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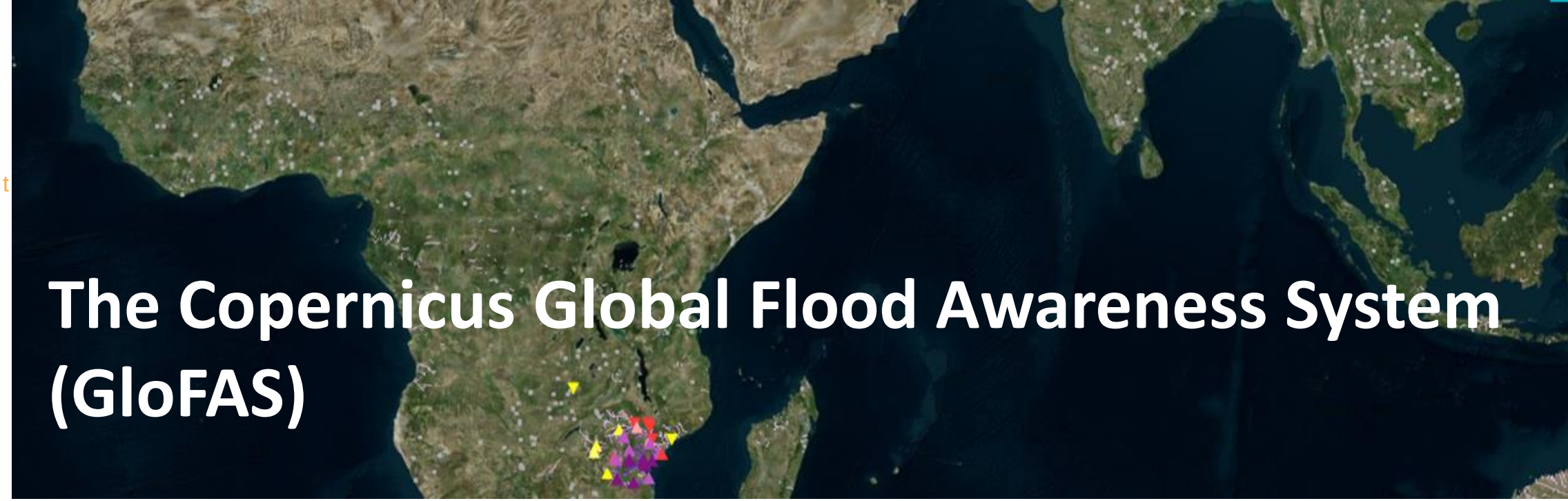

The Copernicus Global Flood Awareness System (GloFAS)

Services and products

Christel Prudhomme, Ervin Zsoter, Calum Baugh and many others in ECMWF, JRC, the University of Reading and other partnerships

GLOFAS
Global Flood Awareness System

ECMWF
EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

European Commission

University of Reading

Copernicus
The European Earth Observation Programme

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What is GloFAS?

GloFAS is part of the Copernicus Emergency Mapping Service (CEMS) **Early Warning & Monitoring**

ECMWF as CEMS Hydrological Computational Centre run both EFAS & GloFAS operationally

- GloFAS couples NWP and Hydrological modelling to produce **global flood forecasts**
- **Complementary** information to National Hydrological and Meteorological Services (NHMS)
- **Freely available**, across the world
- **Riverine** flood forecasting only, mainly for **large catchments** (>2000km2)
- Collaborative effort

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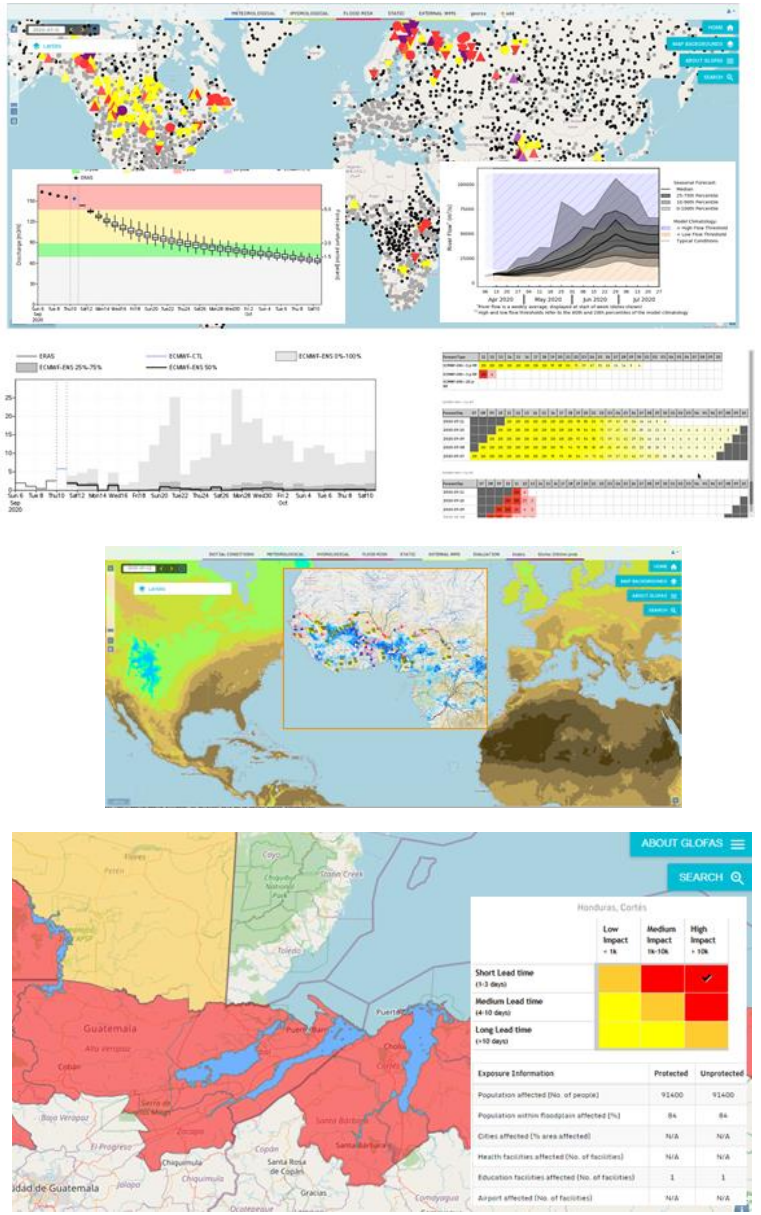
What is GloFAS?

What does GloFAS provide?

- Global **hydrological ensemble forecasts** updated daily
- **Map products and datasets** through dedicated web and data services
- **Highlights** of expected flooding and associated flood risk level over next 30 days
- **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



GloFAS system timeline – a constant evolution

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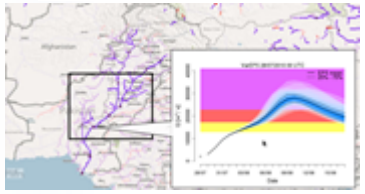
2011

GloFAS experimental produced since July 2011, run at JRC

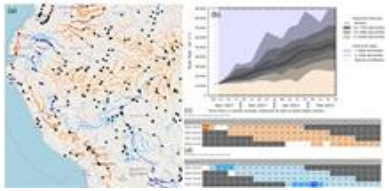


2015

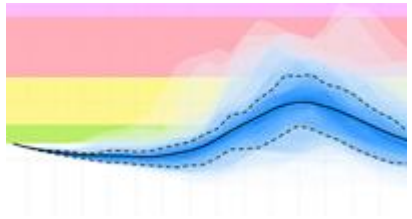
GloFAS adapted to run in ECMWF's pre-operational environment.
Also first reforecasts produced

Nov 2017

GloFAS Seasonal
Added in November 2017



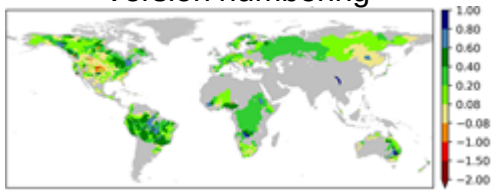
Apr 2018



GloFAS operational
Implemented with 24/7 support, included seamless 30-day predictions using the monthly forecasts

Nov 2018

GloFAS v2.0
Lisflood calibration
ERA5(T) climatology and initialisation
Reanalysis and 20-year reforecasts available
Version numbering

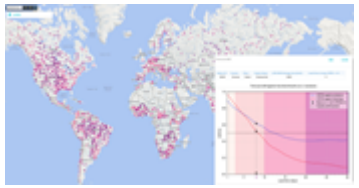


GloFAS v2.1
GloFAS-ERA5 reanalysis in CDS
New reforecasts
Global flood risk assessment
New web products

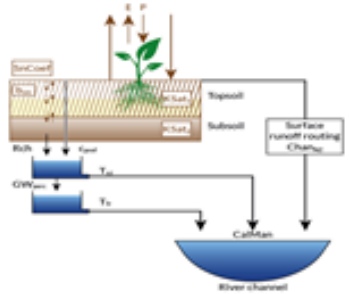
Nov 2019

Dec 2020

GloFAS v2.2
New GloFAS datasets in MARS/CDS
New web and improved products
Forecast skill layer



May 2021



GloFAS v3.1
New model (full Lisflood)
Model recalibration
New evaluation web layers
Other web improvements

Oct 2021

GloFAS v3.2
Global Flood Monitoring products added to GloFAS

27 Oct 2021

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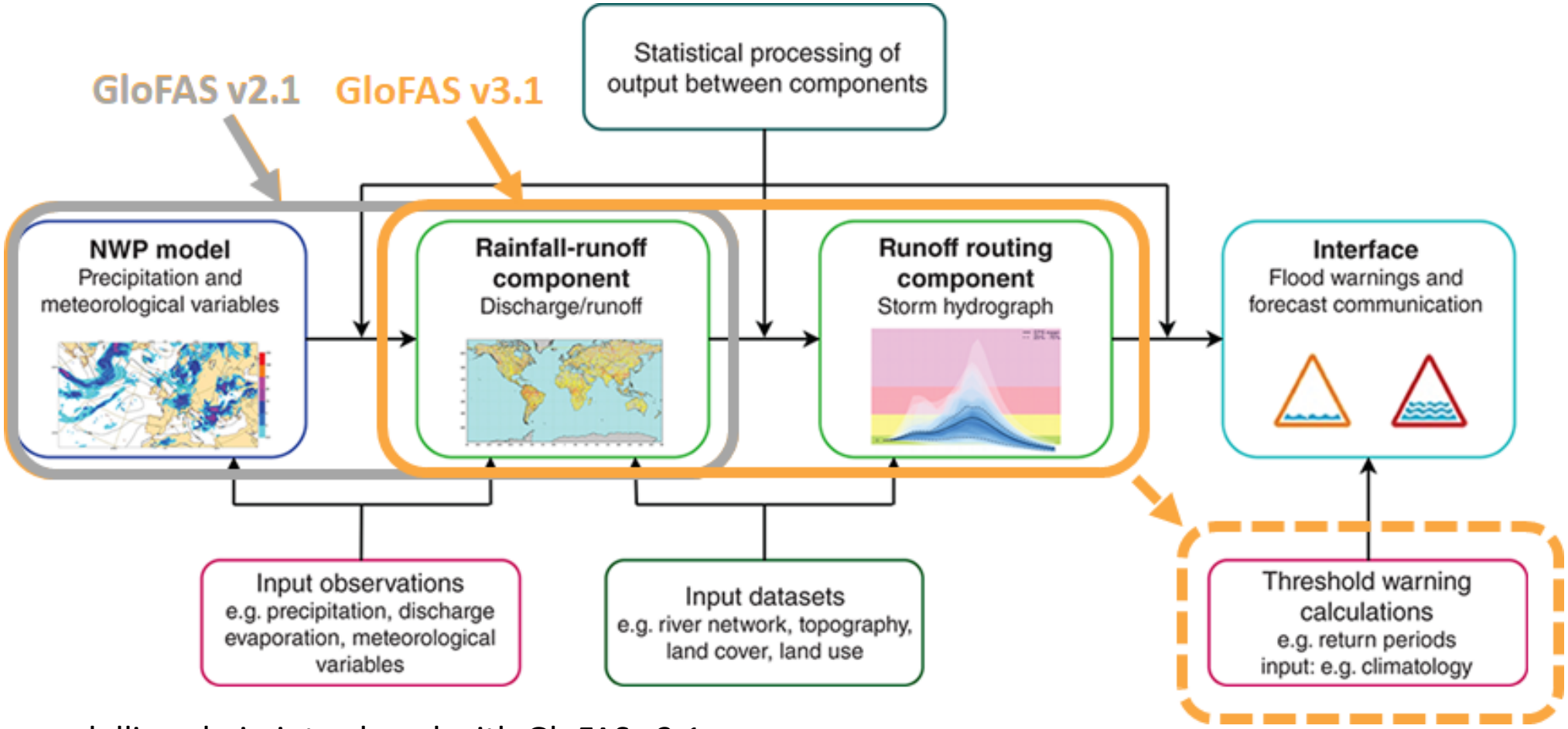
GloFAS modelling chain – backbone of GloFAS



- New modelling chain introduced with GloFAS v3.1
- Same hydrological component for GloFAS and GloFAS Seasonal
- Parallel modelling chains operated for major cycle changes as pre-operational/ legacy systems (from v3.1), with forecasts available on stage.globalfoods.eu

https://confluence.ecmwf.int/display/COPSRV/GloFAS+models+and+procedures

GloFAS hydrological modelling chain and performance

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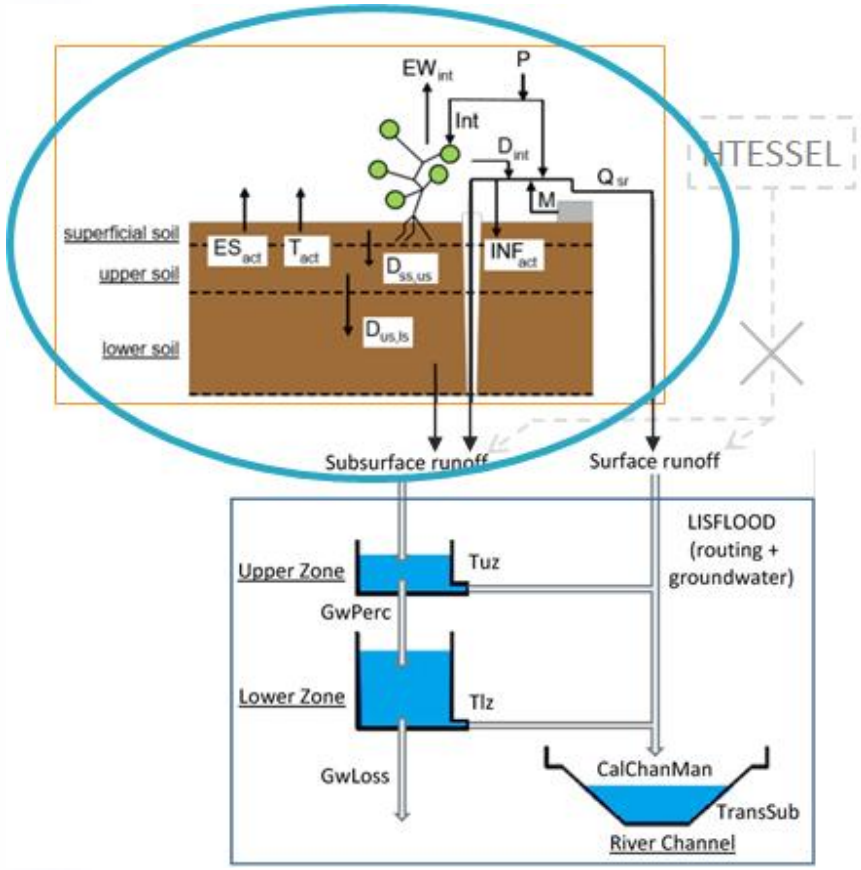
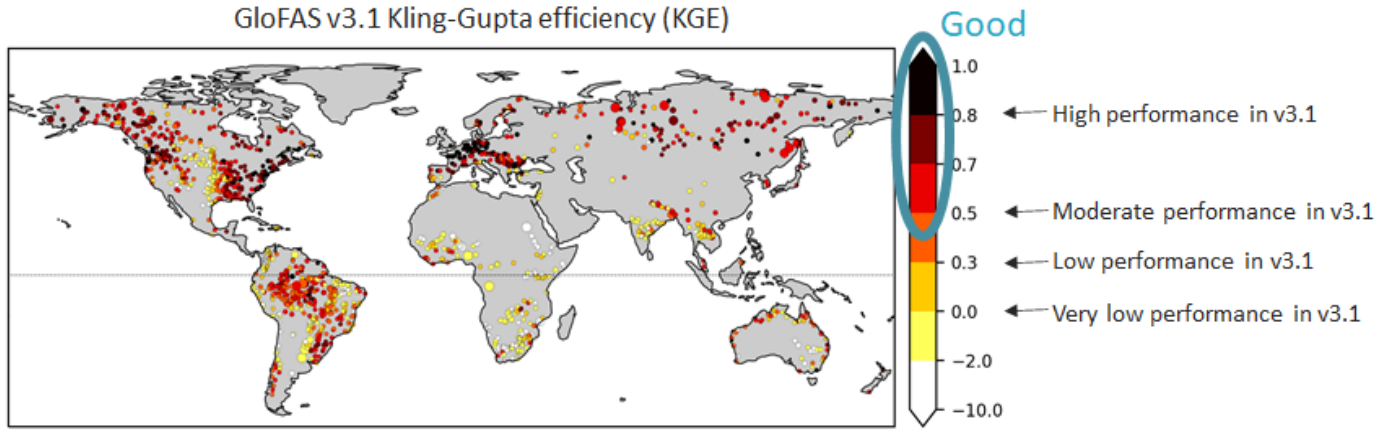
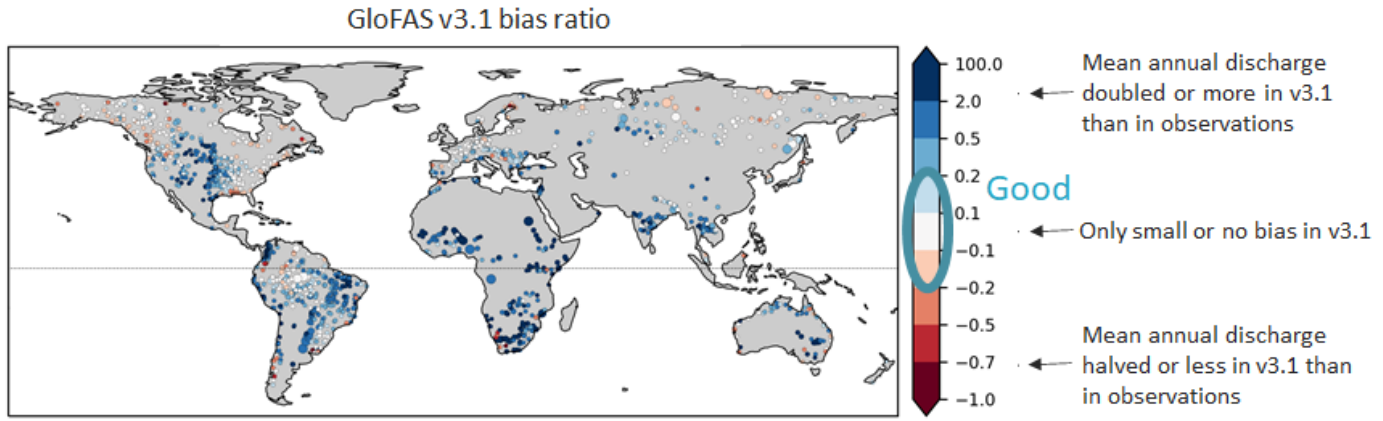


- 0.1 degree grids (excluding Antarctica)
- ERA5(-T) as initial condition, calibration and reference simulation
- Calibration over 1226 catchments globally
- Overall good hydrological representation, some systematic bias





https://confluence.ecmwf.int/display/COPSRV/GloFAS+models+and+procedures

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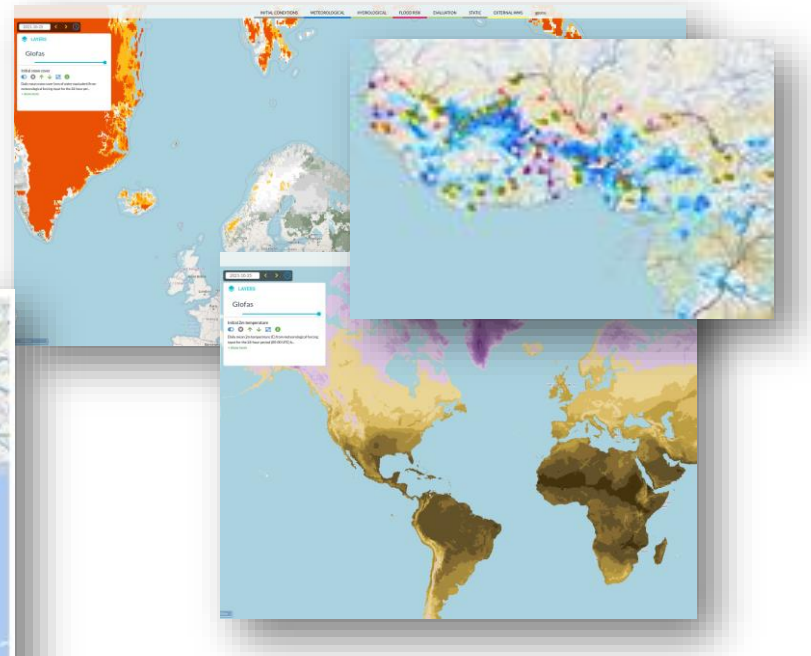
GloFAS products – helping forecast interpretation

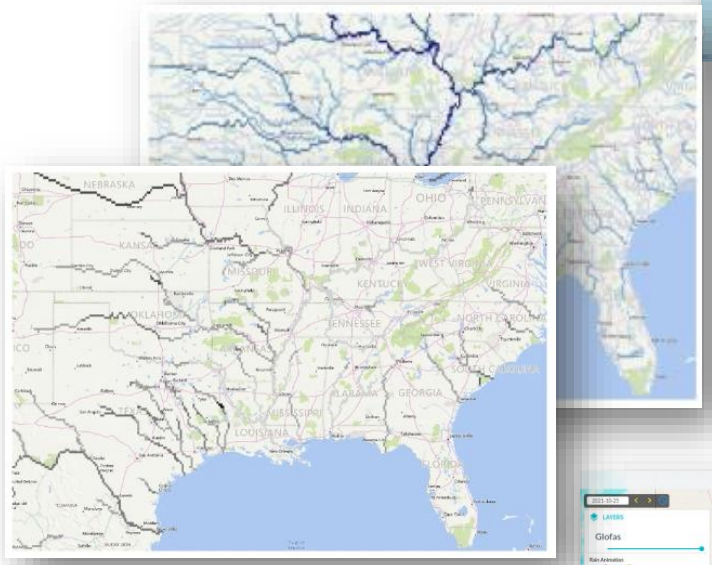
Initial and antecedent condition maps (from v2.2)

- Precipitation, snowmelt of 3 days preceding the forecast and initial snow cover, soil moisture and 2m temperature
- Absolute values and anomaly maps



Static maps

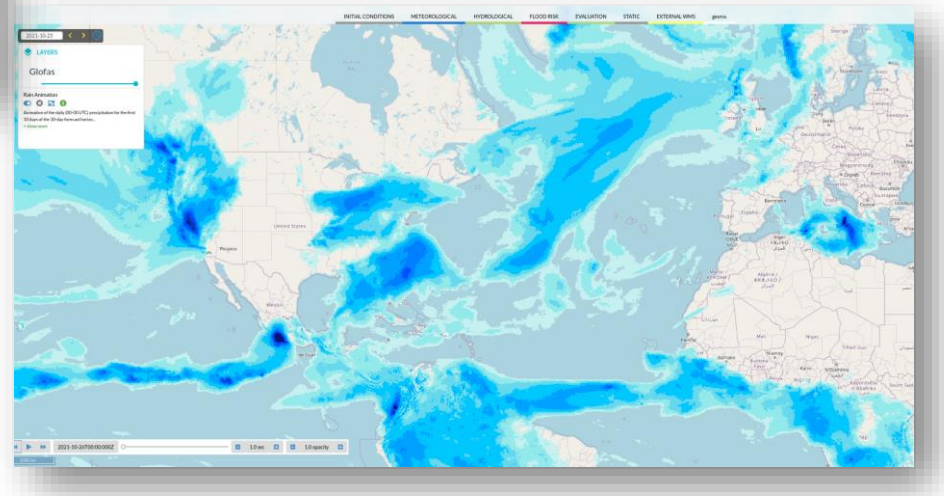
- Hydrological model network (reservoir influence, upstream area, …)
- Geographical features (major rivers, administrative regions



Meteorological forecast maps

- 10-day probability precipitation forecast
- Animated daily precipitation maps of next 10 days ensemble mean forecast to follow meteorological system evolution (from v2.2)

https://confluence.ecmwf.int/display/COPSRV/GloFAS+products



GloFAS products – summary maps and reporting points

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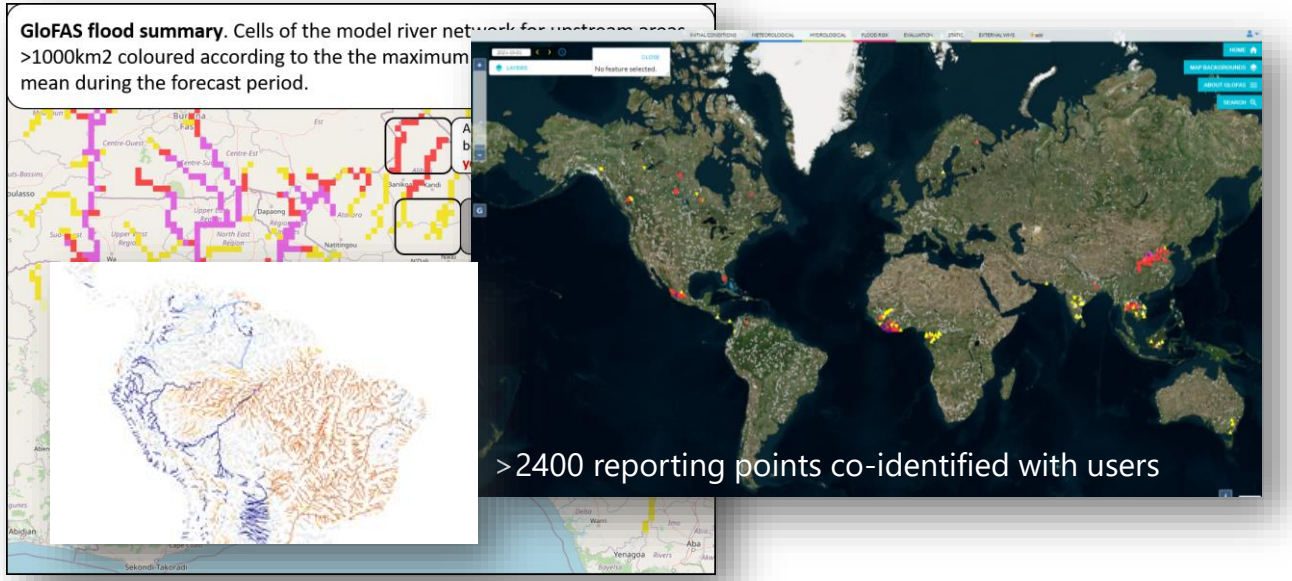
Forecast layers

- Range of products with different emphasis (e.g. forecast range, highlights, etc…)
- Additional detail on forecast timeline for some layers

Maps of flood signal highlights/ seasonal outlooks



Reporting point metadata table

Station ID	Country	Basin	River	Station Name	Point ID	Drainage Area [km2]	Longitude [Deg]	Latitude [Deg]	LISFLOOD Drainage Area [km2]	LISFLOOD X [Deg]	LISFLOOD Y [Deg]
NA	NA	NA	NA	Not a station	DE001244	NA	78.25	24.95	19,282	78.25	24.95

Point Forecast

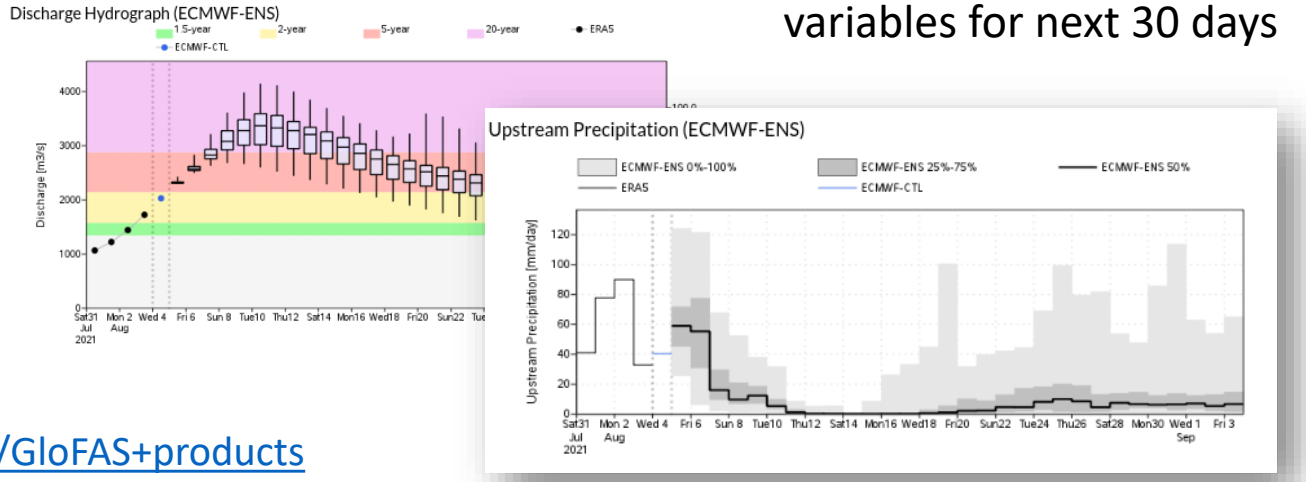
Forecast Date	Maximum probability (2 yr / 5 yr / 20 yr)	Discharge tendency	Alert level	Peak forecasted
2021-08-05 00:00	100 / 100 / 88		3	in 5 days (on 2021-08-10)

Forecast consistency tables

ECMWF-ENS > 20 yr RP

Forecast Day	30	31	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
2021-08-05									31	86	88	88	86	78	75	67	59	47	29	18	14	6	2	2	2			
2021-08-04									18	45	51	49	47	47	37	35	25	18	10	6	4	2	2	2				
2021-08-03								2	18	27	29	35	33	31	29	27	25	20	16	12	12	8	6	6	4	2	2	2
2021-08-02							6	24	33	41	45	47	49	47	43	33	31	24	18	16	14	14	10	10	8	6	2	4
2021-08-01							6	35	53	55	55	53	51	49	49	49	39	37	33	27	22	20	20	18	16	18	18	18
2021-07-31						4	25	41	45	47	53	53	51	49	45	43	43	41	39	33	33	31	29	25	25	25	18	20
2021-07-30					2	6	16	18	22	25	25	29	27	29	22	16	14	14	14	12	10	10	10	4	4	6	6	6

Future evolution of river discharge and associated water balance variables for next 30 days



https://confluence.ecmwf.int/display/COPSRV/GloFAS+products

GloFAS products – evaluation layers

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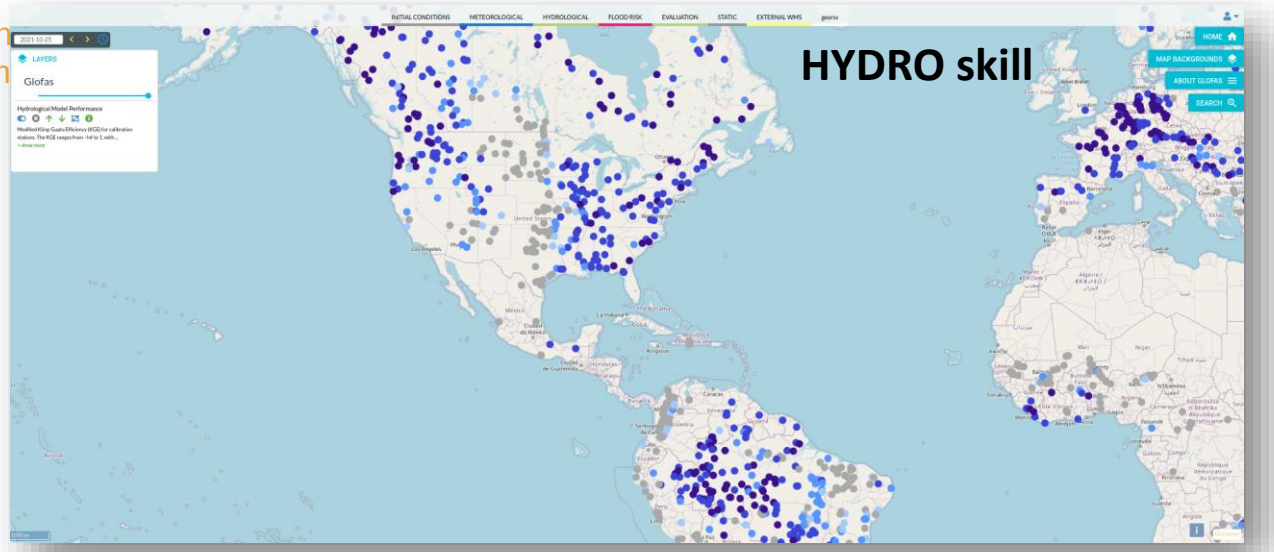
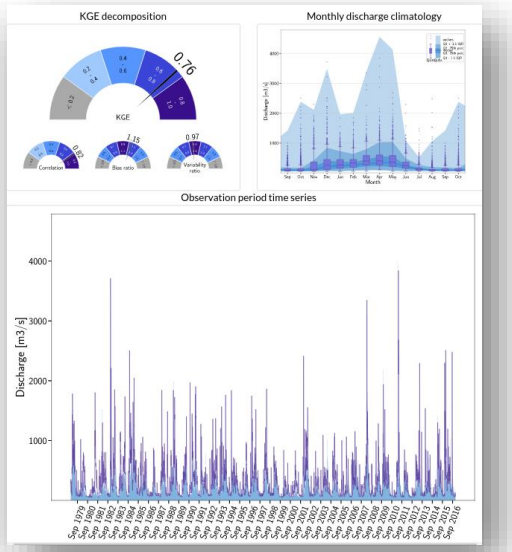
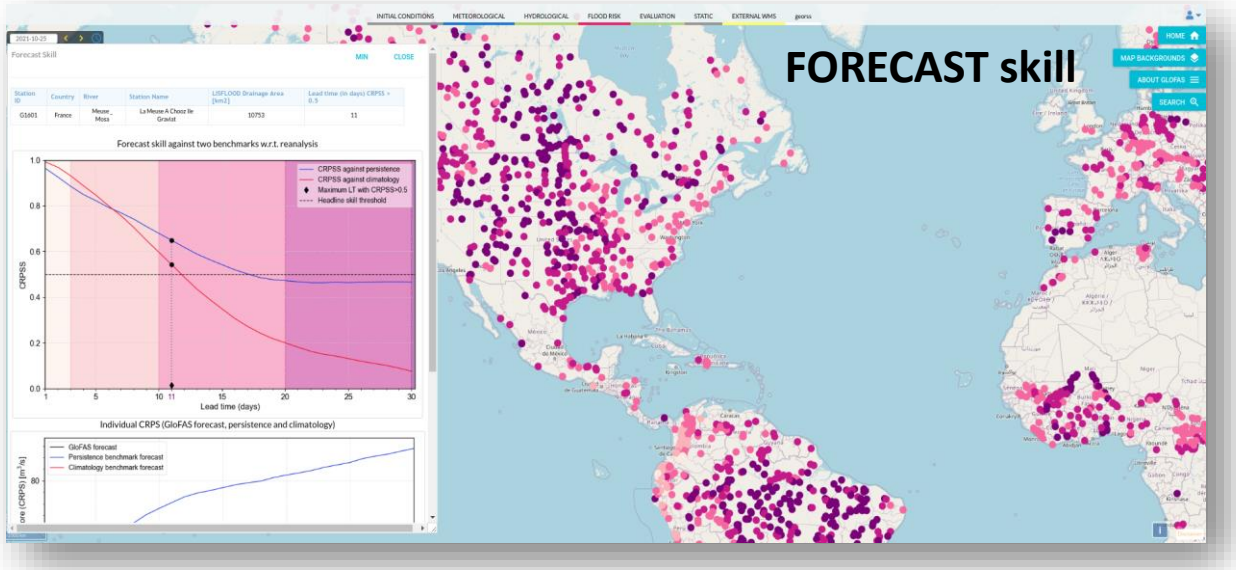




Evaluation layers

- Forecast skill layers with all reporting points
- Hydrological skill layer with points that have sufficient river discharge observations
- Updated at each new modelling cycle (major upgrade)
- Updated when reporting point layer upgrades
- Provide background information to help interpret results



https://confluence.ecmwf.int/display/COPSRV/GloFAS+products

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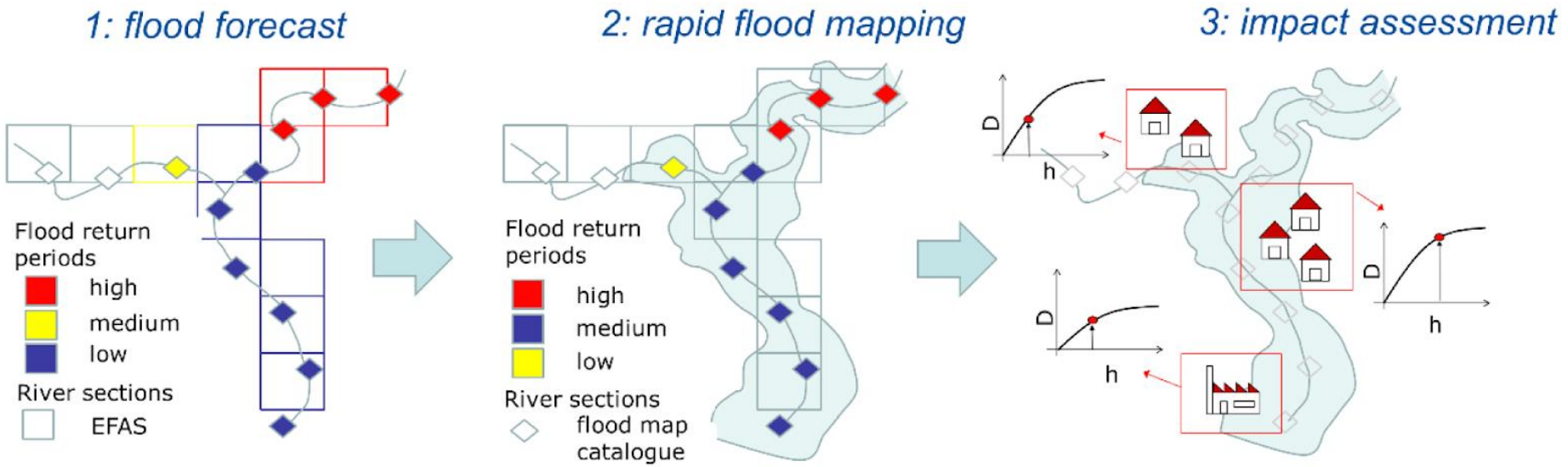
GloFAS products - flood risk assessment layers

Rapid Impact Assessment procedure links streamflow forecasts to inundation estimates – calculate exposure

- At each location where ensemble mean streamflow forecast >10 yr return period
- Extract flood inundation footprint from a library of maps
- Calculate the population, land surface types and critical infrastructure exposed within the flood footprint
- Summarise results to administration regions



Dottori *et al.*, 2017

GloFAS products - flood risk assessment layers

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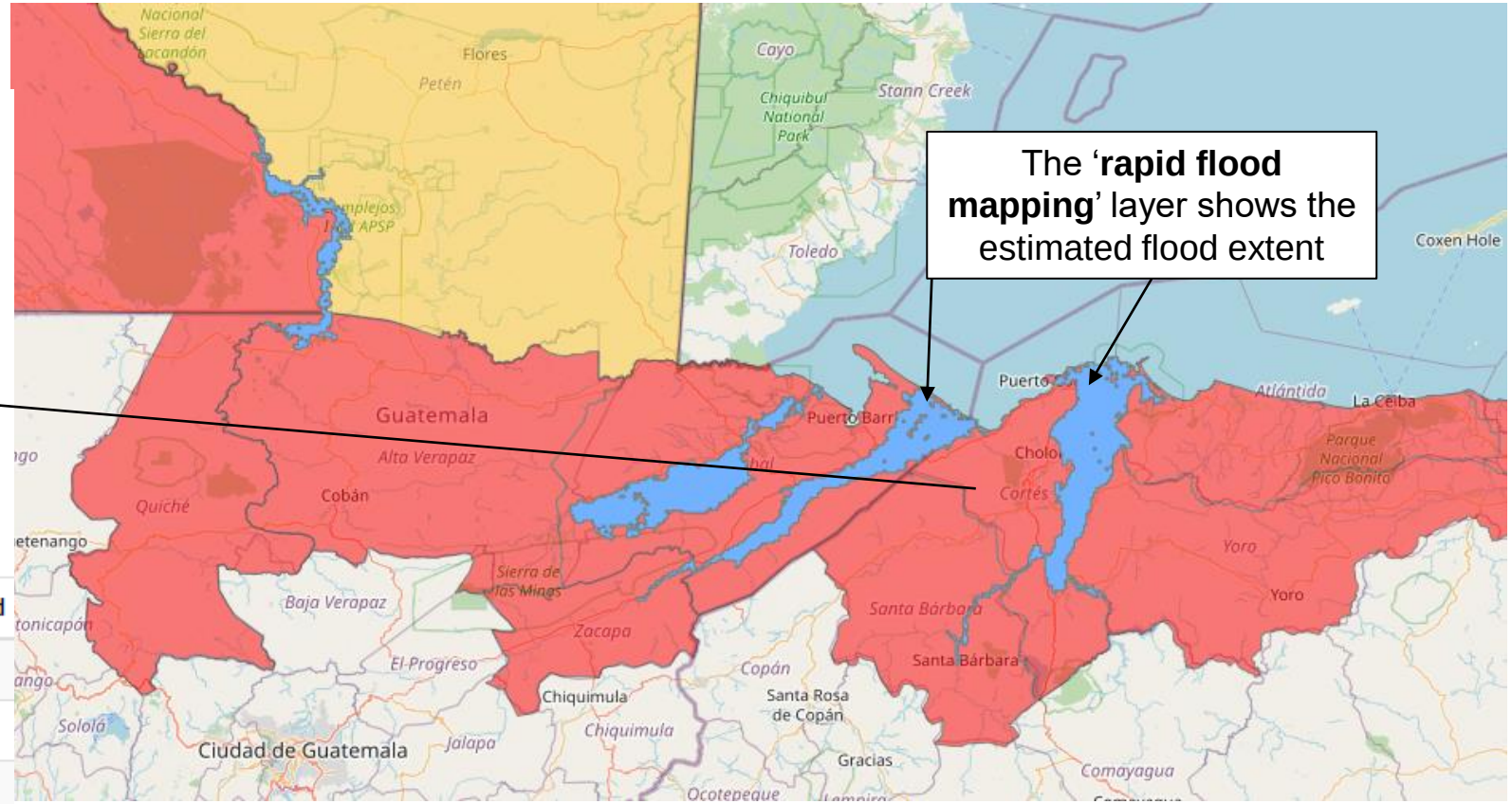
The '**rapid impact assessment**' summarises the exposure and flood event information over the next 30 days per administration region

Honduras, Cortés

	Low Impact < 1k	Medium Impact 1k-10k	High Impact > 10k
Short Lead time (1-3 days)			✔
Medium Lead time (4-10 days)			
Long Lead time (>10 days)			

Exposure Information	Protected	Unprotected
Population affected [No. of people]	91400	91400
Population within floodplain affected [%]	84	84
Cities affected (% area affected)	N/A	N/A
Health facilities affected (No. of facilities)	N/A	N/A
Education facilities affected (No. of facilities)	1	1
Airport affected (No. of facilities)	N/A	N/A



From GloFAS v2.2 (Nov 2019) the exposure to airports, health, powerplants and education facilities and impact of flood defences (FLOPROS) are included

GloFAS data services – Product viewer and WMS-T

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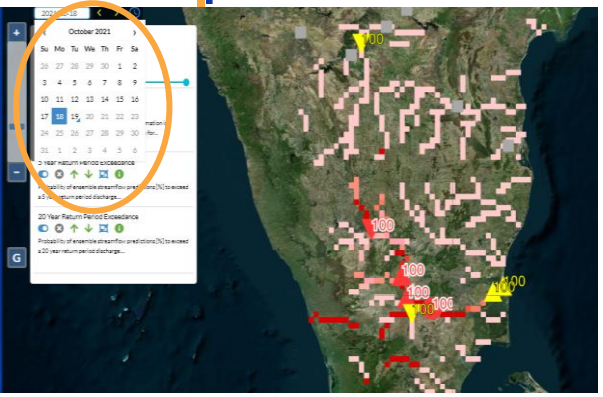
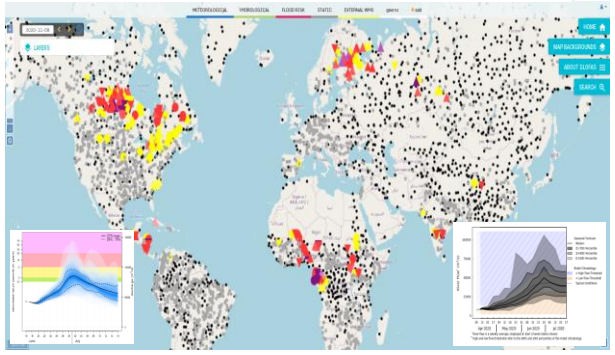
Web map viewer

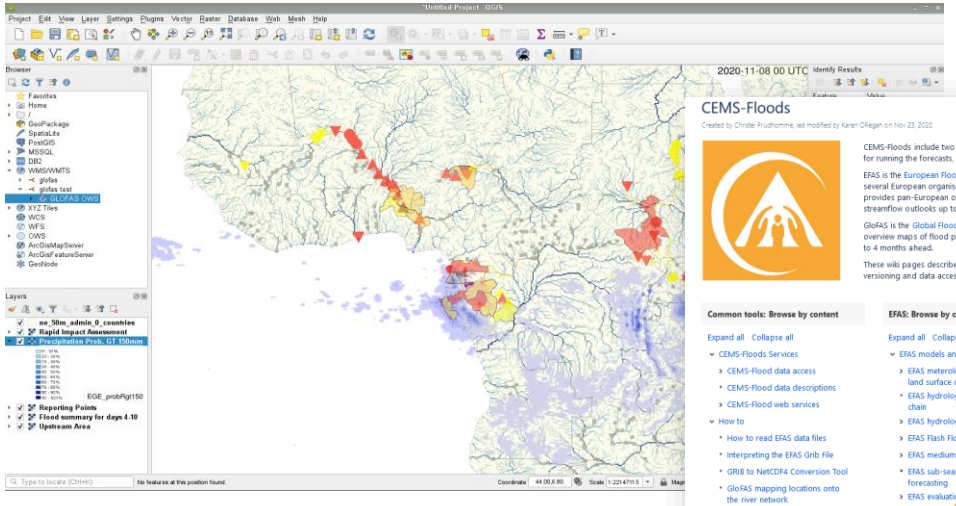
https://www.globalfloods.eu/





Web Mapping Service WMS-T

- From any GIS environment or web browser http://globalfloods-ows.ecmwf.int/glofas-ows/ows.py?SERVICE=WMS&REQUEST=GetCapabilities
- Example of layer that can be accessed: https://ows.globalfloods.eu/glofas-ows/ows.py?SERVICE=WMS&VERSION=1.3.0&REQUEST=GetMap&BBOX=23.07970000000000255,-44.29690000000000083,73.77580000000000382,76.99219999999999686&CRS=EPSG:4326&WIDTH=1439&HEIGHT=602&LAYERS=AccRainEGE&STYLES=&FORMAT=image/png&DPI=96&MAP_RESOLUTION=96&FORMAT_OPTIONS=dpi:96&TRANSPARENT=TRUE



Training, tutorial, wiki documentation

GloFAS data services – Data access

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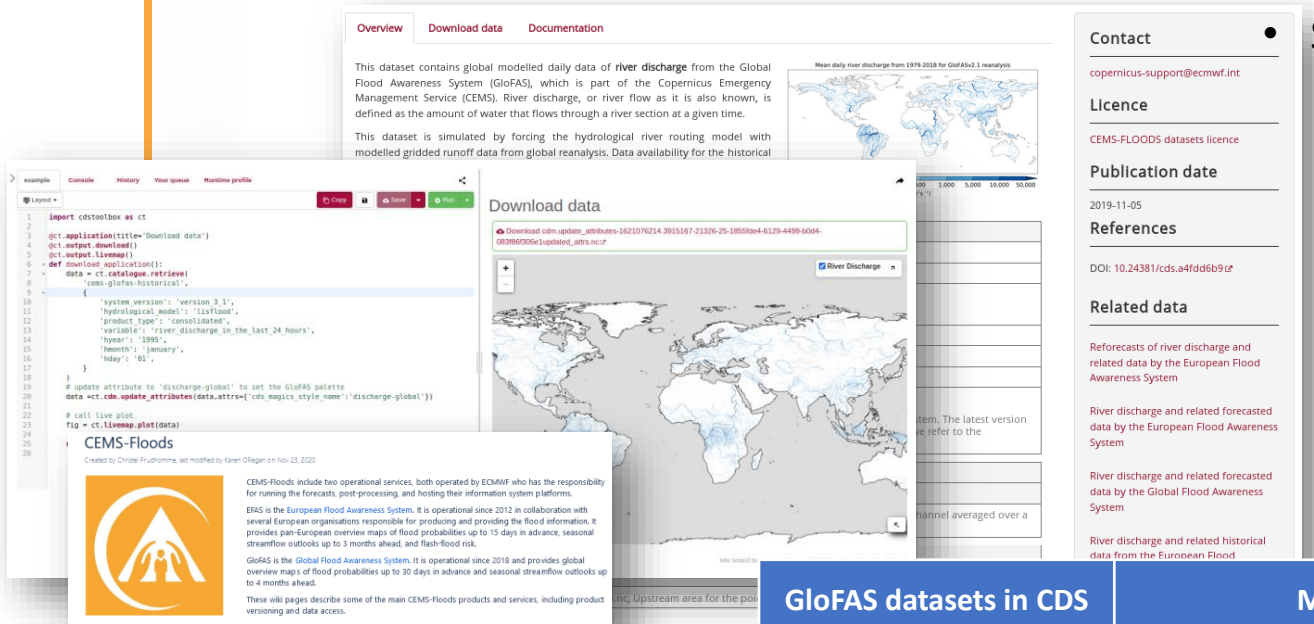
CDS catalogue and access

https://cds.climate.copernicus.eu/cdsapp#!/dataset/cems-glofas-historical?tab=overview



Training, tutorial, wiki documentation

Tailored ftp service

- For information not available through the CDS and time critical access

Set-up up to 15 working days

GloFAS datasets in CDS	Main features
Historical reanalysis	Driven by ERA5 and ERA5T (in near real time)
Forecasts	Daily, 51 ensemble member forecasts out to 30 days
Reforecasts	Unique forecast set covering 20 years, produced with the same model as in real time
Seasonal forecasts	Forecasts with 51 ensemble members issued monthly out to 4 months
Seasonal reforecasts	Unique forecast set covering ~40 years, produced with the same model as in real time

https://confluence.ecmwf.int/display/COPSRV/Data+services

Development and implementation cycle

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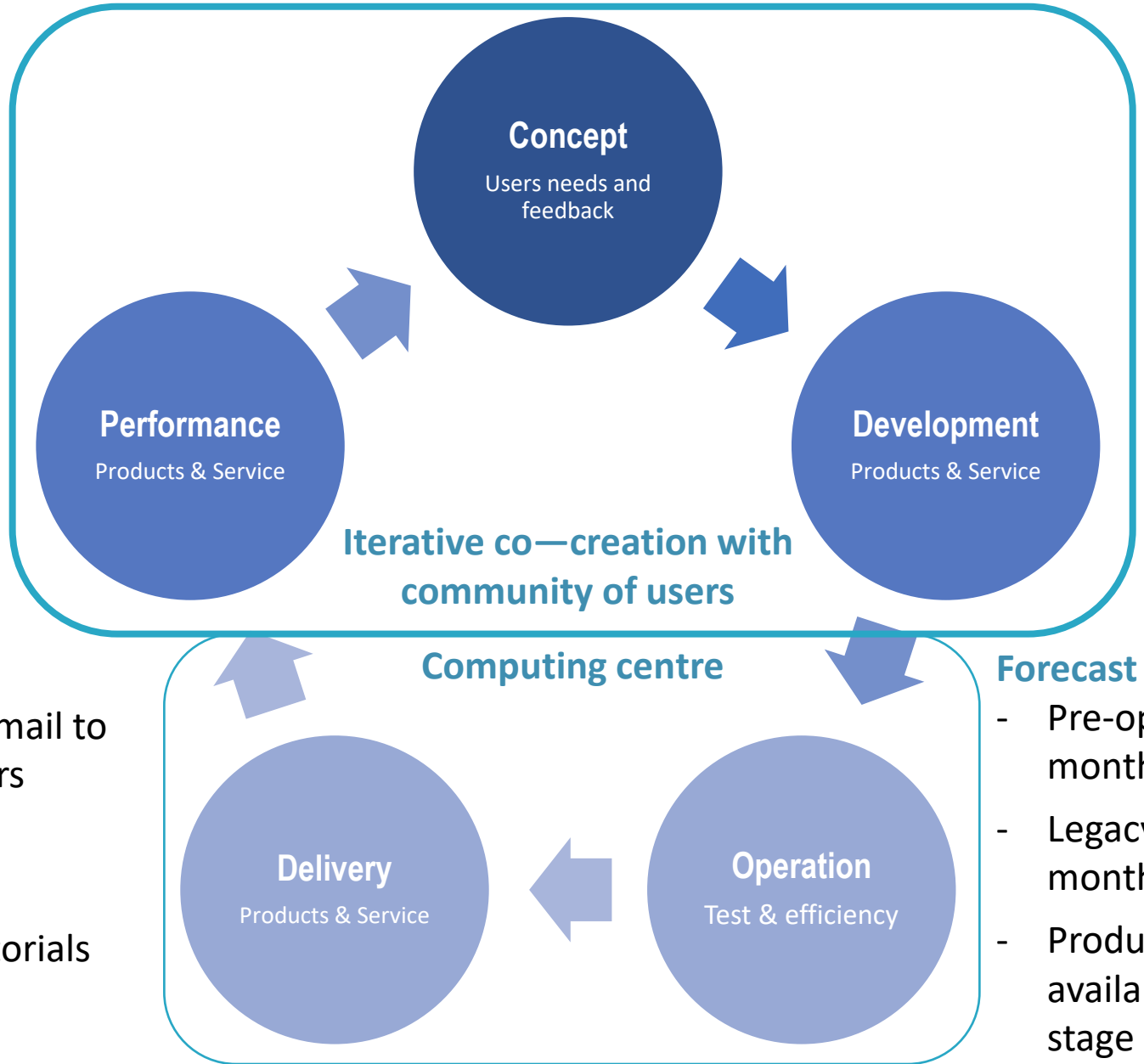

Outreach

- News item and email to close collaborators
- Update of wiki documentation
- Webinars and tutorials

Forecast system

- Pre-operational release at least 1 month ahead of launch
- Legacy suite continued for several months
- Products and services both available in the CDS and on the stage web interface

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Thank you!

Questions and answers