



EuroGEOSS
Agriculture pilot

Pr. Pierre Defourny, UCLouvain
GEOGLAM/JECAM Co-lead
With the contribution of collaborators and
leaders of several EU programs and projects

Logos of partners: SIGMA, sentinel-2, Copernicus, AfriCultuReS, sen4cap, food security tep, ANTARES, innovators, becam, and others.

Washington DC, 23 October 2017

EuroGEOSS Agriculture Pilot - outline

1. EO Agriculture Monitoring - MARS, GEOGLAM and the **current European contribution**
2. **Most recent European activities** on infrastructure and Sentinels exploitation for agriculture
3. **A way forward** for a EuroGEOSS Agriculture Pilot to scale up and streamline the European contribution to GEOSS



Pioneering EO activity for Agriculture Monitoring

EC MARS program (JRC)

providing independent and timely information on crop production since 1988 from emerging technologies incl. EO

- **MARS Bulletin** for NRT Crop Monitoring and Yield Forecasting since 25 years for DG-AGRI, EUROSTAT, downloaded by 32+ countries



European Regulation No 1306/2013

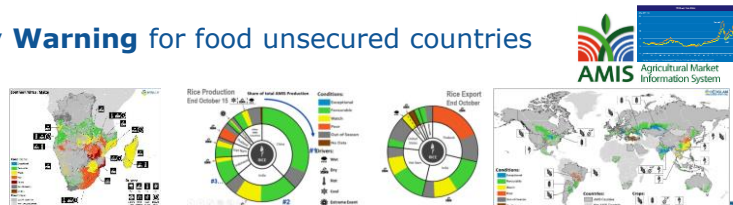
- **Food Security assessments** - EO based ASAP system & ad-hoc reporting DG DEVCO, EU delegations, FAO, WFP



GEOGLAM – a flagship activity of GEO

endorsed and confirmed by G20 (Nov. 2011 till now)

- **Crop Monitor** as System of Ag Monitoring Systems for AMIS
- **Crop Early Warning** for food unsecured countries

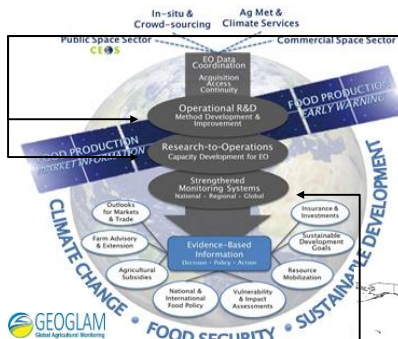


JECAM network as R&D component

Joint Experiment for Crop Assessment and Monitoring



European contribution to GEOGLAM & JECAM by SIGMA



JECAM cross site experiments

Yield estimations, Large field mapping, Small field mapping

Infrastructure



EO indicators in crop yield forecasting

How do (EO based) indicators from publically available, global data sets perform in crop yield forecasting across different agro-environmental landscapes (JECAM sites)?

Future integration in EuroGEOSS

infrastructure -> STAC, ...

integration of methodologies -> e.g. NextGEOSS

capacity building

validation data set (global)

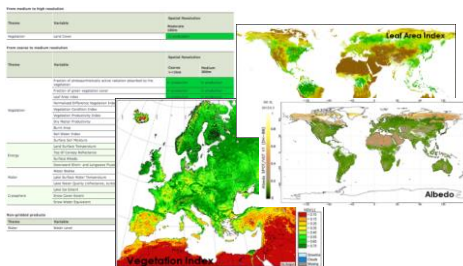
Capacity building



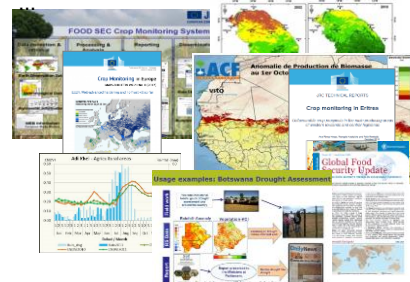
COPERNICUS 300m-1km products for agriculture

More than 20 variables every 10 days at 300 m to 1 km with a world coverage

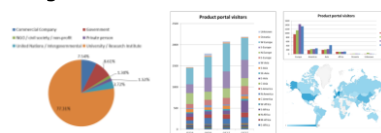
... to be used for crop monitoring, yield forecasting, biomass estimation



... disseminated through INTERNET and GEONETCAST system ...



... with currently more than 2,000 registered users in 66 countries

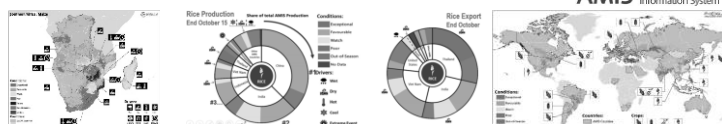


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- **JECAM** network as R&D component

Joint Experiment for Crop Assessment and Monitoring
GEO GROUP ON
EARTH OBSERVATIONS

- **EO requirements for Crop Monitoring to submit to CEOS**

Ad-hoc CEOS-GEOGLAM working group



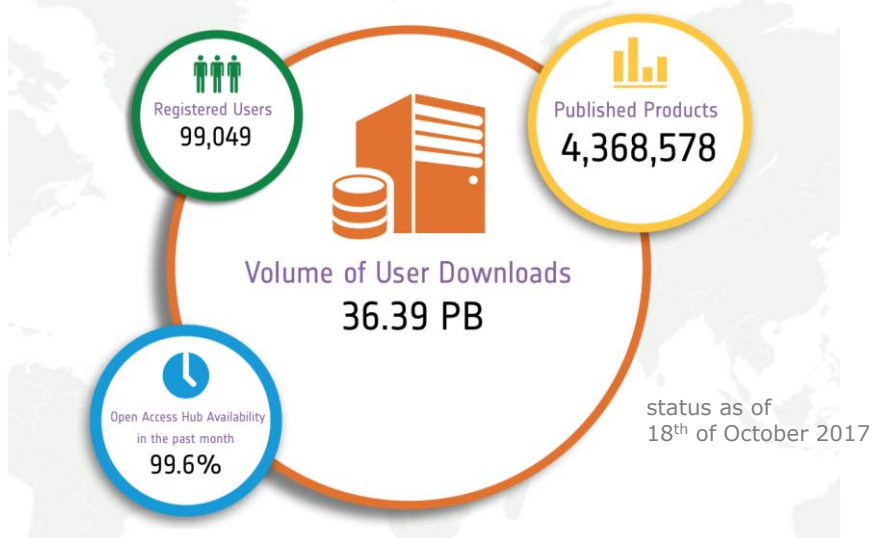
EO Ag. Requirements to CEOS largely met by Sentinel satellites

Target Products												
Req#	Spatial Resolution	Spectral Range	Effective observ. frequency (cloud free)*	Sample Type	Field Size	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		SENTINEL-3: 300-1200m resolution, <2 days revisit						S3-A in Orbit S3-B Launch Q1 2018
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	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		SENTINEL-2: 10-60m resolution, 5 days revisit time						S2-A and B in Orbit
5	10-70m	optical + SWIR + TIR	Weekly (min. 1 per 16 days)	Sample		SENTINEL-2: 10-60m resolution, 5 days revisit time						S2-A and B in Orbit
6	10-100m	SAR	Weekly (min. 1 per 2 weeks)	Cropland Extent of persistent cloudy areas/Rice		SENTINEL-1: 9-40m resolution, 6 days revisit at equator						S1-A and B in orbit

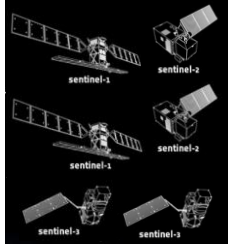
CEOS Source: CEOS Requirements for Agriculture 2012



Copernicus space component : a success story



EO and IT (r)evolution change the game for local, regional to national ag. monitoring

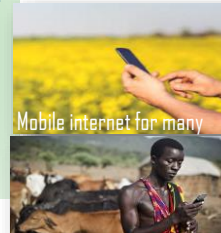


Free, open and long term data
policy (EU)



Change in user's demand for

- big data access in NRT
- high resolution products in NRT
- multi-source integration in a seamless manner
- tailored EO-derived services for ag. management
- ...



3 platform projects handling big data flows



NextGEOSS

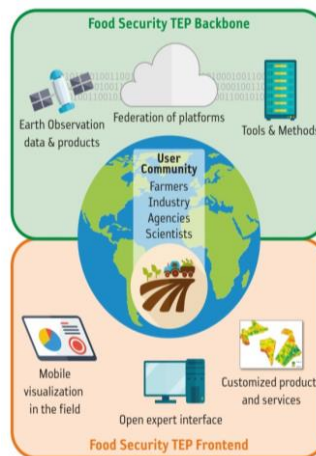
Agriculture pilots
'Crop Monitoring Service'



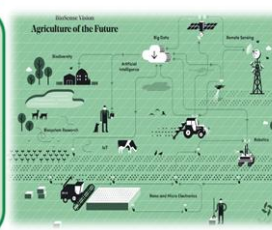
Cloud-based processing: on-demand on user-request OR subscription based

Visit the NextGEOSS on-line demonstrations at the OGC/ESIP booth

food security
tep



ANTARES

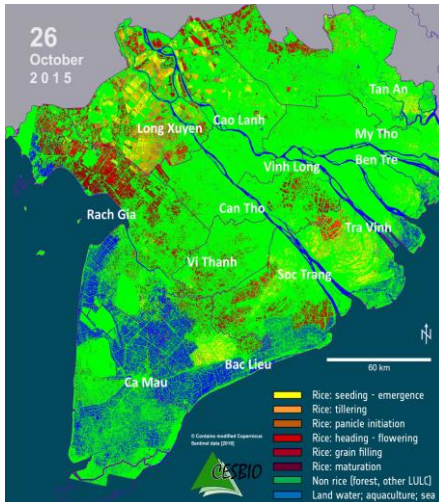


aiming to integrate :

- Sentinels and UAVs
- Internet of things
- Crowdsourcing
- Deep learning algo

BioSense Institute and WUR

Sentinel-1 time series for Rice Crop Stages & Area

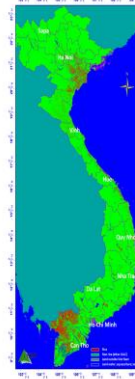


Winter-Spring Rice 2015/16

- March 2016: 1.4 Million ha rice
- March 2015: 1.7 Million ha rice

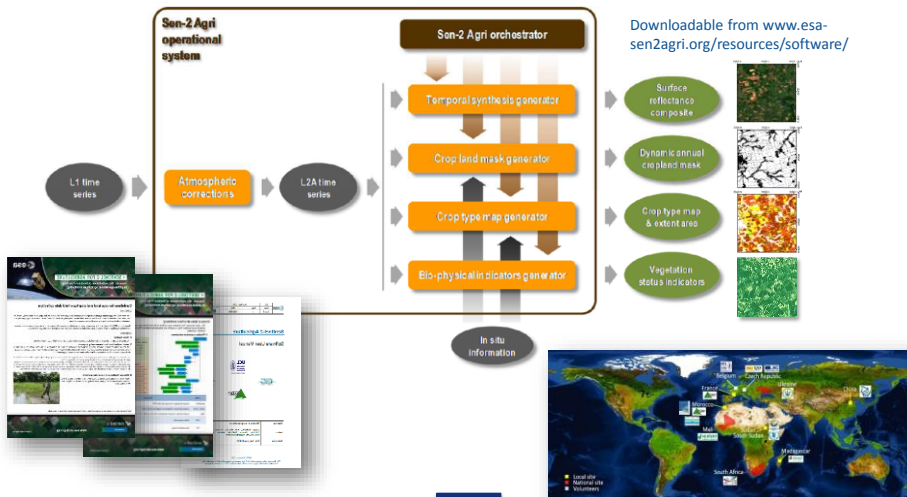
16.5% loss in rice area due to drought & salt water intrusion caused by El Nino

⇒ 976.000 people affected, 67 Mil.\$ estimated damage

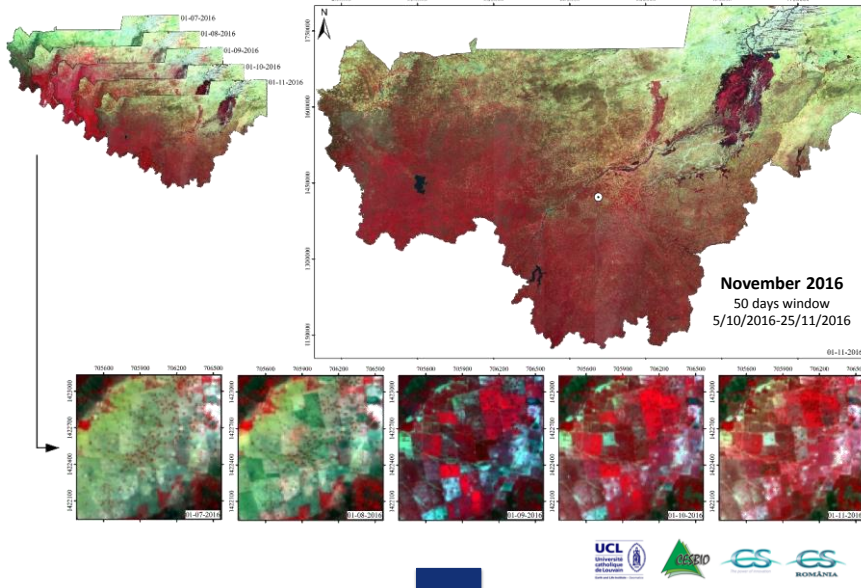


The Mekong Delta, Vietnam
300 km x 300 km, 20 m resolution

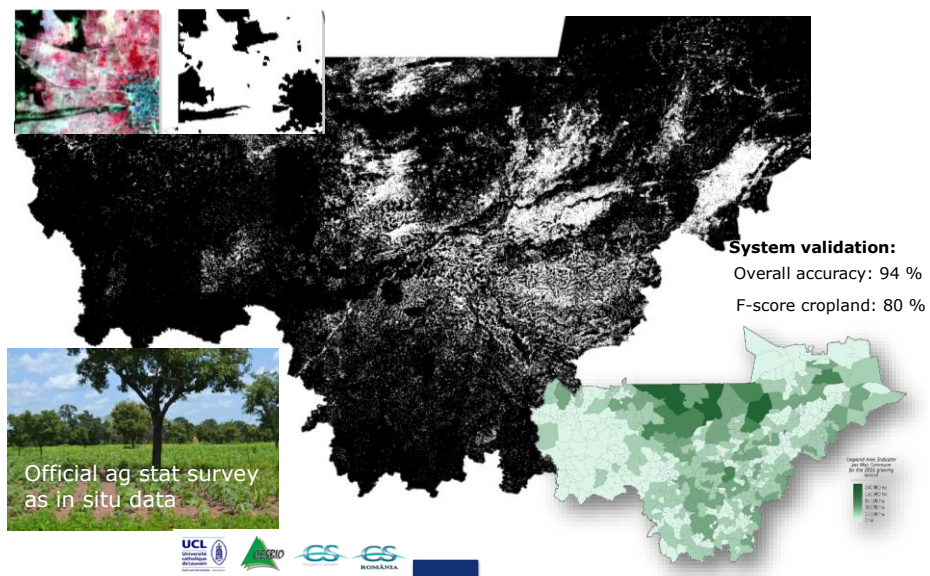
Sen2Agri system : an open source system demonstrated at full scale NRT, running locally or on any cloud computing



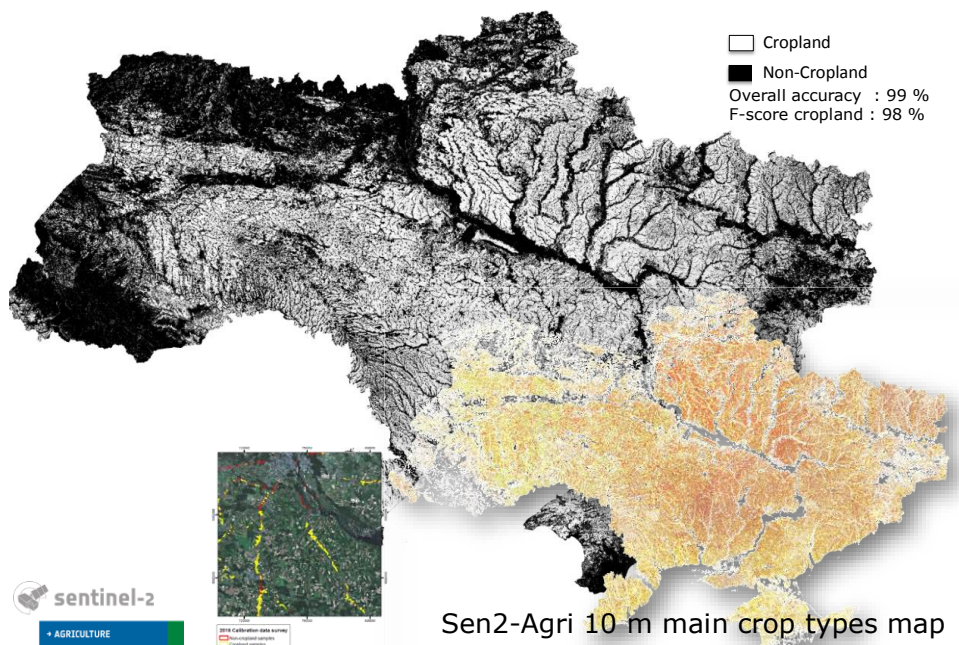
Composite series over Mali at 10m resolution from Sentinel-2 and Landsat 8



2016 Cropland mask at 10m resolution for Mali from Sentinel-2 and Landsat 8



Sen2-Agri 10 m cropland map for Ukraine (July 2016)



European long term programmes and assets :

- ✓ Top class EO data sources thanks to Copernicus
- ✓ Pioneer world class operational crop monitoring at 300m-1km (MARS)
- ✓ World class EO research laboratories and rich in situ data in Europe
- ✓ Competitive EO know-how of private sector

BUT

Fragmented project-based efforts prevent EO innovations from

- having a **long term impact** on the EO ag. practices
- reaching a **critical mass** to create a significant market
- insuring **cumulative progress** from one outcome to another
- sustaining due to **multiple donors** with different mandates
- being adopted **by international initiative** like GEOGLAM

=> **potential impact of EuroGEOSS to sustain EO uptake**



- To address the European users needs and upscale applications
- ✓ **DG-Agri & MS** for Common Agriculture Policy reform 2020+
 - ✓ **Agriculture sector** like agri-business, insurance, ag. service,..
 - ✓ **Food unsecured countries** or with emerging ag. sector
 - ✓ **International partners** like GEOGLAM, JECAM, FAO, WFP

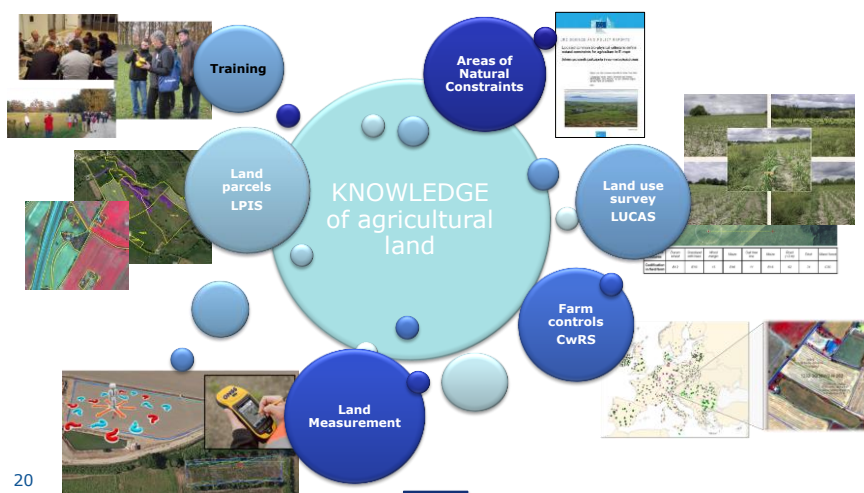
through these possible strategic activities

- **COORDINATE** - activities inventory, manage the redundancy, exchange between projects, between donors to build an European EO ecosystem for ag.
- **COMBINE** - cumulate R&D findings, scale up the success stories, and identify the R&D gaps
- **COOPERATE** - to join forces to propose an sustainable European contribution to internat. initiatives



JRC support to the CAP implementation and
to its reform taking advantages of Sentinels

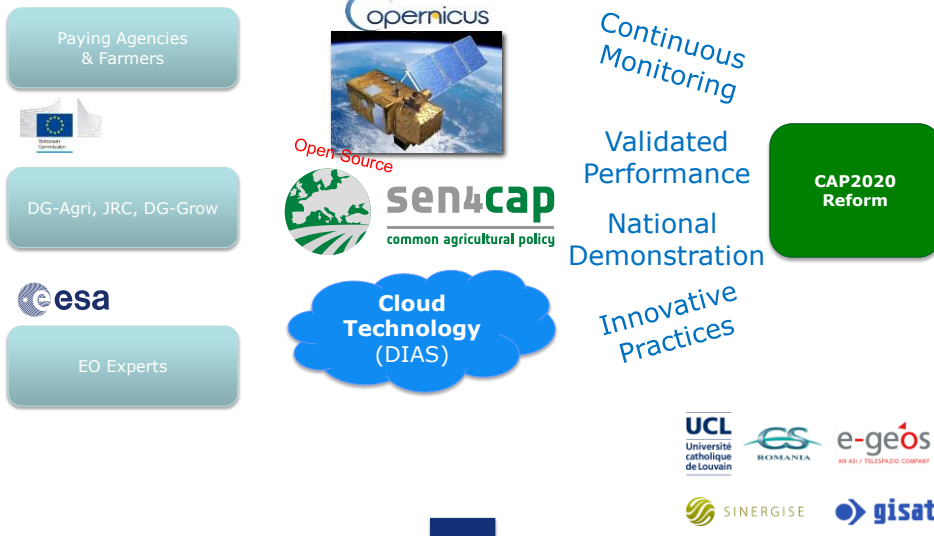
"knowledge that ensures efficient and consistent implementation of the CAP"





Potential element of EuroGEOSS Ag pilot Sen4CAP

Close collaboration between EU DGs, Member States and ESA
to exploit Sentinels for Common Agriculture Policy (current and 2020+)



Potential elements of EuroGEOSS Ag pilot

JECAM support

Joint European for Crop Assessment and Monitoring

Coordination of a best practices compendium to capitalize
GEOGLAM & JECAM the findings of SIGMA and Sen2Agri

Support the European component of JECAM network

to develop ag. services for the European cropping systems (collaboration
between 5 sites – DE, F, SP, BE, PL,...)



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Advanced service example developed on the BE JECAM site

Nitrogen Nutrition Index for all winter wheat fields (Southern Belgium) from Sentinel-2



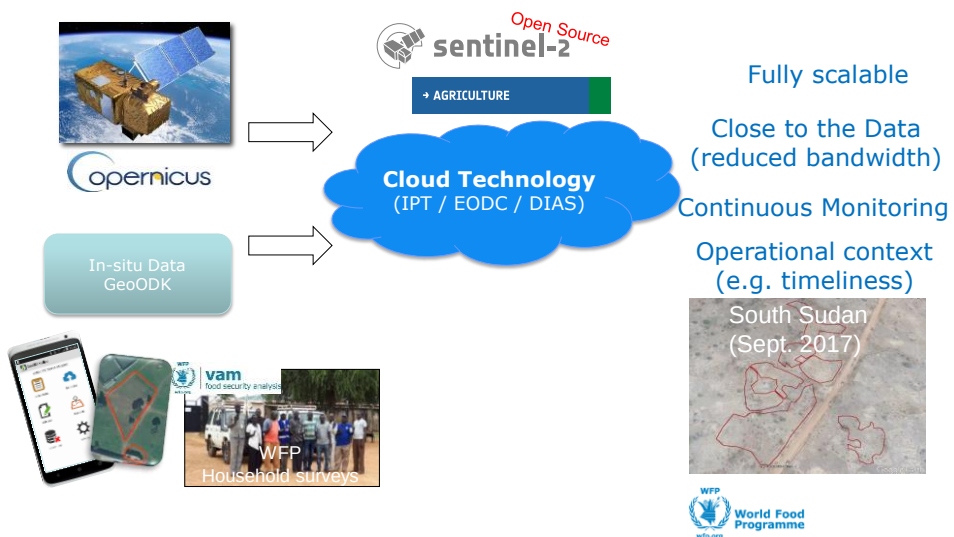
(Delloye et al., submitted RSE2017)

Potential element of EuroGEOSS Ag pilot

Sen2Agri uptake



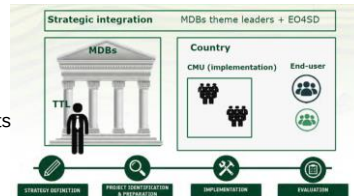
Sen2Agri to provide national monitoring system



EO for Sustainable Development to mainstreaming EO into development bank activities

Addressing several thematic areas across 9 countries

1. Monitoring **agricultural production**
2. M&E of **land degradation**
3. Agricultural **commodities** production's impact assessment
4. **Ecosystem services** provided by agriculture
5. Planning and monitoring of **rural infrastructure** investments
6. **Food security** and agriculture risk management
7. Support environmental and social **safeguards** frameworks
8. **Irrigation** systems development and management



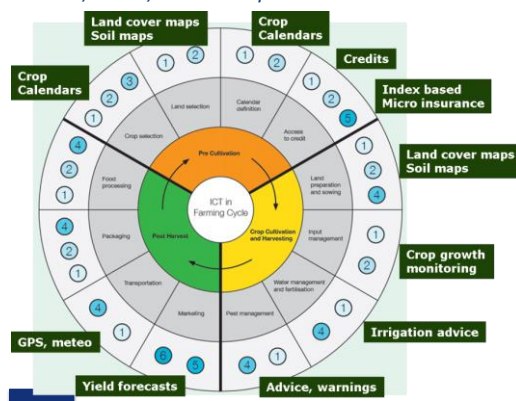
• EARTH OBSERVATION FOR SUSTAINABLE DEVELOPMENT

esa



Lessons learned for EO service development

- **User demand driven:** adding value for customer
- **Business/revenue model** to reach sustainability, e.g.
 - *Freemium business model (services paid by B2B customers)*
 - *Inclusive business model: with credit, seed, fertilizer provision*
- **Aggregator to reach scale**
 - *Local input supplier*
 - *Local commodity trader*
- **Govt support needed**
 - *Extension officers*
 - *Subsidies on premium*
 - *License to operate*

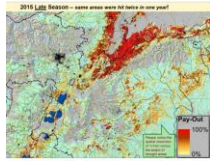


<https://g4aw.spaceoffice.nl>

On-going element of EuroGEOSS Ag pilot



Insurance of credit provision for 1,5 million farmers (Ethiopia)

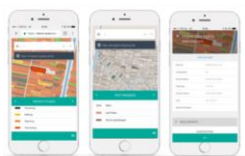
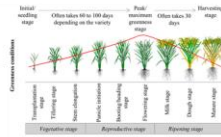
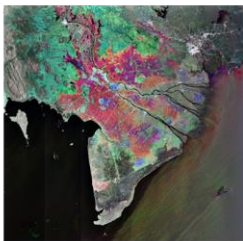


Micro-insurance and drought warnings for millions of farmers
GIACIS - Ethiopia



Agro advice for 400,000 farmers (Vietnam)

From 2 provinces in Mekong to SE Asia?



Growth stages
Yield predictions
Pest warnings

Sat4Rice - Vietnam



Forthcoming element of EuroGEOSS Ag pilot



AfriCultuReS



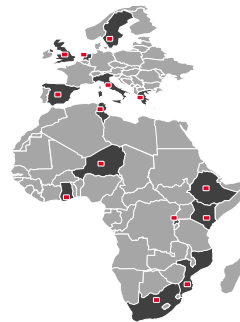
Enhancing Food Security in AFRICan AgriCULTUral Systems with the Support of REMote Sensing (H2020)

Innovative **fusion of data** from **multiple sources** (EO, in-situ, citizen-based crowdsourcing, climate services and weather, crop models)

Enhanced **crop yield and biomass prediction** models, emphasizing the use of the complementary sensors of the EU **Sentinels** constellation

Spatial Decision Support System (DSS) to **enrich decision making and risk assessment and web tool** that will support **early decision making**

Partnership between eight African and eight European partners, **African collaborating networks**, local training, cooperation with **AfriGEOSS**





EuroGEOSS is a triple opportunity for the European EO community :

- ⇒ to **speed up and upscale** the most promising EO applications for the agriculture sector, including in the complex European cropping systems
e.g. a financing mechanism to leverage EU project final outcomes till the effective uptake by users
- => to consolidate the **European know-how and innovation capacity** of the EO research & private sector ecosystem
e.g. (bi-)annual meeting of European EO agric. community to exchange on experience of products and services developed by various projects supported by various donors
- ⇒ to provide a **sustainable and coherent contribution** to international initiatives (GEOGLAM and JECAM)
e.g. through the support of coordination of the European contribution to GEOGLAM and JECAM

