



European
Commission



Joint Research Centre

the European Commission's
in-house science service

Early warning for building resilience to food crises in Africa

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Joint Research Centre (JRC)

The JRC is a Directorate General of the European Commission, governing body of the European Union (EU)

JRC mission is to support EU policies with independent scientific evidence

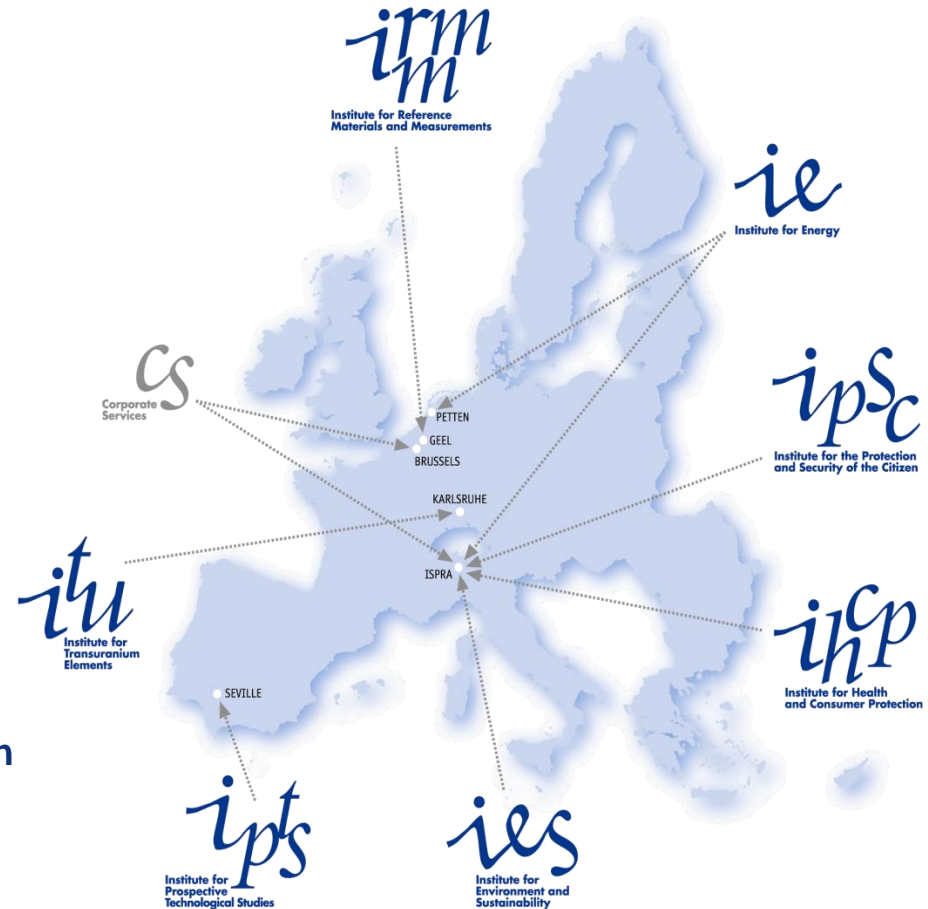
First site (Ispra, Italy) inaugurated in 1959

Originally established under the Euratom treaty to promote nuclear safety and security in Europe.

JRC structure



- IRMM – Geel, Belgium**
Institute for Reference Materials and Measurements
- ITU – Karlsruhe, Germany**
Institute for Transuranium Elements
- IE – Petten, The Netherlands and Ispra, Italy**
Institute for Energy
- IPTS – Seville, Spain**
Institute for Prospective Technological Studies
- IHCP – Ispra, Italy**
Institute for Health and Consumer Protection
- IPSC – Ispra, Italy**
Institute for the Protection and Security of the Citizen
- IES – Ispra, Italy**
Institute for Environment and Sustainability



~ 2750 staff - all sites

Joint Research Centre

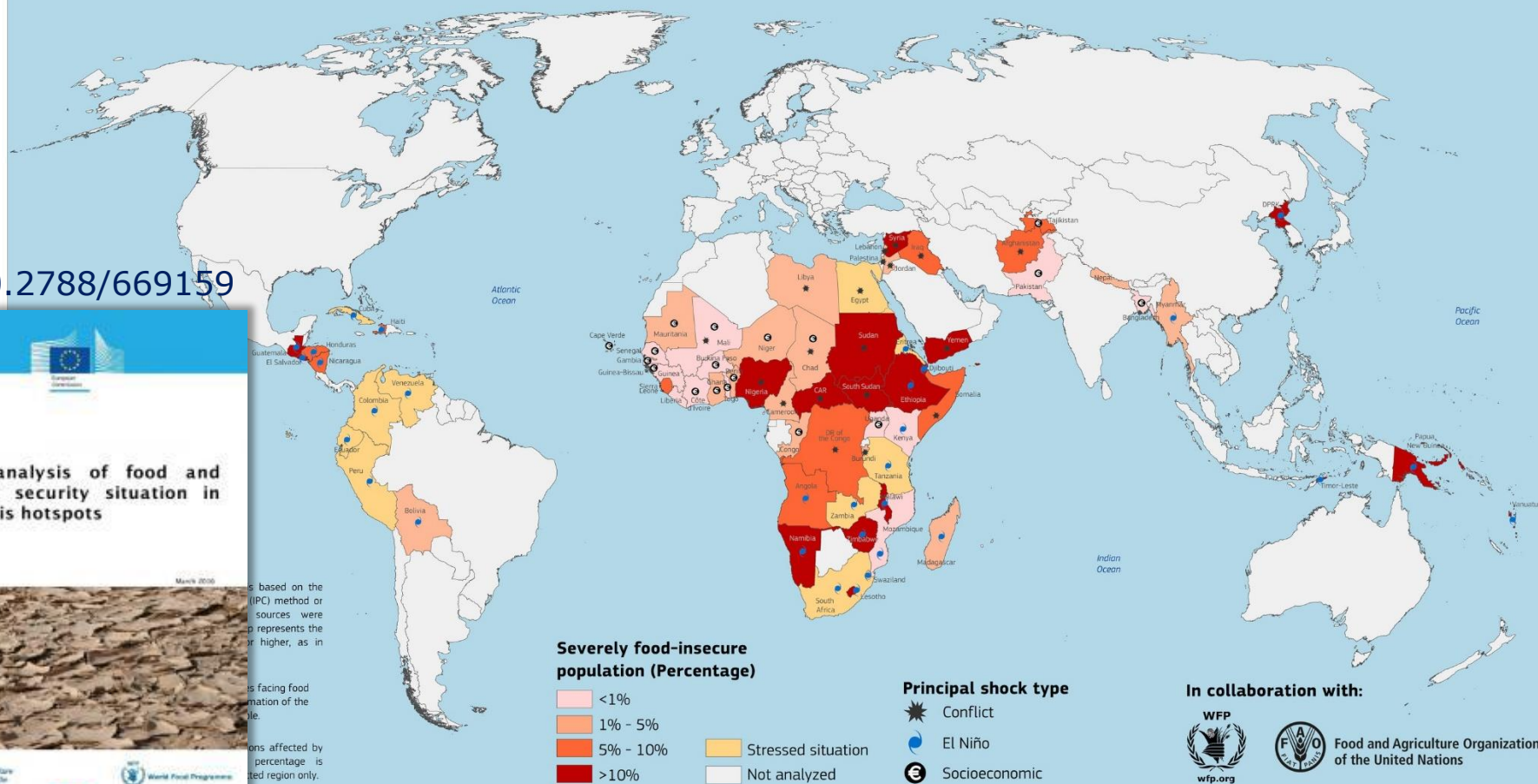
~ 2000 staff – at Ispra site

Background



- As per January 2016, 80 million people were affected by food crises, and 270 million in food stress situation

Population affected by food crises – Situation in January 2016



doi:10.2788/669159



JRC. The boundaries and names shown on this map do not imply official endorsement or acceptance by the European Union.



Early warning for disaster risk reduction

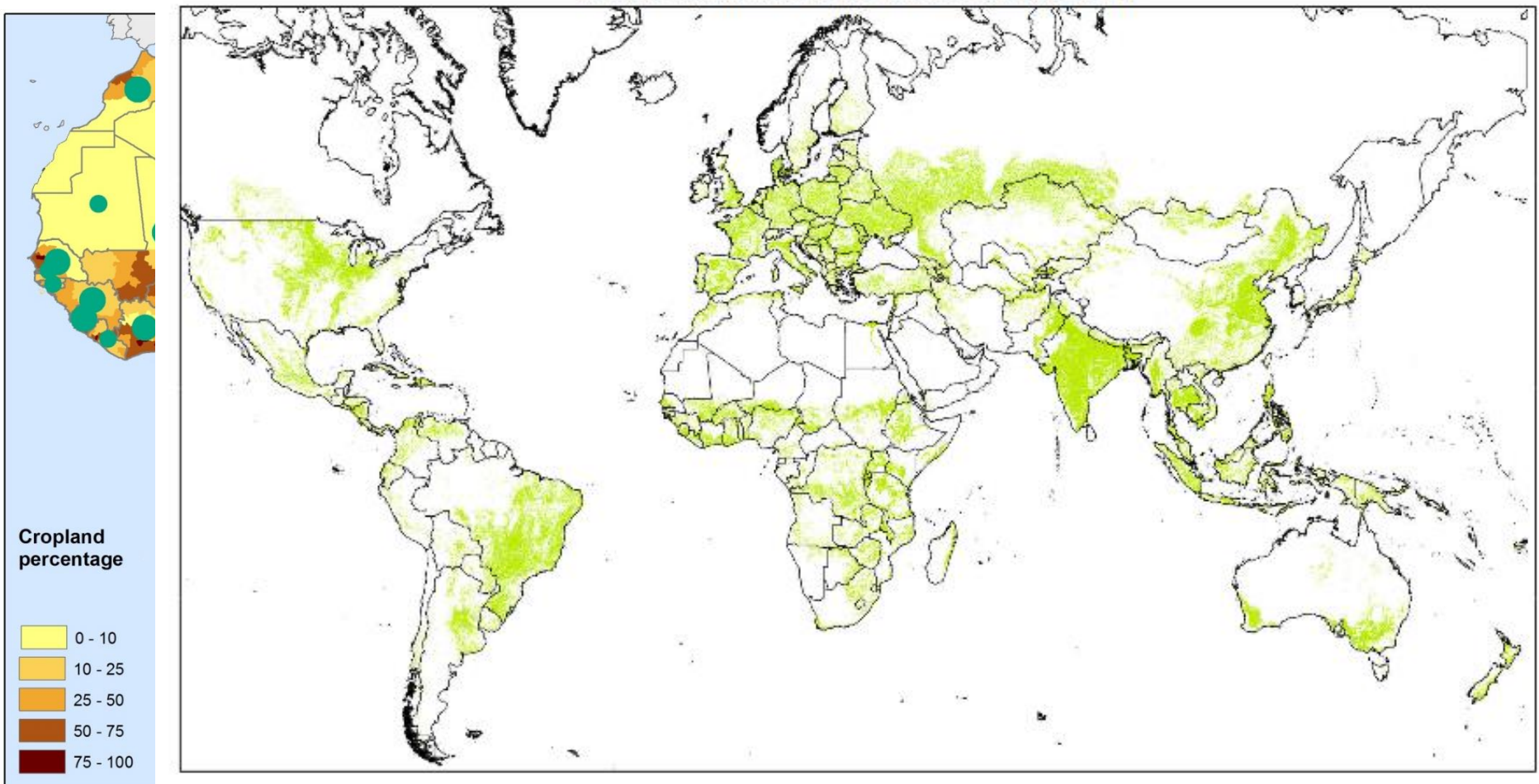
- Disaster risk management is a key pillar for building resilience to food security crises and shocks
- Early warning systems for drought-induced food crises are well developed
- **Objectives:**
 - Early assessment of the crop season outcome
 - Monitor status of pastures in pastoral livelihoods
- Extensive use of data collected by Earth Observation Satellite



Where crops are grown?

- Cropland mapping relies on satellite imagery

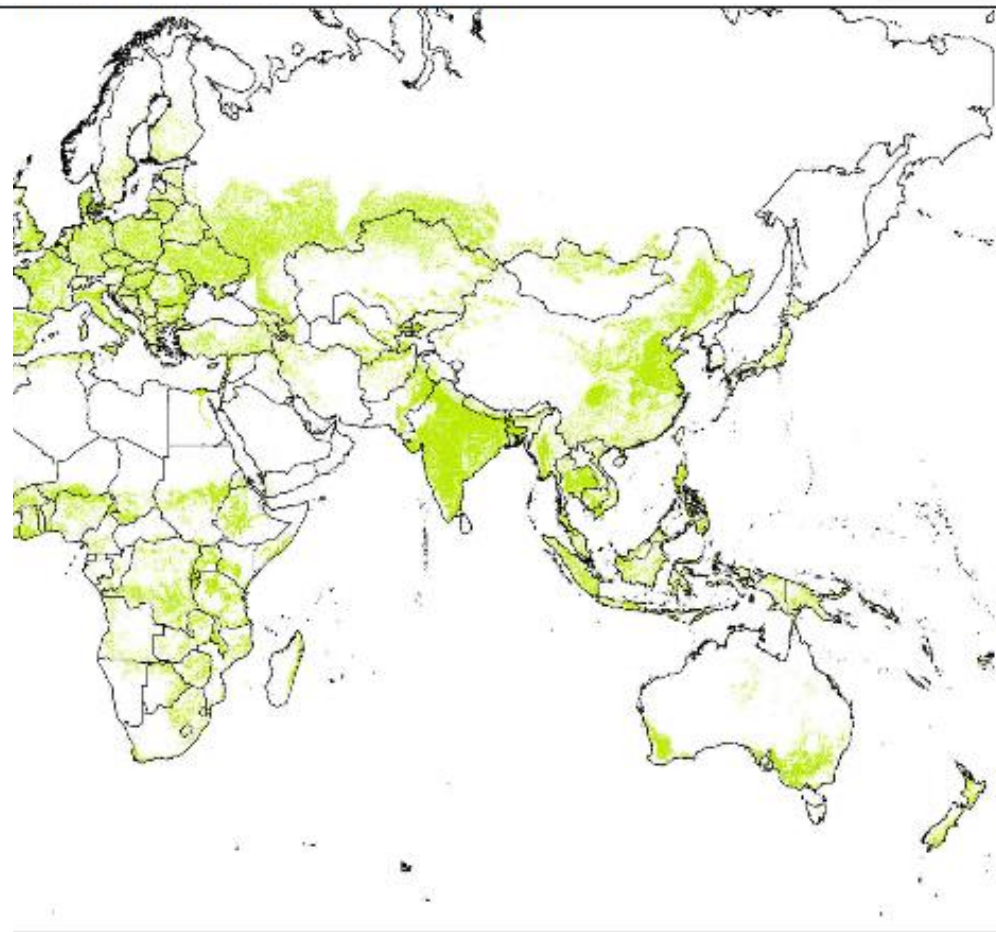
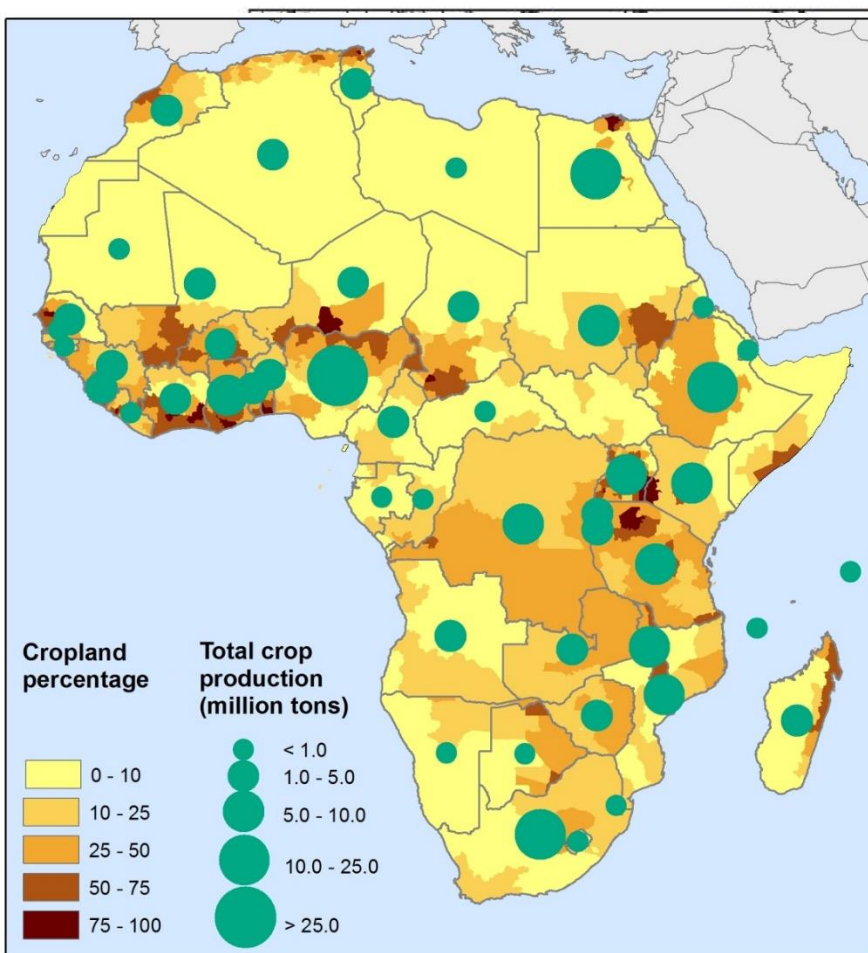
Global Cropland Map (JRC-MARS, 2011)





Where crops are grown?

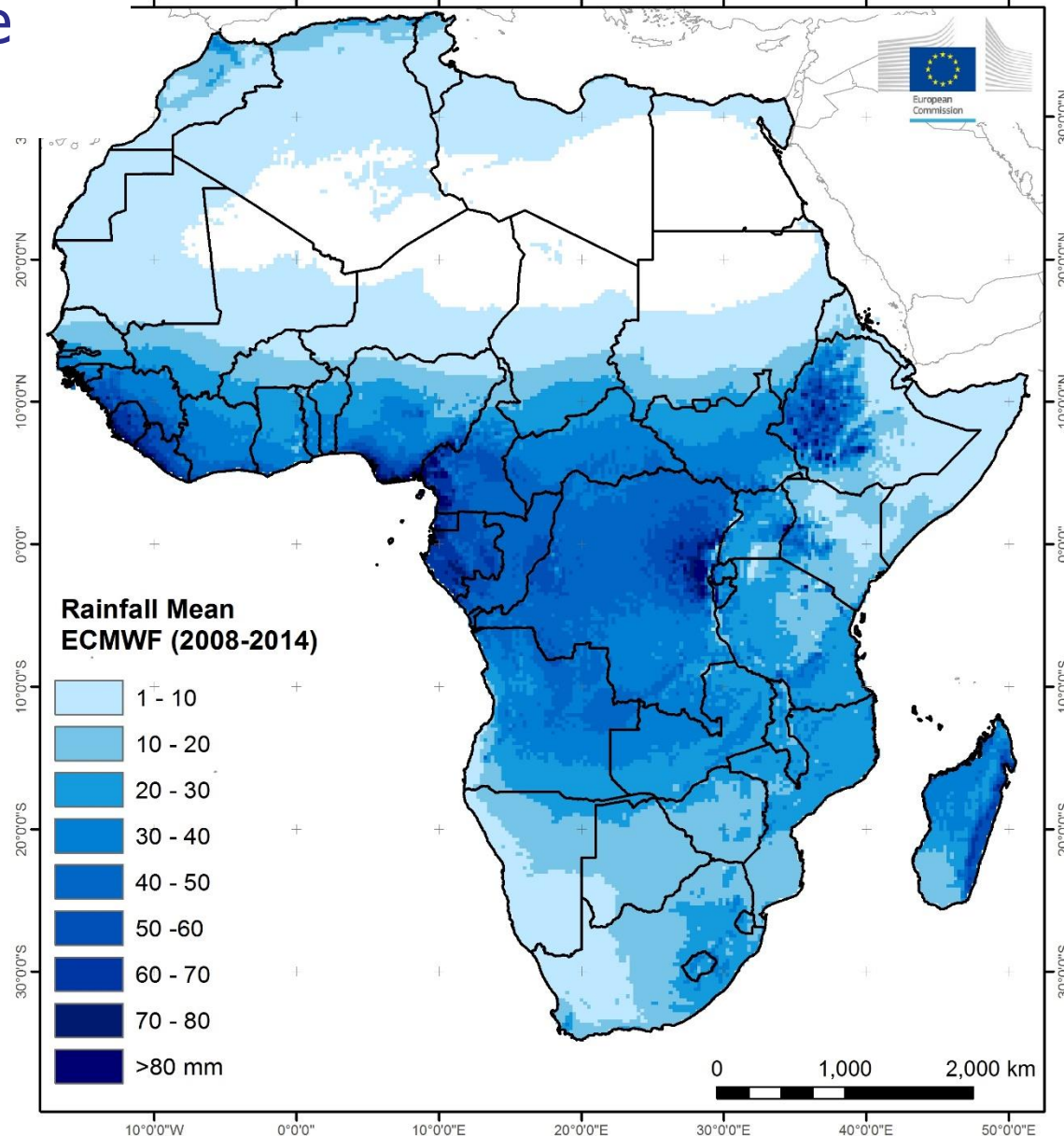
- Focus: Drought-prone areas with high cropland intensity





0°0'0"W 0°0'0"E 10°0'0"E 20°0'0"E 30°0'0"E 40°0'0"E 50°0'0"E

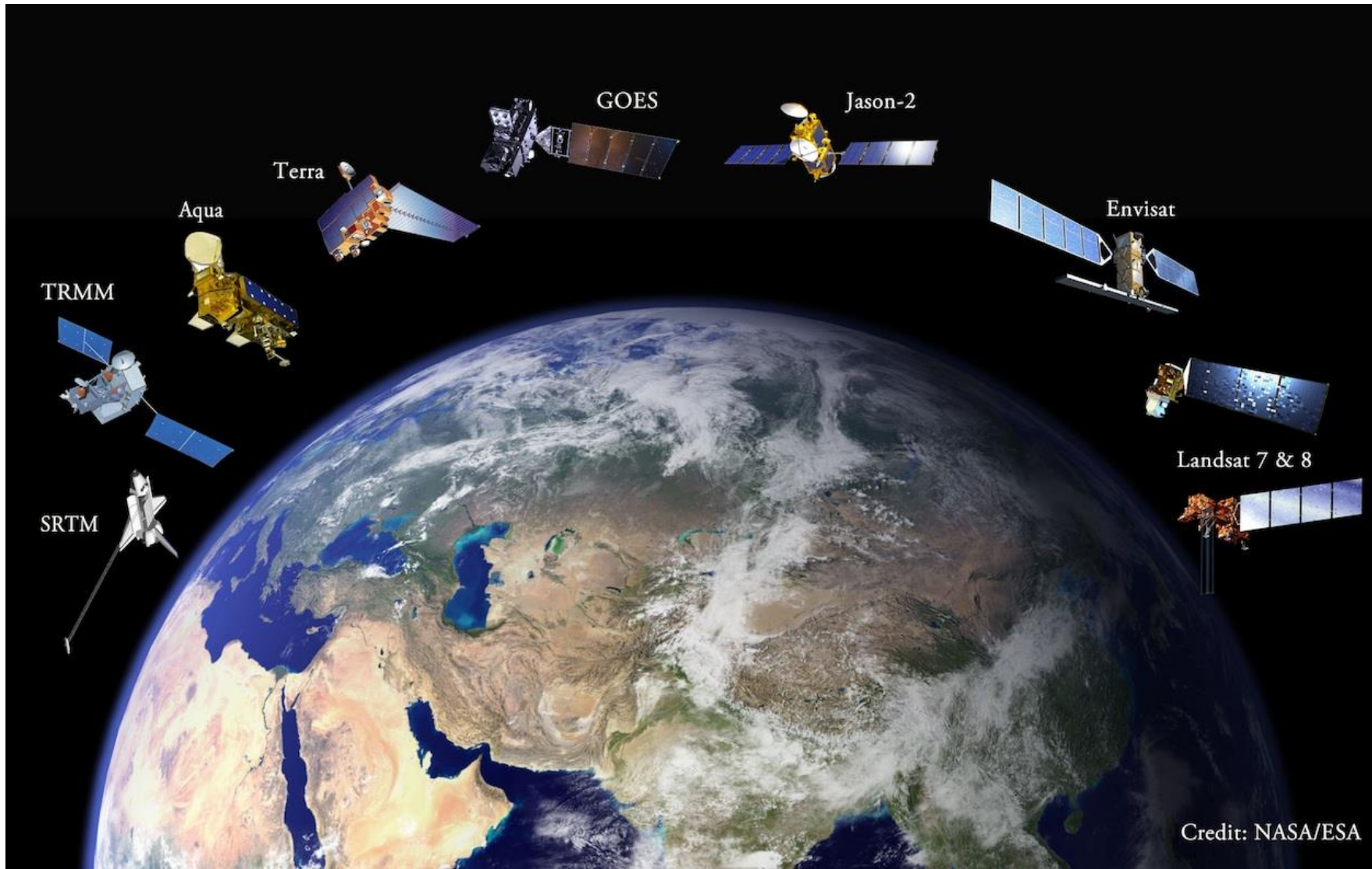
Main risk for agriculture in Africa: drought



Average precipitation per dekade
(10-day period)



Earth observation satellites



COPERNICUS AND ITS SENTINELS

European Earth C

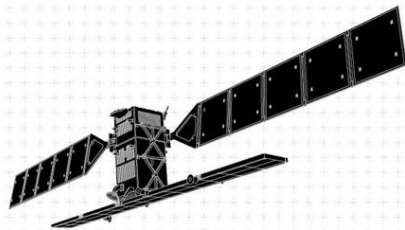
-  Known as **GMES** until 2012 - Global Monitoring for Environment and Security
-  **30** Public and Private missions are also contributing data
-  **16 years** of development and testing
-  **Sentinel-Missions** at the heart of the space component
-  **Civil Security.** Allowing early warning and crisis prevention in conflict and disaster areas
-  **Emergency Management.** Accurate and timely data for emergency plans and rescue for disaster management
-  **Land Surface.** Geographic cover, related development

SENTINEL-1



• **All-weather, day-and-night radar imaging satellite for land and ocean services**

- Able to "see" through clouds and rain
- Data delivery within 1 hour of acquisition
- Airbus Defence and Space developed C-band radar instrument

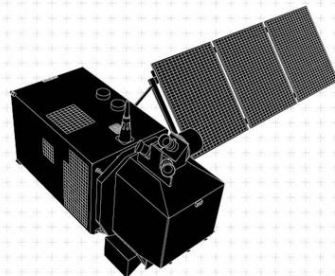


SENTINEL-2



• **Medium Res Multispectral optical satellite for observation of land, vegetation and water**

- 13 spectral bands with 10, 20 or 60m resolution and 290 km swath width
- Global coverage of the Earth's land surface every 5 days
- Airbus Defence and Space prime contractor for satellites and instruments

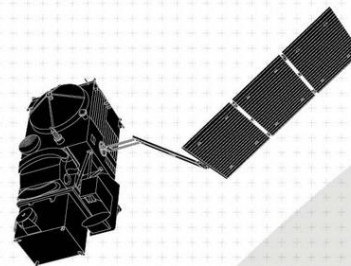


SENTINEL-3



• **Measures sea-surface topography with a resolution of 300 m, sea and land surface temperature and colour with a resolution of 1 km**

- Measures water vapour, cloud water content and thermal radiation emitted by the Earth
- Determines global sea surface temperatures with an accuracy greater than 0.3 K
- Airbus Defence and Space supplies Microwave Radiometer

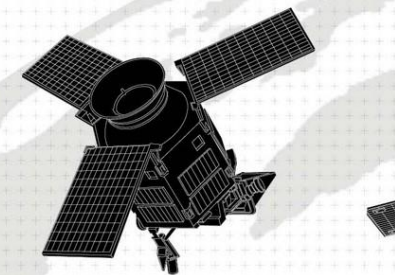


SENTINEL-5P



• **Global observation of key atmospheric constituents, including ozone, nitrogen dioxide, sulphur dioxide and other environmental pollutants**

- Improves climate models and weather forecasts
- Provides data continuously during five-year gap between the retirement of Envisat and the launch of Sentinel-5
- Airbus Defence and Space prime contractor for satellite and TROPOMI instrument



2014





Earth observation satellites with high temporal frequency



Daily image



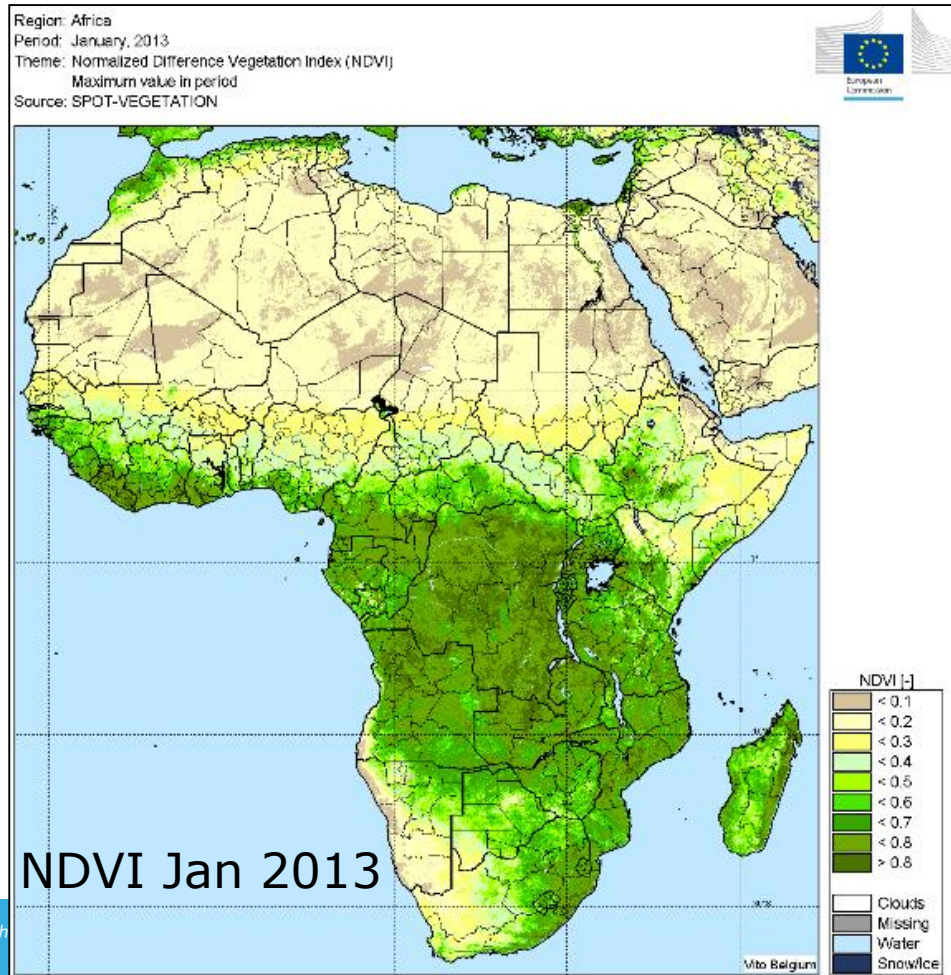
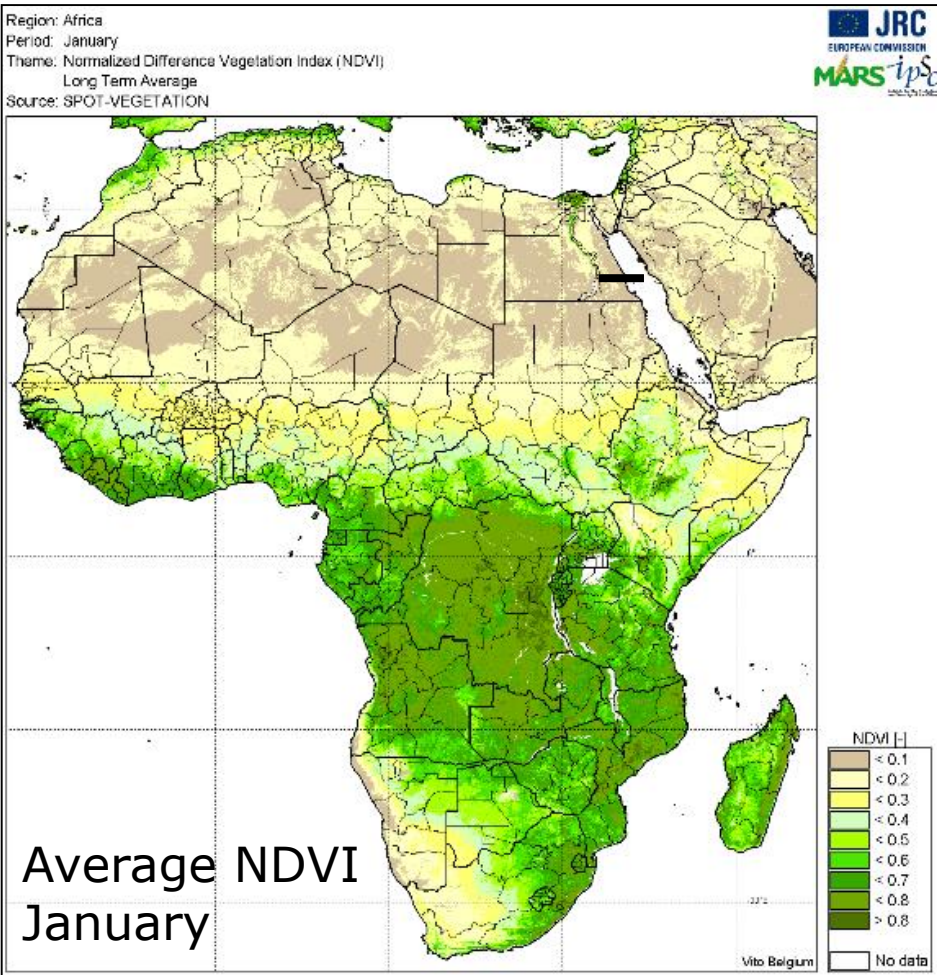
10-day composite

Crop and rangeland monitoring with remote sensing

Satellite imagery:

- Low spatial resolution: PROBA-V (1 km), AVHRR (1.1 km), MODIS (0.25 km)
- Daily image, but usable data are 10-day composites
- Principle:
 - vegetation indices (NDVI or FAPAR) indicate the “greenness of the surface”
 - changes over time in the level of vegetation indices
 - difference compared to a “reference” past period or to historical average
- Qualitative assessment of crop performance

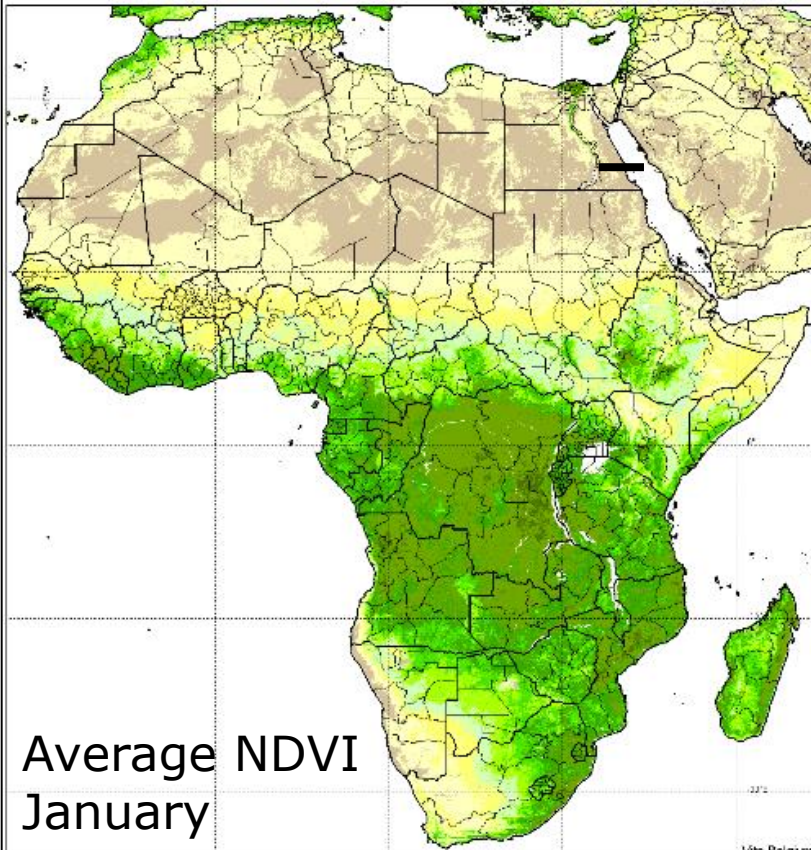
Crop and rangeland monitoring with remote sensing



Crop and rangeland monitoring with remote sensing

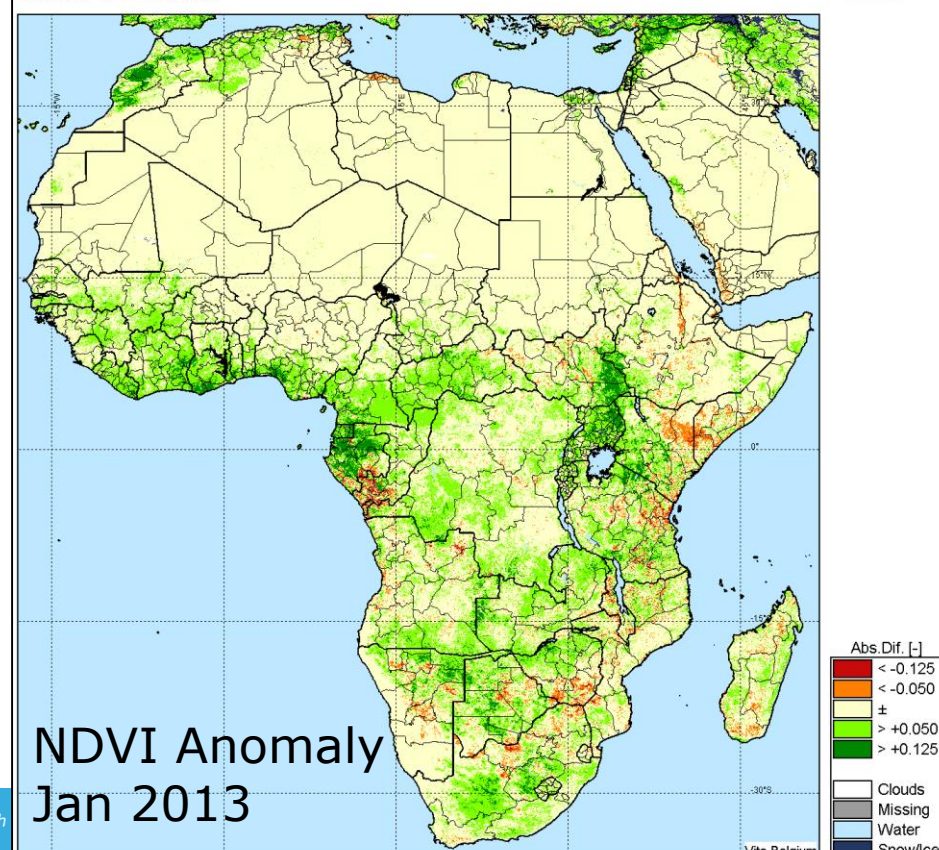
Region: Africa
 Period: January
 Theme: Normalized Difference Vegetation Index (NDVI)
 Long Term Average
 Source: SPOT-VEGETATION

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 MARS *ips*
MONITORING AND ANALYSIS OF RURAL SYSTEMS



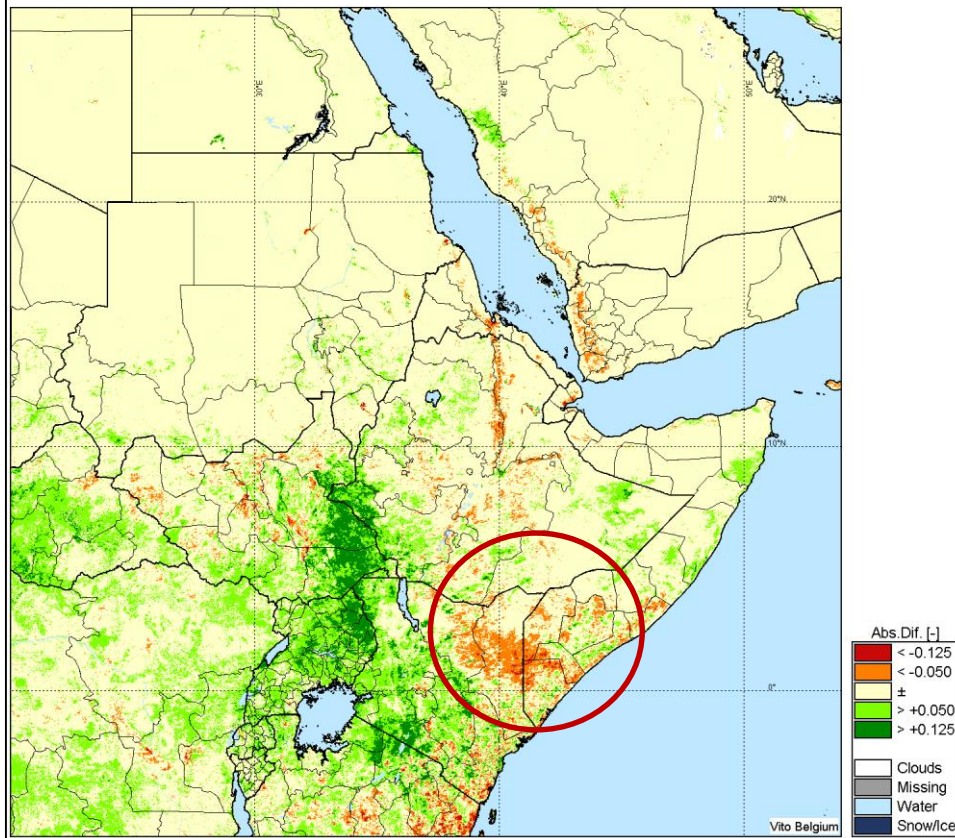
Region: Africa
 Period: January, 2013
 Theme: Normalized Difference Vegetation Index (NDVI)
 Absolute difference w.r.t. historical mean (Act. - Hist.)
 Source: SPOT-VEGETATION

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MONITORING AND ANALYSIS OF RURAL SYSTEMS

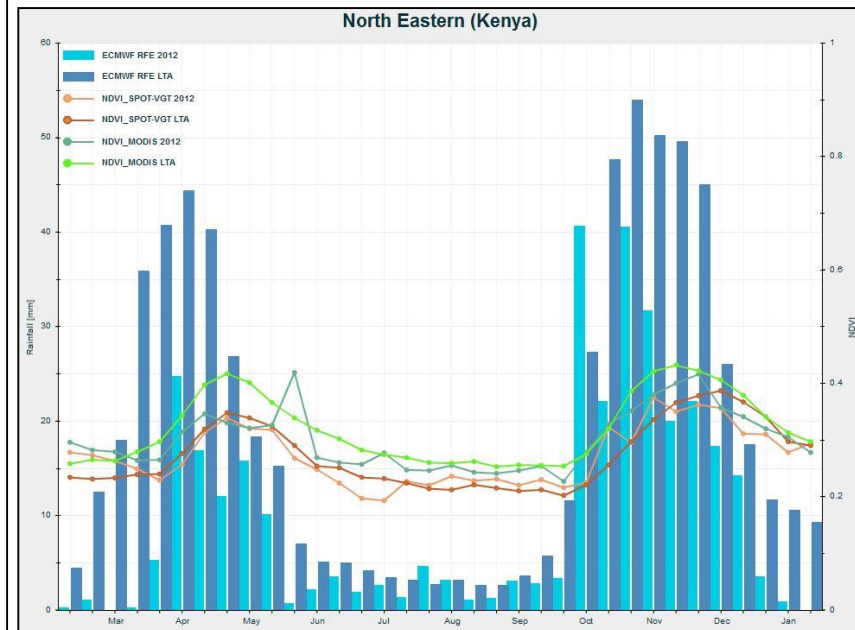


Crop and rangeland monitoring with remote sensing

Region: East Africa: IGAD-States, Burundi and Ruanda
 Period: January, 2013
 Theme: Normalized Difference Vegetation Index (NDVI)
 Absolute difference w.r.t. historical mean (Act. - Hist.)
 Source: SPOT-VEGETATION



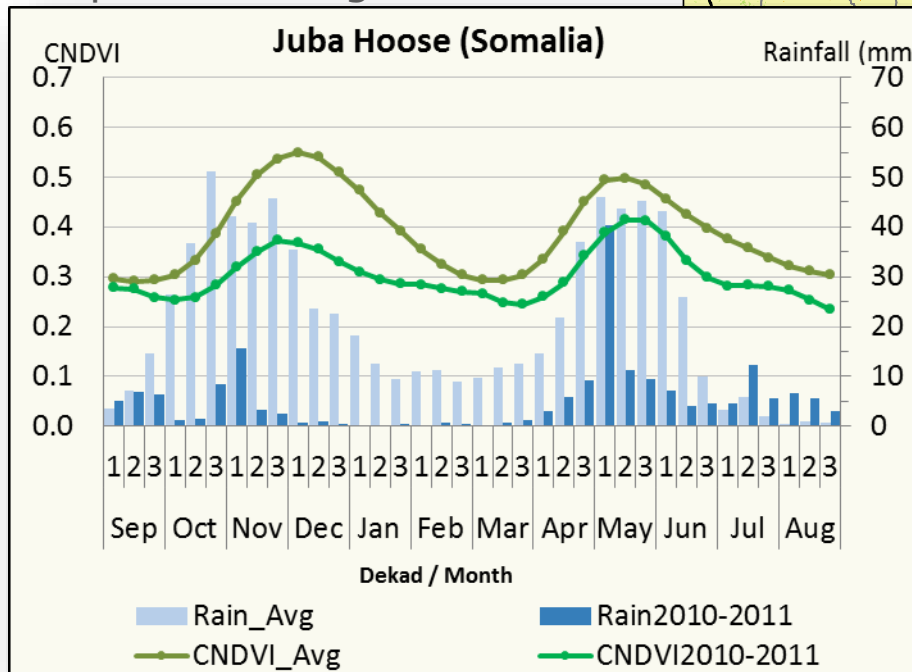
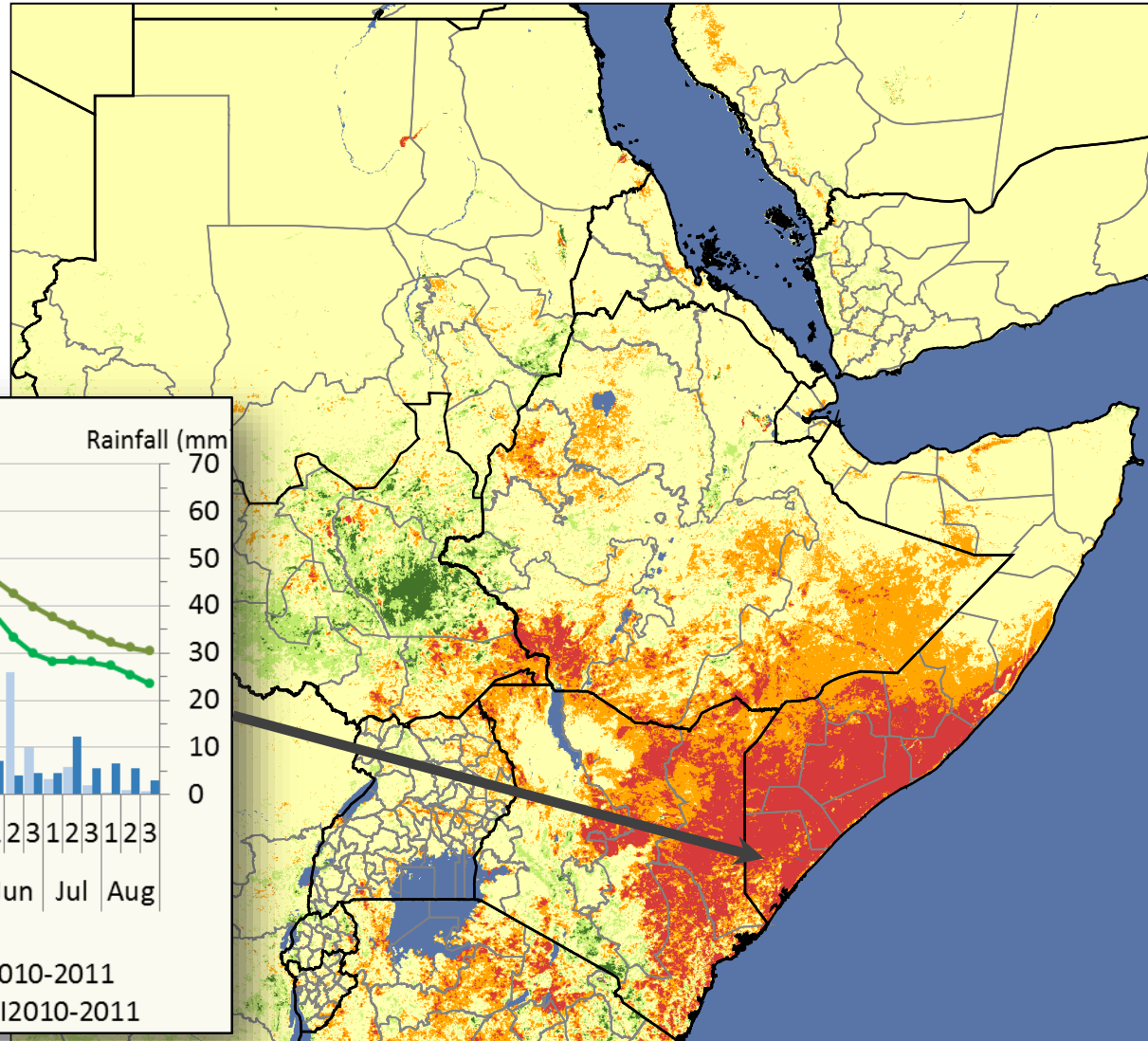
NDVI and Rainfall profiles Feb 2012 - Jan 2013





Crop and rangeland monitoring with remote sensing

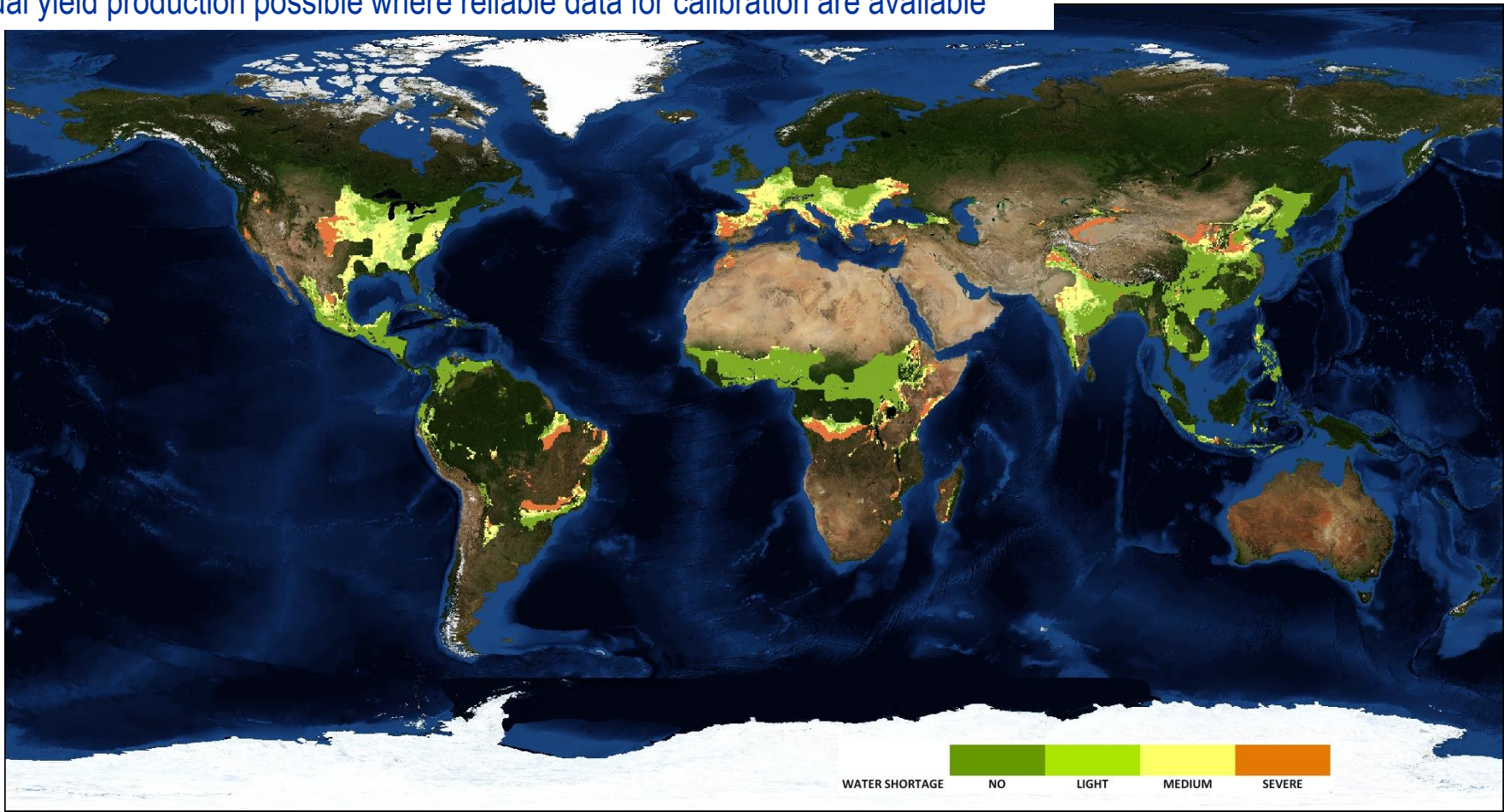
NDVI and Rainfall profiles
Sep 2010 - Aug 2011



Crop growth simulation model

Global Water Satisfaction Index (25x25 km grid, 10-day meteo data)

Actual yield production possible where reliable data for calibration are available



Rangeland monitoring



Modelling pasture green biomass

Application in Niger, in support to Ministry of Livestock

Model using vegetation indices derived from satellite data

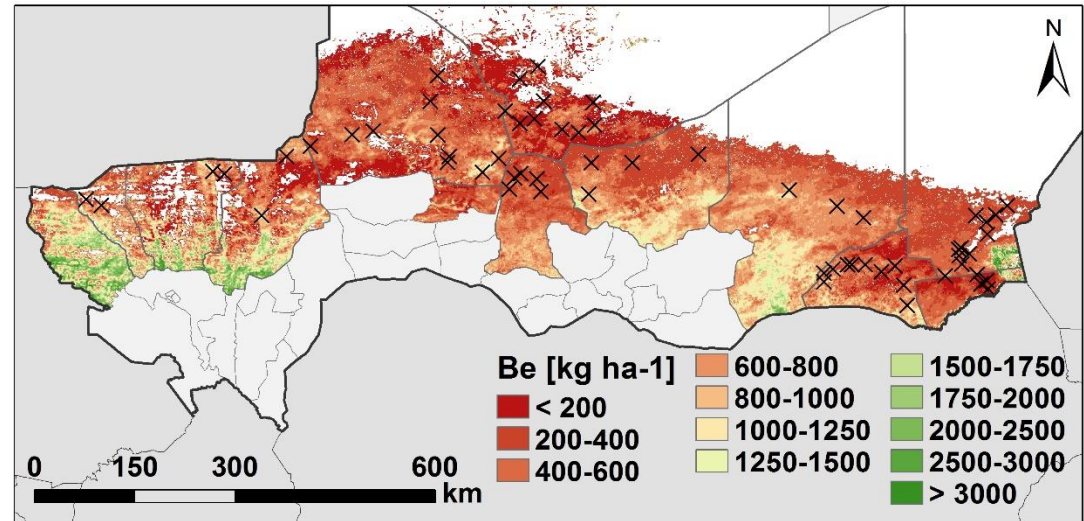


Fig. Estimated biomass for department level aggregation for 2004

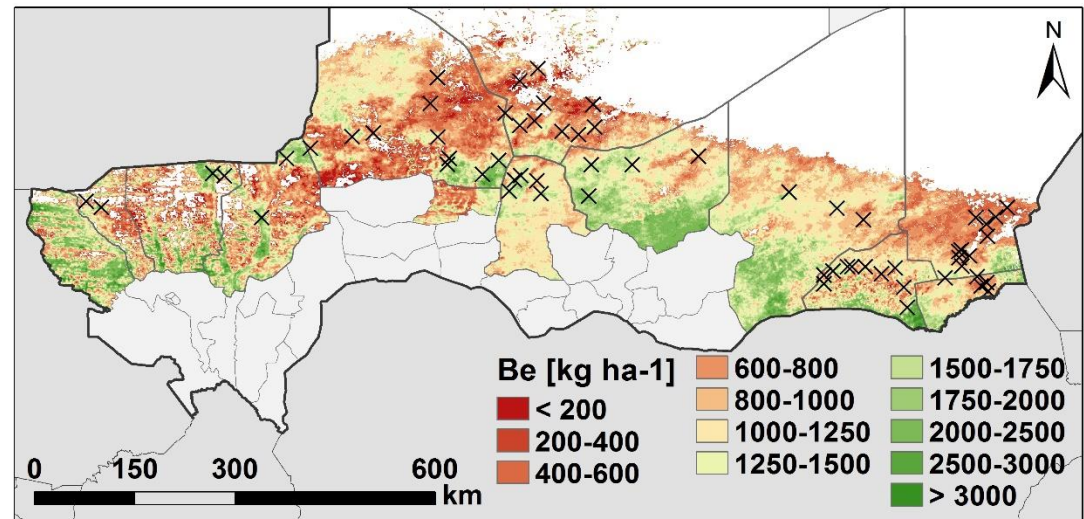
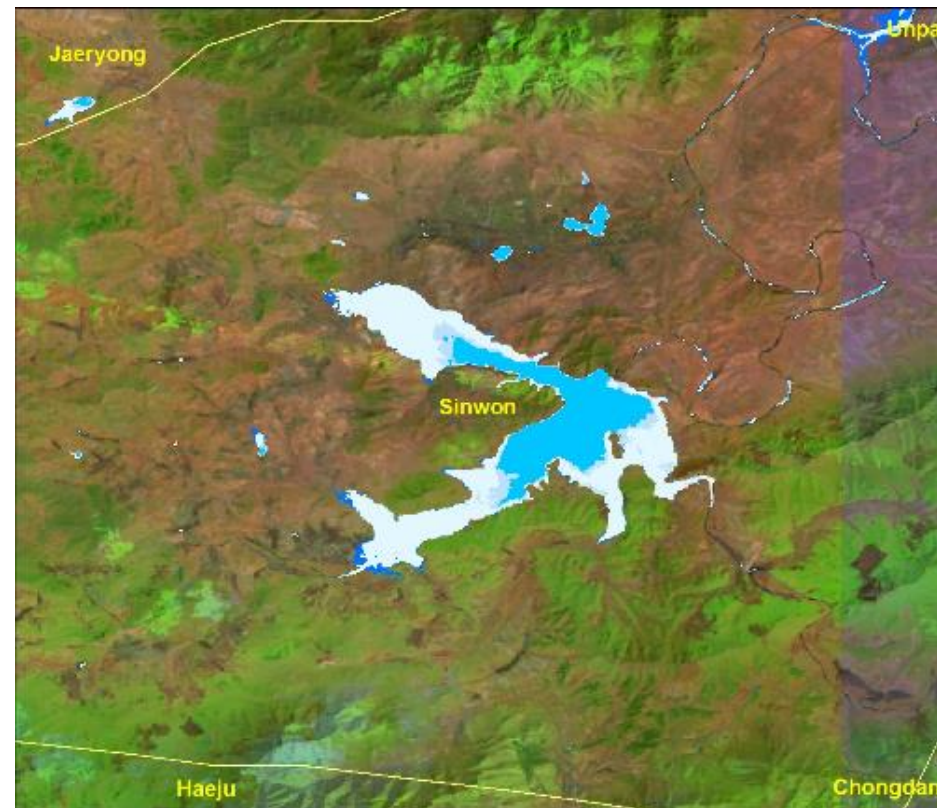
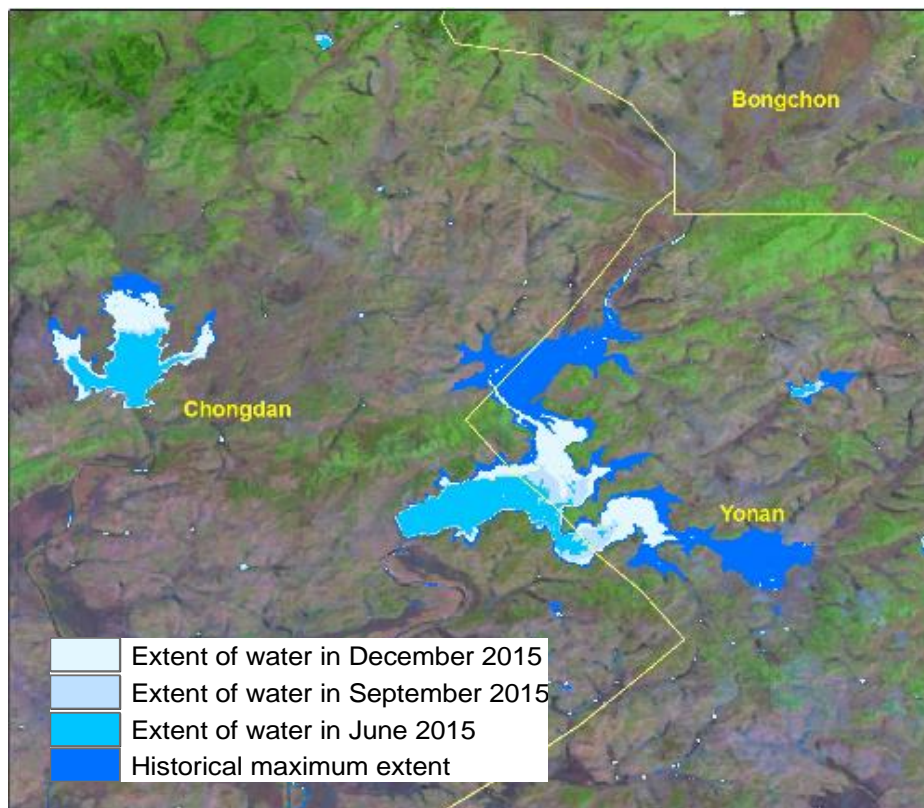


Fig. Estimated biomass for department level aggregation for 2012

Irrigation water reservoirs



Water extent derived from Landsat satellite imagery

Crop monitoring reports



Main regions of interest:

- Horn of Africa
- The Sahel
- Southern Africa
- North Korea (DPRK)

The collage displays four reports from the Joint Research Centre (JRC) of the European Commission:

- Report 1 (Left):** "Seasonal monitoring in Ang... Ad hoc... Southern Regions of the country hit by drought... some areas for second consecutive". It features a map of NDVI anomalies for May 2013 with a legend: large increase (red), small increase (orange), normal (yellow), small decrease (green), large decrease (dark green), and other (blue).
- Report 2 (Middle-Left):** "Rapport de synthèse sur la sécurité alimentaire au Niger à la fin de la saison agricole d'hivernage 2012." (Summary report on food security in Niger at the end of the 2012 winter agricultural season). It includes a photograph of a field and is dated February 2013.
- Report 3 (Middle-Right):** "Crops condition in DPRK Assessment at end of August 2013". It features a map of FAPAR anomaly for August 2013 with a legend: very poor (-0.12), poor (-0.12 to -0.05), normal (0.05 to 0.05), good (0.05 to 0.12), and very good (>0.12). Source: JRC-MARS, SPOT-VGT.
- Report 4 (Right):** "Crop and pasture monitoring in Eritrea Kremti rainy season started with substantial delay". It features a map of NDVI anomaly in the 3rd decade of July 2013 with a legend: Very Poor (red), Poor (orange), Normal (yellow), Good (green), and Very Good (dark green). Source: JRC-MARS, SPOT-VGT.



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Thank you
for your
attention