The Global Flood Awareness System (**GloFAS**) is the global flood service of the **European Commission Copernicus Emergency Management Service**. GloFAS is developed by the European Commission and European Centre for Medium-Range Weather Forecasts (**ECMWF**).

Providing Openly-Available Seasonal Forecasts of Flood and Drought Hazard for Rivers Worldwide

Dr Rebecca Emerton of the National Centre for Atmospheric Science worked alongside scientists at the University of Reading and the European Centre for Medium-Range Weather Forecasts (ECMWF) to develop the world's first open global-scale seasonal hydro-meteorological forecasting system. This work was undertaken as part of Dr Emerton's PhD research with the University's Water@Reading research group, completed in February 2019.

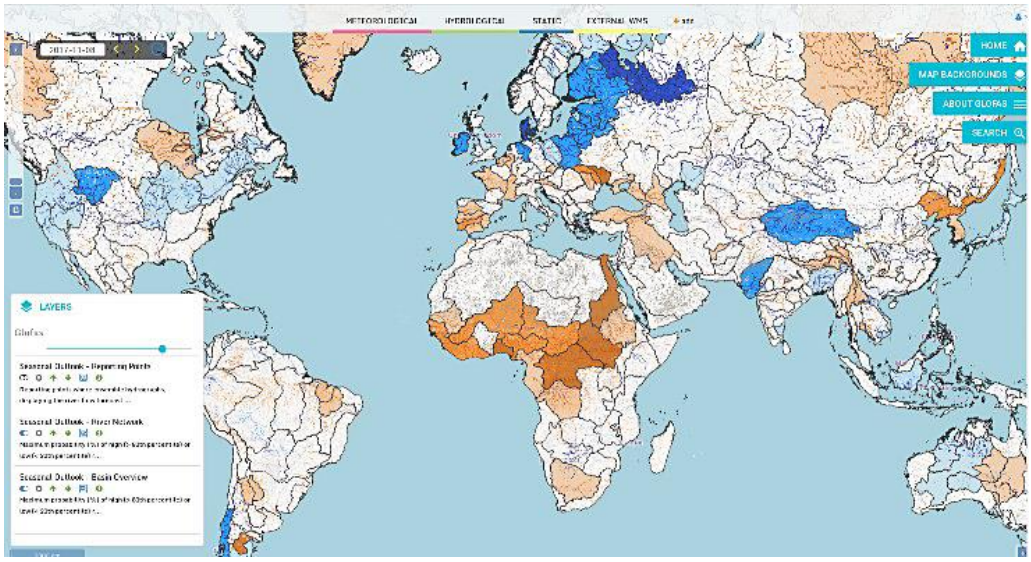
Developing openly-available seasonal forecasts

Global overviews of upcoming flood and drought events are key for many applications, from agriculture and water resource management to disaster risk reduction. Seasonal forecasts of river flows can provide early indications of extreme events, weeks or even months in advance.

The Global Flood Awareness System (**GloFAS**), a component of the **Copernicus Emergency Management Service**, has been producing flood forecasts up to 30 days ahead since 2012. GloFAS products have been used by forecasting agencies around the globe, including the Red Cross Red Crescent Climate Centre, which first used flood forecasts to **trigger actions ahead of flood events in Uganda in 2015**.

We developed GloFAS-Seasonal as an extension of GloFAS, to provide forecasts up to 4 months ahead of high and low flow in the global river network. These new forecasts, **first released in November 2017**, are openly available through the GloFAS web interface.

GloFAS provides early warning information for decision-makers and users in regions where no other forecasting system exists. While seasonal forecasts are useful for many applications, they typically require extensive supercomputing resources, and it is often not possible for national or local forecasting centres to produce their own seasonal forecasts. It is therefore important for the



Using a journal with an open peer review process enabled us to publish information about the forecasts much sooner than would have been possible with other journals, and gave service users the opportunity to participate in the peer review of the science.

GloFAS-Seasonal forecasts to be freely available and easy to access anywhere in the world: they can be viewed on any device, requiring only an internet connection.

The uncertainty associated with seasonal forecasts can be large and difficult to interpret, especially for non-expert users. Our website was designed with this in mind, incorporating feedback from users wherever possible, in order to provide intuitive forecast products displaying detailed uncertainty information in accessible ways.

Beyond open forecasts

Several GloFAS partners and users wanted to assess forecast performance for particular locations. In response to these requirements, the forecast data and several corresponding datasets will be made freely available from ECMWF. Because of the large size of these datasets (totalling tens of terabytes), they will be made available through the **Climate Data Store**, a dedicated Copernicus data archive from the **Copernicus Climate Change Service**, due to be released in Spring 2020.

With our users in mind, we published a model development and evaluation paper[1] in an Open Access journal with an open peer review process. We wanted to ensure the paper was freely available, as it provides information that is essential for decision-makers, many of whom will not have access to journal subscriptions. Using a journal with an open peer review process enabled us to publish information about the forecasts much sooner than would have been possible with other journals, and gave service users the opportunity to participate in the peer review of the science.

The code used to process the forecast data and create the forecast visualisations for the website is based on Open Source software, and is available to download alongside the publication. This allows users to bias-correct the forecasts and re-produce the visualisations with updated data.

There are challenges involved in providing access to huge volumes of data, and designing forecasts for a wide range of users with different levels of expertise in hydrological forecasting. But the uptake of GloFAS forecasts by its international users is in no small part the result of developing the service on an Open Research foundation.

Open at a glance

- First global river flow forecast system that is an open resource – essential for target users worldwide, many of whom could not pay for access
- Open Access model development paper with supporting code provides transparency and increases trust
- Paper published rapidly using open peer review model, allowing stakeholders to participate in peer review
- Plans with partner ECMWF to make raw forecast data open in response to user demand

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References and further information

1. Emerton, R. et al. (2018). Developing a global operational seasonal hydro-meteorological forecasting system: GloFAS-Seasonal v1.0. *Geoscientific Model Development* 11: 3327–46. **https://doi.org/10.5194/gmd-11-3327-2018**

GloFAS Website and Forecasts. **http://www.globalfloods.eu/**