Remote Sensing and GIS Integration

HOA Case Study

WFP – World Food Programme

FILIPPO PONGELLI - UNOOSA Workshop, 23-25 October 2013

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World Food Programme

The world's largest humanitarian organization fighting hunger worldwide,
operating in more than 80 countries

90 million people assisted each year, 58 million of whom are children

Established in 1963 by FAO and the United Nations General Assembly

WFP GIS

SDI and Web Services
Emergency Mapping
Logistics Mapping
Thematic Mapping
Analysis and Planning

→**Emergency Mapping**
→**Analysis and Planning**

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Design of WFP interventions

Contribution of EO data to Programme Design

Preparedness and Development Phases for

- EMOP – Emergency Operation
- PRRO – Protracted Relief and Recovery Operation

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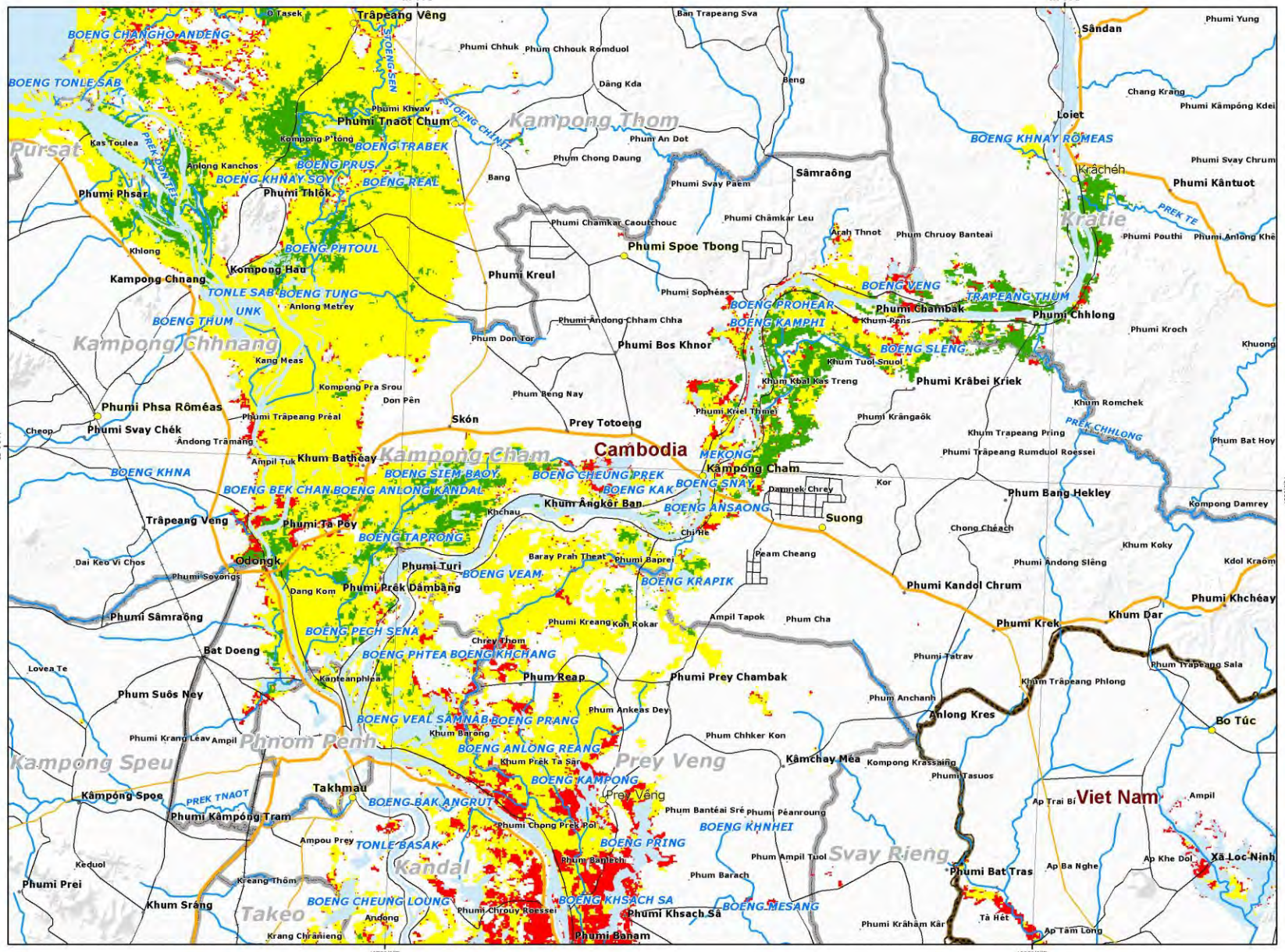
Cambodia - Kampong Cham, Kandal, Phnom Penh Flooded Areas

Map prepared by Emergency Preparedness Branch (OMEP) 02.10.2013



Satellite flood detected areas (DFO)

- 23th Sept to 2nd Oct
- 3rd to 12th Oct
- 13th to 22th Oct

Settlements

- National Capital
- Major Town
- Intermediate Town
- Small Town
- Village

Transportation

- Primary Road
- Secondary Road
- Tertiary Road
- Track/Trail
- Railway

Boundaries

- National
- *Regional*

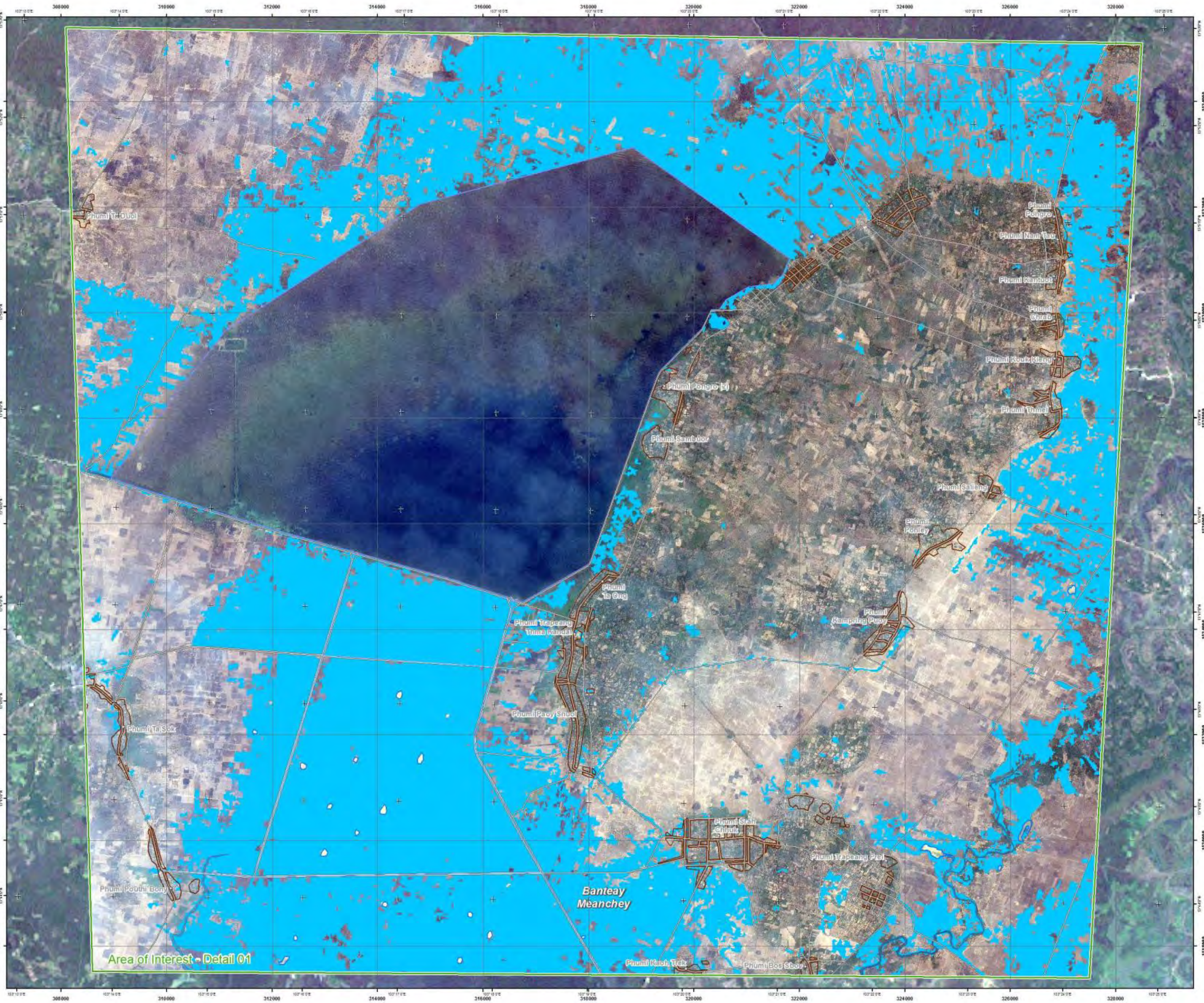
Water Bodies

- River
- Water Body

N

0 4 8 16 Kilometers

Data Sources: DFO, WFP, GLCSC, GAUL, GADM, NGA, DEA, VMAP0



GLIDE number: N/A

Activation ID: EMSR-055
Product N.: 01SiemReap, v1

Siem Reap - CAMBODIA
Flood - 15/10/2013
Delineation Map - Detail 01

Production date: 20.10.2013

Cartographic Information

1:33000

Full color ISO A1, medium resolution (100 dpi)

0 0,5 1 2 km

N

Grid: WGS 1984 UTM Zone 48N map coordinate system
Tick marks: WGS 84 geographical coordinate system

Legend

Crisis Information
Flooded Area (19/10/2013 23:00)

General Information
Area of Interest

Settlements
Residential
Populated Place

Transportation
Local Road

Hydrology
Canal
River
Lake
Reservoir

Consequences within the detail AOI on 19/10/2013				
			Affected	Total in AOI
Flooded area		ha	10800	
Estimated population		inhabitants	1840	39541
Settlements	Residential	ha	24,1	518
Transportation	Local roads	km	101,9	337,5

Map Information

Heavy rains as a result of Cyclone NARI-13 (landfall in Vietnam and Lao PDR on 15 October 2013) have exacerbated the floods in some provinces in the country, especially Banteay Meanchey and Battambang.
The core users of the map are Humanitarian Aid Operators involved in field operations. Potential additional users are Civil Protection authorities involved in operations.
The scope of the map is to provide support to the planning of potential relief operations.

Data Sources

Inset maps based on: Administrative boundaries URC 2013, GISCO 2010, © EuroGeographics), Hydrology, Transportation (Natural Earth, 2012), Settlements (Geonames, 2013).
Radarsat-2 © MDA (acquired on 19/10/2013 at 23:00 UTC, GSD 6,25m) provided under ESA GSC-DA DWH License.
SPOT-6 © Astrium Services 2013, all rights reserved (acquired on 15/02/2013 at 03:15 UTC, GSD 1.5 m, 0% cloud coverage).
Base vector layers based on Openstreetmap, Geonames, GAUL (approx. 1:25:000, extracted on 18/06/2013), refined by ITHACA.
Water bodies extent in nominal conditions provided by WFP.
Elevation data: SRTM (90m posting). Height in meters above mean sea level.
All Data sources are complete and with no gaps.

Dissemination/Publication

No restrictions on the publication of the mapping apply.
Delivery formats are GeoTIFF, GeoPDF, GeoJPEG and vectors (shapefile and KML formats).

Framework

The products elaborated in the framework of current mapping in rush mode activation are realized to the best of our ability, within a very short time frame during a crisis, optimising the available data and information. All geographic information has limitations due to scale, resolution, date and interpretation of the original data sources. The products are compliant with GIO-EMS RUSH Product Portfolio specifications.

Map Production

The present map shows the flood delineation in the area of Phnom Srok, Siem Reap (CAMBODIA). The basic topographic features such as transportation, hydrology and settlements are derived from public datasets, refined by means of visual interpretation of pre-event SPOT-6 imagery © Astrium Services 2013, all rights reserved (acquired on 13/03/2013, GSD 1.5 m, 2% cloud coverage).
Thematic layers, assessing the delineation of the event, have been derived from post-event image Radarsat-2 © MDA (acquired on 19/10/2013 at 23:00 UTC, GSD 6,25m) provided under ESA GSC-DA DWH License.
The estimated geometric accuracy of this product is 35 m CE90 or better, from native positional accuracy of the background satellite image.
The estimated thematic accuracy of this product is 85 % or better, as it is based on previous experience in using high-resolution SAR for flood extent delineation. Please be aware that the thematic accuracy might be lower in urban and forested areas due to known limitations of the analysis techniques.
Map produced on 19/10/2013 by GAF AG under contract 257219 with the European Commission. All products are © of the European Commission.
Name of the release inspector (quality control): e-GEOS (ODO).
E-mail: rush@ems-gmes.eu

Flood
Humanitarian Aid
Response
Delineation Map – Detail
Planning
Radarsat-2 (c) MDA
15-10-2013

Copernicus
The European Earth Observation Programme

European Commission

Usage of Remote Sensing in the Context of Preparedness

Food Security :

- Availability
- Access
- Utilization
- Stability

Relevance of Remote Sensing :

- Availability dimension

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Usage of Remote Sensing in the Context of Preparedness

A tool of growing importance for WFP: Agricultural Monitoring using EO

Relevance :

- Provision of food assistance to beneficiaries – early warning, impact assessment
- Contribution to baseline Food Security surveys (climatology, zoning, history of shocks)
- Support to the design of WFP prepositioning interventions

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Application of Remote Sensing Data

- Monitoring and assessment of agricultural season performance in priority areas/countries [early warning, impact assessment]
- Analysis of past events – frequency, magnitude and spatial distribution.
- COs frequently initiate a request, analysis carried out at HQ.
- Input for Vulnerability Analysis

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Data Sources

- Main Resources : RFE and NDVI.
  - RFE: Key driver for crop performance – USGS
  - NDVI: Direct indicator of vegetation status – SPOT-VGT, MODIS
    - Proxy for household resources (crop and pasture production)
    - Fine resolution, performance over irrigated areas
- Ease of access, free download data sets
- Familiarity
- Long historical time series (reference scenarios)

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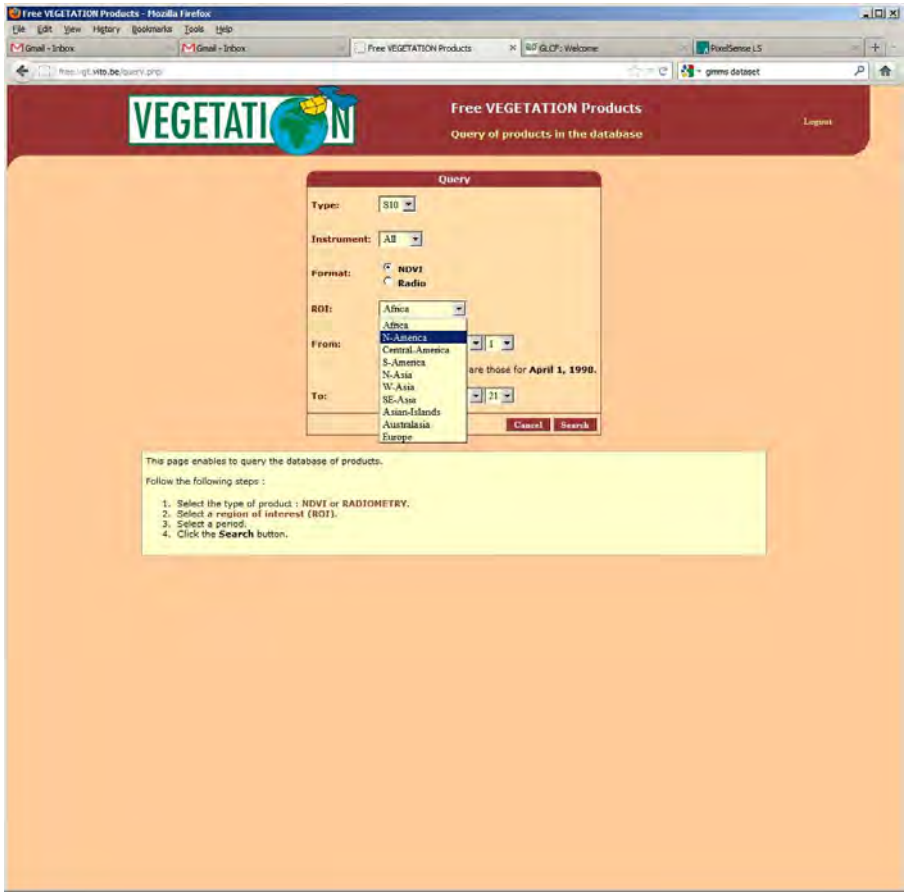
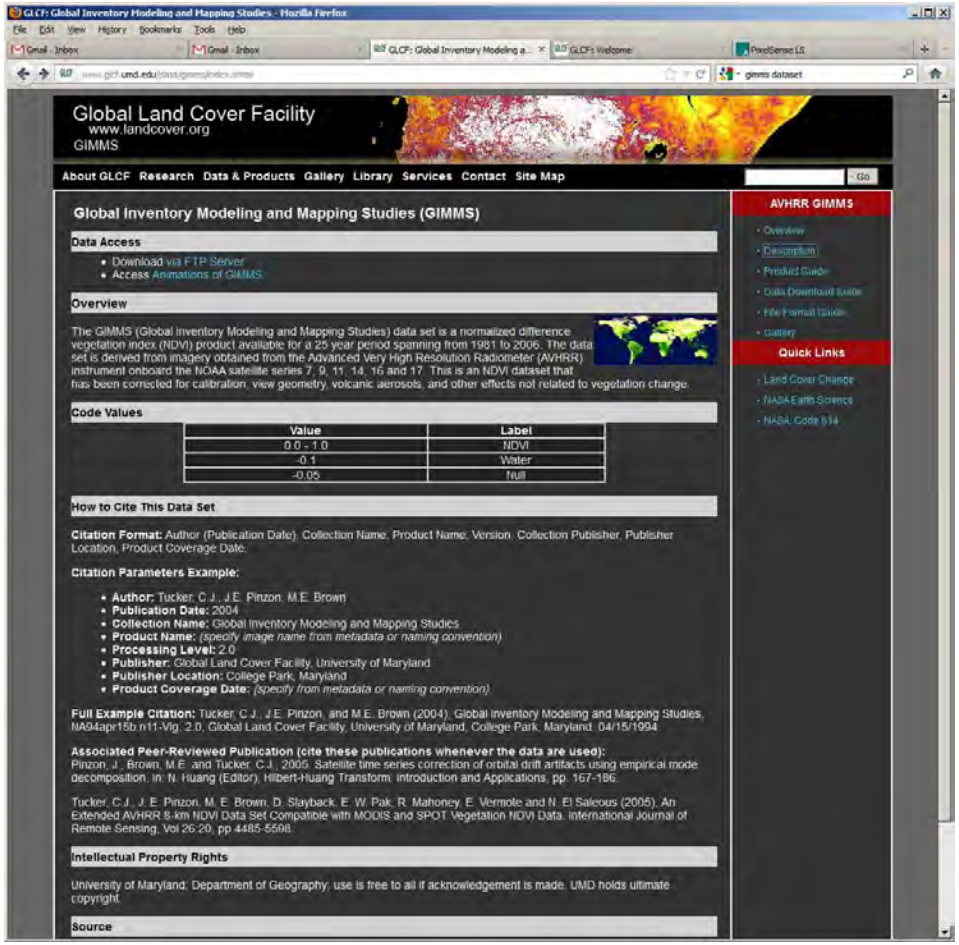


SPOT-VGT Data: Global 1998 - present



GIMMS NDVI: Global 1981 - 2006

Vast repositories of free access data

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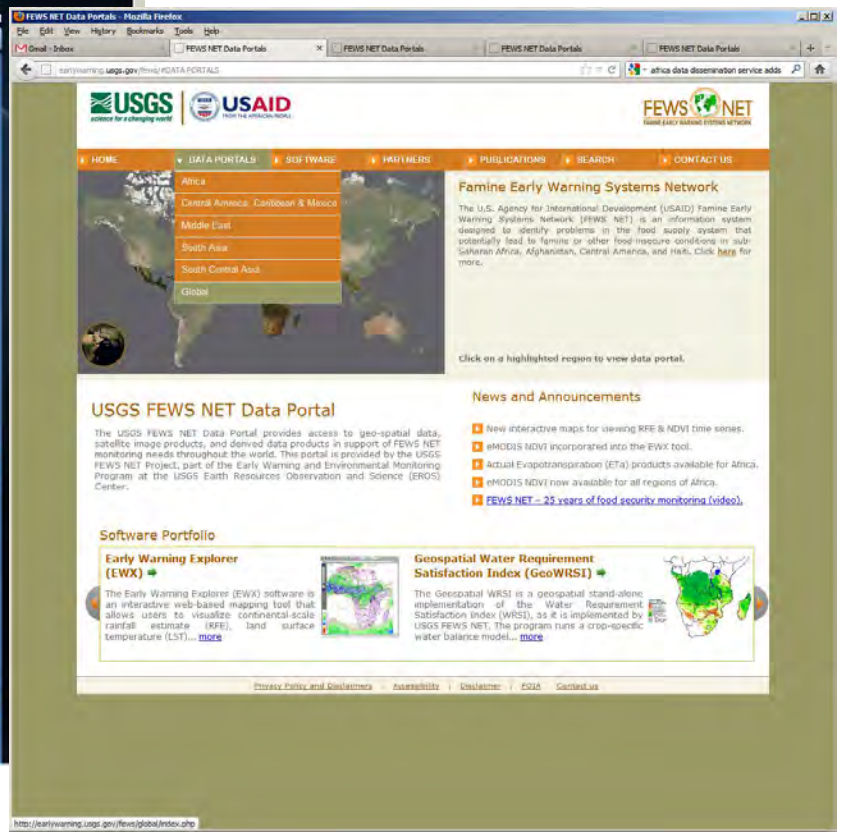
Reverb: access tool for NASA ESDIS ECHO



USGS FEWS-Net Data Portals

Vast repositories of free access data

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Requirements

This type of EO information must be combined with GIS data in order to draw conclusions about possible impacts on households

- Land Cover
- Crop Calendars / Farming Systems
- Household / Livelihoods

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Requirements

Land Cover – distinction between agricultural and non agricultural land. Within agricultural land, distinction between farming systems – irrigated vs rainfed, commercial vs subsistence

- Land Cover
- Crop Calendars / Farming Systems
- Household / Livelihoods

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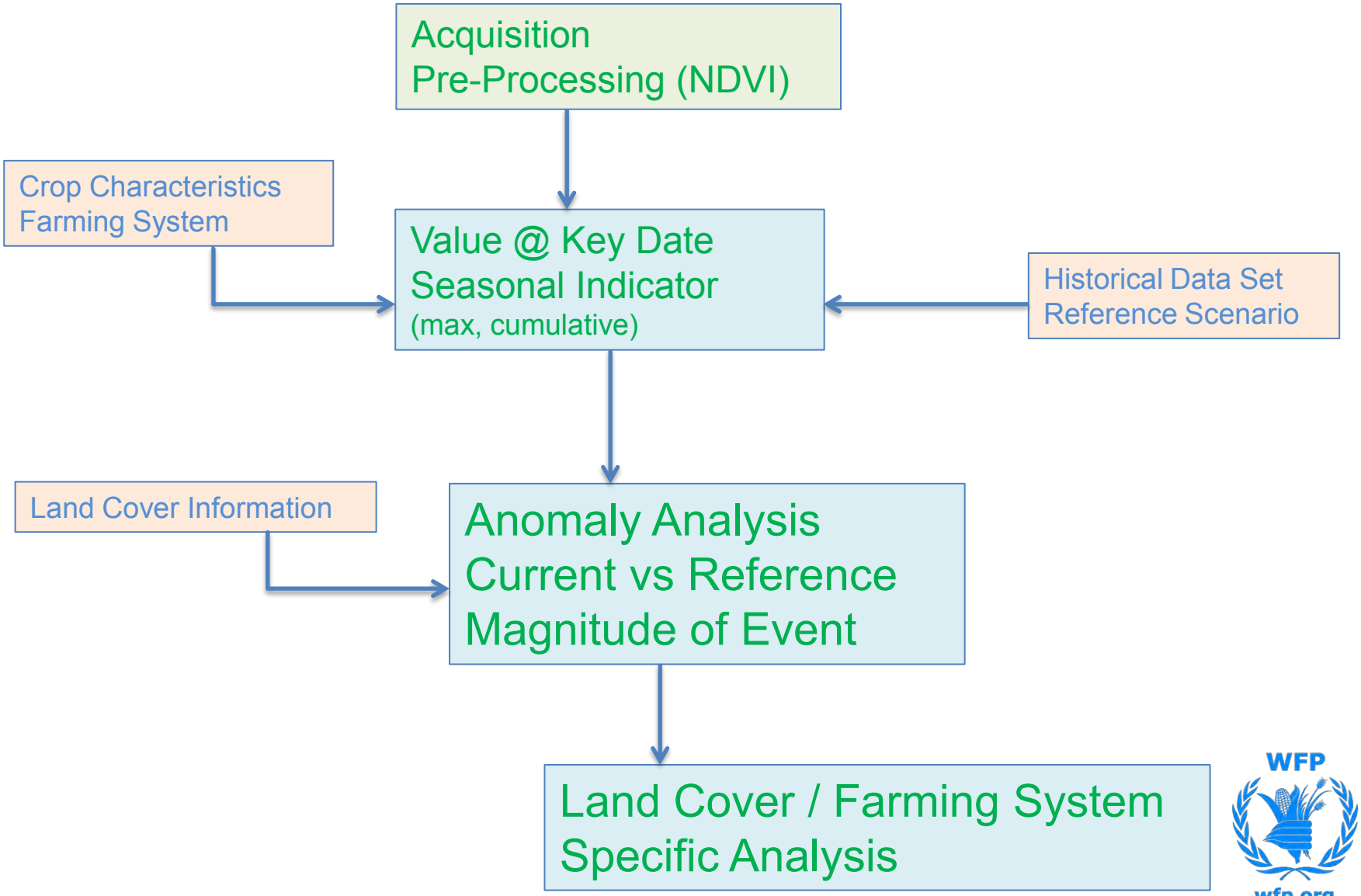
Analysis Framework



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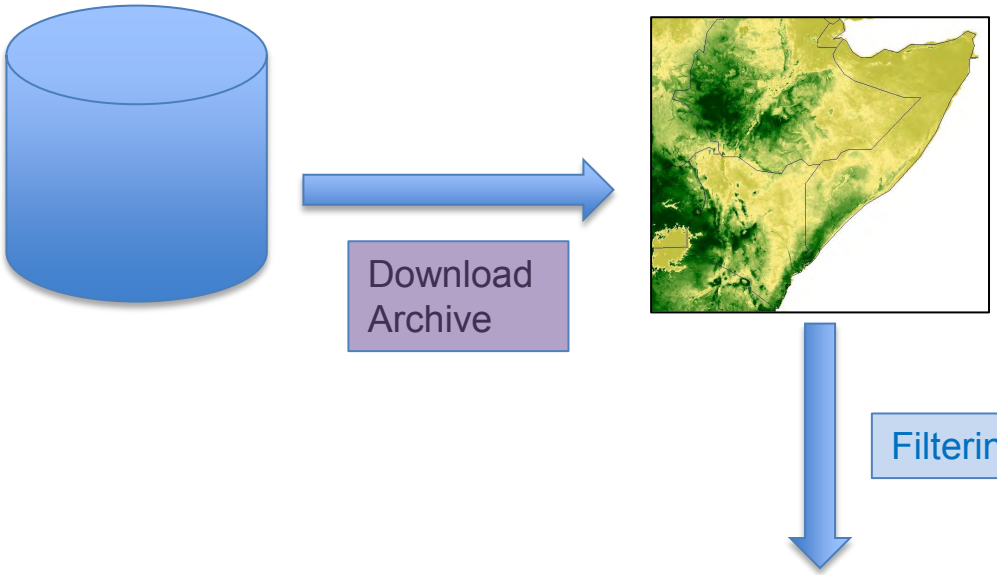
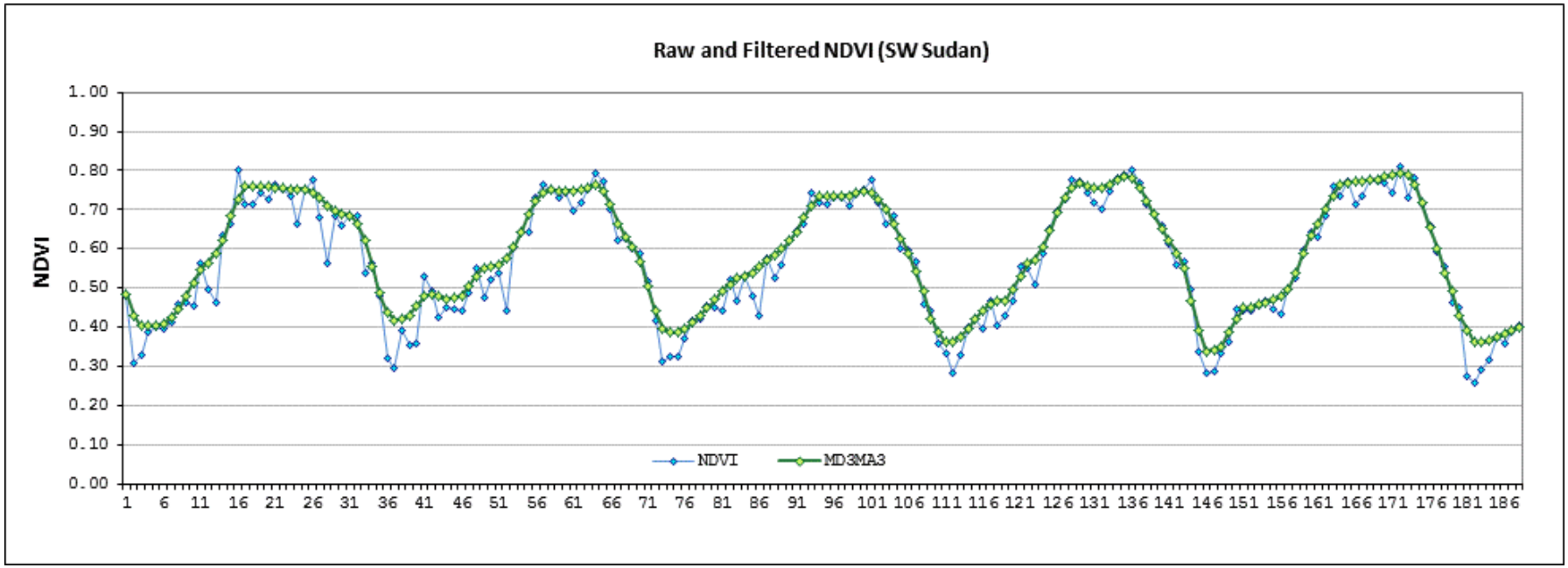
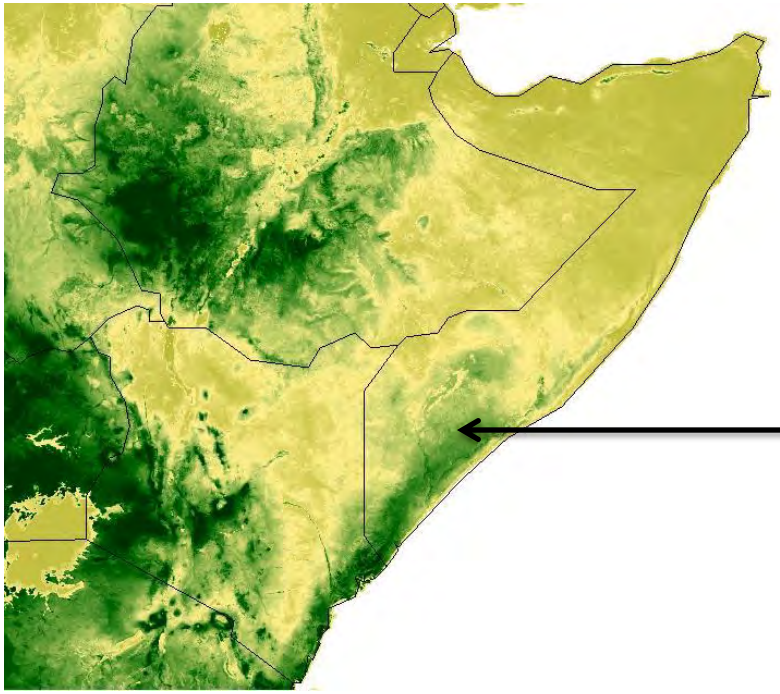
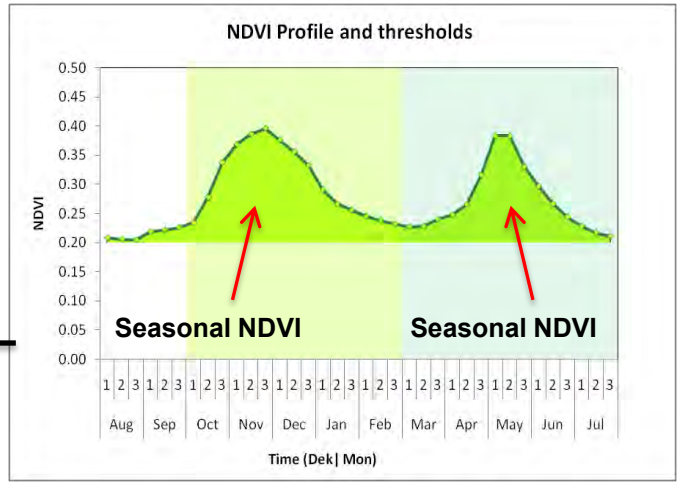
Pre-Processing





Analysis for the Horn of Africa





Horn of Africa :
Bimodal Regime
Integrated NDVI within each individual growing period

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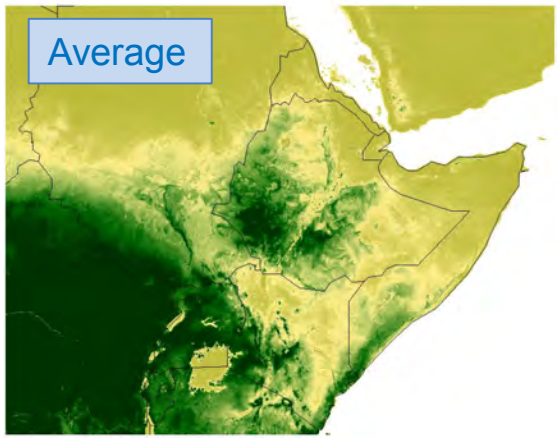
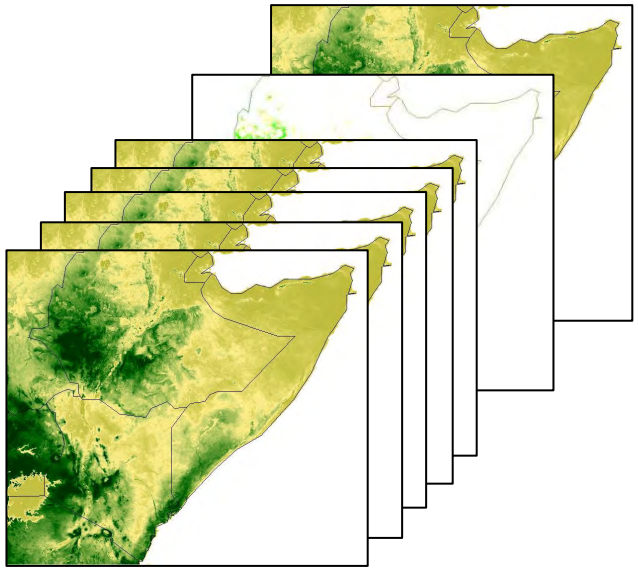
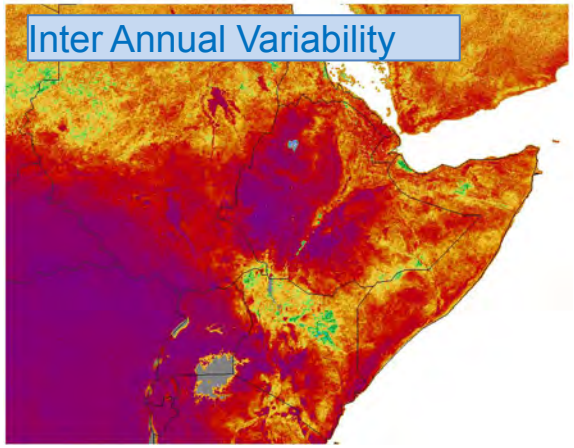
Reference Scenarios



Historical Data Set



Pixel by Pixel Statistics



Reference Scenarios

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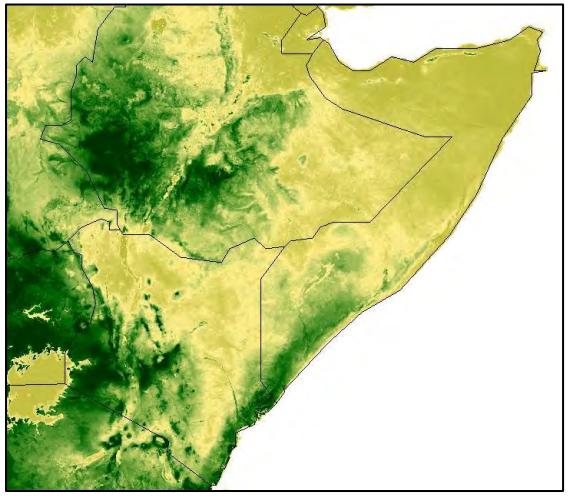
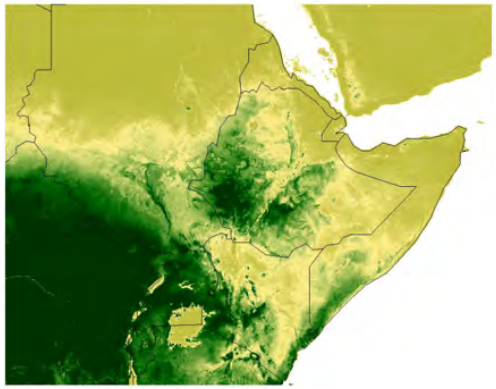
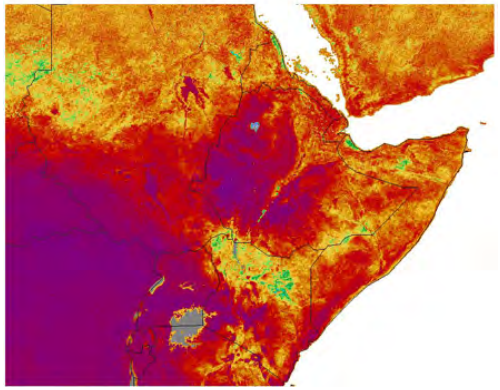
Anomaly Analysis

Reference Parameters

Current Season Data







$$Z_{NDVI} = \frac{NDVI_i - \overline{NDVI}}{\sigma_{NDVI}}$$

Standardized Anomaly

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Analysis for the Horn of Africa

Rationale :

Past variation in NDVI assumed to contain the range of variation in seasonal resources that the household has had to cope with.

- Z btn [-1 to +1]: ***normal*** season to season variation
- Z btn [-1 to -2]: ***moderate*** variation assumed to enclose the limits of the usual coping capacities of agricultural households.
- Z btn [-2 to -3]: ***severe*** variation, stretching coping capacity beyond what many households could achieve. Significant impacts.
- Z < -3: ***extreme*** variation, well outside the coping capacity if not the experience / living memory of households. Extreme impacts, once in a generation events (?)

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Analysis for the Horn of Africa

Integrated view over two seasons:

Z anomaly for aggregated NDVI October 2010 – July 2011

Classify each season Z image into severe (or worse), moderate, normal, cross tabulate and re-group into key groups :

- **Severe impact in both seasons**
- **Severe impact in one season, moderate in other**
- **Moderate impact on both seasons**
- **Severe impact in one season, normal in other**
- **Moderate impact in one season, normal in other**

Rough, but allows quick identification of areas with consecutive significant impact (relative to past behaviour)

Descriptive legend convenient for non technical readers

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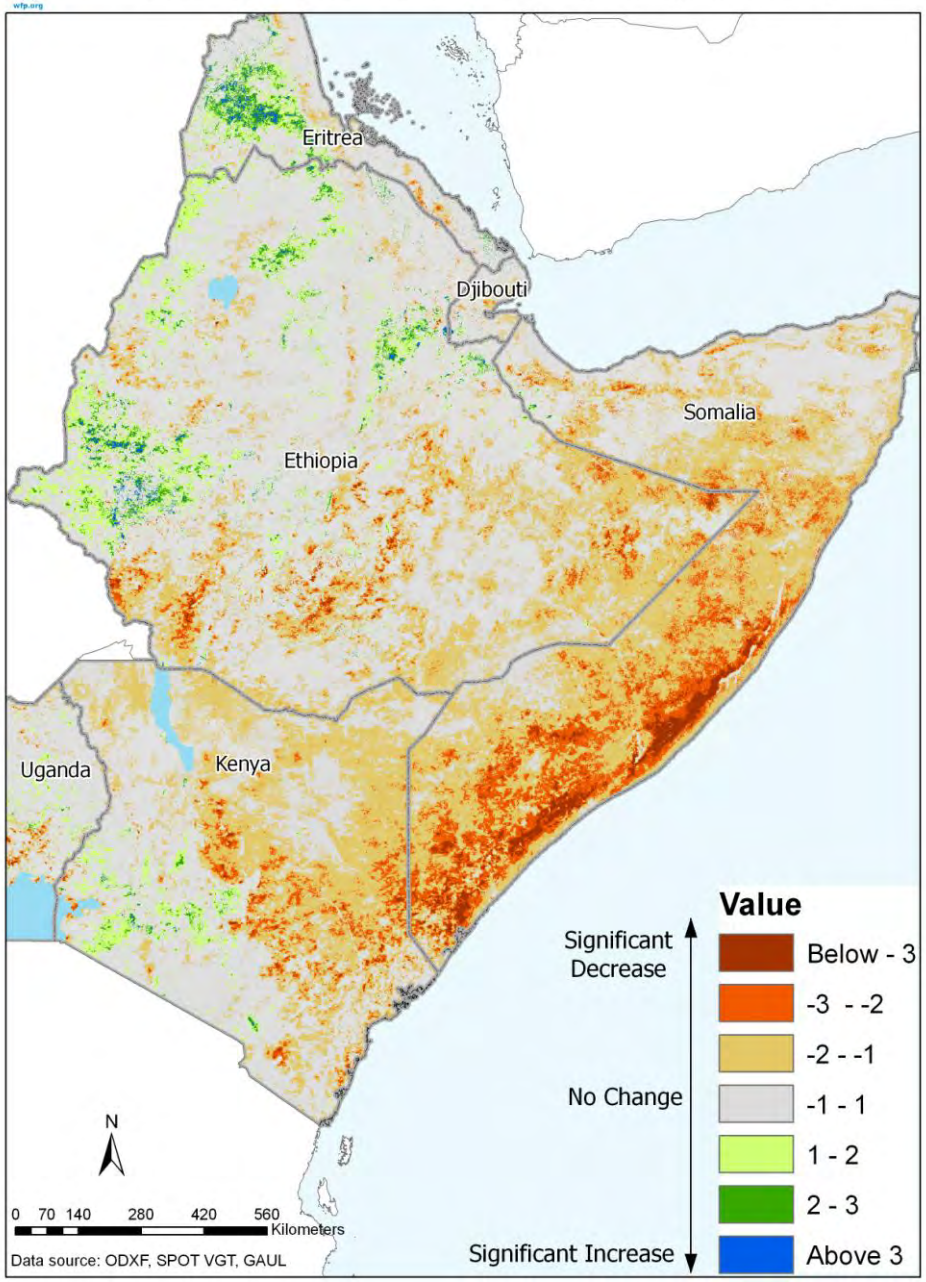
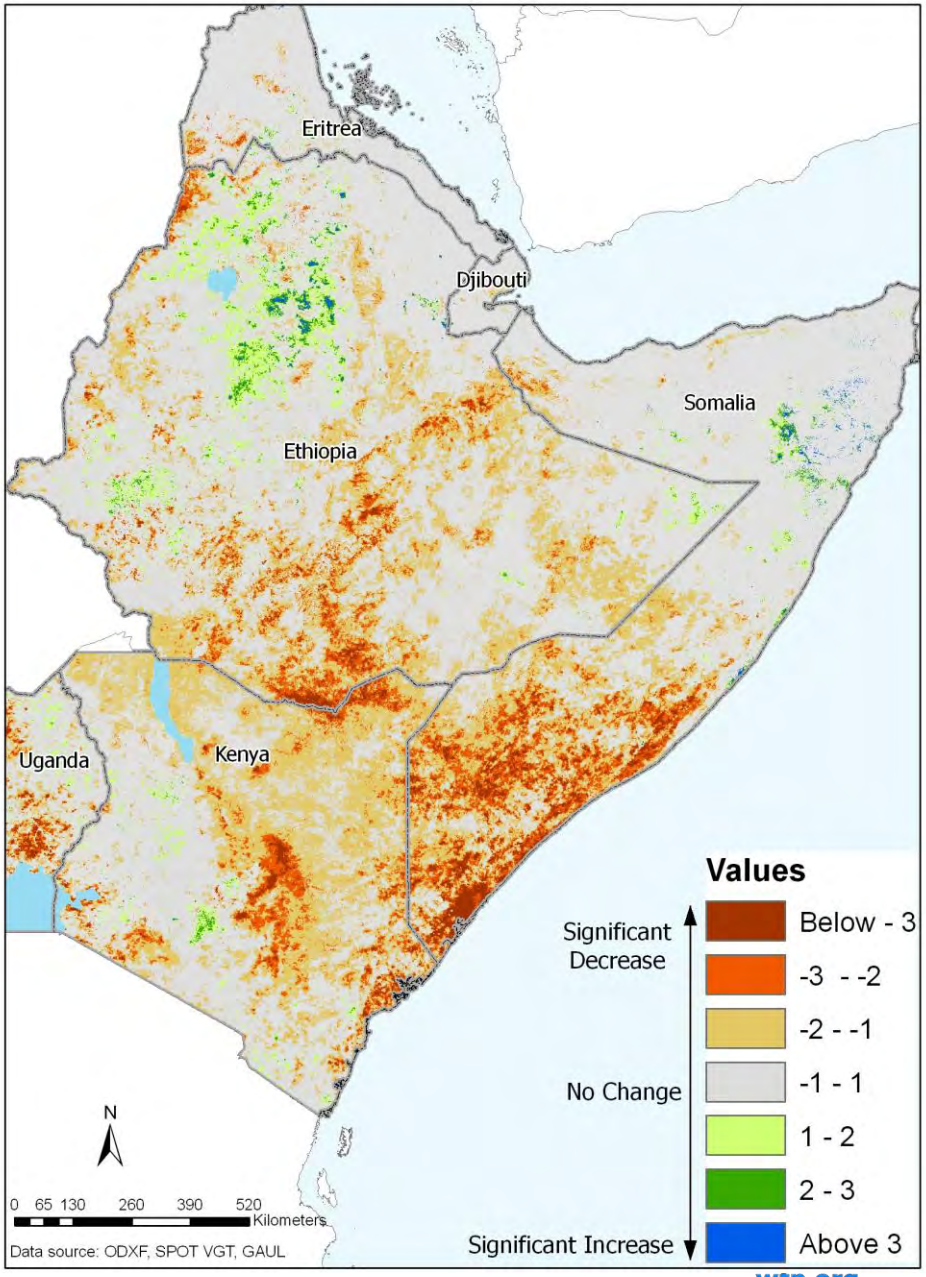
Horn of Africa: NDVI Oct 2010 to Feb 2011 Comparison to Average



Horn of Africa: NDVI March to July 2011 Comparison to Average



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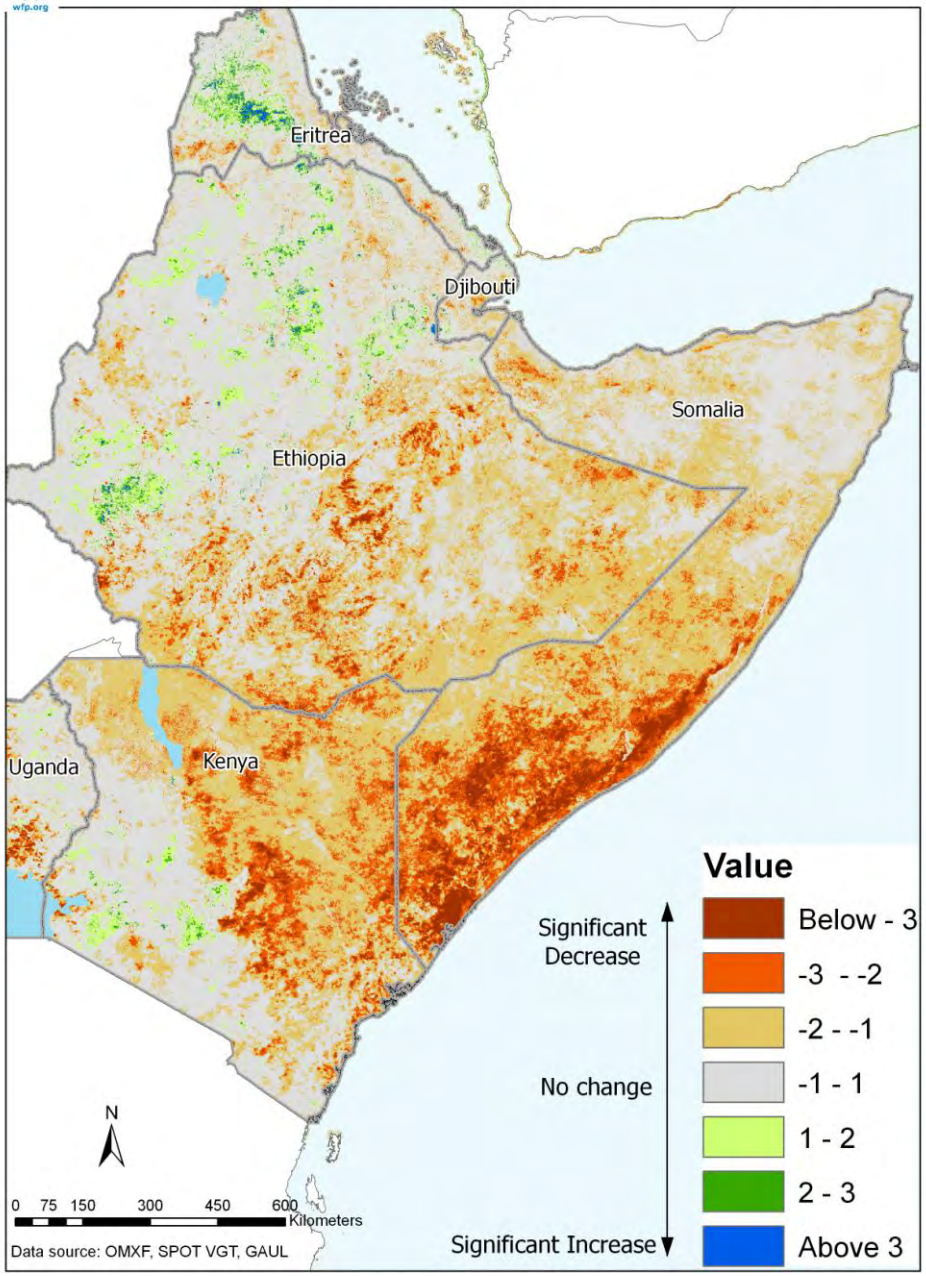
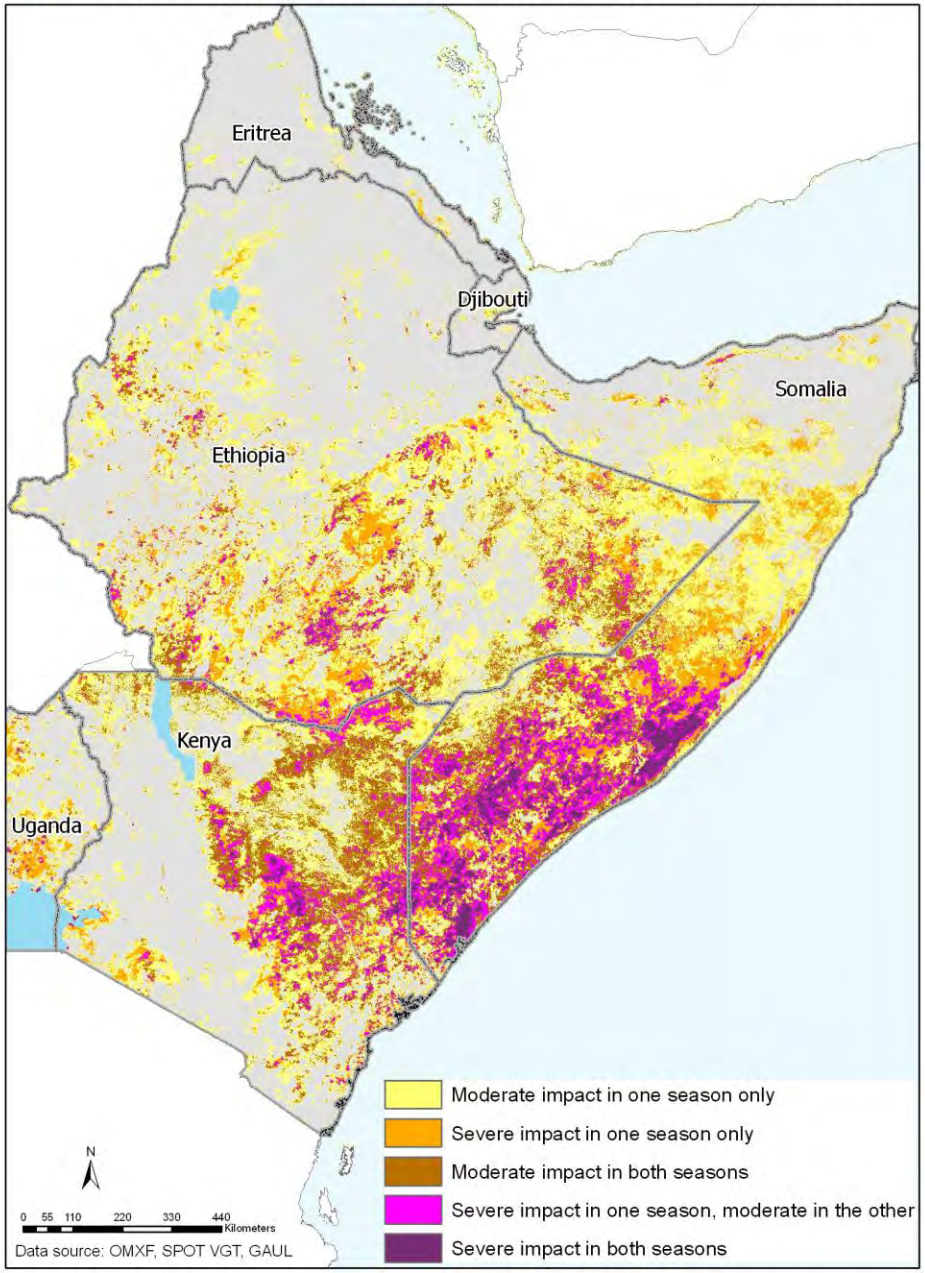
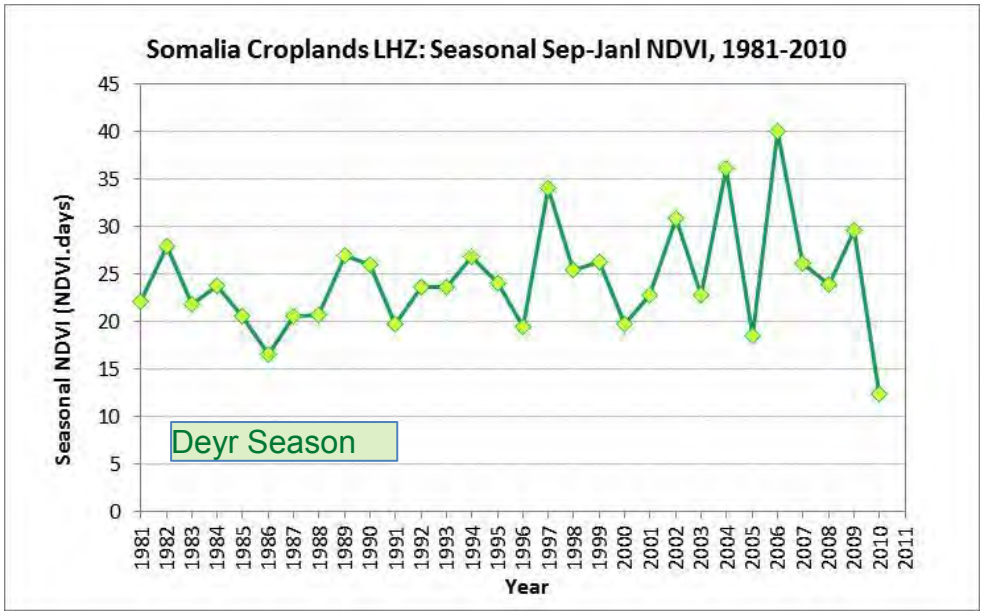
Horn of Africa: NDVI Oct 2010 - Jul 2011 Comparison to Average

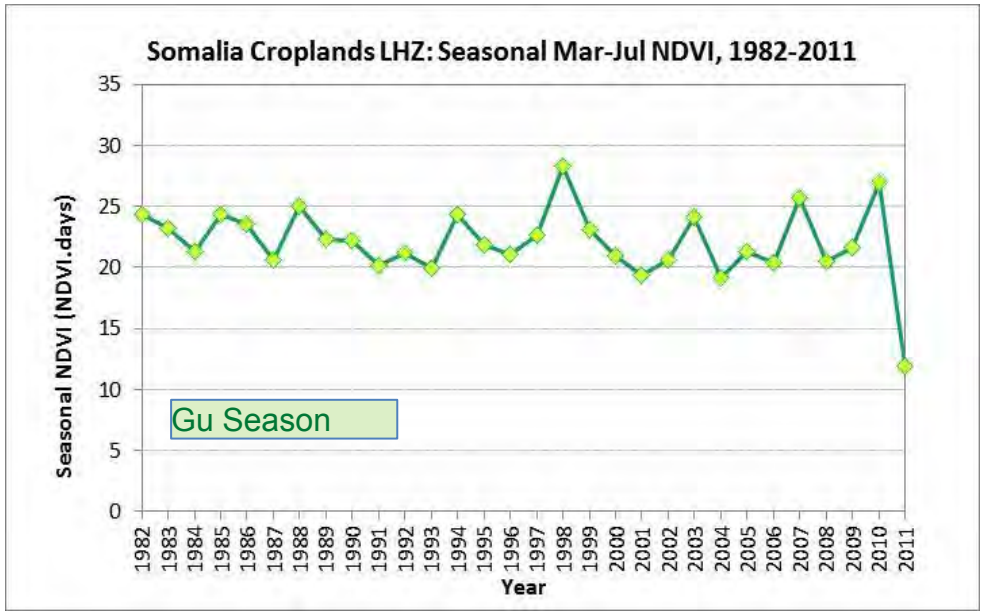


Horn of Africa Affected Areas: Type of Impact on growing seasons (Oct-Feb 2010 and Mar-Jul 2011)



Temporal Context – Somalia Croplands





Agricultural livelihood areas :
Deyr season (Oct-Dec, short rains) much more variable than Gu season (Apr-Jun, long rains)

2010-2011 event exceptional in the 30 year timeframe

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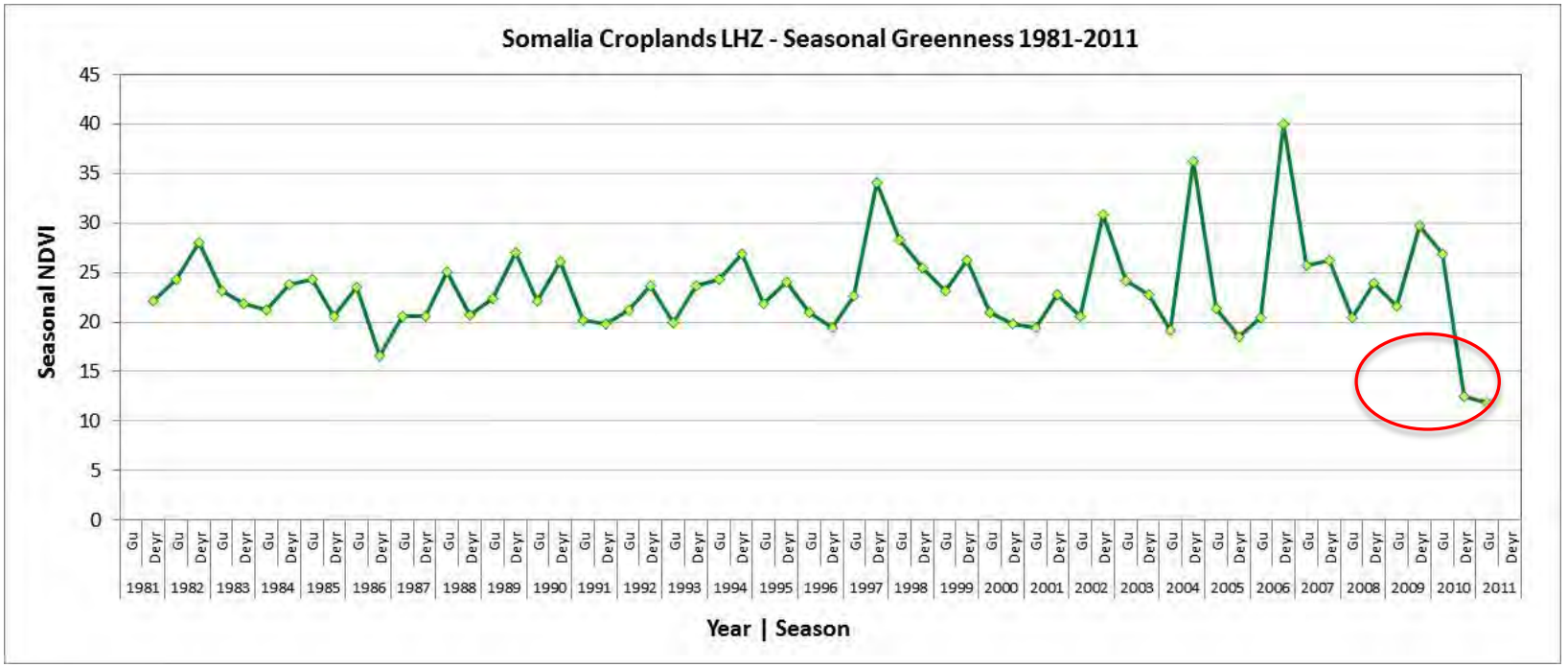
Temporal Context – Somalia Croplands



Agricultural livelihood areas :

No apparent trend, but increasing variability?
2010-2011 event : two consecutive exceptional failures in the 30 year record

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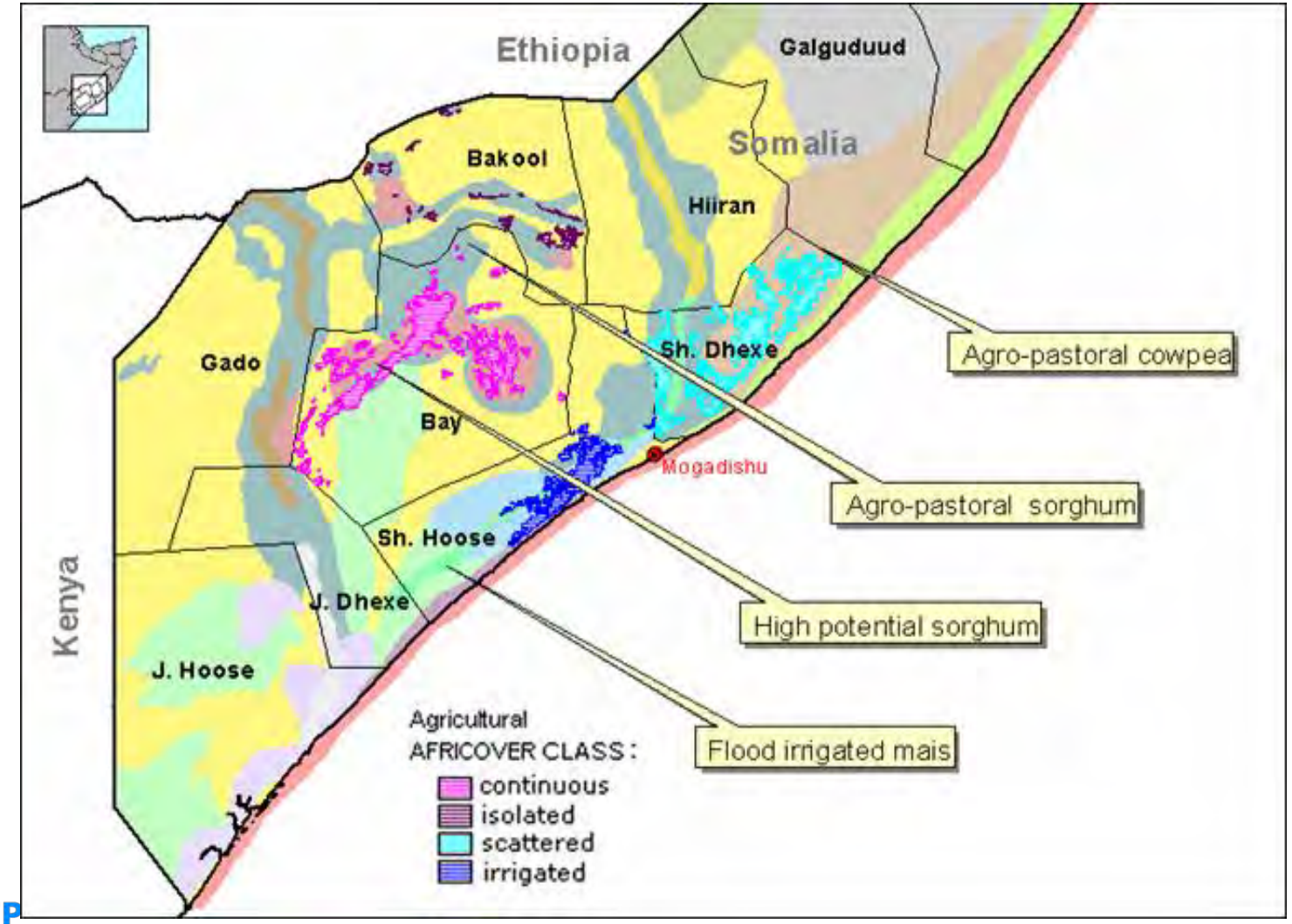

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Analysis for the Horn of Africa

Results:

- The impacts were very strong (extremely strong in places), were spatially very widespread and extended over two consecutive growing seasons which is in itself quite unusual.
- The area most affected both in terms of spatial extent and magnitude of the event was by far Southern Somalia, where both seasons registered extremely poor performance.
- Other impacted areas were central and north-eastern Kenya and areas of Southern Ethiopia but to a lesser degree, as impacts during the late 2010 growing season were much less marked than for Southern Somalia.
- All livelihood zones in Somalia were affected given the extent of the drought impact. In some areas, in particular agricultural areas of the Shabelle, Bay and Juba regions, the values of the standardized anomaly reached below -5 – the simplest way to translate this is that in these regions there would have been no one old enough to remember an event of such magnitude.

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Way Forward

- Looking for partnerships to improve products, expand integration of GIS and remote sensing
- Specific interests in:
  - Using satellite imagery to support life-saving emergency response
  - Integrating geo-referenced data about society into models for early warning and rapid emergency assessment
  - Exploring creative solutions to acquiring data in an organisation funded solely by emergency contributions.

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THANK YOU!!

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