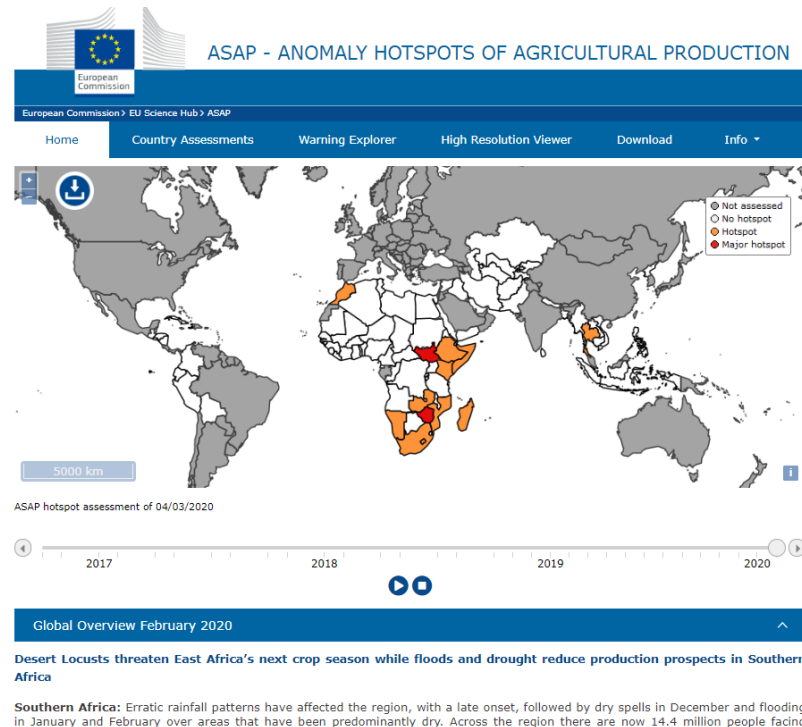


Using global remote sensing and weather data efficiently for agricultural hotspots monitoring anywhere anytime: the ASAP online system

M. Meroni, F. Rembold, F. Urbano, G. Lemoine, H. Kerdiles, A. Perez-Hoyos, G. Csak, M. Dimou, P. Vojnovic.

European Commission, Joint Research Centre, Directorate D – Sustainable Resources

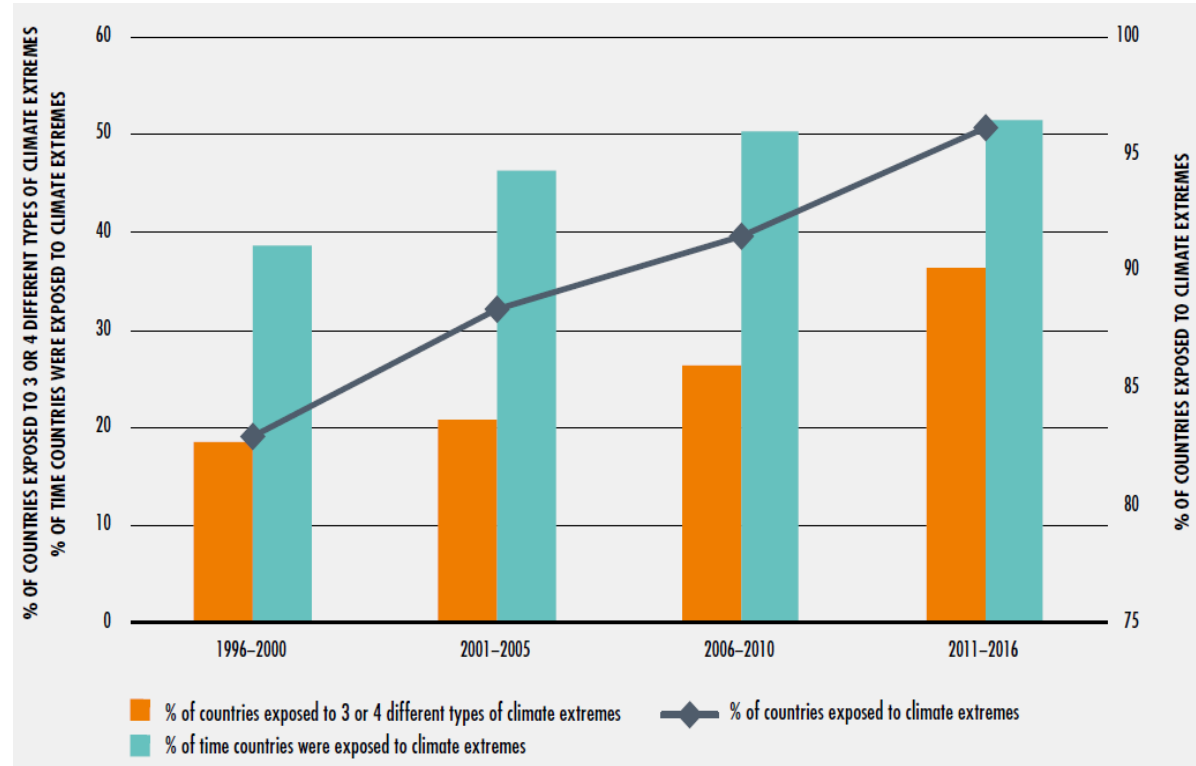



<https://mars.jrc.ec.europa.eu/asap/>



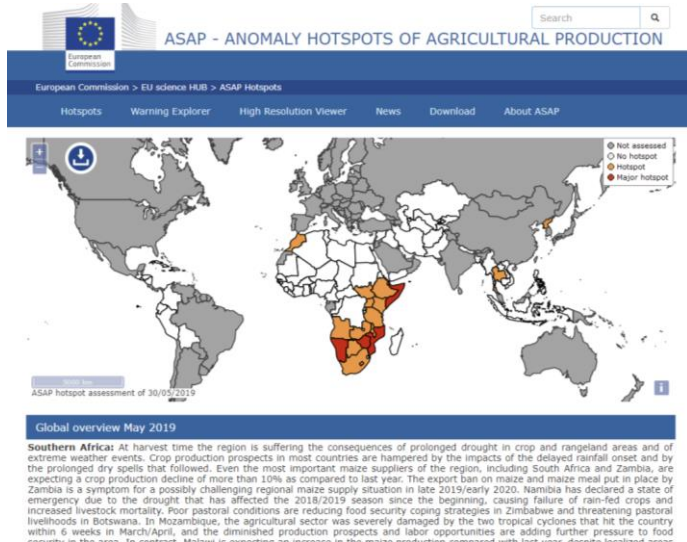
Increased exposure to more frequent and multiple types of climate extremes

- Extreme climate events remain one of the two major drivers of food crises (conflicts being the other one)

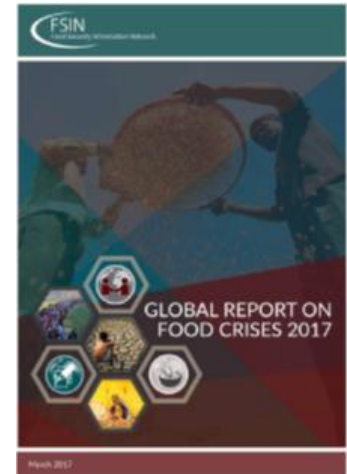


- Improved early warning information is needed for earlier food security response planning
- Out of 5 investment areas with the highest potential return for climate adaptation, Early Warning Systems are the area with the highest benefit-cost ratio (10:1, source: Global Commission on Adaptation's 2019 flagship report)  Commission I

What is ASAP?



- A free and on-line Decision Support System to further improve Early Warning of food production problems for food security assessments and contribute to existing international initiatives (GEOGLAM, IPC, Global Report on Food Crises, African Postharvest Losses Information System, etc...)



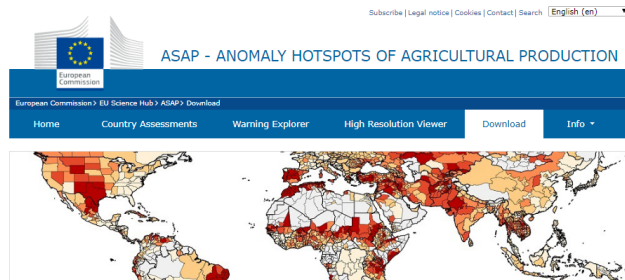
Goals:

- focus on agricultural droughts
- exploit in a coherent, continuous and timely way global Earth Observation and climate data
- go beyond anomaly maps and make available analyzed information and evidence to policy makers while at the same time providing complete information to analysts through **three integrated information platforms**



User friendly

- Working operationally since mid 2016
- 500-600 unique visits/month
- Web help and tutorials
- Newsletter
- Twitter



Data Download

This section makes available data sets used or generated by the ASAP system for download. In addition to the data which can be downloaded from this page, background information on the ASAP system and methodologies used, are available for download here: [About ASAP](#) page. For access to other data sets which are part of the ASAP system, or for additional information on the data listed below, please [contact us](#). When using data downloaded from this web page, please refer to the source or to other sources possibly indicated in the data description.

HOTSPOTS AND WARNINGS

REFERENCE DATA

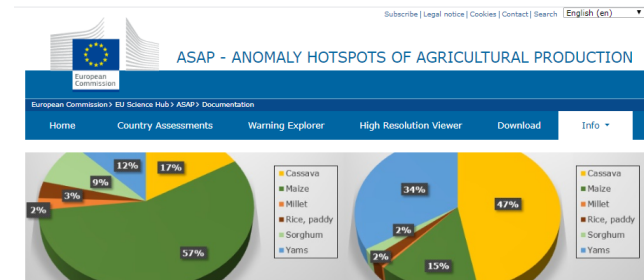
INDICATOR STATISTICS

Software Download

As part of its agricultural monitoring for food security activities, the JRC, in collaboration with external partners, has developed several open access desktop applications. In this section, you can download the image time series processing tool SPIRITS (Software for Processing and Interpretation of Raster Image Time Series) and the yield forecasting tool CST (CGMS Statistical Tool). SPIRITS is used for producing some of the anomaly indicators behind the ASAP warnings, whereas selected ASAP indicators can be used as yield proxies by the CST tool.

SPIRITS

CST



Documentation material

MANUALS AND REPORTS

ASAP warning classification scheme v 4.0.

This document illustrates the ASAP methodology for the automatic calculation of the warning levels at provincial level, including the model, the data used by the system, and the way it is implemented. Version 4.0.

ASAP Water Satisfaction Index - Technical Manual of WSI version 2.0.

This document describes the Water Satisfaction Index model.

Climate summary report in 2018.

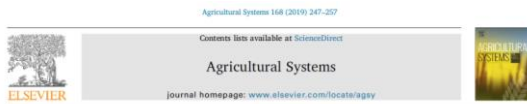
Summary of climate variability and extremes and their main impacts on agricultural production in 2018.

VIDEO TUTORIALS

PAPERS

PRESENTATIONS

Everything can be downloaded and is fully documented



ASAP: A new global early warning system to detect anomaly hot spots of agricultural production for food security analysis

Felix Rembold¹, Michele Meroni¹, Ferdinando Urbano, Gabor Csak, Hervé Kerdiles, Ana Perez-Hoyos, Guido Lemoine, Olivier Leo, Thierry Negre



Near real-time vegetation anomaly detection with MODIS NDVI: Timeliness vs. accuracy and effect of anomaly computation options

Michele Meroni^{1,a}, Dominique Fasbender², Felix Rembold¹, Clement Atzberger³, Anja Klish³



Evaluation of the Standardized Precipitation Index as an early predictor of seasonal vegetation production anomalies in the Sahel

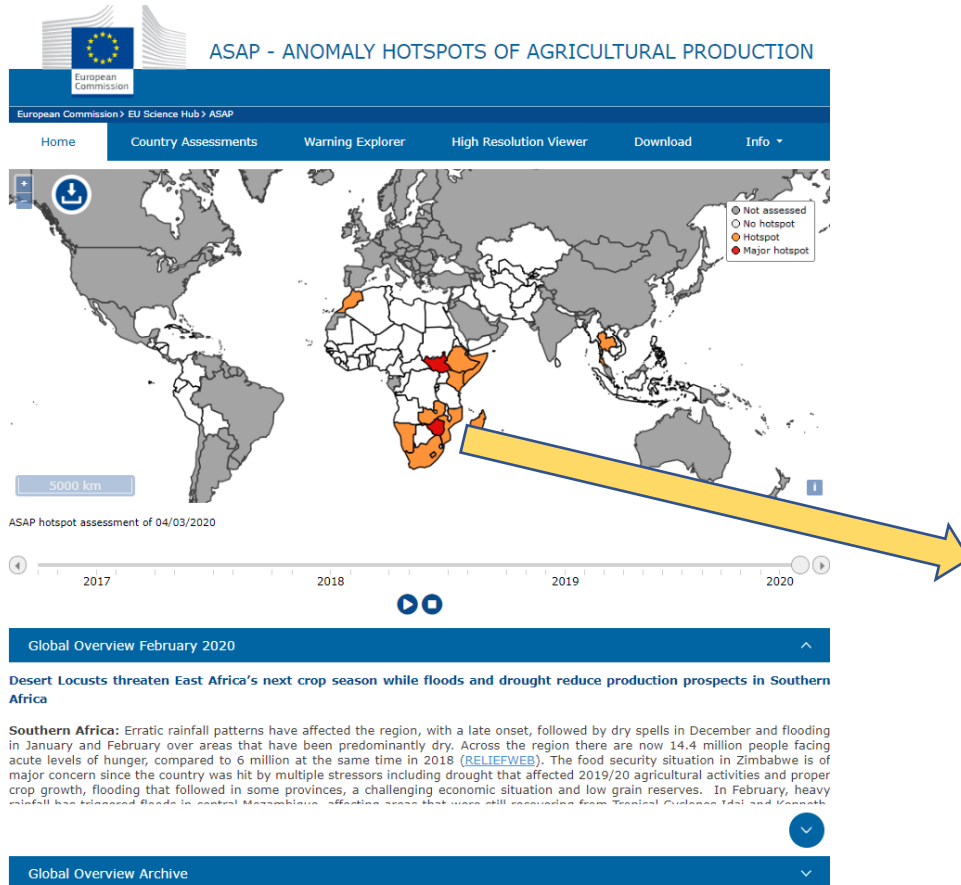
Michele Meroni, Felix Rembold, Dominique Fasbender & Anton Vrieling



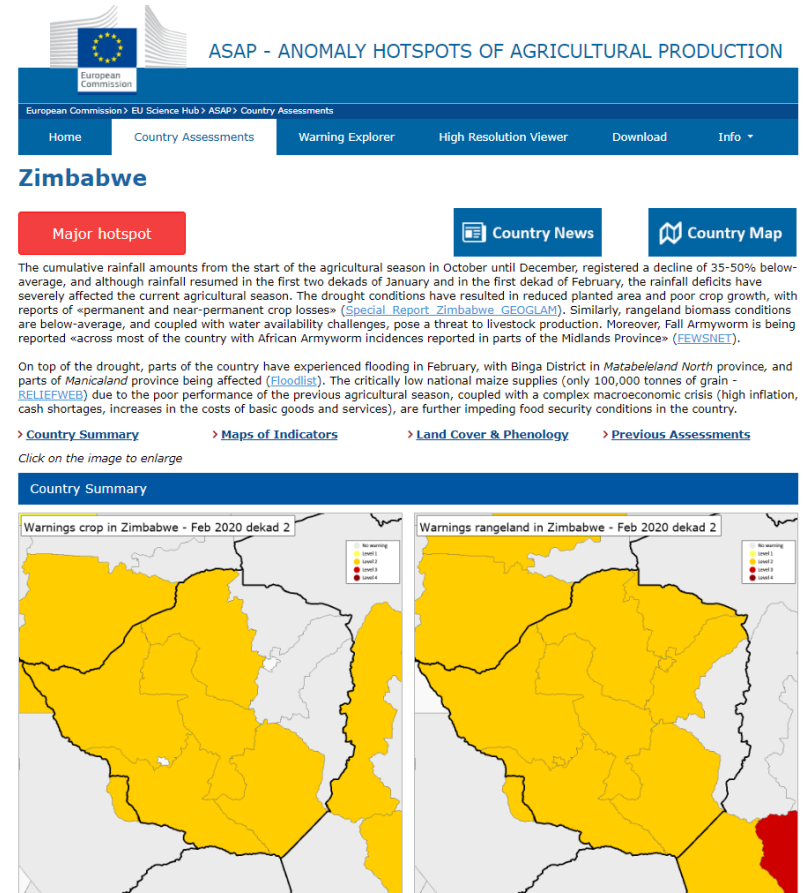
Platform 1: Hotspot analysis

<https://mars.jrc.ec.europa.eu/asap/>

Global overview



National overview



Every month based on expert analysis for
80 countries



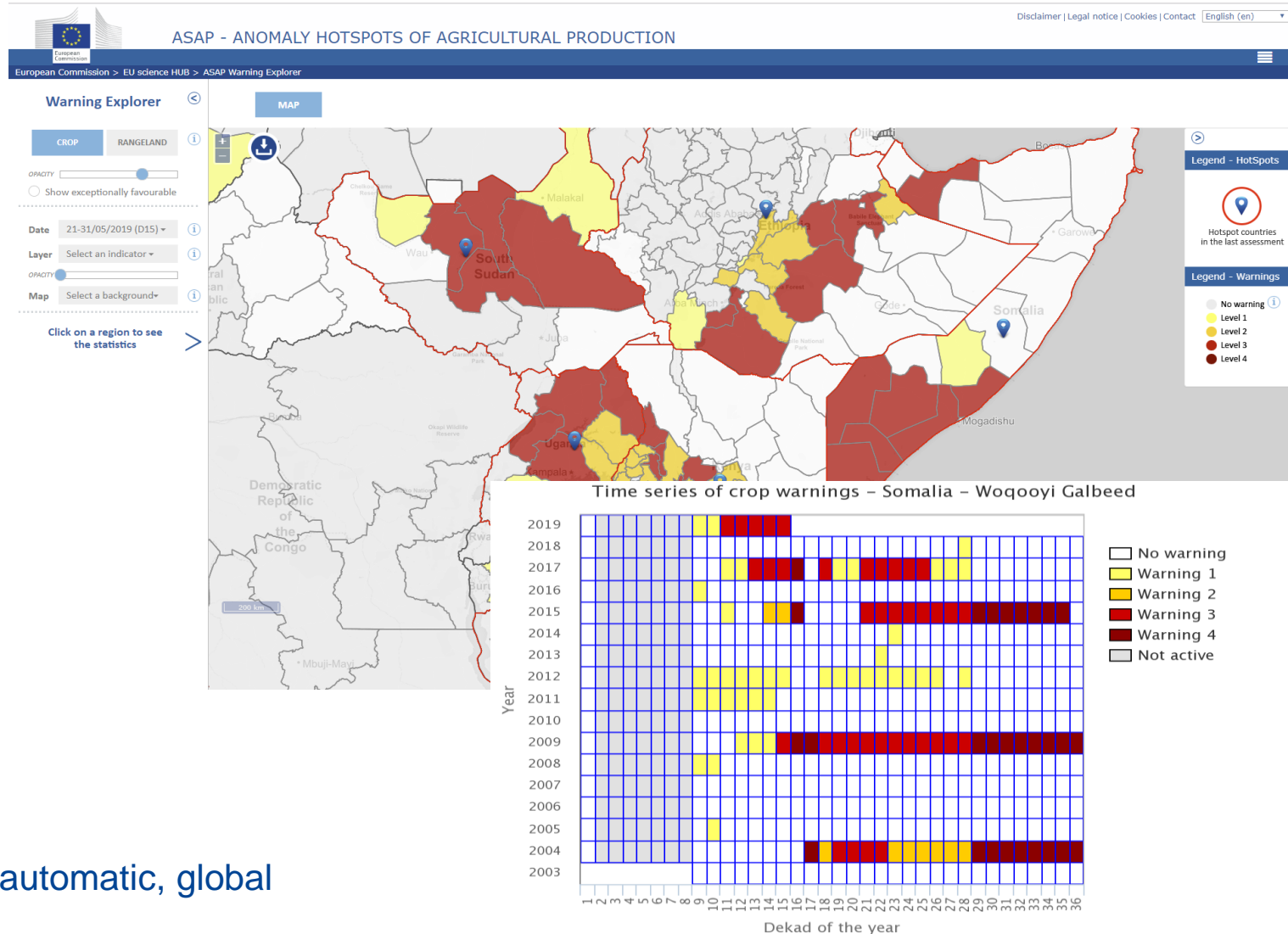
Platform 2: Warning Explorer

<https://mars.jrc.ec.europa.eu/asap/wexplorer/>

Maps and statistics for warnings and indicators (province level)

Example of automatic warning output for May 2019. Increasing level of alert from yellow (only rainfall deficit) to red (combined rainfall and NDVI anomalies).

The time series graphs shows when warnings happened since 2003

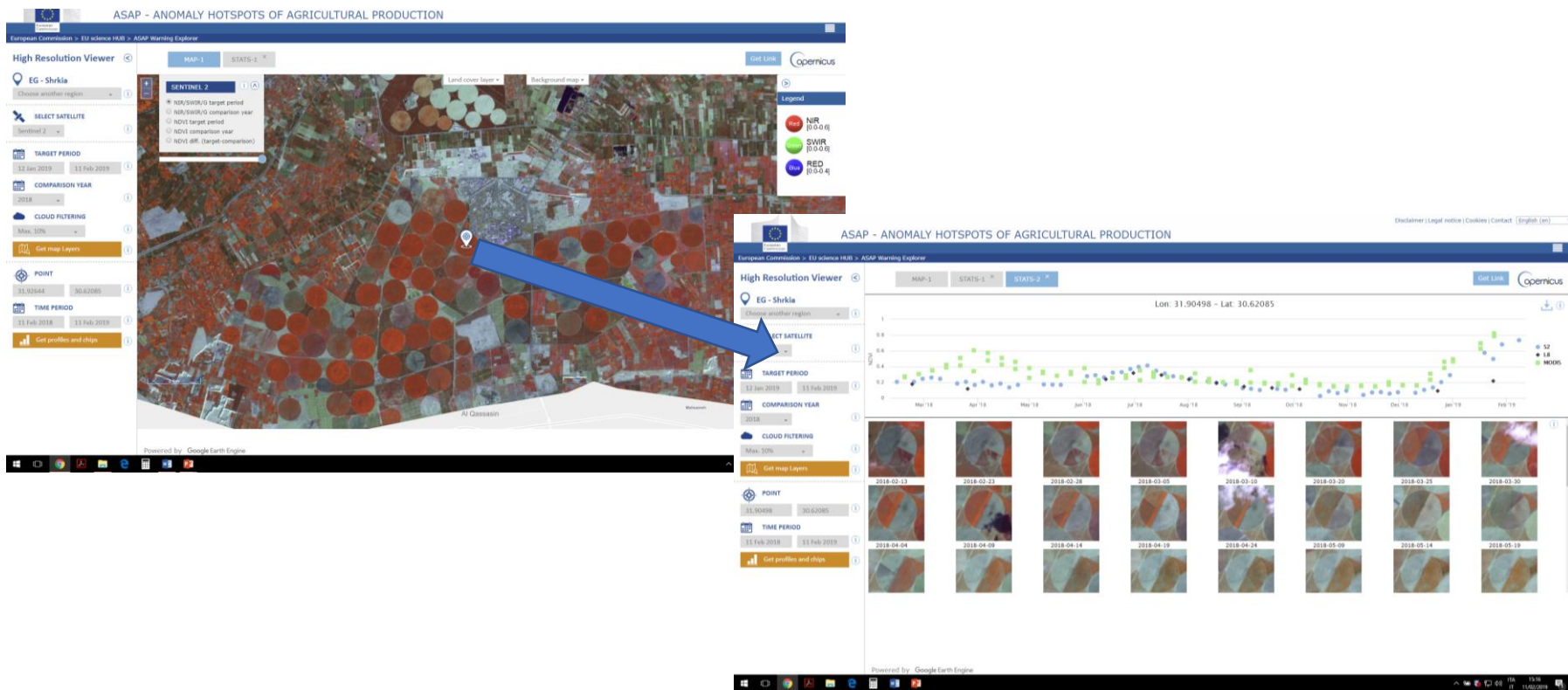


Every 10 days, fully automatic, global

Platform 3: High Resolution Viewer

<https://mars.jrc.ec.europa.eu/asap/hresolution>

A fully autonomous platform for **field level monitoring** at the global scale. Retrieves Sentinel-1/-2 and Landsat imagery quickly in a cloud computing environment and extracts time series statistics and image chips.



Powered by Google Earth Engine

New imagery every 5 days, global



European Commission

What's behind? Workflows of platforms 1 and 2

Warning explorer

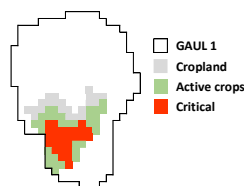
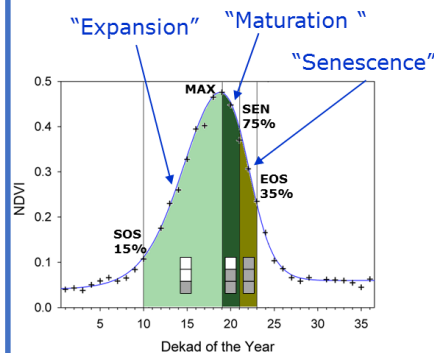
Detect active crop/rangeland season based on satellite imagery

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

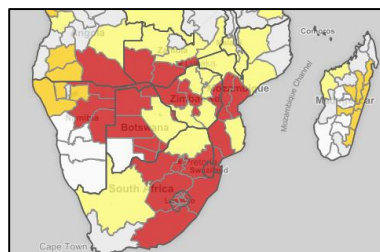
Determine area affected at sub-national admin. level

Classify type of warning

Automatic, every 10 days

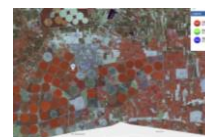


- | Level | Indicators concerned |
|-------|-----------------------------|
| 1 | Poor precipitation |
| 2 | Poor biomass |
| 3 | Poor biomass & prec. |
| 4 | Poor biomass @ end of seas. |

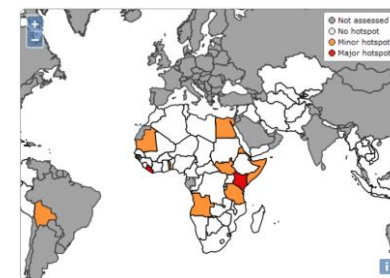


Hotspot assessment

Analyse warnings and auxiliary information and assign hotspot status at national level



online hotspots map, global overview, newsletter, JRC scientific update



Teamwork, every 30 days

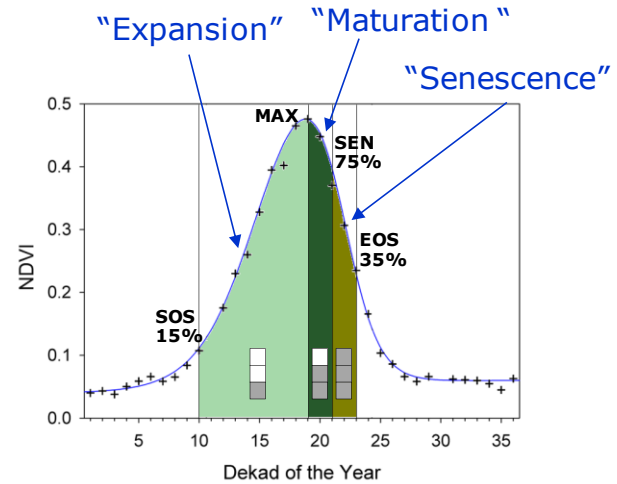


Detect active crop/rangeland season

Pixel level

Based on:

- global pixel-level Land Surface Phenology retrieval on MODIS 1 km resolution
- crop and rangeland masks



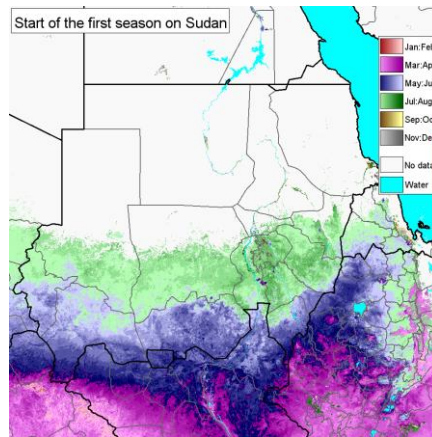
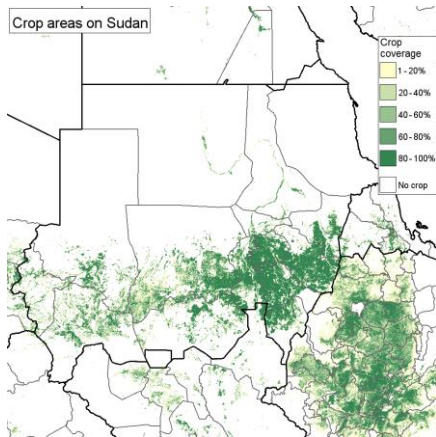
Detect active crop/rangeland season based on satellite imagery

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

Determine area affected at sub-national admin. level

Classify type of warning

Automatic, every 10 days



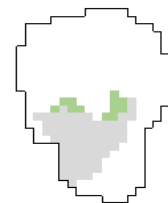
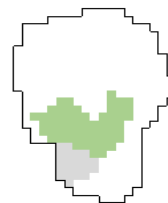
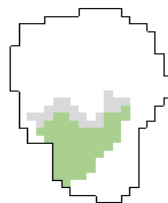
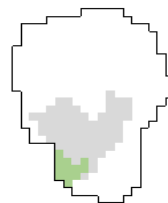
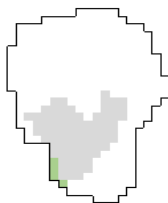
Dekad 10

Dekad 15

Dekad 20

Dekad 25

Dekad 30



GAUL 1

Cropland

Active crops

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

Flag areas where deficit is observed

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

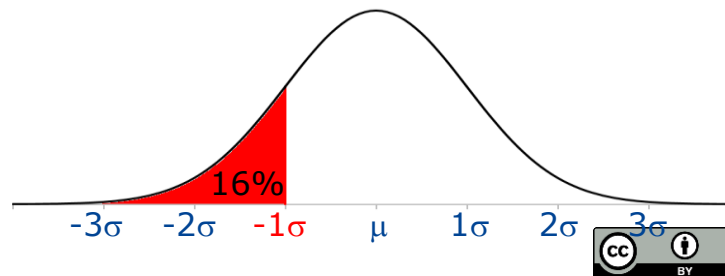
Automatic, every 10 days

Pixel level

Based on three anomaly indicators (all standardised)

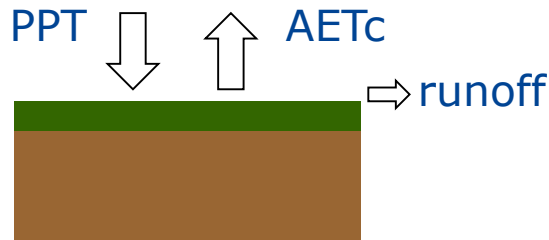
Indicator	Description	Temporal domain	Data Source
SPI3	Rainfall anomaly	Previous 3 months	CHIRPS (up to 50del Lat) 5 km, ECMWF (higher lats) 25 km
zWSI	Anomaly of Water Satisfaction Index (simple soil water balance)	From start of season	CHIRPS precipitation, ECMWF evapotranspiration, various ancillary data
zNDVIc	Anomaly of cumulative NDVI	From start of season	MODIS 1km

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



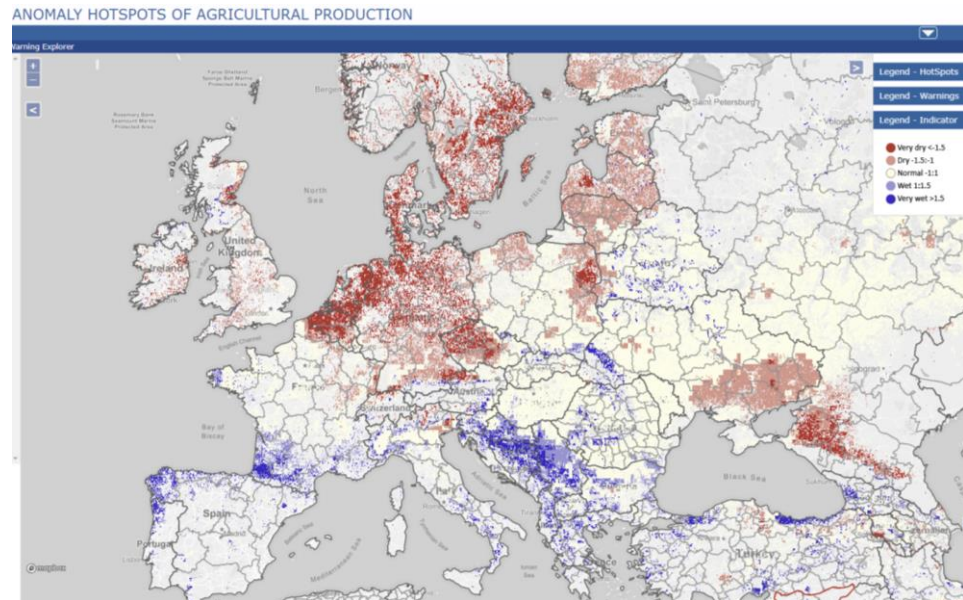
Global Water Satisfaction Index (WSI)

- Indicator of crop (or rangeland) performances based on the availability of water to the plant during the growing season
- It uses NRT precipitation (CHIRPS) and evapotranspiration (ECMWF) in a water balance accounting scheme to estimate water available to the plant



$$WSI = 100 * \frac{\sum_{i=SOs}^{EOS} AETc_i}{\sum_{i=SOs}^{EOS} PETc_i}$$

Example of the new GWSI showing the drought conditions in Northern Europe (1st dekad of August 2018)



More detailed information in the Documentation Section of ASAP

<https://mars.jrc.ec.europa.eu/asap/documentation.php>



Warning explorer

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

Automatic, every 10 days

Determine area affected

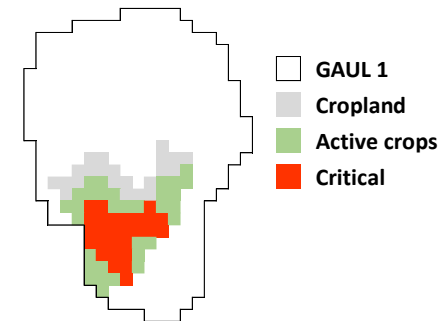
Sub-national admin. Level

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

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

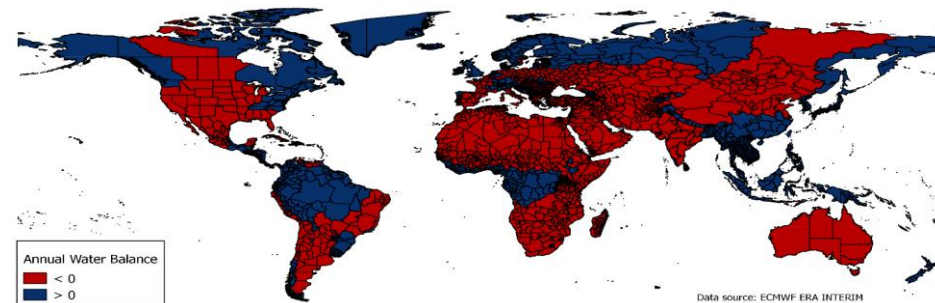
$x = \text{SPI3, zWSI, zNDVIc}$

•Any $CAF > 25\%$ will trigger a warning for that admin level



A warning is triggered only if: active crop or rangeland area is subject to a critical negative anomaly & the area concerned is relevant (>25%)

- Rainfall-based indicators contribute to warning level only for admin. areas with negative climatic water balance
- Warning levels differ for pheno stages



Warning explorer

Classify type of warning, levels from 1 to 4

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

Automatic, every 10 days

Phenological phase

Indicator with CAF>25%

Expansion, maturation

Senescence

Water deficit possibly evolving into poor growth

Meteo-based	Water-balance	zWSI			
		SPI3	● 1	-	
	Rainfall	zWSI SPI3	● 1+	-	

Evidence of poor growth

NDVI-based		zNDVIc	● 2	● 4	
------------	--	--------	-----	-----	--

Poor growth & negative prospects

Meteo & NDVI		zWSI	zNDVIc		
		SPI3	zNDVIc	● 3	● 4
		zWSI SPI3	zNDVIc	● 3+	● 4

More detailed information in the Documentation Section of ASAP

<https://mars.jrc.ec.europa.eu/asap/documentation.php>

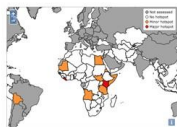


European Commission

Hotspot assessment

Analyse warnings and auxiliary information and assign hotspot status at national level

online hotspots map, global overview, newsletter, JRC scientific update

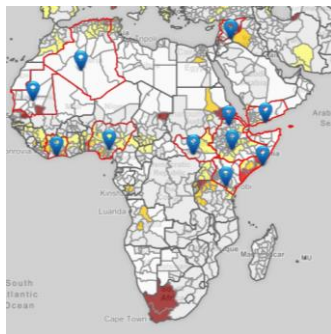


Teamwork, every 30 days

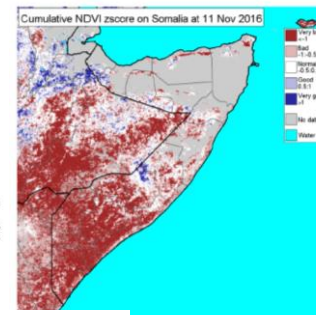
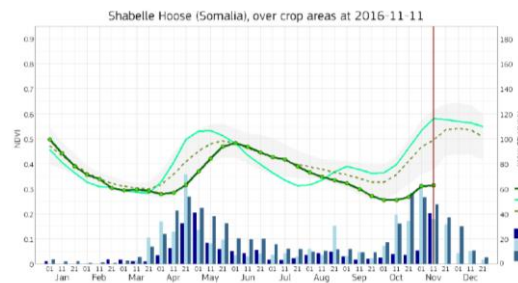
Hotspot assessment

Analyse warnings and auxiliary information and assign hotspot status at national level

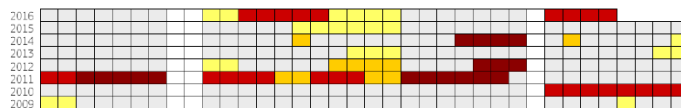
Warning Explorer



Maps and graphs



Overview of past warning levels



Local news by JRC Media Monitor tailored queries

Zoom in with high resolution satellite imagery (Sentinel-1-2, LS)



Multi scale analysis, the power of zooming in with Platform 3, the HR viewer

The warning explorer information is based on coarse resolution satellite and model information that provides rapid overview information at Gaul1-2 level.

For hotspot and areas with warnings, the HR Viewer uses **Sentinel-1, -2** and **Landsat** and allows zooming in to the field level for detecting and visualizing mainly:

- Presence of active vegetation (S2 and LS) and difference with reference years (useful information about planting and performance monitoring, crop failure etc...)
- Presence of land surface changes (S1) and water surface changes (S1 and S2, useful for detecting land preparation, flooding, surface water extent, flood impact)
- Detection of land use changes (clearing, agric. encroachment into natural vegetation, implementation of infrastructure including irrigation infrastructure)
- Access to land (e.g. in areas with limited humanitarian access)

ASAP - ANOMALY HOTSPOTS OF AGRICULTURAL PRODUCTION



European Commission > EU science HUB > ASAP > High Resolution Viewer

High Resolution Viewer

MAP-1

[Get Link](#) [Tutorial](#)

IT - Lazio

[Choose another region](#)

SELECT SATELLITE

Sentinel 2

SELECT LAYER

NDVI

TARGET PERIOD

05 Jan 2020 04 Feb 2020

COMPARISON YEAR

2019

CLOUD FILTERING

Max. 10%

Get map Layers

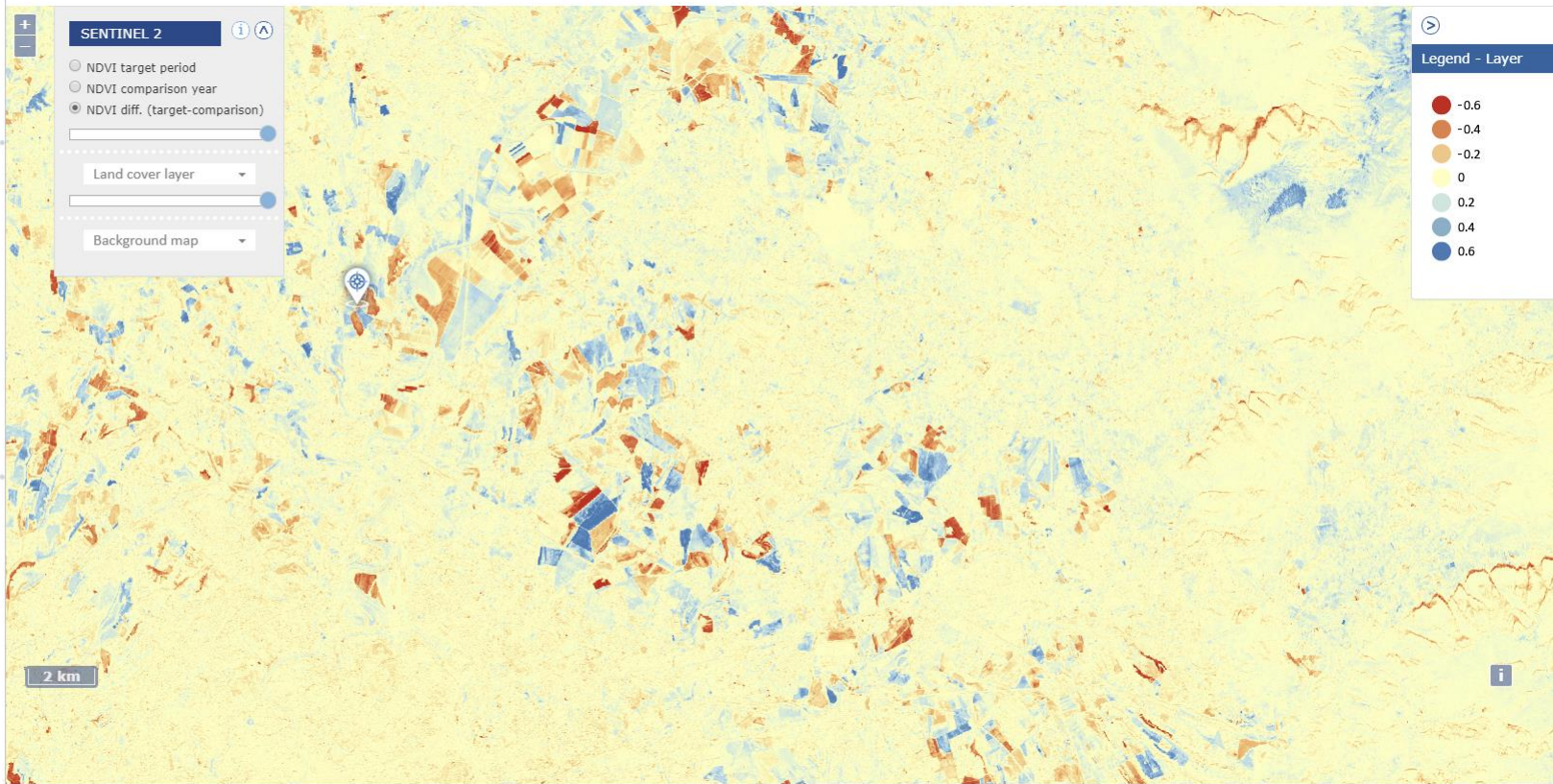
POINT AREA

12.4923 42.0291

TIME PERIOD

04 Jan 2019 04 Feb 2020

Get stats



- Rapid online access to S1 and S2 mosaics
- Comparison with previous years
- On the fly NDVI and NDVI difference computation
- Time series profiles and image chips for points and polygons
- Area measurements polygon
- Share localization with web-link

ASAP HR viewer: zooming to the field level

ASAP - ANOMALY HOTSPOTS OF AGRICULTURAL PRODUCTION

Disclaimer | Legal notice | Cookies | Contact | English (en)



European Commission > EU science HUB > ASAP Warning Explorer



HR explorer



Get Link

EG - Shrkia

Choose another region



COMPOSITING PERIOD

05 Sep 2018 05 Oct 2018



COMPARISON YEAR

Select a year



BAND COMPOSITION

NIR/R/G



Get map Layers



POINT

31.72714

30.73313



Window 1x1



TIME PERIOD

05 Jun 2017 05 Oct 2018



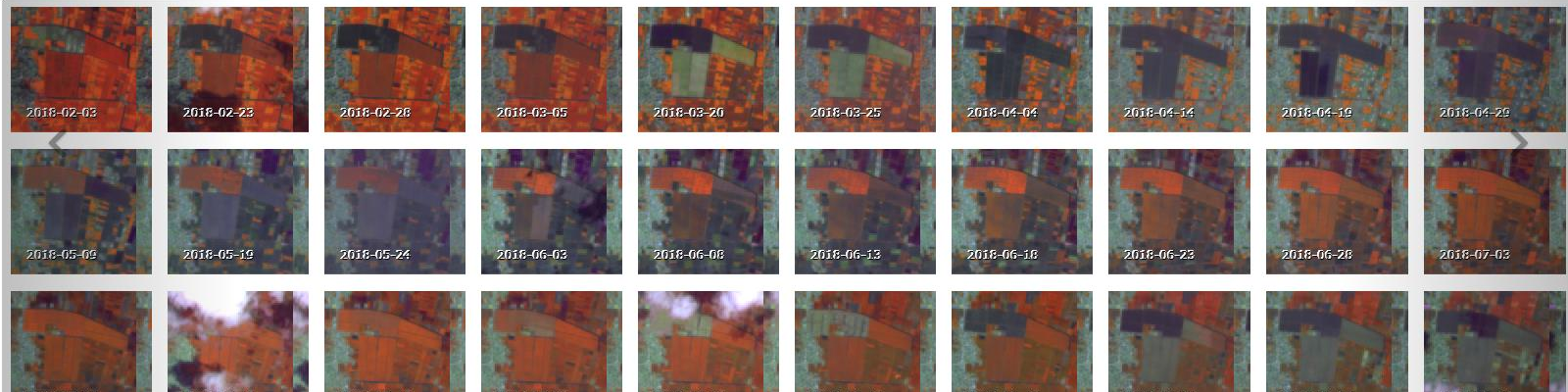
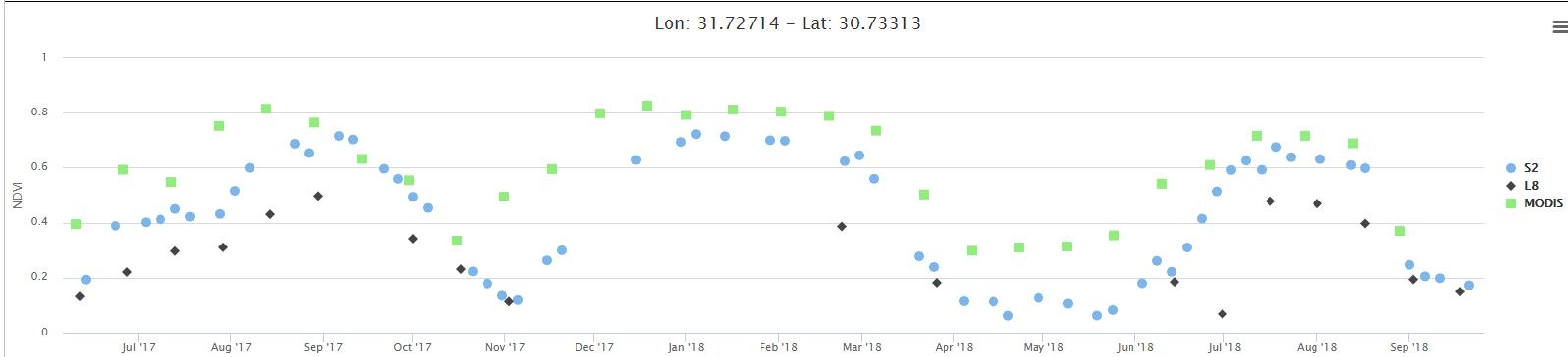
Get NDVI TS



Chip size

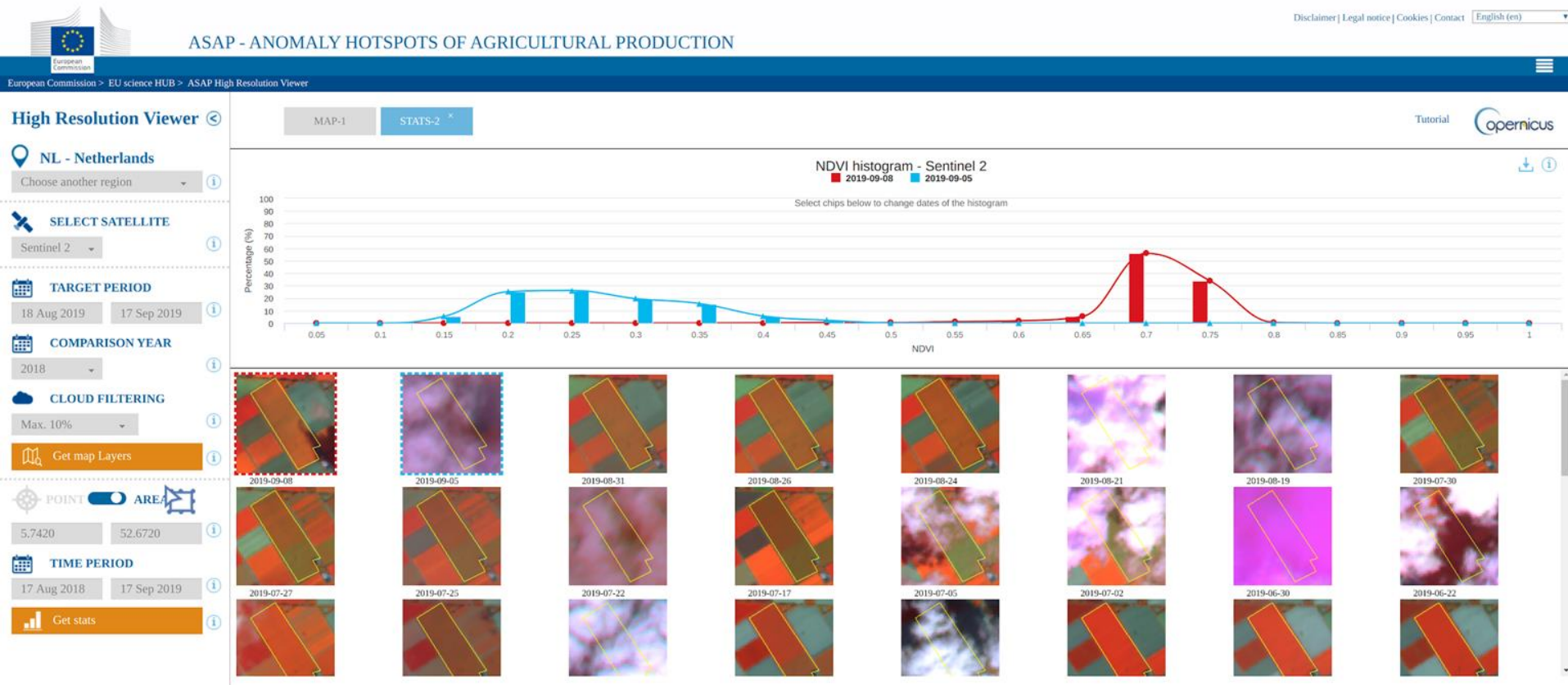


Get Chips

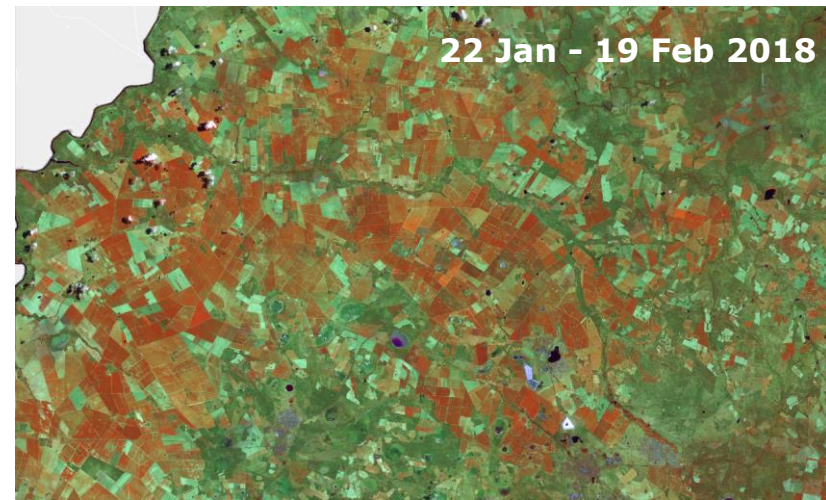
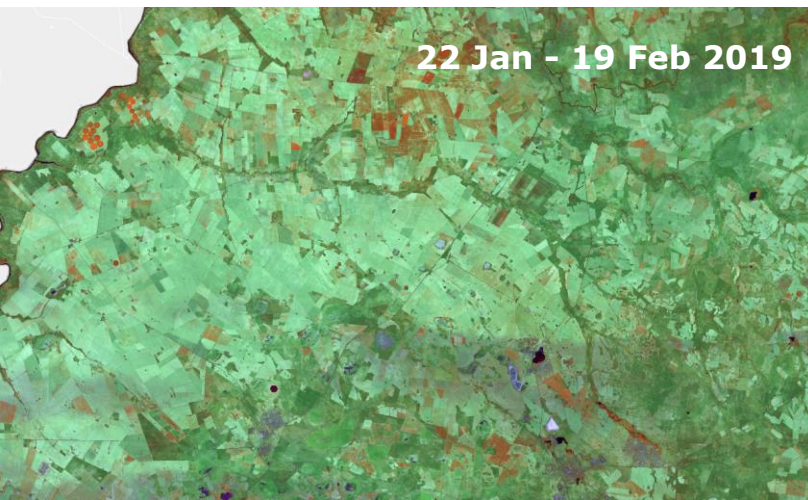


ASAP HR viewer: zooming to the field level

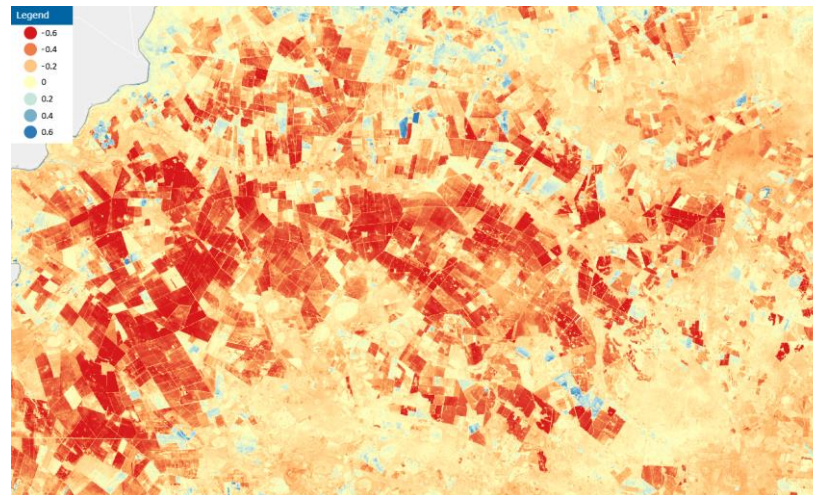
- Comparing NDVI value distribution of two different year for a user-defined polygon



ASAP HR viewer examples: Free State drought (South Africa) in 2019



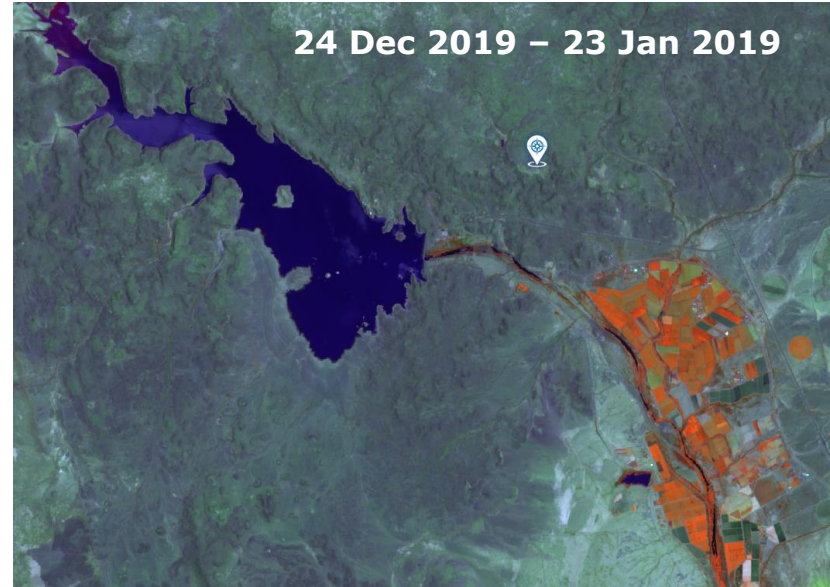
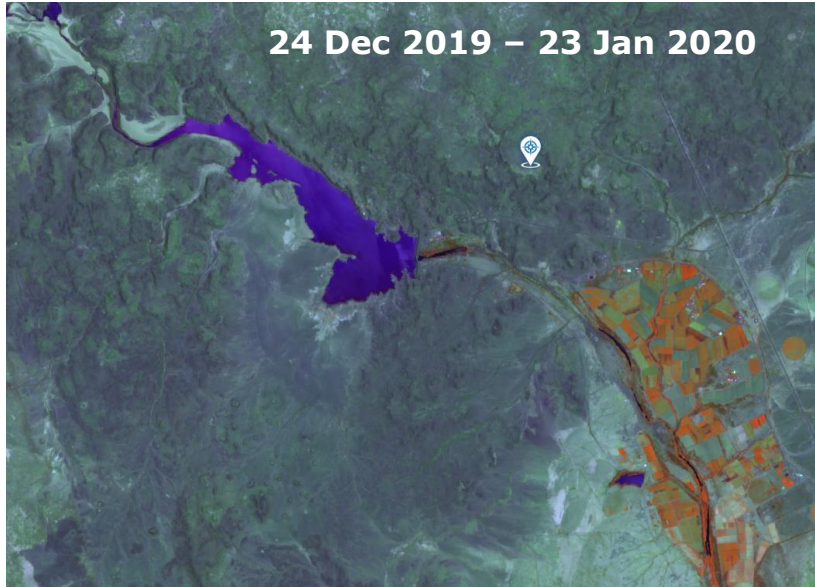
**NDVI
Difference**



Strong negative
NDVI anomalies in
2019.
Crop failure and
decrease in planted
area

<https://mars.jrc.ec.europa.eu/asap/s/d1b78928>

ASAP HR viewer examples: recent drought in Namibia



<https://mars.jrc.ec.europa.eu/asap/s/0c4b80df>

Clear reduction of Hardap Dam
water level and effect on crops

NDVI
Difference



ASAP HR viewer examples: areas with access restrictions, abandoned crop land in 2019 in North East Nigeria



ASAP - ANOMALY HOTSPOTS OF AGRICULTURAL PRODUCTION

Disclaimer | Legal notice | Cookies | Contact | English (en)

European Commission > EU science HUB > ASAP > High Resolution Viewer

High Resolution Viewer

NG - Borno
Choose another region

SELECT SATELLITE
Sentinel 2

TARGET PERIOD
30 Aug 2019 20 Sep 2019

COMPARISON YEAR
2018

CLOUD FILTERING
Max. 50%

Get map Layers

POINT AREA
13.6573 12.9865

TIME PERIOD
24 Dec 2018 24 Jan 2020

Get stats

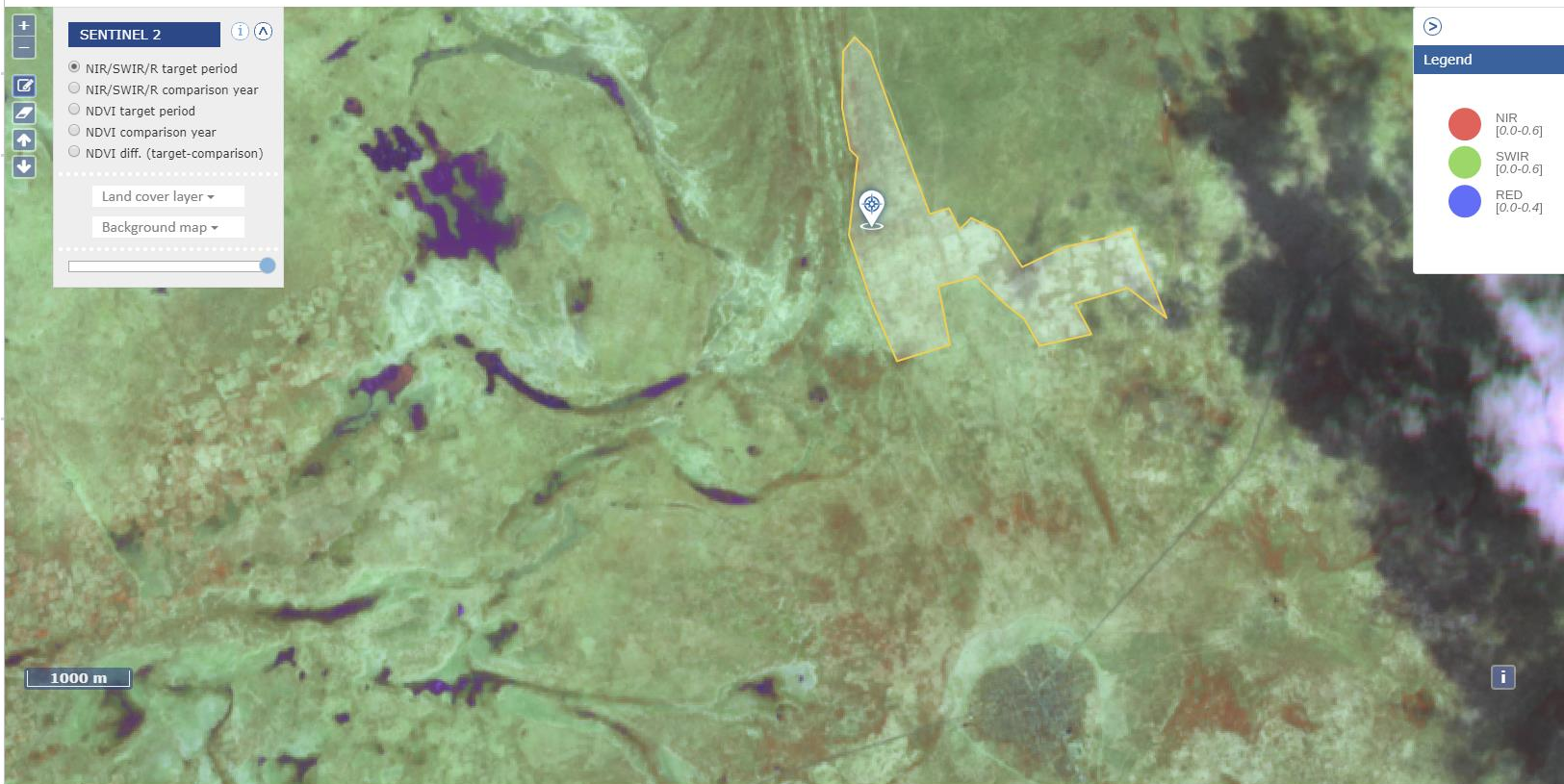
MAP-1

SENTINEL 2

- ☒ NIR/SWIR/R target period
- ☐ NIR/SWIR/R comparison year
- ☐ NDVI target period
- ☐ NDVI comparison year
- ☐ NDVI diff. (target-comparison)

Land cover layer

Background map



Legend

- NIR [0.0-0.6]
- SWIR [0.0-0.6]
- RED [0.0-0.4]

<https://mars.jrc.ec.europa.eu/asap/s/6a18b85e>



European
Commission

Conclusions

- Continuous monitoring and frequent updates for timely early warning and evidence for detailed and multi-stakeholder assessments/analysis (IPC, Cadre Harmonisé, Global Crises report, GEOGLAM CM4EW...)
- Zoom into hotspot areas providing user friendly access to latest generation high resolution imagery for vegetation anomaly mapping at parcel level. Many other uses possible!
- All reference data, warnings and analysis summary are well documented (including video tutorials, presentations, scientific papers) and can be downloaded
- Base data such as crop and rangeland masks, crop calendars and phenology can be downloaded and use as base layer for other applications

Future developments

- Warnings available also at the second sub-national level
- Improved compositing and smoothing of HR time series
- Integration of ECWMF meteorological forecasts in the warning system
- Improved training material including new video tutorials



Thank you!

<https://mars.jrc.ec.europa.eu/asap/>



EU Science Hub
ec.europa.eu/jrc



@EU_ScienceHub



EU Science Hub - Joint Research Centre



Joint Research Centre



EU Science Hub

Contacts

asap@jrc.org

Felix Rembold

Joint Research Centre

Directorate D Sustainable Resources

Food Security Unit



European
Commission