

Do we (still) need ensemble predictions?

Florian Pappenberger & David Richardson

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Do we (still) need ensemble predictions?

All Forecasts have uncertainty
Forecasts without specification of uncertainty are pointless

THE END

~~Do we (still) need ensemble predictions?~~ What do we actually want to achieve?

(within the background of ever increasing skill)

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ECMWF

INTERGOVERNMENTAL ORGANISATION
34 MEMBER AND COOPERATING EUROPEAN STATES
IN READING, UK

Global Medium Range Weather Forecasts – for Europe, in Europe

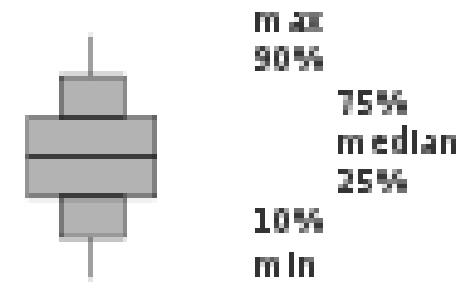
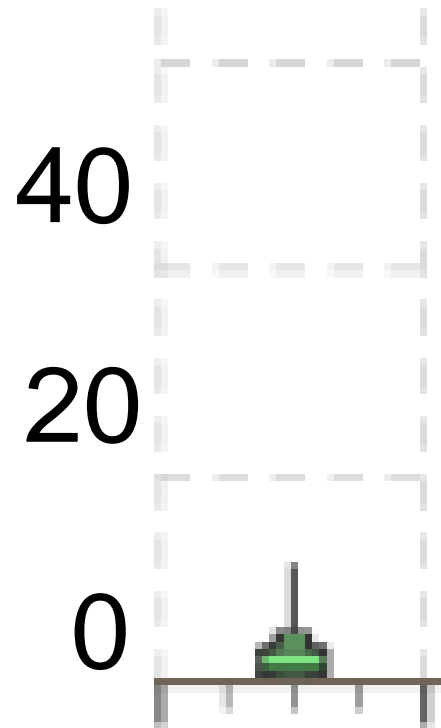


EUROPEAN CENTRE FOR MEDIUM RANGE WEATHER FORECASTS

Take an umbrella?



Take an umbrella?

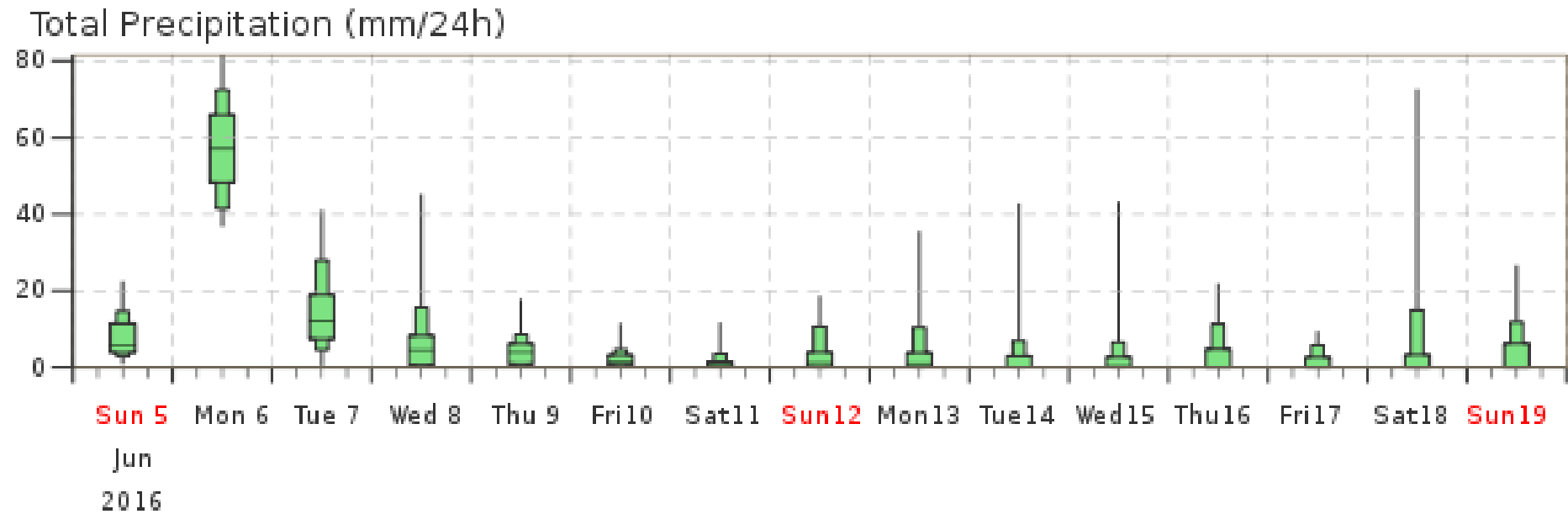


Take an umbrella?

ENS Meteogram

Québec, Canada 46.88°N 71.19°W (ENS land point) 47 m

Extended Range Forecast based on ENS distribution Sunday 5 June 2016 00 UTC

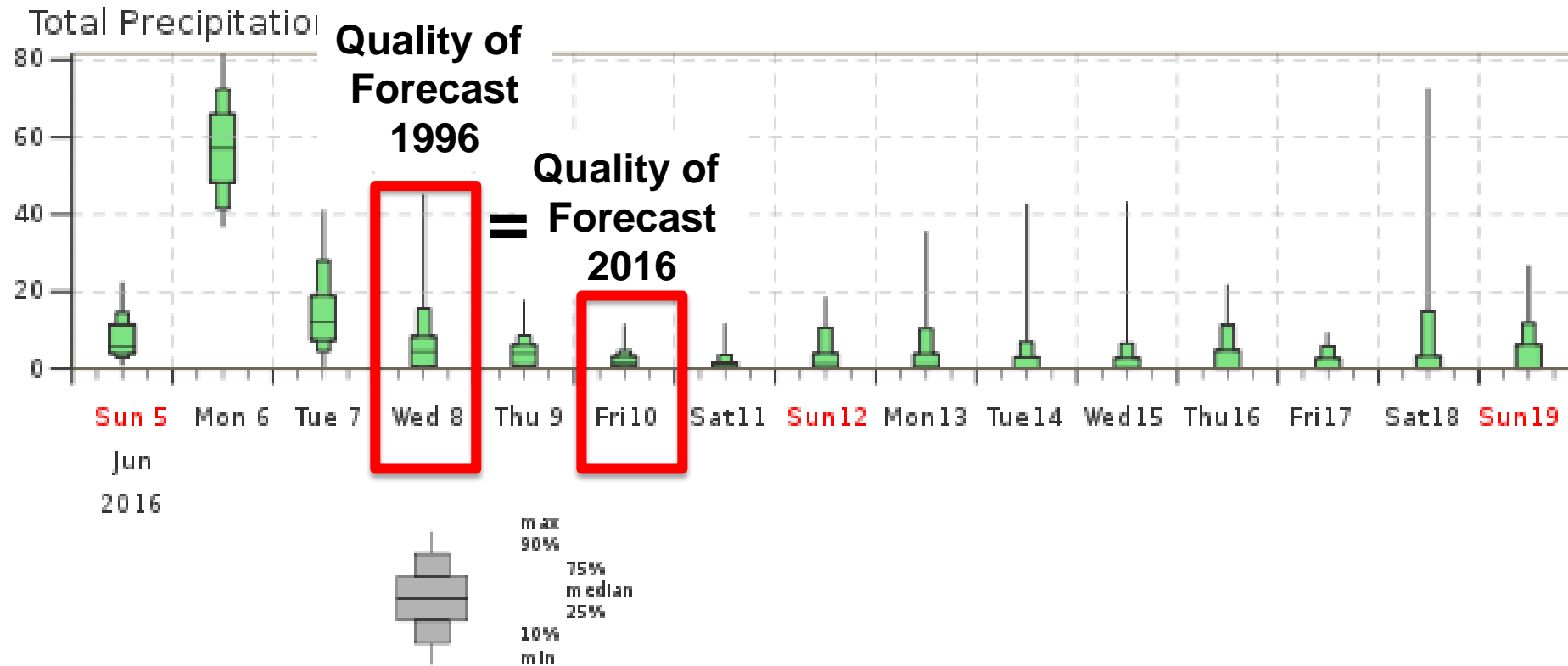


Take an umbrella?

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Extended Range Forecast based on ENS distribution Sunday 5 June 2016 00 UTC



Meteorological Forecast Skill

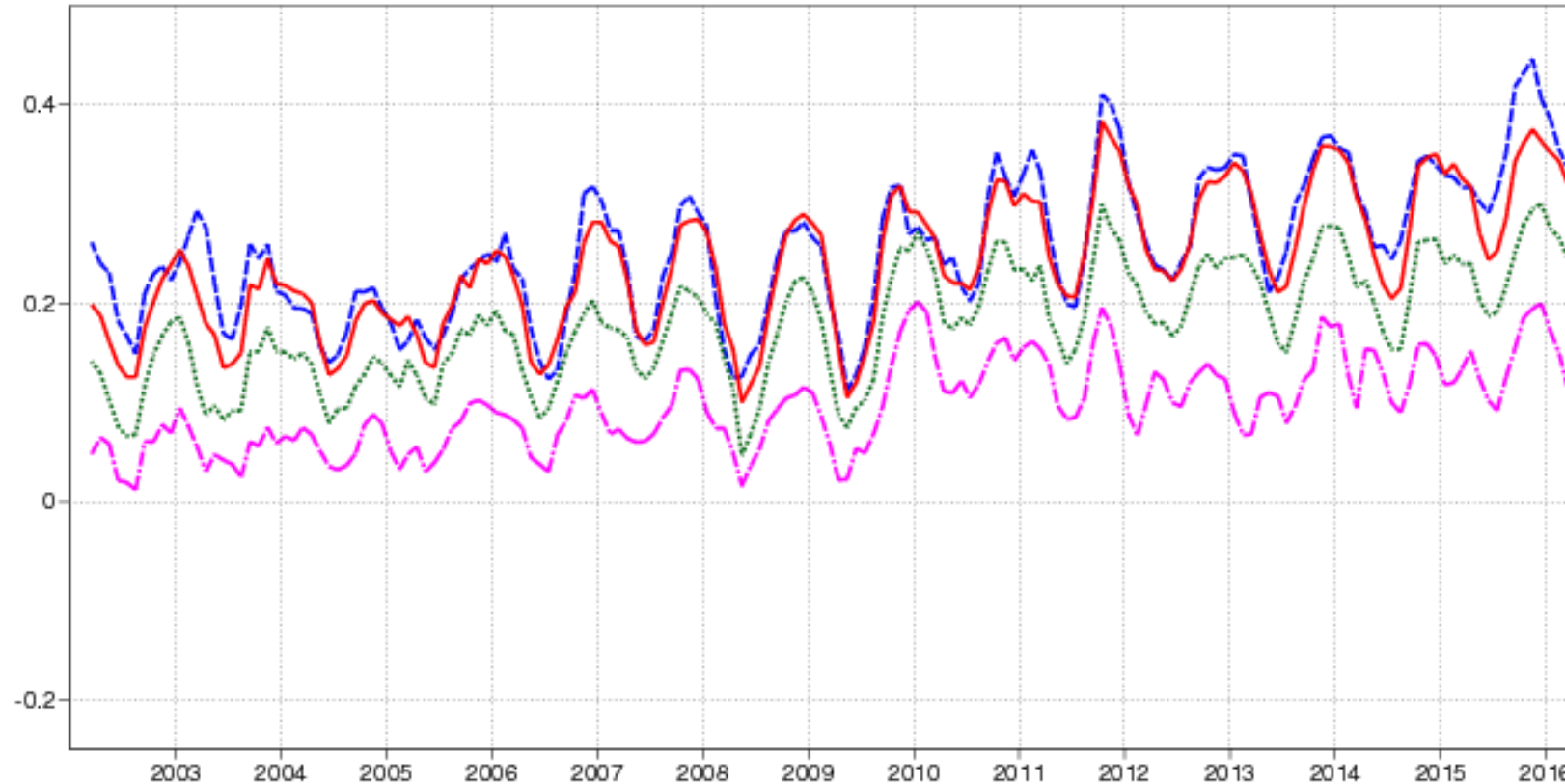
total precipitation
bss_ct (3M running mean)

Europe N Africa (lat 25.0 to 70.0, lon -10.0 to 28.0)

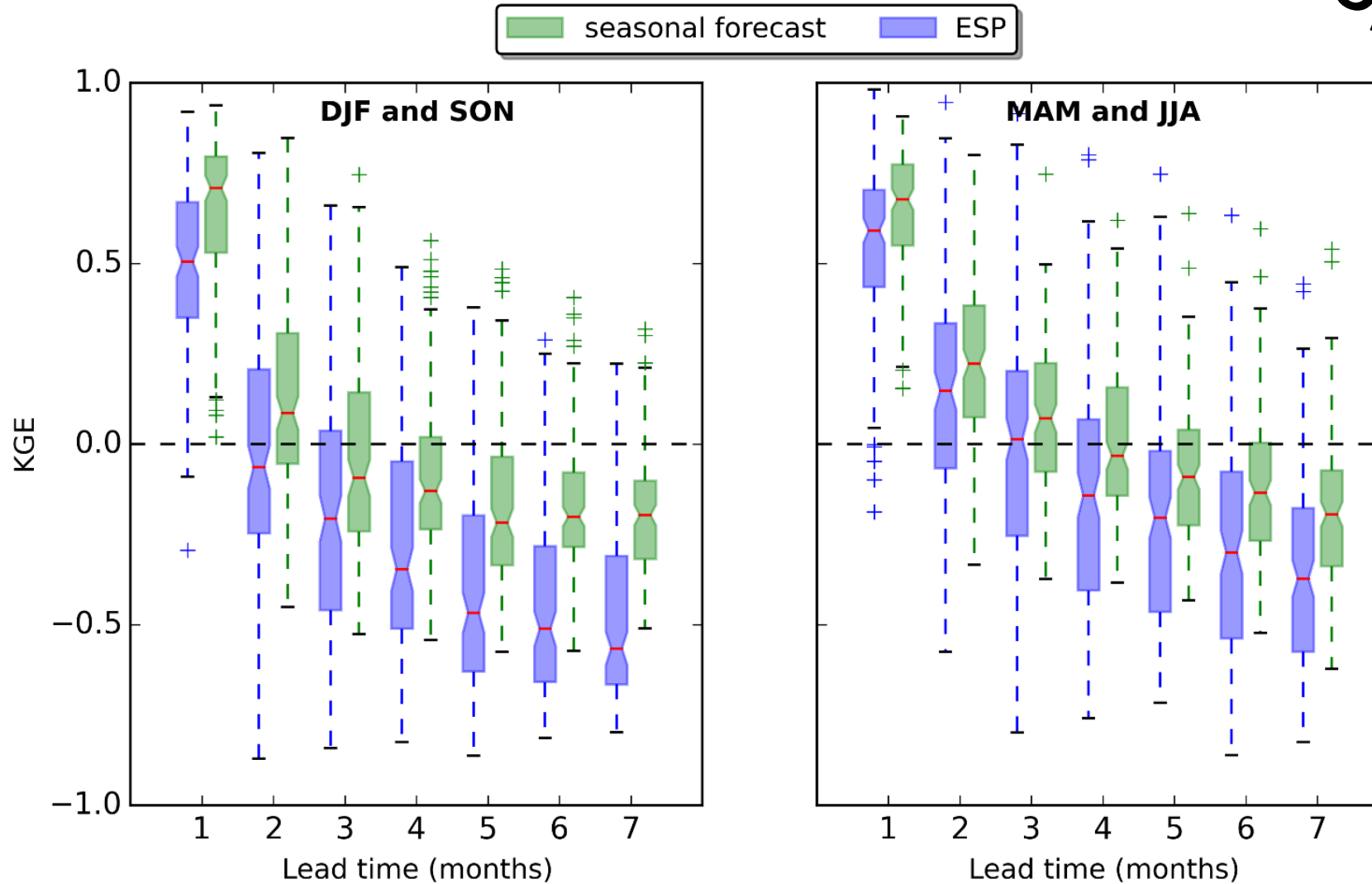
T+96

oper_ob od enfo 0001 | 12UTC

- value >20.0
- value >10.0
- value >5.0
- value >1.0



Hydrological Forecast Skill



Operational

In preparation:
Global hydrological & meteorological seasonal forecasts from 1900-2010 (release ~2month)

Is it a good return on investment?

For medium range flood forecasting - YES



1

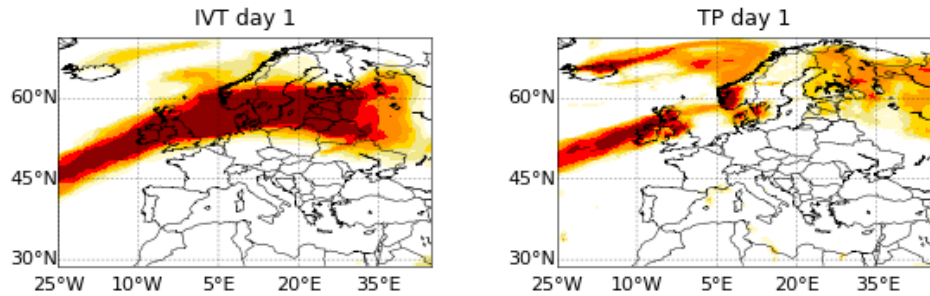
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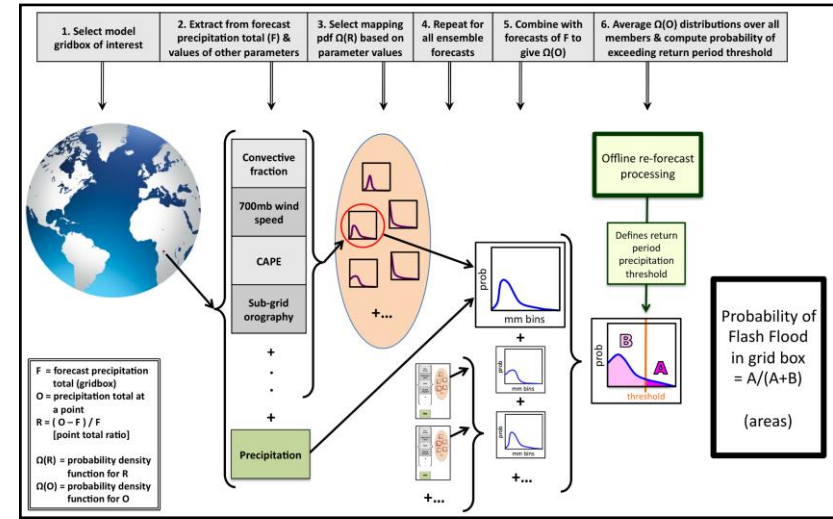
.... Bit more complex – see paper on “Monetary benefit ...”

Pappenberger, F., Cloke, H.L., Parker, D.J.,
Wetterhall, F., Richardson, D.S., Thielen, J., 2015.
The monetary benefit of early flood warnings in
Europe. *Environmental Science & Policy* 51, 278-291

... and we are working on getting it even better ...

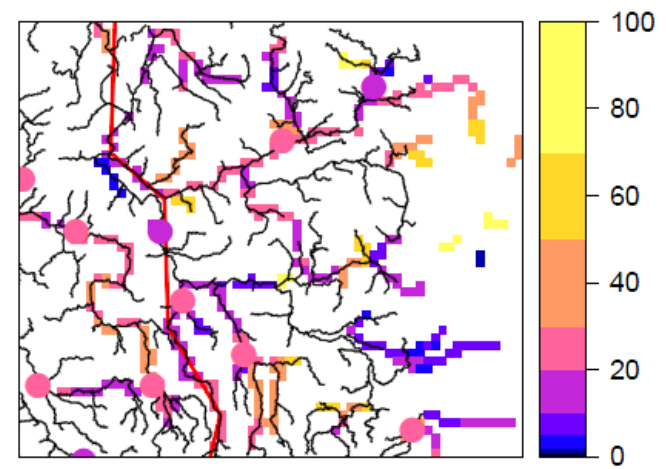


FURTHER - ECMWF Extreme Forecast Index (EFI) for water vapour transport and total precipitation (Q4 2016)

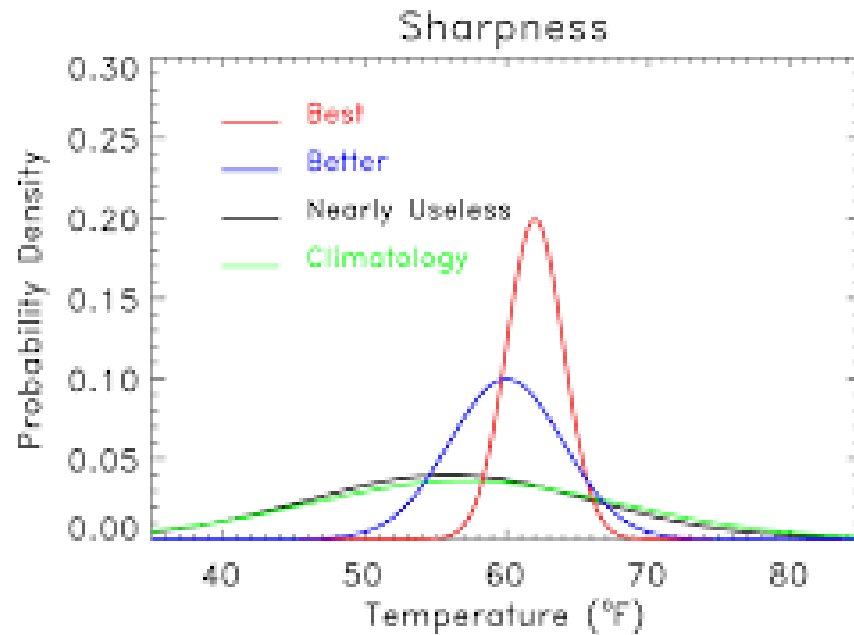
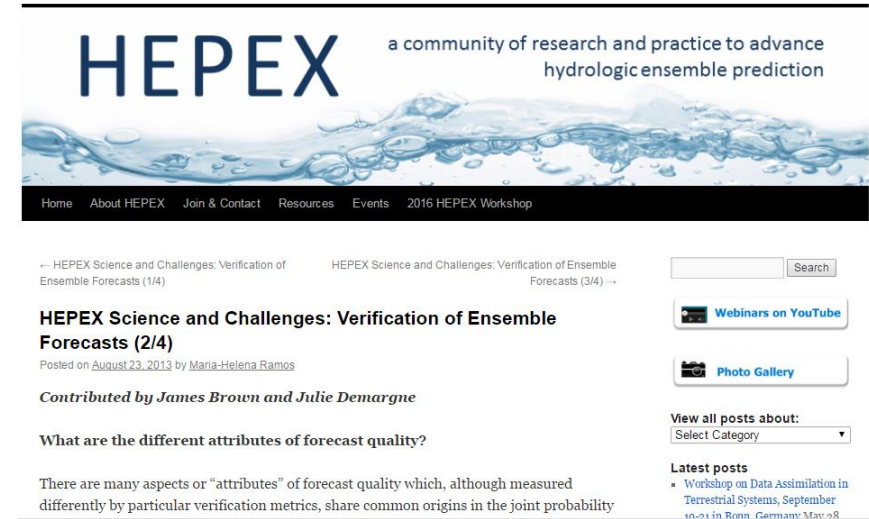


HIGHER - Towards a global Flash Flood Forecasting system (Q2 2017)

More **SKILLFULL** - Regionalization of post-processed ensemble runoff forecasts (Q1 2017)



There are many attributes (see blogpost) Will concentrate on Sharpness & Skill



$$\text{Skill} \sim \frac{f(\text{forecast, observations})}{f(\text{benchmark, observations})}$$

Assume reliability!!!

Traditional question: What is the minimum skill you (you == user) need to make a decision?

Consequence: science plan is focusing on pushing the forecast horizon!

Strategy 2016 - 2025

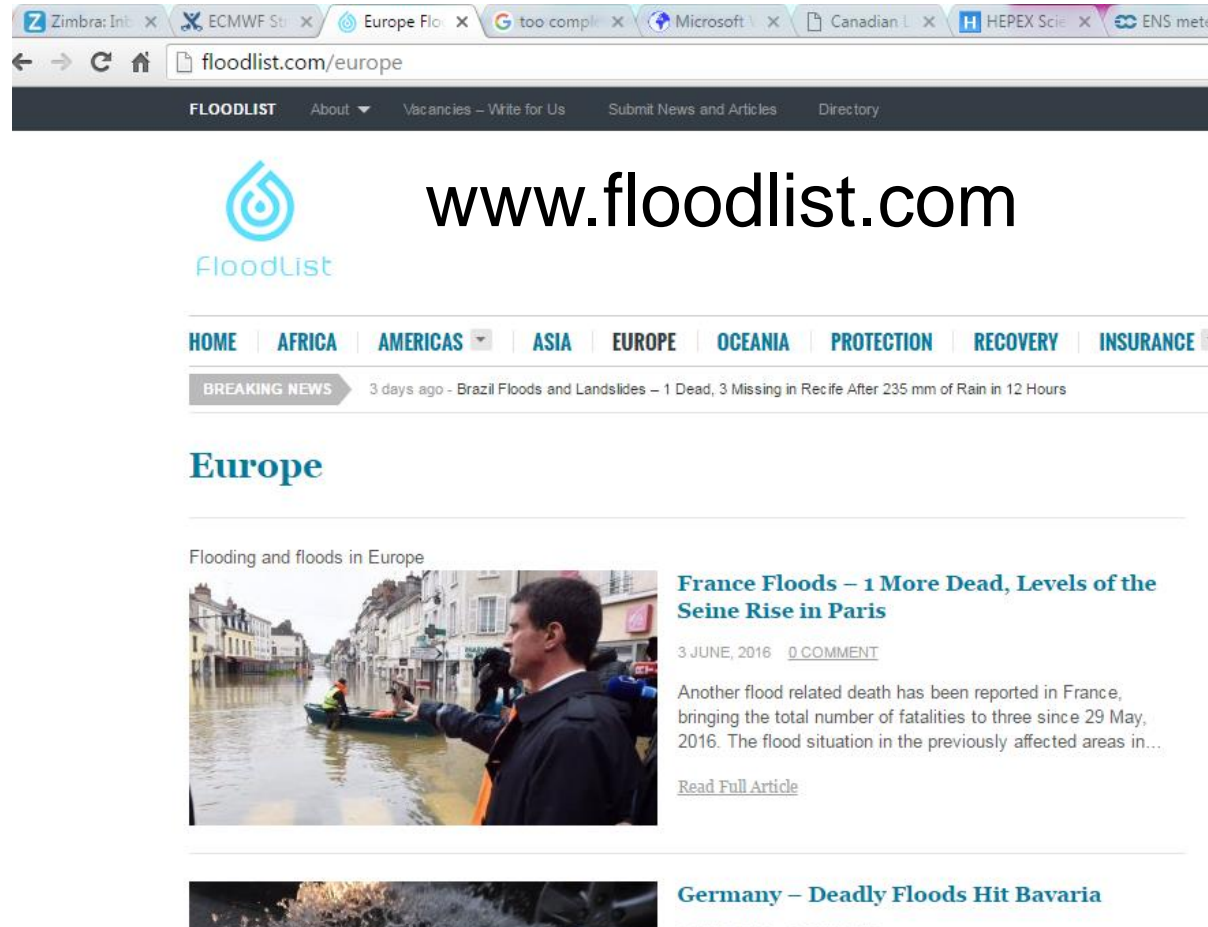
DRAFT

Forecast targets by 2025

- Ensemble predictions of **high impact weather** up to two weeks ahead
- Seamless approach, aiming towards predictions of **large scale patterns and regime transitions** up to four weeks ahead and **global-scale anomalies** up to a year ahead

 **ECMWF** EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

... loads of nice examples ... and then



The screenshot shows a web browser with multiple tabs open, including 'Zimbra: Int...', 'ECMWF Str...', 'Europe Flo...', 'too compl...', 'Microsoft', 'Canadian L...', 'HEPEX Scie...', and 'ENS mete'. The address bar shows 'floodlist.com/europe'. The website header includes 'FLOODLIST' and navigation links: 'About', 'Vacancies - Write for Us', 'Submit News and Articles', and 'Directory'. The main content area features a navigation menu with 'HOME', 'AFRICA', 'AMERICAS', 'ASIA', 'EUROPE', 'OCEANIA', 'PROTECTION', 'RECOVERY', and 'INSURANCE'. A 'BREAKING NEWS' section highlights '3 days ago - Brazil Floods and Landslides - 1 Dead, 3 Missing in Recife After 235 mm of Rain in 12 Hours'. The main article is titled 'Europe' and 'Flooding and floods in Europe'. The featured article is 'France Floods - 1 More Dead, Levels of the Seine Rise in Paris', dated 3 JUNE, 2016, with a 'COMMENT' link. The article text states: 'Another flood related death has been reported in France, bringing the total number of fatalities to three since 29 May, 2016. The flood situation in the previously affected areas in...'. A 'Read Full Article' link is provided. Below this, a partial article titled 'Germany - Deadly Floods Hit Bavaria' is visible.

ECMWF operates:
EFAS - The European Flood Awareness System (efas.eu)
GloFAs – Global Flood Awareness System (globalfloods.eu)

Funded by



EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

Forecast Performance?

From: Somebody

To: Many

Sent: Friday, 3 June, 2016 4:48:20 PM

Subject: EFAS and the floods in France and Germany

Dear all,

After we had some serious flooding in France and Germany (and still ongoing) I thought it was time to give a quick update and feedback on the overall EFAS performance.

In general, I believe that EFAS forecasts have worked very well, especially for the floods in the Seine and Loire river basins where we had quite a long lead time. We furthermore, tested the rapid impact assessment tool and the pre-activation of the Copernicus EMS rapid mapping (was activated on Wednesday) and the results so far seem very promising. More news on these topics to come soon!

Although the EFAS flash flood indicator predicted a number of areas with a high risk of flash flooding during the last week, it unfortunately did not pick up the severe flash floods in Bavaria and Baden-Wuerttemberg. This is, of course, related also to the fact that such events are still very hard to predict and a lot of basic research in meteorology and hydrology still needs to be done to improve this. Nevertheless, with the foreseen incorporation of the OPERA radar data we will do at least the next step to hopefully improve predictability of flash floods a little bit within EFAS.

Forecast Performance?

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- De ➤ Medium Range Flood-Forecast worked well for Seine and Loire river
- Aff ➤ Successfully managed to activate satellite rapid mapping
- fee ➤ Flash Flood forecast for Germany did NOT work
- In
- we
- EM
- co Implications on where we actually put resources!

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How early we need to be?

Pathway	Description	Avoided damages due to early warning (%)
Flood Defence Operations (FDO)	Avoided damages by warning dependent flood defences	32%
Watercourse Capacity Maintenance (WCM)	Damages avoided by Water Course maintenance	0.9%
Community Based Operations (CBO)	Damages avoided by community-level defences	0.36%
Warning Dependent Resistance (WDR)	Residual damage avoided by warning-dependent (temporary resistance measures)	0.0036%
Contents Moved & Evacuated (CME)	Residual damages avoided by moving and evacuation property contents	5.7%
Early Warning measures	FDO, WCM, CBO	32.85%
Total	FDO, WCM, CBO, WDR, CME	36.68%

From:

Pappenberger, F., Cloke, H.L., Parker, D.J., Wetterhall, F., Richardson, D.S., Thielen, J., 2015. The monetary benefit of early flood warnings in Europe. *Environmental Science & Policy* 51, 278-291

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What skill do we actually want to achieve?
& what is the maximum skill we actually need to achieve?

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Contents Moved & Evacuated (CME)	Residual damages avoided by moving and evacuation property contents	5.7%
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Sharpness No time



Inundation forecast



<< sharpness



hydropower forecast



>> sharpness

Ensemble Nr. 2

Ensemble Nr. 1

Sharpness No time



Inundation forecast



<< sharpness

What sharpness do we actually want to achieve?



hydropower forecast



>> sharpness

Ensemble Nr. 2

Ensemble Nr. 1

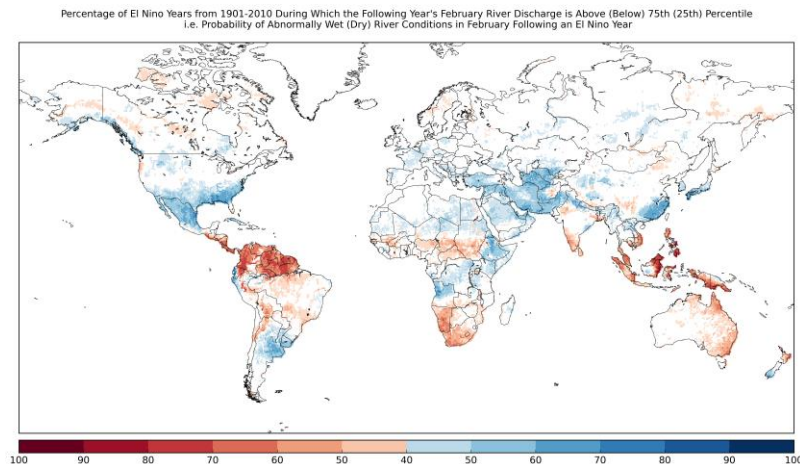
... still some way to go ...



Standard Operating Procedures (SOPs):
For Disaster Preparedness Fund in case of a
flood forecast in Teso

New **ideas** are complex (we only have them after
we have tried something else)

World is complex



Users are complex



Challenges of Operational River Forecasting

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(Manuscript received 16 November 2013, in final form 22 April 2014)

ABSTRACT

Skillful and timely streamflow forecasts are critically important to water managers and emergency protection services. To provide these forecasts, hydrologists must predict the behavior of complex coupled human–natural systems using incomplete and uncertain information and imperfect models. Moreover, operational predictions often integrate anecdotal information and unmodeled factors. Forecasting agencies

Conclusions

- We are very good in pushing boundaries and advancing science and forecasting
- We are bad in setting out what skill & sharpness (and other attributes) we actually want to achieve when we start! **Maybe cause we still think it is far away?**

This workshop will contribute a lot to (1) and hopefully even some answers to (2)

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