**1st GLOFAS Annual Meeting 2021**

Minutes

October 28, 2021, on-line Webex

The 1st GLOFAS Annual Meeting transferred to the on-line platform due to the Covid-19 pandemic situation. In the meeting on 28 October about 80 participants were logged in and took part in the meeting.

All presentations including questions are uploaded to the GLOFAS website.

**Thursday 28-10-2021**

## Opening of the meeting

**Peter Salamon** (JRC) welcomed the participants and opened the meeting On GLOFAS and the Global Flood Monitoring Tool. It is the first annual meeting on Global Flood Early Warning in the framework of the Copernicus EMS.

Peter gave an introduction to the afternoon sessions. We will first focus on the developments in GLOFAS, a system that has been more or less operational for quite a while. We will look in more detail to the satellite based flood monitoring, a system that has been launched this week as beta version within GLOFAS. After the break a first glimpse into the next version of GLOFAS will be presented. The meeting will be closed by some examples of how GLOFAS has been currently used in several locations around the world.

Peter explained the main rules of on-line communication and chaired the whole meeting.

*Q: from Mayar*

*Where we can find the slides after the session is finished?*

*A; from Vera Thiemig - JRC*

*Dear Mayar, we will upload the slides onto the GloFAS website (www.globalfloods.eu) in the next week*

*Q: from Diana Achim - NIHWM*

*The presentations for all the week will be there?*

*A: from Peter Salamon - JRC*

*@Diana: You will find all presentations of the entire week here https://emergency.copernicus.eu/mapping/ems/cems-week-2021 But please be patient as it will take a while until all presentations of the entire week are available*

*Q: from Kay Shelton - JBA Consulting*

*Hello to the organisers - this question may have already been answered, if so, I apologise for repeating. Will the recording of this workshop be available, in addition to the slides at all?*

*A: from Peter Salamon - JRC*

*@Kay: Yes, we aim to make also the recordings available*

GLOFAS – highlights of the last year

Christel Preudhomme, GLOFAS COMP @ ECMWF

Ervin Zsoter, GLOFAS COMP @ ECMWF

Calum Baugh, GLOFAS COMP @ ECMWF

GLOFAS is part of the Copernicus Emergency Management Service (CEMS). The system couples information from numerical weather prediction with hydrological modelling to provide global flood forecasts for large river catchments. GLOFAS is complementary to national hydrological and meteorological systems. Information from GLOFAS is freely available.

GLOFAS provides ensemble hydrological forecasts and is updated on a daily basis. GLOFAS also contains a seasonal component that is updated weekly. Version 3.2 of GLOFAS is available since 27‑10-2021.

Version 3.1 has a new modelling chain, comparable to EFAS. The spatial resolution is 0.1 degree. ERA5 data is used to calculate the initial conditions and 1226 basins have been calibrated. The calibration shows overall good representation. In some catchments there is bias.

Available products:

* Initial and antecedent maps
* Static maps
* Meteorological forecast maps with 10d precipitation probability
* Meteorological forecast maps with animated daily precipitation for the next 10 days
* Forecast layers with flood signals
* Evaluation layers with performance of the system

The flood risk assessment layers are comparable to EFAS. The rapid impact assessment layers gives information on lead time and exposure

Users need to register to be able to see all the maps. Flood monitoring layers are now also available. Web Map Services allow users to import GLOFAS into their own application.

GLOFAS data is accessible via the Copernicus Climate Data Store.

For future developments co-creation with users is necessary.

*Q: from Nuno Moreira – IPMA*

*What is the experience with the forecast in the 15 to 30 days range, as for this extended forecast weekly anomalies of meteorological forecast are (more) usually used?*

*A: from Ervin Zsoter ECMWF*

*The 30-day forecasts use the 15-day ENS (ECMWF) input, blended with the extended range input, i.e. the most recent monthly forecast. So, in short we create a seamless (as possible) 30-day forcing from the 0-15-day and the most recent monthly forecast.*

*Reply from Nuno Moreira - IPMA*

*@Ervin, @Christel - thank you for the clarification on the extended forecasts and on the smaller basin evolution. I can easily understand the problems for small catchments, nevertheless it will continue to be an issue to deal for local extremes*

*Q: from Armin Rauthe-Schöch - DWD*

*Is a GLOFAS account needed to download data from the web services like WMS ?*

*A: from Christel Prudhomme - ECMWF*

*I do not think you need to have a GloFAS registered account for the WMS*

*A: from Armin Rauthe-Schöch - DWD*

*@christel: Thanks! You are right, the WMS download works without authentication.*

*Q: from Mihaela Ionita*

*GLOFAS products are available without activation?*

*A: from Ervin Zsoter - ECMWF*

*Hi Mihaela, the GloFAS forecasts are available regardless of the flood situation, freely for everybody. Only registration is needed.*

*Q: from Emanuele Panizio - E1 Floods*

*What is the authentication method to use the data service API?*

*A: from Christel Prudhomme - ECMWF*

*I believe you need to be registered through the CDS in order to activate the CDI API - registration is open and free*

*Q: from Nuno Moreira - IPMA*

*How feasible may be a reduction of basin areas to be below 2000 km2, to include e.g.. islands (e.g. Madeira island has 800 km2)*

*A: from Christel Prudhomme - ECMWF*

*GloFASNext will be running at 3arcmin. Very small islands will still be an issue, but this should help*

*A: from Ervin Zsoter ECMWF*

*The 2000 km2 is just a recommendation. Currently most maps show river pixels over 1000 km2. With the next version of GLoFAS (with 5-6 km resolution), this will be reduced. So it will become possible to see smaller islands with below 1000 km2. However, this very small catchment size is not necessarily where GloFAS should perform best.*

*A: from Ervin Zsoter - ECMWF*

*@Nuno, as we are going to go down in catchment size, if you have any discharge data available (that could be provided) for any of the smaller islands, we would be super happy to use them in the model calibration (and evaluation).*

*Reply: from Nuno Moreira - IPMA*

*@Ervin, I believe for the islands no discharge data exist, only meteorological stations. For an event last December an activation for CEMS mapping was done and this impact is available, including land displacements (as indirect estimates?) and debris flow*

*A: from Ervin Zsoter - ECMWF*

*@Nuno, thanks, that makes sense. Unfortunately many areas of the world just do not seem to have hydro data at all.*

*Reply from Nuno Moreira - IPMA*

*@Ervin, we are doing a report on this event and may share the results to evaluate further*

*Reply from Christel Prudhomme - ECMWF*

*@nuno, this is would great :). Looking forward to further discuss and evaluate GloFAS*

Global Flood Monitoring

Wolfgang Wagner, Technical University Vienna

Patrick Matgen, LIST

Sandro Martinis, DLR

Candace Chow, DLR

Wolfgang Kapferer, Geoville

Luca Molini, CIMA

A new operational, near real-time global flood monitoring (GFM) has been integrated into GloFAS. The new GFM provides a continuous monitoring of floods worldwide by immediately processing and analyzing all incoming Sentinel-1 Synthetic Aperture Radar (SAR) satellite data. Information is obtained from 2 satellites for systematical monitoring of floods around the world. Three algorithms run in parallel to compute the near-real time flood mapping products.

GFM computes on a regular basis 11 different flood-related products, accessible via the hydrological layer tab of the GloFAS map viewer. Seasonal differences can be taken into account.

Products:

* Observed Flood Extent: is the composite of the flooded areas
* Observed Water Extent identifies the pixels classified as open water
* Reference Water Mask identifies the pixels classified as open water, both permanent and seasonal
* Exclusion Mask indicates the pixel locations where the SAR data could not deliver the necessary information for a robust flood delineation.
* The Uncertainty Value is the estimated uncertainty of flood mapping, for all areas outside exclusion mask.
* The Advisory Flags indicates potential reduced quality of flood mapping.
* The Sentinel-1 Metadata layer contains the available information on the acquisition parameters of the S-1 data used for flood detection.
* Sentinel-1 Footprint is the image boundaries of the S-1 data used.
* Sentinel-1 Schedule is the next scheduled S-1 data acquisition for each specific AOI.
* The Affected Population layer provides the number of people estimated to have been affected by floods, mapped by the spatial overlay of observed flood extent and gridded population (GHS)
* The Affected Land Cover maps the flooded areas in terms of land use as provided by Copernicus Global Land Cover Service

Data is accessible via user entry points API, WMS-T, the notification server and a download application.

Authentication process via: <https://globalfloods.eu>

Product downloads via <https://gfm.portale.geoville.com>

User support is provided via the user support service on working days between 9 and 17h CET. In can be reached via e-mail (gfmsupport@eudc.eu) or via the contact section in GLOFAS. There is also a product user manual.

Peter Salamon thanks the speakers for their presentations. It provides most of the details of the setup of the GFM. It is a nice overview of how the system is build and how it works. The beta version of GFM is now available in GLOFAS. Now is the time to provide user feedback that is needed to finalize the system.

*Remarks from Wolfgang Wagner - TU Wien*

*For all of you interested in how Sentinel-1 backscatter looks on a global scale, here is a new data set publication that was published just a few hours ago:* [*https://www.nature.com/articles/s41597-021-01059-7*](https://www.nature.com/articles/s41597-021-01059-7)

*Here is the link to the viewer of the Sentinel-1 backscatter model:* [*https://s1map.eodc.eu/*](https://s1map.eodc.eu/)

*Remark from Dragana Milinkovic - EODC*

*Dear all, I invite you to share your Global Flood Monitoring related questions via gfm-support@eodc.eu. GFM team is happy to address them!*

After the break Peter Salamon gave a short introduction into the second part of the GLOFAS session where we are going to move back to the forecasting part. Given the fact that this is the first annual meeting for GLOFAS within the Copernicus EMS, some of the participants might not be familiar with the setup of the Copernicus services. JRC is responsible for the management and the future development of the emergency management services but the operational work is contracted to a number of service providers. The element that will be presented in this session is the global hydrological data collection, one of the services of the operational CEMS.

CEMS Hydrological Data Collection Centre

Rafael Garciá, GLOFAS HYDRO @ Soologic

The GLOFAS Hydrological Data Collection is outsourced to the Spanish company Soologic. Soologic (together with REDIAM) has been operating the EFAS hydrological data collection since 2012. The new framework contract that starts 2021 includes data collection for Europe as well as for the global domain. The main tasks of the data collection centre are:

* Collection of historical hydrological data (discharges)
* Collection of metadata
* Harmonization of the data in units, time zones, aggregation
* Quality control of the data
* Data sharing within CEMS
* Network management for data providers

Only freely available data is collected. The data is used for model calibration and for presentation of products and services.

Rafael makes an urgent appeal to make data available. Without your data the system is useless.

Peter Salamon supports this appeal. Data is absolutely necessary for calibration and validation.

*Q: from Yves Tramblay (Institute of Research for Development, France)*

*Thanks for the presentation. About the data collection, your main contacts points are national institutions ? basin-scale management agencies ? What is the strategy to "cover the blank areas", i.e. most developing countries where the data is not included in GLOFAS (-or in many cases data does not exist).*

*A: from Pewter Salamon – JRC
We are in the first stage of data collection, where we focus on open data sources (easy to obtain). At the moment ‘blank areas’ have no high priority.*

*Remark from Mercedes Garcia-Padilla*

*Dear all, contacting email address: glofas-cems-hdcc@soologic.com*

A first glimpse into GLOFAS 4.0

Stefania Grimaldi, JRC

The main features of GloFAS 4.0, also referred to as GLOFAS Next, are:

1. Doubling the spatial resolution from 0.1 degree to 0.05 degree
2. Upgrade LISFLOOD to LISFLOOD OS
3. New calibration with more data

Ad 1.: This will lead to a better representation of the river network and a more accurate representation of the spatial variability of catchments. Eventually the forecasts will improve. With the higher resolution also the soil information will be more up to date.

Ad 2.: LISFLOOD OS is a semi distributed, physically based hydrological model. Lakes and dams are included, as well as water abstraction for anthropogenic use. The increased computational efficiency of the model makes it possible to run GLOFAS at a higher resolution.

Ad 3.: In GLOFAS 4.0 catchments with an area over 500 km2 are calibrated (in the previous version this was 5000 km2). New discharge observations are available for calibration. At the moment the selection of gauging stations is in progress. If all stations are usable, about 1860 stations will be available for calibration (it was 1226 in GLOFAS 3.1).

For ungauged catchments default parameters are determined with help of a regionalization method.

GLOFAS 4.0 will be operational at the end of 2022.

*Q: from Valentin Ruault (MOI)*

*Do you know what is the primary cause behind the 30% global discharge increase from GloFAS 2.1 to GloFAS 3.1 ? (If there is any primary cause since the model is different)*

*A: from Christel Prudhomme, ECMWF*

*Version 3.1 has been calibrated over a different reference meteo forcing than 2.1, and also uses a totally different hydrological model*

*Q: from Nuno Moreira, IPMA*

*The transferring from gauged catchments to ungauged catchments will work somehow with clusters of catchment types?*

*A: from Stafania Grimaldi, JRC
We use predictor maps to transfer characteristics of the catchments to the parameters.*

*Remark from Younes*

*Thanks for this amazing so called GLOFAS platform be in service. It has been really helpful for countries who they suffering from lack of forecast data related to flood. In Iran case it has been performed well for predicting massive flood and preparation for flood disaster...! Best..*

*Remark from Christel Prudhomme - ECMWF*

*We invite you to look at our wiki where we have an overview of the difference of the two systems*

[*https://confluence.ecmwf.int/display/COPSRV/GloFAS+v3.1*](https://confluence.ecmwf.int/display/COPSRV/GloFAS%2Bv3.1)

Global use case and applications – Global user stories

Anticipation flood events in Bangladesh using the GloFAS extended range flood forecast

Arfizzaman Bhuyan, FFWC, Bangladesh

Two extreme flood events occurred in the 2020 monsoon in the Brahmaputra basin. The GloFAS forecasts hydrograph showed high forecasts probabilities for flood onset, peak time and duration with a lead time between 10 and 15 days. Bangladesh flood forecasting and warning centre plans to integrate GloFAS forecasts to the national model to predict water levels.

Flood forecasting to inform humanitarian response

Michael Andrew Manalili, World Food Program

The World Food Program has been using the in house system called the automated disaster analysis and mapping system . Flood forecasting (river reporting points, inundation forecasts and rainfall forecasts) is coming in from GloFAS and from ECMWF.

Challenges are:

* The information from GloFAS is too technical
* Users want to have forecasts with lead time beyond 15 days
* Forecasts are not available for small rivers
* Forecast are not available fort pluvial floods (heavy rain)
* Information is needed for large regulated basins (with reservoirs and dams)

Development of Disaster Risk Financing Systems

Elisabeth Rees, Start Network

The use of flood forecasts and the implementation of systems like GloFAS in Disaster Risk Financing was presented. The aim of DRF is to get the right amount of money gets where it needs to be in the right time. Forecasts are used for risk analytics. Financing an contingency planning will be rolled out based on risk assessment coming from forecasting systems like GloFAS.

Flood Foresight Flood Forecasting for Disaster Risk Financing Systems

Kay Shelton, JBA Consulting

Kay described some of the tools that are used for risk analytics prior to river flooding. Insurance needs a probabilistic analysis of historical events and real time forecasts. A model for river flooding was developed applicable for any area of interest that meets the above requirements. The modelling system consists of 2 models: a static flood risk model used to determine the risk profiles in combination with a dynamic flood forecasting and impact model. For the second model daily ensemble river forecast from GloFAS with a set of pre-computed flood hazard maps are used.

The ensemble of daily flood forecast maps are then combined with population densities to estimate the range of people that may be inundated.

The method allows the financing trigger to be refined.

GloFAS for small scale hydropower

Lorenzo Ramella, DXT Commodities

DXT is a Swiss trader specialized in energy commodities. It dispatches several hydro farms located in the Italian Alps. Discharge forecast from GloFAS is a valuable information to forecast the farms power production. GloFAS improved performances compared to persistency. There is a stronger improvement for farms with larger catchments. There is a stronger improvement in the rainy season and a weak improvement in the snow melt season.

A challenge is that the GLOFAS forecasts are not really usable for small catchments.

The use of GloFAS for flood briefs for the Emergency Response Coordination Centre

Michaela Mikulickova, SHMU, Aristotle Consortium

The Aristotle project aims at transboundary early earning. It started in 2016 and consists of 19 institutions across Europe. Aristotle provides guidance on 6 types of natural hazards to the EU Emergency Response Coordination Centre (ERCC). This guidance is used by the ERCC to coordinate preparatory and response actions to global natural disasters. Information from GloFAS is used for the flood hazard part in the guidance reports.

How GloFAS and GFM complement each other: case studies in Thailand, China, India and Mexico

Wolfgang Wagner, TU Vienna

Knowledge about flood risks is very useful for the interpretation of Sentinel- 1 satellite images.

This was demonstrated for floods in Thailand, China, India and Mexico.

Conclusion: GloFAS is not perfect but usable.

Christel Prudhomme thanked all the speakers. The number of use cases with innovative use of GloFAS data is really fantastic. What is needed now is the setup of a user community for GloFAS and the GFM. The developers need to know what the users find useful, what works well and what doesn’t work well and how the information from GloFAS is used in practice. The challenges are global. How to reach communities all over the world?

There is a mechanism for data exchange. Web Map Services are available. Please let us know if you like or do not like the different products.

The first annual GloFAS meeting was closed by Peter Salamon. There will be more annual meetings and also webinars. Finally Peter called for feedback on developments.