

ESA's Land Cover/Land Use Change projects

Trans-Atlantic Training 2018 (Croatia)

Amalia Castro

07/06/2018

- GlobCover
- CadastreENV (Austria and Sweden)
- Climate Change Initiative – Land Cover project
- Sentinel-2 for Agriculture (Sen2-Agri) + the CzechAgri demonstrator
- Sentinels for Common Agriculture Policy – Sen4CAP
- Copernicus Emergency Services over land

GlobCover

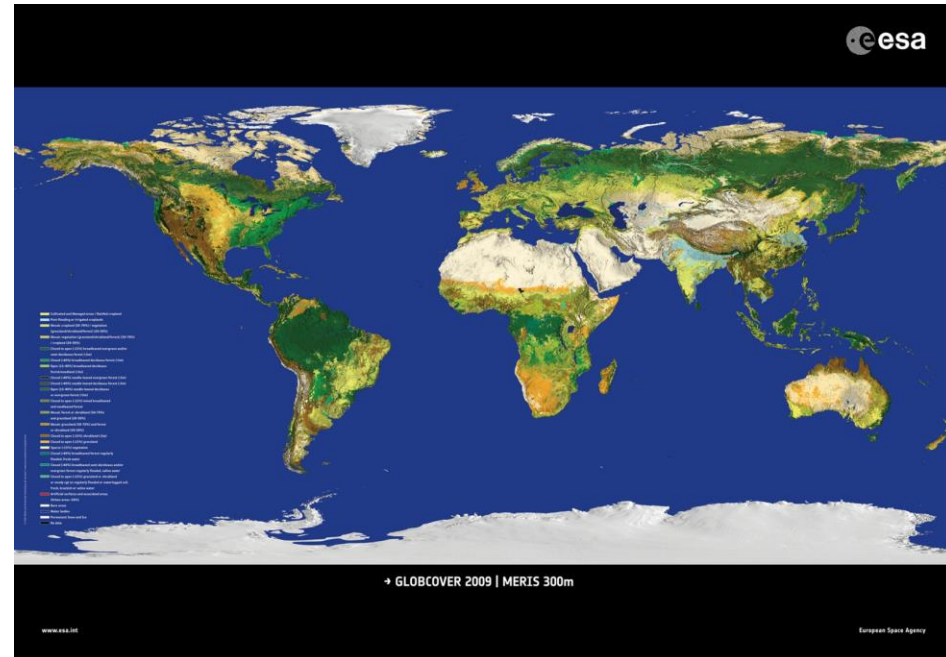
Globcover Portal: http://due.esrin.esa.int/page_globcover.php

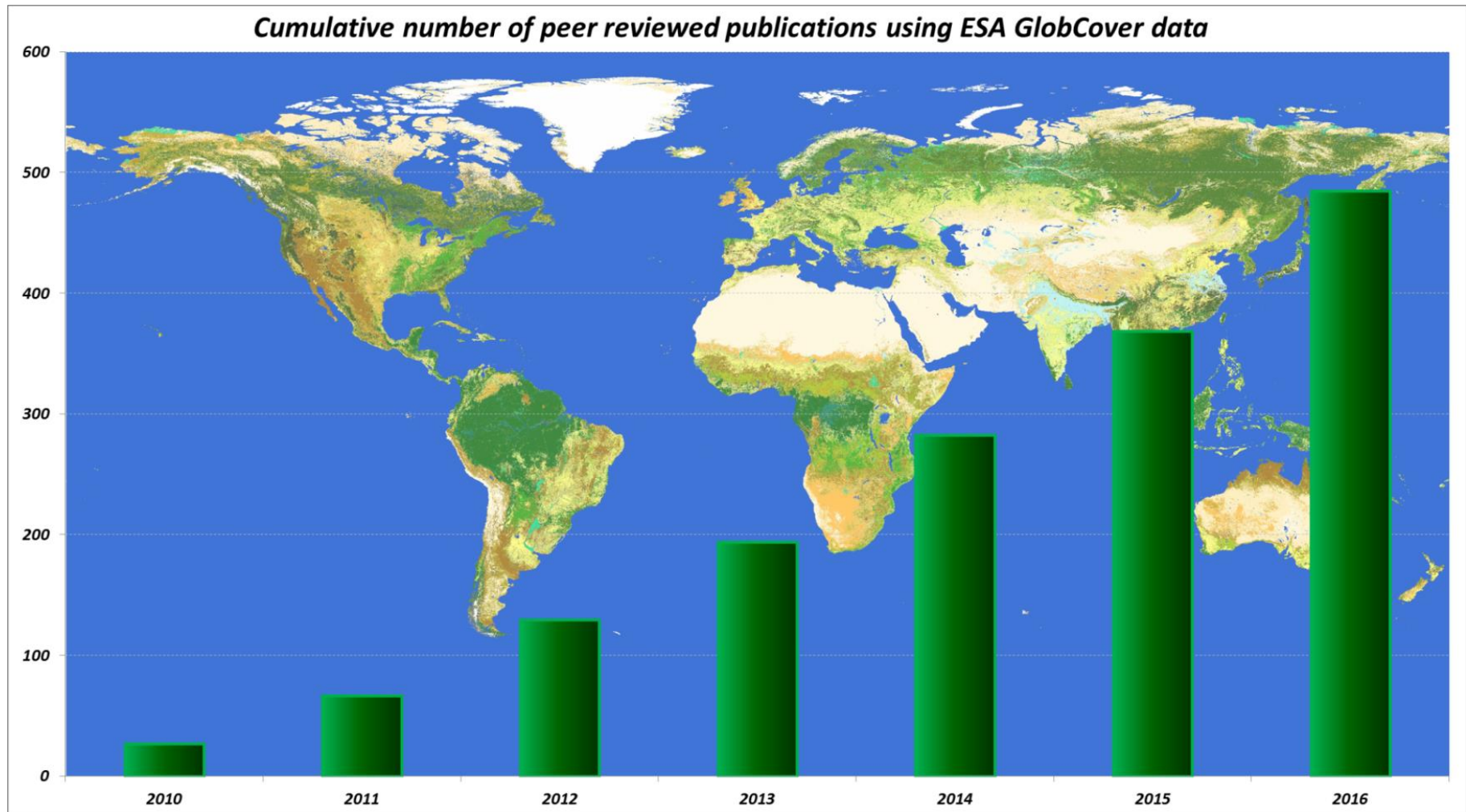
ESA initiative started in 2005, in partnership with JRC, EEA, FAO, UNEP, GOFC-GOLD and IGBP.

Two Global composites & Global LC maps (300m – ENVISAT MERIS) for periods:

- December 2004 to June 2006
- January to December 2009

Legend based on the
UN Food and Agriculture Organisation's
Land Cover Classification System





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GSE CadasterENV – Austria and Sweden

European countries are **required to produce regularly up-to-date detailed and standardized information** on their land cover and its use, at **different scales** and for **different domains** of application.

However, most of the existing national datasets have responded to different needs and been produced with different standards and methodologies. They **lack comparability** and are often **out of date**.

In this context, the CadasterENV projects (one in Austria and one in Sweden, which are the two pilot countries) aims to **implement a multi-scale and multi-purpose Land Cover (LC) mapping and monitoring** system for **large areas** of interest, according to **national user** specifications.

CadasterENV is funded by ESA Earth Watch GMES Service Element (GSE). User participation has been central.

- Austria (2012-2017) <https://www.landinformationsystem.at/> (completed)
- Sweden (2012-2018) http://due.esrin.esa.int/page_project143.php (**ongoing**)

Austria

- Austria initiated its [Land Information System Austria \(LISA\)](#) in 2010, with the objective to achieve a national consensus on how to perform a continuous mapping of the national land cover and monitor its use.
- CadasterENV Austria was therefore in [accordance with the national specifications defined by LISA](#), and built up from its heritage by developing new stages of LISA.
- For HR and VHR mapping, from 2012-2015 the project relied on orthophotos and laser scanning data, with limited use of [Pleiades and WorldView-2 satellites \(both VHR\)](#). Later on, [SPOT-5 and Sentinel-2 and Landsat-8](#) were used (2015-2017).
- It developed [five products](#), all related to Land cover & Land cover change mapping, and developed a HR LC map for the whole Austria.

Sweden

- Aims to [produce a national land cover database](#) and establish an organization for distribution, maintenance and regularly updates.
- Method development 2012 – 2017. Initially using [SPOT and Pleiades](#), and later on improved access to satellite data due to [Sentinels](#).
- Part 2 of the CadasterENV project started in June 2016 and aims to [improve mapping accuracy](#) within the existing product LC HR CadasterENV, have more [detailed classes](#) and [integrate Sentinel-2](#) in the production chain.

CadasterENV Austria /CadasterENV Sweden (2012-2015)

National user bases



- Environment Agency Austria (UBA)
- Federal Office of Metrology and Surveying (BEV)
- Federal Ministry of Agriculture, Forestry, Environment and Water Management
- Statistics Austria
- Federal State of Tyrol
- Federal State of Salzburg
- Federal State of Upper Austria
- Federal State of Styria
- City of Vienna
- Austrian Conference on Spatial Planning (OREK partnership)



- Swedish Environmental Protection Agency (SEPA)
- Swedish Board of Agriculture
- Swedish Forest Agency
- National Land Survey of Sweden (LandMateriet)
- Statistics Sweden
- Country Administrative Board of Stockholm
- Country Administrative Board of Ostergotland
- Country Administrative Board of Vasterbotten

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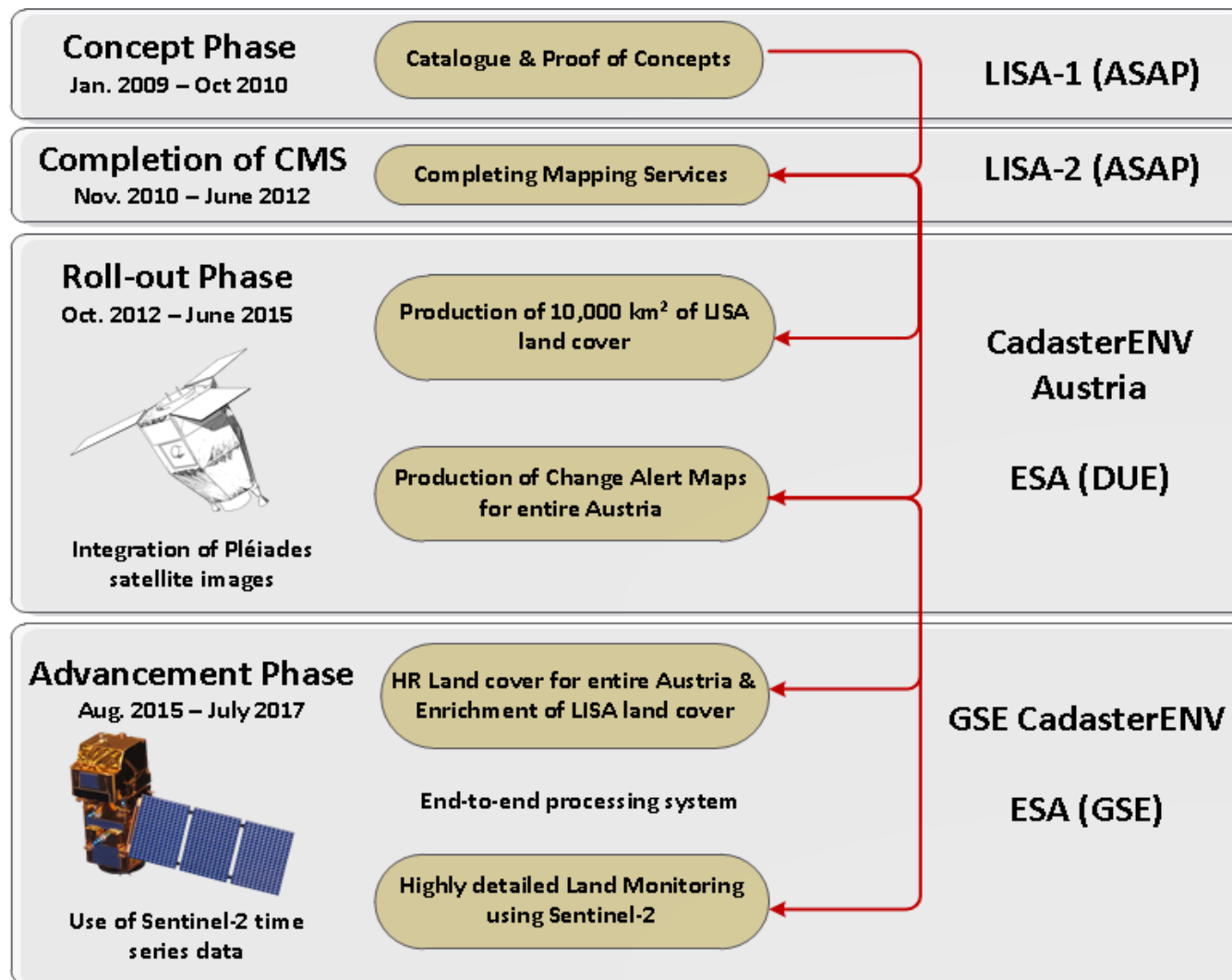


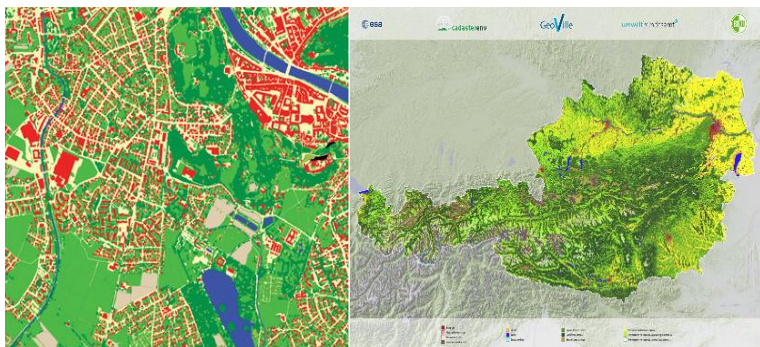
European Space Agency

LISA (Land Information System Austria) Data Models:

- Land Cover data model
 - 13 classes + 12 attributes
 - MMU: starting from 25 m²
 - 95% overall accuracy
 - directly and independently derived from EO data
 - Buildings, other built-up areas, bare soil, bare rocks, trees, bushes, herbaceous vegetation, water ...
- Land Use data model
 - 25 classes + 72 attributes
 - MMU: starting from 1.000 m²
 - based on land cover maps, orthophotos, Digital Surface Models, ancillary and insitu data
 - settlements, roads, railways, arable lands, grasslands, forests, alpine pastures, ...







HR Land Cover Map using Sentinel-2 in 10m resolution, SPOT-5 and Landsat-8 (Prototypical map over 5000 km² + Extended to cover the whole Austria and Liechtenstein with S-2 data of 2015, 2016 and 2017)

And **Enhanced LISA Land Cover Map** (enriching VHR land cover data with Sentinel-2 based information)

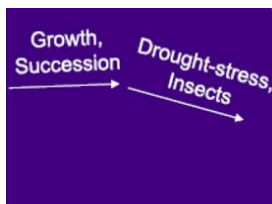


HR Land Cover Change Alert Map
(New urban areas, deforestation)



HR Land Use Monitoring Map
(identify cyclical/ seasonal changes for 1/5 of Austrian territory)

Depends on LC maps. E.g. crop rotation, grassland management



Ecosystem Change map
(identify conditional changes) Experimental product from time series 2015-2017 over 1000 km²

e.g. Forest degradation/ growth, concentration of chlorophyll over time

CadasterENV Austria

The HR Land Cover Map Product



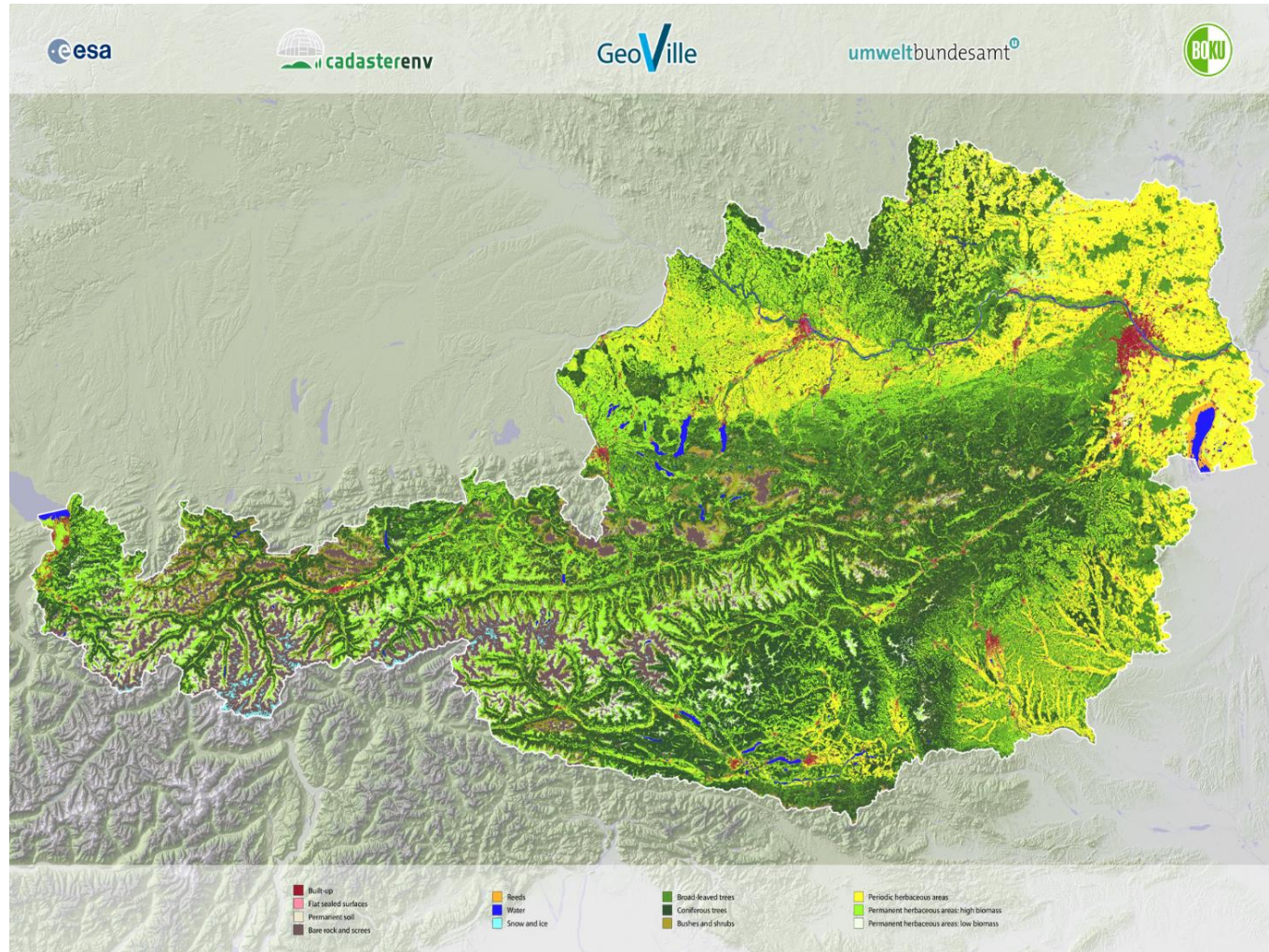
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European Space Agency

CadasterENV Austria

The HR Land Cover Map Product at national scale



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European Space Agency

- Fully automatic **nationwide** land cover processing in place for large-scale implementation
- **Standardised** through compliance with EAGLE data model
- Ongoing, **continuous monitoring** taking into account seasonal changes rather than single snapshots
- Demonstration in Austria, with large **potential for roll-out to other countries**
- Proof of concept for Europe-wide dynamic land monitoring using Sentinel-2:
 - Focus on temporally dynamic agricultural areas
 - Fully automatic production using www.landmonitoring.earth cloud-based mapping technology (linked to Earth Observation Data Centre <https://www.eodc.eu/>)

CadasterENV Sweden

Products



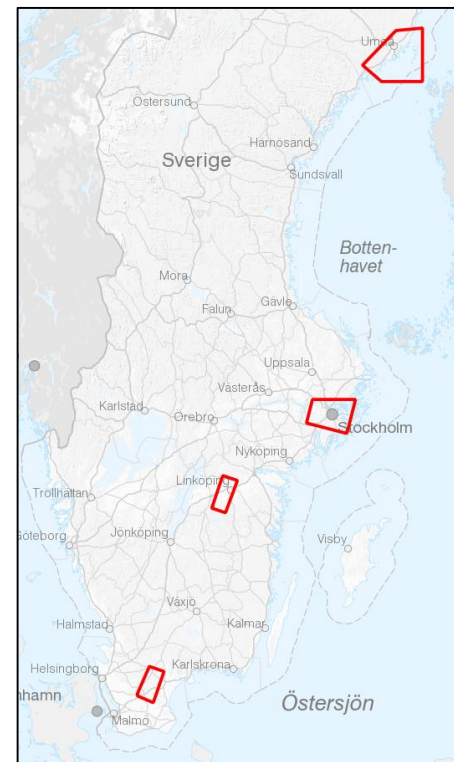
Scale levels:

- **10 meters** resolution to map Land Cover and identify changes at a national level (High Resolution)
- **2 meters** resolution with focus on LC and changes within urban areas for local and regional planning (Very High Resolution)

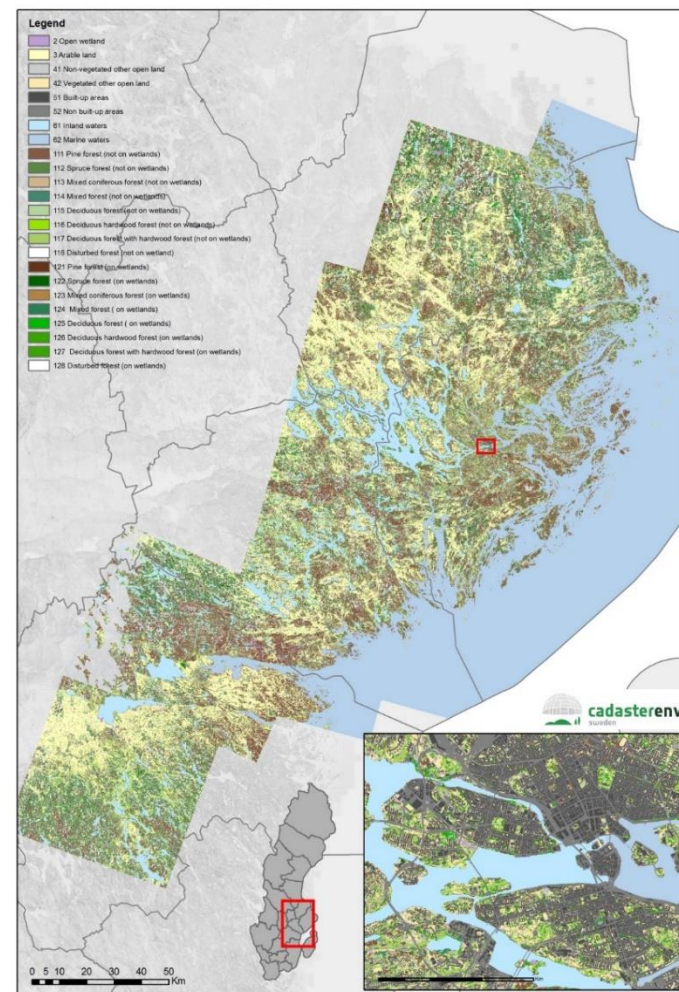
The product is based on **EO data** supplemented by **in-situ** data for reference and validation, as well as **other ancillary data** such as topographical maps, DEM and LiDAR data.

Initially the main EO data source was **SPOT-5 (HR)**, later on replaced with **Sentinel-2**, and **Pleiades (VHR)**.

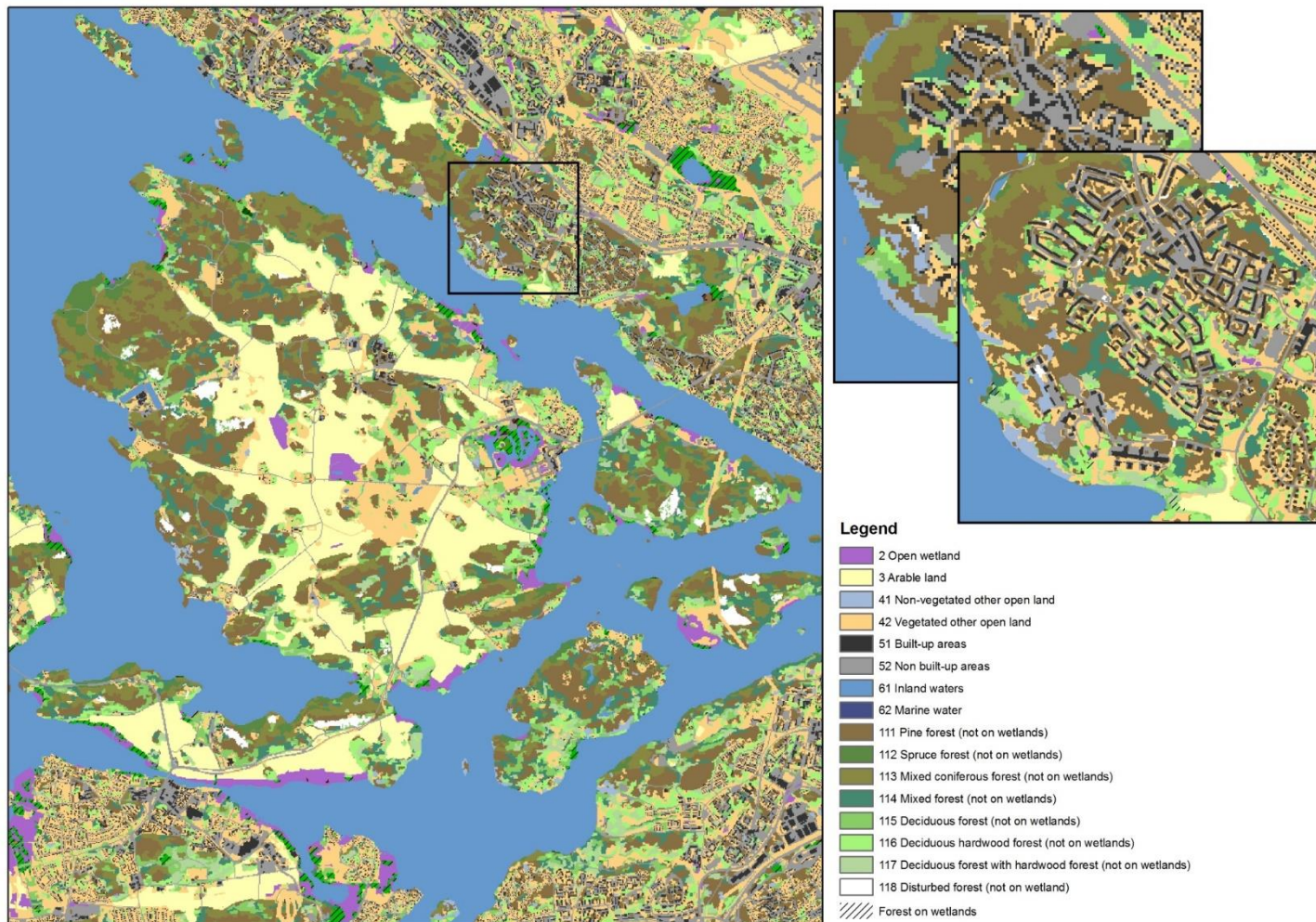
Developed on **4 test sites**.



- LC data model with 24 thematic classes in a hierarchical classification system:
 - Hierarchical Levels 1-3
 - High Resolution (10m)/Very High Resolution (2m)
- 10m HR LC Map (based on SPOT-5 & S2)
- 2m VHR LC Map (based on Pleiades & S2)
- Attributes as separate layers (e.g. Tree and Bush Height & Cover, Land Use, Forest Productivity, Age, etc)
- Different Minimum Mapping Units
- Use of various Swedish Ancillary data (road networks, LPIS data, forest clear cuts, etc.) and LIDAR height measurements



HR LC map over Stockholm county.
VHR map of Stockholm city in the
bottom right corner.



Detailed example of HR and VHR products. The image shows the island Lovön outside Stockholm

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An improved classification accuracy

- Level 1: forest, wetlands, arable land, Water
- Level 2-3: Existing forest types (Forest not on wetlands (Pine Forest, Spruce Forest, etc) and Forest on wetlands (Pine Forest, Spruce Forest, etc)

A more detailed classification

- Stand formation tree species
- Vegetation in water
- Explore the possibility to distinguish different types of field layer

Future R&D

"Best" methods for change detection

- Which bands / indices are useful for different changes?
- Integration of SAR data?

Processing frameworks: Which processes can be automated completely?

Climate Change Initiative – Land Cover project

In 2010, the Global Climate Observing System (GCOS) [listed 50 Essential Climate Variables \(ECVs\)](#). In response, ESA launched its [Climate Change Initiative \(CCI\)](#) to provide a comprehensive and timely response to the need for long-term satellite-based products in the climate domain. Through individual projects, the [ESA-CCI focuses on 14 ECVs, amongst which the Land Cover](#).

6 years CCI Land Cover Project (Phase 1 and 2) achieved the following results:

- ✓ [Annual global LC maps spanning a 24-year period](#), from 1992 to 2015 including NOAA-AVHRR HRPT, SPOT-Vegetation, ENVISAT-MERIS FR and RR, ENVISAT-ASAR, and PROBA-V datasets;
- ✓ Demonstrate the [feasibility of a higher resolution](#) global land cover product by generating a 20m land cover map, over Africa, using Sentinel-2 dataset;
- ✓ Extend the climate impact assessment of a better land surface description for climate modelling;
- ✓ Very good overall accuracy for CCI LC annual map (v2.0.7)

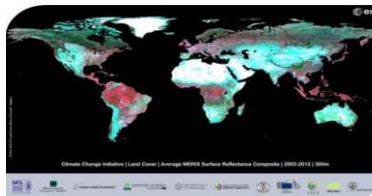
The ESA-CCI global Land Cover maps at 300m (1992 – 2015) are important for understanding changes in land use, modelling climate change extent and impacts, conserving biodiversity and managing natural resources.

The validation of the CCI Land Cover products has been performed by regional experts coordinated by the EC-JRC

<https://www.esa-landcover-cci.org/>



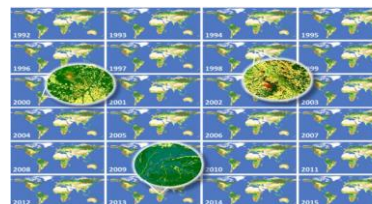
Map of open water bodies (300m/150m)



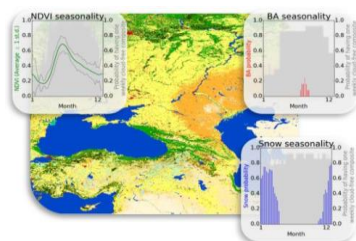
Surface Reflectance time series for 2003-2012 (300m & 1000m)



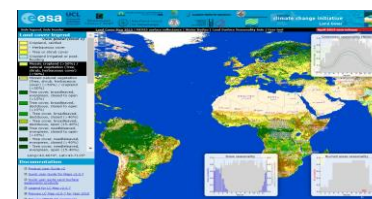
3 Multi-Year Global LC maps (300m) for epochs: 1998-2002, 2003-2007, 2008-2012



Time series of Global LC maps for each year from 1992 to 2015 (300m)



Seasonality products:
3 Global 7-day time series for 1998-2012:
NDVI (1km),
Snow (500m),
Burned areas (500m)



User-tool for resampling, subsetting, projecting & converting.
Package for Sen2Cor.

<http://maps.elie.ucl.ac.be/CCI/viewer>

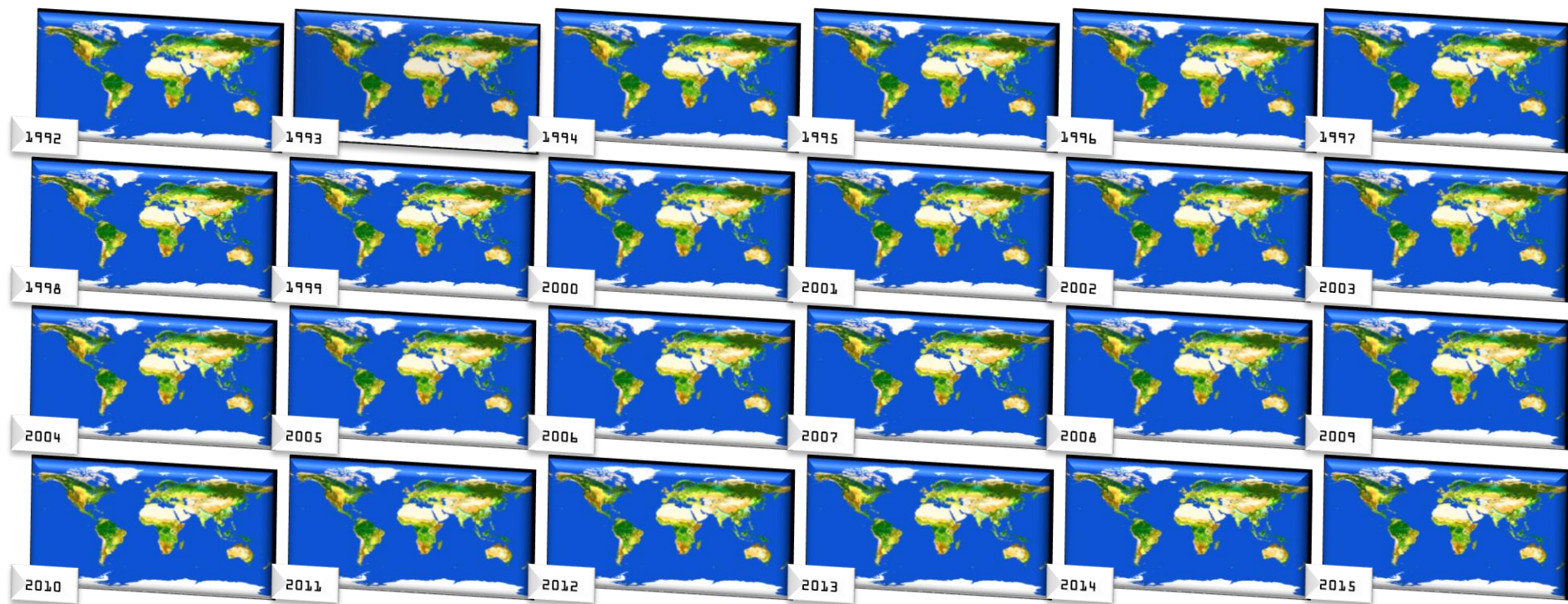
Next:

- Time series extended to 1990s
- Cover current years with PROBA-V & S3

- Prototype map for Africa's 2016 (20m, S2)
- S2 for 10m prototype in Central America

ESA Climate Change Initiative – Land Cover Project

Products: Time Series of Global LC maps from 1992 to 2015 (annual)



300 m resolution, with MERIS FR as baseline

AVHRR + SPOT Vegetation + MERIS + PROBA-V have been used to map the changes

22 global + 14 regional LC classes (following the definition of UN-LCCS)

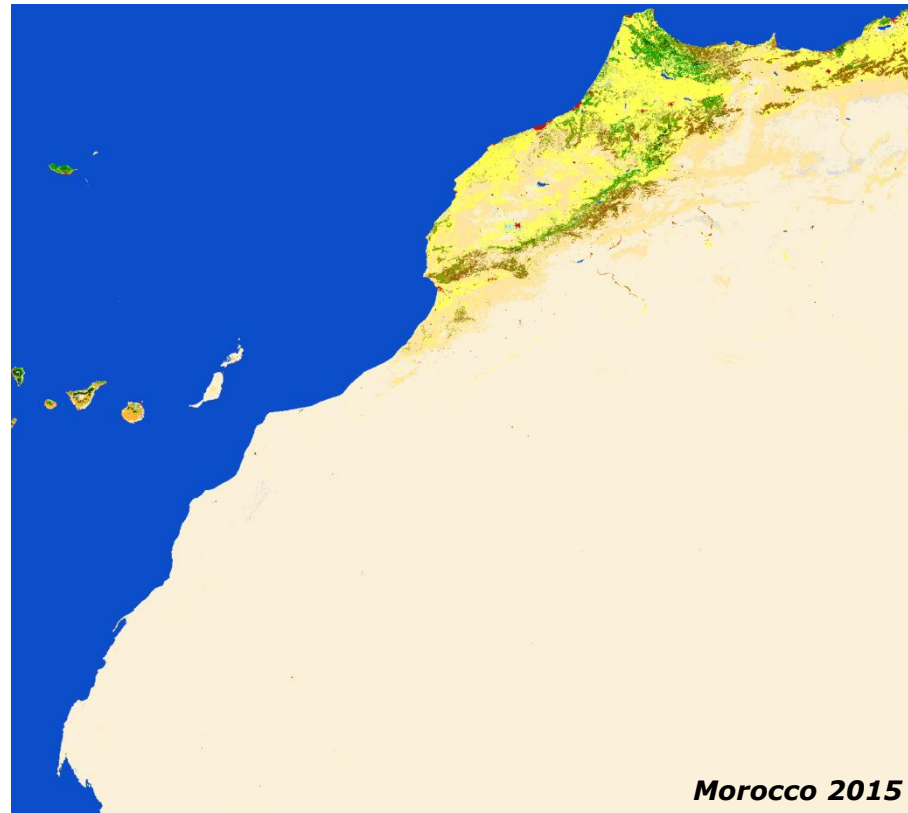
The products are freely distributed from website

ESA Climate Change Initiative – Land Cover Project

Products: Time Series of Global LC maps from 1992 to 2015 (annual)



Example: Animation of the CCI Land Cover map over Morocco, from 1992 to 2015 (300m)



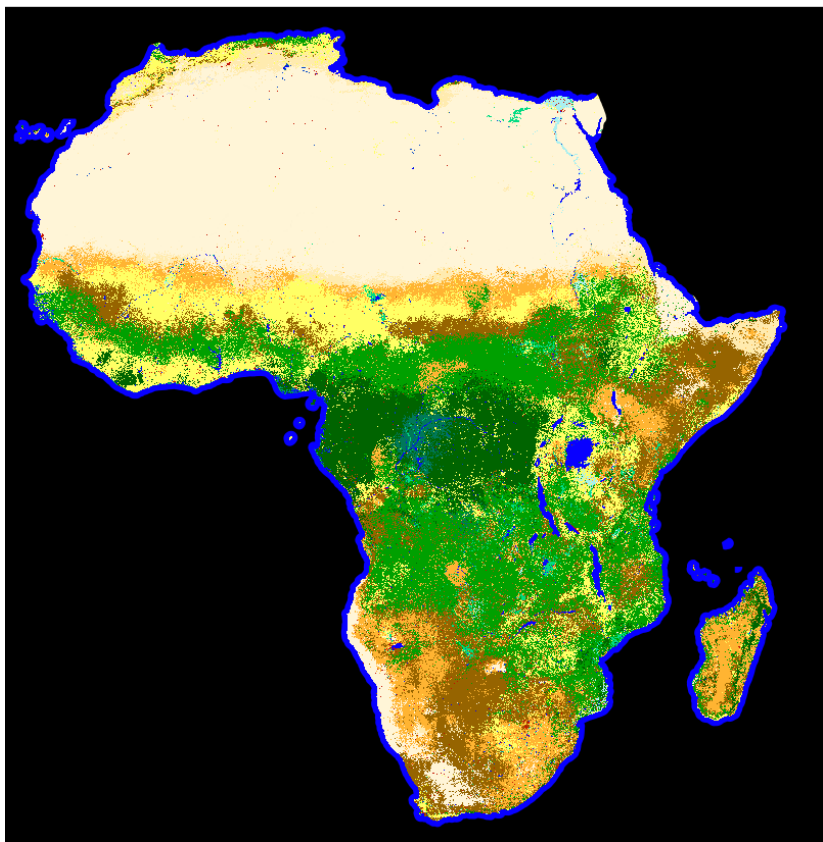
ESA Climate Change Initiative – Land Cover Project

Next developments: Early continental land cover map of Africa 2016 at 20m



<http://2016africallandcover20m.esrin.esa.int/>

Based only on Sentinel 2-A, it has 10 LC classes (following the definition of UN-LCCS) and is freely distributed from the website

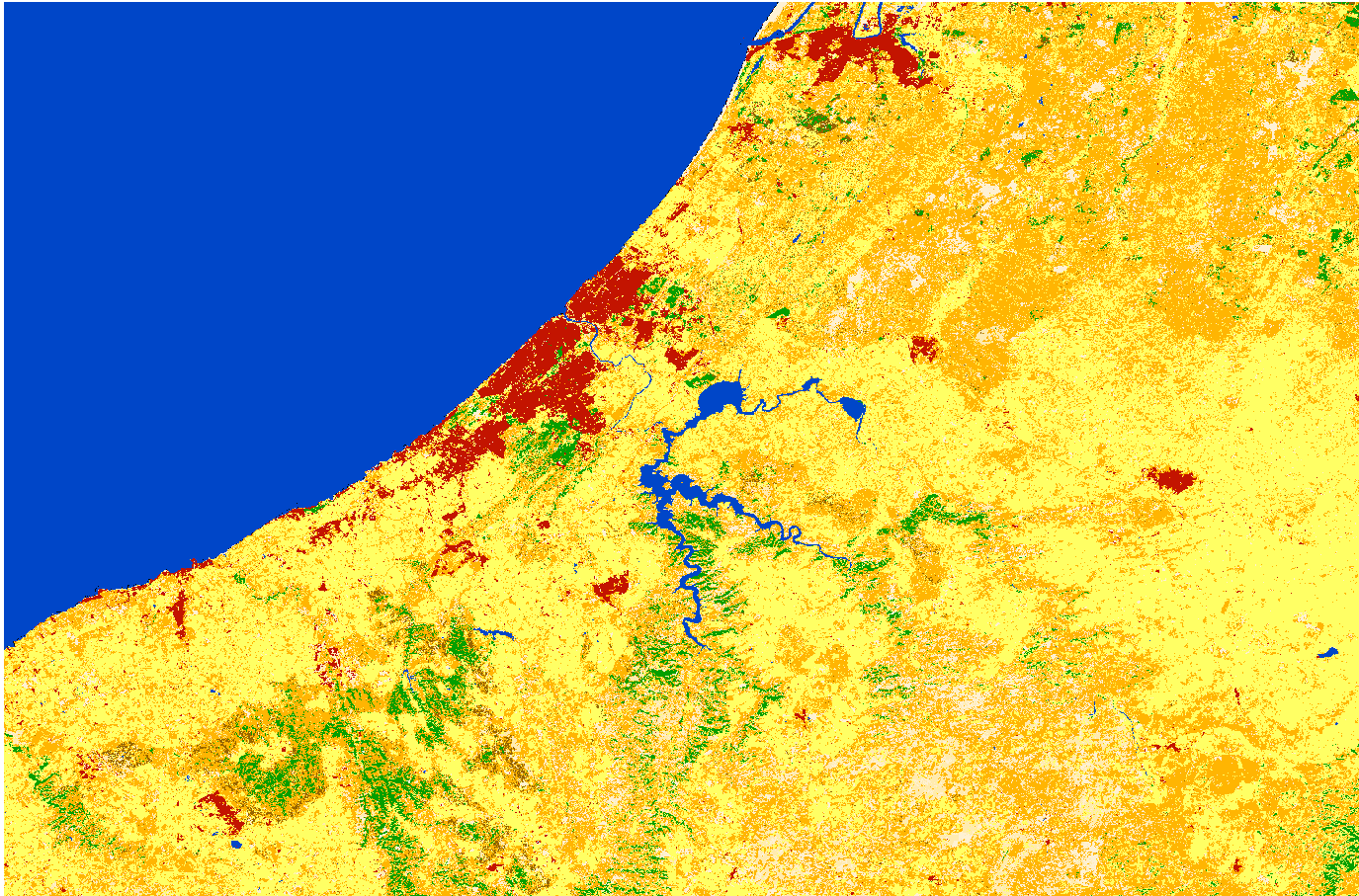


- Great achievement as first classification using Maximum Likelihood. Repeated with Random Forest, 2 reference sources
- Demonstration of feasibility
- Baseline to evaluate progress
 - ✓ "Learning-by-doing" process
- Results analysis provides us valuable feedbacks for
 - ✓ Pre-processing
 - ✓ Input data combinations
 - ✓ Classification methods benchmarking
 - ✓ Post-filtering approach

- | | |
|----|------------------------------------|
| 1 | Tree cover (BrEv, BrDec) |
| 2 | Shrubs cover areas |
| 3 | Grassland |
| 4 | Cropland (rainfed or irrigated) |
| 5 | Vegetation aquatic or reg. flooded |
| 6 | Lichens and mosses |
| 7 | Bare areas |
| 8 | Built up areas |
| 9 | Snow and/or Ice |
| 10 | Open water |

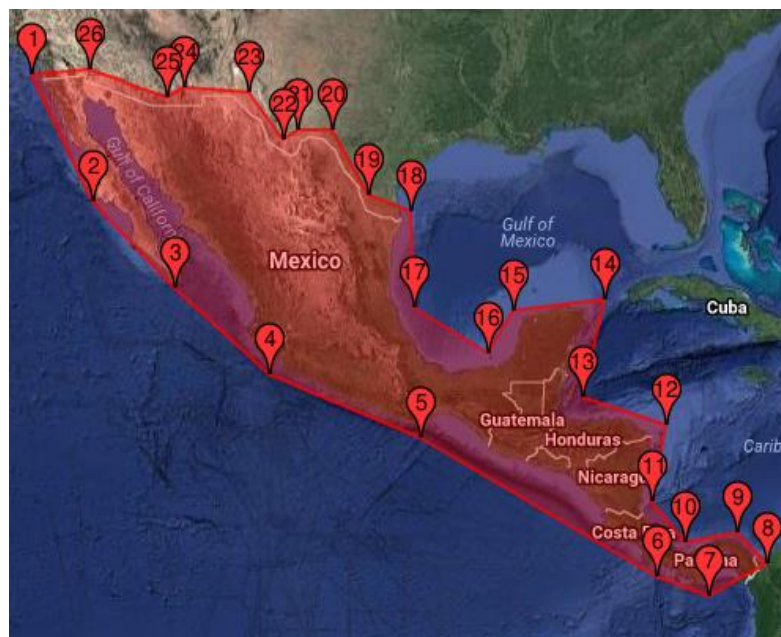


Example over Morocco (*Rabat*)

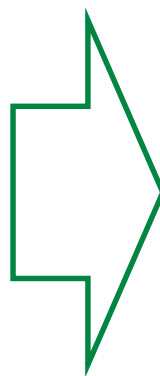


1st September 2017 → 31st August 2018

HR Land Cover Map (10 m) over Central America and Mexico using S2A and S2B datasets



[Covered by ~500 Sentinel-2 L1C granules]



Sentinel-2 for Agriculture (Sen2-Agri)

<http://www.esa-sen2agri.org/>

Major contribution to the R&D and national Capacity Building components of GEOGLAM initiative & JECAM network activities.

It is a project to demonstrate benefits of S2 for agriculture. Launched in 2014, it will provide users with:

- validated open-source [algorithms to derive EO products](#)
- [best practices](#) to process S2 data in an operational manner

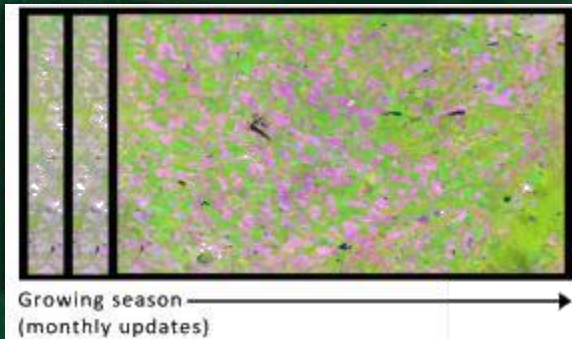
Sen2Agri system is an [operational standalone processing system](#) that generates agricultural products from S2 & Landsat-8 along the growing season.

- Free and open source
- Used on [cloud computing](#) infrastructure or on [own computer](#)
- Used in [automated](#) or [user-oriented](#) mode

[Webinars, User Workshops and Training sessions](#) are organised regularly

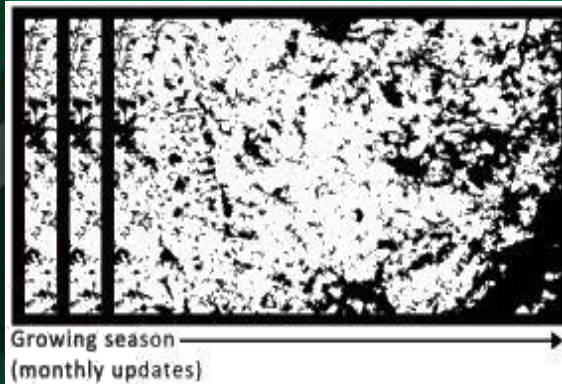
**Monthly cloud free
surface reflectance
composite at 10-20 m**

**CLOUD FREE SURFACE
REFLECTANCE COMPOSITES**



**Vegetation status map
at 10 m delivered
every week (NDVI,
LAI, pheno index)**

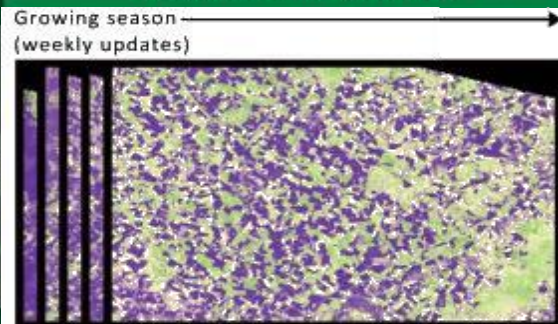
DYNAMIC CROPLAND MASK



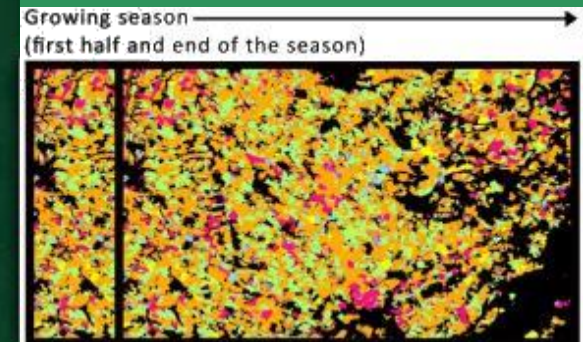
**Binary map identifying
annually cultivated
land at 10m updated
every month**

**Open source toolbox
Capacity building and training**

VEGETATION STATUS



CULTIVATED CROP TYPE MAP



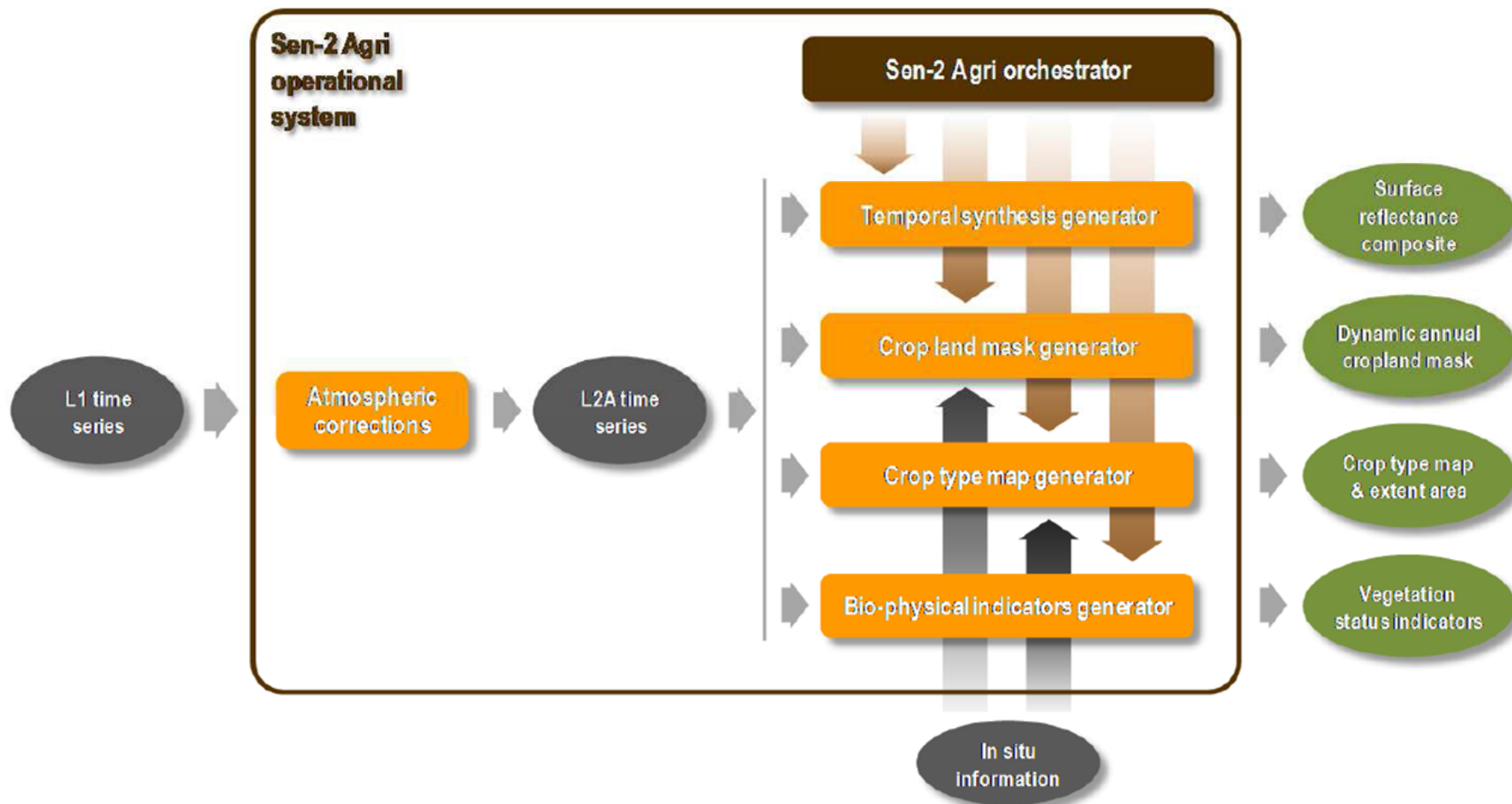
**Crop type map at 10 m
for the main regional
crops including
irrigated/rainfed
discrimination**

ESA Sentinel-2 for Agriculture (Sen2-Agri) project

Processing System



A system designed to run in an **automated** near real time (and off line) mode to deliver agricultural products as satellite images are ingested



ESA Sentinel-2 for Agriculture (Sen2-Agri) project



Project phases

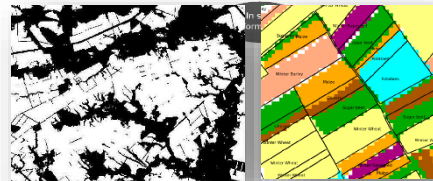
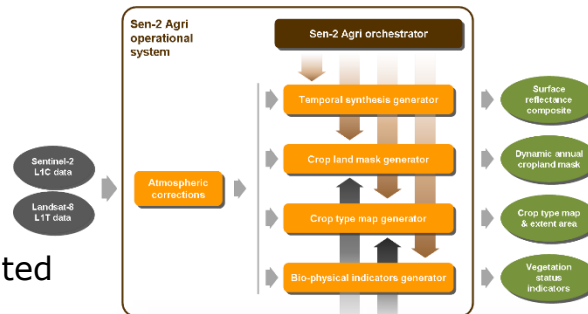
Phase 1- Users req.
and methods
development
2014

Phase 2 - System
development and
EO products
2015

Phase 3 –
Demonstration
& Validation
2016-2017



12 sites globally distributed



JECAM

Joint Experiment for Crop Assessment and Monitoring

- ✓ User Requirements
- ✓ Products specification
- ✓ Methods development

- ✓ 4 agriculture products
- ✓ Open source system

- ✓ Prototypes & validation
based on SPOT 4/5
Take 5 & Landsat-8

National use cases Local use cases



Capacity building Training activities

Fitness-to-use assessment

System qualification

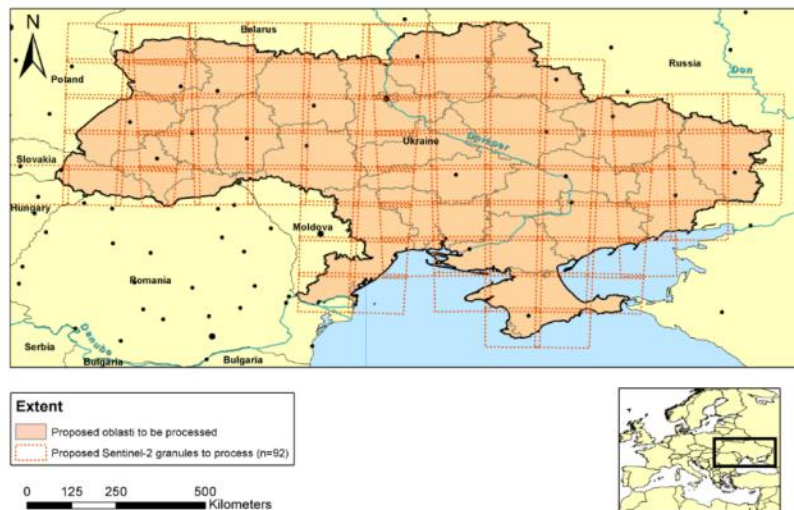
ESA Sentinel-2 for Agriculture (Sen2-Agri) project



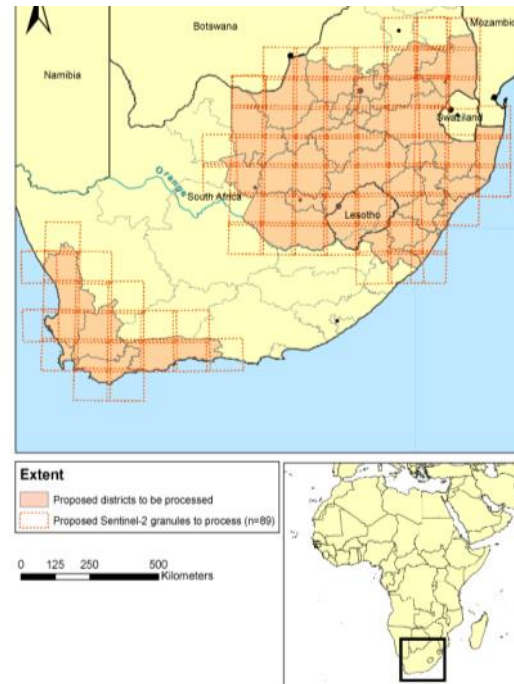
Phase 3: Sen2-Agri system demonstration 3 national sites

To demonstrate the Sen2-Agri system and Near Real Time (NRT) products using Sentinel-2a & Landsat 8 (but without Sentinel-2b) at **national scale** with in situ system implementation

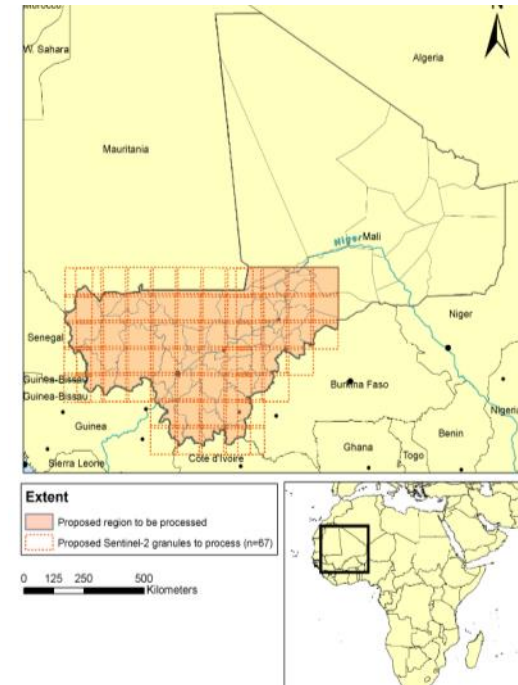
Ukraine (SRI)



South Africa (ARC)



Mali (ICRISAT & IER)

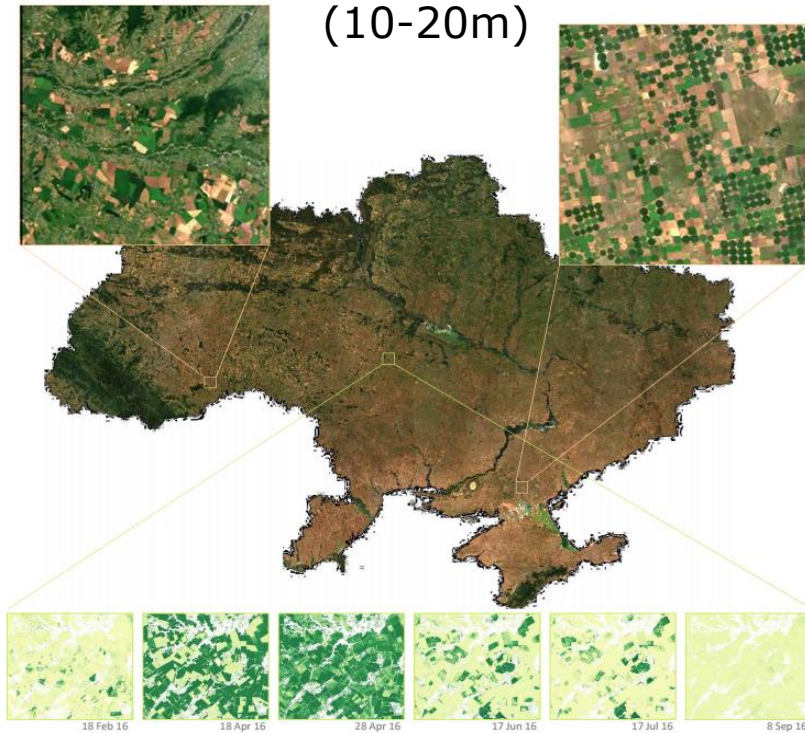


ESA Sentinel-2 for Agriculture (Sen2-Agri) project



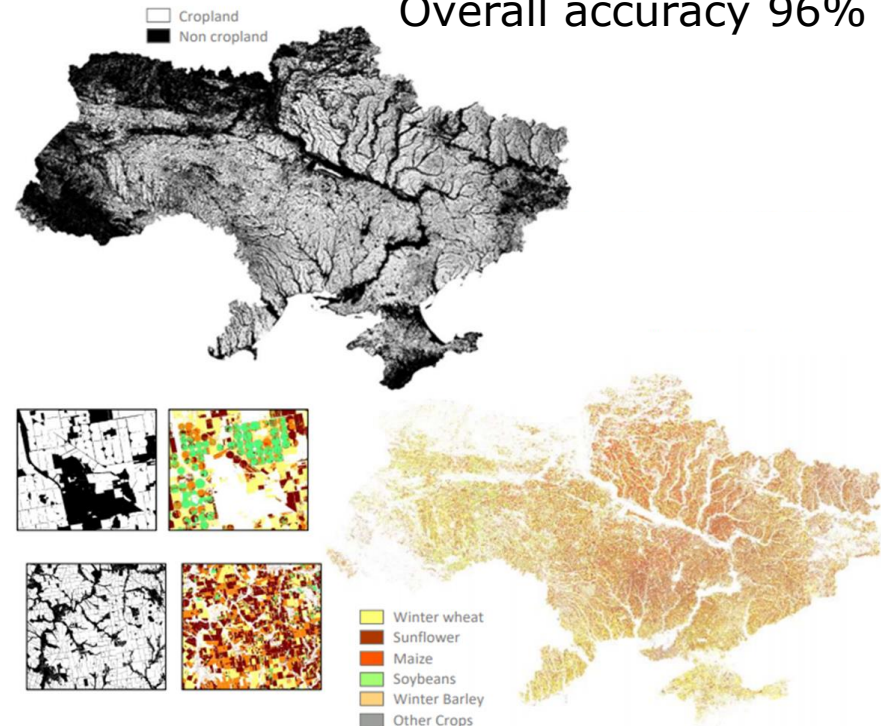
Phase 3: Sen2-Agri system demonstration at national site: Ukraine example

Monthly cloud-free composites
of surface reflectance
(10-20m)



Periodic vegetation status maps (NDVI, LAI) + Phenology Indices (start of growing season, length and date of the maximum growth rate)

Monthly dynamic cropland
mask (10m – July 2016).
Overall accuracy 96%



Cultivated crop type maps
(10m) delivered twice along
agricultural season

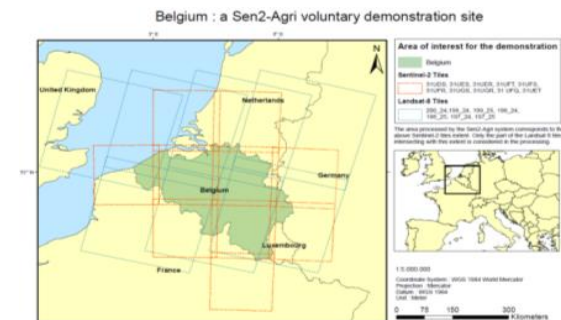
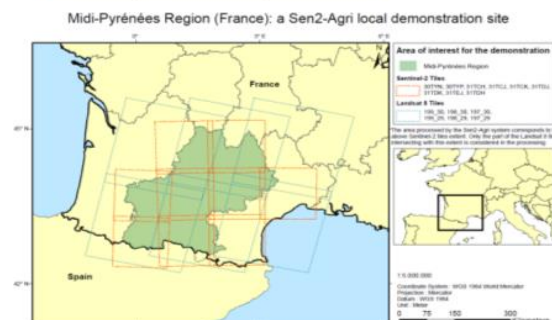
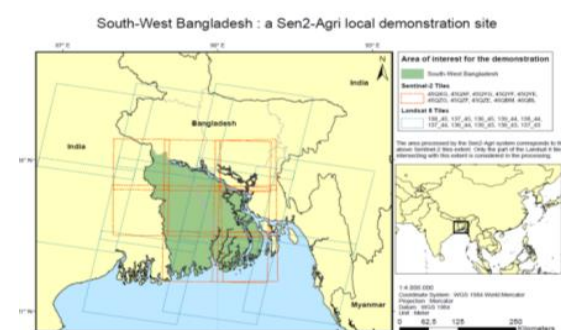
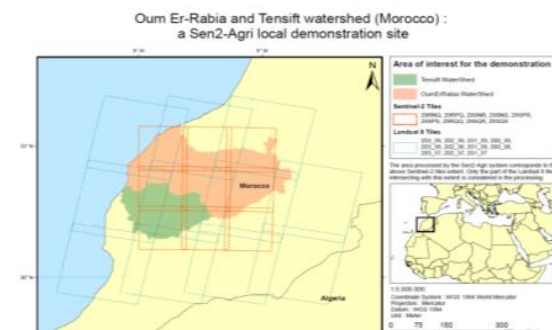
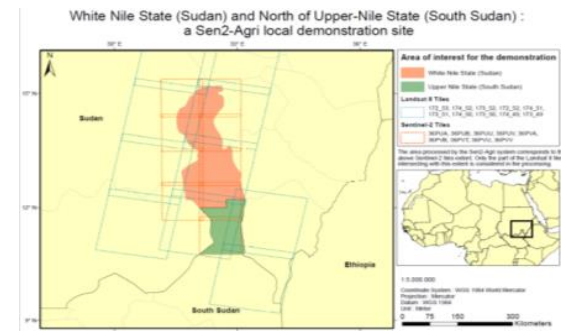
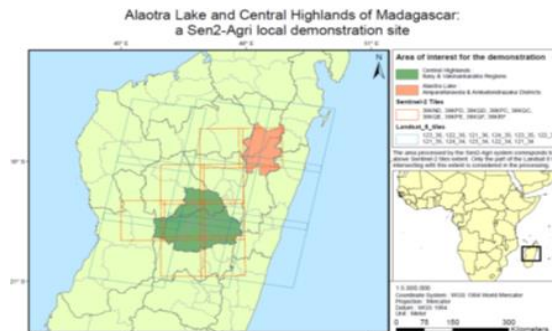
ESA Sentinel-2 for Agriculture (Sen2-Agri) project

Phase 3: Sen2-Agri system demonstration at local sites



To demonstrate NRT products using Sentinel-2 & Landsat 8 at **local scale** (~ 300 x 300 km)

Morocco
France
Madagascar
China
Sudan
Czech Republic
Bangladesh
Belgium
Mexico (TBC)



Sen2Agri: the CzechAgri demonstrator

ESA Sentinel-2 for Agriculture (Sen2-Agri) project

The CzechAgri demonstrator



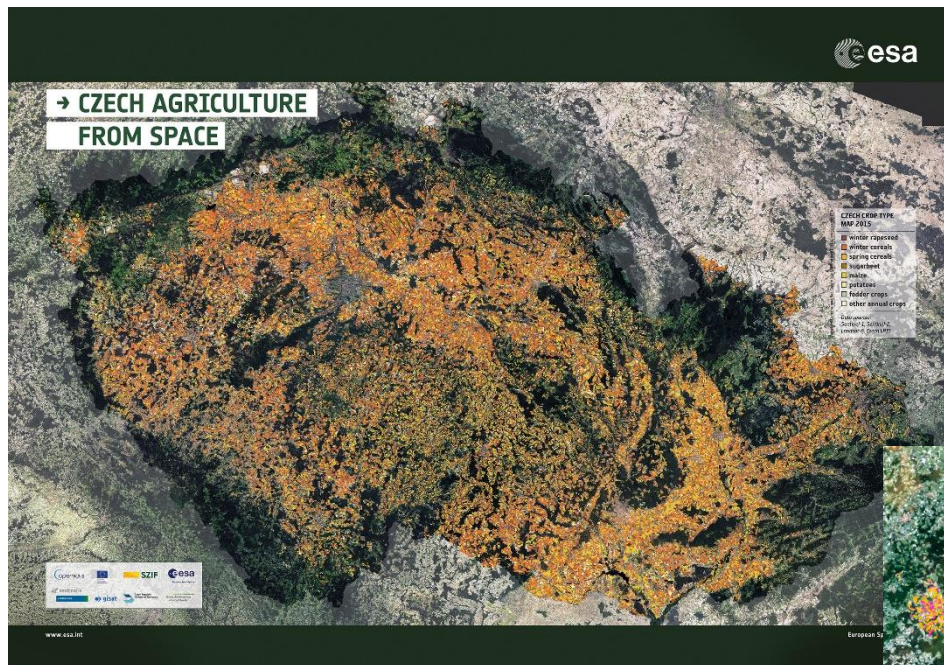
- Initiated in [December 2015](#) by DG JRC, DG- Agri, ESA and SZIF (Czech State Agricultural Intervention Fund - Czech Paying Agency)
- Aimed to demonstrate the unprecedented capabilities of the Copernicus Sentinels [by pilot agricultural crop mapping at national scale in 2015 and 2016](#)
- Focused on [supporting the administration](#) and controlling direct payments and compliance with the sustainable agriculture practices, as well as LPIS (Land Parcel Identification System) management and update processes.
- It used time series of radar [Sentinel-1](#) and optical [Sentinel-2](#) imagery (complemented by [Landsat 7&8](#) imagery), combined with [open public information](#) (Land Parcel Identification System data)

The outputs were [full country crop map products covering the 2015 and 2016](#) crop growing season. Training & validation based on IACS crop declaration data provided by SZIF (2015), and from field survey / on-the-spot-check data (2016)

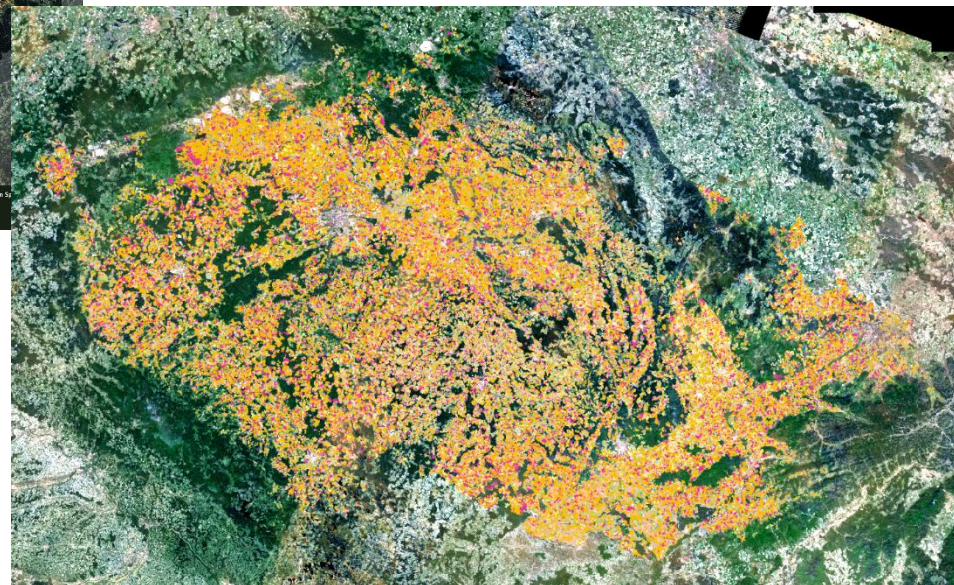
Product specifications:

- Spatial coverage: Full country to regional
- Spatial resolution: 20 meters / LPIS polygons
- Temporal extent: Whole crop growing season
- Temporal frequency: 2-4 crop type maps per crop growing season
- Geometric accuracy: RMS < 20m
- Thematic accuracy: Overall accuracy > 80%
- Individual crop accuracy > 60% (F1-score)
- Format: ArcInfo SHP
- Cartographic projection: Krovak / S-JTSK

Crop type map 2015



Crop type map 2016

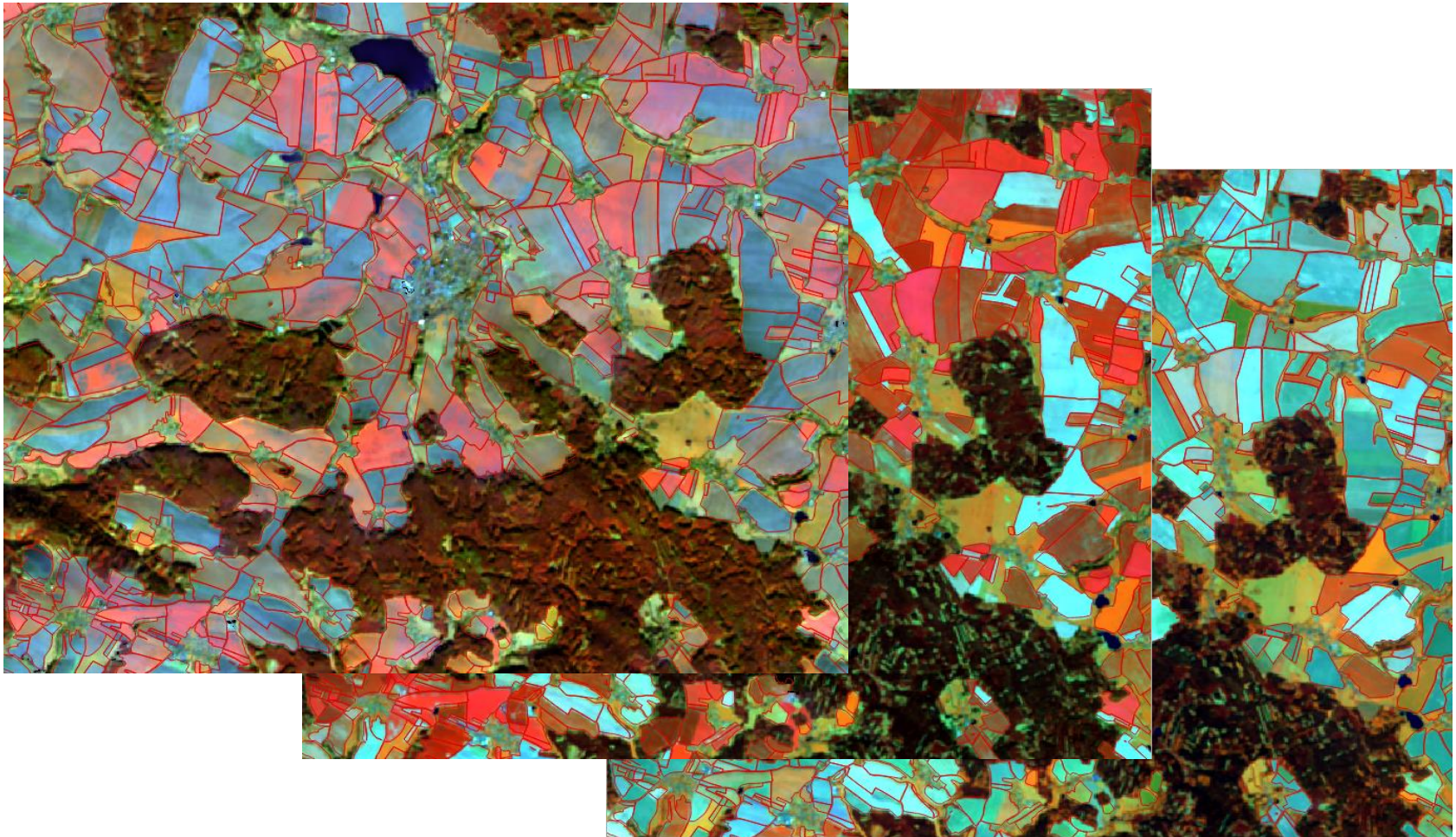


ESA Sentinel-2 for Agriculture (Sen2-Agri) project

The CzechAgri demonstrator

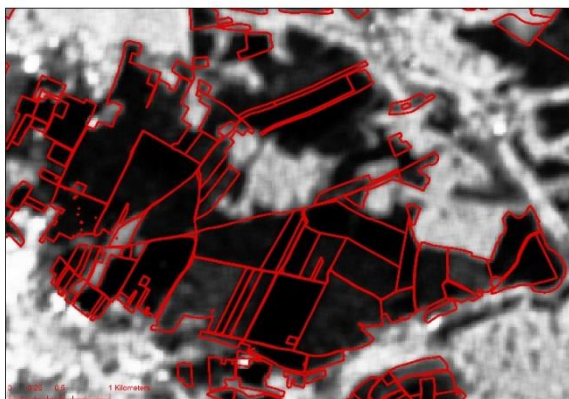


Sentinel-2 & Landsat-7/8 multi-temporal composites:
January – March 2016, April – June 2016, July – September 2016

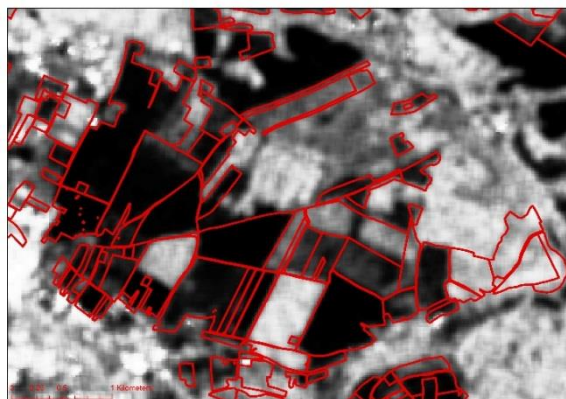


Sentinel-1 multi-temporal composites:

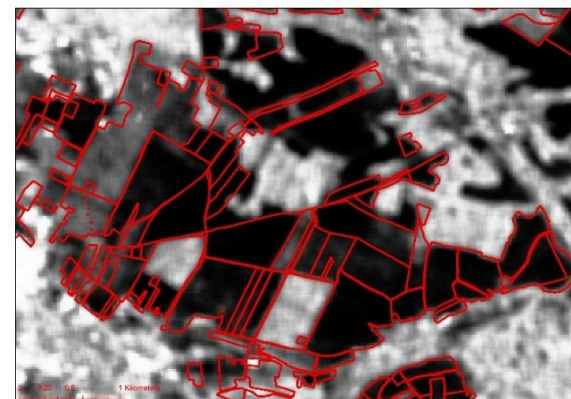
VH : April 2016



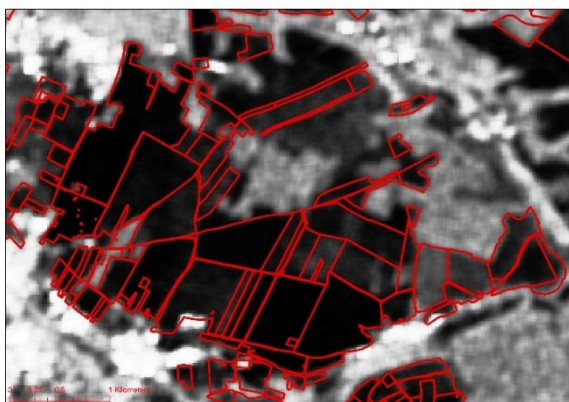
VH : July 2016



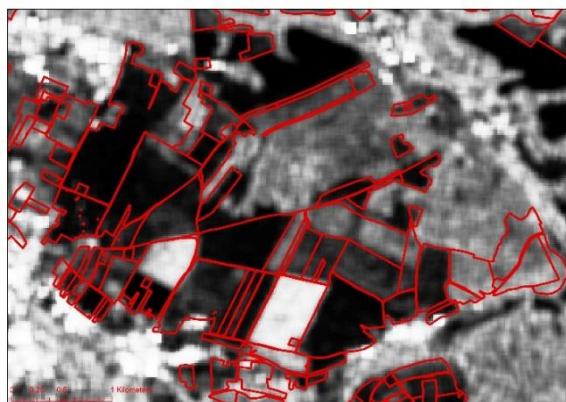
VH : September 2016



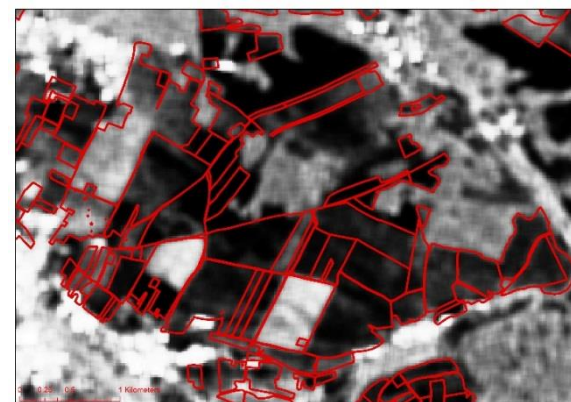
VV : April 2016



VV : July 2016



VV : September 2016

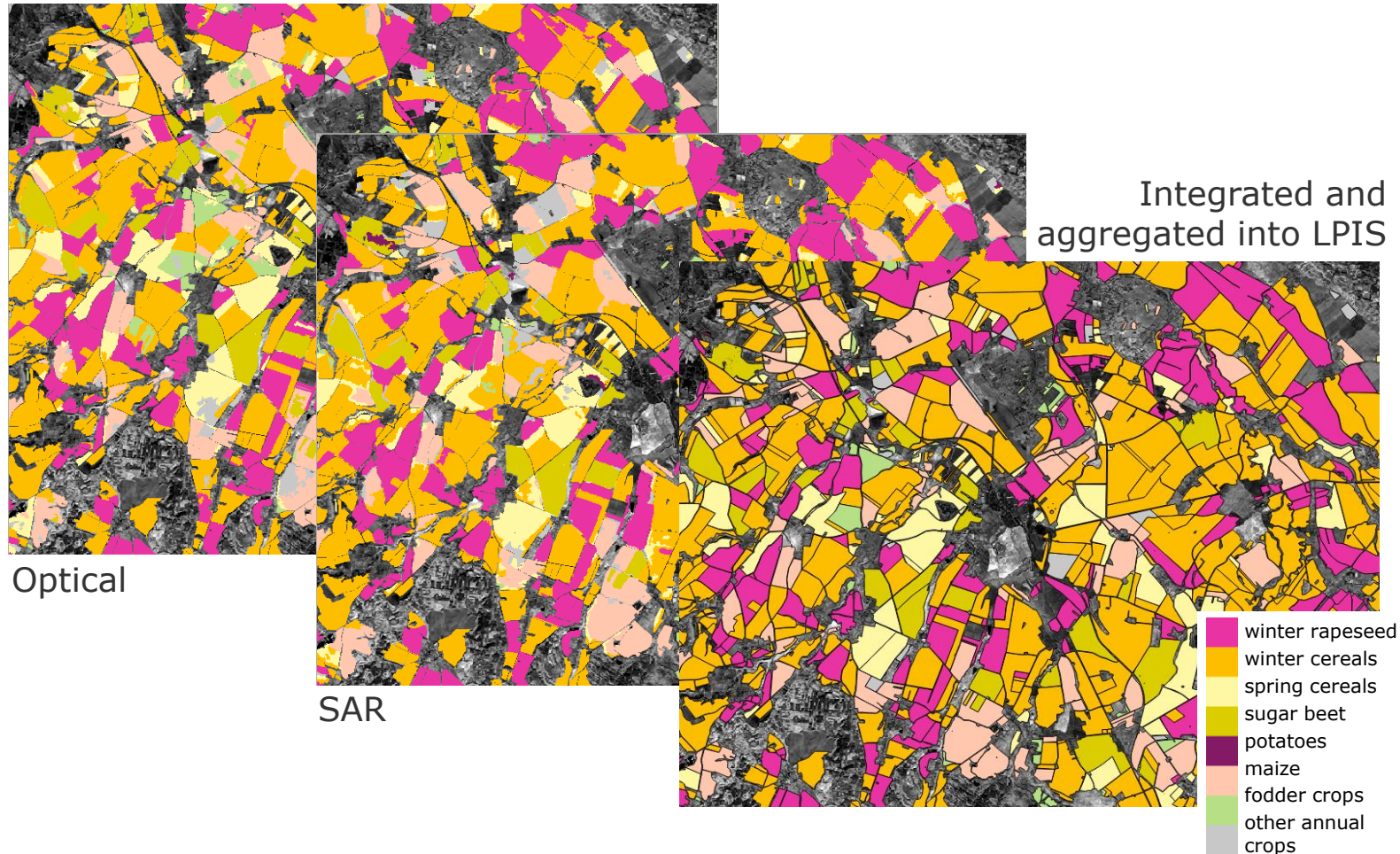


ESA Sentinel-2 for Agriculture (Sen2-Agri) project

The CzechAgri demonstrator



Crop Type Map 2015:



Classification and aggregation into LPIS polygons:

- Pixel- based and using a [Support Vector Machine \(SVM\)](#) classifier
- Uses an arable land mask (derived from Land Parcel Identification System – LPIS)
- Two independent classifications:
 - [Optical](#) - based on Landsat 7/8 and Sentinel-2 multi-temporal composites
 - [SAR](#) - based on Sentinel-1 monthly composites
- [Integration](#) - enhanced crop map to improve the maximum overall accuracy - using maximum posterior probability within the LPIS polygon
- [Aggregation](#) - crop with largest area within the LPIS polygon

- Combination of Sentinel-1&2 performs well for crop classification
- Sentinel-1 ensures timely information early and continuously during the crop growing season
- Early winter crop detection possible already in January - March period with high accuracy
- Local farming practices need to be analysed
- Full country crop classification may be largely automated
- Land Parcel Identification System needs to be available
- Huge amount of data to be processed (> 2TB for single crop growing season)
- Number of technical issues still to be developed
- Multiple crops on single LPIS parcel
- Continuous crop monitoring shall guarantee consistent results in time

Sentinels for Common Agriculture Policy – Sen4CAP



<http://esa-sen4cap.org/>

It is an European effort in preparation for the future developments of the European agriculture and rural development policies (more info at <http://cap2020.ieep.eu/about>)

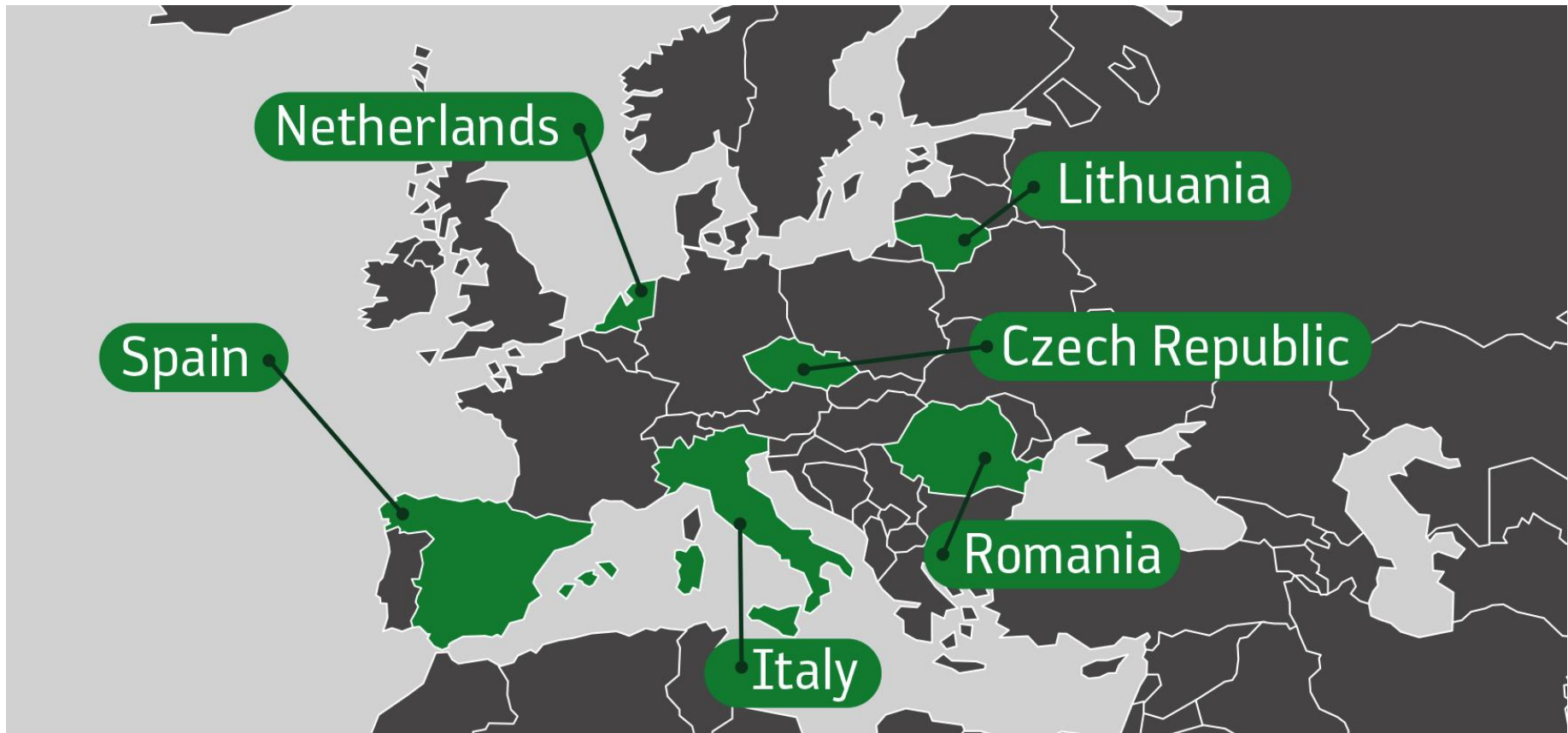
Objectives:

- 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

For the stage of User Requirements collection, there is an analysis of recommendations coming from the **CzechAgri pilot study**.

At the moment, there are **6 National Pilots** for data collection and pre-processing, using Sentinel-1, Sentinel-2 and Landsat-8 and ground truth data from Paying Agencies

The main criteria for the selection of pilot countries was having **heterogeneous agricultural practices** (e.g. field sizes, crops), **landscape** and **climate** present within the EU.

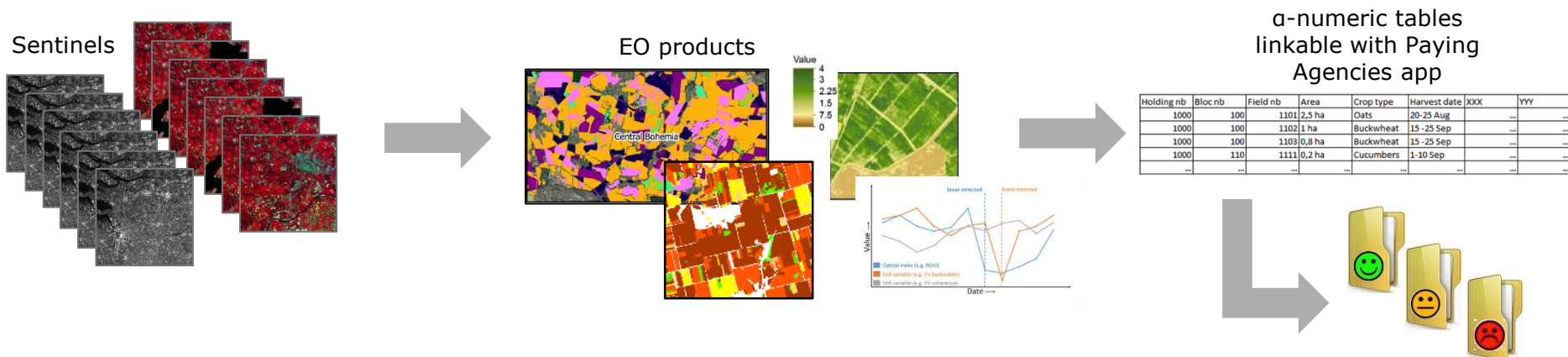


The products that are being developed will build on an **integrated use of Sentinel-1 and Sentinel-2**, as well as complementary sensors (e.g. **Landsat-8**). They will be delivered in WGS84 & in national projections:

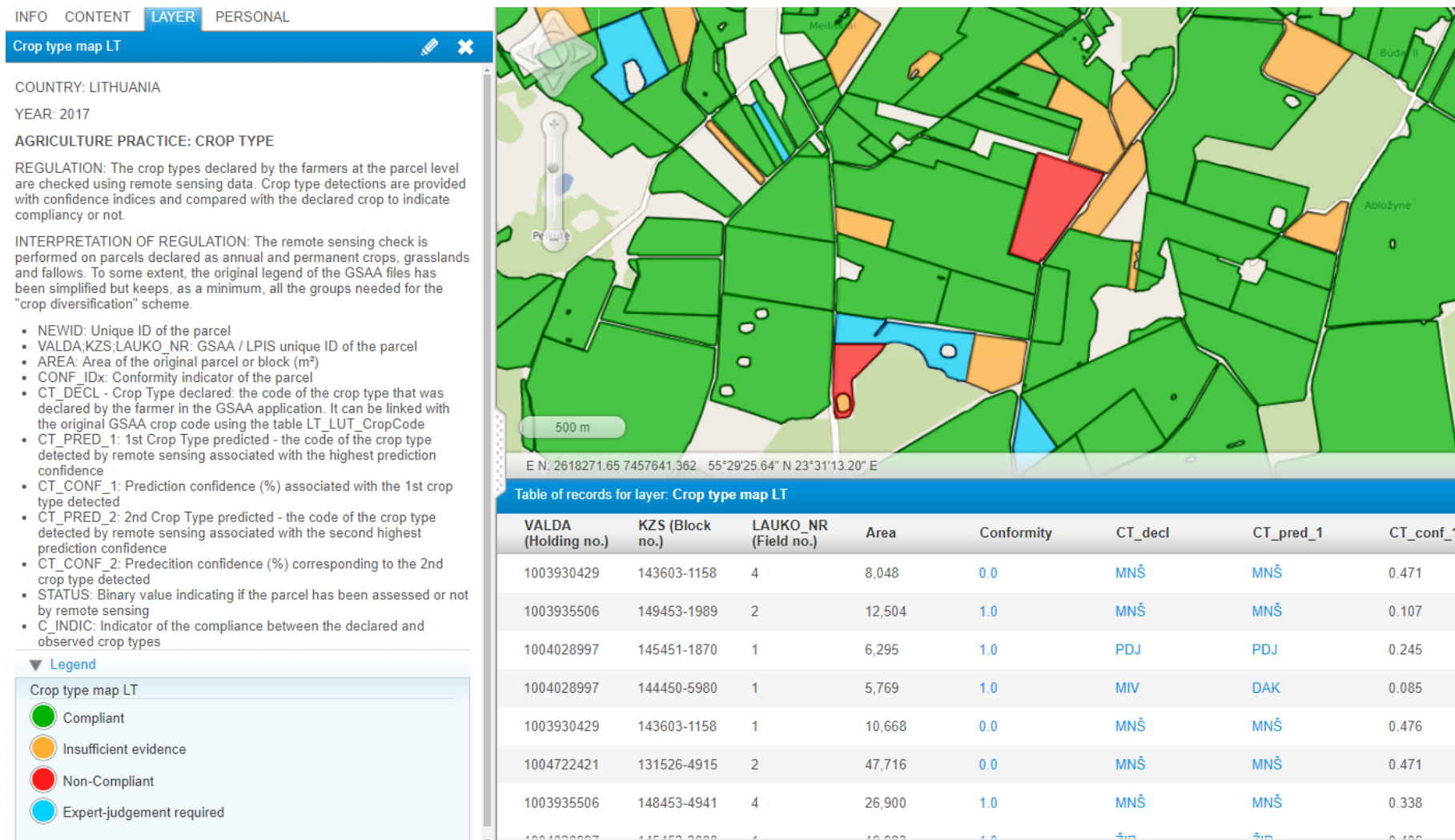
- Cultivated **crop type** map
- **Grassland mowing** product
- **Vegetation status** indicator
- **Agricultural practices** monitoring
- **Interactive visualization services** for satellite imagery and use-case products.

Their performance will be **validated against in-situ data** about agricultural crops, grasslands and agricultural practices.

Various datasets of in-situ data from 2016 and 2017 have been made available for the project.



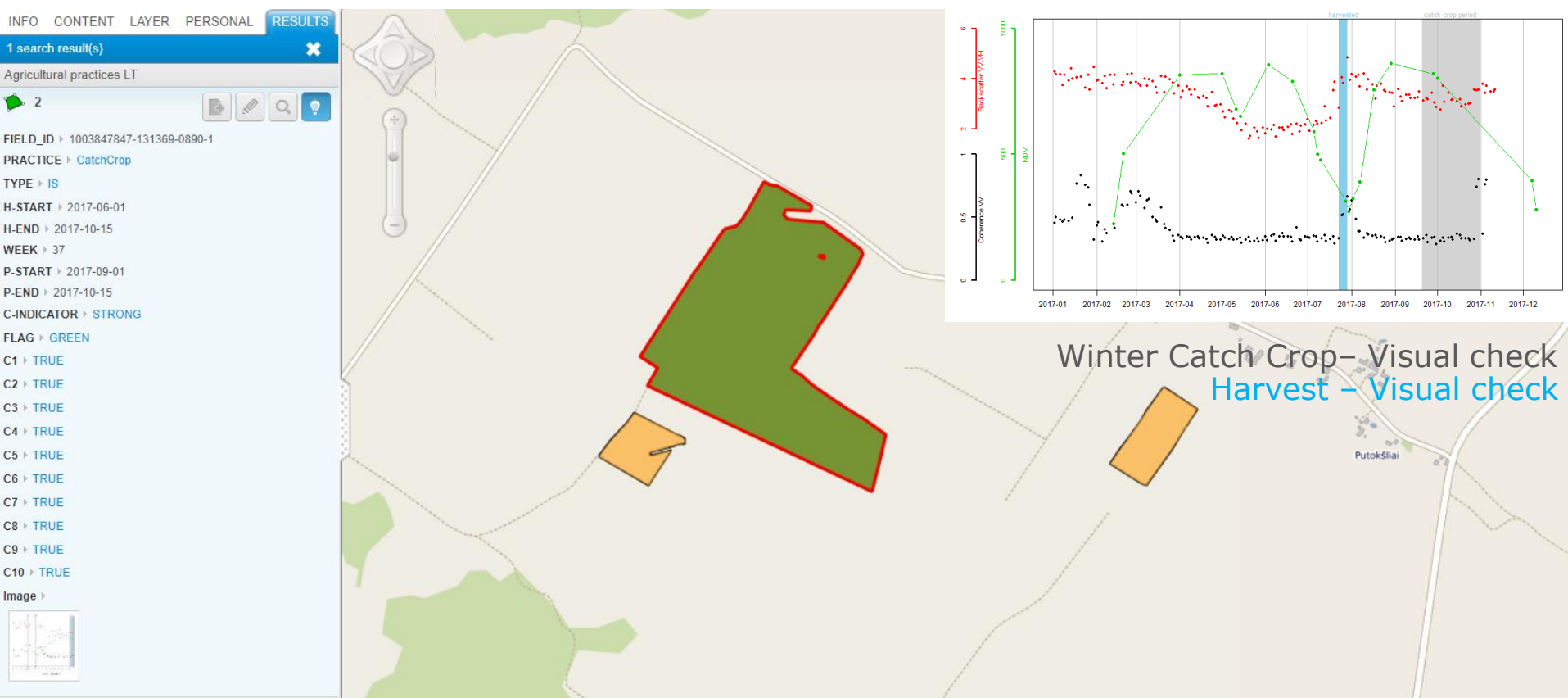
Example: Crop type map over Lithuania



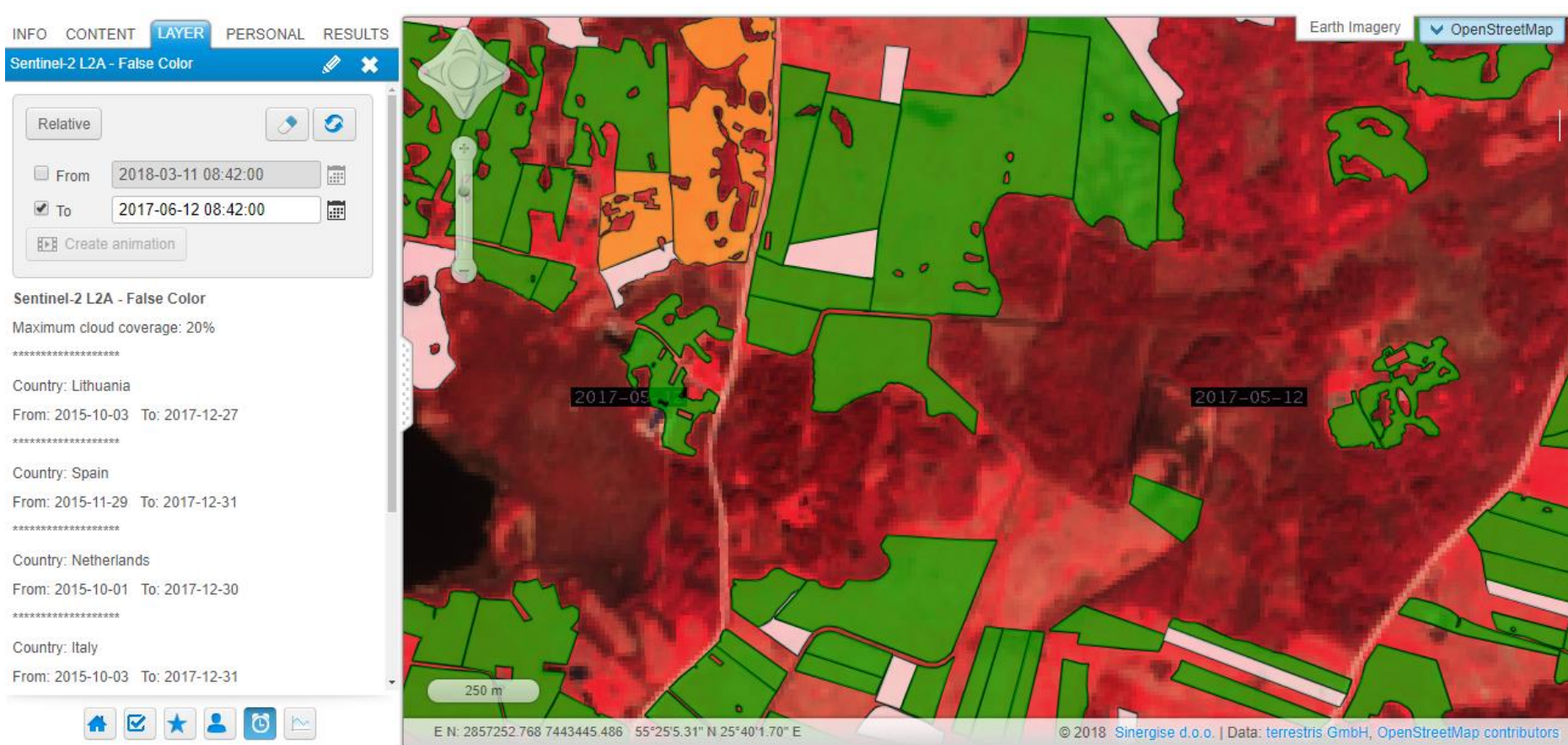
Agricultural practices monitoring: CatchCrop Practice

View attributes of the parcel related to the selected layer

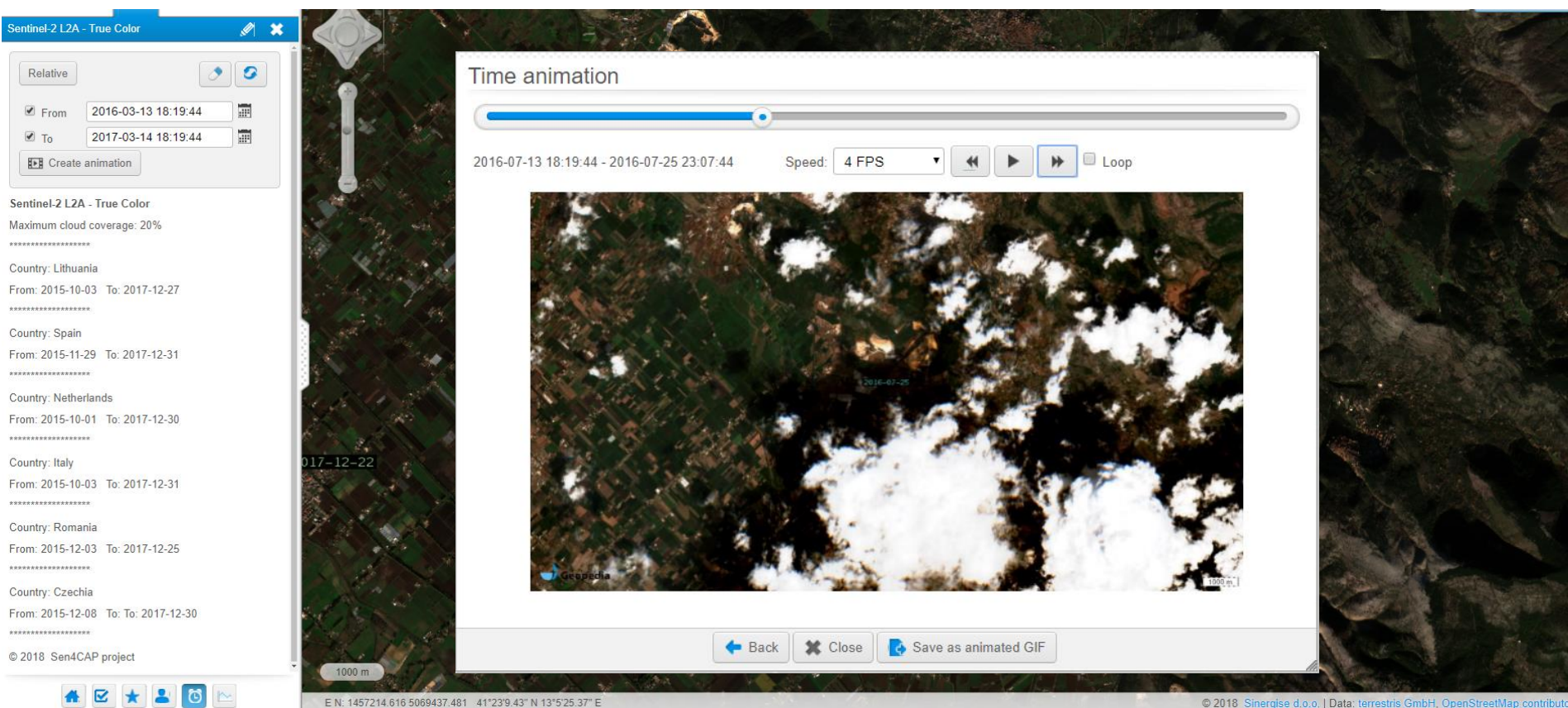
Timeseries from Sentinel-1 (Coherence & Backscatter) and NDVI



Visualize S2 and L8 data on chosen time for timely decisions

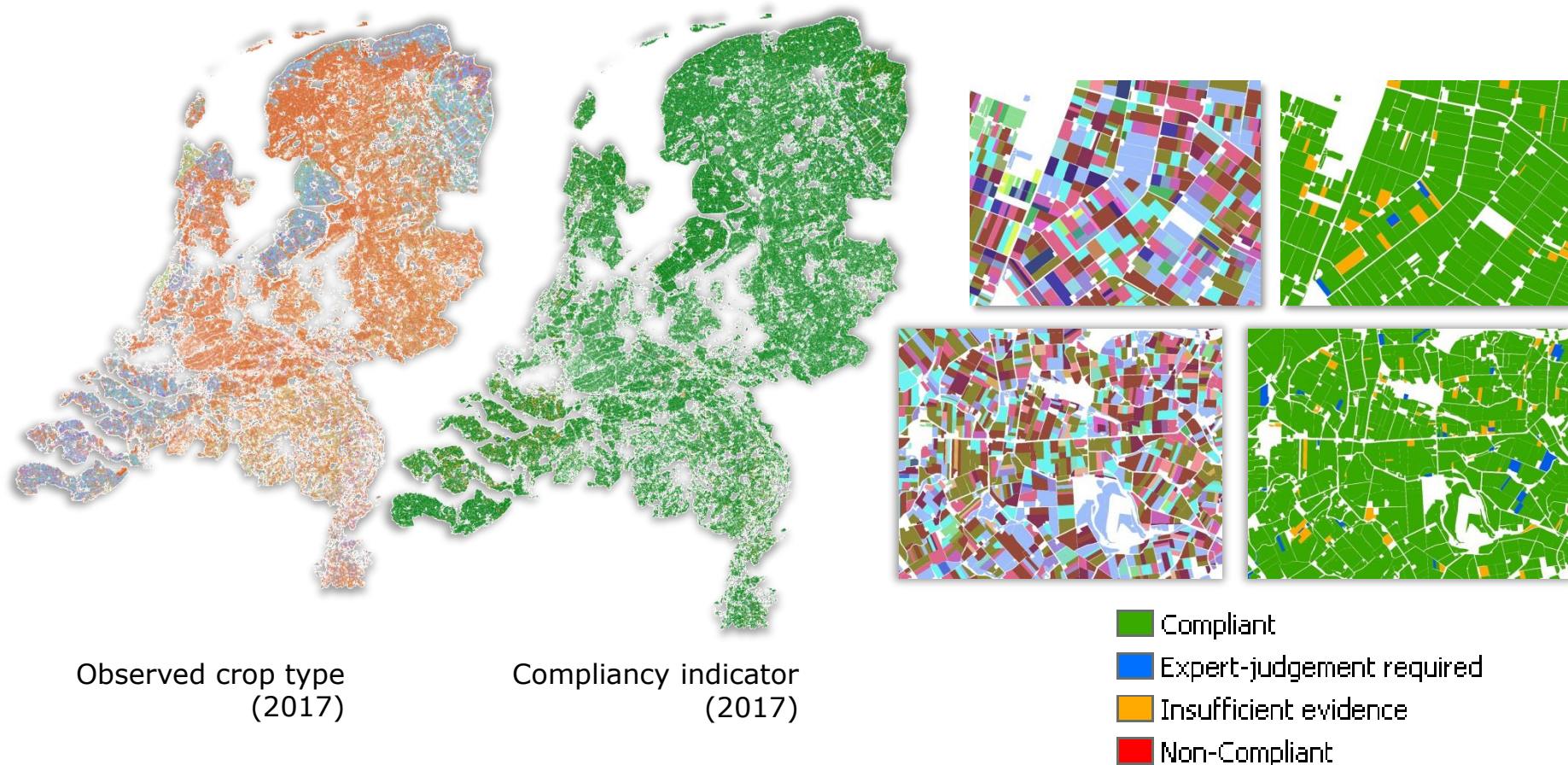


Time animation following crop dynamics



The screenshot displays the Sen4CAP Visualisation tool interface. On the left, a sidebar titled "Sentinel-2 L2A - True Color" contains a "Relative" tab, date selection fields (From: 2016-03-13 18:19:44, To: 2017-03-14 18:19:44), and a "Create animation" button. Below this, a list of countries and their corresponding date ranges is shown: Lithuania (2015-10-03 to 2017-12-27), Spain (2015-11-29 to 2017-12-31), Netherlands (2015-10-01 to 2017-12-30), Italy (2015-10-03 to 2017-12-31), Romania (2015-12-03 to 2017-12-25), and Czechia (2015-12-08 to 2017-12-30). The main area features a "Time animation" window with a progress bar, a date range (2016-07-13 18:19:44 to 2016-07-25 23:07:44), a speed setting of 4 FPS, and playback controls. A video player shows a time-lapse of a landscape with a date stamp "2016-07-25". At the bottom, there are buttons for "Back", "Close", and "Save as animated GIF". The background is a satellite map of a rural area with a scale bar indicating 1000 m. The bottom status bar shows coordinates (E N: 1457214.616 5069437.481 41°23'9.43" N 13°5'25.37" E) and copyright information (© 2018 Sinergise d.o.o. | Data: terrestris GmbH, OpenStreetMap contributors).

Crop type mapping for crop diversification monitoring - Netherlands



Sentinels benefits for CAP monitoring demonstrated with **prototype** products

- For **Integrated Administration Control Systems (IACS) use cases**: crop diversification, permanent grassland and Ecological Focus Areas (EFAs)
- **Under specific assumptions** in terms of parcels size, parcels geometry, etc.
- Several ways identified to **increase relevance** of Sentinels markers:
 - Algorithms improvement
 - Interactions with Paying Agencies to better understand national cropping systems and regulations, and go to the holding-level

Demonstration that Sentinel-based markers can be useful for CAP monitoring

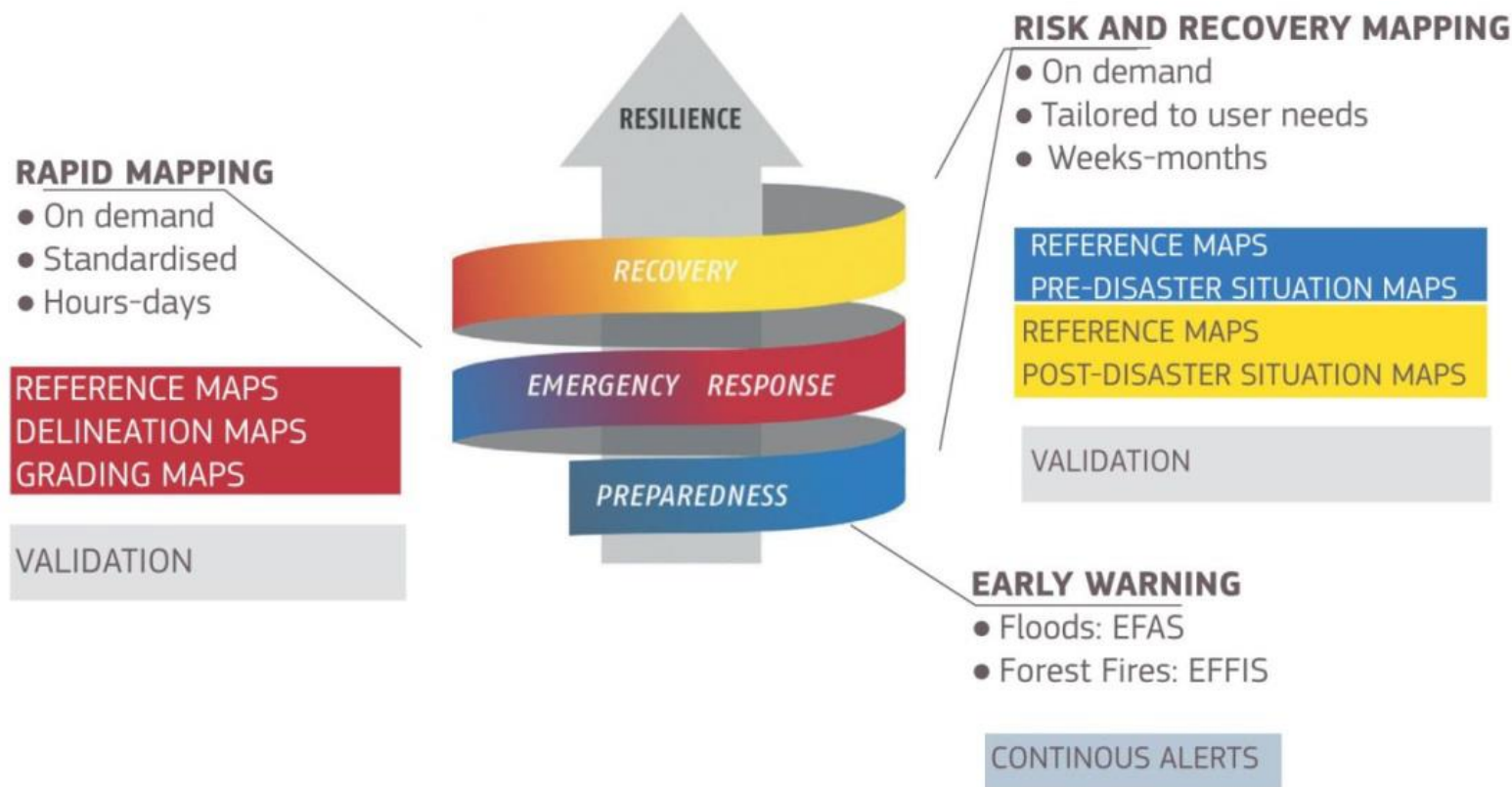
- Using S1 and S2 data (**cloud computing**)
- Over 6 countries with **diverse cropping systems, Land Parcel Identification System, landscape, etc.**
- **Wall-to-wall coverage**, from test sites up to national scale

Copernicus Emergency Management Service: Experience on S-1 Data Use over land

Copernicus EMS - overview

<http://emergency.copernicus.eu/mapping>

- Operational since 2012, to address natural & man-made disasters globally.
- Most data are from Copernicus Contributing Missions
- Validation is activated by JRC, to verify outputs produced and guide service improvement



Copernicus EMS: the Rapid Mapping & Risk and Recovery Mapping modules

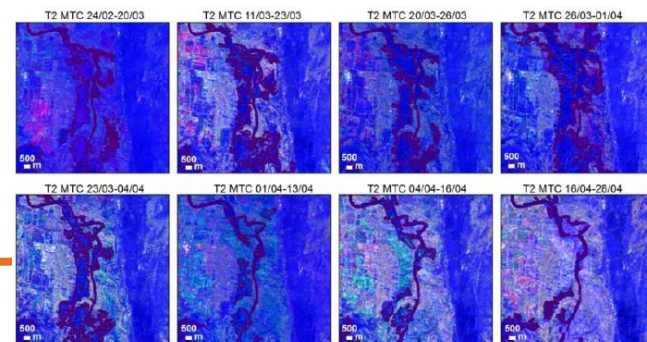
Rapid Mapping (RM)

- 24/7/365
- Highly standardised workflow & products
- Rapid tasking & delivery of satellite images
- Delivery in hours/days

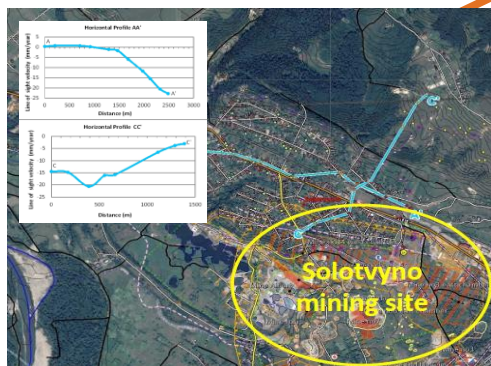
Risk and Recovery Mapping (RRM)

- Not-24/7/365
- Supporting situations which do not require immediate action
- Tailored to user needs (case specific)
- Delivery in weeks/months

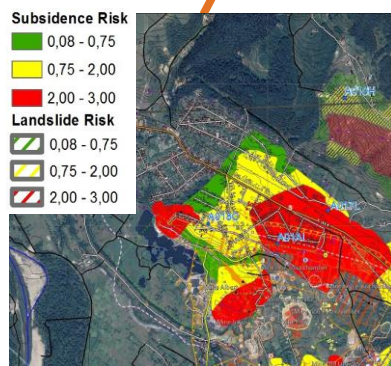
e.g. Floods



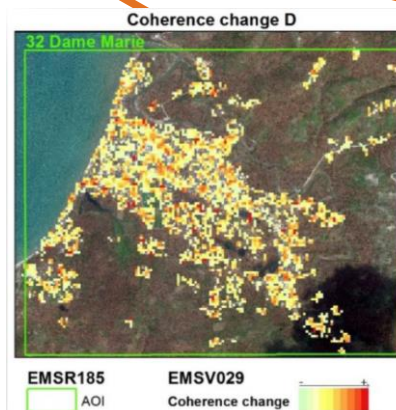
Validation of Rapid Mapping of floods



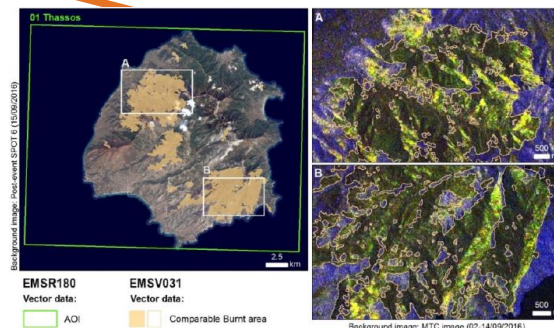
Dynamics of ground deformation



Derived sinkhole and landslide risk for assets



Validation of Rapid Mapping of Cyclone building damage



Validation of Rapid Mapping of fires

2nd Mapping Urban Areas from Space Conference 30-31 October 2018 [ESA-ESRIN]

Background

In the frame of the EO Science for Society Programme Element, the European Space Agency is organising the 2nd Mapping Urban Areas from Space 2018 Conference.

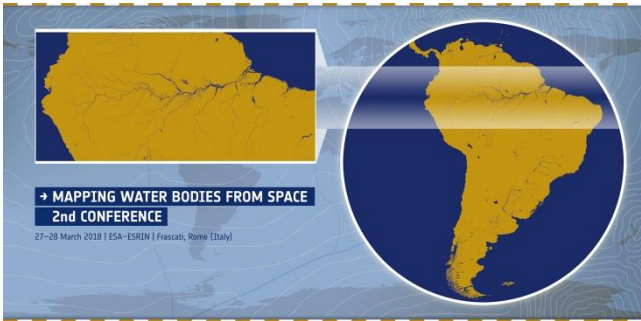
The purpose of this conference is to provide scientists and data users with the opportunity to present first-hand and up-to-date results from their on-going research and application development activities by using data from past and current Satellites.

Participation

- ✓ ESA Principal Investigators
- ✓ Co-investigators
- ✓ Sentinels users
- ✓ Scientists
- ✓ Students
- ✓ Representatives from national, European and international space agencies, research labs and value adding industries

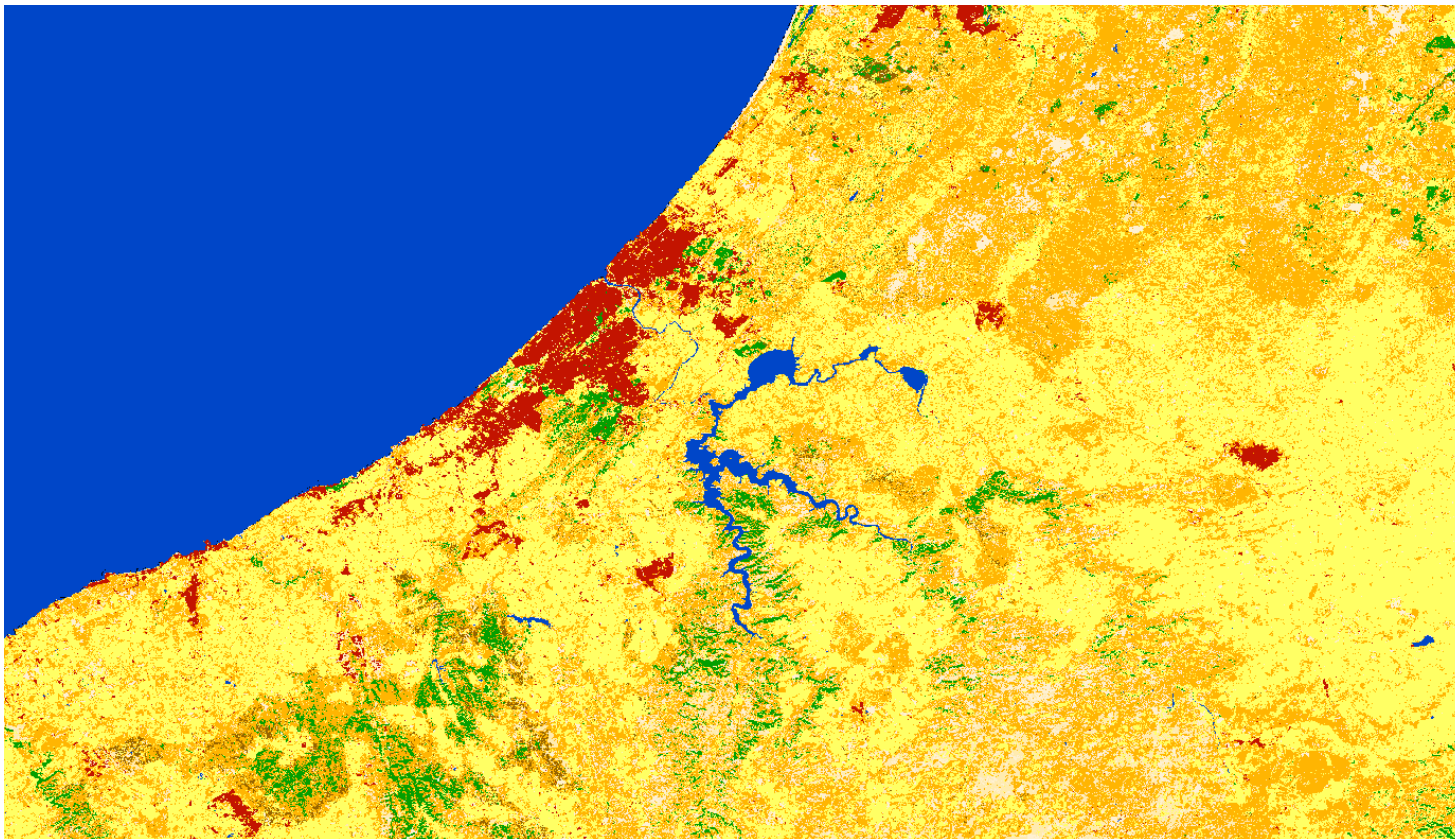


2nd Mapping Water Bodies from Space Conference 27-28 March 2018 [ESA-ESRIN]



WorldCover 2019 Conference February 2019 [ESA-ESRIN]





Thank you!

Questions?