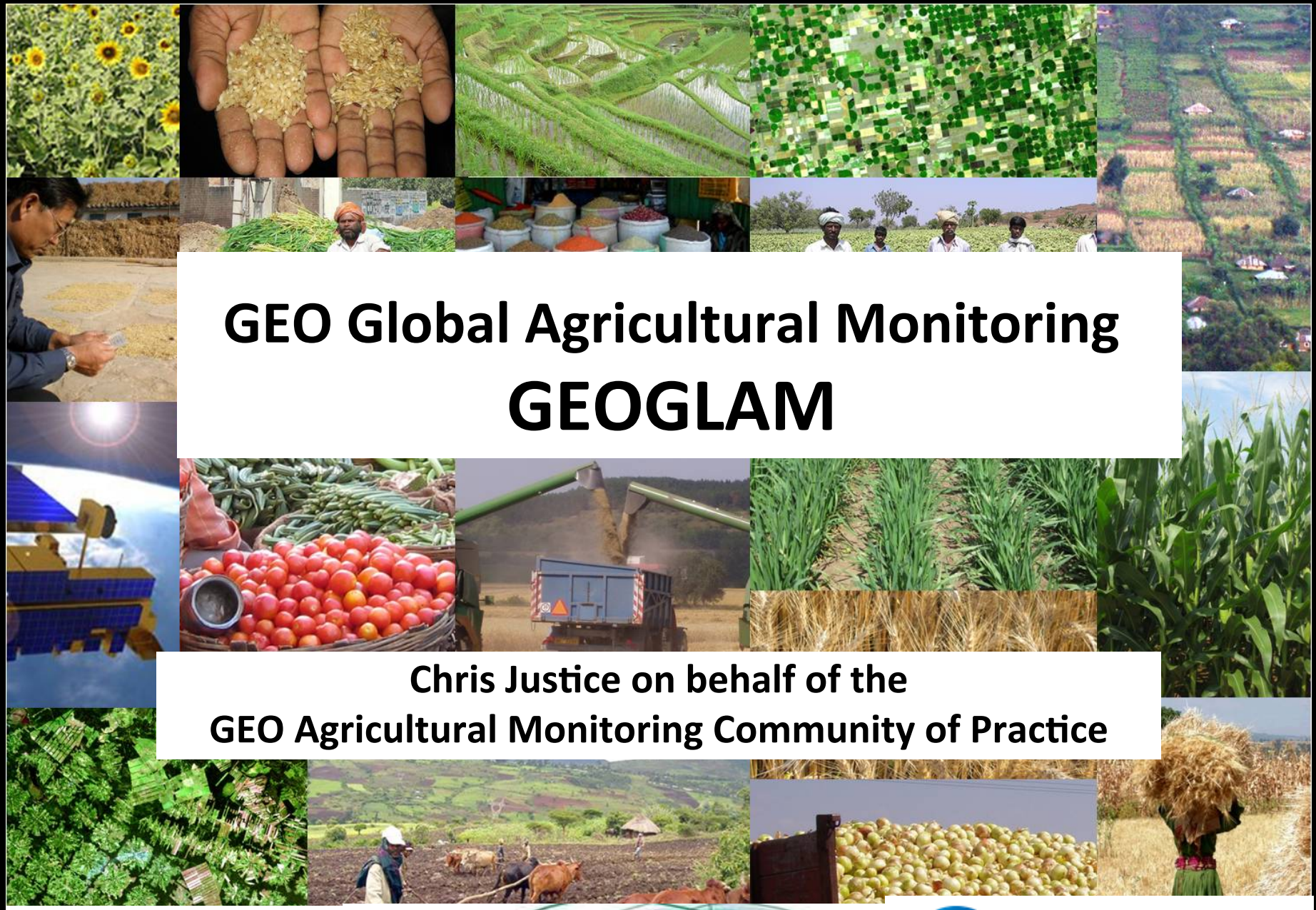


GEO Global Agricultural Monitoring

GEOGLAM

Chris Justice on behalf of the
GEO Agricultural Monitoring Community of Practice

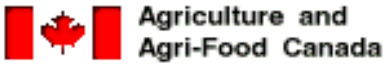
GROUP ON EARTH OBSERVATIONS

GEOGLAM
Global Agricultural Monitoring

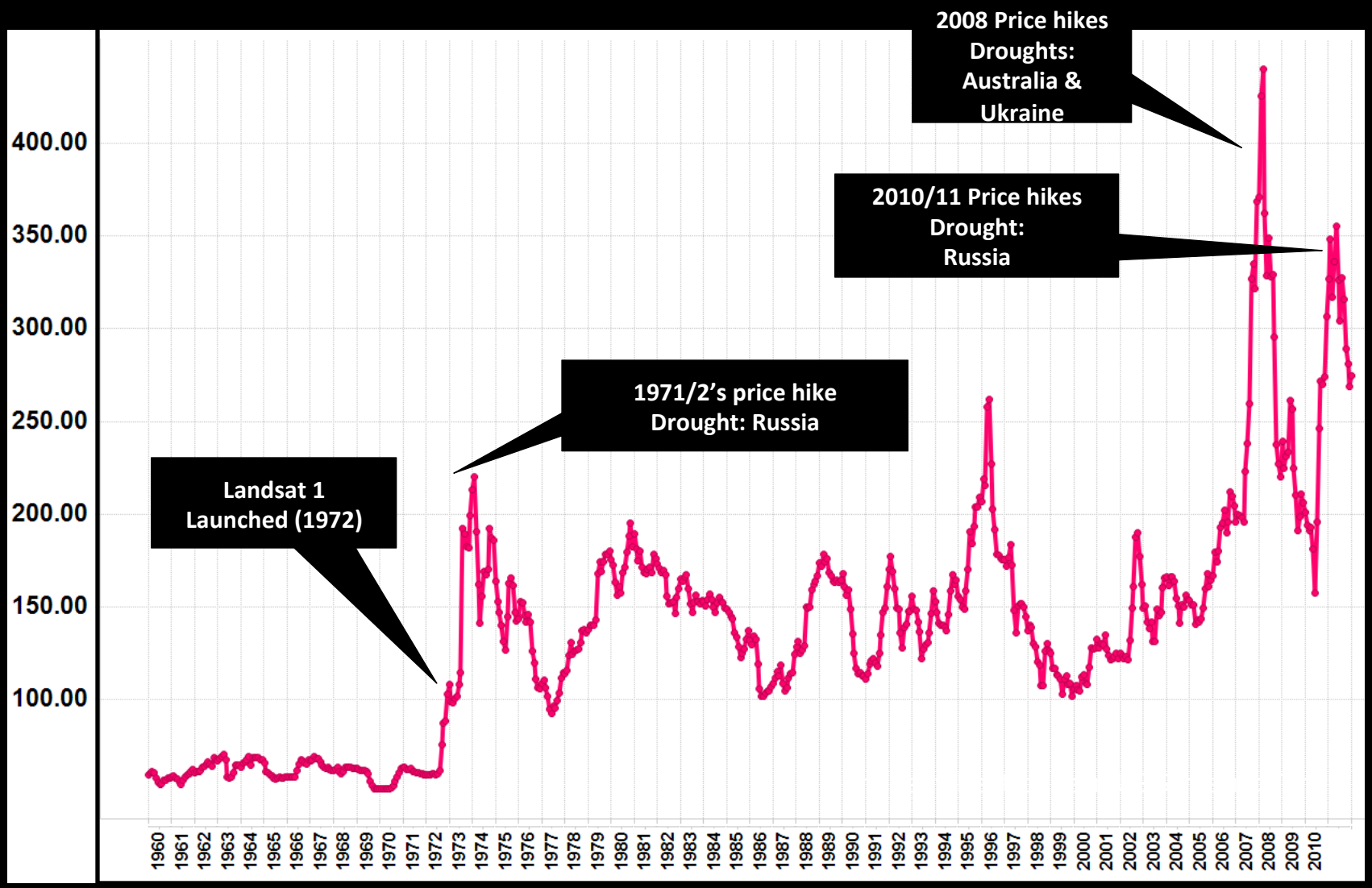
GEO Agriculture Monitoring Community of Practice

an open community of Data Providers, Brokers and Information Users

Initiated under the GEO Agricultural Monitoring Task in 2007 and now focused on GEOGLAM



Context for GEOGLAM




The Washington
NORTH KOREA
Huge Gap Predicted In Supply
guardian.co.uk | TheObserver
Food aid to poorest countries slashed as price of grain soars
UN warns of drastic crisis as relief workers urge donor countries to help beat shortages by switching to giving cash or vouchers
Drought is key factor in Kenya's food cri
Matt Brown, Foreign Correspondent
Last Updated: March 27, 2009 9:30AM UAE / March 27, 2009 5:30AM GMT
TARU, Kenya // Rose Mwembe has not had a corn harvest in six months. Last year's late season rains never came and the current rainy season is already a month late, meaning she cannot plant for at least another month.
The arid red earth in front
Poverty/World Hunger
More than 1 billion hungry, UN a
By Tom Eley
WSWS
Thursday, Oct 15, 2009
15 October 2009
More than 1 billion people, one sixth of humani
undernourishment by the end of 2009, two Uni
reported on Wednesday. The ranks of the hung
100 million people in one year, a result of the r
since the Great Depression.
"The State of Food Insecurity," produced by t
Organization (FAO) and the World Food Progra
the sharp increase in global hunger is not the r
natural disasters, but the man-made causes o
unemployment, and declining incomes.
MATT CAWOOD
Climate change compounds Ethiopia's food crisis
AFP - Standing amidst a group of scrawny fellow Ethiopian farmers, Tuke Shika points to the scorching sun when asked why his food reserves have dwindled this year.
"The weather has changed, it's not as it used to be before," he laments. "The rains are increasingly erratic,
ay 10 November 2011
e Telegraph
HOME NEWS SPORT FINANCE COMMENT BLOGS CULTURE
UK | World | Politics | Obituaries | Education | Earth | Science | Defe
Earth News | Environment | Climate Change | Wildlife | Outdoors | Pic
HOME » EARTH » GREEN POLITICS » POPULATION
Now we are seven billion, let's feed the world
Why do we reject the technology that would put food on the plates of
The New York Times
aturday, May 10, 2008
Food Chain: Drought's To
A de
has e
climate change could affect
the way we feed the world.
SPECIAL REP
Every six seconds a child on this planet dies of hunger.
We've had industrial revolutions in the west and more recently in China and South Asia; budding revolutions in
BBC NEWS
Last Updated: Friday, 23 March 2007, 00:25 GMT
Biofuel demand makes food expensive
Kathmandu.
The Economist
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World politics | Business & finance | Economics | Science & technology | Culture
Africa
Baobab
In pictures
Hunger in the Horn of Africa
Aug 4th 2011, 17:48 by The Economist online
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NEVER again, said the world after the horror Ethiopia's famine in 1984. And for years
eparted Africa. But after the worst drought in 60 years, it has
, south-eastern Ethiopia, southern Somalia and Djibouti have
stimates that more than 12m people in the Horn of Africa nee
sands have already died and hundreds of thousands more risk
e been annihilated. Hundreds of thousands of people are
mps in search of help. Malnutrition rates in some areas are fi
The Great Food Crisis of 2011
It's real, and it's not going away anytime soon.
BY LESTER BROWN | JANUARY 10, 2011
As the new year begins, the price of wheat is setting an all-time high in the United Ki
riots are spreading across Algeria. Russia is importing grain to sustain its cattle herd
DAILY NATION
MONDAY November 16,
Kenya among food crisis nations, U
SHARE BOOKMARK PRINT EMAIL RATING
landing in her fields. PHOTO/ FILE
TIME
FAMINE
Why are Ethiopians starving again?
What should the world do—and not do?
THE SUMMIT
Gorbachev's Tour de Force
The New York Times
RIAL
e Food Crisis
ed: February 24, 2011
prices are soaring to record levels, thre
tries with mass hunger and political ins
sters of the Group of 20 leading econon
meeting in Paris last week, but for all of
BBC Mobile
NEWS AFRICA
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Somalia famine: UN warns of 750,000 deaths
As many as 750,000 people could die as Somalia's drought worsens in the coming months, the UN has warned, declaring a famine in a new area.
The UN says tens of thousands of people have
Rush to Use Crops as Fuel Raises Food Prices and Hunger Fears
The New York Times
Thursday, November 10, 2011
Time
WORLD | U.S. | N.Y. / REGION | BUSINESS | TECHNOLOGY | SCI
TIMES TOPICS > SUBJECTS > F > FLOODS > 2010 PAKISTAN FLOODS
2010 Pakistan Floods
Bloomberg.com Update
Hunger in India: The Crisis Wors
WORLD
Food crisis grip rural parts of Nepali Chitwan district
www.chinaview.cn 2009-11-15 11:52:27
China View
washingtonpost.com > World
Global Food Crisis
The new world of soaring food prices
FOOD INSECURITY
Little Keeps Nigeria From Crisis
BBC NEWS
Welch ONE-MINUTE WORLD NEWS
Bangladesh bans most rice expo
Bangladesh has banned exports of nearly all the rice it produces to prevent shortages and keep food costs down.
The government said the ban began on Tuesday and will last six months.
TIME
IN PARTNERSHIP WITH CNN
The World's Growing Food
By VIVIENNE WALT
U.N. Food Agency Issues Warning on China Drought
Food security for 7 billio
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REUTERS

Policy Framework for GEOGLAM

G20 Final Declaration

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" (GEO-GLAM)** 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 and weather forecasting data.

➢The G20 Cannes Summit (November 2011) Action Plan on Food Price Volatility and Agriculture

➢Reaffirmed GEOGLAM commitment at the 2012 G-20 Los Cabos Declaration & in Agriculture Ministers Report

G20 GEOGLAM Goal:

To strengthen the international community's capacity to produce and disseminate relevant, timely and accurate forecasts of agricultural production at national, regional and global scales through the use of EO

Outcome: an improved and more harmonized systems of systems taking advantage of new satellite assets and methods and a higher level of international coordination

- GEOGLAM is implemented in the framework of GEO

Why This Matters: Looking Forward

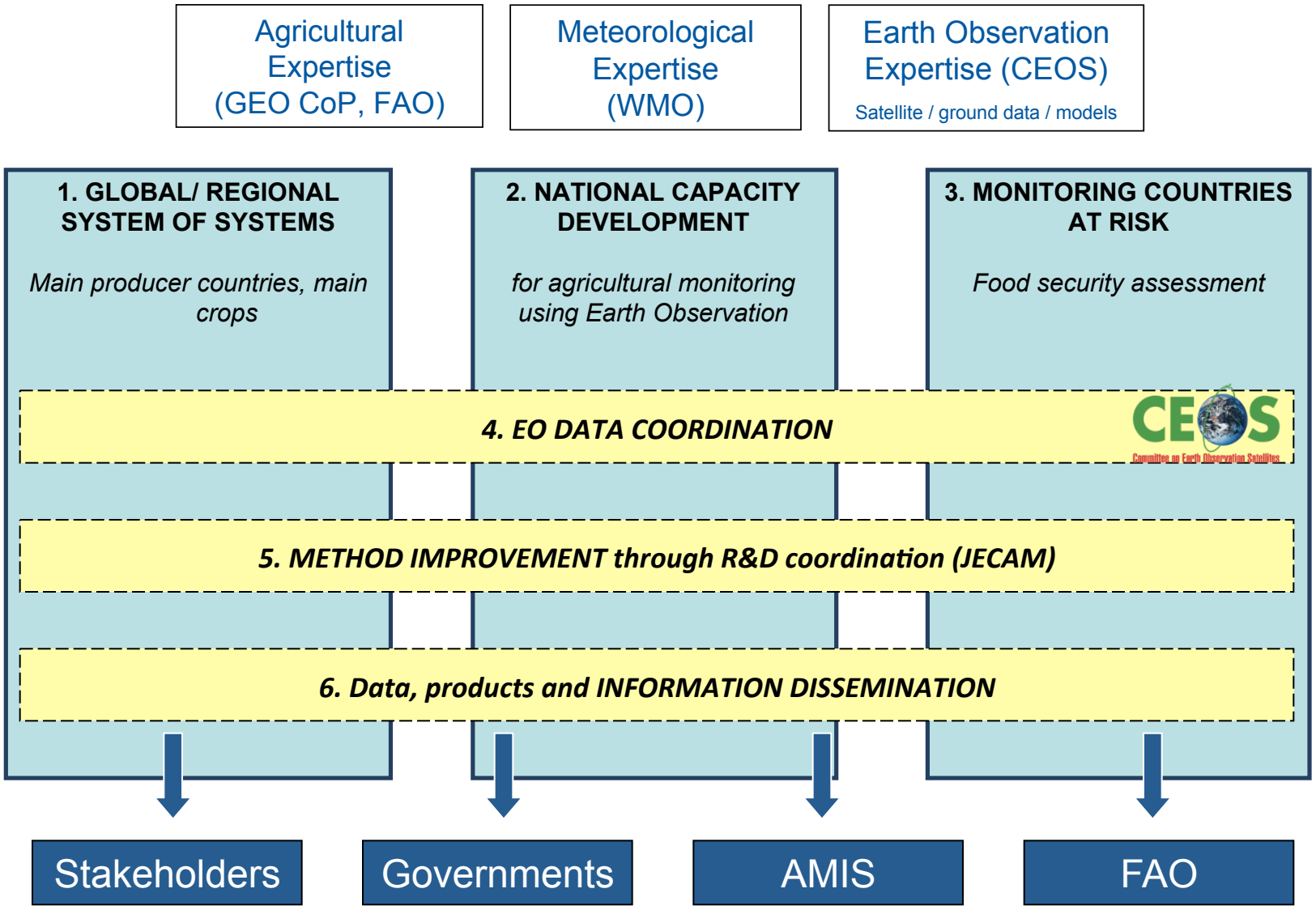
Agriculture Faces Major Challenges in this Century

- Increasing pressures on agricultural land and production from:
  - Increased severe weather events and climate change
  - Population growth & changing diets
  - Fuel vs. Food vs. Feed
  - Limited water and suitable arable land
- Higher price volatility for major grains
- Commodity markets are increasingly linked (good and bad)
- Rising fuel prices impact food prices (transport, fertilizer)

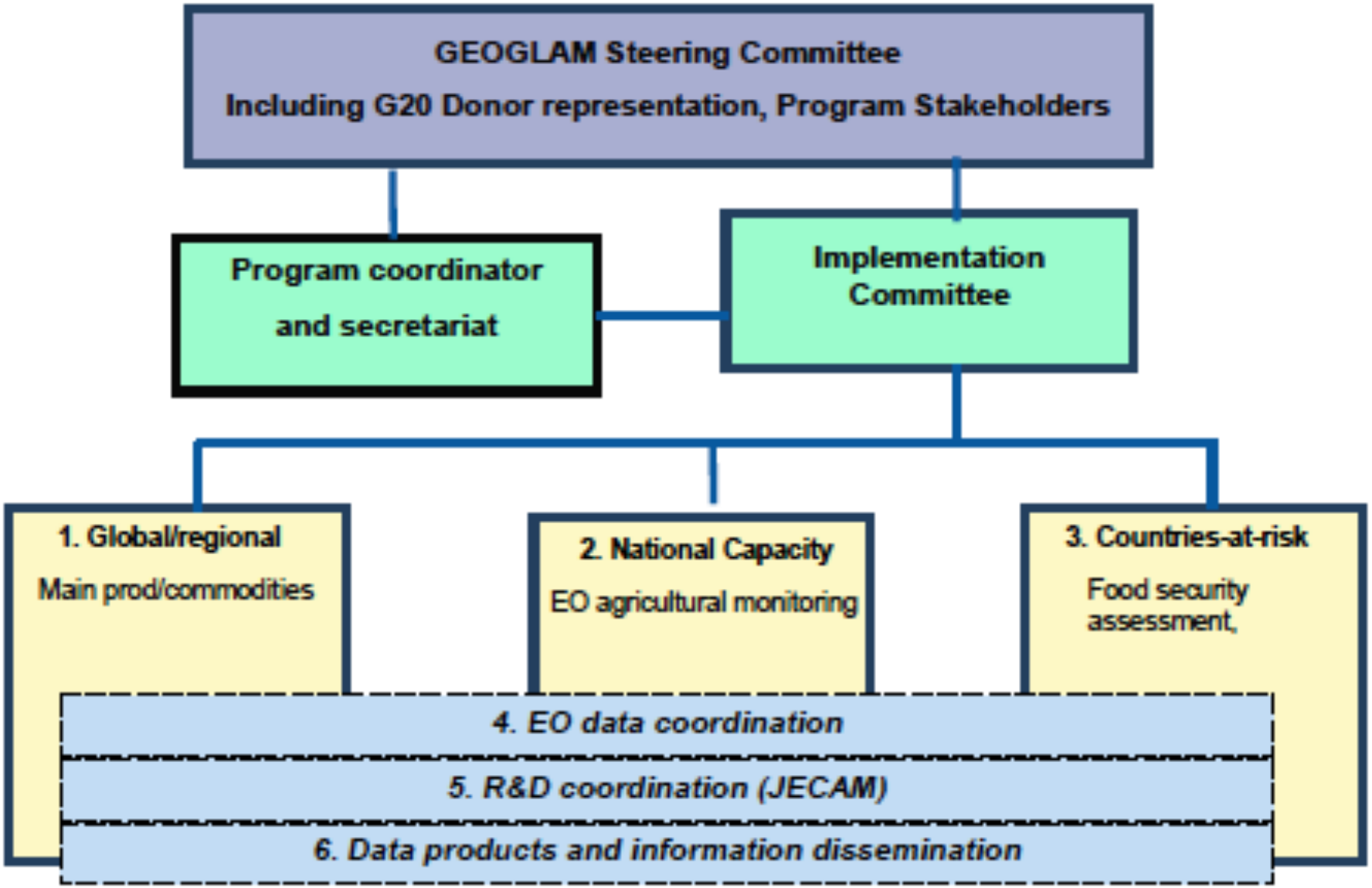
- NEED TO INCREASE GLOBAL PRODUCTION BY 70% BY 2050 TO MEET DEMAND (FAO)

→ Data and tools for monitoring and reliably forecasting production are essential for anticipating market imbalances and enhancing policy responses

GEOGLAM Components



GEOGLAM Governance



Organization and Roles

- **Steering Committee**
  - Stakeholder Program Steering and Donor Coordination
- **Program Coordinator** (Secretariat at the GEOSec)
  - Program coordination, fund raising and management, program reporting and outreach
  - Chair of Implementation Committee
  - Ex Officio member of the Steering Committee
- **Implementation Committee**
  - Coordination across Implementation Teams
  - Reporting to and discussion with the SC on progress and future developments
  - Coordination with AMIS and other Partner programs
- **Implementation Teams**
  - representation from the individual project/ activities
- **Projects w. Project Leads**
  - projects contributing to meeting the GEOGLAM goals

GEOGLAM Planning Meeting

Washington DC, February 2013

Refining the phased GEOGLAM phased implementation

GEOGLAM Phased implementation across all components

- **Phase 0 (P0) 2011-2013 Foundation Activities**
- **Phase 1 (P1) 2013-2015 Demonstration & Early Feasibility**
  - Build on existing activities
  - Initiate Pilot Projects
- **Phase 2 (P2) 2014 – 2016 Review and Expansion**
  - Continue/Complete Phase 1 Activities
  - New Starts
- **Phase 3 (P3) 2015- 2017 Pre-Operational**
  - Completion of Phase 1 / 2 Projects
  - Geographic Expansion

- Operational Phase 2017 >

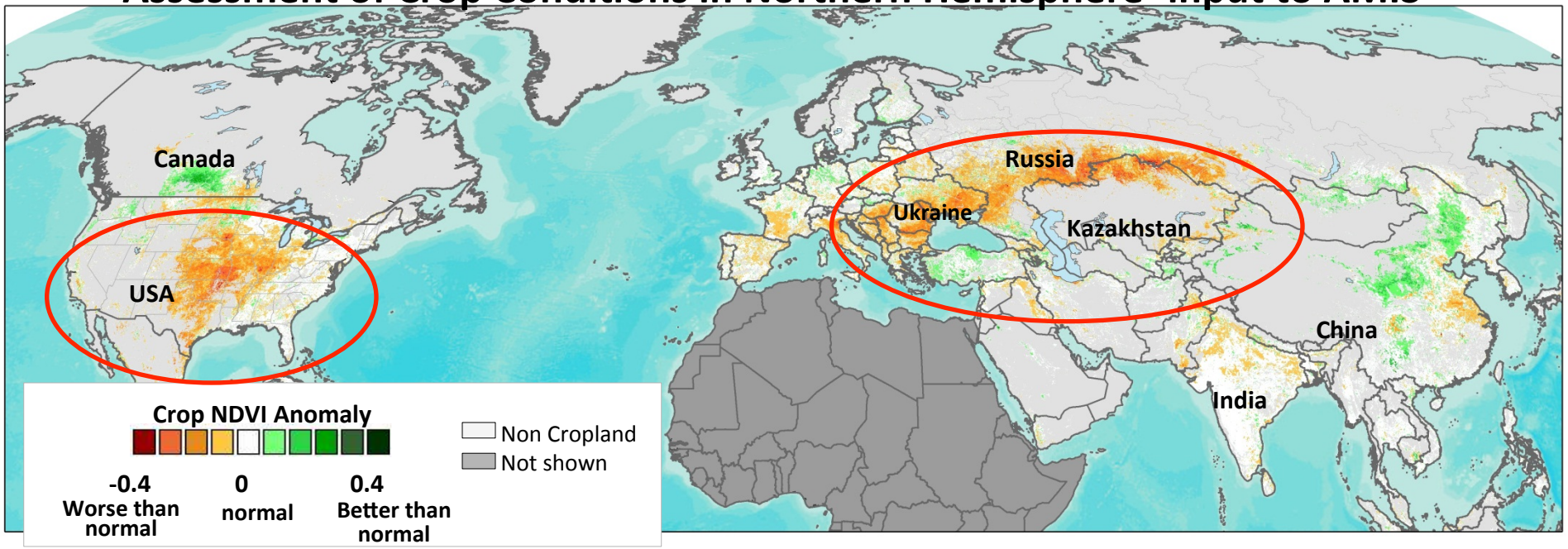
GEOGLAM Demonstration & Early Feasibility
Phase 0 > Phase 1

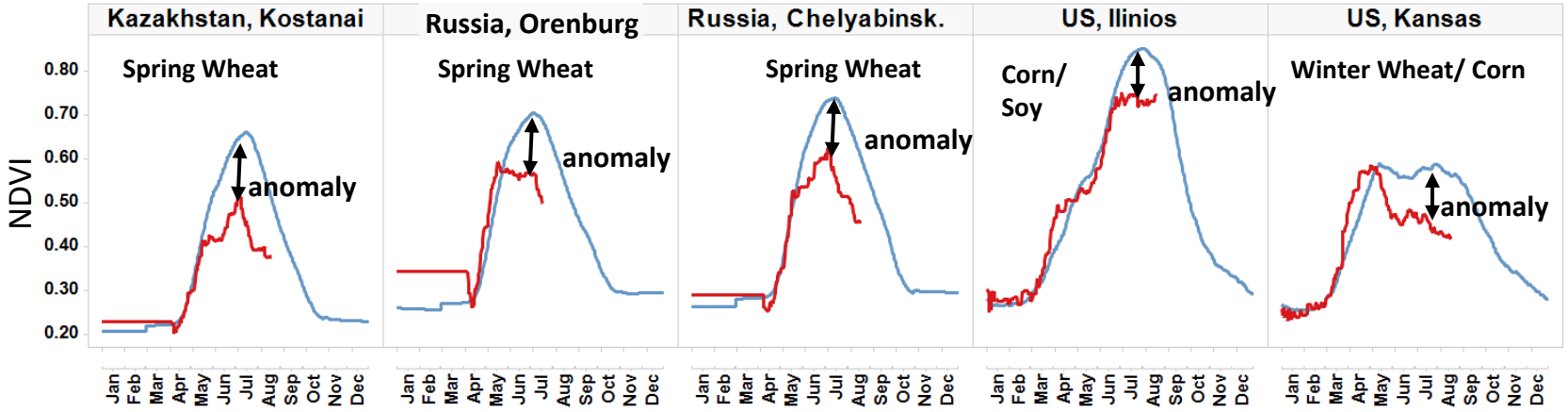
Examples by Component

Component 1

Crop Condition Global Outlook: Building International Consensus

Assessment of Crop Conditions in Northern Hemisphere- input to AMIS





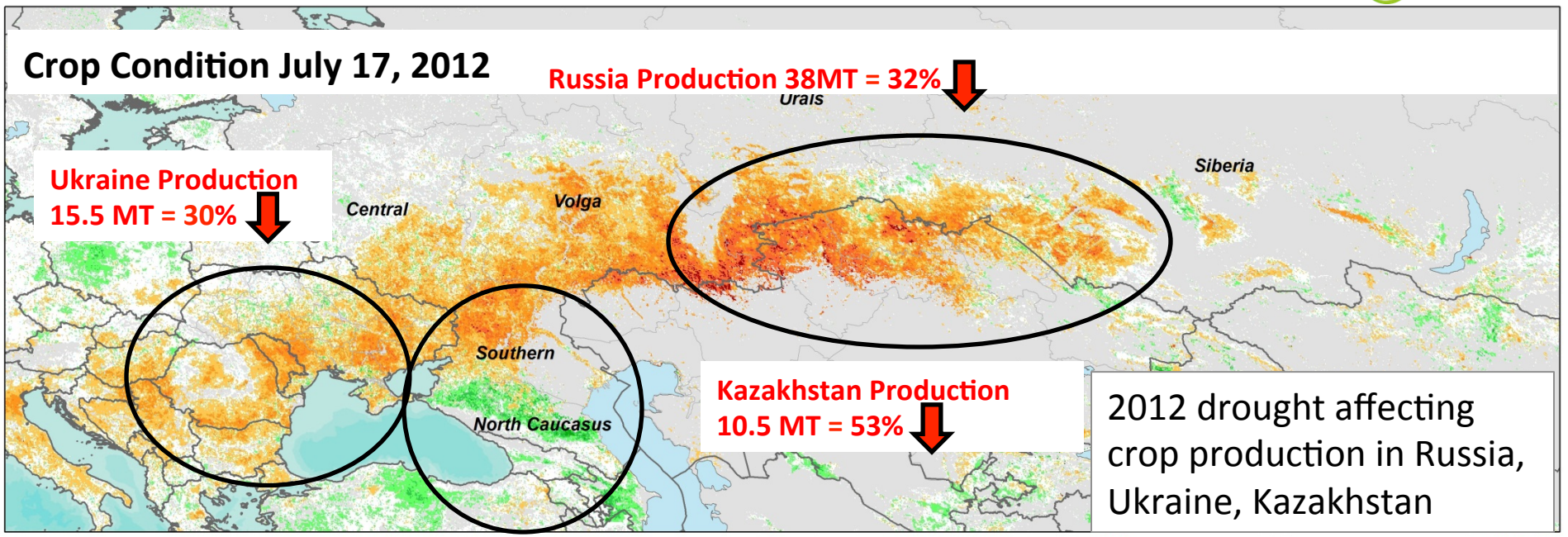
Current season crop development (2012)
Average season development (2000-2011)

Crop NDVI Anomaly, August 13th, 2012

Component 1 - Phase 1 : N. Hemisphere Crop Outlook for AMIS 2012

GEOGLAM Global Agricultural Monitoring

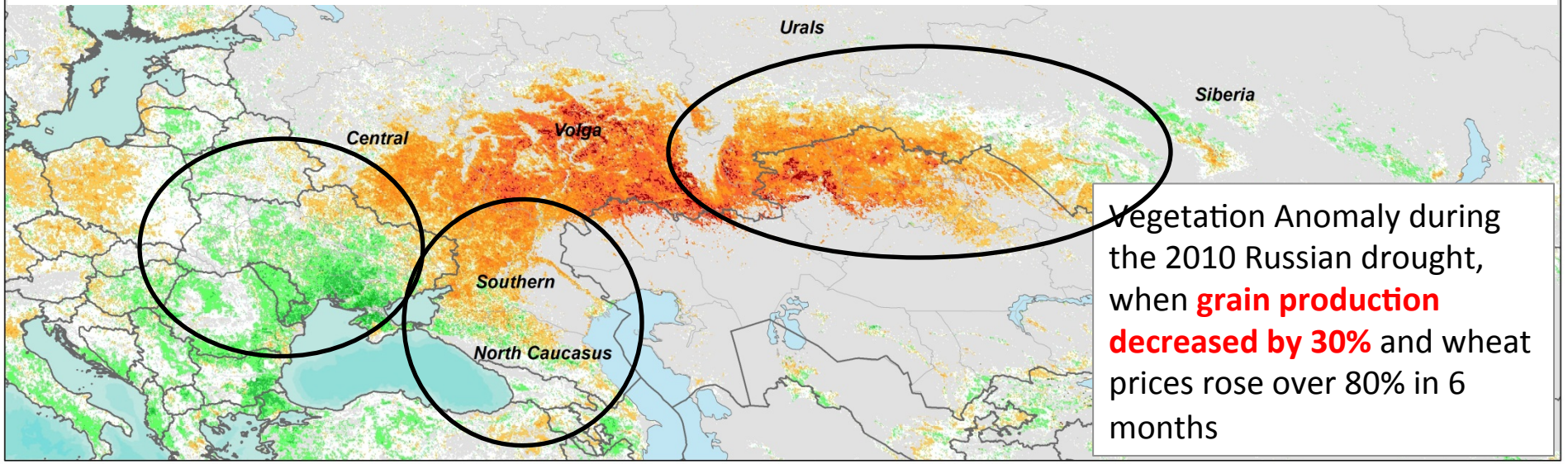
Crop Condition July 17, 2012



2012 drought affecting crop production in Russia, Ukraine, Kazakhstan

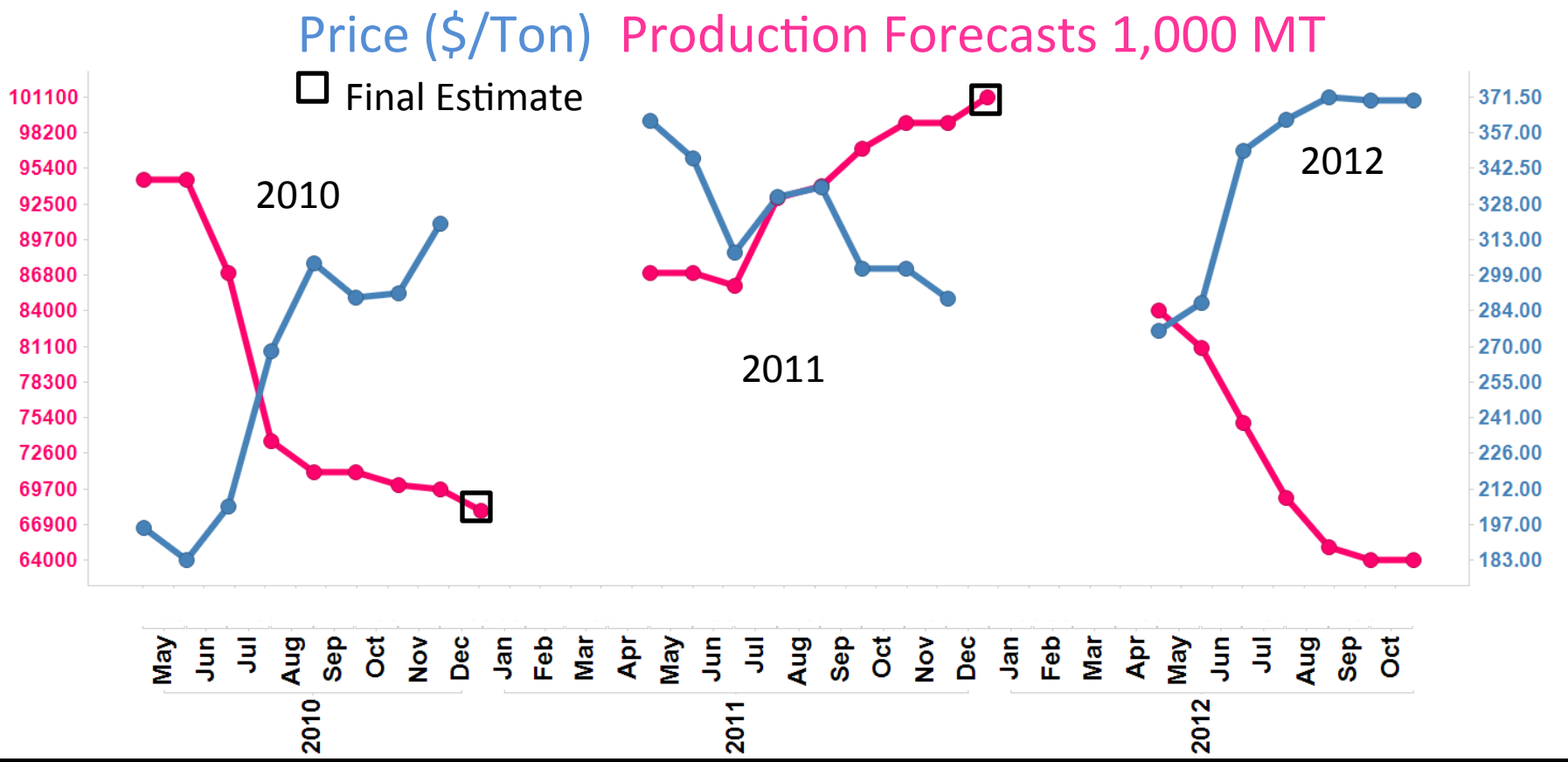
Comparing the 2012 Black Sea Region Drought to the 2010 Drought

Crop Condition During the 2010 Russian Drought: (July 17 2010)



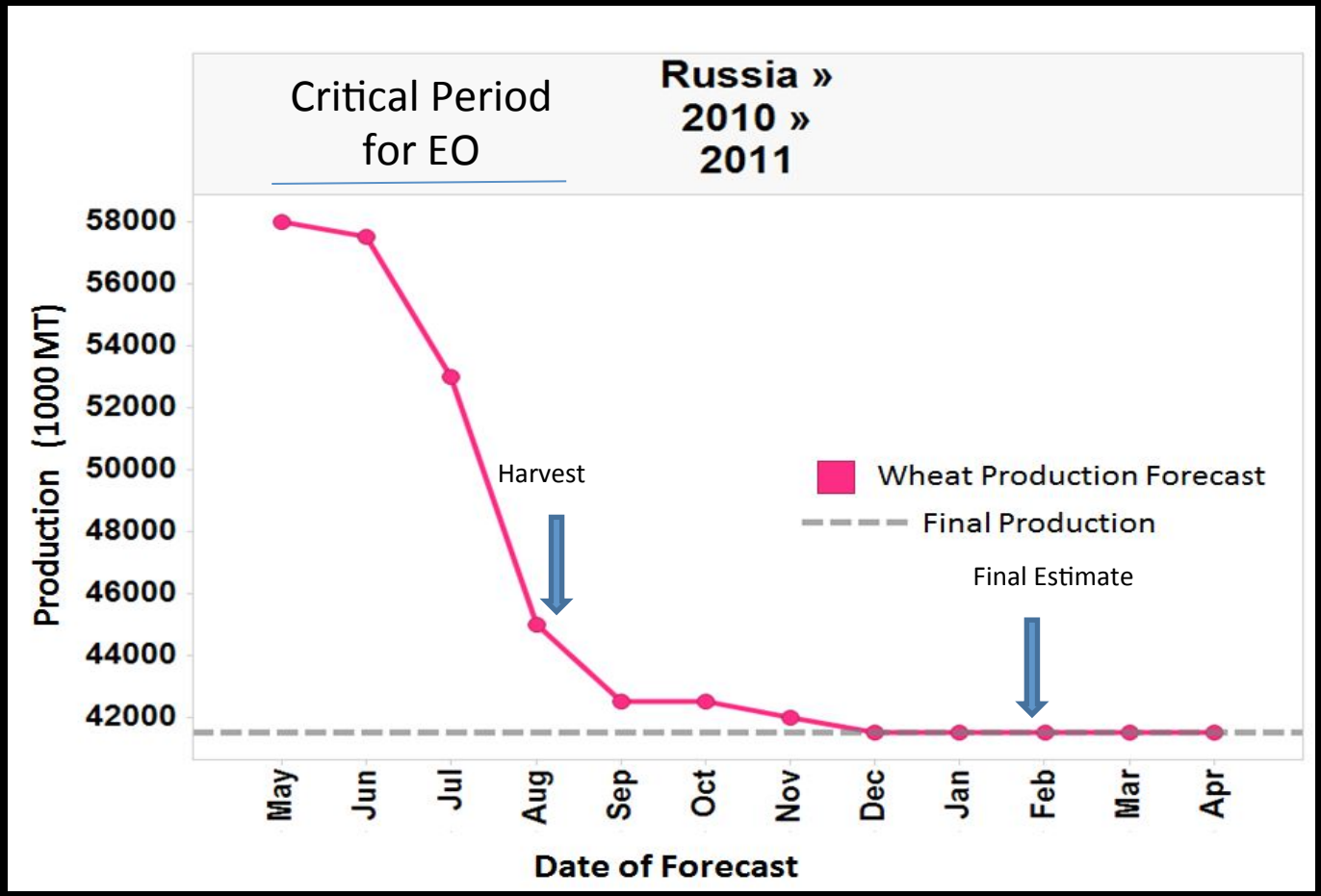
Vegetation Anomaly during the 2010 Russian drought, when **grain production decreased by 30%** and wheat prices rose over 80% in 6 months

Aggregation of Wheat Production Forecasts from Main Wheat Export Countries vs. International Market Price 2010-2012



Becker-Reshef et al.

GEOGLAM Goal of Timely Information on Crop Production using repeatable scientific methods to augment current operational procedures



Points to the current advances in near real time EO data

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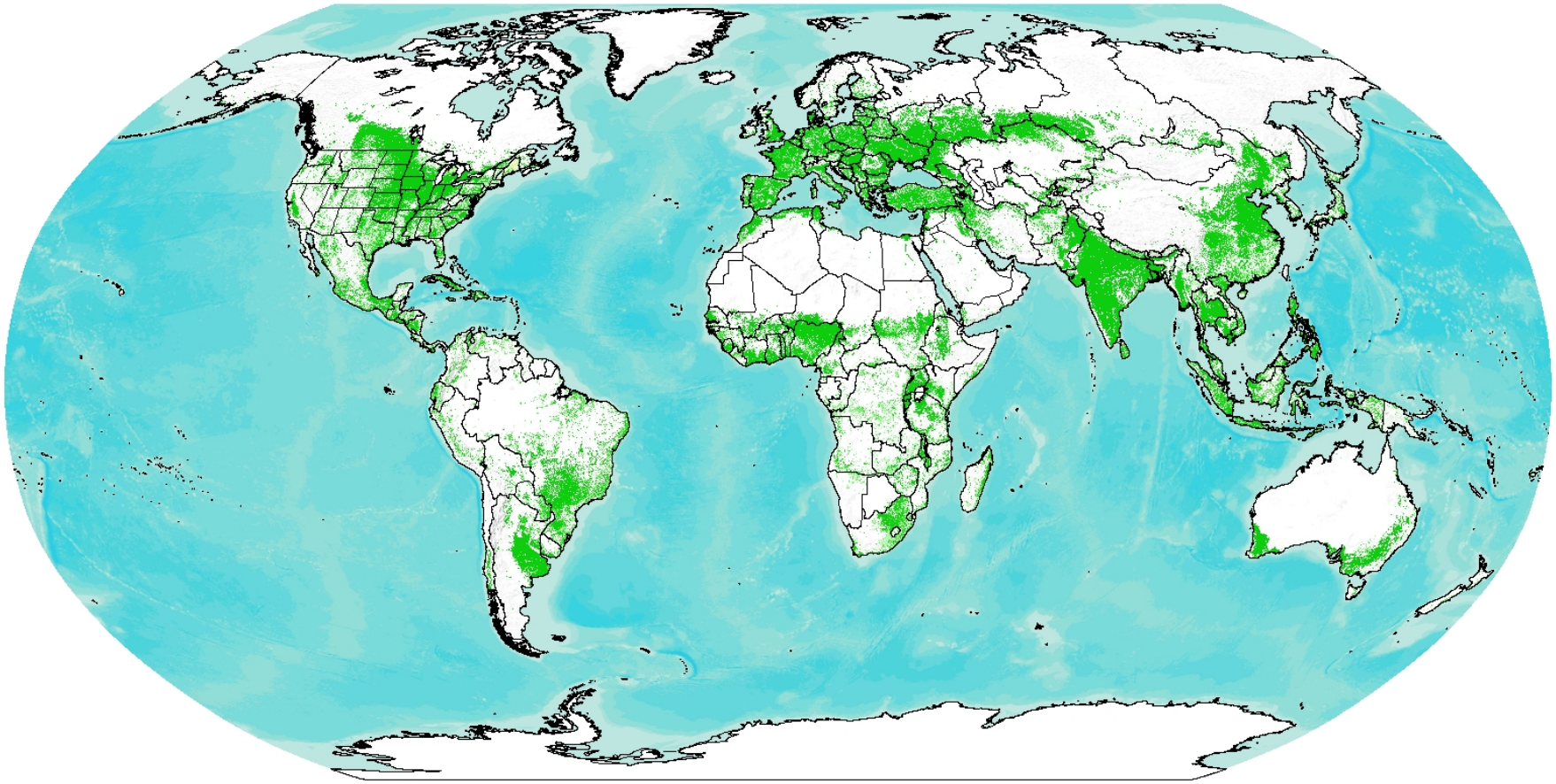
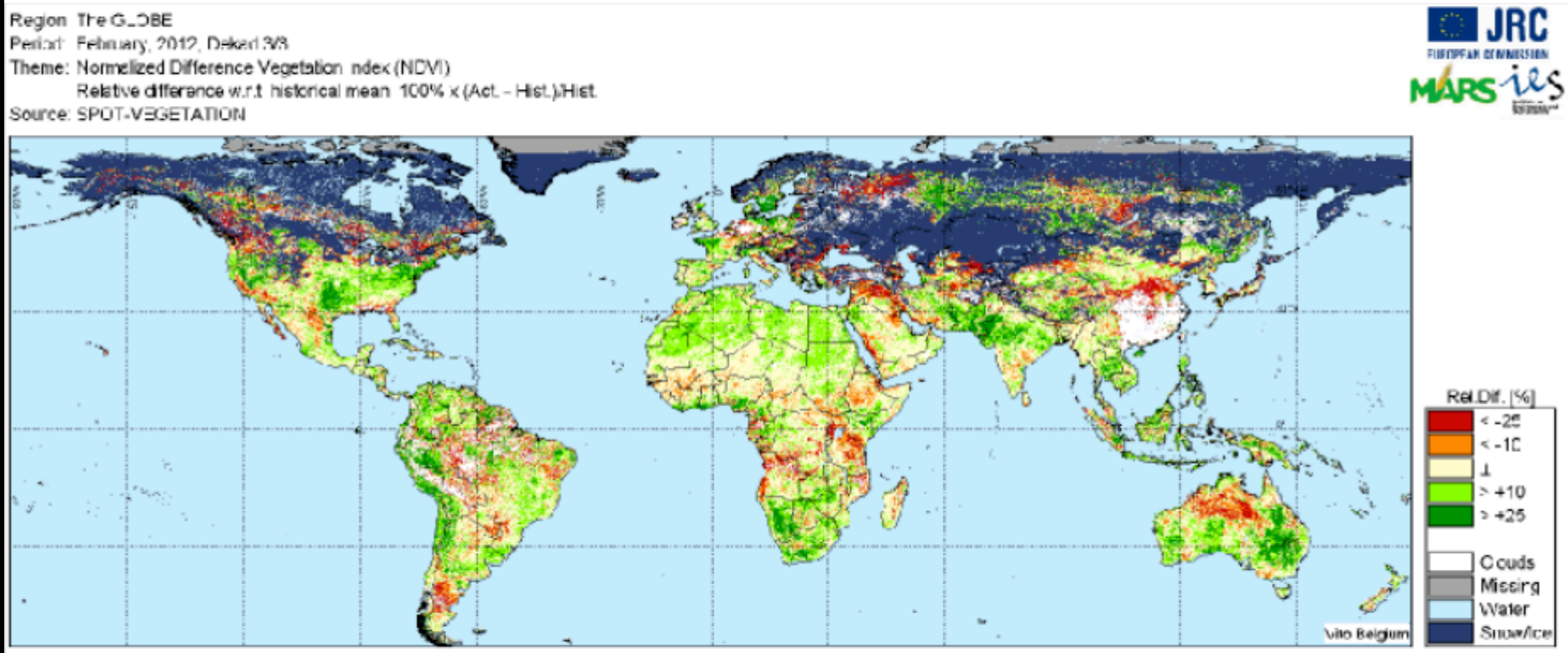
Global Agricultural Monitoring

Current Cropland Distribution: best available from existing satellite-derived sources



Source: IIASA, Fritz et al. Beta Version 1

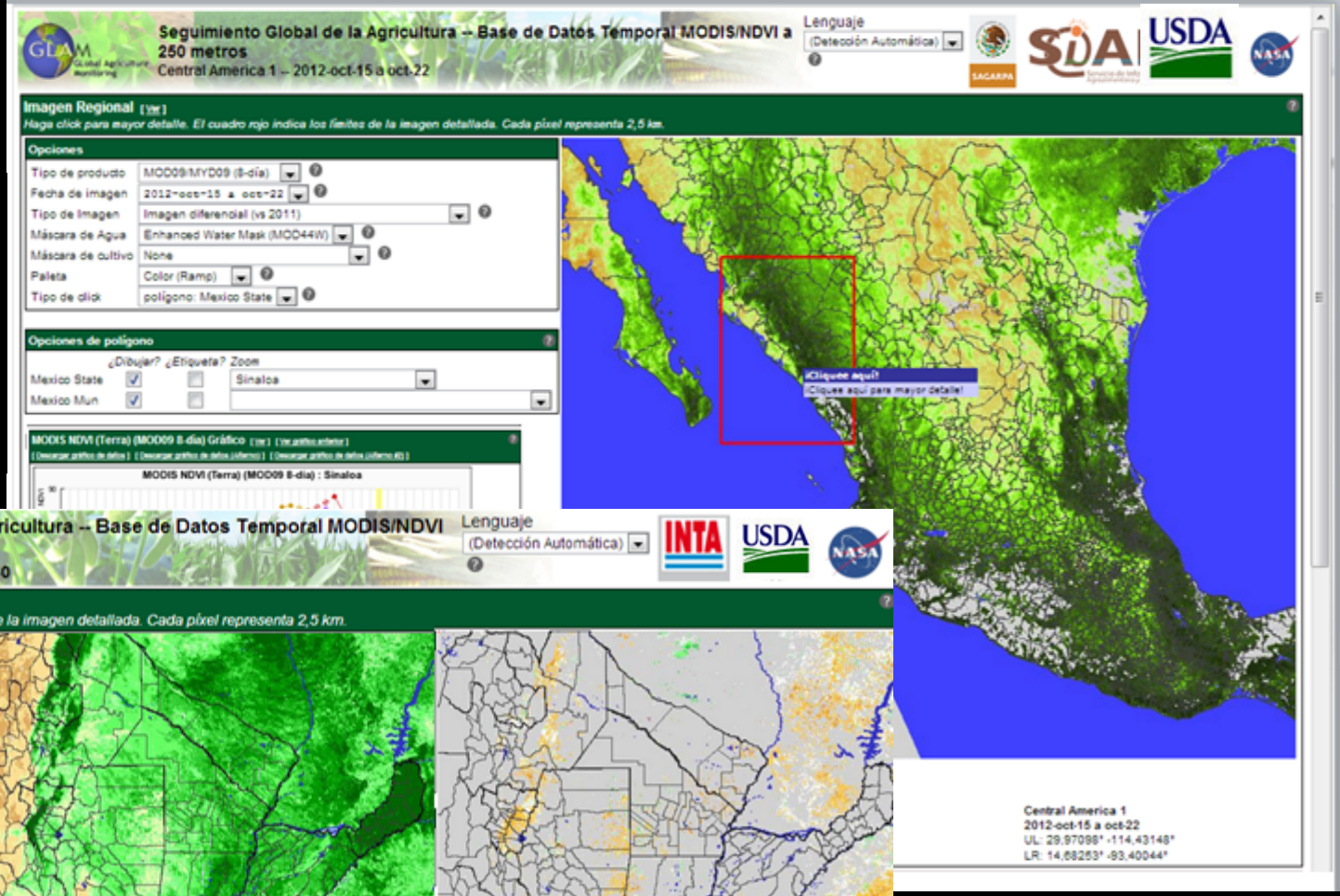
Transferring JRC MARS Monitoring Capabilities to UN FAO GIEWS

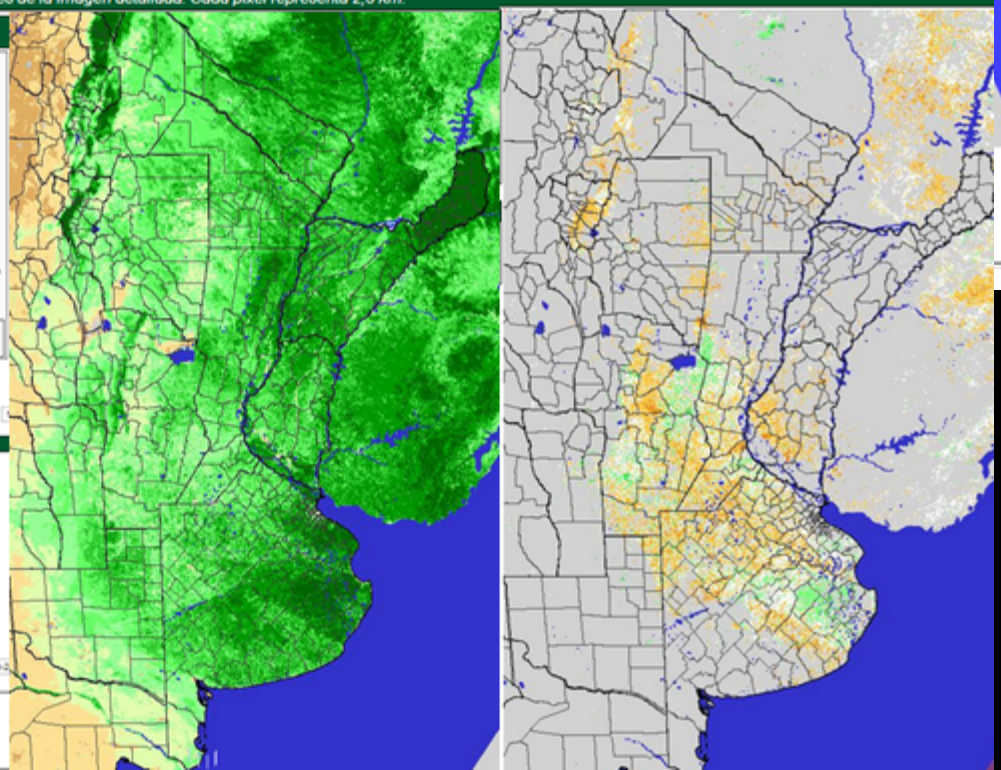


Component 2: National Capacity Building

Argentina and Mexico Examples:

Developing National EO Crop Condition Monitoring Systems





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Global Agricultural Monitoring

Asia RiCE: implementation plan

Component 2

Phase 1: Pilot activities of rice crop monitoring for Agricultural and rural statistics in Thailand / Lao/ Philippines/ Vietnam/ Indonesia/ India

- Technical demonstration sites used for proof of concept and early results

Phase 2: Implementation of Asia rice crop activity in Asia including regional and regional workshops and capacity building

*** ISRO will serve as a co-lead of technical demonstration site coordination including RiSAT data provision with JAXA

*** Regional workshop may be co-located with other related activity as ADB, ESCAP, etc.

Early warning information dissemination JAXA will continue to provide agro-meteorological information using AMSR-2/GCOM-W and TRMM/GPM

http://www.asia-rice.org

JECAM
Joint Experiment for Crop Assessment and Monitoring

Component 5 Data and Method Inter-comparisons

GEO GROUP ON EARTH OBSERVATIONS

- JECAM activities are being undertaken at a **series of study sites** which represent many of the world's main cropping systems
- 15 sites currently exist, at least 5 new in development, 3 emerging
- Phase 0 - Pilot activity for CEOS data acquisition

Sites in development

Identifying Information and Product Types

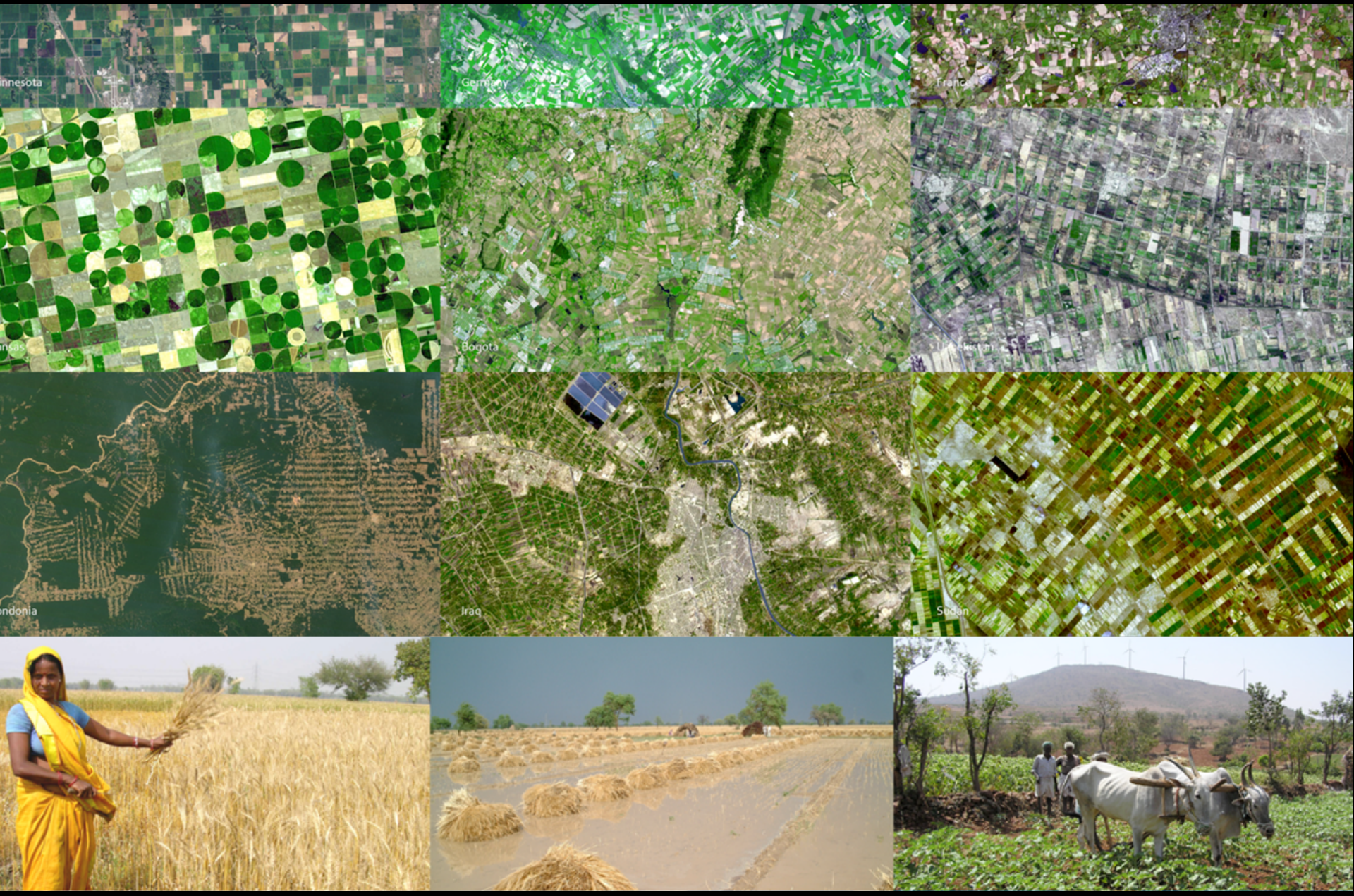
Information Products

- Crop outlook / Early warning
- Area estimate
- Yield forecast
- Production estimate
- Food Sec/vulnerability report
- Statistics reports

EO Data Products

- Cropland mask /Pasturelands
- Ag practices
- Crop condition indicators
- Crop type
- Biophysical variables
- Environmental variables (soil moisture)
- In-situ Weather

Recognition that cropping systems are inherently diverse which dictates the monitoring observations and methods



GEOGLAM / CEOS: EO Data Requirements Table

developed taking into consideration the observation needs, the derived products they will serve, and regional specificities; CEOS-GEOGLAM July 2012 Montreal)

	OBSERVATION & SENSOR TYPE			REGIONAL CHARACTERISTICS & GEOGRAPHICAL EXTENT						DERIVED PRODUCTS & MONITORING APPLICATONS							
	SPATIAL RES.	SPECTRAL RES.	TEMPORAL RES.	WHERE? (+ cropland mask & sampling scheme)				WHEN?									
Sensor Mission	Spatial resolution	Spectral range	Effective observ. frequency (cloud free)*	Swath / Extent	Sample (s), Refined (rs) or Wall -to-Wall (ws)	Large, Medium, Small fields	Crop types diversity	Calendar/ Multiple Cropping	Cloud coverage	Use (Primary or Secondary Source)	Cropland s mask	Crop type area	Crop cond. indicators	Crop bioph. var.	Env. variables (reservoir, water, soil moisture)	Ag. Practices / Cropping systems	Crop yield
MODIS (aqua/Terra), VIIRS(NPP), Vegetation (SPOT-5)	2000 - 500 m	thermal IR + optical	few per day	global	w2w					NRT products (PS)			x	x (L)			
MODIS (optical not SWIR), Sentinel 3? (future), CMA FY series?, Proba-V (future)	100-300m	optical + SWIR	2 to 5 per week	global	w2w	L/M/S		*		NRT products (PS)	x	x	x	x (L)		x (L)	x (L)
FUTURE	1-15km	passive microwave	daily	global	w2w					NRT products (PS)					x		
	50-150 m	SAR dual pol. (X,C,L) ****	5 per season	main crops	s	L/M/S	rice area	entire growing season	high cloud cov.	NRT products (SS/PS)*	x	x	x	x (L)	x	x (L)	
FUTURE	5-20m	SAR dual pol. (X,C,L) ****	5 per season	main crops	s	L/M/S	rice area		high cloud cov.	NRT products (SS/PS)*		x	x	x	x	x	
FUTURE	Footprint	RADAR Altimetry	weekly		s					NRT products (PS)					x		
ETM+ (Landsat-7), ASTER (Terra), TIRS(LDCM), IRMSS (CBERS-3)	50-100m	thermal	daily ?	main crops	s	L/M/S		entire growing season		NRT products (PS)			x				
All Optical Mid-Resoltuion (Landsat, Terra, EO-1, ResourceSat-2, CBERS-3, Sentinel-2)	20-70m	optical + SWIR	1 per month (if possible same sensor) (min 2 out of season + 3 in season)	croplands	w2w	all M/S		year-round, focus on growing season		annual products (PS)	M/S	M					
All Optical Mid-Resoltuion (Landsat, Terra, EO-1, ResourceSat-2, CBERS-3, Sentinel-2)	20-70m	optical+SWIR	1 per week (min. 1 per 2 weeks)	main crops	s	country specific (see phasing) L/M/S		entire growing season		NRT products (PS)	L/M/S	M/S	x	x	x	x	
HGR (SPOT-5), Rapid Eye (optical)	5-10 m	optical (+SWIR)***	1 per month (if possible same sensor) (min 2 out of season + 3 in season)	croplands	rs	L/M/S (focus on S)		year-round, focus on growing season		annual products (PS)	L/M/S	L/M/S					
HGR (SPOT-5), Rapid Eye (optical)	5-10 m	optical (+SWIR)***	1 per week (min. 1 per 2 weeks)	main crops	rs2	country specific (see phasing) S		entire growing season		NRT products (PS)			x	x	x	x	
HIRI (Pleiades), IKONOS, GeoEye, WorldView2 (optical)	< 5 m	optical	1 to 2 per month	croplands	rs3	demo. case (2 - 5% of croplands L/M/S)		2 - 4 coverages per year		annual products (PS)		x				x	x

Component 4 Phase 1: Defining Observation Requirements

spatial & spectral

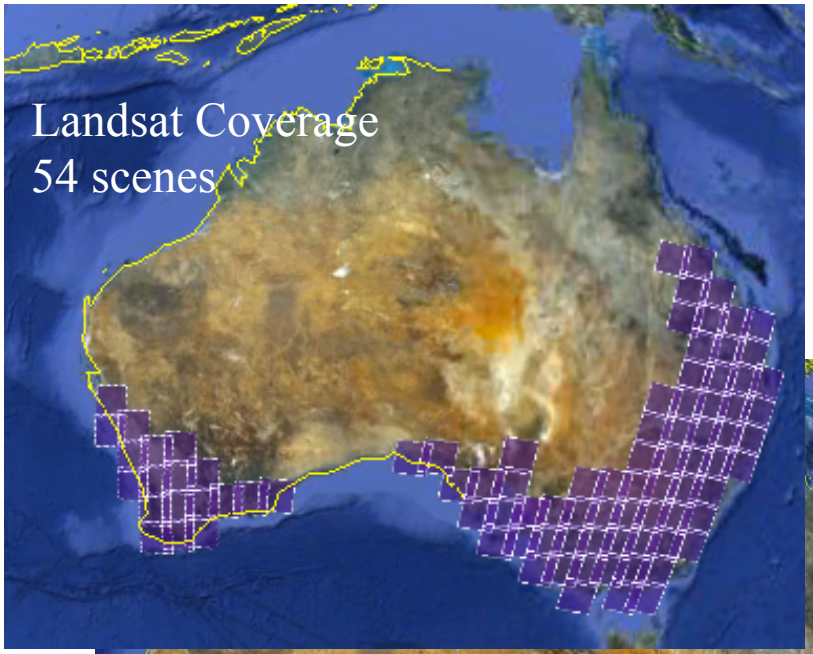
How often ?

Where?

When?

For What?

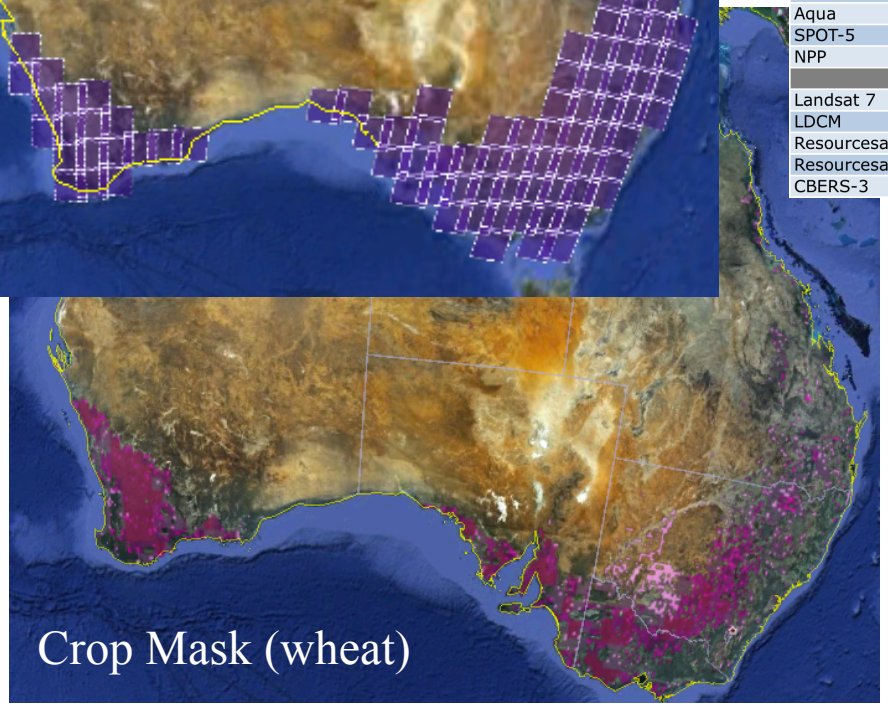
CEOS SEO Support to GEOGLAM

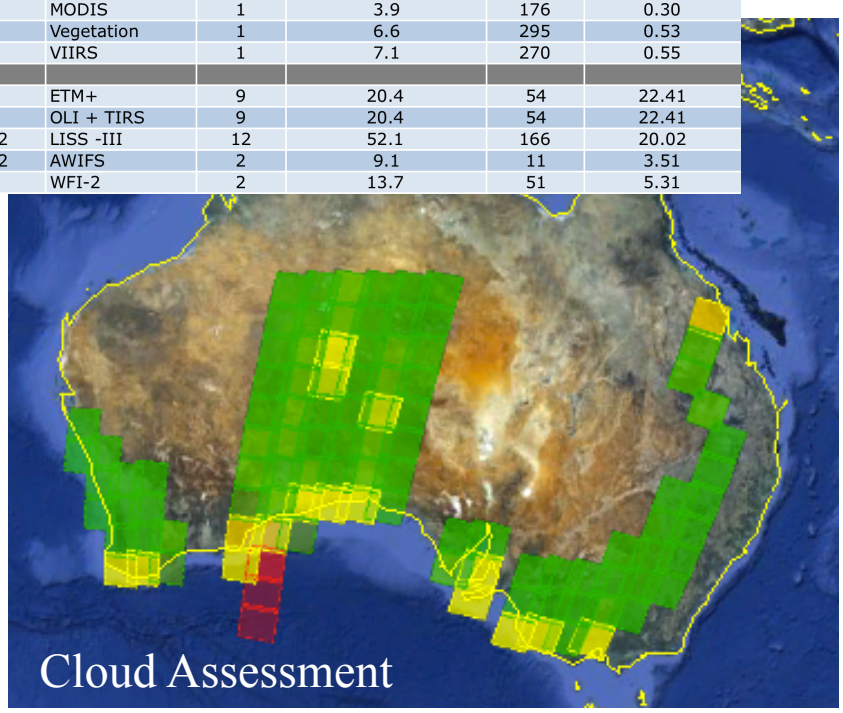


Data Acquisition Planning and Analysis

- Crop Masks, Crop Calendars
- Cloud Statistics (MODIS and ISCCP)
- Data Volume (# paths, duration, # scenes)

Mission	Instrument	Total Paths	Total Duration of Acquisitions (min)	Total Scenes	Total Data Volume (GB)
Terra	MODIS	1	3.9	176	0.30
Aqua	MODIS	1	3.9	176	0.30
SPOT-5	Vegetation	1	6.6	295	0.53
NPP	VIIRS	1	7.1	270	0.55
Landsat 7	ETM+	9	20.4	54	22.41
LDCM	OLI + TIRS	9	20.4	54	22.41
Resourcesat-2	LISS -III	12	52.1	166	20.02
Resourcesat-2	AWIFS	2	9.1	11	3.51
CBERS-3	WFI-2	2	13.7	51	5.31





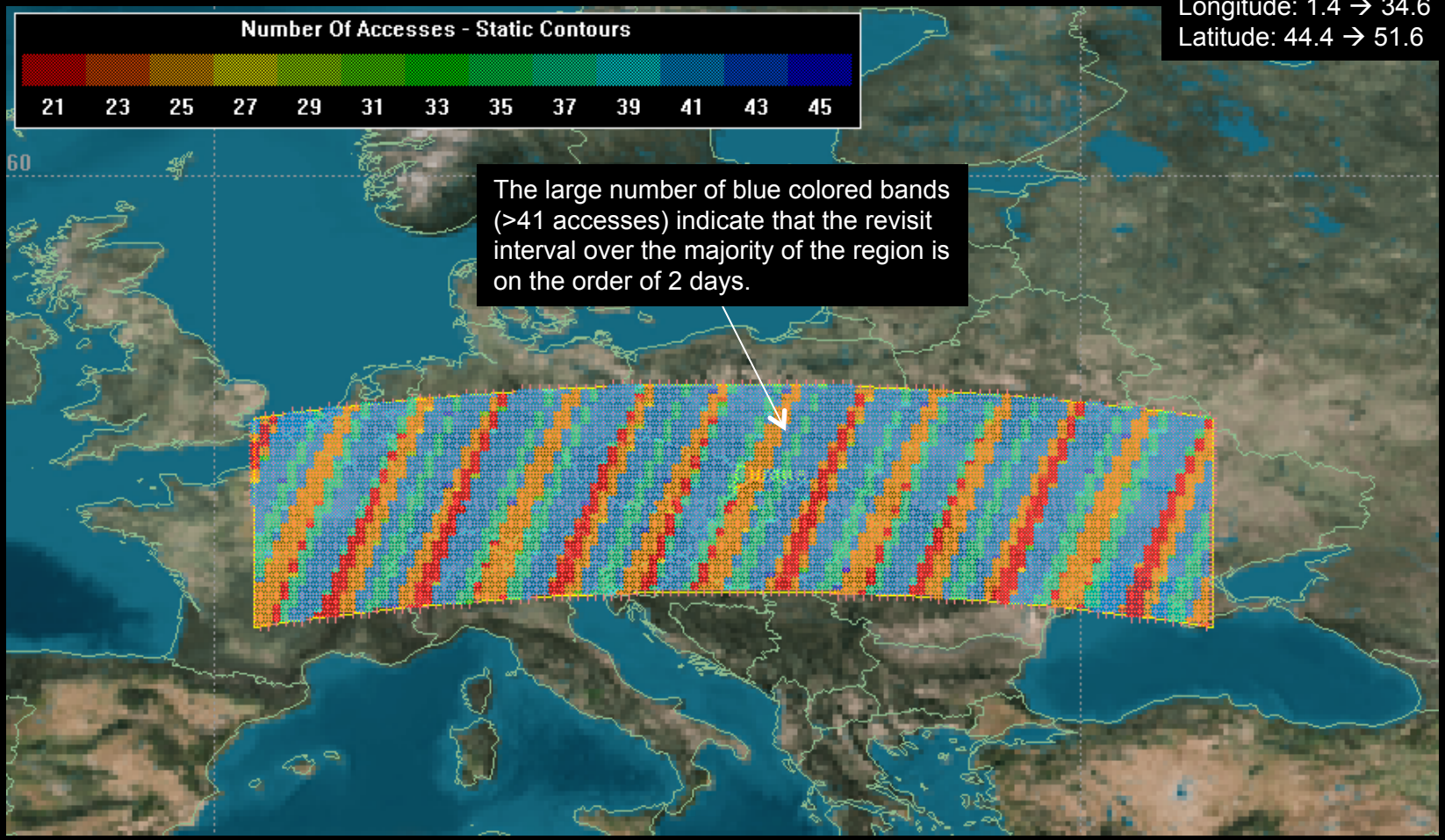
Phased Implementation of EO Component 4

- **Phase 0: Foundation Activities (2011-2013) Completed**
  - Developing approach, strategy & obs. Requirements
  - Targeted program outreach – regional workshops and partnerships
  - Development of baseline datasets & and initiate pilot activities
- **Phase 1: Demonstration & Early Feasibility Phase (2013 - 2015)**
  - Focused on 7 countries (4 large producer, 3 small producers) +1 Region
  - Initial volumetric assessments
  - Focus on available Optical and SWIR + Regional SAR (Asia Rice)
- **Phase 2: Assessment & Expansion (2014 –2016)**
  - Pilot global sampling strategy for the main producers
  - New countries (~ 5)
  - New missions (Global SAR & sentinels)
  - Sampling strategy for at risk region- initiated
- **Phase 3: Pre-Operational (2015-2017)**
  - Expand to all large producer countries (global producer sampling)
  - 3-5 small producers TBD
  - New missions acquired and new products
  - Validation/evaluation

GEOGLAM
Global Agricultural Monitoring

Component 4

Developing Inter-operable Sentinel-LDCM Datasets for Agriculture Monitoring



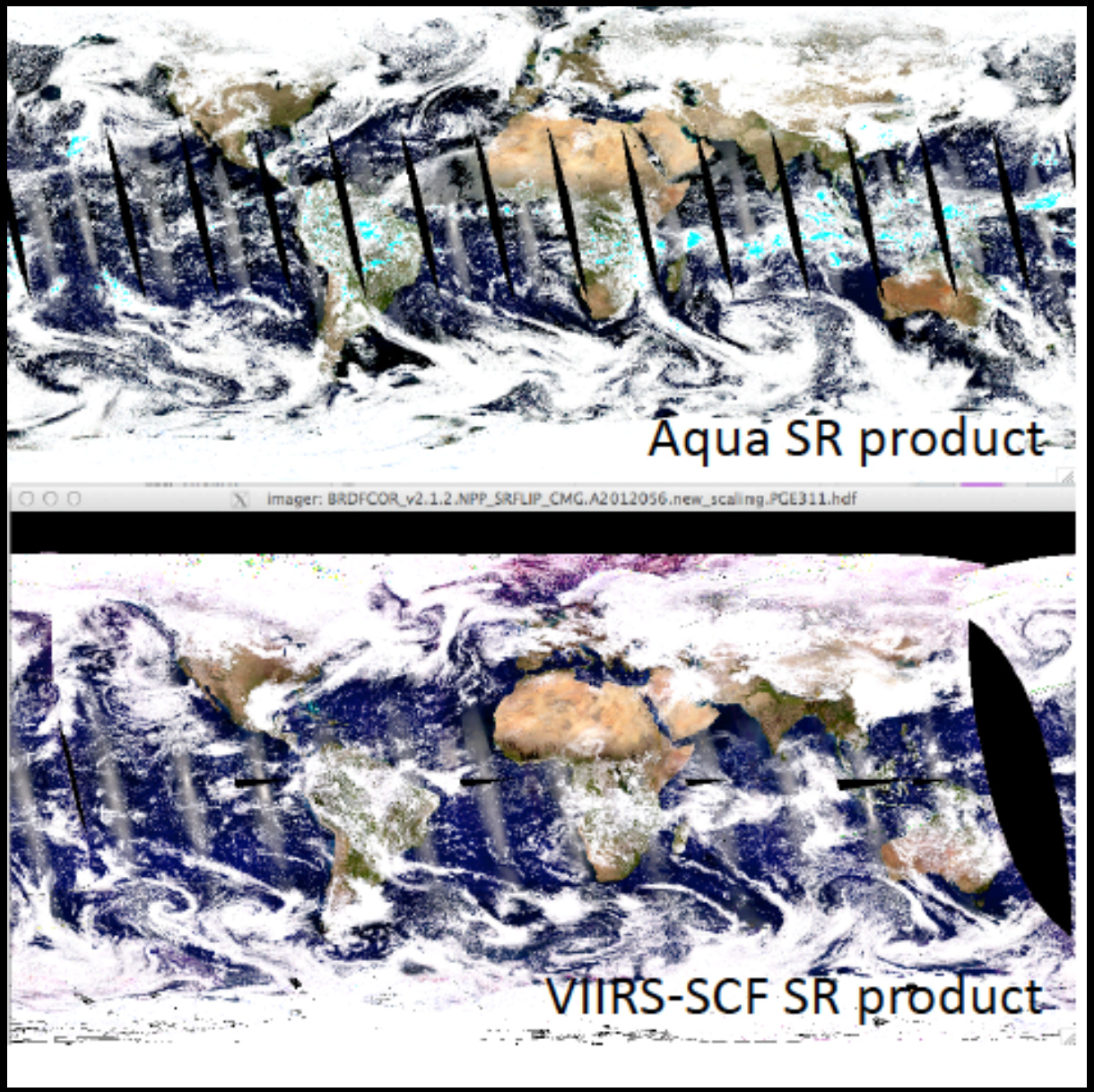
The picture shows the potential number of times LDCM and the Sentinel 2 satellites accessed areas on the ground over an 80 day period of time.

21 accesses indicates a maximum revisit interval of ~3 days 19 hours
46 accesses indicates a minimum revisit interval of ~1 day 18 hours

NASA, ESA, CESBIO

Component 4

JPSS VIIRS / MODIS inter-operabilty for agricultural monitoring



Vermote et al.

Sampling Strategy

Preference is for wall to wall coverage of agricultural regions BUT

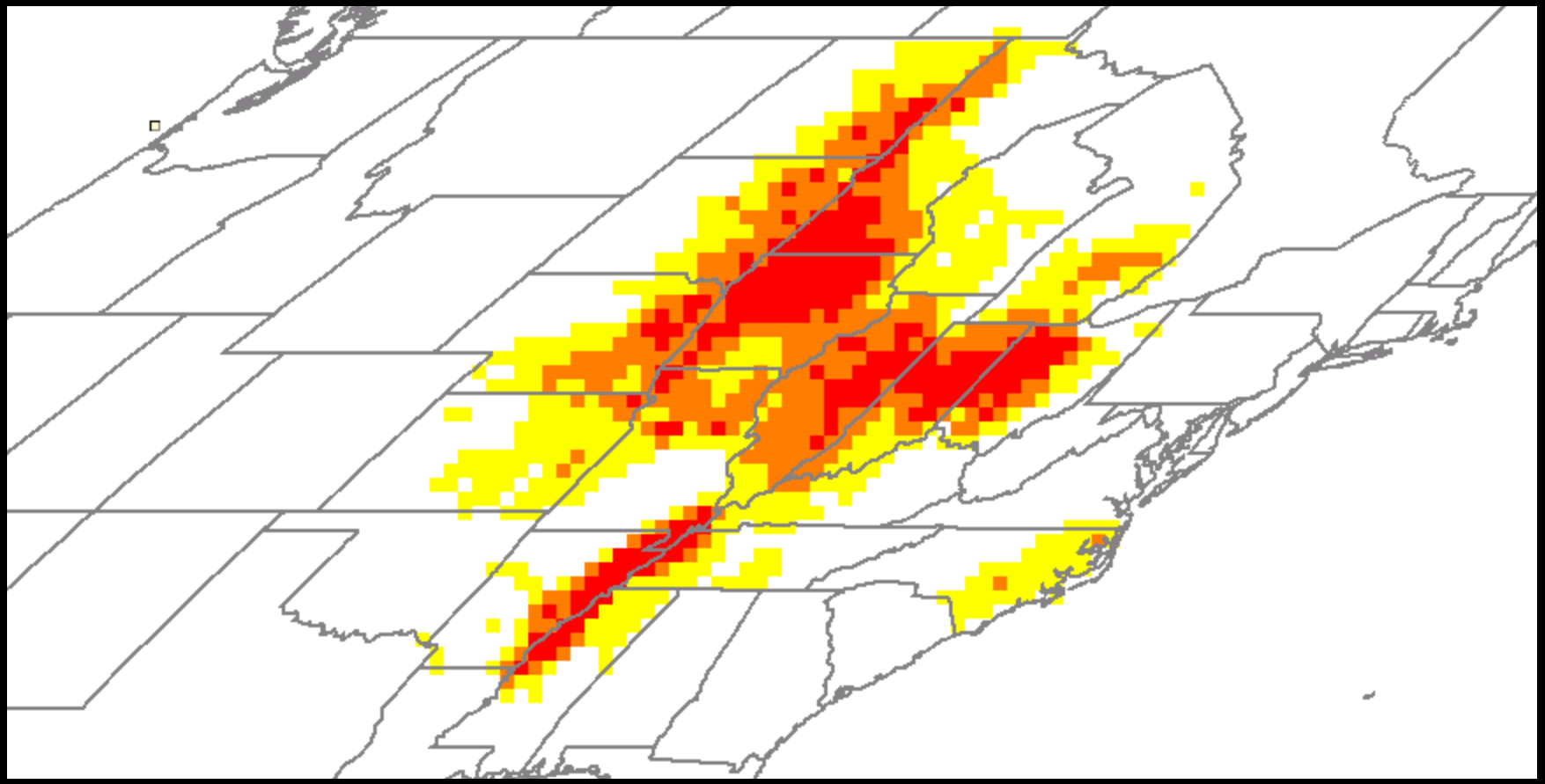
- recognizing this is not feasible for all GEOGLAM regions with high acquisition frequency, especially given cloud cover during growing season.

- A nested stratified, multi-resolution sampling approach is being developed as an alternative
  - allows for more frequent acquisitions over selected sites that are statistically representative of entire area

- *NASA has indicated intent to fund initial design of sampling approach*

Example of Multistage Sampling

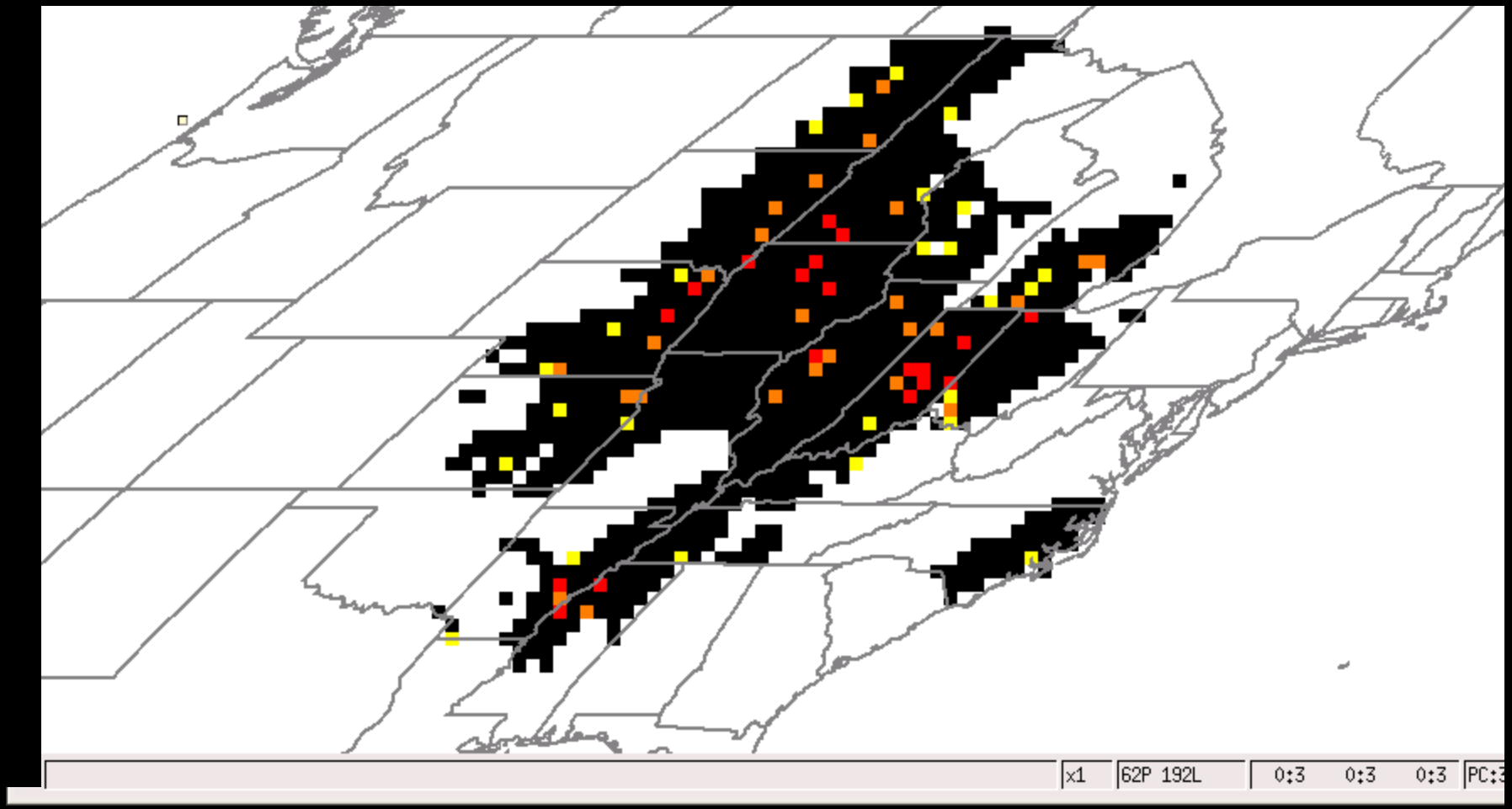
Argentina high, medium and low soybean strata using MODIS 250m



Red=high (>19.8%), orange=medium (7.2-19.8%), yellow=low (0.5-7.2%)

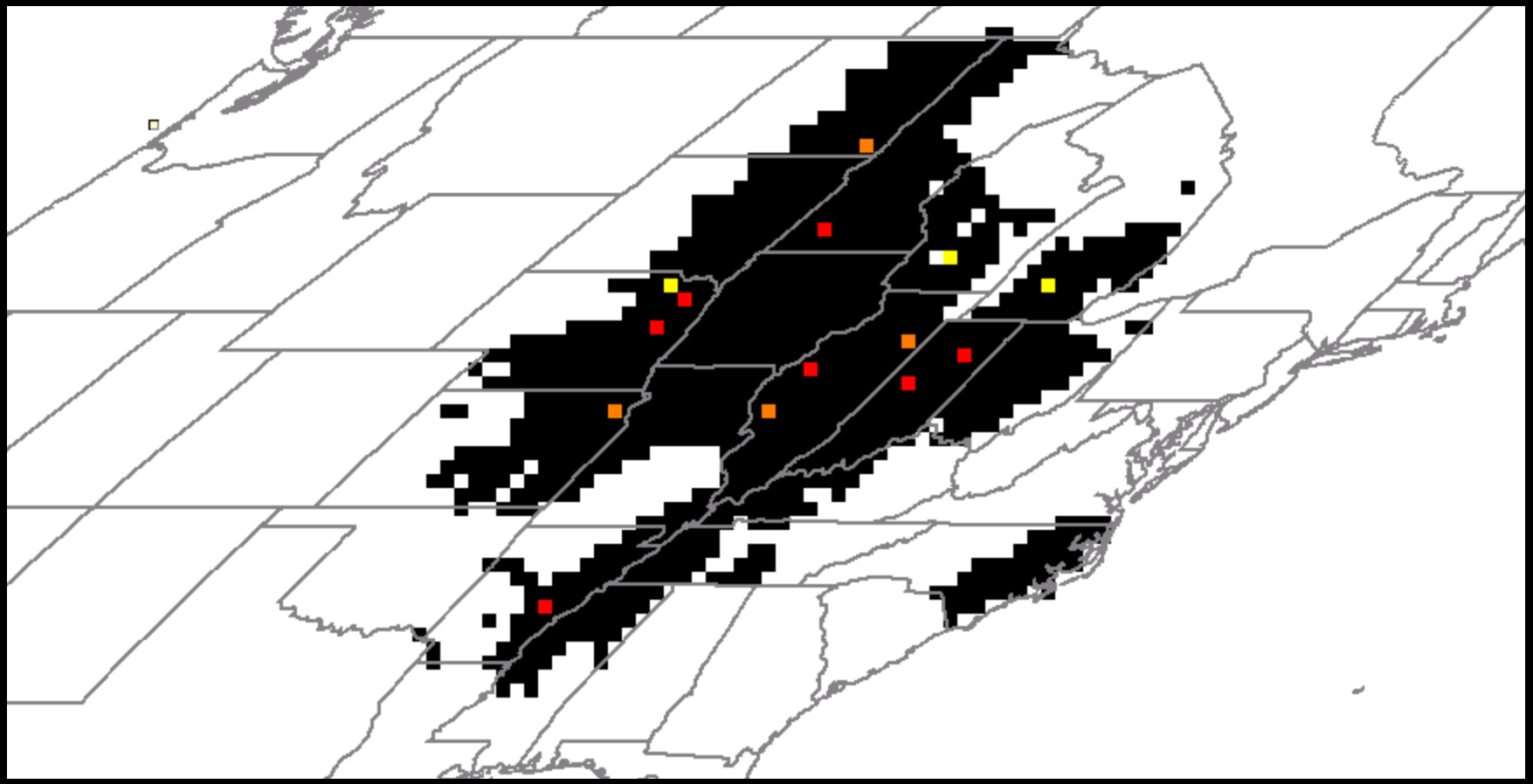
Hansen, Di Bella et al

Landsat (30m) sample blocks (S1)
3-4 acquisitions during growing season



Red=high (>19.8%), orange=medium (7.2-19.8%), yellow=low (0.5-7.2%)

RapidEye (5m) sample blocks- S2



Red=high (>19.8%), orange=medium (7.2-19.8%), yellow=low (0.5-7.2%)

Examples of GEOGLAM Phase 1 Support:

- US

  NASA
  - Global Soy Area Estimation
  - GEOGLAM operations
  - Drought monitoring system prototype
  - Wheat Yield Forecasting prototype
  - Global Sampling approach

  USDA
  - Pakistan Capacity Building
  - GLAM Operation w. NASA
- Japan:
  - Asia Rice Initiative (Asian Development Bank)
- China:
  - GEO Agriculture- MOST, indication will support GEOGLAM 2014

Canada

JECAM office and Implementation

EU FP 7

9 Million Euro Call in Process

France

GEOGLAM operations- secondment of project coordinator

Gates Foundation

Interest in supporting Africa capacity building activities

Germany (Min. Food and Ag…)

Indicated interest to support

Argentina (Ministry of Ag)

National capacity building initiative

Mexico (SIAP)

National capacity building initiative

World Bank

interest to support national capacity building as requested

Russia / FSU - regional workshop planned

Summary

- GEO Ag Community of Practice established and has a consensus
- Political support for GEOGLAM at a high level
- National institutional participation established and growing
- GEOGLAM Governance structure established
- Phased approach for implementation developed (following GEO and CEOS guidance)
- International and national funding support exists and is growing
- Early successes (Phase 0 completed) > Phase 1 under way
- Working closely with CEOS Ad Hoc Advisory Working Group
  - Has forced a clear articulation of community observation requirements !
  - Mapping GEOGLAM requirements to CEOS capabilities through an iterative process to ensure realistic expectations & scope
  - Significant progress by CEOS SEO and GEOGLAM in developing the EO requirements
  - Build upon lessons learned from GFOI and explore synergies and linkages with GFOI

GEOGLAM Way Forward with CEOS

GEOGLAM would like a formal endorsement of the phased implementation approach from CEOS and that CEOS will support the GEOGLAM implementation (CEOS Plenary 2013)

We are off to a very good start with CEOS – the Ad Hoc WG has been extremely helpful and we are making real progress in matching requirements to capabilities

We recommend that the CEOS Ad-hoc working group continue to work with GEOGLAM to ensure a manageable and effective implementation > e.g. establishing a SDCG GEOGLAM

GEOGLAM cannot be successful without coordinated space agency involvement - CEOS is the right partner for this GEO Activity

GEOGLAM provides a highly visible and feasible opportunity for CEOS to make an impact on using EO for societal benefit in an important and politically relevant sector