



Global Flood Awareness System Learning Framework Report

October 2016

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Learning activities, outcomes and key actions from the first GloFAS Community Workshop

4th – 6th May 2016





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1. Introduction

The recent development of large scale probabilistic methods for flood early warning has great potential for improving community resilience to floods. There is however, a grand challenge in interpreting these forecasts into locally relevant information for improving preparedness for flood disasters. A solution to this challenge requires an approach that engages and applies the expertise of on-the-ground users in the development of the forecasting system.

A pilot project was set-up by the University of Reading with the aim of developing a Learning Framework for GloFAS flood forecast users. This framework appoints a two-way 'practical solutions and learning focus', whereby GloFAS forecasters and developers learn how to tailor forecasts and uncertainty information to local users and incorporate local information into the forecasting system, and local users learn how to interpret and use probabilistic early flood information.

The first stage of the Learning Framework was developed in a Global Flood Awareness System (GloFAS) Community Workshop. This report presents the learning activities, outcomes and key actions from this first Community Workshop, held on May 4th – 6th 2016 at the University of Reading.

1.1 Project rationale

In order to save lives and livelihoods and improve community resilience to severe events, cross-border early warning systems are needed to strengthen the preparedness phases of disaster risk management. Continental and global scale flood forecasting systems provide vital early flood warning and incident management information which can be used to support decision-making on how to prepare for upcoming floods and how to respond to events as they evolve from local to international scales1. Although several developed countries have well-established systems for river monitoring and flood early warning, figures of populations affected every year by floods in developing countries are unsettling2.

The recent development of large scale probabilistic 'ensemble' methods for flood forecasting and early warning, improve upon conventional forecasting by providing a suite of predictions that can communicate forecast uncertainty and enable both the most likely and also possible extreme scenarios to be identified. This helps to evaluate risks and undertake cost-benefit analysis on flood preparedness actions such as distributing water purification tablets, transporting volunteers or moving food into safe storage, leading to better resilience to floods3.

The largest challenges in making the most of probabilistic flood early warning systems are effective engagement with local users of the forecast system in order to effectively communicate the flood risk and to provide the locally tailored information to put the forecast information in context4. Meeting this challenge, must involve coproduction of the forecasting system in order to develop effective communication tools and guide scientific developments. This is incredibly challenging where data and forecasting technology is sparse, and resources for mobility are limited.

1.2 About GloFAS

The **Global Flood Awareness System (GloFAS)** was developed by the European Centre for Medium Range Weather Forecasts (ECMWF) and the European Commission Joint Research Centre (JRC) to provide flood forecasts up to 1 month ahead on a global scale, providing a comprehensive overview on upcoming floods in large world river basins (http://www.globalfloods.eu/en/).

The University of Reading collaborates with ECMWF and the JRC on the technical development and effective implementation of this global flood early warning system through research fellowships, PhD studentships and other joint research projects within the Global Floods Partnership including work with the Red Cross Red Crescent Climate Centre.

The GloFAS is composed of an integrated hydrometeorological forecasting chain and of a monitoring system that analyses daily results and shows forecast flood events on a web platform. An overview of the system structure is shown in the Figure opposite. To set up a forecasting and warning system that runs on a daily basis with global coverage, initial conditions and input forcing data must be provided seamlessly to every point within the domain. To this end, two products are used. The first consists of operational ensemble forecasts of near-surface meteorological parameters. The second is a long-term dataset consistent with daily forecasts, used to derive a reference climatology. They are both computed by the Integrated Forecast System (IFS) of the ECMWF, whose main components are a data assimilation system (DAS) and a global circulation model (GCM).

GloFAS users include national and regional water authorities, hydropower companies, water resource managers, civil protection and first line responders, and international humanitarian aid organisations.



Overview schematic of the GloFAS

1.3 The importance of a Learning Framework

The GloFAS Learning Framework is designed to enable a two-way knowledge transfer. Throughout the Community Workshop, developers worked first-hand with local users to help tailor the forecasting system to their needs. Local users in turn, were able to explore the potential of probabilistic forecasts from their own local context, to identify local data which could be used to improve and interpret GloFAS forecasts and to provide practical next steps to address barriers to forecast and data sharing.

The benefits of shared learning in a community workshop setting:

- To allow organisations to forge new and develop existing research collaborations at a global level.
- To provide support and opportunity to early-career researchers and students.
- To allow interdisciplinary knowledge exchange to deliver impact to society.

The Learning Framework was delivered through 4 key tasks:

1: Share and Learn: Flood Forecasting

Explore the potential benefits of probabilistic flood forecasts with experts in the field in a workshop setting based on their local experiences and requirements.

2: Plotting GloFAS Forecasts and Understanding the Outputs

Explore local ground data which could be used to improve and interpret the GloFAS forecasts.

3: Forecast Evaluation and Post-Processing

Identify solutions for technological differences and barriers to implementing and acting upon GloFAS forecasts and sharing data.

4: Decision-making and Feedback

Discuss, collate and highlight the shared outcomes of the workshop, the action points and provisional agreements.



Two-way knowledge transfer between GloFAS developers, forecasters and local users

2. Workshop Overview

Development of the Learning Framework throughout the full 3 day GloFAS Community Workshop comprised two complementary sessions:

May 4th: The GloFAS Open Event followed by ...

May 5th - 6th: 2 days of dedicated GloFAS Community Workshop sessions

The workshop programmes, presentation abstracts and list of delegates can be found in the Appendices at the end of this report.

An international audience of over 90 people attended the Open Event representing scientific research, development, flood forecasting and policy making.

18 invited delegates took part in the full 3-day Community Workshop including scientists, researchers, forecasters and policy-makers from:

- Servicio Nacional de Meteorología e Hydrología del Perú (SENAMHI)
- The Red Cross Red Crescent Climate Centre (U.S., Peru and London)
- The Mozambique Red Cross
- The Belize Hydromet Service
- The Xiamen Weather Service Centre (China)



- The European Commission Joint Research Centre (JRC)
- The European Centre for Medium-Range Weather Forecasts (ECMWF)
- The University of Reading

Workshop presentations and materials will be available on the GloFAS website: http://www.globalfloods.eu

2.1 The Open Event

An afternoon showcasing the University's work in developing and supporting flood forecasting capabilities globally

A free event featuring:

- Talks from key members of the international community
- Posters showcasing research from the University of Reading and collaborators
- Opportunity to network

The University of Reading welcomed a diverse audience of 91 delegates to the Open Event including forecasters, academics, policy-makers, decision makers and students from around the world.

The Vice Chancellor, Sir David Bell welcomed everyone and introduced the University's connections and research collaborations with institutions including the ECMWF, the Red Cross, and the JRC.



Community Workshop organisers Prof. Hannah Cloke and Dr. Liz Stephens; co-directors of Water@Reading⁵ Centre of Research in the School of Archaeology, Geography and Environmental Science

>> Share and Learn: Keynote talks and Evening poster session

Dr. Florence Rabier, the director of the ECMWF, kicked off the seminars with an engaging presentation, providing an insight into the role of the ECMWF and its forecasts, and how GloFAS came to be, highlighting their strong research collaboration with the University of Reading.



Keynote presenters Dr. Florence Rabier (ECMWF) and Dr. Nicola Ranger (DFID).

The second keynote was given by Dr. Nicola Ranger from the UK's Department for International Development (DFID). Nicola discussed how DFID make direct and indirect use of global long-range forecasts, regional, and

local short-range forecasts from many different sources. Specifically mentioned was the use of forecasts for humanitarian action.

On the same humanitarian theme, Erin's interactive presentation, entitled "Think globally, act locally?" discussed how GloFAS can be applied at the local scale typically operated by the Red Cross. Enthusiastic audience participation was used to highlight the difficulties experienced when using forecasts to employ humanitarian action – striking a balance that ensures risk is minimised without raising false alarm is imperative. Erin provided an example whereby Forecast-based Financing, an initiative which aims to distribute humanitarian funding ahead of a natural disaster, was successful ahead of floods in Uganda in late 2015 based on GloFAS forecasts.



Prof. Ros Cornforth (The Walker Institute)



Erin Coughlan-de-Perez (Red Cross Red Crescent Climate Centre)

Prof. Ros Cornforth, Director of the Walker Institute discussed how science can be used to help, by breaking down academic borders and working together with communities, policy-makers and forecasting services. The AMMA Forecasters' Handbook⁷, a guide for operational forecasting in West Africa, was discussed as an example; a significant project developed through

collaboration between researchers and forecasters, to include long-used local forecasting knowledge alongside new research and techniques.



Peter Salamon from the Joint Research Centre of the European Commission rounded off the afternoon's presentations by providing insight into the technical aspects of GloFAS and how the system can be used to support flood risk management globally. Operational use of GloFAS included the provision of forecasts during the Myanmar floods in the summer of 2015, whereby daily reports to the European Emergency Response Coordination Centre were shared with local authorities.

Dr. Peter Salamon (Joint Research Centre)

"The principal objectives of GloFAS are to provide added, complementary value for national emergency response services and to support international organisations and global actors."



An engaged audience and poster presentation

During the evening, participants had the chance to present posters, and both the seminars and posters provided a platform for many lively discussions and a brilliant end to the day.





An evening of discussion and learning

2.2 Community Workshop sessions

Supporting the Integration of Global Flood Forecasts Locally

Focus was on the use and integration of GloFAS forecasts. Local users gave a presentation on forecasting practices in their country or region and highlighted their own roles and experiences. Developers and forecasters provided training sessions on ensemble forecasting and hydrological modelling with specific focus on the GloFAS interface.

>> SESSION 1: Share and Learn - Flood Forecasting

In this session participants introduced themselves and their experience and understanding with flood forecasting and early warning. Participants from SENAMHI and the Red Cross in Peru provided longer presentations setting the context for the later workshop exercises by providing an overview of flood forecasting, river gauges and decision making. The session then continued with seminars on ensemble forecasting, hydrological modelling and routing, GloFAS and observational data.

>> SESSION 2: Plotting GloFAS Forecasts and Understanding the Outputs

In this session the principles of evaluating hydrological predictions and ensemble forecasts were covered in seminars, games and with hands-on computer sessions on plotting GloFAS forecasts and evaluating them. The participants worked in groups of mixed previous GloFAS experience. Translation services were provided for

some participants. The session concluded with group feedback presentations on "what do the GloFAS forecasts tell you" and an interactive discussion.

>> SESSION 3: Forecast Evaluation and Post-Processing

In this session further principles of forecast evaluation and post-processing were covered in seminars, games and with hands-on computer sessions on forecast evaluation and bias-correction. The session concluded with an interactive discussion on the datasets used and initial conditions generated to run GloFAS and their advantages and drawbacks.

>> SESSION 4: Decision-making and Feedback

The final session used seminars and games to explain the concepts of decision making with uncertain forecasts. The principles of forecast based financing were discussed. The session continued with explanations on how to access GloFAS forecasts and finished with discussion on future actions, dataset sharing and feedback for the Learning Framework Report.



The GloFAS user interface

3. Workshop outcomes

The workshop provided an excellent opportunity for forecasters, decision-makers, researchers and model developers to work and learn together:

- to explore the potential benefits of probabilistic flood forecasts with experts in the field based on their local experiences and requirements.
- to identify local data which could be used to improve and interpret the GloFAS forecasts.
- to identify solutions for technological differences and barriers to implementing and acting upon GloFAS forecasts and sharing data.
- to discuss, collate and highlight the shared outcomes of the workshop, the action points and provisional agreements and to provide practical next steps to a two-way share of forecasts and data.

3.1 Individual learning outcomes



GloFAS Community Workshop participants



Shanae Young Early Career Researcher in Climatology at the Belize Hydromet Service

I particularly enjoyed determining the score of the model's performance and performing the bias corrections – the main thing I learnt was the difference that application of bias correction can make to the GloFAS model. It is also important to know the dimensions and the variables that are utilized in the model and to be aware of the reliability of the model.

It would be great to have access to further training activities including running the model, producing plots, interpreting/decoding scripts, manoeuvring in R and running scripts with our own local data.



Fiorella Vega Jacome and Carlos Antonio Fernandez-Palomino Hydroclimate scientists at SENAMHI (Peru)

The principal thing we have learnt is the way that GloFAS works, also how to use the GloFAS forecast and to evaluate the performance in different basins of Peru – this is very important to us.

We would like to learn more about the hydrological model used by GloFAS because currently, we only use aggregated models for our simulation and flow predictions. We would also like to be part of the GloFAS Community so we can give feedback to GloFAS for the improvement of the forecasting in our country's rivers.



Juan Bazo Technical Support at Red Cross Red Crescent Climate Centre (Peru).

I provide technical support for the interpretation and use of climate information by disaster managers for forecast-based financing in Peru and elsewhere in the Americas, so learning how the GloFAS works through lab exercises and games has been engaging and highly useful.

As an action for the future, GloFAS may need to improve the initial conditions and post-processing methods. Further training and access to videos, presentations and codes would also help staff and students to better understand GloFAS.



Jamie Towner PhD student at the University of Reading

I found the presentations by Erin Coughlan-de-Perez and Juan Bazo on the Red Cross and Forecast-based Financing (FbF) very interesting. More time focused on the FbF would be desirable, perhaps consisting of a game based on analysing particular forecasts. For example, teams could work collectively to decide on whether to take action and if so what specific action depending on the lead time and probability.

My take-home message was the importance of communication of forecasts to end users and looking into ways to enhance their understanding for decision making. There is a necessity to promote further GloFAS events for students and staff in decision-making organisations so that they can fully understand the forecast outputs.

3.2 Shared outcomes



Collaborative GloFAS development

"Collaborations across disciplines are of utmost importance in order for science and research to really have an impact" The key conclusions emerging from the workshop and the benefits to participants, developers and wider community are:

- Community workshop participants found that the workshop format of seminars, interactive learning
 and computer sessions with GloFAS users and developers together is one that works well. GloFAS users
 believed that they had improved their understanding of probabilistic forecasting and the opportunities
 for using GloFAS. They also understood its limitations and identified where improvements are needed.
 This provides evidence that further GloFAS workshops should be undertaken as part of a continuance
 of the GloFAS Learning Framework.
- User data from workshop participants will be used by GloFAS developers to improve the GloFAS forecasts, for example, by improving reporting points on the river network. Workshop participants remain in close contact with the GloFAS development team.
- A wider conclusion is that the success of the GloFAS workshop has demonstrated that interactive community workshops can help to bridge the gap between technology and on-the-ground user needs in the field of disaster risk identification, and contributes to building greater resilience.

3.3 Next steps

- The GloFAS Learning Framework will be continued with support from the University of Reading, ECMWF, JRC and other GloFAS partners. The presentations and learning materials will be made available on the GloFAS website.
- Further hands-on workshops are planned. Consideration for future training will also be given to further development of the web accessible materials on GloFAS forecasts.

4. Further information

Further information on the workshop can be found here:

https://hepex.irstea.fr/the-glofas-community-workshop-supporting-the-integration-of-global-flood-forecasts-locally/

http://www.ecmwf.int/sites/default/files/elibrary/2016/16523-newsletter-no148-summer-2016.pdf

GloFAS website:

www.globalfloods.eu

Further Reading:

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7. Appendices

GloFAS Community Workshop Programme

Open Event: Wednesday 4th May – The Meadow Suite

11.00am:	Registration for GloFAS Community workshop participants (with tea and coffee)		
11.30am:	GloFAS Community Workshop welcome and icebreaker games led by Hannah Cloke and Liz Stephens		
12.00pm:	Buffet lunch		
1.30pm:	GloFAS Open Event Registration opens		
2.00pm:	Introduction by Hannah Cloke, University of Reading		
2.05pm:	Welcome Speech by Sir David Bell, Vice Chancellor, University of Reading		
2.20pm:	Keynote by Florence Rabier, European Centre for Medium-Range Weather Forecas (ECMWF)		
	"The European Centre for Medium-Range Weather Forecasts and the Global Flood Awareness System"		
2.45pm:	Keynote by Nicola Ranger, Department for International Development (DFID)		
	"Forecasting in action: how it is used and how this could be improved"		
3.10pm:	Tea, coffee and networking		
3.30pm:	Presentation by Erin Coughlan de Perez, Red Cross Red Crescent Climate Centre		
	"Think globally, act locally? GloFAS and the local scale"		
3.50pm:	Presentation by Rosalind Cornforth, The Walker Institute, University of Reading		
	"Making Forecasts Matter"		
4:10pm:	Presentation by Peter Salamon, Joint Research Centre		
	"The Global Flood Awareness System - supporting flood risk management globally"		
4.30pm:	Poster session with wine and canapés		
6.00pm:	Open Event closes		
7.30pm:	Dinner at Dolce Vita (Mediterranean) – 19-23 King's Rd, Reading, RG1 2HG.		









Workshop sessions: Thursday 5th May - Sorby Room/ Allen Lab G.10 PC Room (Wager **Building**)



Dinner at the Queens Head (Thai buffet) - 54 Christchurch Rd, Reading RG2 7AZ. 7.30pm:



GloFAS Learning Framework Report, October 2016

Workshop sessions: Friday 6th May – Sorby Room/ Allen Lab G.10 PC Room

(Wager Building)



9:00am:	Post-processing
9:10am:	Bias correction exercise, presentation and discussion by Liz Stephens and Ervin Zsoter
10:45am:	Tea and coffee break (in the Sorby Room)
11.15am:	Decision making
11:15am:	Forecast based financing by Erin Coughlan de Perez
11:45am:	Decision making with uncertain forecasts by Liz Stephens
12:45pm:	Buffet lunch (in the Sorby room)
2:00pm:	How to access GloFAS forecasts by members of the ECMWF.
2.15pm:	Free play '#Flood Hack#' by Liz Stephens
3.15pm:	Discussion and feedback guided report by Hannah Cloke
4:15pm:	Close of workshop (with option to go to Senior Common Room bar afterwards).



Sir David Bell



Sir David Bell is Vice Chancellor of the University of Reading. He chairs the Senate and the University Executive Board, and is an ex-officio member of all major committees in the University. Sir David studied history and philosophy at the University of Glasgow and obtained his PGCE from Jordanhill College of Education. He then went onto receive a Master of Education degree in Management and Administration, also from the University of Glasgow. He began his career as a primary school teacher and later became a head teacher. He then moved to Newcastleupon-Tyne, ending up as Director of Education and Libraries between 1995 and 2000. Sir David's last post in local government was as Chief Executive of Bedfordshire County Council between 2000 and 2002. He

is a Board member of Universities UK and is the principal channel of communication with the Higher Education Funding Council, other universities, outside bodies and the general public.

Sir David gave the Welcome Speech at the GloFAS Open Event.

Florence Rabier



Dr Florence Rabier is the Director General of the European Centre for Medium-Range Weather Forecasts and is an internationally recognised expert in Numerical Weather Prediction. Florence first joined ECMWF as a consultant during her PhD in 1991, then as a scientist in data assimilation for 6 years in the 1990s. She came back from Météo-France in October 2013 to take up the position of Director of the newly formed Forecast Department. She has led major operational changes, including the 4D-Var assimilation at ECMWF and the assimilation of satellite data at Météo-France, and was responsible for the transition of NWP developments from research to operations at Météo-France in close collaboration with the Forecasting Department. Florence has

experience in both externally-funded and cross-departmental project management. She led an international experiment involving a major field campaign over Antarctica, in the context of the International Polar Year and Thorpex. She has been awarded the title of "Chevalier de la Legion d'Honneur", one of the highest decorations awarded by the French honours system.

Florence gave the first keynote presentation on "The European Centre for Medium-Range Weather Forecasts and the Global Flood Awareness System".

Nicola Ranger



Dr Nicola Ranger is an advisor at the Department for International Development, focussing on weather, climate and natural disasters. She manages a £50m portfolio of R&D projects in areas of climate services, adaptation and disaster risk assessment. Her particular interests are in the use of science in decision making and bringing innovation, such as big data, into action. Previously, Nicola was a Senior Research Fellow at the London School of Economics and Political Sciences focussing on risk assessment, decision making under uncertainty and insurance. She has fifteen years of experience working in policy analysis, scientific advice and research. Since completing her PhD in Atmospheric Physics, she has worked in government, academia and industry, including for Risk

Management Solutions, Defra/DECC and HM Treasury. She has written more than 30 peer-reviewed articles and contributed to the Foresight report on Future Disasters, UK National Climate Change Risk Assessment, the IPCC Special Report on Extreme Events and the Stern Review.

Nicola's keynote presentation was on "Forecasting in action: how it is used and how this could be improved..."

Erin Coughlan de Perez



Erin Coughlan de Perez is a Manager and Lead Climate Specialist at the Red Cross Red Crescent Climate Centre. Her work bridges policy, practice, and science on climate risk management. She has pioneered research that links the statistics of extreme climate events with thresholds for preventative action in the humanitarian and development sectors.

Erin specializes in evaluation of early warning systems and developing tools for operationalization and uptake by developing country actors. Erin also co-teaches a graduate seminar in managing and adapting to

climate variability and change at Columbia University. She is the liaison with the International Research Institute for Climate and Society (IRI).

Erin's presentation was titled "Think globally, act locally? GloFAS and the local scale".

Rosalind Cornforth



Ros Cornforth, Professor in Climate and Development, is the Director of The Walker Institute at the University of Reading and leader of the Africa Climate Exchange (AfClix). She is an expert in inter-disciplinary research to support climate resilience and development. As a leading innovator in knowledge exchange and multi-stakeholder engagement, she links science, policy and practice to drive user-orientated research and solutions. She has many years' experience collaborating with international organisations, African Institutes, Meteorological Services, Governments and NGOs, particularly across sub-Saharan Africa. Her extensive work with policymakers, communities and international organisations is creating a portfolio of inter-disciplinary, user-orientated

research with a wide range of stakeholder groups to help build a climate resilient future. This reflects a deep desire across the academic community to make a meaningful difference in people's lives – to carry out risk-taking, innovative and novel research that can tackle the complexity of the global challenges now facing society. The African Climate Exchange established by Prof Cornforth in 2011, facilitates the interaction between scientists, policymakers and practitioners on the ground. The initiative is identifying how climate science can help to reduce people's vulnerabilities to weather-related hazards in Africa and is following this through with action on the ground to promote resilience.

Ros's presentation was titled "Making forecasts matter".

Peter Salamon



Dr Peter Salamon graduated as an M.Sc. in Applied Environmental Geoscience in 2001 at the Eberhard-Karls University in Tübingen (Germany). After working two years for an international environmental consulting company in Frankfurt (Germany) as a Project Manager, he started in 2003 his doctorate studies at the Polytechnic University of Valencia (Spain), where he received his Ph.D. in 2006. Since 2007 Peter is a scientific project manager at the Joint Research Centre of the European Commission where his main tasks are to provide policy support in the area of flood risk management at European and global level. During his research activities and professional career he has gained experience in hydrology, numerical modeling, flood risk and

hazard mapping as well as development of flood forecasting systems. He is the responsible project manager for the European and Global Flood Awareness Systems (EFAS & GloFAS) which form part of the Copernicus Emergency Management Service.

Peter spoke about "The Global Flood Awareness System - supporting flood risk management globally".

List of delegates

The list below details all participants registered for the GloFAS Community Workshop (marked with an asterisk) and the GloFAS Open Event. Delegates who requested that their details were not shared are not included.

Name	Affiliation	Contact email	
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