PROGRAMME OF THE EUROPEAN UNION

Copernicus
Europe's eyes on Earth

European Commission

Introduction to the European Flood Awareness System

Member State Visit – Portugal

22 February 2024

Christel Prudhomme

COPERNICUS EMERGENCY MANAGEMENT SERVICE

THE COPERNICUS EMERGENCY MANAGEMENT SERVICE

On-demand mapping — Rapid Mapping — Risk & Recovery Mapping

Early warning and monitoring — Floods — Fires — Droughts

Exposure Mapping — Population — Built-up areas

European & Global Flood Awareness Systems

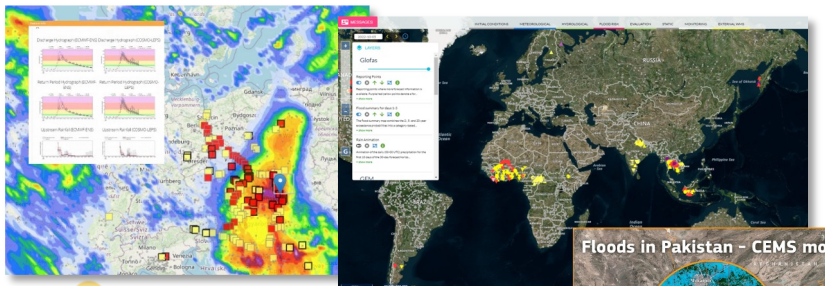
- Continental & global scale flood forecasting and monitoring systems
- Complementary (river basin wide, probabilistic, medium-range) flood forecast information
- Sentinel-1 global flood monitoring
- Knowledge sharing & networking

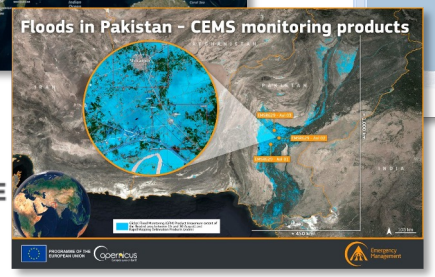
European & Global Drought Observatories

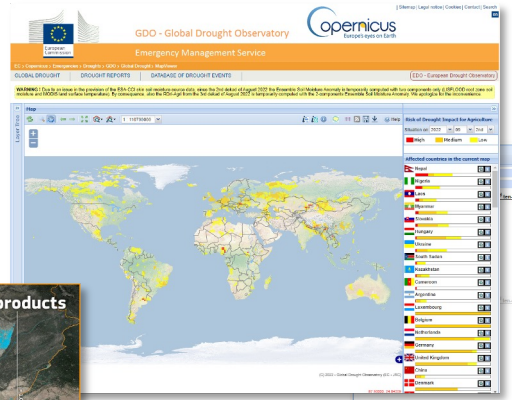
- Combined Drought Indicator plus other drought indicators
- Periodical reports focused on severe drought events
- Forecast of the soil moisture drought conditions for the coming week.

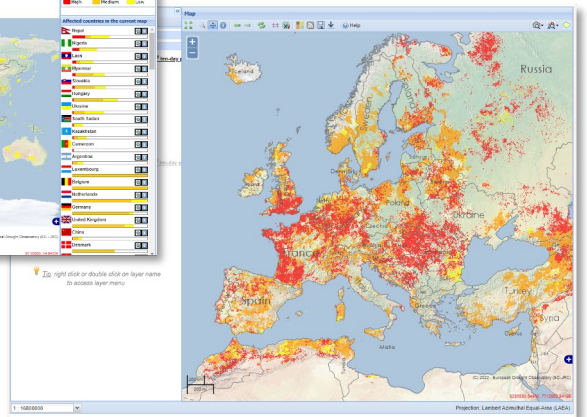
European Forest Fire Information System

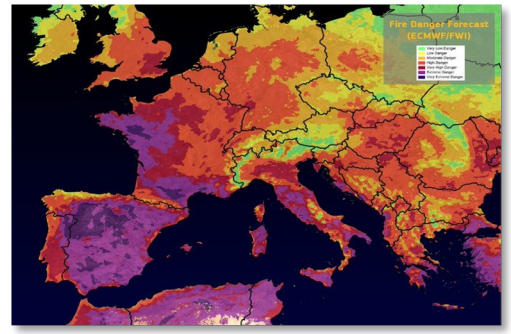
- Monitoring active fires and burnt areas
- Fire danger forecasts
- Seasonal fire forecasts
- Annual report
- Coordinated with DG ENV Forest Fire Expert Group











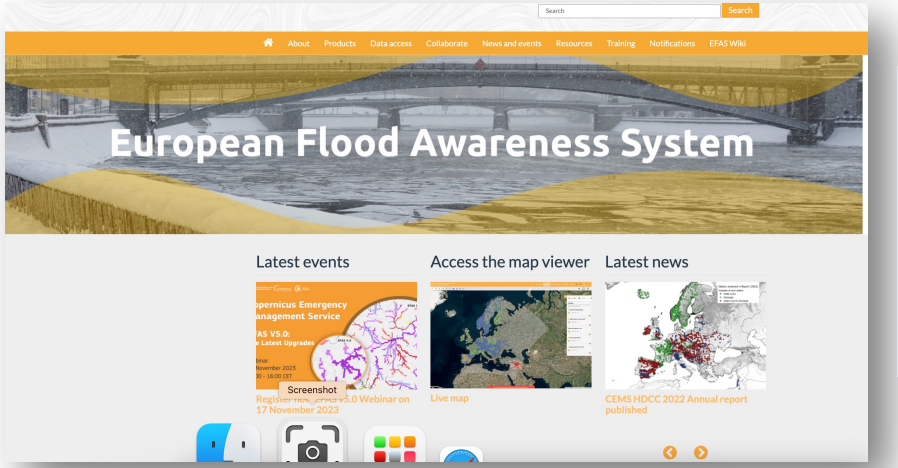
PROGRAMME OF THE EUROPEAN UNION

Copernicus Europe's eyes on Earth

What is EFAS?

Transboundary, European-wide probabilistic flood forecasting system available to eligible partners through a web platform and data service providing information on upcoming floods and associated risk at medium-range and seasonal forecast horizon

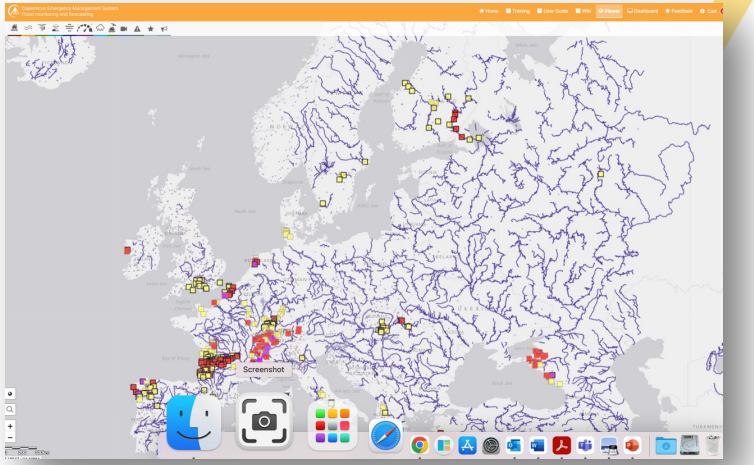
What do EFAS and GloFAS offer?

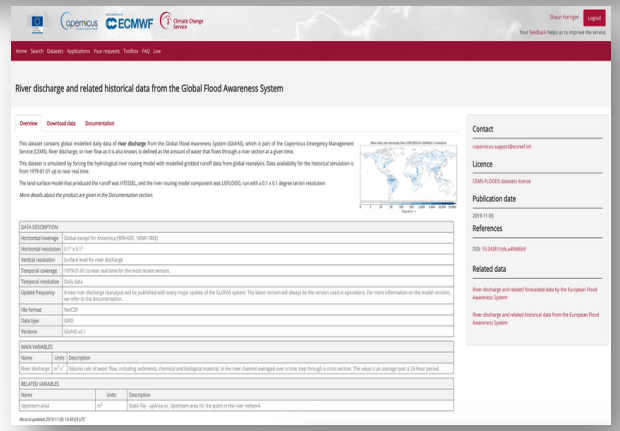


EFAS website

www.efas.eu

Access to real-time maps only for EFAS partners

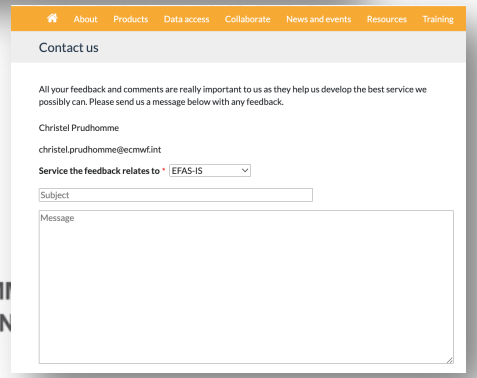




EFAS data service (CDS)

On-demand ftp service (EFAS partners)

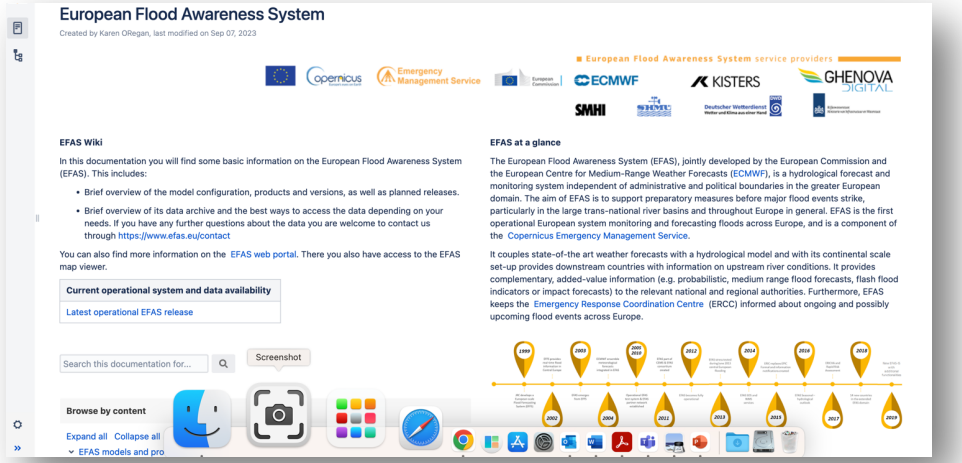
- Password protected service
- Latest EFAS forecasts for fixed reporting points
- Available as netCDF files



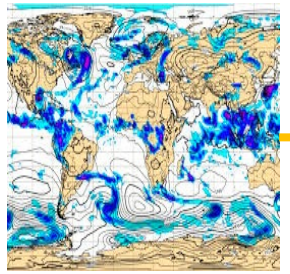
EFAS support

Wiki documentation

On-demand support service

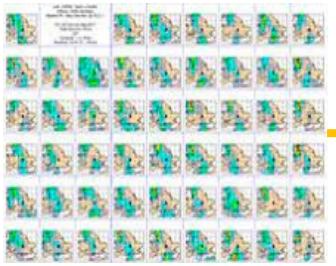


Processing chain



Weather up to forecast date

EFAS METEO

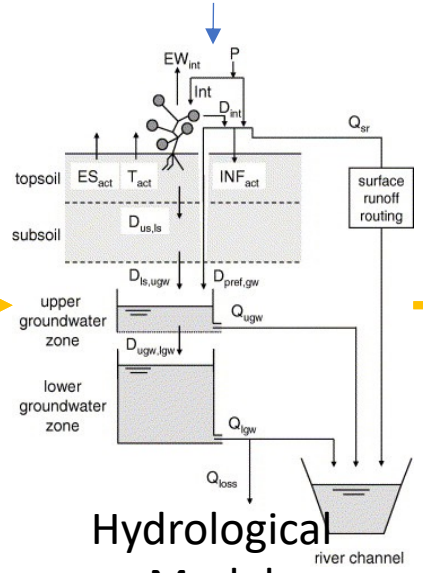


Weather forecasts up to 7 months

ECMWF ENS/DWD/ COSMO/SEAS5

Time-invariant data

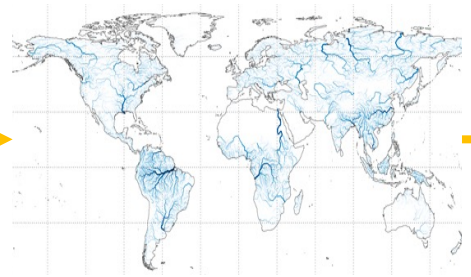
Geo-spatial maps, parameters



Hydrological Model

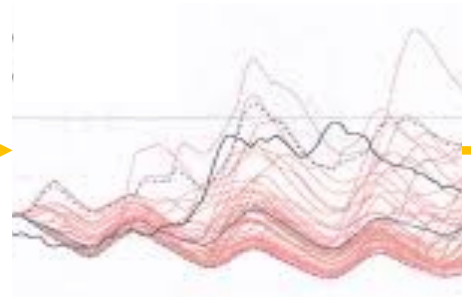
LISVAP, LISFLOOD

Surface fields at ~1.5 km resolution
Calibrated over ~2000 catchments
Covering European domain



Hydrological status update

River discharge, Soil moisture, etc…

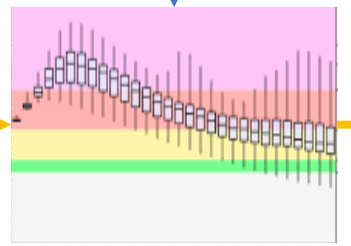


Ensemble hydrological forecast datasets

River discharge, soil moisture, etc..

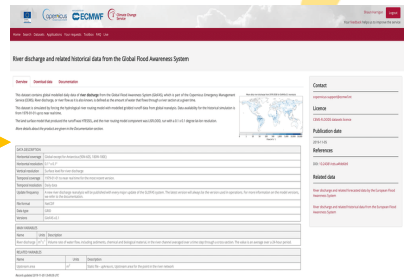
Climatology

Flood thresholds



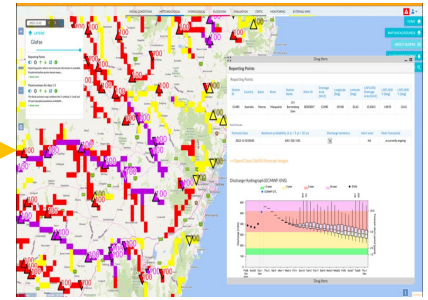
Hydrological forecast product generation

Flood hydrographs, seasonal outlooks, etc…



Data Service

Copernicus Climate Data Store



Web Service

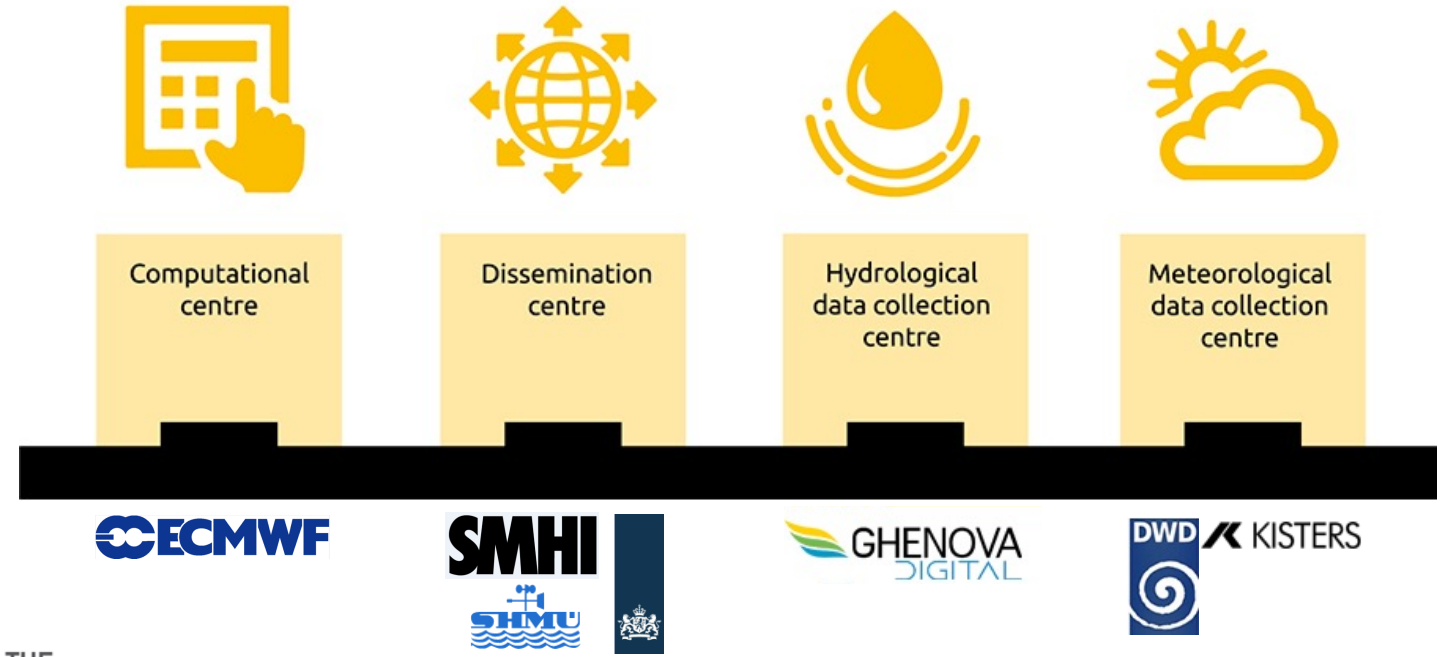
CEMS EFAS

PROGRAMME OF THE EUROPEAN UNION

Copernicus Europe's eyes on Earth

EFAS consortium

Operational EFAS is made of 4 centres executed by different consortia. The Joint Research Centre of the European Commission is the entrusted entity responsible of CEMS-EFAS in terms of management, technical implementation and evolution.

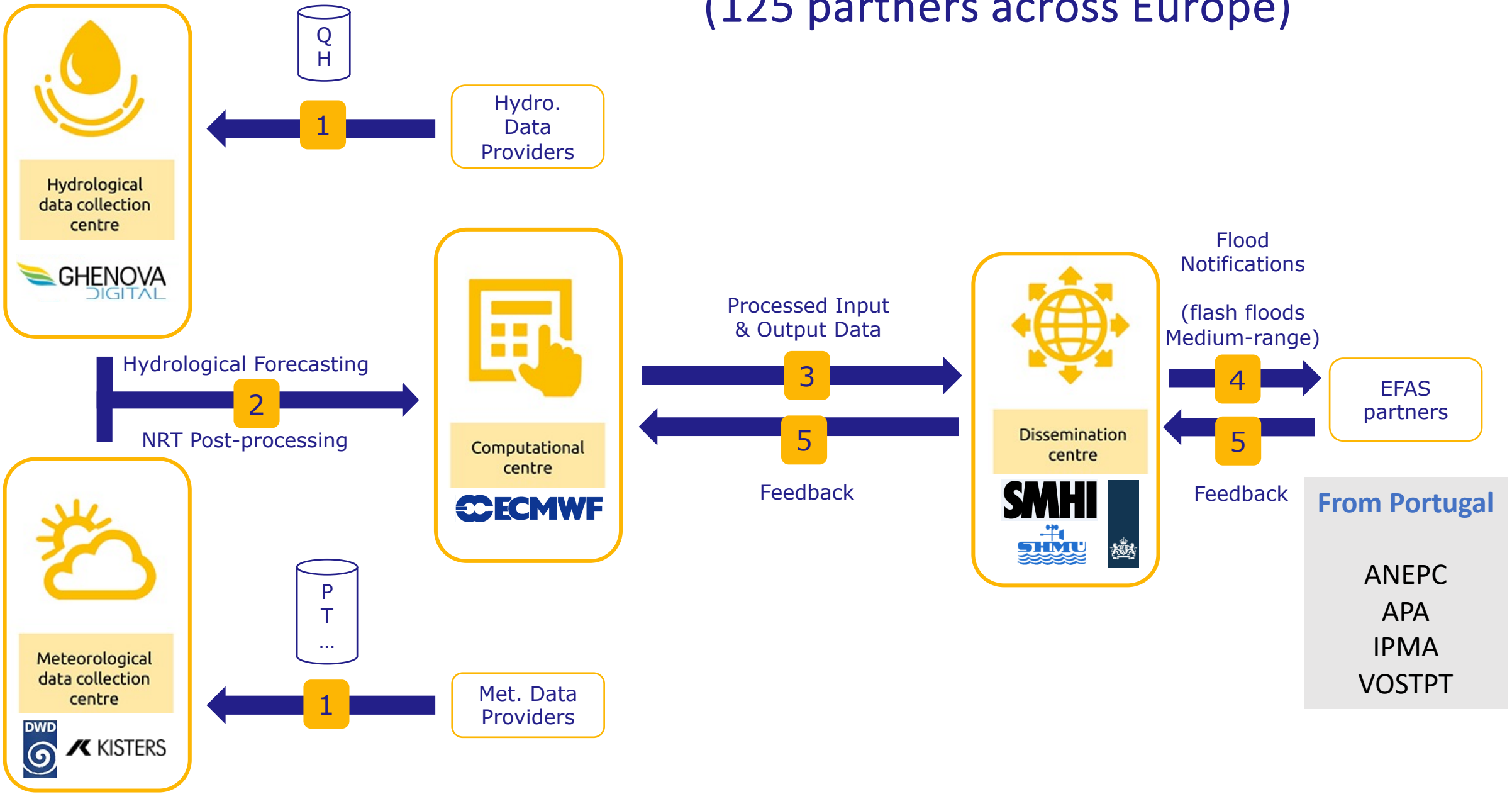


European Commission

PROGRAMME OF THE EUROPEAN UNION

Copernicus Europe's eyes on Earth

EFAS interactions with partners (125 partners across Europe)



EFAS Hydrological Model & domain

- **Latest version launched Sep 2023 (v5)**
- **LISFLOOD-OS (JRC)**
- ~1.5 km **spatial resolution**
  - **Much finer river network**
  - **In Portugal**: Just over **60 'static reporting points'**

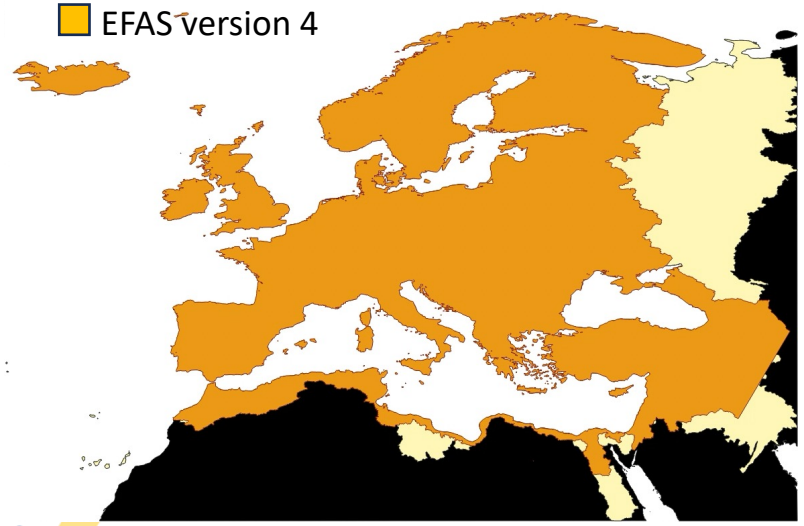
Open Source code and documentation:

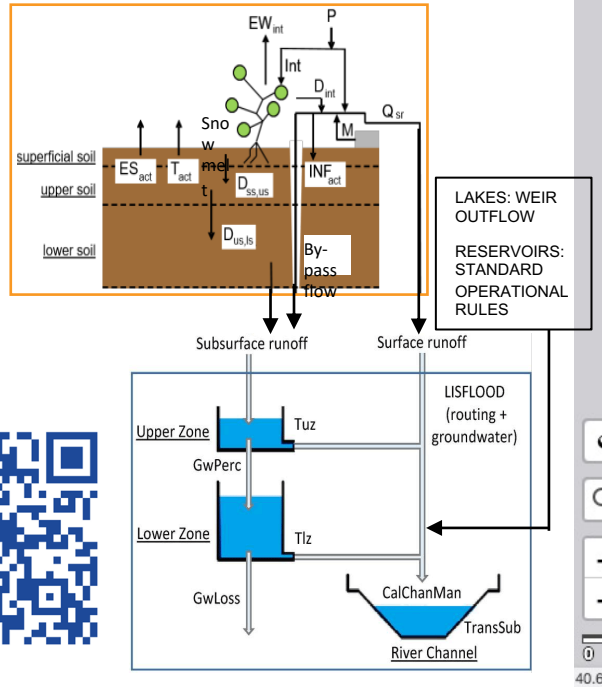
https://github.com/ec-jrc/lisflood-code

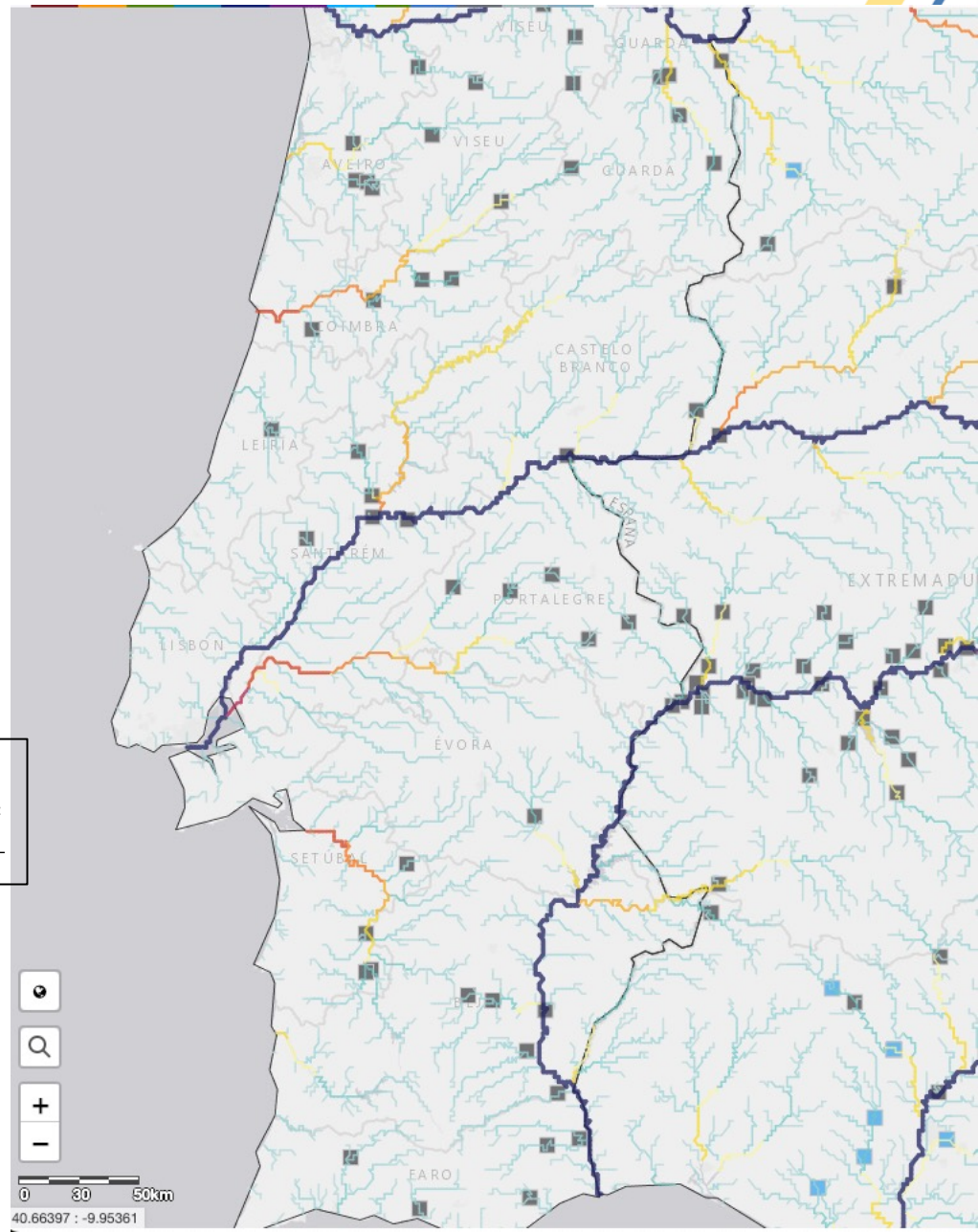
https://ec-jrc.github.io/lisflood-model/

EFAS version 5

EFAS version 4





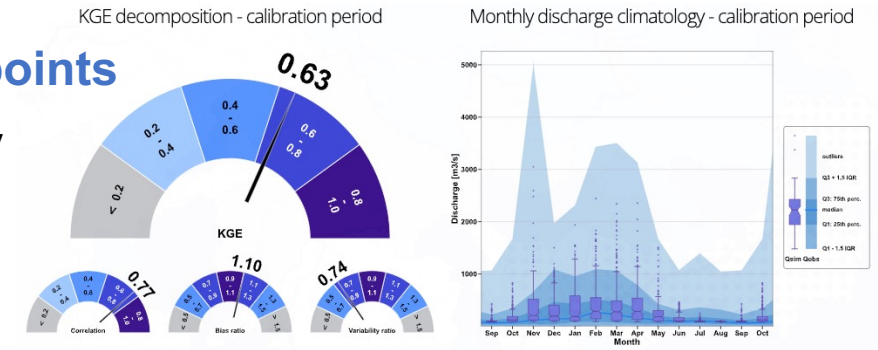


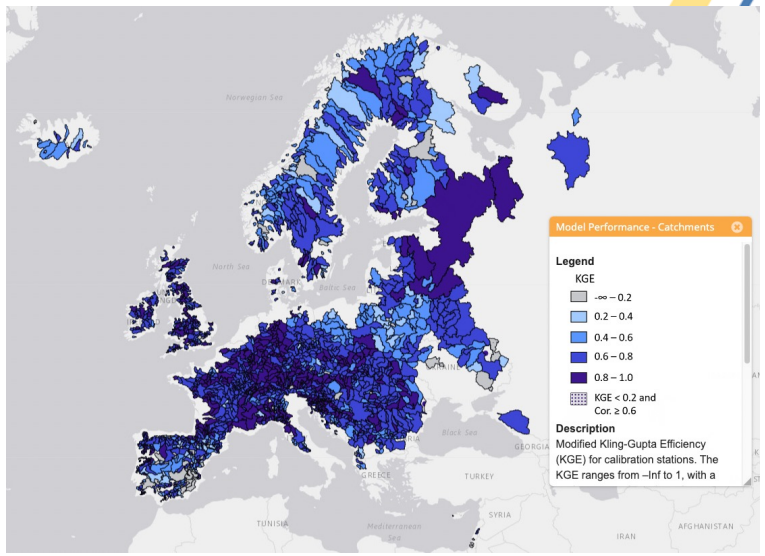
PROGRAMME OF THE EUROPEAN UNION

LISFLOOD Calibration

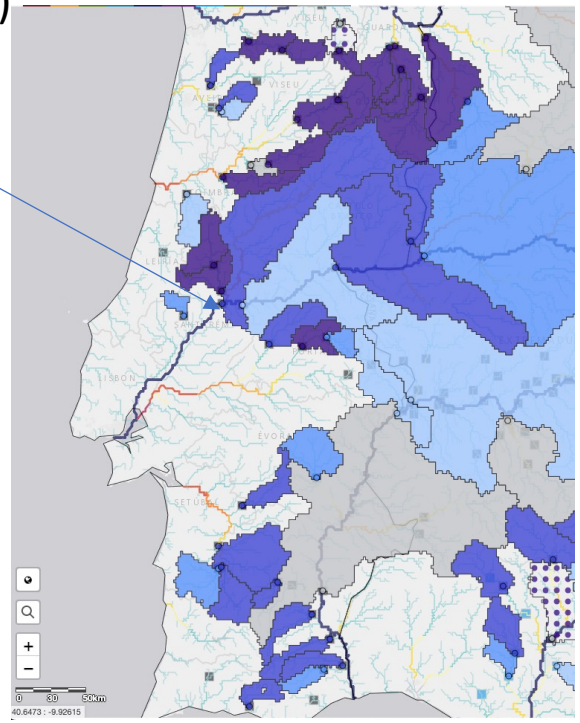
- Over domain: **1903 calibration points**
- Parameter **regionalisation**

- **In Portugal: 50 calibration points**
- Mixed performance, generally associated with strong bias





Tagus @ Almourol (~67000km2)



- **New calibration** to start in Sep 2024
  - Opportunity to add **more calibration points**
  - Opportunity to **update time series** of existing calibration points
  - **Hydro Data Collection Centre** to contact all hydro data providers to ask for inputs

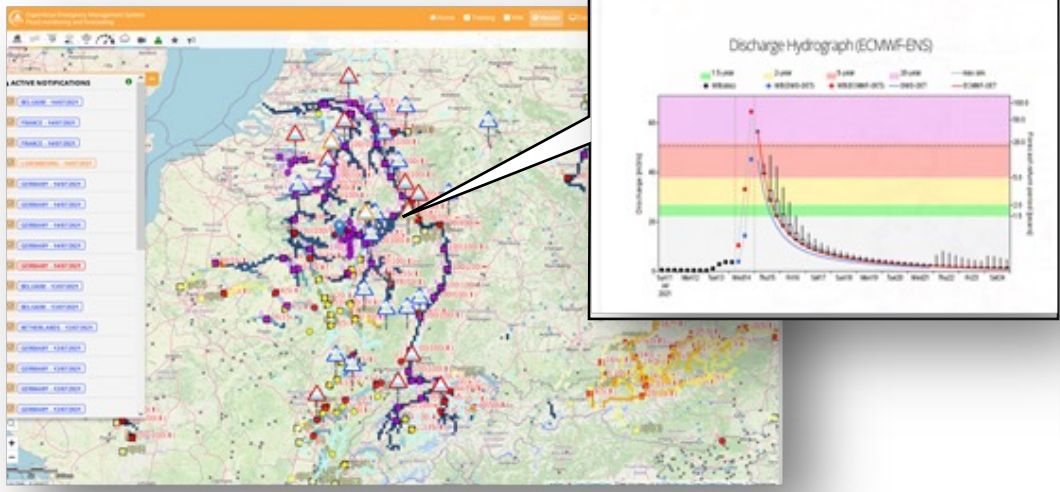
PROGRAMME OF THE EUROPEAN UNION

Copernicus Europe's eyes on Earth

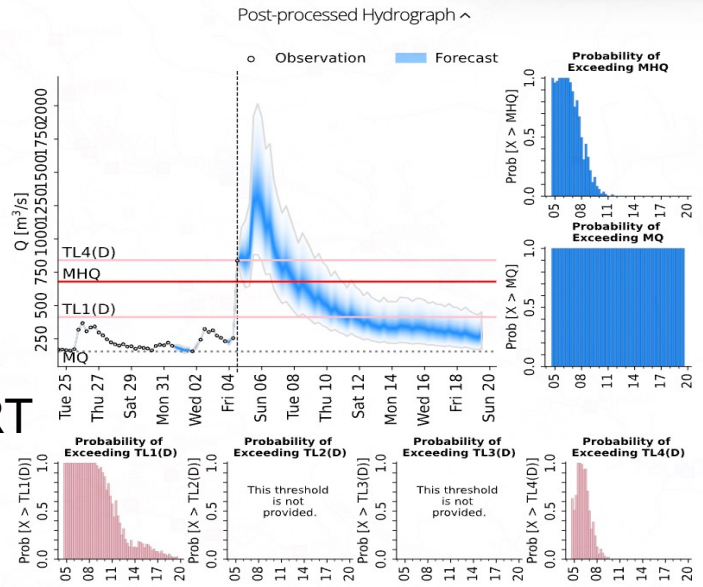
Medium-range flood information

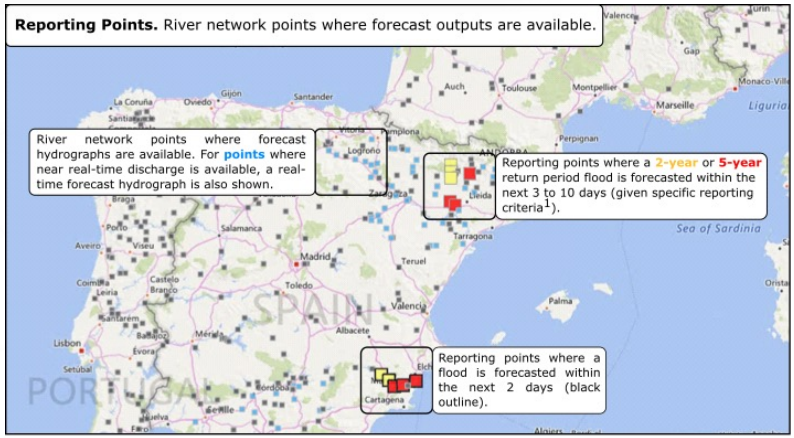
- **Flood summary layers & reporting points**
  - European coverage, twice/ day up to 15 days
  - 4 meteorological forecast input
  - Different flood probability layers
  - **Notifications** to partners (activated by EFAS duty forecaster)
- **Post-processed flood forecasts**
  - Over 1500 points over Europe
  - Produced twice/day to 15 days
  - Statistical correction where real-time observed discharge is provided
  - **No point over Portugal** (lack of NRT hydro data)

Rhine River on 15 July 2021



Station ID	Name	Provider Drainage Area
95	Gornja Radgona	10197.2



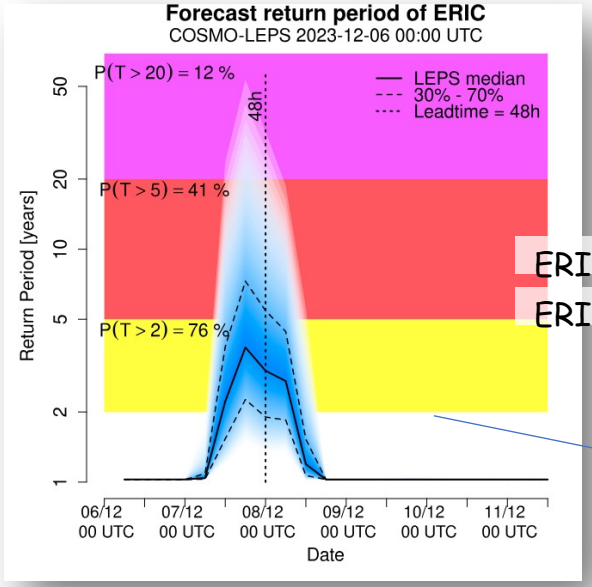


PROGRAMME OF THE EUROPEAN UNION

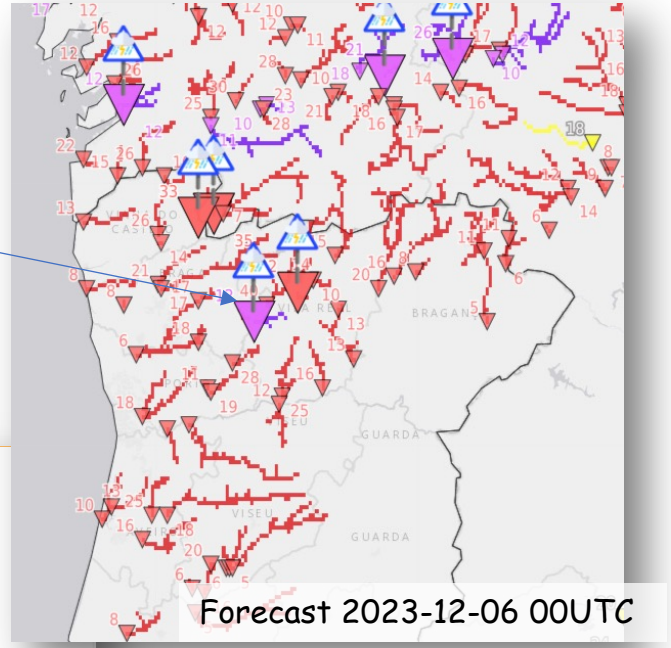
Copernicus Europe's eyes on Earth

Short-range- Flash flood products

- **Flash Flood Awareness layers**
  - European coverage; twice/day up to 5 days
  - **Probabilistic forecasts** for given return periods, affected areas and accumulated runoff
  - Catchment size up to **1000km²**
  - **Notification to partners** (activated by EFAS duty forecaster)



ERIC Affected Areas
ERIC Reporting Points



Notification Detail

EFAS Flash Flood Notification*

NOTIFICATION DETAILS:
- Country(ies): **Portugal**
- Administration Region(s): **Alto Minho, Alto Tâmega**
- Likely start of event: **Thursday, 7th of December 2023 - 12:00**
- Probability to exceed a 5-year flash flood return period threshold: **33 %**
- Probability to exceed a 20-year flash flood return period threshold: **9 %**

ADDITIONAL INFORMATION:
- Forecast date: 2023-12-06 00 UTC
- Affected area susceptible to landslides: Very High: 11 km², High: 13 km², Moderate: 8 km²
- Forecaster Comments: -

This is the only notification you will receive for this event! Please follow the evolution of the event on EFAS.
More information about the EFAS flash flood notifications is available on the EFAS wiki

EFAS FORECASTER ON DUTY

Maarten Smoorenburg
Institute: Rijkswaterstaat Water Management Center for the Netherlands (RWS) / Deltares Department Operational Water Management
email: info@efas.eu

** indicating a high probability of extreme precipitation and potential flash flooding*

PROGRAMME OF THE EUROPEAN UNION

Copernicus Europe's eyes on Earth

Rapid Flood Mapping and Impact Assessment

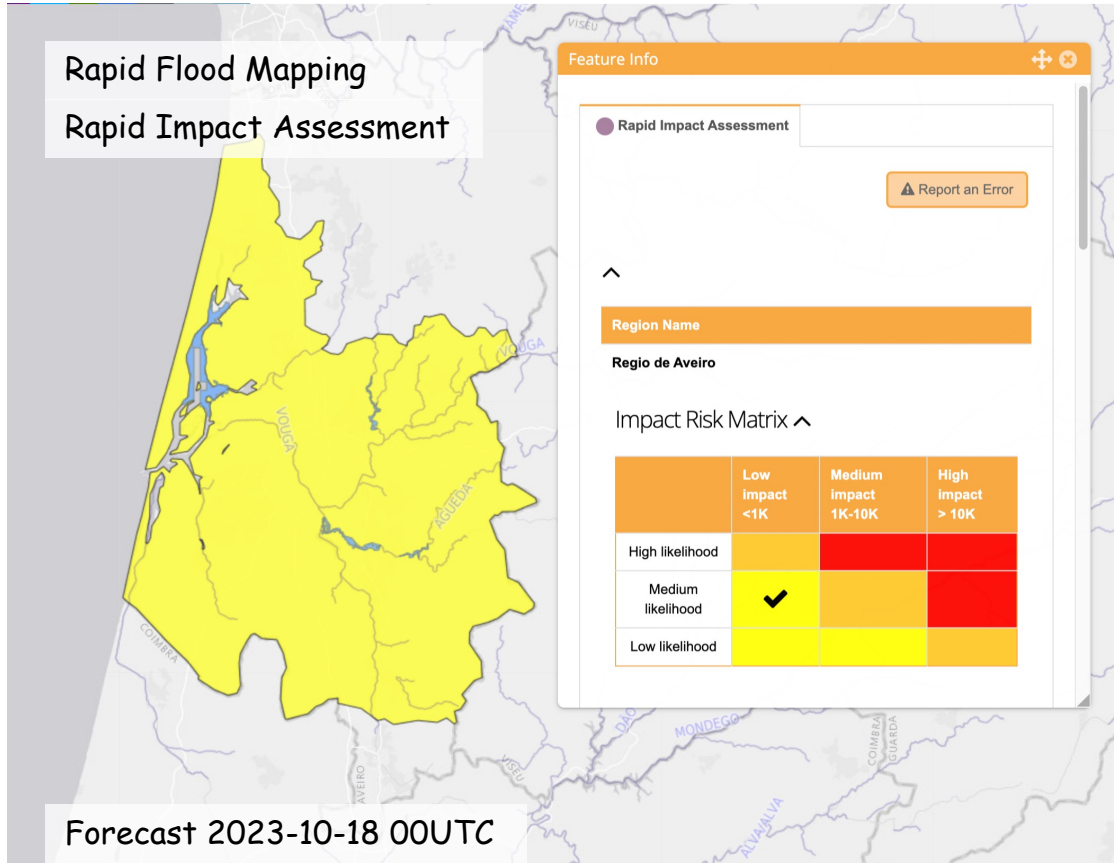
- **Flood hazard** catalogue (90m resolution)
- **Impact maps** according risk matrix (population affected)
- **Exposure & flood event information** in Rapid Impact Assessment in pop-out tables.

Exposure Information

Population affected [No. of people]
Artificial surfaces [ha]
Agricultural surfaces [ha]
Forest and Seminatural [ha]
Settlements affected [No of Settlements]
Airports affected [No of facilities]
Education facilities affected [No of facilities]
Powerplant facilities affected [No of facilities]
Health facilities affected [No of facilities]
Refugees sites affected [No of sites]
Dams affected [No of dams]

Flood Event Information

	PROTECTED	UNPROTECTED
Estimated peak return period [yr]	7	7
Estimated protection level [yr]	64	0
Estimated flooding start date	2023-10-19 12 hours	2023-10-19 06 hours
Estimated flooding end date	2023-10-20 00 hours	2023-10-20 00 hours
Estimated flooding duration [days]	18 hours	1 days
Estimated peak date	2023-10-19 12 hours	2023-10-19 06 hours
Estimated flooded area [km ^ 2]	8	67
Mean probability exceeding 2-years threshold [%]	91	87
Mean probability exceeding 5-years threshold [%]	63	55
Mean probability exceeding 20-years threshold [%]	18	17



PROGRAMME OF THE EUROPEAN UNION

EFAS wiki

- Go-to for extended documentation
- Methods, products, operational system
- Information on version upgrades, evaluation etc…

Latest operational EFAS release

Created by Karen ORegan, last modified on Sept 20, 2023

The following is a description of the latest operational release of EFAS **v5.0**. For an overview of other EFAS releases, please see: EFAS versioning system.

Summary

EFAS v5.0 introduces a number of major changes to the system, including:

- a higher spatial resolution. EFAS v5.0 has 1 arcmin/ 0.0166667 degrees resolution (~1.4km resolution.
- a different project system, now based on EPSG4326 instead of ETRS89 Lambert Azimuth previous versions.
- a larger modelling domain whose extension has been enlarged to match the river catchme
- an entirely new set of 0.0166667 degrees resolution input maps produced using the most
- major improvements to the open-source hydrological model LISFLOOD.
- a new calibration at 1903 in-situ gauging stations, with a parameter regionalisation perfor discharge observations were not available.
- new return period thresholds and snow water/soil moisture anomaly maps based on a clim climatology is available at the C3S Climate Data Store.
- updated hydrological post-processing models, recalibrated for EFAS v5.0.
- new flood hazard maps, generated using LISFLOOD-FP at 90m resolution and MERIT hyd
- new reforecast configuration (medium-range), with the hydrological reforecast datasets b
- ERIC based on LISFLOOD surface runoff outputs instead of empirical relationships
- ERIC notification points and reporting points shown only for catchments below 1000km^2
- additional flood event information available in the Rapid Impact Assessment pop-out tabl
- updated exposure information used in Rapid Impact Assessment (see CEMS-Flood flood
- an updated major rivers layer (see Static Layers Overview)
- new rules for defining dynamic reporting points (see EFAS v5.0 - Dynamic Reporting Poin

This upgrade of EFAS has large impacts on the EFAS modelling results.

Other smaller changes include the adjustment of the temperature evolution graph in the reporti temperature of the whole catchment.

EFAS v5.0 - Flash Flood Skill Assessment - Results

Created by Calum Baugh, last modified by Karen ORegan on Sept 20, 2023

This analysis evaluated the skill of the ERIC flash flood products when compared against flash flood observations, the results are used to decide the criteria for issuing flash flood notifications. It was necessary to perform a new skill assessment for EFAS v5.0 to decide these criteria, rather than using the criteria from EFAS v4.1 because of the following changes:

- The new calibration of the LISFLOOD hydrological model which is used within the generation of the ERIC flash flood products
- The ERIC products are now calculated directly from the surface runoff predictions from LISFLOOD, previously precipitation was combined with LISFLOOD predictions of soil moisture to estimate surface runoff

or ERIC flash flood predictions between **1st January 2022 - 31st Dece**

UTC on each day during the evaluation period were evaluated. A range o ng from 0 to 100% in increments of 10%. The evaluation was performe

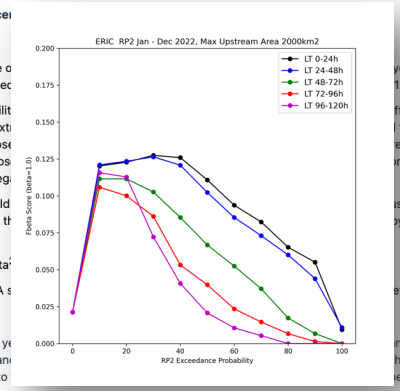
points were extracted, then each of the different exceedance probabilit oints which satisfied the threshold criteria were extracted. For each ext regions layer were extracted. These were then compared with the obse was no corresponding observation (false alarm), or if there was an obs eriod and the total number of hits, misses, false alarms and correct neg

unique combination of exceedance probability and lead time threshold es the recall (also known as the hit rate) and precision (also known as th eir evaluation of the EFAS formal and informal notifications.

$$f(beta) = (1+ beta2) * Hits / (1+ beta^2) * Hits + beta$$

er which by default is 1.0 giving equal weight to recall and precision. A s

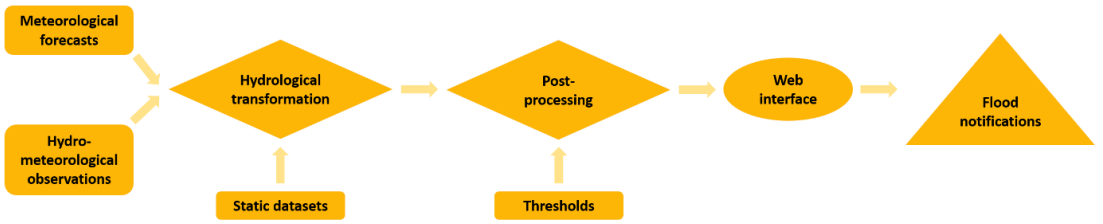
ta) score for the different exceedance probabilities of the 2, 5 and 20 y eriod at 0-24 and 24-48 hours lead time, and also a 10-20% exceedan the 20 year return period had lower f(beta) scores, this could be due to



EFAS hydrological forecasting chain

Created by Karen ORegan, last modified on Sept 07, 2023

To provide information on upcoming flood events, EFAS relies on a hydrological forecasting chain.



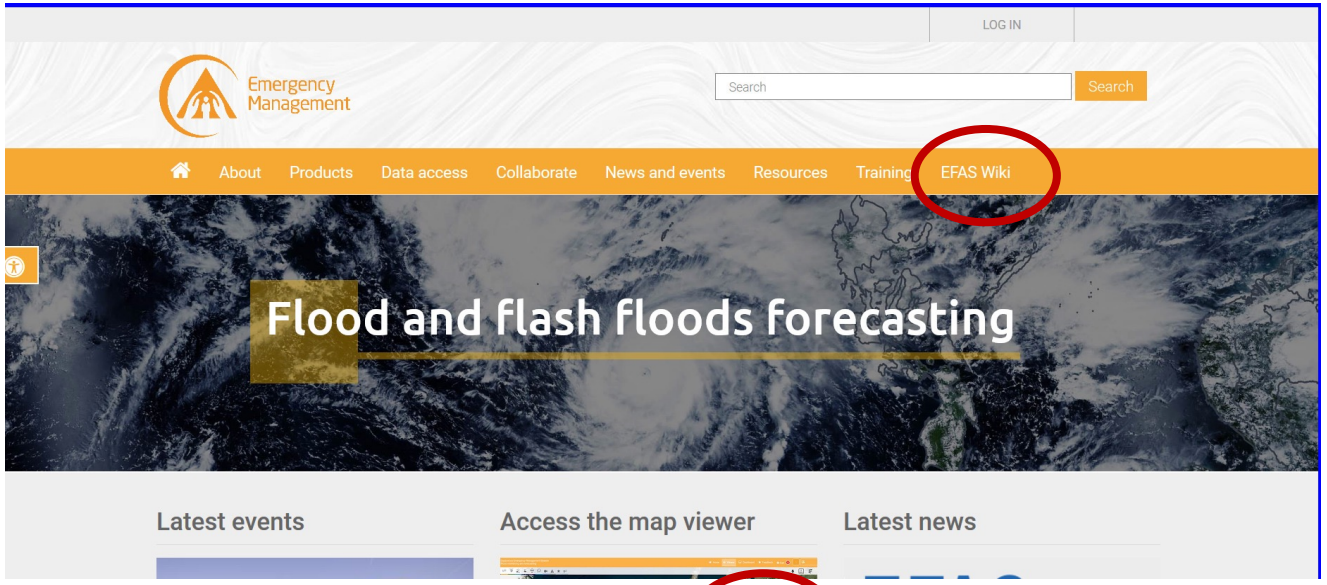
The EFAS hydrological forecasting chain

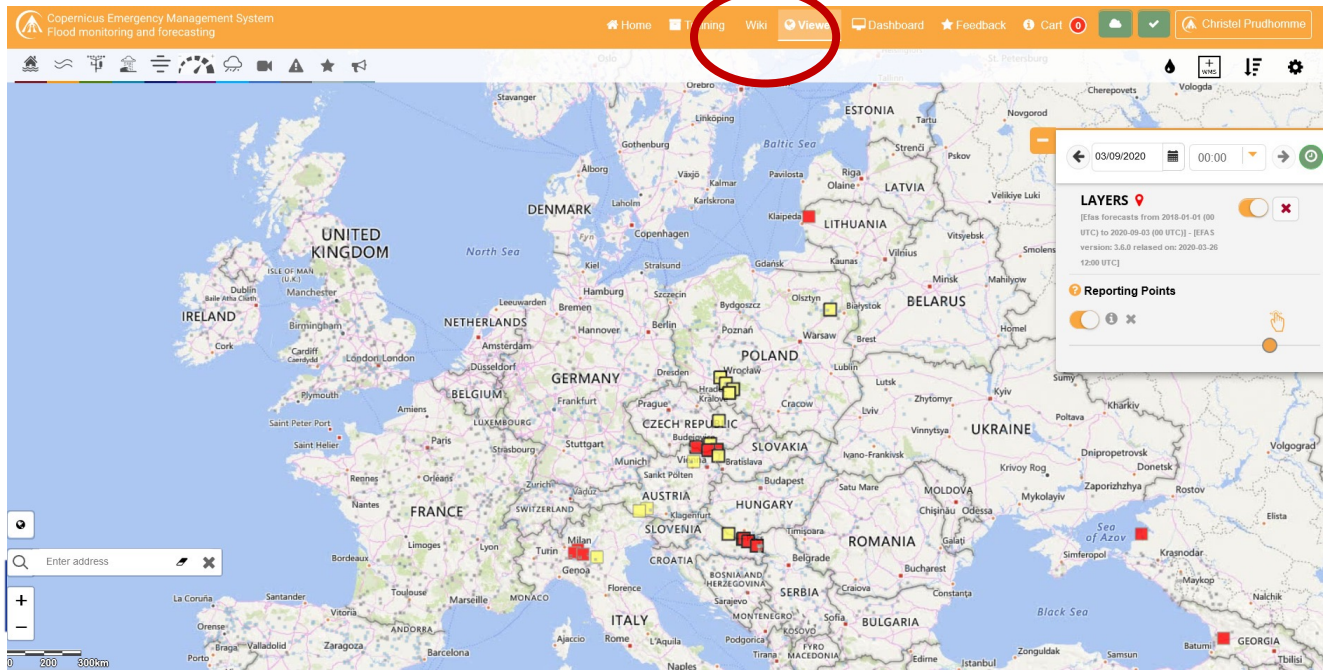
There are key elements in the EFAS production chain: the meteorological forcing and land surface data; the hydrological models; and the EFAS forecasts and products.

PROGRAMME OF THE EUROPEAN UNION

Copernicus Europe's eyes on Earth

EFAS wiki



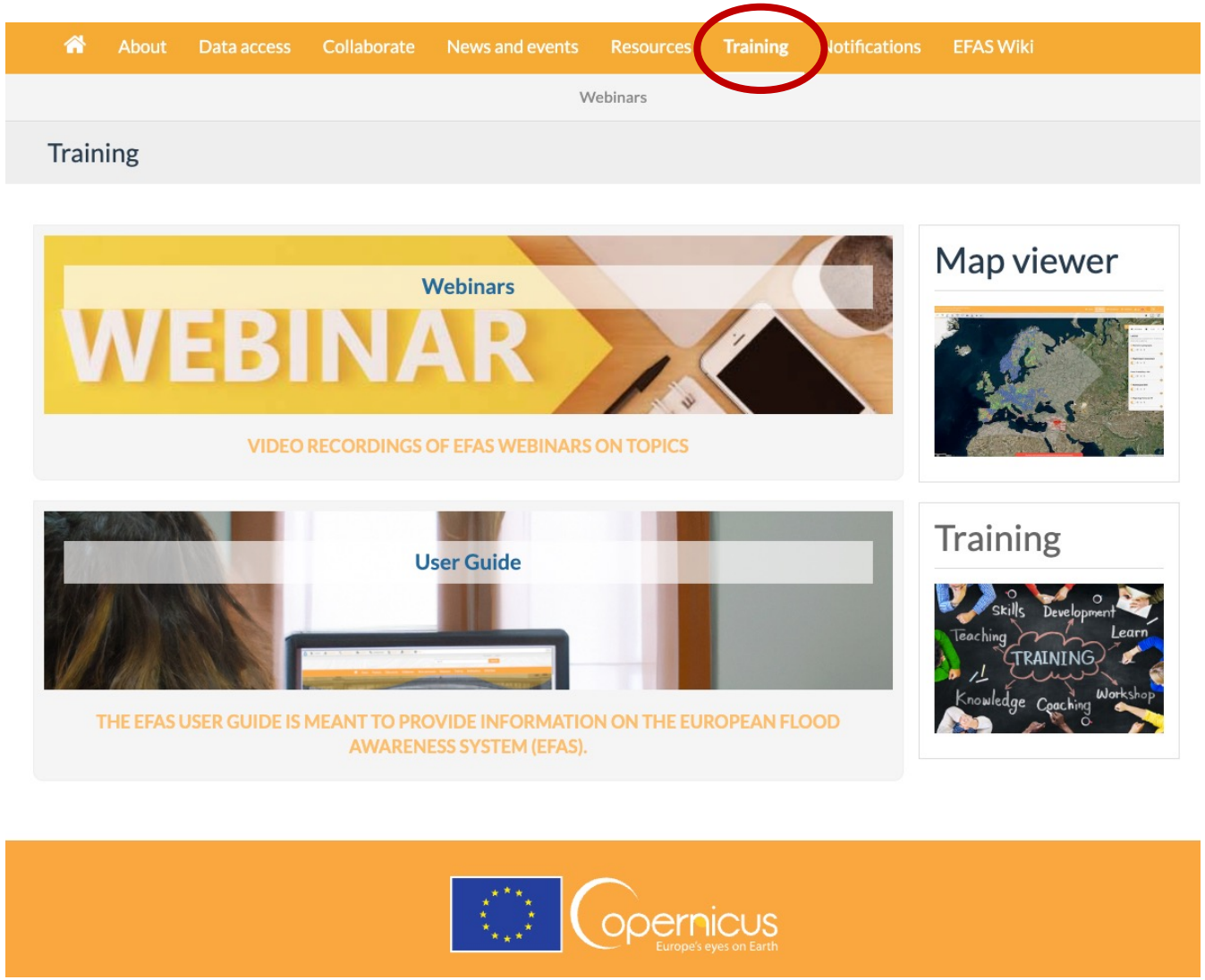


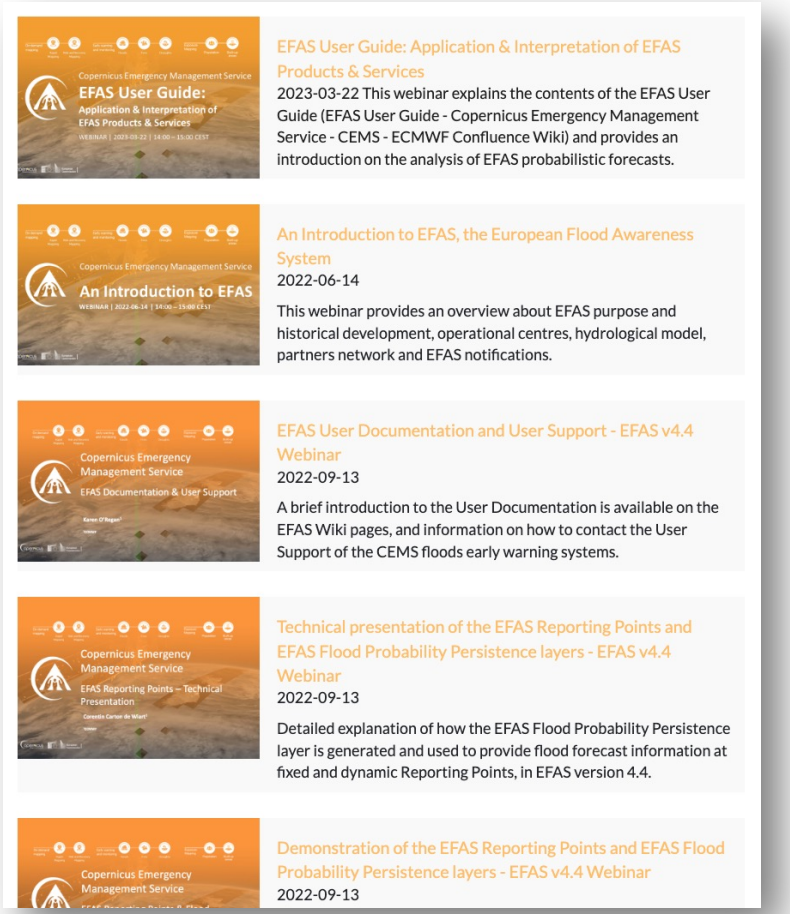
Link to the CEMS-Flood wiki on EFAS web site https://confluence.ecmwf.int/display/COPSRV/European+Flood+Awareness+System

-> fast access to detailed documentation

SCAN ME

EFAS training material





PROGRAMME OF THE EUROPEAN UNION

Copernicus
Europe's eyes on Earth

PROGRAMME OF THE EUROPEAN UNION

Thank you!

❖ Get in touch

EFAS website:

- **https://efas.eu**

EFAS documentation wiki:

- **https://confluence.ecmwf.int/display/CEMS/European+Flood+Awareness+System**

https://www.efas.eu/en/form/feedback

Contact

EFAS partners & conditions of access

- EFAS partner: any national, regional or local authority that is legally obliged to provide flood forecasting services or has a national role in flood risk management in their country & the European Commission Services i.e. DG ECHO-ERCC, DG ENTR-COPERNICUS & DG JRC
  - All EFAS partners sign a Condition of Access agreement with EFAS DC
  - EFAS partnership gives
    - Free of charge, password protected, real-time access to EFAS products through the EFAS Information System for river basins previously agreed upon
    - The right to attend and get 1 vote at the annual EFAS partners meeting
- Limited EFAS access for Third Party and Research Partners. Archived EFAS forecasts (older than 1 month) freely available