GLOBAL FLOOD FORECASTING FOR ANTICIPATORY HUMANITARIAN ACTION

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Why Anticipatory Action?

Why are individuals and organisations are motivated by Anticipatory Action (AA)?

Five rationales:

- Reducing disaster impacts - a framing around particular disasters that 'shouldn't have happened', particularly the 2011 Horn of Africa famine, and the 2015/16 El Niño event
- Desire to make better use of improvements in forecasting science
- Bridging the divide between humanitarian response and adaptation/ long-term risk reduction interventions
- Improve cost-effectiveness of aid
- Sendai Framework: develop national early warning systems and capacity

Pre-existing use of flood forecasts

Disasters

Full Access

Climate forecasts in disaster management: Red Cross flood operations in West Africa, 2008

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Abstract

In 2008, the International Federation of Red Cross and Red Crescent Societies (IFRC) used a 'seasonal forecast' for West Africa for the first time to implement an Early Warning, Early Action strategy for enhanced flood preparedness and response. Interviews with disaster managers suggest that this approach improved their capacity and response. Relief supplies reached flood victims within days, as opposed to weeks in previous years, thereby preventing further loss of life, illness, and setbacks to livelihoods, as well as augmenting the efficiency of resource use. This case demonstrates the potential benefits to be realised from the use of medium-to-long-range forecasts in disaster management, especially in the context of potential increases in extreme weather and climate-related events due to climate variability and change. However, harnessing the full potential of these forecasts will require continued effort and collaboration among disaster managers, climate service providers, and major humanitarian donors.

Pre-existing use of forecasts was infrequent, and focussed on climate services / seasonal forecasting:

Tercile forecast = probability that rainfall will be 'below normal', 'normal' or 'above normal' as defined by the reference climatology.

In this example: tercile seasonal rainfall forecasts used for flood preparedness

Change #1 How forecasts are used

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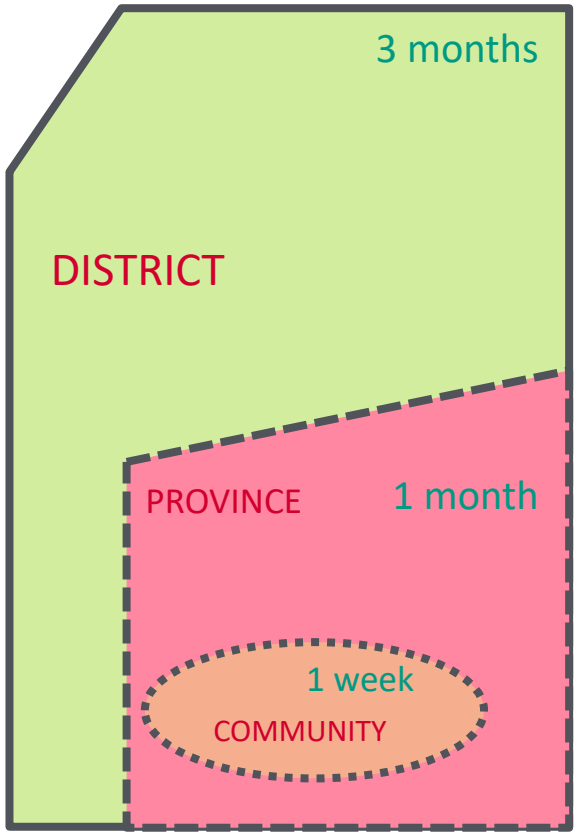
Shift towards triggering humanitarian action at the shorter lead times. More robust and informed use of forecasts that better matches appropriate actions with the limit of forecast predictability – finding the 'window of opportunity'

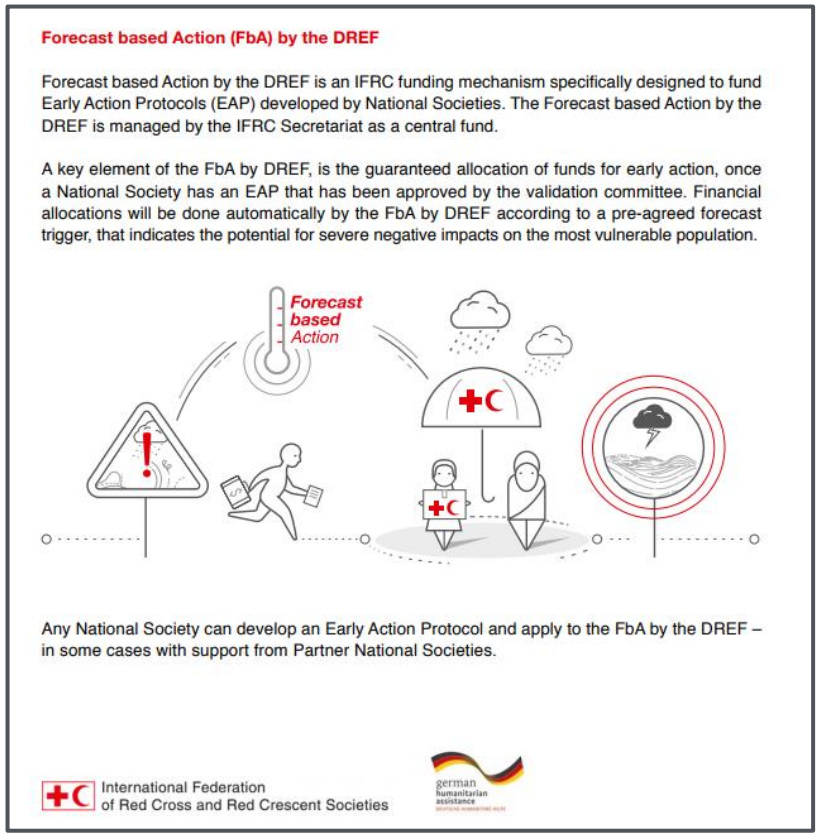


Preparedness and Readiness

Prepositioning

Distribution

Change #2 Systematic Funding



Forecast based Action (FbA) by the DREF

Forecast based Action by the DREF is an IFRC funding mechanism specifically designed to fund Early Action Protocols (EAP) developed by National Societies. The Forecast based Action by the DREF is managed by the IFRC Secretariat as a central fund.

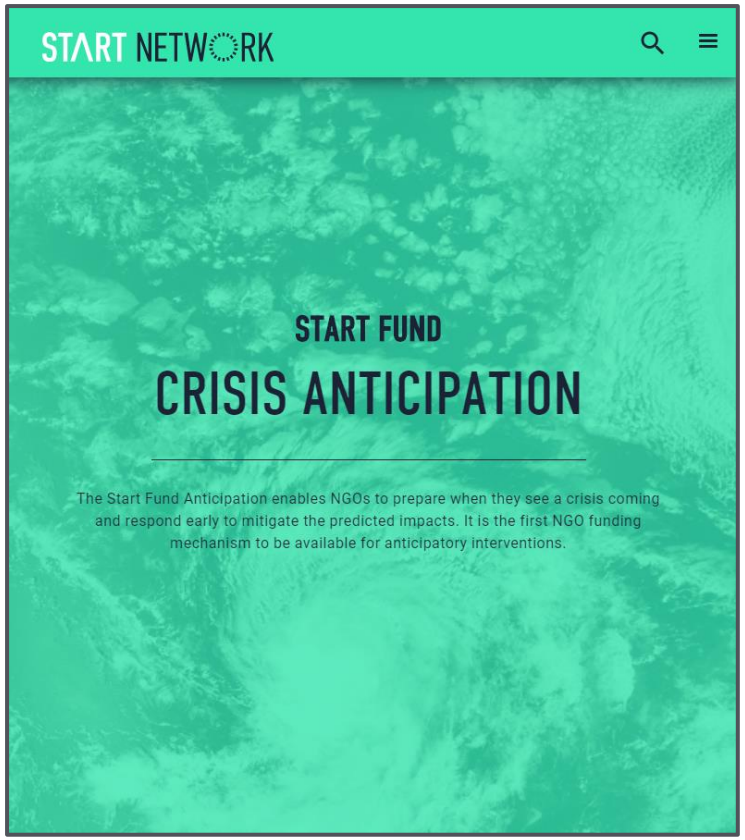
A key element of the FbA by DREF, is the guaranteed allocation of funds for early action, once a National Society has an EAP that has been approved by the validation committee. Financial allocations will be done automatically by the FbA by DREF according to a pre-agreed forecast trigger, that indicates the potential for severe negative impacts on the most vulnerable population.

Any National Society can develop an Early Action Protocol and apply to the FbA by the DREF – in some cases with support from Partner National Societies.

International Federation of Red Cross and Red Crescent Societies

german humanitarian assistance

- Pre-defined plans
- Evidence-led use of forecasts



START NETWORK

START FUND

CRISIS ANTICIPATION

The Start Fund Anticipation enables NGOs to prepare when they see a crisis coming and respond early to mitigate the predicted impacts. It is the first NGO funding mechanism to be available for anticipatory interventions.

- Decision by committee
- Faster process

Red Cross Red Crescent Process

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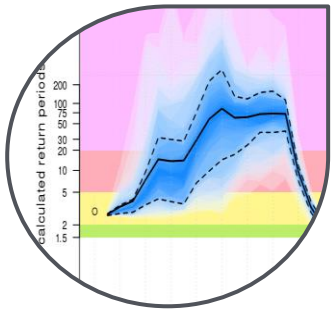
Forecast trigger needs clear definition of:



Forecasting system

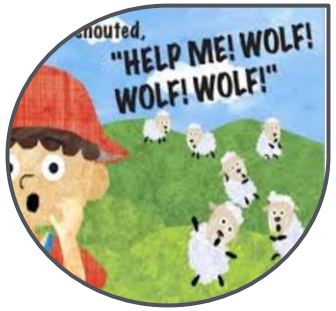
Lead time

Probability

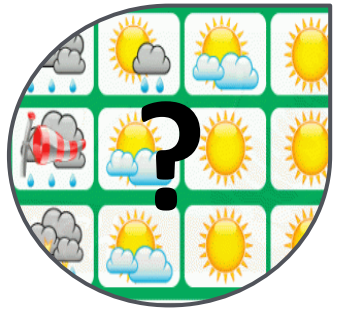
Magnitude

Validation Committee wants an evaluation of:

Return period



False Alarm Ratio



Frequency of Trigger

Global or local forecasts?

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Global Computational Centres

- Computational power
- Ensemble approaches and longer lead times
- Reforecast datasets to support forecast evaluation

National Forecasting Agencies

- Better understanding of local context
- Mandates to issue forecasts and early warnings
- Links with other national and local government agencies

Global models in use

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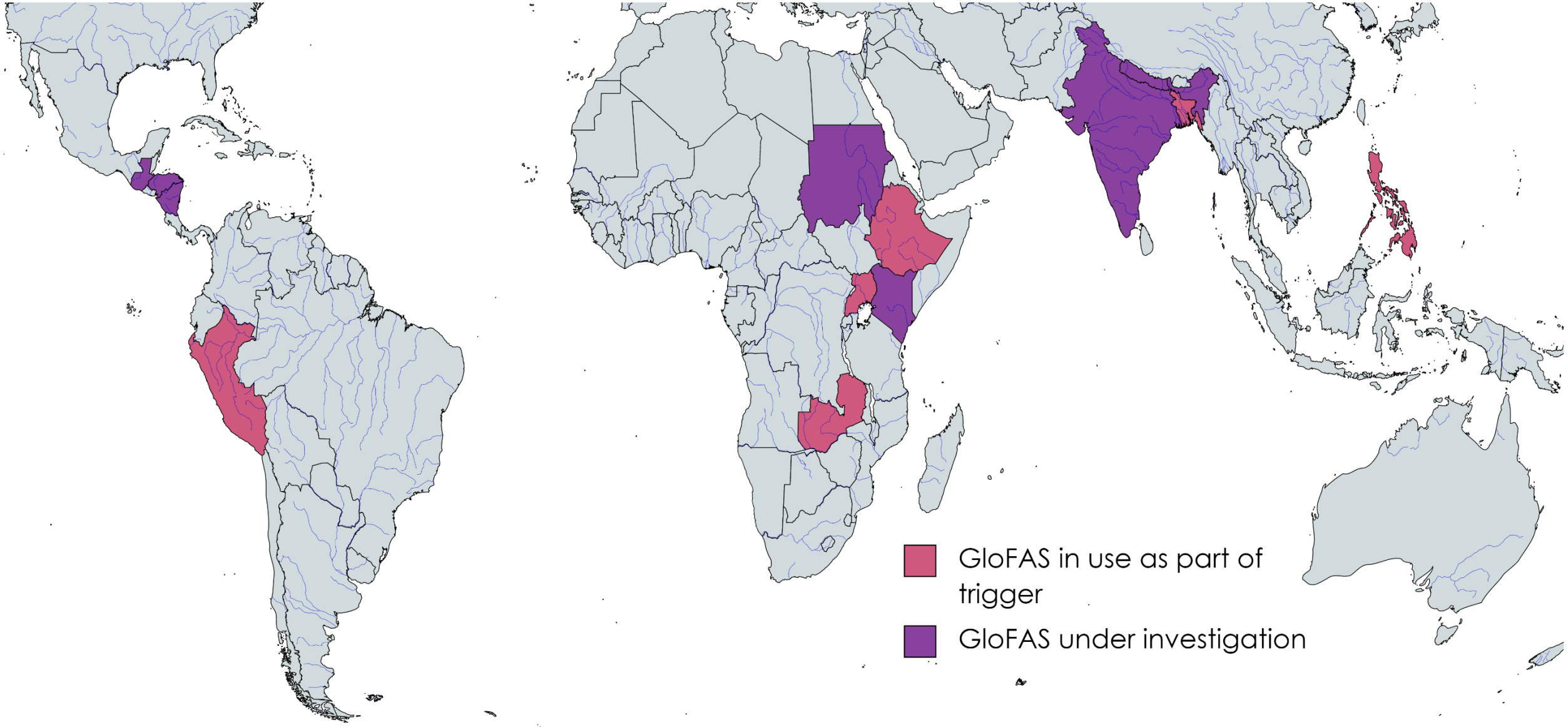

Global model: interim solution

- 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

‘Decision-Blind’ skill guidance

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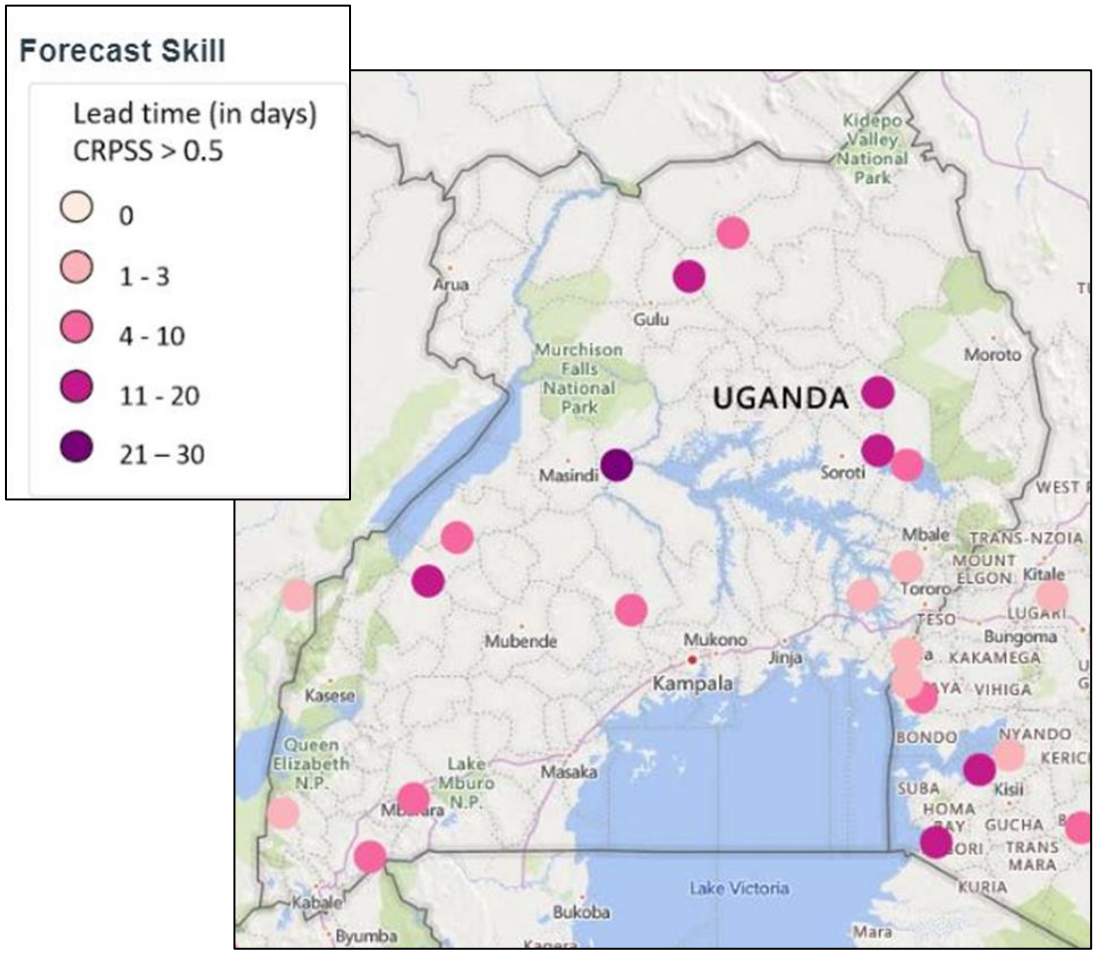
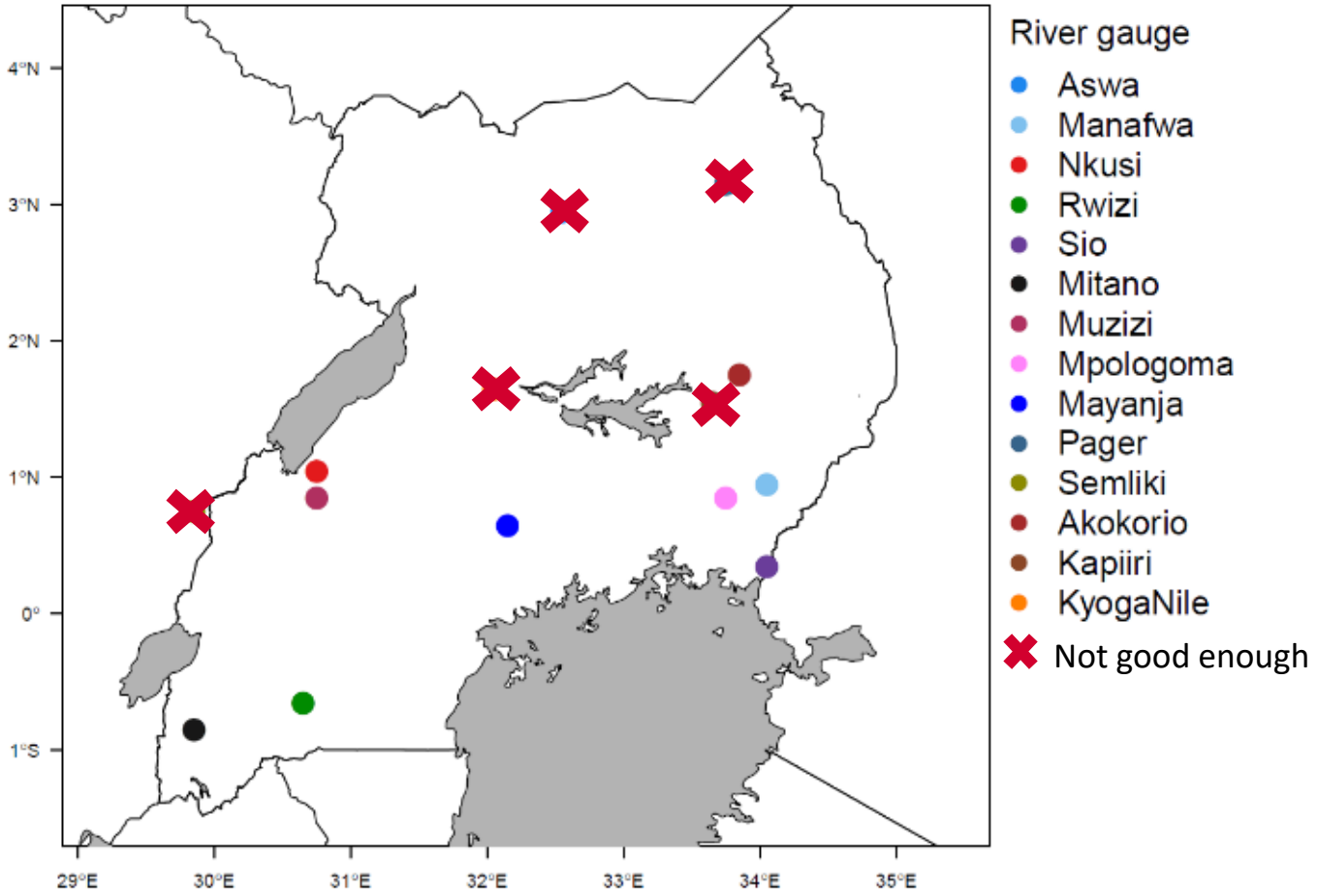
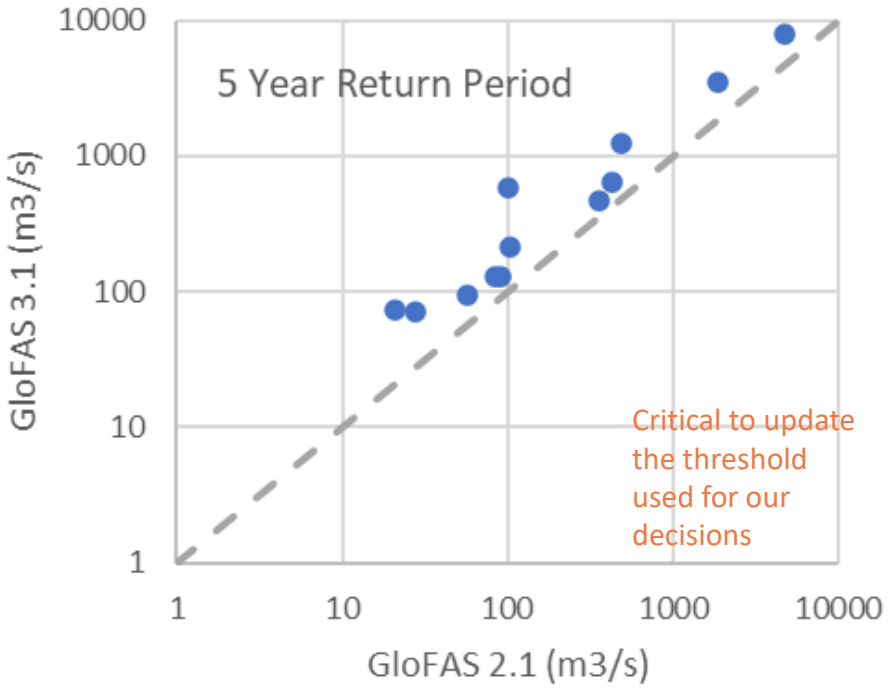


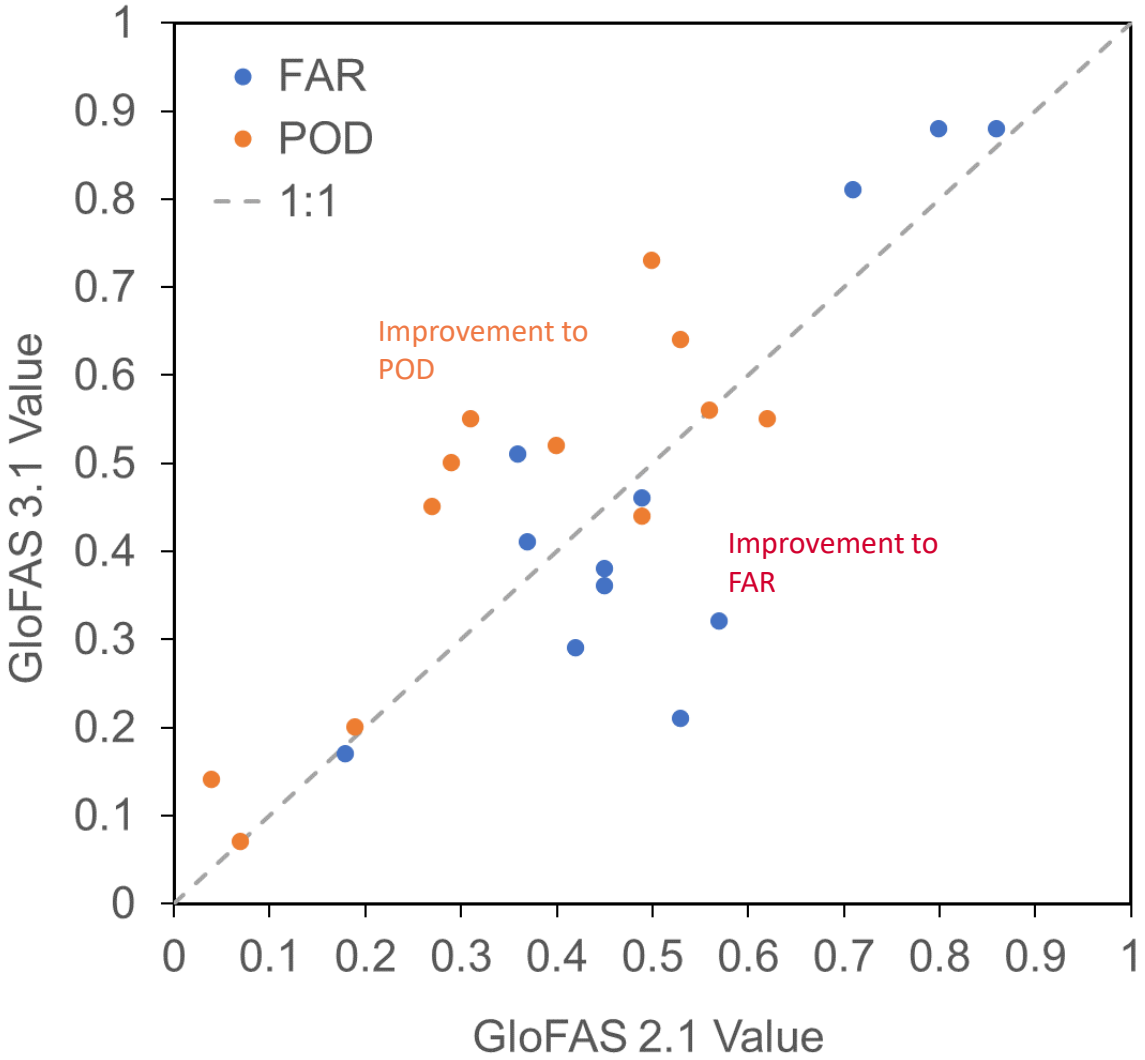


(Thanks to Andrea Ficchi, University of Reading)

Updating for new model version

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

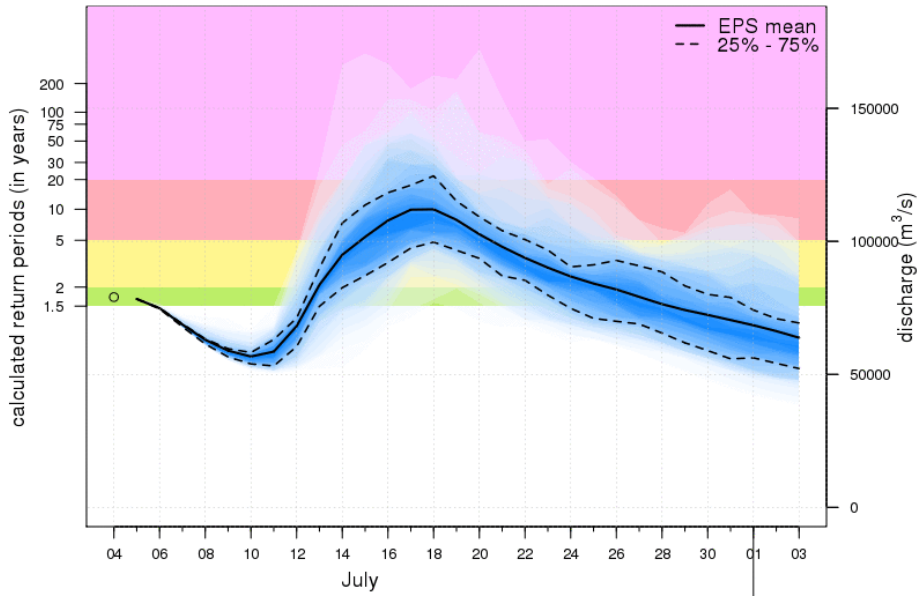




(Thanks to Andrea Ficchi and Harshita Gupta, University of Reading)

Global model: longer lead times

- Case Study: Brahmaputra in Bangladesh
- Collaborating with the Bangladesh Flood Forecasting and Warning Centre to develop extended-range forecasting capacity on the Brahmaputra River
- Two-step process, GloFAS as pre-activation at longer lead times (15 days), FFWC forecasts at short lead times (3 days)
- 2020:
  - July 4th forecast: $5.2million funds by UNCERF & CHF 234,803 released by IFRC's FbA by DREF, preparations made
  - July 10th: distribution of cash, livestock feed, storage drums, and hygiene, dignity and health kits. >200,000 people reached

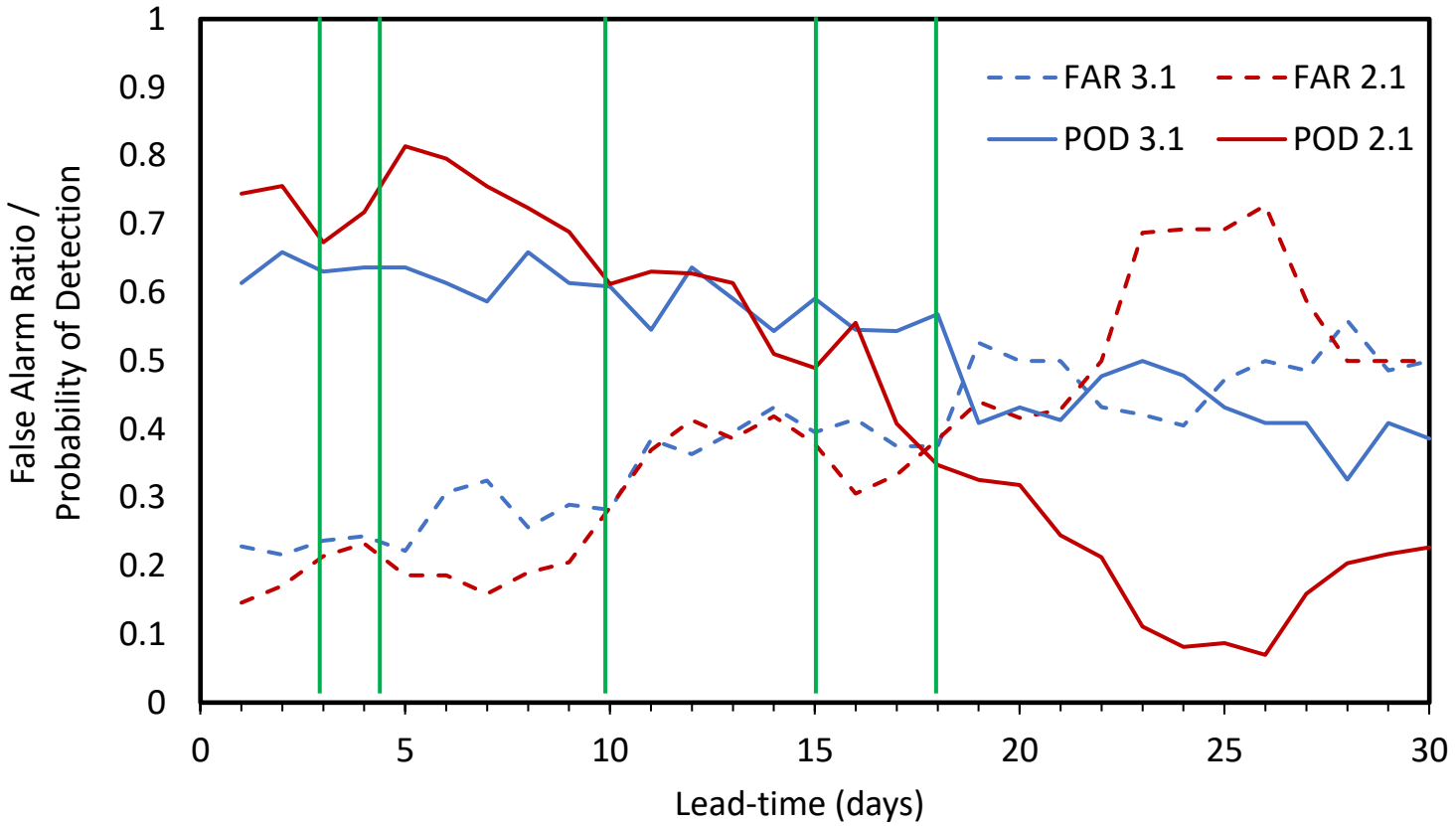


Decision-led evaluation

- Brahmaputra River at Bahadurabad, Bangladesh
- Threshold 50% chance of 95th percentile river flow
- Lead-time bias correction using Zsoter et al. 2020
- Improvement at longer lead times, degradation at shorter lead times

Decision	Required lead-time (days)
Evacuation flood affected people to flood shelter	3
Evacuation of livestock to safe place	4-5
Household level preparedness	4-5
Aid distribution by humanitarian agencies	15
Communication of flood preparedness and response decisions to government agencies	10
Agriculture planning decisions by farmers	18

(Thanks to Sazzad Hossain, University of Reading / FFWC)

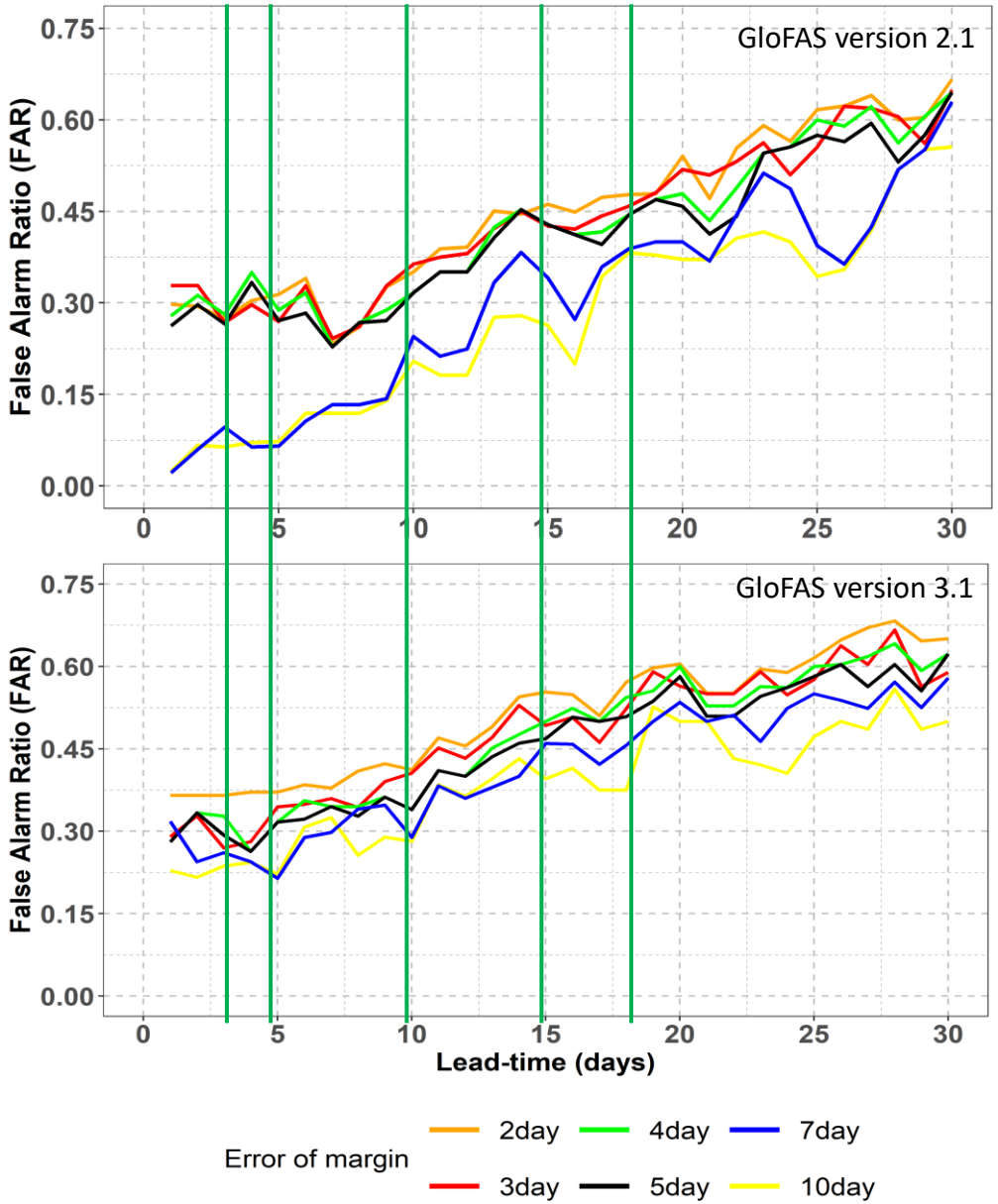


Decision-led evaluation

- Take into account the acceptable error margin in timing of flood
- No improvement in 3.1

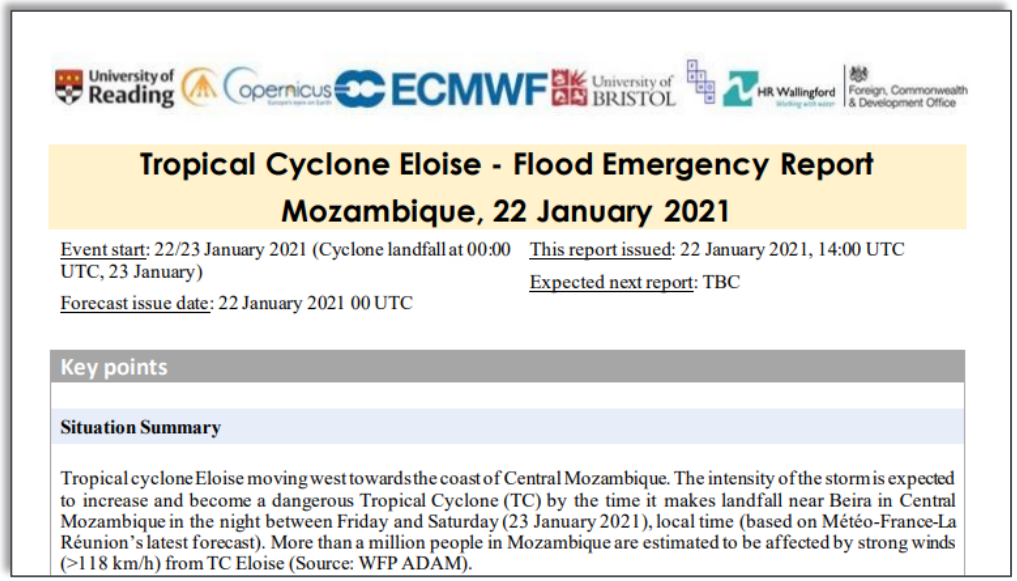
Decision	Required lead-time (days)	Acceptable error margin (days later)
Evacuation flood affected people to flood shelter	3	2
Evacuation of livestock to safe place	4-5	2
Household level preparedness	4-5	2
Aid distribution by humanitarian agencies	15	10
Communication flood preparedness and response decisions to government agencies	10	3
Agriculture planning decisions by farmers	18	7

(Thanks to Sazzad Hossain, University of Reading / FFWC)



Global model: major disasters

- Case Study: Flood forecast bulletins for UK Foreign, Commonwealth and Development Office
- Linking with inundation mapping from U. Bristol / Fathom, surge forecasts from HR Wallingford
- Used to support humanitarian operations for Tropical Cyclones Idai and Kenneth (2019), Iota (2020), Eloise (2021)



University of Reading | Copernicus | ECMWF | University of BRISTOL | HR Wallingford | Foreign, Commonwealth & Development Office

Tropical Cyclone Eloise - Flood Emergency Report

Mozambique, 22 January 2021

Event start: 22/23 January 2021 (Cyclone landfall at 00:00 UTC, 23 January)

This report issued: 22 January 2021, 14:00 UTC

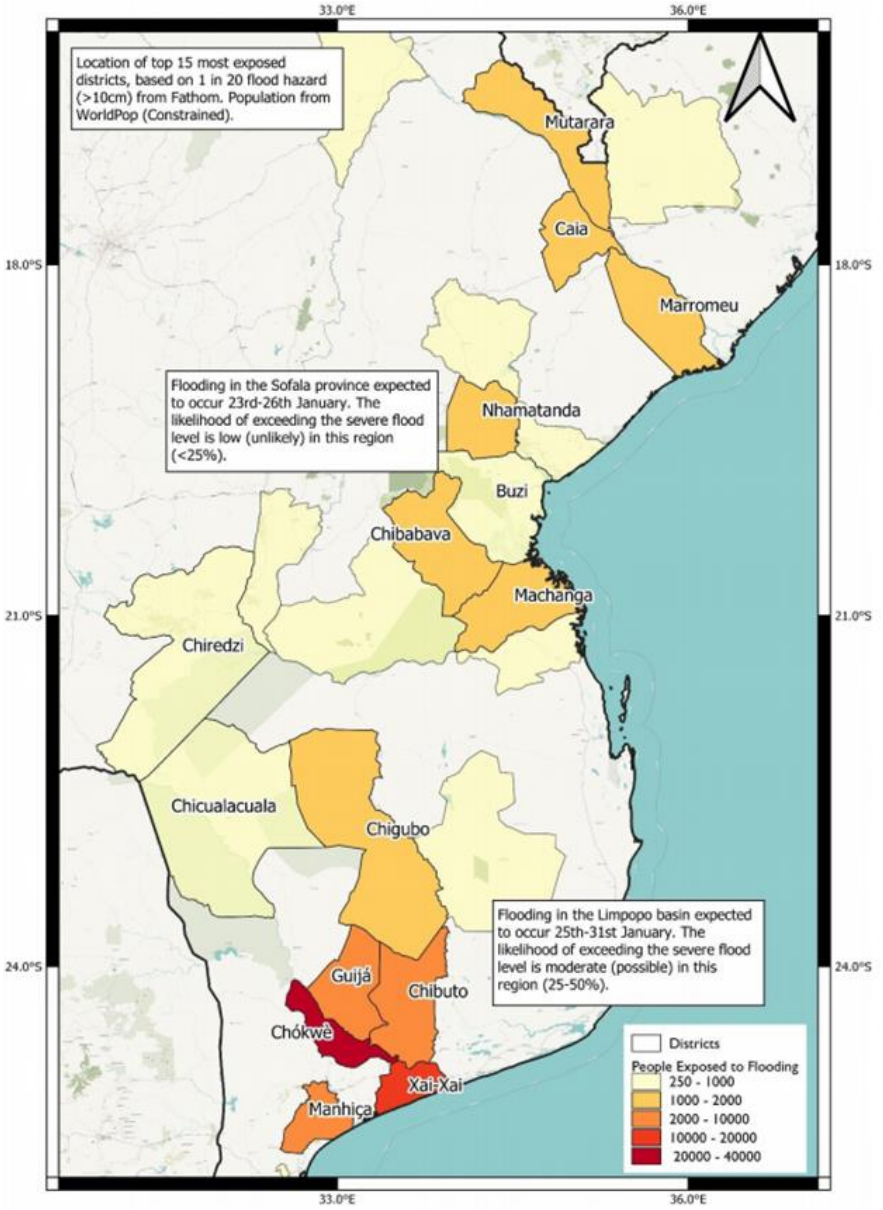
Expected next report: TBC

Forecast issue date: 22 January 2021 00 UTC

Key points

Situation Summary

Tropical cyclone Eloise moving west towards the coast of Central Mozambique. The intensity of the storm is expected to increase and become a dangerous Tropical Cyclone (TC) by the time it makes landfall near Beira in Central Mozambique in the night between Friday and Saturday (23 January 2021), local time (based on Météo-France-La Réunion's latest forecast). More than a million people in Mozambique are estimated to be affected by strong winds (>118 km/h) from TC Eloise (Source: WFP ADAM).



Global to local

Are global forecasts compatible with the original rationales for anticipatory action?

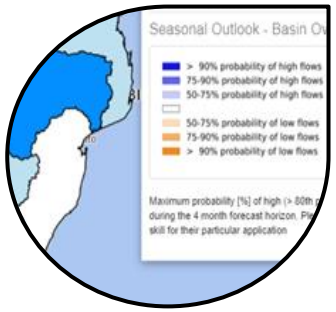
- Yes:
  - Consistent source of information
  - Provide longer lead times / ensemble forecasts that require pooled computational resources
  - Reforecast datasets can give us confidence in their use (if compared with local observations)
- No:
  - On their own, they are not building national capacity
  - Be careful that model updates are improving decision-making; difficult to cover all use-cases
  - Release time of forecast and update frequency not useful for some time zones / flood drivers
  - Currently limited scope for national hydromet services to feedback and inform developments

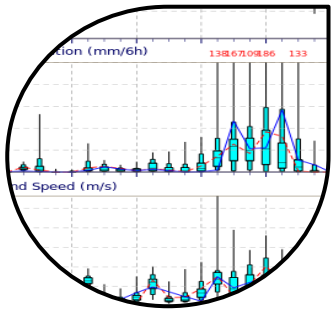
Global to local

How should the development and use of global forecasts be undertaken going forward?

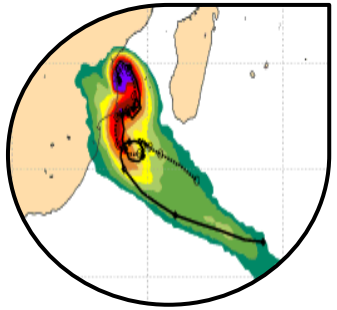
- Consider how national capacity can be supported with internationally-developed forecasting systems:
  - Interim solutions
  - Longer-lead times
  - Support for major disasters
- More work to be done on seamless integration of local short-term forecasts and global longer-term forecasts
- Build ownership of GloFAS / global forecasts through improved (even formalised) engagement with national hydromet services
- More workshops like this one!

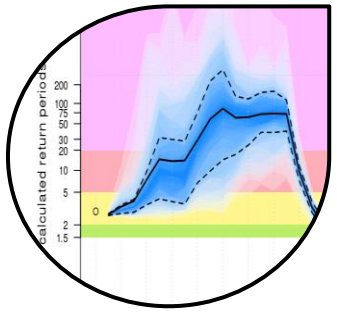
Future developments



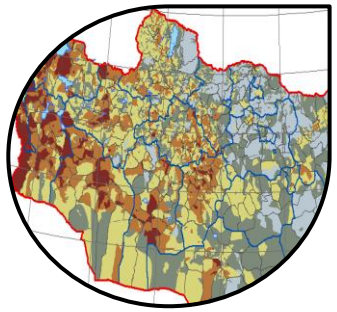


Forecast not specific to hazard
e.g. what amount of rainfall causes an impactful flood?





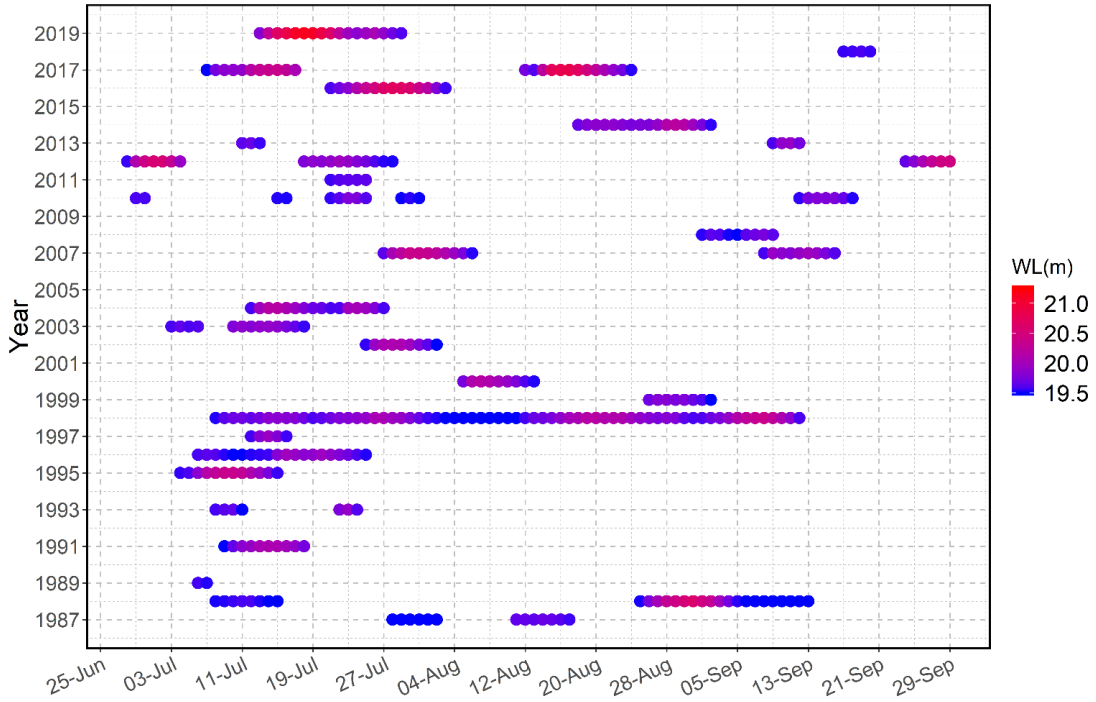
Hazard forecast which can be linked to impact
e.g. a forecast of a 1 in 20 year flood could be linked to 1 in 20 year hazard maps



Impact-based forecast
e.g. acute food insecurity

Impact-based Forecasts

- Recognise that timing and duration of flooding is important for predicting the livelihood impact
- Improved targeting of humanitarian resources based on this information



Variability in flood characteristics in Bangladesh (from Hossain et al. In Review)

Crop Type	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Green beans					20%	30%					20%	30%
Cassava	10%	10%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%
Cowpeas	3%	3%	10%	10%	10%	10%	10%	10%	10%	10%	10%	4%
Green maize, cob						25%	25%				25%	25%
Groundnuts	15%					15%	35%				15%	20%
Kales	3%	3%	10%	10%	10%	10%	10%	10%	10%	10%	10%	4%
Maize	15%						25%	25%				35%
Millet							100%					
Potatoes				25%	25%						25%	25%
Pumpkin leaves				25%	25%						25%	25%
Sugar cane				15%	15%	15%	15%			15%	15%	10%
Sweet potatoes	15%	10%		15%	15%					15%	15%	15%
Tomatoes	25%							50%				25%
Cabbages	25%	25%					25%				25%	

Crop Calendar for Katakwi District, Uganda (From NIMFRU project)

Impact-based forecast

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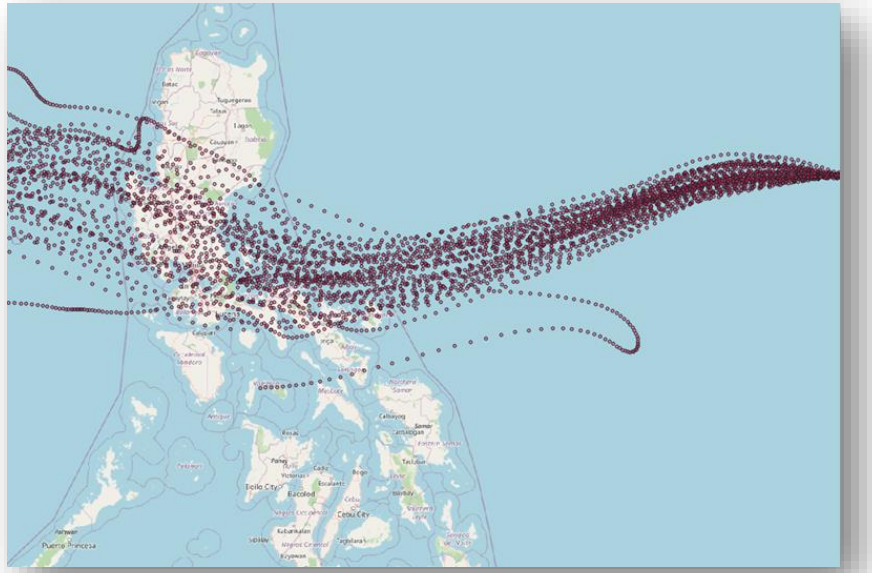

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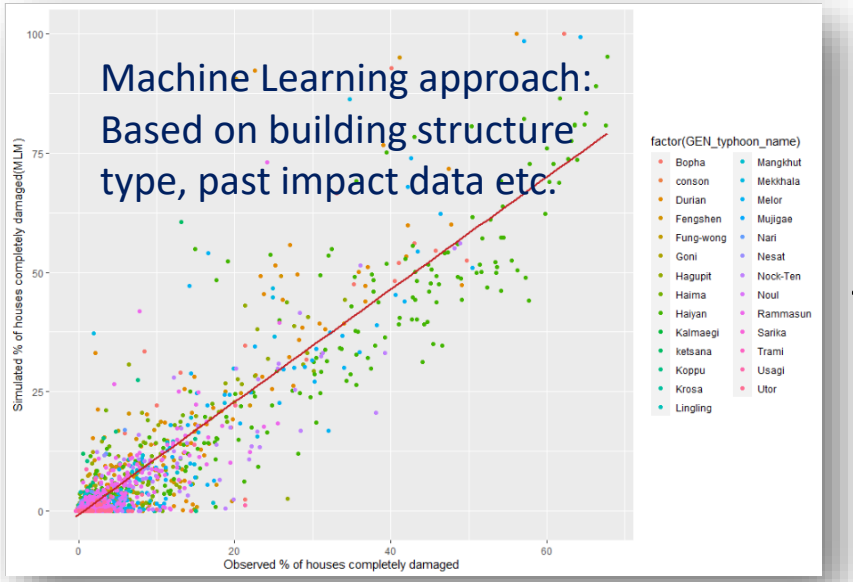

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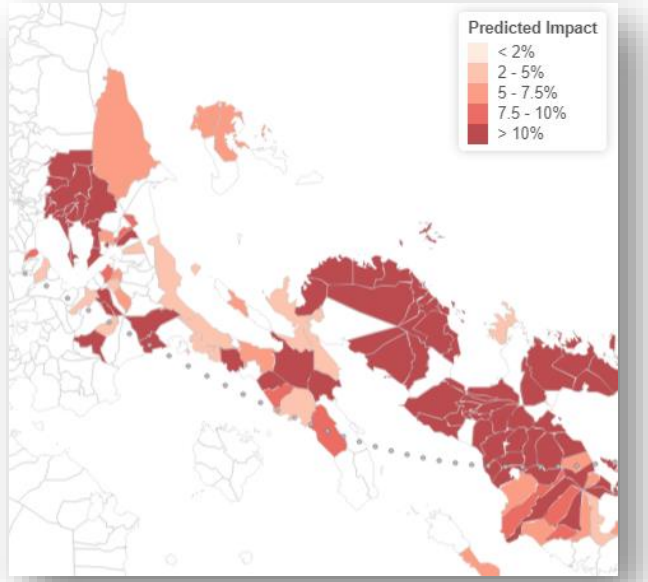

Impact-based Forecast 72hrs before predicted landfall

Probability for Number of Buildings Damaged

Typhoon_name	VH_100K	H_80K	M_50K	L_30K
bopha	15	17	62	98
goni	62	69	81	87
hagupit	25	33	88	92
haima	0	0	0	0
haiyan	0	4	8	62
kammuri	54	58	85	98
mangkhut	0	0	0	0
nock-ten	37	44	56	100

Thanks to Aklilu Teklesadik, 510

Thank you

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