GROUP ON EARTH OBSERVATIONS

GEOGLAM
Global Agricultural Monitoring

GEOGLAM
Global Agricultural Monitoring

Michel Deshayes
GEOGLAM Coordinator
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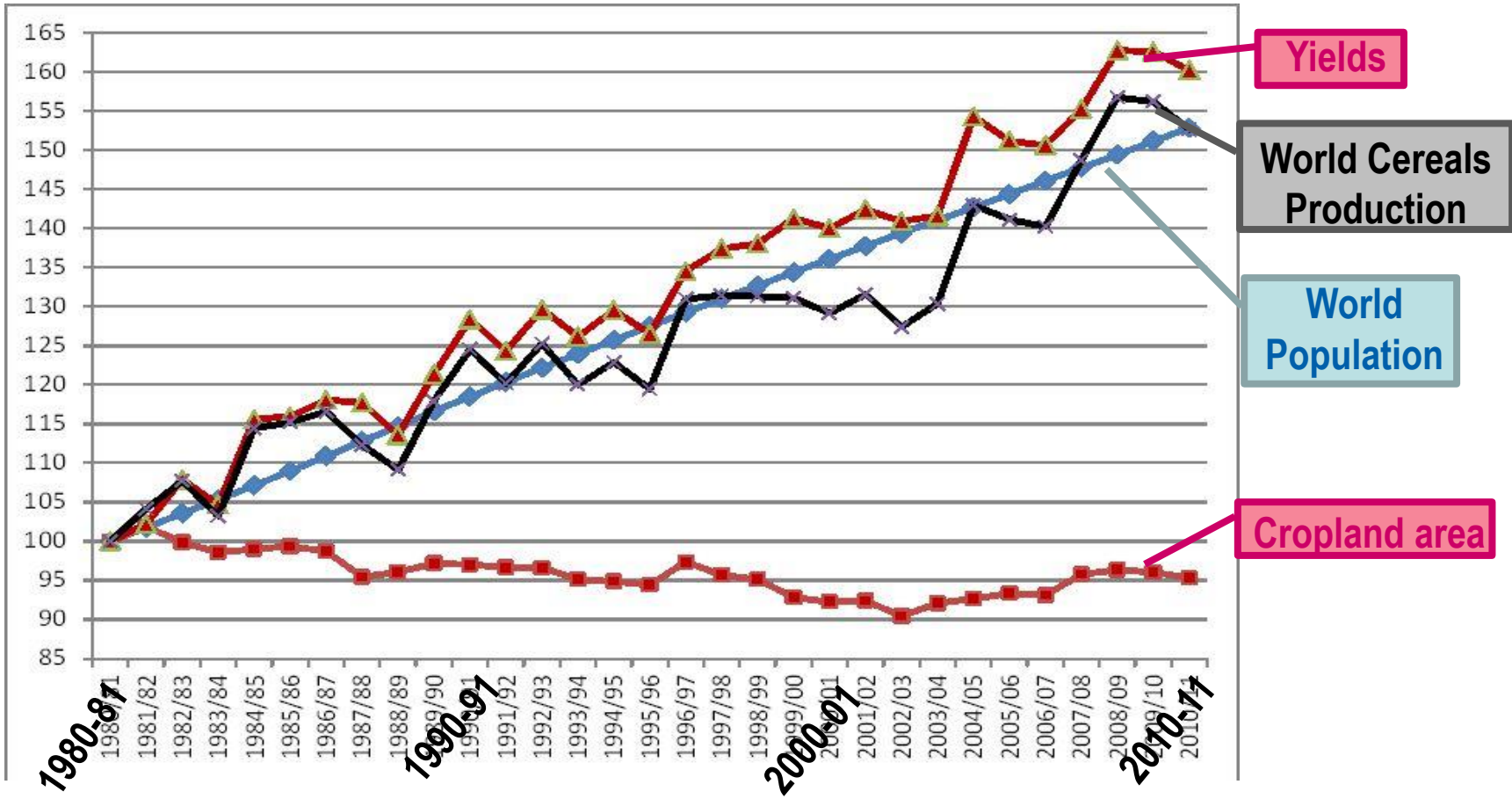
Challenge : Feeding the planet (1/2)



World population and World area, yields and production in cereals (including rice), 1980/81 to 2010/11, base 100 in 1980/81; Source: INRA from USDA/PSD and FAOSTAT data

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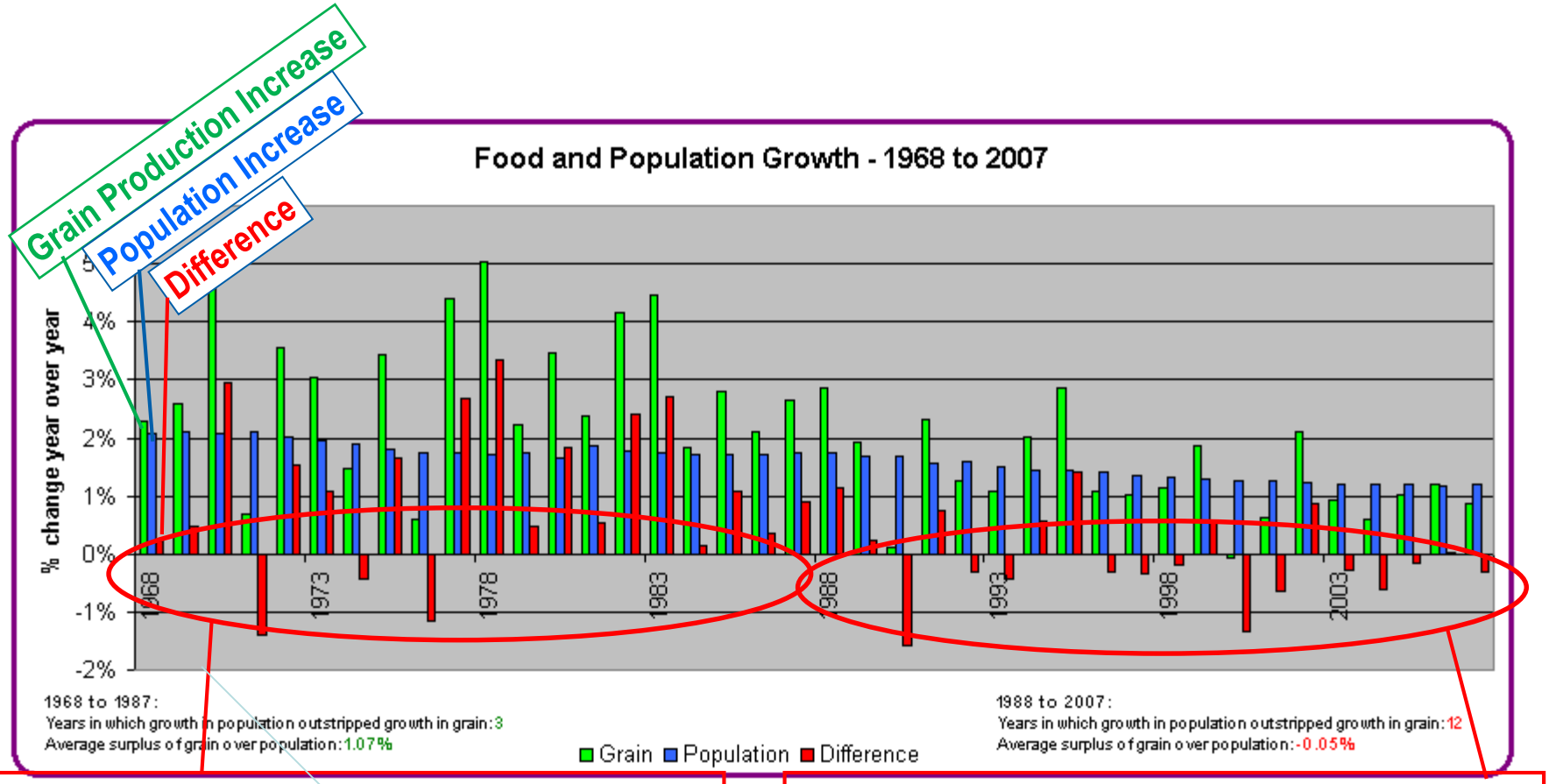
Challenge : Feeding the planet (2/2)

Food production increase vs Population growth



1968-1987 : 3 "deficit" years
Average surplus grain / population : 1.07%

1988-2007 : 12 "deficit" years
Average surplus grain / population : -0.05%

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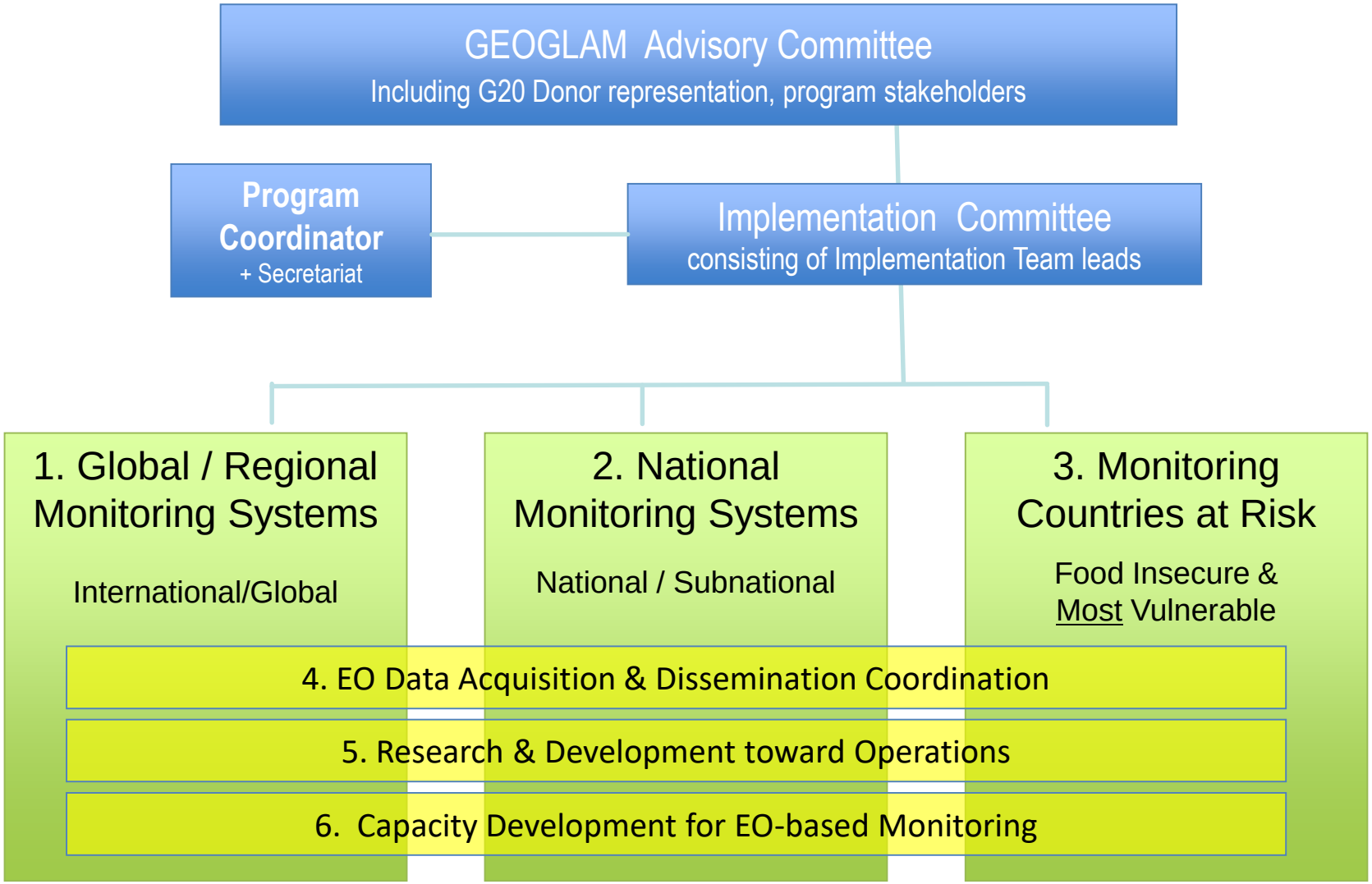
GEOGLAM Structure & Governance



GEOGLAM Actors
GEOGLAM Community of Practice

Open Community made up of international and national agencies concerned with agricultural monitoring including Ministries of Ag, Space agencies, Universities, & Industry

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GEOGLAM Global Agricultural Monitoring

GEOGLAM Component #1
Global Agricultural Monitoring

1. Global Crop Monitor (<-> AMIS)
2. Global Products for Agricultural monitoring
3. Regional Coordination (Asia-RiCE)

The G20 Agriculture Priority (2011)

G20 Final Declaration – Cannes, November 2011

- *44. We commit to **improve market information and transparency** in order to make international markets for agricultural commodities more effective. To that end, we launched:*
  - *The **"Agricultural Market Information System" (AMIS)** in Rome on September 15, 2011, to improve information on markets ...;*
  - *The **"Global Agricultural Geo-monitoring Initiative" (GEOGLAM)** in Geneva on September 22-23, 2011. This initiative will coordinate satellite monitoring observation systems in different regions of the world in order to enhance crop production projections…*

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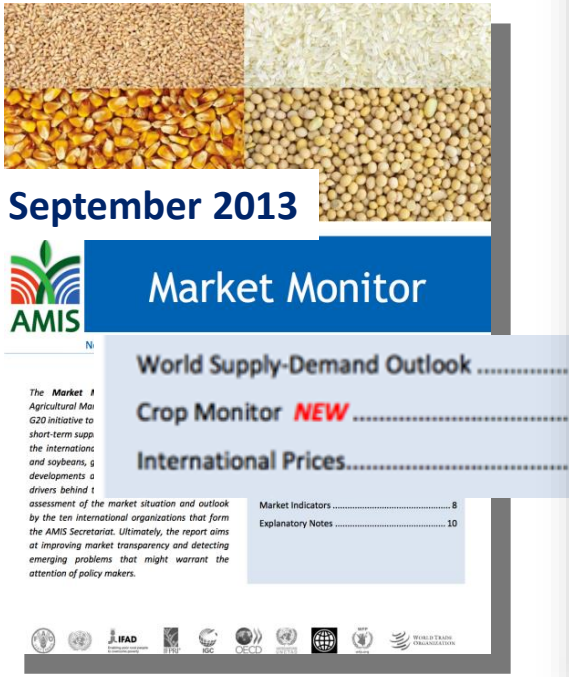
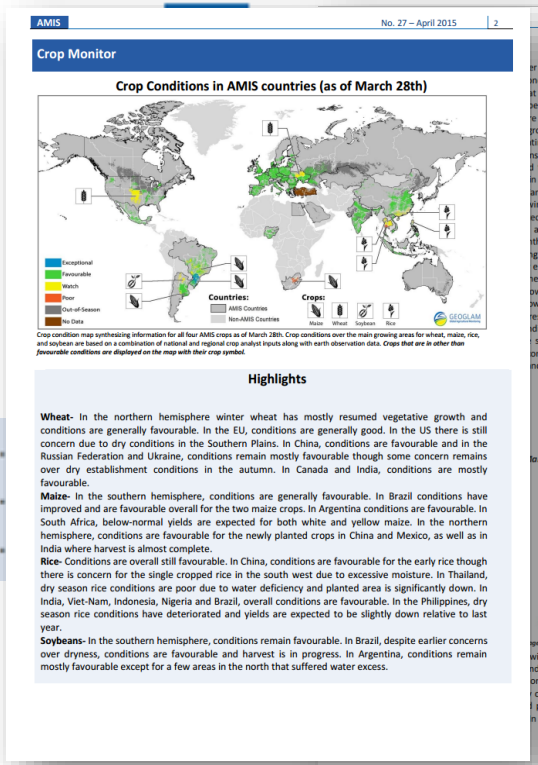
GEOGLAM Global Agricultural Monitoring

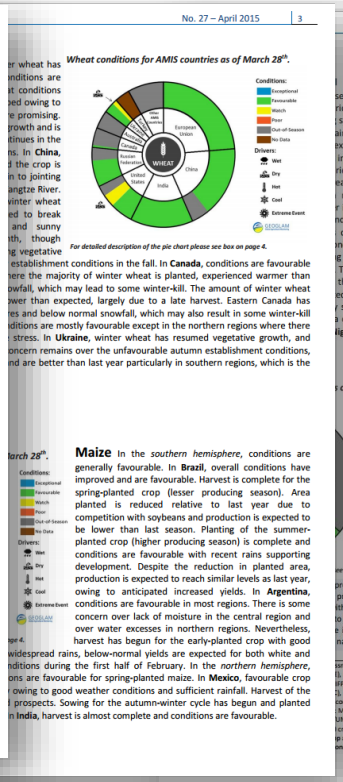
Achievements (1/3)

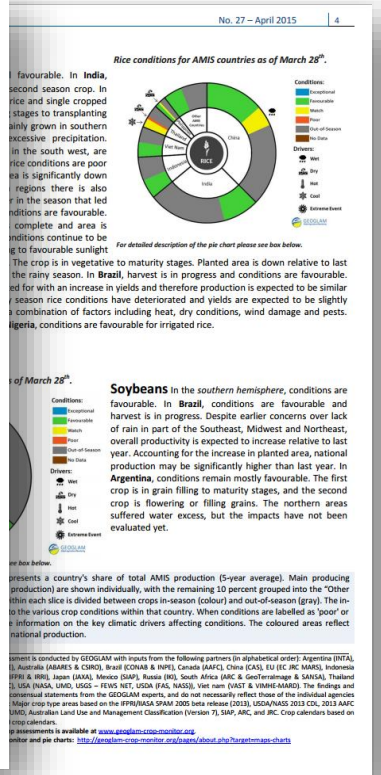
GEOGLAM Crop Monitor Current Status

- **June-July 2013**: **Prototyped crop outlooks** for review by AMIS
- **Sept. 2013**: Started **provision of routine Crop Monitor to AMIS**
- **Since Sept. 2013:** Regular **monthly reporting** and **refining tools and processes** for information collection, maps and synthesis



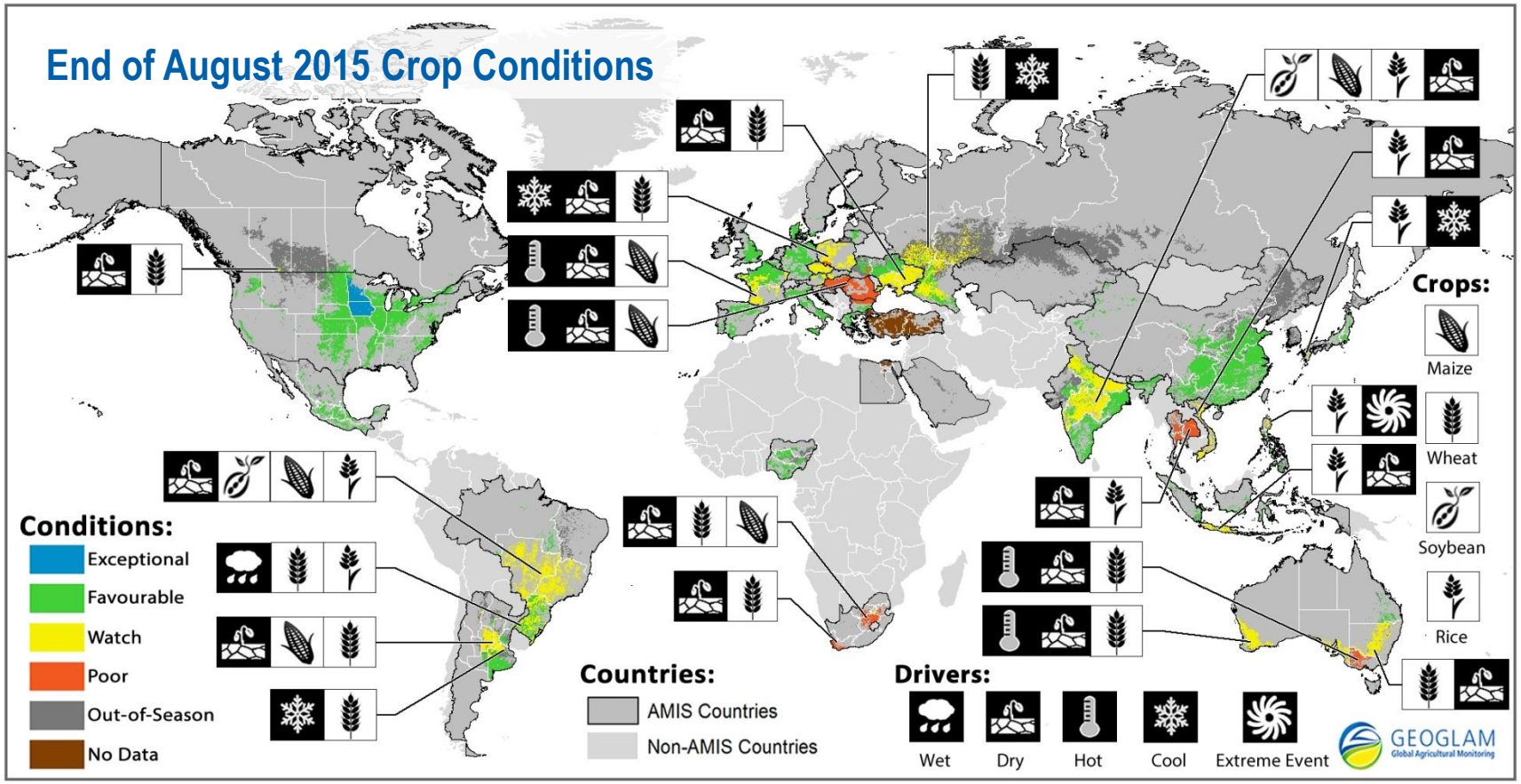






GEOGLAM Crop Monitor for AMIS *(1/3)*

- **Crop Monitor for AMIS: operational since Sept. 2013 !**
  - **40 institutions (24 countries, 4 international organisations, leader: Univ. Maryland)**
- **A presentation of results with graphics and text (1/3)**
  - **a. A global map for the 4 AMIS crops (Maize, Wheat, Soybean, Rice)**



GEOGLAM Crop Monitor for AMIS *(2/3)*

- **A presentation of results with graphics and text (2/3)**
  - **4 synthetic texts**

Maize Conditions for AMIS countries as of June 28th.

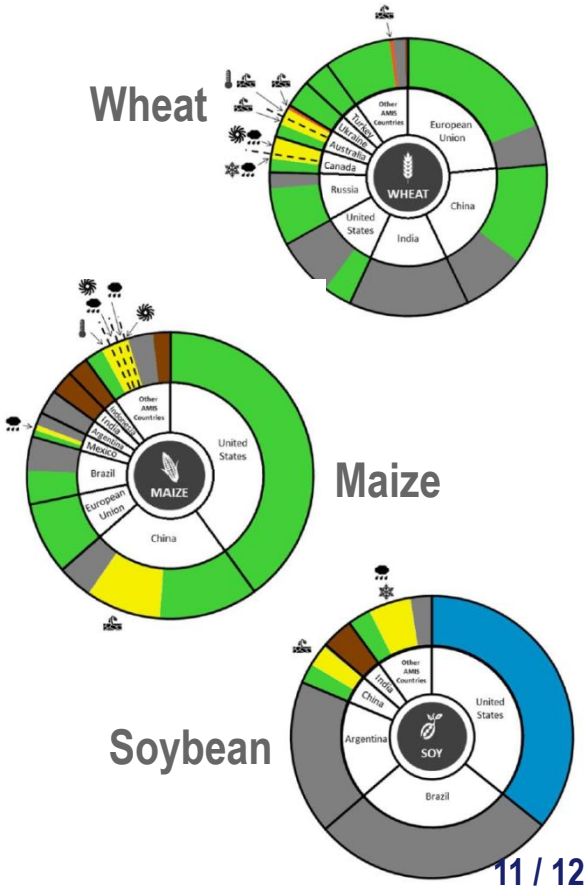
Maize In the *southern hemisphere,* harvest is nearly complete and conditions are favourable. In **Argentina** overall conditions remain favourable and harvest is almost complete with significant delay relative to last year due to excess moisture. In **Brazil** the second maize crop, which is in maturity to harvest stages, is in good condition. In the *northern hemisphere,* conditions are generally favourable at this early stage of the season. In the **US**, conditions remain good despite heavy rains in the northern plains. In the **EU**, the crop is still in early development stages with a promising start to the season. In **Russia**, moisture conditions are favourable for the emergence and establishment stages. In **Ukraine**, moisture conditions are good for crop development while temperatures have been slightly cool. In **China**, overall conditions remain favourable and the crop is between seedling to flowering stages. There is some concern over pockets of dryness in central growing regions. In **Mexico** conditions are good across the country. Harvest of the winter crop is progressing and production is expected to be higher than last year. Sowing of the spring-summer crop is at its peak, and favourable conditions prevail, though there are some slight delays due to heavy rains in the southwestern regions. In **Nigeria**, conditions are mostly favourable owing to good moisture in central and southern regions where maize is in maturity stages. There is some concern over the northern drier region where warm temperatures and long dry spells, mainly in May and early June, affected maize that is in early vegetative stages.

GEOGLAM Crop Monitor for AMIS *(3/3)*

- **A presentation of results with graphics and text (cont')**

  c. 4 synthetic pie-charts

  - sectors proportional to countries average share of world production
  - colors according to local crop conditions
  - symbols to explain reasons for bad conditions

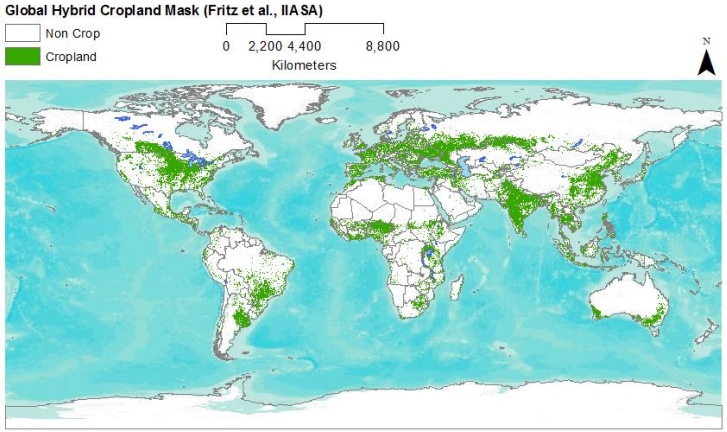


Achievements (2/3)

Development of Baseline Datasets as inputs to Agricultural Monitoring Strategy

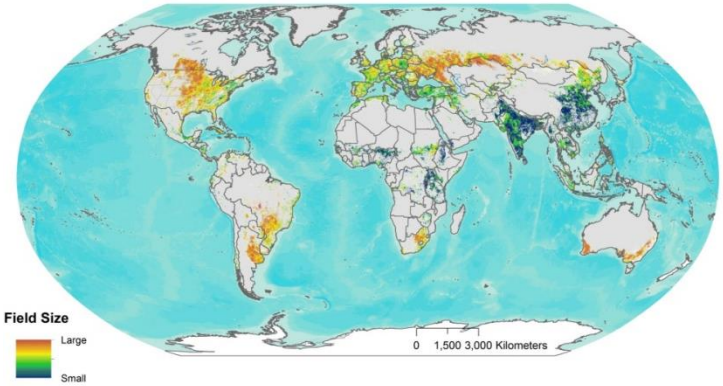
Cropland Distribution

(Fritz et al., IIASA)



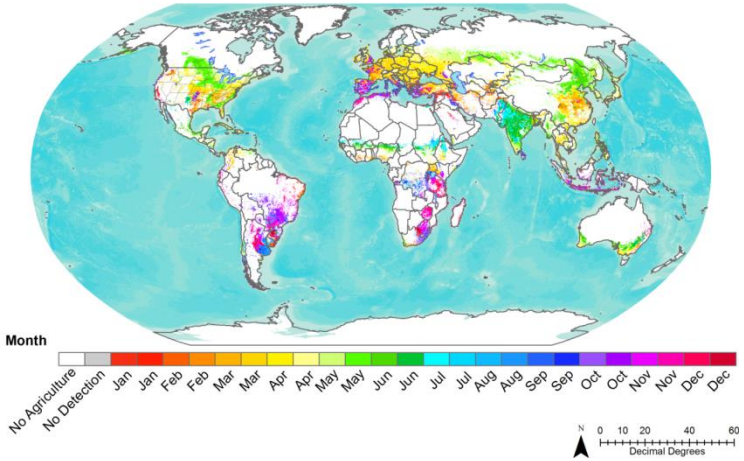
Field Size Distribution

(Fritz et al., IIASA)



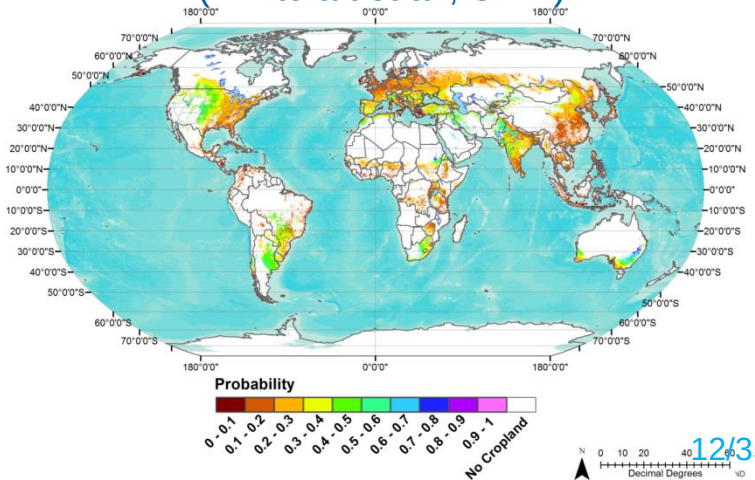
When are the crops growing?

(Whitcraft et al., UMD)



How do clouds impact clear views?

(Whitcraft et al., UMD)



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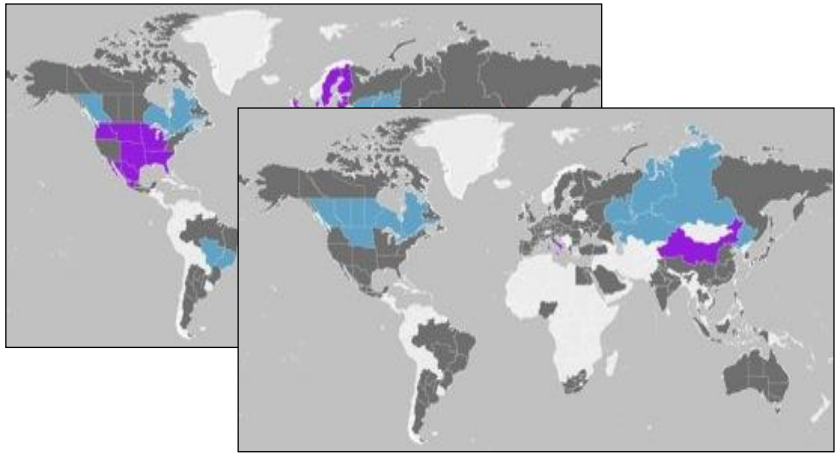
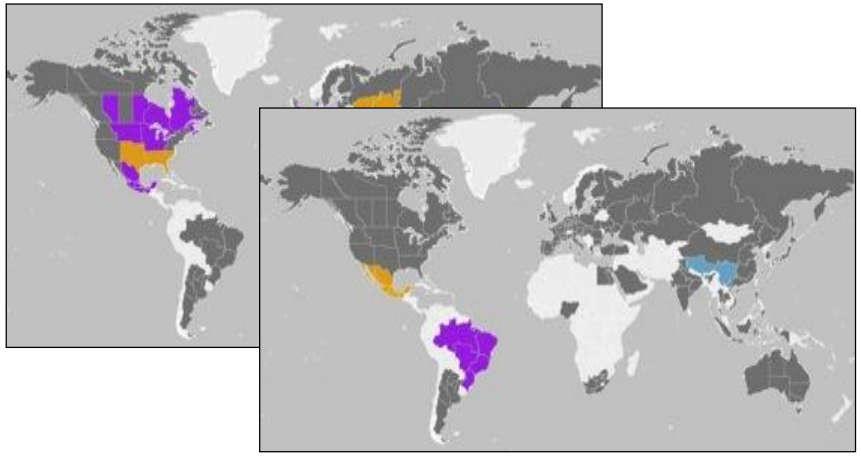
GEOGLAM Global Agricultural Monitoring

Best Available Multi-Season Crop Calendars

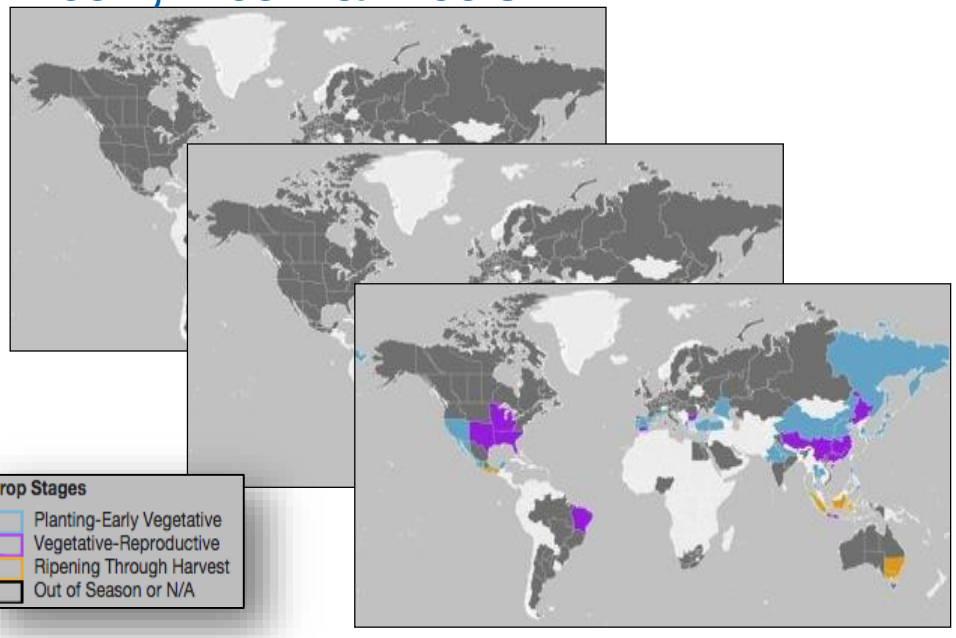
Winter & Spring Wheat



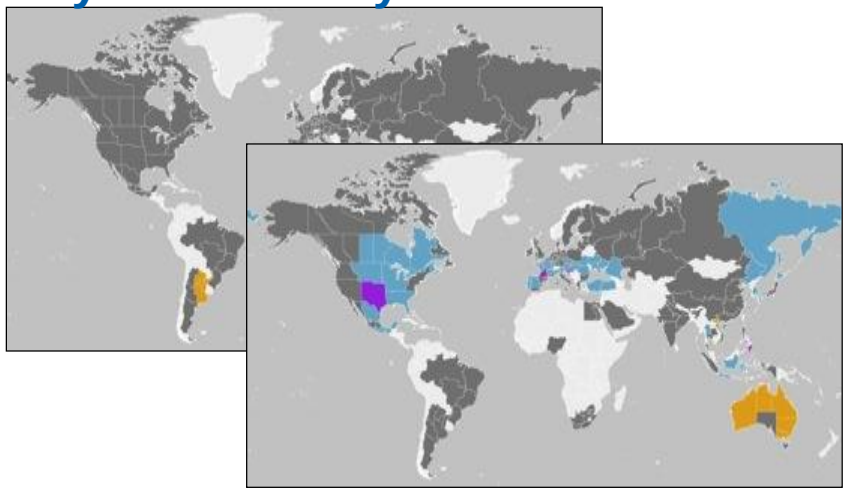
Maize 1 & Maize 2



Rice 1, Rice 2 & Rice 3



Soybean 1 & Soybean 2

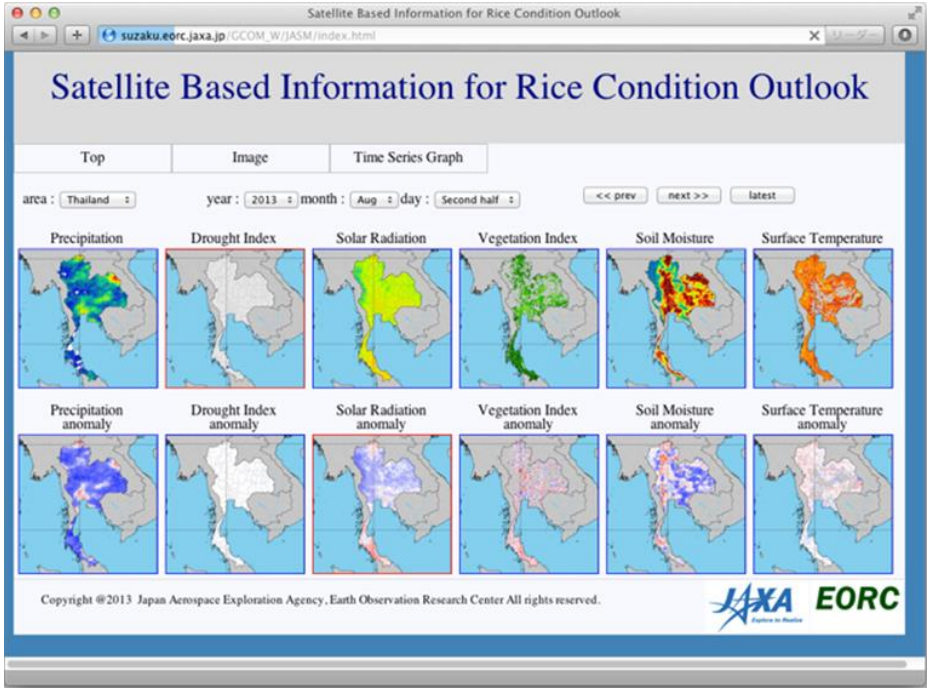


Based on Crop Monitor Partner Inputs

Achievements (3/3)

Asia-RiCE – Asian Rice Monitoring

- **A multi-national project** led by Japan (JAXA), with collaborations in ASEAN+3 countries and India
- **A regional view** using agro-meteorological data derived from low resolution optical satellite imagery (MODIS, GCOM-W, TRMM and others)
- **A local view** to estimate rice crop area and production using available radar and other satellite data with ground observation data and statistical information (test-sites in Indonesia, Thailand and Vietnam)

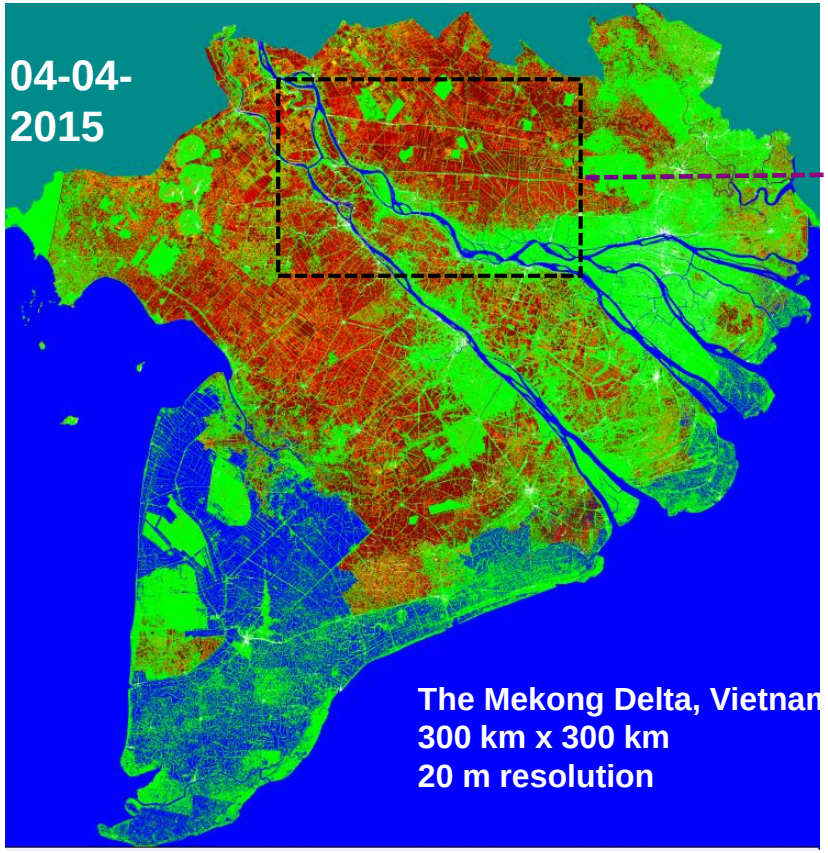


http://www.asia-rice.org

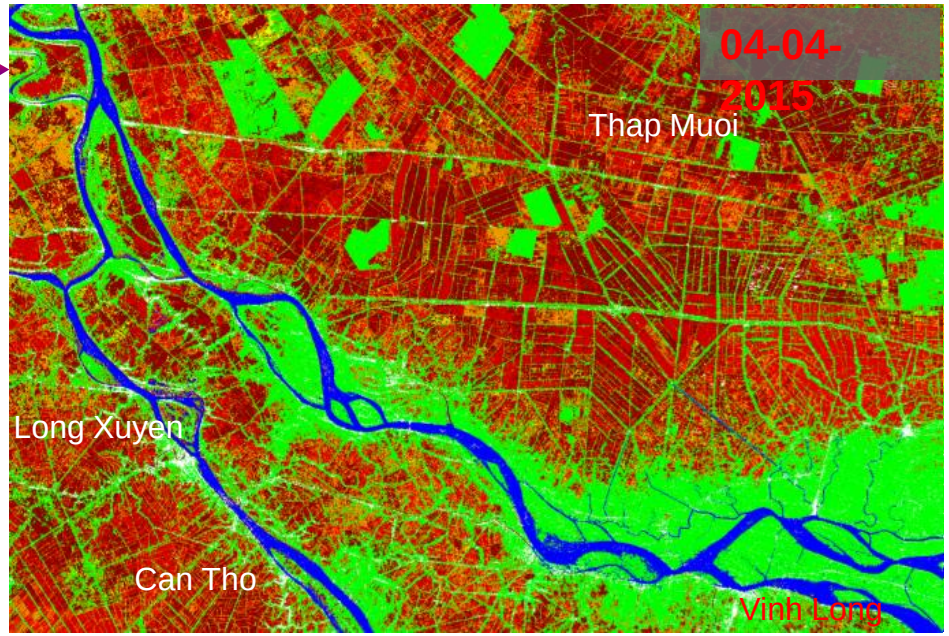
Asia-RiCE

Rice monitoring using Sentinel-1A data

Monitoring of Winter-Spring rice



100 km x 70 km, 20 m resolution



- Rice: early stage
- Rice: tillering stage
- Rice: reproductive stage
- Rice: maturity stage
- Non rice (forest, other LULC)
- Water (ocean, river, aquaculture)
- Land outside the Vietnam Mekong delta

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GEOGLAM Component #1
Global Agricultural Monitoring

RAPP

Rangelands and Pasture Productivity

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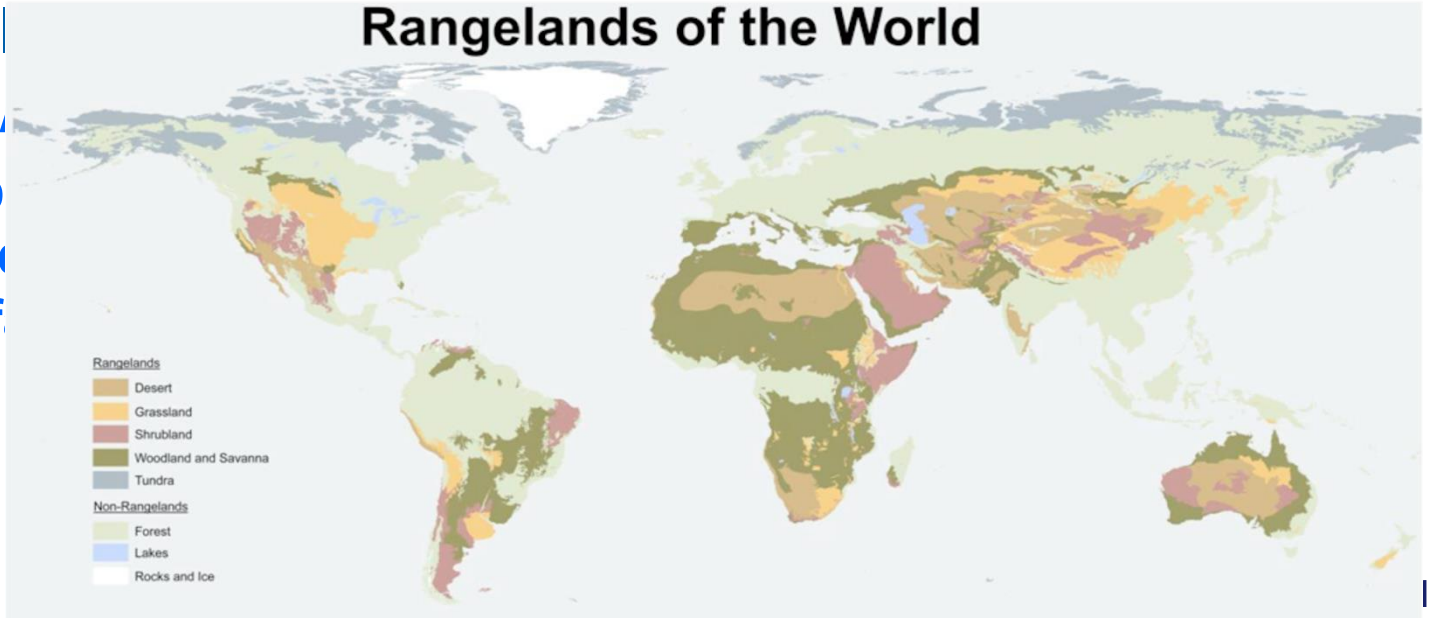
GEOGLAM Global Agricultural Monitoring

Future Achievement

RAPP - Rangelands and Pasture Productivity

- **Objectives**
  - establish a dedicated global system for observing pastures & rangeland status, biomass dynamics & productivity
  - more effective planning based on accurate forecasts of pasture & rangelands productivity variability.
  - improved global understanding of risk across all landscapes as climate & land use change through the addition of these lands into global agricultural monitoring.



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GEOGLAM Component #2
National Monitoring Systems

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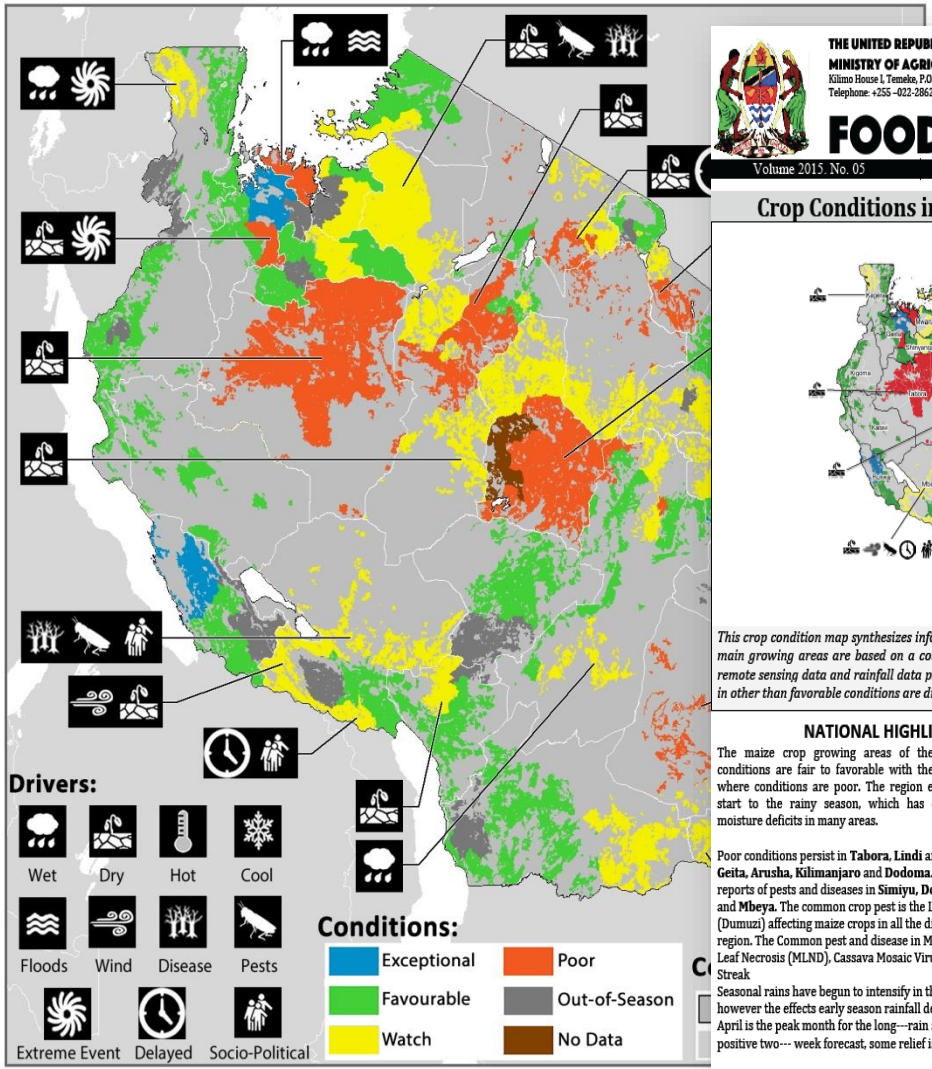
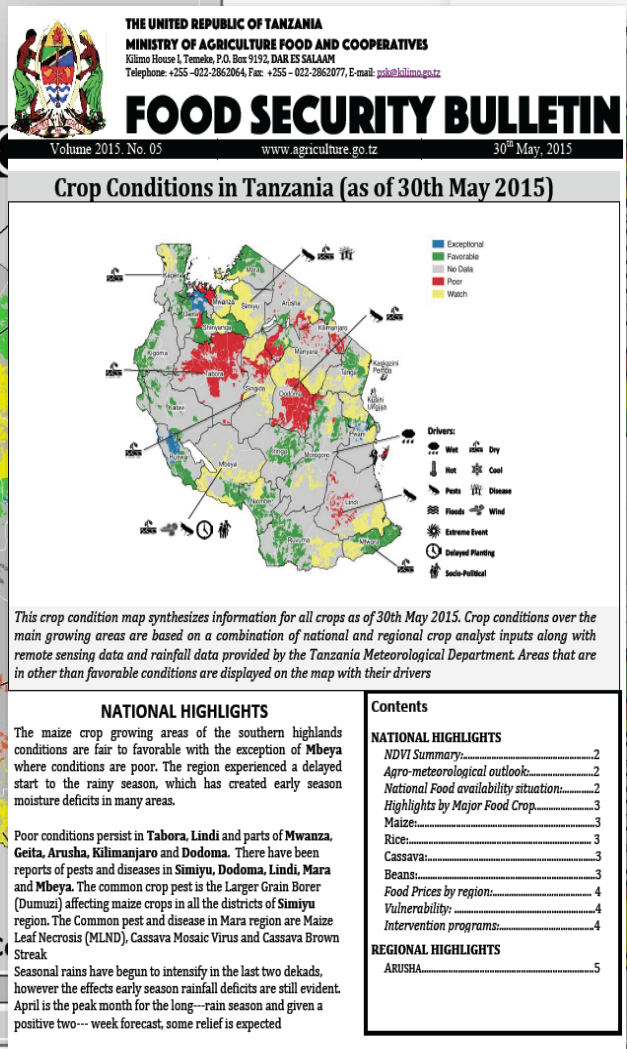
STARS

GEOGLAM Global Agricultural Monitoring

Initiation of National Crop Monitors:

Tanzania Example





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MINISTRY OF AGRICULTURE FOOD AND COOPERATIVES
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FOOD SECURITY BULLETIN

Volume 2015. No. 05 www.agriculture.go.tz 30th May, 2015

Crop Conditions in Tanzania (as of 30th May 2015)

This crop condition map synthesizes information for all crops as of 30th May 2015. Crop conditions over the main growing areas are based on a combination of national and regional crop analyst inputs along with remote sensing data and rainfall data provided by the Tanzania Meteorological Department. Areas that are in other than favorable conditions are displayed on the map with their drivers

NATIONAL HIGHLIGHTS

The maize crop growing areas of the southern highlands conditions are fair to favorable with the exception of **Mbeya** where conditions are poor. The region experienced a delayed start to the rainy season, which has created early season moisture deficits in many areas.

Poor conditions persist in **Tabora**, **Lindi** and parts of **Mwanza**, **Geita**, **Arusha**, **Kilimanjaro** and **Dodoma**. There have been reports of pests and diseases in **Simiyu**, **Dodoma**, **Lindi**, **Mara** and **Mbeya**. The common crop pest is the Larger Grain Borer (Dumuzi) affecting maize crops in all the districts of **Simiyu** region. The Common pest and disease in Mara region are Maize Leaf Necrosis (MLND), Cassava Mosaic Virus and Cassava Brown Streak

Seasonal rains have begun to intensify in the last two dekads, however the effects early season rainfall deficits are still evident. April is the peak month for the long---rain season and given a positive two--- week forecast, some relief is expected

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Agro-meteorological outlook:.....2
National Food availability situation:.....2
Highlights by Major Food Crop.....3
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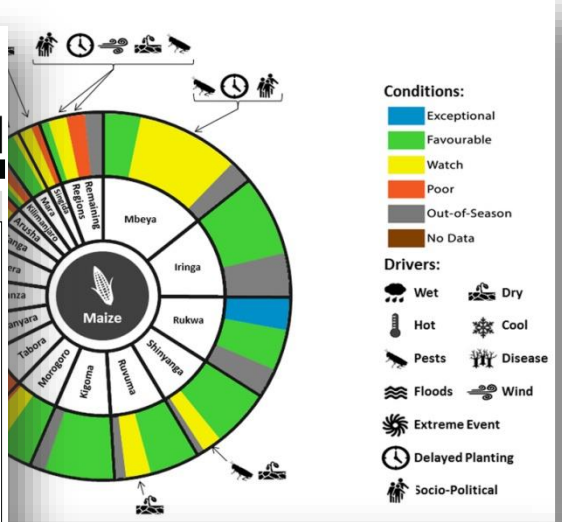
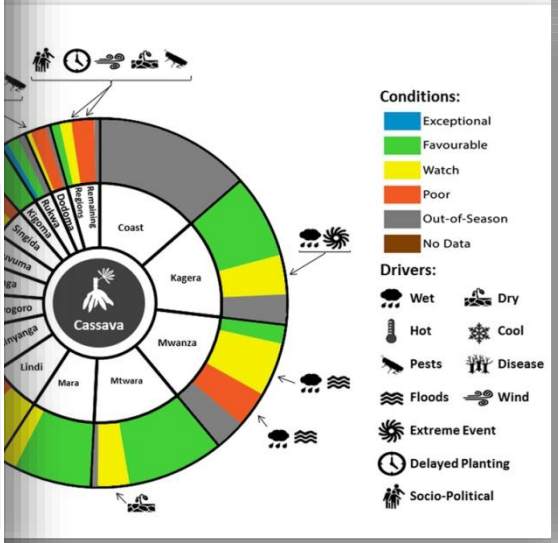
Rice:.....3
Cassava:.....3
Beans:.....3
Food Prices by region:.....4
Vulnerability:.....4
Intervention programs:.....4

REGIONAL HIGHLIGHTS
ARUSHA.....5





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GEOGLAM Global Agricultural Monitoring

GEOGLAM Component #3
Countries at risk

Countries at risk

- **Subsistence agriculture & Pastoralism**
  - **basis of livelihood systems in many countries**
  - **highly climate-sensitive**
- **Climate station networks not well working (sparse, bad or late reporting)**
- **Satellite remote sensing & models can fill the gap**
  - **and provide the basis for early detection of agricultural droughts**
- ***On all continents:***
  - ***Africa* : Senegal, Mauritania, Mali, Burkina, Niger, Chad, Somalia, Sudan, Eritrea, Ethiopia, Djibouti, Somalia, Kenya, Uganda, Rwanda, Tanzania, Zambia, Mozambique, Zimbabwe, Botswana, South Africa, Lesotho, Swaziland…**
  - ***Central America:* Guatemala, Honduras, El Salvador, Nicaragua**
  - ***Caribbean:* Haiti**
  - ***Central Asia:* Afghanistan**

Early Warning Crop Monitor (EWCM)

- **Existing Early Warning activities**
  - GEOGLAM partners having Monitoring activities on Countries at Risk : FAO (GIEWS), WFP (VAM), USA (FEWSNET), EU (JRC-FS), CN (CropWatch-FS)…
- **Early Warning Crop Monitor (EWCM)**
  - Agreement on organising a collaborative monitoring of Countries at Risk
  - 1st Meeting: IMAAFS Conference, Addis-Ababa, Oct. 2014
  - 2nd Meeting: FAO Rome, May 2015 (prior to AMIS meeting)
  - On-going: Development of a prototype Website, allowing partners inputs and data & information sharing (next slide)

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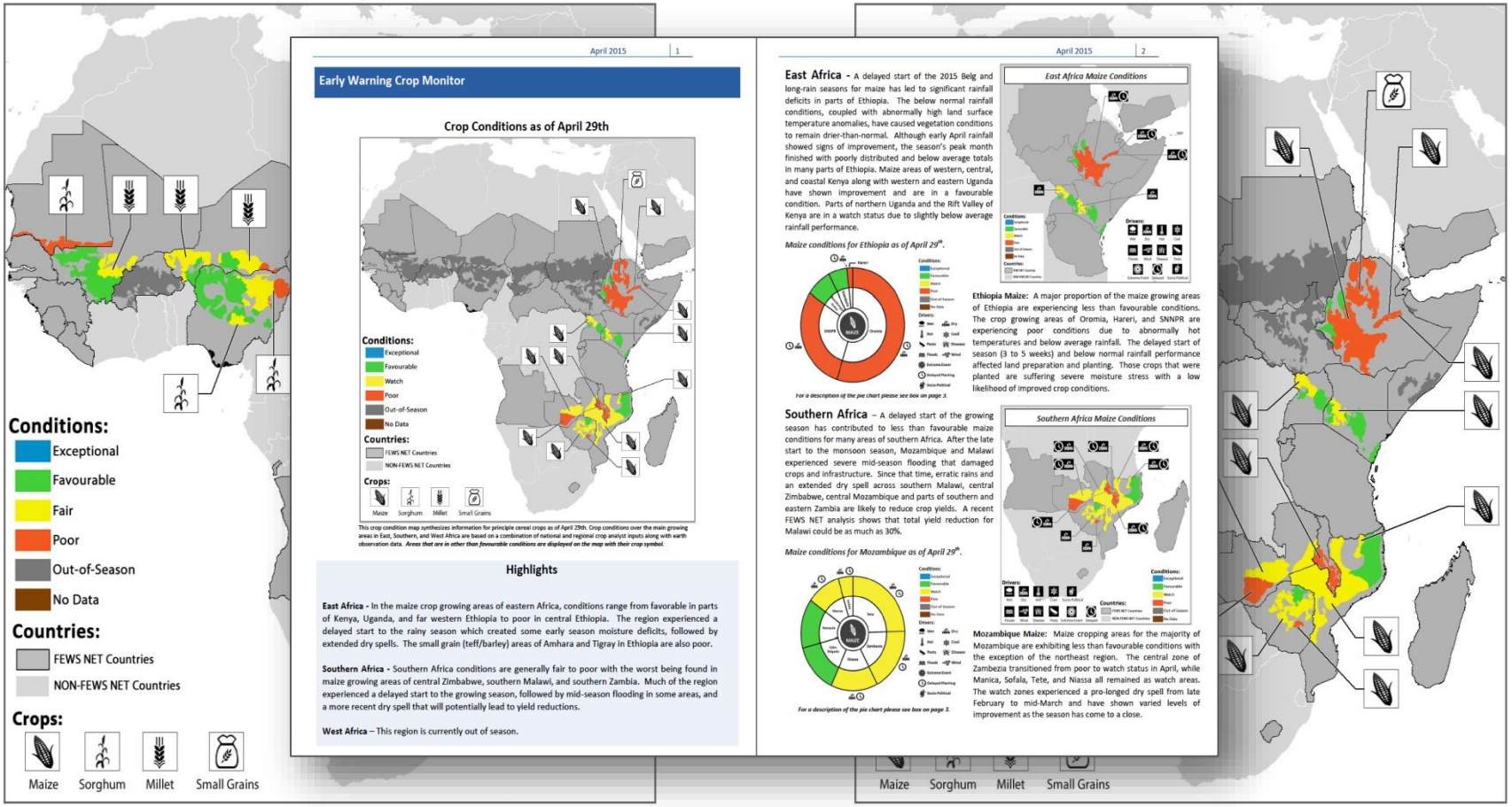
GEOGLAM Global Agricultural Monitoring

Developing an Early Warning Crop Monitor

FEWS NET · WFP World Food Programme · European Commission · University of Maryland · FAO

September 2014 Synthesis

April 2015 Synthesis



Results of an early FEWS NET prototype showing two time periods with different zones in season

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GEOGLAM Global Agricultural Monitoring

GEOGLAM Component #4
Cooperation with Space Agencies

CEOS – Committee on Earth Observation Satellites

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GEOGLAM Global Agricultural Monitoring

GEOGLAM & CEOS Collaboration

Ag Requirements to EO Requirements

- Ad-hoc advisory group translating *requirements from science community* *→Earth observation requirements*

Target Products						
Crop Mask	Crop Type Area and Growing Calendar	Crop Condition Indicators	Crop Yield	Crop Biophysical Variables	Environ. Variables	Ag Practices / Cropping Systems

Req#	Spatial Resolution	Spectral Range	Effective observ. frequency (cloud free)*	Sample Type	Field Size
Coarse Resolution Sampling (>100m)					
1	500 - 2000 m	thermal IR + optical	Daily	Wall-to-Wall	All

	Moderate Resolution Sampling (10 to 100m)											
4	10-70m	optical +	Monthly (min 2 out of season + 3 in season).	Cropland Extent	All	X	L/M					X
			Required every 3 years.	small fields								
11	< 5 m	optical	1 to 2 per month	Refined Sample	All (Demo)		X		X			X

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GEOGLAM Global Agricultural Monitoring

GEOGLAM & CEOS Collaboration

EO Requirements to Data Streams

- Ad-hoc advisory group translating *requirements from science communi →Earth observati requirements*
- **… and converting them into an acquisition strategy by linking *EO requirements → Data streams***

Spatial Resolution	Spectral Range	Sample Type	Field Size	Effective observ. frequency (cloud free)*
500 - 2000 m	thermal IR + optical	Wall-to-Wall	All	Daily

4	Landsat 7/8 (30m)	ResourceSat-2 (56m) / Sentinel-2A (20m)	20-70m	optical + SWIR + TIR	Cropland Extent	season + 3 in season). Required every 3-5 years.	all year

Req#	Proposed Primary Missions	Proposed Secondary Missions	Proposed Potential Missions
	Coarse Resolution Sampling (>100m)		
1	Aqua/Terra (1000m) NPP (750m) Sentinel-3A (500m)	SPOT-5 (1150m) Proba-V (1000m)	

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GEOGLAM Component #5
Research & Development

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GEOGLAM Global Agricultural Monitoring

JECAM: Joint Experiment for Crop Assessment and Monitoring

- A R&D network to develop operational agricultural monitoring systems
- A network of sites representative of the world's cropping systems
- A focus for international satellite data acquisition by CEOS (*Com^{tee} of Earth Observ. Satellites)*
- JECAM Program Office coordinated by AAFC-Canada and UCL-Belgium
- Developing linkages with AgMIP sites and modeling community

www.jecam.org

JECAM

GEOGLAM Global Agricultural Monitoring

Joint Experiment for Crop Assessment and Monitoring

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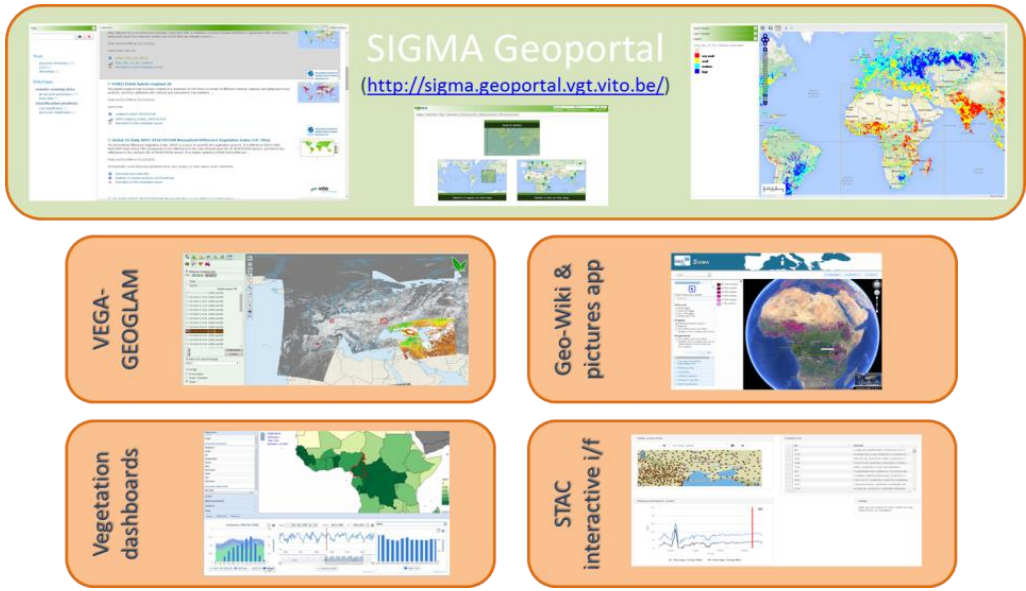
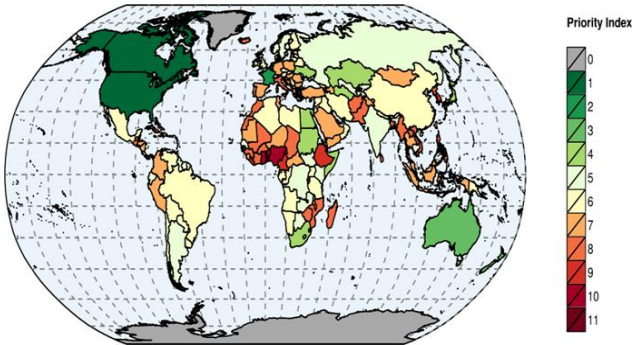
SIGMA Achievements

- **Data**
  - SIGMA distribution facility
  - SIGMA Analysis facility (VEGA)
  - SIGMA Validation facility(GeoWiki)
  - Agricultural database (STAC)
- **Standards and Best practices**
  - Cropland definition,…
  - Cross site experiments
    - *Land cover mapping*
    - *Yield estimations*



- **Priority map for land cover mapping + Global cropland map**
- **Capacity Needs Assessment-> selection of Priority countries**
- **Models developed for Environmental Impact Assessment of Agricultural land use change**



- More info ->
  SIGMA meeting 19-20 November

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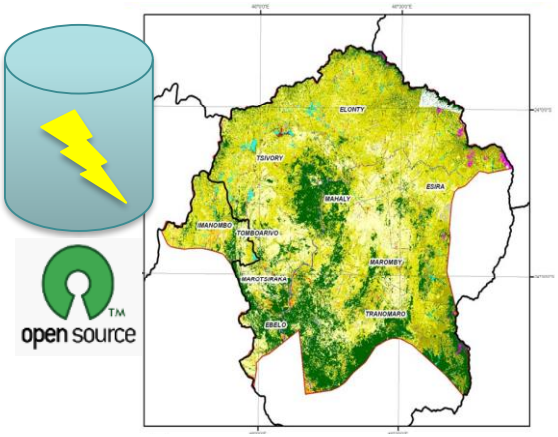
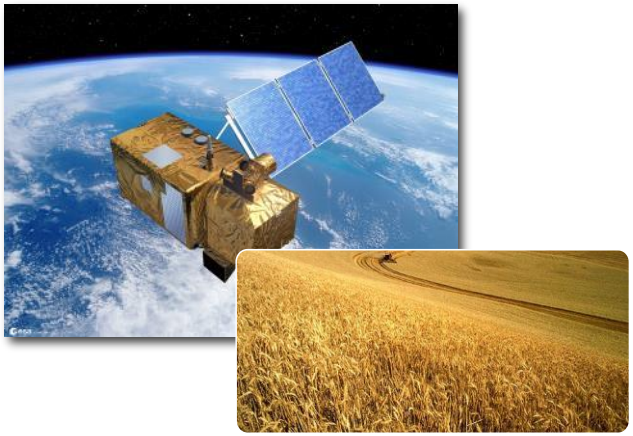
Sen2-Agri Achievements

GEOGLAM Global Agricultural Monitoring

Users Req. & Methods Selection 2014 → **Prototypes of EO Products 2015** → **Demonstration & Validation 2016**

JECAM
Joint Experiment for Crop Assessment and Monitoring





- ✓ User Requirements
- ✓ 4 products specification
- ✓ Methods benchmarking and selection
- ✓ System design completed

- ✓ 4 agriculture products developed (4 publications)
- ✓ Open source system completely developed
- ➢ Prototypes & validation based on SPOT 5 Take 5

- ➢ 3 national use cases
- ➢ 5 local use cases
- ➢ Sen2Agri system training
- ➢ Transfer to national users

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Achievements Summary

GEOGLAM Global Agricultural Monitoring

Global Crop Monitor (UMD-NASA)

Asia-RiCE reporting to GCM (JAXA-ASEAN)

Asia-RiCE transfer of methods (JAXA-ASEAN)

CB projects in Argentina, Mongolia, Pakistan, Ukraina…

Early Warning Crop Monitor (FEWSNET)

Close links with Committee of Earth Observation Satellites (CEOS)

Rangelands & Pasture Productivity (RAPP-CSIRO)

1. Global / Regional System of Systems

main producer countries, major commodities

2. National Monitoring Systems

for agricultural monitoring using earth observation

3. Monitoring countries at risk

food security assessment

4. EO data coordination

5. Method improvement through R&D coordination

6. Capacity Development for EO-based Monitoring

Joint Experiment for Crop Assessment & Monitoring – JECAM (AAFC – UCL)

EC FP7 SIGMA project *Stimulating Innovation for Global Monitoring of Agri-culture and its Impact on the Environment in support of GEOGLAM* (VITO)

Data services prototypes developed/ tested NASA/CEOS SEO

ESA projects:
- SEN2-FOR-AGRI (UCL) *4 Agri. Products + Software + 4 Use cases*
- GEORICE (CESBIO) *Radar for Rice growth monitoring*

STARS (BM Gates) *Spurring a Transfor-mation for Agricul-ture through Remote Sensing* (ITC-UMD)

GEONetCast Satellite Broadcasting

GEOGLAM : a global collaborative initiative with already significant achievements…

… with a need for continuous support to address monitoring of continuously changing global agricultural issues