AGRICULTURE

AI4 copernicus café

Copernicus data in Agriculture and Food Security domains

webinar on Open Calls

31 August 2021 | **15.00 CET**
30' duration

pre register at ai4copernicus-project.eu

UNIVERSITY OF TRENTO

Lorenzo Bruzzone

Reinforcing the AI4EU Platform by Advancing
Earth Observation Intelligence, Innovation & Adoption

Copernicus data in Agriculture and Food Security domains

Lorenzo Bruzzone

Remote Sensing Laboratory (RSLab), University of Trento, Italy

AI4Copernicus Café 31st August 2021

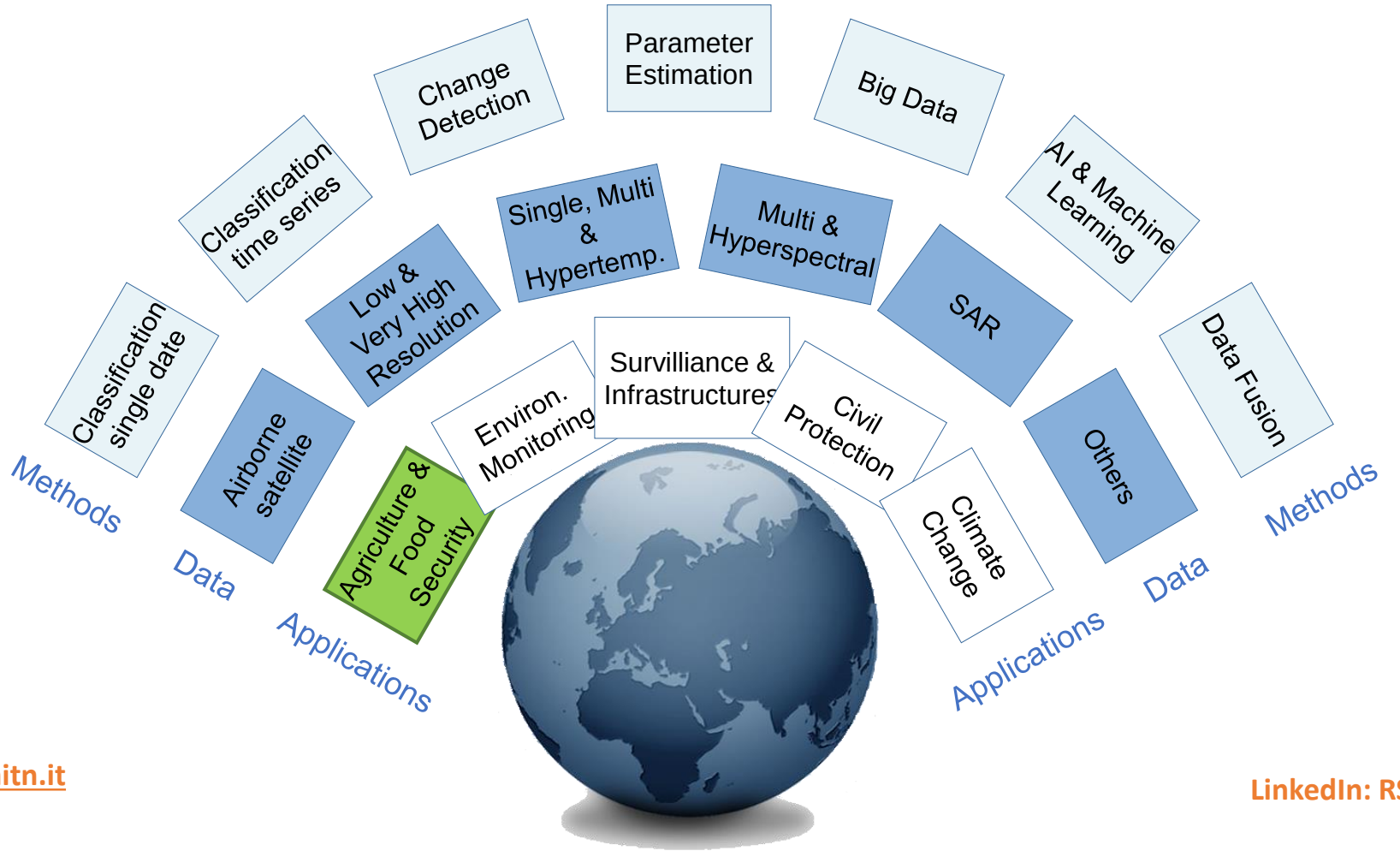
Outline

- Introduction of RSLab @ University of Trento
- Food Security and agriculture domains
- Open calls and related scenarios
- Available bootstrapping services

UniTN Activities and Overview

- Remote Sensing Laboratory (RSLab) at the University of Trento (Italy) has a long experience (20+ years) in remote sensing, pattern recognition and machine learning.
- Published 320+ journal papers on remote sensing and automatic/semi-automatic data analysis.
- Developed 35+ projects with many different institutions (EU, ESA, ASI, NASA, Industry, Public bodies).

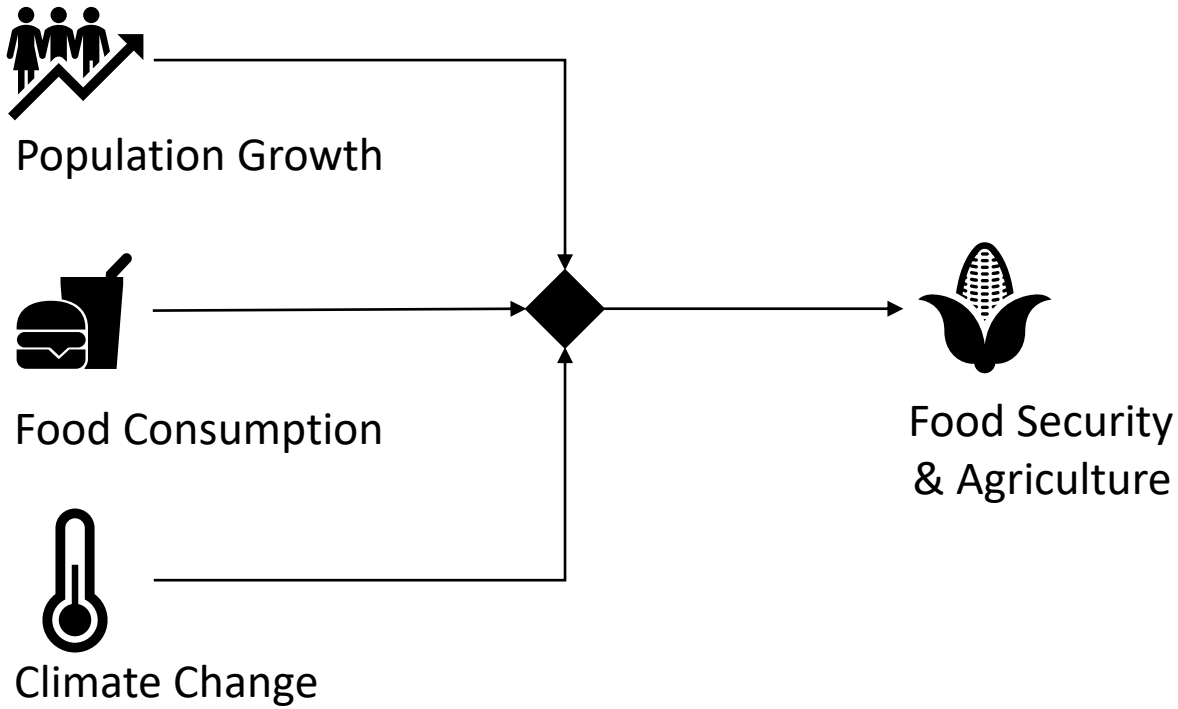
UniTN Activities and Overview



https://rslab.disi.unitn.it

LinkedIn: RSLab UniTrento

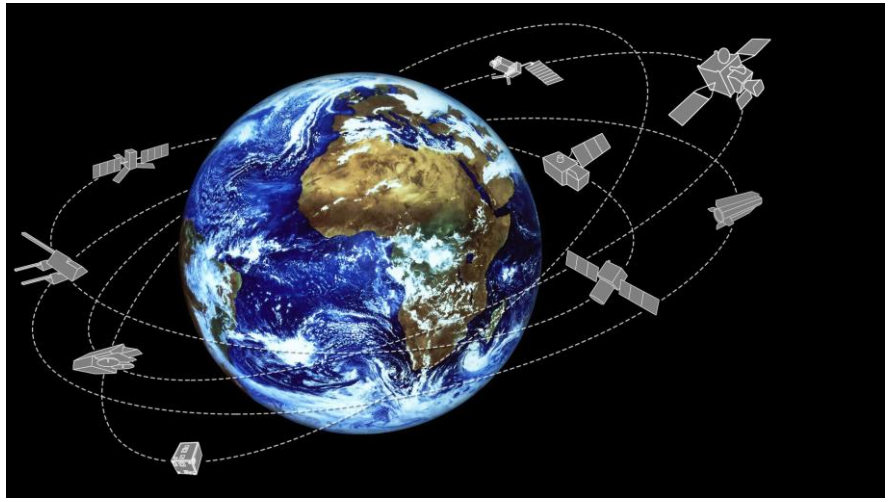
Why Food Security & Agriculture?

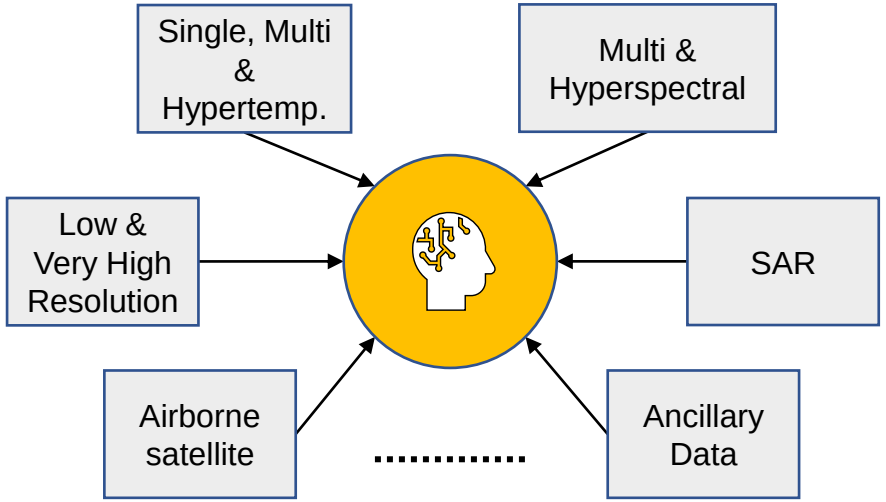


- The huge increase in population and food consumption, as well as the climate change, require the definition of a sustainable biomass production.
- Need to have agriculture monitoring, mapping of crops and related variables (e.g., water use, fertilization).
- Crucial to predict and optimize the production.
- Important to manage irrigation also for the significant financial impact.

AI & Remote Sensing in FS & Agriculture

- Huge amount of satellite data provided within the Copernicus program.
- Different kinds of data (multispectral, SAR, etc.) with different spatial and temporal resolutions.
- Need of AI technologies for an accurate extraction of the semantic from multisource, multiscale, multidimensional and multitemporal data.





AI4Copernicus

- Reinforcing the AI4EU Platform by Advancing Earth Observation Intelligence, Innovation and Adoption
- ICT-49-2020: Artificial Intelligence on demand platform

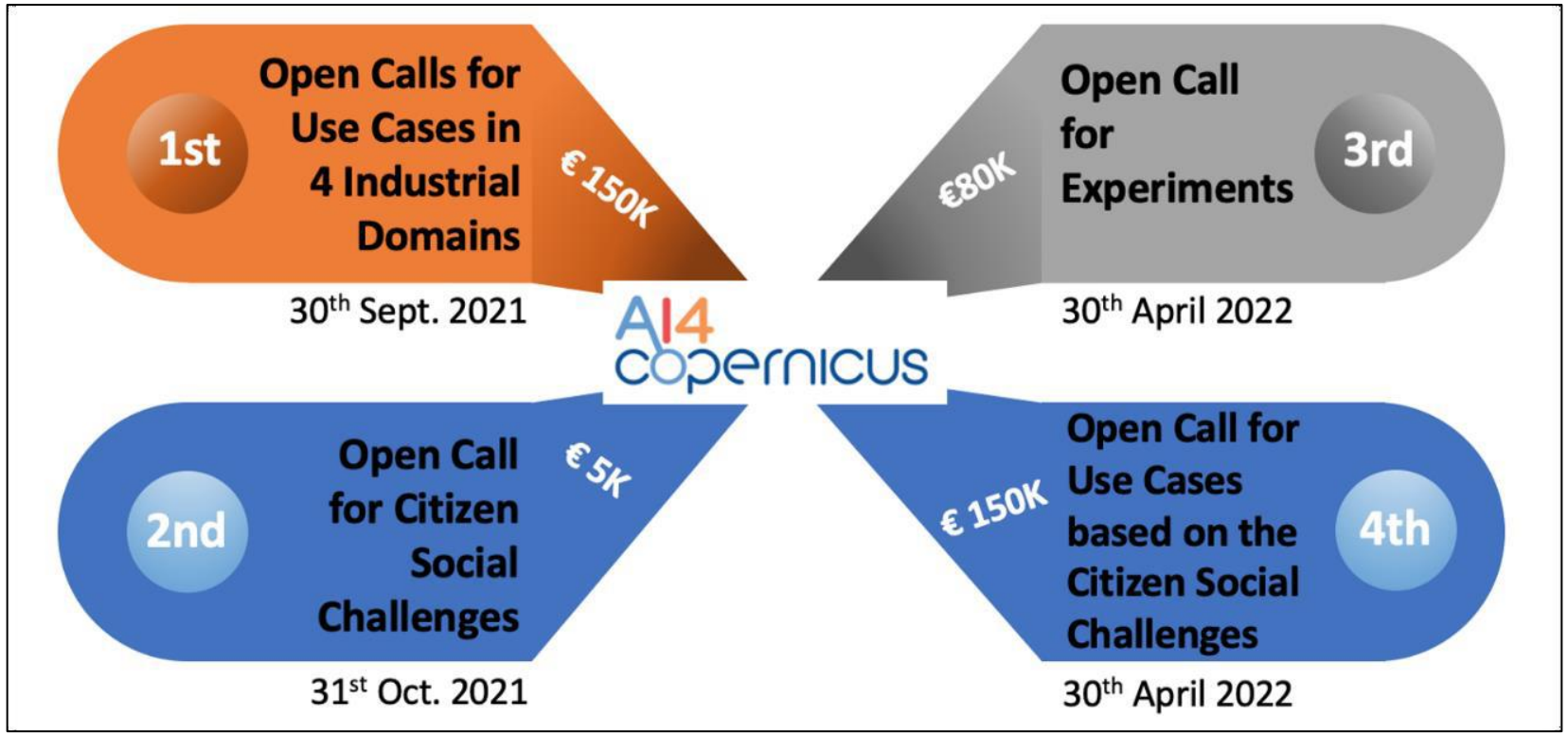
- Goals:
  - Integrate EO ecosystems (DIASes) in the AI4EU platform
  - Solve real problems of business and societal value
  - Provide services to exploit Copernicus data and services in an AI workflow
  - Open calls activities

- UniTN
  - Manage the open calls related to Agriculture
  - Responsible of bootstrapping services in the Agriculture domain

AI4Copernicus Open Calls

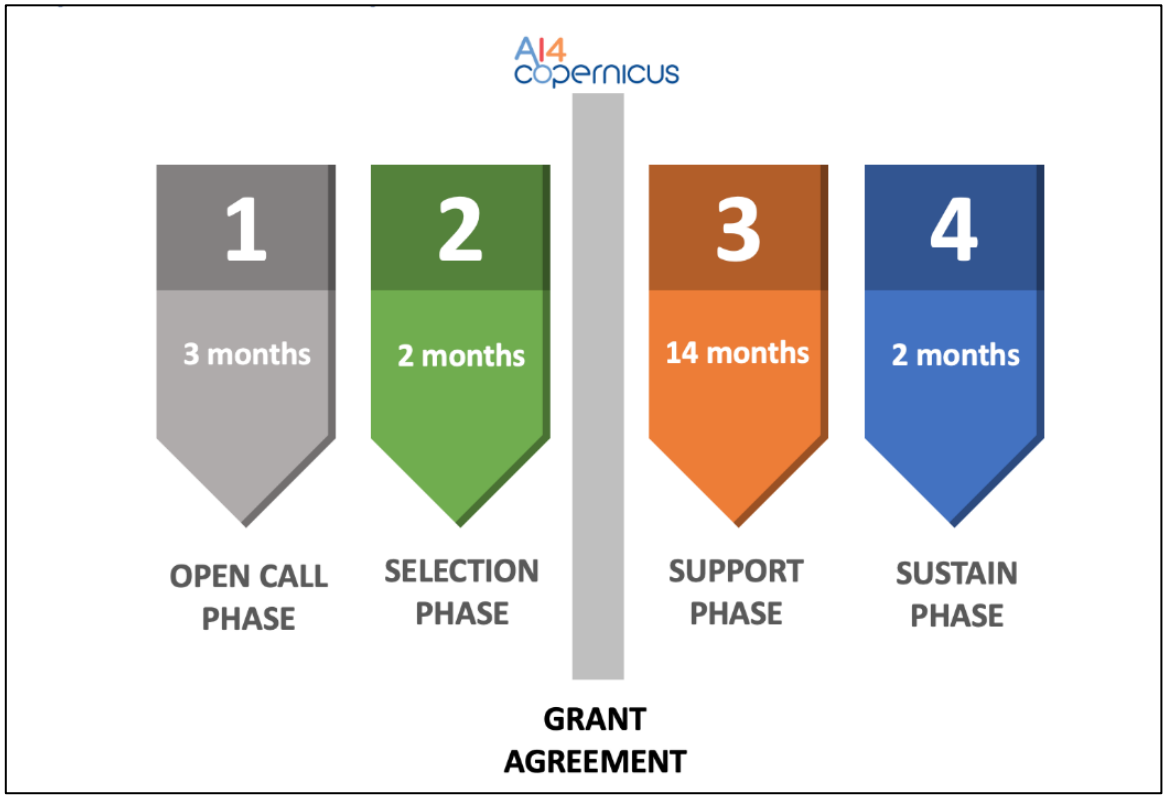
Two rounds of Open Calls are open.

- 1st round. AI solutions based on AI technologies and EO data. For SMEs, Start-Ups and Entrepreneurs.
- 2nd round. Citizen-driven social problems/challenges that can be solved using AI and EO data. For individuals.



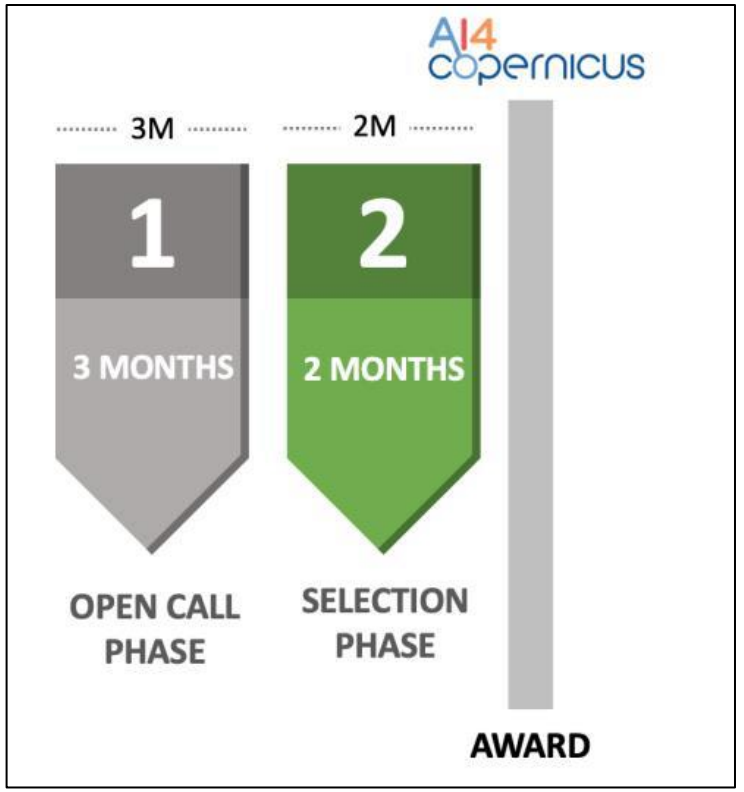
AI4Copernicus Open Calls

1st round



https://ai4copernicus-project.eu/1st-round-of-open-calls-now-open/

2nd round



https://ai4copernicus-project.eu/2nd-round-of-open-calls-now-open/

Indicative Scenarios (Annex 2.1)

- Crop type mapping: extract crop boundaries and/or identify crop type at country or continental level from time series of satellite images.
- Crop dynamic monitoring: extract near-real time phenological parameters of vegetation and fields, collect statistics, perform prediction of yields.
- Support irrigation management: increase water savings and get optimized crop production.

Sentinel 1, 2, 3

In-Situ measurement

Ancillary Maps

Meteorological Data

Examples of Scenarios

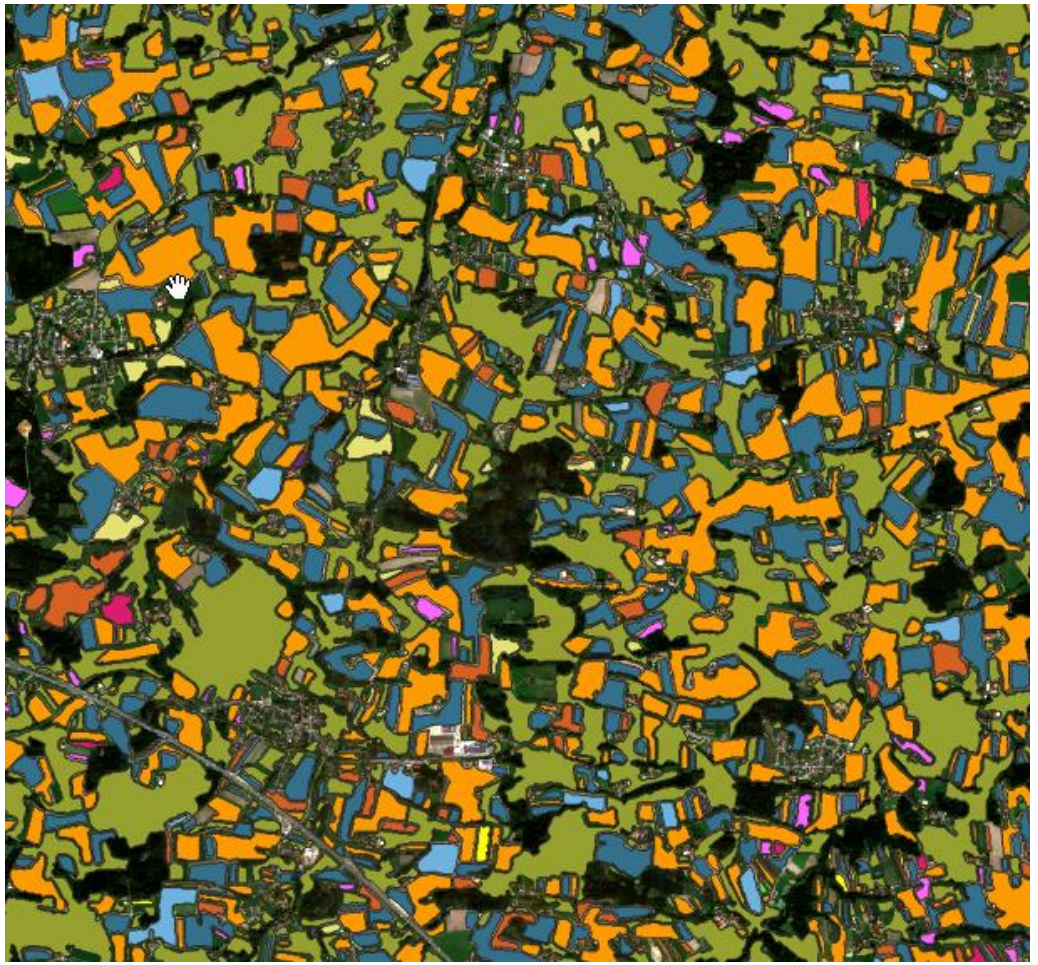
RSLab has many projects related to agriculture and food security. Few example of recent projects are:

- ExtremeEarth – From Copernicus Big Data to Extreme Earth Analytics (European Commission H2020 - ICT)

- S2-4Sci Land and Water – Multitemporal Analysis - Scientific Exploitation of Operational Missions Sentinel 2 for Science Land and Water – Multi-temporal Analysis (European Space Agency)

Examples of Scenarios

Sentinel 2 image from a time series



Crop Type Map

- Beet
- Spring Cereals
- Soy
- Sunflower
- Fruit Trees
- Flowering legumes
- Winter Cereal
- Rapeseed
- Potato
- Grassland
- Maize
- Legumes
- Rye

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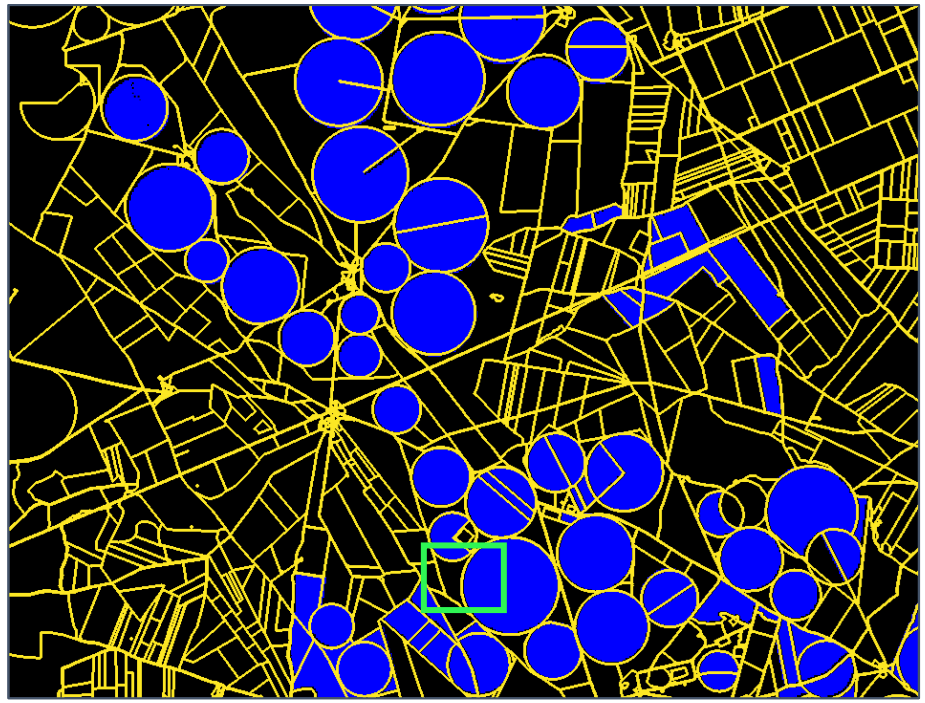
Remote Sensing Laboratory
RS LAB

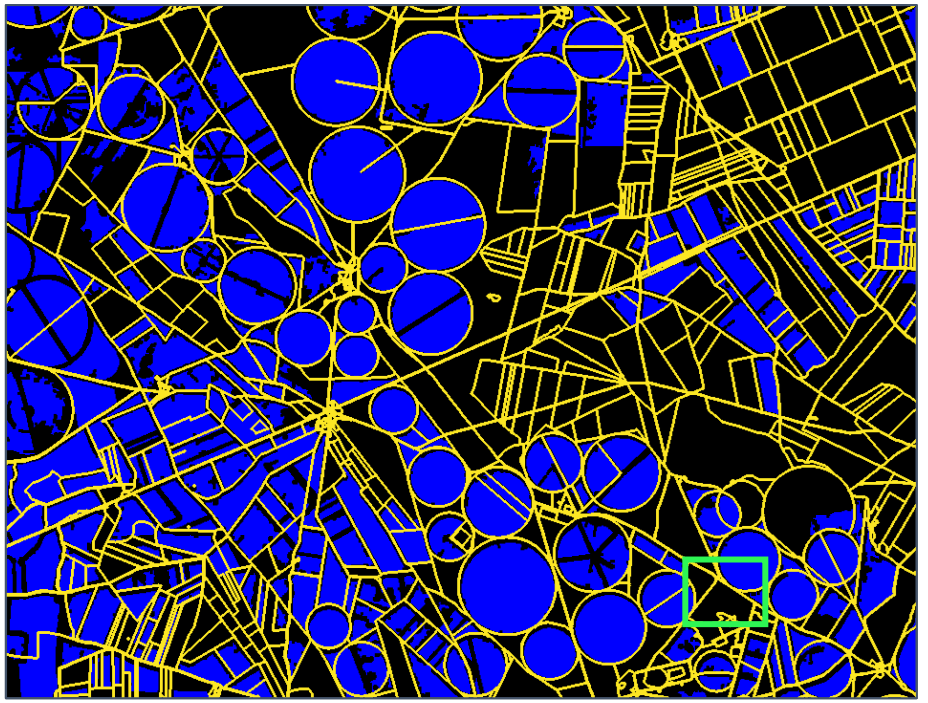
Multi-temporal Analysis for Precision Agriculture

Examples of Scenarios

Ground truth data - 2009



Automatic Classification - 2015-2016



Administrative Boundaries Irrigated Non-irrigated or Non-cultivated

Open Calls: Output and Impacts

Output and coverage:

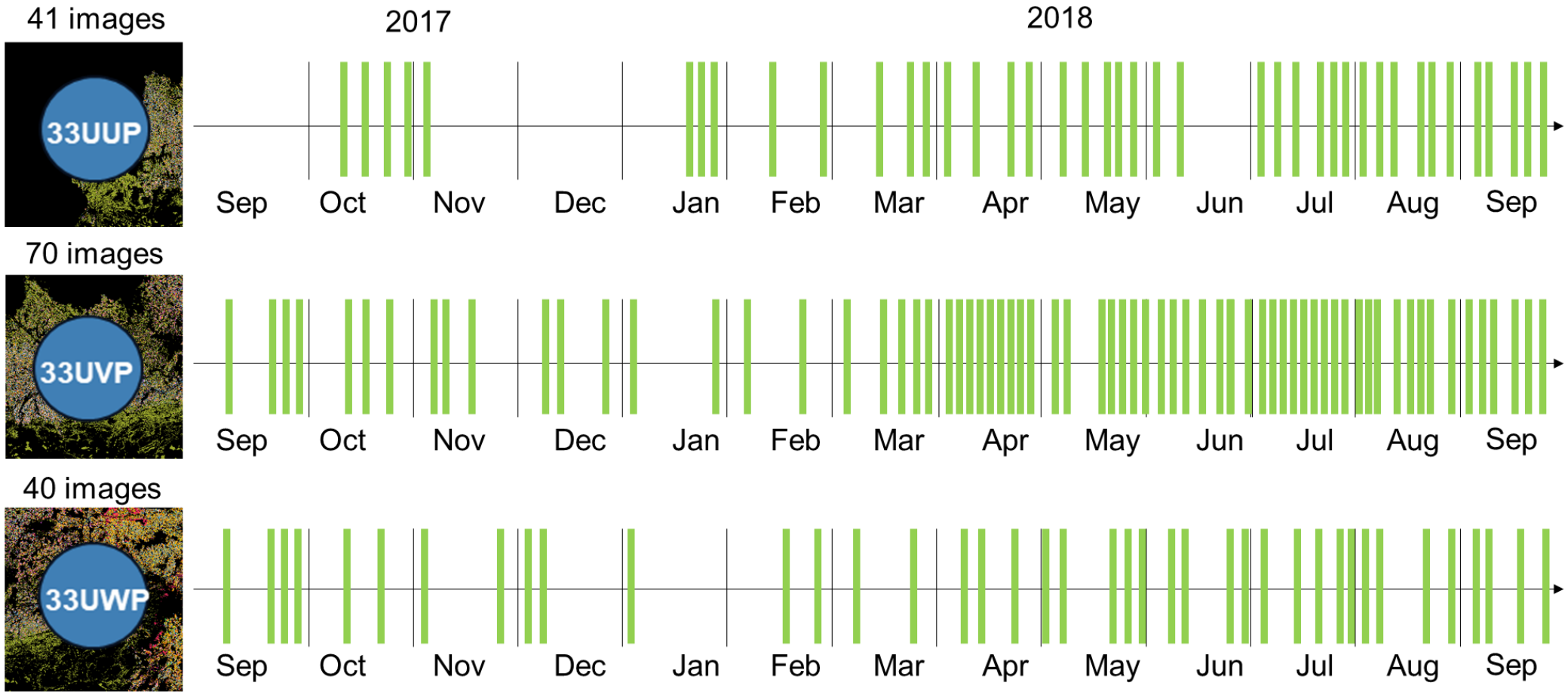
- Services that can be executed in different AoIs.
- Good generalization capability.
- Generate products at local and/or global scale.

- Expected impact:
  - Enhance accuracy of existing systems, and generate accurate products.
  - Extract semantic information for supporting mapping and management at large scale, and improve food security.
  - Proper management of crops and related resources has a huge impact on the environment.
  - Develop new applications and services.

Agriculture Bootstrapping services

Resources	Scope	Pre-requisite
#1 Sentinel-2 time series monthly composite techniques	Harmonization of time-series through monthly composite approach.	Sentinel-2 (Level2A)
#2 Supervised classifier based on LSTM deep network	Classification technique based on Long-Short Term Memory (LSTM) deep network optimized for the analysis of time series of Sentinel-2 images	Sentinel-2 (Level2A) time series
#3 Large and detailed crop training set [1]	Large data set with crop-type labeled multitemporal samples for the training of deep learning architectures	N/A (produced in the H2020 ExtremeEarth project)

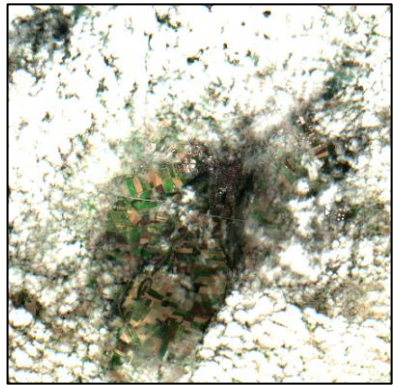
Resource #1: Monthly Composites



Resource #1: Monthly Composites

8th September

11st September



13rd September

18th September

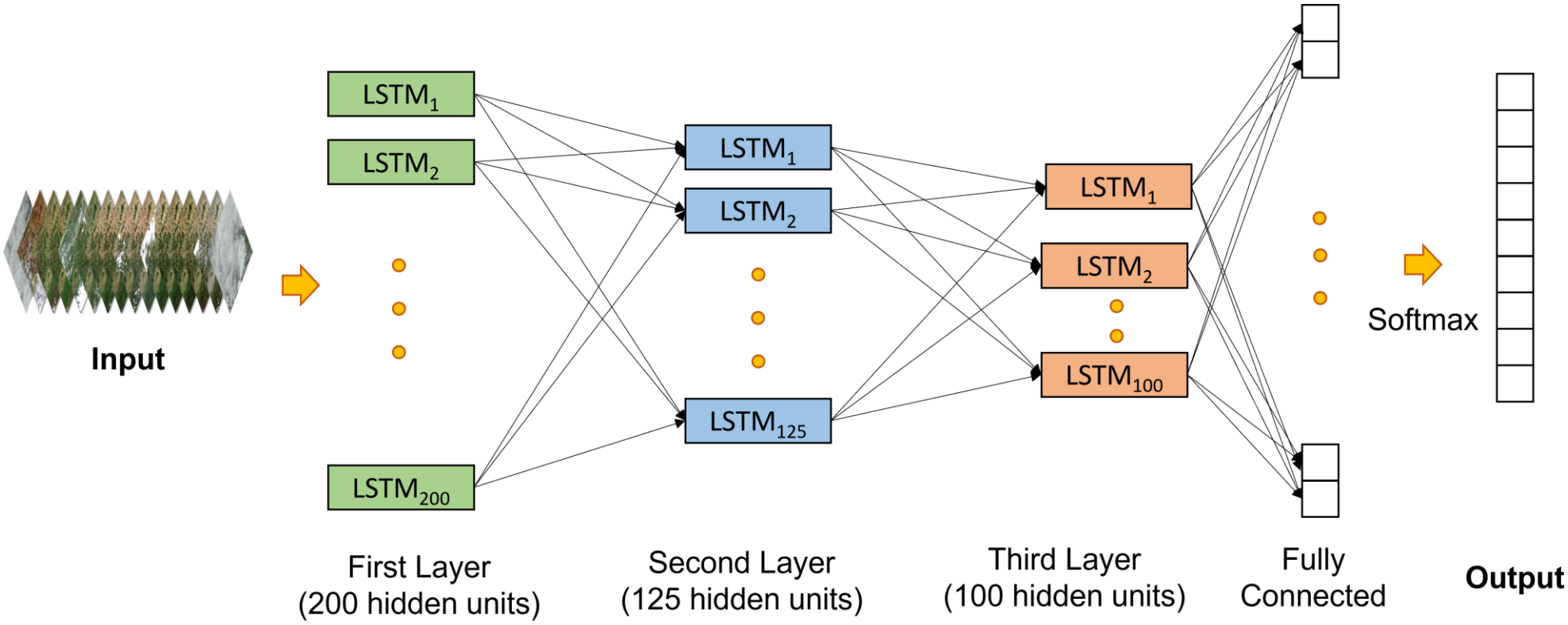
21st September

28th September

Monthly Composite (September)

- Harmonization of Time Series (TSs) through monthly composite approach to create temporally homogeneous time series.
- Allows processing of different TSs length.
- Mitigates the presence of clouds in the scene.

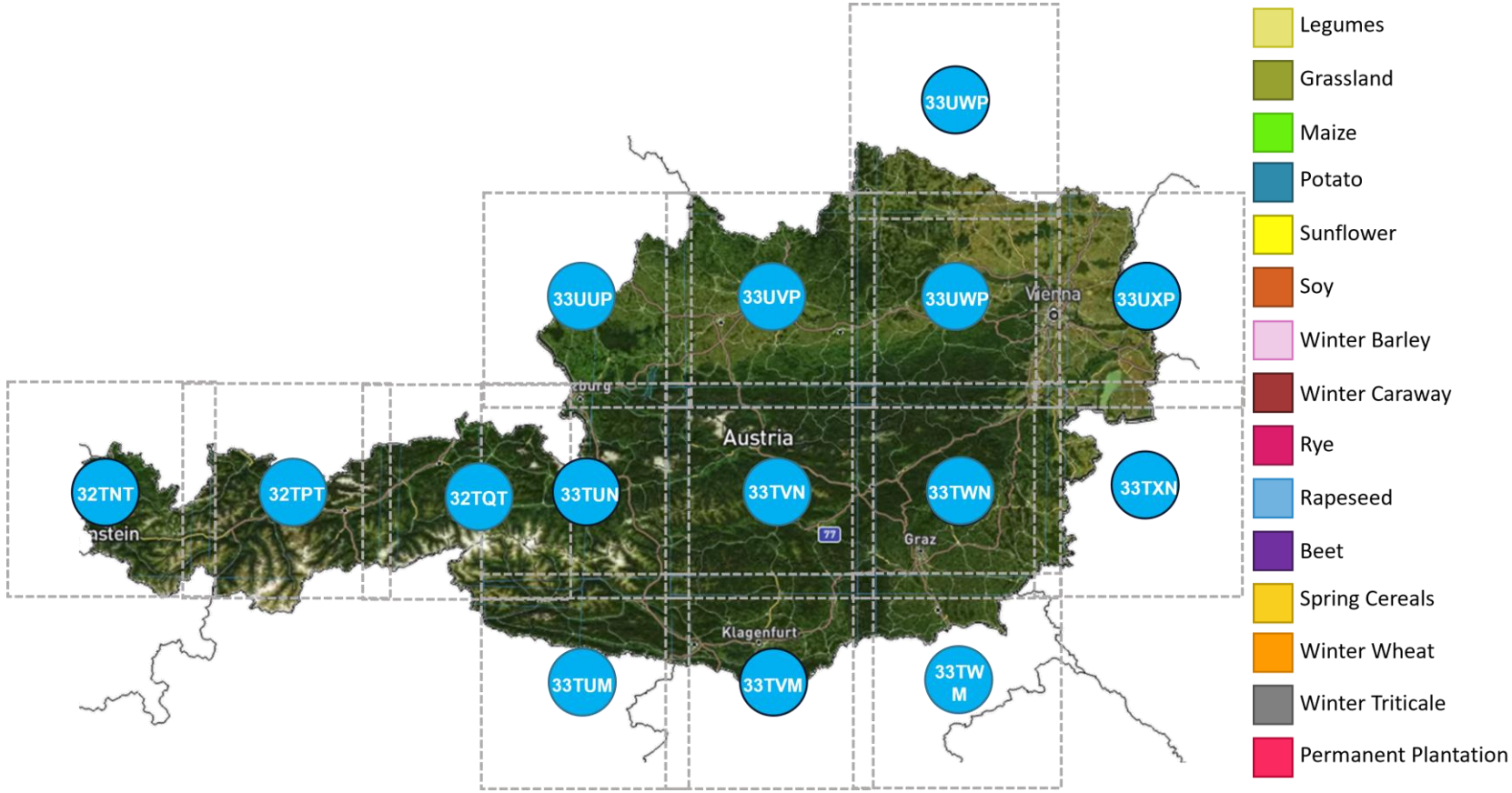
Resource #2: Long Short-Term Memory



G. Weikmann, C. Paris and L. Bruzzone, "TimeSen2Crop: A Million Labeled Samples Dataset of Sentinel 2 Image Time Series for Crop-Type Classification," in IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol. 14, pp. 4699-4708, 2021, doi: 10.1109/JSTARS.2021.3073965.

Resource #3: TimeSen2Crop Training Set

- 1 million samples of S2 TSs associated to 15 crop types (plus one representing other crops).
- Acquisitions from September 2017 to August 2018.



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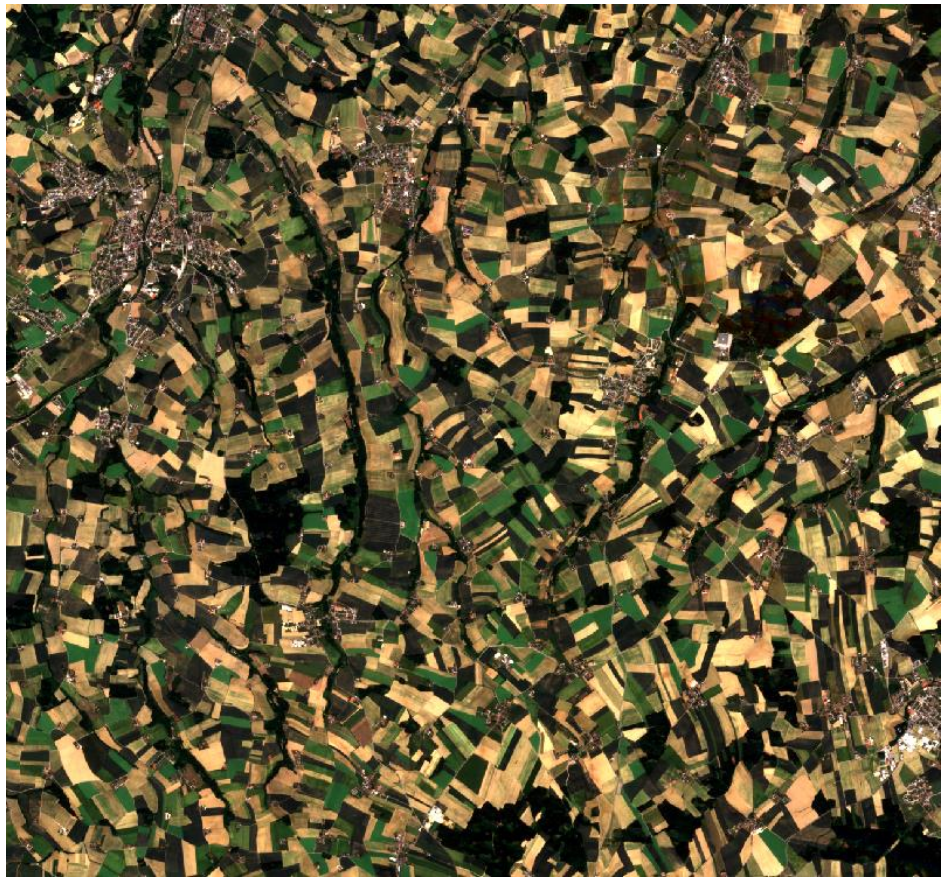
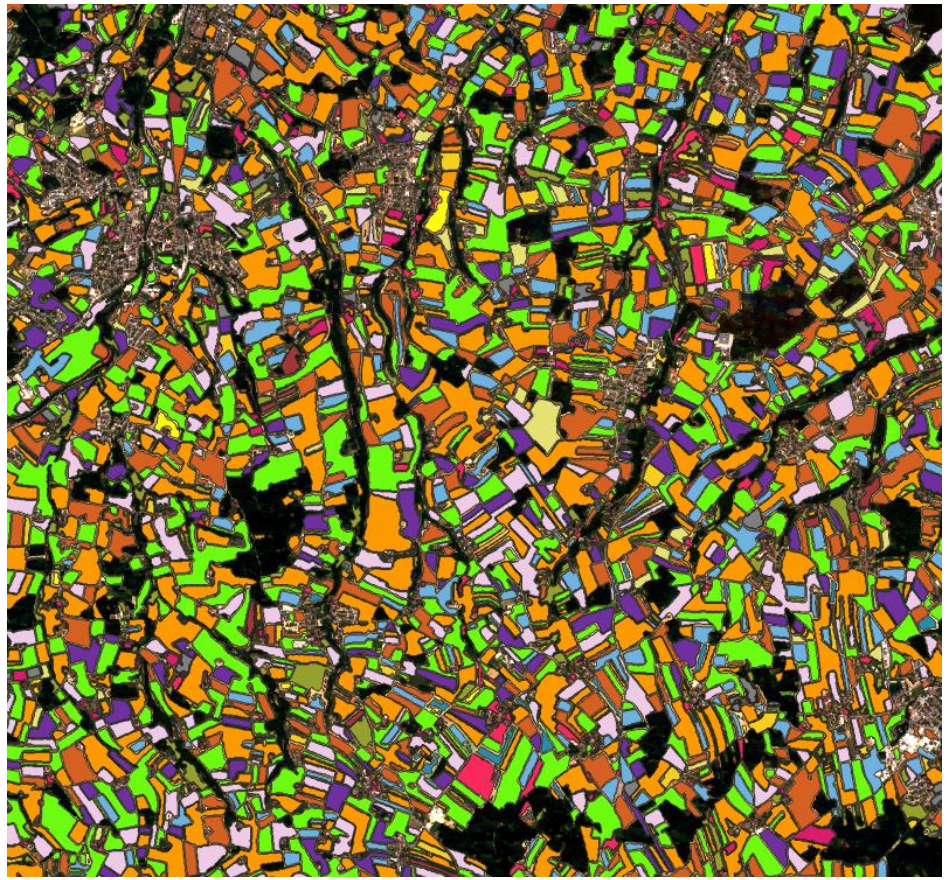
Example of product



Sentinel 2 image from a time series



Crop Type Map

- Legumes
- Grassland
- Maize
- Potato
- Sunflower
- Soy
- Winter Barley
- Winter Caraway
- Rye
- Rapeseed
- Beet
- Spring Cereals
- Winter Wheat
- Winter Triticale
- Permanent Plantation

Conclusion

- Agriculture and Food Security are key application domains that can benefit from the huge amount of Copernicus data currently available.

- It is crucial to exploit AI technologies for the extraction of the rich semantic information present in the satellite data (integrated with other information sources) for developing new and more advanced services.

- AI4Copernicus and the related open call mechanisms are an excellent opportunity for developing new technologies and applications for Agriculture and Food Security to foster the European services and the related market.

Thank You!

Any Questions?

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101016798.