



Satellite operational products for precipitation, soil moisture and snow: applications and case studies

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Intro

The EUMETSAT Satellite Application Facility in Support to Operational Hydrology and Water Management (H SAF) generates and archives high quality products for operational hydrological applications.

H SAF focuses on geophysical products of precipitation, soil moisture and snow parameters and the exploitation of these datasets to mitigate hazards and natural disasters such as flash floods, landslides, and to monitor drought conditions, improving water resources management.

During the current phase of the project, the Continuous Development and Operational Phase 4 (CDOP4, 2022-2027), the list products has been widened, including more Low Earth Orbit (LEO) satellites, extending the coverage, extending the range period of data records and the development of new products to fully exploit the EUMETSAT primary missions (MTG and EPS-SG).

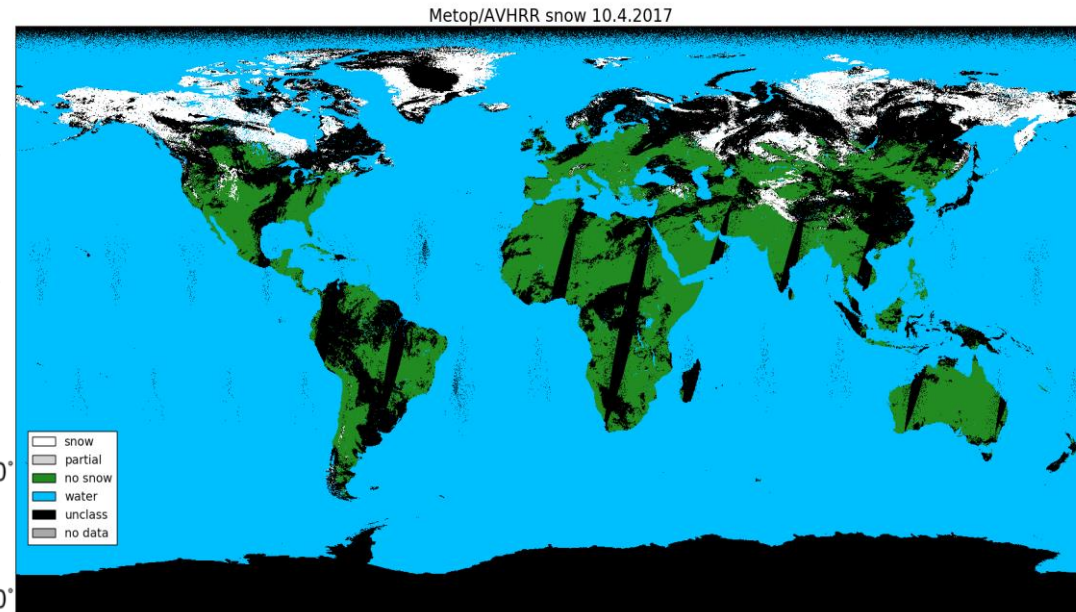
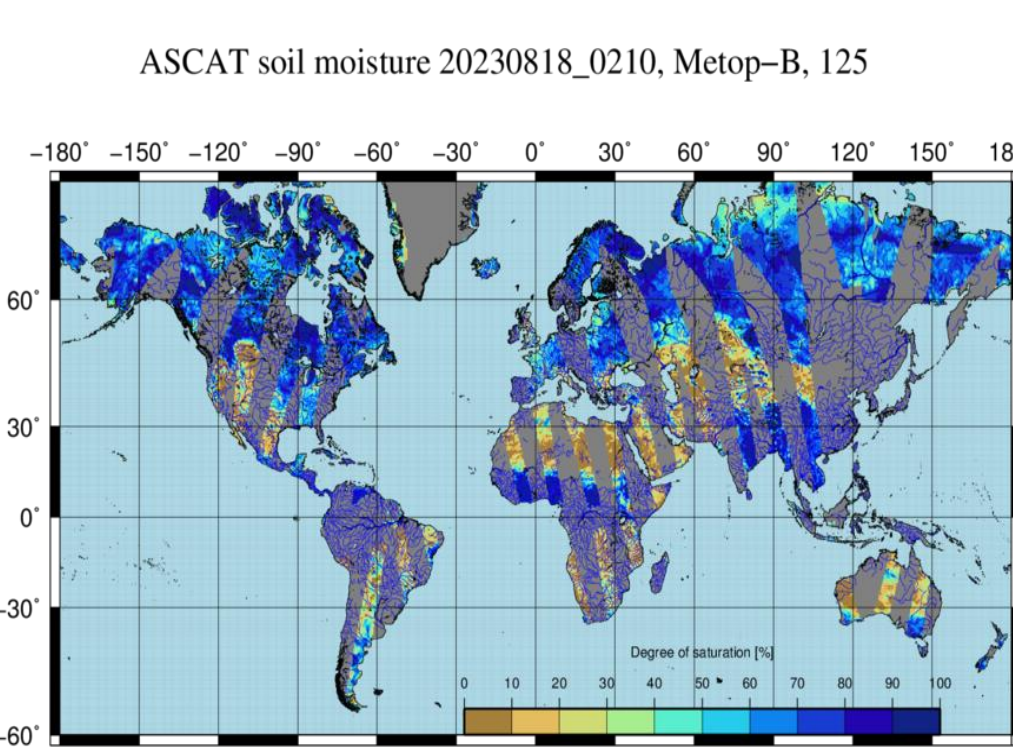
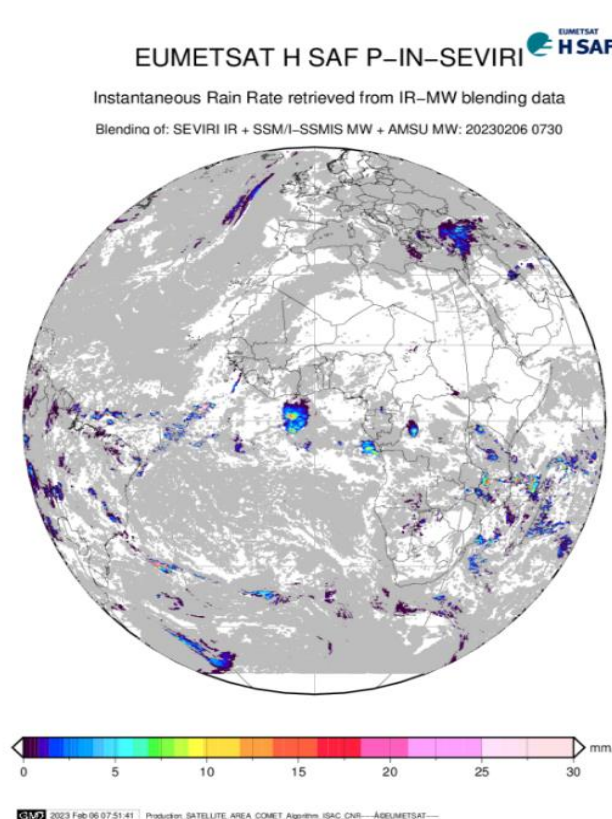
The use of H SAF operational products is mainly for meteorological, hydrological and climatic applications. Monitoring of heavy rain events, droughts, floods and water resources assessment are some of the fields of application.

Products

PRECIPITATION
rate and accumulated

SOIL MOISTURE
surface and root zone

SNOW
cover, melting condition, water equivalent



Near Real Time products

Data record

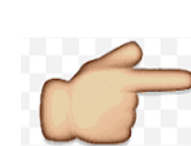
Coverage: Europe, Full Disk, Global

Spatial resolution: Regular grid, pixel based

Products validation: quality assessment and hydrovalidation

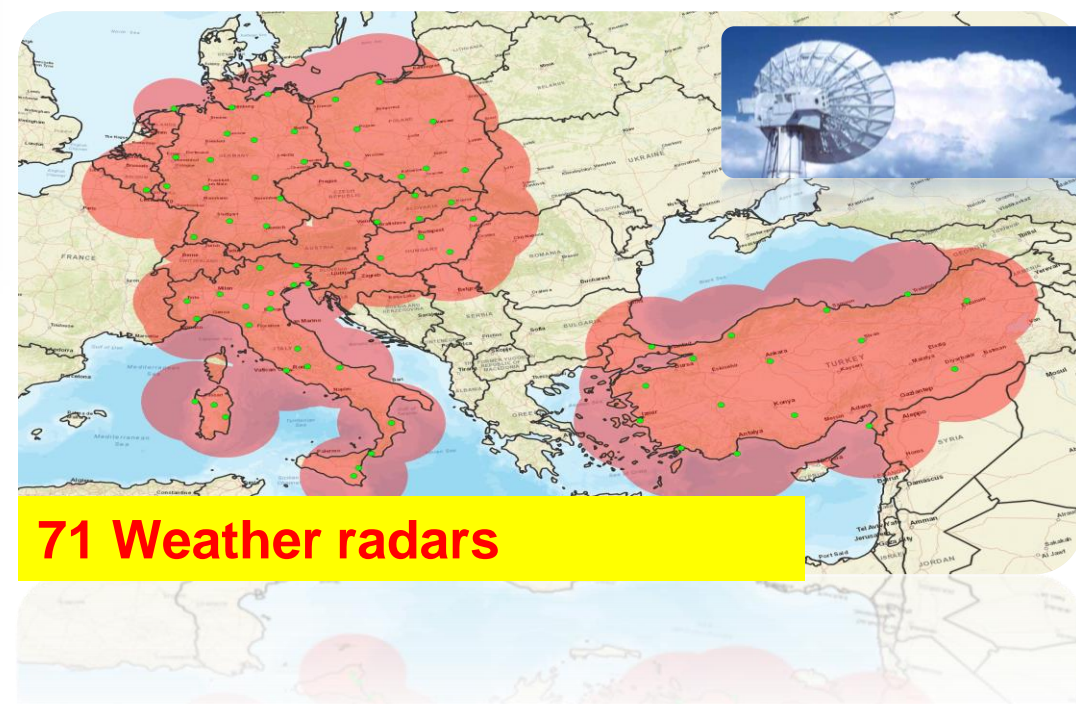
Validation

Each H SAF product undergoes an extensive quality evaluation process, including validation with ground data to ensure users receive high-quality products, and hydrological validation that evaluates practical hydrological applications and improves the products and their usability.



To find out more about the H SAF

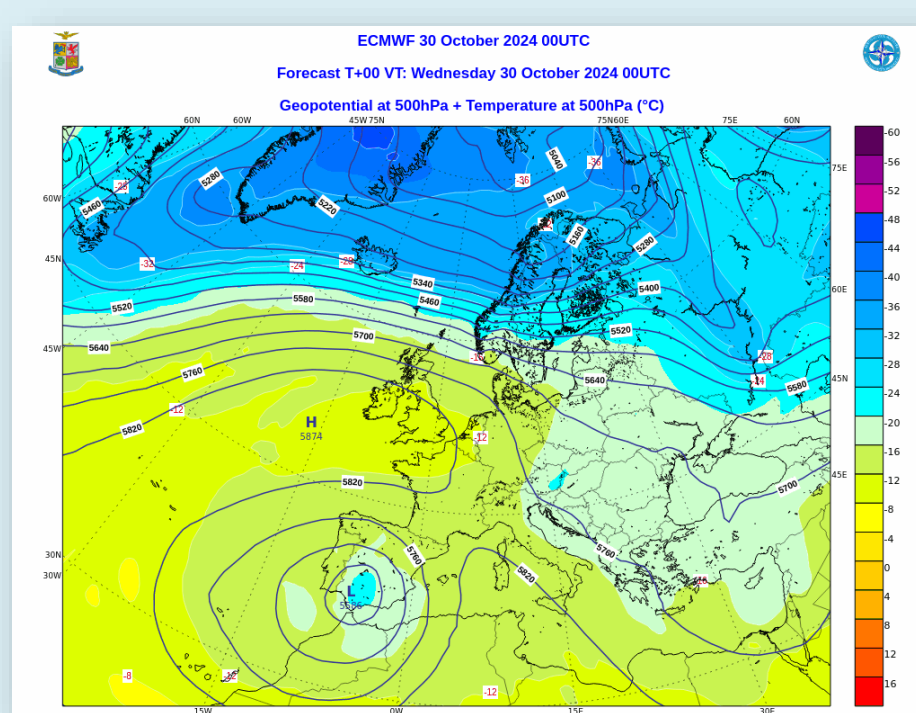
Every two years the operational precipitation products (PP) are evaluated to guarantee a continuous high-level quality standard. It is performed applying different approaches and references as ground based networks (rain gauges and radars) and radar on satellite (DPR). An automatic tool for the near real time comparison using satellites and ground products is under development.



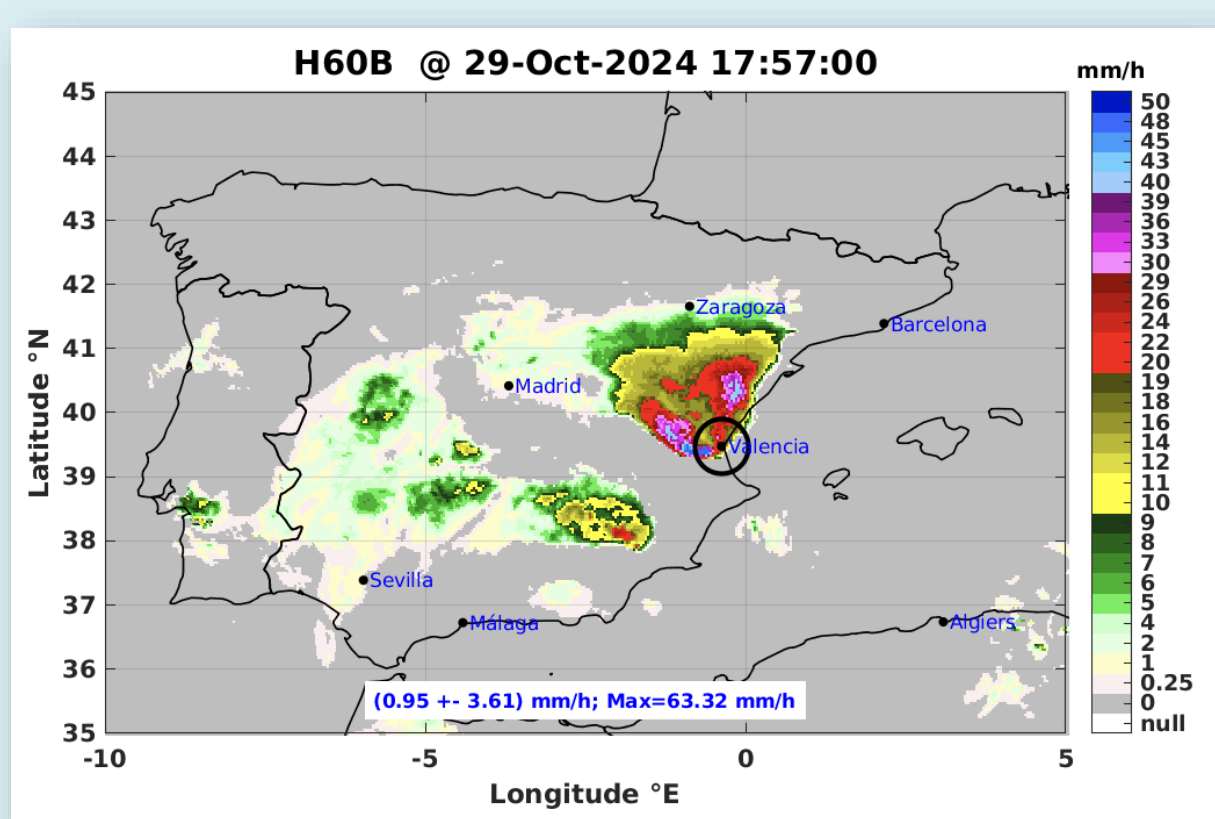
Spain 2024

An extraordinary rain event that occurred between 29 and 31 October 2024 affected Spain, especially in the region of Valencia, where up to 350 mm of rain were recorded in a few hours. High water levels in rivers caused flash floods that killed more than 150 people.

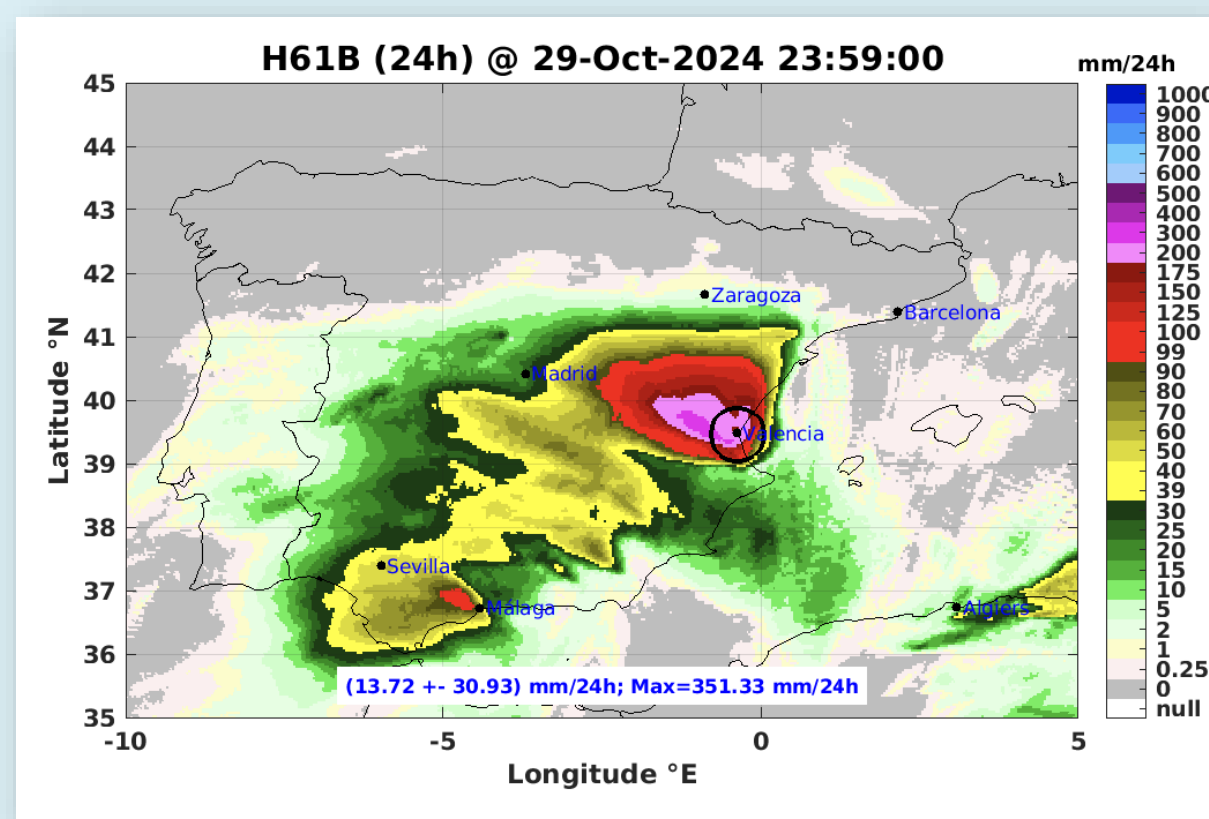
Low pressure system, slowly moving from Morocco to the North, affected the Iberian Peninsula during the 29th and 30th of October. Thunderstorm systems developed in the strong South-easterly flow over the South of Spain and then on the Mediterranean-eastern part of the country. Especially in parts of the region of Valencia, the storms were very strong and stationary.



Instantaneous precipitation rate (H60)



24 hour of accumulated precipitation (H61)

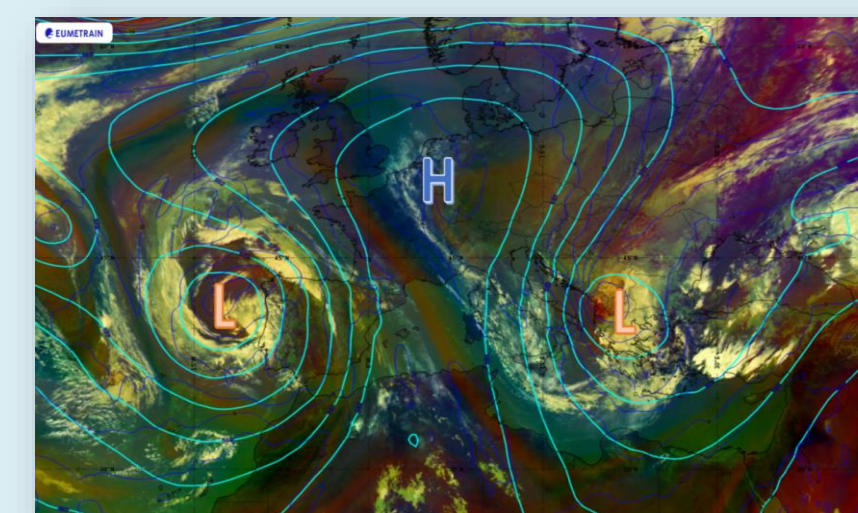


Satellites estimated for Valencia, on October 29, a rainfall of more than 60 mm/h and an accumulated rainfall of 350 mm.

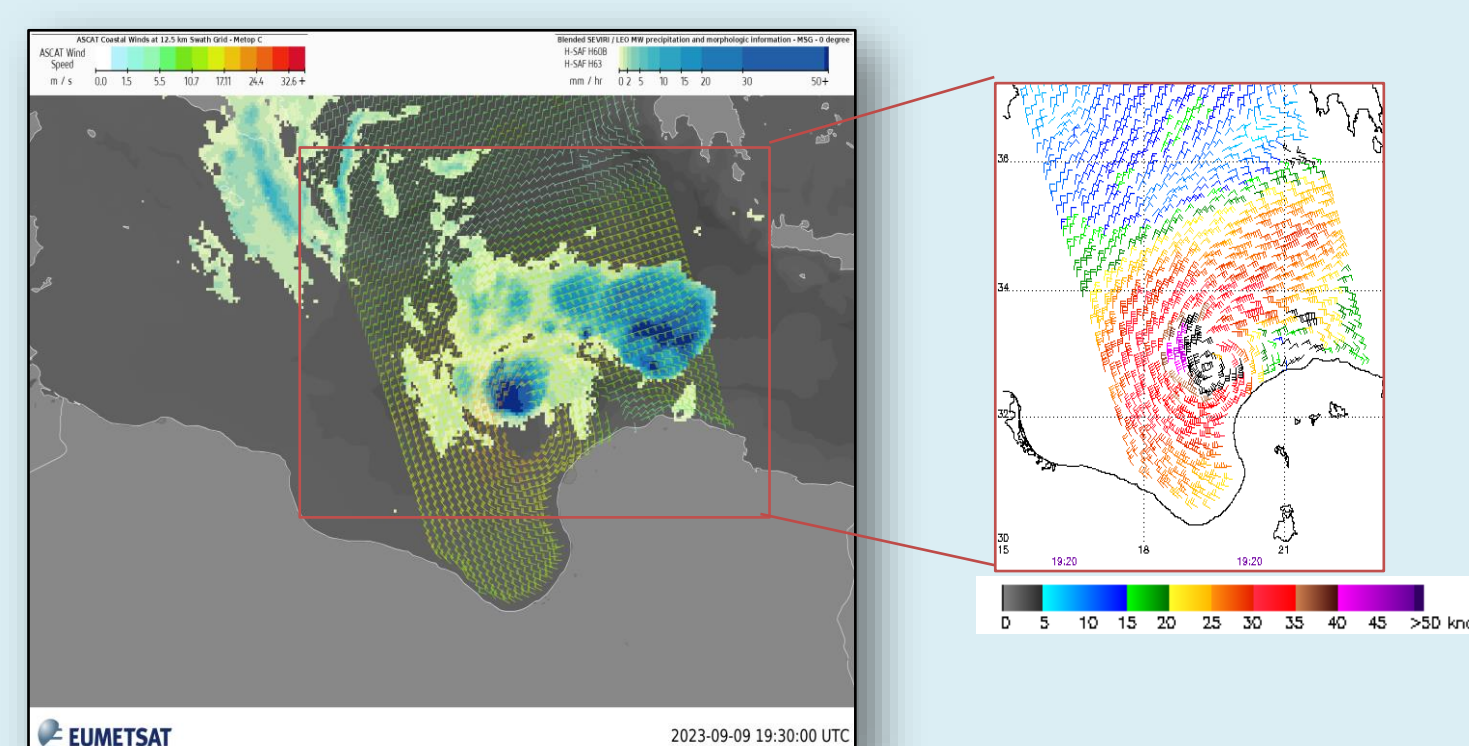
Mediterranean cyclone – Daniel 2023

In September 2023, an intense Mediterranean cyclone caused severe floodings in the eastern Mediterranean regions. It first hit Greece, Bulgaria and Turkey bringing heavy rain and causing extensive flooding and casualties. In the following days it intensified over the Ionian Sea, moving towards the Libyan coast with intense precipitation. In the coastal city of Derna two dams collapsed causing over 11,000 victims.

Air mass and geopotential at 500 hPa

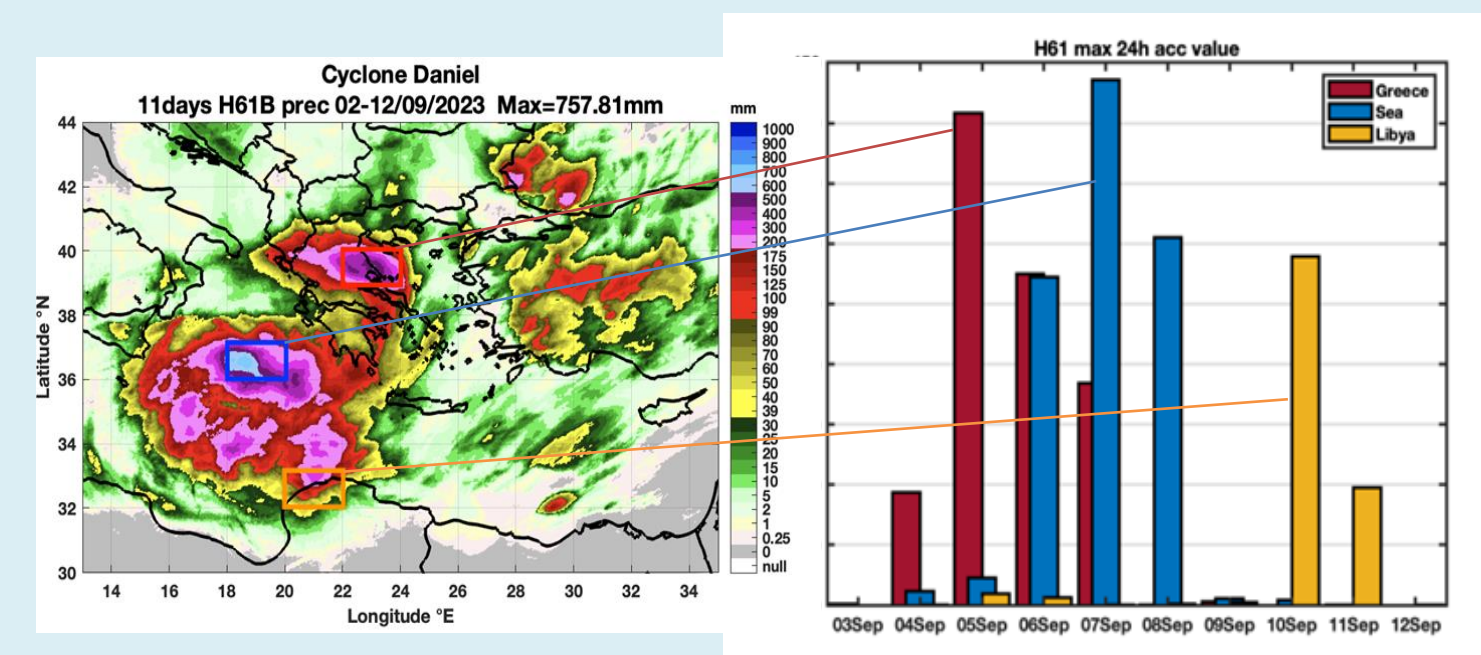


Costal wind and Instantaneous precipitation (H60)



Exceeding the 34 kt threshold, Daniel has intensified to Storm category, due to the strong diabatic forcing over the very warm weathers of the southern Mediterranean

Accumulated precipitation



3-5 September

Accumulated precipitation estimated by satellites was mainly located in the Peloponnese area, exceeding 500 mm.

6-8 September

Precipitation fell in the Ionian Sea, reaching the maximum for the entire event (over 730mm).

9-11 September

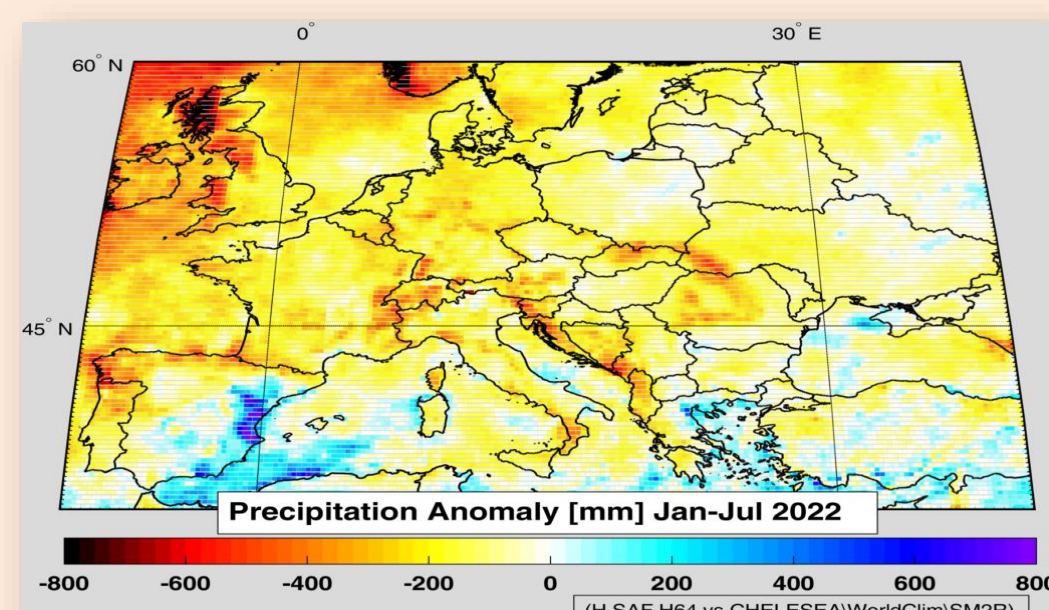
The cyclone affected the Libyan coast: an anomalous amount of rainfall with a daily peak of 294 mm.

Floods

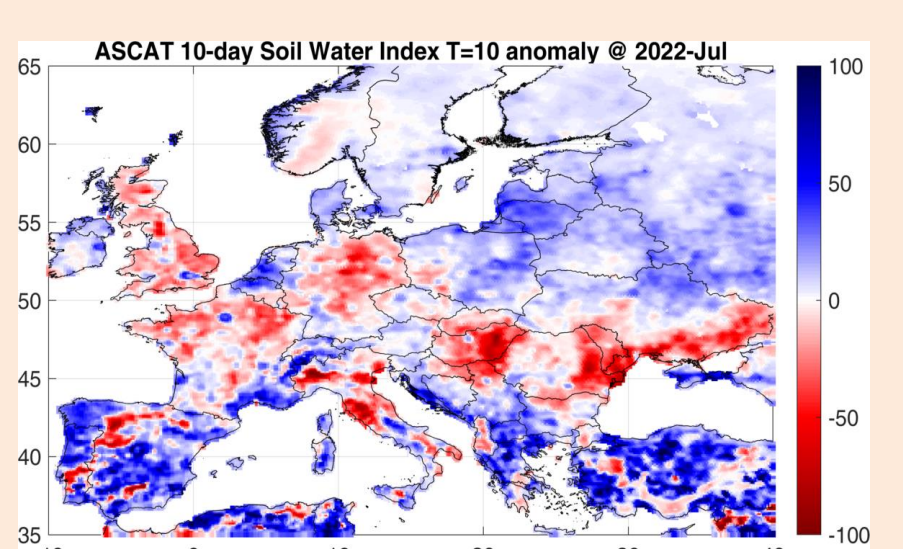
Heatwaves in Europe in 2022

Precipitation analysis

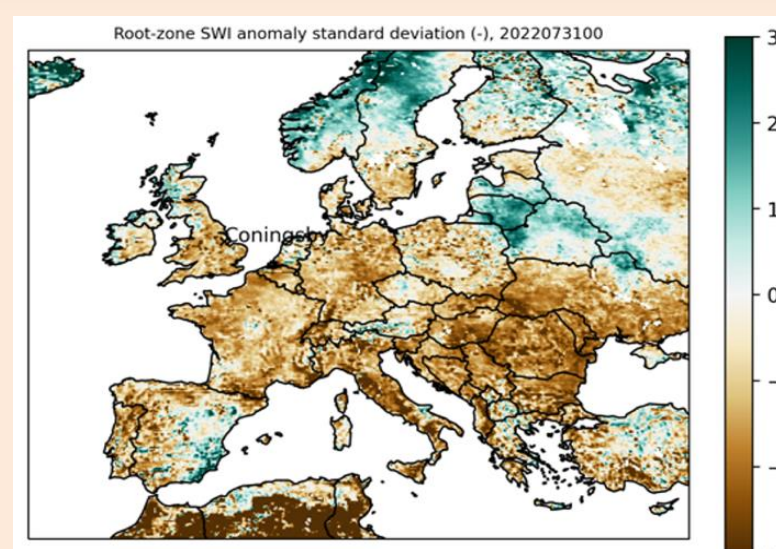
In the summer of 2022, droughts and heatwaves affected many parts of Europe, leading to high temperatures, forest fires and crop failures. The drought conditions were caused by a lack of precipitation and above average temperatures.



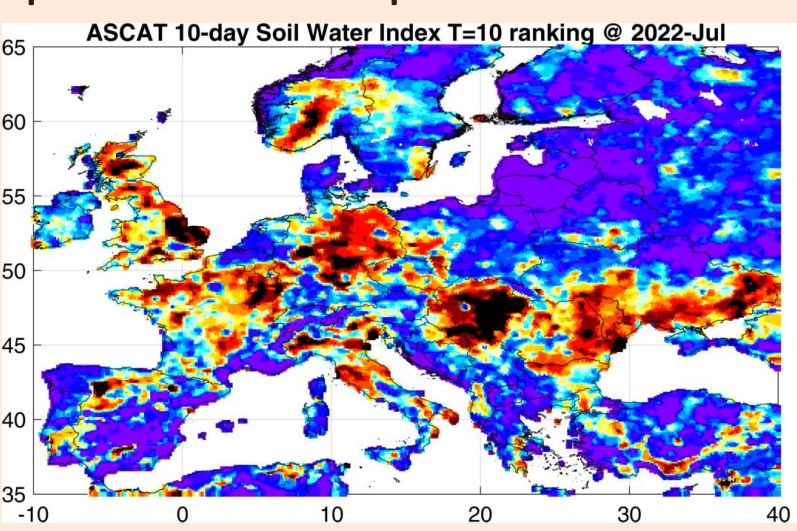
Soil moisture anomalies



The Copernicus Global Land Service (CGLS) Soil Water Index 10-daily SWI 12.5km V3 (SWI10) product, which takes H SAF ASCAT NRT SSM products as input.



A ranking of 1 (16 years 2007-2022) indicates the driest (wettest) July during the period. Several parts of Europe were ranked as 1, highlighting the severity and extent of the drought.

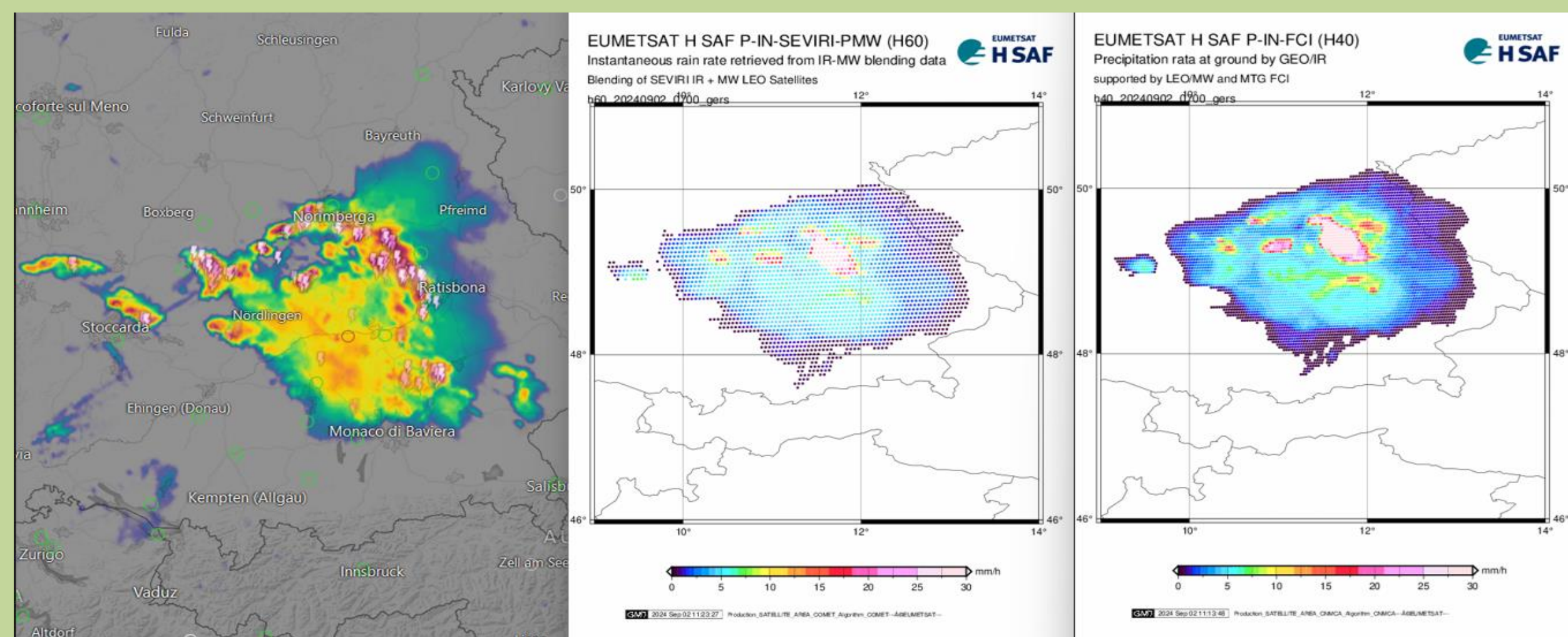


RZSM-ASCAT-NRT-10km (H26) root-zone (28-100 cm depth) soil moisture anomaly as standard deviations from the July mean. Figures show unusually dry conditions of -1 to -3 standard deviations below the mean at the end of July (upper panel) and the end of August (lower panel).

Day-1 precipitation products are UNDER TESTING (QA phase).

Instantaneous precipitation products: blended IR (FCI) + PMW Rain Rate (H 40)

Accumulated precipitation hourly and daily (H 42)



	Main features	
	H 40	H 60
Coverage	MTG Full-disk area	MSG Full-disk area
Cycle	10 minutes	15 minutes
Spatial Resolution	2 Km s.s.p. ~3-4 km over Europe	3 Km s.s.p. ~5-8 km over Europe
Timeliness	Within 5 minutes from the end of acquisition	Within 5 minutes from the end of acquisition
Dissemination	EUMETCast and H SAF website	EUMETCast and H SAF website
Formats	NetCDF	NetCDF

Visual comparison for the event in South Germany, 2 Sept 24, 07:00 UTC
Meteosat Third Generation allows for an unprecedented level of detail.

MTG