

An introduction to the Global Flood Awareness System

UN-SPIDER / DLR / ZFL International Training Workshop "Space technologies for flood management"

UN Bonn – 20 February 2023



COPERNICUS EMERGENCY MANAGEMENT SERVICE

What is GloFAS ?

Component of the Copernicus Emergency Mapping Service (CEMS) Early Warning & Monitoring

• Early warning system

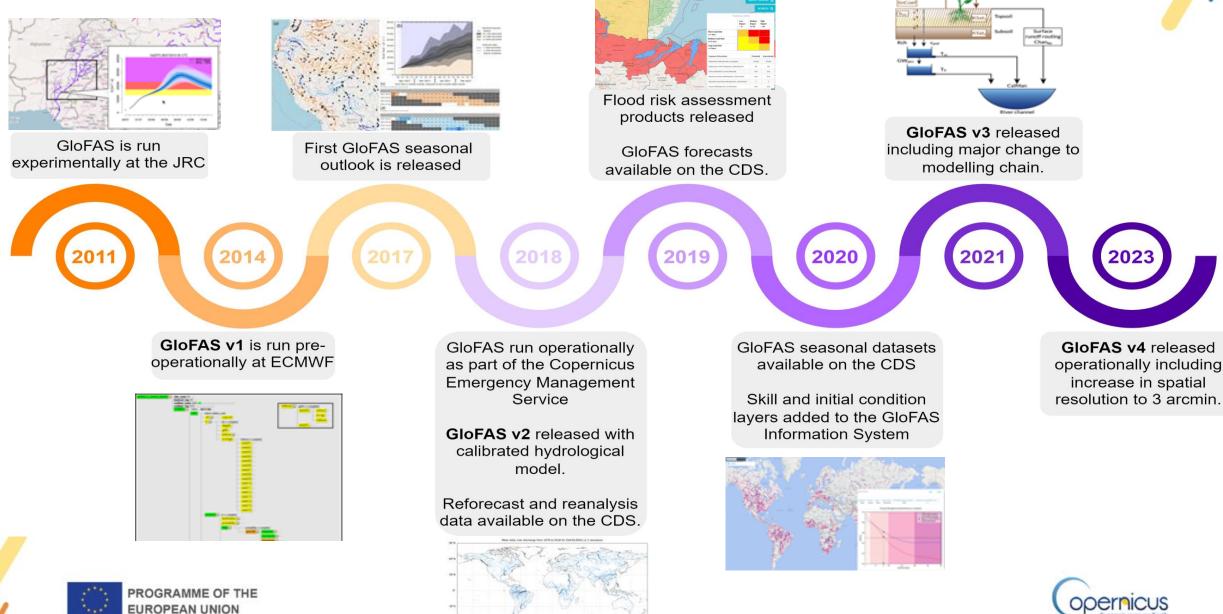
- Complementary information to National Hydrological and Meteorological Services (NHMS)
- **Support** to international organisations and local decision making
- Global forecast products and data freely available





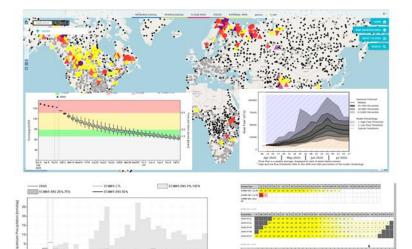


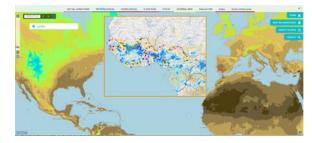
GIoFAS a constant evolution

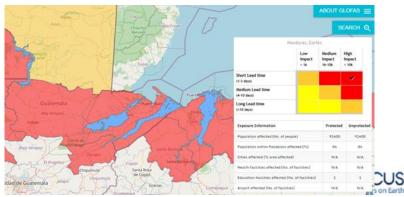


What does GloFAS provide?

- Global hydrological ensemble forecasts updated daily with output resolution of 0.1 degrees (~10 km)
- Highlights of expected flooding over next 30 days
- Rapid flood mapping and rapid flood **impact assessment**
- Seasonal hydrological outlook showing wet/dry anomalies over next 16 weeks
- Additional information as hydrographs, initial condition maps, forecast consistency tables and performance layers to help interpret results
- Complementary Global Flood Monitoring











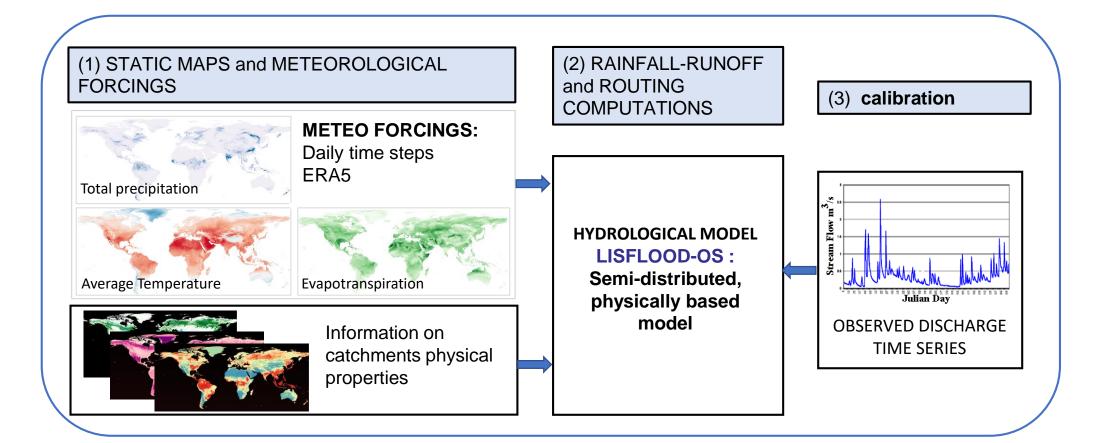
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The model set-up at the core of GloFAS

The engine that powers GloFAS



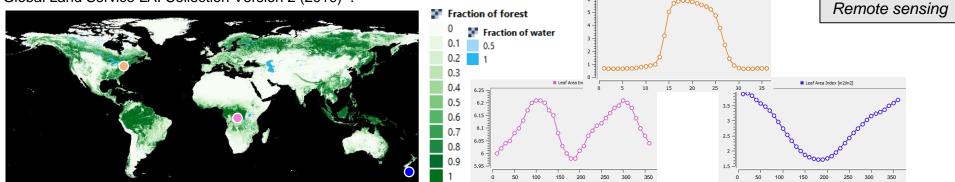




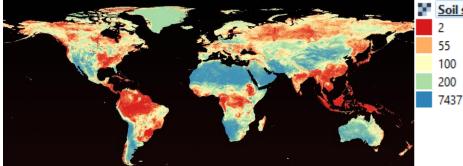
(1) Static maps dataset

~100 maps providing information on catchments' morphology, land cover and land use, soil properties, water demand for human use (*Collaborative effort: JRC and ECMWF*).

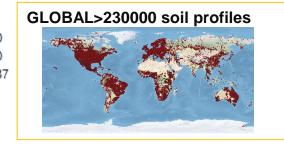
Leaf area index: half the total area of green elements of the canopy per unit horizontal ground area m²/m². Copernicus Global Land Service LAI Collection Version 2 (2019)¹.



Soil properties: hydraulic conductivity, saturated and residual water content, Van Genuchten parameters. International Soil Reference and Information Centre (ISRIC) – SoilGrids[™] (2020)² and pedotransfer equations by Toth et al. (2015)³.



Soil sat. hydr. conductivity [mm/day]



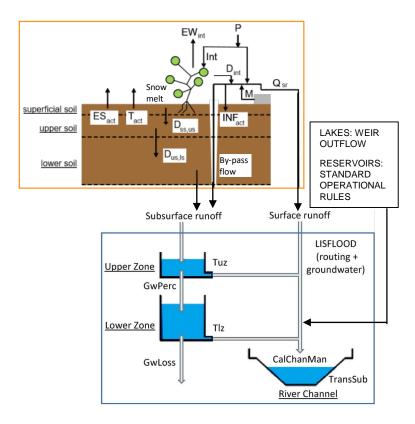
In situ



¹https://land.copernicus.eu/global/products/LAI;
 ²https://www.isric.org/;
 ³https://esdac.jrc.ec.europa.eu/themes/soil-hydraulic-properties



(2) OS LISFLOOD hydrological model



Open Source code and documentation: https://github.com/ec-jrc/lisflood-code https://ec-jrc.github.io/lisflood-model/

LISFLOOD-OS: Semi-distributed, physically based model

- 6 land cover fractions within a pixel;
- 3 soil layers;
- 2 groundwater storages;
- kinematic wave routing in channels and floodplains;
- lakes and dams;
- water abstraction for anthropogenic use.

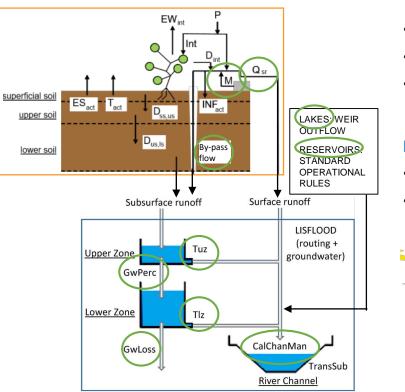
COMPUTATIONALLY EFFICIENT!

- Optimal management of large input.
- Parallel computations.





(3) Calibration

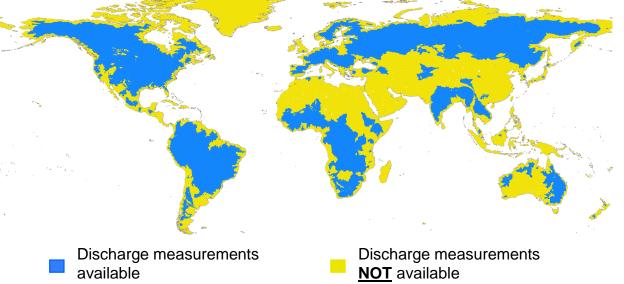


WHAT IS CALIBRATION AND WHY DO WE NEED IT?

- Every model is an approximate representation of reality.
- Tuning of the parameters to improve the model capability to represent local processes.
- (14 parameters.

HOW IS GIOFAS CALIBRATED?

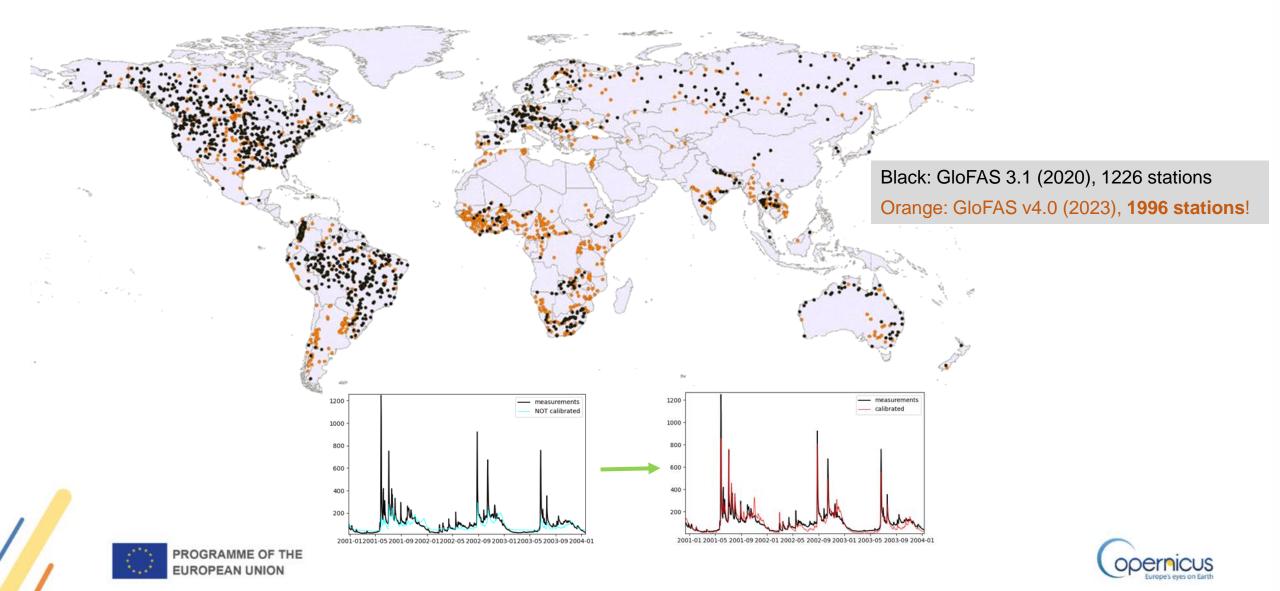
- · Comparison of model results with observations.
- GloFAS observations: in situ discharge measurements.





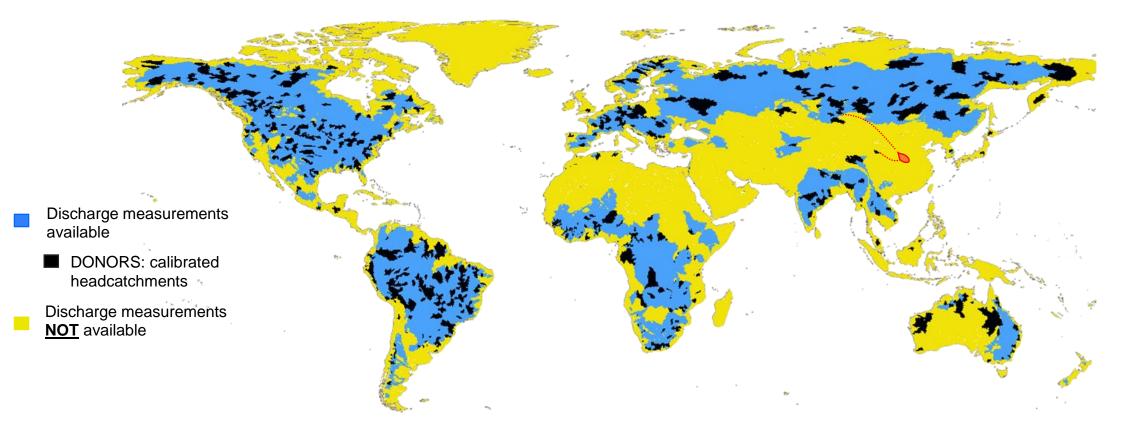


(3a) Available discharge data



(3.b) Discharge data NOT available: parameters regionalization

Pragmatic regionalization approach







The importance of discharge observations

- Discharge observations are used to calibrate the hydrological model.
 A calibrated model is more accurate.
- Discharge observations are used to evaluate the performance of the hydrological model. This evaluation allows the users to make an **informed decision** on the results of the model.
- GloFAS is constantly seeking to expand the data base of discharge observations. Detailed information is available here https://confluence.ecmwf.int/display/CEMS/Share+your+data+with+GloFAS









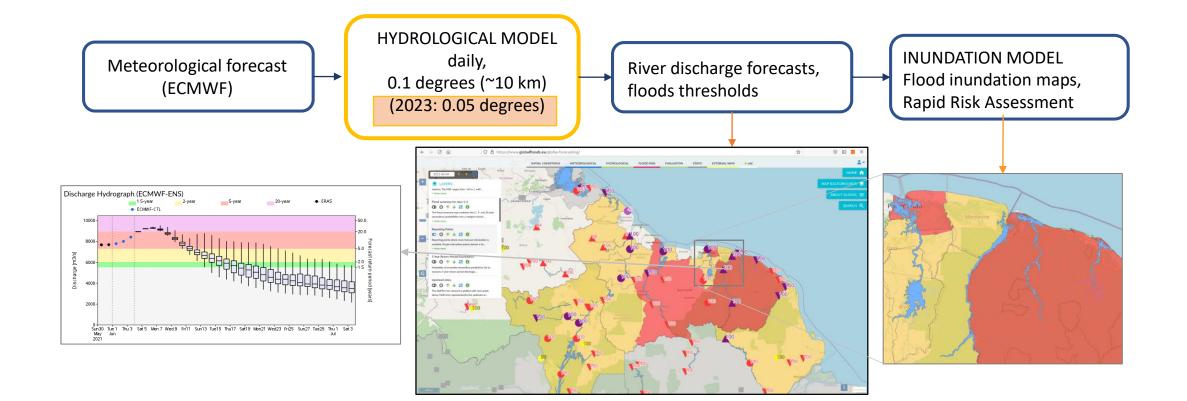
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How are GloFAS forecasts generated?

How does GloFAS work?









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GloFAS scope and essential concepts

GloFAS scope and limitations

GloFAS provides **COMPLEMENTARY**, **PROBABILISTIC**, **EARLY WARNING** information on upcoming and ongoing flood events at the global scale.

GloFAS is specifically relevant for **large**, transboundary catchments affected by **riverine** flooding.

As of today, GloFAS cannot model flash floods, coastal floods, urban floods.

• If available, always use national/regional forecasts and information to complement and evaluate GloFAS forecasts.





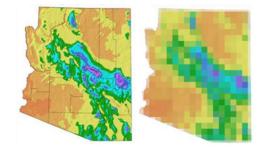
Probabilistic forecasts

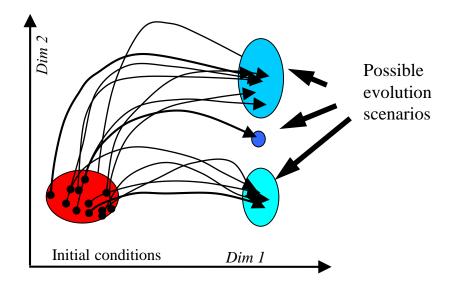
- Different sources of uncertainties in the model forecast.
- > Small differences in initial conditions result in diverging outcomes.
- Long-term predictions are impossible in general there is a limit to the predictability of the weather.

But: we can stretch the limit of predictability when we quantify the uncertainties

- *n* weather forecasts are calculated = ensemble
- all n members of the ensemble are equally likely
- Ensembles are designed to capture a large variety of possibilities the truth may not always be captured

Extreme events may be captured by 1 or few members



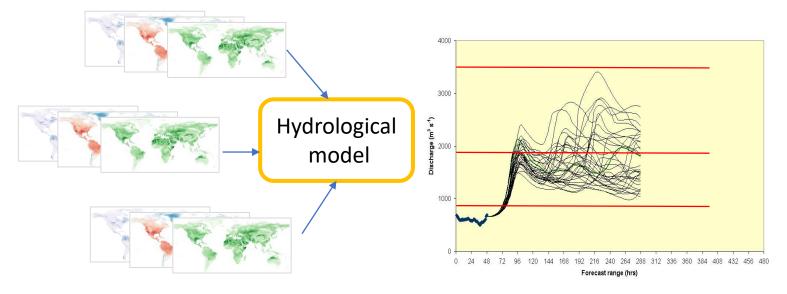






Probabilistic forecasts

Ensembles are most useful for early warning to prepare for serious events – in the range when weather forecasts are most uncertain (several days ahead)



- At the beginning the differences are small between the ensembles. The longer the forecasting range, the bigger the differences
- Errors grow with time
- Ensemble forecasting increases the robustness of the system through multiple inputs. Designed to capture a large variety – but the true outcome may not always be captured
- The closer to the event, the more accurate weather can be forecasted or even measured. Radar, satellite data and ground measurements can be used to establish the true conditions

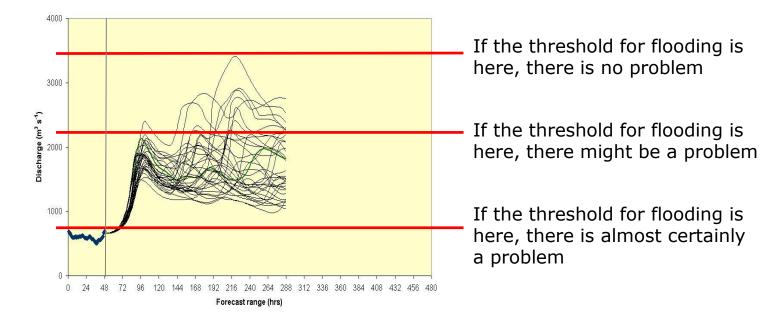




Thresholds computation



For floods: not the discharge is important but if the discharges EXCEED critical values

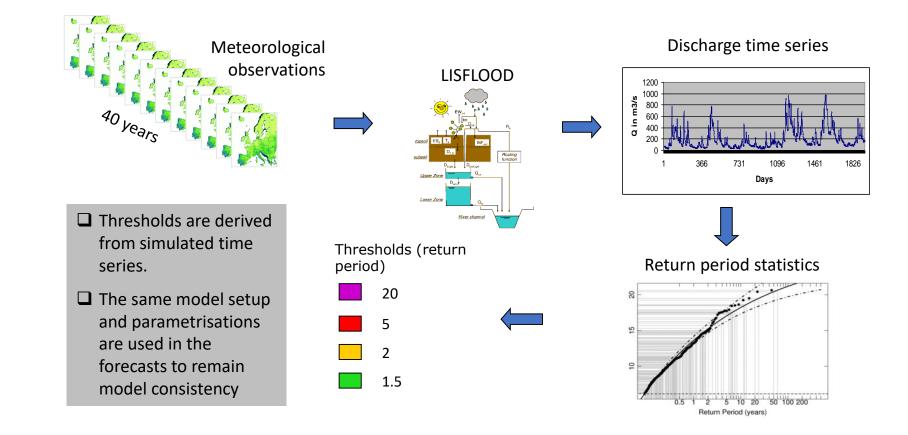


- In national institutions critical levels are computed using historical measurements and they are often linked to "local" phenomena: bridges overtopped, roads flooded, ...
- These pieces of information are not available at the global scale.





Thresholds computation





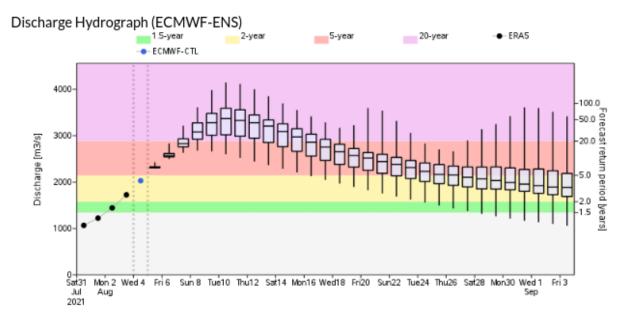


Thresholds computation

GloFAS flood summary. Cells of the model river network (for upstream area >1000 km2) coloured according to the dominant flood signal in the forecast period. The darkening colours show increasing probability of the relevant flood severity category (2-, 5- or 20-year). Areas expected between 5-20year return period Areas expected to exceed 20-year return period Areas expected between 2-5-year return period Melbourn Bass PROGRAMME OF THE

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- Thresholds are calculated with the same method for every pixel of the global domain.
- Every pixel has its own threshold derived from the local climatology of the pixel.







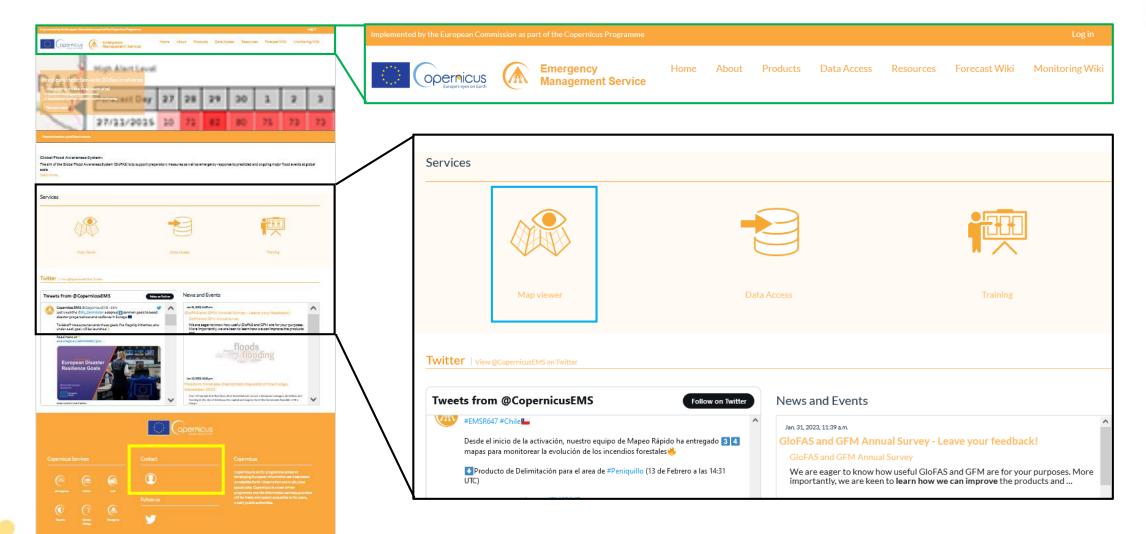
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GloFAS Map Viewer

GloFAS: https://www.globalfloods.eu/







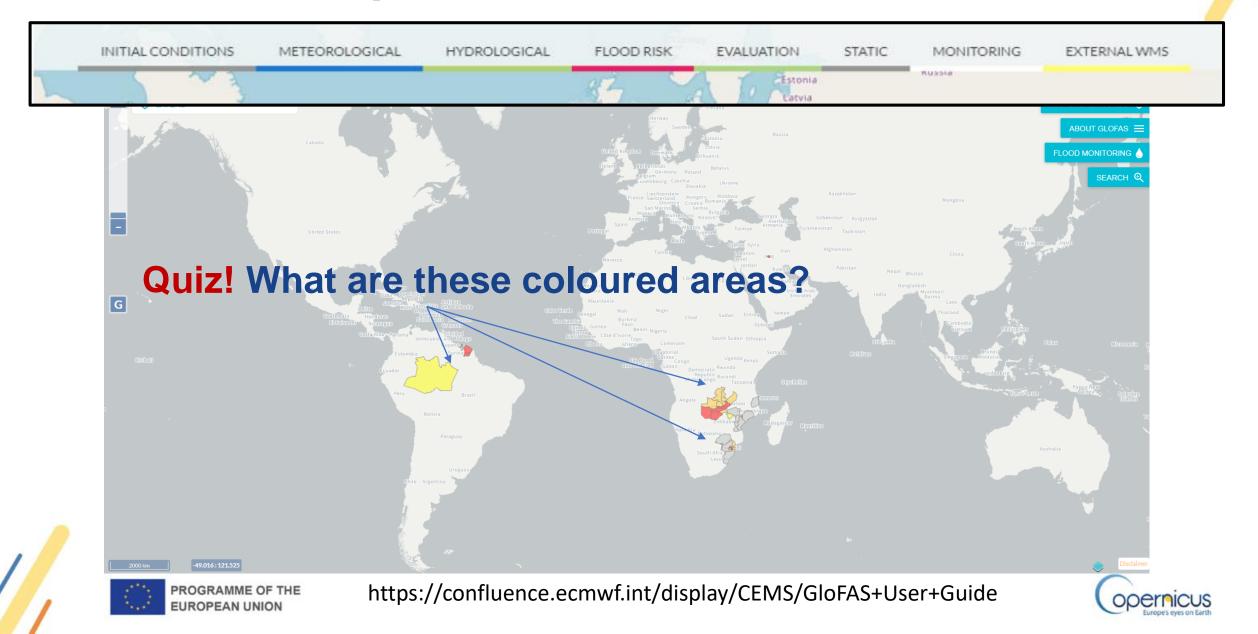
How to register

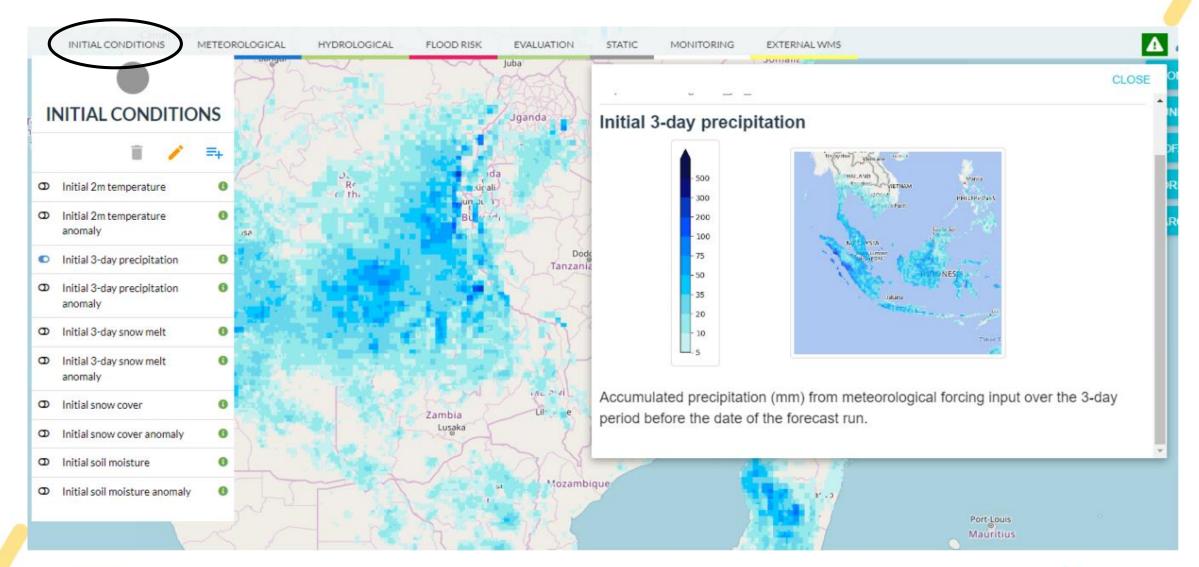
https://www.globalfloods.eu/accounts/signup/

lemented by the European Commission as pa	rt of the Copernicus Programme							Log in
	Emergency Management Service	Home	About	Products	Data Access	Resources	Forecast Wiki	Monitoring Wiki
Create a new account								
Already have an account? The	n please log in.							
E-mail address								
Name								
Surname								
MBQN								
Captcha								
I have read and agreed to th	e GloFAS terms and conditions o	faccess						
Password								
Password (again)								
Create account								



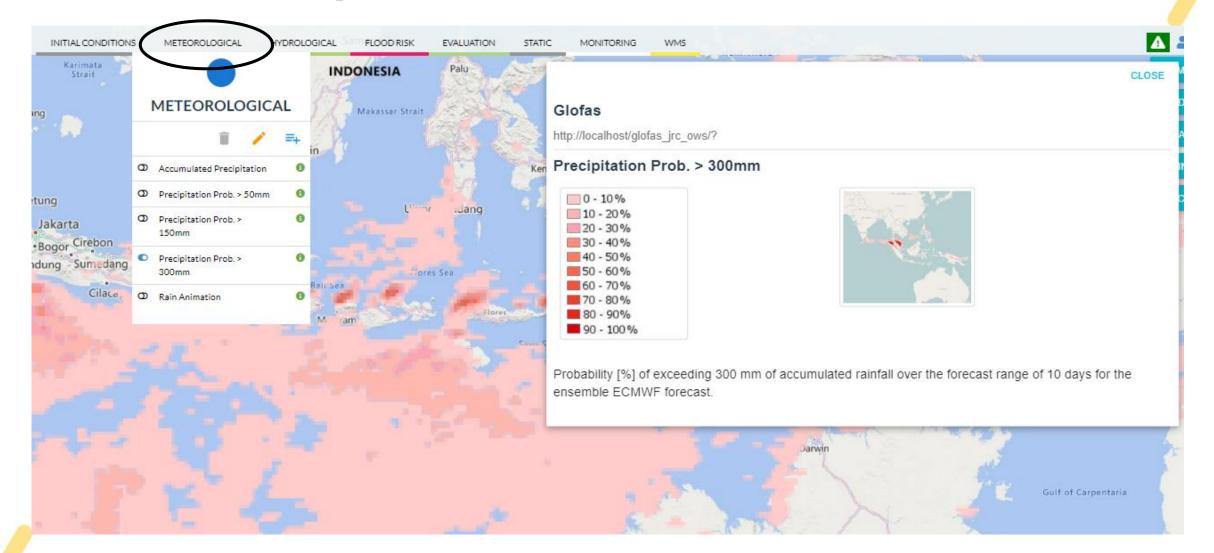






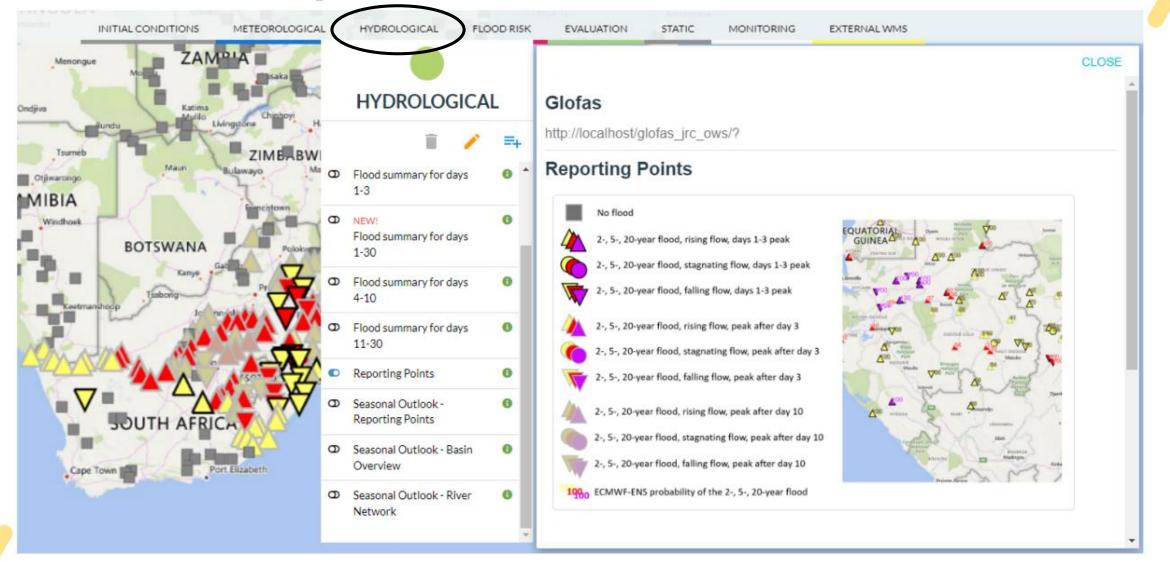






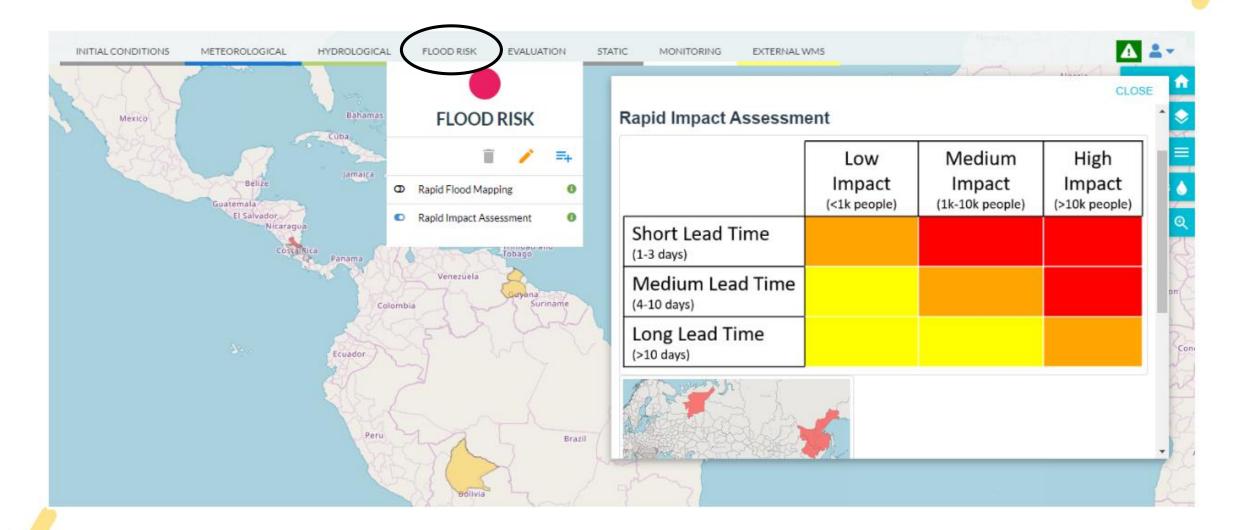






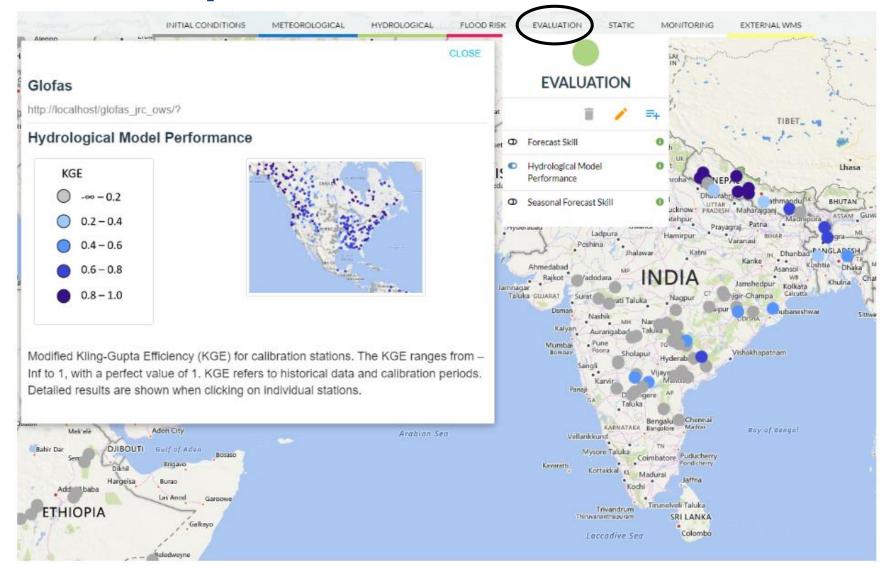
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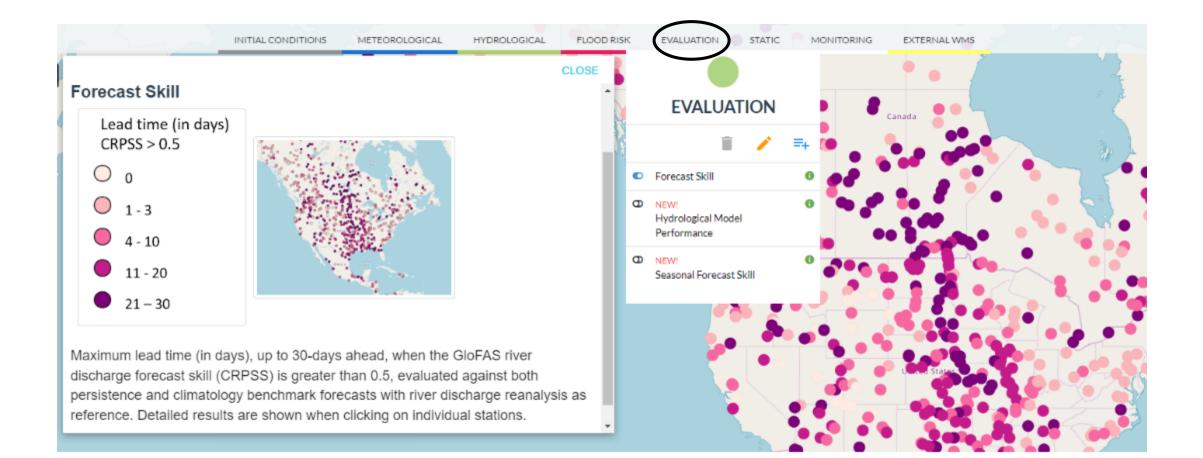






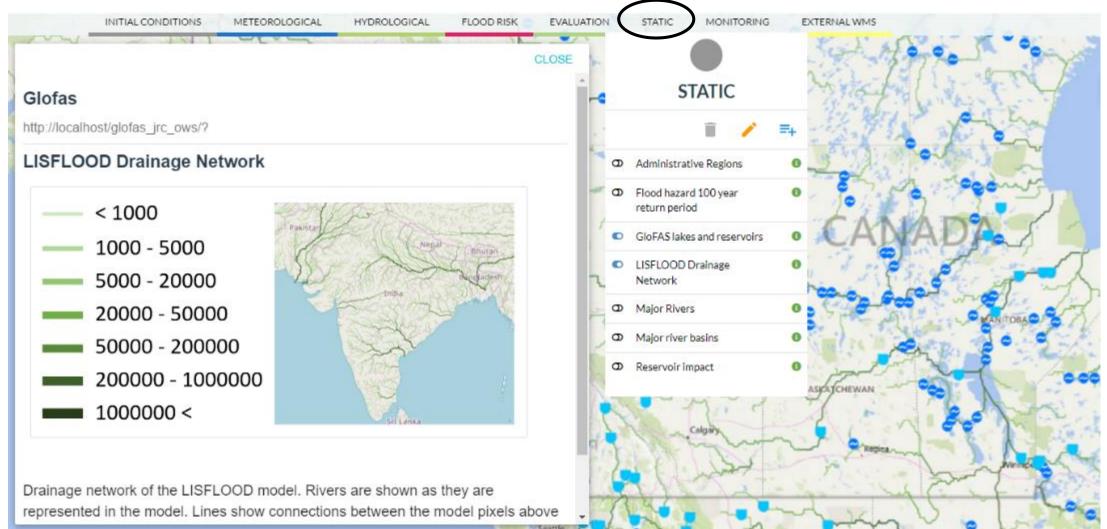






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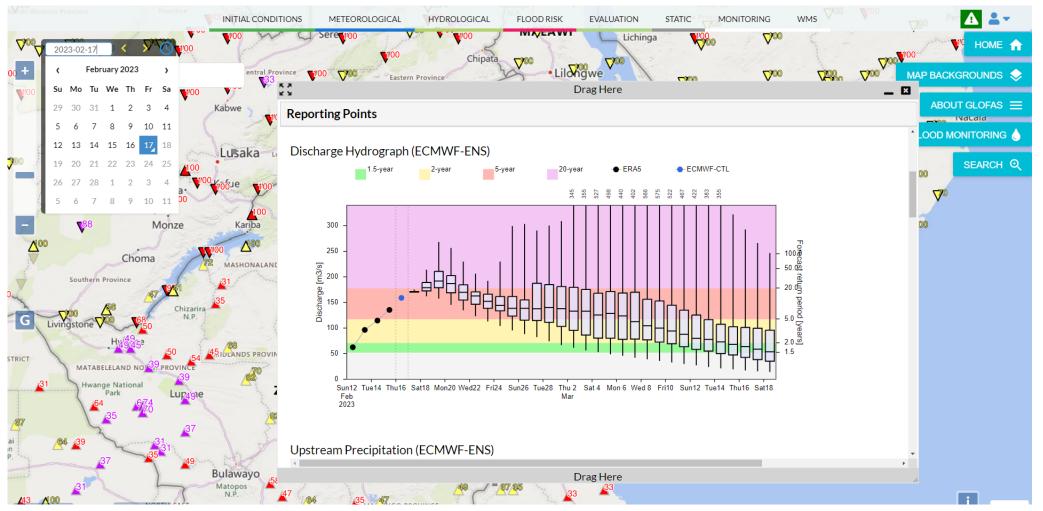


INITIAL CONDITIONS METEOROLOGICAL HYDROLOGICAL FLOOD RISK EVALUATION STATIC	c (MONITORING EXTERNAL W
GFM		MONITORING
		i / =+
Affected Population	θ	Advisory Flags
No Data	θ	Affected Landcover 0
1	•	Affected Population 0
2 Tenmark Expanse	0	Exclusion Mask 0
4 Germany Polard, Britarus Bourg Czeo Slovaka, Ukraine	θ	Likelihood Values
12 Austein Pringary doldova Itzerland Soverly egoatis homena	Θ	Observed Flood Extent 0
20 Marino Serbia Luloria or ¹⁰ Montreoro Kosotoki or Interna Northola edonia	θ	Observed Water Extent
> 30 (people / 400m ²) Affected Population Footprint	θ	Reference Water Mask 0
Sentinel-1 image outline with observed flooding < 2km ² Sentinel-1 image outline with observed flooding > 2km ² and made up of small, scattered flooded areas	θ	Sentinel1 Footprint 0
Sentinel-1 image outline with observed flooding > 2km ² and made up of mid-sized contiguous flooded areas Sentinel-1 image outline with observed flooding > 2km ² and made up of large contiguous flooded areas Libya	θ	Sentinel1 Schedule
Cuba Commission Jamaica Antiqua Jamaica Jamaica Jamaica Antiqua Jamaica Antiqua Guatemala Hankista El Salvador Nicaragua Costa Rica Panama Costa Rica Suriname Guyana Costa Rica Colombia Suriname	bouti	7 Southing





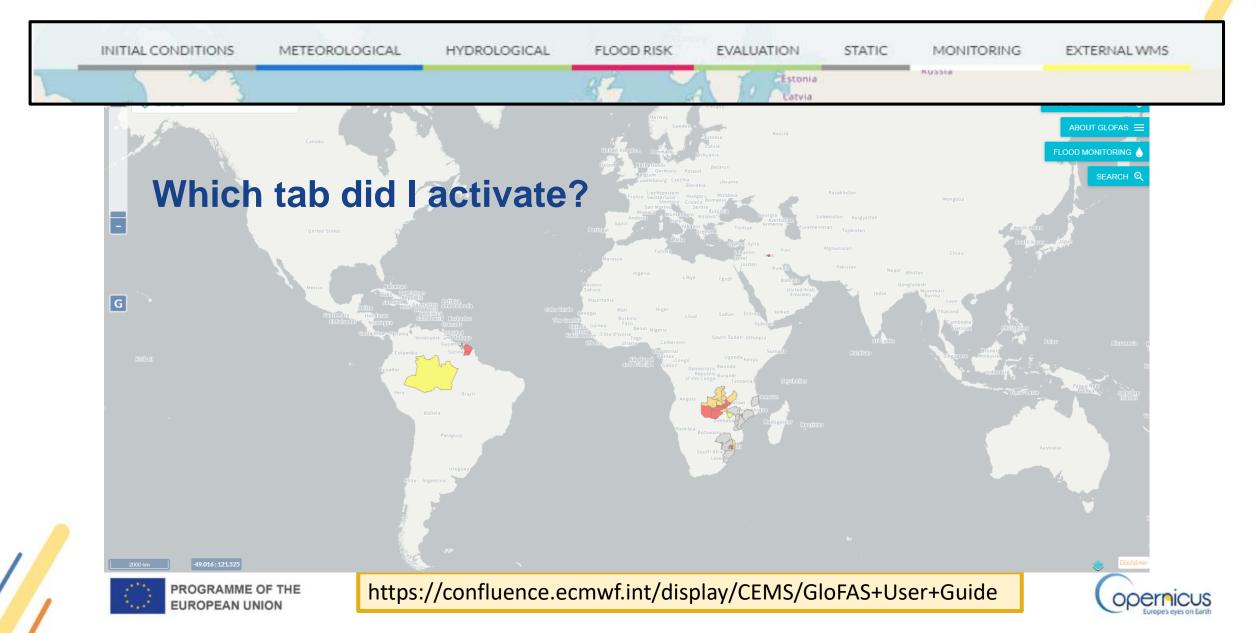
Forecasts updated every day to provide an overview of the next 30 days







GIoFAS map viewer: **QUIZ!**





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Documentation, users support

1. GloFAS user guide

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GloFAS User Guide

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3

- > CEMS-Fire
- CEMS-Flood
 - > European Flood Awareness System

Copernicus Emergency

Management Service - CEMS

- > Global Flood Awareness System
- CEMS-Flood User Guide Corner \mathbf{v}
 - > Background on Copernicus Emergen(
 - > EFAS User Guide

GloFAS User Guide

- > 1 Introduction to the services
- 2 GloFAS products (brief overview)
- 3 GloFAS interface (GloFAS-IS)
- > 4 GloFAS resources
- > 5 Contributing to GloFAS
- 6 FAQ in GloFAS
- 7 GloFAS Glossary



Emergency Management Service



The GloFAS User Guide provides information on the Global Flood Awareness System (GloFAS) and its many products and services for both the first-time users and those who want to learn more about available services and data. The complementary Global Flood Monitoring (GFM) data that can be accessed through GloFAS are presented as well.

Please use the shortcuts in the table of contents below to browse the content or the page tree to the left to navigate directly to the section of interest. Questions or suggestions for improvement are always welcome and can be send to us using the GloFAS contact form.

Table of Contents

- 1 Introduction to the services
 - 1.1 GloFAS and GFM scope and limitations
 - 1.2 How to access the service
- 2 GloFAS products (brief overview)
- 3 GloFAS interface (GloFAS-IS)
 - 3.1 GloFAS homepage
 - 3.2 GloFAS Map Viewer
 - 3.2.1 GloFAS functionalities explained

1. GloFAS user guide



Copernicus Emergency Management Service - CEMS

Pages

- PAGE TREE
- > CEMS-Fire
- CEMS-Flood
- European Flood Awareness System
- Global Flood Awareness System
- CEMS-Flood User Guide Corner
- > Background on Copernicus Emergency Management Services CEN
- > EFAS User Guide
- GloFAS User Guide
- > 1 Introduction to the services
- 2 GloFAS products (brief overview)
- 3 GloFAS interface (GloFAS-IS)
 - 3.1 GloFAS homepage
- 3.2 GloFAS Map Viewer
- 3.2.1 GloFAS Map Viewer Functionalities explained
- 3.2.2 GloFAS Map Viewer Layer categories explained
- 3.2.3 Getting started using GloFAS
- > 4 GloFAS resources
- 5 Contributing to GloFAS
- 6 FAQ in GloFAS
- 7 GloFAS Glossary
- > CEMS-Flood Data User Guide
- > CEMS-Flood Development and Outreach

O Space tools



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Pages /... / 3.2 GloFAS Map Viewer

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3.2.1 GloFAS Map Viewer - Functionalities explained

Created by Svea Bertolatus, last modified by nina bosshard on Feb 02, 2023

Global Flood Awareness System service providers 🛸 GHENOVA THE EUROPEAN UNION OPERAICUS **C**ECMWF European

This section provides the relevant technical instructions to navigate the web interface. The table below guides through the different general functionalities of the GloFAS Map Viewer.

	For zooming in and out you can use the bar on the top left hand side or a mouse wheel.
G	G zooms out to the global view.
Δ	Operational status of GFM system components
Messages Profie O Sign out	Clicking on the arrow next to the user profile symbol (20) you can sign out, edit your profile settings and view messages from the GloFAS operational team.
HOME IN THE INFORMATION INTERVALUE INTERVALU	 Using buttons on the top right-hand side, you can quickly move to the Home page (HOME), change your background map (MAP BACKGROUNDS), find information about GloFAS (Tutorial, Data, Products and Terms and conditions sections) (ABOUT GLOFAS), Access the portal to download GFM data, and use specific GFM functionalities such as the definition of area(s) of interest (FLOOD MONITORING), search a specific location in the map viewer (SEARCH).

The GloFAS products are presented in layers, which are sorted in different categories in the top menu bar:



2. GloFAS wiki: detailed documentation

https://confluence.ecmwf.int/display/CEMS/Global+Flood+Awareness+System

Copernicus Emergency Management Service - CEMS	☆	Pages / Copernicus Emergency Management Service - C	EMS Home / CEMS-Flood 🚡 🥔 🛇
		Global Flood Awareness Syste	m
Pages		Created by Karen ORegan, last modified on Oct 14, 2022	Browse by content
PAGE TREE			Expand all Collapse all
> CEMS-Fire			 GloFAS models and procedures
✓ CEMS-Flood			 GIOFAS meteorological forcings
European Flood Awareness System			 GloFAS hydrological models
✓ Global Flood Awareness System		GloFAS wiki	 GIoFAS medium-range forecasting
> GIoFAS models and procedures		In this documentation you will find some basic informa	 GloFAS sub-seasonal and seasonal forecasting
 GIOFAS operational system 		 Brief overview of the model configuration and ve 	 GIOFAS evaluation
 GIOFAS products 		 Brief overview of its data archive and the best way 	 GIoFAS diagnostic and web reporting points
> CEMS-Flood User Guide Corner		further questions about the data you are welcom	 GIOFAS operational system
> CEMS-Flood Development and Outreach		You can also find more information on the GloFAS web	GIoFAS contributors
> UTCI		Current operational system and data availability	 GIoFAS versioning system
		Latest operational GIoFAS release	 Latest operational GIoFAS release
			GIoFAS - Known Issues
		Search this documentation for Q	✓ GIoFAS products
			> Overall GloFAS products summary
			 GIoFAS evaluation products
			 GIOFAS medium-range forecast products
			> GIoFAS seasonal forecast products



GIOFAS Social Media Activity Analysis (SMAA)

3. CEMS data user guide

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https://confluence.ecmwf.int/display/CEMS/CEMS-Flood+Data+User+Guide

	Copernicus Emergency Management Service - CEMS			Q Search 🔗 🖓 🖈
. 5	 Pages PAGE TREE > CEMS-Fire 	GloFAS datasets GloFAS historical This dataset contains gl operational historical sin	ble Data overview of the GloFAS data made available to the public. For a full overview of the GloFAS system, please go to the dedicated obal modelled daily data of river discharge from GloFAS. River discharge. This dataset is simulated by forcing the the LISFLC nulation is from 1979-01-01 up to near real time. Data can be accessed is several ways, the most common is through the CDS (s id related historical data from GloFAS	DOD hydrological modelling chain with inputs from the ERA5 global reanalysis. Data availability for the
1	 CEMS-Flood European Flood Awareness System Global Flood Awareness System CEMS-Flood User Guide Corner 	DATA DESCRIPTION Data type Horizontal coverage Horizontal resolution Vertical resolution	Gridded Global except for Antarctica (90N-605, 180W-180E) 0.1* x 0.1* Surface level for river discharge	
	 Background on Copernicus Emergency Management Services - CEMS EFAS User Guide 	Temporal coverage Update frequency Conventions Versions	January 1979 to near real time for the most recent version A new river discharge reanalysis will be published with every major update of the GLOFAS system. The latest version will all GloFAS versioning system. WMO standards for GRIB2 Current version - GloFAS v3.1 released 2021-05-26. For more information on versions we refer to GloFAS versioning system.	
2	 GloFAS User Guide CEMS-Flood Data User Guide CEMS-Flood Terminology 	> Pre-release: GloFAS	version 4.0	
	 Data Catalogue Data Structure and Formats 	with the ECMWF extend	obal modelled daily data of river discharge forced with meteorological forecasts from GIoFAS. This dataset is simulated by forci ed-range ensemble forecast up to 30 days. Data availability for the GIoFAS forecast is from 2019-11-05 up to near real time. Dat Id related forecasted data from GIoFAS	
	 > Data Access > Working with CEMS-Flood Data > FAOs 	Data type Projection Horizontal coverage	Gridded Regular latitude-longitude grid Global except for Antarctica (90N-605, 180W-180E)	
	CEMS-Flood Data Support CEMS-Flood Development and Outreach	Horizontal resolution Temporal coverage Temporal resolution	5 November 2019 to near real time Daily data	
				\sim



Documentation and users support

ONLINE DOCUMENTATION

- **GloFAS User guide:** hands-on instructions on how to use the map viewer https://confluence.ecmwf.int/display/CEMS/GloFAS+User+Guide
- GloFAS wiki: detailed description of models and products <u>https://confluence.ecmwf.int/display/CEMS/Global+Flood+Awareness+System</u>
- **CEMS Data User guide:** instructions to download GloFAS data <u>https://confluence.ecmwf.int/display/CEMS/CEMS-Flood+Data+User+Guide</u>

JOIN THE COMMUNITY and HELP SHAPE THE FUTURE OF GloFAS

- Annual meetings and webinars
- User surveys

ASK FOR HELP! FLAG an ISSUE! SHARE YOUR DATA and STUDY!

Contact form



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https://www.globalfloods.eu/

Contact				
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COPERMICUS Management Service	Home	About	Products	Data Access
All your feedback and comments are really important to us as	s they help u	s develop t	he best service	e we possibly can
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Shape the future of GloFAS!

GIOFAS and GFM 2022 annual survey

Get in touch

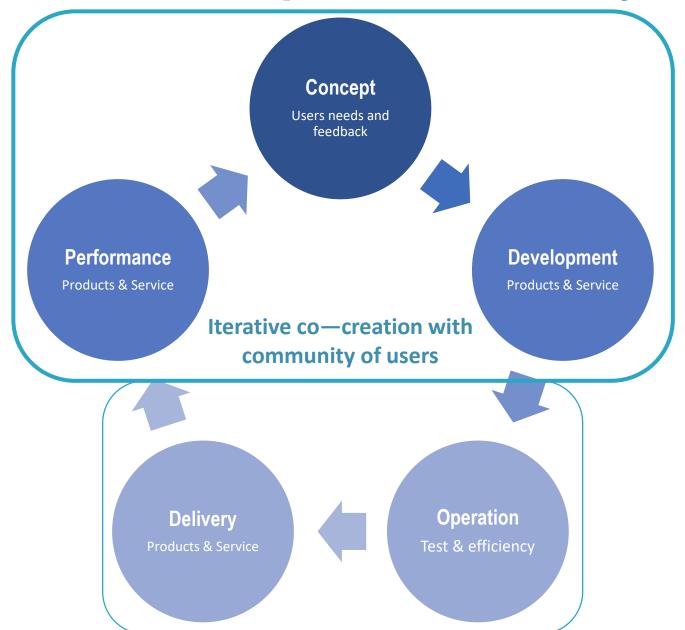
https://www.globalfloods.eu/



Contact



Development and implementation cycle



STAY CONNECTED EVENTS, ONLINE, and MAP VIEWERS

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emergency.copernicus.eu

activations.emergency.copernicus.eu

