GEOGLAM
Global Agricultural Monitoring

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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%
Challenge: Feeding the planet (3/3)
Role of grazing lands
(Rangelands, Grasslands, Pastures and Savannas)

• % World population relying on livestock rearing?
Recent volatility of Agricultural Prices (1/2)

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
Recent volatility of Agricultural Prices (2/2)

Food price dynamics is not crop specific

Wheat
Wheat Monthly Price$/MT 2002-2012

Soybeans
Soybeans Monthly Price $/MT 2002-2012

Maize
Corn Monthly Prices $/MT 2002-2012

Societal impact is worldwide
40. 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 & 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 programme », aiming at
- supporting, strengthening and articulating existing efforts
- developing capacities and awareness at national and global level
- disseminating information
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 Structure & Governance

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

2. National Capacity Building
   - 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

Tasks

GEOGLAM Advisory Committee
Including G20 Donor representation, program stakeholders

Implementation Committee
Consisting of Implementation Team leads

Program Coordinator
+ Secretariat
GEOGLAM Component #1
Global Agricultural Monitoring
GEOGLAM Crop Monitor 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
Achievements
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)
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.
Achievements
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
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
GEOGLAM & CEOS Collaboration
ASIA-RiCE Technical Demonstration Site: An Giang (Mekong River Delta, Vietnam)
Use of GEOGLAM Crop Monitor in Crop Production Crisis: the 2012 Drought in USA, Russia, Ukraine & Kazakhstan (2 slides)
Use of Earth Observation in a Crop Crisis 2012 (1/2)

Use of NDVI, Normalised Difference Vegetation Index:

\[ \text{NDVI} = \frac{\text{Red} - \text{InfraRed}}{\text{Red} + \text{InfraRed}} \]

NDVI Crop Condition

- Better than average
- No change
- Worse than average

Average normal year NDVI Profile

on-going year

August 13th 2012

Becker-Reshef et al.
2010 & 2012 Crop Crisis Situation (4/4)
Eastern Europe – Central Asia Crop Outlook for 2010 & 2012

Crop Condition – 2012 Russian, Ukraine, Kazakhstan Drought (July 17 2012)

- Ukraine Production 15.5 MT = - 30%
- Russia Production 38MT = - 32%
- Kazakhstan Production 10.5 MT = - 53%

2012 drought affecting crop production in Russia, Ukraine, Kazakhstan

Crop Condition - 2010 Russia & Kazakhstan Drought: (July 17 2010)

- Russia & Kazakhstan 2010 grain production decreased by 30%
- Wheat prices rose over 80% in 6 months
GEOGLAM Component #2
Capacities Building
GEOGLAM Capacity Building Component

Ex: Pakistan Agricultural Information System
(Collaboration among CRS, FAO, SUPARCO, UMD & USDA)
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:**
  - *Central America*: Guatemala, Honduras, El Salvador, Nicaragua
  - *Caribbean*: Haiti
  - *Central Asia*: Afghanistan
Countries at Risk: Challenge #1
Gaps in Rainfall Station Reporting

• For one year, systematic sample on the 1st, 11th & 21st of month (3×12=36 samples)
• 1232 African GTS stations:
  – 40% did not report on any of the 36 days of the sample
  – only 25% sent all reports or missed only one

GTS = Global Telecommunication System
Challenge #2: Changes in rainfall patterns
Precipitation changes in Kenya, 1980 - 2008

1. Decrease in Rainfall
   - Average of last 4 rainy seasons is ranked lowest in last 50 years
   - Since 1980, almost 20% decrease in main rainfall season
   - Average rainfall for 4 consecutive seasons

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

Main season (March-April-May)

Second season (Oct-Nov-December)

Since 1980, rainfall increasing in second rainfall season
Countries at Risk: Challenge #3
Issue of Quality of Global Cropland Maps

- Which accuracy of global Land Cover maps?
  - Ex. MODIS Land Cover Product
  - Assessment in Sub-Saharan Africa (29 countries) using:

  - Cropland map at site scale
  - Major Farming Systems
    - Irrigated
    - Tree Crop
    - Forest Based
    - Rice Tree Crop
    - Highland Perennial
    - Highland Temperate Mixed
    - Root Crop
    - Cereal-Root Crop Mixed
    - Maize Mixed
    - Large Commercial & Smallholder
    - Agro-Pastoral Millet/Sorghum
    - Pastoral
    - Sparse (Arid)
    - Coastal Artisanal Fishing
Countries at Risk: EO products for Crop Monitoring

Satellite Vegetation Index (NDVI) Difference 2009

Yearly Evapotranspiration Anomaly 2009

Water Requirement Satisfaction Index 2009

Daily Rainfall estimate for 6 Apr., 2003
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 building 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)
Early Warning Crop Monitor (EWCM) Prototype
GEOGLAM Component #4
Cooperation with Space Agencies

CEOS – Committee on Earth Observation Satellites
GEOGLAM Component #5
Research & Development
JECAM: Joint Experiment for Crop Assessment and Monitoring

- A network of sites representative of the world’s cropping systems
- A focus for international satellite data acquisition by 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

www.jecam.org
Research Foci at the JECAM Sites

- Crop Type mapping
- Crop Condition monitoring
- Yield estimation
- Soil Moisture estimation
- Residue and Tillage monitoring

- EC SIGMA Project is strengthening the JECAM field data collection protocols and intercomparison
Achievements & Planned activities
GEOGLAM: a global collaborative initiative with already significant achievements...

... with a need for continuous support to address monitoring of continuously changing global agricultural issues
Challenges & Planned Activities
Research Challenge: Adaption to Regional Agrosystems

- ex. 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