GEOGLAM
Global Agricultural Monitoring

Michel Deshayes
mdeshayes@geosec.org
Context (1/3)
Recent volatility of Agricultural Prices

Monthly Wheat Prices 1960-2011($/Metric Ton)
Source: World Bank

2008 Price hikes
Droughts: Australia & Ukraine

2010/11 Price hikes
Drought: Russia

1971/2’s price hike
Drought: Russia

Landsat 1
Launched (1972)

Nominal wheat price in US $/metric Ton
Context (2/3)
Link Food Prices - Production Forecasts

- Aggregation of Wheat Production Forecasts from Main Wheat Export Countries vs. International Market Price – Period 2010-2012
Context (3/3)

All-crop volatility and Societal impact

Food price dynamics not crop specific

Maize
Corn Monthly Prices
$/MT 2002-2012

Soybeans
Soybeans Monthly
Price $/MT 2002-2012

Wheat
Wheat Monthly
Price$/MT 2002-2012

Societal impact is global
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...
2011: The G20 Agriculture Priority
GEOGLAM & AMIS

- Two initiatives to increase information availability, quality and transparency:
  - GEOGLAM: improve information on supply (GEO)
  - AMIS: improve information on markets (FAO)
GEOGLAM Objectives

• To strengthen the international community’s capacity to produce and disseminate relevant, timely and accurate information and forecasts on agricultural production at national, regional and global scales, through reinforced use of Earth Observations

GEOGLAM is a coordination initiative, aiming at:
- supporting, strengthening and articulating existing efforts
- developing capacities and awareness at national and global level
- disseminating information
GEOGLAM Governance

GEOGLAM Steering Committee
Including G20 Donor representation, program stakeholders

Program Coordinator
+ Secretariat

Implementation Committee
consisting of Implementation Team leads

1. Global / Regional System of Systems
   main producer countries, main commodities

2. National Capacity Development
   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 (eg. JECAM)

6. Data products and information dissemination
GEOGLAM implementation
Phased approach across all 6 components

• Phase 1: Foundation Activities (2012-2014)
  • Build on existing activities
  • Initiate Pilot Projects

• Phase 2: Review and Expansion (2014-2016)
  • Continue/Complete Phase-1 Activities
  • New Starts

• Phase 3: Pre-Operational (2015-2017)
  • Completion of Phase 1 / 2 Projects
  • Geographic Expansion

• Phase 4: Operational Phase
  • from 2017

6 GEOGLAM components

1. Global / Regional System of Systems
   main producer countries, main commodities

2. National Capacity Development
   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 (eg. JECAM)

6. Data products and information dissemination
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 Crop Monitor - Phase 1 Support

• US-NASA
  • Global Soy Area Estimation
  • Drought monitoring system prototype
  • Wheat Yield Forecasting prototype
  • GEOGLAM operations

• US-USDA
  • Pakistan Capacity Building
  • GEOGLAM Operation w. NASA

• Canada
  • JECAM office

• China:
  • CropWatch project

• EU FP 7
  • SIGMA project

• EU-ESA
  • Sentinel-2 for Agriculture project

• CEOS
  • CEOS = Committee on Earth Observation Satellites
  • Provision of satellite imagery to GEOGLAM

• Japan
  • Asia-RICE Project (JAXA + ADB)

• France
  • secondment of GEOGLAM project coordinator

• Gates Foundation
  • Supporting 2 capacity building activities in Africa

• Germany
  • Indicated interest to support GEOGLAM

• Argentina (Ministry of Ag)
  • National capacity building initiative

• Mexico (SIAP)
  • National capacity building initiative
GEOGLAM Component #1
Global Agricultural Monitoring
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)
GEOGLAM Crop Monitoring as input for AMIS

• Objective
  – to develop a transparent, timely, international, qualitative crop condition assessment in primary agricultural production areas highlighting potential hotspots of stress/bumper crops

• GEOGLAM Crop Monitor:
  – an international community process, with international and national agencies, coordinated by UMD, supported by NASA
  – based on evidence from near real time satellite, weather, agromet, and national expert assessments
  – for synthesizing and reviewing data and information
  – and establishing the consensus assessment
  – Results: a monthly 2-page synthesis note for AMIS Market Monitor
    + detailed information and maps on GEOGLAM Crop Monitor Website
**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
Enables comparison among relevant datasets (global, regional and national), by crop type and accounting for crop calendars; enables crop condition labeling and commenting to reflect national expert assessments.
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
GEOGLAM Component #2
Capacities Building
**GEOGLAM Capacity Building Component**

**Ex:** Pakistan Agricultural Information System

(Collaboration among CRS, FAO, SUPARCO, UMD & USDA)

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**Crop type classification**

**Crop condition**

**EO Estimated vs Reported Wheat Production**

\[ R^2 = 0.9191 \]

- RMSE at district level = 72 (1000 MT) ~ 14%
- RMSE at Punjab level = 48 (1000 MT) < 1%
GEOGLAM Component #3
Countries at Risk
Countries at risk

- Livelihood systems are based on subsistence agriculture and/or pastoralism, and are highly climate-sensitive
- Conventional climate station networks are sparse and/or late reporting
- Satellite remote sensing and models fill the gap, and provide the basis for early detection of agricultural drought
- **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
Gaps in Rainfall Station Reporting

- Systematic sample on the 1st, 11th, and 21st of month
- Of the 1232 GTS stations in Africa:
  - 25% missed one or zero reports
  - 40% did not report on any of the 36 days of the sample
Changes in rainfall
Precipitation changes in Kenya, 1980 - 2008

Average Rainfall for 4 consecutive seasons

- Decrease inRainfall in second season rainfall
- Increase in second season rainfall

Since 1980 almost 20% drop in main season rainfall

Decrease in Rainfall
Average of last 4 rainy seasons is ranked lowest

Change in distribution of rainfall in year
- Decrease in main season rainfall
- Increase in second season rainfall

Main season
a. March-April-May
Rainfall Mean

Percent
0 15
79–88 89–98 98–08

Second season
Oct-Nov-December
Rainfall Mean

Percent
0 15
79–88 89–98 98–08

Rainfall in second season is increasing
Satellite Information for Crop Monitoring

Satellite Vegetation Index (NDVI) Difference 2009

Evapotranspiration Yearly Anomaly 2009

Water Requirement Satisfaction Index 2009
GEOGLAM Component #4
Cooperation with Space Agencies

CEOS – Committee on Earth Observation Satellites
**GEOGLAM & Space Agencies Collaboration**

**Ag Requirements to EO Requirements**

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

<table>
<thead>
<tr>
<th>Target Products</th>
<th>Crop Mask</th>
<th>Crop Type Area and Growing Calendar</th>
<th>Crop Condition Indicators</th>
<th>Crop Yield</th>
<th>Crop Biophysical Variables</th>
<th>Environ. Variables</th>
<th>Ag Practices / Cropping Systems</th>
</tr>
</thead>
</table>

**Spatial Resolution**

- 1
  - 500 - 2000 m thermal IR + optical
  - Daily
  - Wall-to-Wall
  - All

**Spectral Range**

- Effective observ. frequency (cloud free)*

**Sample Type**

- Coarse Resolution Sampling (>100m)
  - Required every 3 years
  - 11
  - < 5 m optical 1 to 2 per month Refined Sample All (Demo)
**GEOGLAM & Space agencies Collaboration**

**EO Requirements to Data Streams**

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

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<th>Spatial Resolution</th>
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<th>Sample Type</th>
<th>Field Size</th>
<th>Effective observ. frequency (cloud free)*</th>
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<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)</td>
<td>SPOT-5 (1150m)</td>
<td>Proba-V (1000m)</td>
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<tr>
<td></td>
<td>NPP (750m)</td>
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<tr>
<td></td>
<td>Sentinel-3A (500m)</td>
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GEOGLAM Component #5
Research & Development
JECAM: Joint Experiments for Crop Assessments and Monitoring

- A network of sites representative of the world’s cropping systems
- A focus for international satellite data acquisition by Space Agencies (CEOS)
- R&D to support enhancements for operational agricultural monitoring systems
- JECAM Program Office coordinated by AAFC-Canada and UCL-Belgium
- Developing linkages with AgMIP sites and modeling community
Achievements Summary

- **Community of Practice** of more than 300 members voluntarily engaged in achieving the GEO strategic targets for agriculture
- **Baseline datasets** developed
- **a network of pilot sites** across the globe established for developing best practices (JECAM - *Joint Experiment for Crop Assessment & Monitoring*, [www.jecam.org](http://www.jecam.org))
- **Asia-RiCE**, a regional system for Rice Crop Estimation & Monitoring being developed
- Engaged national governments in developing **capacity for incorporating EO** into their crop projections system (*Argentina, Australia, Mexico, Pakistan, Ukraine…*)
- **GEOGLAM** at **high level meetings** such as *G8 Open Data for Agriculture*
- Commitment from USDA to co-lead GEOGLAM R&D office
- **Space Ag. endorsement** of Phase 1 & close working relationship w. Ad-hoc Working group
- **Funds secured** for projects in support of GEOGLAM [JAXA (Asia-RiCE), EC FP7 (SIGMA), ESA (S2 for Ag), NASA (Crop Monitor), Canada (JECAM), Asia Development Bank, USDA]
- **Increasing attention** of potential **donors** such as *World Bank, Gates Foundation* – shared goals with GEOGLAM
Challenges & Planned Activities
Research Challenge: Adaptation to Regional Agrosystems

- **Mixed crops** – Rungbe, Tanzania
- **Agroforestry systems** based on:
  - Crops: perennial (coffee, banana, cocoa, fruit trees, tea) and annual (corn, rice).
  - Small fields: 300-1500 m².
  - « CBM »: Coffee, Banana, and Maize

**Trends**
- Upper zone: CBM progressing, with gradual trimming of the tea-cropping areas and the Afromontane forest.
- Lower areas: CBM being abandoned in advantage of cocoa and rice monoculture, supported by significant investments (irrigation).

C. Lelong  
CIRAD
Challenges in Implementation

• Training – Capacity building
  – Need to adjust Tools & Methods to local agrosystems
  – Transfer Research → Min. Agriculture Depts (Statistics, Food)
  – Huge needs in Training / Capacity building in new User-countries
    (Learning engineering: Skills to be acquired, Pre-requisites, Online-presence.. TurnOver)
  – Prerequisite. Dialog with stakeholders (needs time and expertise)

• Great funding needs
  – GEO overall voluntary nature great, but institutionalizing require firm commitments (research, capacity building)
  – Identification of new funds: an issue in many member countries
  – Need for leadership: member countries** to lead the early phases of GEOGLAM implementation
Planned Activities 2014 (2/2)

• Setting up a GEOGLAM website
  – Designing the website structure
  – Developing and putting the website online
  – Collecting minimum info to feed all pages

• Structuring & Coordinating “Countries at Risk” Component **
  – Main actors: USA (USDA, USAID), FAO, EU (DevCo, JRC), WFP...
  – Collect and organise info on on-going projects
  – Look to synergies - gaps

• Structuring & Coordinating “Capacity Building” Component **
  – Identifying on-going projects in countries such as Argentina, South Africa, Pakistan, Algeria, Morocco....
  – Analyze activities to identify possible synergies and gaps
  – Identify relevant R&D projects, such as EOpower FP7 project
http://www.earthobservations.org

Michel Deshayes
mdehayes@geosec.org
Use of GEOGLAM Crop Monitor in Crop Production Crisis: the 2012 Drought in USA, Russia, Ukraine & Kazakhstan (4 slides)
Example of Crop Crisis Situation: 2012 (1/4)

2012 Northern Hemisphere Crop NDVI Anomalies (UMD)

Worse than average situation

Crop NDVI Anomaly

- Non Cropland
- Not shown
Example of Crop Crisis Situation: 2012 (2/4)

Northern Hemisphere NDVI Crop Anomaly, July 1st 2012

Notes/Questions?
- US NDVI anoms continues to spread and intensify: effects on maize/soybeans?
- NDVI anoms in Ukraine intensifying in the south
- NDVI anoms in Russia, Kazakhstan intensifying: impact on summer crops/wheat?

Crop stage sensitive to moisture and temperature
Crop stages largely based on USDA/NOAA Joint Agricultural Weather Facility (JAWF)
Example of Crop Crisis Situation: 2012 (3/4)
Northern Hemisphere Crop NDVI Anomalies - August 13th 2012

Canada
USA
Russia
Ukraine
Kazakhstan
China
India

Non Cropland
Not shown

US, Illinios
US, Kansas
Kazakhstan, Kostanai
Orenburg, Russia
Russia, Chelyabinsk

Corn/ Soy
Winter Wheat/ Corn
Spring Wheat
Spring Wheat
Spring Wheat

on-going year
Average normal year

Example of Crop Crisis Situation: 2012 (3/4)
Northern Hemisphere Crop NDVI Anomalies - August 13th 2012

Example of Crop Crisis Situation: 2012 (3/4)
Northern Hemisphere Crop NDVI Anomalies - August 13th 2012
Comparing the 2012 Black Sea Region Drought to the 2010 Drought

Crop Condition - 2010 Russian Drought: (July 17 2010)
- Wheat prices rose over 80% in 6 months

Crop Condition – 2012 Russian, Ukraina, Kazakhstan Drought (July 17 2012)
- Russia Production 38MT = - 32%
- Ukraine Production 15.5 MT = - 30%
- Kazakhstan Production 10.5 MT = 53%

2012 drought affecting crop production in Russia, Ukraine, Kazakhstan

Crop Condition - 2010 Russian Drought: (July 17 2010)
- 2010 grain production decreased by 30%
- Wheat prices rose over 80% in 6 months