



Contribution of EO data and H SAF products for Hydrology

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& All the H SAF team
H SAF Project Manager



Outline

- why satellite products are important for hydrology
- Satellite products for hydrological applications
- some severe events

Hydrological Services

Operational Service	Application
Operational Hydrological services	Flood and landslides forecasting
	Land management
	Water resources management
Agriculture	Drought monitoring
	Water resources management
Civil defence	Preparation for emergencies
	Emergency management
	Post-emergency phase

Precipitation

Soil moisture

Snow

Evapotranspiration

River discharge

Water body extent

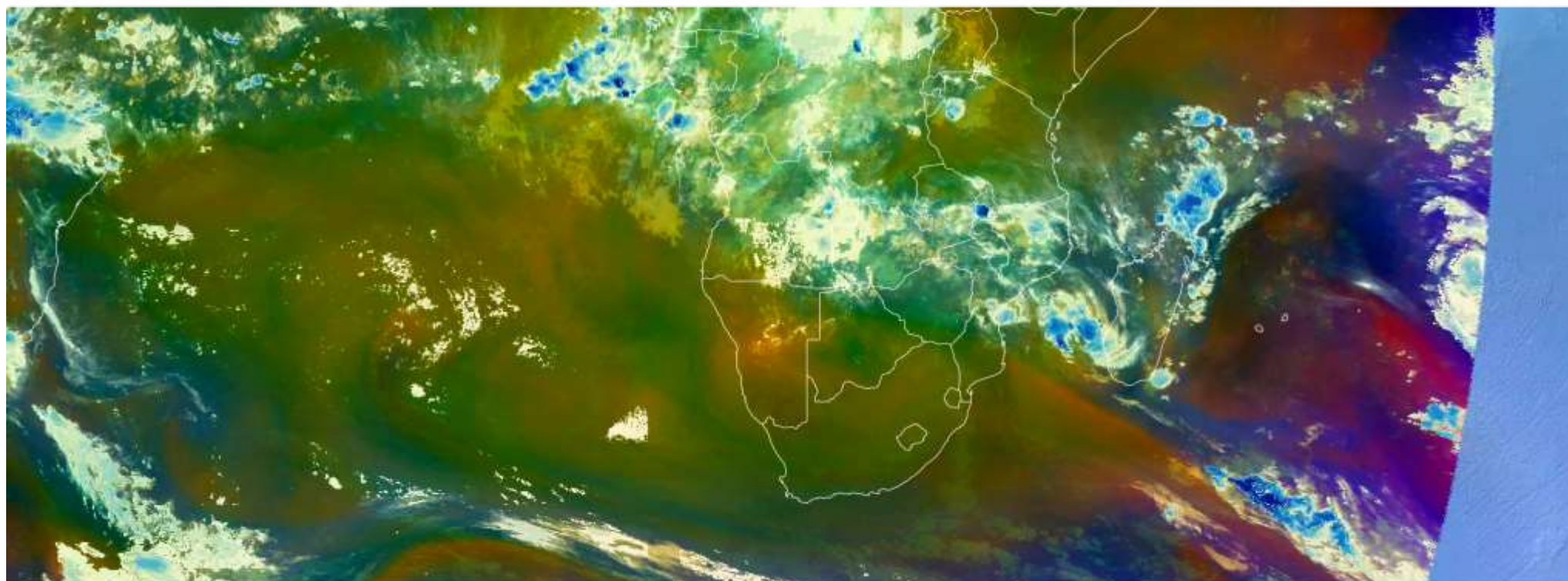
Several hydrological Operational services are employed by National and international agencies and authorities in order to prevent hazards and natural disasters, as well to improve water management.

These services to cope their mandate need accurate and timely meteorological and hydrological parameters

Why satellite products are SO IMPORTANT for Hydrology

Blended SEVIRI / LED MW precipitation and morphologic information - MSG - 0 degree
H-SAF H60B
H-SAF H63
mm / hr 0.2 5 10 15 20 30 50+

EUMETVIEW: real time monitoring of precipitation

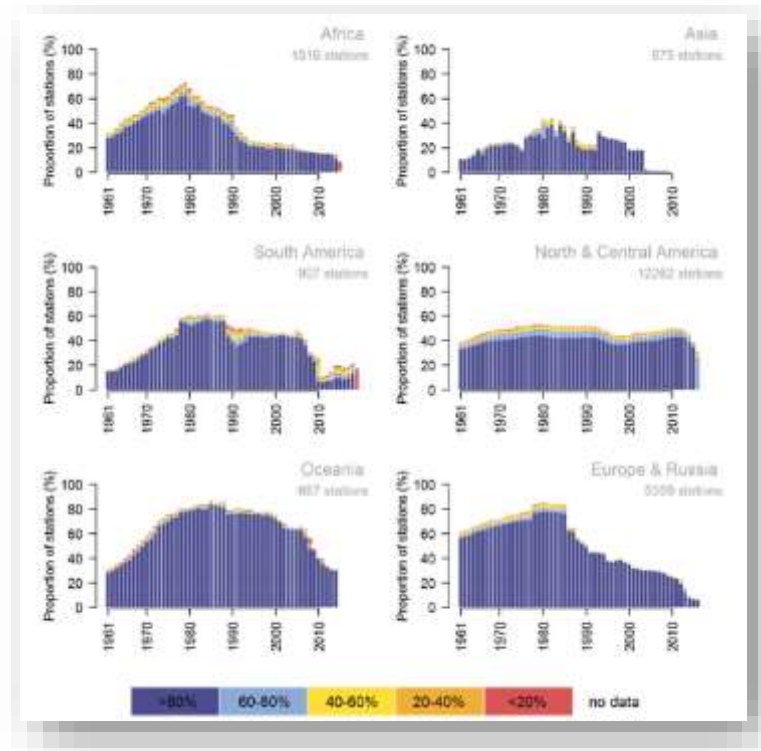
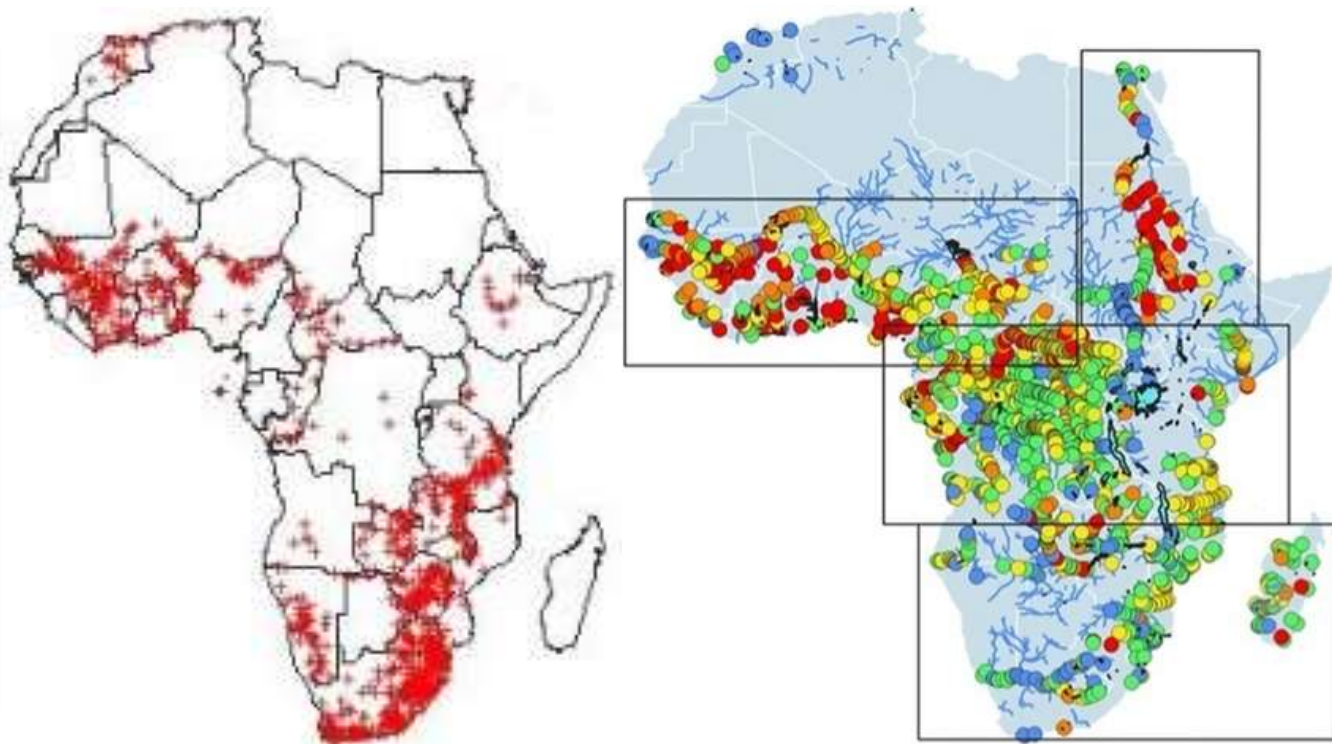


2023-02-23 00:00:00 UTC

Satellite products continuously provide data independent from ground station with a wider view.

Why satellite products are SO IMPORTANT for Hydrology

RIVER DISCHARGE



Satellite products can largely increase our monitoring capability of the water cycle, particularly due to the recent strong decline of in situ observation networks.

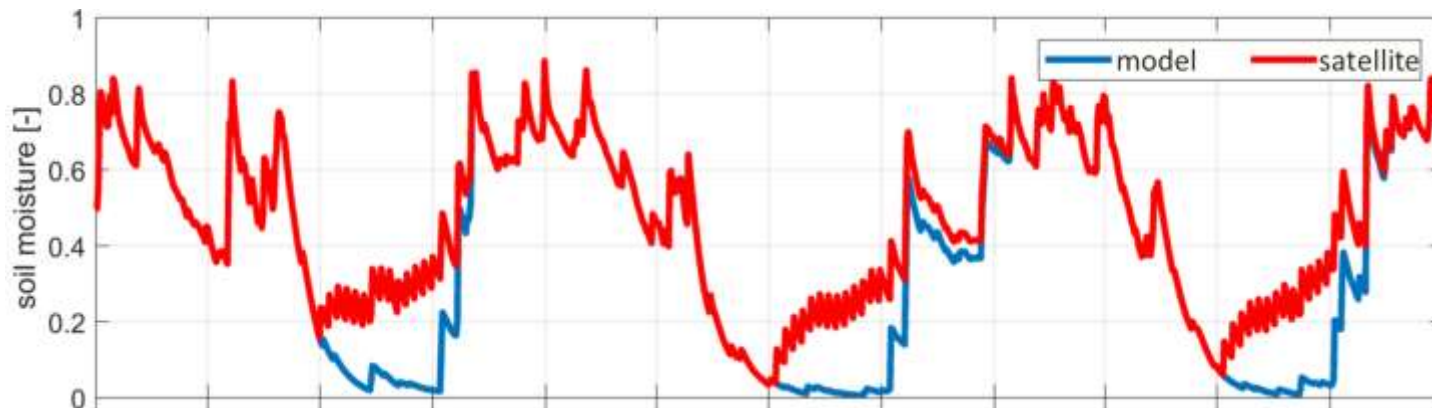
Papa et al (2022 Surv Geophys)

<https://doi.org/10.1007/s10712-022-09700-9>

Krabbenhoft et al (2022 Nat Sustain)

<https://doi.org/10.1038/s41893-022-00873-0>

Why satellite products are SO IMPORTANT for Hydrology



Satellite products can “see” processes that we are not able to model such as IRRIGATION

Earth observation missions from 2010 to 2030

In the last 50 years hundreds of satellites have been launched for earth observation purposes.

Relevant to hydrology, as the EUMETSAT satellites (MSG-MTG and Metop), SMOS and Sentinel-1, Sentinel 2. NASA Earth science missions, SMAP, GPM,

Different sources of satellite monitoring systems, diverse range of data-sets which allow us to estimate the parameters needed to answer to hydrological services.



Satellite Application Facilities in Support to Operational Hydrology and Water Management

H SAF generates and archives satellite high-quality products to estimate:

- ✓ **precipitation** (rate and accumulated);
- ✓ **soil moisture** (at surface and in the roots region);
- ✓ **snow parameters** (as snow cover, melting conditions, water equivalent)

**The consortium is composed by 11 countries:
Austria, Belgium, Bulgaria, Finland, France, Germany, Hungary,
Italy, Poland, Slovakia, Turkey and ECMWF.**

More than 50 researchers are involved in the project.



<http://hsaf.meteoam.it/>



[@HydroSAF](https://twitter.com/HydroSAF)



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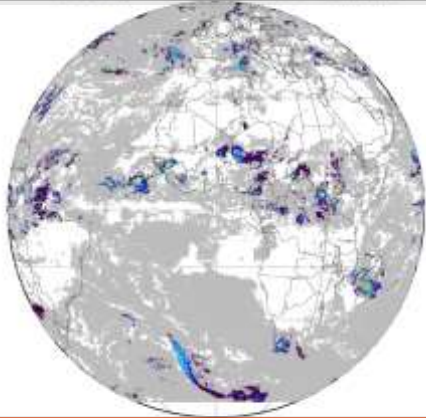
luca.brocca@irpi.cnr.it

simone.gabellani@cimafoundation.org

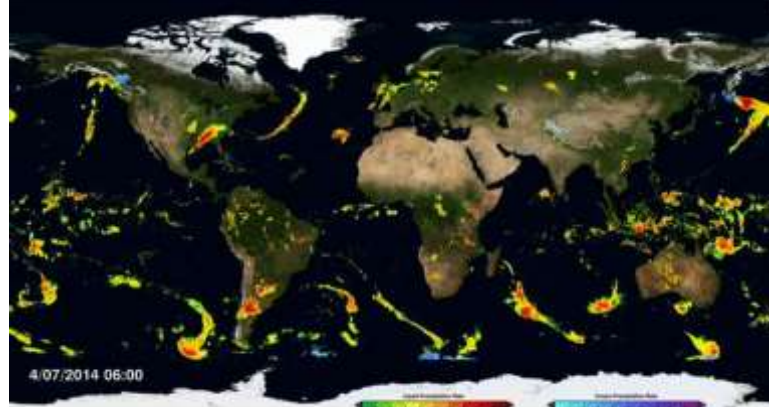


REMOTE SENSING OF PRECIPITATION

H SAF H60: 2020 to present
Rain Rate, 15-min, 0.05-degree



GPM IMERG: 2000 to present,
Rain Rate, 30-min, 0.1-degree

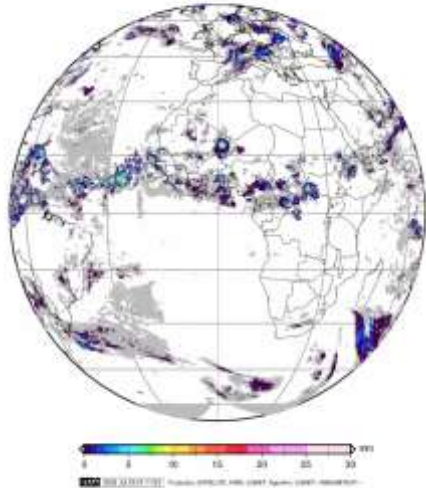


GSMaP: 2000 to present
Rain Rate, 1-h, 0.1-degree

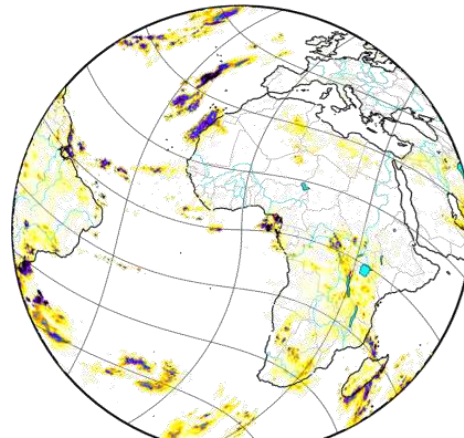


...and many others:
 TAMSAT
 PERSIANN
 CMORPH

H SAF H61: 2020 to present
Accum. Prec., 1-24 h, 0.05-degree

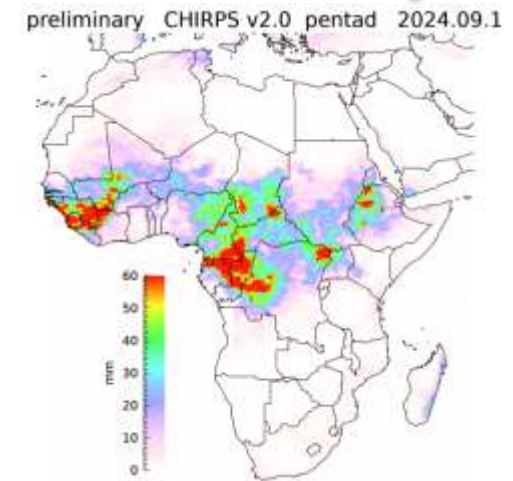


H SAF H64: 2020 to present,
Accum. Prec., 24-h, 0.25-degree



Daily Rainfall [mm] H SAF H64 2022-01-16

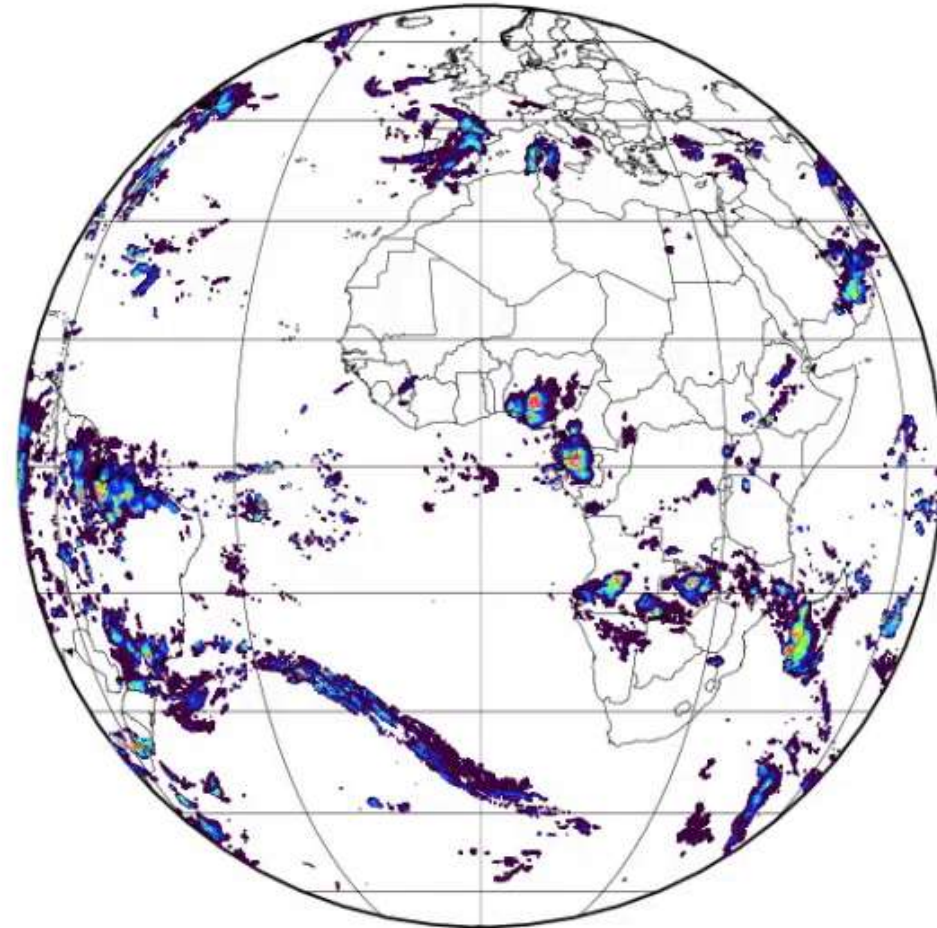
CHIRPS: 1981 to present,
Accum. Prec., 24-h, 0.05-degree



H SAF precipitation products (MW+IR): Rain Rate

- Parameter: **Rain Rate**
- Frequency: **15 minutes**
- Spatial Sampling: **3 Km**
- Latency: **10 minutes**
- Available: **EUMETCAST**

EUMETSAT H SAF P-IN-SEVIRI-PMW (H60)
Instantaneous rain rate retrieved from IR-MW blending data
Blending of SEVIRI IR + MW LEO Satellites 20240309_0000

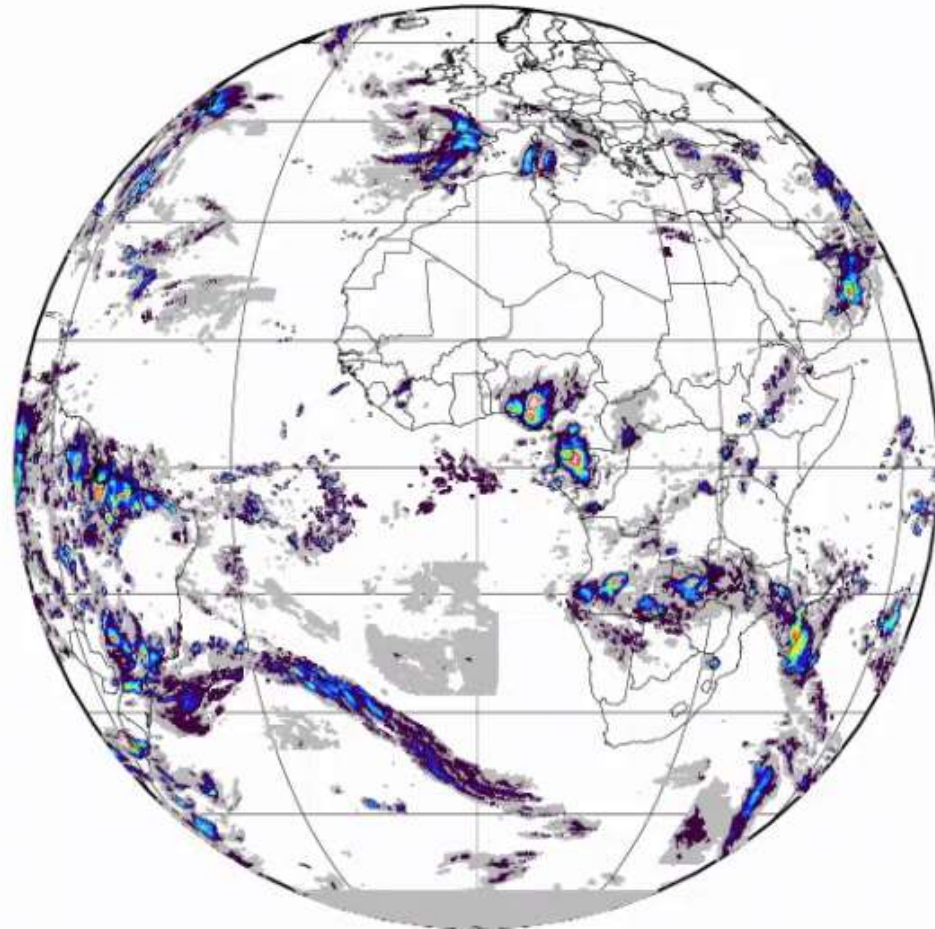


COMET 2024 Mar 09 00:28:18 Production SATELLITE AREA COMET Algorithm: COMET-ABEUMETSAT

H SAF precipitation products (MW+IR): Accumulated Rain

- Parameter: **Accumulated Rain**
- Frequency: **1 hour**
- Spatial Sampling: **3 Km**
- Latency: **20 minutes**
- Available: **EUMETCAST**

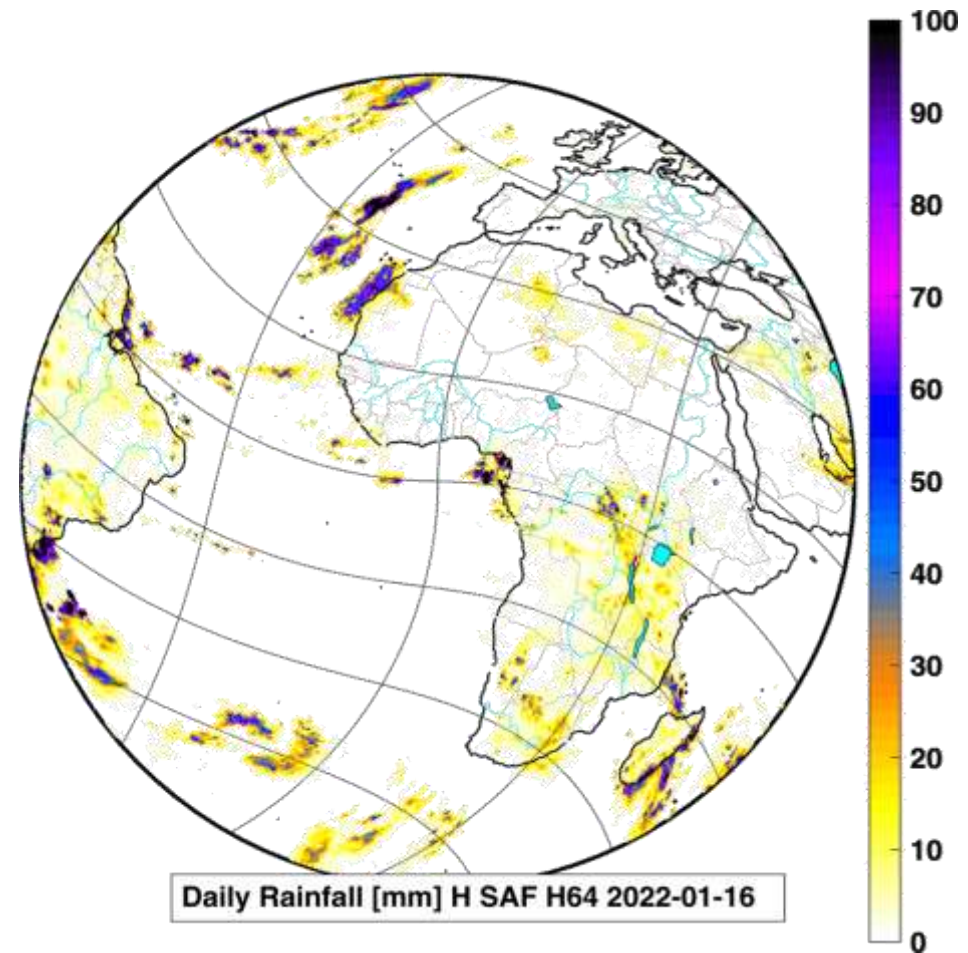
EUMETSAT H SAF P-AC-SEVIRI-PMW (H61)
Accumulated precipitation at ground
by blended MW and IR h61_20240309_0000_01_fdk



03/07 2024 Mar 09 00:17:59 Production SATELLITE AREA COMET Algorithm COMET-ABEUMETSAT-

H SAF precipitation products (SM +MW): Daily Rain

- Parameter: **Daily Rain**
- Frequency: **24 hours**
- Spatial Sampling: **25 Km**
- Latency: **15 hours**
- Available: **EUMETCAST**



REMOTE SENSING OF SOIL MOISTURE

COPERNICUS C3S SOIL MOISTURE
1978 to present, 1/10-day, 0.25-degree

Soil moisture gridded data from 1978 to present

Overview Download data Documentation

This dataset provides estimates of soil moisture over the globe from a large set of satellite sensors. It is based on the ESA Climate Change Initiative soil moisture version (3.3) and represents the current state-of-the-art for satellite-based soil moisture climate data record production, in line with the 'Systematic observation requirements for satellite-based products for climate' as defined by GCOSS (Global Climate Observing System). Data are on a regular latitude/longitude grid especially with gaps in space and time.

When dealing with satellite data it is common to encounter references to Climate Data Records (CDR) and Mission CDR (MCDR). For this dataset, both the CDR and MCDR parts of each product were generated using the same software and algorithms. The CDR is intended to have sufficient length, consistency, and continuity to detect climate variability and change. The MCDR provides a short-delay access to current data where consistency with the CDR baseline is expected but was not extensively checked. The dataset consists of the following products: 'soilmo', 'soilmo10' and 'soilmo100'. The 'soilmo' and 'soilmo10' products were created by using scatterometer and radiometer soil moisture products, respectively. The 'soilmo100' product results from a blend based on the two previous products.

More details about the product are given in the Documentation section.

SOIL WATER INDEX: 2007 to present,
1/10-day, 0.1-degree

Soil Water Index

SWI product updates

SWI: Interim update to version 3.1
Mon, 24 Sep 2018
Quality information on the SWI product available
Mon, 24 Sep 2018

The Soil Water Index quantifies the moisture condition at various depths in soil. It is mainly driven by the precipitation via the process of infiltration. Soil moisture is a very heterogeneous variable and varies on small scales with soil properties and drainage patterns. Satellite measurements integrate over relative

SURFACE SOIL MOISTURE: 2014 to present,
5-day, 1 km

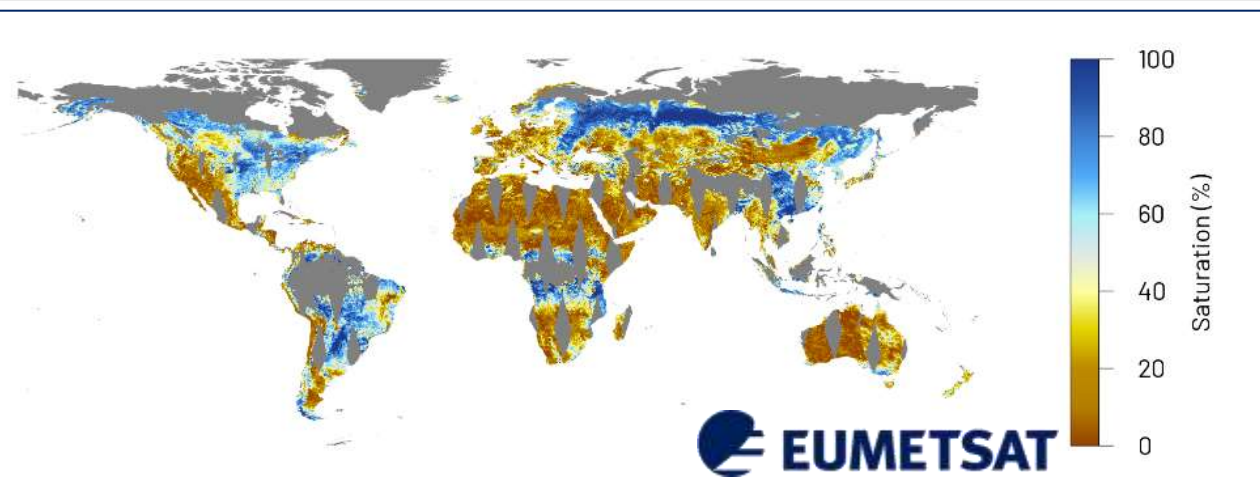
Surface Soil Moisture

SSM product updates

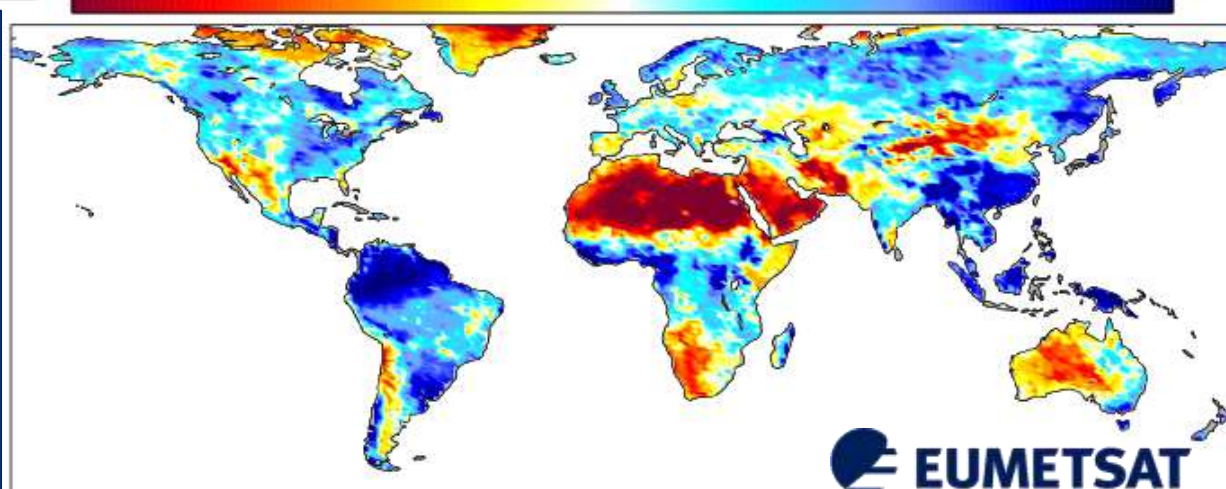
Early Access - Surface Soil Moisture of 0.1m resolution over Europe
Mon, 24 Sep 2018

Surface Soil Moisture (SSM) is the relative water content of the top few centimeters soil, describing how wet or dry the soil is in its topmost layer, expressed in percent saturation. It is measured by satellite

H SAF SURFACE SOIL MOISTURE: 2007 to present, 1-day, 1-10-
12,5 km

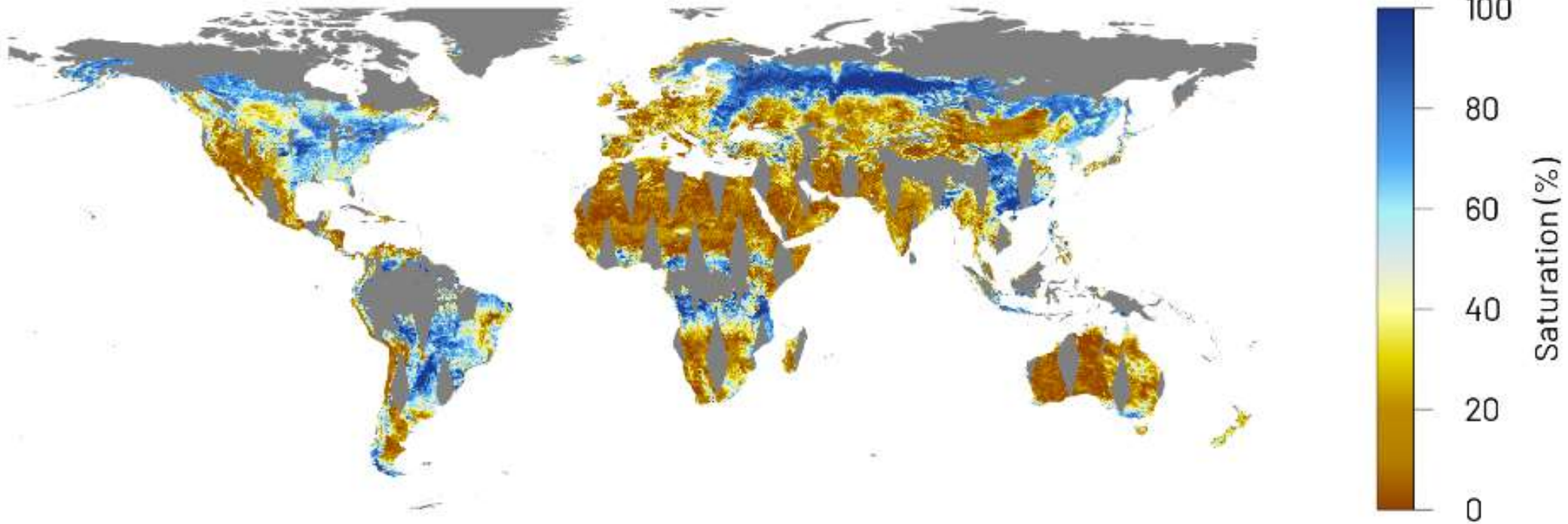
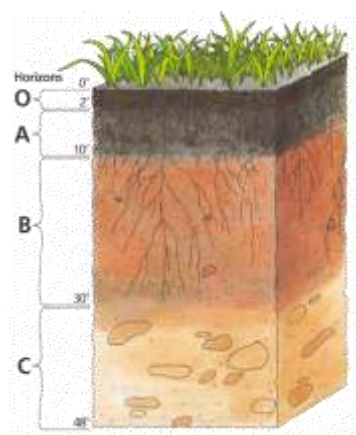


H SAF ROOT ZONE SOIL MOISTURE: 1992 to present, 1-day,
16 km



H SAF Soil Moisture products: Surface Soil Moisture

- SSM is expressed in soil saturation (0-100%) representing the topmost soil layer (< 5 cm)
- (Sub-)daily observations,
- **Near Real Time Products (Latency 2 hours)** : Spatial sampling **25 Km → 12.5km → 6.25 km → 1 Km (disaggregated)**
- **Data Record: from 2007, with spatial sampling 12.5 km.**

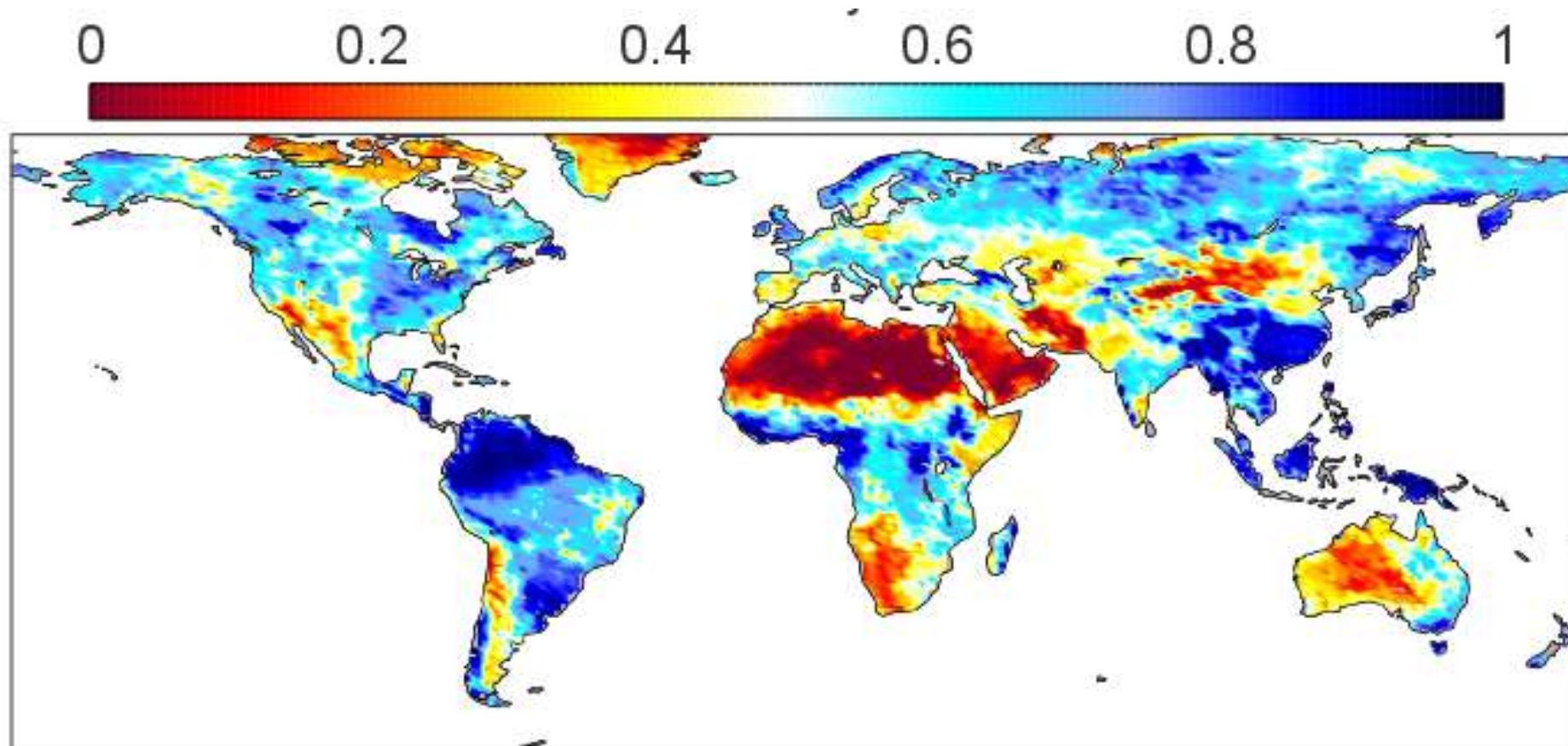


[Wagner et al. 2013 \(METZET\)](#)

H SAF Soil Moisture products: Root Zone Soil Moisture

- **RZSM is expressed as liquid soil wetness index at 4 layers;**
- **Daily observations (00 UTC);**
- **Near Real Time Products: 10 km spatial sampling**
- **Data Record: from 1992, with spatial sampling 10 km.**

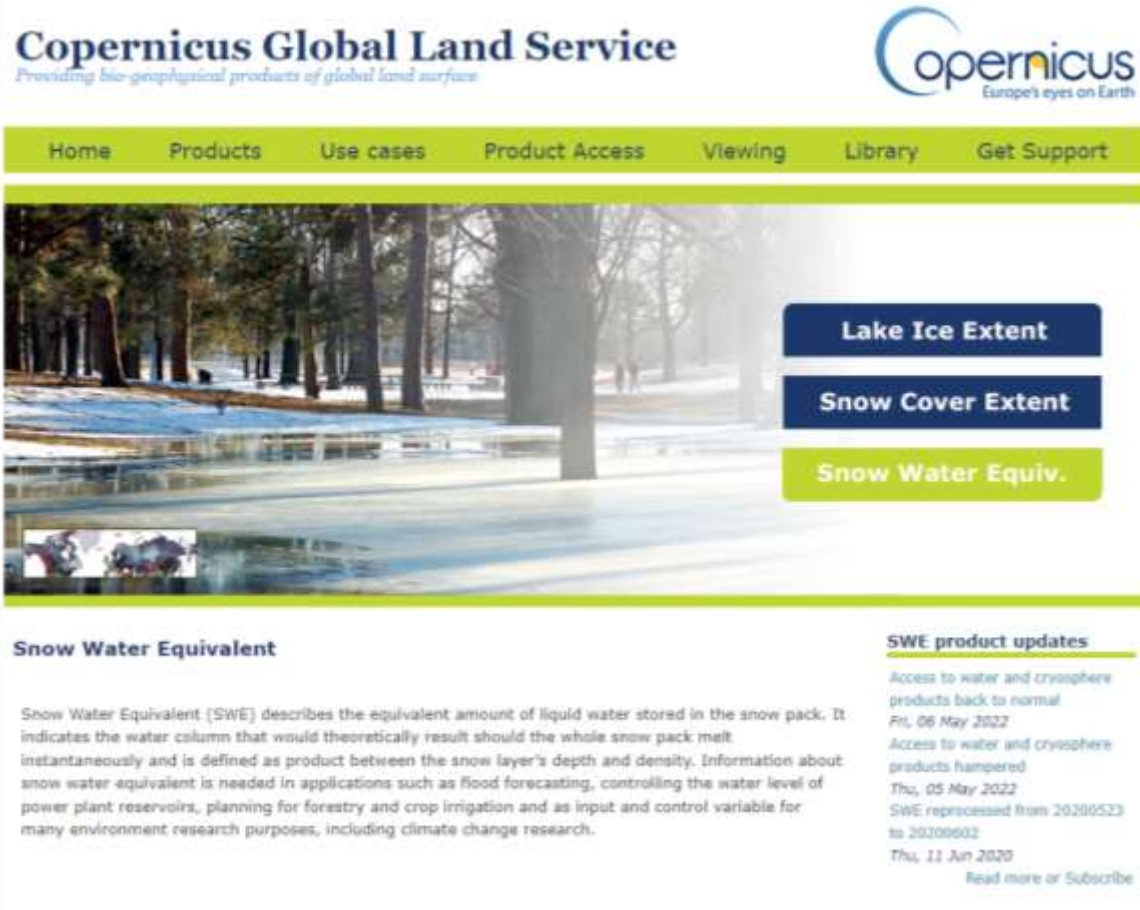
SM analysed over first 3 layers in H-TESEL:
Layer 1: 0-7 cm
Layer 2: 7-28 cm
Layer 3: 28-100 cm
Layer 4 (not analysed): 100-289 cm



[De Rosnay et al. 2013 \(QJRMS\)](#)
[Fairbairn et al. 2019 \(JHM\)](#)

REMOTE SENSING OF SNOW

Snow Water Equivalent
2006 to present, Northern Hemisphere (35N-85N), 5km



Copernicus Global Land Service
Providing bio-geophysical products of global land surface

Home Products Use cases Product Access Viewing Library Get Support

Lake Ice Extent
Snow Cover Extent
Snow Water Equiv.

Snow Water Equivalent

Snow Water Equivalent (SWE) describes the equivalent amount of liquid water stored in the snow pack. It indicates the water column that would theoretically result should the whole snow pack melt instantaneously and is defined as product between the snow layer's depth and density. Information about snow water equivalent is needed in applications such as flood forecasting, controlling the water level of power plant reservoirs, planning for forestry and crop irrigation and as input and control variable for many environment research purposes, including climate change research.

SWE product updates

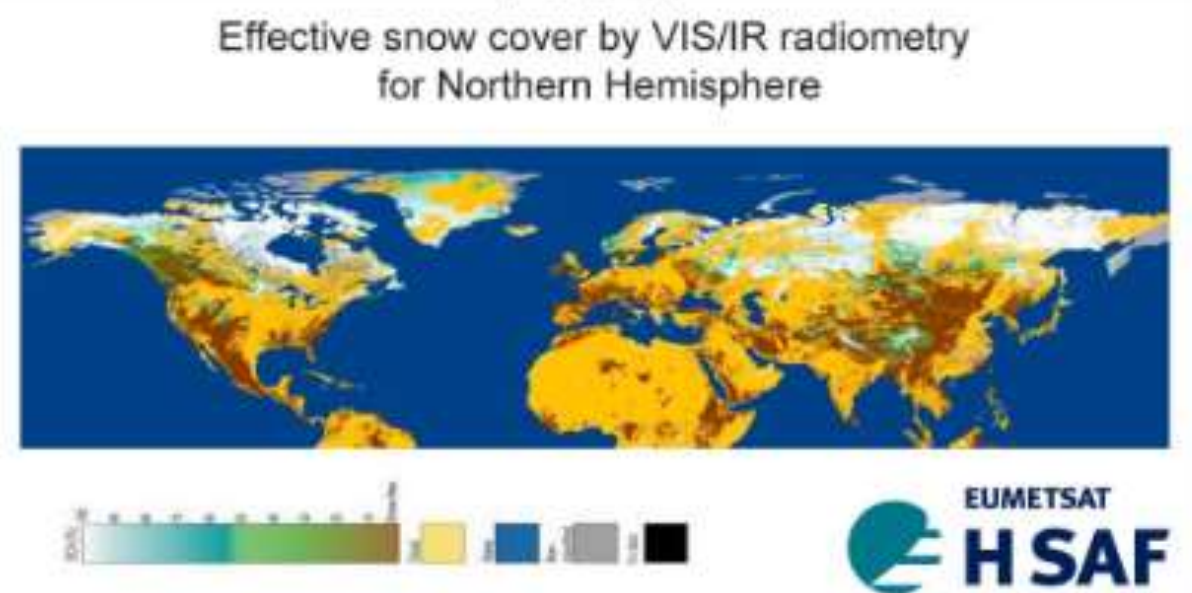
Access to water and cryosphere products back to normal
Fri, 06 May 2022

Access to water and cryosphere products hampered
Thu, 05 May 2022

SWE reprocessed from 20200523 to 20200602
Thu, 11 Jun 2020

[Read more or Subscribe](#)

H SAF Effective snow cover by VIS/IR radiometry
2022 to present, global coverage, 1-day, 2 km



ESC-H (H35)

Pre-Operational

Effective snow cover by VIS/IR radiometry

Effective snow cover product by VIS/IR radiometry is based on multi-channel analysis of the AVHRR instrument onboard MetOp satellites.

[Algorithm Theoretical Baseline Document \(ATBD\)](#)

EUMETSAT

H SAF Snow products

Daily EPS Snow Cover: presence of snow over land.

- Sub-daily : Four products (integrals over 3, 6, 12 and 24 h) every three hours (rolling)
- Near Real Time Products (3 hours): spatial sampling 10 Km

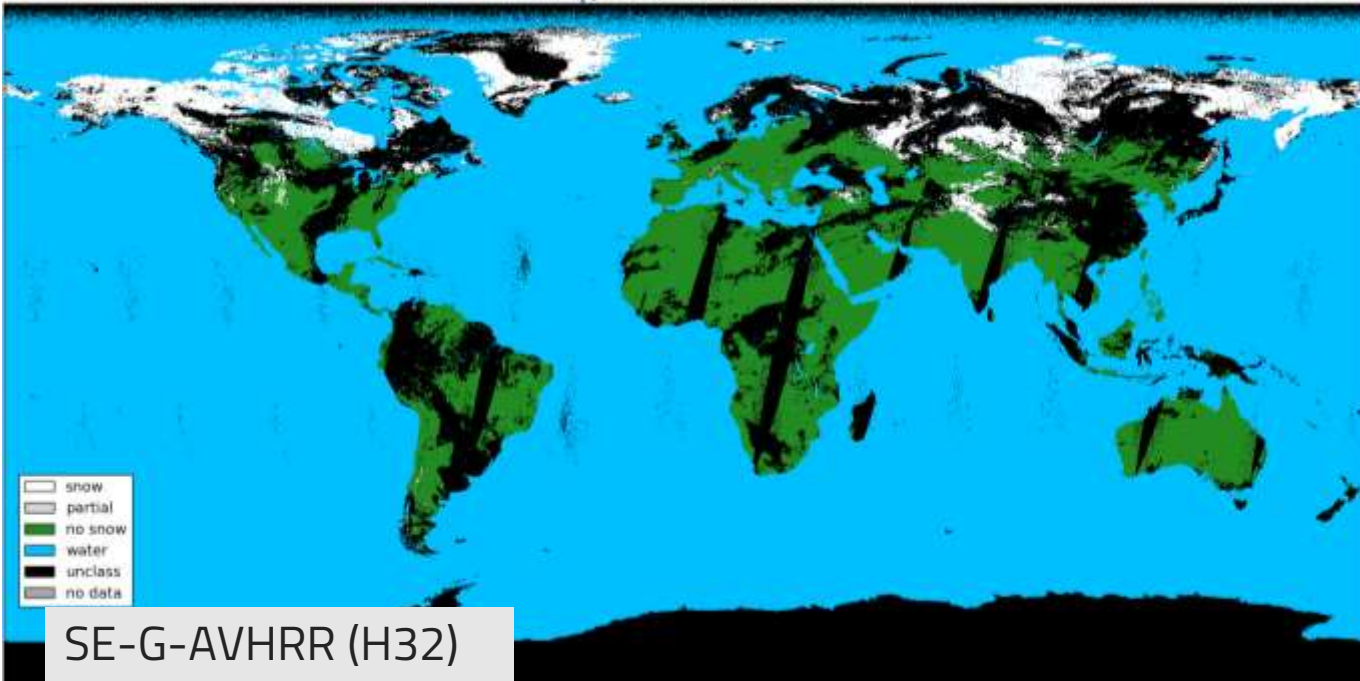
Snow detection (snow mask) by VIS/IR radiometry:

- Daily , Near Real Time Products (6 hours): SEVIRI Resolution

Effective snow cover by VIS/IR radiometry

- Daily, Near Real Time Products (6 hours): spatial sampling 10 Km

Metop/AVHRR snow 10.4.2017



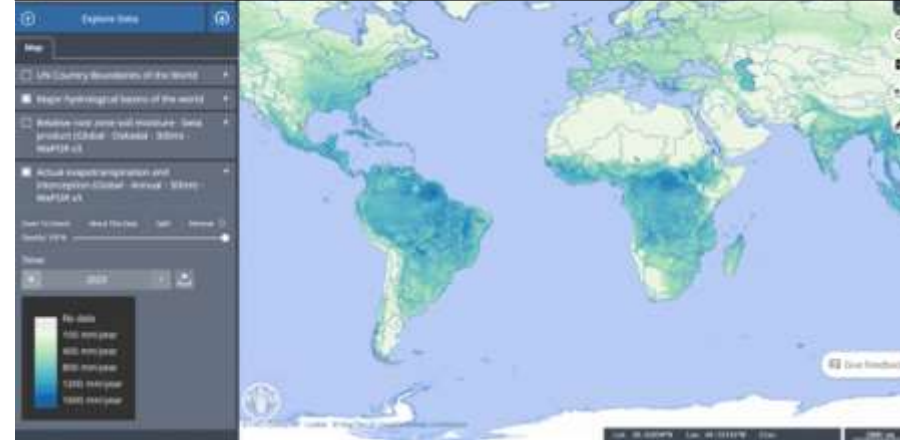
SE-G-AVHRR (H32)

ESC-H (H35)

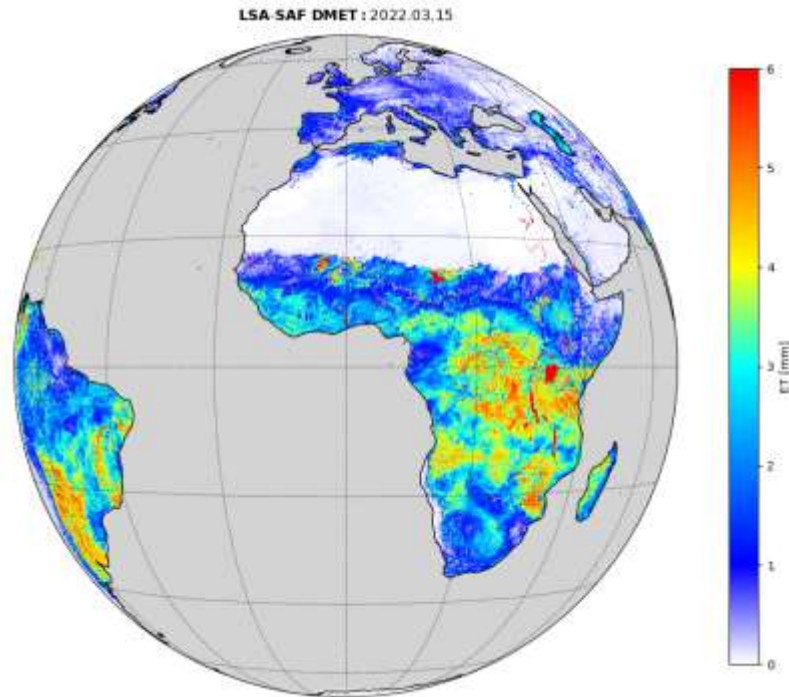


REMOTE SENSING OF EVAPOTRANSPIRATION

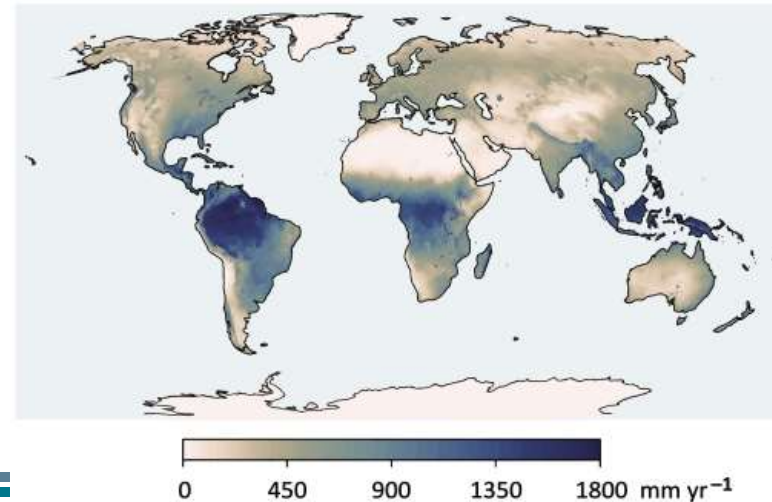
WaPOR: 2009 to present
Evaporation rate, 10-day, 300 m



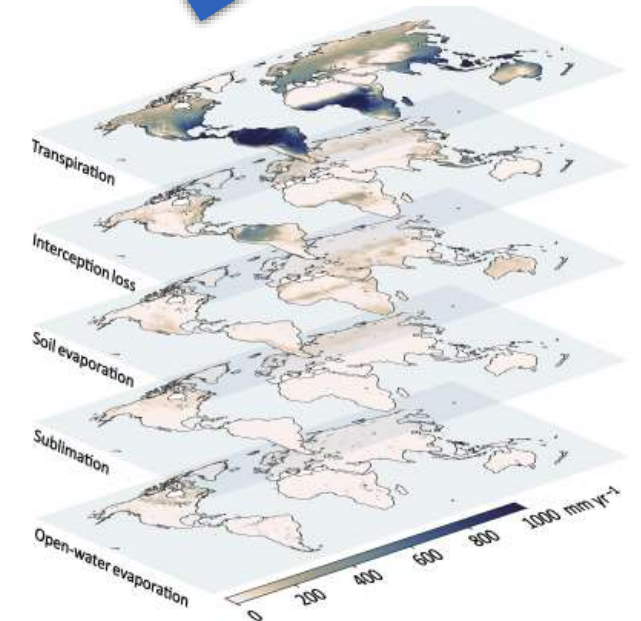
Land SAF: 2004 to present
Evaporation rate, 1-day, 3 km
(different versions)



GLEAM4: 2003 to 2023
Evaporation rate, 1-day, 10 km



...and many others:
USGS FEWS NET
ALEXI
EEFlux
PT-JPL
...



REMOTE SENSING FLOODS: COPERNICUS EMS- MAPPING

The image shows a screenshot of the Copernicus Emergency Management Service (EMS) Mapping website. At the top, the Copernicus logo is displayed with the tagline 'Europe's eyes on Earth'. Below the logo, there is a navigation menu with links for 'Home', 'What is Copernicus?', 'What is EMS - Mapping?', and 'Link to Early Warning Systems'. A search bar is located in the top right corner. The main content area features a heading 'The Emergency Management Service - Mapping' and a sub-heading 'The Copernicus Emergency Management Service (CEMS) uses satellite imagery and other geospatial data to provide free of charge mapping services in cases of natural disasters, human-made emergency situations and humanitarian crises throughout the world. It covers in particular:'. Below this, there is a list of services: 'Who can use the service', 'How to use the service', 'Portfolio: Rapid Mapping', and 'Portfolio: Risk and Recovery'. The website also includes a 'LATEST NEWS' section with a date '2023-09-22 | (Wednesday) edition in Fabrice Island, Greece'.

Post-disaster evaluation and preparedness analysis of flood in Togo 20/10/2020: delineation map



Sentinel 1 and Sentinel

Post-disaster evaluation and preparedness analysis of flood in Zimbabwe 26/03/2019: grading map



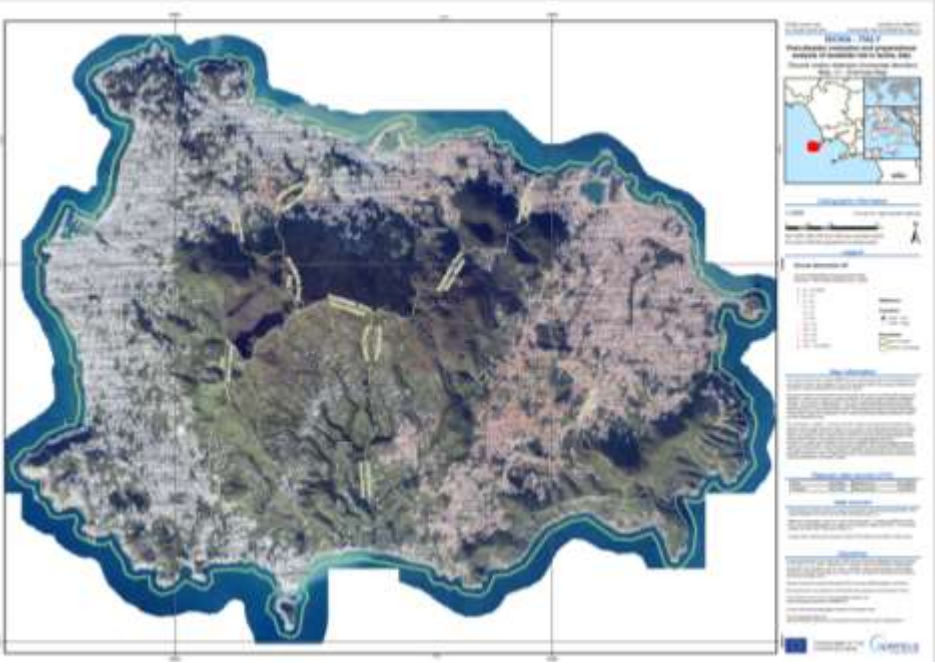
SPOT6 and Pleiades -1B

REMOTE SENSING LANDSLIDE: COPERNICUS EMS- MAPPING



The image shows the top section of the Copernicus EMS - Mapping website. It includes the Copernicus logo, the European Union flag, and the text 'COPERNICUS Emergency Management Service - Mapping'. Below this is a navigation menu with links for 'Home', 'What is Copernicus?', 'What is EMS - Mapping?', 'Link to Early Warning Systems', and 'News'. A 'LATEST NEWS' section is also visible, with a date of '2023-08-22' and a link to a 'Webinar in Europe Island, Geneva'. A sidebar on the right contains a search bar and a 'News' button.

Post-disaster evaluation and preparedness analysis of landslide risk in Ischia, Italy – Ground motion analysis



interferometric product based on Copernicus Sentinel - 1 data (2014 - 2022) GSD=20 m

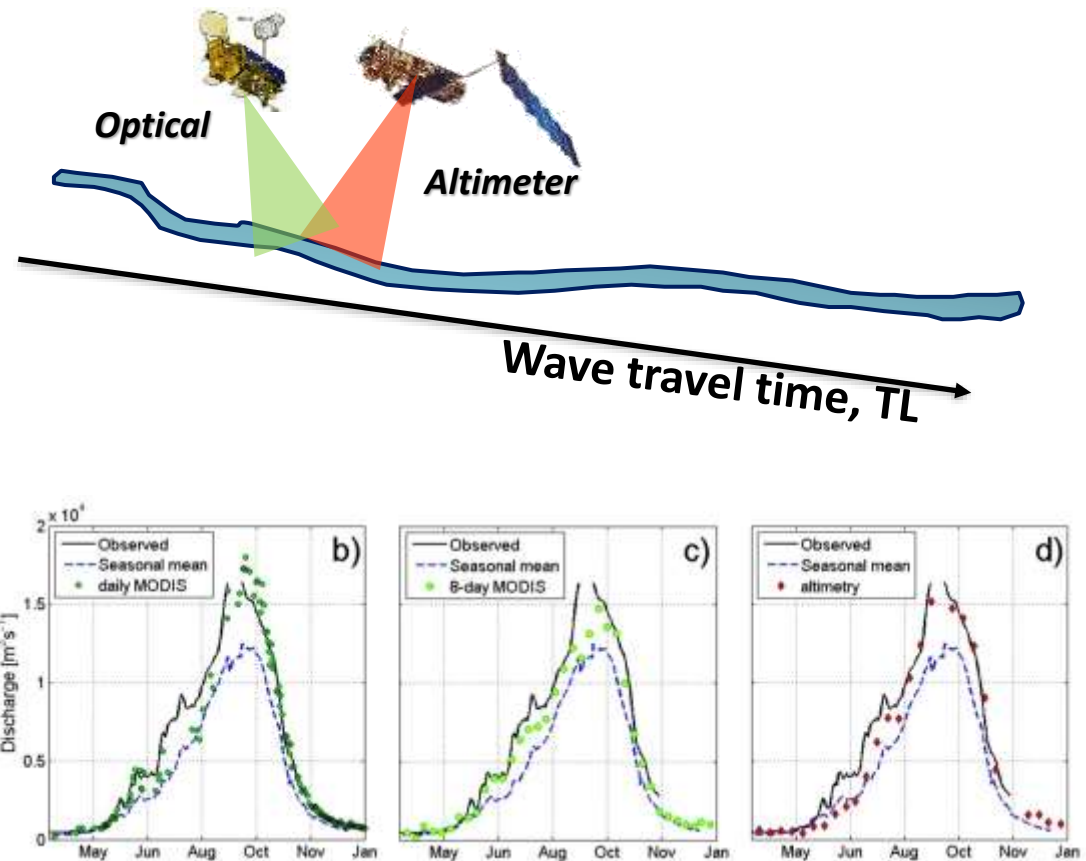
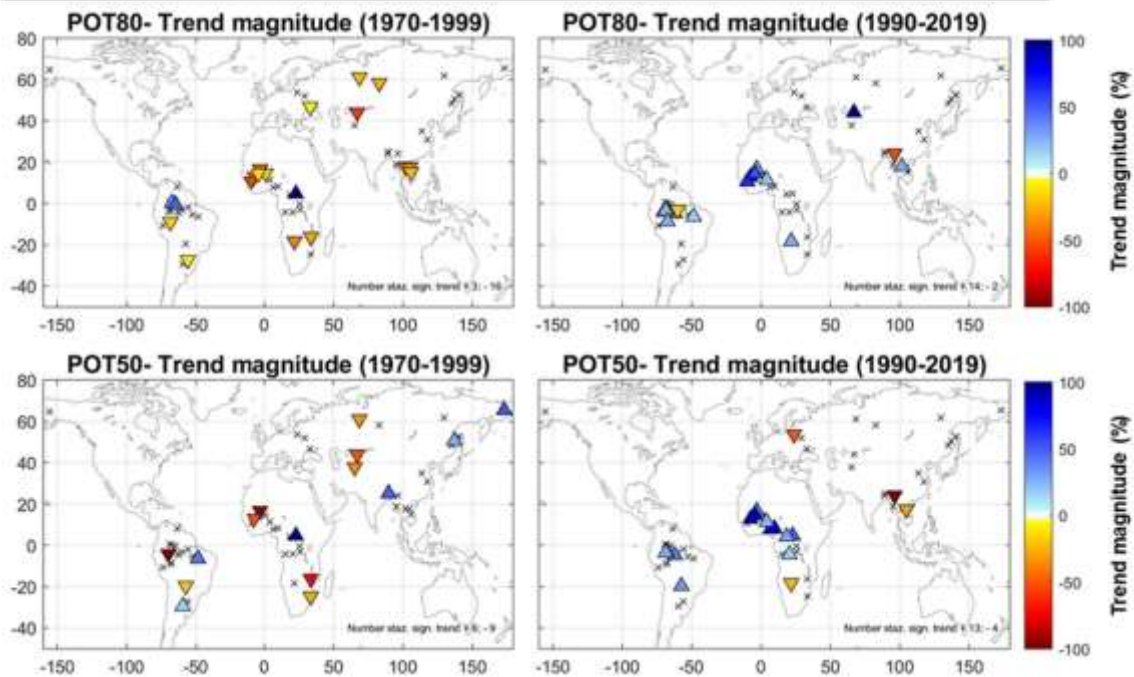
Post-disaster evaluation and preparedness analysis of landslide risk in Ischia, Italy – Delineation map



Pleiades data

REMOTE SENSING FOR RIVER DISCHARGE

Rating curves are used to extend the temporal series of river discharge in poorly gauged rivers and investigate long-term climate trend



REMOTE SENSING FOR WATER BODIES EXTENT: S2



San Giuliano Reservoir (Basilicata)

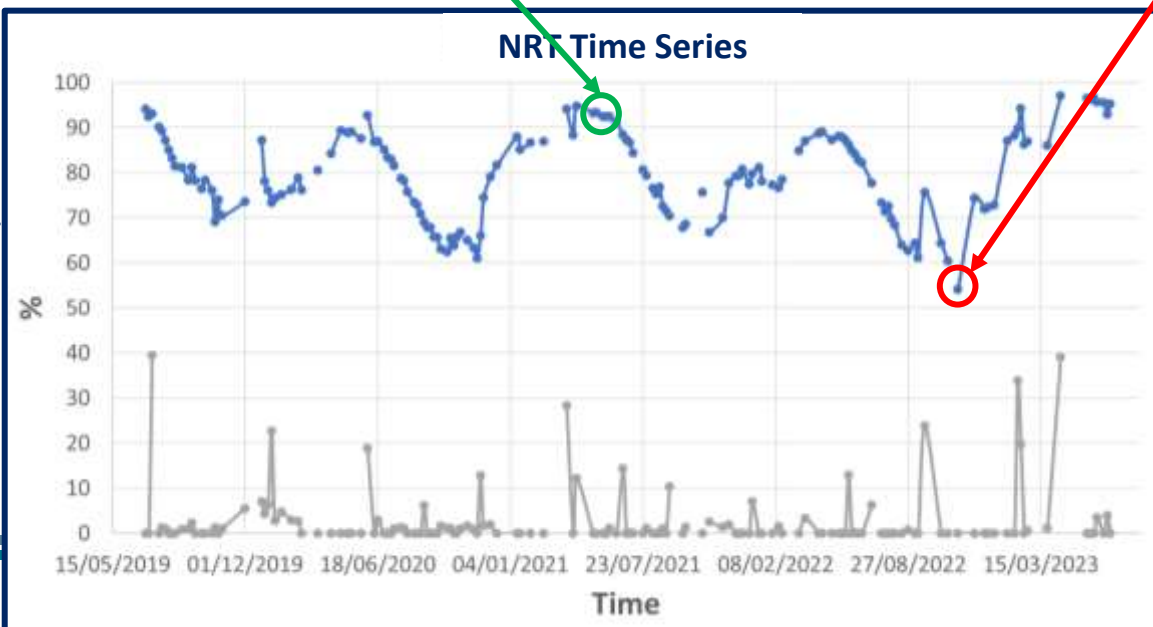
1. NRT WB Extent map

S2 Acquisition Day	13/06/2021
Daily WB % Extent	91 %



1. NRT WB Extent map

S2 Acquisition Day	10/11/2022
Daily WB % Extent	54 %



2. NRT time series of WB % Extent



*Masked pixels are pixels covered by clouds and clouds' shadows

June 2020

Fanaco Lake

COSMO-SkyMed (SAR Image)
Spatial Resolution: 5 m



S2 (Optical Image)
Spatial Resolution: 10 m



June 2021

Fanaco Lake

COSMO-SkyMed (SAR Image)
Spatial Resolution: 5 m



S2 (Optical Image)
Spatial Resolution: 10 m



June 2022

Fanaco Lake

COSMO-SkyMed (SAR Image)
Spatial Resolution: 5 m



S2 (Optical Image)
Spatial Resolution: 10 m



June 2023

Fanaco Lake

COSMO-SkyMed (SAR Image)
Spatial Resolution: 5 m



S2 (Optical Image)
Spatial Resolution: 10 m



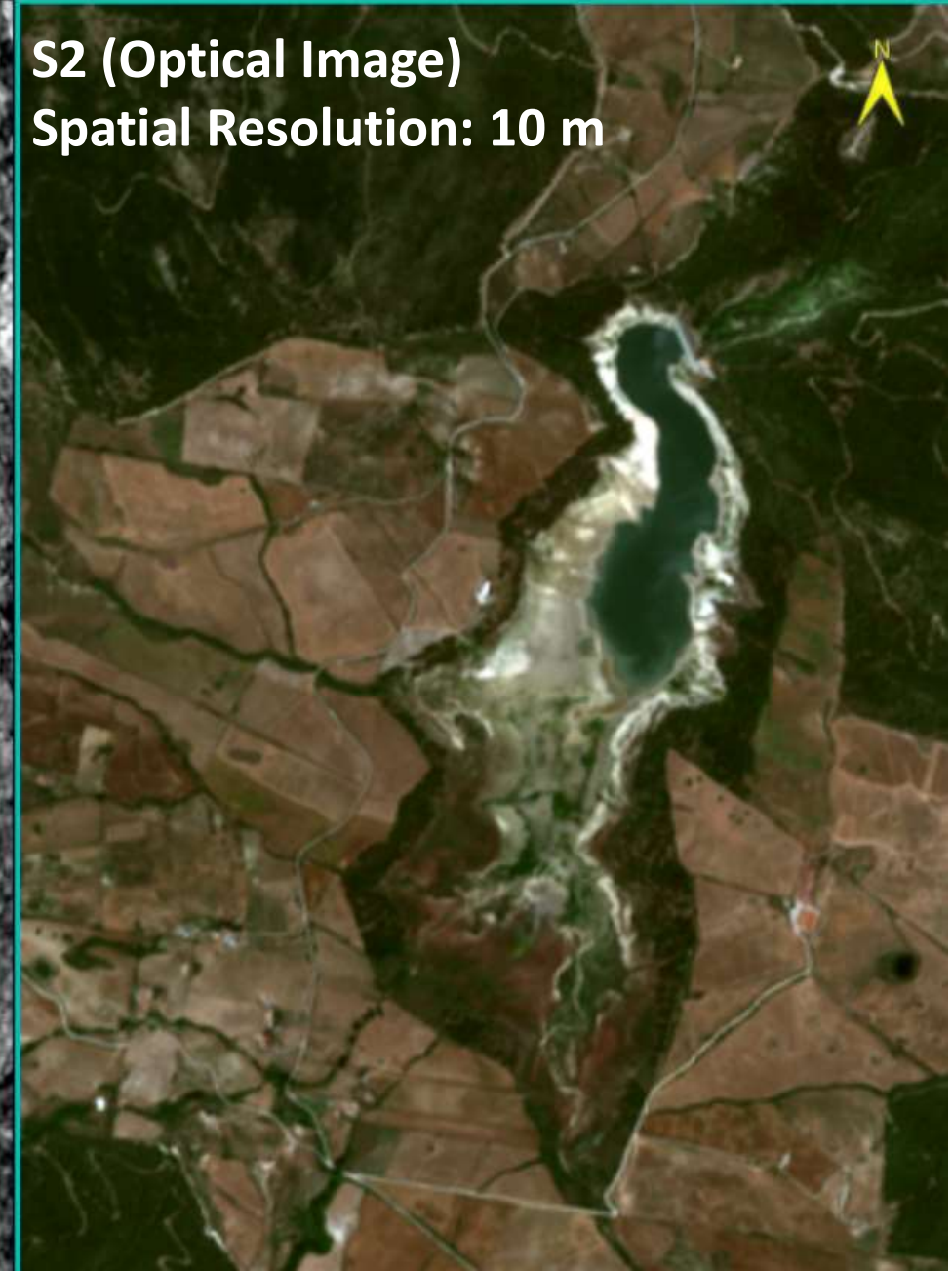
June 2024

Fanaco Lake

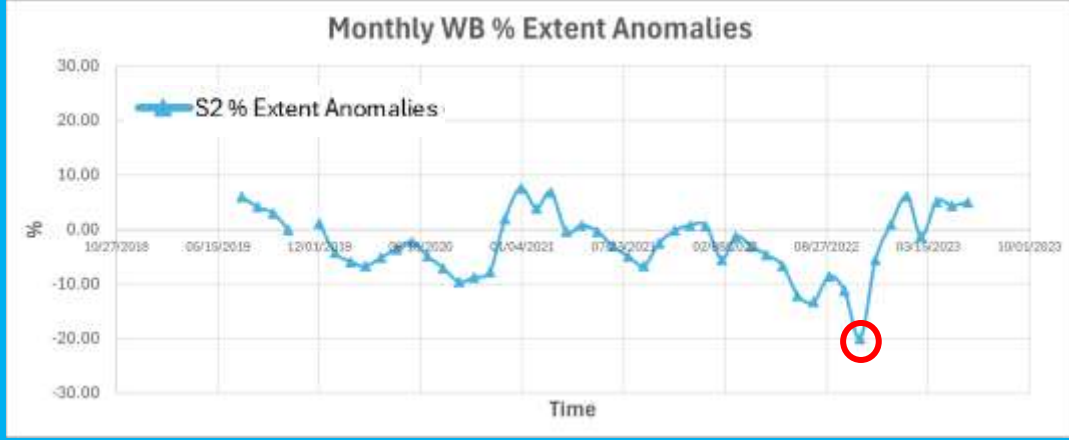
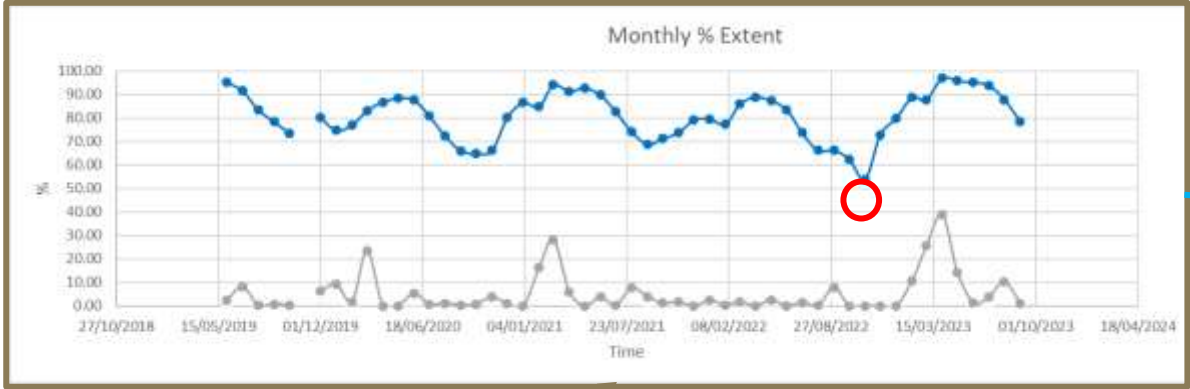
COSMO-SkyMed (SAR Image)
Spatial Resolution: 5 m



S2 (Optical Image)
Spatial Resolution: 10 m

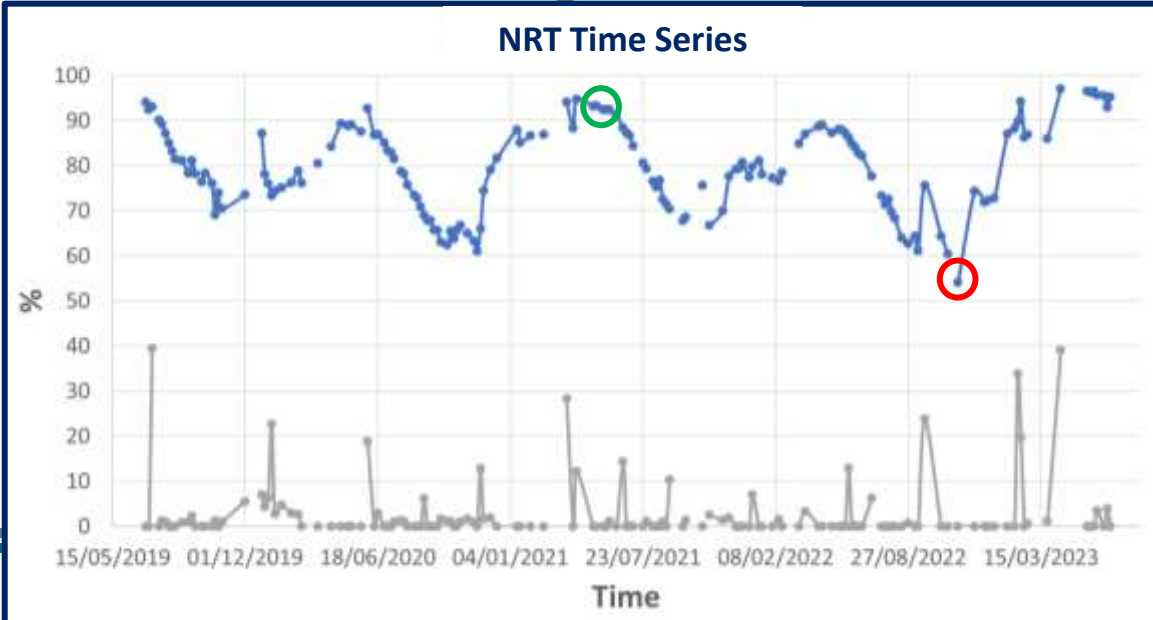


REMOTE SENSING FOR WATER BODIES EXTENT: S2



3. Monthly time series of WB % Extent

4. Monthly time series of WB % Extent Anomalies (long-term reference time period 2015-2023)



2. NRT time series of WB % Extent

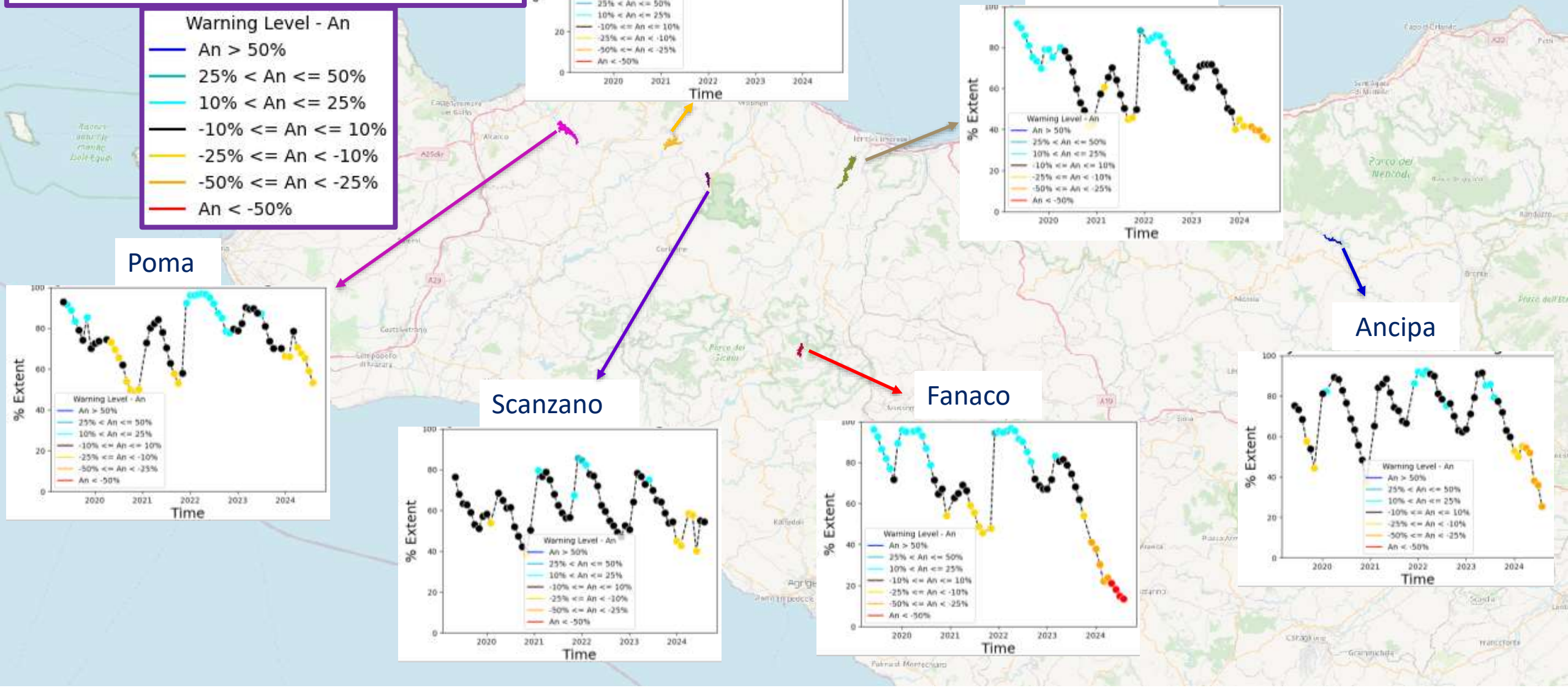
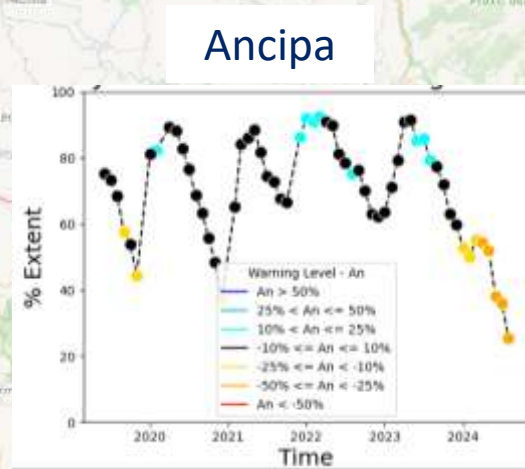
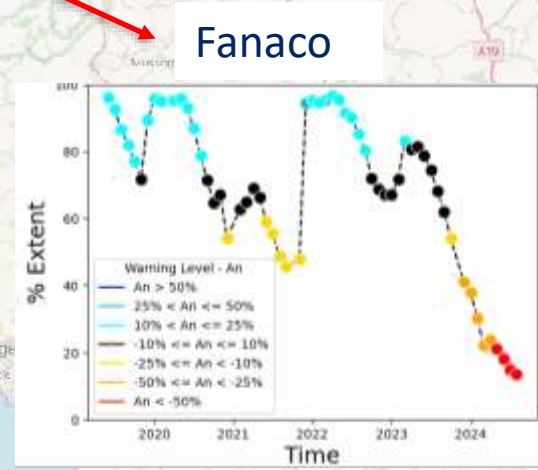
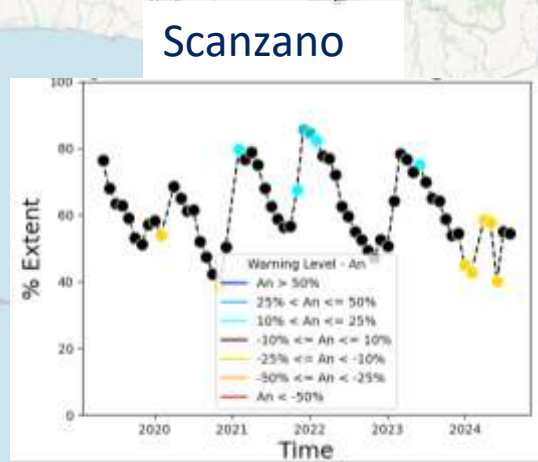
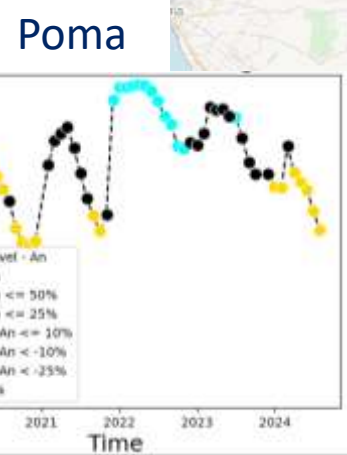
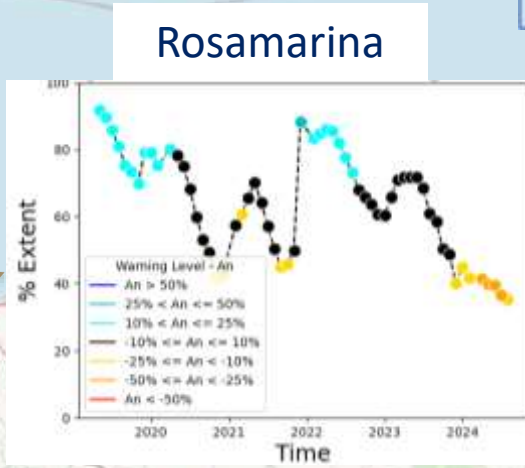
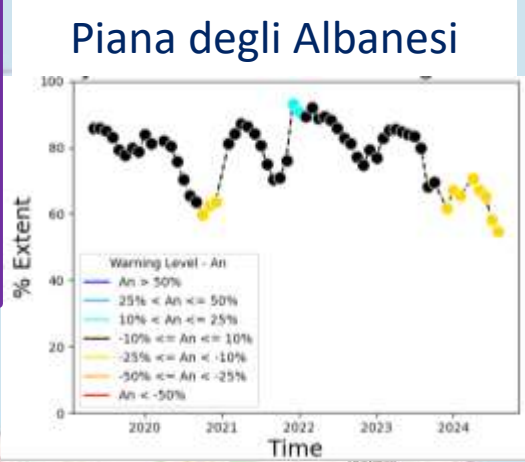


*Masked pixels are pixels covered by clouds and clouds' shadows

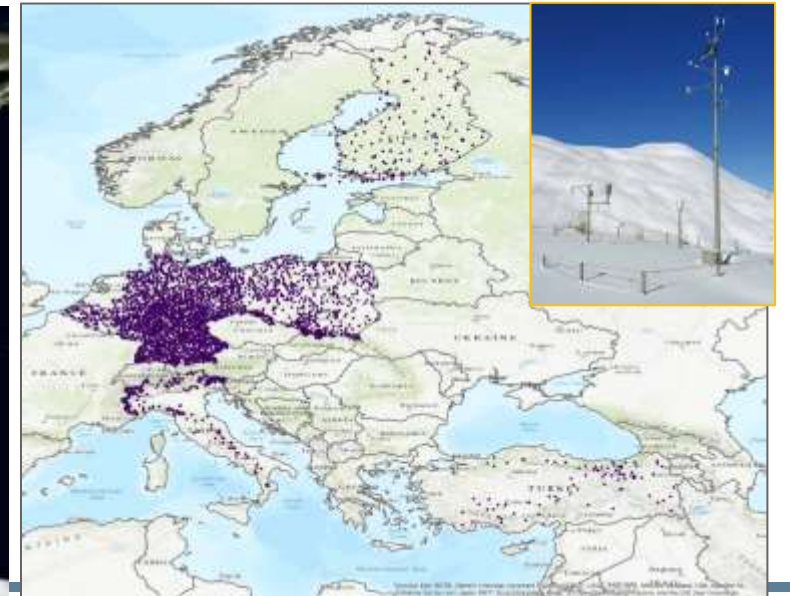
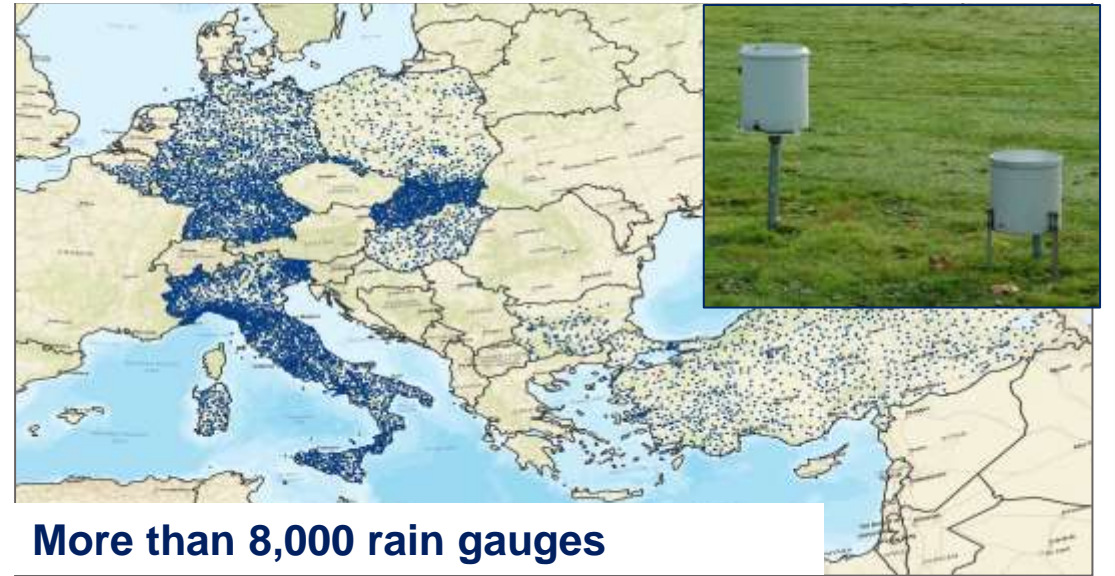
Monthly time series of WB % Extent for selected reservoirs located in Sicily + Anomaly Indicators for Warnings (January 2018 – August 2024)



- Warning Level - An**
- An > 50%
 - 25% < An <= 50%
 - 10% < An <= 25%
 - -10% <= An <= 10%
 - -25% <= An < -10%
 - -50% <= An < -25%
 - An < -50%



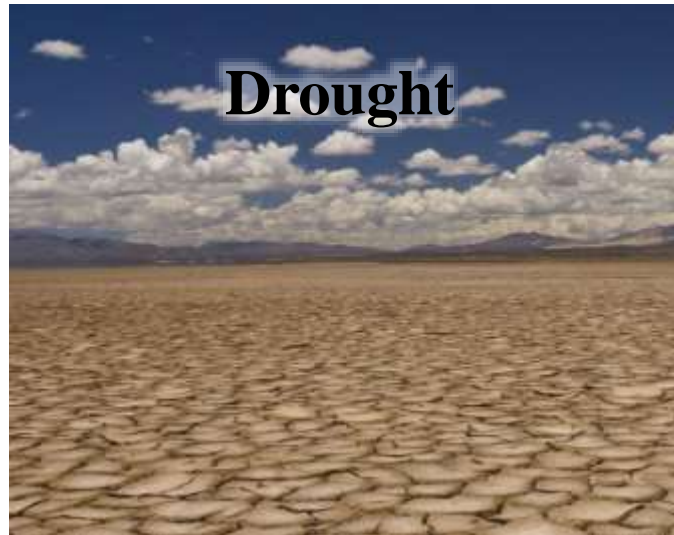
VALIDATION



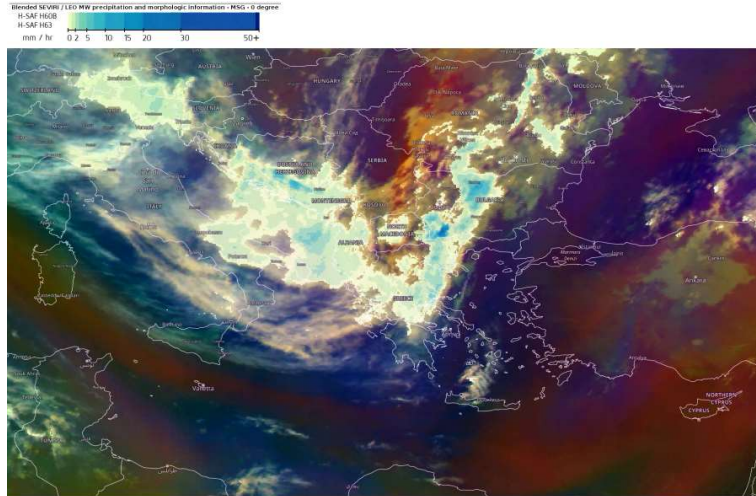
APPLICATIONS



EXTREME EVENTS



Flood in Grace and Lybia September 2023



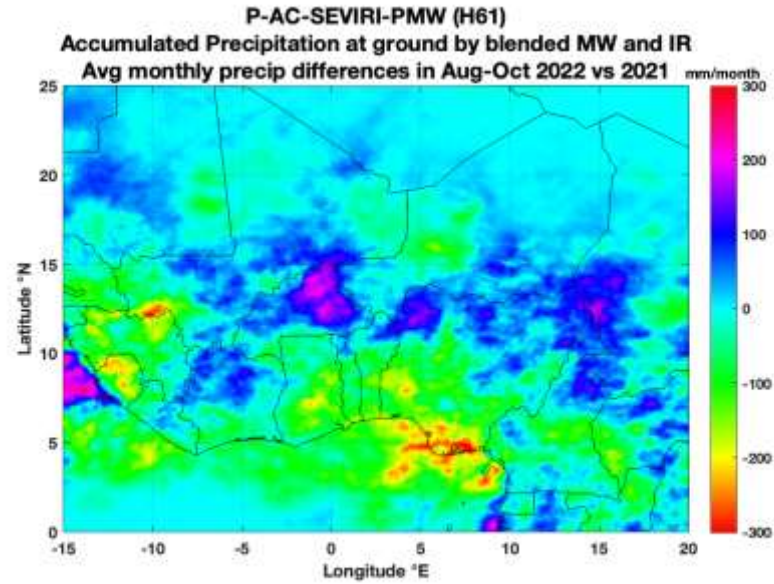
EUMETSAT

2023-09-04 00:00:00 UTC

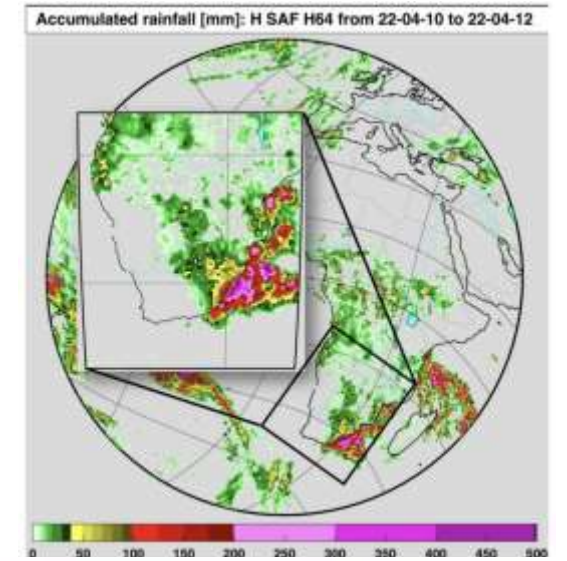


SkySat imagery of Zaria, captured on Sept. 2 and 12, 2022 (satellite photo: Planet/Lab/PRC)

Flood in Nigeria July 2022



Flood in South Africa 11-13 April 2022

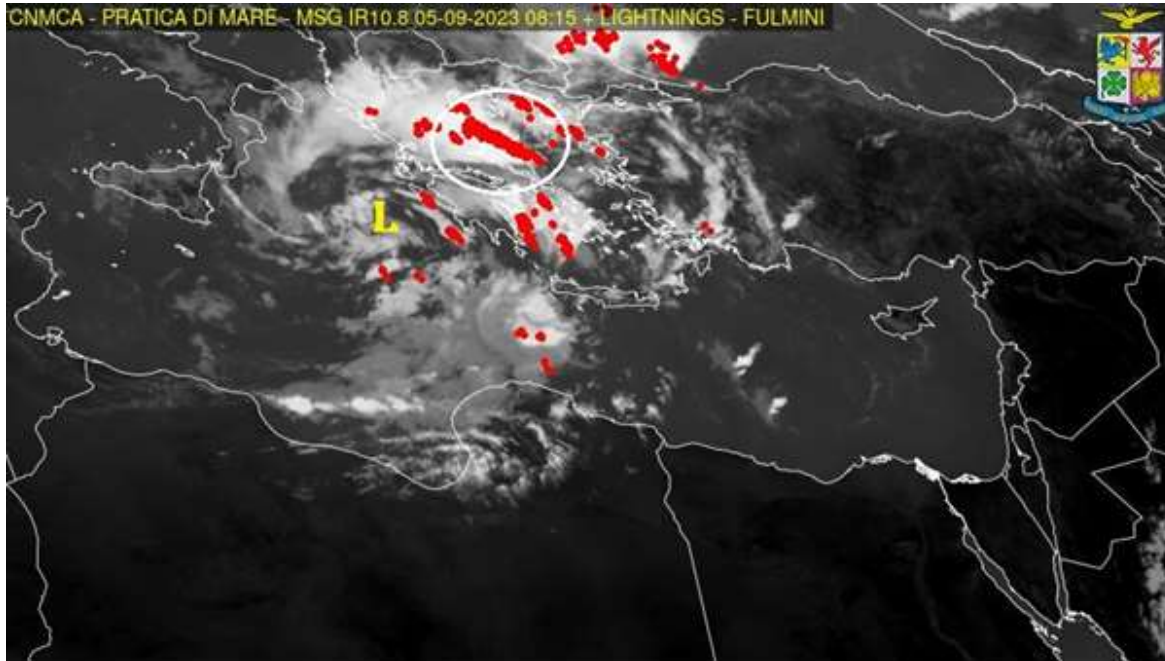


Cite: <https://www.france24.com/en/live-news/20220418-what-s-behind-southafrica-s-flood-disas>

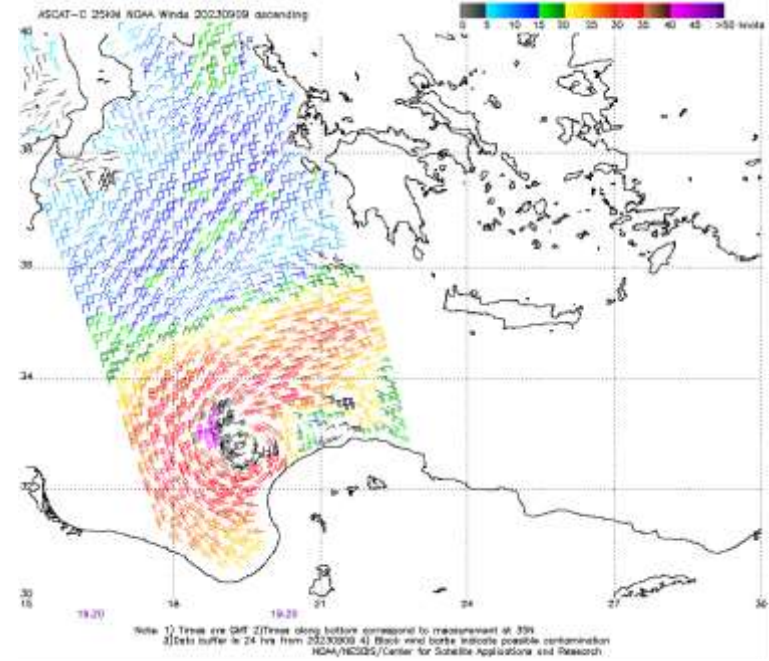
THE STORM DANIEL

FLOOD IN GRACE AND LYBIA - SEPTEMBER 2023

MSG satellite in the morning of the 5th September
Mediterranean Low (L), west of Peloponnesus; very thick clouds,
lightnings with widespread thunderstorms (white circle)



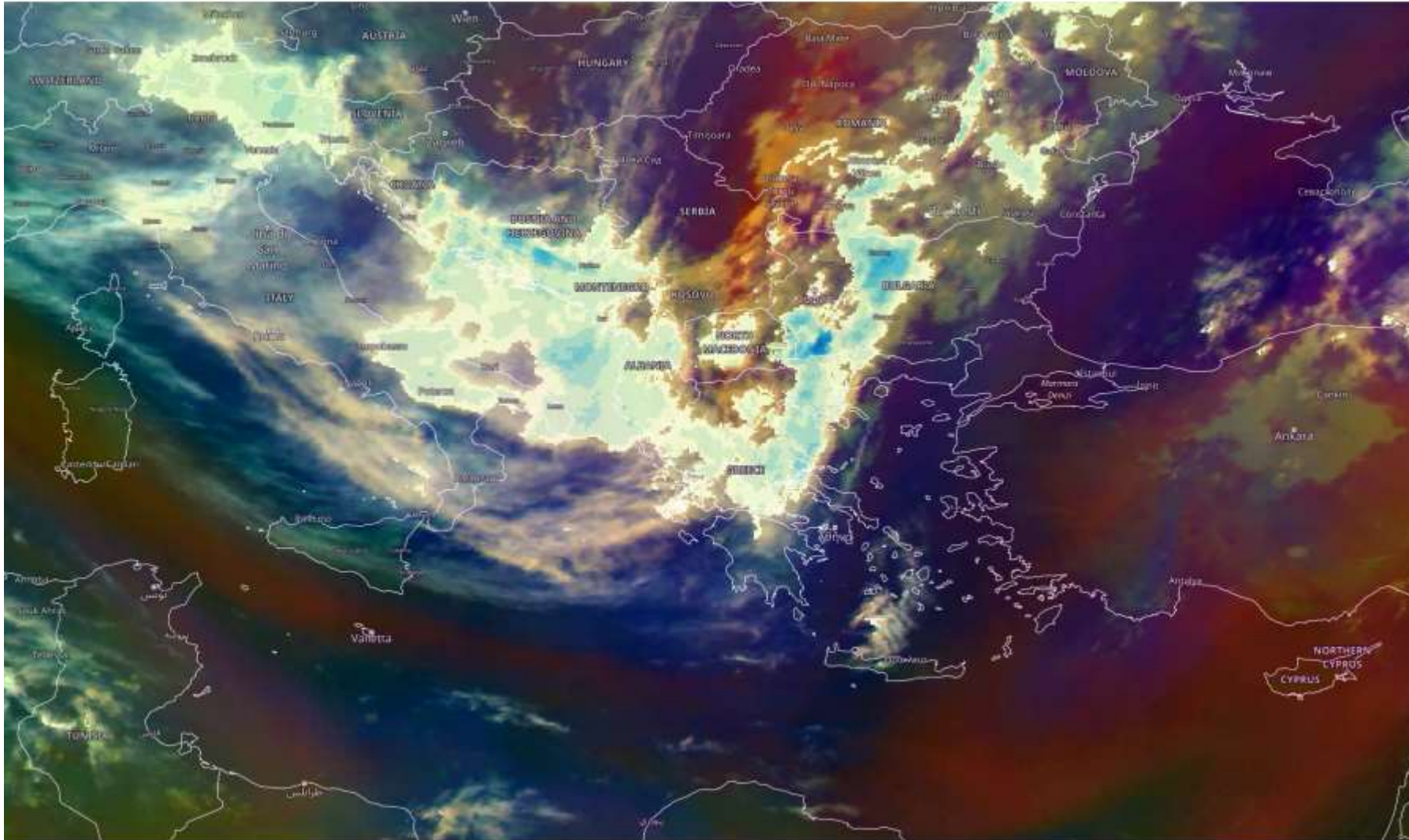
ASCAT wind vectors



On 4th September 2023, a through, coming from eastern Europe and developing over Central Europe and the Middle East, begins to move south over the Balkan area. Widespread rain affects Greece, especially the eastern and central parts. On 5th, 6th and 7th September the through remains quasi-stationary and develops into a Mediterranean Cyclone over the Ionian

THE STORM DANIEL

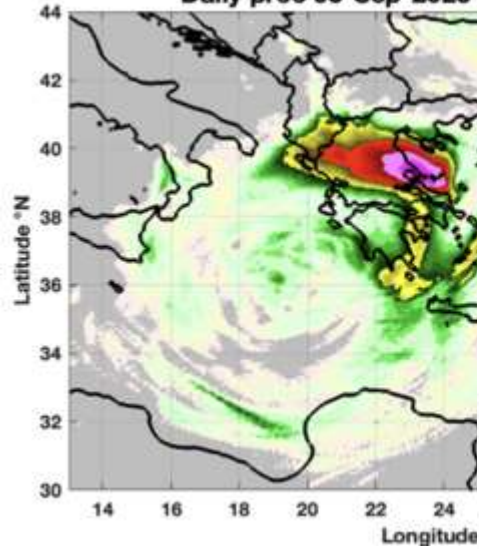
Blended SEVIRI / LEO MW precipitation and morphologic information - MSG - 0 degree
H-SAF H60B
H-SAF H63
mm / hr 0 2 5 10 15 20 30 50+



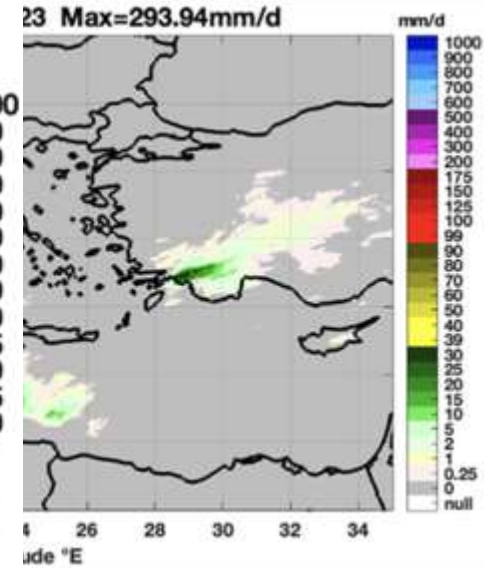
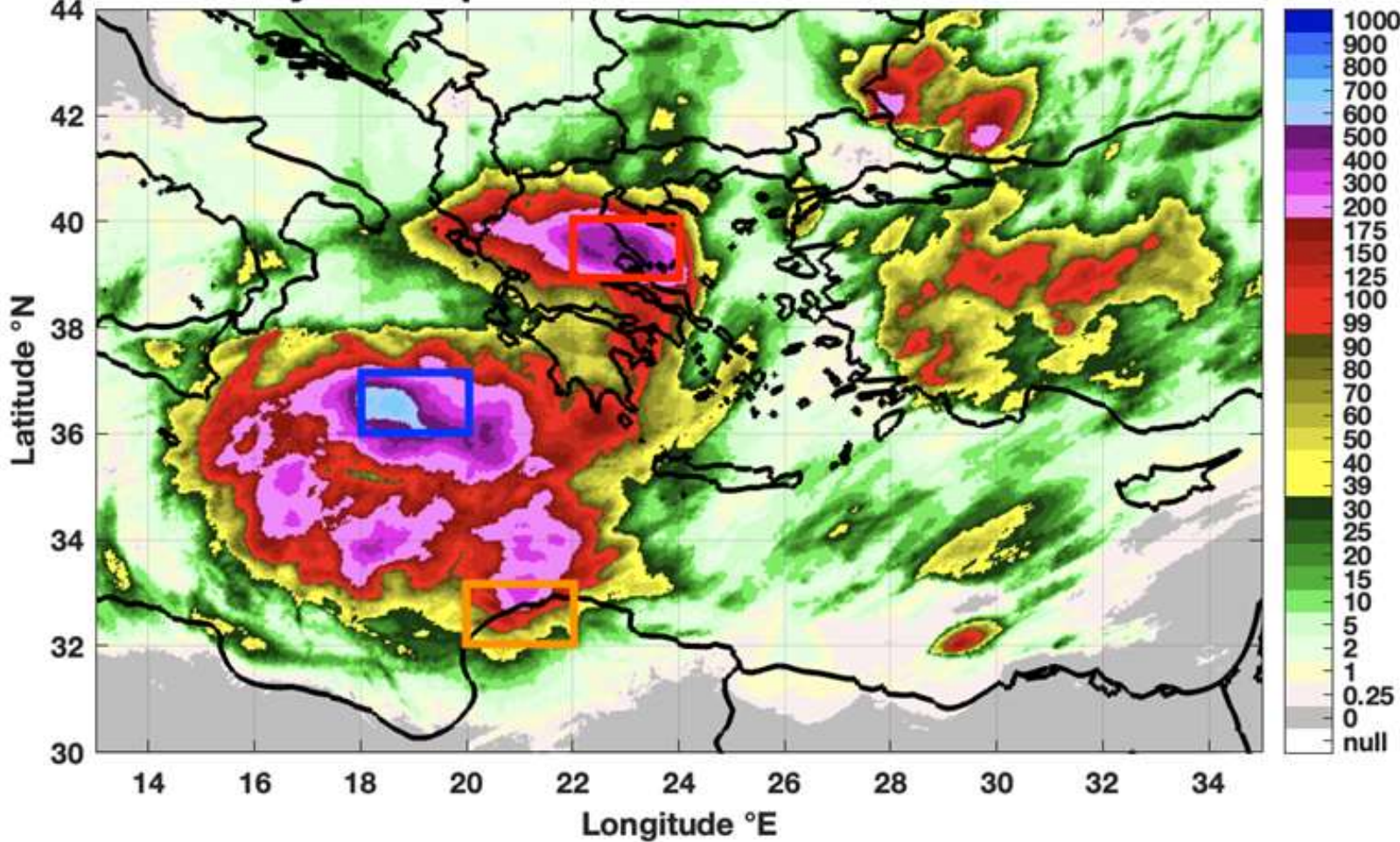
THE STORM DANIEL

September 2023

Daily prec 05-Sep-2023



Cyclone Daniel
11days H61B prec 02-12/09/2023 Max=757.81mm



<https://user.eumetsat.int/resources/case-studies/extreme-floods-in-libya-and-central-greece>



Satellite imagery of Qena, captured on Sept. 2 and 3, 2022 (satellite photo: Planet Labs PBC)

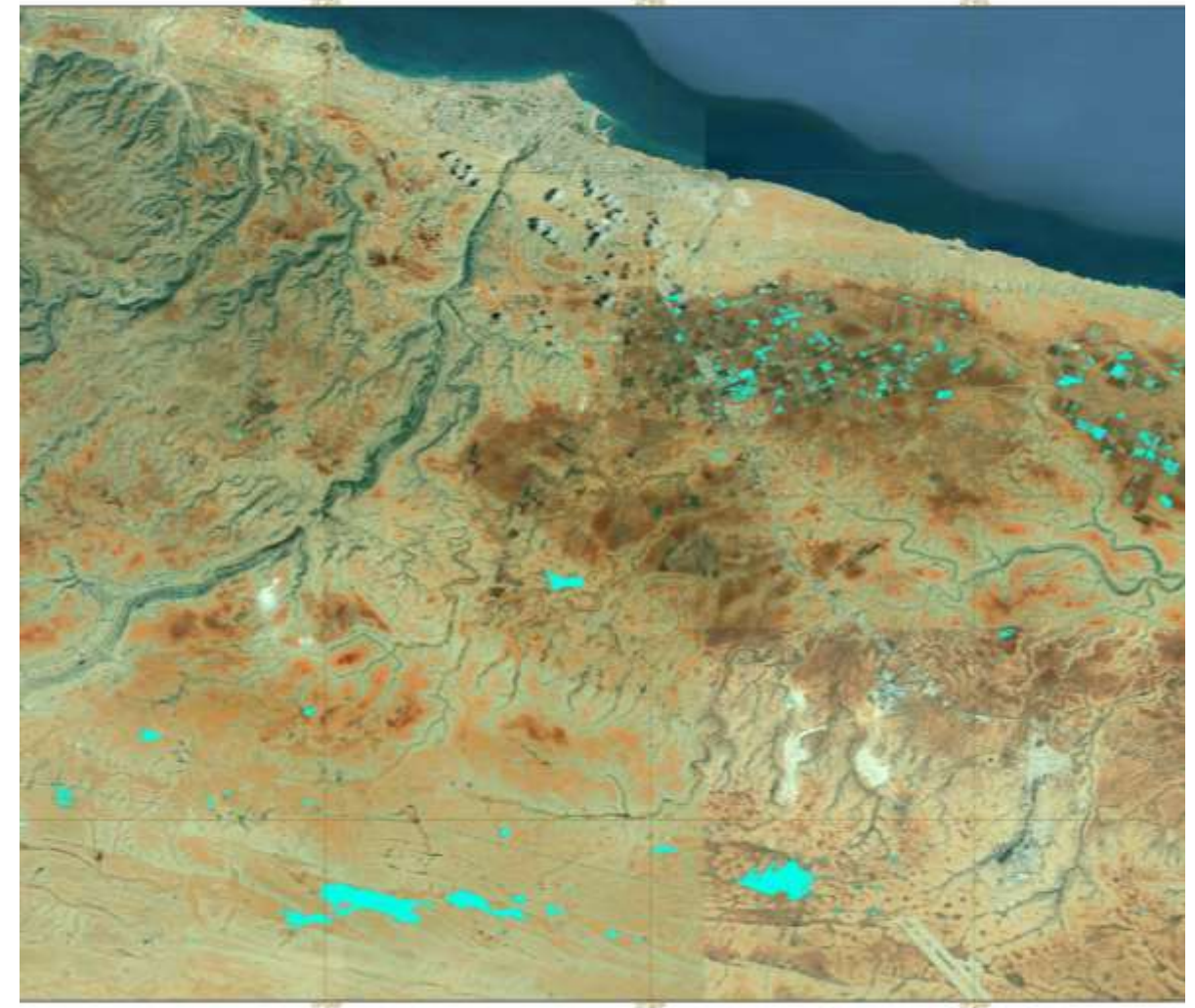
Satellite images taken before and after [floodwaters in northeastern Libya](#) burst through dams and wiped out buildings and entire neighborhoods show the sheer scale of the deadly destruction caused by Mediterranean storm Daniel.



Satellite imagery of Qena, captured on Sept. 2 and 3, 2022 (satellite photo: Planet Labs PBC)

Satellite images taken before and after [floodwaters in northeastern Libya](#) burst through dams and wiped out buildings and entire neighborhoods show the sheer scale of the deadly

Flooded areas map



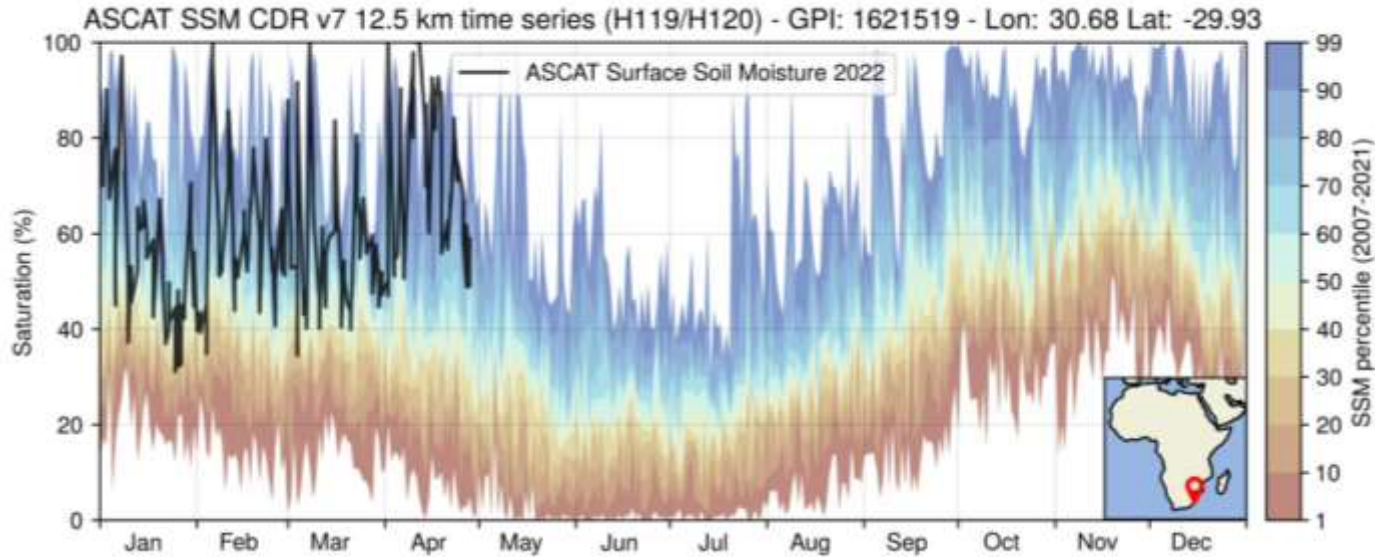
Legenda

- Water bodies
- Flooded Areas

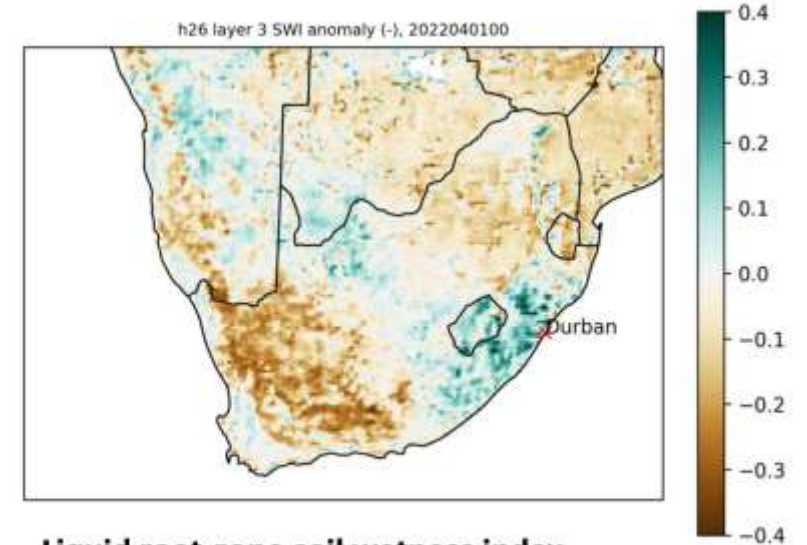
Data source
 ©2024 10880022 10 10/24

Terms of use
 "The product 'Flooded areas map' was created in emergency and algorithm chosen using the AUTODRIVE (AUTOMATIC Disaster Visual Detection) processing developed by the USRA Foundation and it has not been validated with data and observations on the ground. Mapping activity aims to provide the most accurate products possible, however, the information produced has limitations due to the scale, resolution, data, and processing methods of satellite data. The CPC assumes no responsibility for the content provided or their possible subsequent use by third parties."

FLOOD IN SOUTH AFRICA APRIL 2022, ANTECEDENT CONDITION



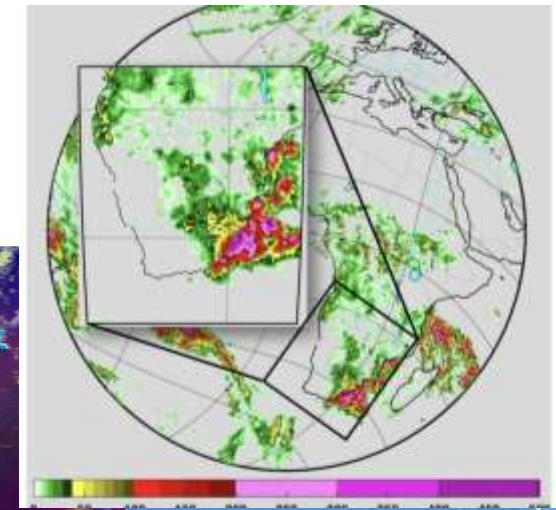
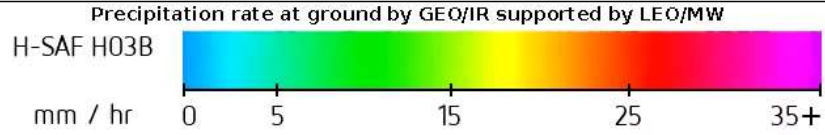
ASCAT SSM DR for an area close to Durban. Highly saturated soil surface conditions can be seen in the beginning of April 2022 compared to surface soil moisture percentiles derived from previous years 2007-2021.



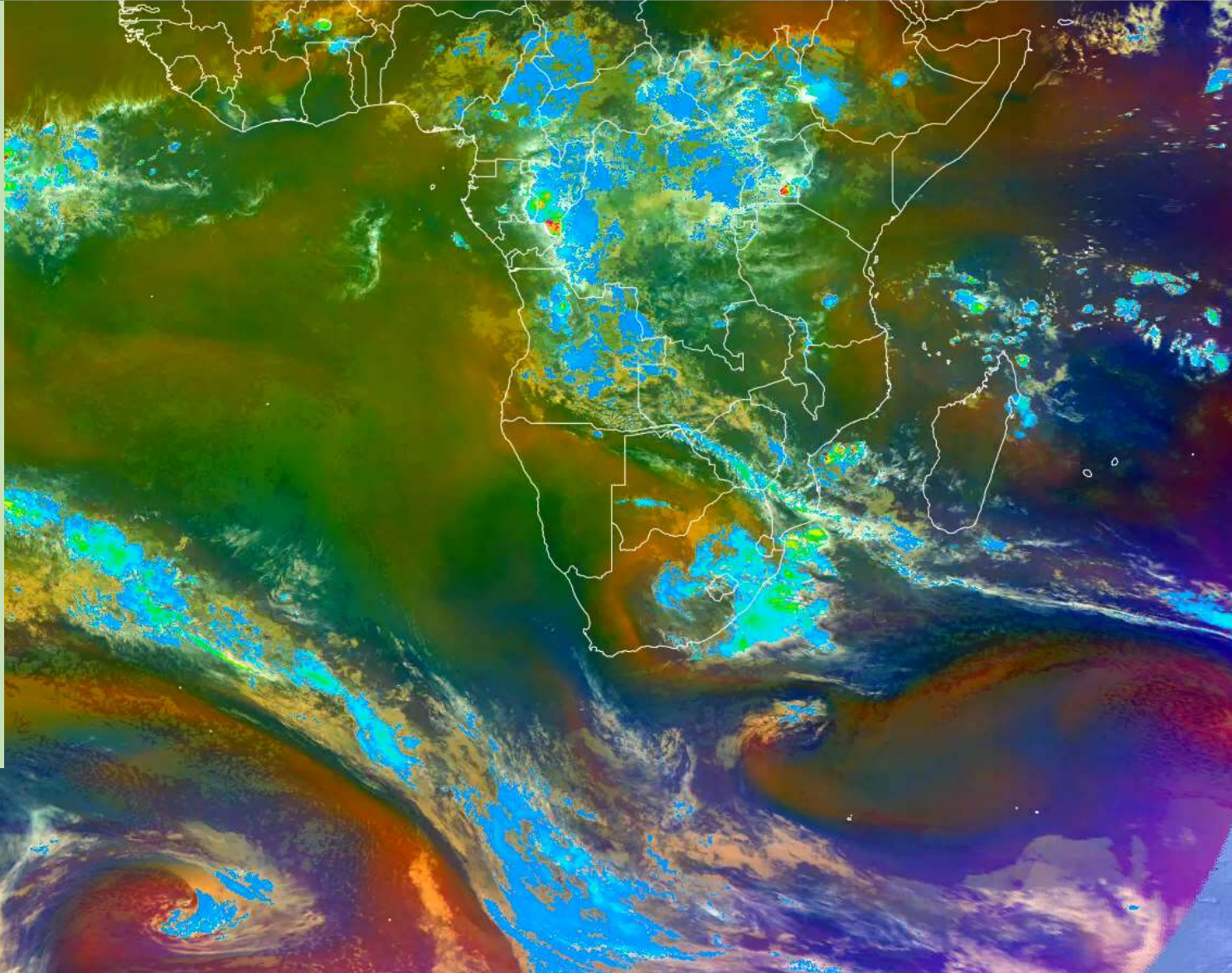
Liquid root-zone soil wetness index anomaly (RZSM-ASCAT-NRT-10 [H26])

Liquid root-zone soil wetness index 1st of April 2022 for layer 3, (28-100 cm depth). Saturated soil moisture conditions are present around Durban.

FLOOD IN SOUTH AFRICA APRIL 2022, PRECIPITATION

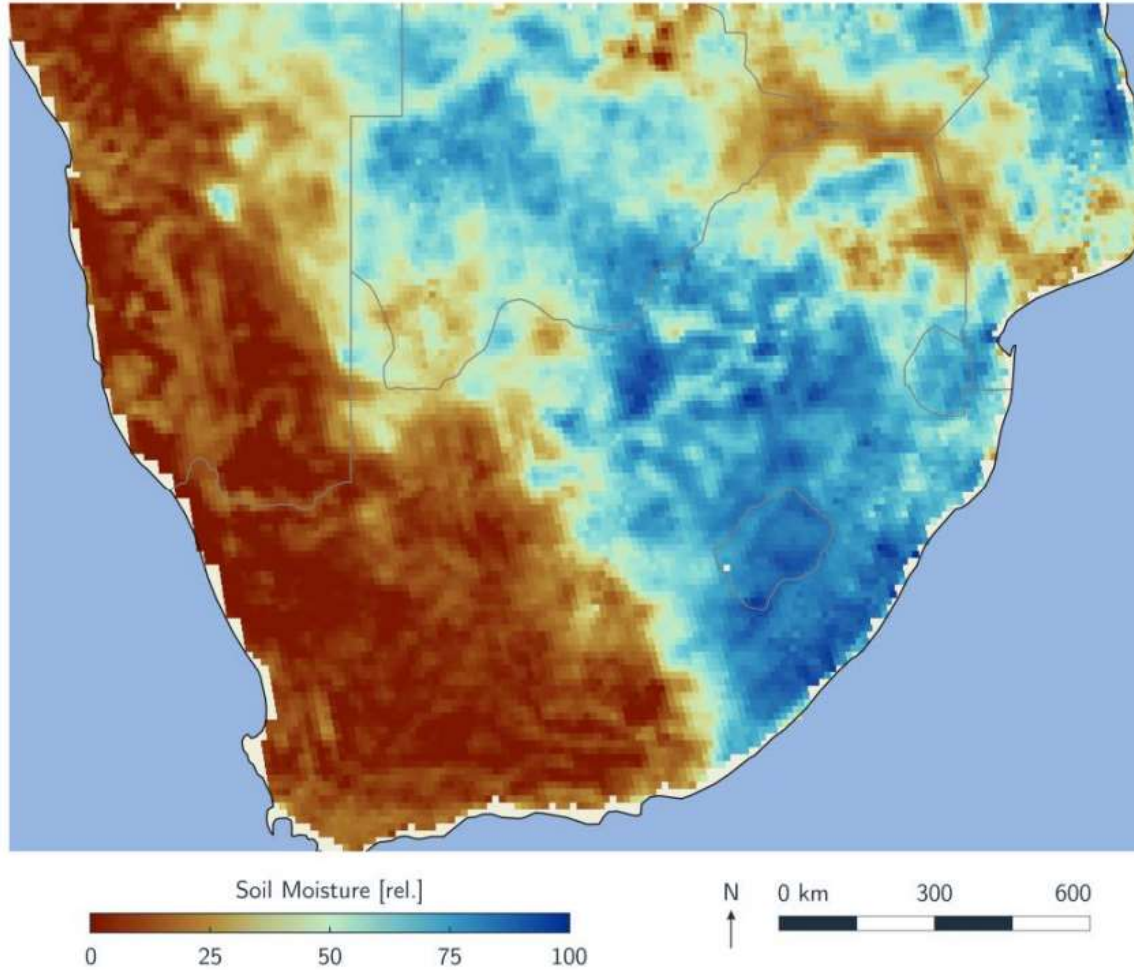


The city of Durban, in South Africa, is particularly vulnerable to heavy rainfall. An intense flooding has been registered in the period 11-13th April 2022. P-AC-SM2RAIN [H64] product highlighted 300 mm of accumulated precipitation in 3 days, in the South Africa (11-13 April 2022). P-IN-SEVIRI [H03] (Precipitation rate at ground by blended MW and IR) animation from EUMETview shows persistent, over nearly 3 days, precipitation in the South Africa (11-12 April 2022).



FLOOD IN SOUTH AFRICA APRIL 2022, ANTECEDENT CONDITION

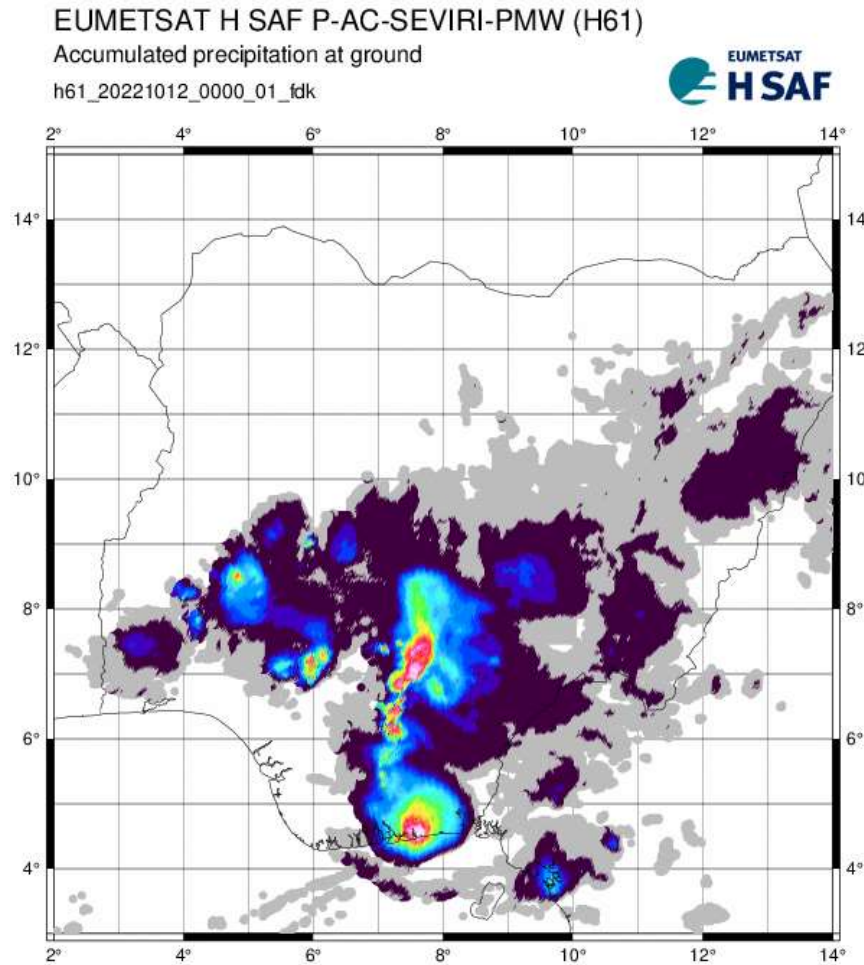
ASCAT NRT Surface Soil Moisture | South Africa | 2022/04/12 - 2022/04/14



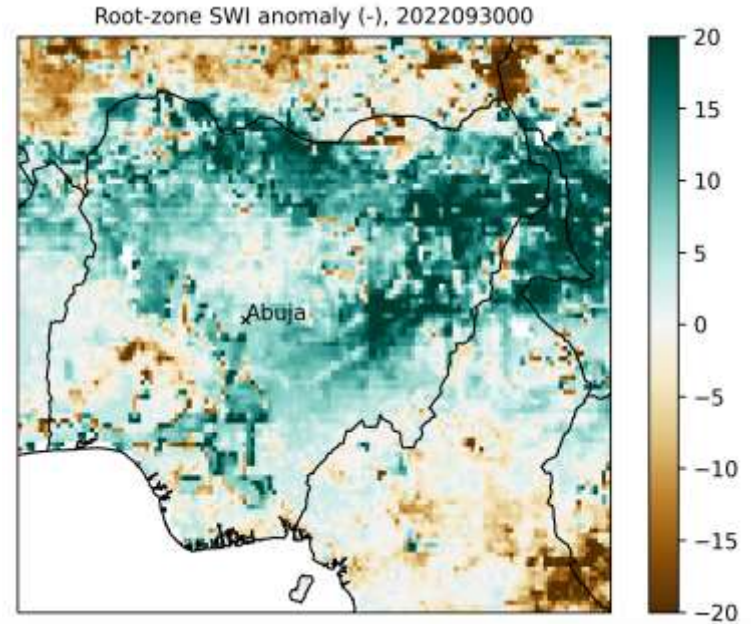
ASCAT SSM NRT products for the period 12-14 April 2022. Surface soil moisture saturation levels are very high in south-eastern South Africa due to heavy rainfall.

FLOODING IN NIGERIA: 1 Aug 2022 - 31 Oct 2022

Rainfall events occurred in the upstream section of River Niger during the month of October. These exceptional rainfall amounts along with the wetter conditions of the soil created the flood event that impacted 27 out of 36 states causing more than 600 fatalities. Transport was affected for at least two weeks, and food and fuel supplies blocked.

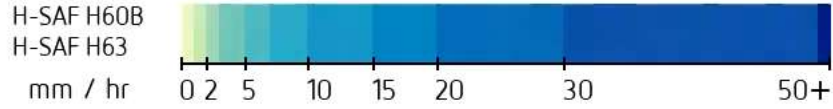


Plot of the H SAF precipitation and root-zone soil wetness index anomaly (expressed as a percentage of saturation) for layer 3 (28-100cm depth) for 30 September 2022.

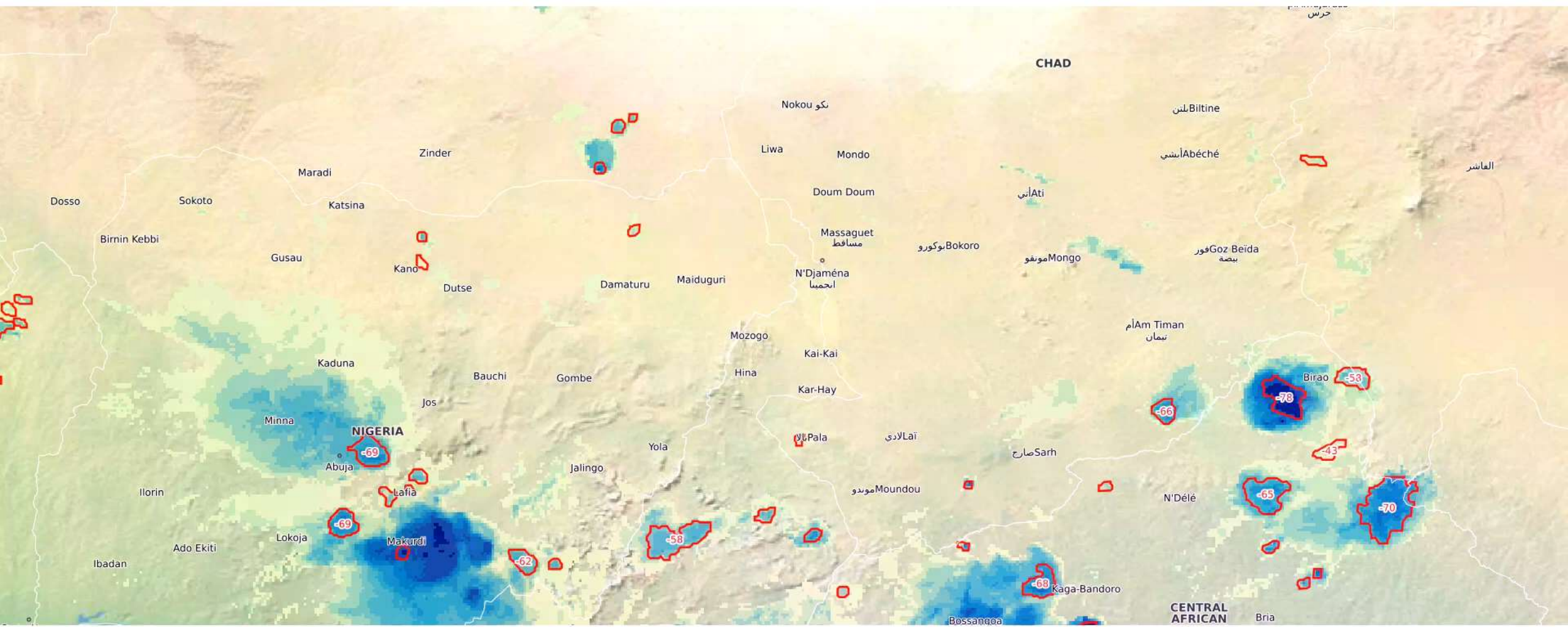


GMV 2022 Oct 19 12:12:27 Production_SATELLITE_AREA_COMET_Algorithm_COMET--AGEUMETSAT--

Blended SEVIRI / LEO MW precipitation and morphologic - MSG - 0 degree

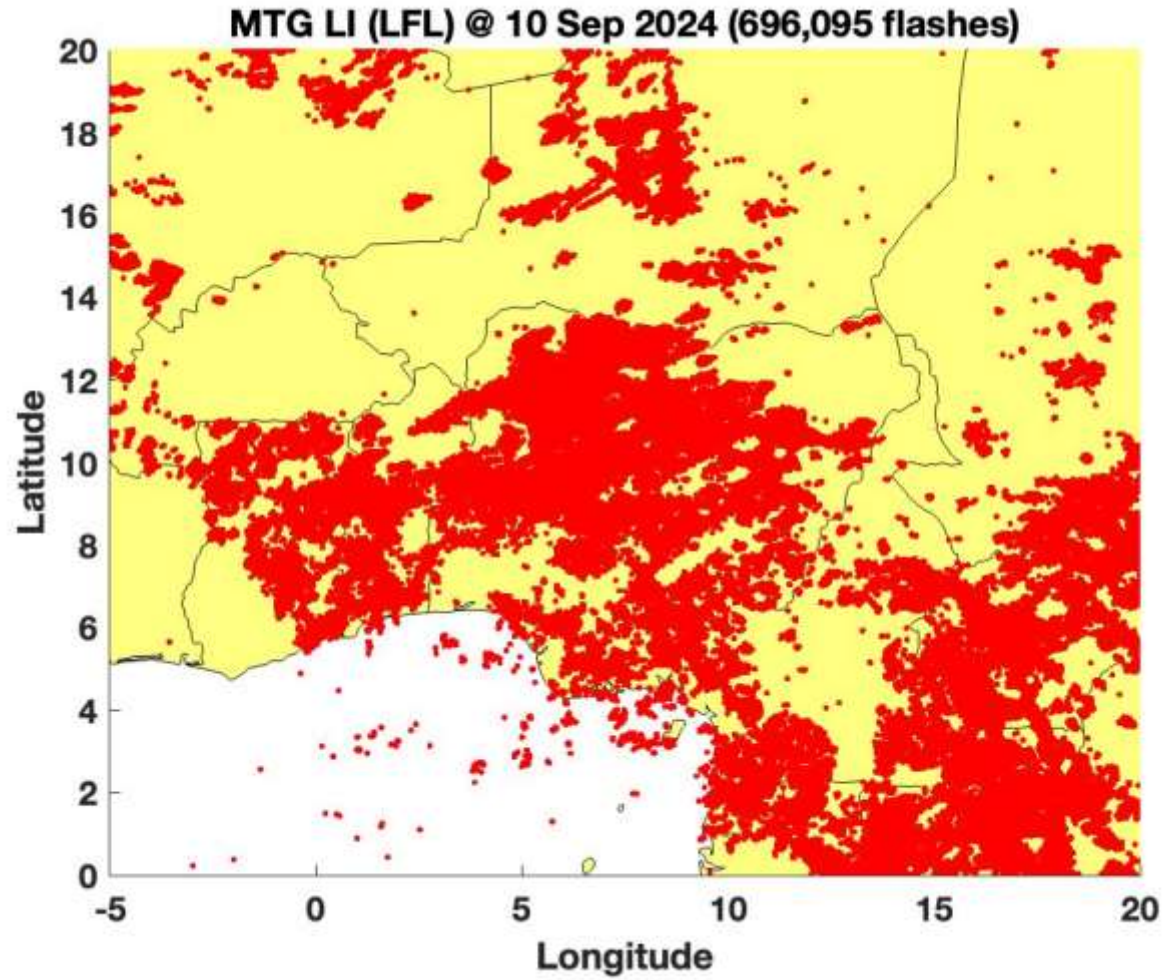


FLOODING IN NIGERIA: SEPTEMBER 2024



2024-09-06 00:30:00 UTC

FLOODING IN NIGERIA: SEPTEMBER 2024



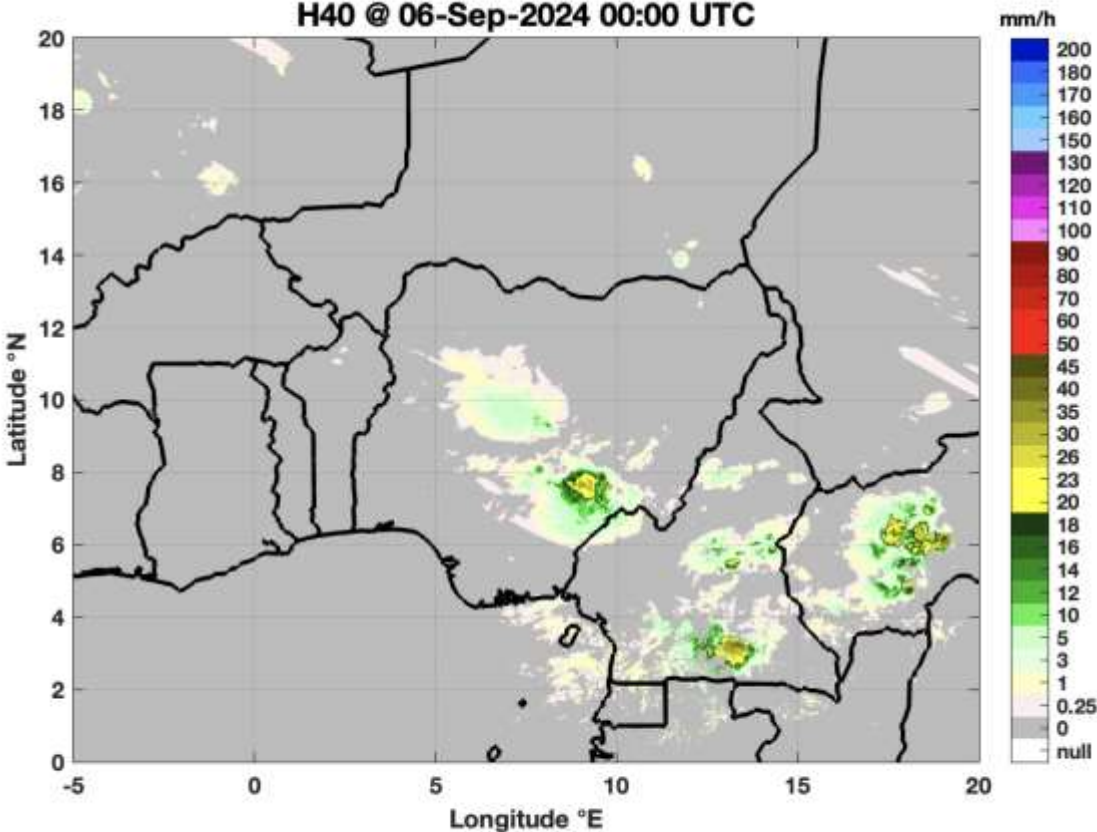
FLOODING IN NIGERIA: SEPTEMBER 2024

Rain Rate (MTG) vs Rain Rate (MSG)

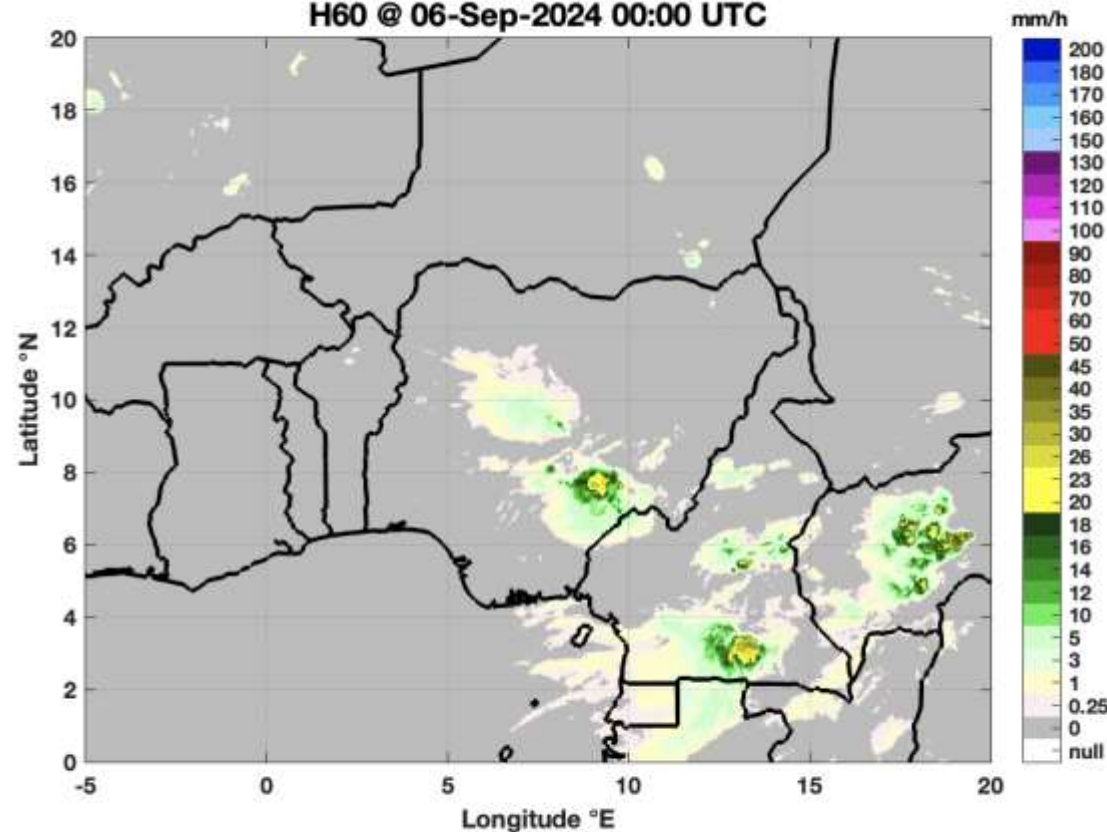
Spat. Res:2km | Temp. Res: 10 min

Spat. Res:3km | Temp. Res: 15 min

H40 @ 06-Sep-2024 00:00 UTC



H60 @ 06-Sep-2024 00:00 UTC

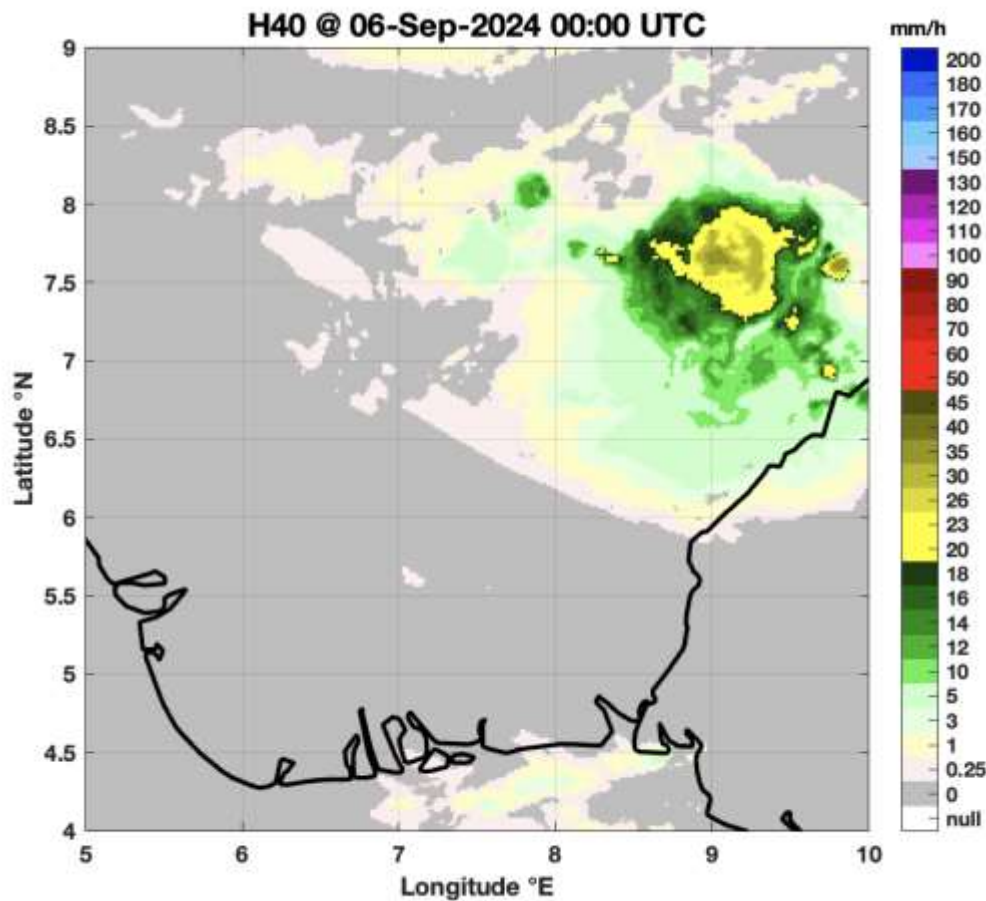


FLOODING IN NIGERIA: SEPTEMBER 2024

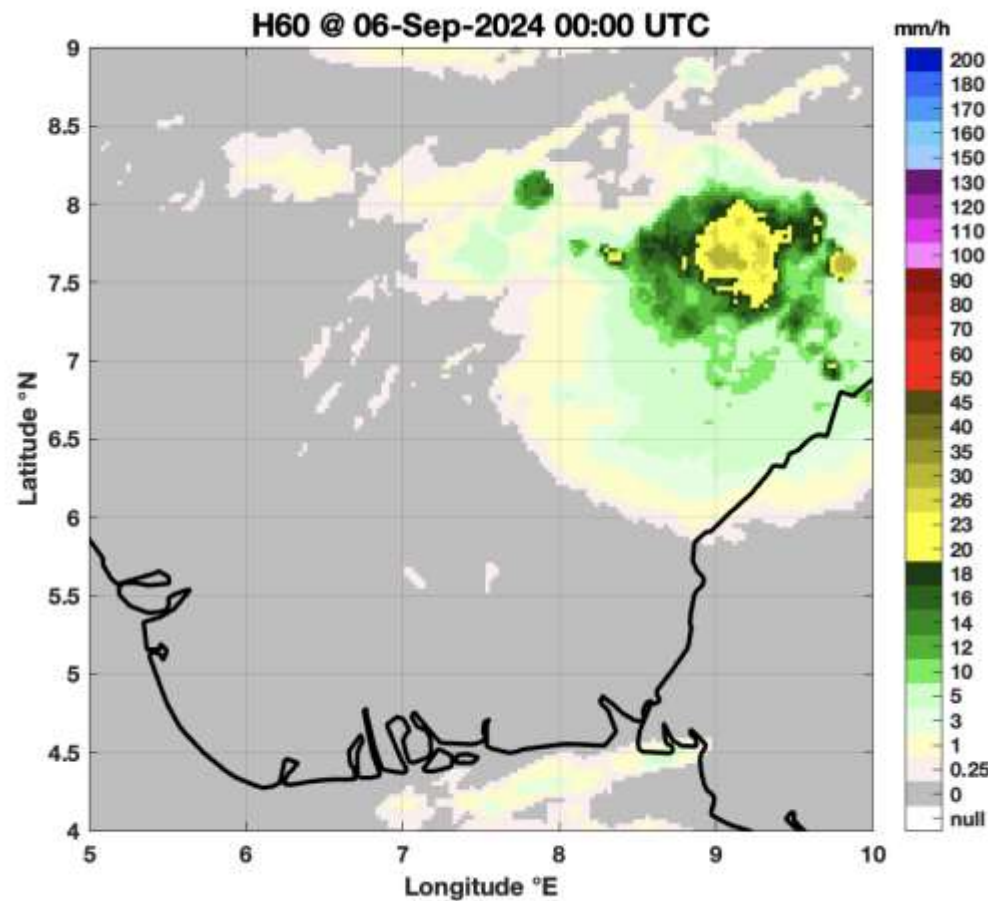
Rain Rate (MTG) vs Rain Rate (MSG)

Spat. Res:2km | Temp. Res: 10 min

Spat. Res:3km | Temp. Res: 15 min



Zoom

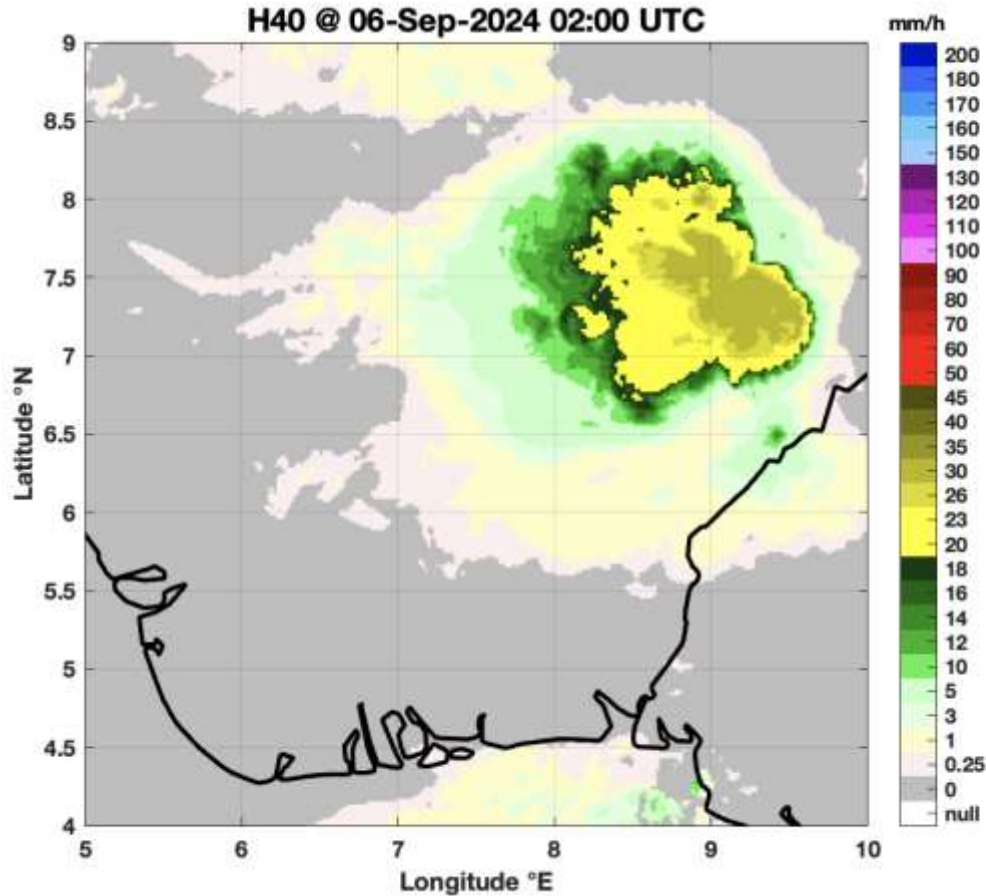


FLOODING IN NIGERIA: SEPTEMBER 2024

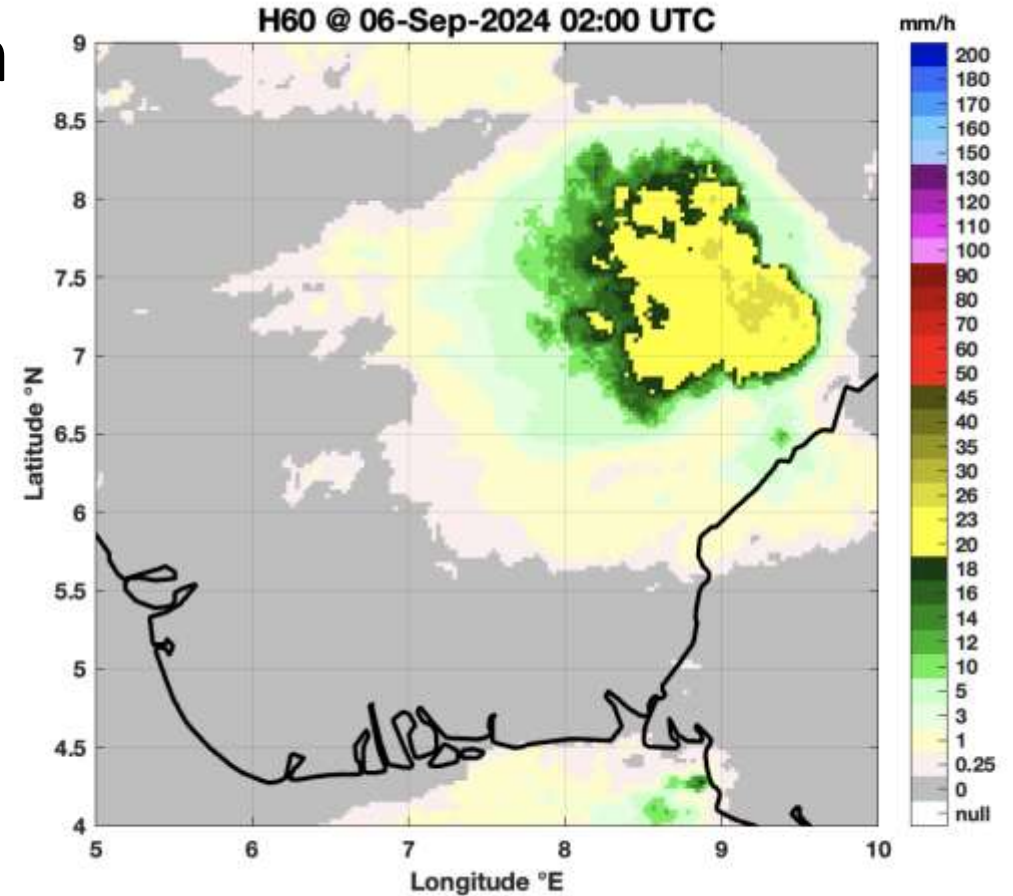
Rain Rate (MTG) vs Rain Rate (MSG)

Spat. Res:2km | Temp. Res: 10 min

Spat. Res:3km | Temp. Res: 15 min



Zoom

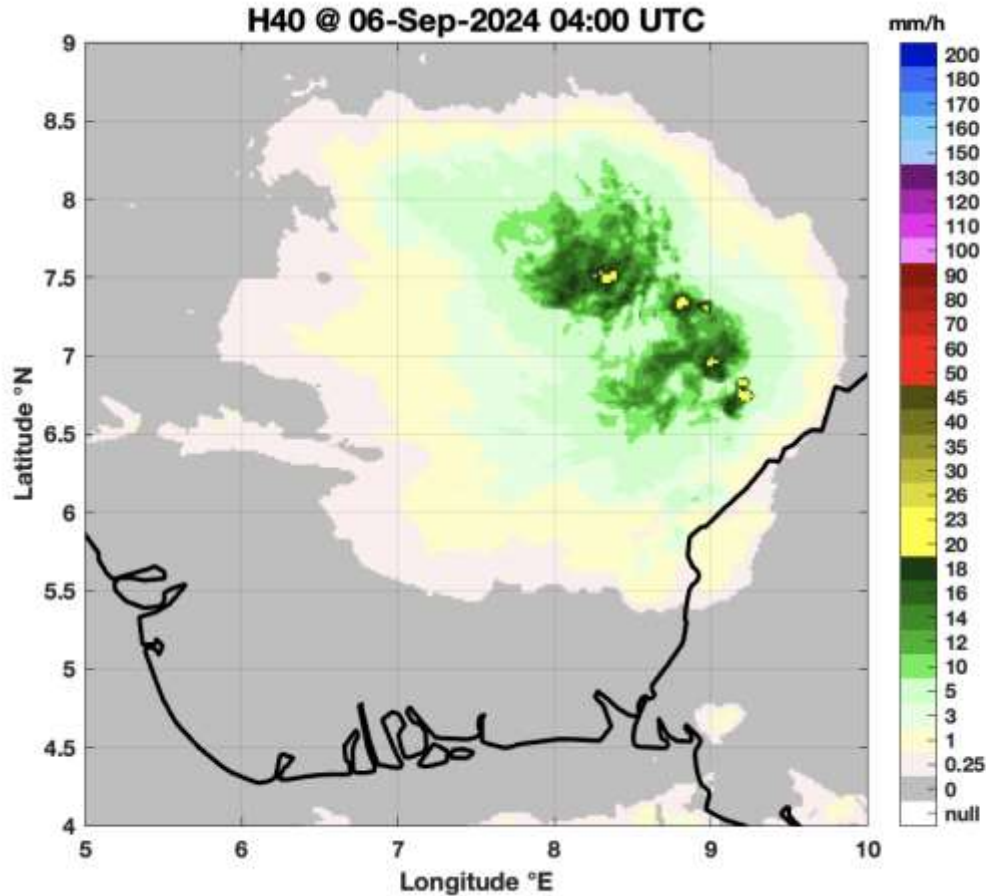


FLOODING IN NIGERIA: SEPTEMBER 2024

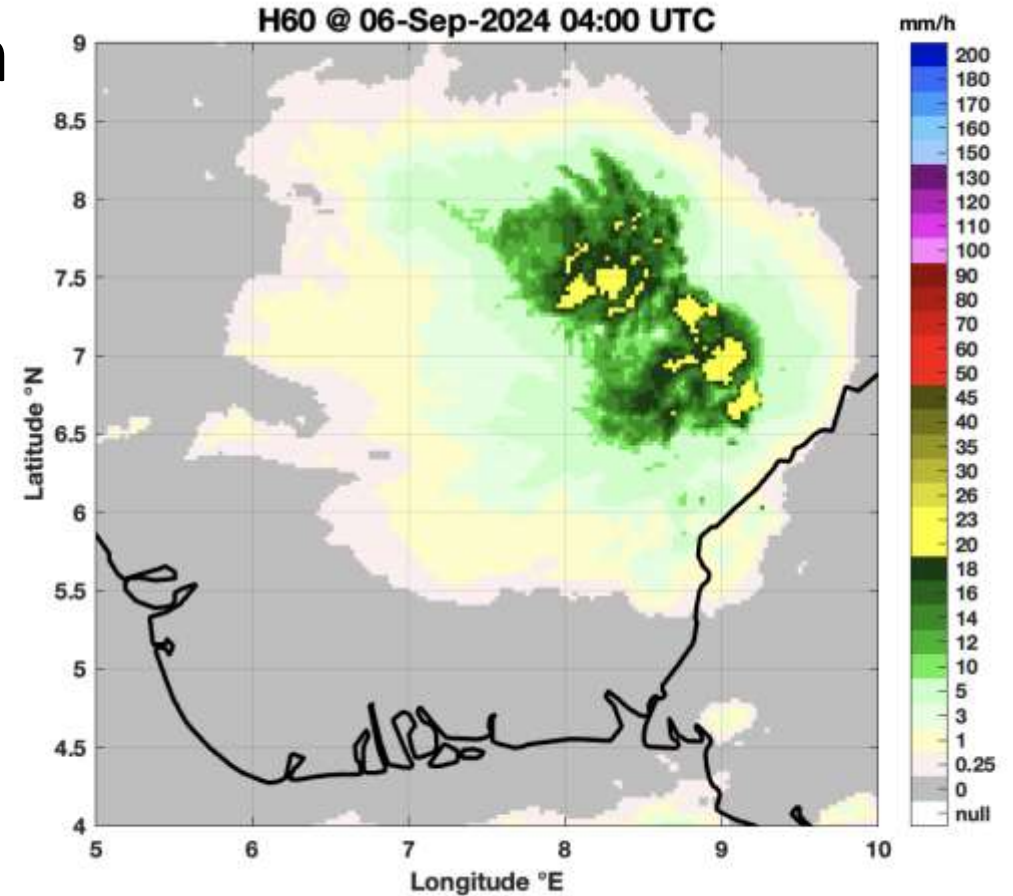
Rain Rate (MTG) vs Rain Rate (MSG)

Spat. Res:2km | Temp. Res: 10 min

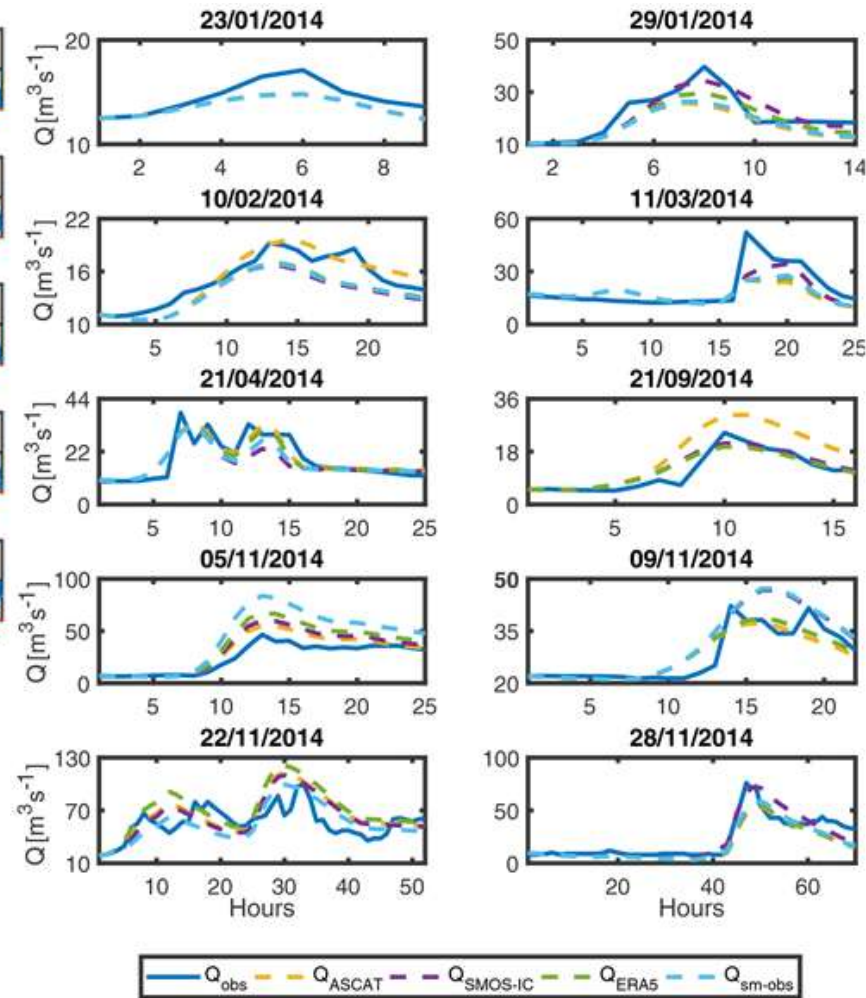
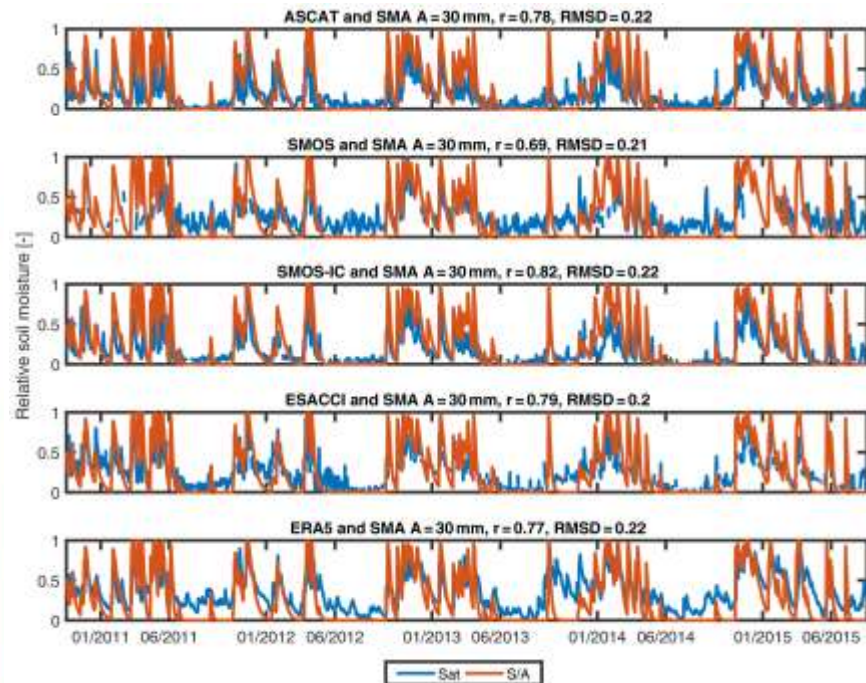
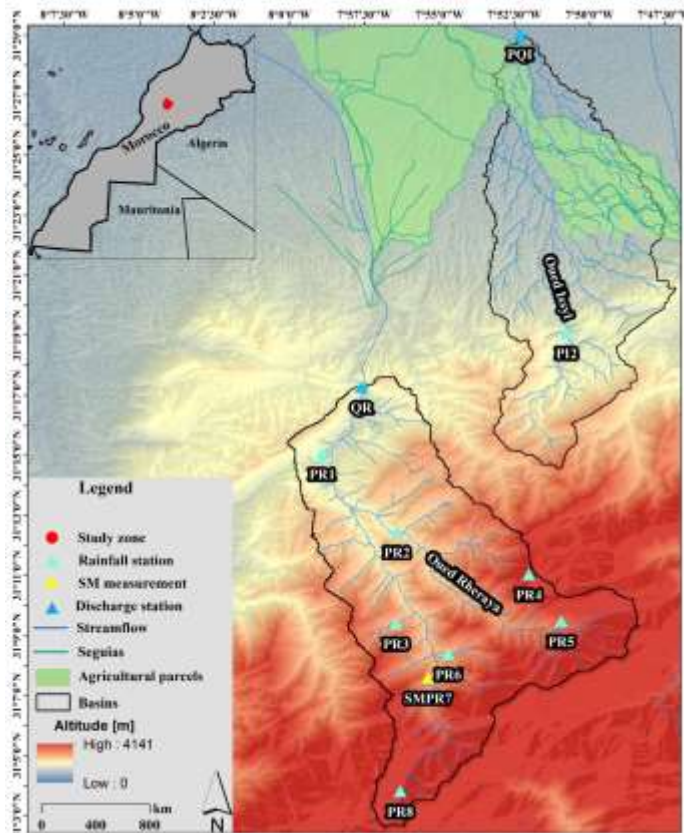
Spat. Res:3km | Temp. Res: 15 min



Zoom



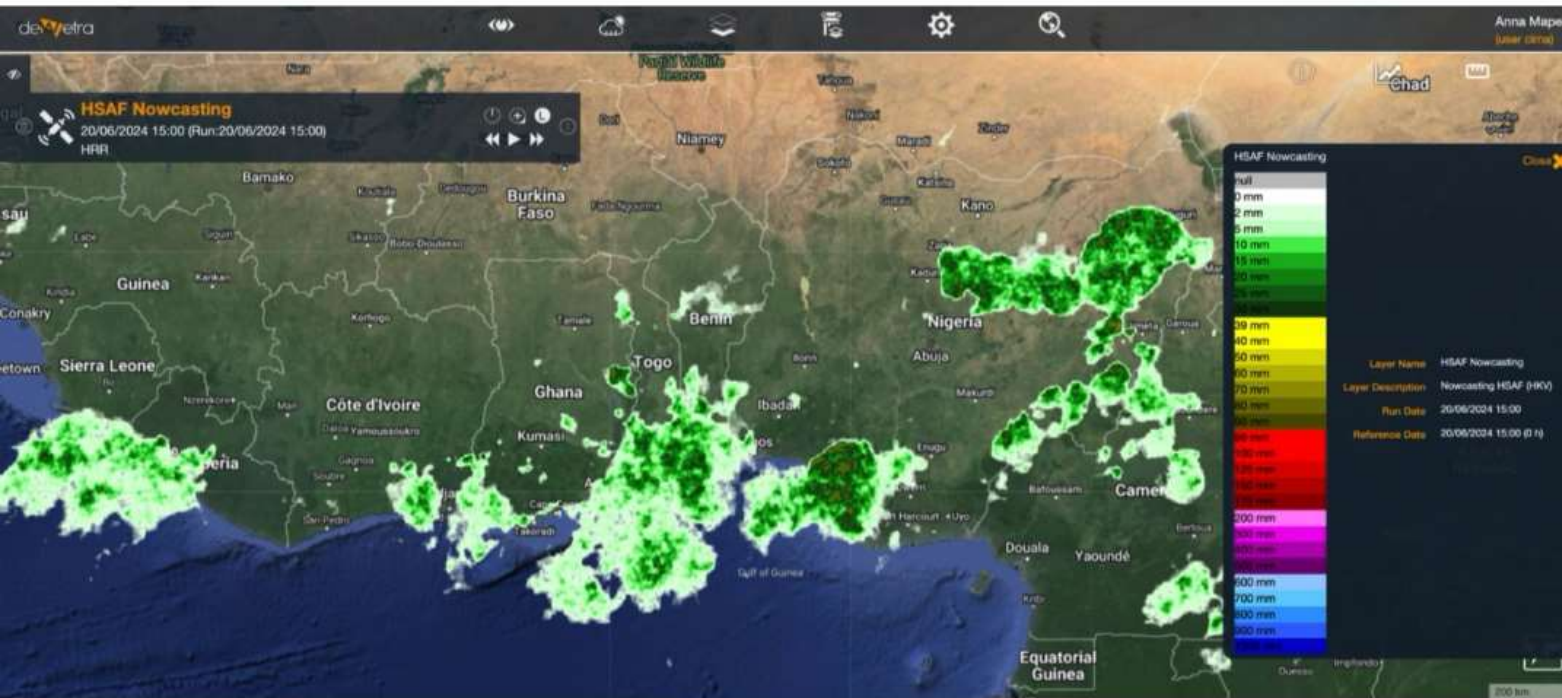
FLOOD FORECASTING IN MOROCCO



Satellite soil moisture are very useful to estimate the antecedent conditions before a rainfall event, thus providing essential information for flood prediction

El Khalki Mahdi et al. 2020 (NHES)
Tramblay et al. 2012 (HES)

RAINFALL EVENT NOWCASTING



Nowcasting product developed by HKV (<https://www.hkv.nl/en/>) in a WMO-project. The nowcast is based on the P-IN-SEVIRI-PMW (60B) product. The nowcasted rainfall is presented in mm/h for each 15min interval

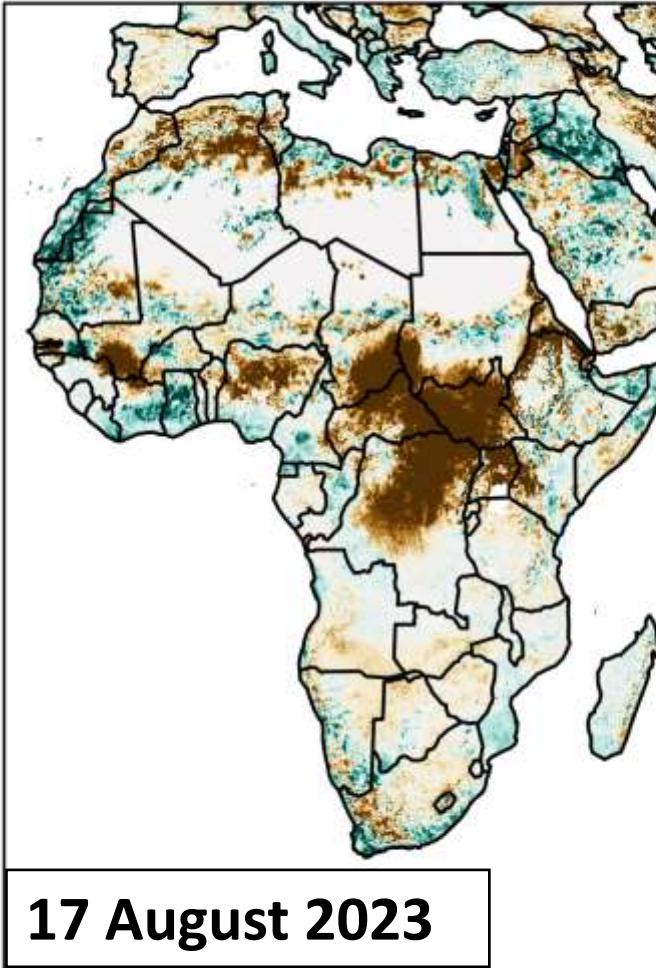
Contacts

Dorien Lugt: d.lugt@hkv.nl

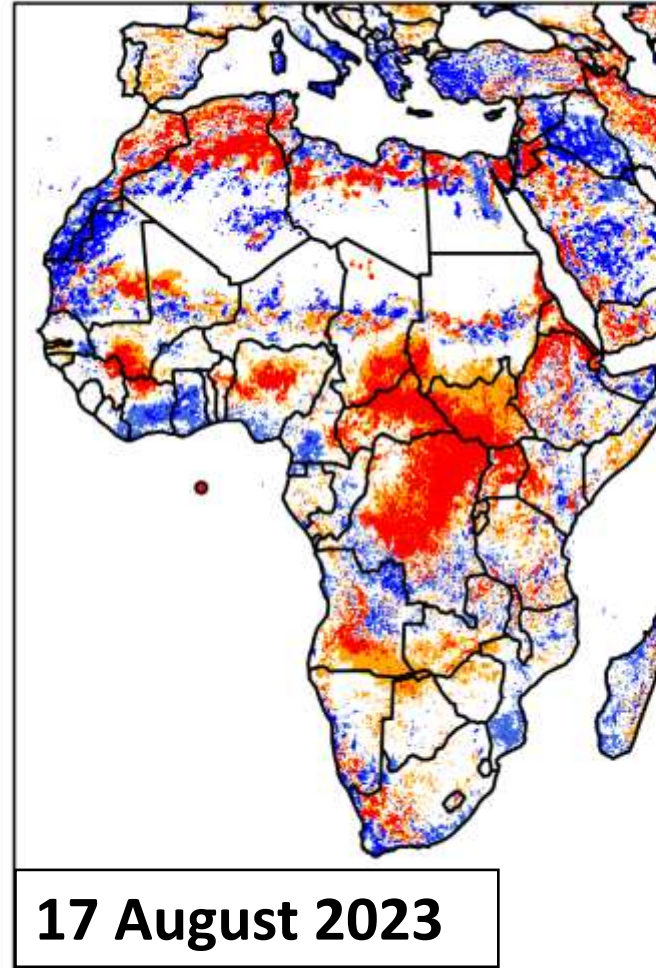
Nicole Jungermann: n.jungermann@hkv.nl

DROUGHT MONITORING IN AFRICA ROOT-ZONE SOIL MOISTURE

Root-zone SM anomaly (%), 2023081700



Drought hazard index (-), 2023081700

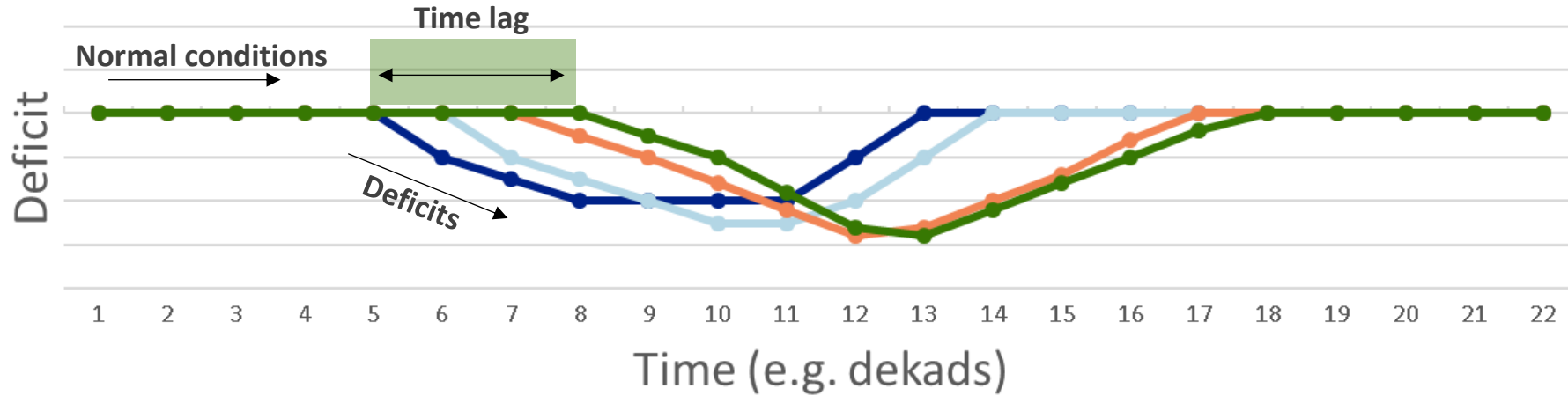


Comparison of near-real-time (NRT) product with data record can indicate droughts or flood

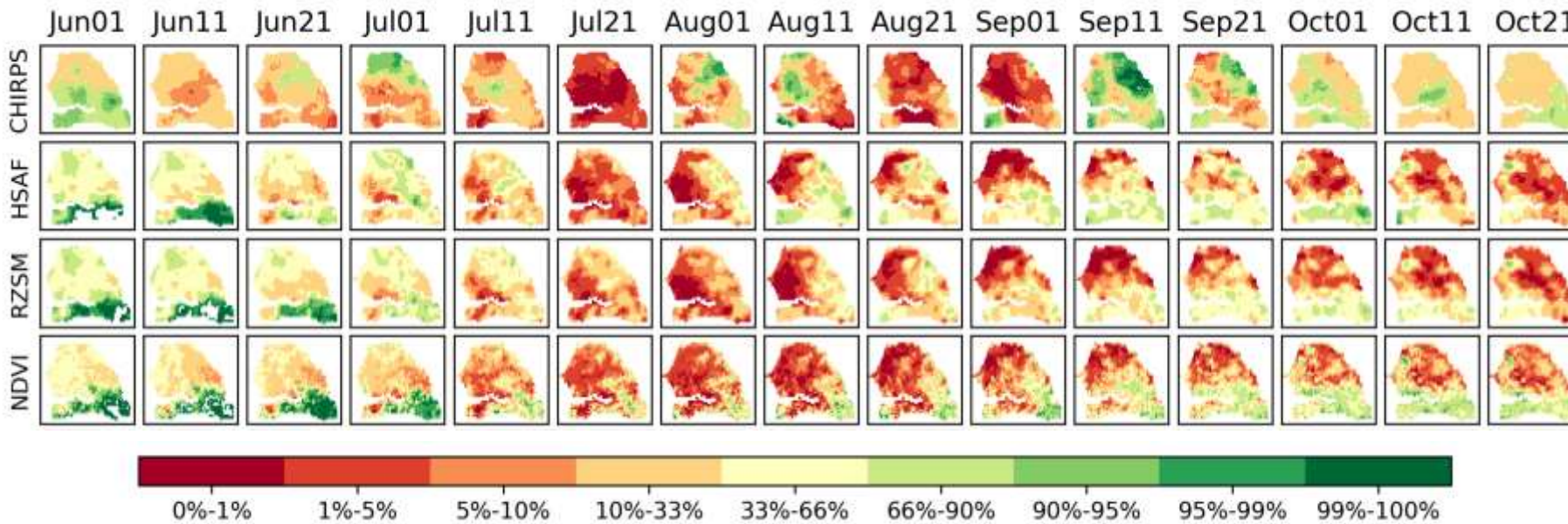
Drought conditions (<-1),
Severe drought (<-2)

Severe drought present over parts of central and eastern Africa

DROUGHT MONITORING IN SENEGAL



- Rainfall
- Surface SM
- Root-zone SM
- Vegetation



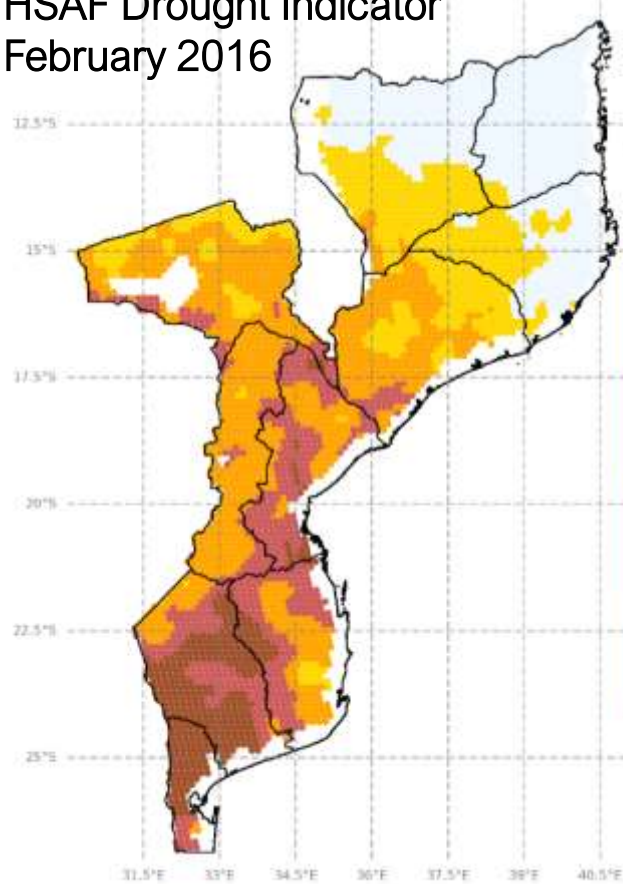
2014 drought in Senegal

Exploiting multiple variable we can monitor drought over time

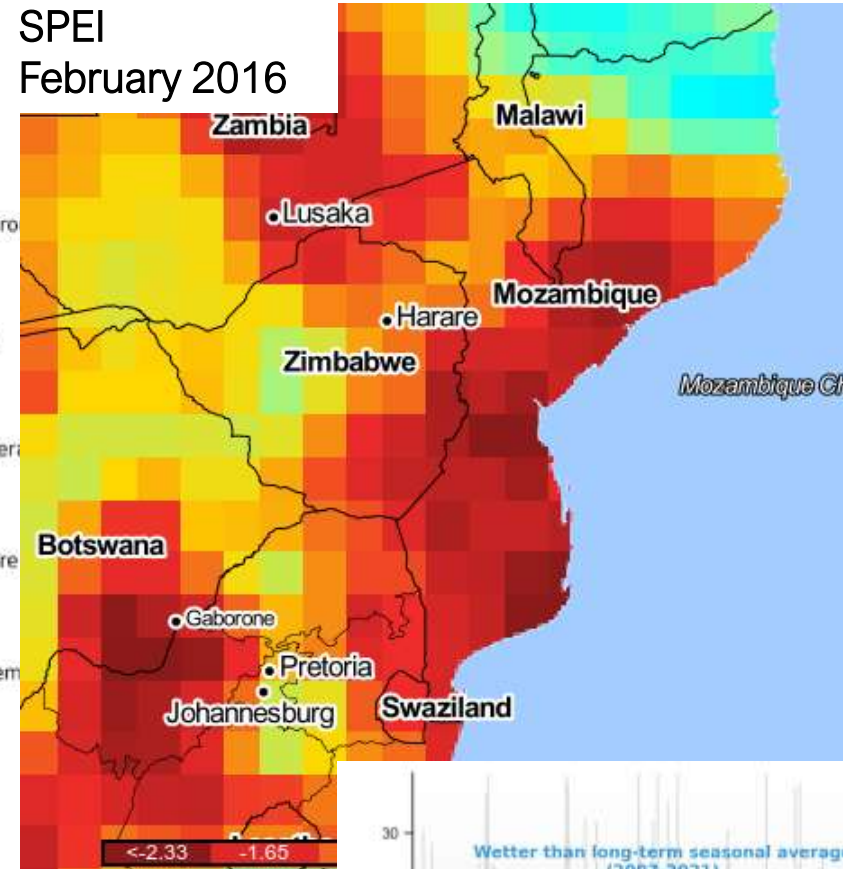
Vreugdenhil et al. 2022 (Frontiers in Water)

DROUGHT MONITORING IN MOZAMBIQUE

HSAF Drought Indicator
February 2016



SPEI
February 2016



HSAF Soil moisture can provide reliable drought information at higher spatial resolution and NRT

Drought in 2015/2016 affecting 1.5m people mainly in south and central part



H SAF SOIL MOISTURE FOR DROUGHT MONITORING



Distinct strengths / weaknesses exist between modelled (GLOFASv4) and RS SM products (H120, CCIp, SMAP)

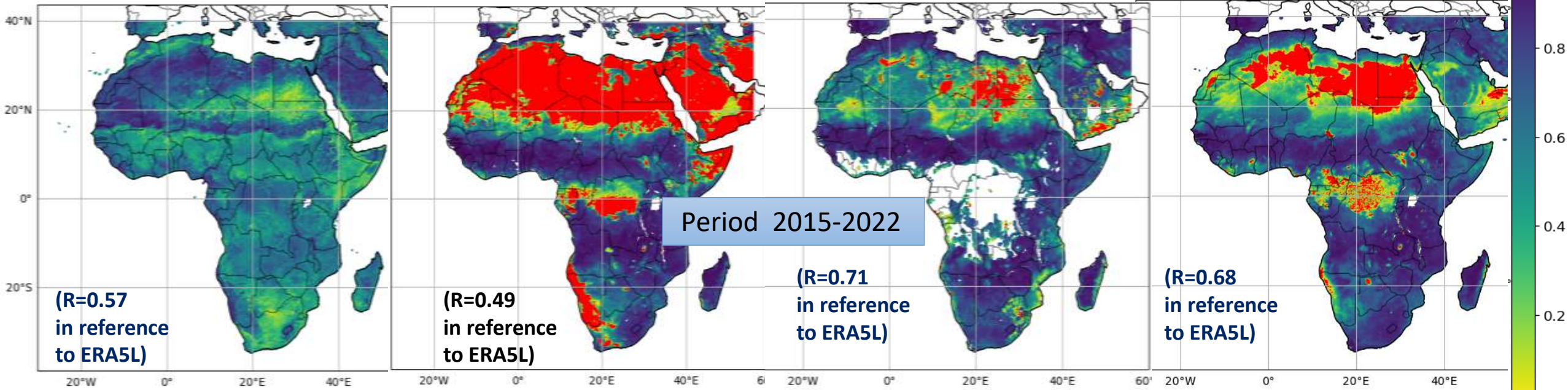
GLOFASv4

H-SAF H120

CCIpv9

SMAP9km

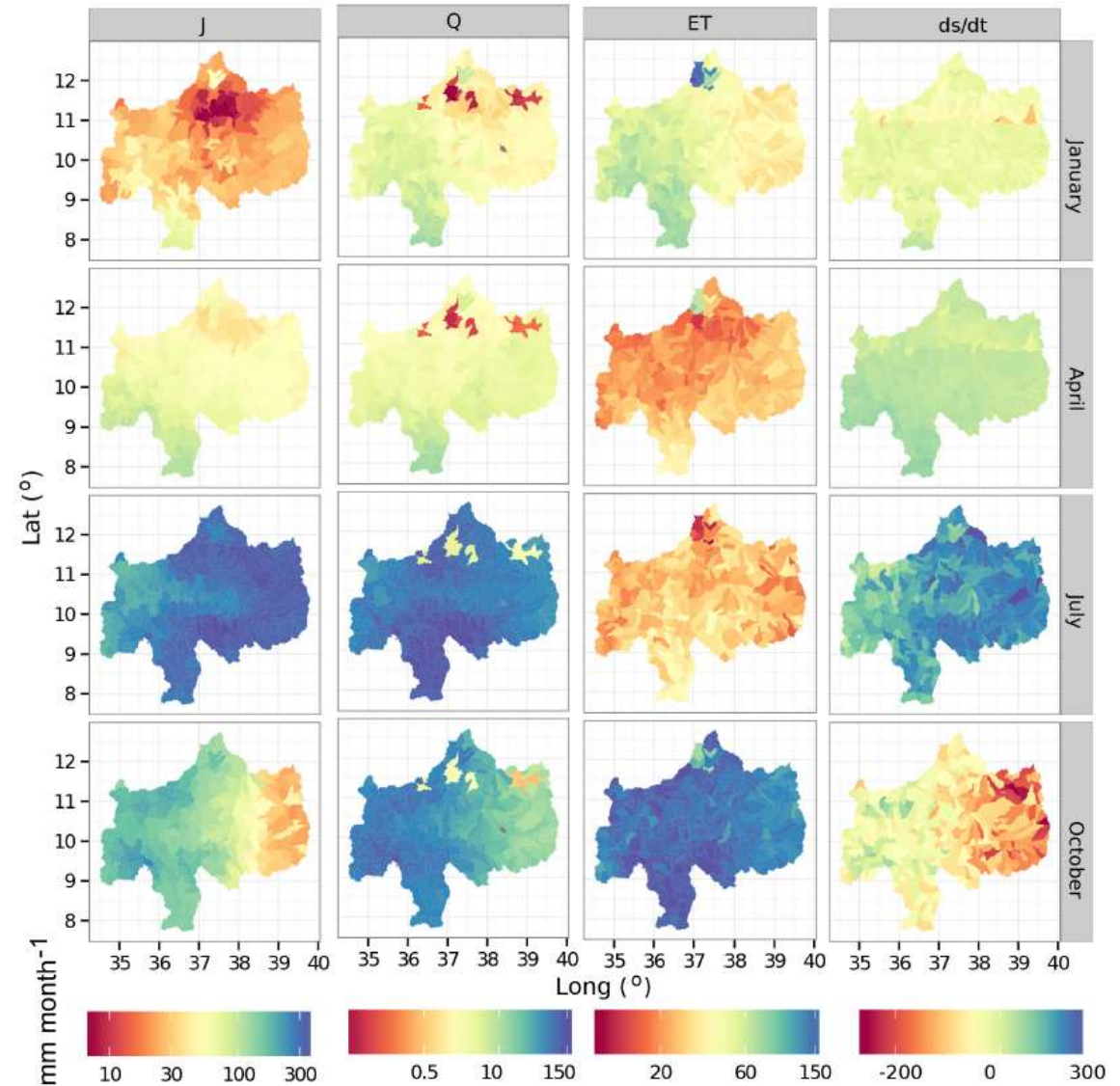
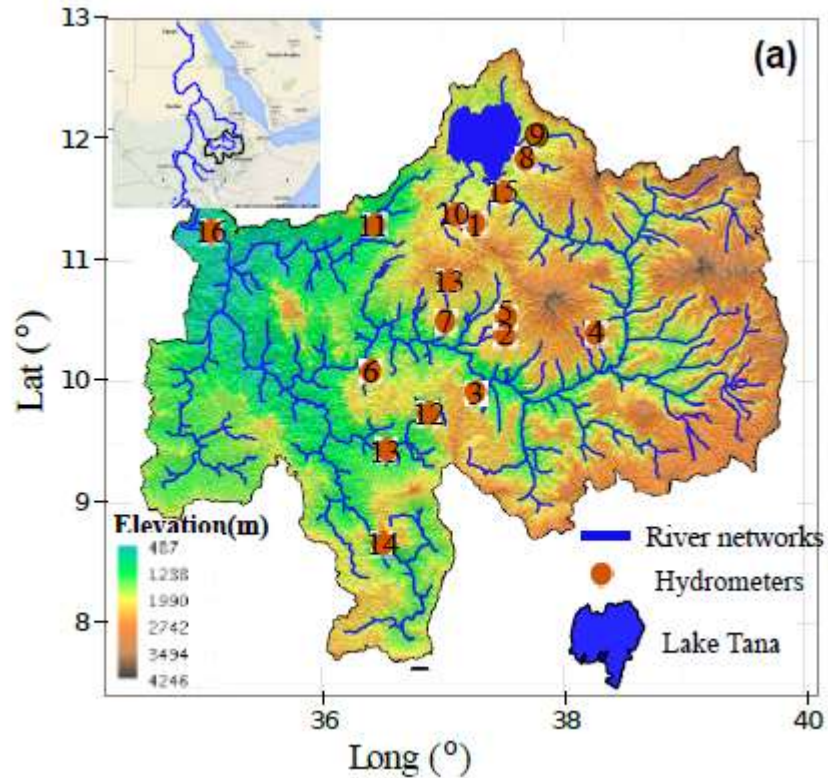
R Spearman



- The model-based GLOFAS (LISFLOOD model inside) excels at covering areas unable for RS but struggles in regions with singular hydrology
- Active ASCAT data surpasses all products in coverage over vegetation, continuity, frequency of visit but finds difficulties over arid areas
- Passive data sources (CCIp, SMAP9km) surpass the other data types of SM over arid areas but are the less capable over equatorial regions

Combining different types of data optimizes the applicability of these global SM products for drought monitoring

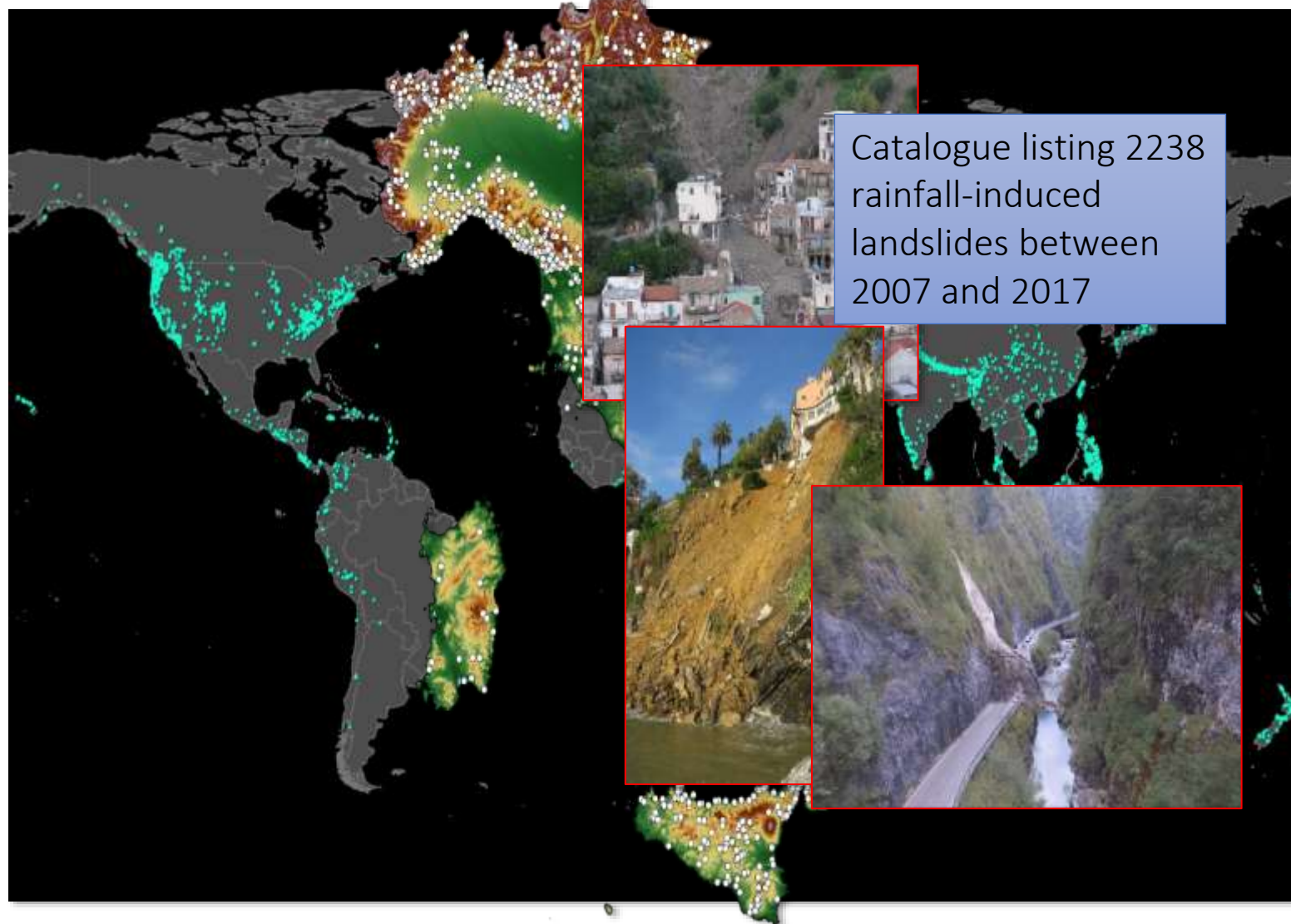
MODELLING THE WATER BUDGET: UPPER BLUE NILE



Satellite soil moisture (+precipitation and evaporation) products are useful to assess the long-term water balance essential for water resources management

[Abera et al. 2017 \(HESS\)](#)

LANDSLIDE



HOW TO DOWNLOAD DATA

<https://h-saf.eumetsat.int>

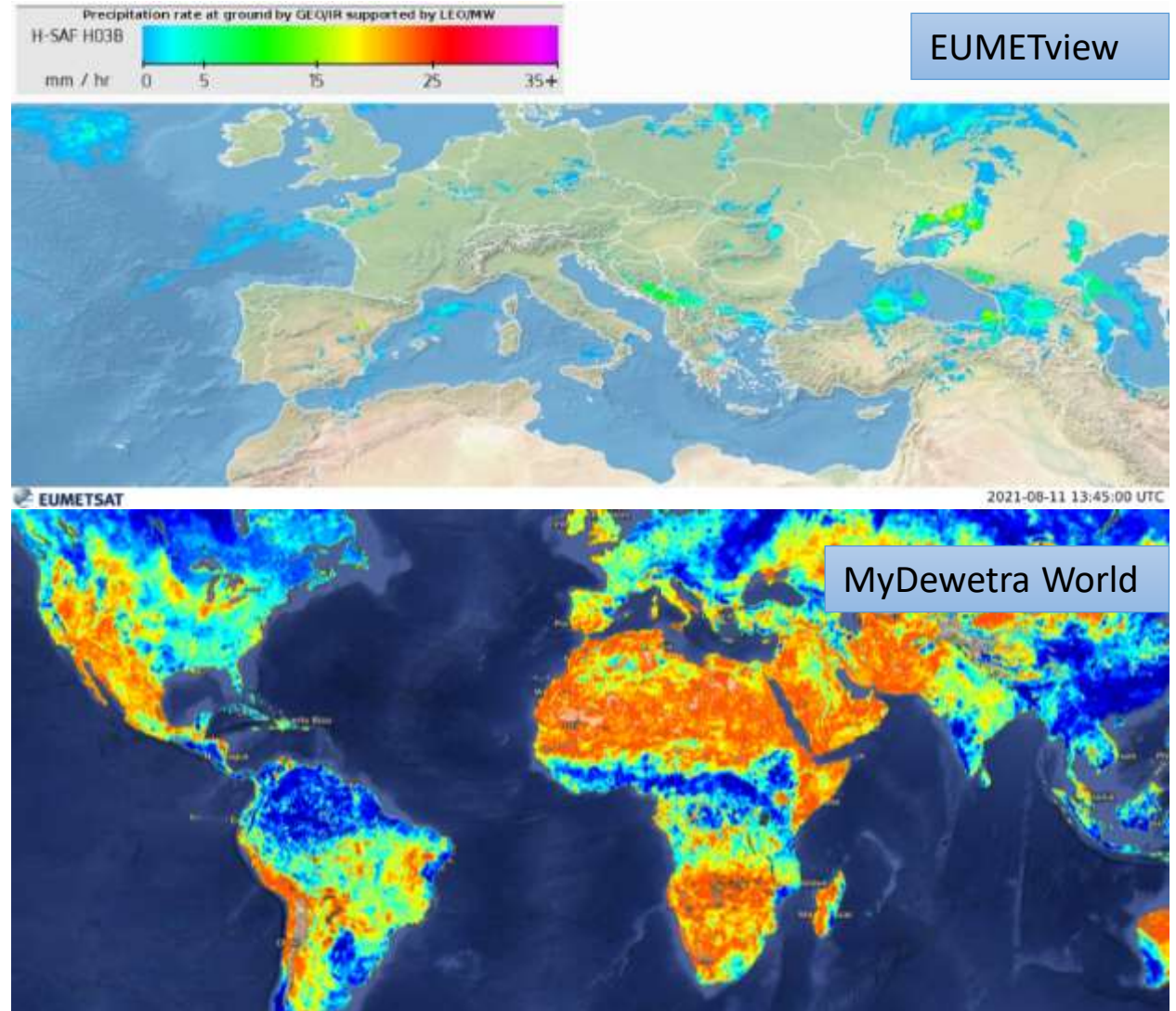
PUMA

EUMETCAST

EUMETSAT DATA CUBE

EUMETview

MyDewetra World



What we have NOW using Satellites data

Precipitation

Soilmoisture

Snow

Floods monitoring

Landslide

River Discharge

Water bodies extent

OPERATIONAL

DEVELOP

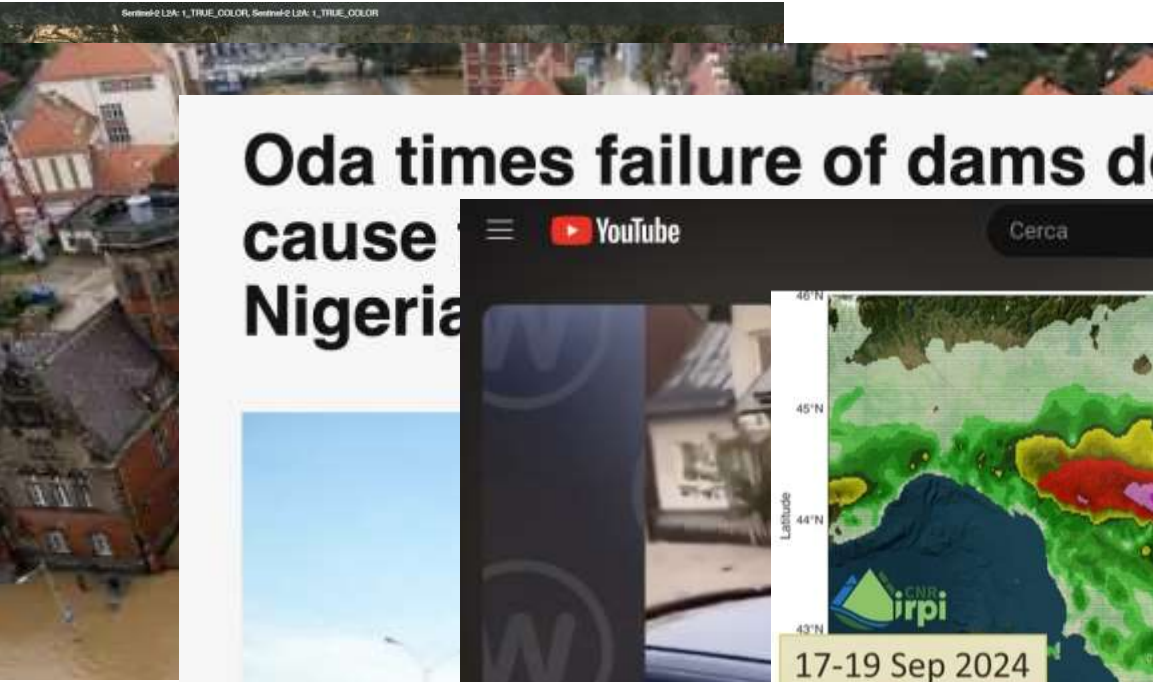


Which applications?

- Drought monitoring
- Extreme events monitoring and alert
- Water resources management
- Flood prediction and forecasting
- Agriculture

only In the last week

Different Countries
with the same problems!



flooding in the
precipitation
ESA

Polish city battered

1 day ago

Laura Gozzi, Nick Thor
BBC News

Reporting from London, Bu

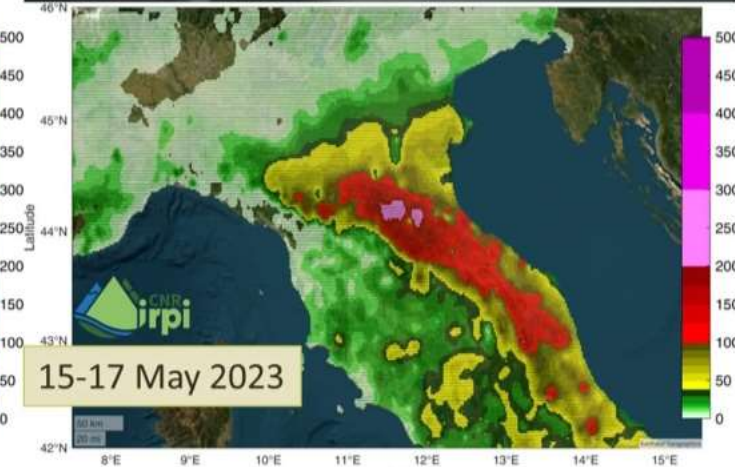
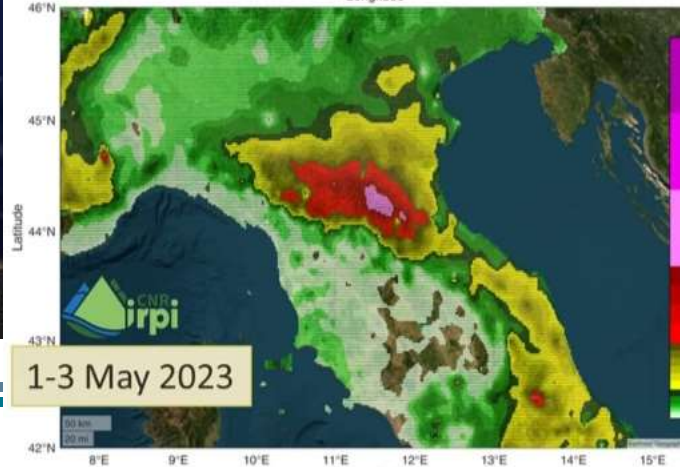
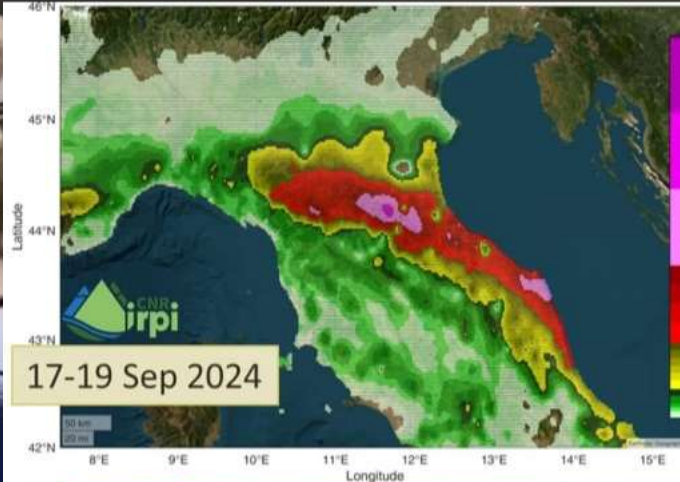
11 September 2024



Oda times failure of dams don cause Nigeria



Evacuazione di massa





Thanks for your attention!

Silvia.puca@protezionecivile.it