

WHEN SPACE MEETS AGRICULTURE

14-15 November 2016 | Matera, Italy

Join the conversation
#WSMA16

USE OF COPERNICUS SENTINELS FOR AGRICULTURAL MONITORING

Simon Jutz, Head of Copernicus Space Office, ESA

Copernicus Sentinel Data (2016)



REGIONE BASILICATA



in collaboration with



and the support of



The Copernicus Programme

- Copernicus provides the necessary data for operational monitoring of the environment and for civil security:
 - In-situ Component
 - Space component
 - Service component
- Copernicus is led by the **European Union**; ESA coordinates the Space Component



Sent-1A/B



Sentinel-2A/B



Sentinel-3A/B



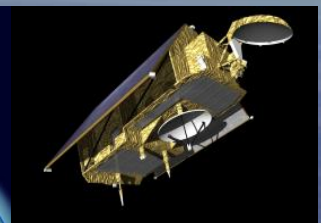
Sentinel-4A/B



Sentinel-5/5P



Sentinel-6A/B



- Long term Commitment
- Free and open data policy



Copernicus dedicated missions: Sentinels



Sentinel 1 (A/B/C/D) – SAR imaging

All weather, day/night applications, interferometry



Sentinel 2 (A/B/C/D) – Multispectral imaging

Land applications: urban, forest, agriculture,..
Continuity of Landsat, SPOT



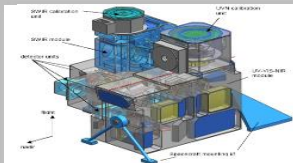
Sentinel 3 (A/B/C/D) – Ocean and global land monitoring

Wide-swath ocean colour, vegetation, sea/land
surface temperature, altimetry



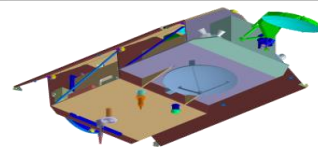
Sentinel 4 – Geostationary atmospheric

Atmospheric composition monitoring, trans-
boundary pollution; instrument embarked on MTG-S satellites



Sentinel 5 (A/B/C) and Precursor – Low-orbit atmospheric

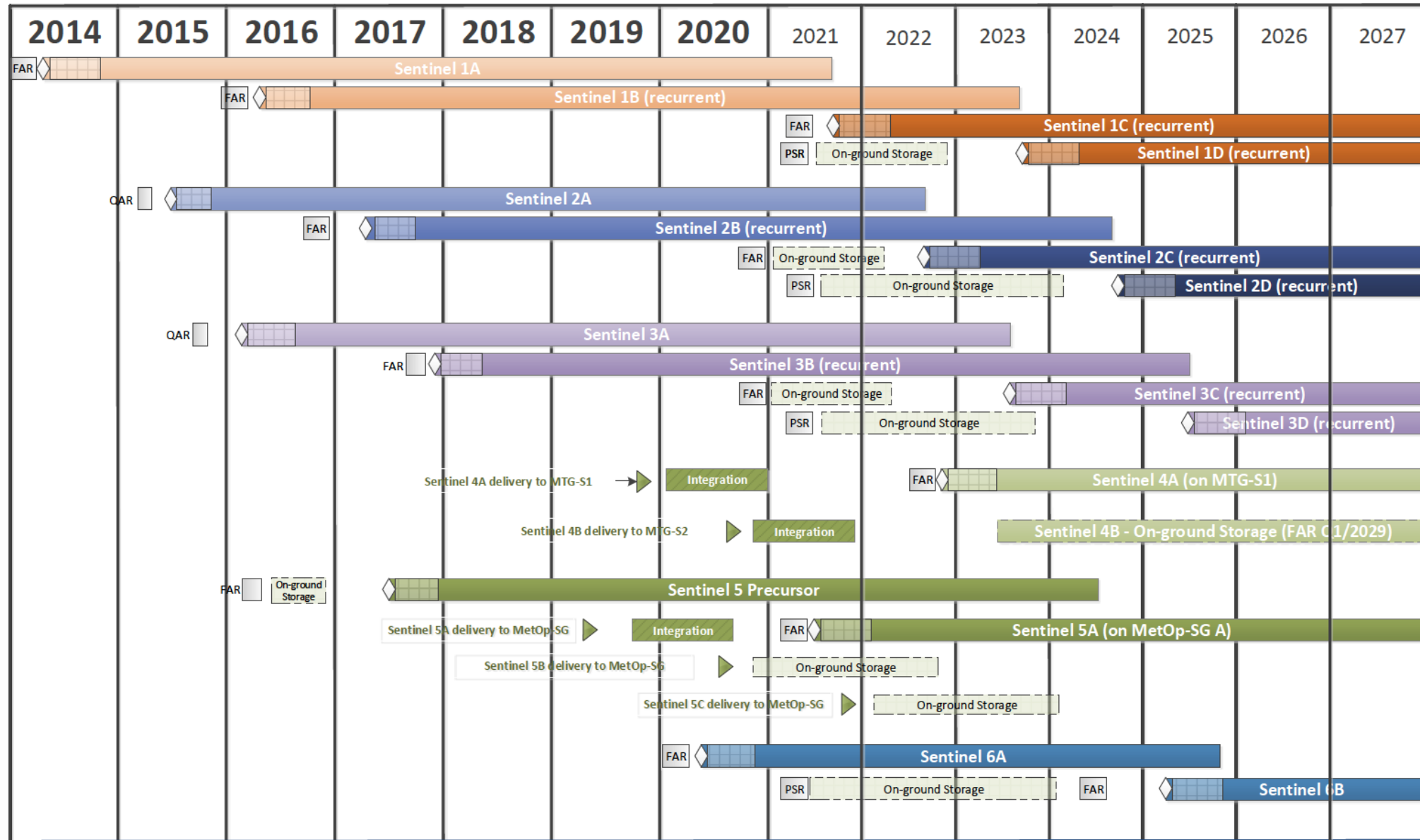
Atmospheric composition monitoring; instrument embarked on
MetOp-SG A satellites.



Sentinel 6 - Jason CS (A/B)

Altimetry reference mission

Copernicus Constellation Deployment Schedule



Legend:
 Qualification Acceptance Review (QAR)
 Flight Acceptance Review (FAR) or PreStorage Review (PSR)
 On-ground Storage
 Tentative launch date
 In-orbit Commissioning

Status: 8 November 2016

Sentinels Data Access Current Configuration

Scientific Data Hub

Self Registration



51,033 Users



No Rolling Policy Applied



Sentinel-1 NTC
Sentinel-2 L1C

03-Oct-2014



16-Nov-2015



Max 2 Concurrent Downloads

Collaborative Data Hub



13 Collaborative Users
5 Data Hub Relay Users



Node 1: 30 days
Node 2: 9 days



Sentinel-1 NRT & NTC
Sentinel-2 L1C



Node 1: Max 10 downloads

Node 2: No specific threshold

International Access Hub



4 Users



30 Days



Sentinel-1 NTC
Sentinel-2 L1C



No specific threshold

Copernicus Services Data Hub

copernicus
space component data access



153 Users



No Rolling Policy Applied



Sentinel-1 NRT & NTC
Sentinel-2 L1C

01-Dec-2015

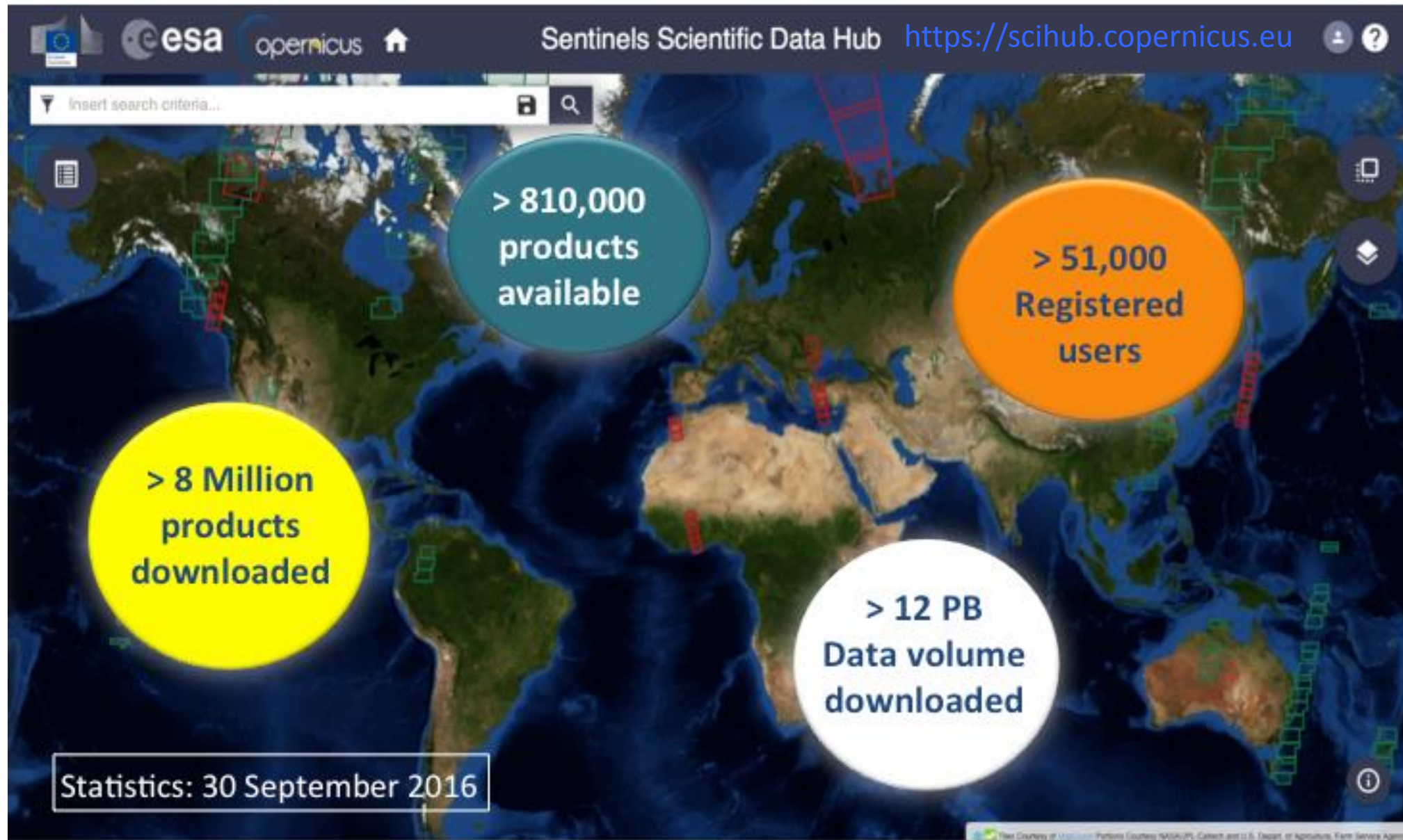


Max 10 concurrent downloads



Statistics: 30 September 2016

Sentinels Data Access Statistics – Open Hub



An aerial photograph showing a dense patchwork of agricultural fields in various shades of green, brown, and tan, with some circular patterns visible, likely from irrigation or crop rotation.

Copernicus Data Policy

Sentinel Data Policy = **FULL, FREE, OPEN** access

- **ESA Sentinel Data Policy** (Sep 2013) and **EU Delegated Act** on Copernicus Data and Information Policy (Dec 2013)
- Main principles of Sentinel data policy:
 - **Open** access to Sentinel data by anybody and for any use
 - **Free** of charge data licenses
 - Restrictions possible due to technical limitations or for security reasons

Sentinels – for Agriculture

Long-term Continuity & Access to Earth Observation data



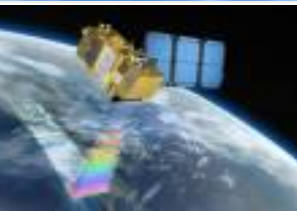
(*)



Sentinel 1 – SAR imaging

All weather, day/night application e.g. **crop type**, floods, water bodies

2014 & 2016



Sentinel 2 – Multi-spectral imaging

Land applications: urban, forest, **crop status & type**

Continuity of Landsat, SPOT

2015 & 2017



Sentinel 3 – Ocean & global land monitoring

Wide swath ocean color, **global vegetation**, **evapotranspiration**, land/sea surface temperature, altimetry

2016 & 2017



OPERATIONAL

* Joint EU/ESA Data Policy Principles adopted by ESA member states in Sep '09, EU announced in Nov. 2013

Sentinels watching over Agriculture



0 days 00 hours 00 minutes
Sentinel-2 constellation:
summer solstice



Sentinels and Agriculture: GEOGLAM

Primary missions for all Targets Products

Req#	Spatial Resolution	Spectral Range	Effective observ. frequency (cloud free)*	Sample Type	Field Size	Target Products						
						Crop Mask	Crop Type Area and Growing Calendar	Crop Condition Indicators	Crop Yield	Crop Biophysical Variables	Environ. Variables	Ag Practices / Cropping Systems
Coarse Resolution Sampling (>100m)												
1	500 - 2000 m	thermal IR + optical	Daily	Wall-to-Wall	All			X		Sentinel-3		
2	100-500 m	optical + SWIR	2 to 5 per week	Cropland Extent	All	X	X	X	L	L		L
3	5-50 km	microwave	Daily	Cropland Extent	All			X	X SMOS		X	
Moderate Resolution Sampling (10 to 100m)												
4	10-70m	optical + SWIR + TIR	Monthly (min 2 out of season + 3 in season). Required every 1-3 years.	Cropland Extent	All	X	L/M	Sentinel-2			X	
5	10-70m	optical + SWIR + TIR	Weekly (min. 1 per 16 days)	Sample	All	X	X	X	Sentinel-2		X	X
6	10-100m	SAR	Weekly (min. 1 per 2 weeks)	Cropland Extent of persistent cloudy areas/Rice	All	X	X	X	Sentinel-1		X	X

Sentinel-1 & -2 crop type mapping

National crop mapping at field scale



→ CZECH AGRICULTURE FROM SPACE



CZECH CROP TYPE MAP 2015

- winter rapeseed
- winter cereals
- spring cereals
- sugarbeet
- maize
- potatoes
- fodder crops
- other annual crops

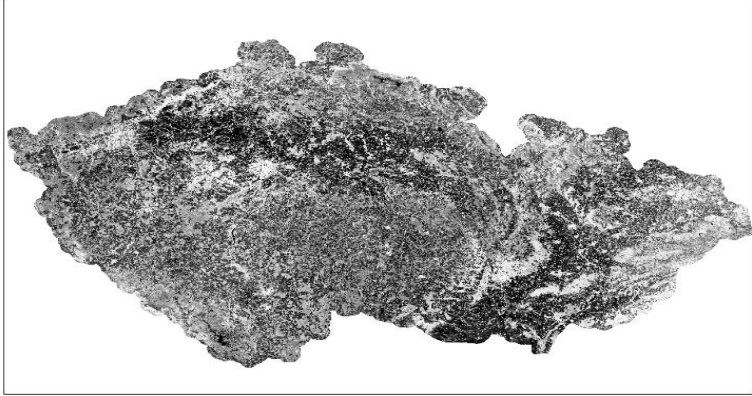
Data sources: Sentinel-1, Sentinel-2, Landsat-8, Czech LPIS

Opernicus | European Union | SZIF | ESA
sentinel-2 | gisat | Czech Republic Ministry of Transport | Ministry of the Environment of the Czech Republic
Funded by the 4th Earth Observation Envelope Programme (EDEPA) of ESA

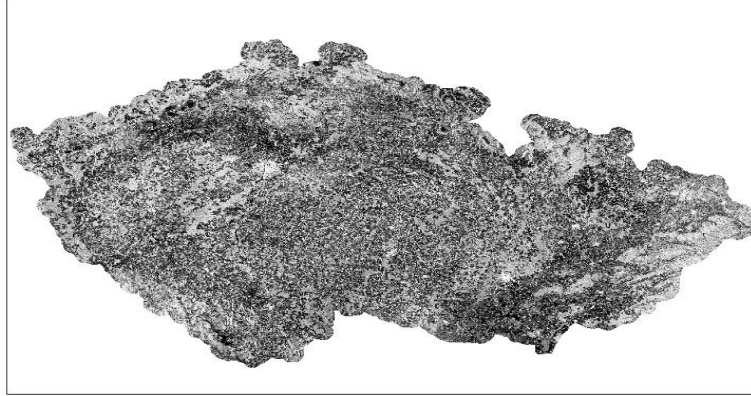


Sentinel-1 Multi-temporal composites (800 GB)

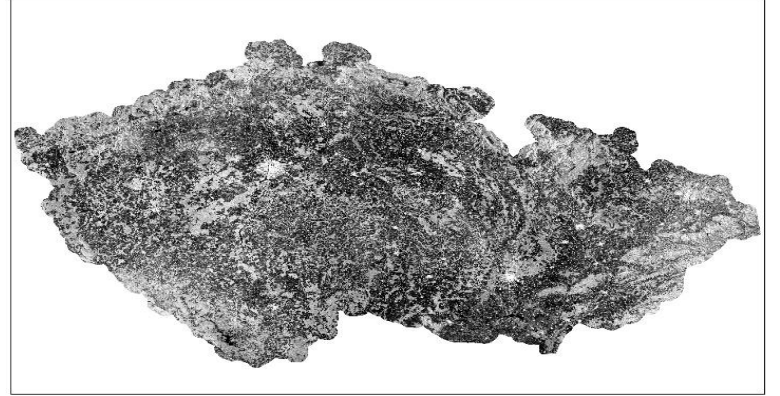
VH : April 2016



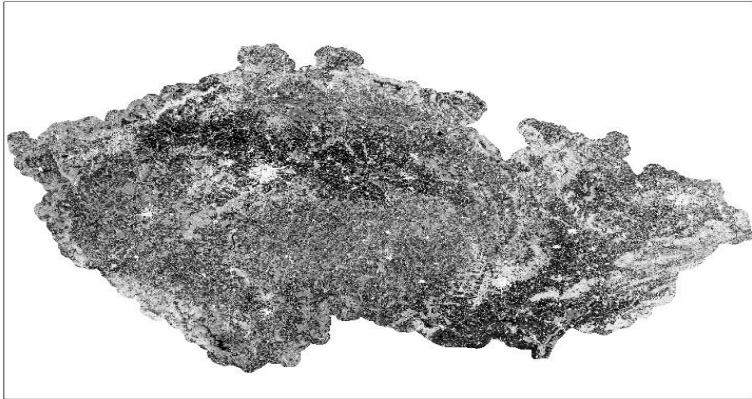
VH : July 2016



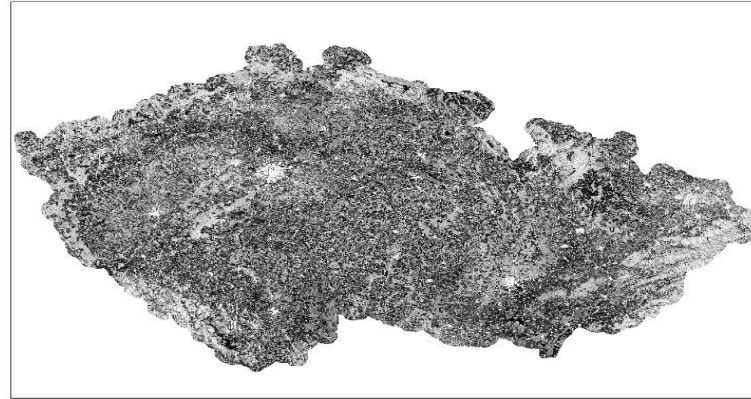
VH : September 2016



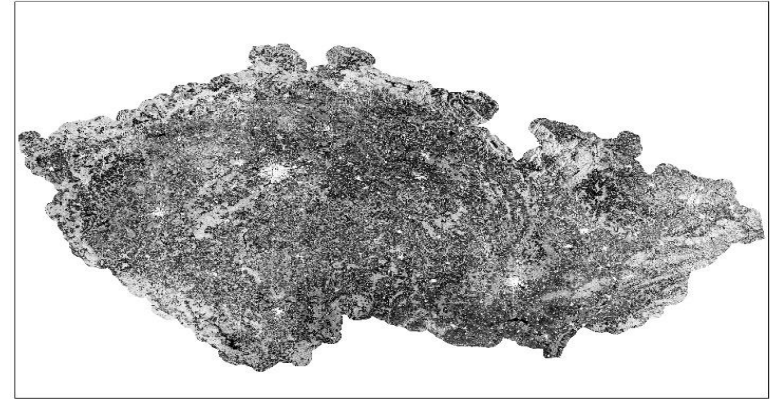
VV : April 2016



VV : July 2016

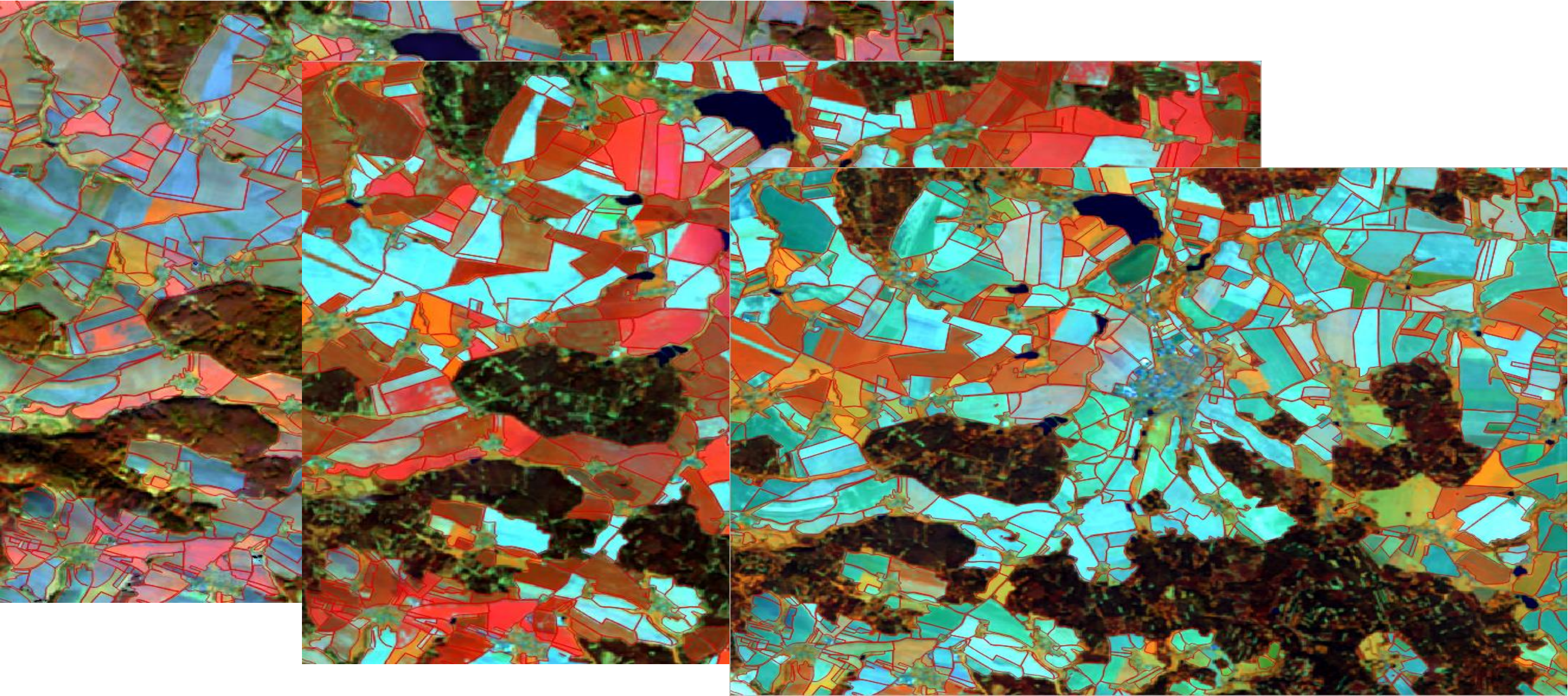


VV : September 2016



Sentinel-2 & Landsat-7/8 Multi-temporal composites (1.65 TB)

Jan16-Mar16, Apr16-Jun16, Jul16-Sep16



FEEDBACKS from the CZECH User Forum

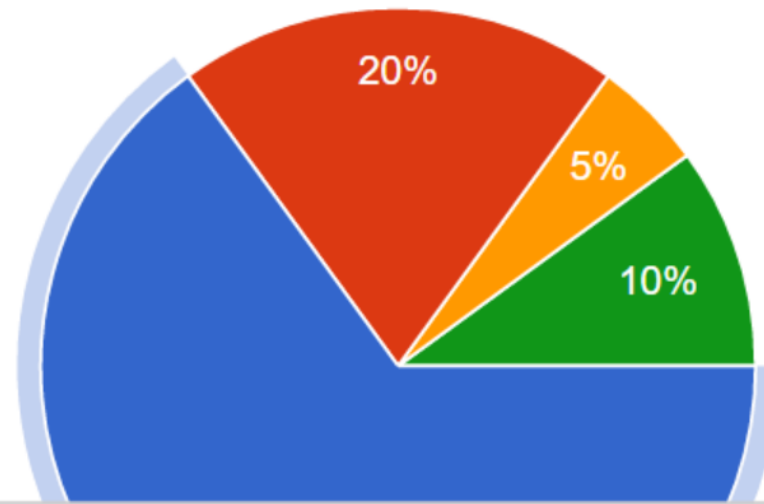
Lucie ŠAVELKOVÁ





National Paying Agency Survey: Interest in Sentinel data

Experience in using of Sentinel data (20 responses)



- Agency is willing to use the data, but we have no experience yet
- We have a team in Agency experimenting or learning to use the data
- We are doing some pilots with external help (outsourcing)
- We have integrated use of Sentinel data in our workflow already

Agency is willing to use the data, but we have no experience yet
13 (65%)

Panta Rhei

EUROPEAN AGRICULTURE PAYING AGENCIES PLATFORM



50th Panta Rhei Conference

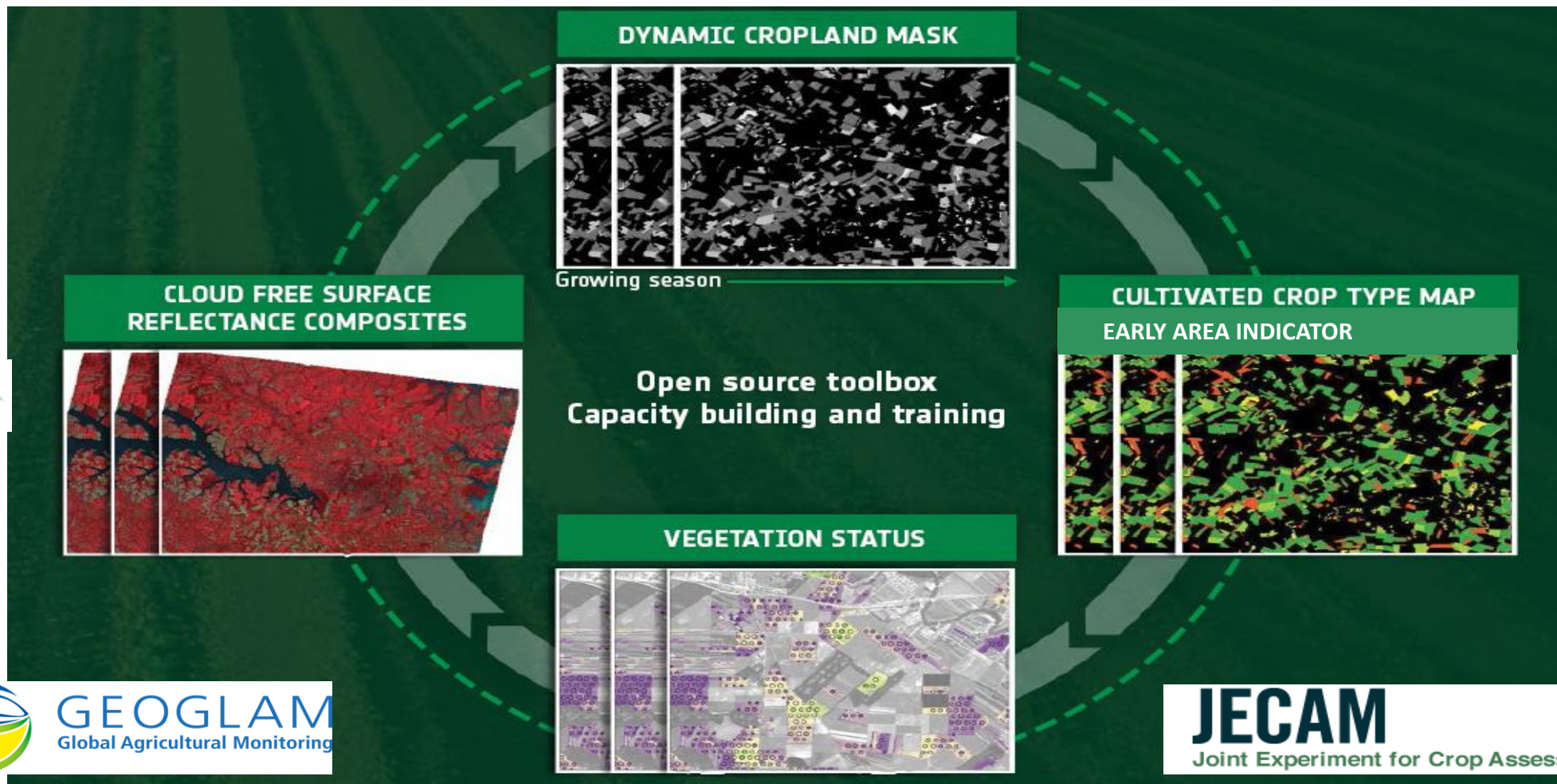
(Riga, 5th-7th October 2016)

WHEN SPACE MEETS AGRICULTURE | 14-15 November, Matera

Sentinel-2 for Agriculture

Towards exploitation of Sentinel-2 for local to global agricultural monitoring - contribution to GEOGLAM

Project



Key Users



Sentinel-2: 10 m cloud free composite (July 2016)

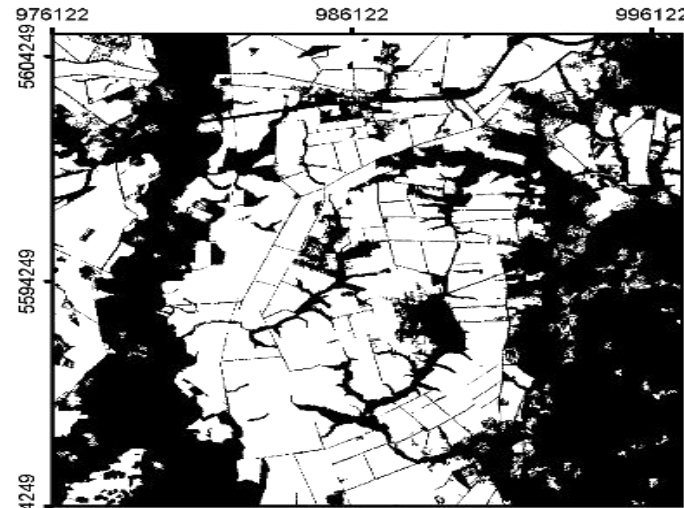


Sentinel-2: Crop mask & type mapping Ukraine 2016

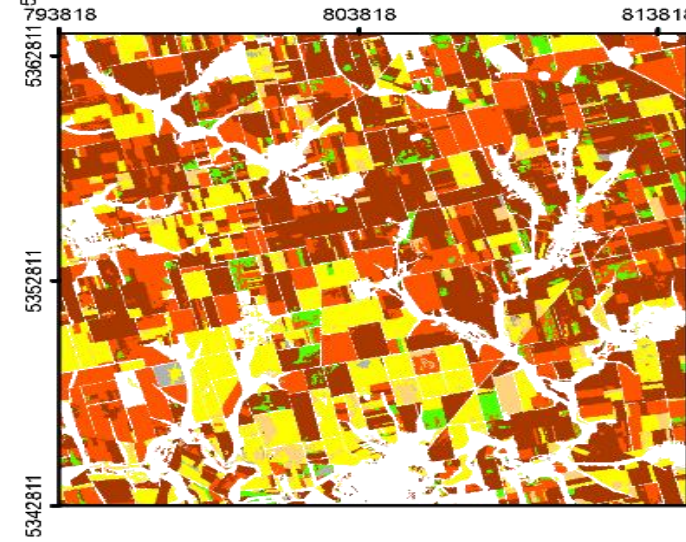
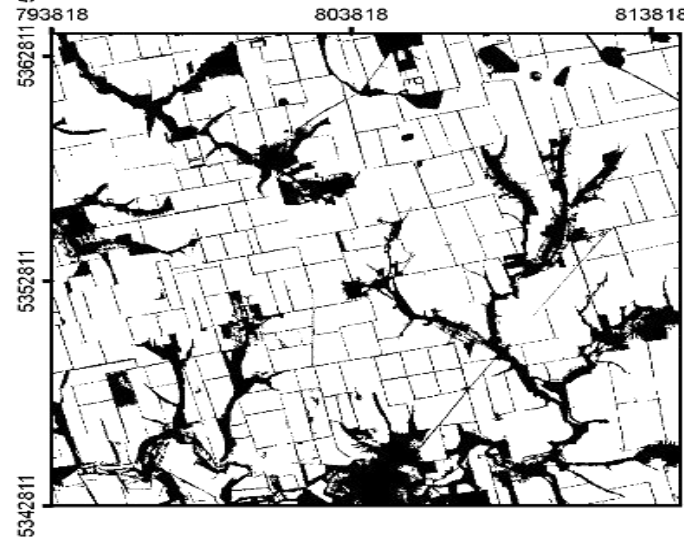
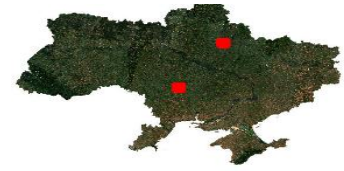
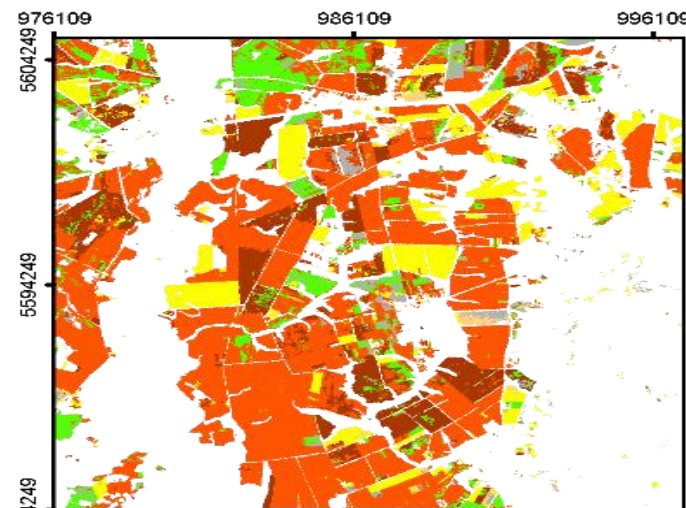
Cloud free composite - July 2016



Cropland Mask - 2016



Crop type map - 2016



Sentinel-2: Crop status monitoring Ukraine 2016

18 Feb. 16

18 Apr. 16

28 Apr. 16

17 Jun. 16

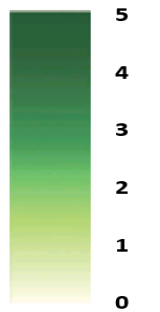
17 Jul. 16

8 Sept. 16

Requires dedicated spectral bands & dense cloud-free time series



Leaf Area Index
values





Sentinels for Agriculture: Benefits & Next Steps

Benefits: Operational, Open & Sustainable

Crop dynamics: Frequent and free coverage (5 days globally)

Crop mapping: at field scale in complex landscapes (10 m resolution)

Crop status: Improved spectral bands for crop health and growth

Crop Forecasting: Long term perspective to build multi-year archive

Operational Crop Monitoring: Systematic and global coverage

Following Steps:

Assessment of **early & timely crop detection** during the 2016 season (March, June, September)

Demonstration of **cloud based computing** for national applications

Concept Note (JRC) "Towards Future Copernicus Services Components in support to Agriculture?"

Joint Research Centre
Institute for Environment
and sustainability
HD4 - MARS Unit



Ref. Area(2016)1613477 - 05/04/2016

Doc: V3.3 - 5 April 2016
Ref: <http://ies.intranet.jrc.it/HD4/apps/Chrono021649.doc>

Concept note

Towards Future Copernicus Service Components in support to Agriculture?

This concept note has been prepared at the request of the Copernicus Unit of DG GROW by the Joint Research Centre of the European Commission (JRC-MARS Unit).

Its purpose is to raise the awareness on the huge potential and opportunities arising from the Copernicus program in the agricultural monitoring and management domains. The present document will help to initiate a joint reflection amongst the different Copernicus stakeholders to explore the best road map(s) for the definition and deployment of new agriculture products, some of which could be implemented, in the medium term, within the Copernicus Land Service.

The concept note sets out several dedicated "Agriculture & Food Security" Copernicus products and how these could be developed and implemented in the coming years. A key challenge in this application domain is to accelerate the take up by operational applications serving both public information needs and private agri-business downstream services. We propose to distinguish between pre-operational R&D, demonstration (outside the direct Copernicus program scope, but relevant for accompanying lines of action) and an operational phase (within the Copernicus scope) in terms of possible activities, key stakeholder involvement at local, regional, Pan-European and global levels.

The document is structured in three parts:

- Chapter 1 describes the overall context and the rationale making Copernicus agriculture products highly relevant with the arrival of Sentinel 1 and Sentinel 2 sensors;
- Chapter 2 provides an overview of some of the main agricultural EO use cases which are identified at different levels, in Europe and globally;
- Chapter 3 describes what could be the future road map(s), including some initial building blocks.

1. Context and rationale

1.1. Context

The introduction of Sentinel-1 and Sentinel-2 high resolution image time series (i.e. with 10-20 m spatial resolution) will facilitate a significant "scale-step" in the use of Earth Observation (EO) data in agricultural mapping and monitoring applications. Furthermore, Sentinel-3, which was successfully launched on 22 February 2020, will significantly enhance global agricultural monitoring capacities in the medium resolution range (300 m spatial resolution).



MANY THANKS!

ESA Copernicus website
<http://www.esa.int/copernicus>

EC Copernicus website
<http://copernicus.eu>

Simon.Jutz@esa.int