



# Early Warning Systems in Eastern and Southern Africa:

by

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# Regional Centre for Mapping of Resources for Development {RCMRD}



Regional Centre for Mapping of Resources  
for Development  
{RCMRD}





# REGIONAL CENTRE FOR MAPPING OF RESOURCES FOR DEVELOPMENT



## *Our Vision*

To be a premier Centre of excellence in the provision of Geo-Information & Information Technology Applications in Africa & beyond

## *Our Mission*

To provide quality Geo - Information & allied Information Communication Technology products & services in environmental & resource management for sustainable development in our Member countries & beyond



# *Our Products and Services*

**Training:** Geoinformation and IT applications,

**Project Services:** at Local, Regional and Continental levels,

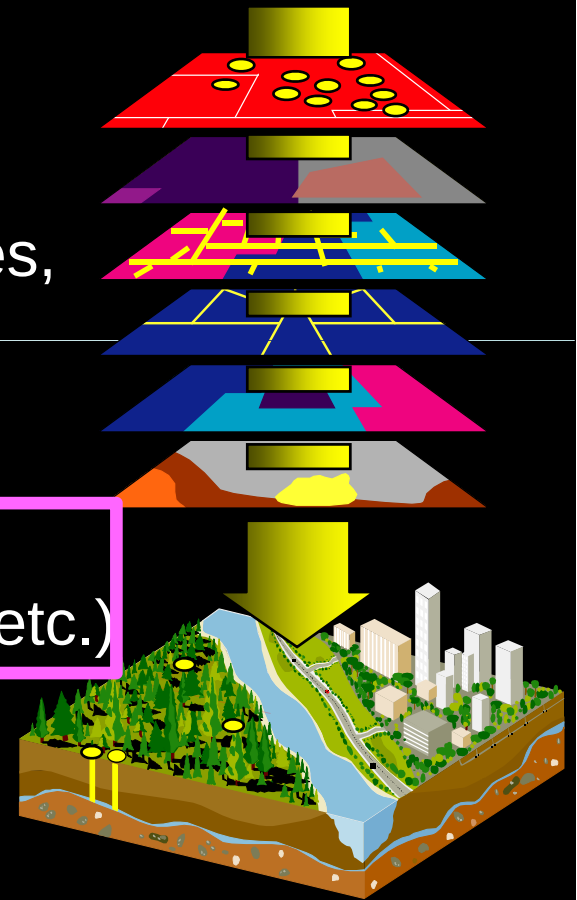
**Advisory Services:** mainly to Member States,

**Spatial Data:** acquisition, archiving and dissemination,

**Early warning and forecast:** Disaster early warning (flood, famine, epidemic diseases, etc.)

**Research and Development:** both applied and fundamental research, and

**Engineering Services:** maintenance, repair and calibration of Survey and mapping equipments



# The Role of RCMRD in Disaster Management in Eastern and Southern Africa

To Strengthen national and regional capabilities in the area of Remote Sensing and GIS to cater for early warning information for food security, natural resources and disaster management.

## MORE SPECIFICALLY:

- ❖ To promote use of space technology in early warning for food security and disaster management
- ❖ Capacity building in Geo-information technologies and ICT
- ❖ Promotion of National and Regional development of SDI
- ❖ Provision of advisory services in the application of Geo-information technologies for sustainable development



# RCMRD's sample activities in Early Warning

- ❖ **Food Security and environmental monitoring** (USGS/Fewsnet, IGAD Climate Prediction and Application Centre, DLCO, WFP, ILRI, LEWIS, GMFS)
- ❖ **Flood modeling and prediction** (USGS, SERVIR-Africa)
- ❖ **Disease Modeling and Prediction**
  - Rift Valley Fever (WRI, AU-IBAR, UoN, USGS)
  - Mapping of HIV/AIDS on the Mombasa – Kampala highway (Manitoba University, UoN)
- ❖ **Land degradation mapping and monitoring**
  - Deforestation (Mau Forest)
  - Land use / Land cover change (Kordofan Region, South Sudan)
  - AMESD (African Monitoring of the Environment for Sustainable Development)
- ❖ **Capacity building for disaster management**
  - Training in the use of modern Geo-information technologies in early warning and food security, disease mapping, land degradation, disaster risk management
  - Servir-Africa Project: a capacity building project enhancing access to data and tools
  - Garnet-E Project: a networking project for disaster management actors
- ❖ **Monitoring urban sprawl** (Informal settlements)-Urban growth prediction
- ❖ **Development of Multi-Hazard Atlas** of the GHA Region
- ❖ Plans to install a **MODIS Direct Receiving Station at RCMRD** are underway







# SERVIR-AFRICA

Regional Visualization and Monitoring System

## 1. What is SERVIR-Africa?

Enabling the use of  
earth observations  
and predictive models  
for timely decision  
making to benefit  
society



# Garnet-e

**GARNET-E** is a **GMES Project** under the Seventh Framework Programme:

*EC 7FP: Theme 9\GMES*

*SPA.2009.3.2.01: International Cooperation*



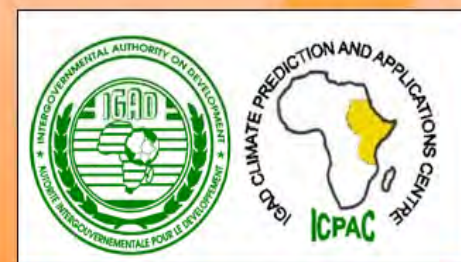
## GARNET-E...

**GMES** for **A**frica: **R**egional **N**etwork for Information **E**xchange and **T**raining in **E**mergencies

...brings the GMES Emergency Response Service to Africa









**IGAD**  
Intergovernmental Authority  
on Development

*Peace, Prosperity  
and Regional Integration*

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## IGAD Ministers Meet on the Establishment of Disaster Response Fund and the Launching Hazard Maps and Atlas

31 Sunday, 21 April 2013 21:56



(IGAD – Khartoum) The Ministers of the IGAD Member States responsible for Disaster Risk Management (DRM) convened a meeting in Khartoum, Sudan to consider the establishment of an IGAD Disaster Response Fund and to launch an IGAD Hazard Maps and Atlas.

The IGAD Secretariat in close consultation and active participation from the DRM institutions and relevant sectors of Member States with the financial support of the EU through the Africa, Caribbean and Pacific (ACP) Group of States has been undertaking

rigorous feasibility studies for the establishment of a regional disaster response fund and the development of Hazard Maps and Atlas.



# Some EW Activities Undertaken By RCMRD

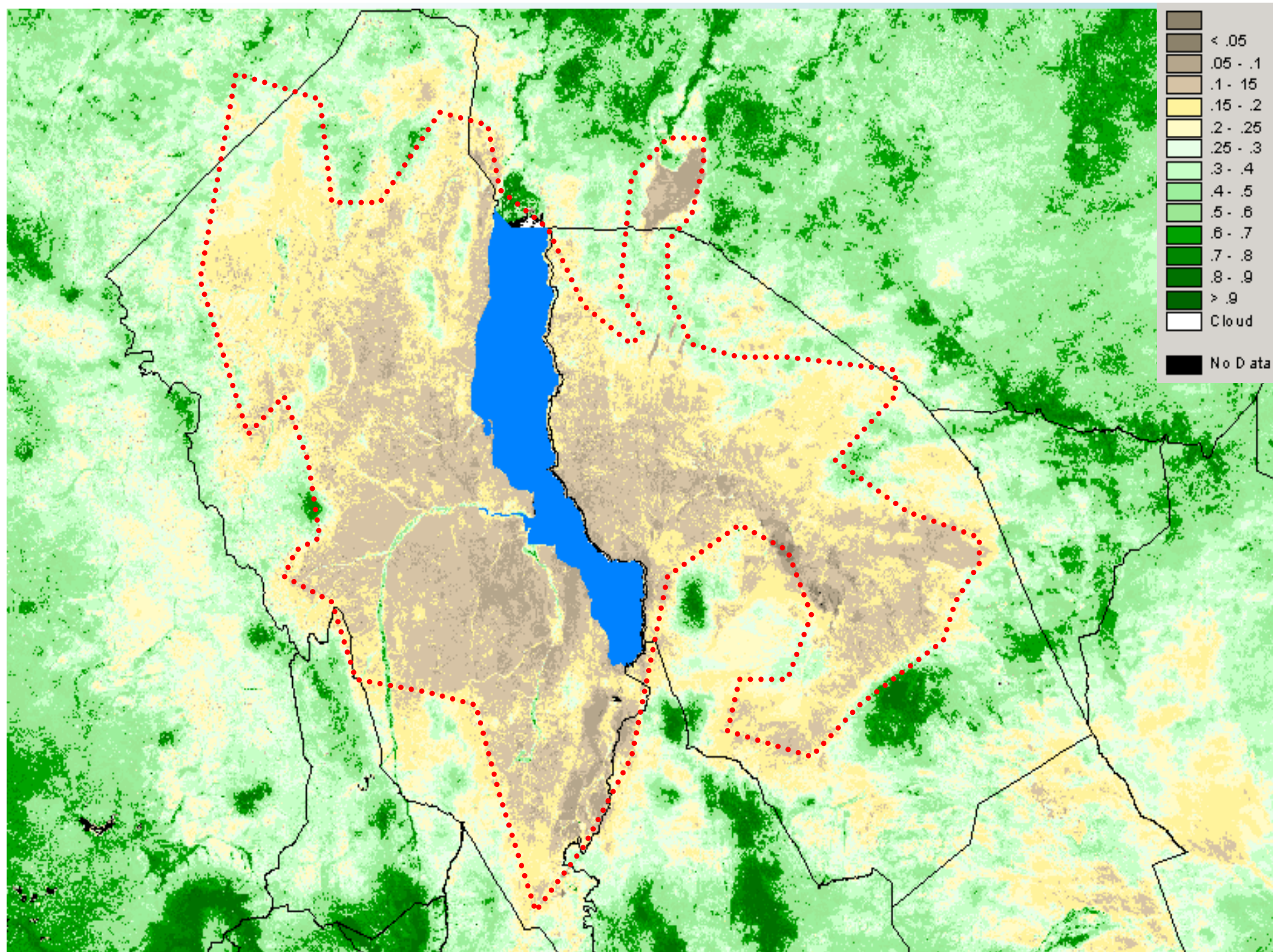




**Drought:** has become a recurrent phenomenon affecting millions of people in Africa each year

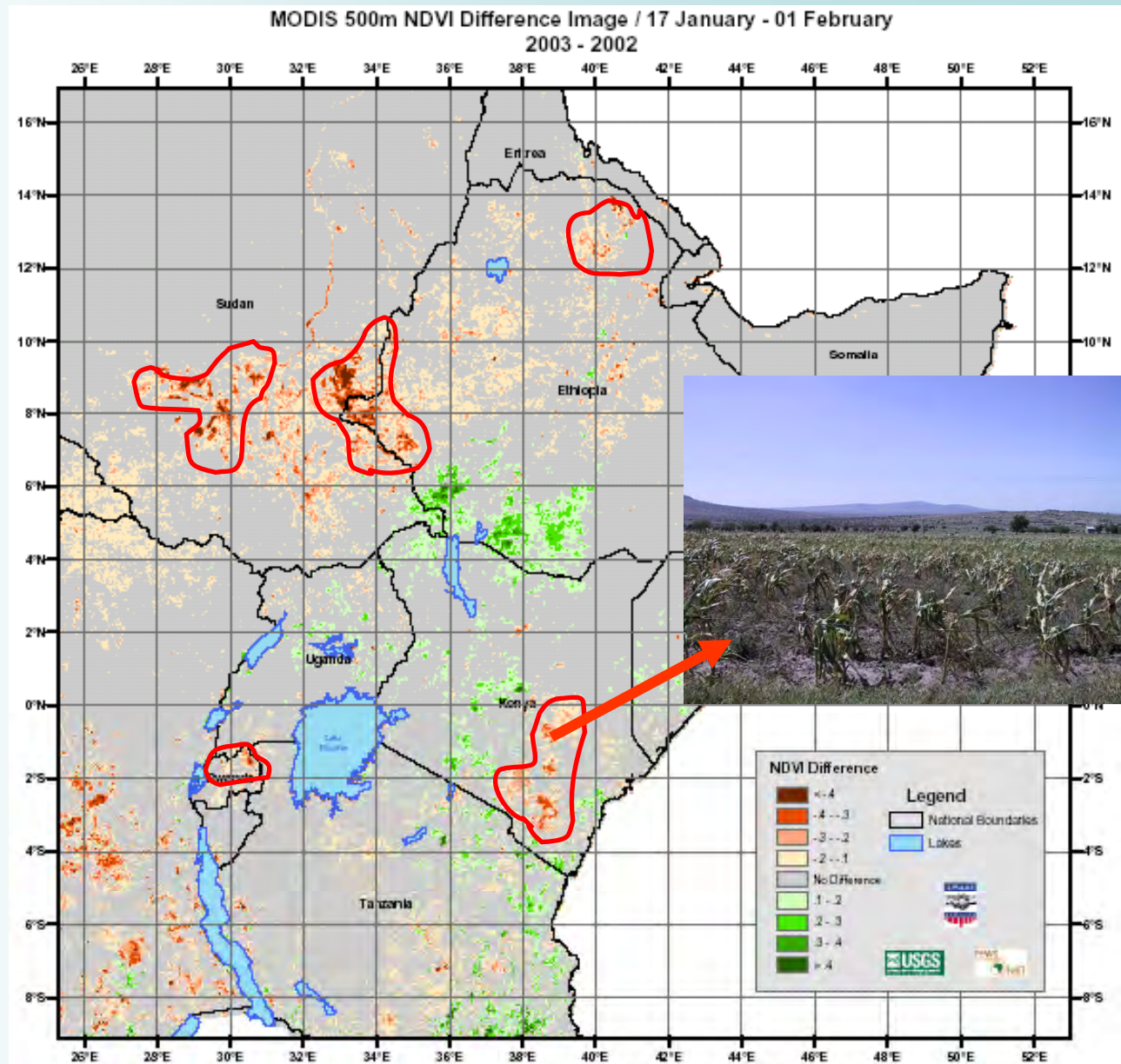
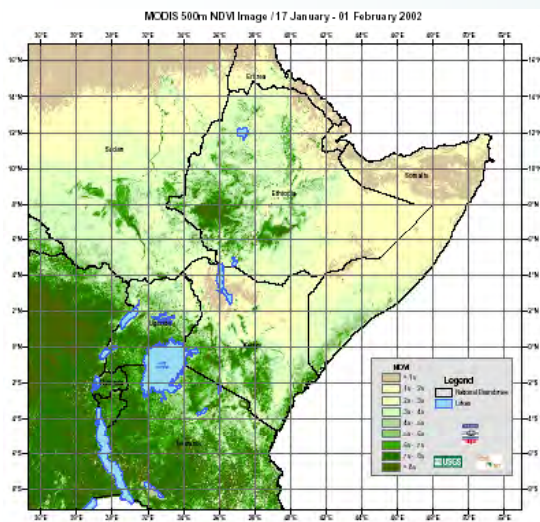
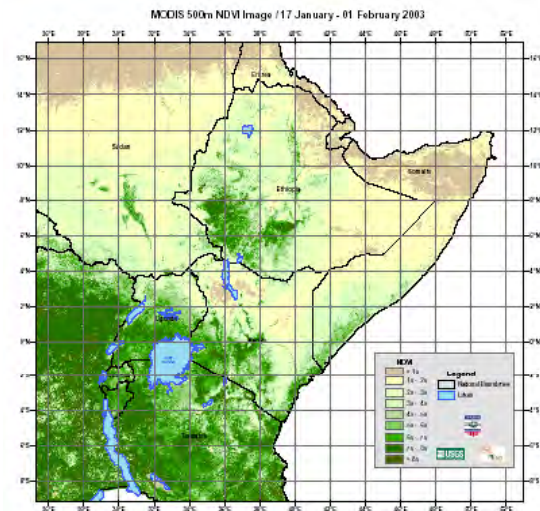








## Identification of Hotspots





## Ground Confirmation of hotspots





Ground Confirmation of areas with better conditions





## Flooding:

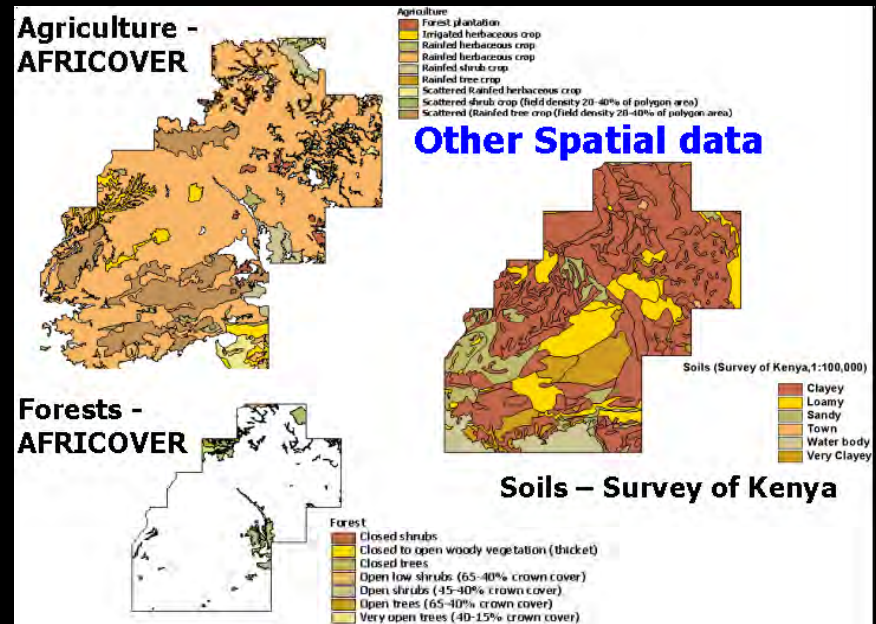
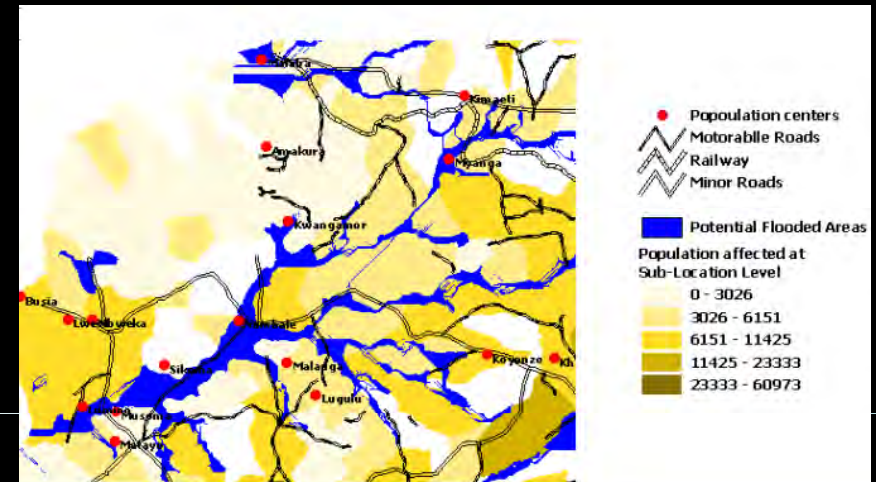
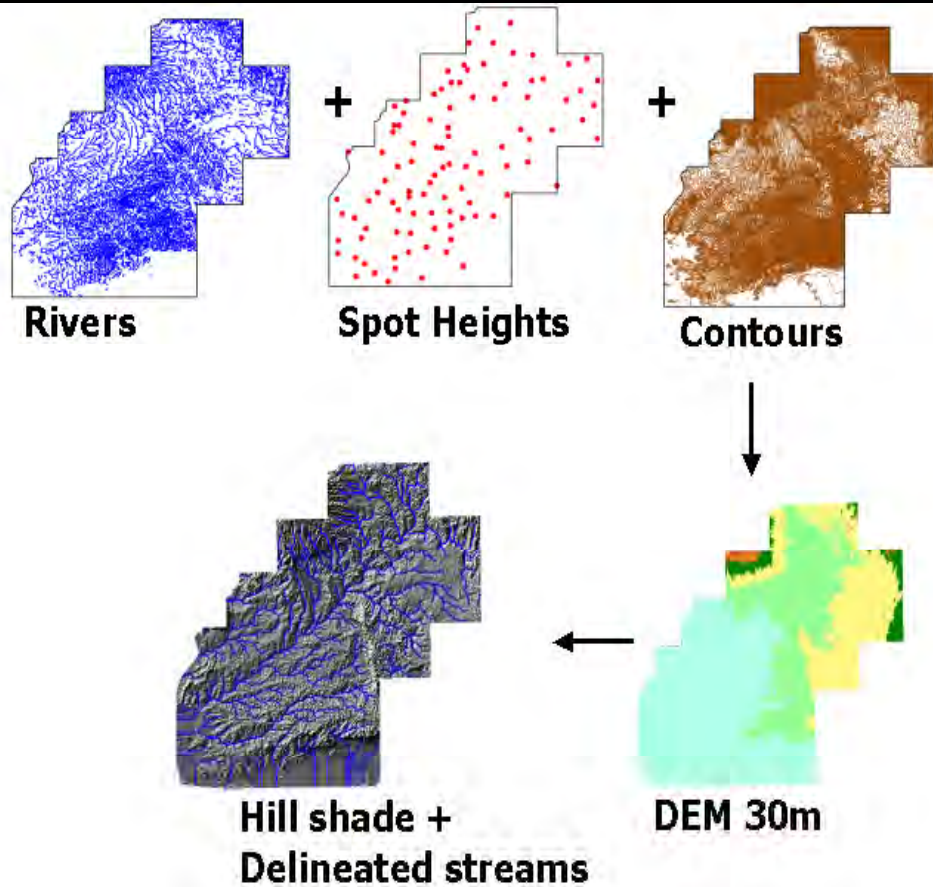
- ❖ Flooding is the second major disaster in the region.
- ❖ The predictability lead time of flooding varies from minutes (flash floods) to weeks (stream floods)
- ❖ The key variables that need to be indicated in the prediction of flooding are:
  - The timing (when),
  - The geographical area (where) 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.





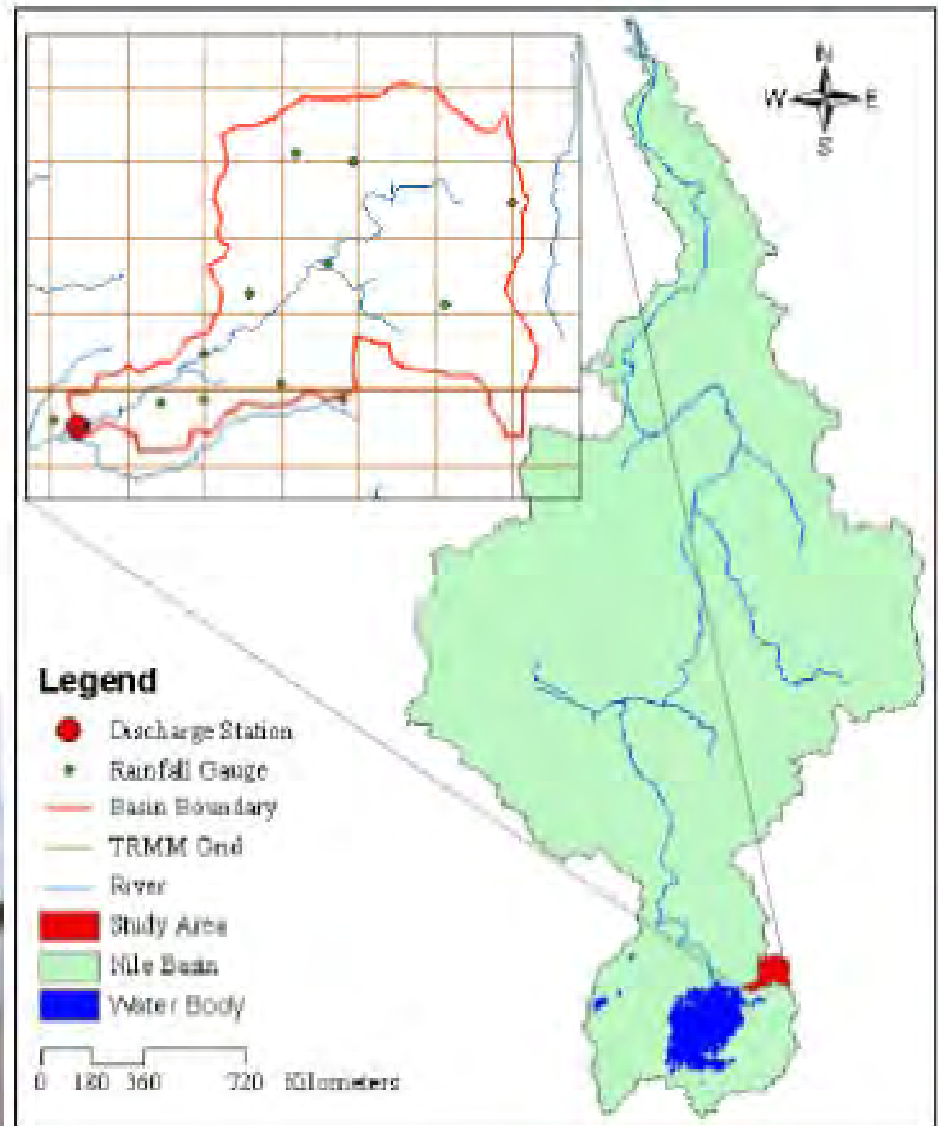
# Flood forecasting using GeoSFM: case of Nzoia basin



# Implementing hydrological model over Nzoia Basin and Lake Victoria Basin

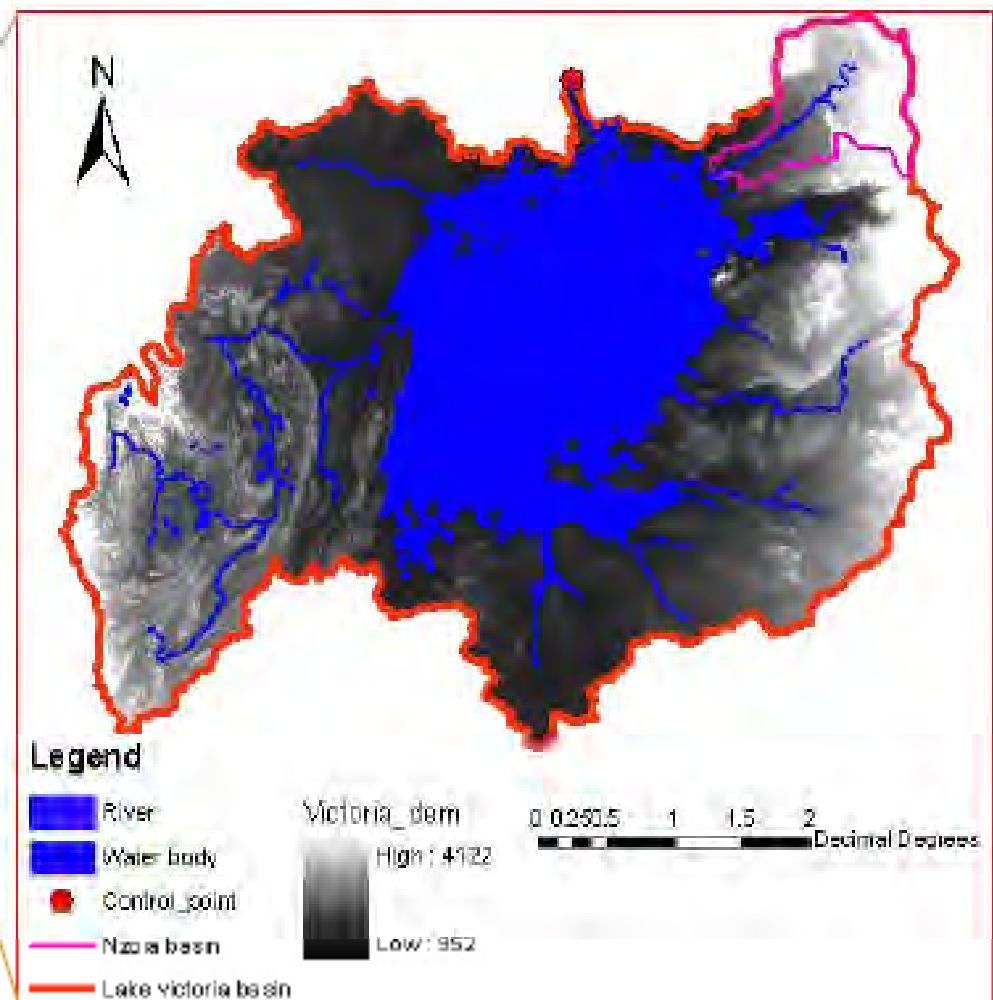
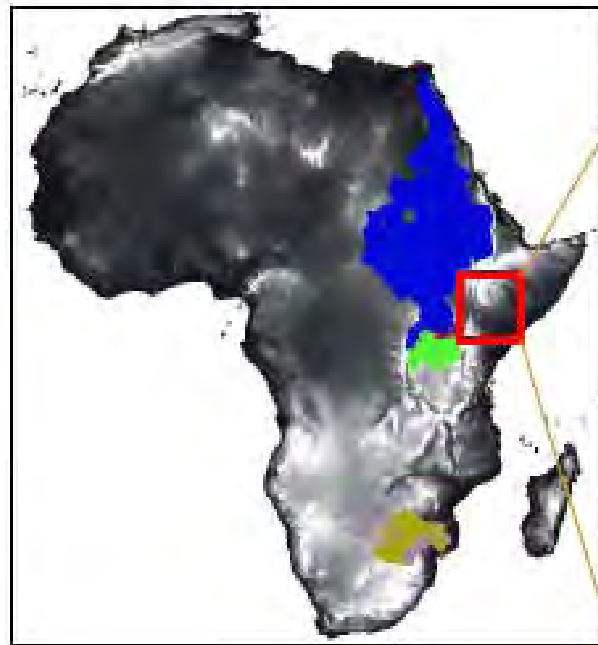
## Inputs:

- ☐ Archived Soil data
- ☐ Archived Vegetation data
- ☐ Archived Meteorological Data
- ☐ Nzoia Basin gages and discharge data
- ☐ Need more gage rainfall and streamflow data for Lake Victoria Basin





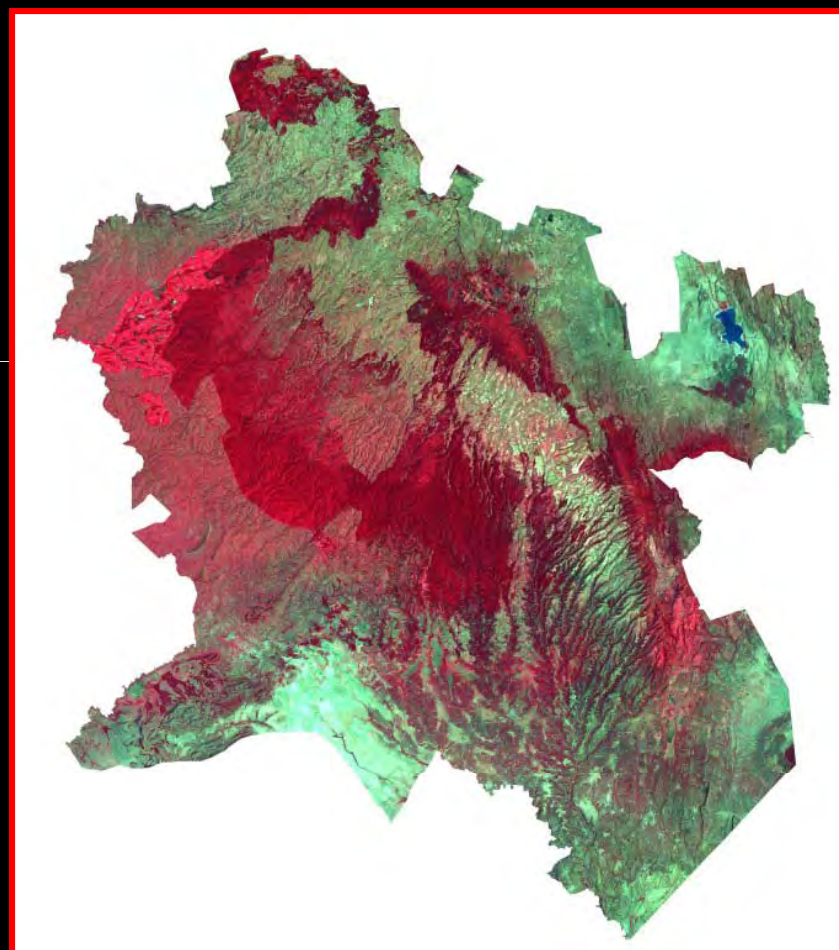
# Expand the Hydrological Model to Entire Lake Victoria Basin



# Landslides



**Mau Forest: 1986**



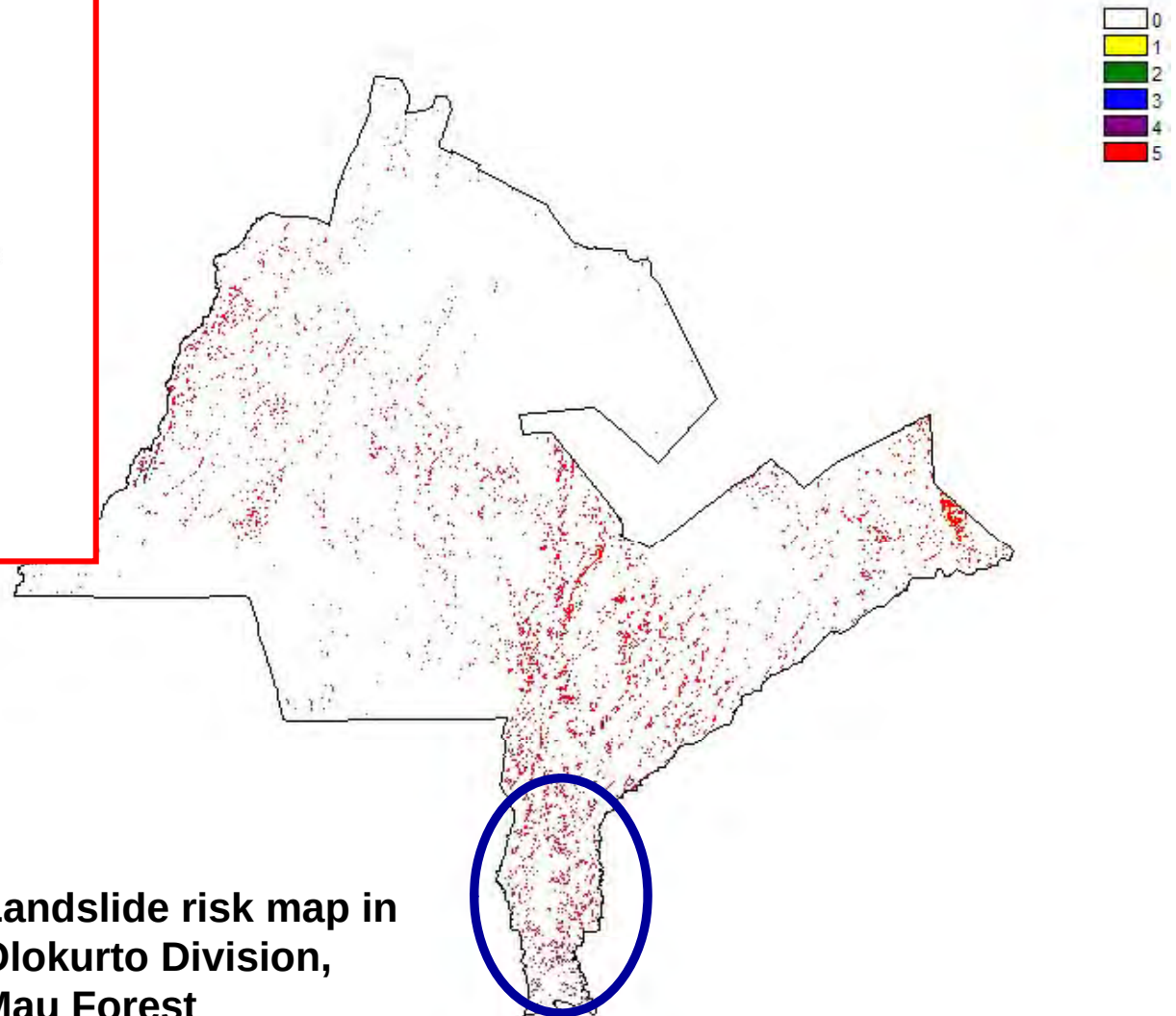
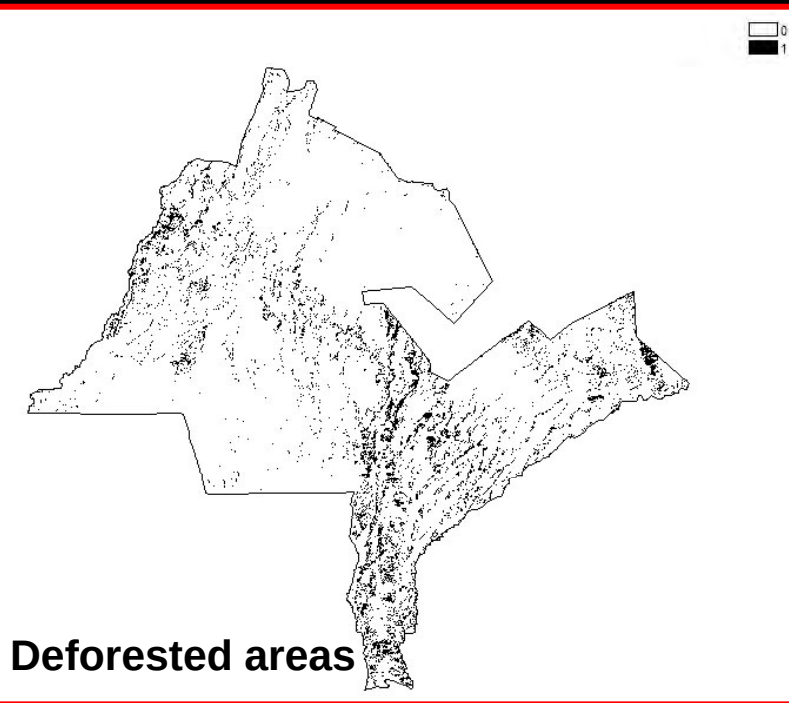
**Mau Forest: 2000**





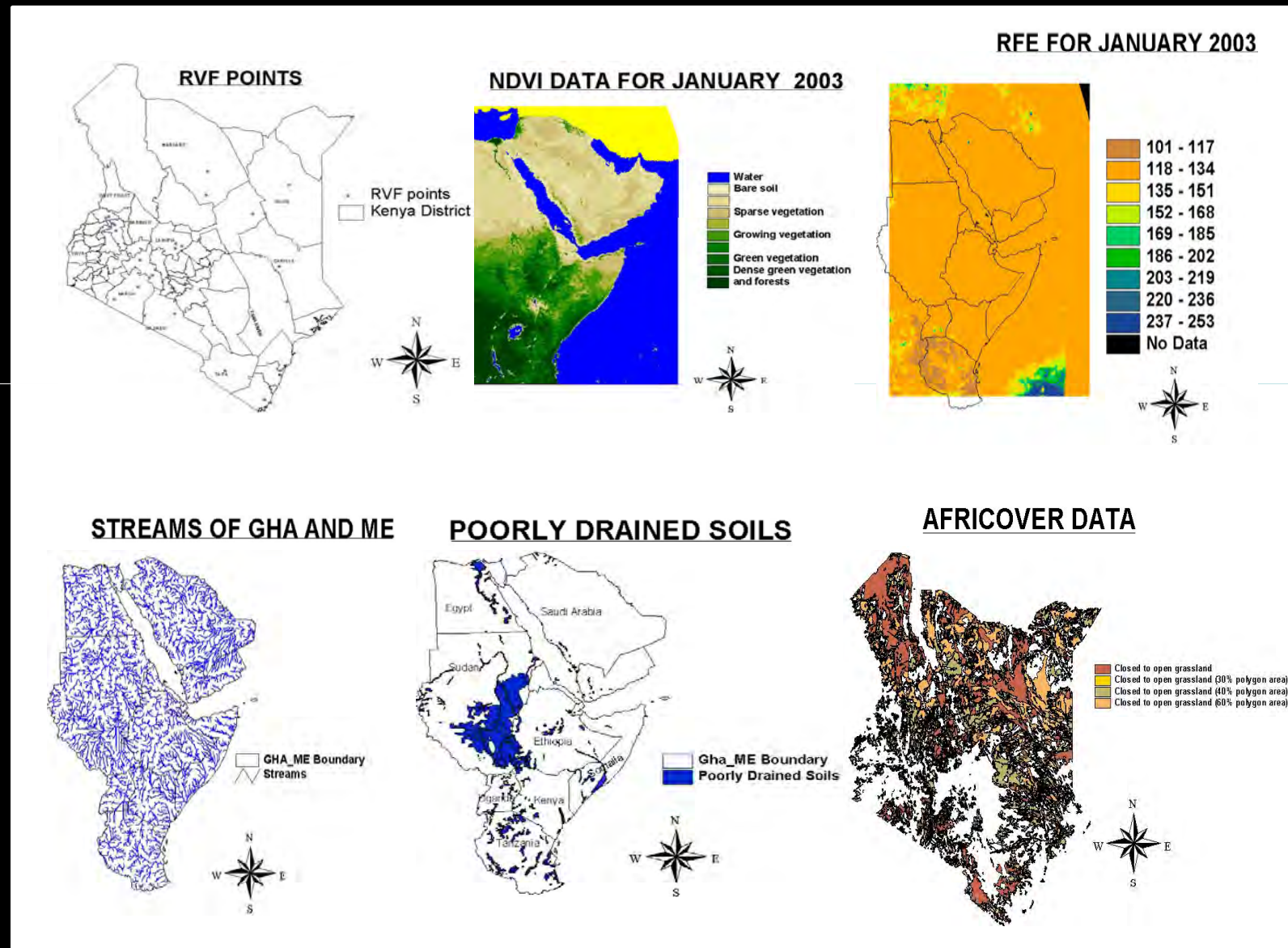


## The 2004 landslide in Olokurto Division





## F. Epidemic diseases (predicting outbreaks of RVF in GHA)

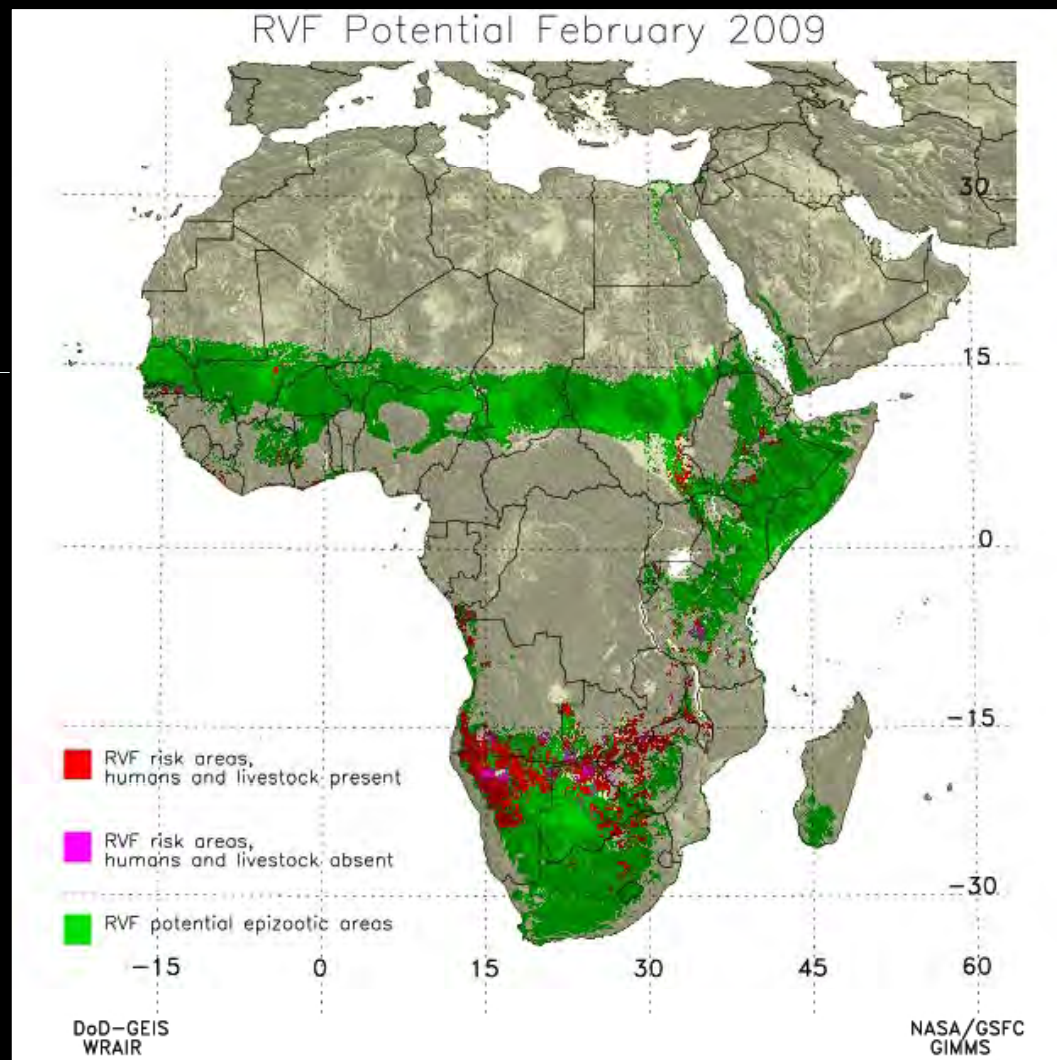


# Rift Valley Fever Outbreak Prediction

**Rift Valley Fever Risk Map**  
(Livestock and human disease transmitted by mosquito)

Uses NDVI, Precipitation and Temperature information

Sensors: MODIS and AVHRR





# **International Charter:**

Project Manager's (RCMRD) experiences from activations in Africa

**Cases of Charter activation 109 and 309**



# Charter Activation 309

## **Charter Activation 309:**

- Disaster call was received from Kenyan Red Cross and UNOCHA and confirmed from international news agencies
- USGS and UNOSAT had jointly activated the charter and appointed RCMRD as project manager
- RCMRD had been following the situation of flooding in the region using SERVIR-Africa flood forecasting tool
- It had produced regional early warning maps

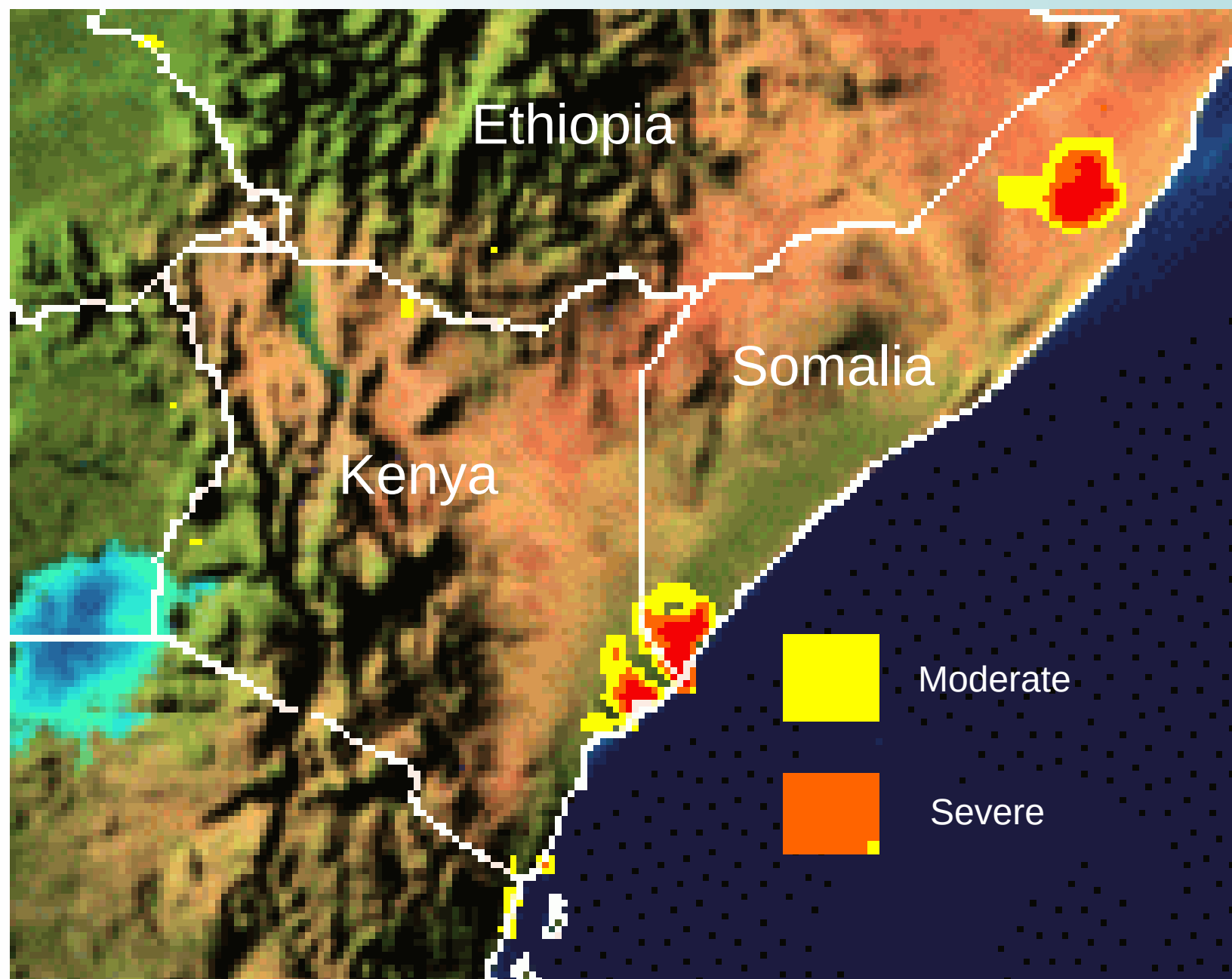


# Charter Activation Cont...

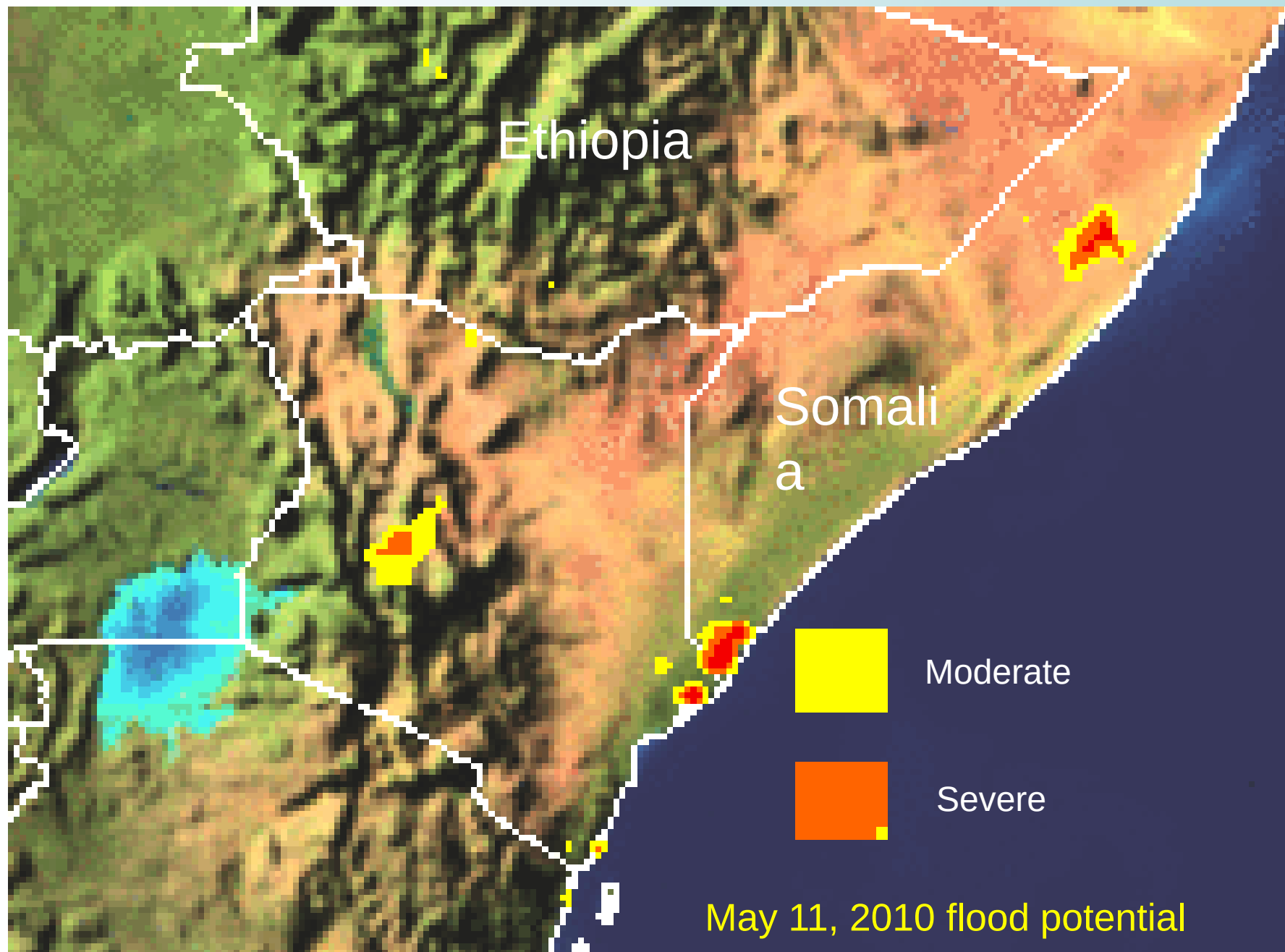
## **Charter Activation 309:**

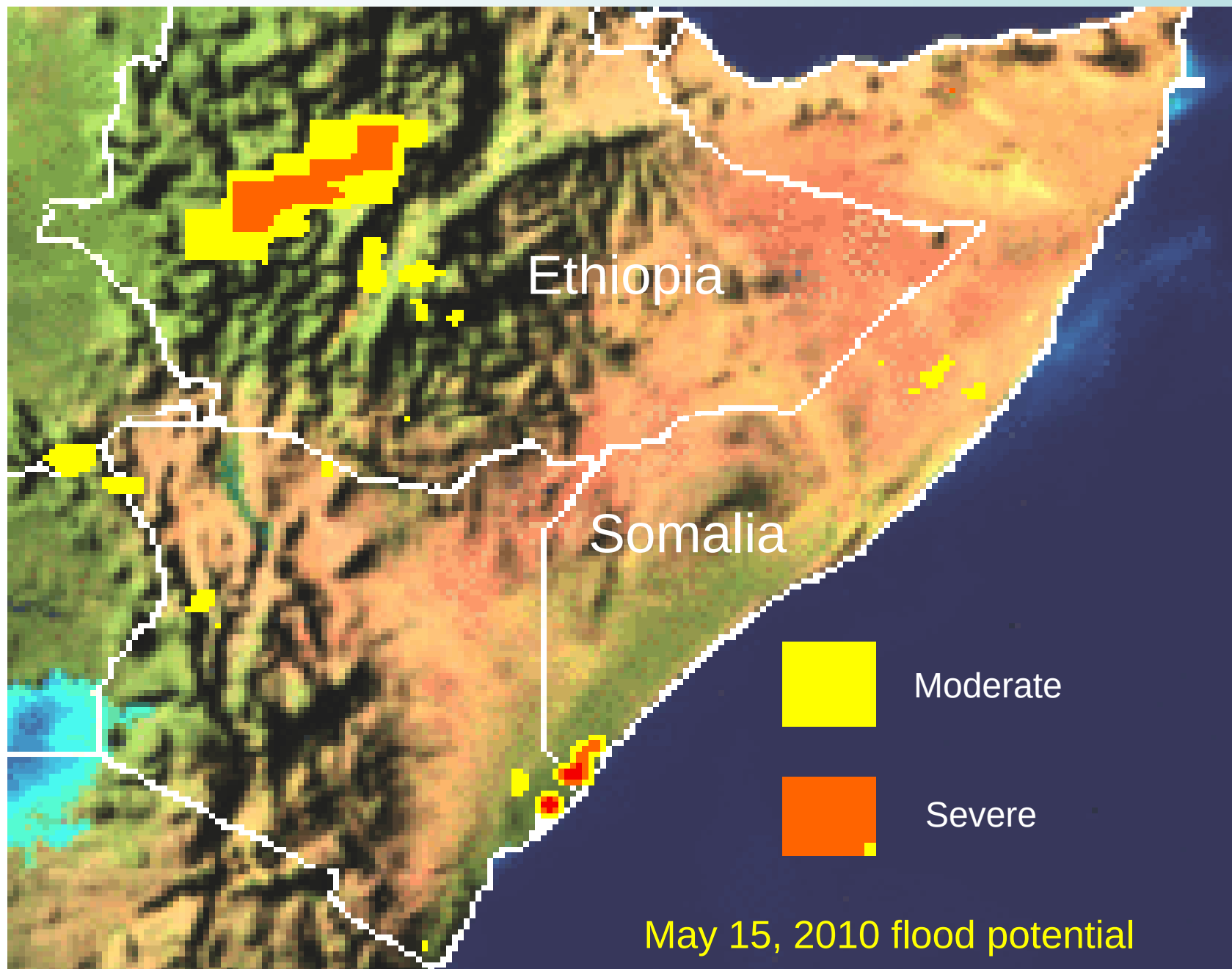
**Disaster type:** Flooding in Eastern Kenya from 2<sup>nd</sup> to 10<sup>th</sup> of May 2010

- It was a wide spread flooding that affected more than 300,000 people with more than 20 casualties (Daily Nation, Red Cross and UNOCHA).
- Flooding occurred as a result of swelling of Tana River in Kenya as a result of heavy rains in the upper part of the basin.









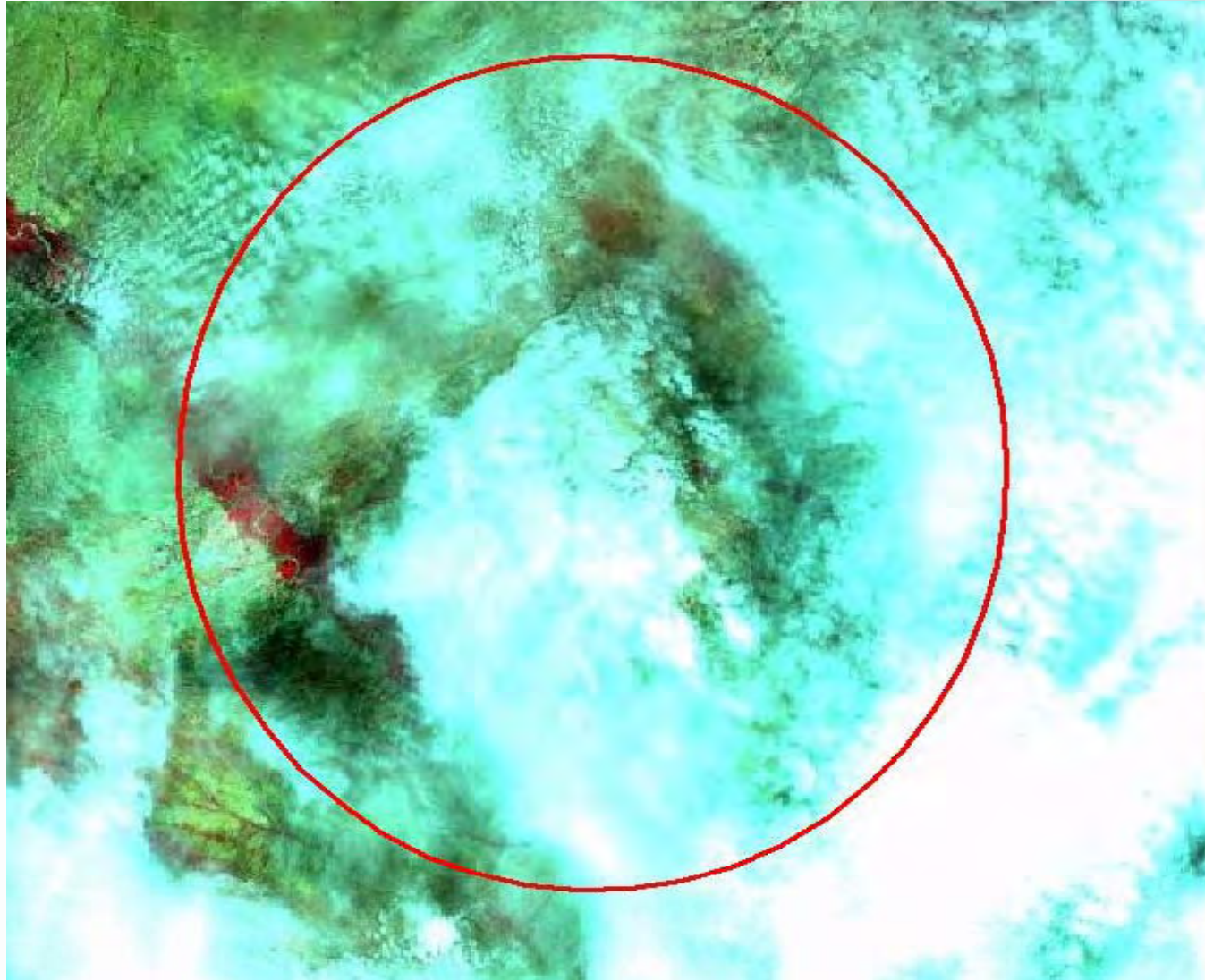


# Charter Activation 309 Cont...

## **Data Acquisition:**

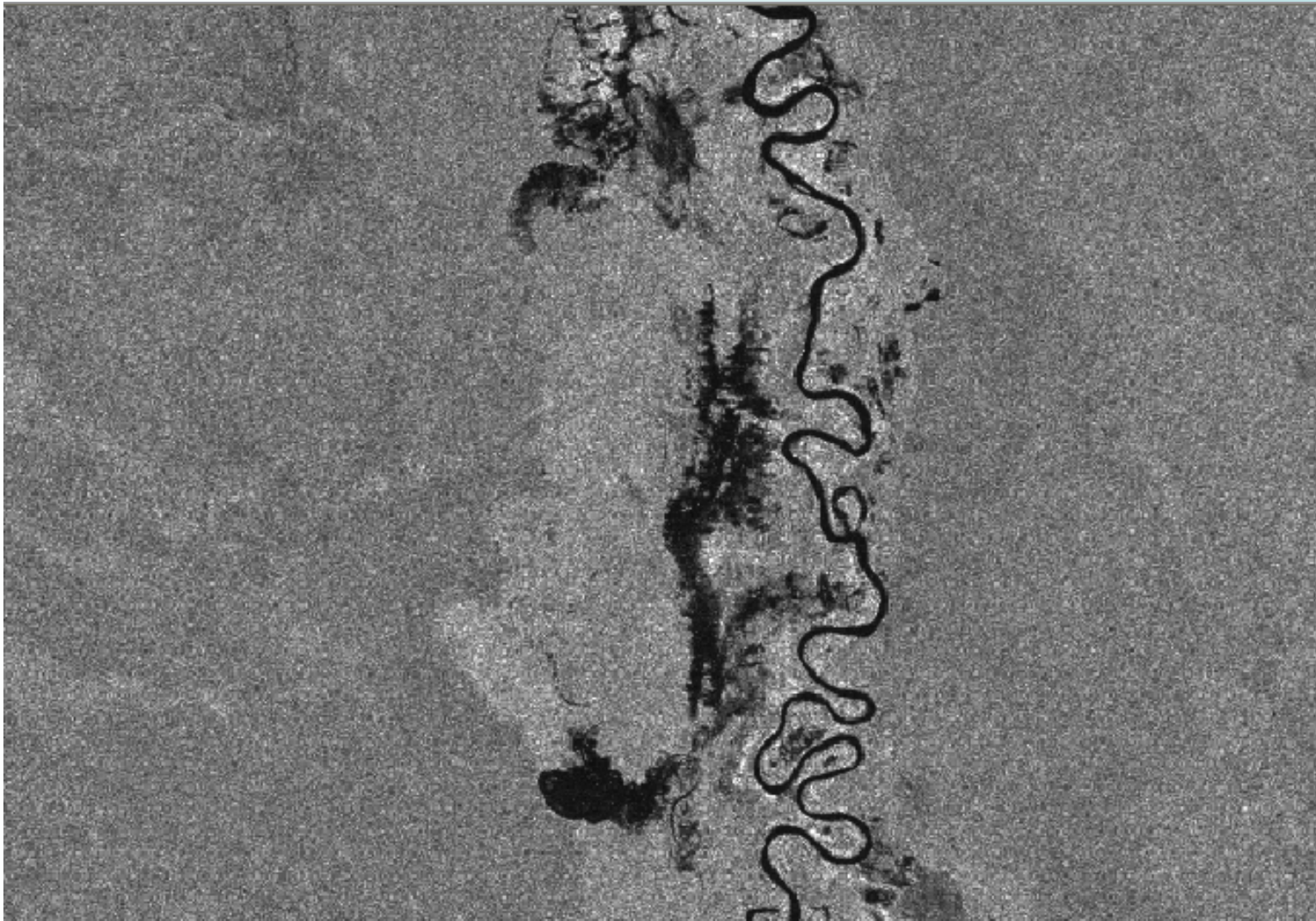
- MERIS and MSG were looked at:
  - But very cloudy and not usable
- SPOT -5 image and IKONOS received
  - But not usable due to cloud cover
- DMC data was also received
  - But not usable due to cloud cover
- **RADARSAT for May 3<sup>rd</sup> and 6<sup>th</sup> was found to be the appropriate image**

## SPOT Image of 6<sup>th</sup> of May



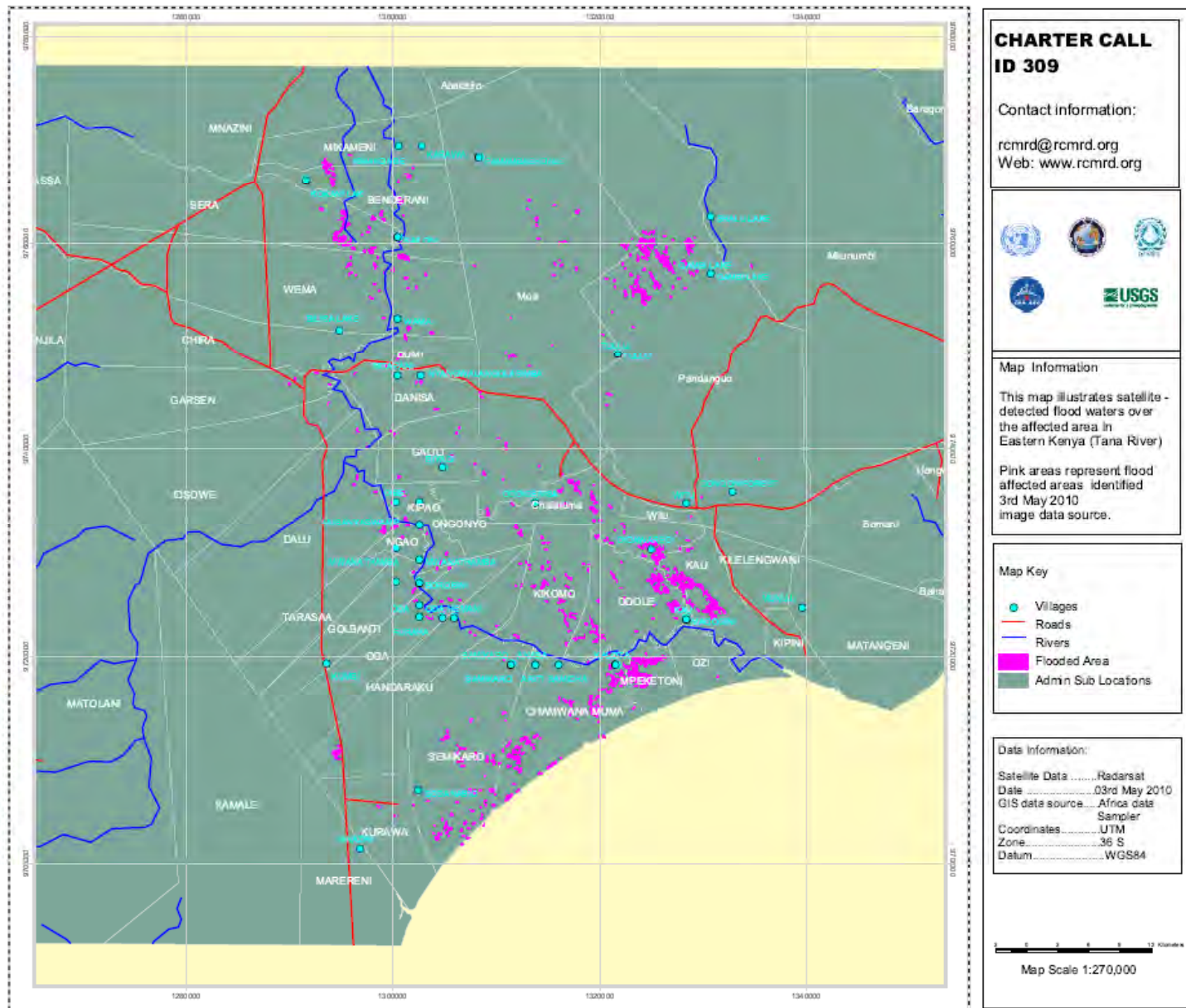


## Charter Activation 309 Cont...



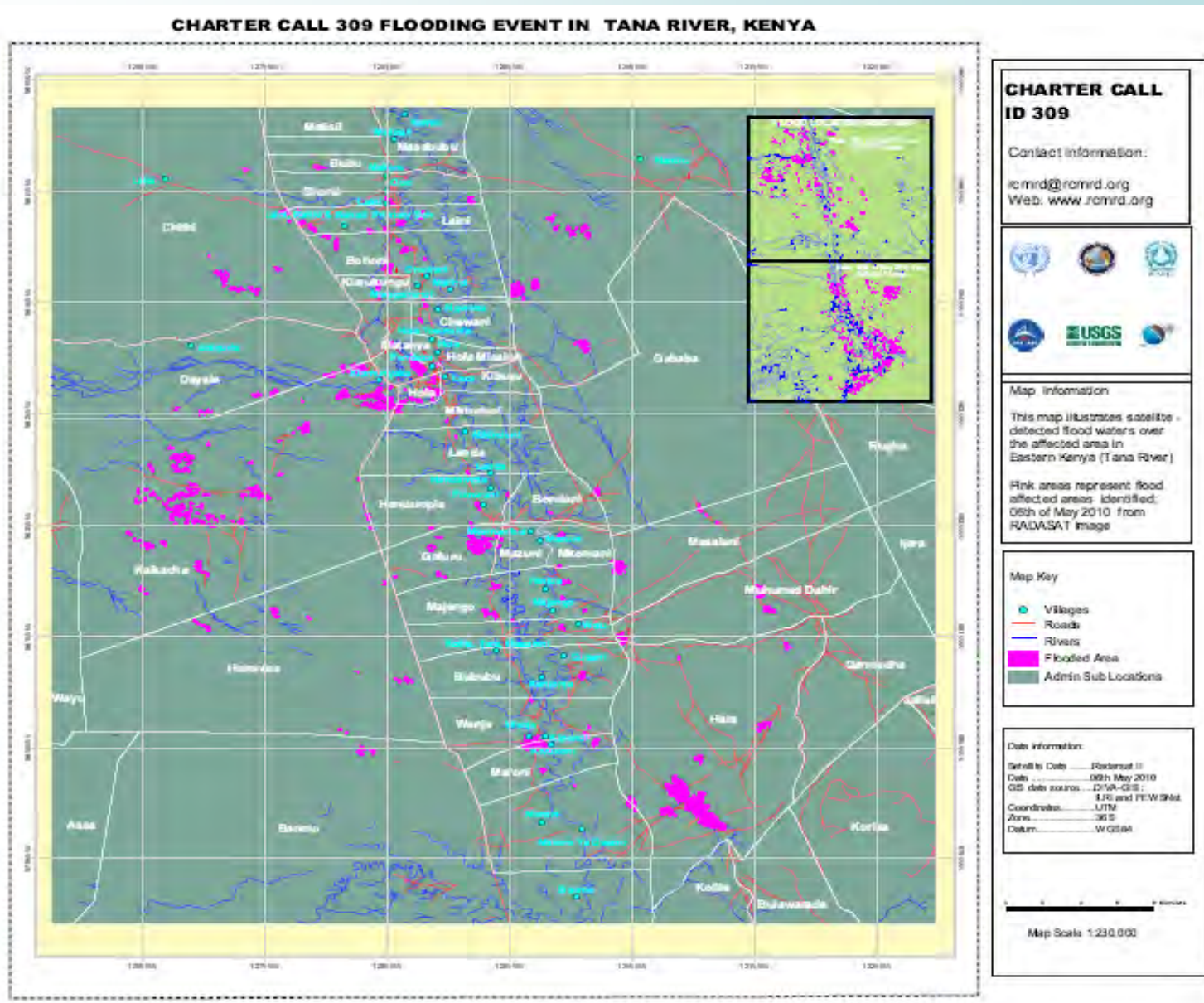
# Disaster Map for Activation 309

## CHARTER CALL 309 FLOODING EVENT IN LOW TANA RIVER, KENYA





# Disaster Map for Activation 309



# Long-Term Early Warning Systems

Human induced environmental changes are increasing the frequency and the intensity of natural disasters

e.g

- ❖ Global Warming
- ❖ Land degradation and desertification (deforestation, overgrazing, wetlands encroachment, etc)

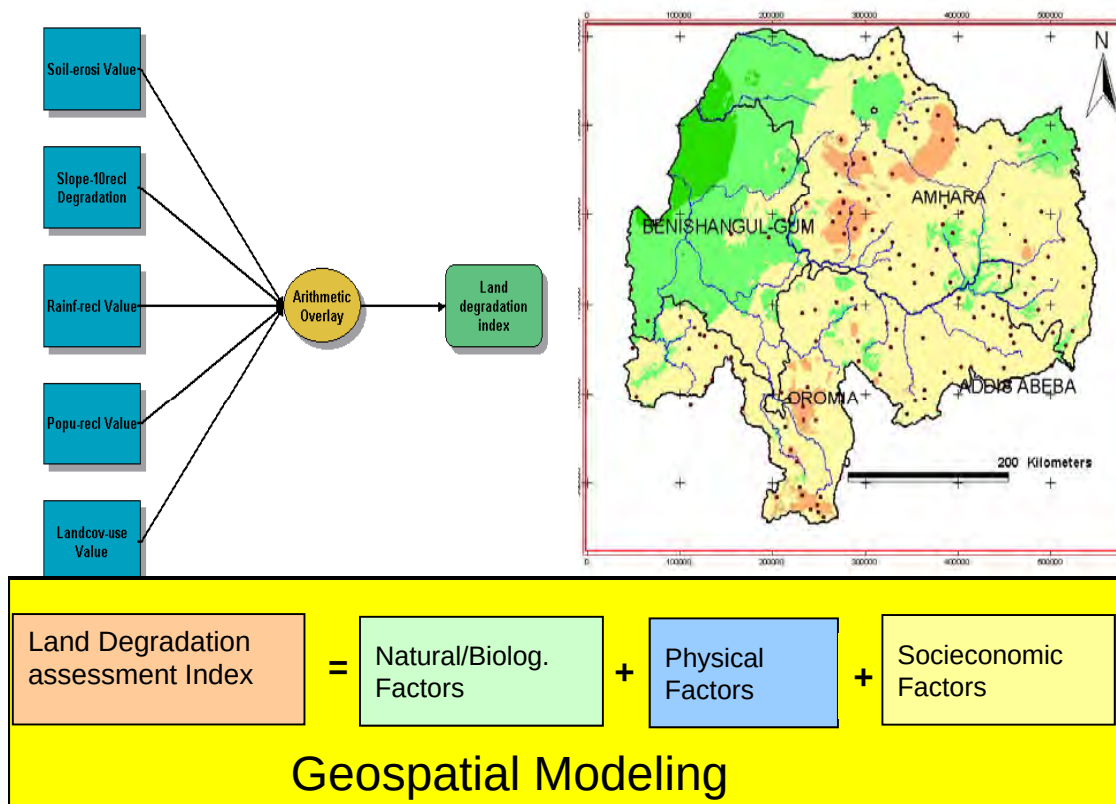
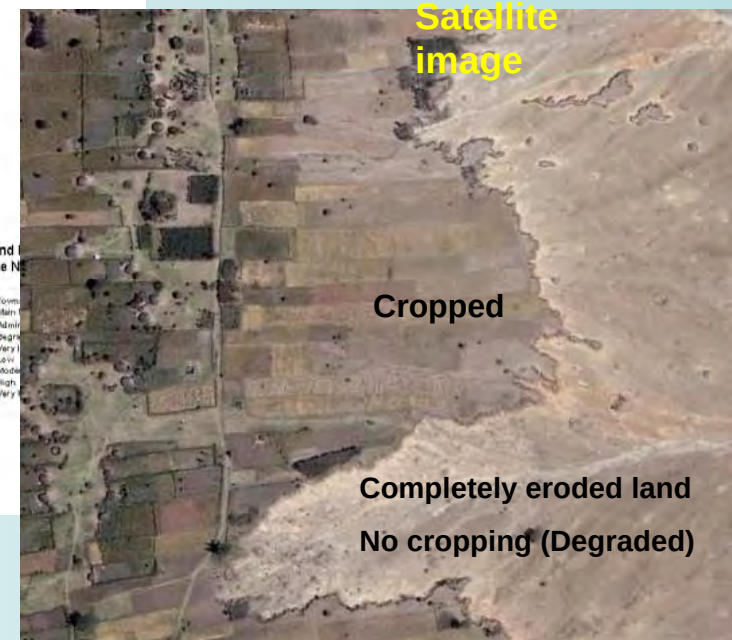
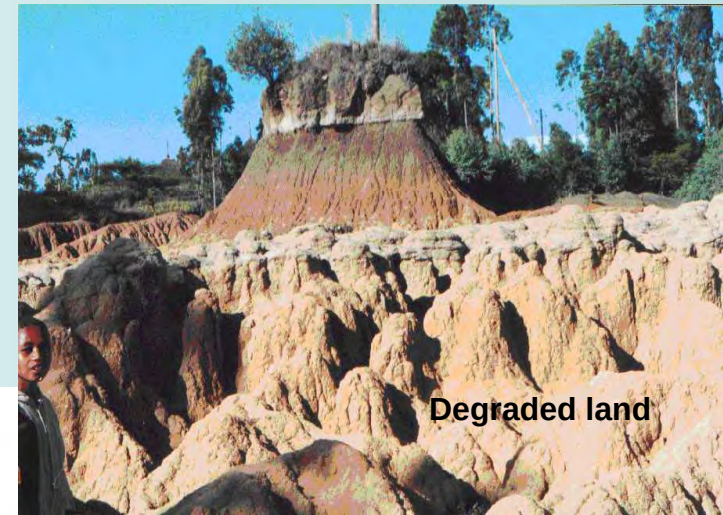




# AMESD: Land Degradation Assessment Component

*The Key environmental Issues are:*

- *Deforestation*
- *Uncontrolled and unplanned land use*
- *Accelerated soil erosion*
- *Extensive Land degradation (Loss of the fertile top part of soil horizon)*





# The case of Lake Victoria

1973



Increasing levels of  
siltation over the years

1986



2001

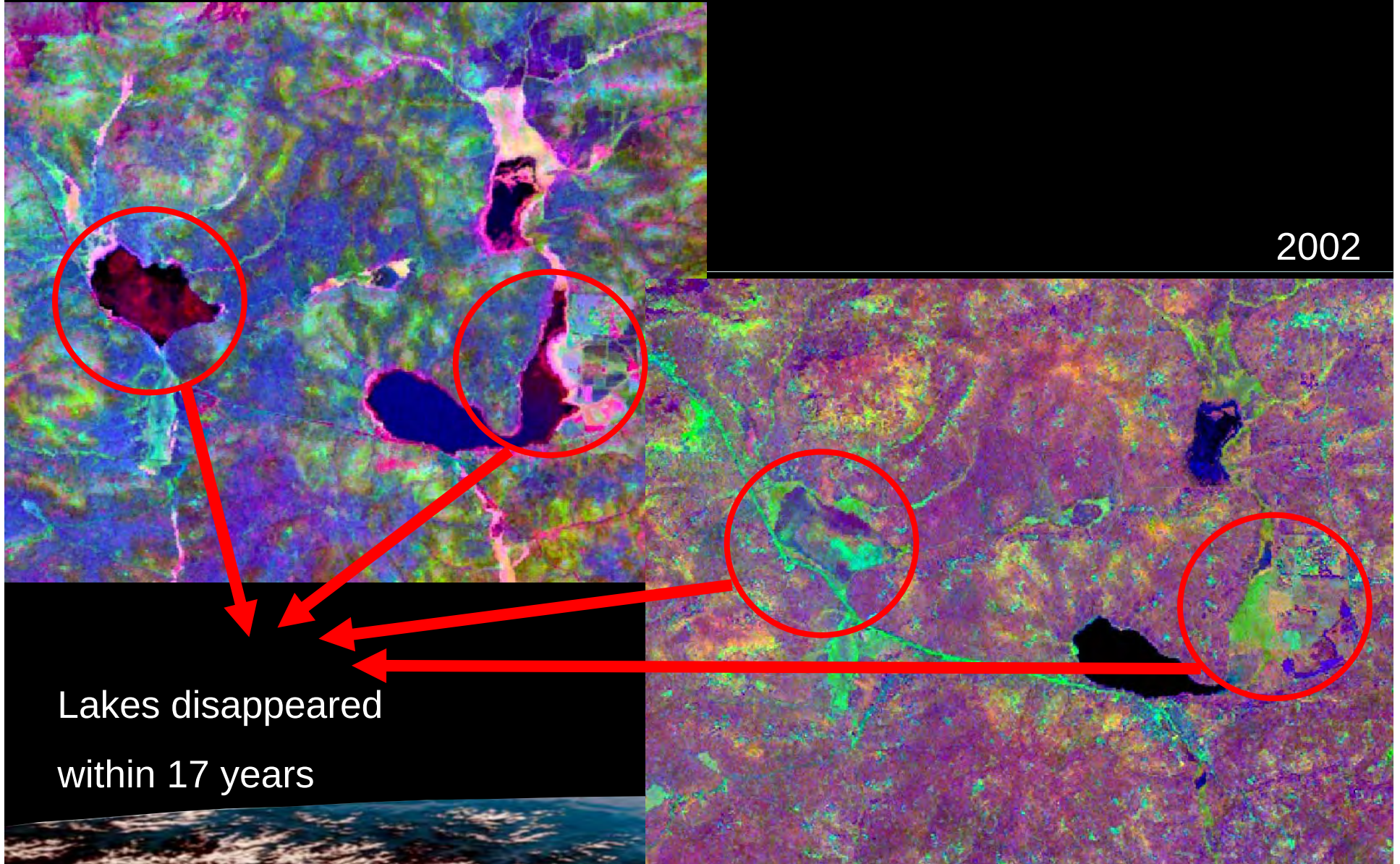




# The case of disappearing lakes in Ethiopia

1985

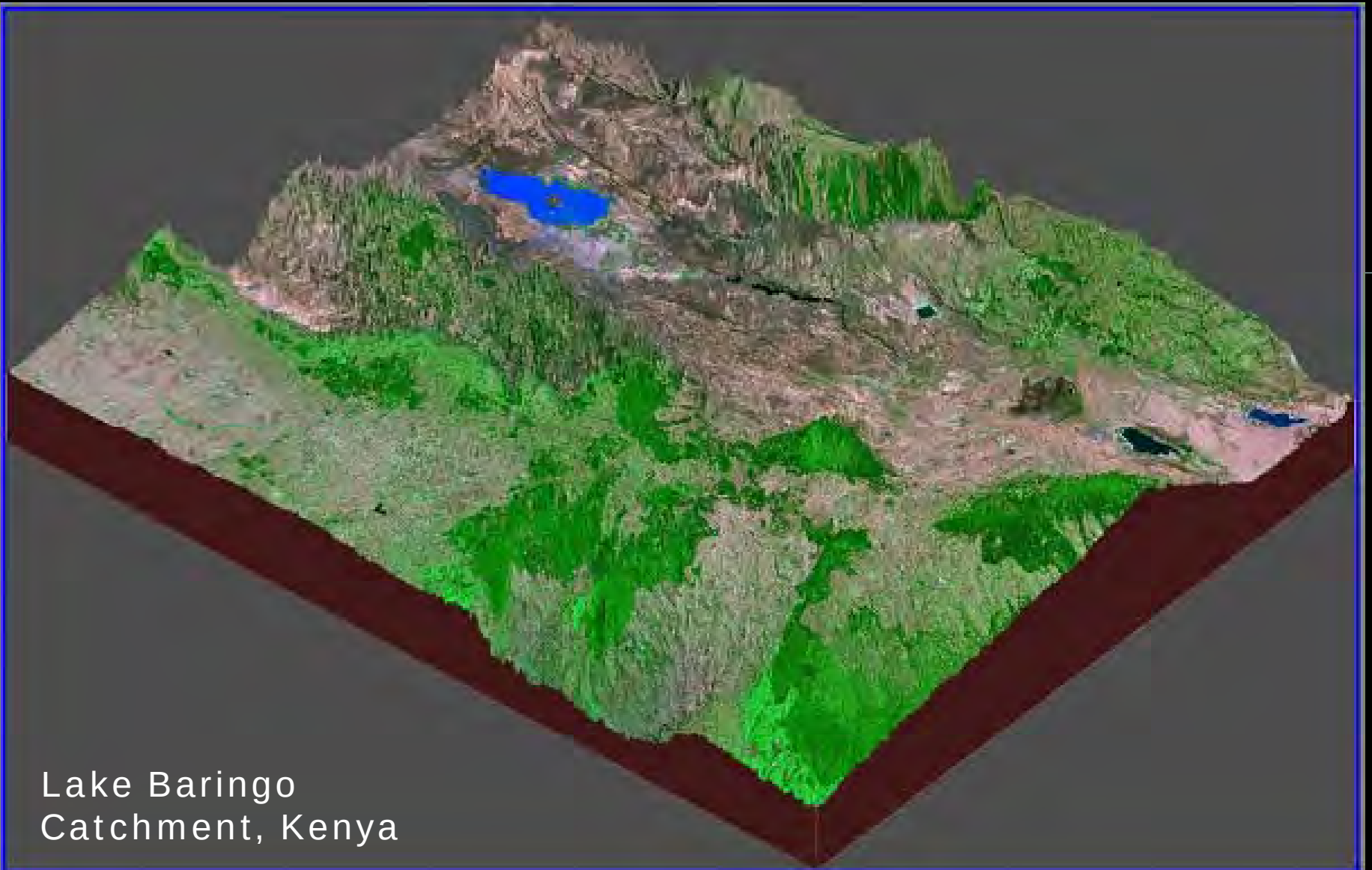
2002



Lakes disappeared  
within 17 years

# Climate Change

*..... implications to agriculture*



Lake Baringo  
Catchment, Kenya



# Past, Current and Future Deforestation

1973

1986

2009

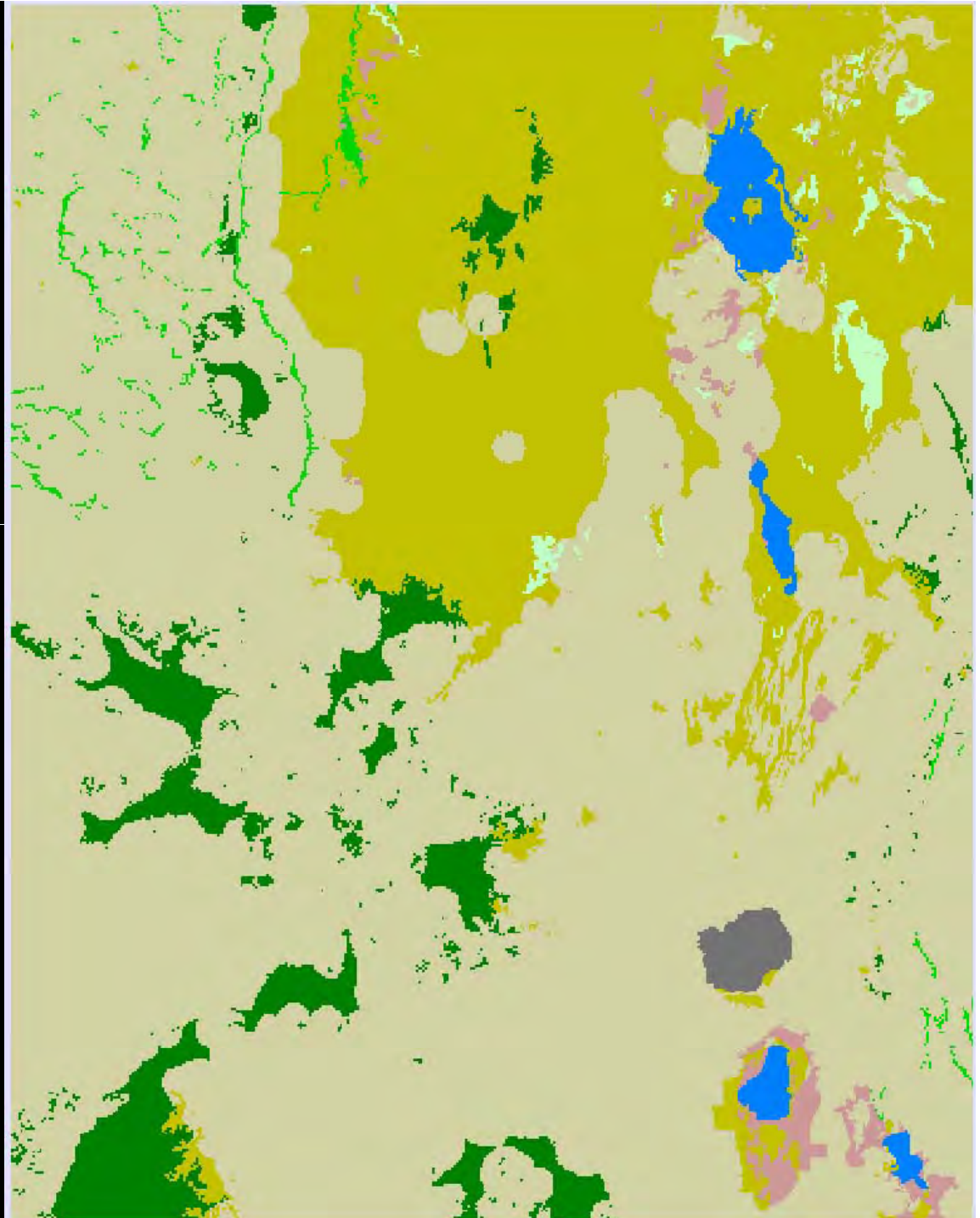
(Kenya's Vision 2030) 2030

2050

2080

## LEGEND

- Bare
- Anthropogenic Disturbances
- Crater
- Forest
- Grassland
- Lake
- Open to Closed Shrubs
- Riverine Vegetation



*\*If factors were to remain constant*

## *Historical and Future Land Use / Land Cover Change Analysis*

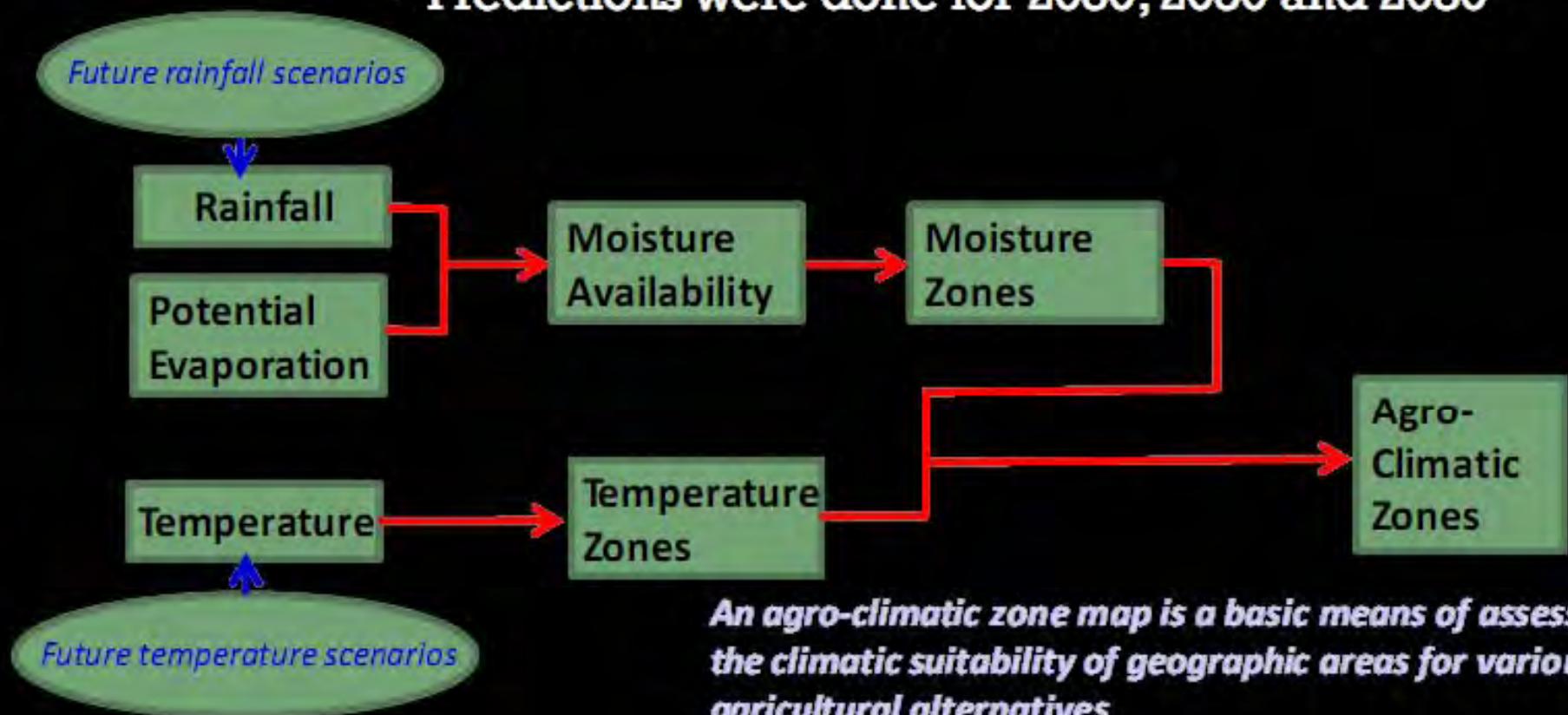
| LULC Class                 | 1973        | 1986        | 2009        | 2030        | 2050        | 2080        |
|----------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Bare                       | 513.2611112 | 317.0562656 | 224.4623801 | 224.4623801 | 224.4623801 | 223.6213821 |
| Anthropogenic Disturbances | 7114.759421 | 7675.957421 | 8794.73713  | 9747.756123 | 10486.74111 | 11073.92595 |
| Crater                     | 81.9973101  | 84.2680048  | 84.2680048  | 84.2680048  | 84.2680048  | 84.2680048  |
| Forest                     | 3124.644163 | 2782.442055 | 2206.44249  | 1699.236564 | 1343.578488 | 1221.633771 |
| Grassland                  | 535.6316594 | 374.748732  | 289.2192301 | 208.2311177 | 180.3940822 | 168.9565087 |
| Lake                       | 251.9630164 | 231.863163  | 235.2271552 | 235.2271552 | 235.2271552 | 235.2271552 |
| Open to Closed Shrubs      | 5869.745905 | 6045.934997 | 5669.924768 | 5305.099813 | 4949.862235 | 4498.75088  |
| Riverine Vegetation        | 135.6529858 | 115.4690326 | 123.4585141 | 123.4585141 | 123.2062146 | 121.3560189 |

**Area in Km<sup>2</sup>**



# Understanding Future Climate Change Trends and their implications to Agriculture

- ❖ Climate change scenarios were modeled as follows:
  - Current agricultural suitability analysis
  - Future agricultural suitability analysis based on precipitation and temperature trends
  - Predictions were done for 2030, 2050 and 2080



Current Potential  
Pyrethrum  
Growing Areas



Future Potential  
Pyrethrum  
Growing Area





## Area in Square Kilometers in 2080

2053.5538000 Agriculture and Pyrethrum

230.1817000 Forest and Pyrethrum

2.5230000 Open to Closed Shrubs and Pyrethrum

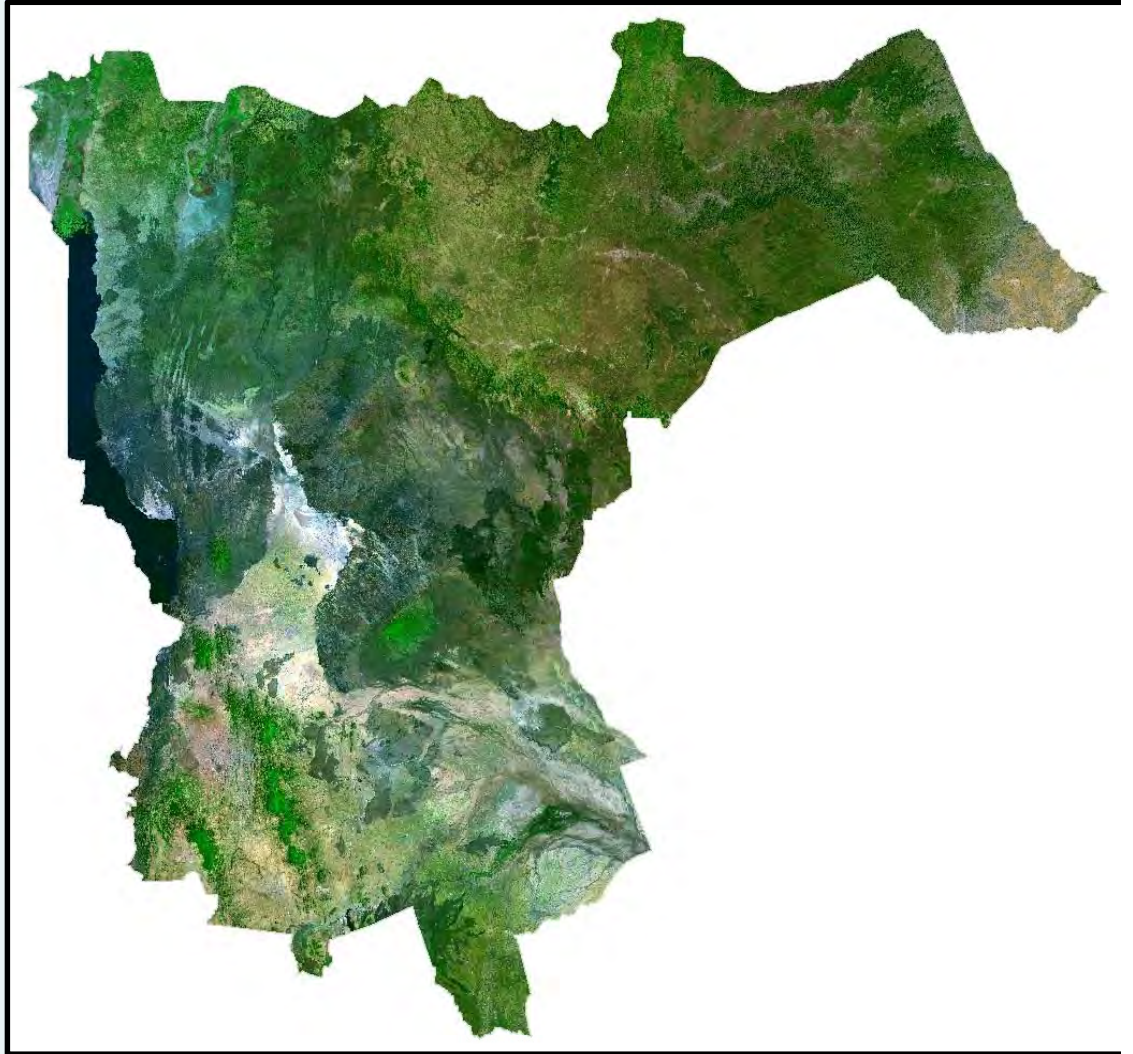
20.2681000 Riverine Vegetation and Pyrethrum



## Legend

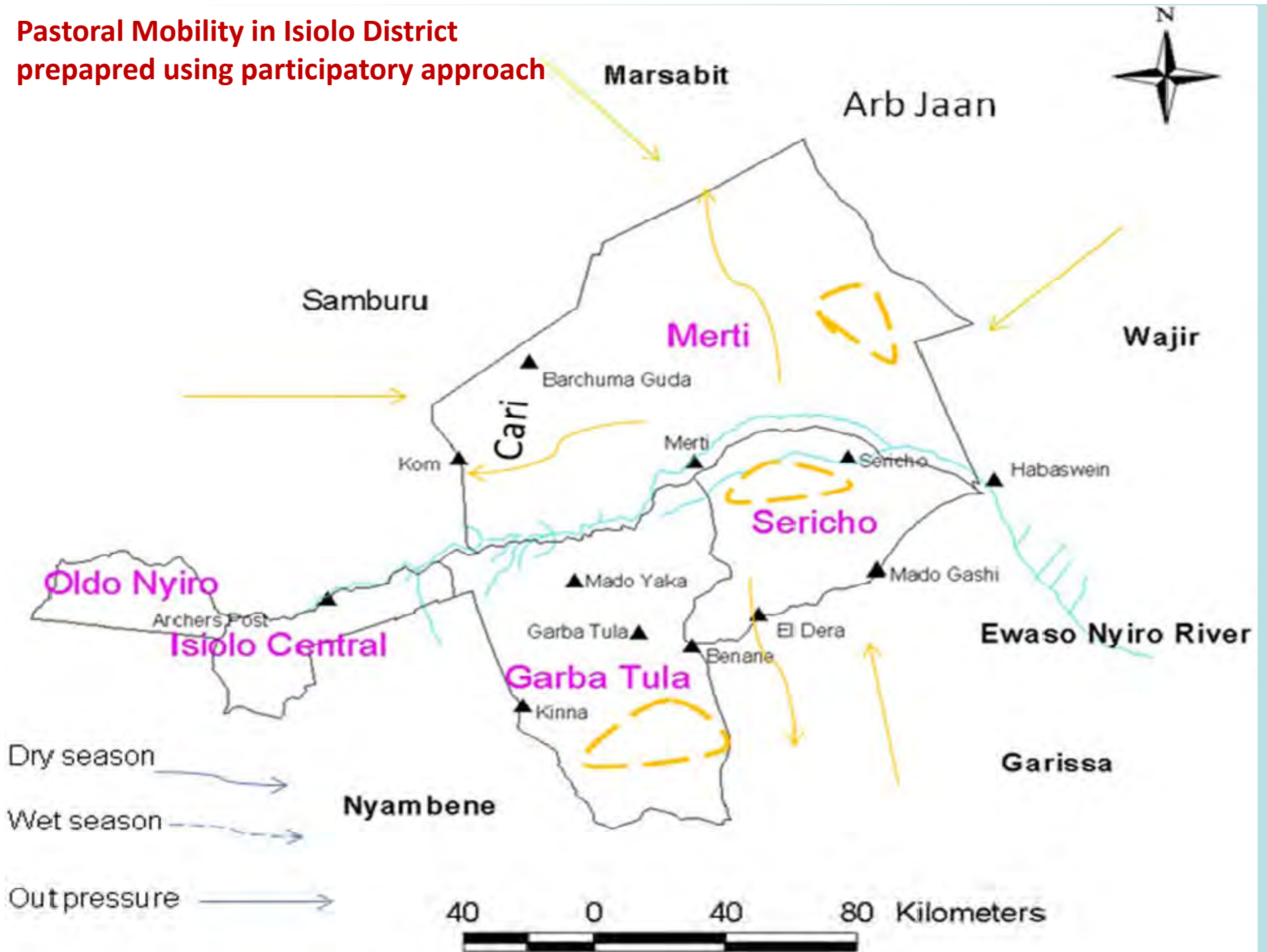
-  Currently Agriculture: Future Pyrethrum
-  Currently Forest: Future Pyrethrum
-  Currently Open to Closed Shrubs: Future Pyrethrum
-  Currently Riverine Vegetation: Future Pyrethrum

**Enhance Drought  
Risk Reduction  
in Northern Kenya  
and Southern Ethiopia**  
especially for the natural resources  
management interventions

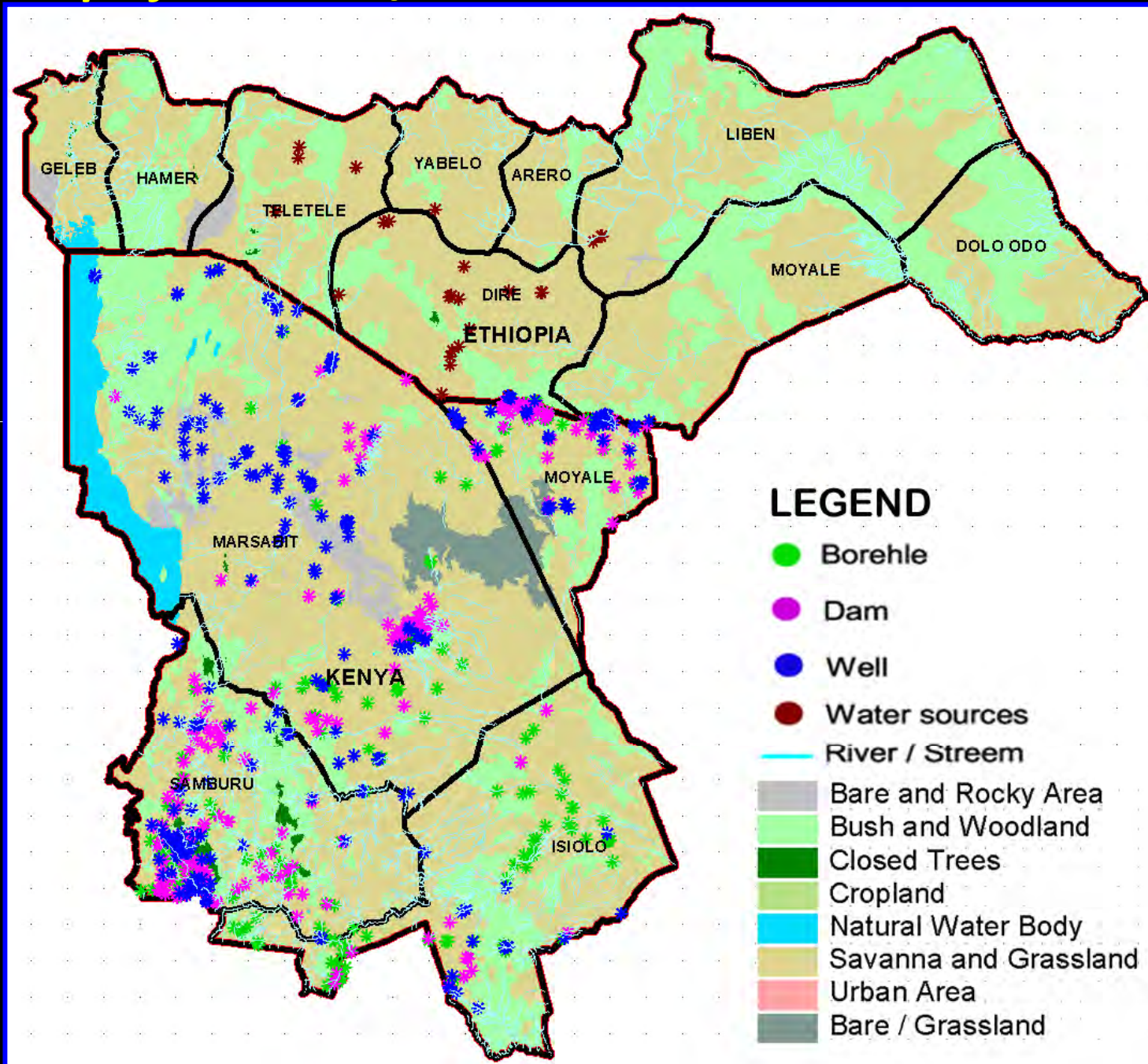




**Pastoral Mobility in Isiolo District**  
prepared using participatory approach



# Map of Land use / Land Cover and Water Resources



**Thank You !**

