acq date 02/09

UC1a: Past and Current Activities related with Sen4CAP

- ▶ Installing to NP infrastructure

- ▶ Access to pre-installed VM in CreoDIAS

- ▶ Testing and Evaluation of the Sen4CAP software in CreoDIAS VM

- ▶ Continuous communication with the Sen4CAP developers for support on operating the software and bug reporting

- ▶ Crop type map generation with 31 labels at ~300.000 parcels

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UC1a: Problems Encountered and Achievements by using Sen4CAP

▶ Installing to our own infrastructure was problematic and took significant effort.

▶ The usage of Sen4CAP in our own infrastructure is currently limited.

  ▶ Most of the functionality works, but not all.

  ▶ Working on understanding how generate the classification product

▶ **The access to the CreoDIAS VM enabled us to test and generate crop type maps**

▶ We have been in significant contact with the developers of Sen4CAP, due to bugs in the pre-installed VM

	Crop Type	Experiment 1	Experiment 2
1	Olivetree	Yes	Yes
2	weed	Yes	Yes
3	No cultivation	Yes	No
4	cotton	Yes	Yes
5	alfalfa	Yes	Yes
6	vetch	Yes	Yes
7	corn	Yes	Yes
8	Almond tree	Yes	Yes
9	grapes	Yes	Yes
10	Apple tree	Yes	Yes
11	clover	Yes	Yes
12	chestnut	Yes	Yes
13	cheakpeas	Yes	Yes
14	lentil	Yes	Yes
15	walnuts	Yes	Yes
16	Cherry tree	Yes	Yes
17	rapeseed	Yes	Yes
18	grassland	Yes	No
19	sunflower	Yes	Yes
20	Peach tree	Yes	Yes
21	Acacia	Yes	Yes
22	peas	Yes	Yes
23	Un-cultivated	Yes	No
24	cutlery	Yes	No
25	tomato	Yes	Yes
26	beans	Yes	Yes
27	rice	Yes	Yes
28	apricot	Yes	Yes
29	kiwi	Yes	Yes
30	potato	Yes	Yes
31	lupine	Yes	Yes
32	tobacco	Yes	Yes

Crop Type Classification Experiments

▶ Two main experiments:

   ▶ All crop type classes included

   ▶ Removed grassland, fallow land, and un-cultivated lands

▶ Purpose: Understand the effect of specific "problematic" classes

Crop Type Classification Results

Experiment 1
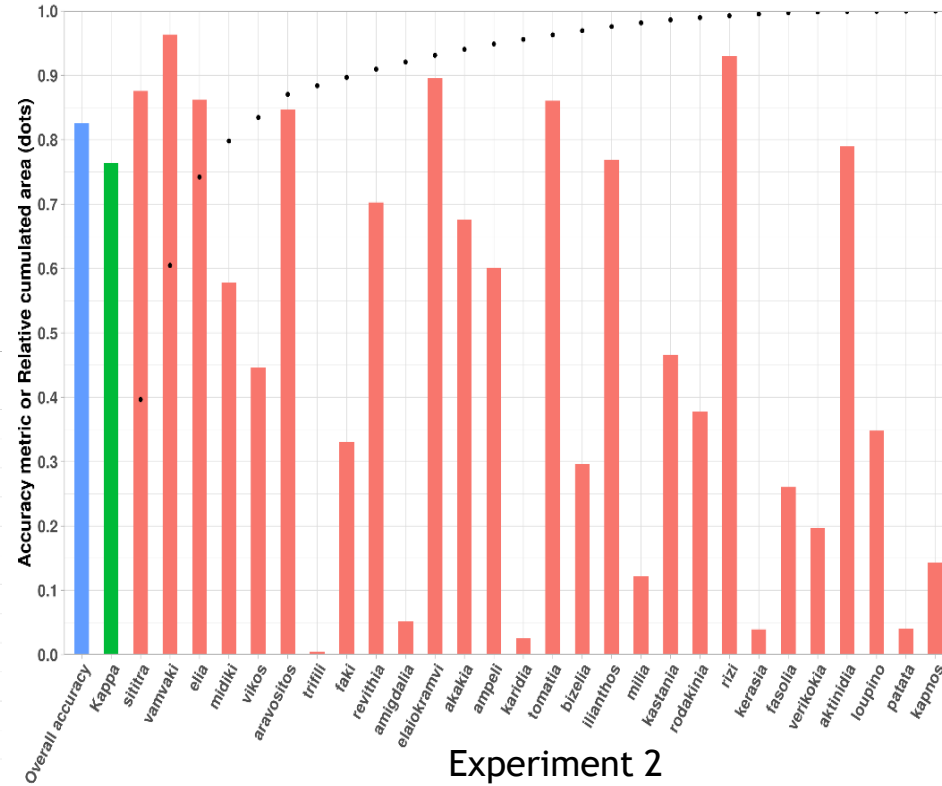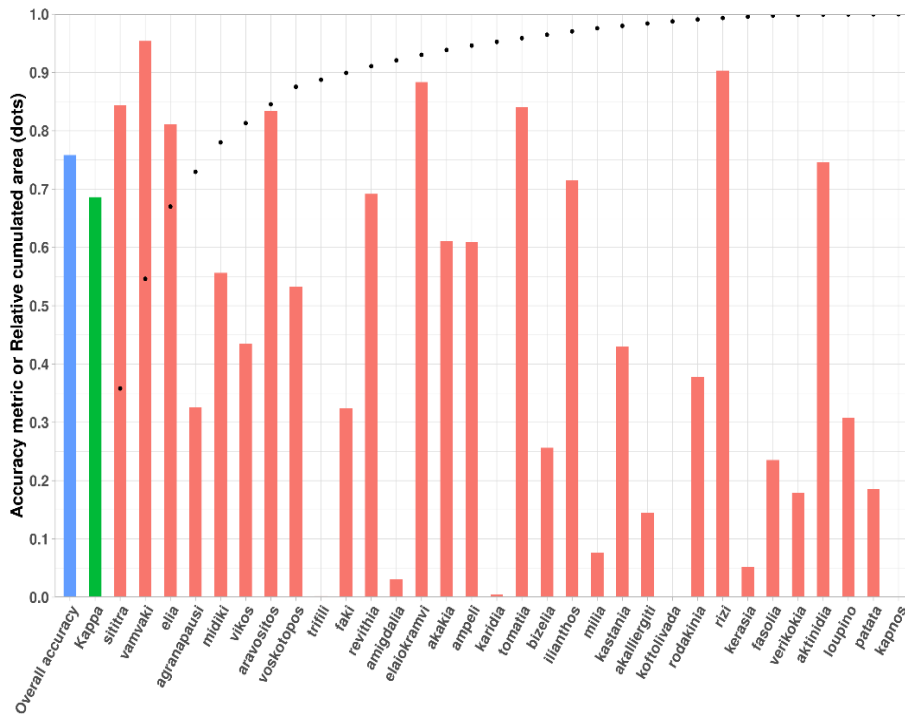
Experiment 2

- Overall accuracy:
  - Experiment 1: 75.8%
  - Experiment 2: 82.6%

UC1a: Future Activities related with Sen4CAP

▶ Expand the testing of the crop type classifier to larger areas

▶ Test the mowing product

▶ Map the structure of the of outputs in order to integrate with NIVA-DSS

▶ Define 3 areas of interest customised to the context of the 3 different EC (e.g. which area contains cotton etc) – M13-14 (OPEKEPE)

▶ NIVA Semantics (i.e. mapping between IACS codes and crop classes, the LUT input for Sen4CAP) (OPEKEPE) – M14-15

▶ Apply the Sen4CAP process – fine-tune Sen4CAP for NIVA purposes by addressing issues related with potential bugs of the software (OPEKEPE with NP support) –M15-17

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# Decision Support System (DSS)
Yorgos Efstathiou
## Nikos Kalantzis

DSS's main key and innovative aspects

▶ The NIVA-DSS will be open and capable to plug-in and receive outcomes from EO classification 'engines' (having as a starting point the Sen4Cap) aiming to enhance the assessment procedure of farmer's declarations.

▶ The NIVA-DSS will deploy and put into practice the data-sharing interoperability mechanisms imposed by the NIVA project (e.g. openEO API, FMIS data brokering services), also incorporating outcomes from different UCs.

▶ The NIVA-DSS mechanism will incorporate data fusion techniques aiming to enhance the capability of such systems to receive large volume of different datasets and from diverse sources of information, improving the reliability and accuracy of the generated traffic lights with minimum human intervention.

The NIVA-DSS operation is composed of the following phases:

1. Primary input phase:

   a) Selected data referring to farmers and parcels details (e.g. parcel geometry, parcel identifier, farmer's VAT) along with the respective information items derived from the farmer's declaration (e.g. crop type, land type).

   b) EO data processing systems products. Primarily, UC1a will utilize products from Sen4CAP as it is considered the dominant approach in EO data processing systems

   c) The underlying logic of specific Eligibility Criteria (EC) (e.g. Classification regarding Land Cover, BPS scheme, VCS schemes) will be coded as computing algorithms and will be available for use within the NIVA-DSS

2. Decision-making using traffic light system based on registered EO outcomes concerning the eligibility criteria.

3. Secondary input phase: In case of inconclusive evidence additional data from secondary sources (e.g. geotagged photos, farmer's e-calendar activities) will be requested by the farmers and incorporated to the system.

4. Secondary decision-making on eligibility criteria utilising the additional data incorporated in step (3)
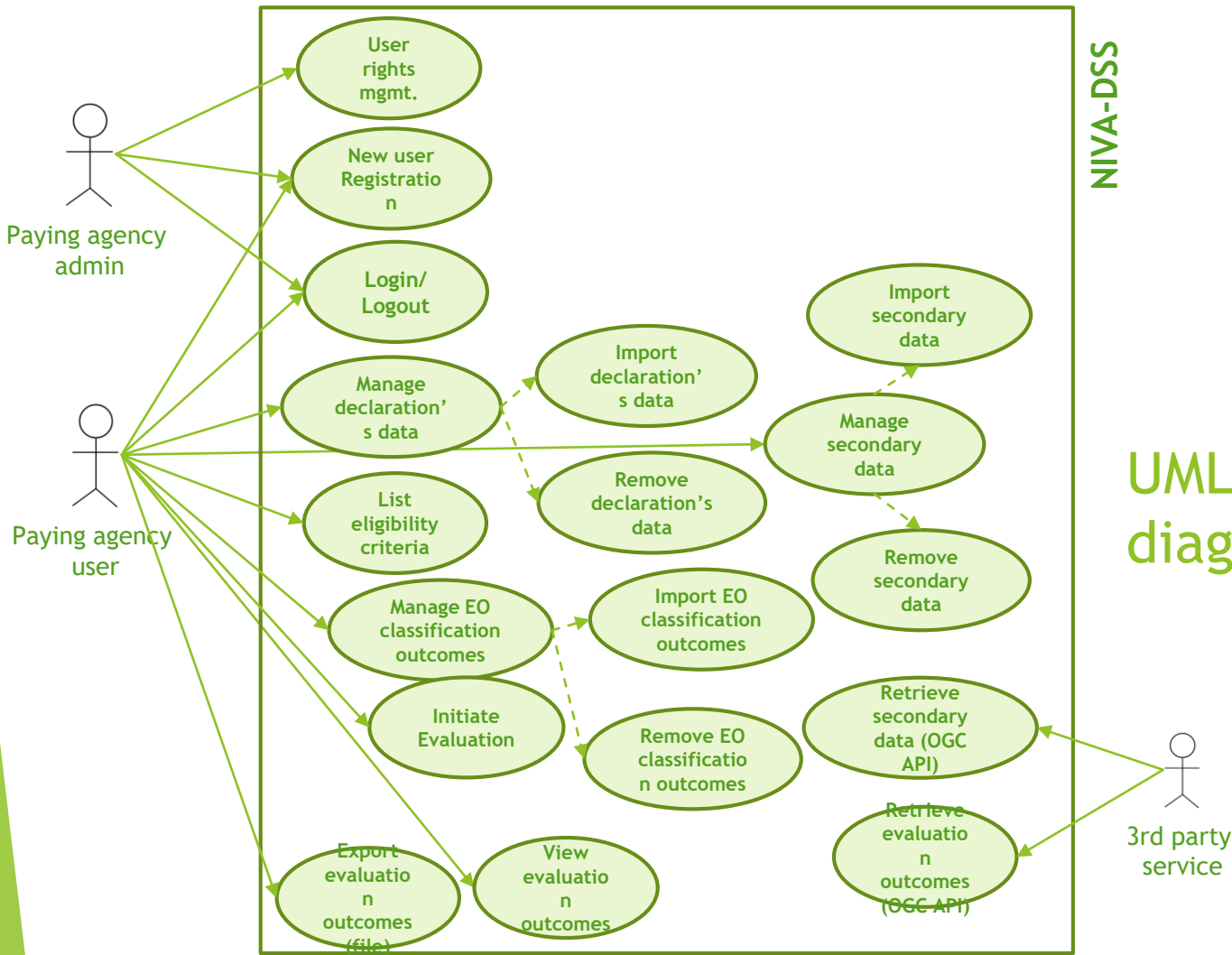
UML Use case diagram
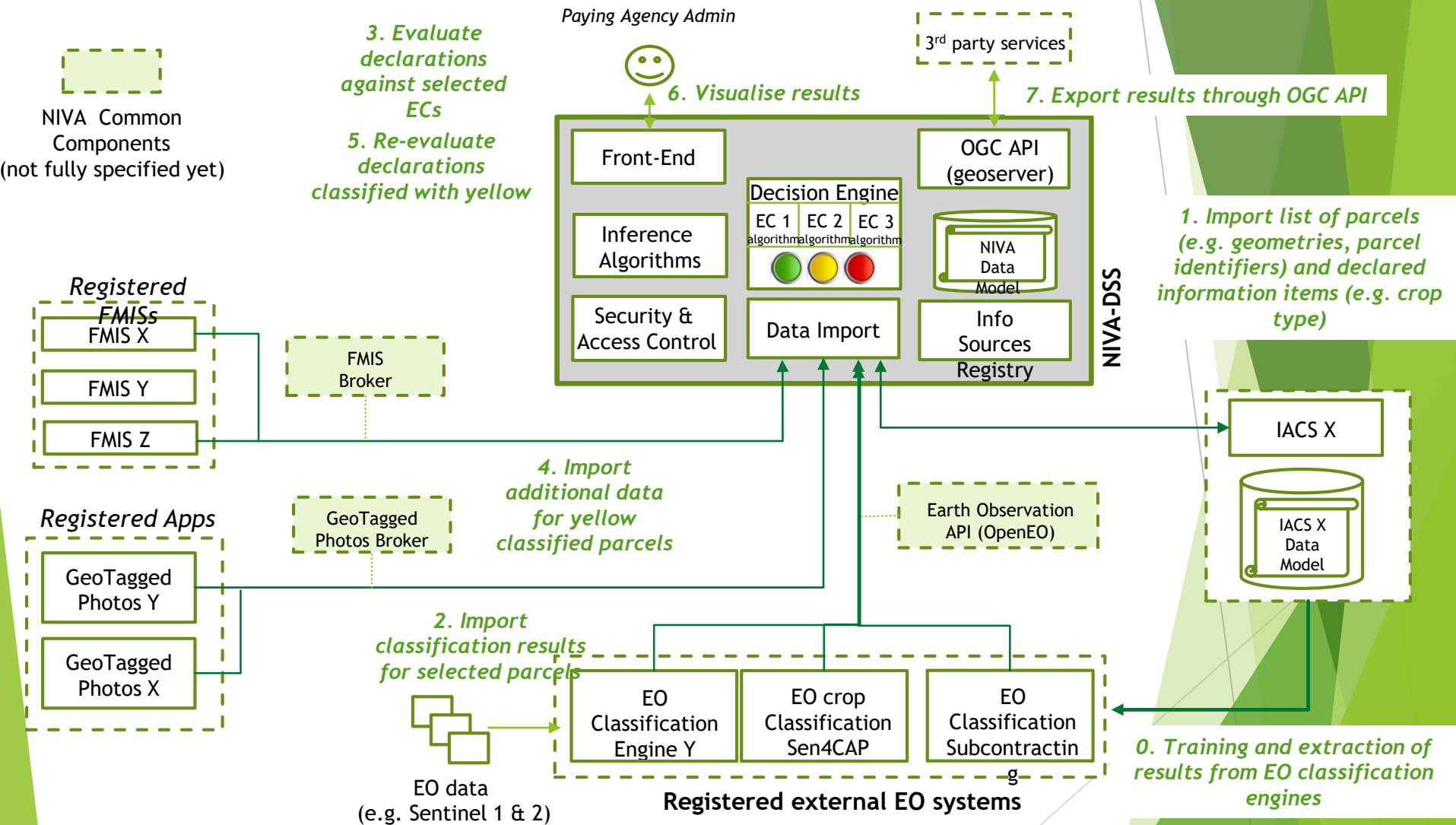
NIVA-DSS Components (1)

- Data Import

  - This component provides a web-service API and the required data import mechanisms (e.g. imported data format validation) in order to make feasible the provision of the information to the NIVA-DSS from the various sources (e.g. EO classification engines, FMIS calendar, Geotagged Photos).

- Decision Engine

  - This component operates logical algorithms that are customised to each eligibility criterion (EC) that are actually evaluating the claims based on the processing of the collected evidences. Each decision outcome will be escorted by a score corresponding to the system's confidence level. Based on predetermined threshold levels each score will qualify to a traffic light colour for each eligibility criterion that will be the final outcome of the NIVA-DSS.

  - In case of inconclusive evidence (i.e. orange traffic light), key information from secondary sources (e.g. FMIS, Geo-tagged photos) are proposed to be inserted directly in the decision engine and/or employed for the re-training of the EO crop classification engine (TBD, it is highlighted that both the initial training and the re-training of the EO crop classification engine will be a manual process).

NIVA-DSS Components (2)

➤ <u>Security & Access Control</u>

- This component enforces the required security mechanisms that ensure confidentiality, integrity and access control on information items.

➤ <u>Information sources registry</u>:

- This component is responsible for maintaining a registry of the information sources (EO based classification systems, FMISs, Apps, IACS) that are registered with the NIVA-DSS and are able to provide useful information for the realisation of the controls. Given that the Paying Agency Admin should be able to import/remove data from these sources for the needs of the EC evaluations this registry will maintain unique identifiers and descriptions (metadata) for the registered sources.

Missing Component: Sub-contracting

Kostas Kountouris

Missing component: Subcontracting

- Markers & crop classifiers based on different classification methods than Random Forest e.g. deep learning, machine learning algorithms

- Workbench evaluation of different machine learning/deep learning algorithms (other than Random Forest)

- Methodologies to deal with: a) small parcel sizes, b) Mediterranean pastures and c) unclear boundaries

- Processing of High High Resolution Satellite data (4m to 1m)

 Shall be addressed with subcontracting a new EO Classification Engine

(Also missing: Change detection algorithms with Sentinel + High-high or similar. Uc5a will deal with that. Joined Proposal is pursued

Time planning

Kostas Kountouris – Yorgos Efstathiou

UC1a: Time Schedule

- Eligibility Criteria / Markers check with other PAs
- UC1a final Description
- DSS development

Ongoing – M12

- Check/define UC1a input and output connections with other UCs
- DSS development

M13 – M15

- Test User involvement
- UC1a internal Testing
- Debugging ready for testing with users in Greece

M14 – M16

DSS: Time Schedule

- Set up GeoServer instance
- Configuration of GeoServer security
- Database and filesystem configuration
- Defining the process of importing parcel declarations

Ongoing – M12

- Building data model for supporting crop classification results
- User management implementation
- Development of decision engine system- create decision/rule models for each EC
- Development export functionality

M13 – M15

- Create/adjust graphical user interface (GUI) for data visualization
- Extra web-gis functionality (search tools, extra layers, etc.)
- Configuration of GeoServer exchange system
- UI, Testing, refinement and debugging

M14 – M16

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KPIs and Innovation Management

Kostas Kountouris

KPIs and Innovation Management

- ✓ A special session by Use Case has been arranged on that

Please attent this webinar on Thursday the 28th of May

Risks – Lessons Learned

Kostas Kountouris

Risks- Lessons Learned

- dependency of UC1a on another WPs/tasks

  (e.g. T4.2: interoperability enablers for EO engines, FMIS, Geo-tagged) and (e.g. T3.2 and T3.5: semantic issues and proposals in technical interoperability.

  … IN PARTNERS WE TRUST | SPEEDING UP TIMESCHEDULE …

- Adoption of Sen4CAP (learning process, support by the consortium)

  …2 MONTHS DELAY OF UC1a DUE TO THAT …

- Coronavirus pandemic consequences

  … EXTRA 2 MONTHS DELAY OF UC1a DUE TO THAT …

THANK YOU!
EFCHARISTO!