Emergency Management

GloFAS and GFM use case

Ignite talks

Emergency Management

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

Arfizzaman Bhuyan, Executive Engineer, FFWC, Bangladesh

ANTICIPATING FLOOD EVENTS IN BANGLADESH USING THE GLOFAS EXTENDED RANGE FLOOD FORECAST

ARIFUZZAMAN BHUYAN
FLOOD FORECASTING AND WARNING CENTRE, BANGLADESH

- Though flood is an annual phenomenon, and there is strong variation in flood occurrence from year to year in Bangladesh.
- Flood onset, duration and peak timing are essential for flood preparedness.
- Short to medium-range forecasts provides forecast information for a limited time period.
- GloFAS provides 30 days lead-time river flow forecast for the river basins in Bangladesh.
- GloFAS extended-range forecasts help to anticipate onset and probable flood duration for the monsoon floods in Bangladesh.

2020 extreme floods in Bangladesh and GloFAS forecasts

- Two extreme flood events occurred in the 2020 monsoon in the Brahmaputra basin (26 June to 7 July and 11 July to 7 August 2020).
- First flood wave onset of floods 26 June and reached peak on 30 June and second wave onset on 11 July and peak 16 July.
- GloFAS forecasts hydrograph showed high forecast probabilities for flood onset, peak time and duration for the 2020 floods with a lead-time between 10 to 15 days.

Implication of extended range forecast

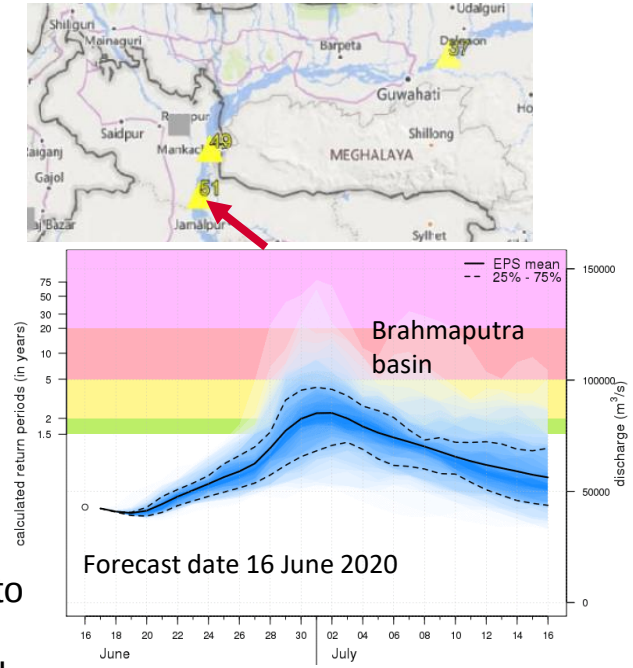
Agriculture planning, pre-activation for forecast based finance (FbF) and flood management activities e.g. maintenance work for flood defence structures.

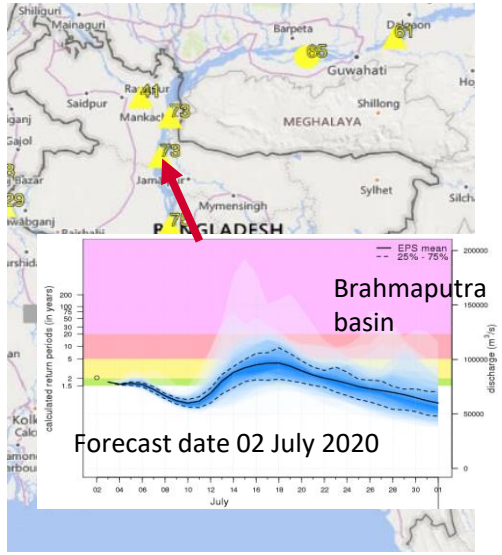
Challenges

- GloFAS has different thresholds than the FFWC, so FFWC needs to consider respective thresholds both the GloFAS and FFWC flood threshold.
- Sometimes forecast probabilities change compare to previous day forecasts.

Future plan

- Probable integrating GloFAS forecasts to the national model to predict water level for rivers in Bangladesh.
- Post processing to improve skills for rivers in Bangladesh.
- Historical evaluation of past flood events to study biases in forecasts.
- At present, GloFAS reforecast evaluation work is underway at the University of Reading for the Brahmaputra basin in Bangladesh.





Evolution of floods in the GLOFAS forecast (Brahmaputra basin in Bangladesh)

World Food Programme

SAVING LIVES
CHANGING LIVES

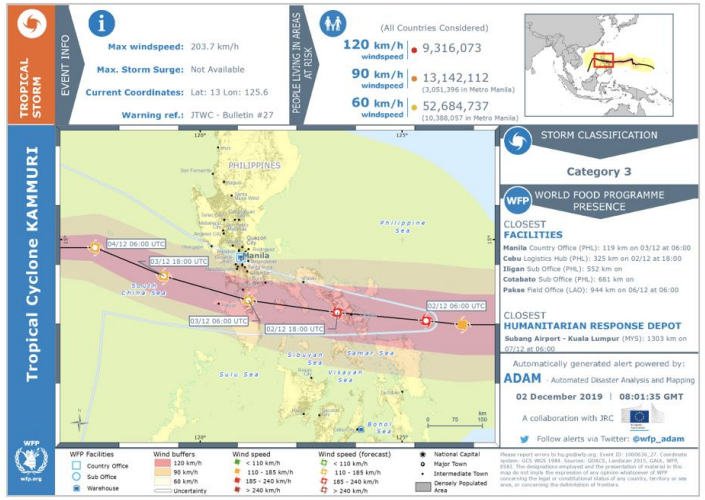
Flood forecasting to inform humanitarian response

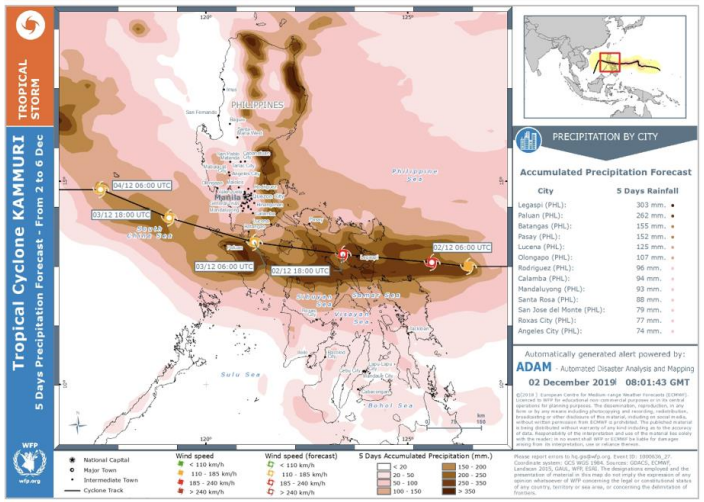
Michael Manalili – *GIS Developer (Emergency Operations Unit)*
Abdel Latif-Yunous – *Climatologist (Early Warning Unit)*
Jesse Mason – *Global Anticipatory Action Coordinator (Climate Change Unit)*
Guy Schumann – *Remote Sensing Advisor (Emergency Operations Unit)*

Introduction

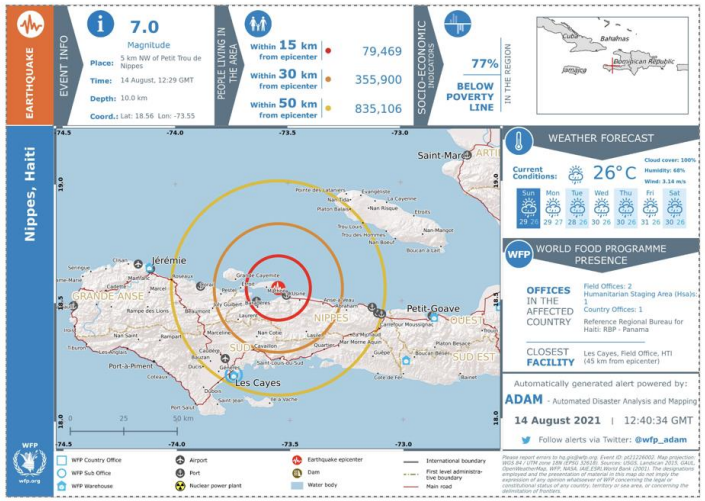
- WFP has developed an in-house system to monitor natural disasters relevant to its operations. The Automated Disaster Analysis and Mapping (ADAM) aims to provide rapid geospatial analysis of potential of a significant natural disaster (Floods, Tropical Storm and Earthquake) in the first 72 hours of a disaster.

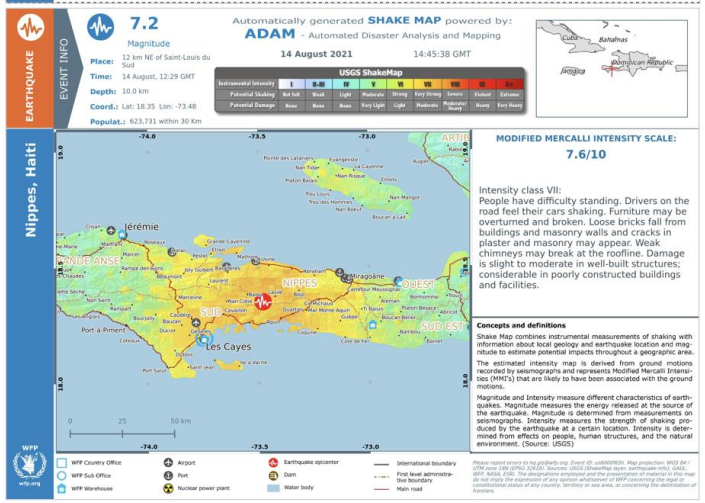
Tropical Storm



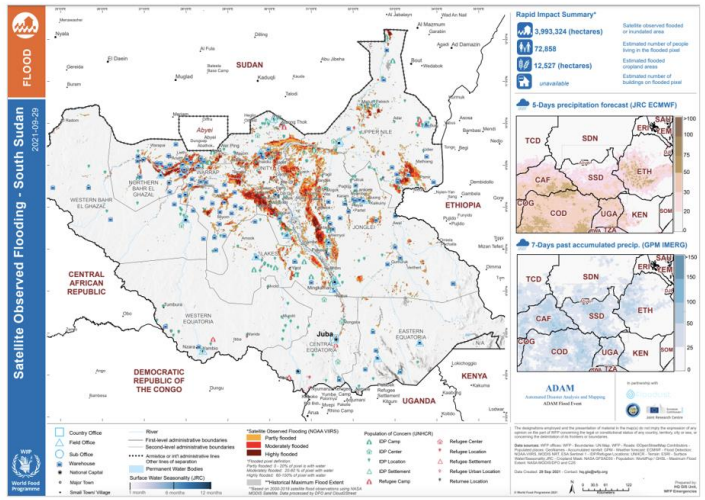


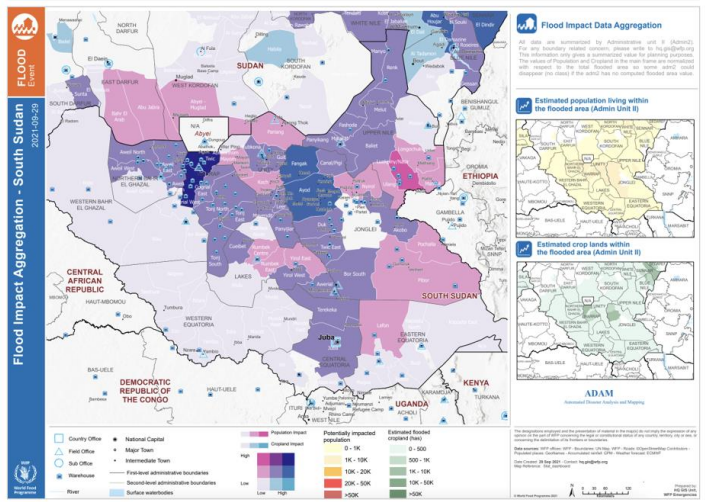
Earthquake



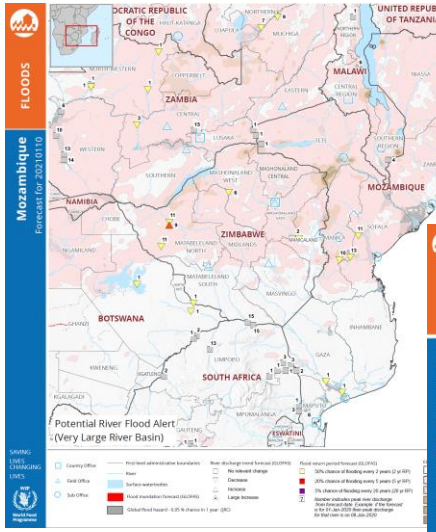


Flood

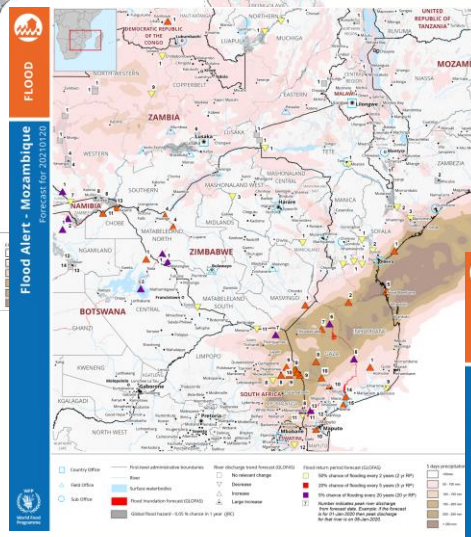




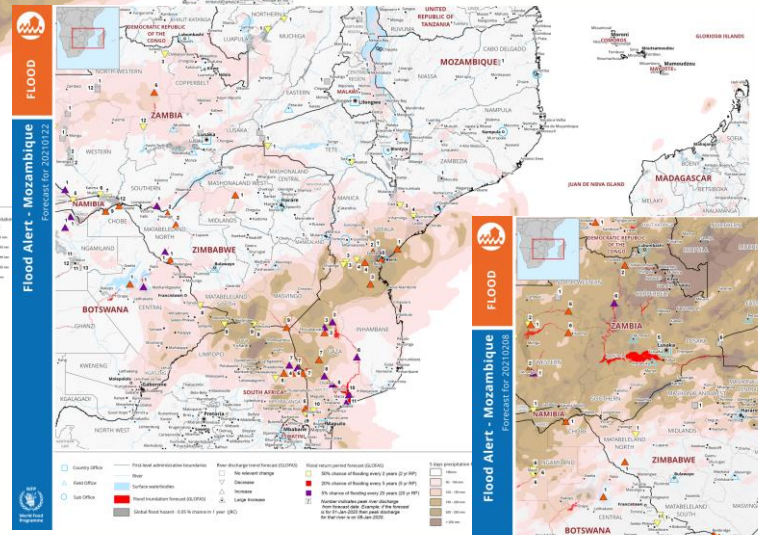
Example of ADAM Alert (Large River Flood Forecast) using GLOFAS information



Alert 1 (10th Jan)

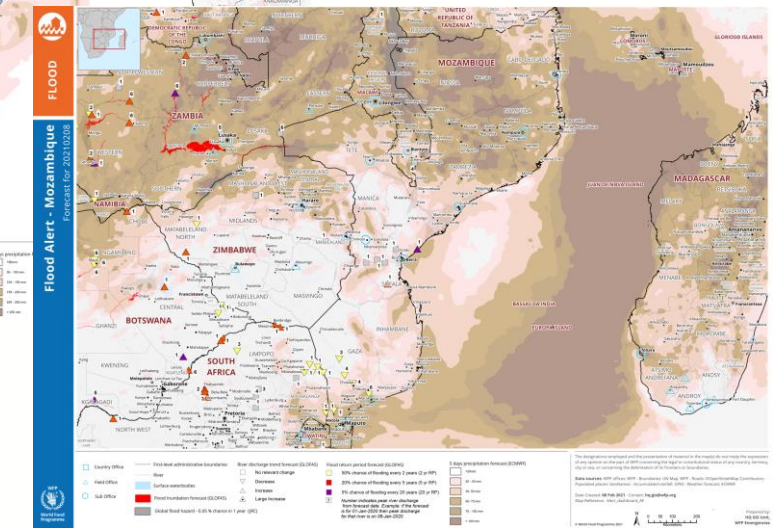


Alert 2 (20th Jan)



Alert 3 (22nd Jan)

Landfall



Alert 4 (24th Jan)

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Challenges

- Initial Feedback
  - Too Technical – descriptions of forecast reporting points especially return periods
  - Users wanted a forecast way beyond 15 days – quite dangerous
  - Unavailability of flood forecast for small rivers
  - Flood forecast for pluvial (floods due to heavy rainfall events)
  - What about large regulated basins (with dams)

How (are we trying to) did we address these complex challenge

- Work in progress
  - Make a balance to maintain the scientific detail at the same time laymanise the result
  - Partnership with FATHOM Company for high resolution flood forecast globally
  - Question to ECMWF – is there a future plan to include small rivers in GLOFAS?
  - Make the impact more explicit – so what if the river will overflow?
    - We did include initial impact analysis based on populated places exposure and facilities. To add roads/bridges and IDP Settlements

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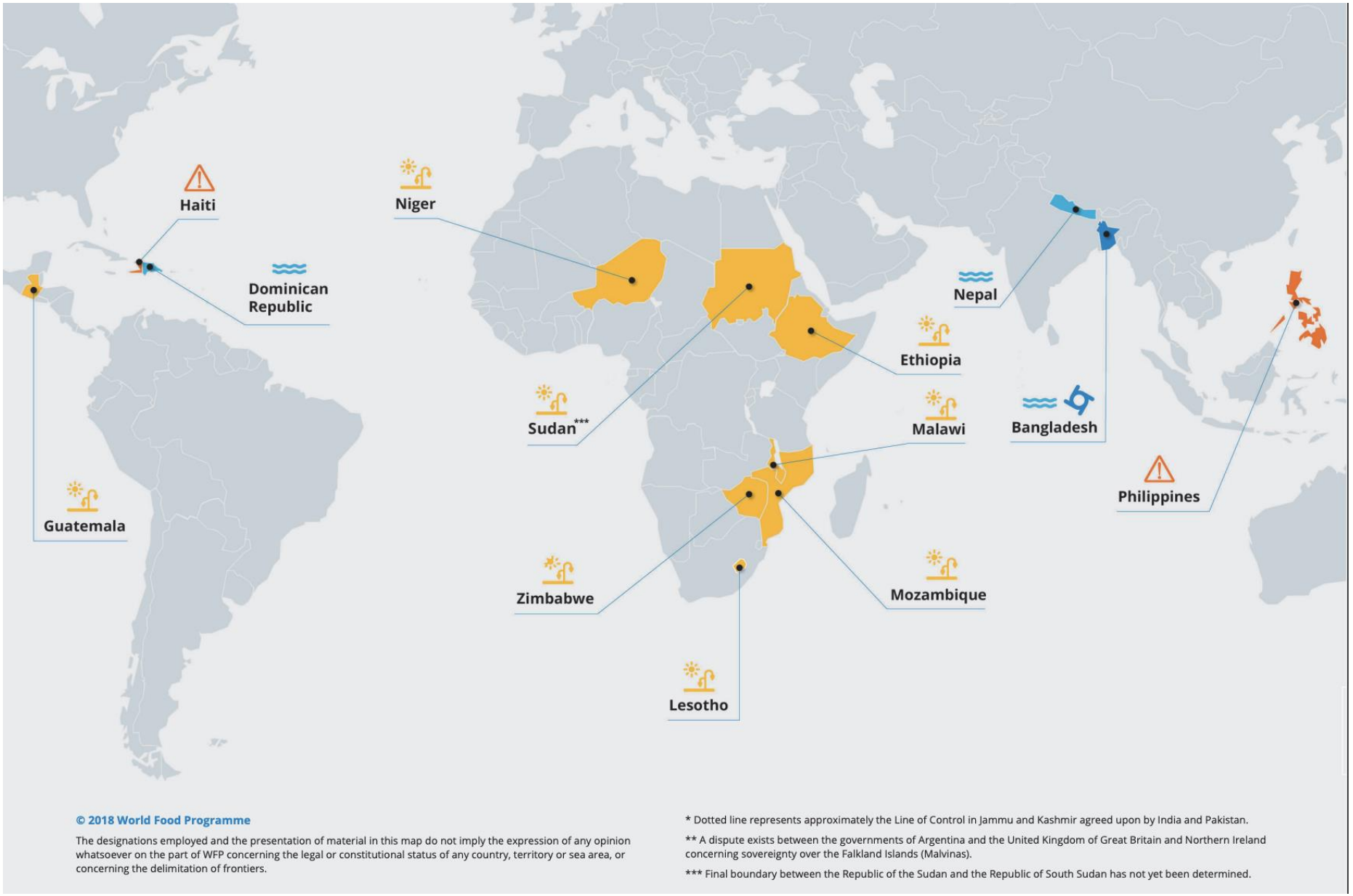
SAVING LIVES
CHANGING LIVES

WFP
World Food Programme

Forecast-based Financing (FbF)

Anticipatory actions for food security



The designations employed and the presentation of material in this map do not imply the expression of any opinion whatsoever on the part of WFP concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers.

* Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan.

** A dispute exists between the governments of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Malvinas).

*** Final boundary between the Republic of the Sudan and the Republic of South Sudan has not yet been determined.

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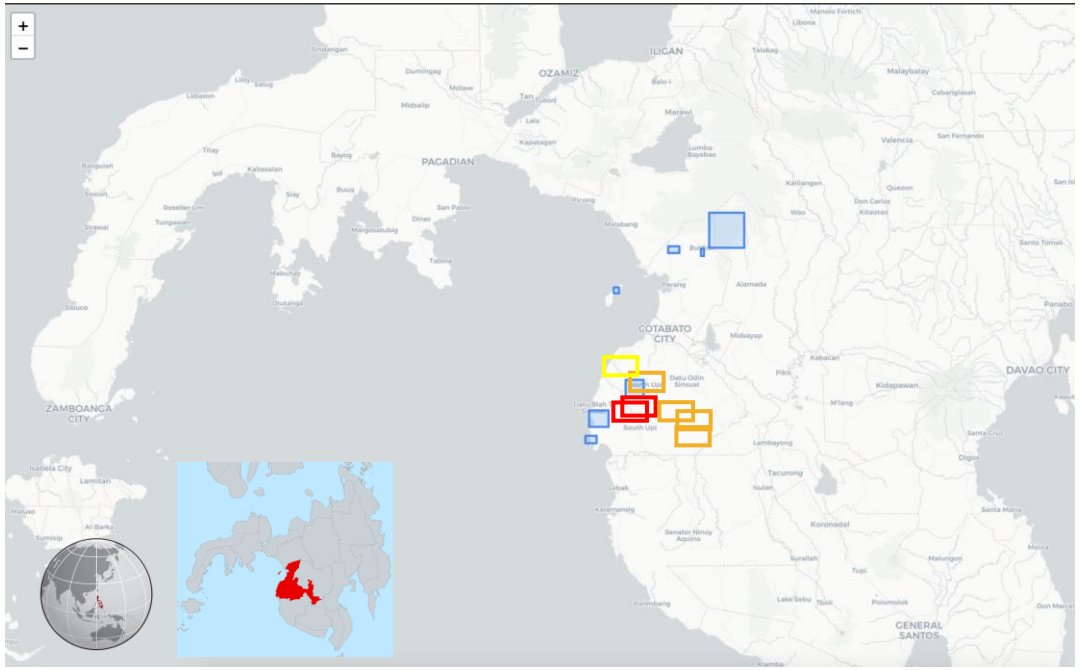
Initial result

Early Warning Protocol by bounding geometry

- Blue for ‘Monitor’
- Yellow for ‘Ready’
- Orange for ‘Set’
- And Red for ‘Go’



RATING	RAINFALL INTENSITY AND DURATION [mm/hr.]	FLOOD HAZARD	EARLY WARNING PROTOCOL	ANTECEDENT [mm]
Light	<2.5	None	Monitor	<100
Moderate	2.5-7.5	Very Low		100-150
Heavy	7.5-15	Low	Ready	150-200
Intense	15-30	Moderate	Set	200-250
Torrential	>30	High	Go	>250

The model is based on information feed from local climatological and hydrometeorological models (observations) and gauge data to simulate historical flood events using GLOFAS forecast and ECMWF rainfall forecast to come up with a geographical targeting for cash distribution in anticipation of an event.

The below table is taken from Inter Agency Standing Committee with WMO to determine some form of threshold on what will trigger an action.

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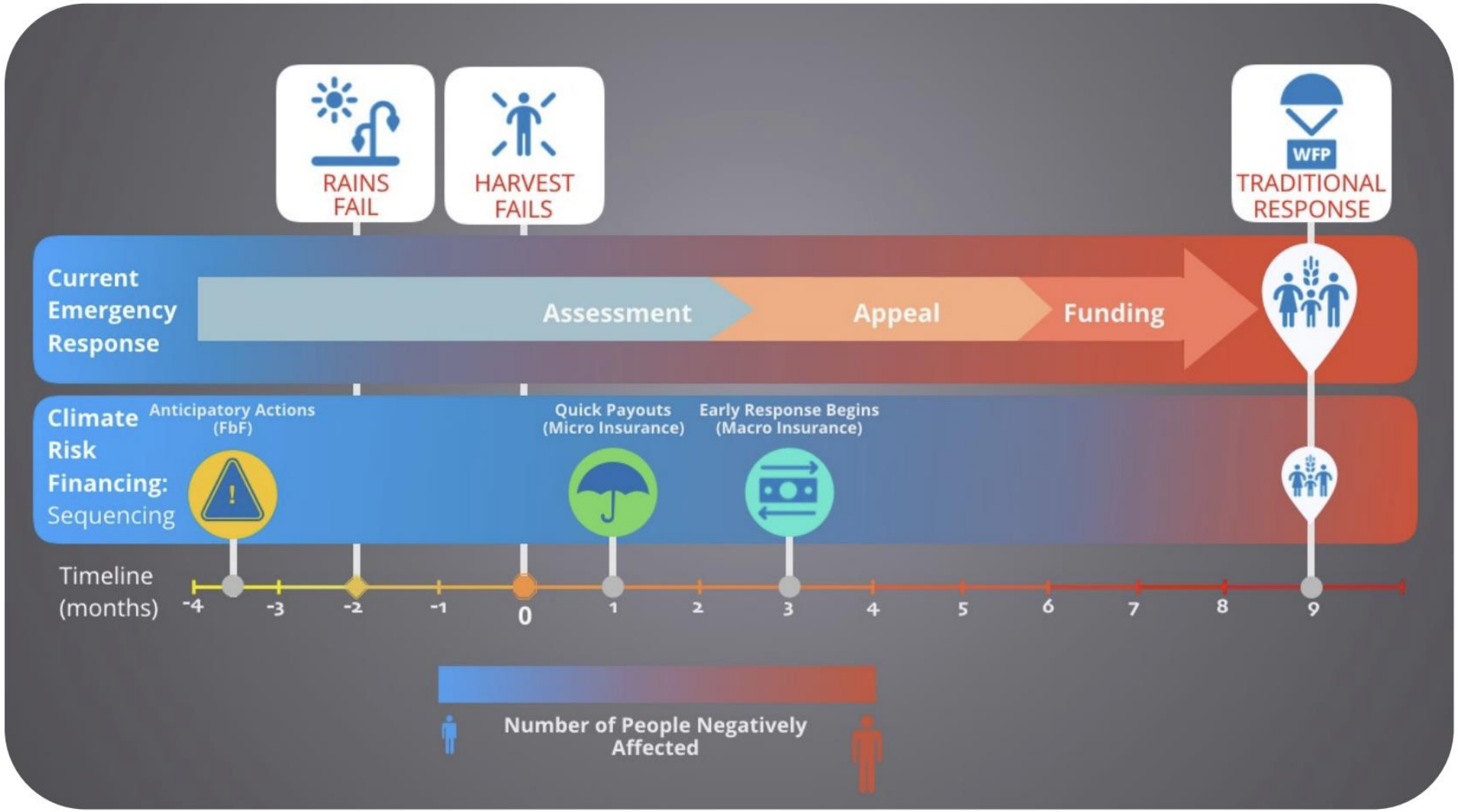


Figure 1. An example timeline of when a rainfall shortage results in a food crisis and when the various climate risk financing programmes provide assistance to affected populations compared to a traditional humanitarian response. This illustrates WFP's specific programmes and when these approaches are triggered (FbF, R4 and ARC Replica).

Emergency Management

Development of Disaster Risk Financing Systems

Elizabeth Rees, Start Network

Development of Disaster Risk Financing Systems

Elizabeth.Rees@startprogrammes.org

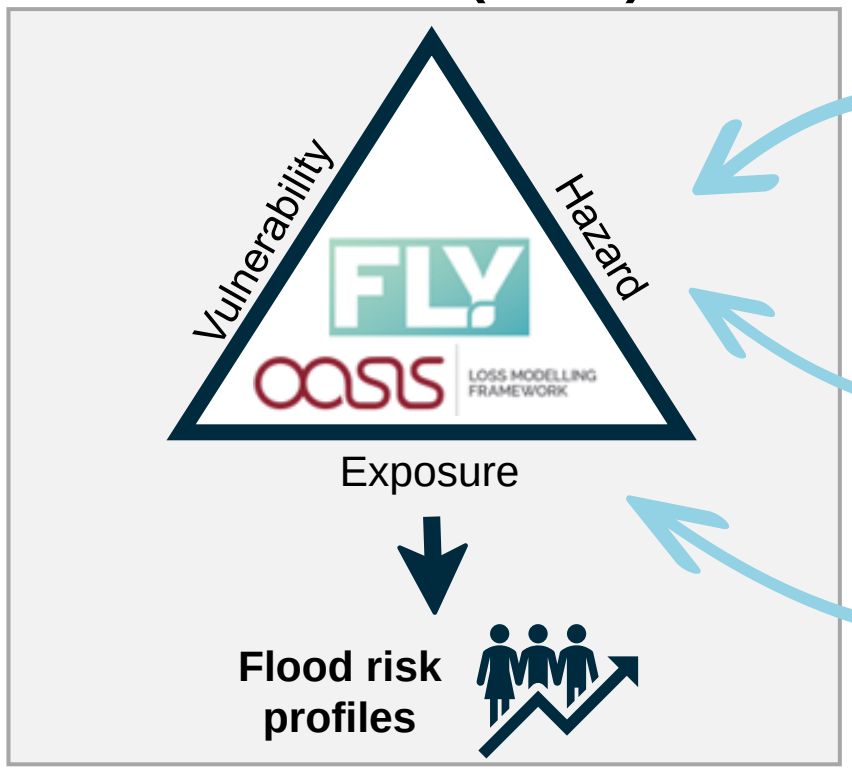
Emergency Management

Flood Foresight: Flood forecasting for Disaster Risk Financing systems

Kay Shelton, JBA consulting

Flood Foresight: Flood forecasting for Disaster Risk Financing systems

Flood Risk Model (static)

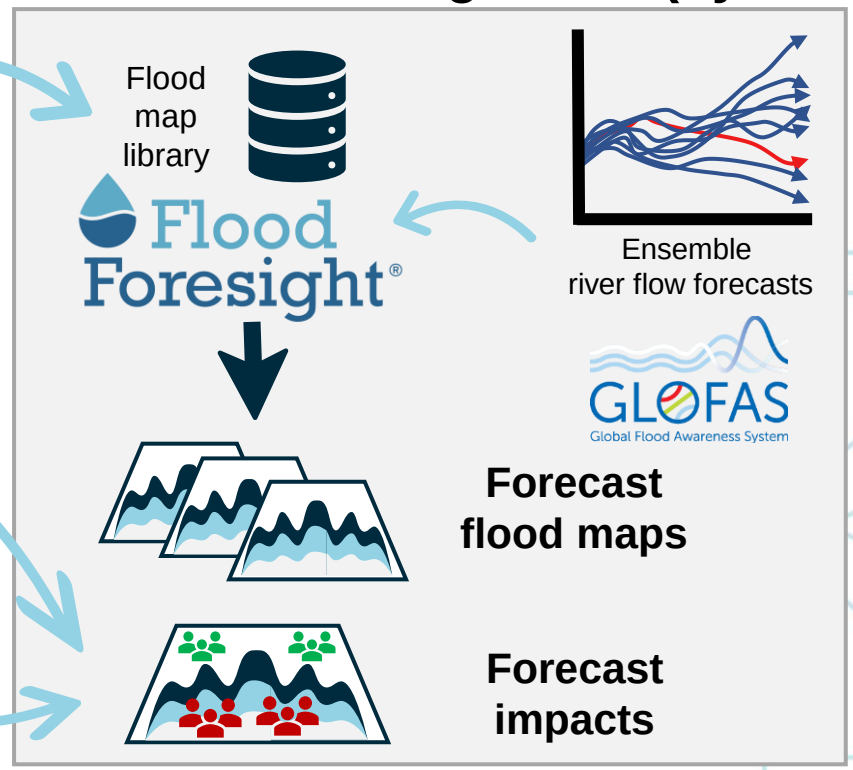


Global Flood Maps

Flood Defence Data

Population Data

Flood Forecasting Model (dynamic)



Design of anticipation actions

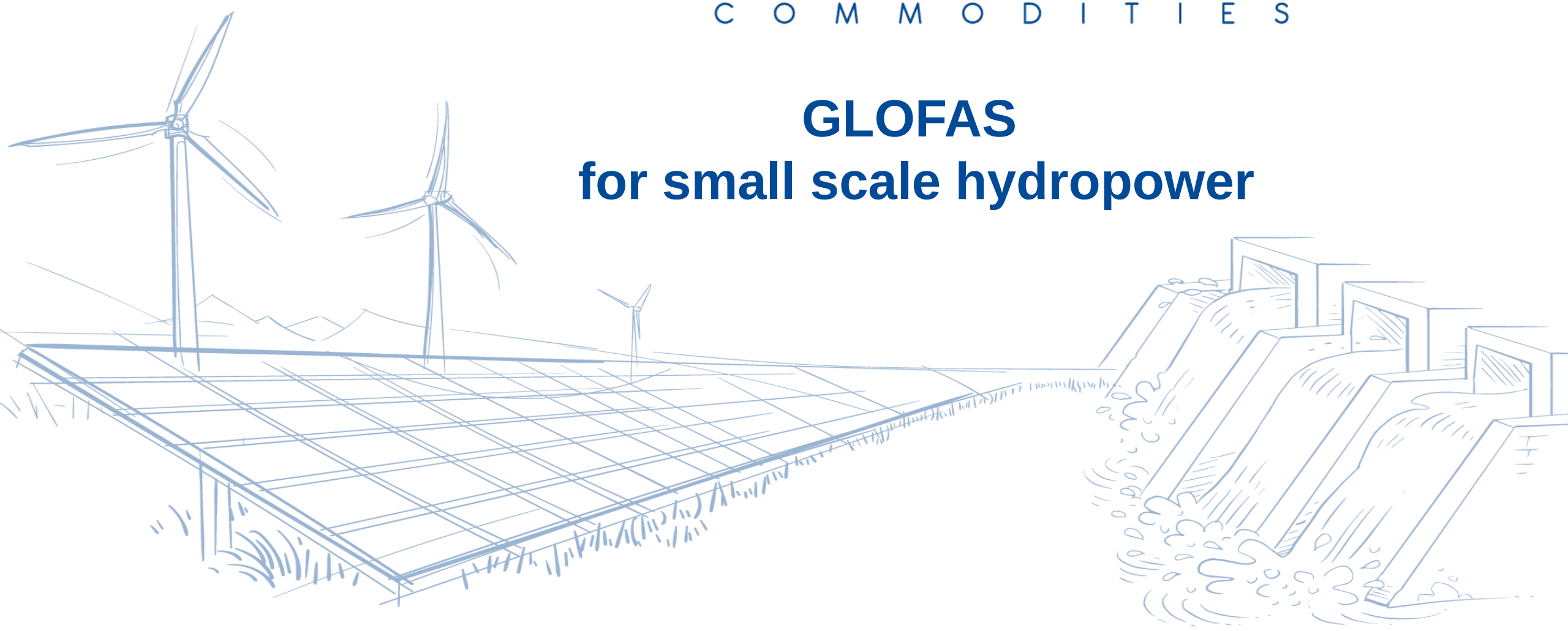
Operational index triggering

START NETWORK

info@floodforesight.com

DXT COMMODITIES

GLOFAS
for small scale hydropower

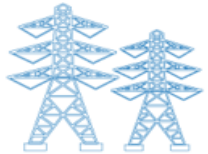


DXT Commodities – General Overview

We are a **Swiss trader specialized in energy commodities** operating **worldwide**

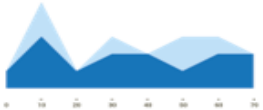
150 people
18 nationalities

1’700 TWh of energy traded annually



Investments in research, analysis and new technologies developed internally

(weather forecasting, blockchain, market simulations, machine learning, artificial intelligence…)



Financially Sound and creditworthy

Trading desk active **24/7**

Small-scale hydropower forecast using GLOFAS

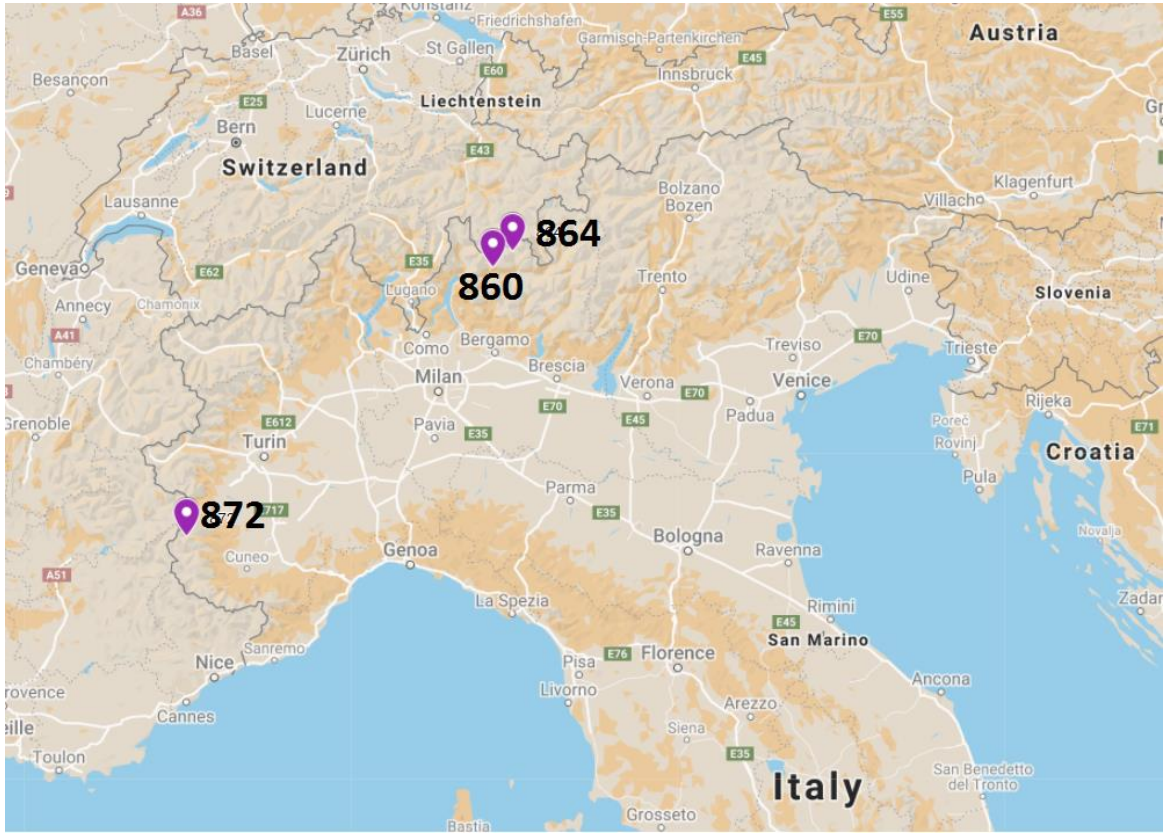
TARGET

- DXT dispatches several hydro farms located in the Italian Alps
- Discharge forecast is a valuable information to forecast the farms power production
- Farm monitoring is very sparse and of low quality

CHALLENGES for GLOFAS:

- The farms have small catchments
- The farm river has very low inertia to precipitation

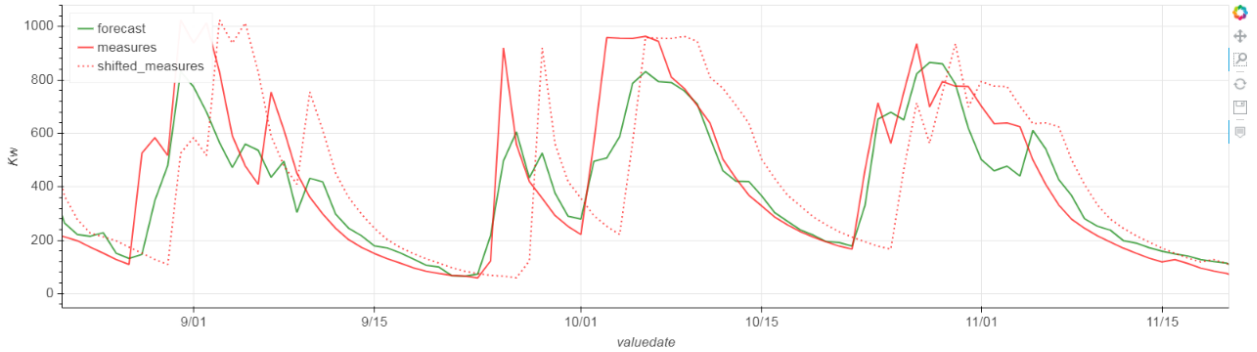
Farms info



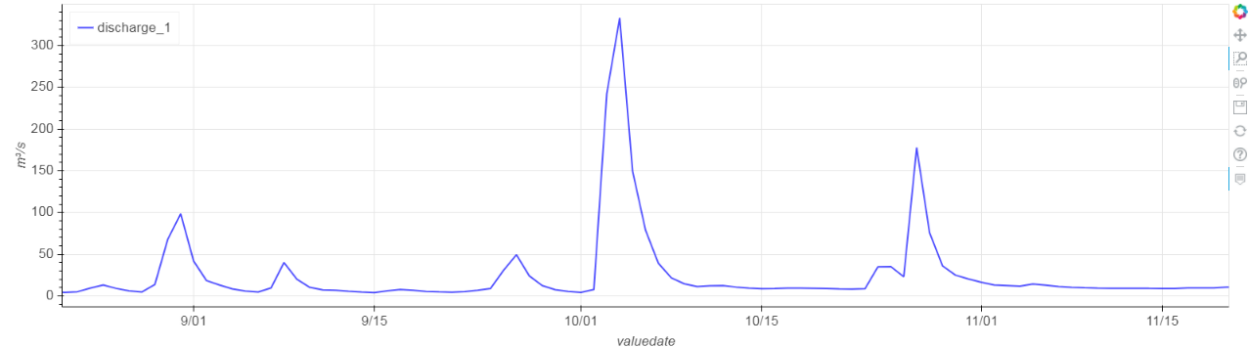
Point id	catchment points	Upstream [km^2]
860	14	2569
864	4	513
872	2	264

Farm forecast

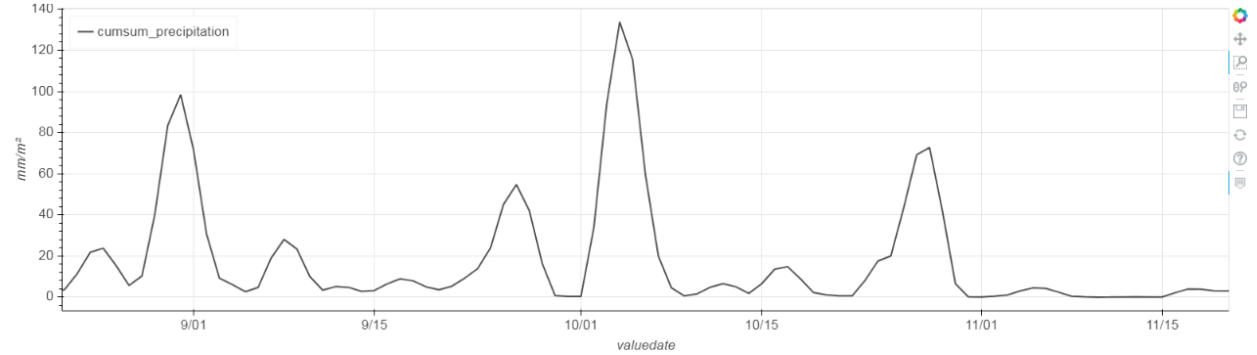
Production [KWh]



Discharge $[m^3/s]$



Precipitation [mm in 3 days]



Results

Year 2020					
point_id	catchment points	forecast	persistency	Gain	count (days)
	#	MAPE	MAPE	%	#
860	14	20.4	32.7	12.3	345
864	4	22.1	28.8	6.6	329
872	2	10.3	12.8	2.5	330
Year 2020 - Discharge quantile 90%					
point_id	catchment points	forecast	persistency	Gain	count (days)
	#	MAPE	MAPE	%	#
860	14	15.0	34.5	19.6	35
864	4	16.0	21.4	5.4	34
872	2	6.3	12.3	6.0	34
Yer 2020 - Wet season - SOND					
point_id	catchment points	forecast	persistency	Gain	count (days)
	#	MAPE	MAPE	%	#
860	14	21.6	47.3	25.7	107
864	4	21.5	45.4	23.8	91
872	2	13.8	22.2	8.4	92
Yer 2020 - Snow melt season - MAM					
point_id	catchment points	forecast	persistency	Gain	count (days)
	#	MAPE	MAPE	%	#
860	14	19.2	23.3	4.1	92
864	4	21.9	18.2	-3.7	92
872	2	12.8	14.4	1.6	92

GLOFAS

- Improved performances compared to persistency D+3 (also for D+1)
- Stronger improvement for farms with bigger catchment
- Stronger improvement for rainy season
- Weak performance for snow melt season

ARISTOTLE-eENHSP flood hazard service

Michaela Mikuličková

Slovak Hydrometeorological Institute (SHMU)

on behalf of the ARISTOTLE-eENHSP consortium

and based on ECMWF slides

Contract n. ECHO/SER/2020/830887+830888

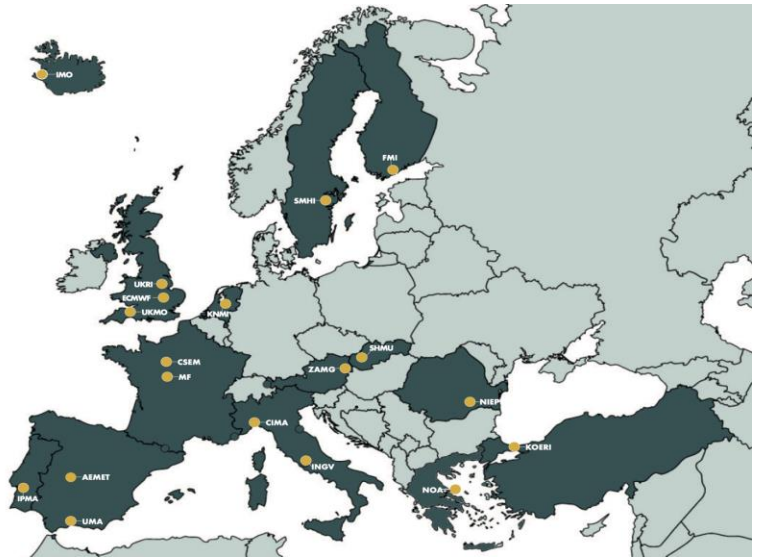
ARISTOTLE - eENHSP

enhanced European Natural Hazards Scientific Partnership

All Risk Integrated System TOwards Trans-boundary hoListic Early-warning

www.aristotle.ingv.it

- Project started in 2016, phase 3 from 2020 - 2024
- 19 institutions across Europe
- Provide guidance on 6 interrelated natural hazards to the EU Emergency Response Coordination Centre (ERCC)
- Guidance is used by ERCC to coordinate preparatory and response actions to global natural disasters
- Multi-hazard = Earthquake, Tsunami, Volcanoes, Severe weather, Flooding and Forest fires



Multi-hazard impact experts advice

Routine Multi-Hazard Impact Oriented Brief

- Every Mon/Wed/Fri
- Each hazard reports events where impacts are possible

ARISTOTLE-ENHSP
MULTI-HAZARD IMPACT ORIENTED BRIEF

Date: September 23, 2020
Report Secretary: INGV_operator, Carlo Giunchi, aristotle.ingv_opmhob@ingv.it

HEADLINES

- Ash fall and possible lahars continue to affect the areas surrounding Fuego volcano, Guatemala
- Rockfalls, possible pyroclastic flows and lahars continue to affect the areas surrounding Santiaguito volcano, Guatemala
- Ash and possible lahars following a major eruption affect the areas surrounding Sangay volcano, Ecuador
- Landslide threat at Irazu volcano, Costa Rica
- High forest fire danger - Eastern Spain

SUMMARY

Based on the Decision Matrix, the **12** events in this report are grouped as follows:

0 "Act" (red) - **5** "Prepare" (orange)
5 "Monitor" (yellow) - **2** "Nil" (green)

Single/Multi-Hazard Emergency Report

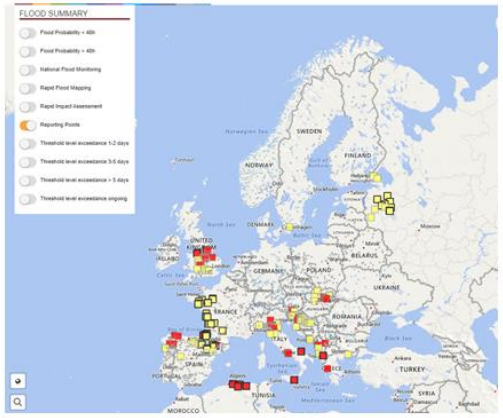
- Triggered proactively or reactively
- Report provided to ERCC within 3 hours of request
- Details the natural hazard(s) and the potential and reported impacts

Contract n. ECHO/SER/2020/830887+830888
Funded by European Union Civil Protection and Humanitarian Aid

Flooding hazard group

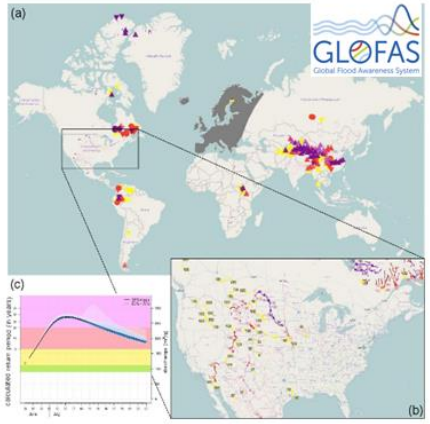
European Flood Awareness System (EFAS)

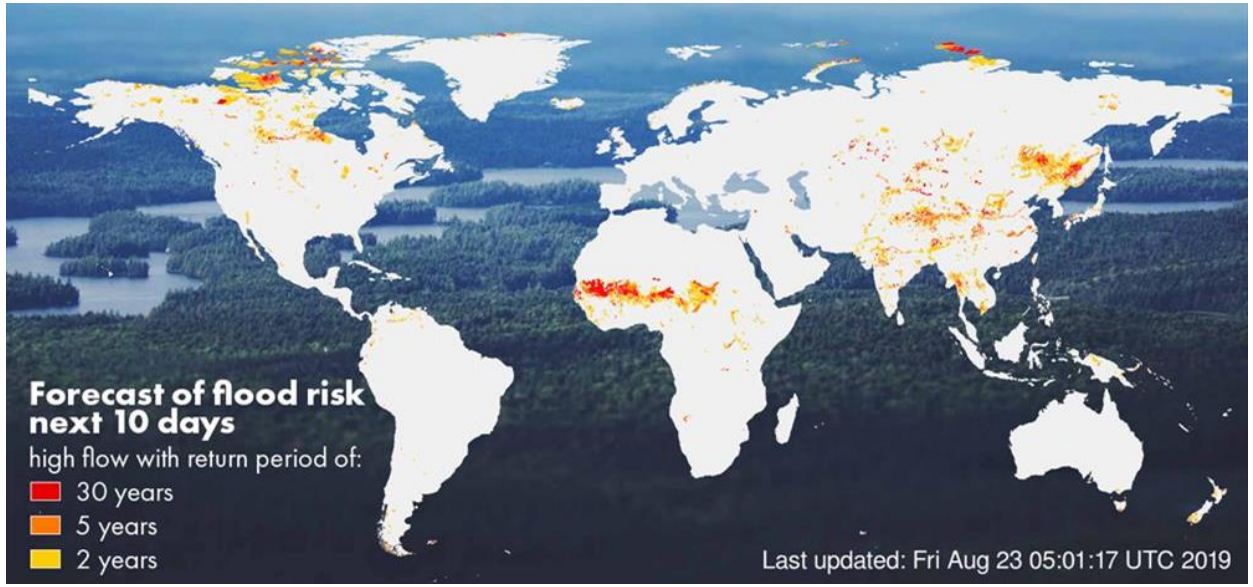
- European forecasts
- 5 km resolution, 6 hourly time step
- Open access 30 days after forecast has been produced
  - Before this data are restricted to flood warning agencies
- efas.eu

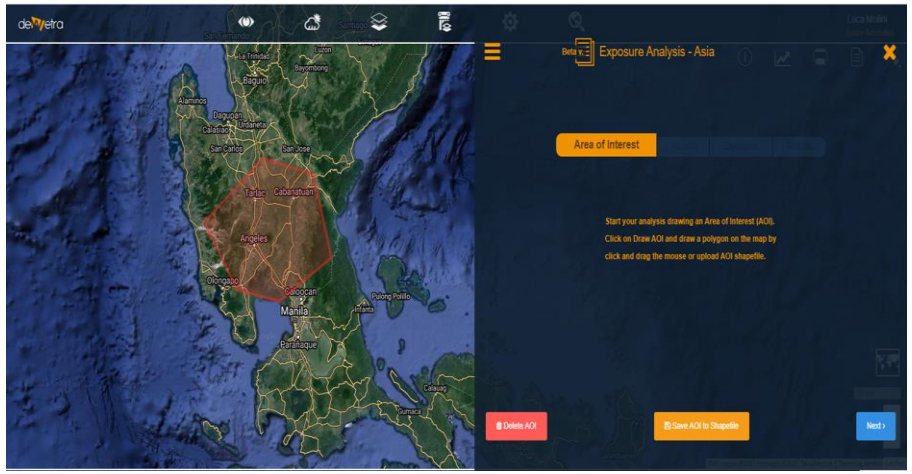


Global Flood Awareness System (GloFAS)

- Global forecasts
- ~10 km resolution, daily time step
- Open access, >2000 registered users
- globalfloods.eu







- Information of national hydrological services
- Meteorological assessment of the Severe weather group
- Satellite imagery
- Media reports

Contract n. ECHO/SER/2020/830887+830888

Funded by European Union Civil Protection and Humanitarian Aid

Procedure to Analyse Forecasts

1. **Identify at risk areas**
   a. Identify areas where flood impacts are forecasted
   b. Focus on areas where high probability of flooding
   c. Analyse streamflow forecast information
2. **Analyse hydro-meteorological conditions**
   a. Initial conditions - soil moist., antecedent rainfall
   b. Forecasted rainfall
3. **Understand forecast confidence**
   a. Evolution of previous forecasts
   b. Forecast skill
   c. Human processes
4. **Assess flood impacts**

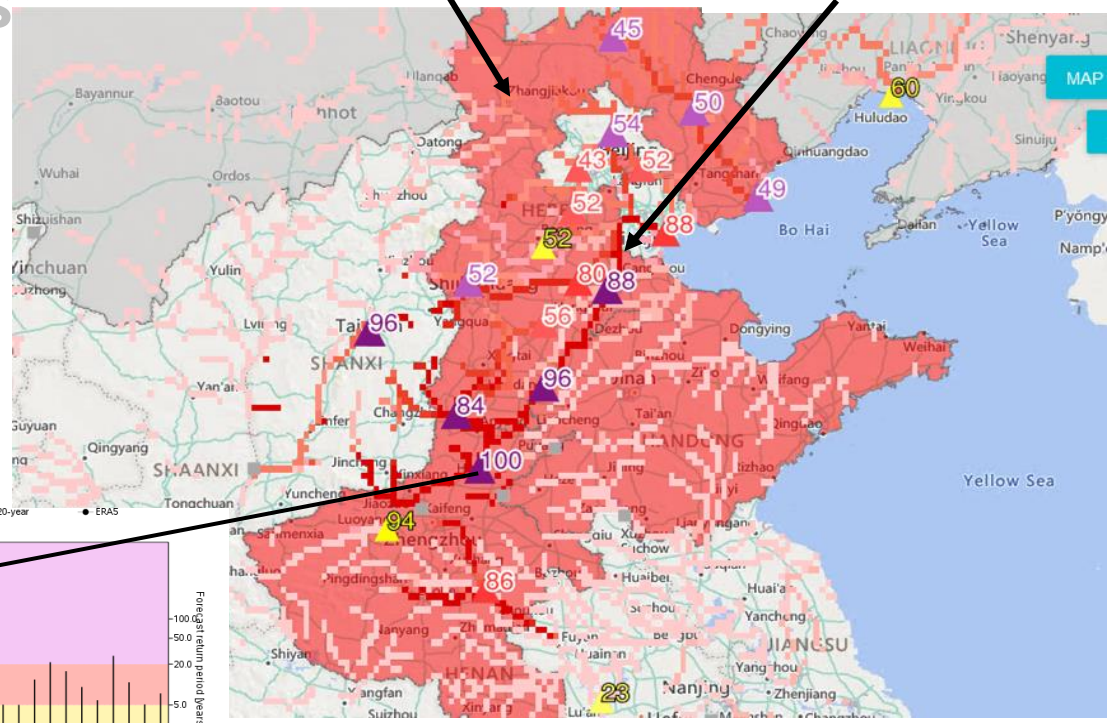
Probability of flooding (>5 yr return period)

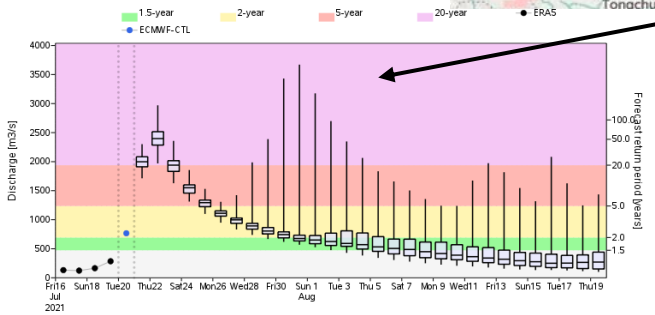
0 - 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 60
60 - 70
70 - 80
80 - 90
90 - 100

Rapid impact assessment layer

Regions where flood impacts are possible

High probability of flooding





Reporting points

Procedure to Analyse Forecasts

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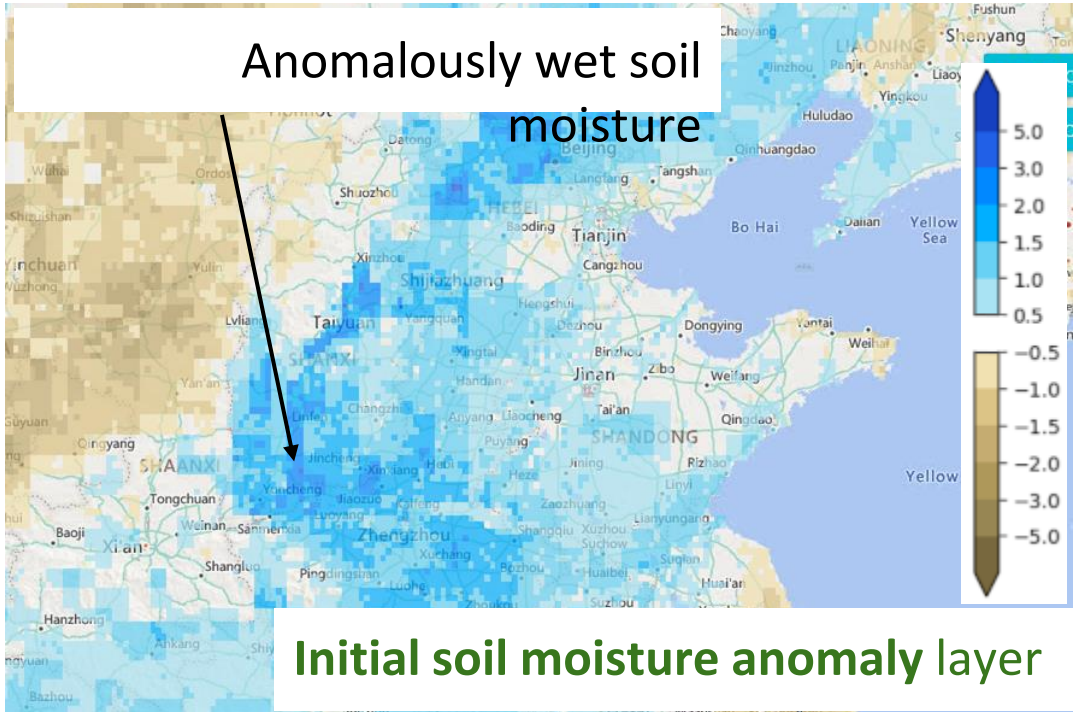

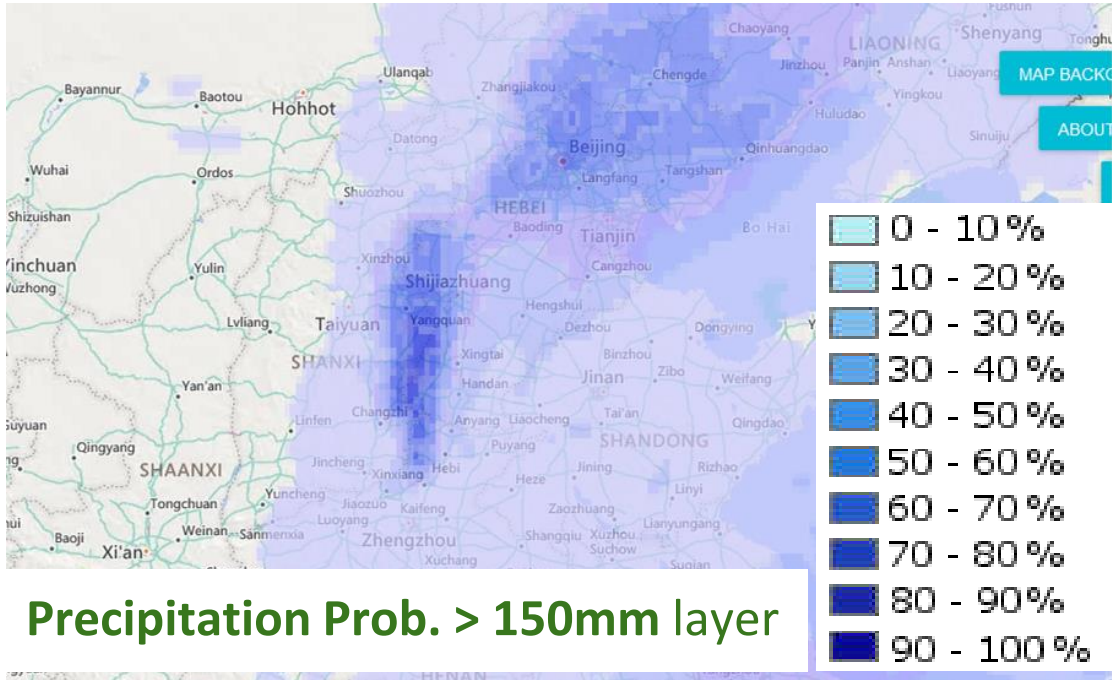

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   a. Evolution of previous forecasts
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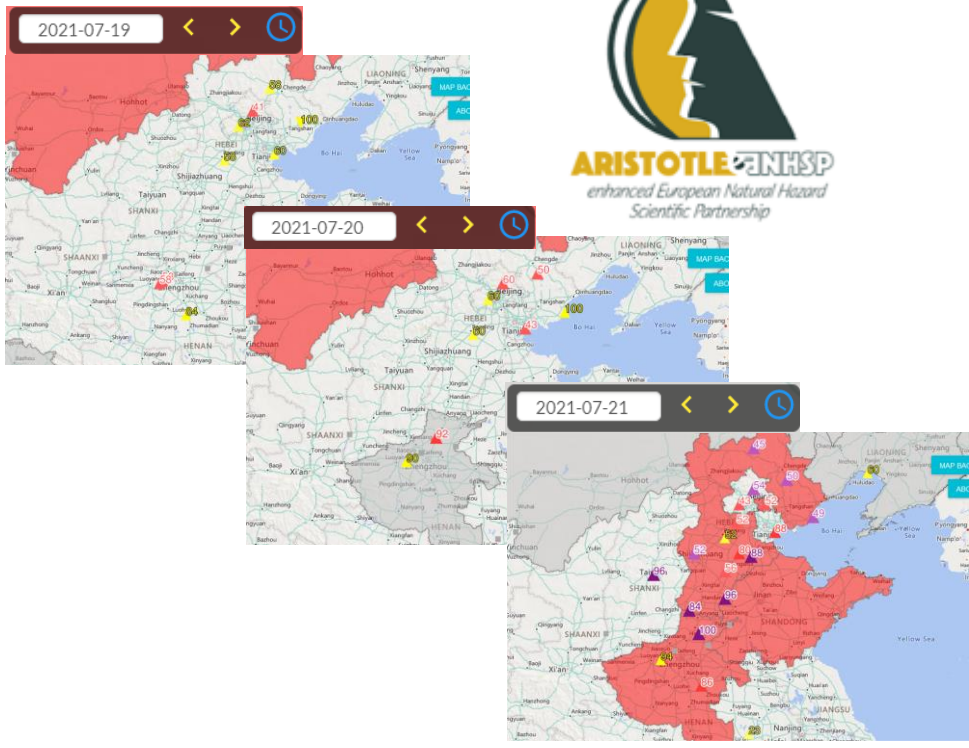
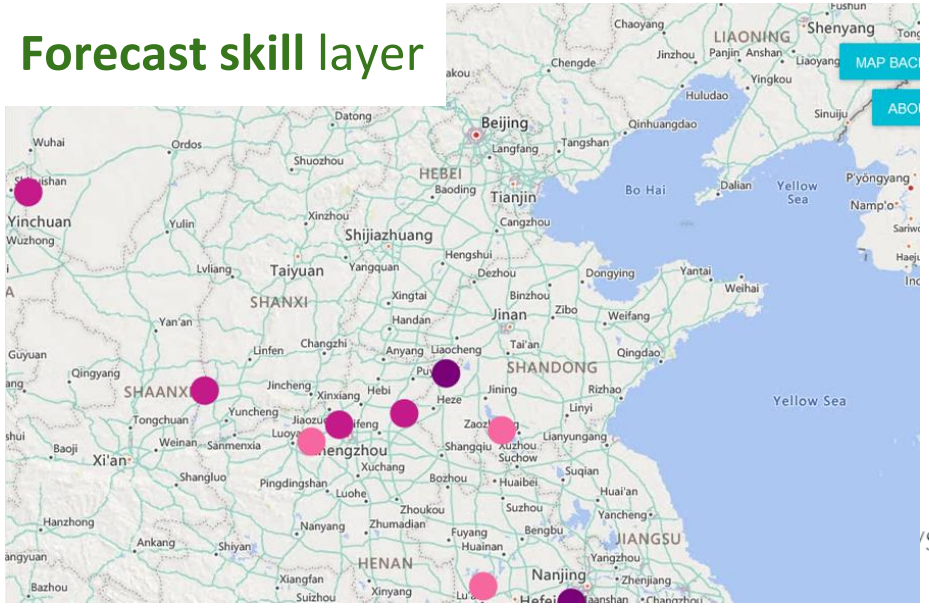
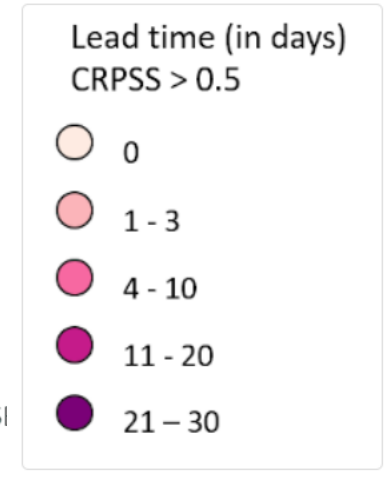
   c. Human processes
4. **Assess flood impacts**



Forecast skill layer



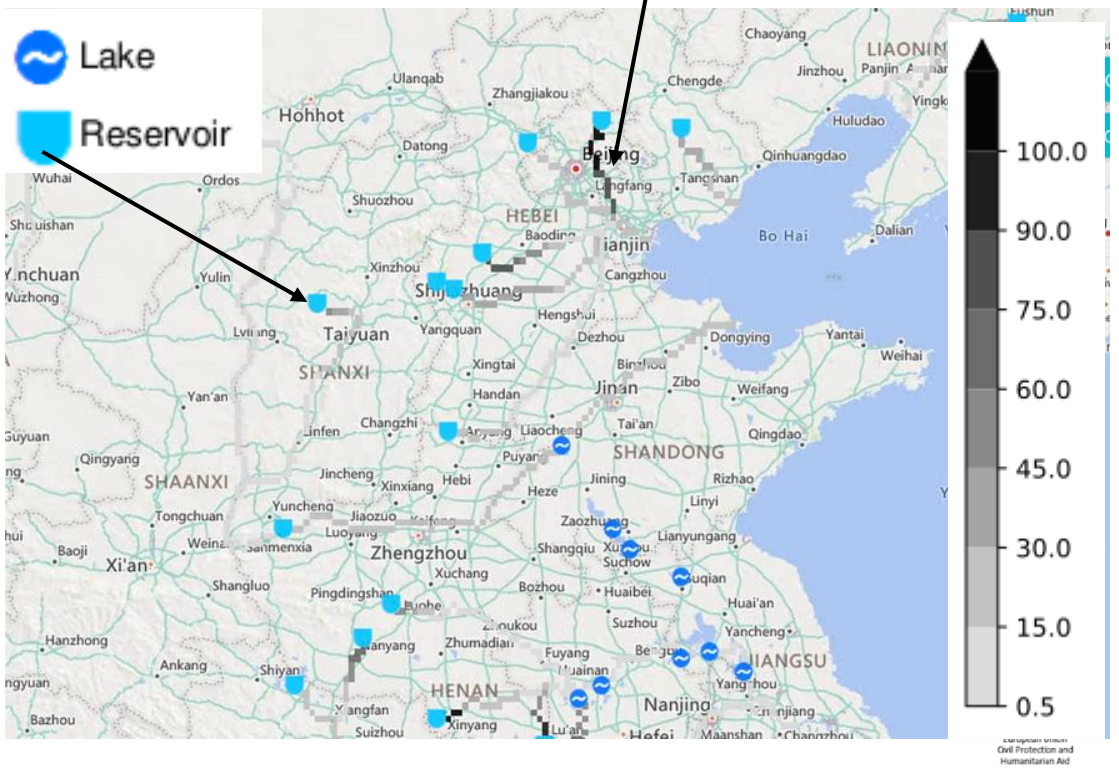


Procedure to Analyse Forecasts

1. **Identify at risk areas**
   a. Identify areas where flood impacts are forecasted
   b. Focus on areas where high probability of flooding
   c. Analyse streamflow forecast information
2. **Analyse hydro-meteorological conditions**
   a. Initial conditions - soil moist., antecedent rainfall
   b. Forecasted rainfall
3. **Understand forecast confidence**
   a. Evolution of previous forecasts
   b. Forecast skill
   c. Human processes
4. **Assess flood impacts**

Potential impact of reservoirs

Reservoir impact



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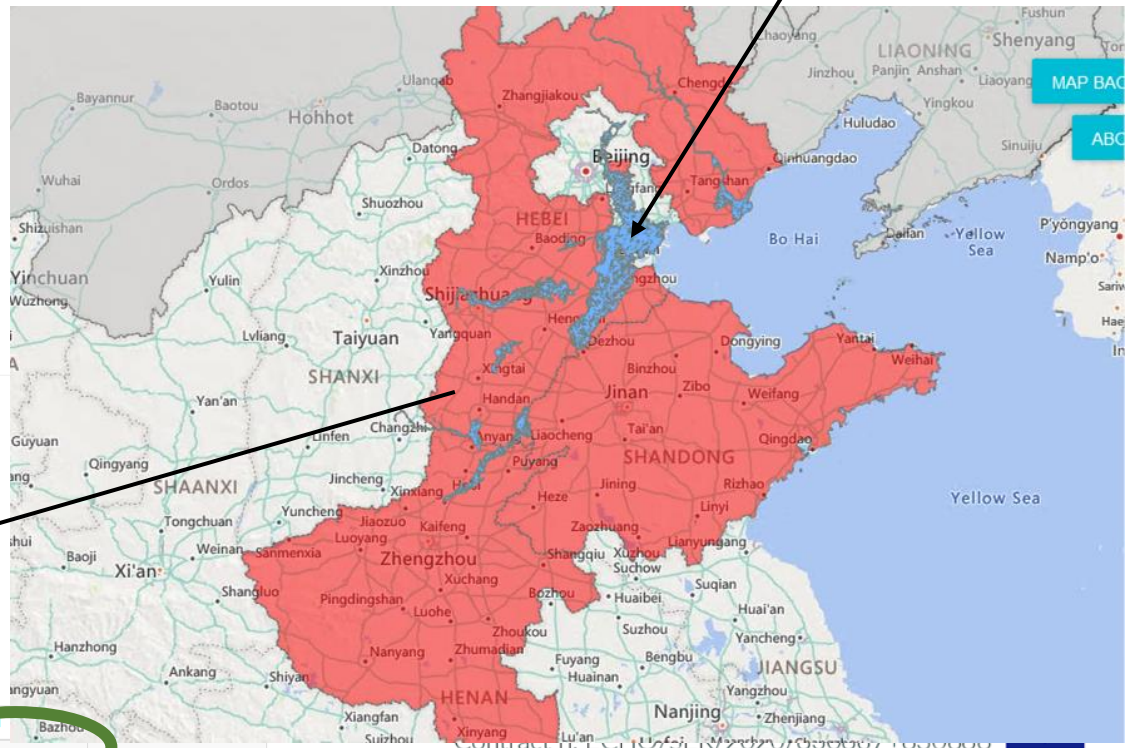
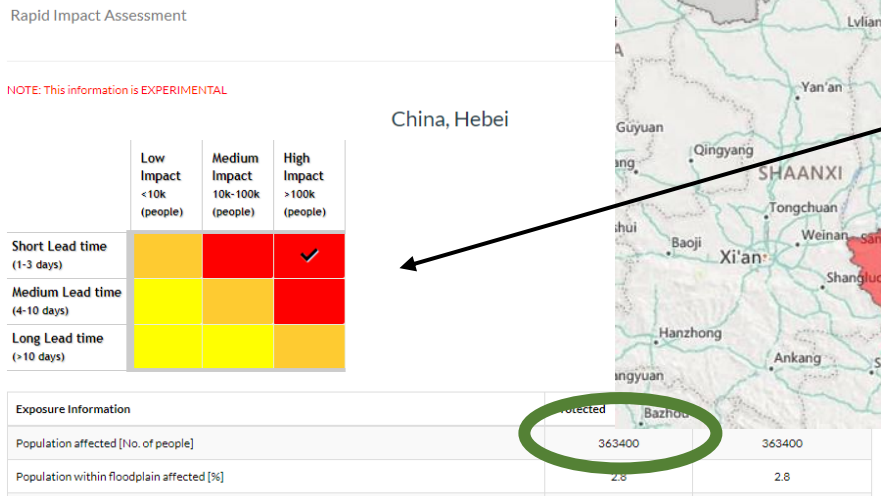
Potential inundated areas




Rapid Impact Assessment

NOTE: This information is EXPERIMENTAL

China, Hebei

	Low Impact <10k (people)	Medium Impact 10k-100k (people)	High Impact >100k (people)
Short Lead time (1-3 days)			✓
Medium Lead time (4-10 days)			
Long Lead time (>10 days)			

Exposure Information	Protected	
Population affected [No. of people]	363400	363400
Population within floodplain affected [%]	2.8	2.8

Contribution to the multi-hazard brief report

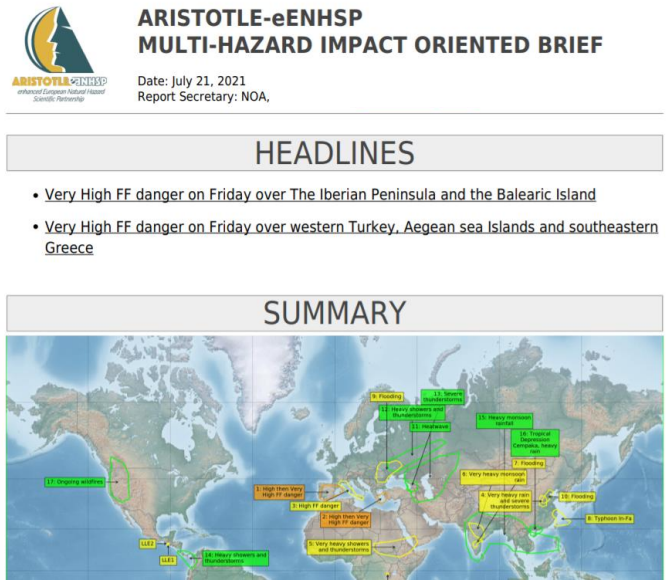
10: Flooding - North eastern China

Description

Recent heavy rain in Henan, Hebei and Shangdong provinces will begin to move downstream, potentially leading to flooding from Saturday 24th July and into the following week. In Shangdong and Hebei provinces flooding is possible in the Zhangwhei Xinhe river between Dezhou to Tianjin between Sunday 26th to Thursday 29th July with the peak on Monday 26th July. The Hutuo He river near Shijiazhuang in Hebei is expected to exceed the 5 year return period between Saturday 24th to Sunday 25th July. High flows are forecast on the Hai river between Beijing to Tianjin from Monday 26th July until Sunday 1st August. A similar situation is also predicted for the Luan Hei river in Hebei near Luanzhou.

Impacts

~460,000 people could be exposed to flooding in the provinces of Shangdong and Hebei in addition to the ~730,000 people who are exposed to the ongoing flooding in Henan province. Flood impacts are possible in several urban areas, the city of Tianjin is the largest which may be affected.



ARISTOTLE-eENHSP
MULTI-HAZARD IMPACT ORIENTED BRIEF

Date: July 21, 2021
Report Secretary: NOA,

HEADLINES

- Very High FF danger on Friday over The Iberian Peninsula and the Balearic Island
- Very High FF danger on Friday over western Turkey, Aegean sea Islands and southeastern Greece

SUMMARY

Thank you for your attention

Questions are welcome
michaela.mikulickova@shmu.sk

Contract n. ECHO/SER/2020/830887+830888

Funded by European Union Civil Protection and Humanitarian Aid

How GFM and GloFAS complement each other

Emergency Management

Wolfgang Wagner
Technische Universität Wien (TU Wien)
Earth Observation Data Centre for Water Resources Monitoring (EODC)
28th October 2021

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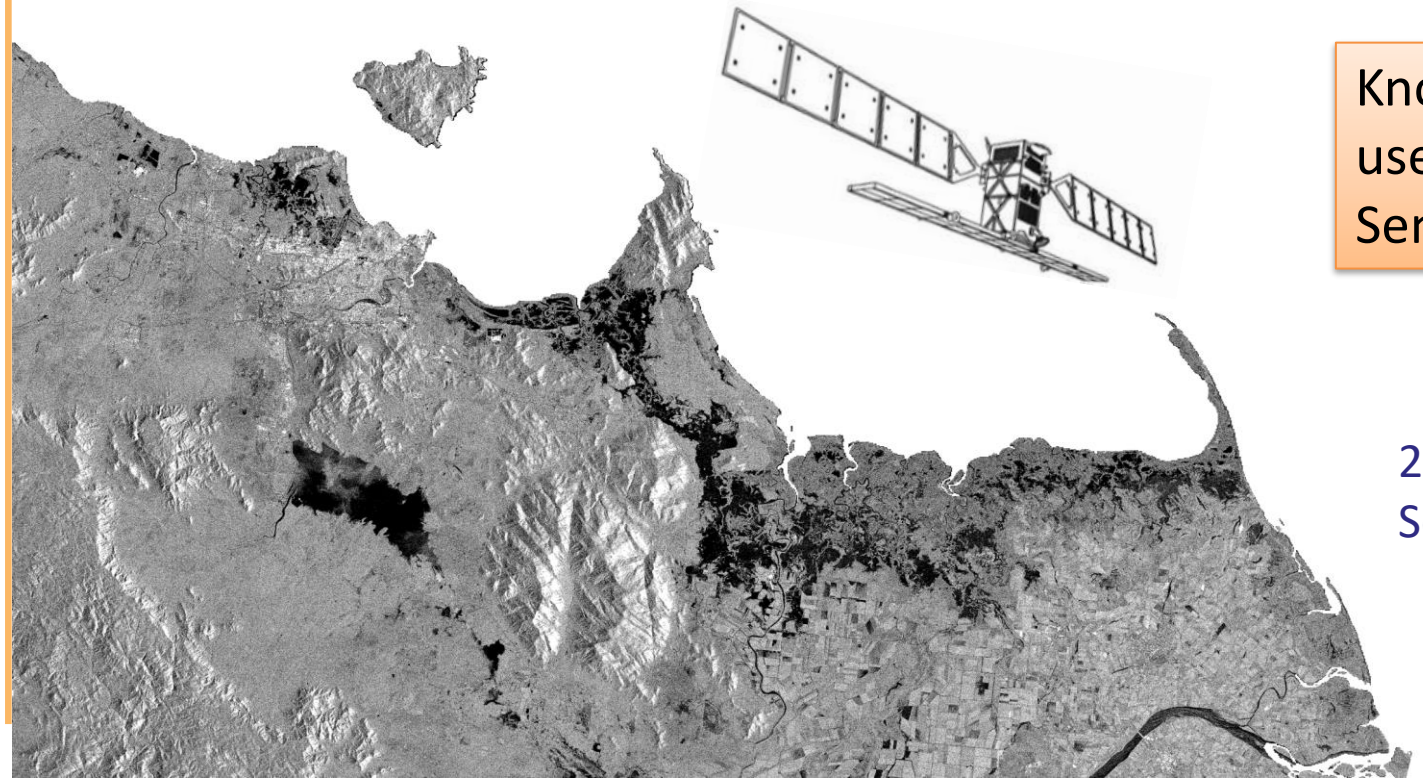
Sentinel-1 SAR for flood mapping

- What do we look for?
  - A change to very low backscatter (in the order of -18 dB) as characteristic for open inland waters
- What can do wrong?
  - There are many “water-look-alike” surfaces → false positives in no-flood scenes
  - There are no sensitivity areas → false negatives in flood scenes



Knowledge about flood risk very useful for the interpretation of Sentinel-1 results → GloFAS

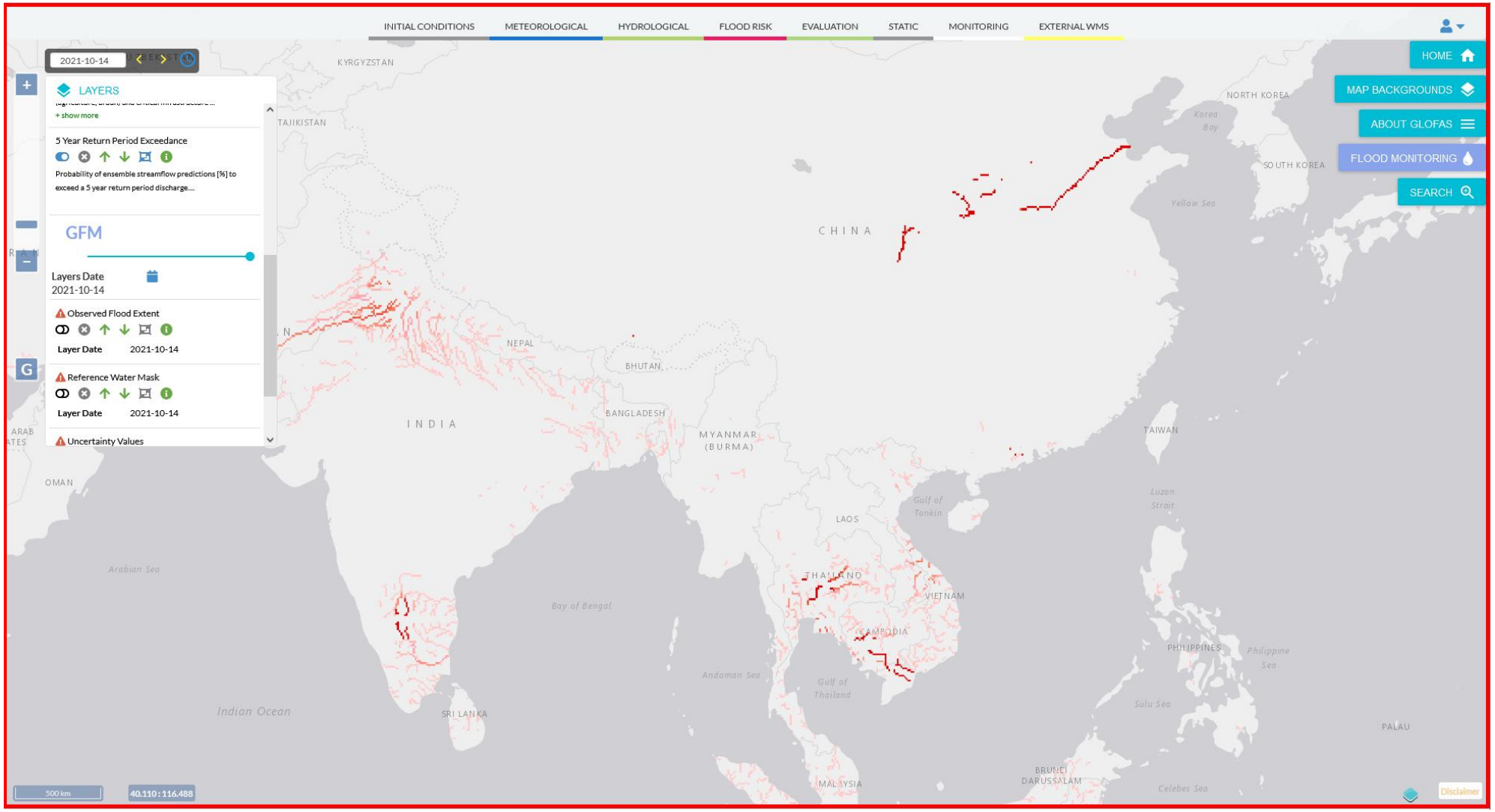
2019 Queensland flood as captured by Sentinel-1 on 30 January 2019

Copernicus Europe's eyes on Earth

European Commission

Emergency Management

Get Overview with 5 Year Return Period



4 October 2021

Copernicus Europe's eyes on Earth

European Commission

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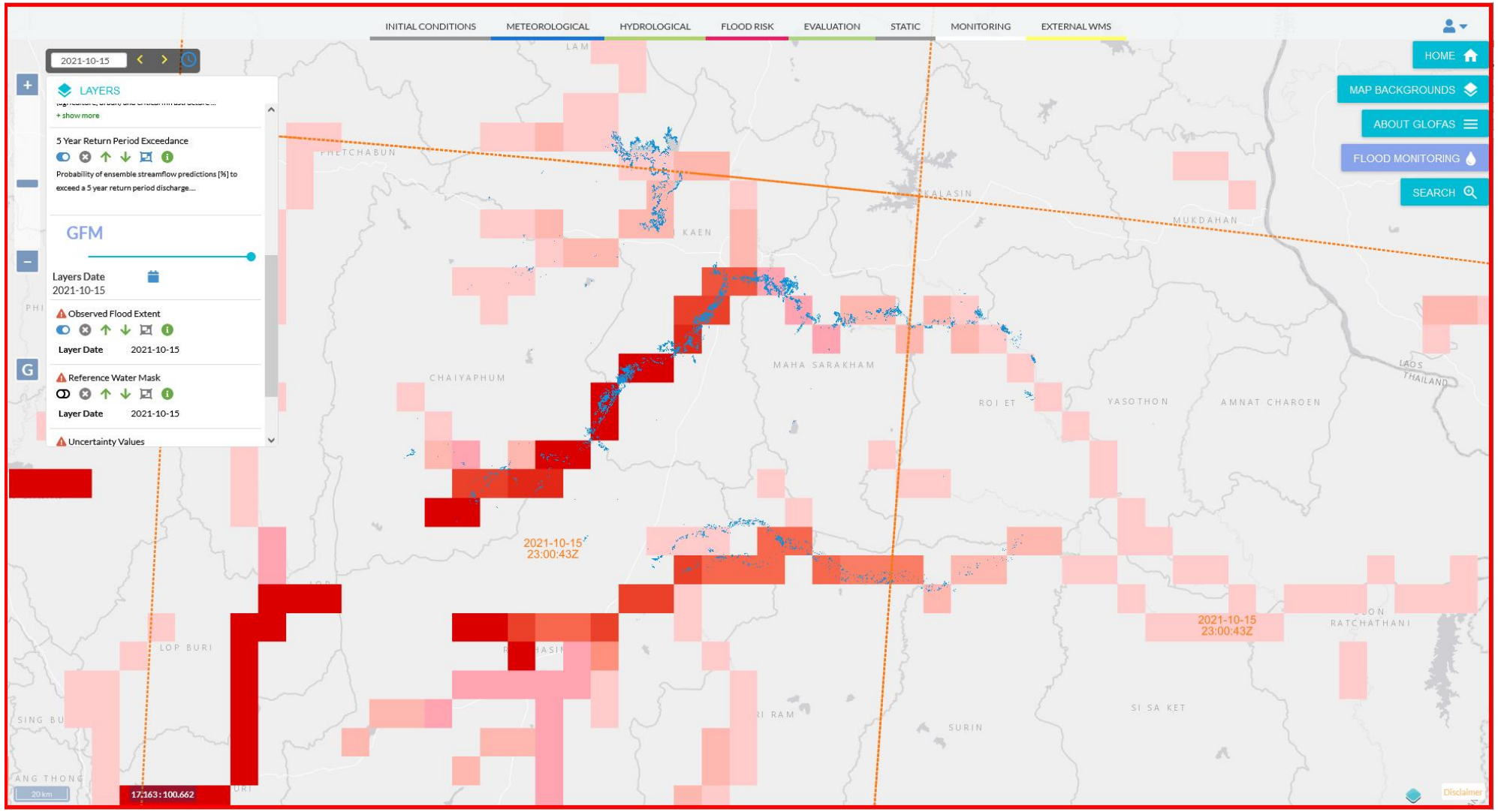
Thailand 15 October 2021



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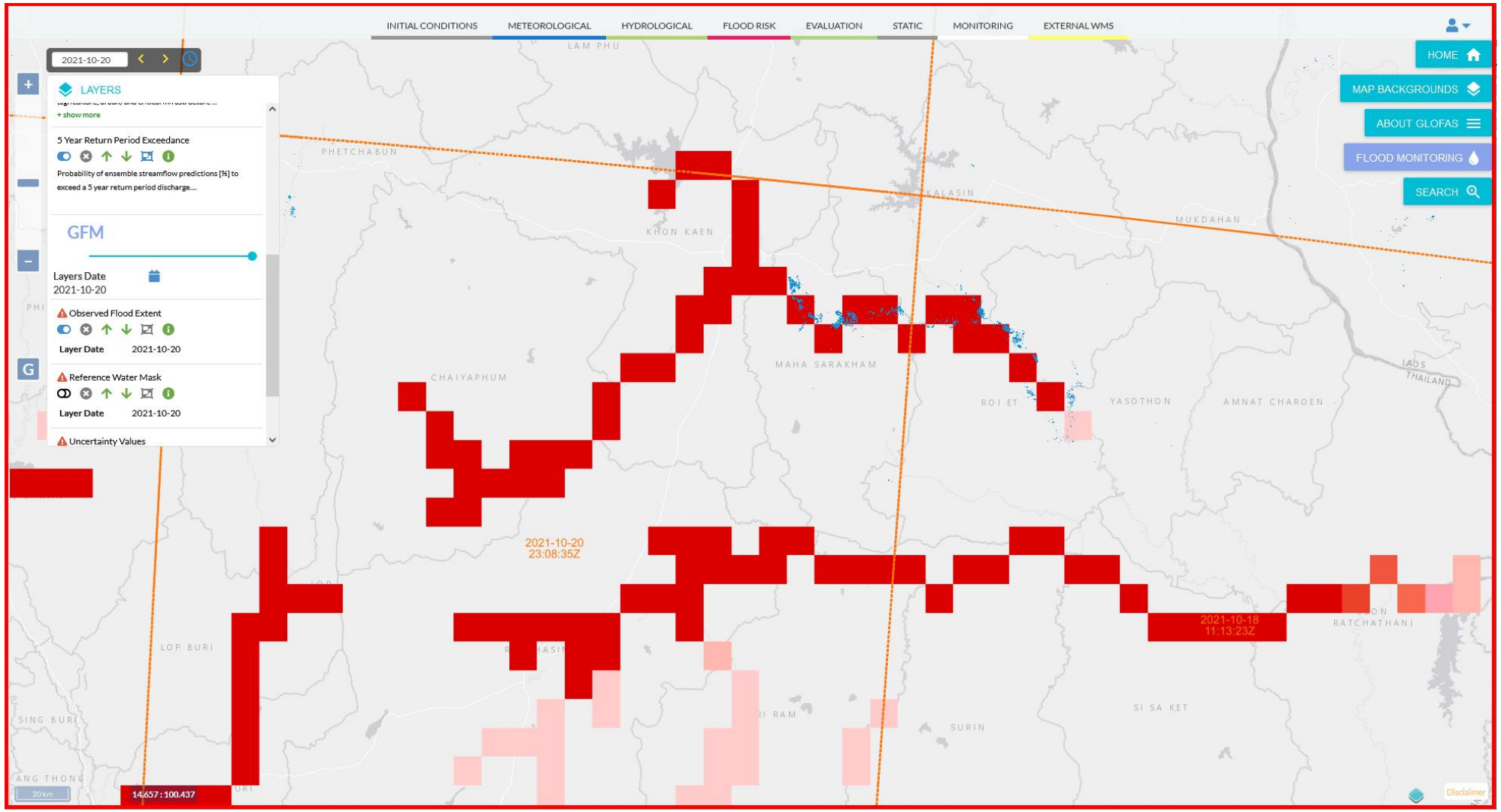
Thailand 20 October 2021



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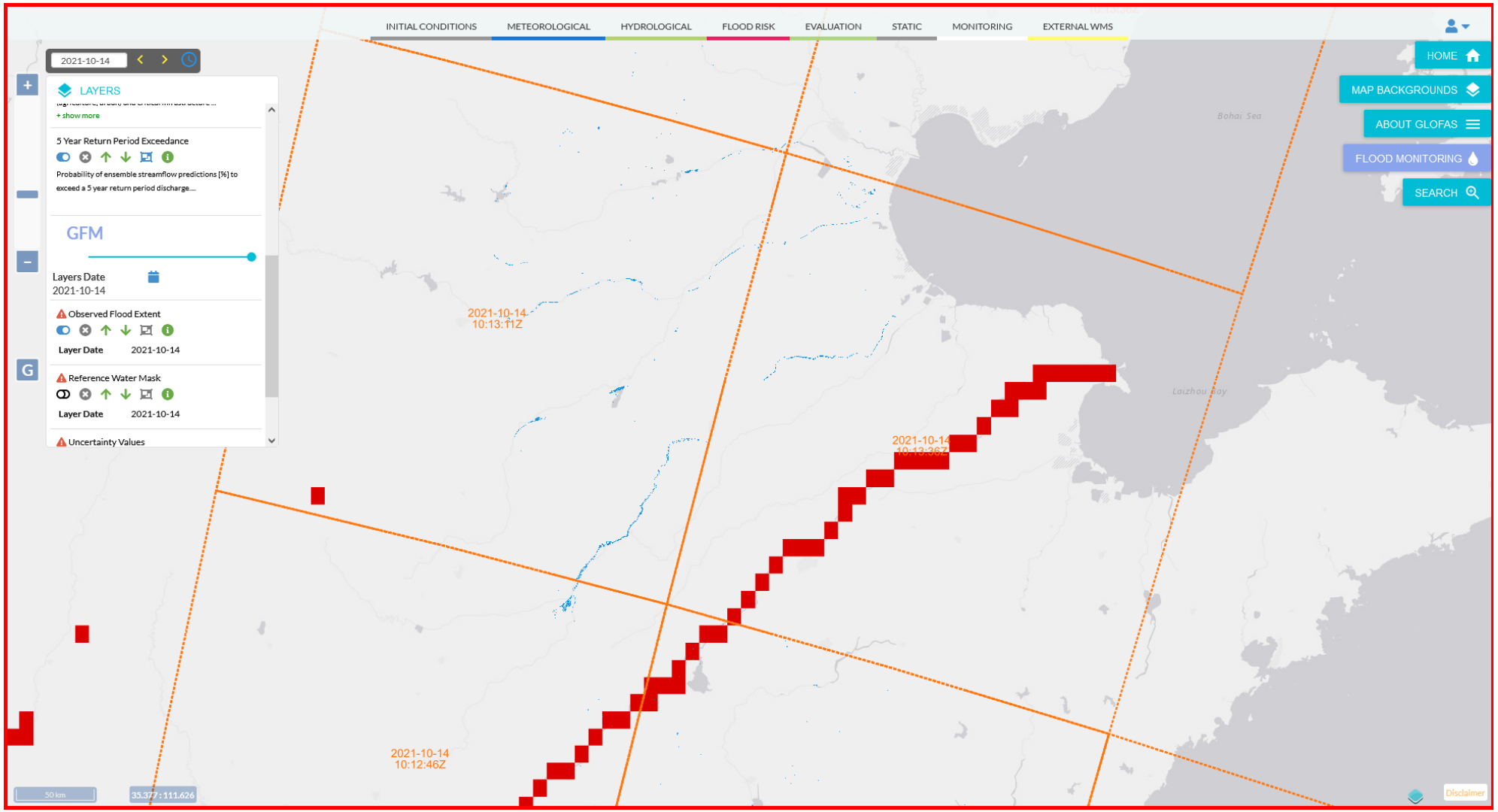
China 14 October 2021



Copernicus Europe's eyes on Earth

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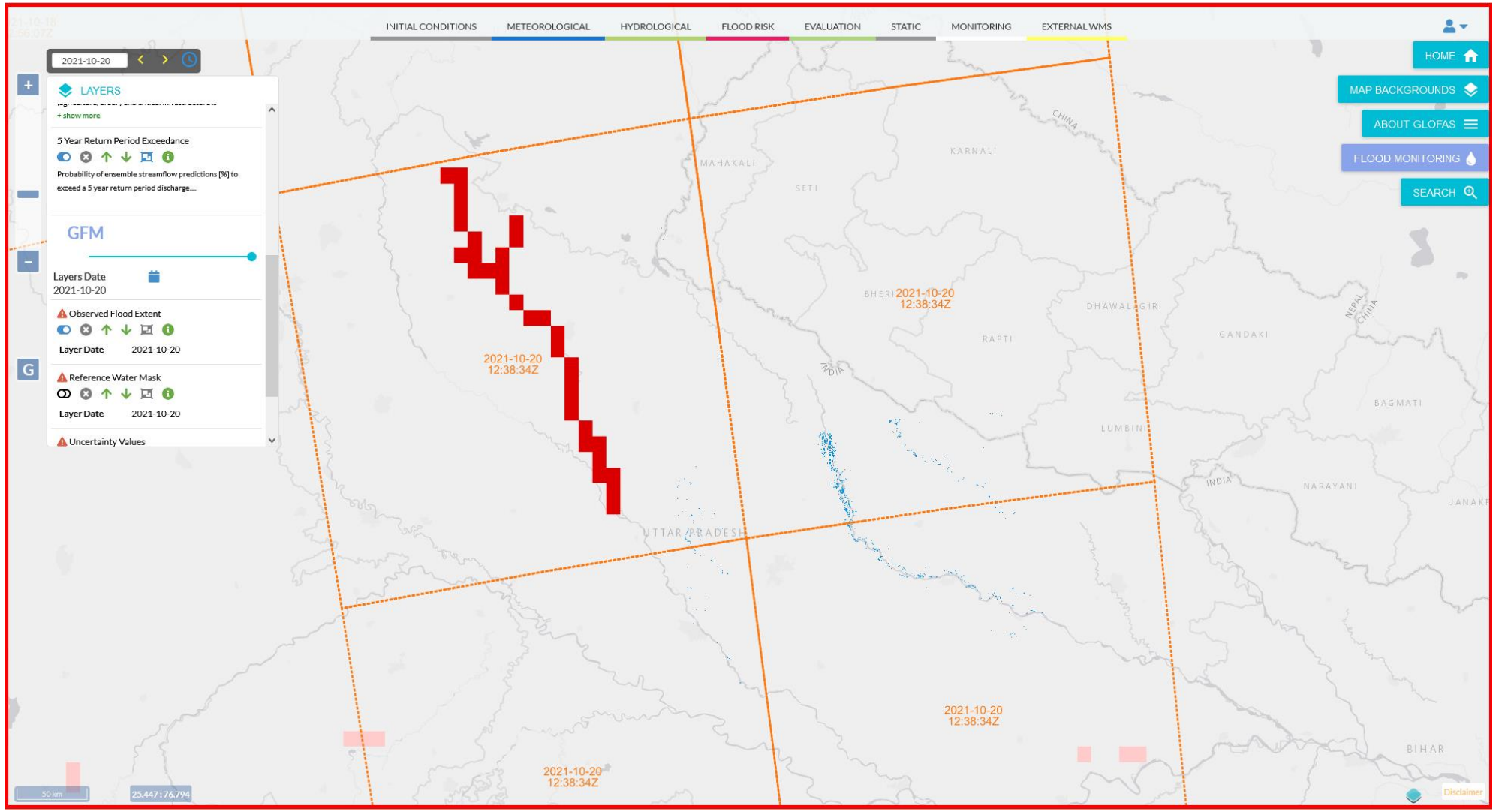
India 20 October 2021



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Mexico 26 October 2021

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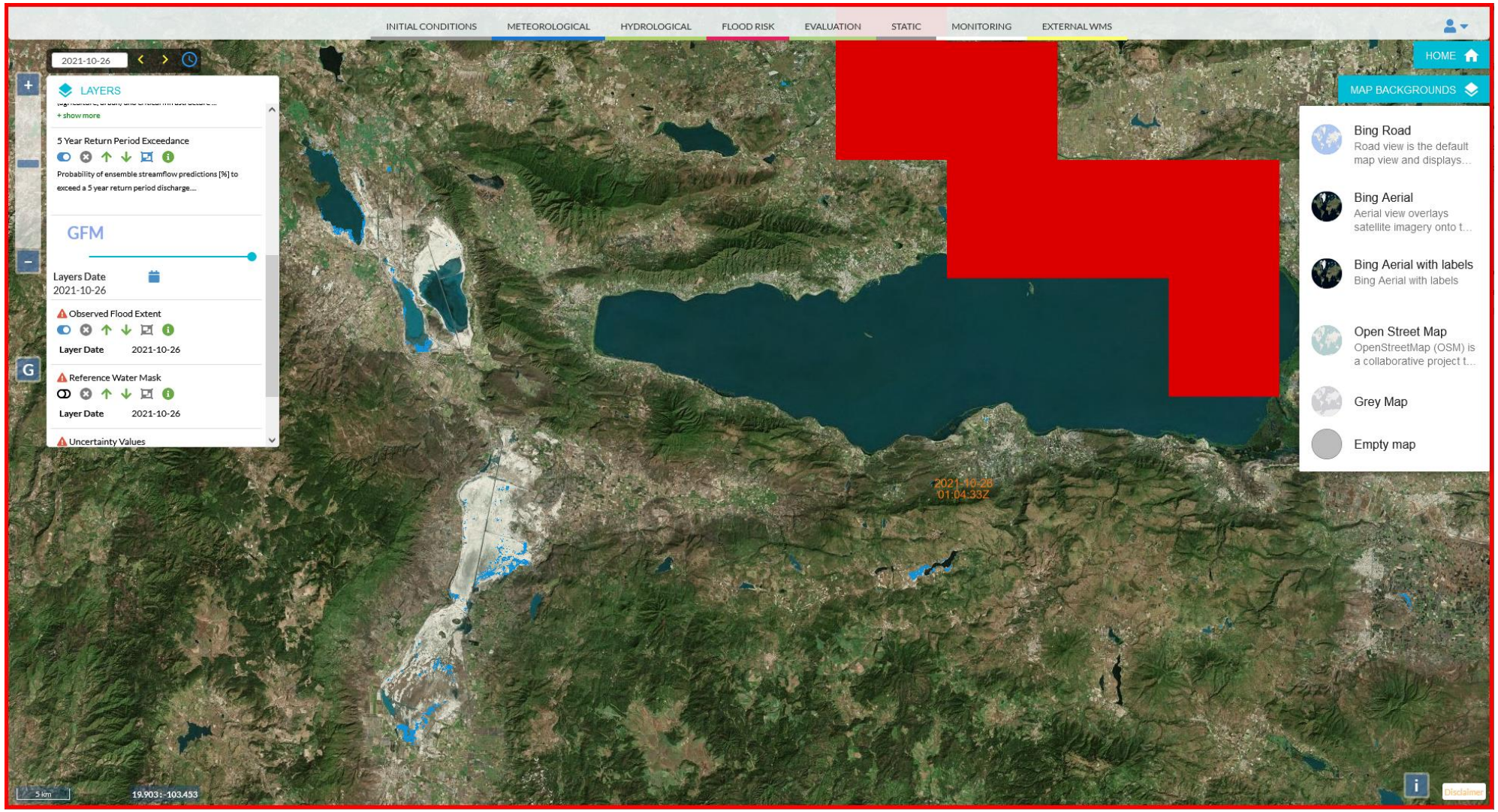

Copernicus Europe's eyes on Earth

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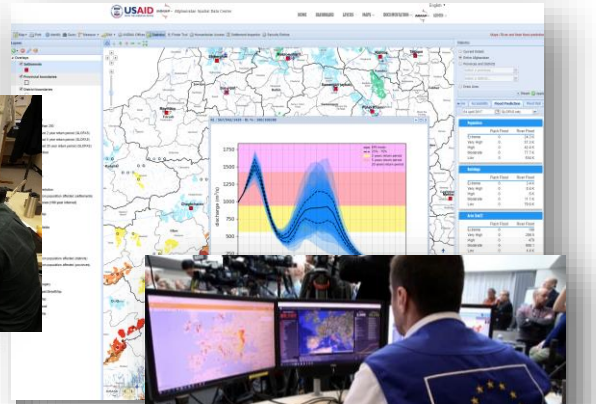
Community of users

Christel Prudhomme, ECMWF, GloFAS

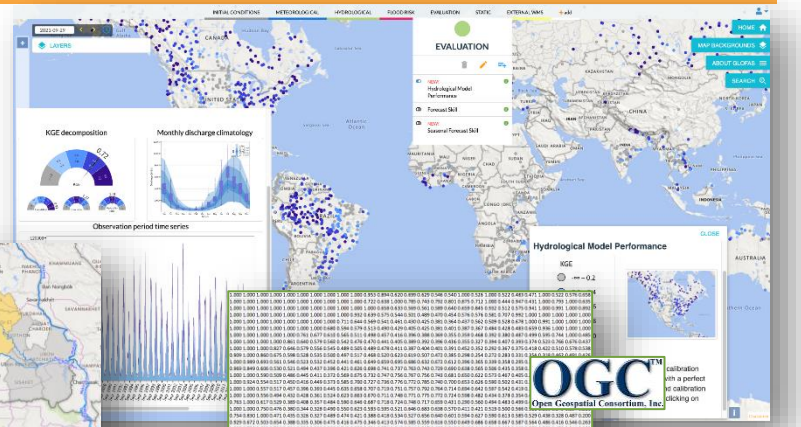
Dragana Milinkovic, GFM

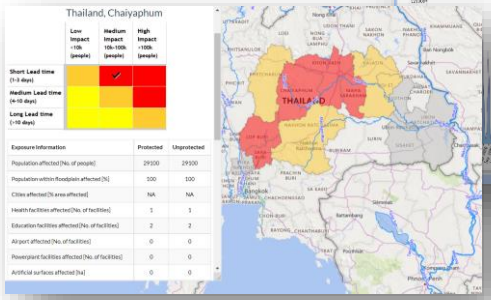
Open discussion: how to build a community of users



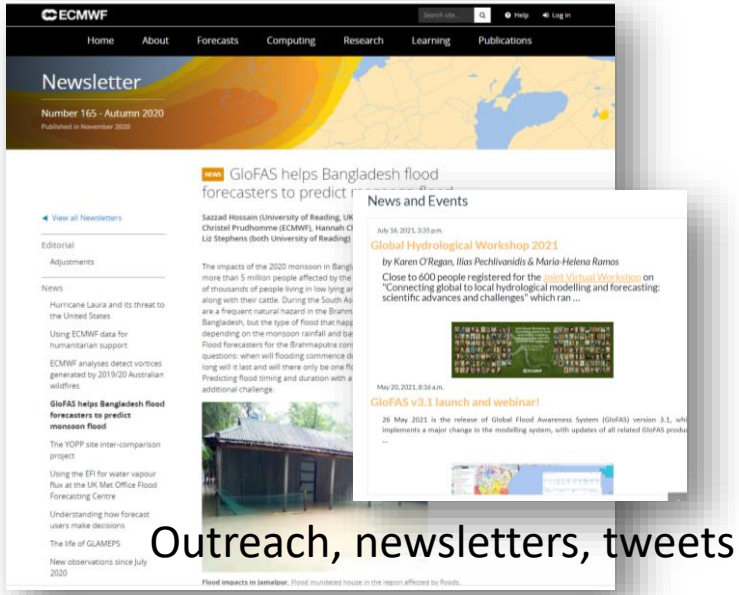
Case study, partnerships, understanding users needs

Data exchange, feedback, evaluation, product design





Community of Users Workshops and annual meetings



Outreach, newsletters, tweets

Jira

Helpdesk, user support, tutorial, documentation, wiki

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Thank you!