

IS IT POSSIBLE TO IDENTIFY AREAS AT FLASH FLOOD RISK WITH GLOBAL ENSEMBLE RAINFALL FORECASTS?

A comparative study between ECMWF ENS and
post-processed (ecPoint) rainfall forecasts

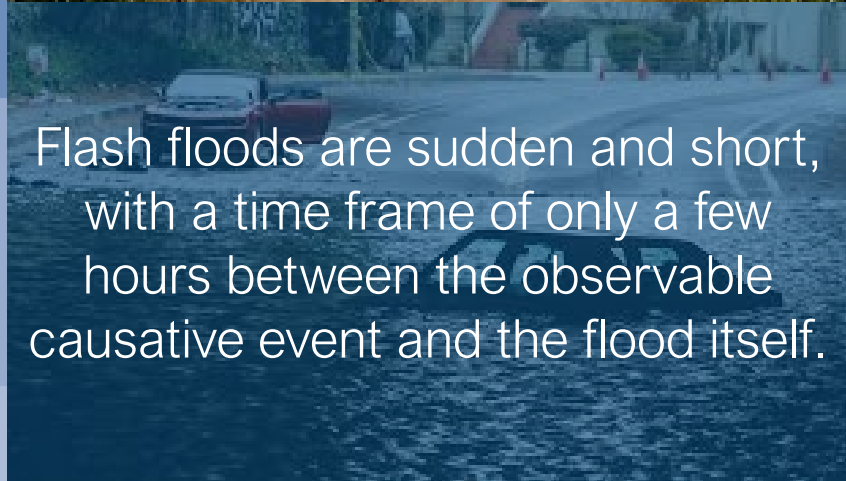
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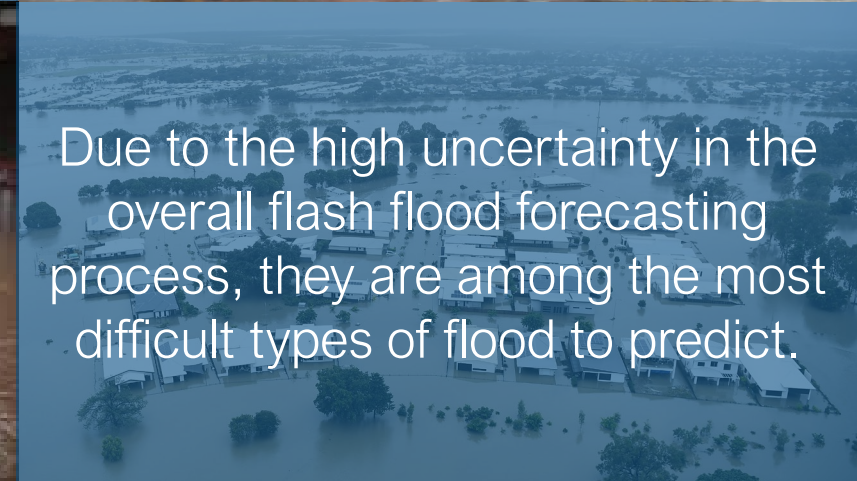




Globally, flash floods account for 85% of all floods, have the highest mortality rate among all categories of flooding (causing more than 5000 deaths annually), and have severe social, economic and environmental impacts.



Flash floods are sudden and short, with a time frame of only a few hours between the observable causative event and the flood itself.



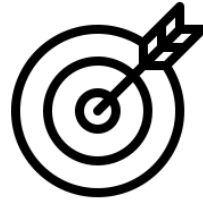
Due to the high uncertainty in the overall flash flood forecasting process, they are among the most difficult types of flood to predict.



Forecast-triggered mitigation strategies for flood risk reduction, can enhance resilience, reduce mortality and recovery costs, especially in low-income countries with poor or no alternative solutions for flood protection.



Global flash flood forecasts: what would users like?



ACCURATE PREDICTIONS OF THE AREAS AT RISK OF FLASH FLOODS

To reduce false alarms or missed events



LONG LEAD TIMES

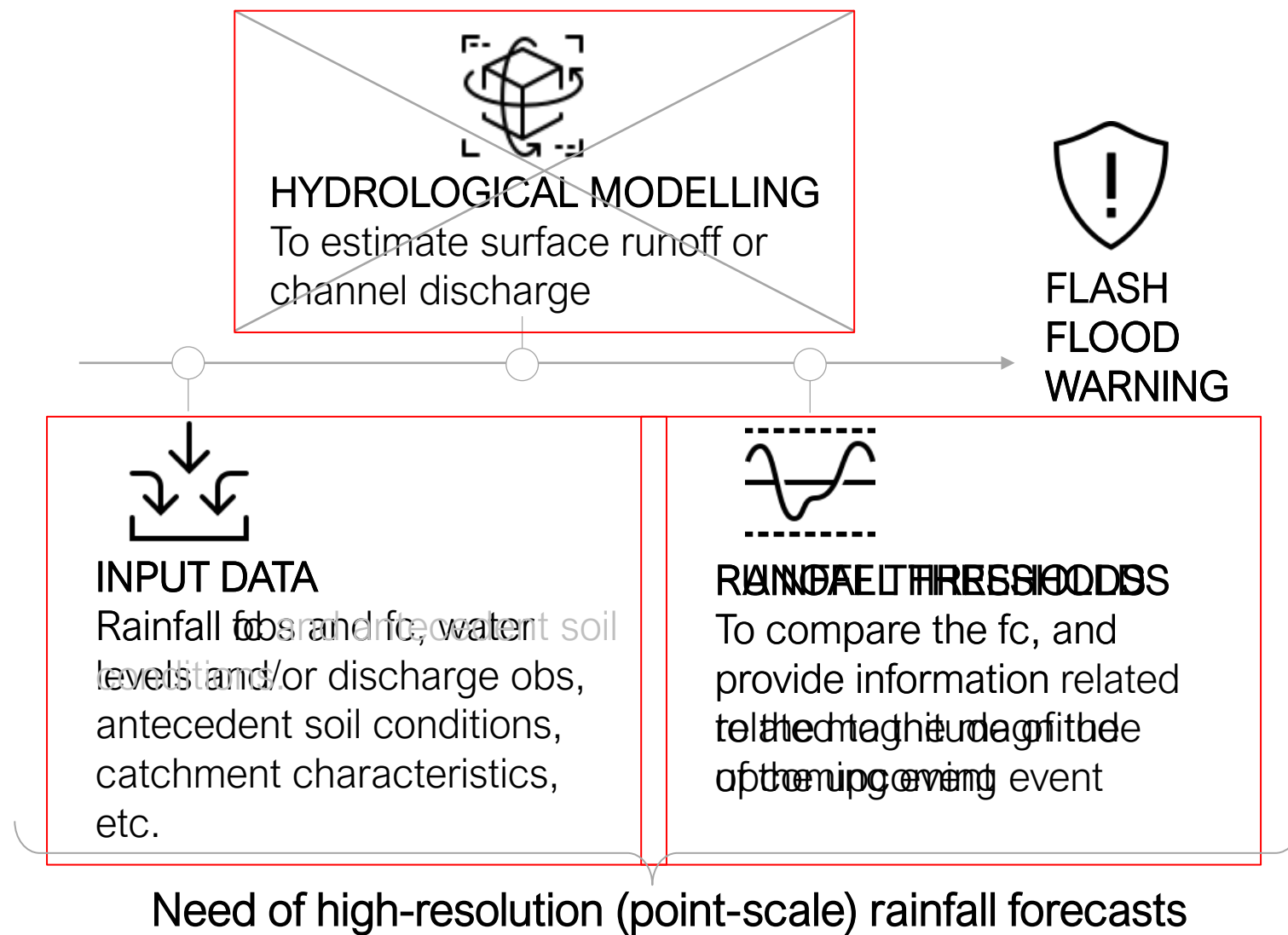
To increase decision makers' action times and the ability to reach the community



CONTINUOUS GLOBAL DOMAIN

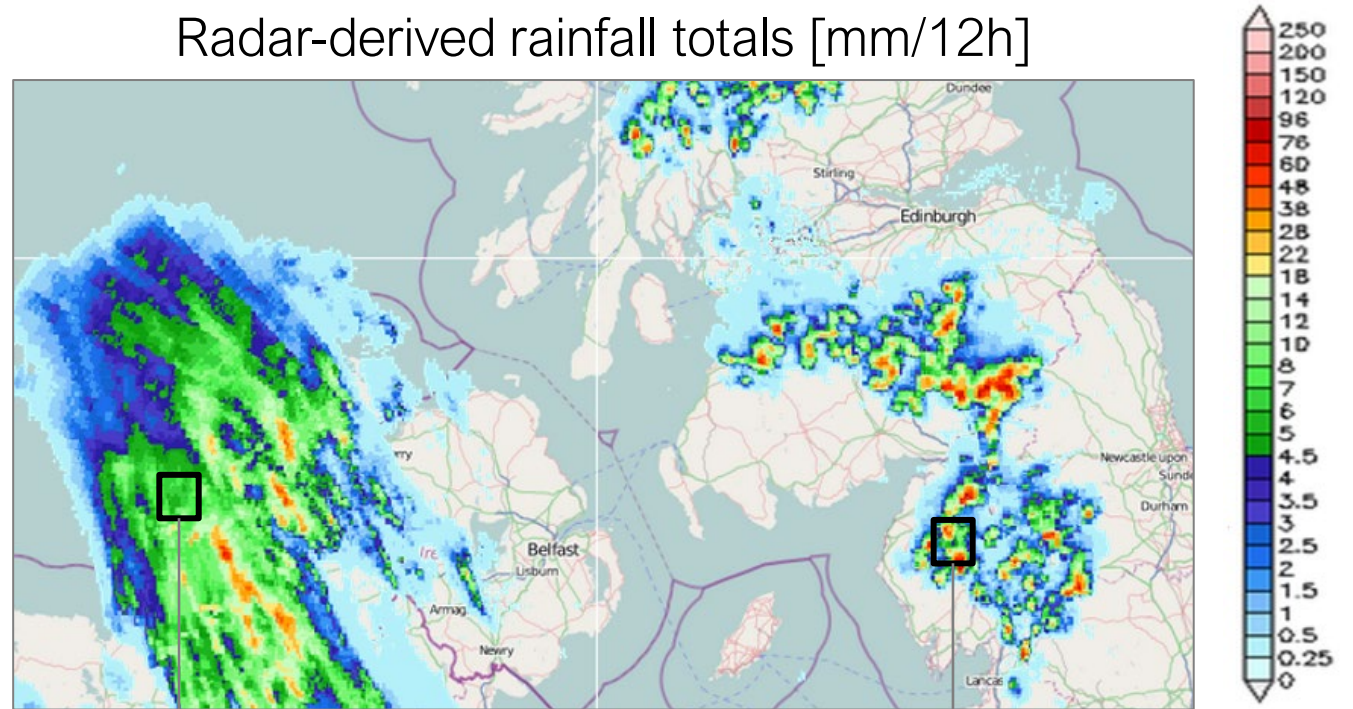
To produce seamless forecasts around the world

Can we satisfy users needs? Let's have a look at the generic flash flood forecasting chain



How well
global
ensemble
NWP models
represent
point rainfall
totals?

Radar-derived rainfall totals [mm/12h]



GRID-BOX FC
REPRESENTATIVE OF
POINT VALUES
5 to 12 mm [point totals]
Mean = 8 mm [grid-box fc]

GRID-BOX FC NOT
REPRESENTATIVE OF
POINT VALUES
0 to 80 mm [point totals]
Mean = 6 mm [grid-box fc]

How do other options predict point-scale rainfall to produce



flash flood predictions?

	Global NWP	Km-scale NWP	Nowcasting
Spatial coverage	Very good Global	Good Up to continental scale	Poor Regional
Lead times	Very good Up to medium or monthly scales	Good Up to a few days	Poor Up to a few hours
Distribution of rainfall totals	Good Better for large-scale than convective rain	Very good	Very good
Location of extremes	Good Better for large-scale than convective rain	Good Not always in the right place	Very good

ecPoint

Statistical post-processing technique that produces probabilistic rainfall forecasts at point-scale.

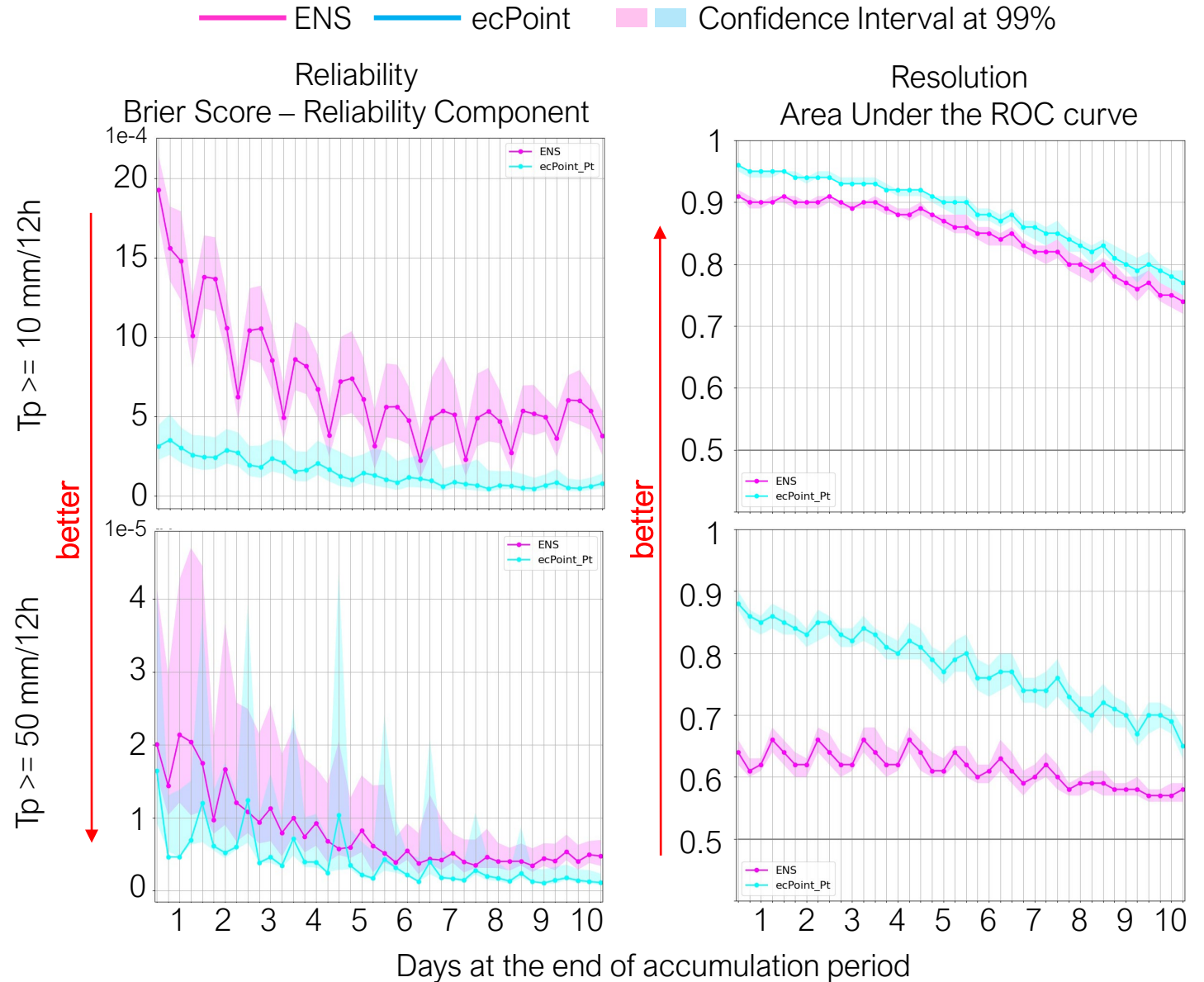
Methodology

Nature, Communications Earth & Environment, 2021

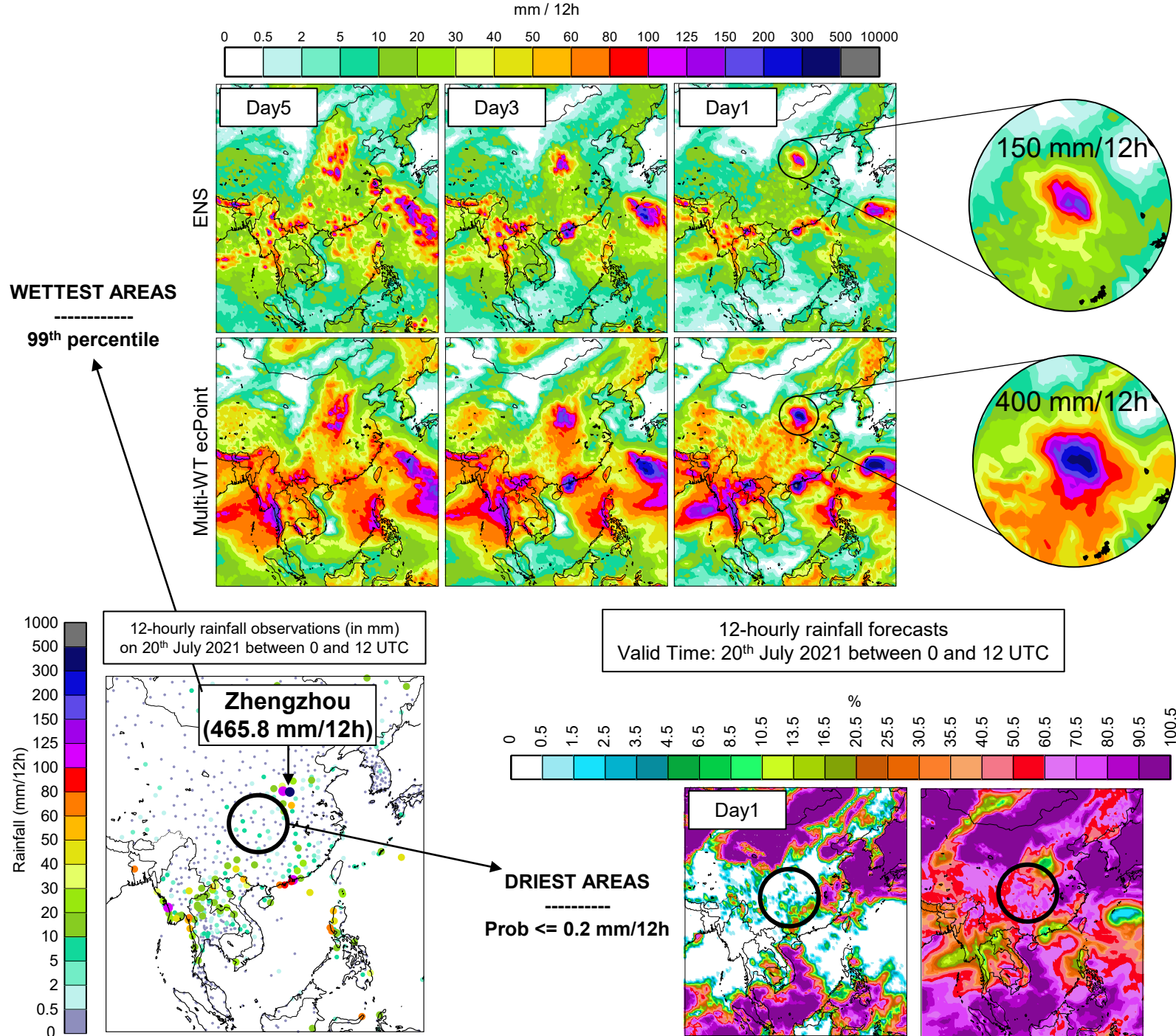


Forecasters		ecPoint
Forecasters relate upcoming weather pattern to their experience of similar local patterns , and recall how the model performed relative to local observations .	Learning from past observations	ecPoint cross-references the upcoming weather pattern to similar past patterns worldwide , and assesses model performance relative to worldwide observations .
Forecasters approach is subjective , adjusting forecasts intuitively based on personal experience. The qualitative probabilities might be unreliable and inconsistent .	Post-processing	ecPoint is objective , converting forecasts using mathematical transformations . The quantitative probabilities are generally reliable and consistent .
Forecasters will be slow adapting to NWP model updates as it takes time to build experience of a new model version.	Keeping up with model evolution	ecPoint can adapt immediately to NWP model updates via a dynamical calibration process.

Compared to ECMWF ENS, how well does ecPoint represent point rainfall totals?
 1-year global verification for 47r3

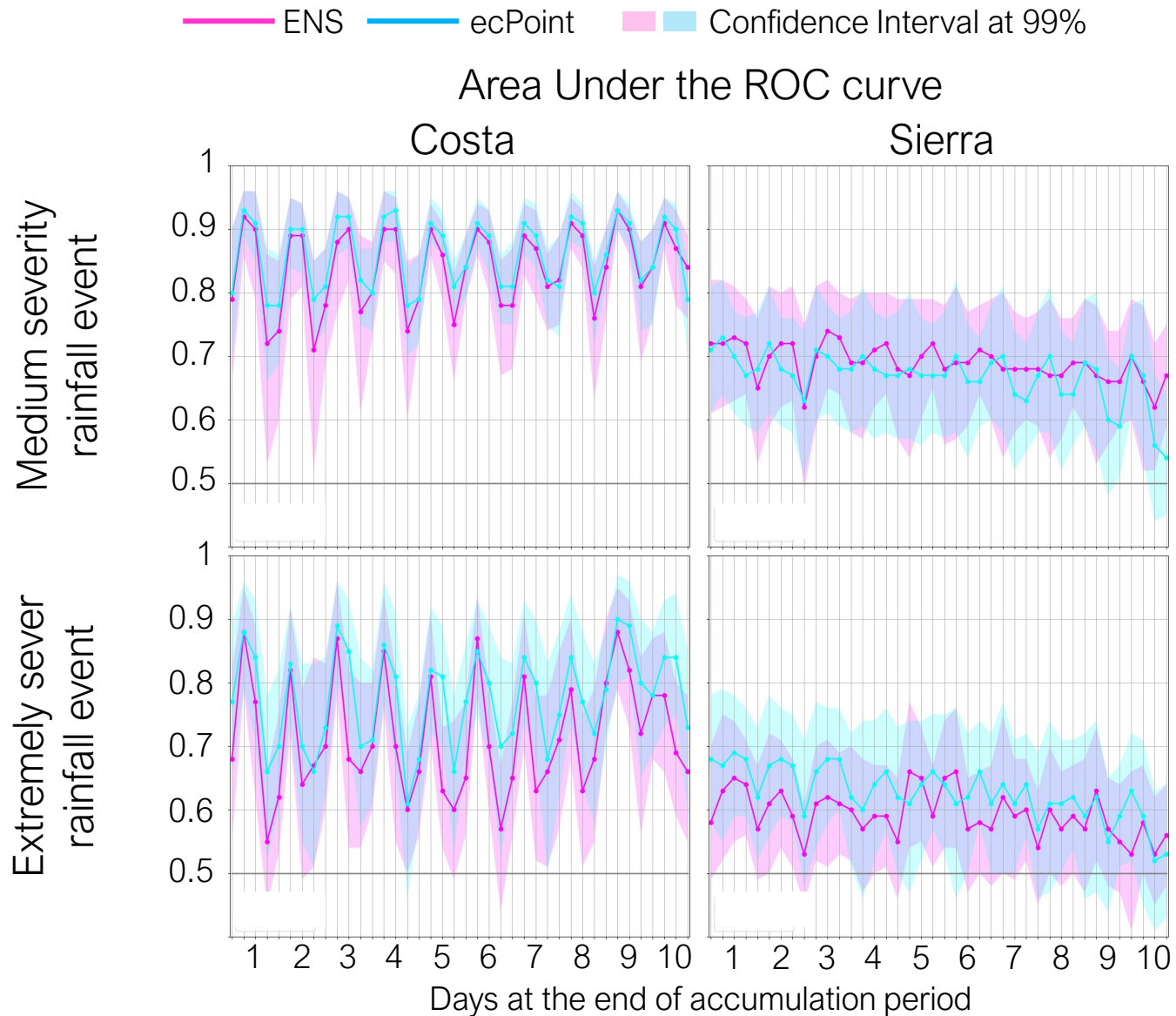
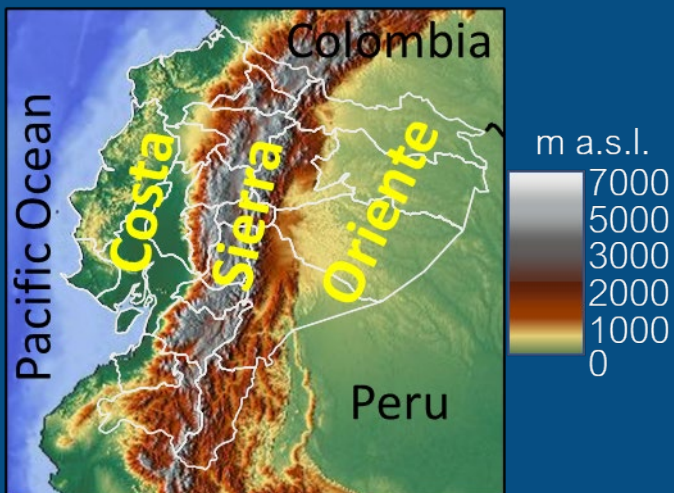


Compared to ECMW ENS, how well does ecPoint represent areas at risk of flash flood? Case study for Henan, China (20th July 2021)



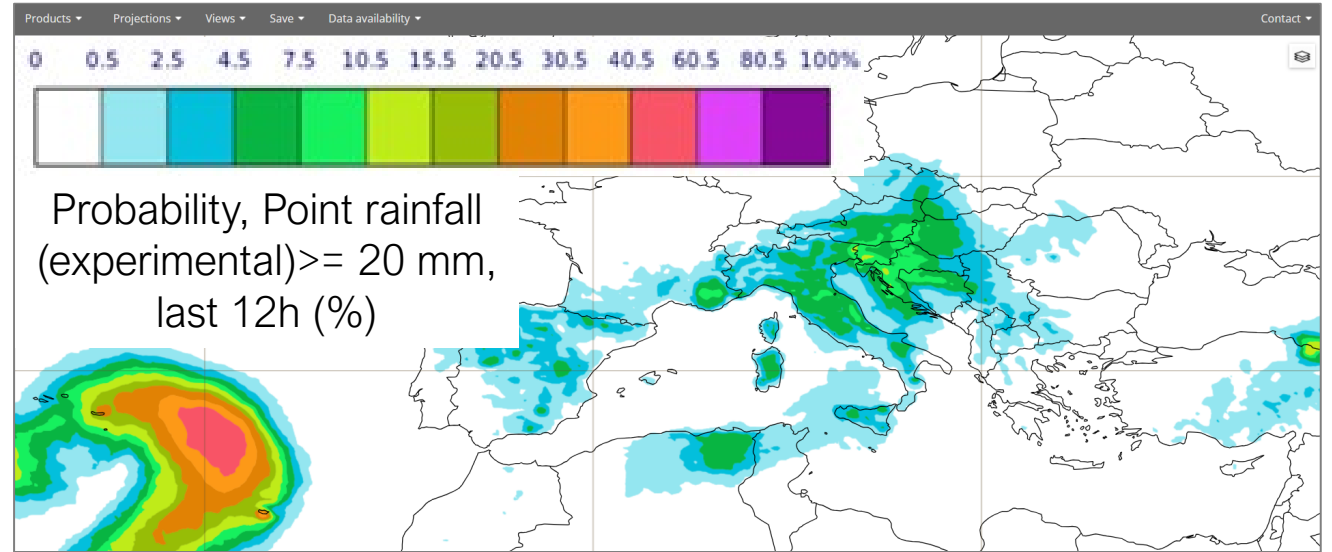
Proof of concept

1-year verification at national scale in Ecuador of ENS and ecPoint rainfall forecasts, up to medium-range forecasts.

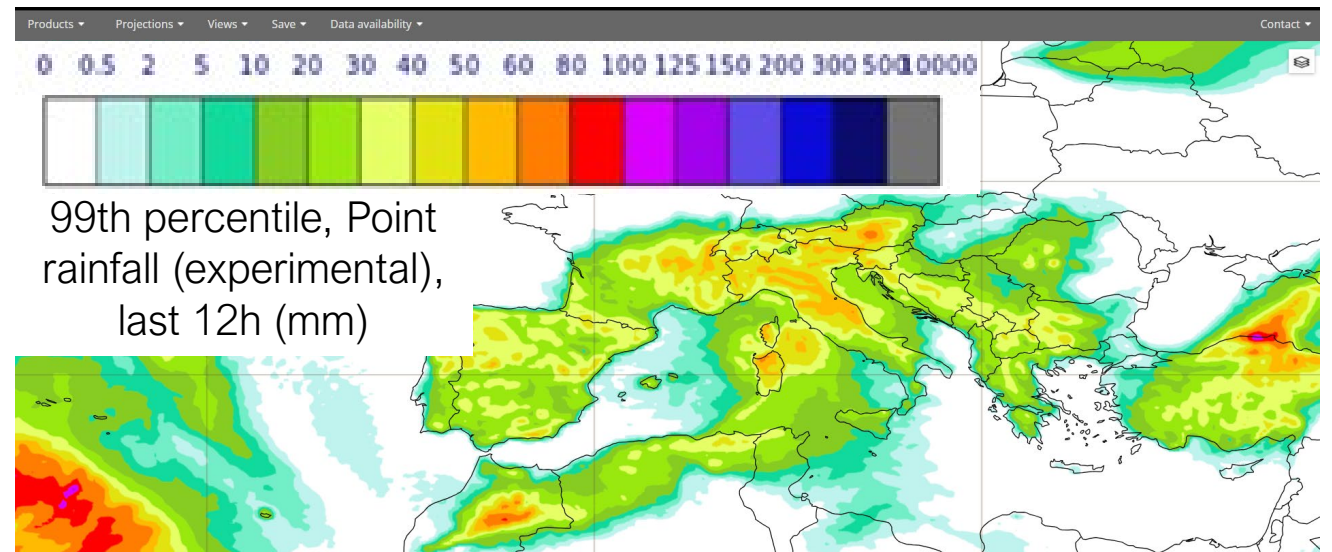


Is it possible to identify areas at flash flood risk with global ensemble rainfall forecasts?

If the user **knows** the rainfall value that can cause flash floods in an area

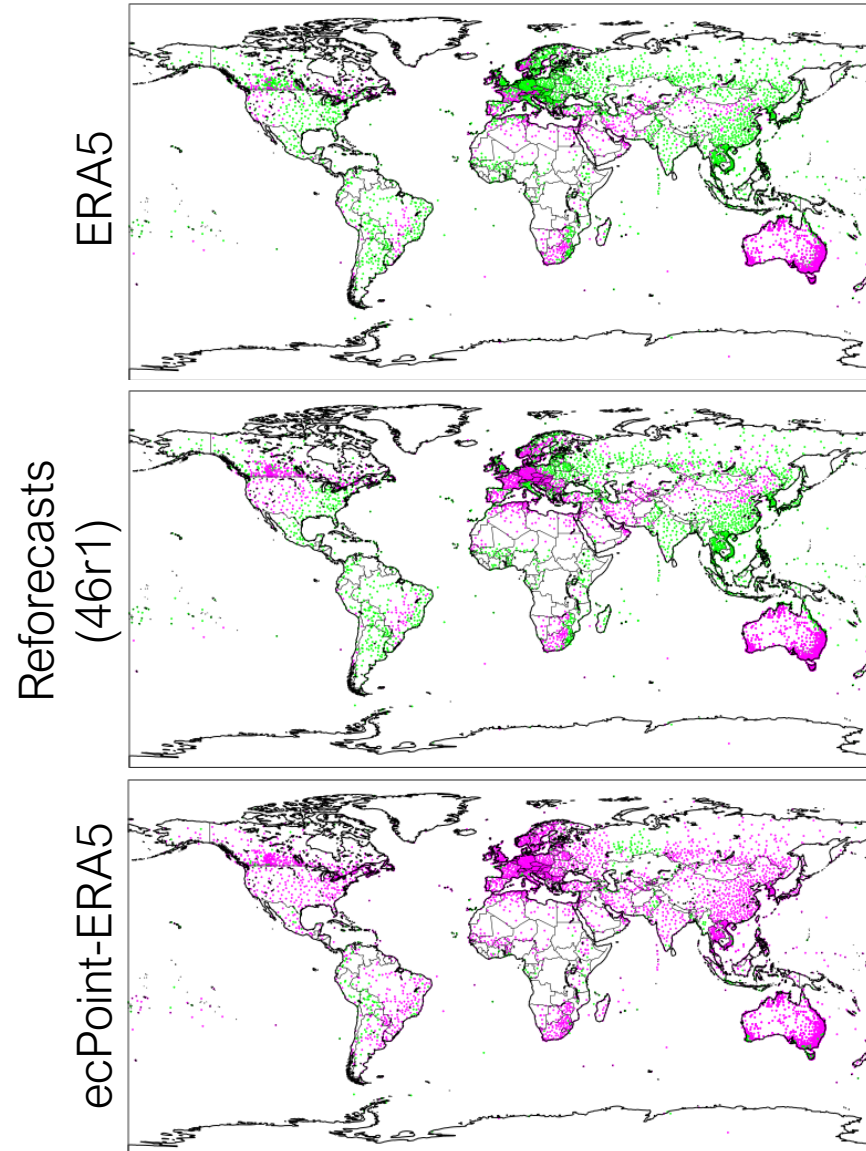


If the user **does not know** the rainfall value that can cause flash floods in an area



Where can this rainfall cause flash floods?

How can point-based rainfall climatologies be produced? ecPoint-ERA5



Rainfall climatologies at point stations (2000 to 2019)

Anderson – Darling test

Modelled climatology IS representative of point rainfall climatologies

Modelled climatology IS NOT representative of point rainfall climatologies

Future work

Developing a global layer of areas at flash flood risk by combining point-scale probabilistic rainfall forecasts with point-scale modelled rainfall climatology.

Information on antecedent soil condition could be added to further refine the areas at risk.

Mock-up

