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.
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%
GEOGLAM Structure & Governance

GEOGLAM Advisory Committee
Including G20 Donor representation, program stakeholders

Implementation Committee
consisting of Implementation Team leads

Program Coordinator
+ Secretariat

1. Global / Regional Monitoring Systems
   International/Global

2. National Monitoring Systems
   National / Subnational

3. Monitoring Countries at Risk
   Food Insecure & Most Vulnerable

4. EO Data Acquisition & Dissemination Coordination

5. Research & Development toward Operations

6. Capacity Development for EO-based Monitoring
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
GEOGLAM Component #1
Global Agricultural Monitoring

1. Global Crop Monitor (↔ AMIS)
2. Global Products for Agricultural monitoring
3. Regional Coordination (Asia-RiCE)
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**…
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

September 2013

Market Monitor

World Supply-Demand Outlook

Crop Monitor NEW

International Prices
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)

End of August 2015 Crop Conditions
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)

When are the crops growing?
(Whitcraft et al., UMD)

**Field Size Distribution**
(Fritz et al., IIASA)

How do clouds impact clear views?
(Whitcraft et al., UMD)
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

04-04-2015

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

100 km x 70 km, 20 m resolution

04-04-2015

Thap Muoi

Long Xuyen

Can Tho

Vinh Long

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
GEOGLAM Component #1
Global Agricultural Monitoring
RAPP
Rangelands and Pasture Productivity
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.
GEOGLAM Component #2
National Monitoring Systems
Initiation of National Crop Monitors: Tanzania Example

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 Mbeya, Gombe, Arusha, Kilimanjaro and Dodoma. There have been reports of pests and diseases in Tanga, Dodoma, Lindi, Mara and Mbeya. The common crop pest is the larger green borer (Dimorphic) affecting maize crops in all the districts of Tanga region. The Common pest and disease in Mara region are Maize Leaf Nosema (MLN), Camausa Mosaic Virus and Camausa Brown Streak.

Seasonal rains have begun to intensify in the last two decades, however the effects early season rainfall deficits are still evident. April is the peak months for the long—rain season and given a positive two—week forecast, some relief is expected.
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
  – 1\textsuperscript{st} Meeting: IMAAFS Conference, Addis-Ababa, Oct. 2014
  – 2\textsuperscript{nd} 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)
Developing an Early Warning Crop Monitor

September 2014 Synthesis

April 2015 Synthesis

Results of an early FEWS NET prototype showing two time periods with different zones in season.
GEOGLAM Component #4
Cooperation with Space Agencies

CEOS – Committee on Earth Observation Satellites
GEOGLAM & CEOS Collaboration
Ag Requirements to EO Requirements

• Ad-hoc advisory group translating requirements from science community → Earth observation requirements
GEOGLAM & CEOS Collaboration

**EO Requirements to Data Streams**

- Ad-hoc advisory group translating requirements from science community → Earth observation requirements
- ... and converting them into an acquisition strategy by linking EO requirements → Data streams

### Table: EO Requirements to Data Streams

<table>
<thead>
<tr>
<th>Spatial Resolution</th>
<th>Spectral Range</th>
<th>Sample Type</th>
<th>Field Size</th>
<th>Effective observ. frequency (cloud free)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 - 2000 m</td>
<td>thermal IR + optical</td>
<td>Wall-to-Wall</td>
<td>All</td>
<td>Daily</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Req#</th>
<th>Proposed Primary Missions</th>
<th>Proposed Secondary Missions</th>
<th>Proposed Potential Missions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aqua/Terra (1000m) NPP (750m) Sentinel-3A (500m)</td>
<td>SPOT-5 (1150m) Proba-V (1000m)</td>
<td></td>
</tr>
</tbody>
</table>

Note: GEOGLAM & CEOS Collaboration

GEO Global Agricultural Monitoring

**Adaptation & Implementation of GEO Harmonized Observation Requirements**
GEOGLAM Component #5
Research & Development
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 (Committee 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
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
Sen2-Agri Achievements

- **Users Req. & Methods Selection 2014**
  - User Requirements
  - 4 products specification
  - Methods benchmarking and selection
  - System design completed

- **Prototypes of EO Products 2015**
  - 4 agriculture products developed (4 publications)
  - Open source system completely developed
  - Prototypes & validation based on SPOT 5 Take

- **Demonstration & Validation 2016**
  - 3 national use cases
  - 5 local use cases
  - Sen2Agri system training
  - Transfer to national users
Achievements Summary

1. Global / Regional System of Systems
   - Global Crop Monitor (UMD-NASA)
   - Rangelands & Pasture Productivity (RAPP-CSIRO)

2. National Monitoring Systems
   - Asian-Rice transfer of methods (JAXA-ASEAN)
   - CB projects in Argentina, Mongolia, Pakistan, Ukraine...

3. Monitoring countries at risk
   - Early Warning Crop Monitor (FEWSNET)

4. EO data coordination

5. Method improvement through R&D coordination
   - EC FP7 SIGMA project
     Stimulating Innovation for Global Monitoring of Agriculture and its Impact on the Environment in support of GEOGLAM (VITO)
   - Joint Experiment for Crop Assessment & Monitoring – JECAM (AAFC – UCL)

6. Capacity Development for EO-based Monitoring
   - Data services prototypes developed/ tested NASA/CEOS SEO
   - GEOCast Satellite Broadcasting
   - STARS (BM Gates) Spurring a Transformation for Agriculture through Remote Sensing (ITC-UMD)
   - ESA projects:
     - SEN2-FOR-AGRI (UCL) 4 Agri. Products + Software + 4 Use cases
     - GEORICE (CESBIO) Radar for Rice growth monitoring

GEOGLAM: a global collaborative initiative with already significant achievements...
...with a need for continuous support to address monitoring of continuously changing global agricultural issues