The Potential of Copernicus Sentinels for Agricultural monitoring

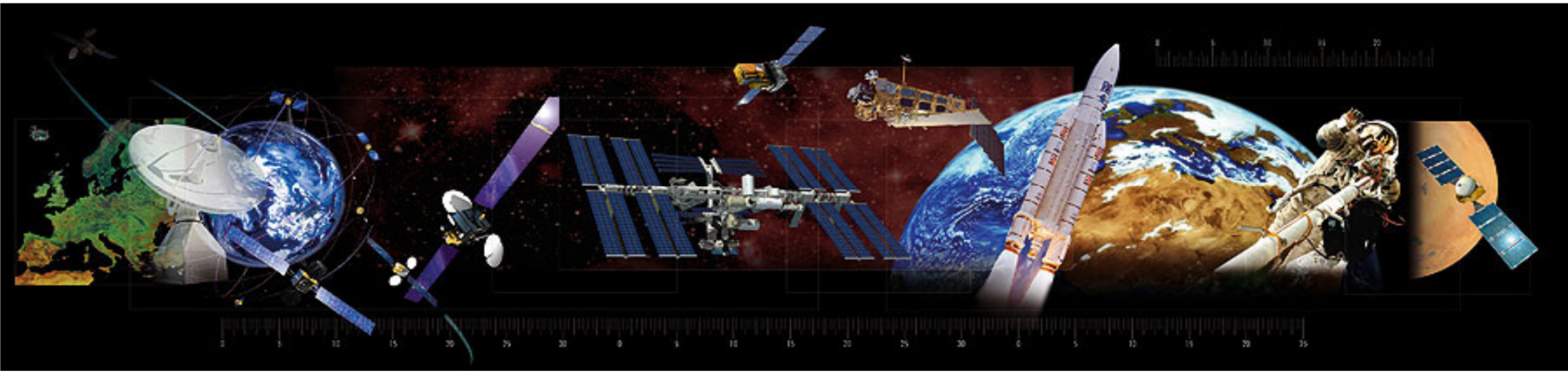
Benjamin Koetz
European Space Agency

The European Space Agency

Intergovernmental Organisation w/ 20 member states

40+ years experience
5 centres in Europe
2200 staff members

4 billion Euro per year
70+ satellites developed
20+ satellites in operation

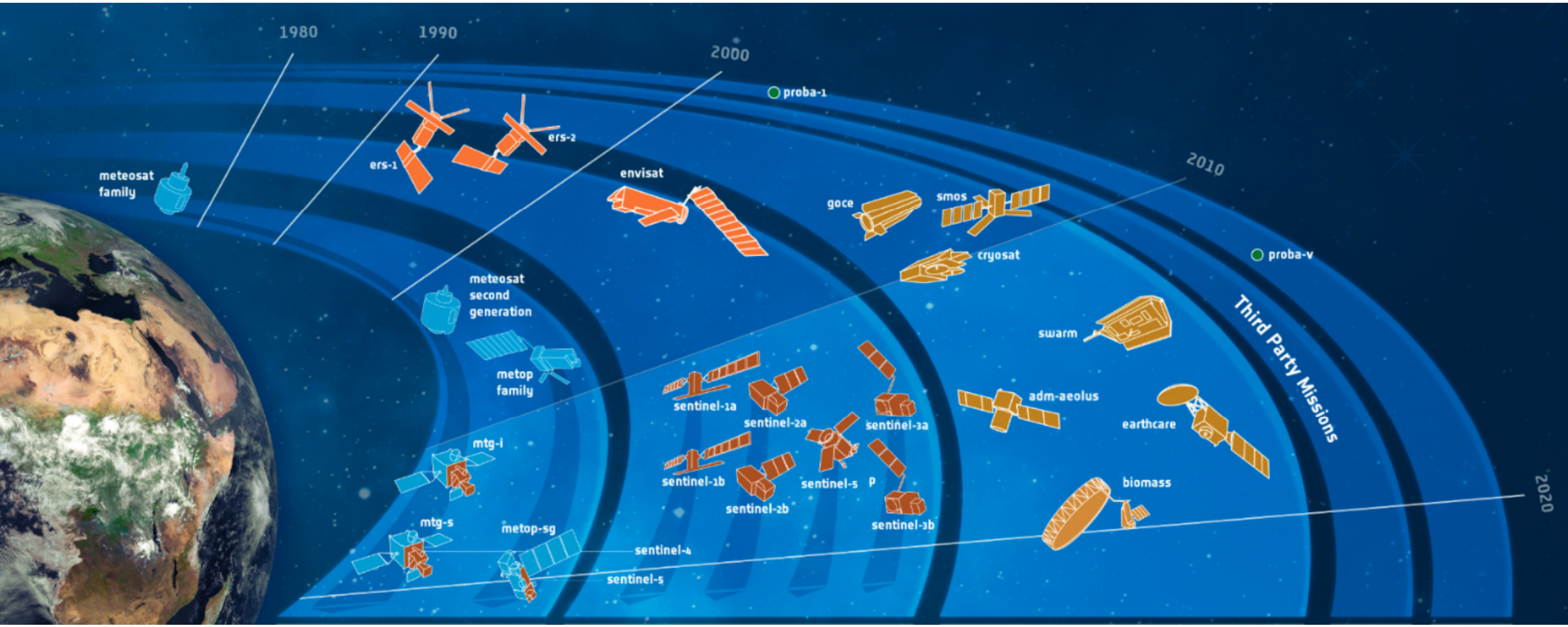


- **Space science**
- **Human spaceflight**
- **Exploration**
- **Launchers**
- **Earth observation**

- **Navigation**
- **Telecommunications**
- **Technology**
- **Operations**

The ESA EO Programme

Scientific: Earth Explorer Missions
Operational: Copernicus Sentinel Missions
Operational: Meteorological Missions



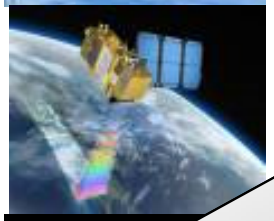
Meteorological **Sentinels** **Explorers**

Sentinel Missions
Joint EU-ESA Copernicus Space Programme

Long-term Continuity and Access to suitable EO data

- Free, full and open data policy*

Sentinel 1 – SAR imaging
All weather, day/night appl
mapping



Sentinel 2
Land ap
Co
iture,..

d global land monitoring
olor, **global vegetation**,
temperature, altimetry

OPERATIONAL

EUROPEAN COMMISSION

PRESS RELEASE

Brussels, 13 November 2013

Business, citizens and environment to benefit from free access to EU satellite data

Press Release:
Open data policy

201

2014/15 & 2016

IP/13/1067

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

Copernicus Sentinel-1

- Launch: **Spring 2014**, 2016, ...
- Constellation of two satellites
- C-Band Synthetic Aperture Radar, weekly coverage (2 satellites)
- Nominal lifetime in orbit of 7 years (max. 12 yrs)
- Sees through cloud cover!

Sentinel-1: Rice mapping example

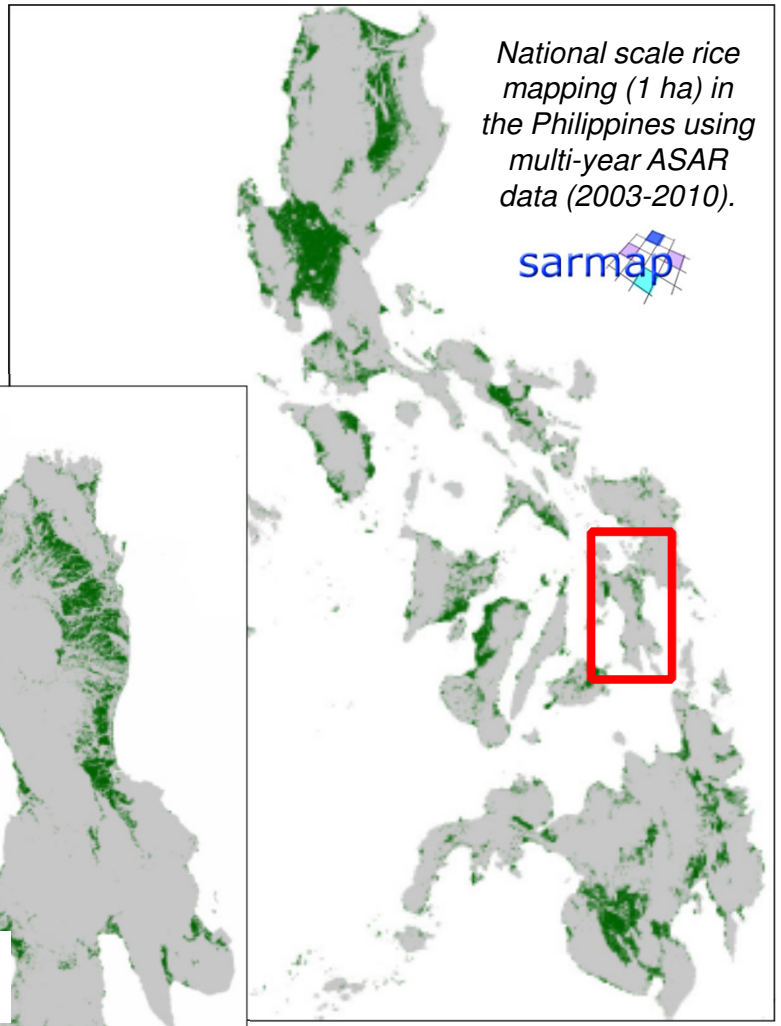
Supporting national scale crop information in Asia:

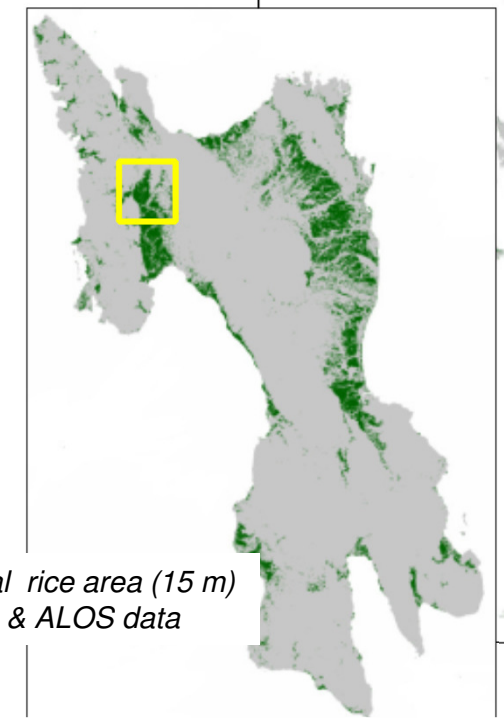
RIICE project with Swiss Develepment Cooperation

Issues: food security and crop insurance.

EO service: crop acreage & crop season stage

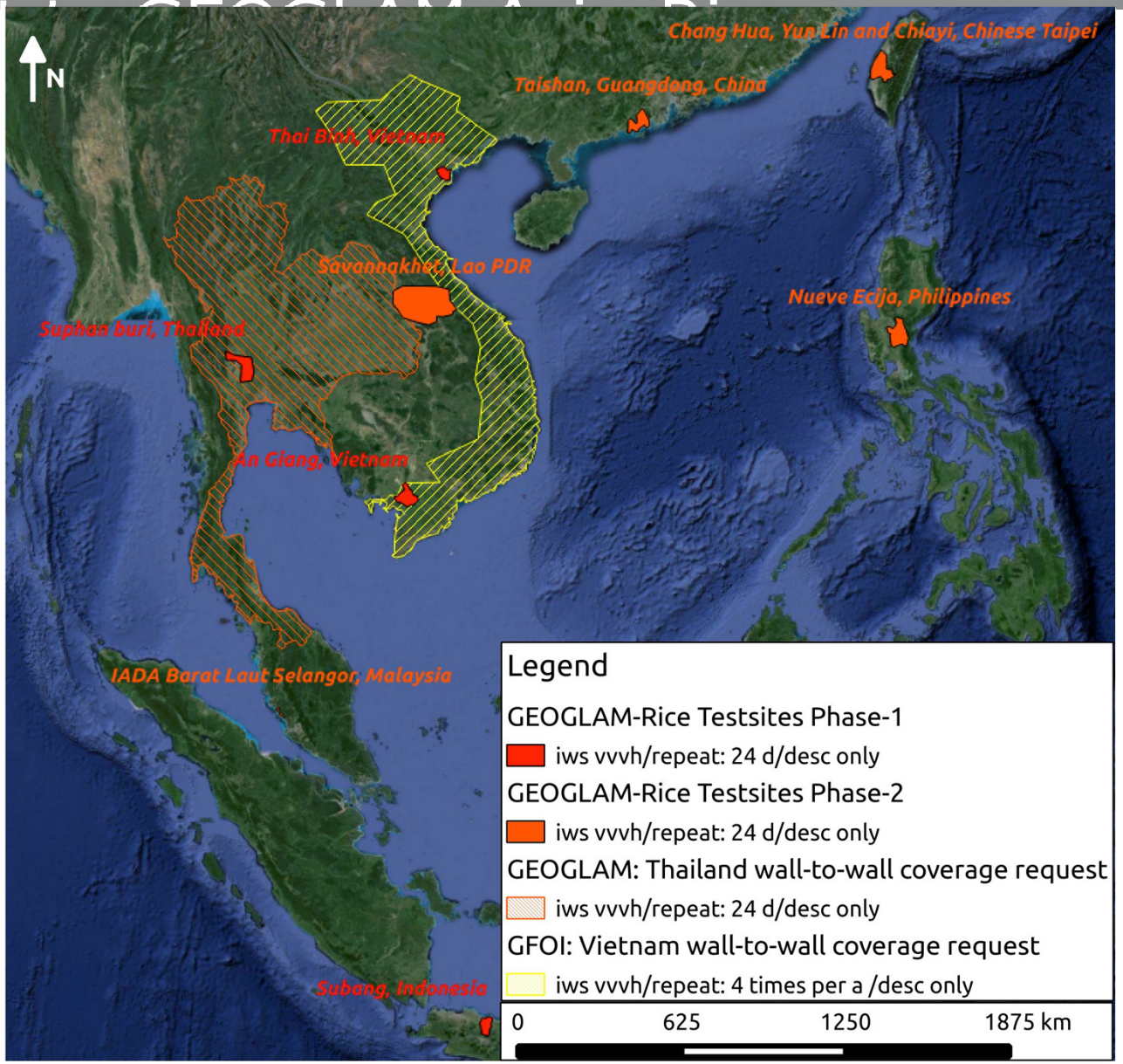
Full scale testing in 7 countries.





Annual rice area (15 m)
ASAR & ALOS data

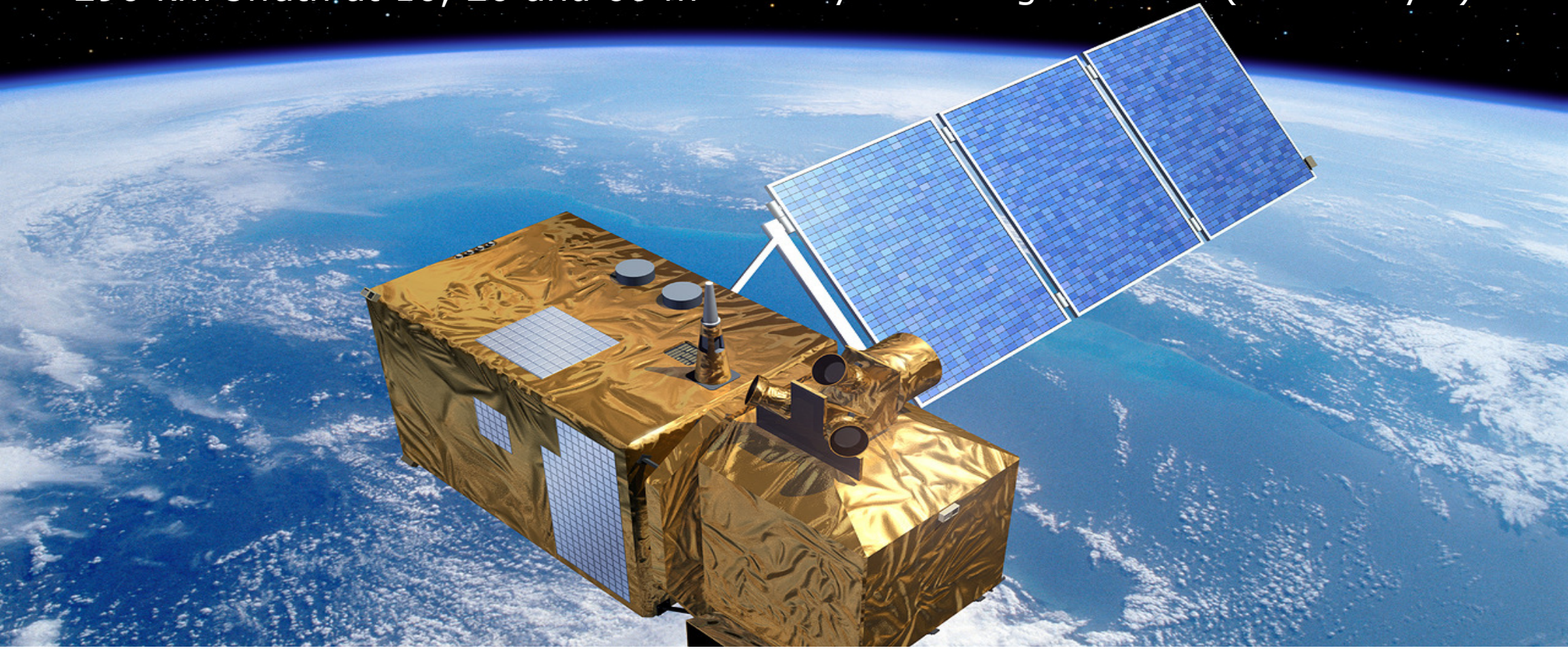
Tentative Sentinel-1 acquisition plan



Copernicus Sentinel-2

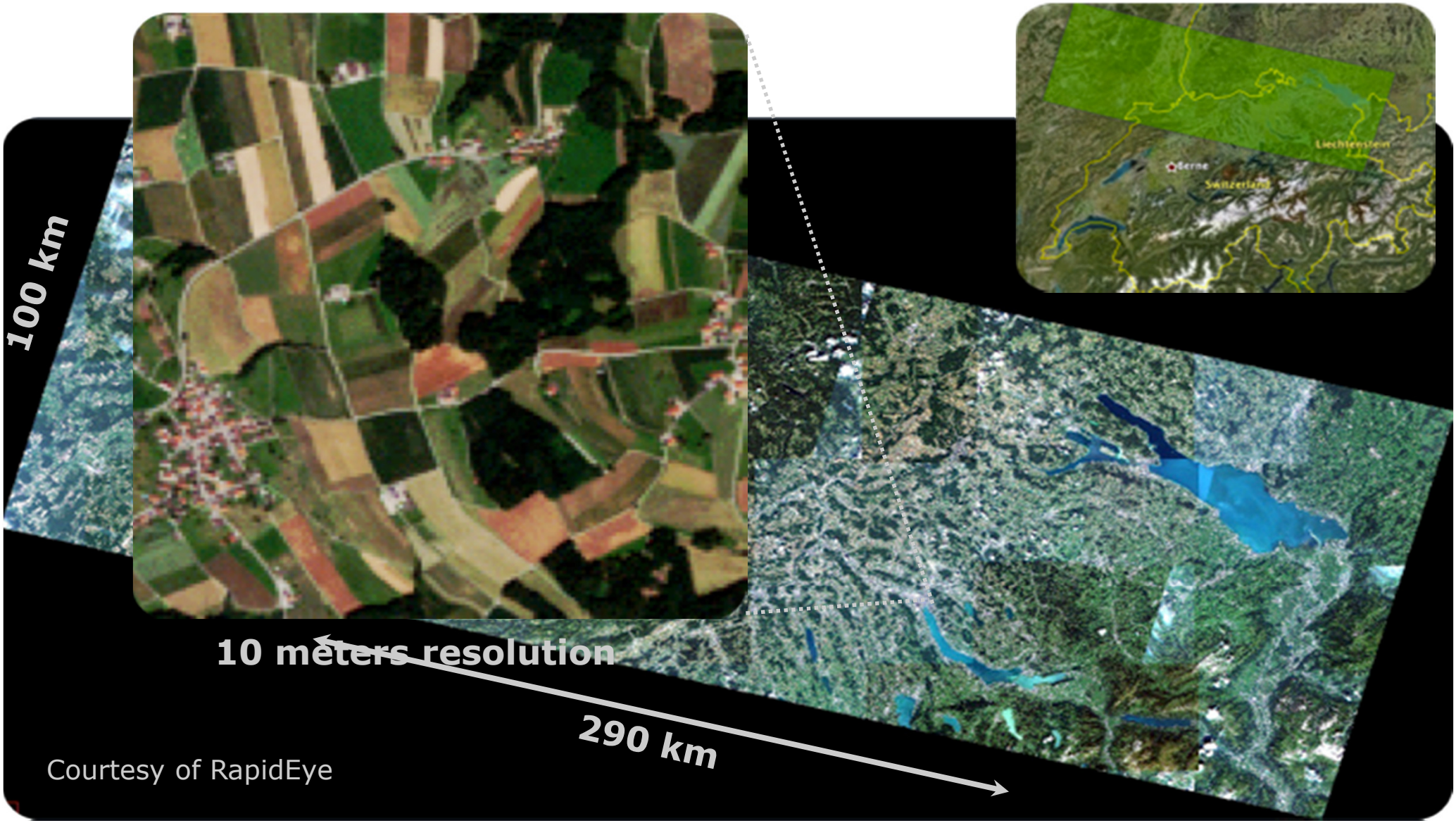
Multispectral High Resolution Optical Imager

- Launch: 2014/15, 2016, ...
- 13 bands (VIS, NIR & SWIR)
- 290 km swath at 10, 20 and 60 m
- Systematic acq. of all land and coasts
- 5 days repeat cycle with 2 satellites
- 7 years design lifetime (max. 12 yrs)

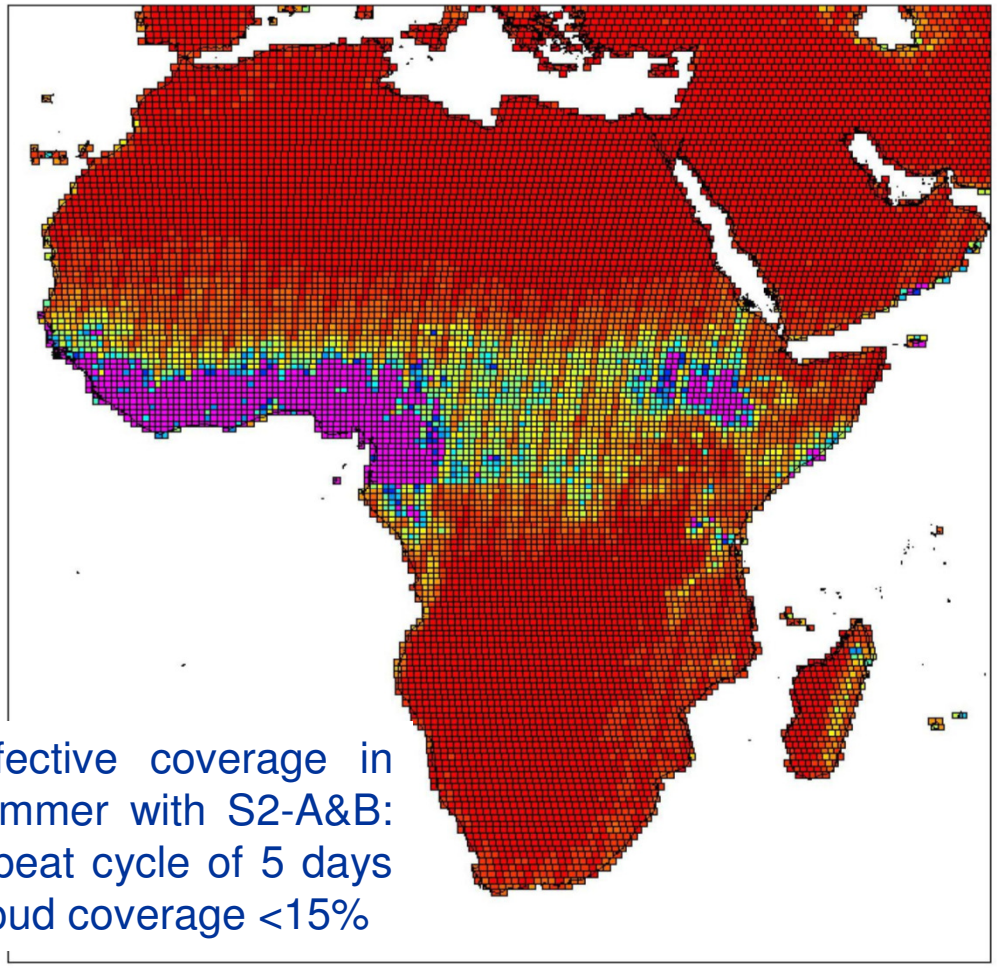


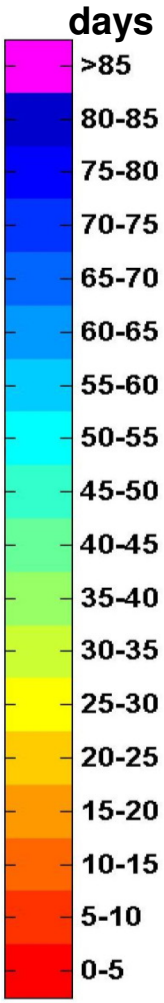
Sentinel-2: Coverage & Resolution

10 m resolution for field scale mapping



Sentinel-2 Revisit Time Capability
5 days revisit for crop dynamics





Effective coverage in summer with S2-A&B: repeat cycle of 5 days cloud coverage <15%

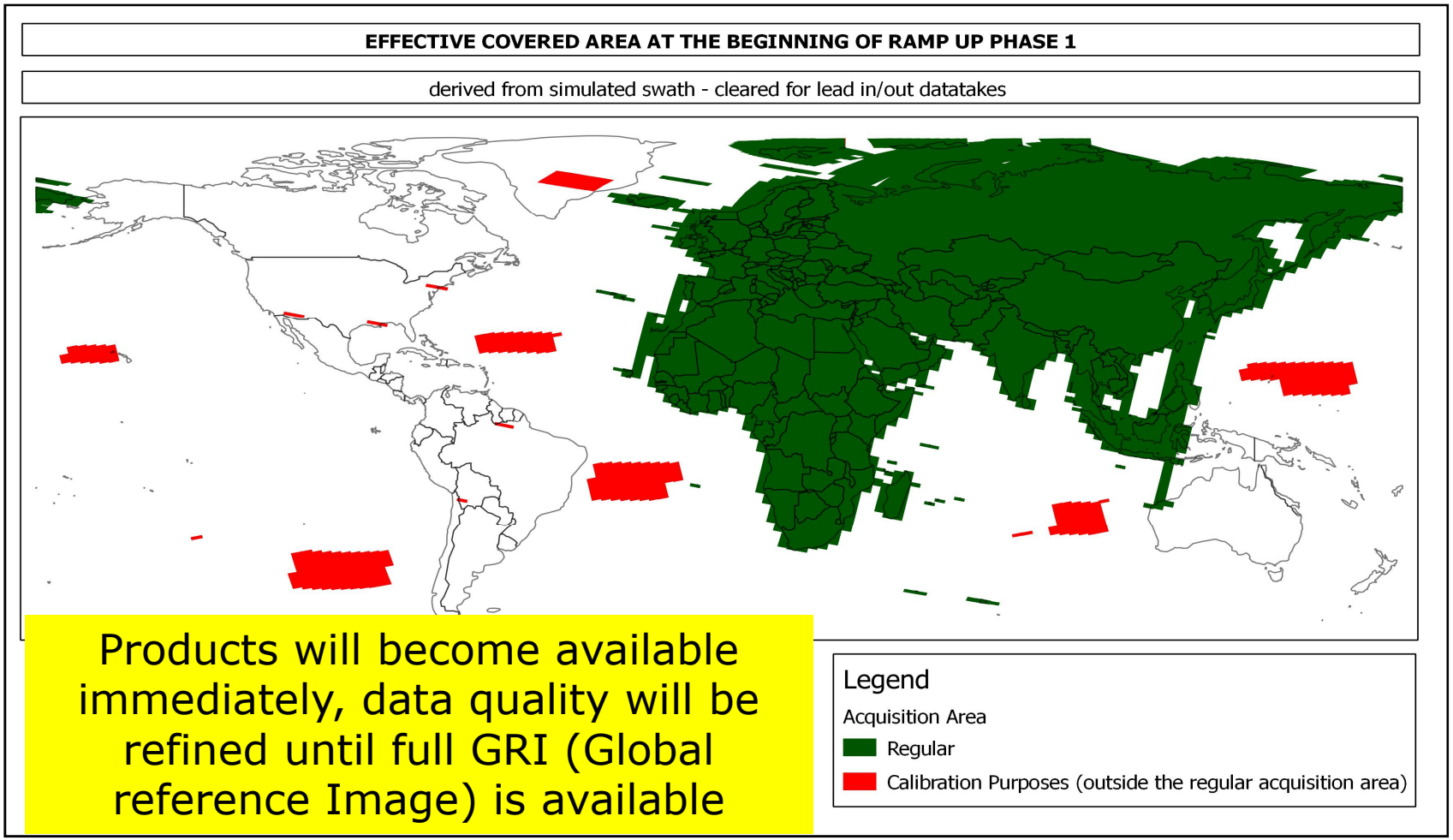
South Africa JECAM site: 5 days revisit, February-June 2013 - RapidEye

Monthly cloud free composites possible for most areas

Sentinel-2 Indicative Acquisition Plan:

Gradual ramp-up focusing on Europe & Africa

- Ensuring coverage of global Cal/Val
- Ensuring COPERNICUS CORE datasets needs for Europe/Africa systematically
- Ensuring maximum coverage/orbit length for GRI generation

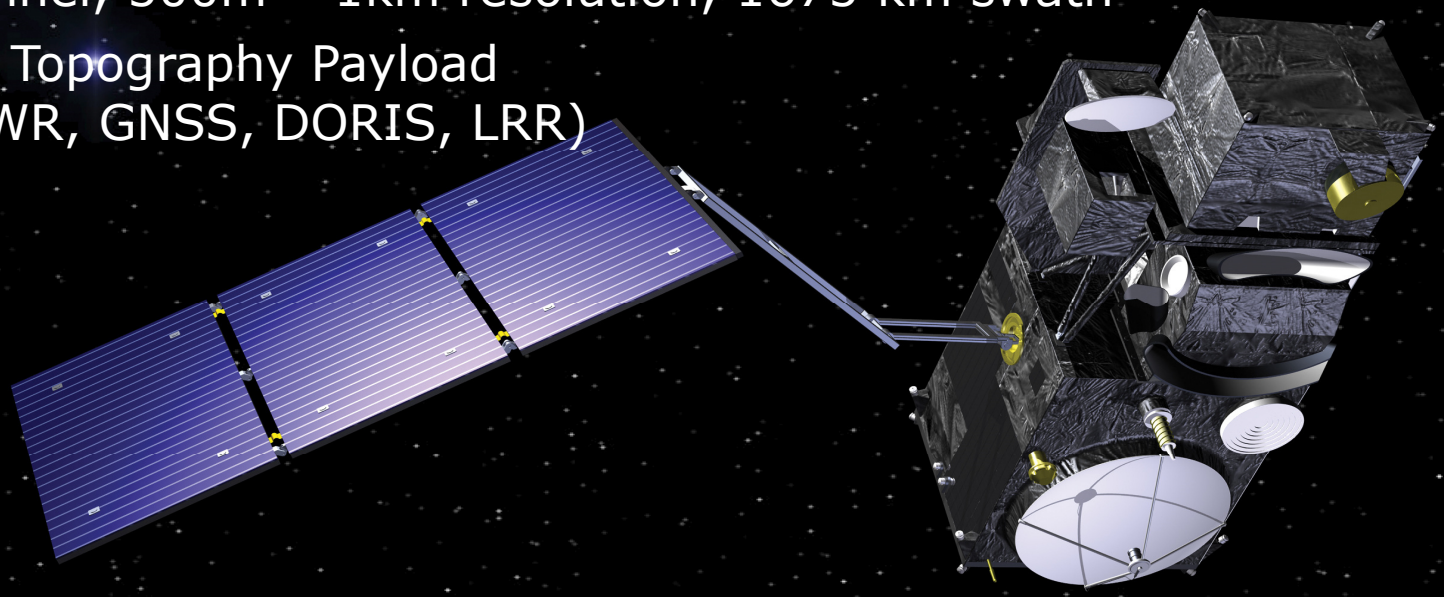


Products will become available immediately, data quality will be refined until full GRI (Global reference Image) is available

Assuming availability of 2 downlink stations out of 4

Copernicus Sentinel-3

1. Ocean and **Land Colour Instrument** (OLCI) – an improved MERIS
   - 21 channels, **300 m resolution**, 1270 km swath
2. Sea **and Land Surface Temperature** Radiometer (SLSTR) – an improved ATSR
   - 9 channel, 500m – 1km resolution, 1675 km swath
3. Sea & Ice Topography Payload
   (SRAL, MWR, GNSS, DORIS, LRR)



- Launch: 2014/15, ...
- Revisit at equator = **2 days (or daily with 2 satellites)**

Sentinel contribution to 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						X		L		
2	100-500 m	optical + SWIR				X	X	X	L	L		L
3	5-50 km	microwave	Daily	Cropland Extent	All			X	X	X	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	X				X
5	10-70m	optical + SWIR + TIR	Weekly (min. 1 per 16 days)	Sample	All	X	X	X	X	X	X	X
6	10-100m	SAR	Weekly (min. 1 per 2 weeks)	Cropland Extent of persistant cloudy areas/Rice	All	X	X	X	X	X	X	X

Copernicus Global Land Programme

Sentinel-3

SMOS

Sentinel-2

Sentinel-2

Sentinel-1

Source: CEOS ACQUISITION STRATEGY FOR GEOGLAM PHASE 1

Sentinel-2 Preparatory Activities for Agriculture

sentinel-2 agriculture

Resolution and temporal frequency of Sentinel-2 present unique opportunities for agricultural monitoring

Agricultural Needs & Drivers:

- High temporal crop dynamics
- Large variability of crops / practices
- Wide range of applications (local – global)

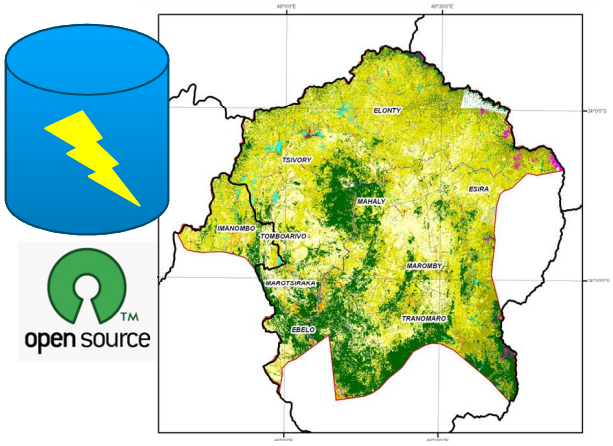
Sentinel-2 Advantages:

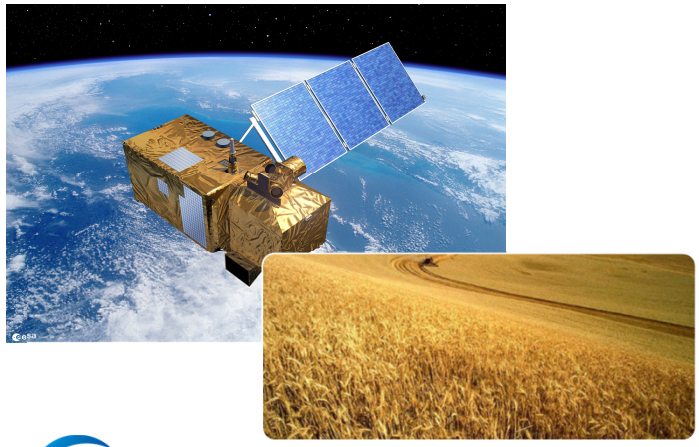
- 10 m resolution is a necessity for crop area at field scale
- Improved crop type & status mapping with 5 days revisit

Sentinel-2 for Agriculture: Objectives & Concept

Algorithm Development → Prototypes of EO products → Demonstration & Validation

JECAM
Joint Experiment for Crop Assessment and Monitoring





GEOGLAM
Global Agricultural Monitoring

Main Design Activities:
- User Requirements
- EO product specification
- Algorithm Development

Processing System:
- 4 agricultural EO products
- Open source system
- Testing & validating of EO prototypes (12 sites)

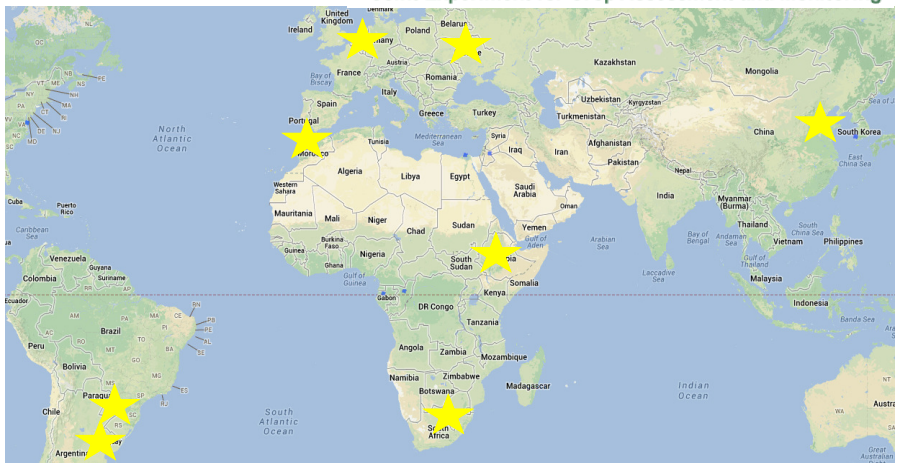
Use cases:
- 3 national coverages & 5 local sites (290x290 km)
- Validation of EO products
- Transfer to national users

Sentinel-2 for Agriculture: Project Implementation

Sentinel-2 Time Series (February-June 2013)

- SPOT4: 5 days, 20 m, 60x60 km2 (CESBIO/CNES)
- RapidEye: 5 days, 5 m, 25x25 km2
- Landsat-8: 16 days*, 30 m, 180x180 km2

JECAM
Joint Experiment for Crop Assessment and Monitoring



*since 15th of April (preferential acquisition)

Agricultural EO products

- Dynamic Cropland mask
- Cultivated crop type & area
- Crop condition indicator / biophysical var.
- Cloud free S2 composites

Project Set-up

- Team*: UCL, CESBIO, CS-France, CS-Rumania
- Time Frame: 3 years, KO January 2014
- Budget: 1.5 Meuro

*currently under negotiation

Sentinel-2 Time Series Emulation

Sentinel-2 for Agriculture: Expected Outcome

Preparation for national to regional agricultural monitoring based on Sentinel-2

- R&D for full exploitation of temporal & spatial resolution of S2

Consolidate Best Practices for EO agricultural monitoring

- Benchmarking & validation of algorithms for 4 EO products
- Testing products over a wide range of conditions (JECAM community)

Strengthening National Capacity for Agricultural Monitoring

- Open source system supporting **national reporting & food security**
- Transfer to users including local system installation & training
- Demonstration of validated agricultural EO products at national scale

User & Partners

- 15+ committed key users: national institutions, experts, internat. Organization
- 6 JECAM sites: Belgium, South Africa, Ukraine, China, Argentina, Paraguay +?

JECAM Joint Experiment for Crop Assessment and Monitoring

Conclusions:
Sentinels Potential for Agriculture

Operational Observations from the Sentinels

- Continuous information from field to global scale
- Responding to most GEOGLAM target products
- Open data policy & long-term continuity for sustainable uptake

Preparatory activities needed for full exploitation

- R&D for optimized and validated EO products
- Facilitation of EO data access & handling (e.g. composites)

Sentinel-2 for Science Workshop

20th-22nd of May 2014

http://seom.esa.int/S2forScience2014/

Agency

esa Sentinel Online

Need Help? Contact Us About sentinel online

Google™ Custom Search

Missions | User Guides | Technical Guides | Thematic Areas | Sentinel Data Access

You are here Home

http://sentinel.esa.int

Share

Welcome to Sentinel Online

Welcome to Sentinel Online, the ESA Sentinel website.

The site is constructed in such a way as to enable you to navigate easily through a variety of topics related to each Mission, Instrument, and their associated Data, as well as highlighting the Copernicus Thematic Areas served by the Missions. For more information see About sentinel online.

The GMES (Global Monitoring for Environment and Security) program has been recently renamed by the European Union to 'Copernicus'. It shall be noted that currently the content of this Website refers to the terms GMES and Copernicus alongside.

Sentinel News

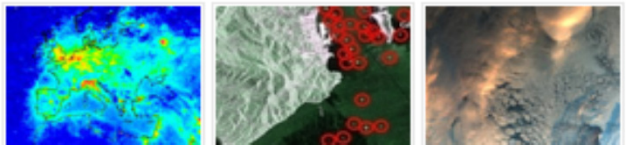
- Apply for 'Sentinel-1 Student Transponders'
- Turning up the heat on Europe's first Sentinel
- Green light for GMES Copernicus
- International effort helps users get ready for
- Greece's ups and downs
- Securing operational EU funding for GMES
- ESA-NASA collaboration fosters comparable

Featured Image

- Vancouver Radar Image
- ESA EO Image Gallery

Sentinel Missions

Sentinel Data Products



http://spaceinvideos.esa.int/Videos/2013/09/Living_Planet_2013_-_Sentinel-2_mission

e Agency