

Space-based Technologies for Disaster Management - "Risk Assessment in the Context of Global Climate Change"

Disaster Early Warning and Response Activities at RCMRD

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Nairobi-Kenya

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Beijing, China

1. RCMRD and its member States

About RCMRD:

- Established in 1975 by ECA
- Intergovernmental Institution
- It is based in Nairobi-Kenya
- Currently, has 19 member States

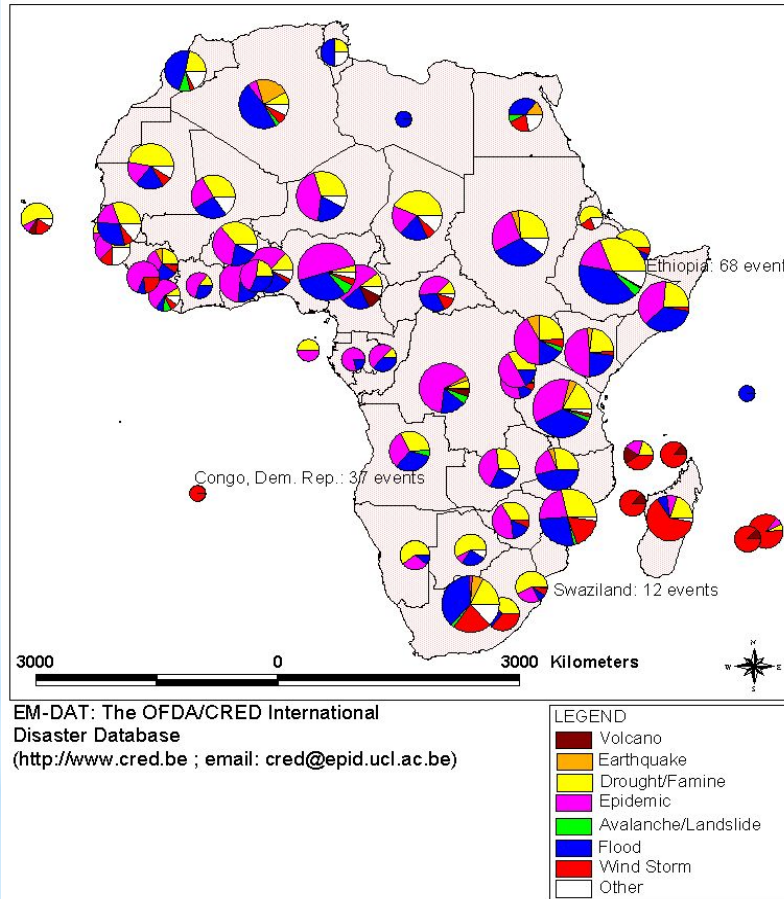


2. RCMRD Main Activities

- Training: Geoinformation and IT applications,
- Project Services: at Local, Regional and Continental levels
- Advisory Services: mainly to member States
- Research and Development: both applied and fundamental researches
- Spatial Data: acquisition, archiving and dissemination
- Early warning and forecast: Disaster early warning (flood, famine, epidemic diseases, etc.)
- Engineering Services: Maintenance, repair and calibration of survey and mapping equipments

3. Major Disasters in the Region

Distribution of natural disasters, by country and type of phenomena, in Africa (1975-2001)



Current Situation, (Ref. GARNET-E, 2012)

1. Droughts
2. Flooding
3. Landslides
4. Fire
5. Volcanic Hazards
6. Epidemic Diseases
7. Land Degradation
8. Tsunami

- **95%** of hazards are caused by droughts and flooding.
- **70%** of loss of life and **75%** of economic loss is by both

4. Disaster Early Warning At RCMRD

Early Warning Defined As:

- ❖ The provision of timely and effective information, through identified institutions, that allows individuals exposed to hazard to take action to avoid or reduce their risk and prepare for effective response (*ISDR, 2006*)
- ❖ EW integrates four key elements, namely; risk knowledge, monitoring and prediction, information dissemination, and response
- ❖ Failure of any of these elements usually collapses the entire system

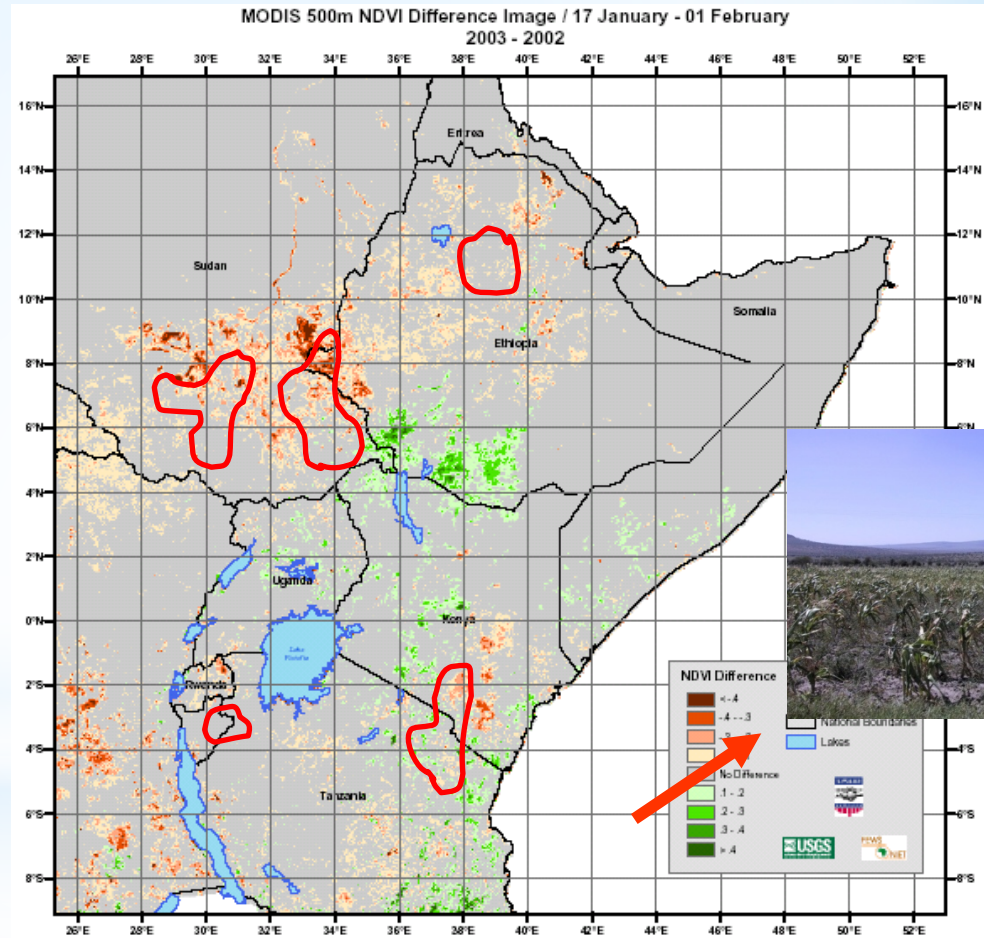
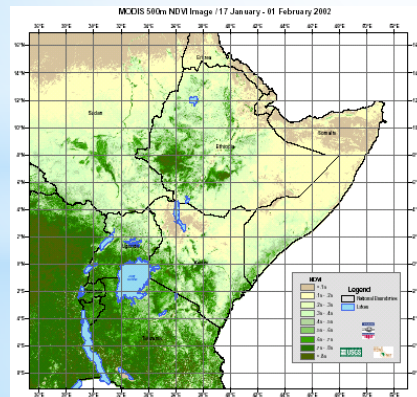
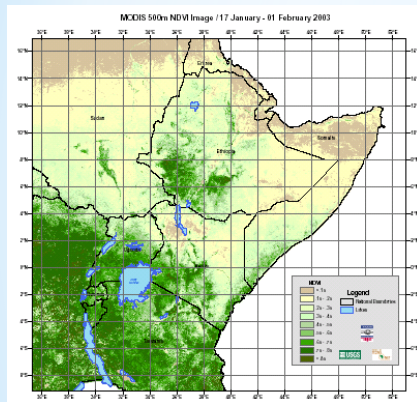
Disaster Early Warning At RCMRD...

A. Drought:

- ❖ Using the existing technologies and skills, it is possible to predict drought with lead time from weeks to seasons that may last up to four months.
- ❖ The key variables that need to be indicated in the prediction of drought are:
 - The timing (when),
 - The geographical area (where) and
 - Intensity and duration of the drought
- ❖ The indicators to be monitored are:
 - Precipitation,
 - Groundwater and reservoir levels and
 - Soil moisture.

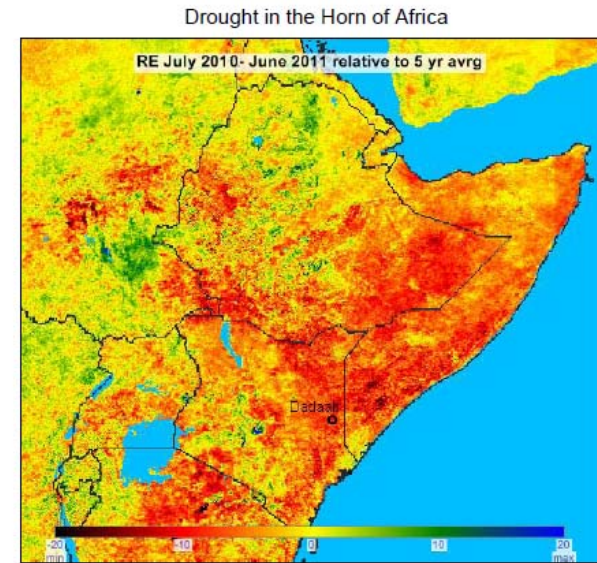
Drought Early Warning using NDVI...

Identification of Hotspots Using EO and Climate outlook data



Drought Early Warning using NDVI...

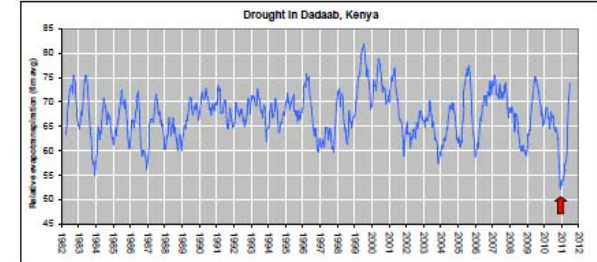
2011 Drought in the GHA



Map shows the Meteosat derived relative evapotranspiration (RE) during a 12 month period from July 2010 to June 2011 relative to the 5 yr average. RE is a measure of water availability and plant productivity. Red colors indicate lower than average productivity due to drought. The location of the UN fugitive centre in Dadaab is indicated.

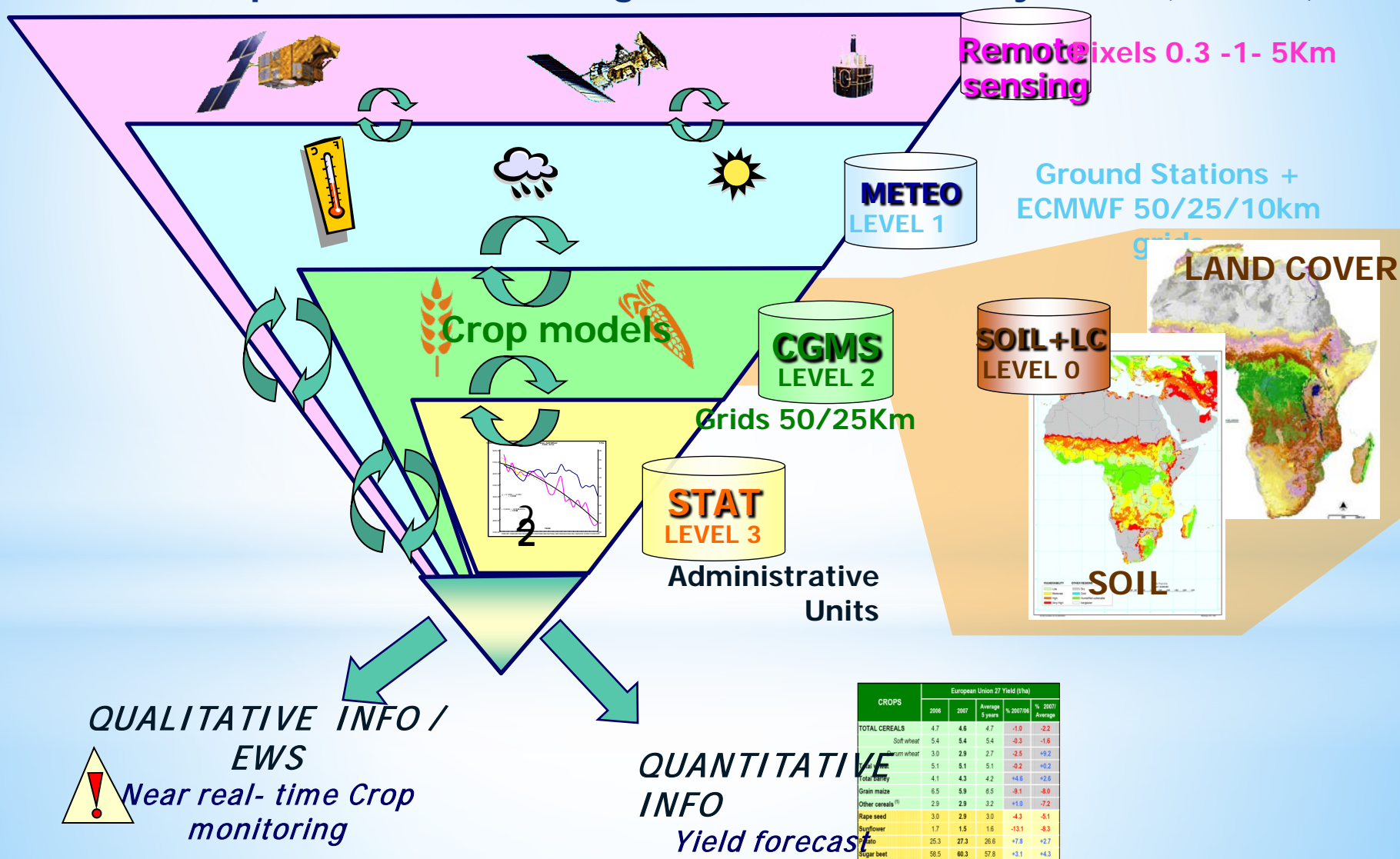
The graph below shows the course of RE during the past 29 year in an area of 30°30 km around Dadaab. The second half of 2010 and first half of 2011 are the driest period during the past 30 year.

EAHS Earth Environment Monitoring BV, Delft, the Netherlands, 20 July 2011



Crop Monitoring and Yield forecast Systems

MARS Crop Growth Monitoring and Yield forecast Systems (CGMYS)



Crop Monitoring and Yield forecast Systems

Crop yeild forecast in the Horn of AFRICA, application of EO

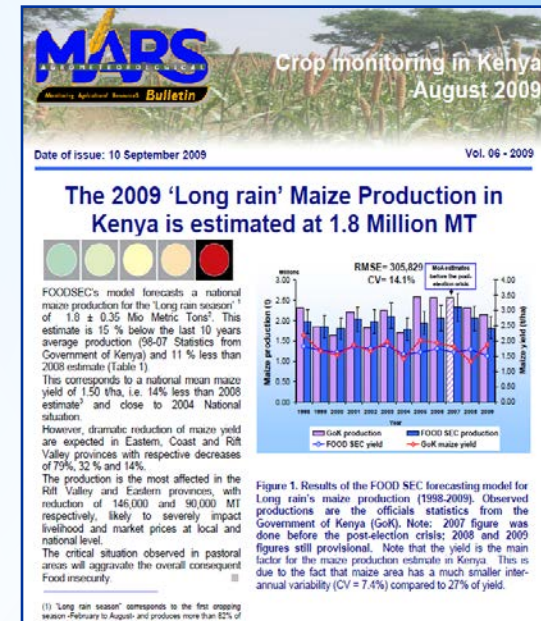
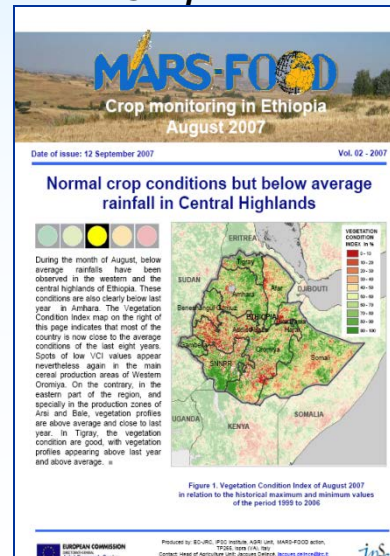
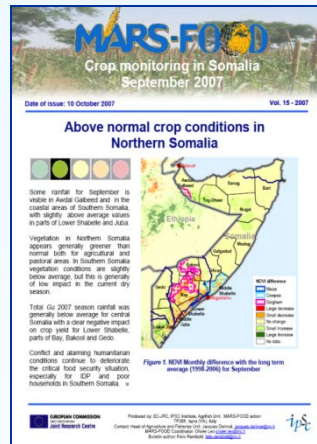


Table 1. Estimation of the National maize production during the "Long rain" crop season 2009 and comparison with the FOOD SEC 2008 estimates.

Province	Estimated yield 2009	WI*	Estimated maize area 2009	Maize production 09 MT	Maize production 08 MT	Variation % (2009 vs 2008)	Absolute difference MT
Central	1.60	0.07	84,890	136,129	134,312	1	1,817
Coast	0.71	0.04	48,508	34,348	49,975	-31	-15,627
Eastern	0.11	0.18	218,287	24,072	114,365	-79	-90,293
Nyanza	1.61	0.13	157,652	254,402	252,361	1	2,041
Rift Valley	1.80	0.43	521,465	939,715	1,085,765	-13	-146,050
Western	2.39	0.15	181,906	435,431	418,706	4	16,725
National	1.50		1,212,708	1,824,097	2,335,886	-22	-511,789

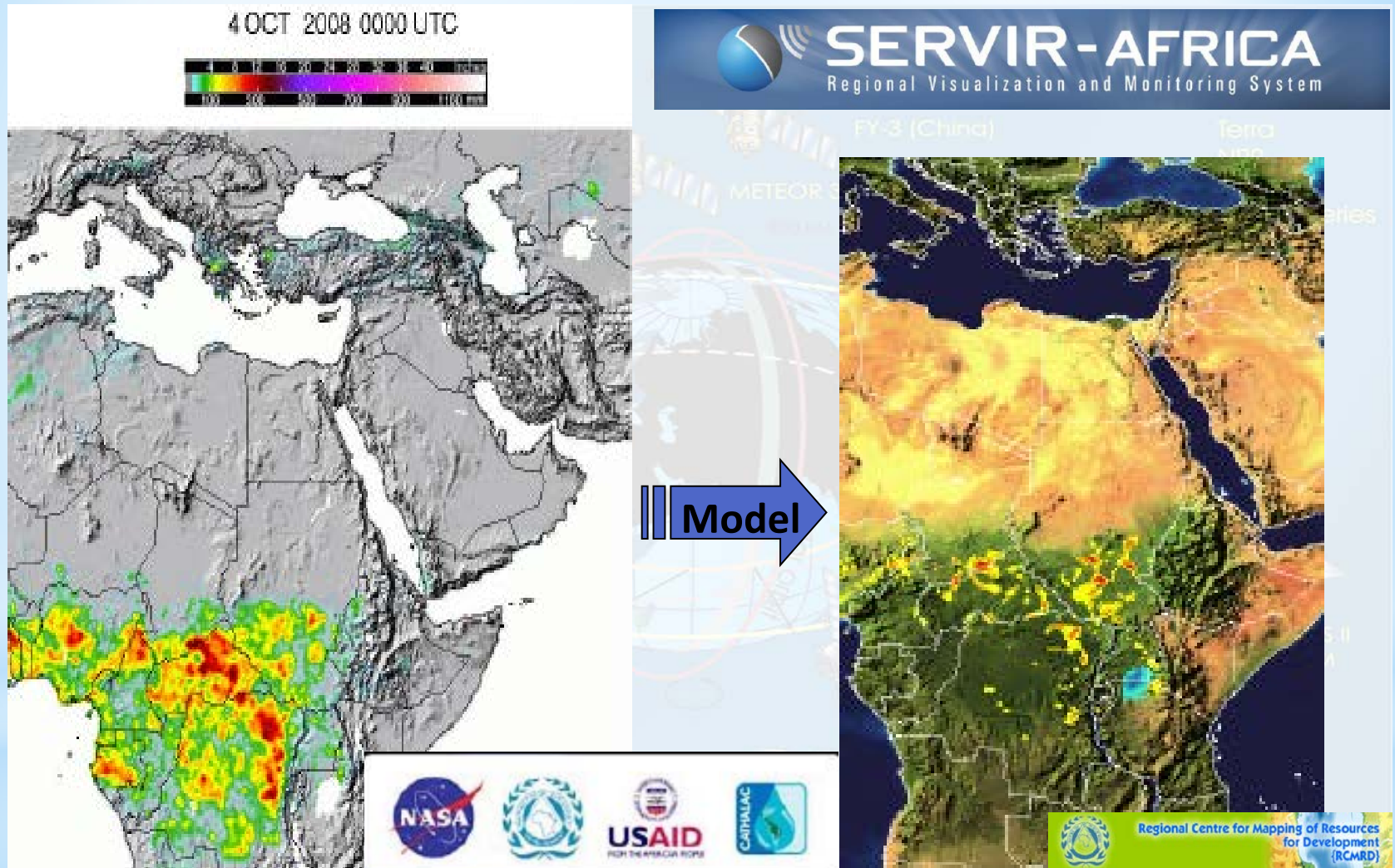
Statistical models combining best predictors from EO (NDVI, LAI, DMP) or Agromet model and trend.

B. Flooding:

- ❖ Flooding is the second major disaster in the region.
- ❖ The predictability lead time of flooding varies from minutes (flash floods) to weeks (stream floods)
- ❖ The key variables that need to be indicated in the prediction of flooding are:
 - The timing (when),
 - The geographical area (where) and
 - Water level, and velocity.
- ❖ The indicators that are monitored for flood prediction are:
 - Precipitation,
 - Soil moisture,
 - River gauge level

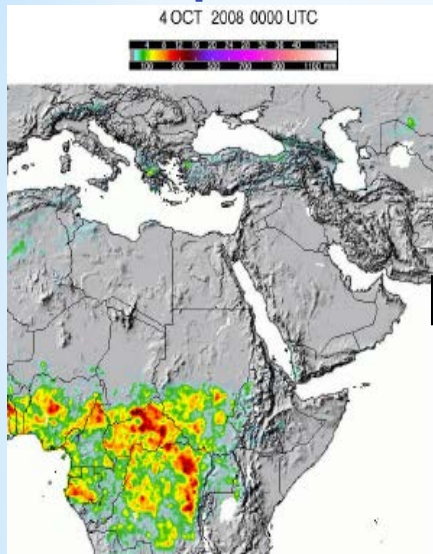
All of these indicators are monitored both from satellite and ground observations.

Flood Early Warning and Forecasting



Flood Early Warning and Forecasting

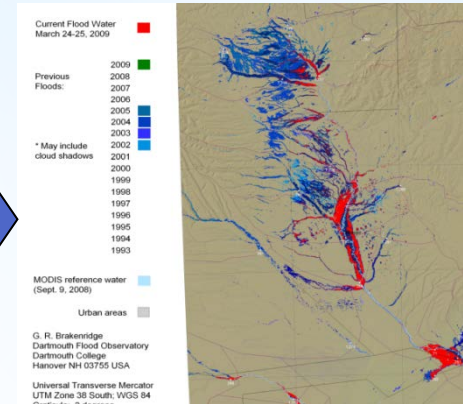
Precipitation



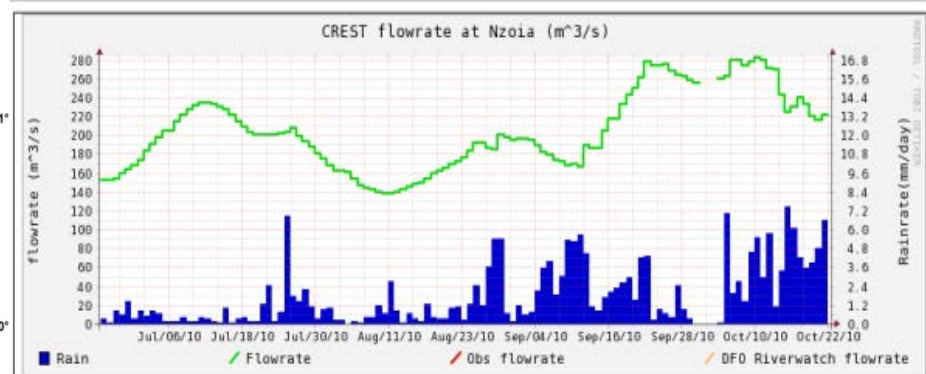
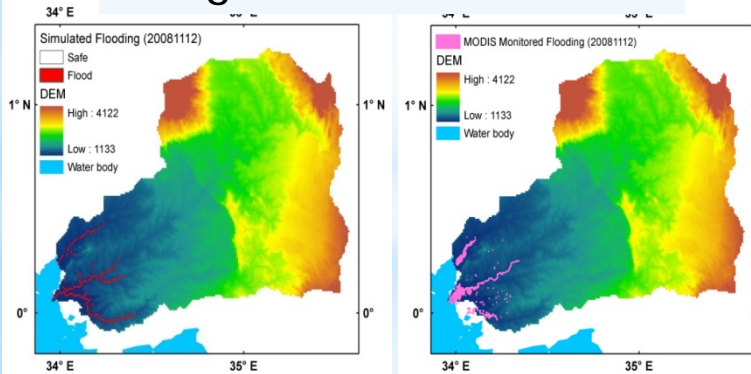
Flood Potential



Flood Event Mapping

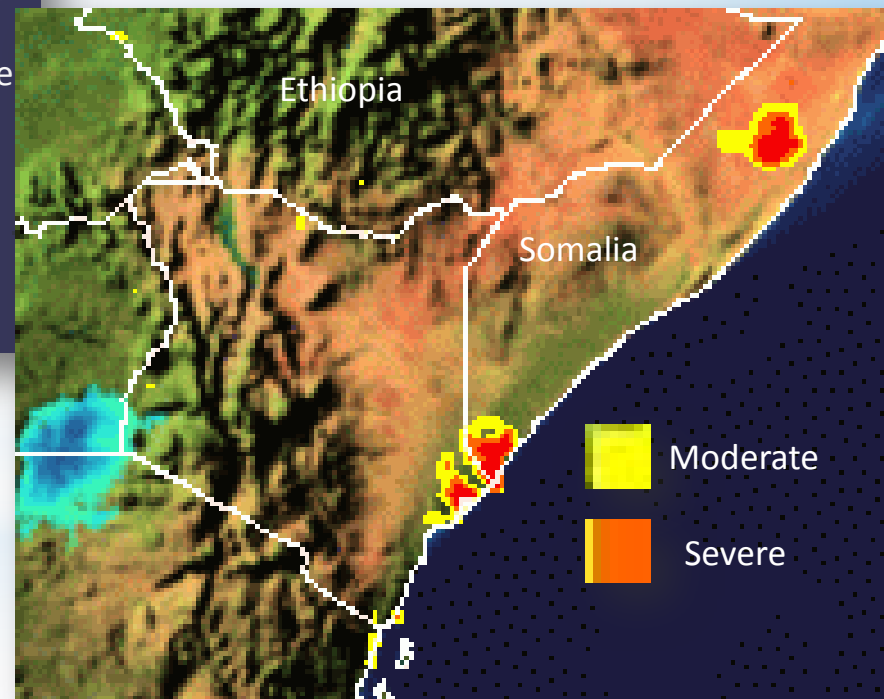
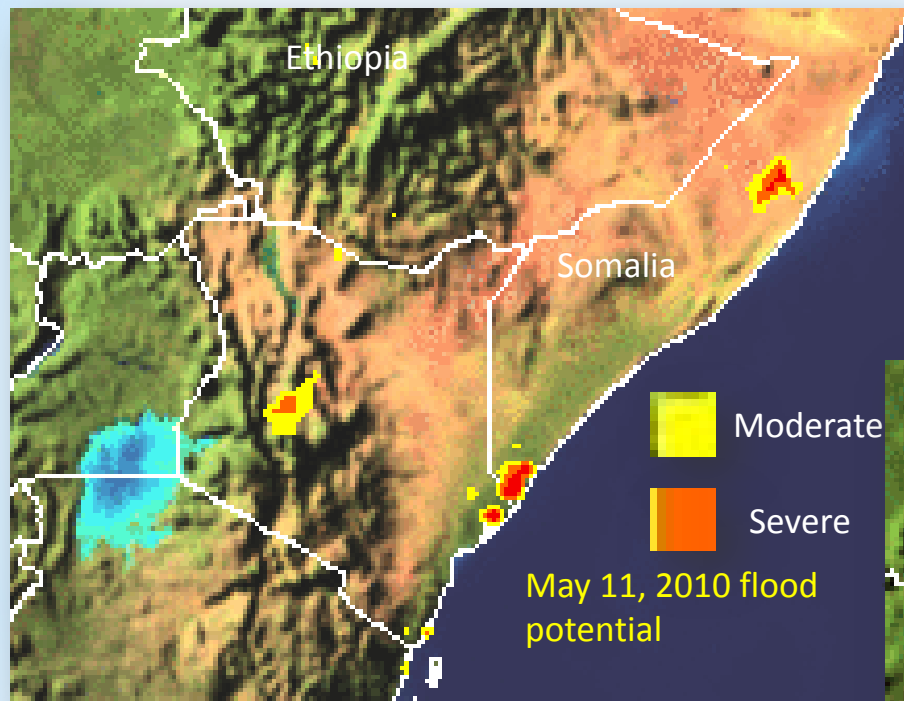


High resolution Model



CREST Stream Model

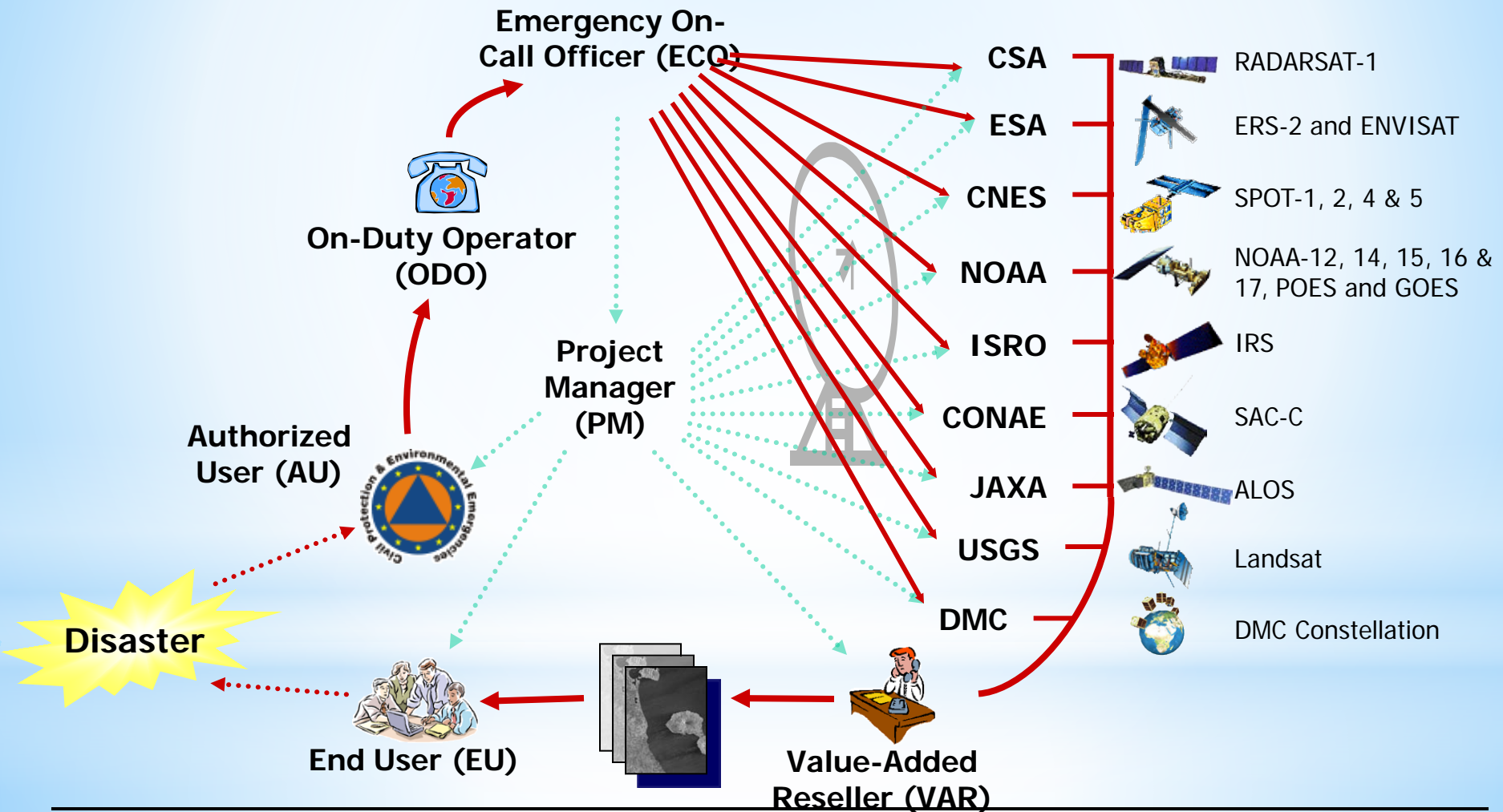
Flood Early Warning and Forecasting , Kenya



Flood Early Warning and Forecasting

COUNTRY	WATER LEVEL & Latitude/Longitude		NEARBY LOCATION
Kenya	142mm	-2.13 40.88	~ 16.76km from LAMU/MANDA ISLAND -2.27 40.83
Kenya	159mm	-1.63 40.88	~ 72.17km from LAMU/MANDA ISLAND -2.27 40.83
Kenya	172mm	-1.38 41.38	~ 116.62km from LAMU/MANDA ISLAND -2.27 40.83
Kenya	193mm	-1.88 40.88	~ 44.28km from LAMU/MANDA ISLAND -2.27 40.83
Kenya	204mm	-1.38 41.63	~ 133.21km from LAMU/MANDA ISLAND -2.27 40.83
Kenya	221mm	-1.88 41.13	~ 55.00km from LAMU/MANDA ISLAND -2.27 40.83
Kenya	256mm	-1.63 41.63	~ 113.70km from LAMU/MANDA ISLAND -2.27 40.83

Response through International Disaster Charter

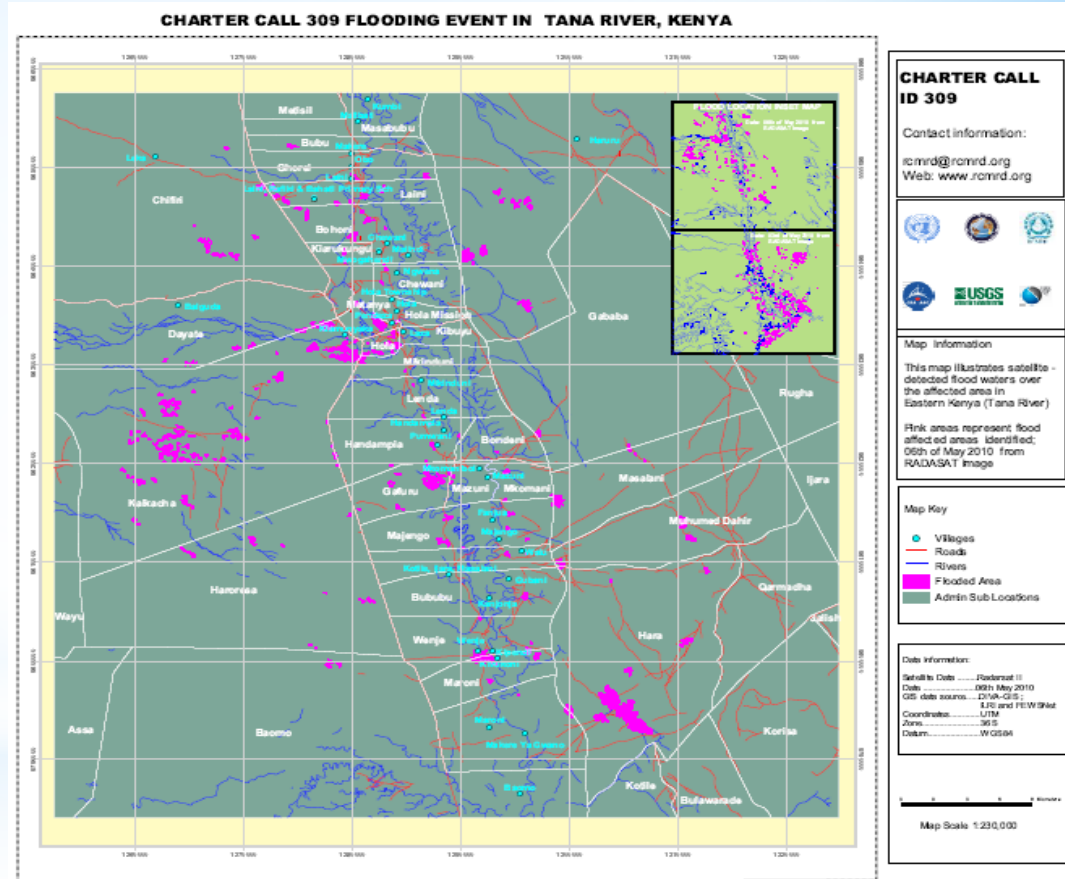


Response for Flooding in Kenya in June 2010

Charter Activation 309, RADARSAT Image



Flood Disaster Rapid Map



Response for Landslide Disaster in Uganda

C. Landslides/ Mud flow/ Rock fall

- ❖ Stereoscopic EO data provides DEM and Land Cover Information which are required for landslide vulnerability assessment and monitoring.
- ❖ Several historical landslide scars were mapped from Landsat Images in Kenya and Ethiopia

Examples: Western Kenya, Ethiopia, Malawi

Response: Landslide



On March 2, 2010 a massive landslide occurred in Eastern Uganda's Bududa District. A trading centre in a village was flattened, leaving shops and houses buried under the mud. By morning March 3 2010 the official death toll had raised to 85 people but more than 350 were still unaccounted for.

The Advanced Land Imager (ALI) on NASA's Earth Observing-1 (EO-1) satellite captured this natural-color image on March 11, 2010. Gravity constantly tugs downward on a slope, but only when gravity's force exceeds the strength of the rocks, soils, and sediments composing the slope does land begin to slide down hill. Landslides often occur in conjunction with other events, and rainfall in the Bududa region likely initiated this slide



For more information,
visit www.servir.net

LANDSLIDE AFFECTED BUILDINGS IN NAMASHETI & ULUKUSI PARISH, UGANDA

Analysis with Formosat-2 & Radarsat-2 Data Acquired 5-8 March 2010 & Spot-5 Data Acquired 20 Feb. 2007

This map illustrates satellite-observed areas of potential landslides as located in Parasheti-2 images acquired on 7 March 2010, and previous Spot-5 images acquired 20 February 2007. Most buildings likely affected by landslides were identified through automatic landslide mapping from the previous SPOT-5 imagery. Please note there is an associated degree of uncertainty for some areas of landslide because of false cloud cover and the building must be deep to be an indication that the land beneath it. Affected buildings in this area. This assessment is a preliminary analysis & has not yet been validated in the field. Please see ground truth data in UNOSAT.

Greater coverage by the international Charter Space and other countries. For more information on the Charter, which is about assisting the disaster relief organizations with satellite-based data and information, visit www.internationalcharter.org

Legend

- Satellite-observed building
- Satellite-observed building likely affected by landslide
- Unimproved Trail, Roadway
- Parish Administrative Boundary
- Elevation contour (25 meter interval)
- Spring/Water
- Health Center
- School
- Health Center

SATELLITE ASSESSMENT CLASSIFICATION

- Probable Landslide surface area
- Possible Landslides, or landslides affected land (high uncertainty because of cloud cover)

Map Scale for A3: 1:9,000

0 50 100 200 300 400 Meters

Metadata

Satellite Data (1)	Formosat-2 (2.5m Panchromatic)
Image Date (1)	2 February 2007
Copyright (1)	NSPO 2007
Satellite Data (2)	SPOT-5 (2.5m Panchromatic)
Image Date (2)	2 February 2007
Copyright (2)	SPOT Image 2007
Satellite Data (3)	Radarsat-2 L1
Image Date (3)	5 March 2010/2504
Resolution	10m / 25m
Copyright (3)	RADARSAT-2 © MDA 2010
Cloud	Canadian Space Agency
Dist. / Prod Date	UNOSAT / UNOSAT
Classification	ASTER / UNOSAT
Other Data	UNOSAT, UNOSAT, UNOSAT
Geographic Analysis	UNOSAT / UNOSAT
Projection	UTM Zone 38 North
Datum	WGS-84 (EGM96)

The depiction and use of boundaries, geographic names and related data shown here are not warranted to be accurate nor do they imply official endorsement or acceptance by the United Nations. UNOSAT is a program of the United Nations Institute for Training and Research (UNITAR) providing satellite imagery and related geographic information, research, and analysis to UN member states & development agencies & their implementing partners.

unitar
United Nations Institute for Training and Research

UNOSAT

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www.unosat.org

Challenges in Disaster EW for the Region

- ❖ Most of the EWS in the GHA (and Africa in general) are project based – thus have a limited lifespan,
 - ❖ Inadequate / inaccurate in-situ data, lack of standardized baseline data,
 - ❖ There is Need for promoting Research on development of EWS and disaster rapid mapping,
 - ❖ Need for awareness creation among decision makers on the importance and use of geospatial mapping for disaster risk assessment.
 - ❖ Focus more on long-term EWS (Preparedness rather than costly response)
-

The DRM program at RCMRD

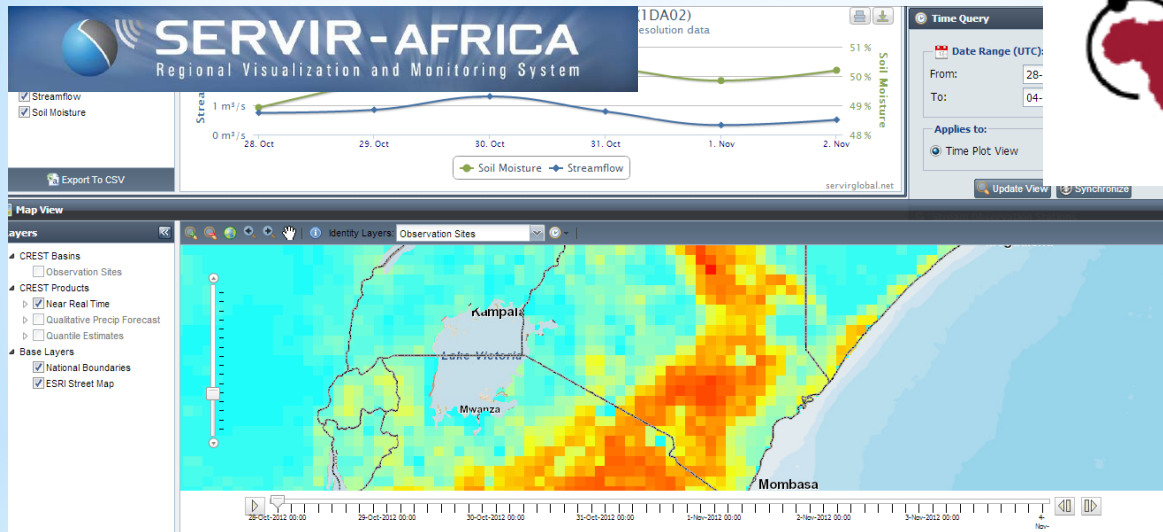
- Four confirmed years of initialization (2012-2014)
- Established in light of all phases of disaster management

Initial focus on:

- Preparedness and early warning – Development of tools and applications and leveraging on existing ones
- Risk assessment – Hazard, vulnerability and risk mapping
- Response – Rapid mapping, EO based damage and loss assessments
- Mitigation – Capacity building (Institutional and individual levels)

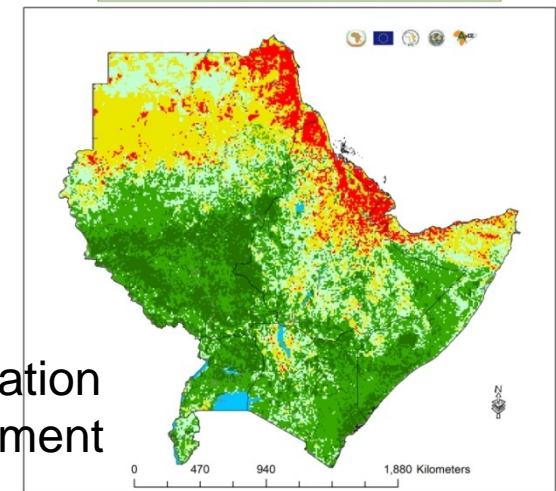
Building on past and current disaster related activities/projects

SERVIR CREST Flood warning and mapping tools



- Rapid mapping
- Charter activation

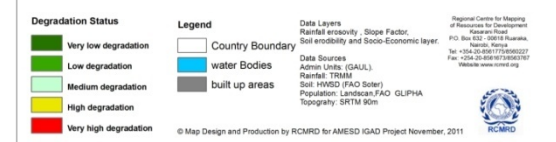
ACTUAL LAND DEGRADATION INDEX MAP
IGAD REGION (MAY-SEP 2010)



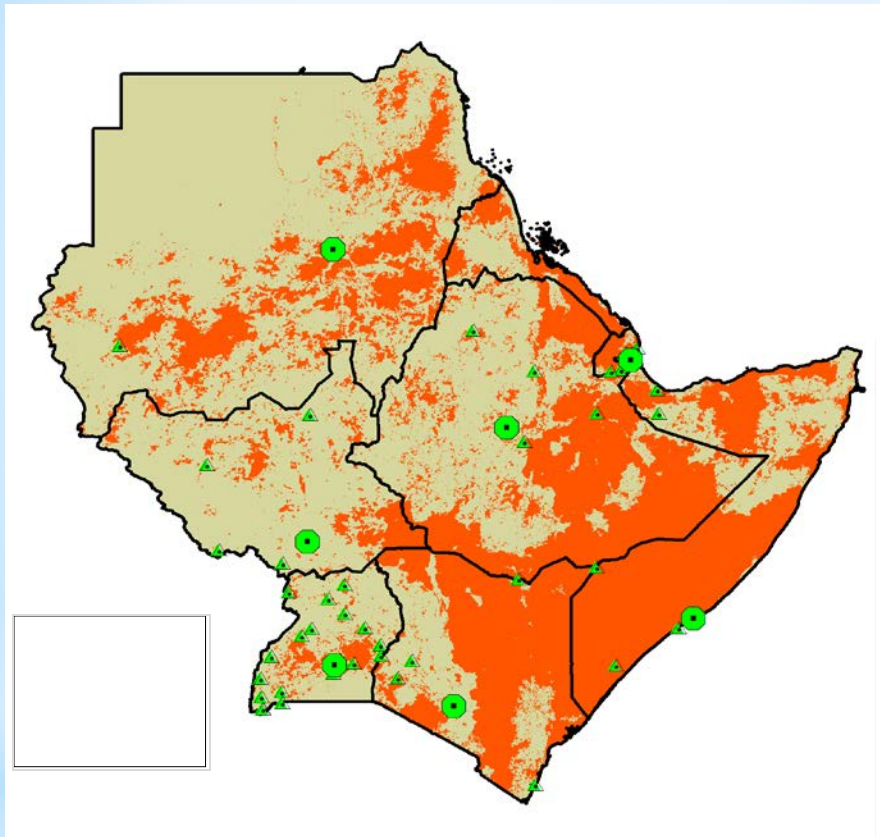
Land
degradation
assessment



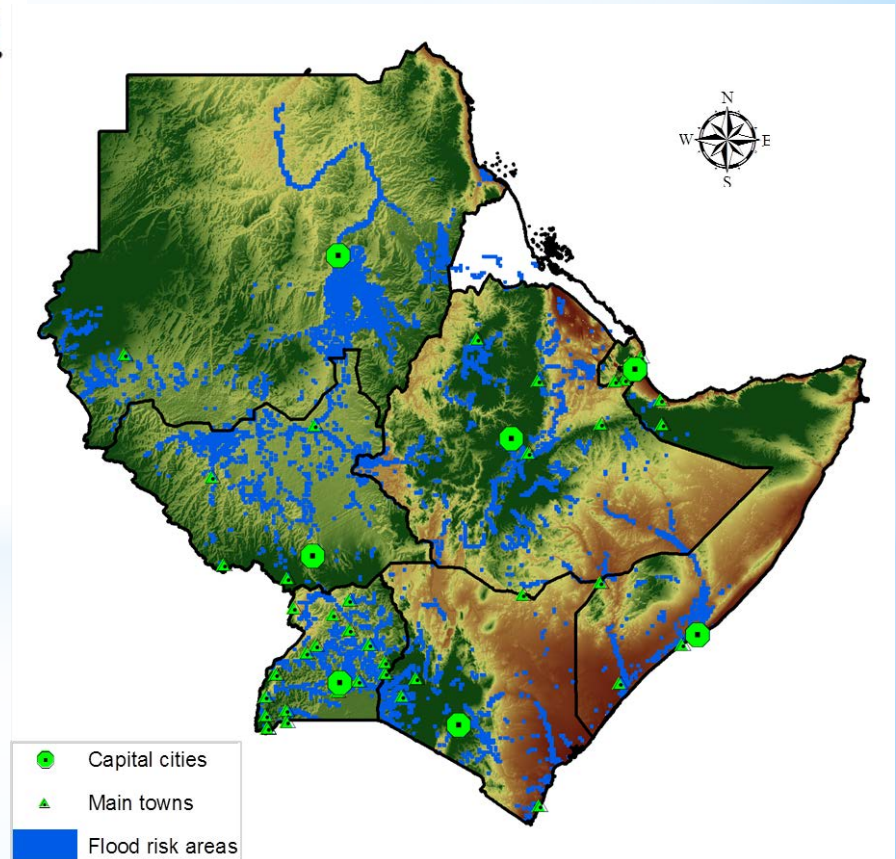
- Drought early warning
- Crop monitoring



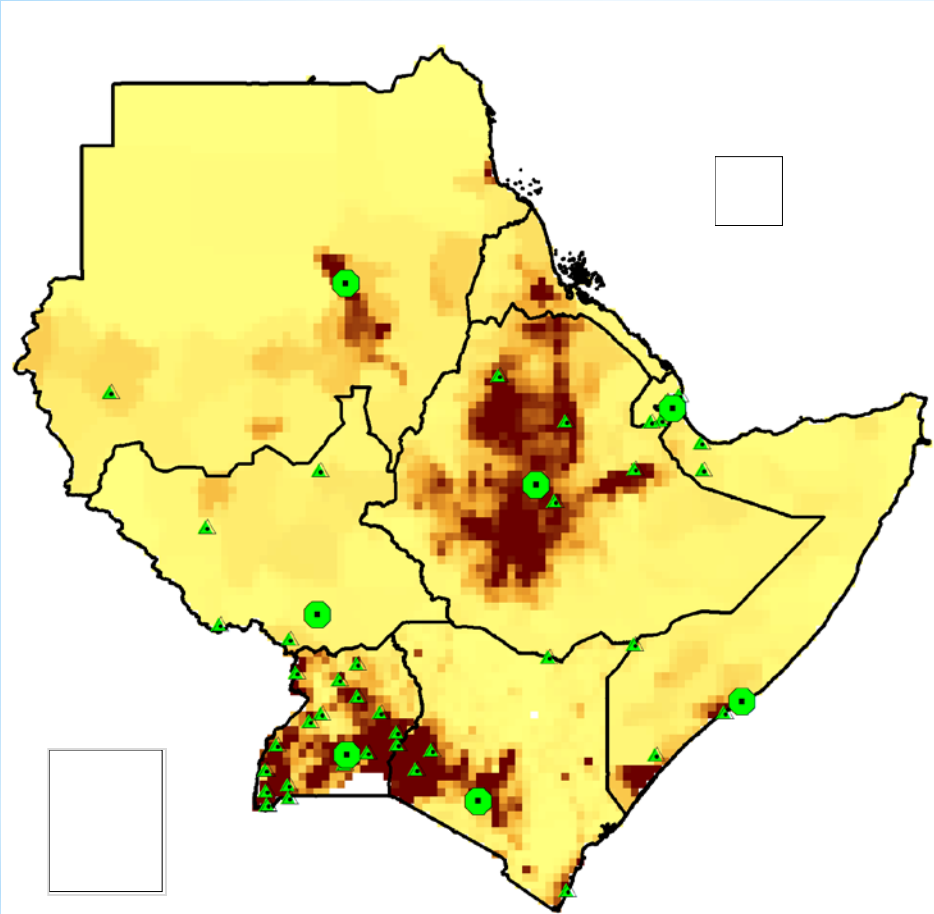
IGAD region Hazard mapping



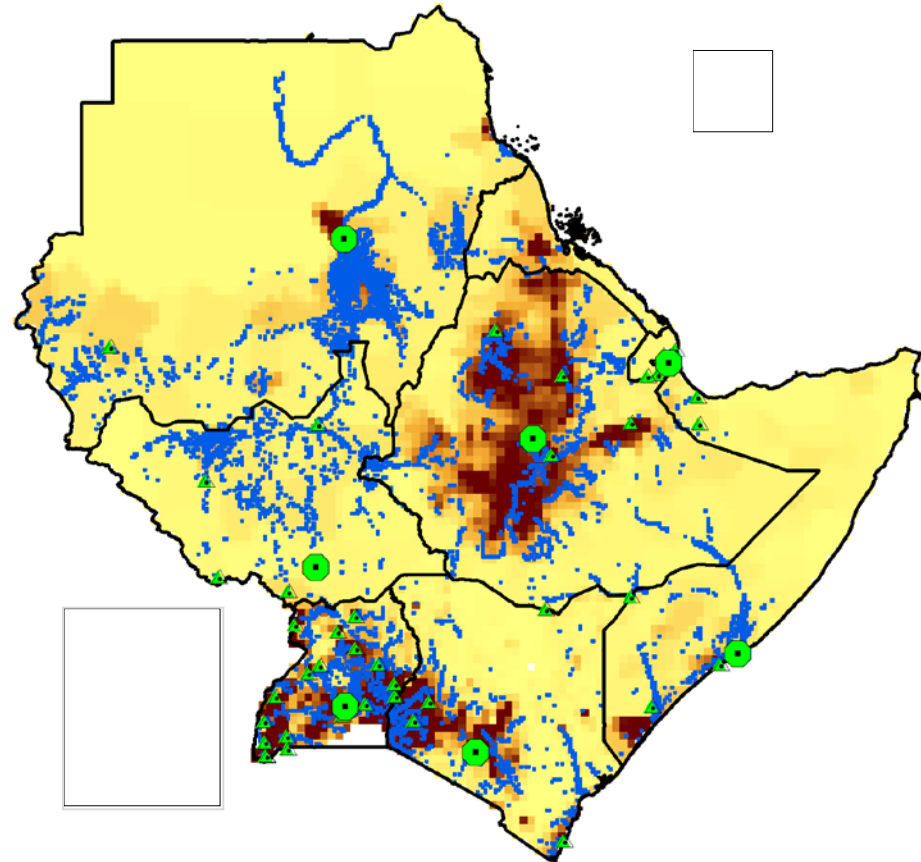
Who's the 'elephant' in the room?



Where are the people living?



What's the level of exposure, who's vulnerable?



What is the risk?

**Our disasters want to
party all the time!**



Thank You,

Contact Information:

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