CREST HIRES Summer 2016 Research Project

Analysis of drought and food security from satellite remote sensing data

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Research Group/Theme:
Land Processes and Water Resources

- Food is one of the most essential factors for our physical wellbeing; it is a fundamental requirement for a healthy and happy life.

- Droughts:

  - Meteorological drought happens when dry weather patterns dominate an area.

  - Hydrological drought occurs when low water supply becomes evident, especially in streams, reservoirs, and groundwater levels.

  - Agricultural drought happens when crops become affected.

Food Security
means the state of having reliable access to a sufficient quantity of **affordable**, nutritious food.

Importance of studying food security

Based on FAO definition Food security exists when all people, at all times, have physical, social and economic access to sufficient, **safe** and nutritious food, **but**:
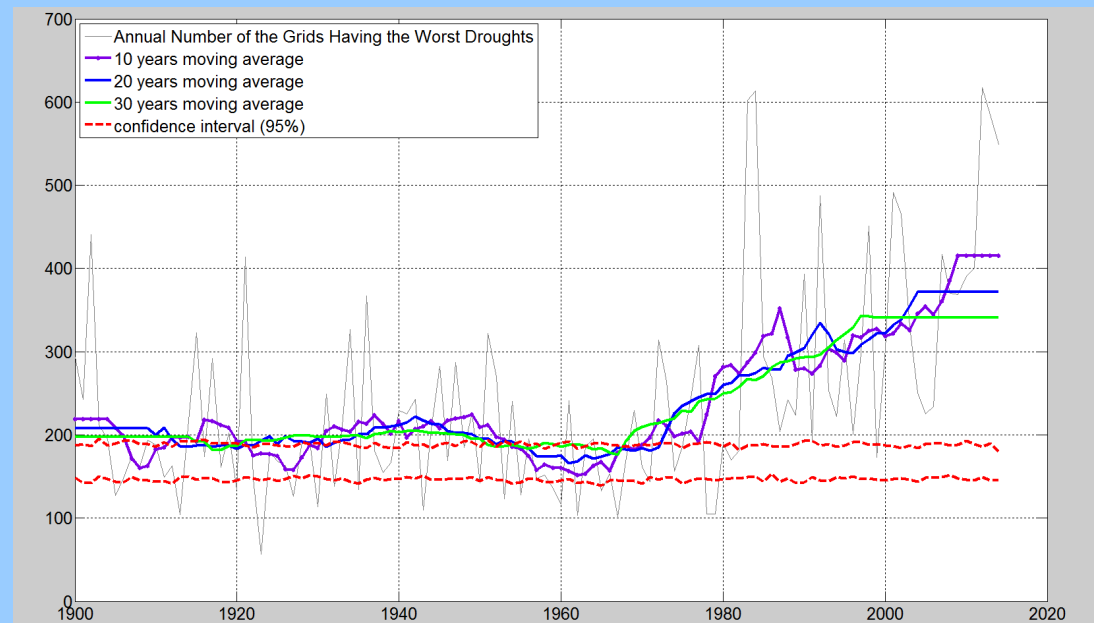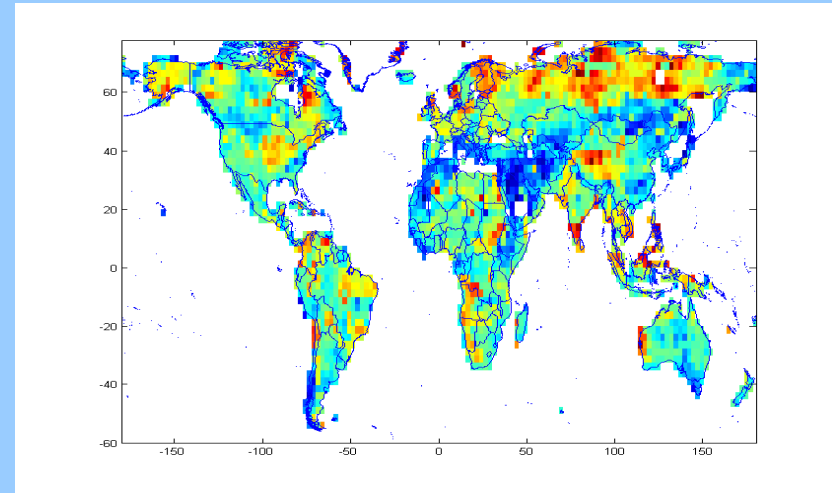
- Population increase from 7 billion in 2011 to 9.2 billion in 2050
- Approximately a billion people are chronically malnourished
- Agricultural systems are degrading land, water, biodiversity and climate on a global scale.
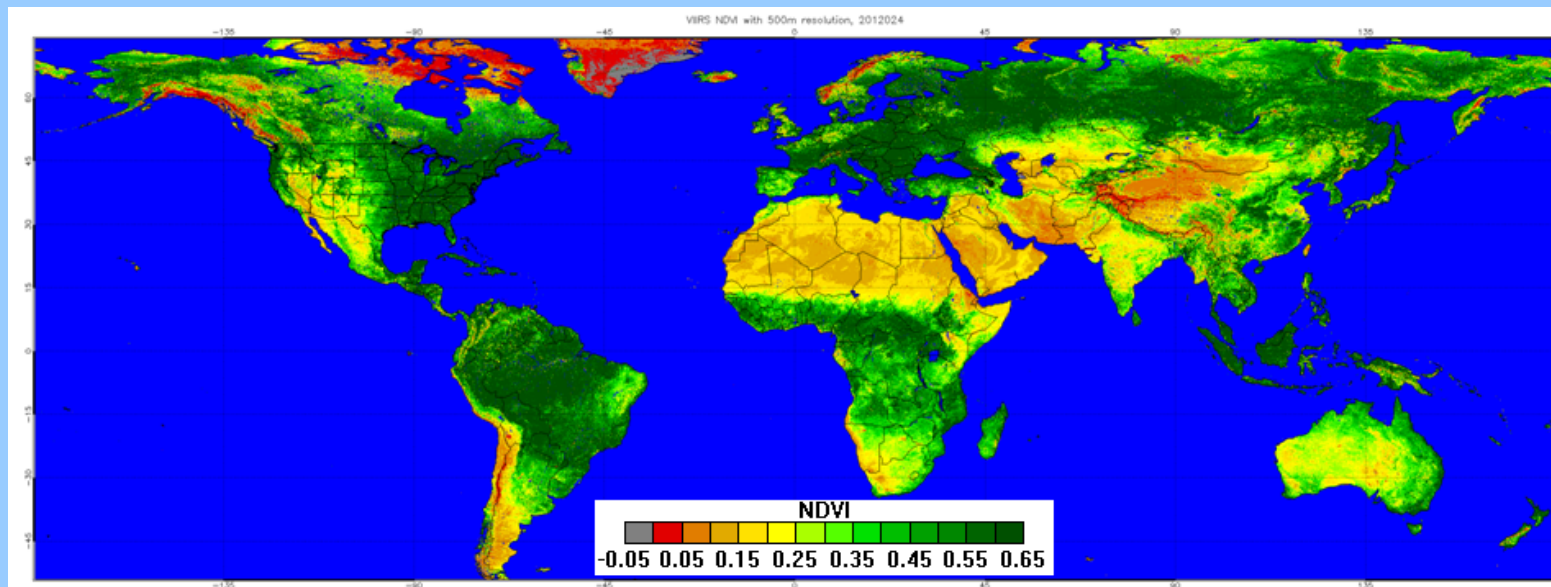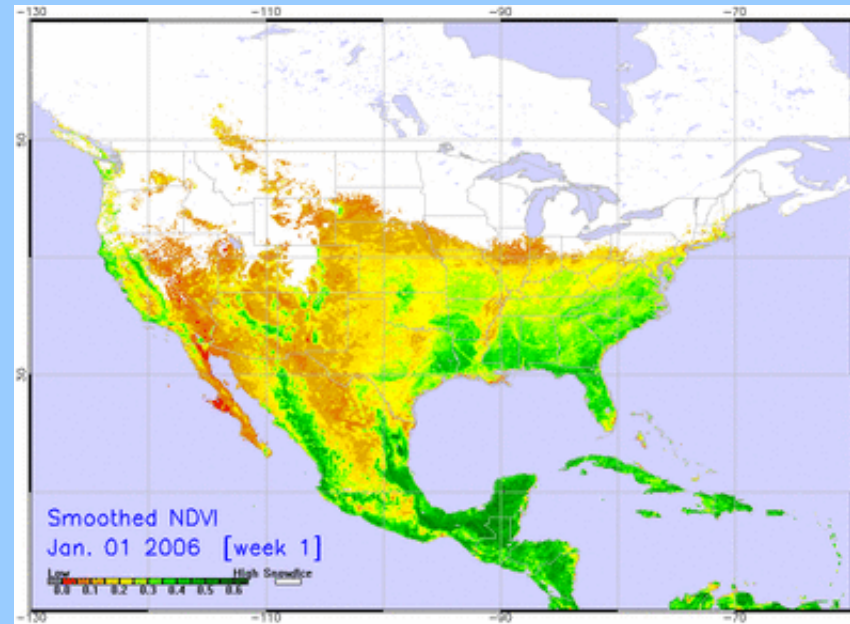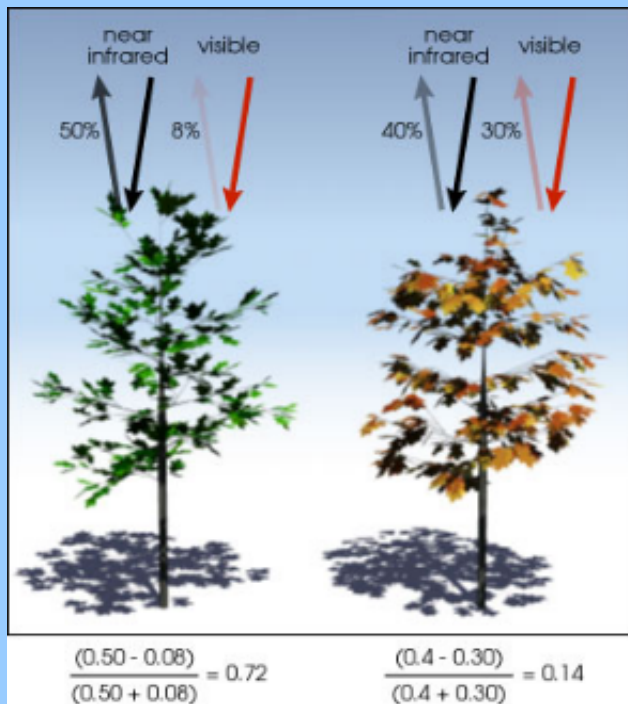- Droughts and climate change have caused shortfalls in the world grain production.

Feeding the World

Extent of drought?

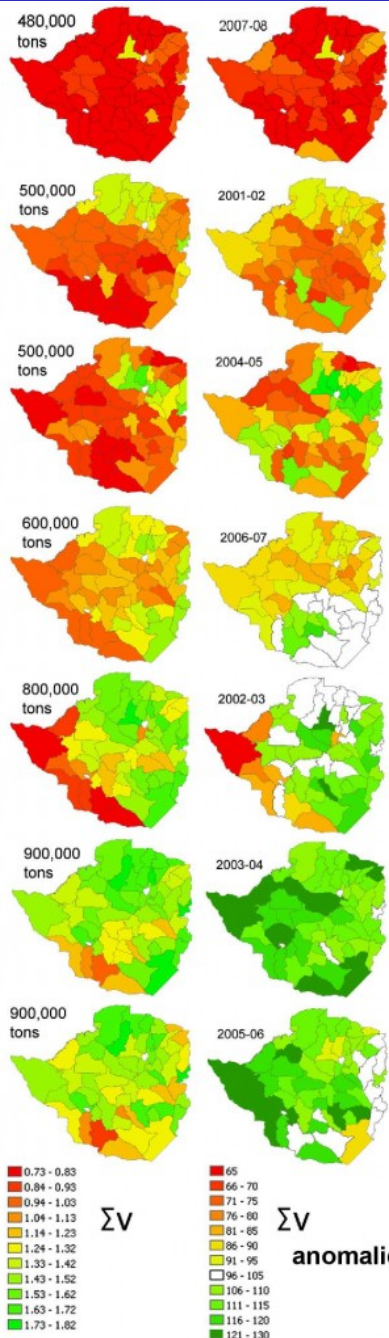**In order to study food security we should know drought. Why?**

- **Drought frequency and extent is increasing globally.**
- **Droughts have direct and indirect unfavorable impacts on food security.**

Vegetation

$$\frac{(0.50 - 0.08)}{(0.50 + 0.08)} = 0.72 \qquad \frac{(0.4 - 0.30)}{(0.4 + 0.30)} = 0.14$$

Smoothed NDVI
Jan. 01 2006 [week 1]

VIIRS NDVI with 500m resolution, 2012024

NDVI

-0.05 0.05 0.15 0.25 0.35 0.45 0.55 0.65

Vegetation Index (NDVI) for Food Security

Zimbabwe

250-meter MODIS-NDVI: Nov. 16, 2009

MODIS NDVI (Terra) : Rift Valley (Crops Only) (No Water)

- Detail Shape 2009-10
- Detail Shape 2008-9
- Detail Shape 2007-8
- Detail Shape 2006-7
- Detail Shape 2005-6
- Detail Shape 2004-5
- Detail Shape 2003-4
- Detail Shape 2002-3
- Detail Shape 2001-2
- Detail Shape 2000-1

MODIS-NDVI or vegetation "greenness" in 2009 is the lowest in past 9-years during grain filling stages in northern Rift Valley.

Σv relies on measures of vegetation condition (NDVI) throughout the growing season to assess the likely production outcome.

Budde et al (2010)
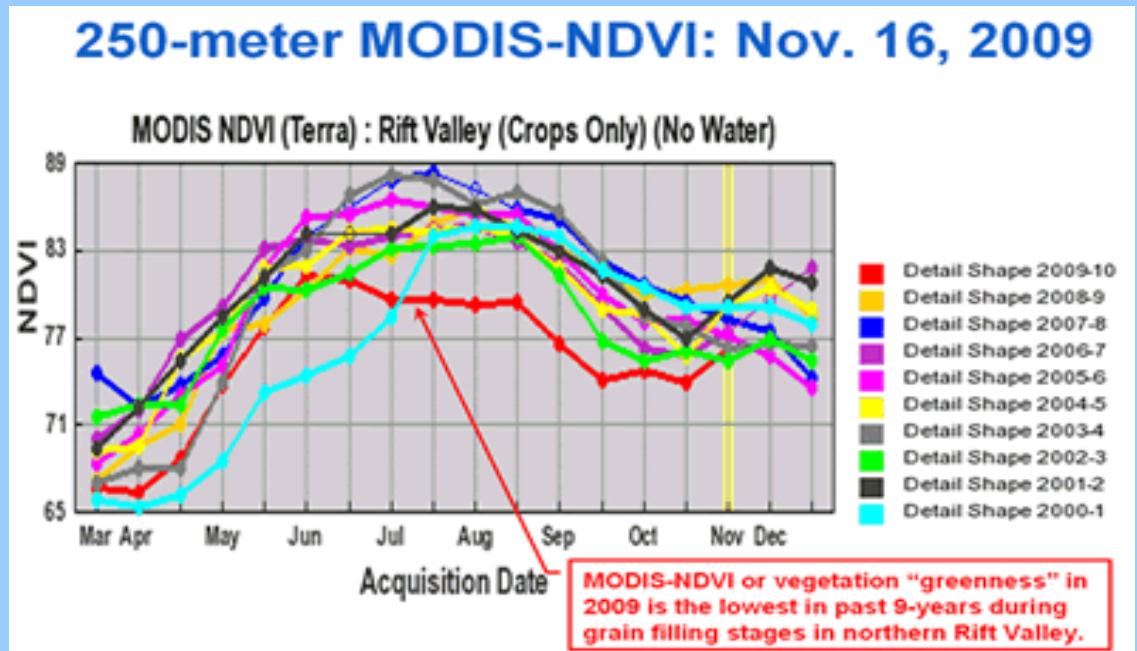
Nationally, 2008 ranks as worst year since 2000 FEWS NET

Irrigated Areas

Year	Maximum NDVI	Yield (t/ha)
2003	0.381	2.85
2007	0.373	2.69
2005	0.364	2.51
2006	0.357	2.58
2002	0.355	2.02
2004	0.335	1.93
2000	0.320	1.12
2001	0.317	1.31
2008	0.313	1.14*

* Estimated based on regression of maximum NDVI and historical yield figures
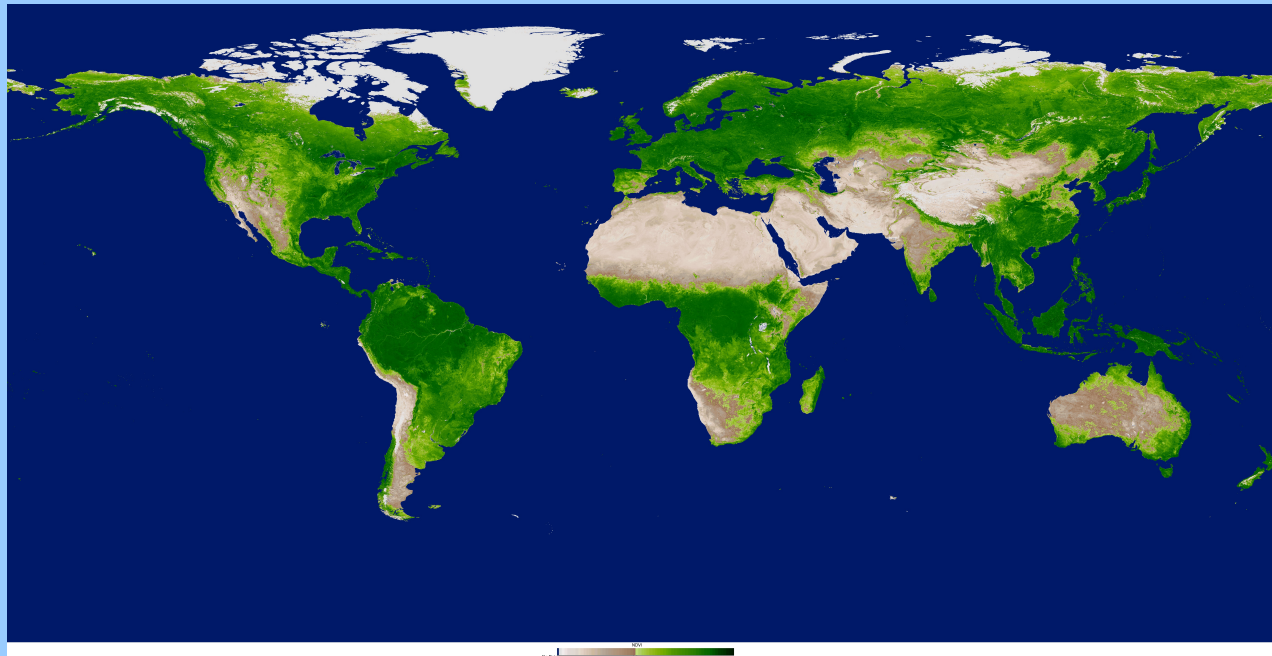
Objectives

- Analyze and compare the countrywide food production with respect to the remote sensing based vegetation indices.

- Create time series data of vegetation indices for globally.

- Compare the food prices (data downloaded from FAO) with respect vegetation indices/food production.

- Provide analysis and conclusion based on statistical comparison.

- Write a abstract and paper based on research findings.

Supervision and Logistics

- Research group: Land and Water Resources

- Lab location – ST-CM7 (or ST-424)

Remote Sensing Data

- MODIS Satellite data will be used.

- Vegetation Indices 16-Day L3 Global 0.05 Deg (~5.6 km)

- Each file size 95 MB (hdf format)

- Period: 2002 - 2016

June 21, 2016 (Tue)

http://e4ftl01.cr.usgs.gov/MOLA/MYD13C1.006/2016.06.01/BROWSE.MYD13C1.A2016153.006.2016173072234.2.jpg

Software

- ## Matlab

  - Use for open and processing the global MODIS data

- ## ArcMap (GIS)

  - Shapefiles to extract countrywide data

- ## Microsoft Excel

  - Process the food production and prices data

  - Prepare time series charts average vegetative
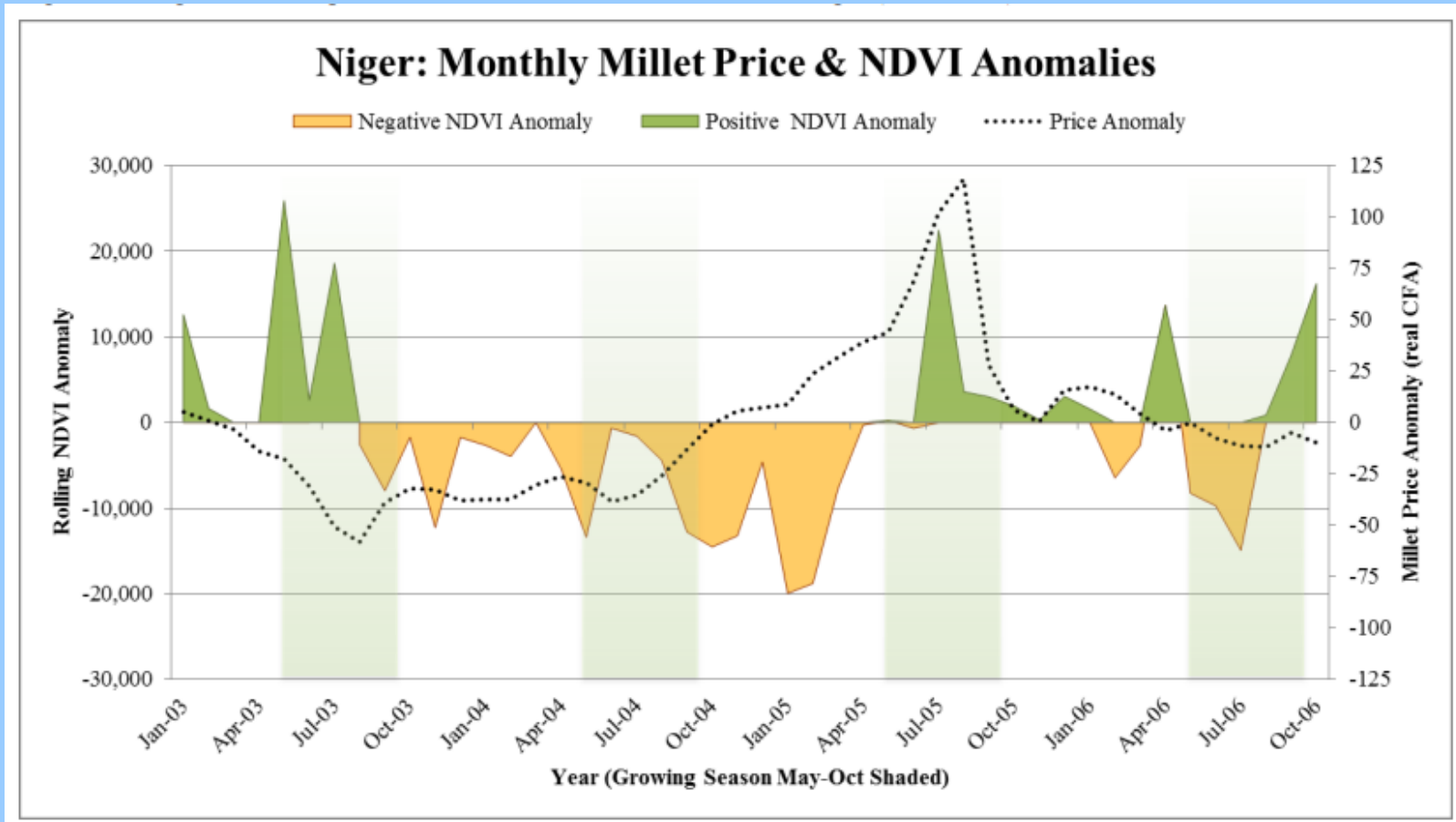
Matlab

GIS Software: ArcMap

Data Analysis and Modelling

- You will perform statistical modelling

  - Mean/Average

  - Outliers

  - Correlation coefficient

  - Regression analysis

  - Anomaly

  - Lag
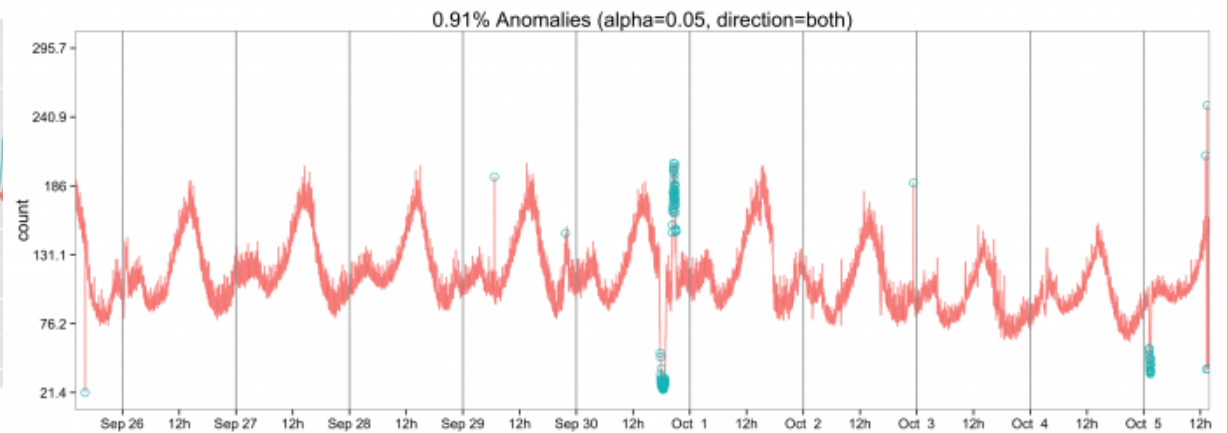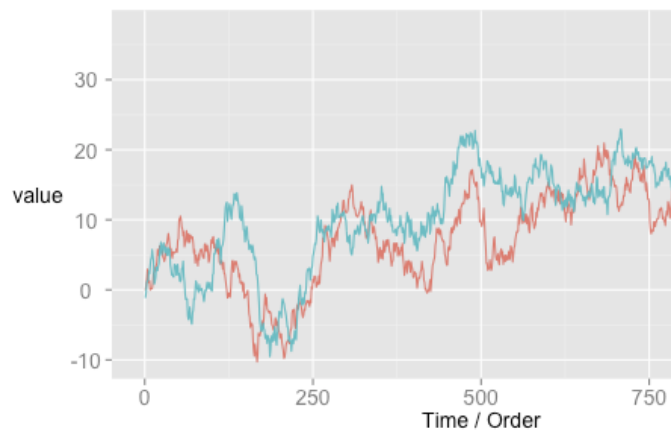
Can we effectively analyze vegetation indices to with food security crises?

Niger: Monthly Millet Price & NDVI Anomalies

What you will learn:

- How remote sensing satellite works?

- How to open, process and analyze the satellite data?

- How to use GIS software to create maps.

- How to use GIS to open and process remote sensing data

- How to do statistical analysis for large data.

- Impact of climate change on food production and food security

- What are countries and in critical conditions.