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?

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

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

GloFAS experimental produced since July 2011, run at JRC.

GloFAS Seasonal Added in November 2017.

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


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


GloFAS v3.2 Global Flood Monitoring products added to GloFAS.

27 Oct 2021
GloFAS set-up

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. km² over 66 countries
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
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

https://confluence.ecmwf.int/display/COPSRV/GloFAS+products
GloFAS interface
GloFAS products – summary maps and reporting points

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

Reporting point metadata table

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

Maps of flood signal highlights/ seasonal outlooks

>2400 reporting points co-identified with users

Forecast consistency tables

https://confluence.ecmwf.int/display/COPSRV/GloFAS+products
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
The ‘rapid impact assessment’ summarises the exposure and flood event information over the next 30 days per administration region.

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

The ‘rapid flood mapping’ layer shows the estimated flood extent.
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
Main access to GloFAS:

www.globalfloods.eu

Supporting resources:

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

2) Climate Data Store:

• Access GloFAS raw data
GloFAS use case

GloFAS part of >1.5 million CHF in Red Cross Red Crescent funding
GloFAS is free and open for you!

Come and visit us: www.globalfloods.eu
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
Emergency Management

GloFAS use case

‘Decision-Blind’ skill guidance

(Thanks to Andrea Ficchi, University of Reading)

Not good enough
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GloFAS use case

Updating for new model version

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

Improvement to FAR
Improvement to POD

Critical to update the threshold used for our decisions

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