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East Africa Agriculture Watch (EAAW)

16-EUMETSAT User Forum in Africa

September 20, 2024 | Cotonou, Benin

REGIONAL OVERVIEW

- Approximately 70% of the region highly dependent on subsistence rain-fed agriculture (crops & animals) that contributes significantly to its economy/livelihoods of many
- More than 80% of the region classified under Arid & Semi-Arid
- Climate variability and change are one of the main drivers of food crises
- Future climate projections indicate increased frequency and intensity of extreme weather/climate events (drought, floods)
- Therefore, need for continuous monitoring of agricultural conditions across seasons and across boundaries as early warning tool for early action
- 11 Eastern Africa countries
  - Burundi, Djibouti, Ethiopia, Eritrea, Kenya, Somalia, South Sudan, Sudan Tanzania, Rwanda, Uganda

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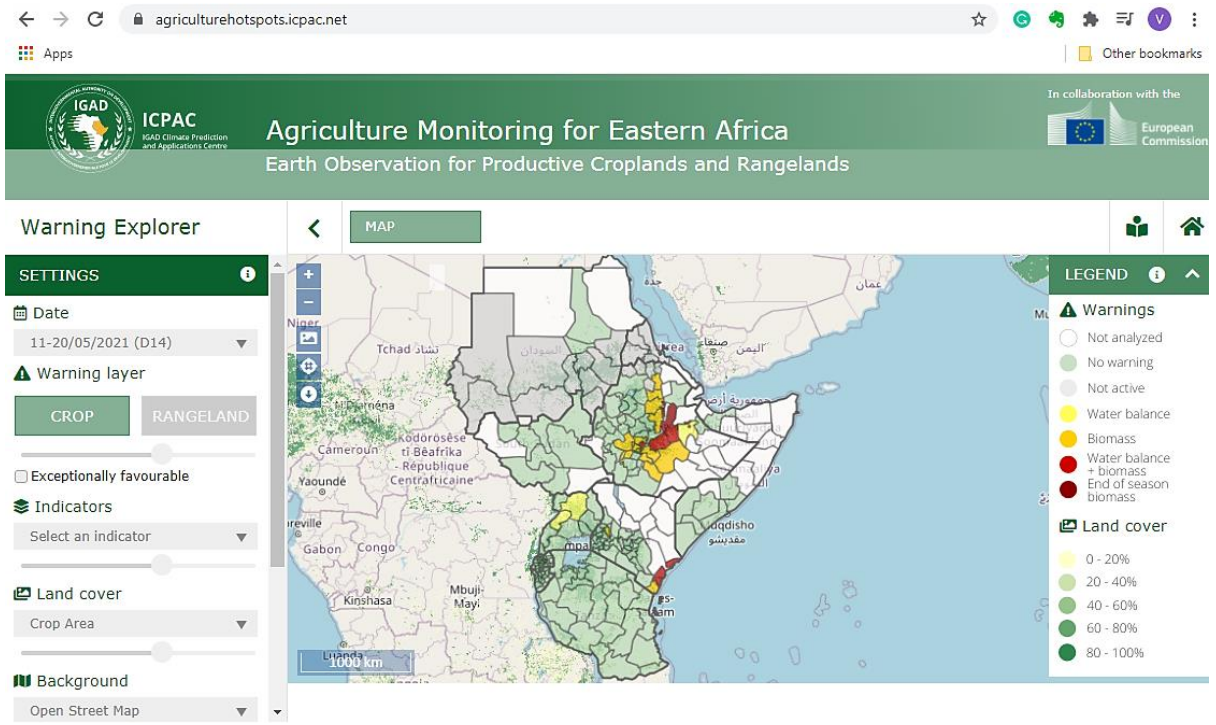
EAST AFRICA AGRICULTURE WATCH



- **A web-GIS environment:**
- **Weather** and
- **Earth Observation** (EO) indicators
- Automatic warnings regarding poor or delayed vegetation performance every 10

- **A statistics dashboard:**
- Indicators statistics aggregated at sub-national level(s)
- Additional information such as crop calendars, warnings time-series, progress of the season

East Africa Agriculture Hotspots in a nutshell: a complete platform to explore and analyze EO-derived data for agricultural monitoring

https://agriculturehotspots.icpac.net/

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EAST AFRICA AGRICULTURE WATCH

- Public online decision support system for **monitoring crop and rangeland conditions** in near-real time and support FS
- Provides **automatic 10-day** warnings for poor or delayed vegetation

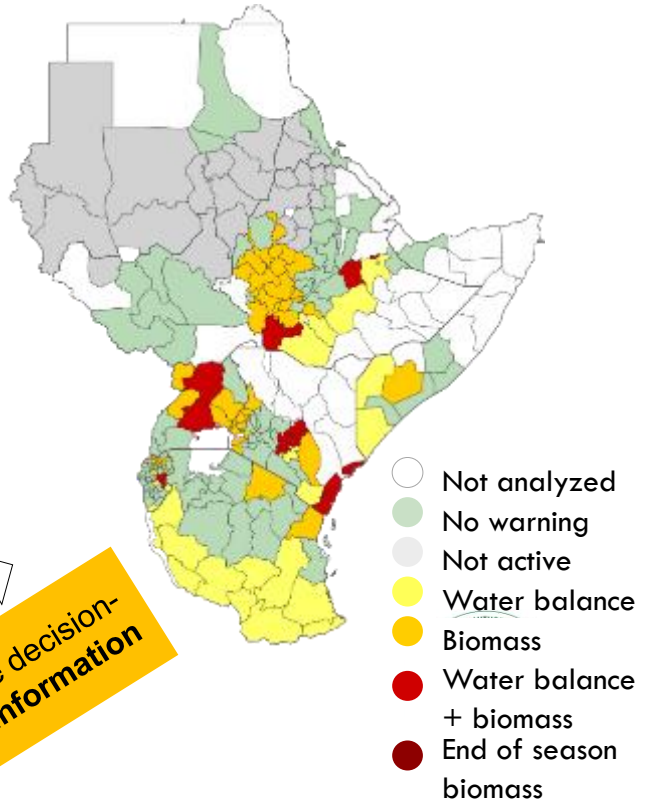
- ICPAC system that uses a service of the JRC implemented under the **Intra-ACP ClimSA project**
- An adaptation of the ASAP system developed by JRC

Conditions in the field

Recorded by satellites

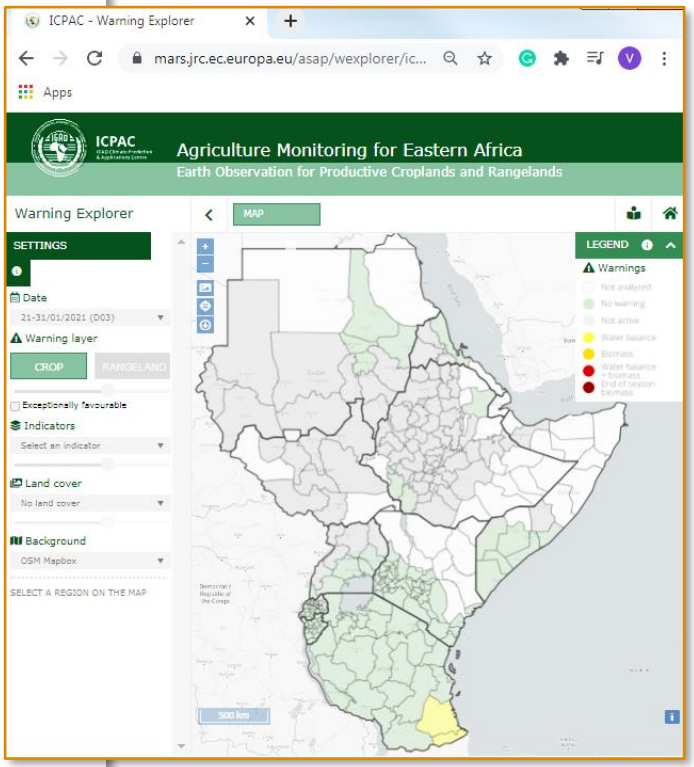
Satellite derived data

Actionable decision-making **information**



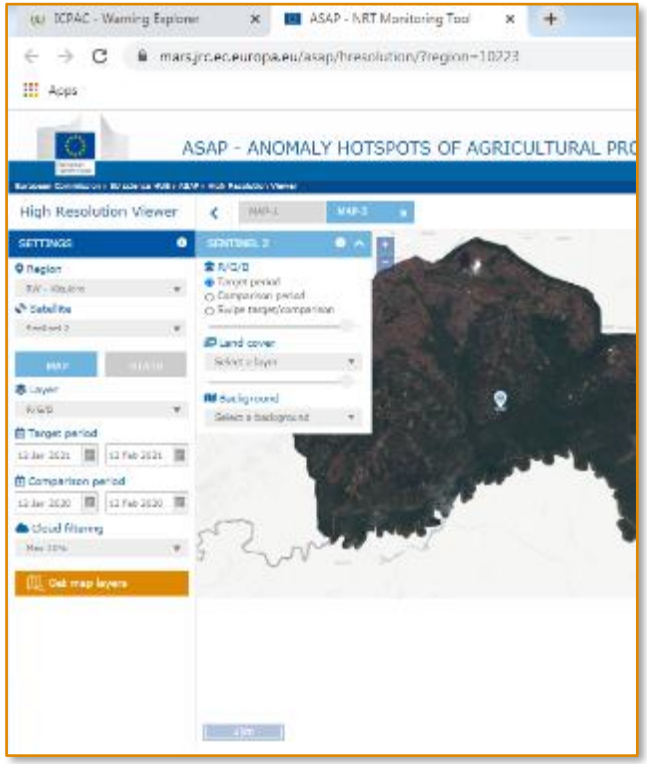
WHAT CAN YOU DO IN THE SYSTEM?

1. Automatic warning classification



2. Statistics dashboard

3. High Resolution Viewer (JRC)



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DERIVING AUTOMATIC WARNING CLASSIFICATION

1. Detect active crop/rangeland season based on satellite imagery
   - Pixel level
   - Global Land Surface Phenology (periodic events in vegetation life cycles)
   - MODIS 1 km resolution
   - Average year
   - Crop and rangeland masks

2. Flag areas where precipitation, water requirement satisfaction, or biomass deficit is observed
   - SPI3, zWSI, zFPAR, consider phenological season
   - Flag as critical all pixels with standardized anomalies <-1 standard deviation

3. Determine area affected at sub-national admin. level
   - Sub-national administrative Levels
   - Retrieve the Critical Area Fraction (CAF) for each of the 3 indicators
   - Any CAF > 25% will trigger a warning for that admin level

4. Classify type of warning
   - Level 1 - Water Balance deficit
   - Level 2 - Biomass (Vegetation deficit)
   - Level 3 – Water deficit Plus Biomass deficit
   - Level 4 – End of season biomass deficit

Automatic, every 10 days

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1. DETECT ACTIVE CROP/RANGELAND SEASON

Detect active crop/rangeland season based on satellite imagery

↓

Flag areas where precipitation, water requirement satisfaction, or biomass deficit is observed

↓

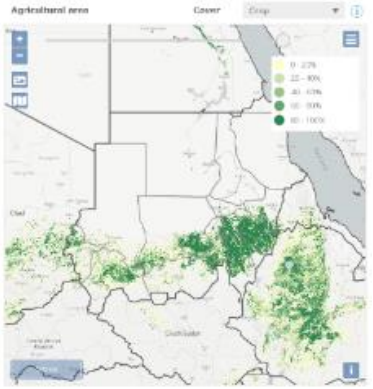
Determine area affected at sub-national admin. level

↓

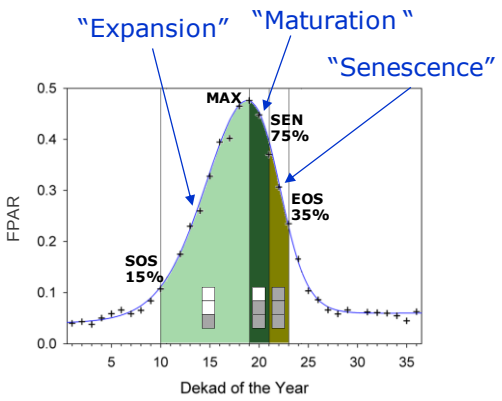
Classify type of warning

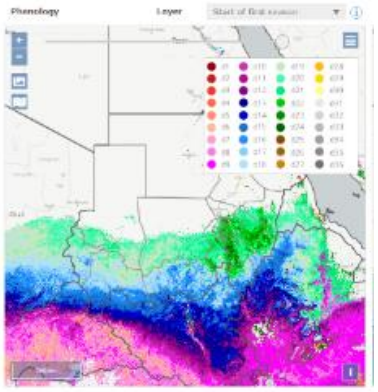
Pixel level, based on:

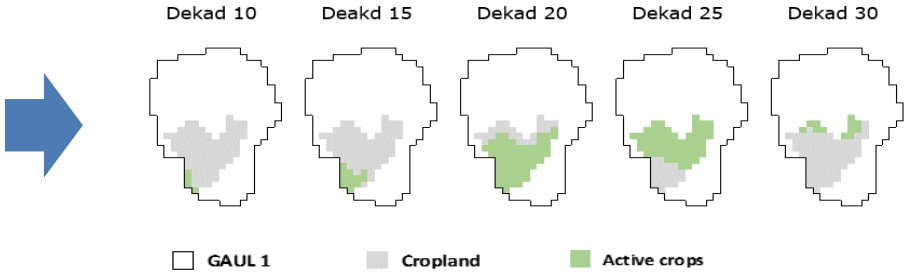
- Global crop and rangeland masks (Area Fraction Images)



- Global pixel-level Land Surface Phenology retrieval on MODIS 500 m resolution FPAR



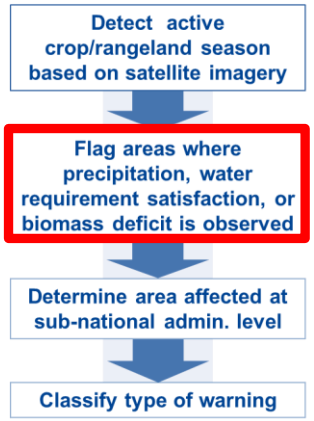




Active cropland pixels for each dekad (10-day period)

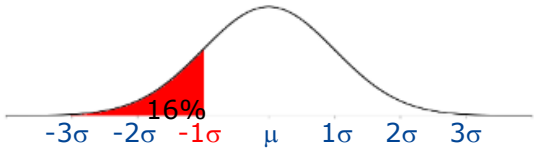
2. FLAG AREAS WHERE DEFICIT IS OBSERVED

Pixel level, based on three anomaly indicators (all standardized)

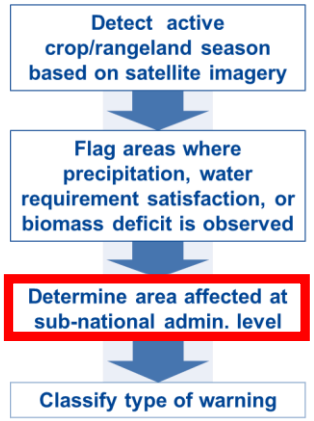


Indicator	Description	Temporal domain	Data Source, resolution	Use of EO data
SPI3	Rainfall anomaly	Previous 3 months	CHIRPS (up to 50° Lat) 5 km, ECMWF (higher lats) 25 km	Satellite-derived Cold Cloud Duration (https://www.chc.ucsb.edu/data/chirps)
zWSI	Anomaly of Water Satisfaction Index (simple soil water balance)	From start of season	CHIRPS precipitation, ECMWF evapotranspiration, various ancillary data	Satellite derive phenology and satellite-based crop type maps (SPAM)
zFPARc	Anomaly of cumulative FPAR	From start of season	MODIS/VIIRS 500m NEW	Satellite phenology, satellite FPAR

Flag as critical all pixels with standardized anomalies <-1 standard deviation



3. DETERMINE AREA AFFECTED

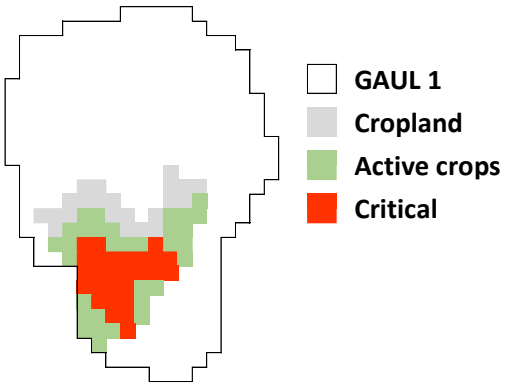


Sub-national admin. Level

Retrieve the Critical Area Fraction (CAF) for each of the 3 indicators

$$CAF_x = \frac{area\ flagged\ as\ critical for\ indicator\ x}{total\ \ area\ of\ active\ pixels}$$

x = SPI3, zWSI, zFPARc

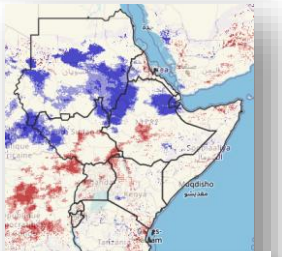


Any *CAF* > 25% will trigger a warning for that admin level

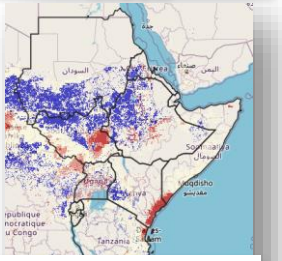
WARNING CLASSIFICATION

EA Agriculture Watch Indicator

1 **Precipitation Anomalies (SPI)**

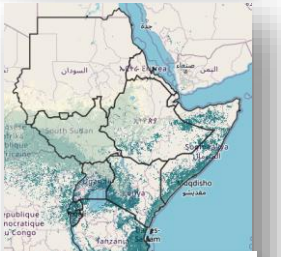


2 **Water Satisfaction Index**



3 **Vegetation (FPAR)**

4 **Phenological Stage**



Expansion, Maturation, Senescence

4 categories of Warnings

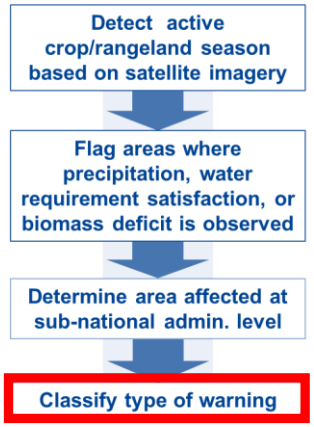
Worsening Situation;
Convergence of evidence;
Progress of season;

- Water balance deficit (rainfall, WSI)
- Vegetation stress (reduced)
- Water balance deficit + Vegetation stress
- End of Season Biomass deficit

NB: Only for active season and crop/rangeland area

- Not active
- No Warning
- Not analysed
- Exceptional

4. CLASSIFY WARNING LEVEL



		Indicator with CAF>25%			Phenological phase: Expansion, maturation	Phenological phase: Senescence
Water deficit possibly evolving into poor growth						
Meteo-based	Water-balance	zWSI			1	-
Meteo-based	Rainfall		SPI3			
Meteo-based		zWSI	SPI3		1+	-
Evidence of poor growth						
FPAR-based				zFPARc	2	4
Poor growth & negative yield prospects						
Meteo & FPAR		zWSI		zFPARc	3	4
Meteo & FPAR			SPI3	zFPARc		
Meteo & FPAR		zWSI	SPI3	zFPARc	3+	4

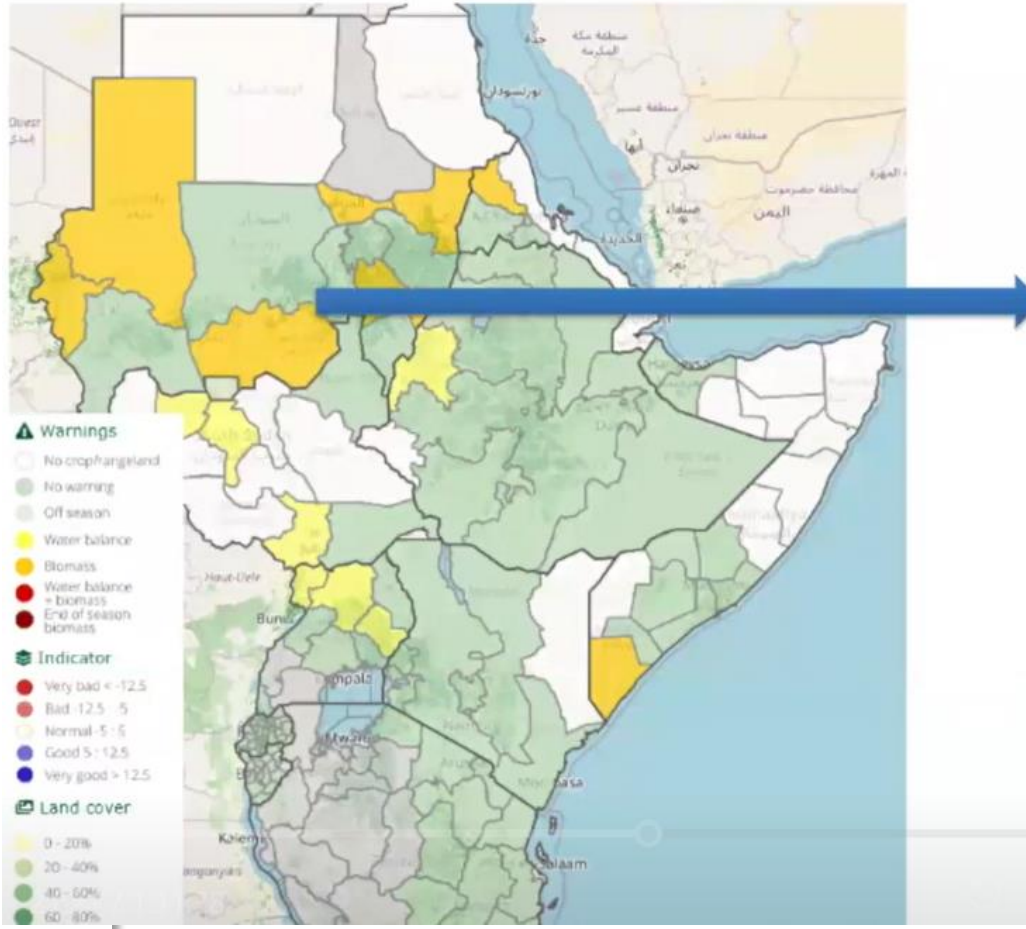
No warning
Not active
Water balance
Biomass
Water balance + biomass
End of season biomass

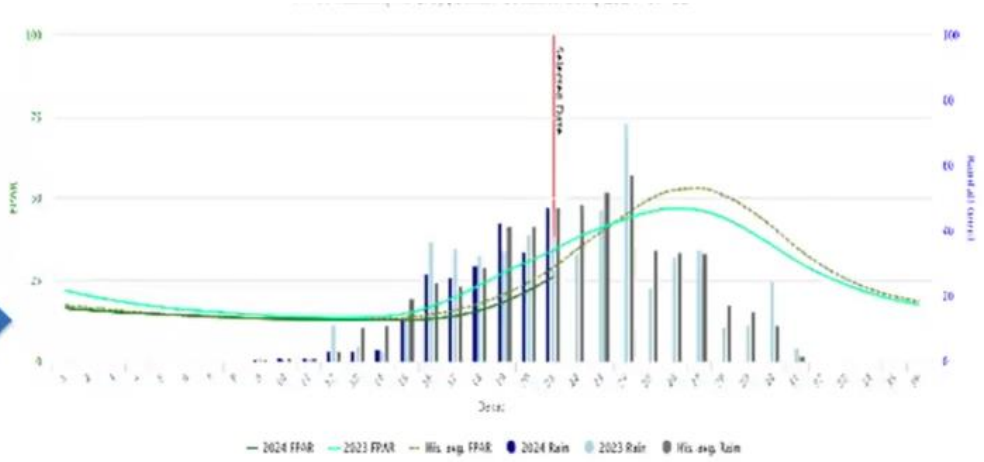
Warning levels differ for pheno stages

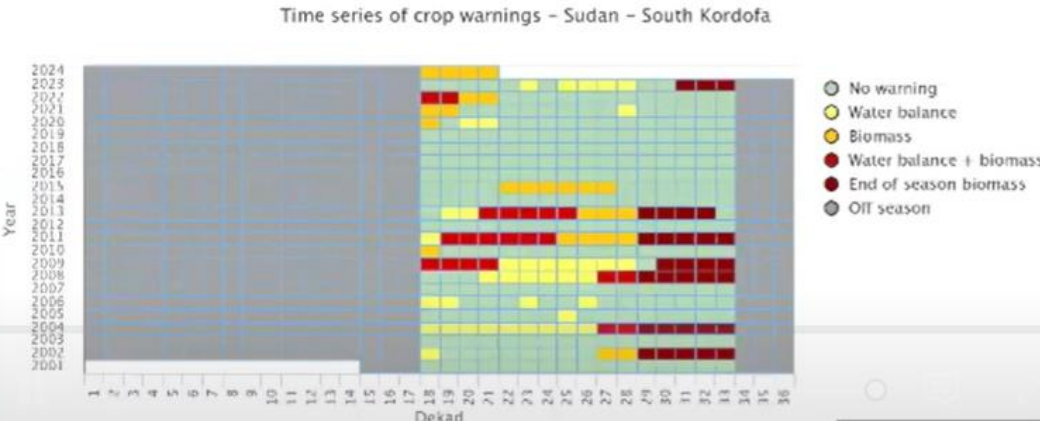
More detailed information in the Documentation Section of ASAP

https://agricultural-production-hotspots.ec.europa.eu/documentation.php

EXAMPLE DOWNLOAD FOR INDICATOR MAPS IN NEAR REAL TIME







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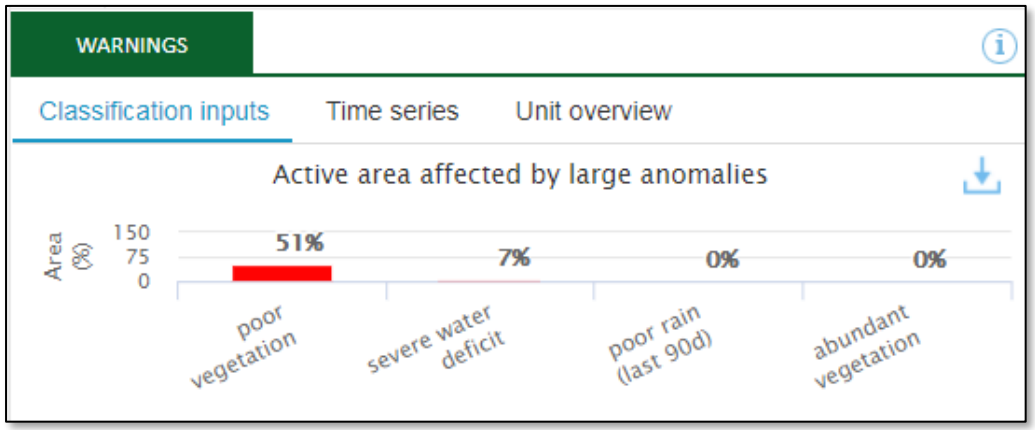
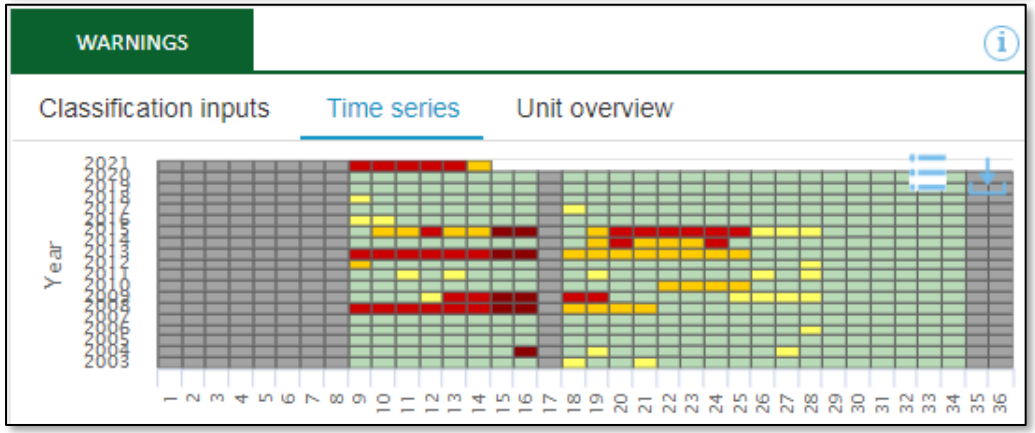
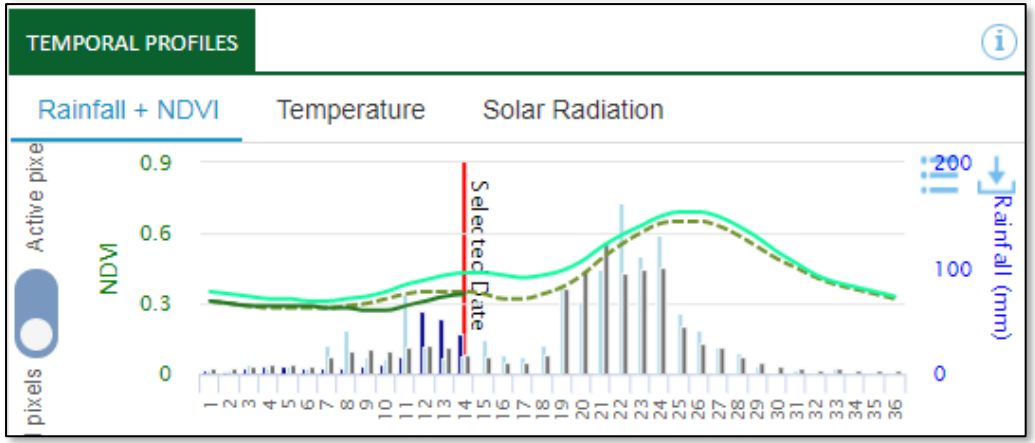
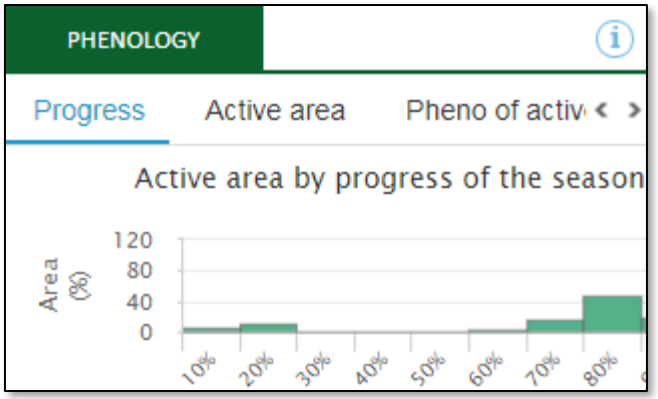
STATISTICS AT ADMINISTRATIVE 2 LEVEL

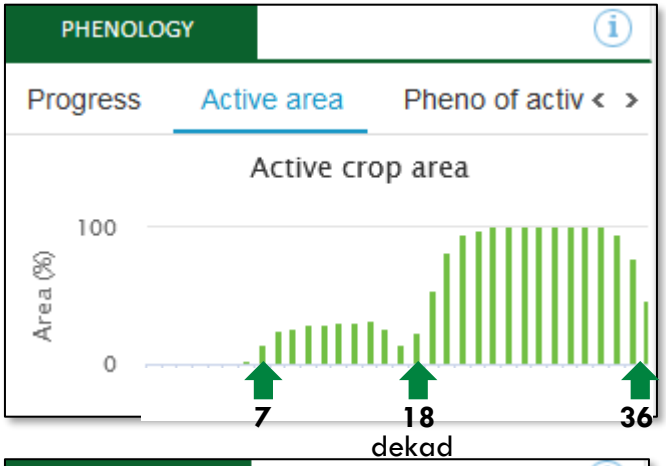
South Wollo, Ethiopia

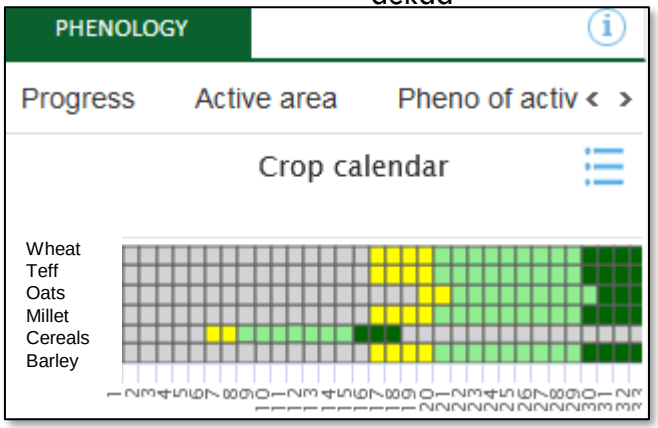




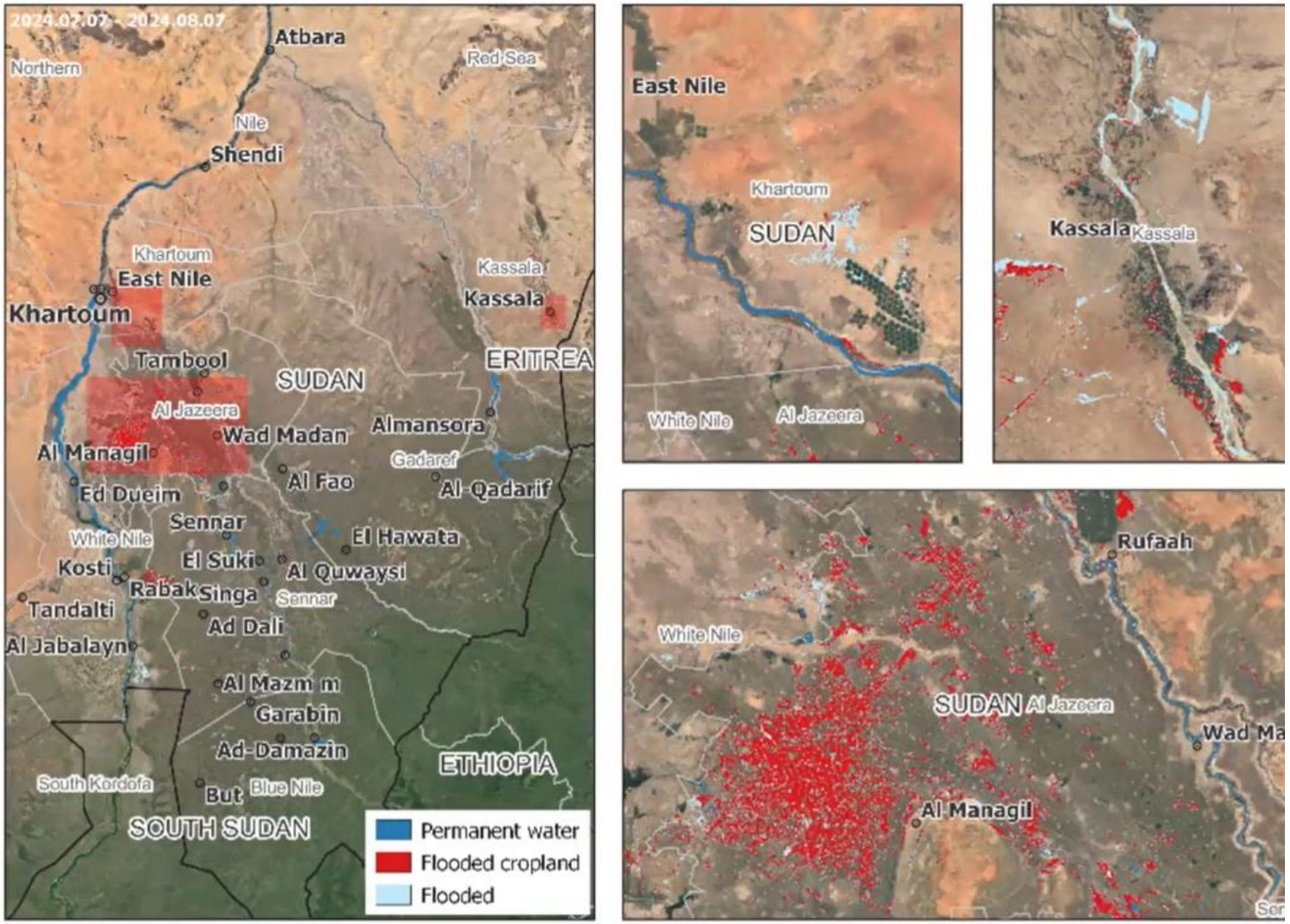








ADDITIONAL INFO IN HIGH RESOLUTION VIEWER



Flooded areas as of 7th of August in Kharthoum, Al Jazeera and Kassala states (Sudan)

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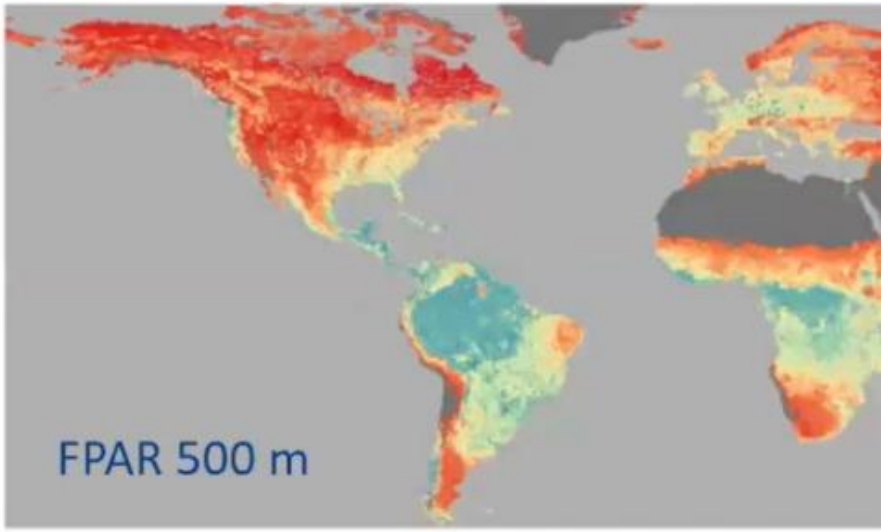
WHAT'S NEW IN VERSION 8?

- Replacement of the previous biomass indicators based on NDVI at 1 km with FPAR 500 m (ensuring MODIS continuity using VIIRS sensors)
- Land Surface Phenology dataset update
- New Crop and Rangeland masks (using hybridization of recent global HR products – ESA World Cereal, UMD – GLAD, ESA World Cover), see ASAP docs
- Improvement of level 2 units spatial detail in the GHOA
- Short link button for sharing and recreate on-the-fly selection of map and statistics windows



USEFUL LINKS

ICPAC Agriculture Hotspots	• visit: https://agriculturehotspots.icpac.net/
More detailed information on methodology	• visit: https://mars.jrc.ec.europa.eu/asap/documentation.php
For global conditions visit	• visit : https://mars.jrc.ec.europa.eu/asap/wexplorer/

Meroni, M., Vojonovic, P., Zampieri, M., Materia, S., Rembold, F., Kipkogei, O., & Toreti, A. (2024). ***Increasing the prospective capacity of global crop and rangeland monitoring with phenology tailored seasonal precipitation forecasts***. *Climate Services*, *33*, 100434.

Rembold, F., Meroni, M., Otieno, V., Kipkogei, O., Mwangi, K., de Sousa Afonso, J. M., ... & Toreti, A. (2023). ***New Functionalities and Regional/National Use Cases of the Anomaly Hotspots of Agricultural Production (ASAP) Platform***. *Remote Sensing*, *15*(17), 4284.