

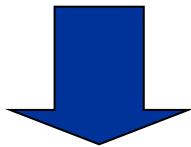
Monitoring Drought with Meteorological and Remote Sensing Data – A case study on the Horn of Africa

Paulo Barbosa and Gustavo Naumann

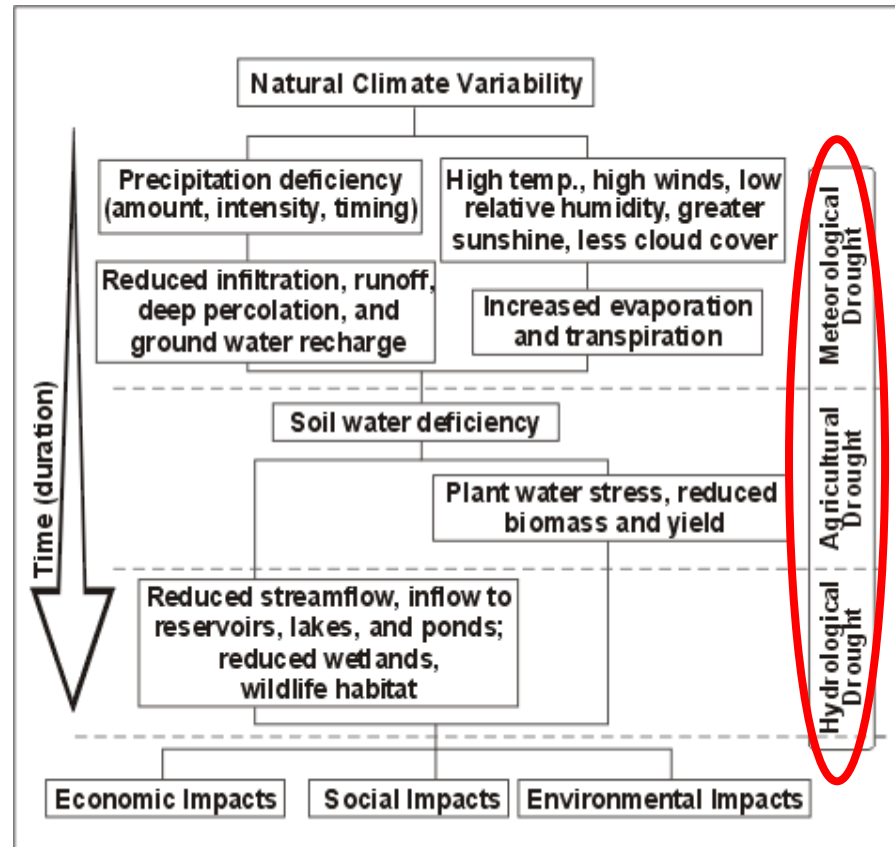
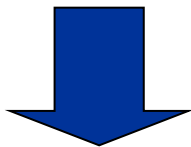
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<http://desert.jrc.ec.europa.eu>

No single definition of drought



Need for a set of indicators to constantly monitor the various environmental components potentially affected by droughts (e.g., soil, vegetation)



comprehensive and updated picture of the situation.

SPI categories

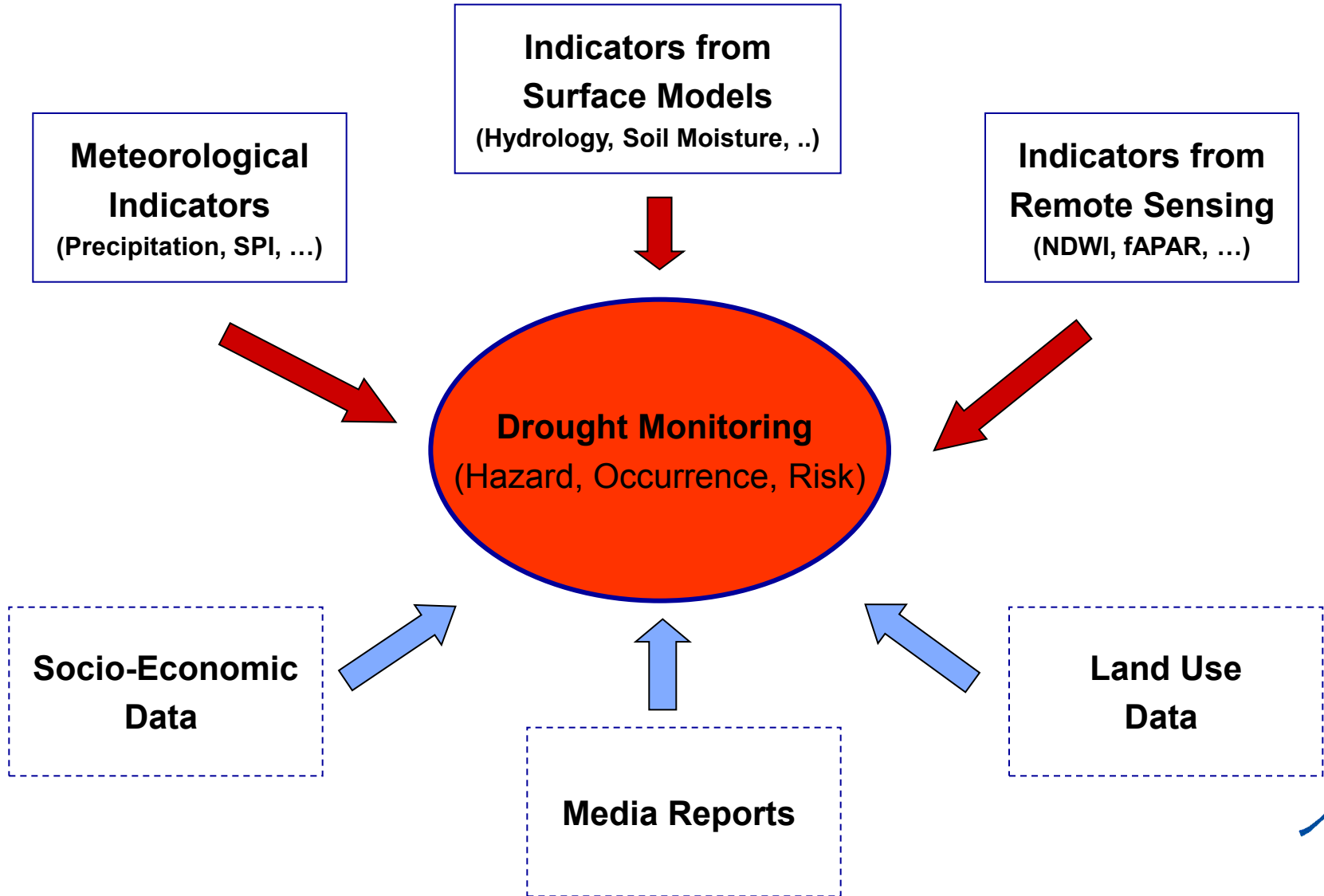
SPI Values	Category	Cumulative Probability	Probability of Event [%]
$SPI \geq 2.00$	Extremely wet	0.977 – 1.000	2.3%
$1.50 < SPI \leq 2.00$	Very wet	0.933 – 0.977	4.4%
$1.00 < SPI \leq 1.50$	Moderately wet	0.841 – 0.933	9.2%
$-1.00 < SPI \leq 1.00$	Near normal	0.159 – 0.841	68.2%
$-1.50 < SPI \leq -1.00$	Moderate drought	0.067 – 0.159	9.2%
$-2.00 < SPI \leq -1.50$	Severe drought	0.023 – 0.067	4.4%
$SPI < -2.00$	Extreme drought	0.000 – 0.023	2.3%

Normalized Difference Water Index (NDWI) (GAO, 1996)

$$NDWI = \frac{\rho_{SWIR} - \rho_{NIR}}{\rho_{SWIR} + \rho_{NIR}}$$

- **SWIR reflectance** reflects changes in both the vegetation water content and the spongy mesophyll structure in vegetation canopies.
- **NIR reflectance** is affected by leaf internal structure and leaf dry matter content but not by water content.
- **The combination of the NIR with the SWIR** removes variations induced by leaf internal structure and leaf dry matter content, improving the accuracy in retrieving the vegetation water content.

Gu et al. (2007) observed that NDWI exhibits a quicker response to drought conditions than NDVI.

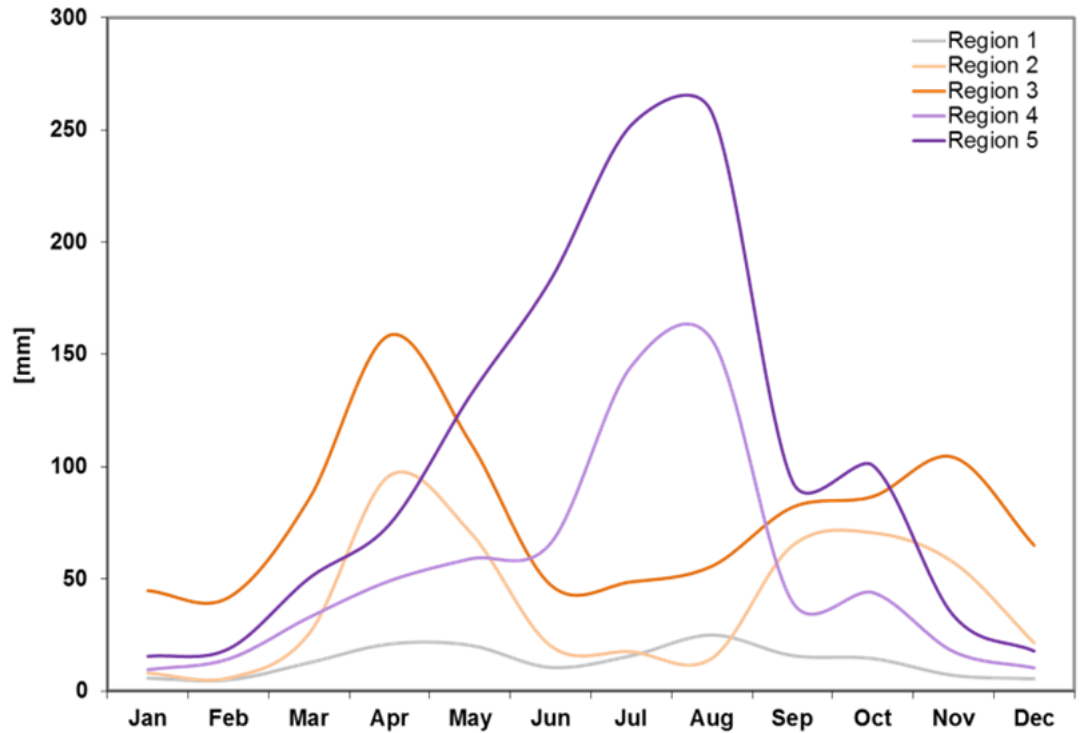
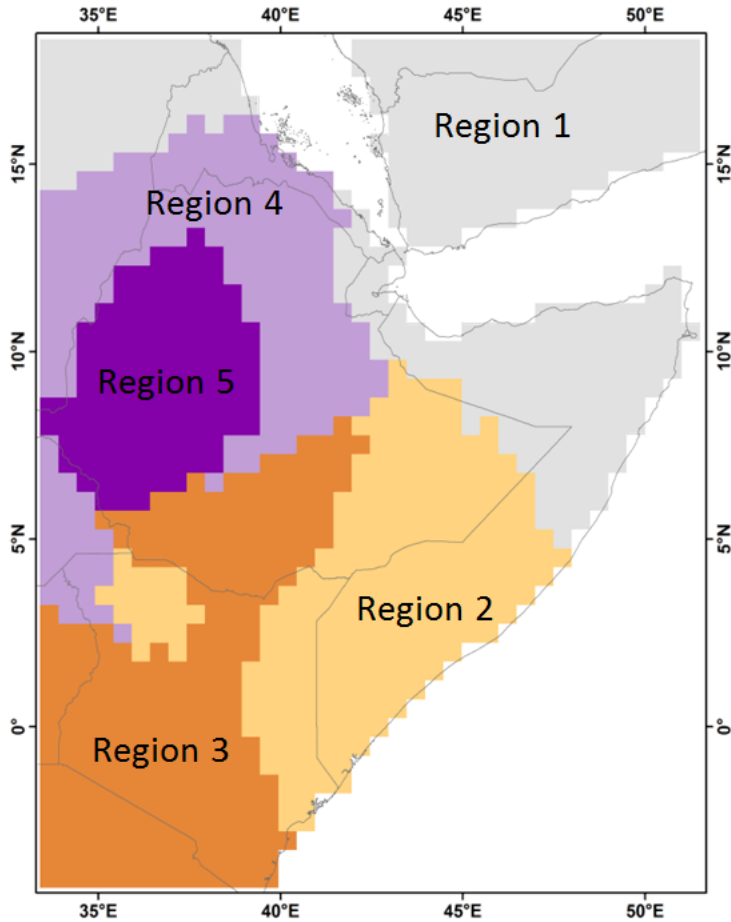


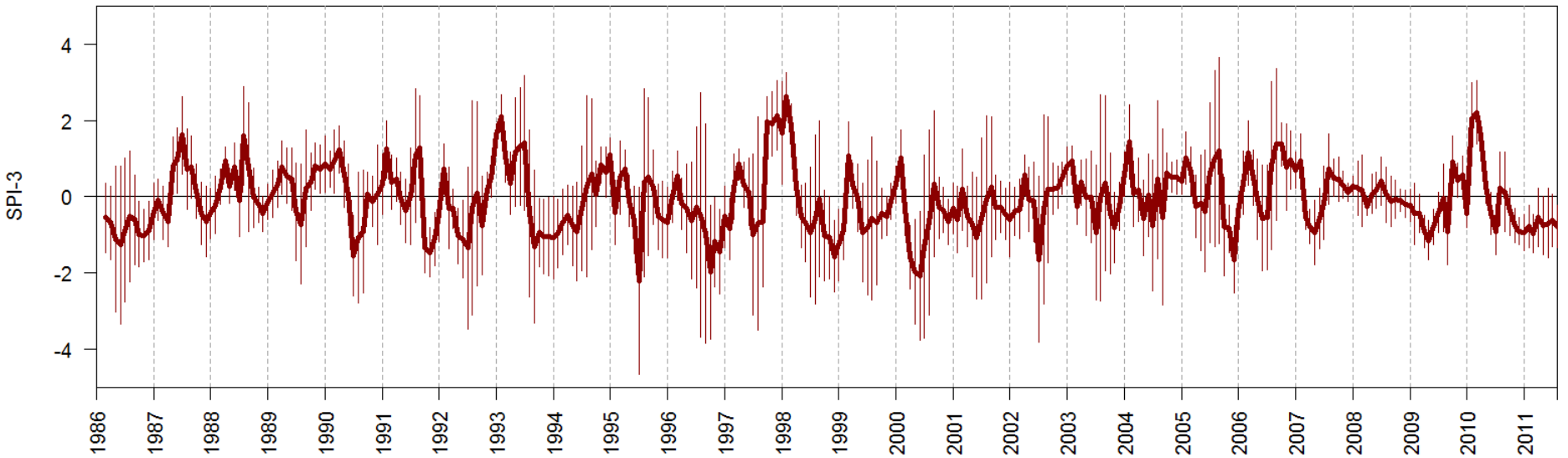
- **Datasets to be used:**
 - GPCC monitoring and first guess products (Source: DWD)
 - ERA interim (Source: ECMWF) – possibility of computing many other drought indicators
 - Precipitation estimation from Remote Sensing products (TRMM, GPCP, CMAP, ...)

- **Datasets used:**

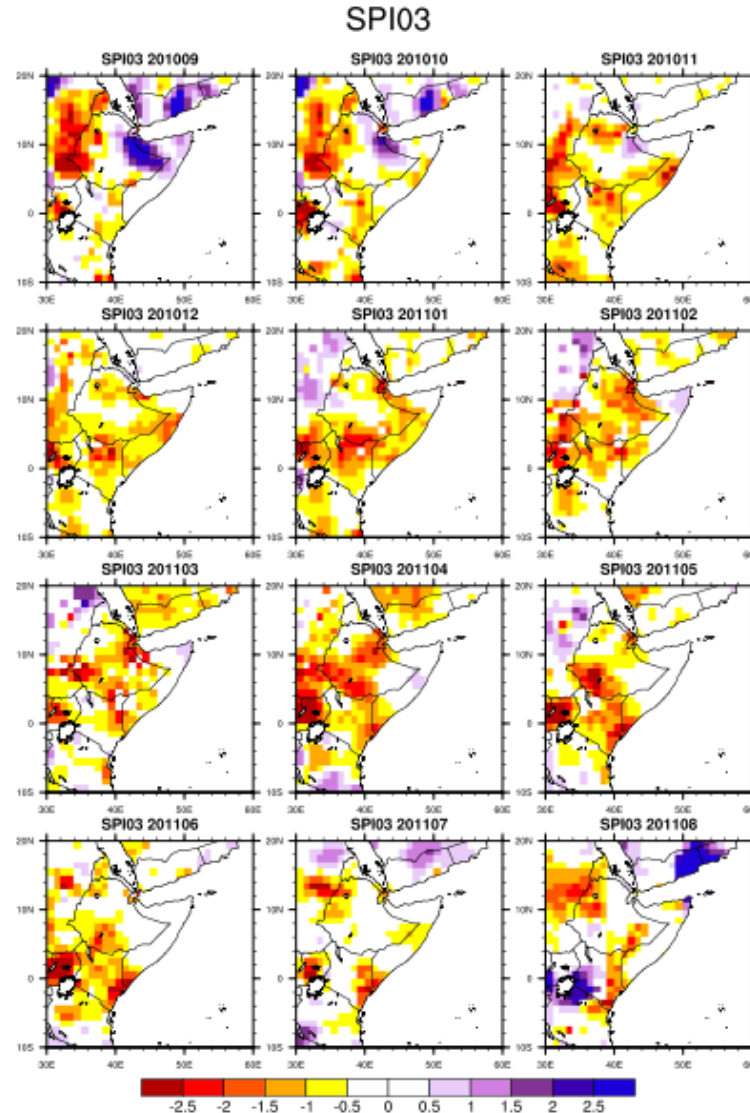
- Normalized Difference Water Index (NDWI) derived from SPOT-VGT (Source: VGT4AFRICA project)
- MERIS Global Vegetation Index (MGVI) – fAPAR derived from ENVISAT-MERIS (Source: ESA-JRC)

Dataset	NDWI (SPOT-VGT)	MGVI (ENVISAT-MERIS)
Geographic coverage	Africa	Greater Horn of Africa
Temporal coverage	April 1998 – present	March 2002 – present
Spatial resolution	1 km ²	1km ²
Temporal resolution	10-days, monthly	10-days

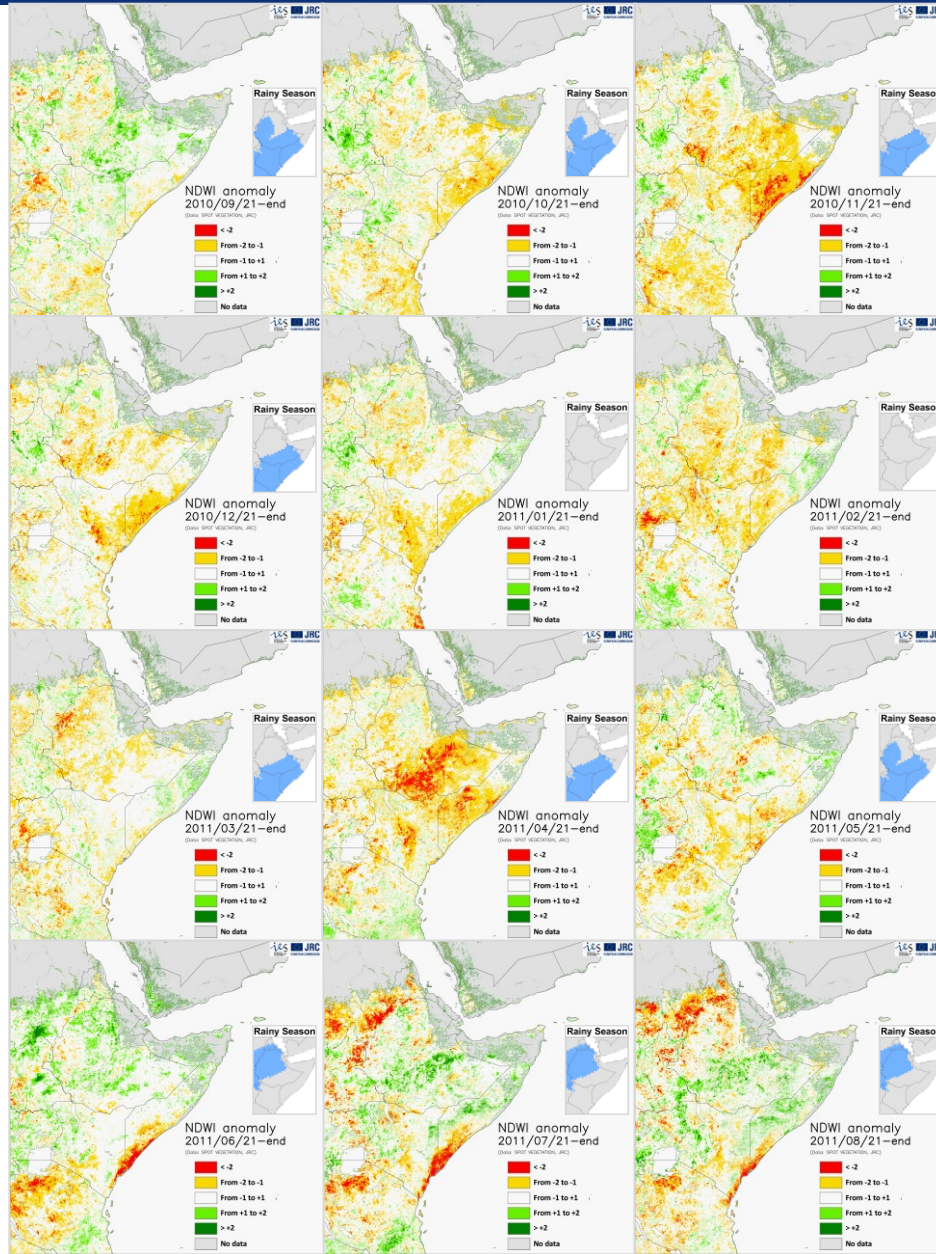


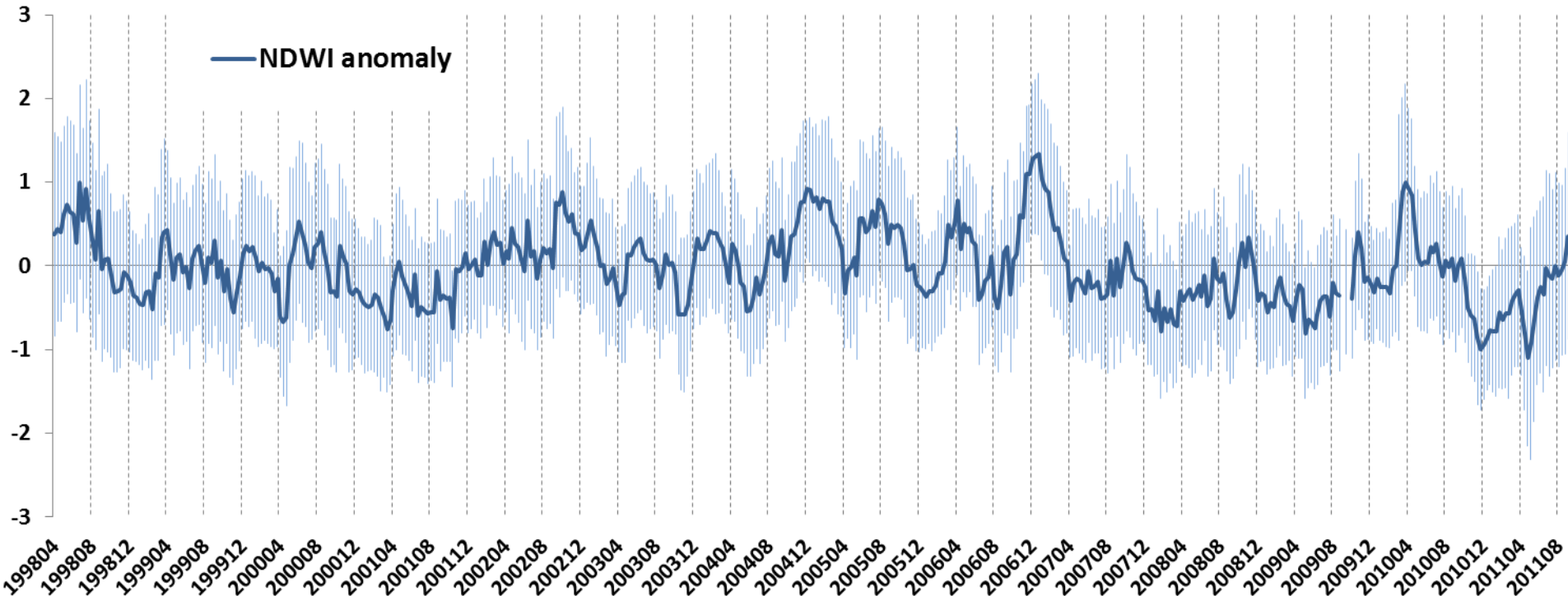


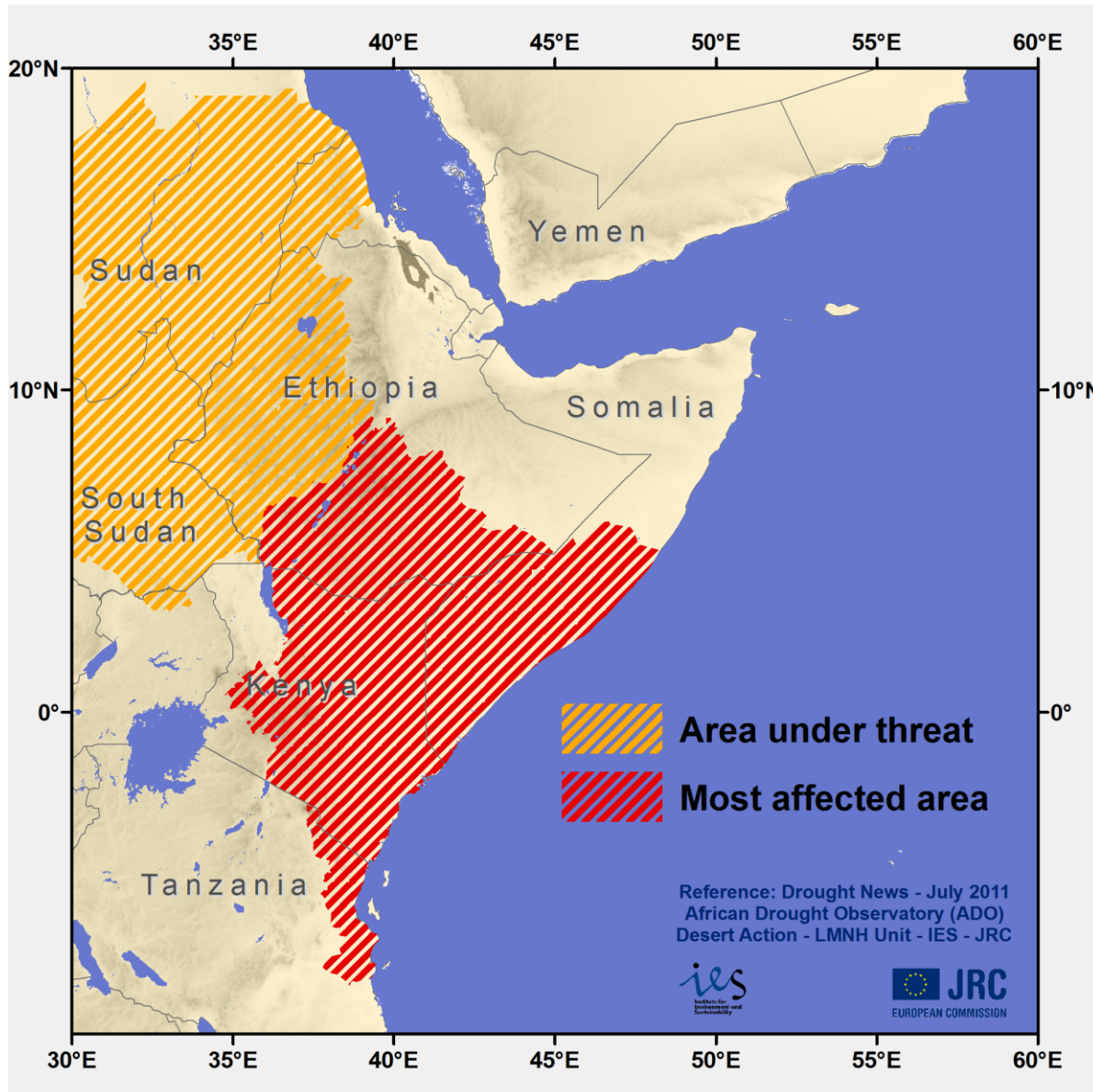
SPI3- September 2009 to June 2011

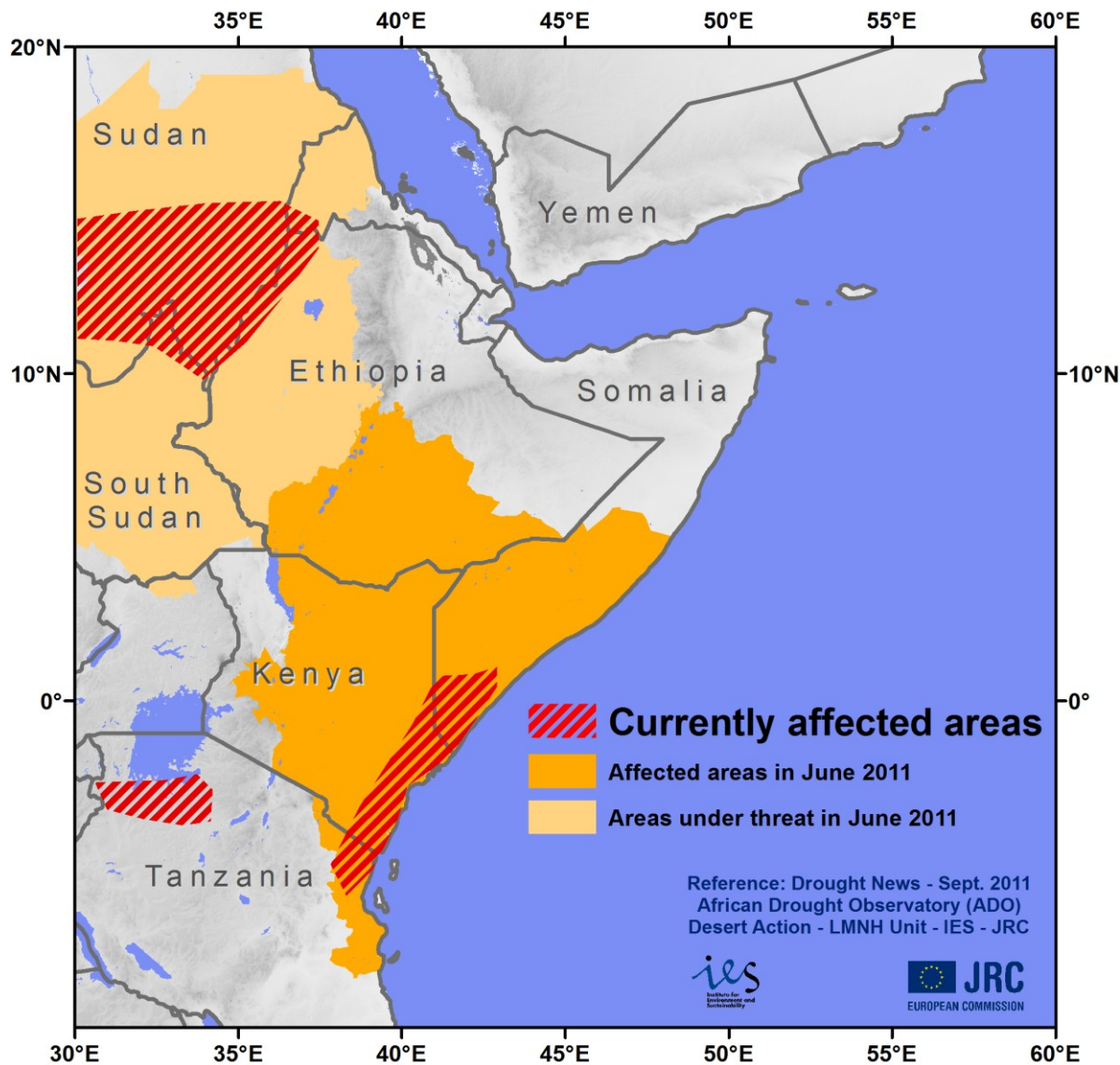


NDWI anomalies September 2010 to August 2011









- The map of the drought affected areas reflects the severe anomalies in both meteorological and remote sensing indicators, implying a significant drought impact on vegetation
- The integration of other type of indicators, e.g. soil moisture, hydrological indicators (e.g. runoff, low flows) can provide further information on drought occurrence and impacts.
- DEWFORA will assess the possibility of using outputs from short to medium term meteorological forecasts as well as seasonal forecasts in order to test its added value for drought management and drought impact mitigation.