Copernicus Emergency Management Service

Global flood forecasting and monitoring (GloFAS & GFM)

UN-SPIDER Bonn International Conference (virtual) Space-based Solutions for Disaster Management in Africa

Presented by Vera Thiemig on behalf of the CEMS Flood group

17 November 2021

What is GloFAS?

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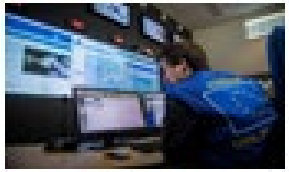
GloFAS is part of the **Copernicus Emergency Mapping Service** (CEMS) and **is free for everyone!!**



Early warning for preparation of aid assistance

European/World-wide comparable information

Complement National/regional services

EFAS

European Flood Awareness System

GLOFAS

Knowledge transfer & exchange

Support international organisations

Improved data sharing

Copernicus

European Commission

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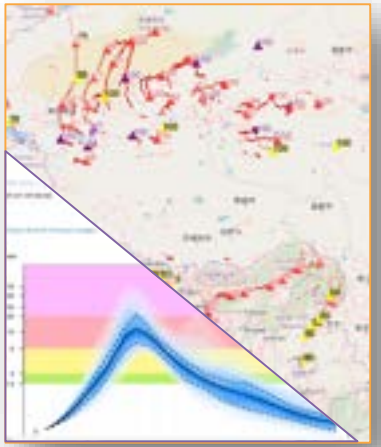
What does GloFAS provide?

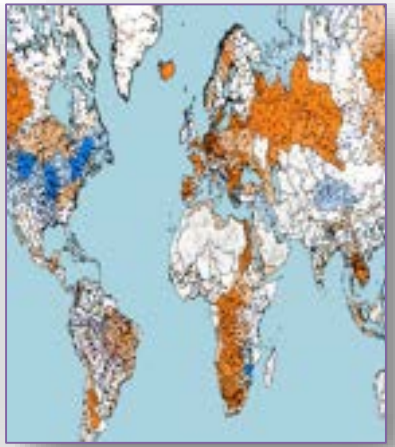
- **Flood hazard and impact forecasts** flooding and associated flood risk level over next 30 days, updated daily
- **Seasonal hydrological outlook** showing wet/dry anomalies over next 16 weeks
- access to GFM: automated, satellite-based **flood monitoring**

Riverine flood forecast (hazard)



Riverine flood forecast (impact)

Seasonal outlook



Monitoring & ongoing situation

GloFAS system timeline – a constant evolution

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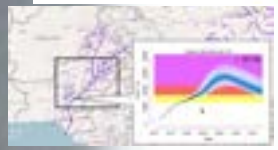
2011

GloFAS experimental produced since July 2011, run at JRC

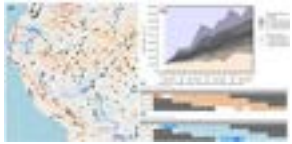


2015

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

Nov 2017

GloFAS Seasonal
Added in November 2017



Apr 2018

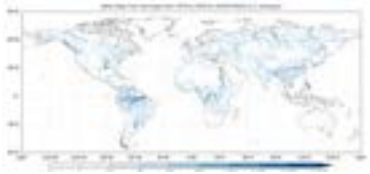
GloFAS operational
Implemented with 24/7 support, included seamless 30-day predictions using the monthly forecasts

Nov 2018

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

Nov 2019

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

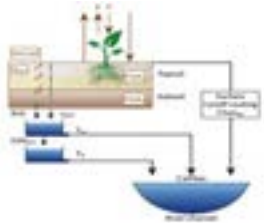


Dec 2020

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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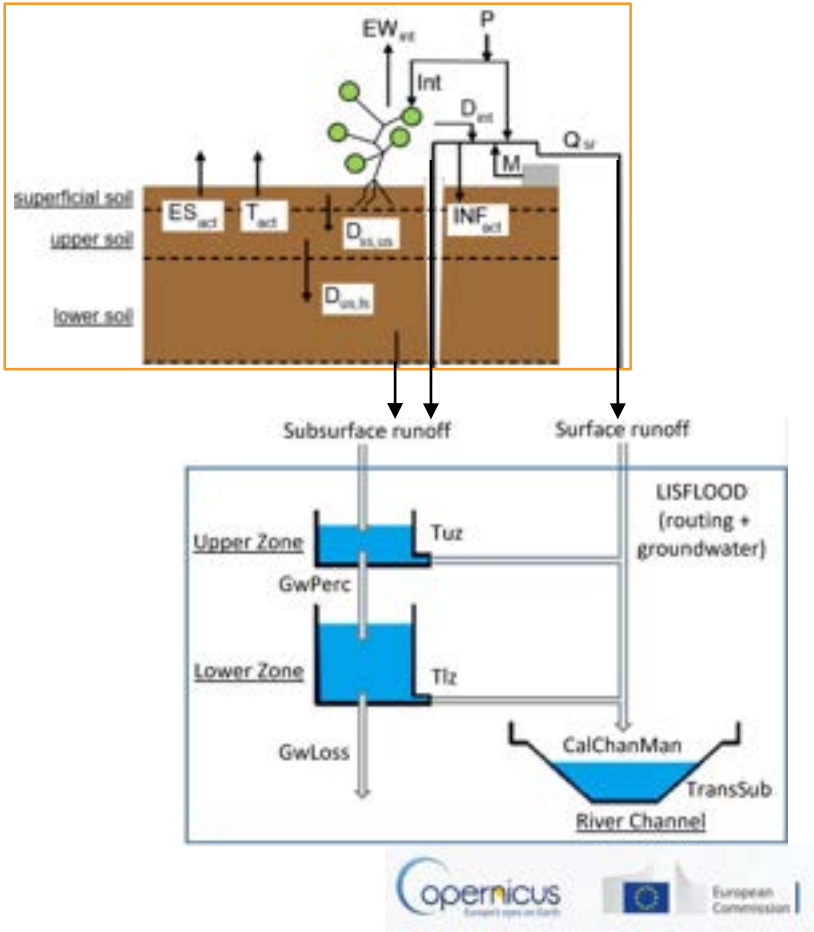
Hydrological modelling framework

- hydrological processes from precipitation to river routing are modelled with LISFLOOD (open-source: https://ec-jrc.github.io/lisflood/)
- 0.1 degree grids (excluding Antarctica)
- ERA5 as initial condition, calibration and reference simulation
- Calibration over 1226 river sections with a total drainage of 51 Mio. km^2 over 66 countries



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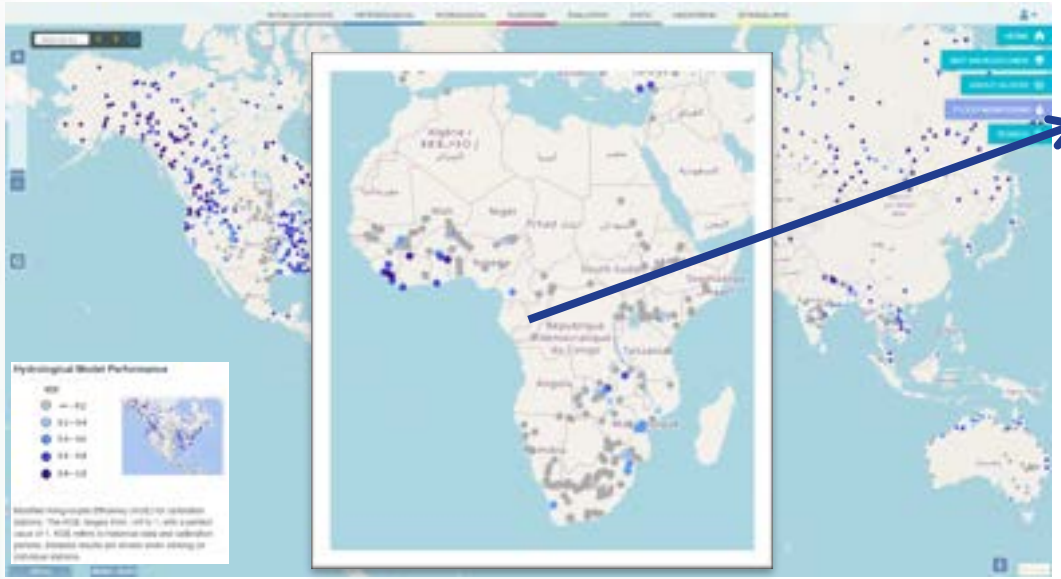
Hydrological modelling skill

KGE' score at calibration points (and additional stations)



pop-out window with KGE component score values and sim/obs time series

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

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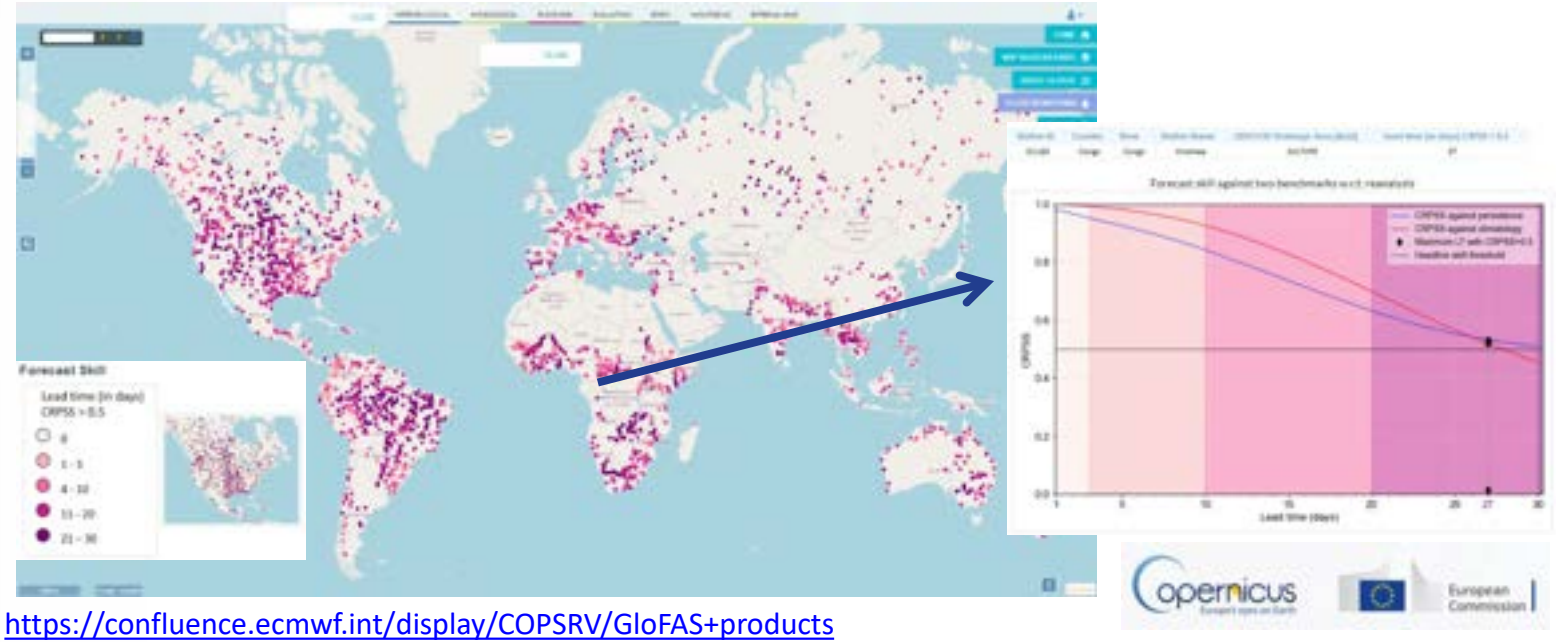
Forecast skill

summarizing the **maximum lead time** (up to 30 days) when forecast skill score against both persistence and climatology benchmarks still exceeds 0.5



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GloFAS interface

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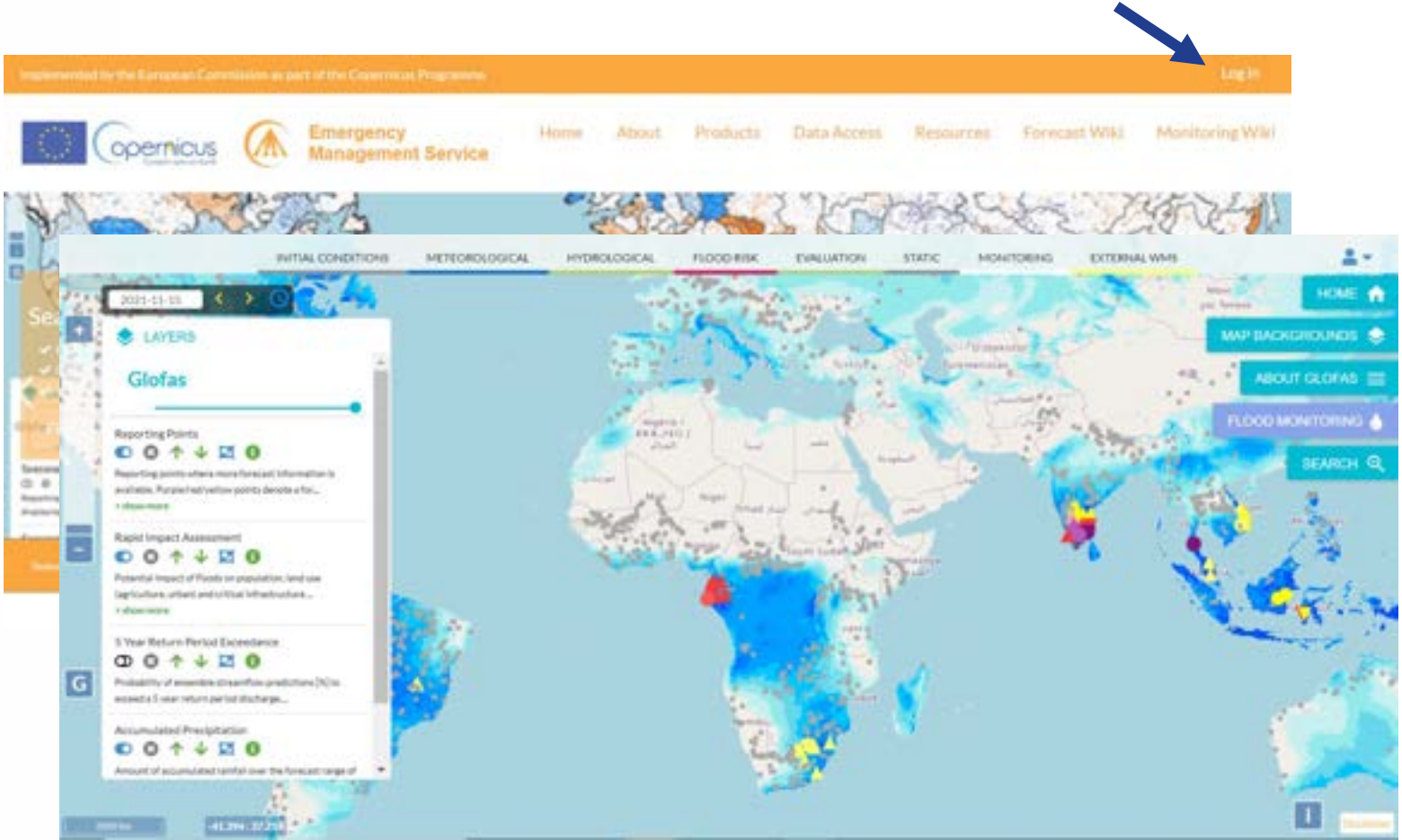

GloFAS products – summary maps and reporting points

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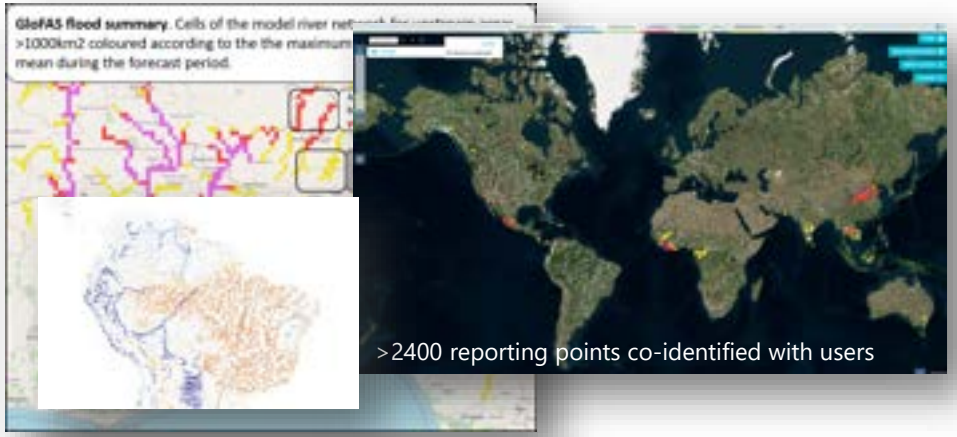
Forecast layers

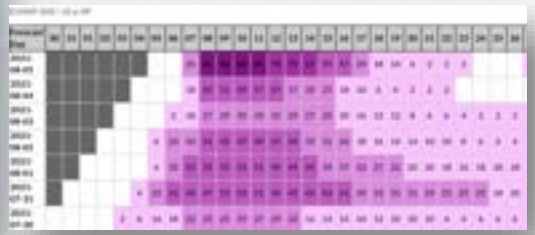
- Range of products with different emphasis (e.g. forecast range, highlights, etc…)
- Additional detail on forecast timeline for some layers

Maps of flood signal highlights/ seasonal outlooks

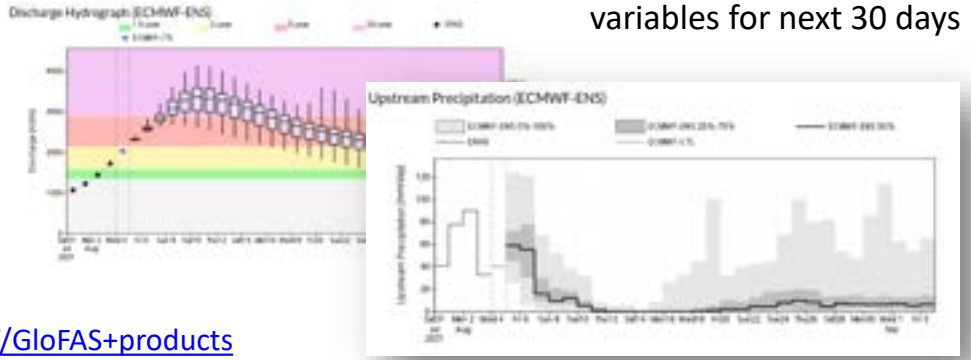


Reporting point metadata table

Forecast consistency tables



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



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

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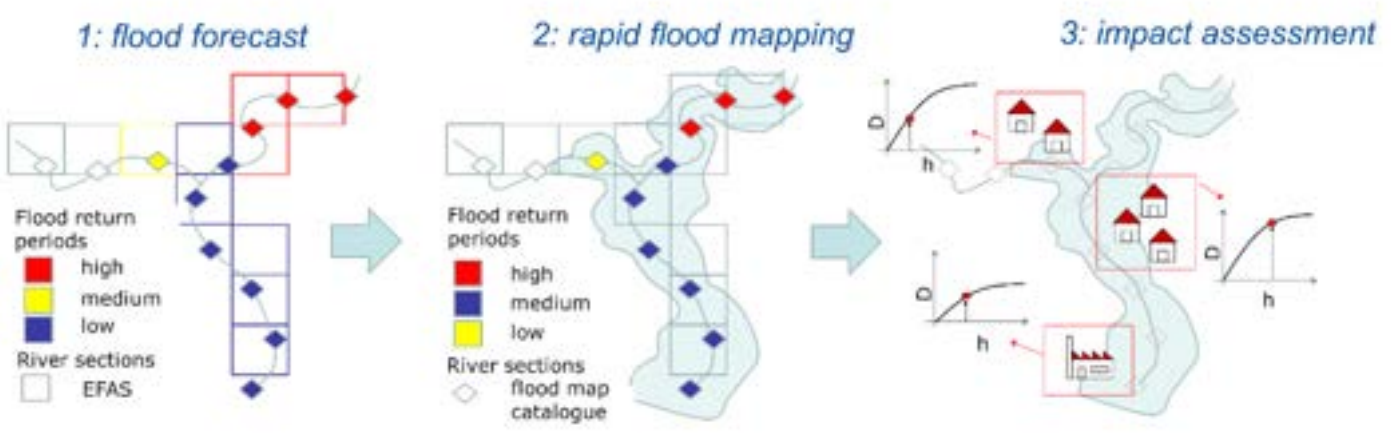
GloFAS products - flood risk assessment layers

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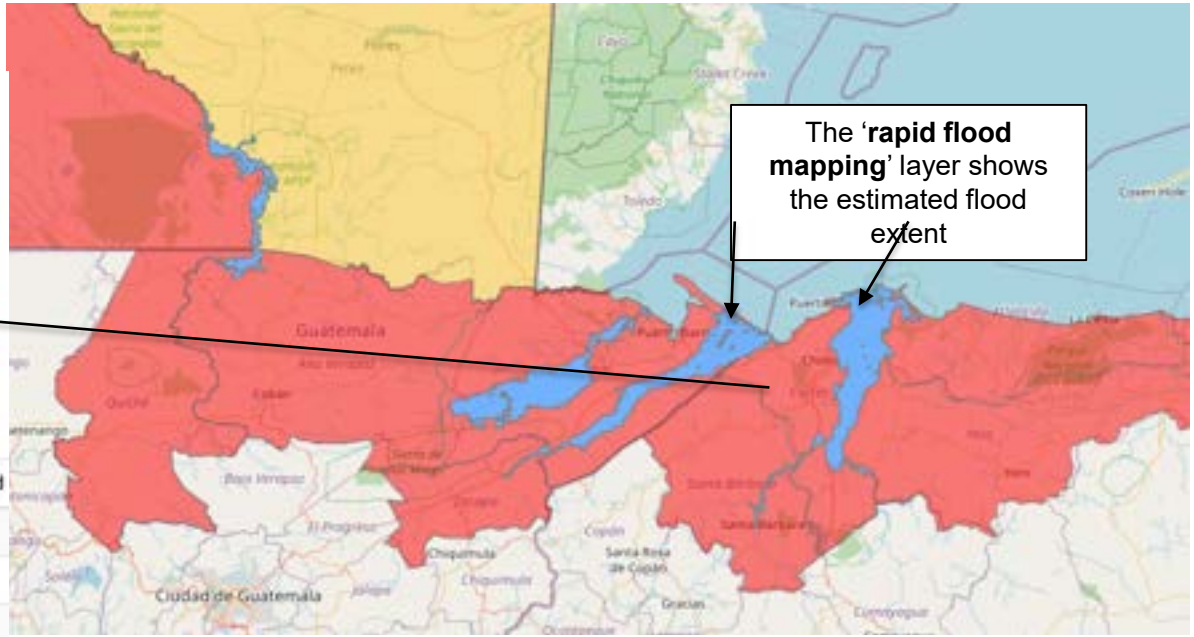
The '**rapid impact assessment**' summarises the exposure and flood event information over the next 30 days per administration region

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

Global Flood Monitoring

Sentinel-1 based:

- SAR enables **all day and all weather** flood monitoring
- High **spatial resolution of 20 m**
- High **revisit frequency**: Europe **~ 1 – 3 days** World **~ 3 – 14 days** (to be further increased with Sentinel-1 C)

Automatic:

- **High timeliness** of the product – **less than 8 hours** between sensing and product delivery
- **Continuous monitoring** for large areas

Access

Main access to GloFAS:

www.globalfloods.eu

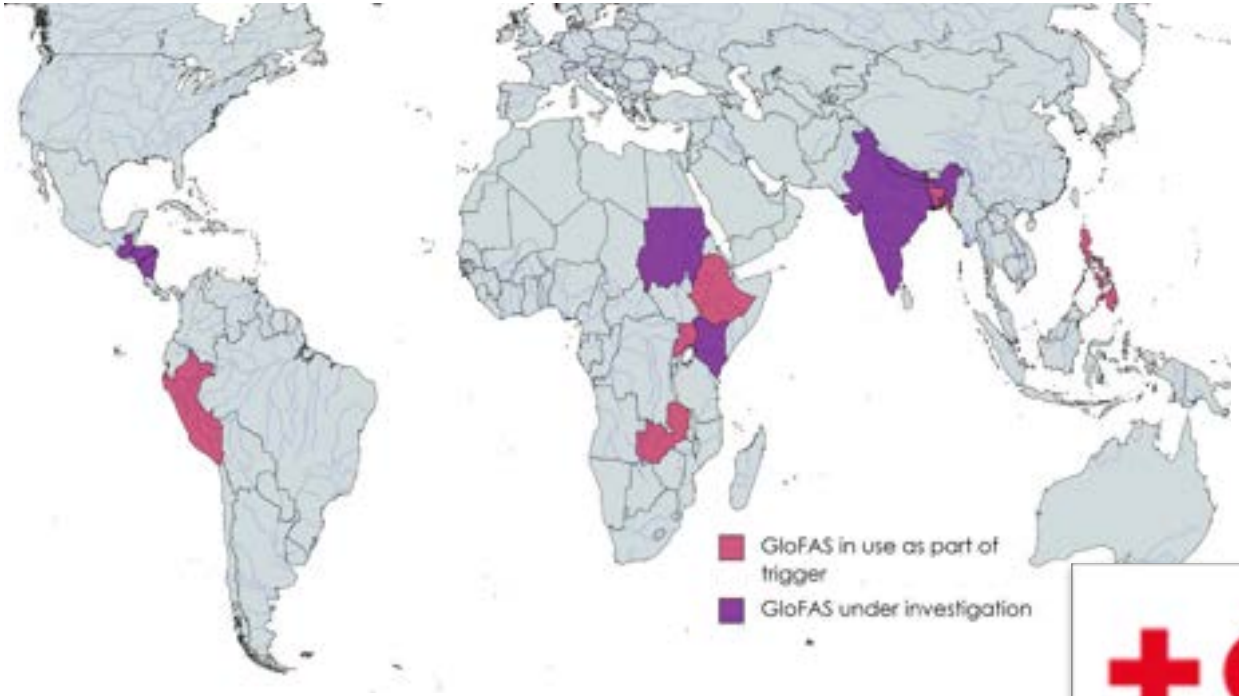
Supporting resources:

1) Wiki space:
https://confluence.ecmwf.int/display/COPSRV/CEMS-Floods

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

- Access GloFAS **raw data**

GloFAS part of >1.5 million CHF in Red Cross Red Crescent funding



Climate Centre

GloFAS is free and open for you!

Come and visit us: www.globalfloods.eu

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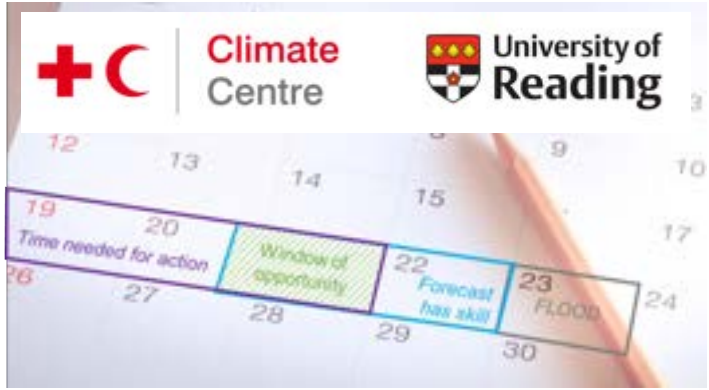
Global model: interim solution

- Case study: Uganda
- Collaborating with Uganda Red Cross Society, Ugandan Ministry of Water and the Environment (MWE) *(Douglas Mulangwa, speaking later)*, Uganda National Meteorological Authority, 510Global
- **Limited existing capacity** for hydrological forecasting in Uganda
- GloFAS was used for an initial pilot project in Kapelebyong sub-county, reached ~370 households in November 2015
- Scaled-up across the country
- Evaluation carried out using GloFAS reforecasts and gauged data from MWE



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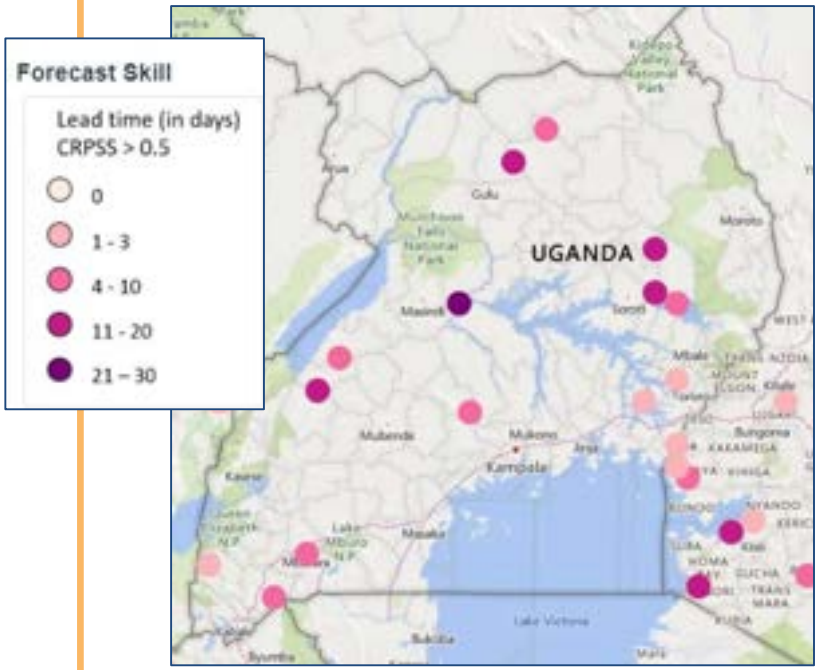
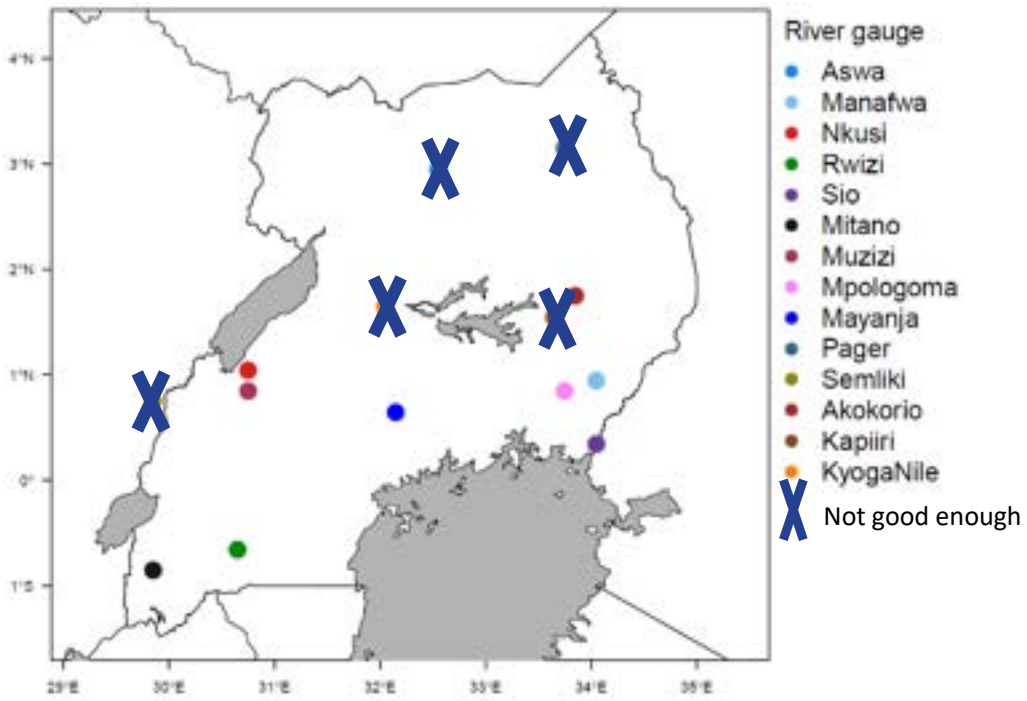
‘Decision-Blind’ skill guidance

(Thanks to Andrea Ficchi, University of Reading)





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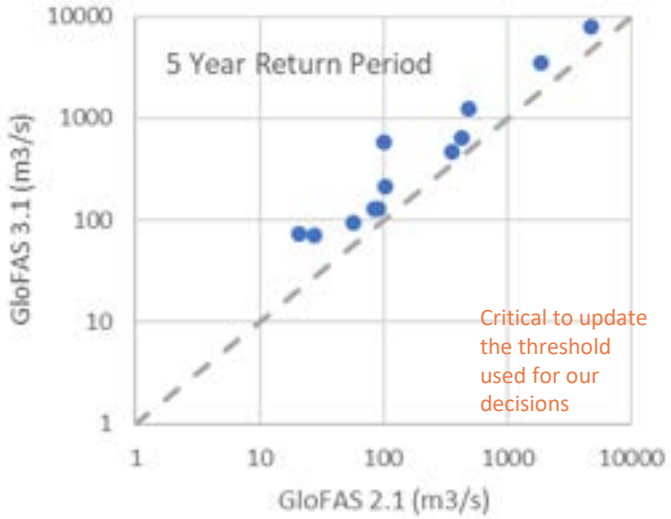
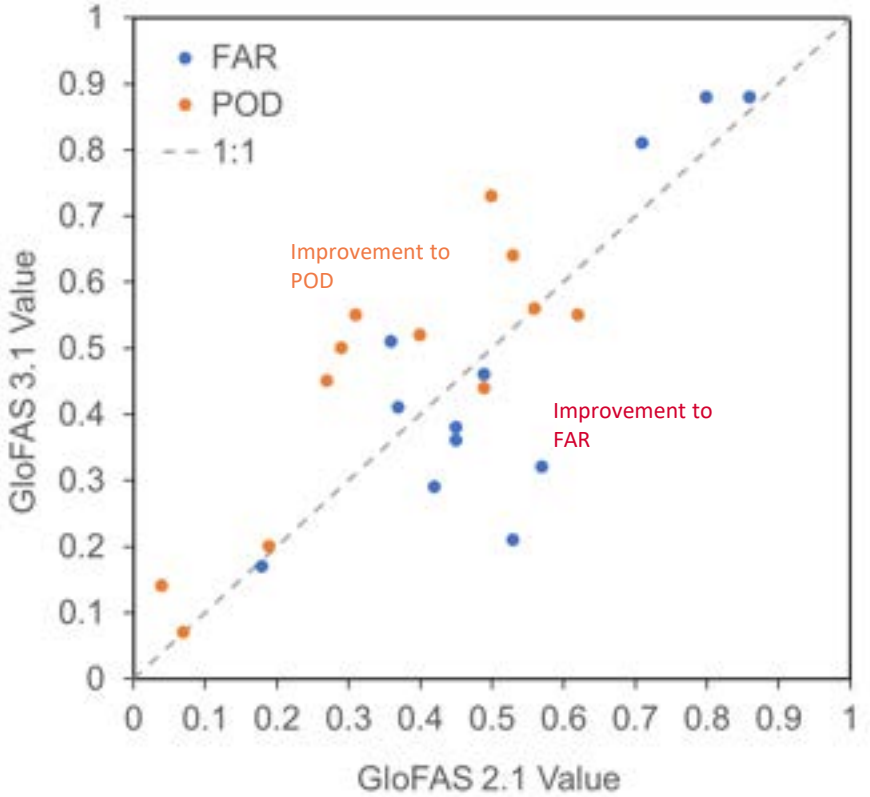
Updating for new model version

(Thanks to Andrea Ficchi and Harshita Gupta, University of Reading)

- Rivers across Uganda
- Evaluation: 70% chance of 90th percentile flow at 5 day lead time





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Next GloFAS upgrade

- Increase in spatial resolution from 0.1deg (6 arcmin) to 0.05deg (3arcmin)
- Complete update of all static maps (landcover, soil, topography, drainage, etc.)
- Improvements and bug fixes to the hydrological model
- New calibration including more stations in Africa
- Work ongoing – release plan: Q3 2022