S2S hydrological forecasts over Europe

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Motivation

Sub-seasonal to seasonal hydrological forecasts are ***potentially*** useful for decision makers.

BUT, they need to be **skilful** and **reliable** on the **lead times** needed for a **specific application.**

The main aim of the study: To assess the limits of hydrological forecast predictability at the S2S time scale over Europe

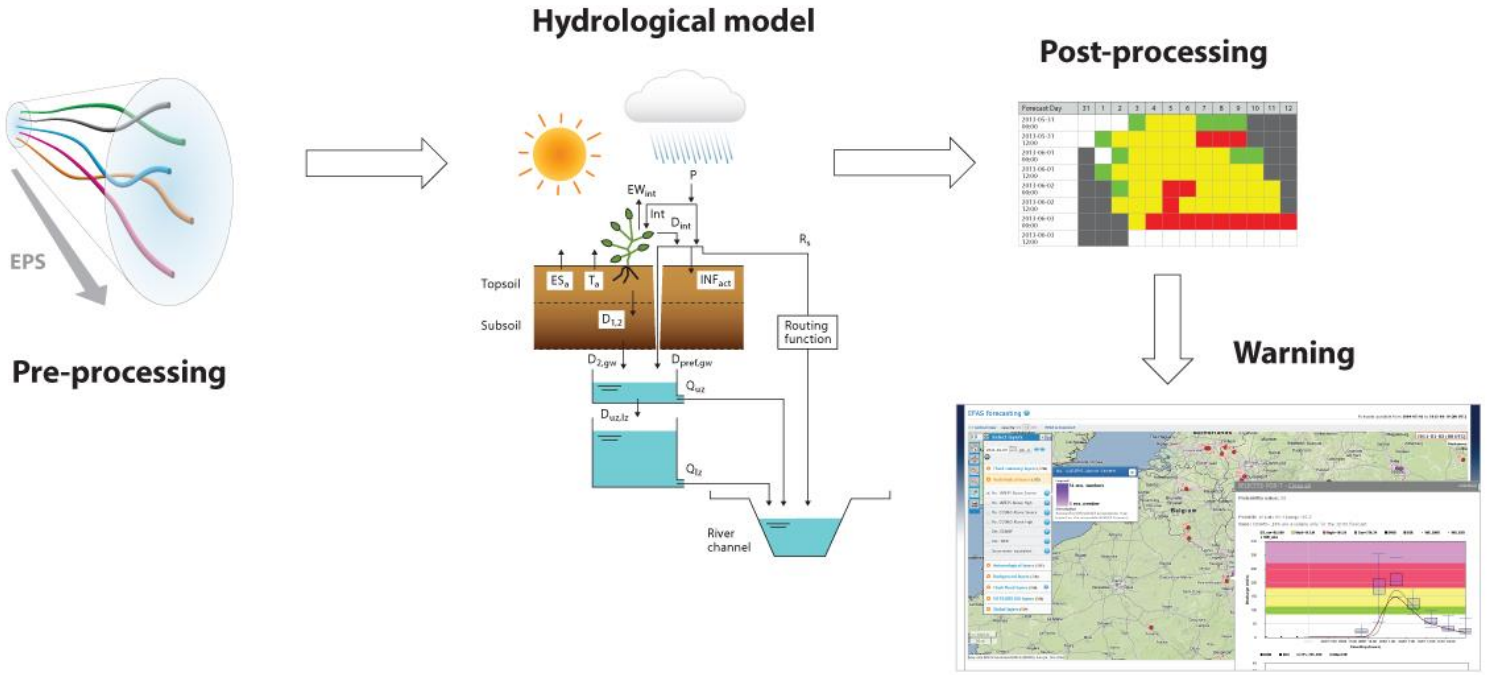
Q: How to construct the best S2S forecast given operational systems?

Q: Are there regimes (high/low flow), regional and seasonal variations that affect the predictability?

Q: How much of the predictability can be attributed to hydrological initial conditions and how much from atmospheric model?

Q: Given that the above is are answered, can the forecasts provide "actionable" information?

European flood awareness system (www.efas.eu)



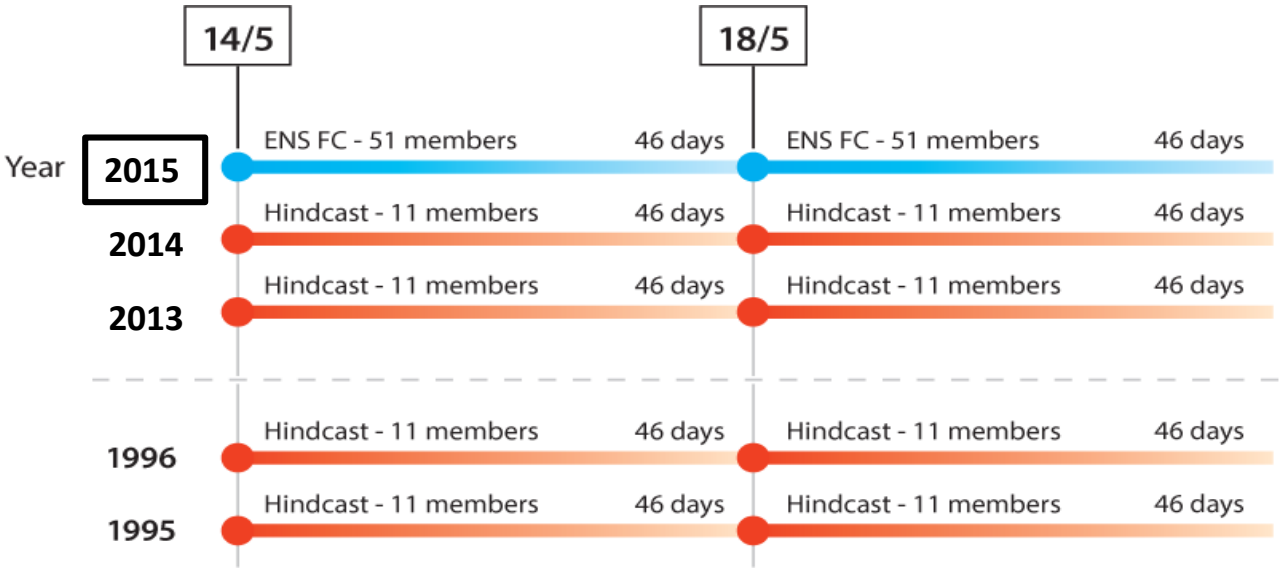
Operational 24/7/365

5 km resolution across Europe ~250K points

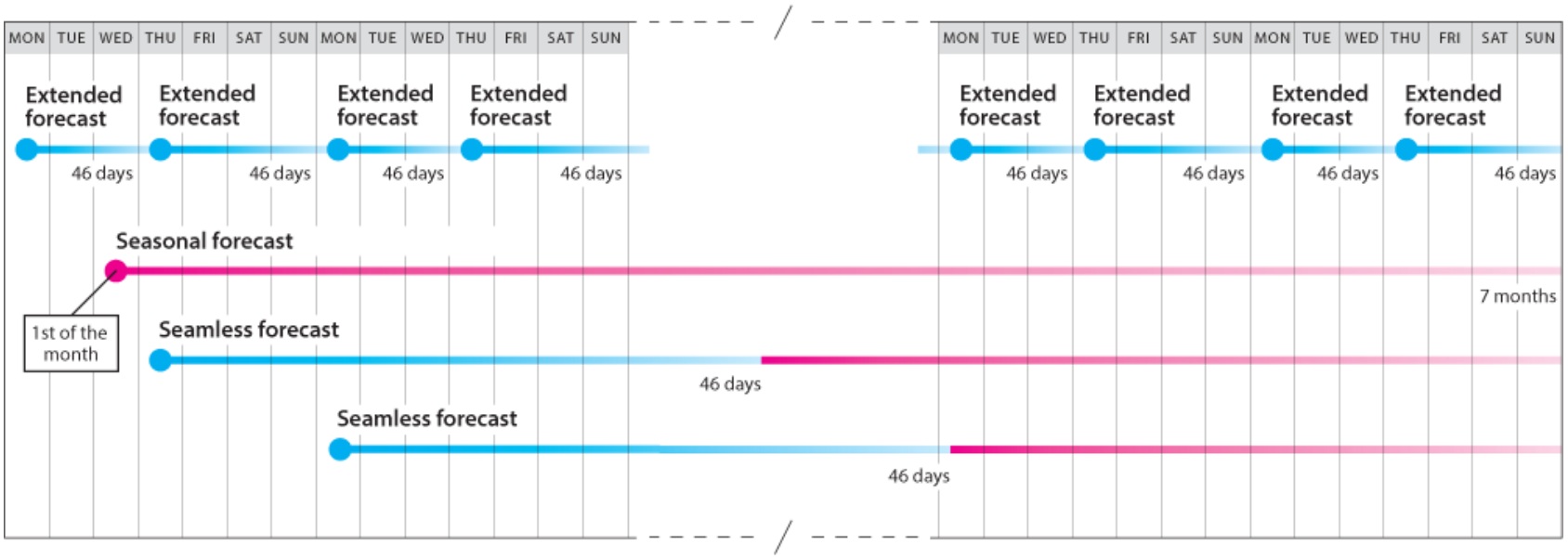
Twice daily probabilistic forecasts

Experiment setup

Forcing	Spatial	Lead time	Issued	Ensembles	Hindcast
Seasonal	80 km	7/12 months	Monthly	51/15	30 years
Extended	18/32 km	46 days	2/week	51/11	20 years
Obs.	5 km	N/A	N/A	Climatology	27 years



A first step towards a “seamless” forecast



Concatenation of extended-range and seasonal forecast after day 47

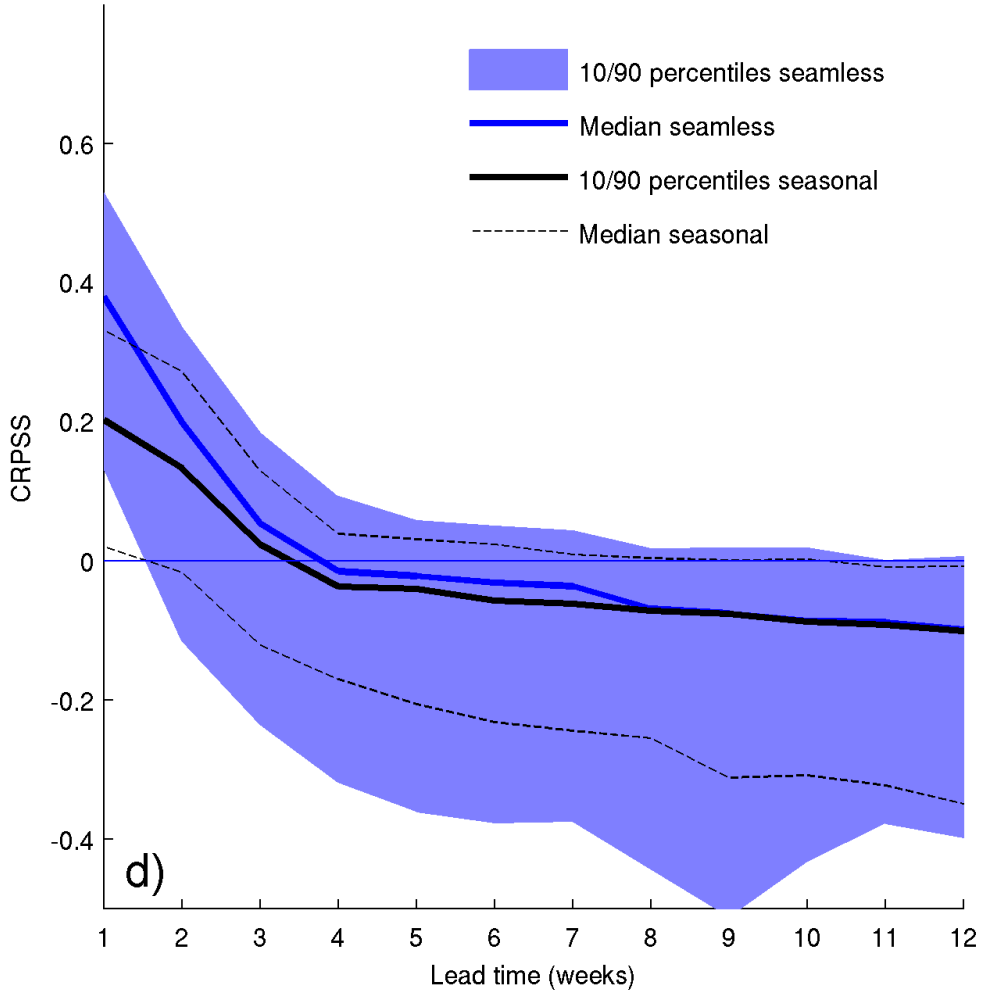
One year of experiments, 111 starting dates, 20 years, 6 months fc

Validation on outlets against model climatology using weekly averages

Advantage: Frequent updates of S2S forecast and long lead times

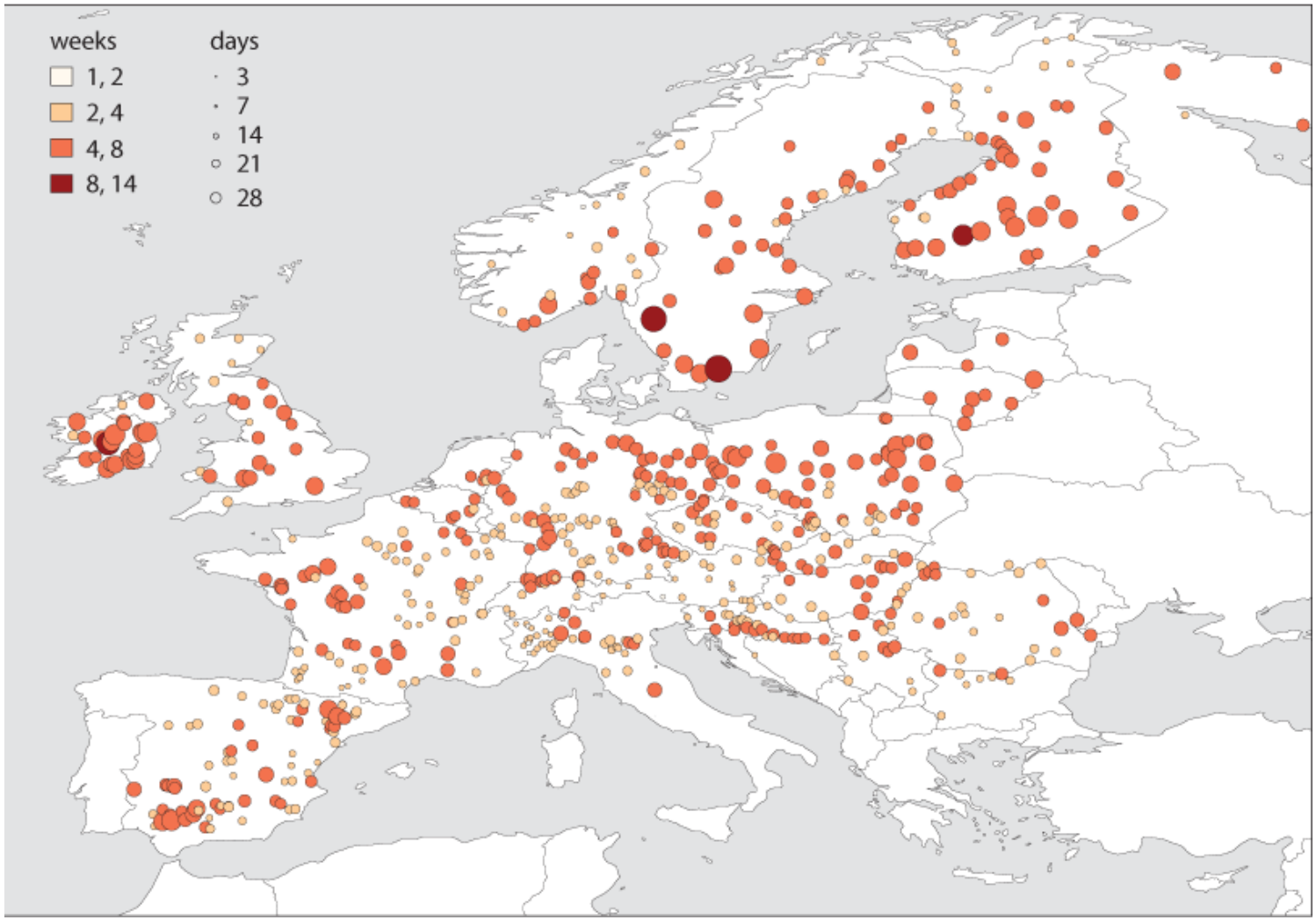
Problem: Forecasts are not fully compatible. Not “seamless”, but merged

Results: CRPSS against climatology

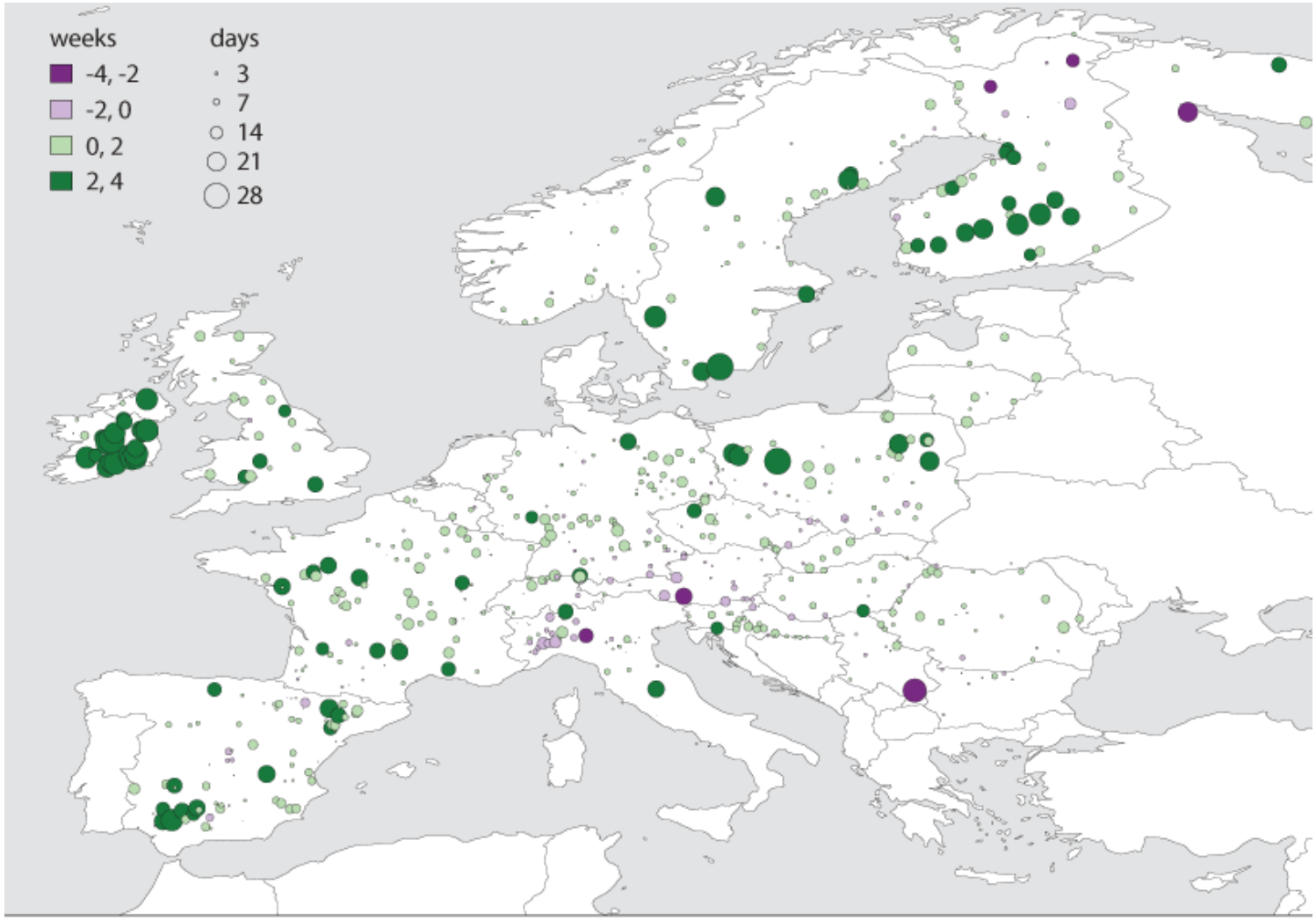


The skill drops quite quickly. After 4 weeks, most areas show no skill against climatology

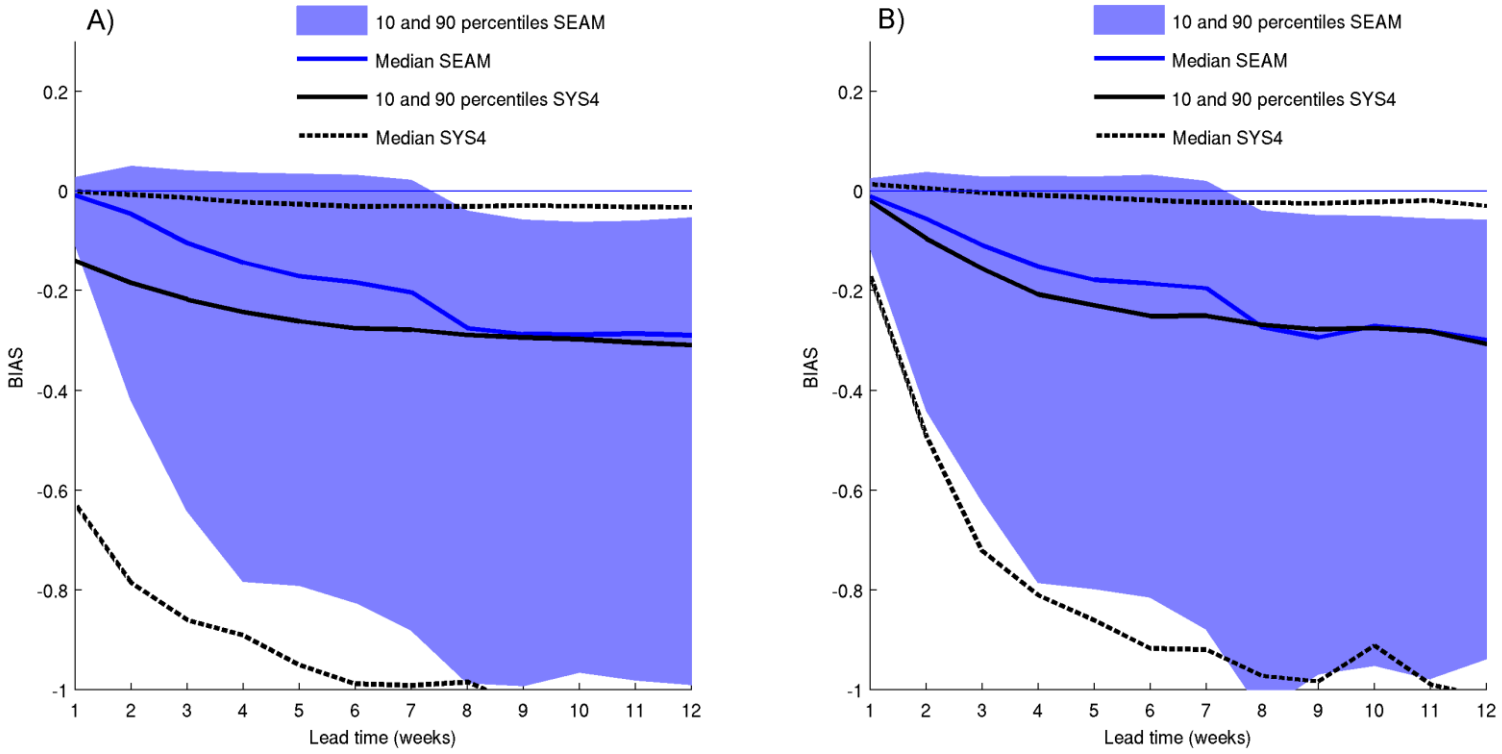
CRPSS SEAM, limit of probability



CRPSS SEAM vs SYS4



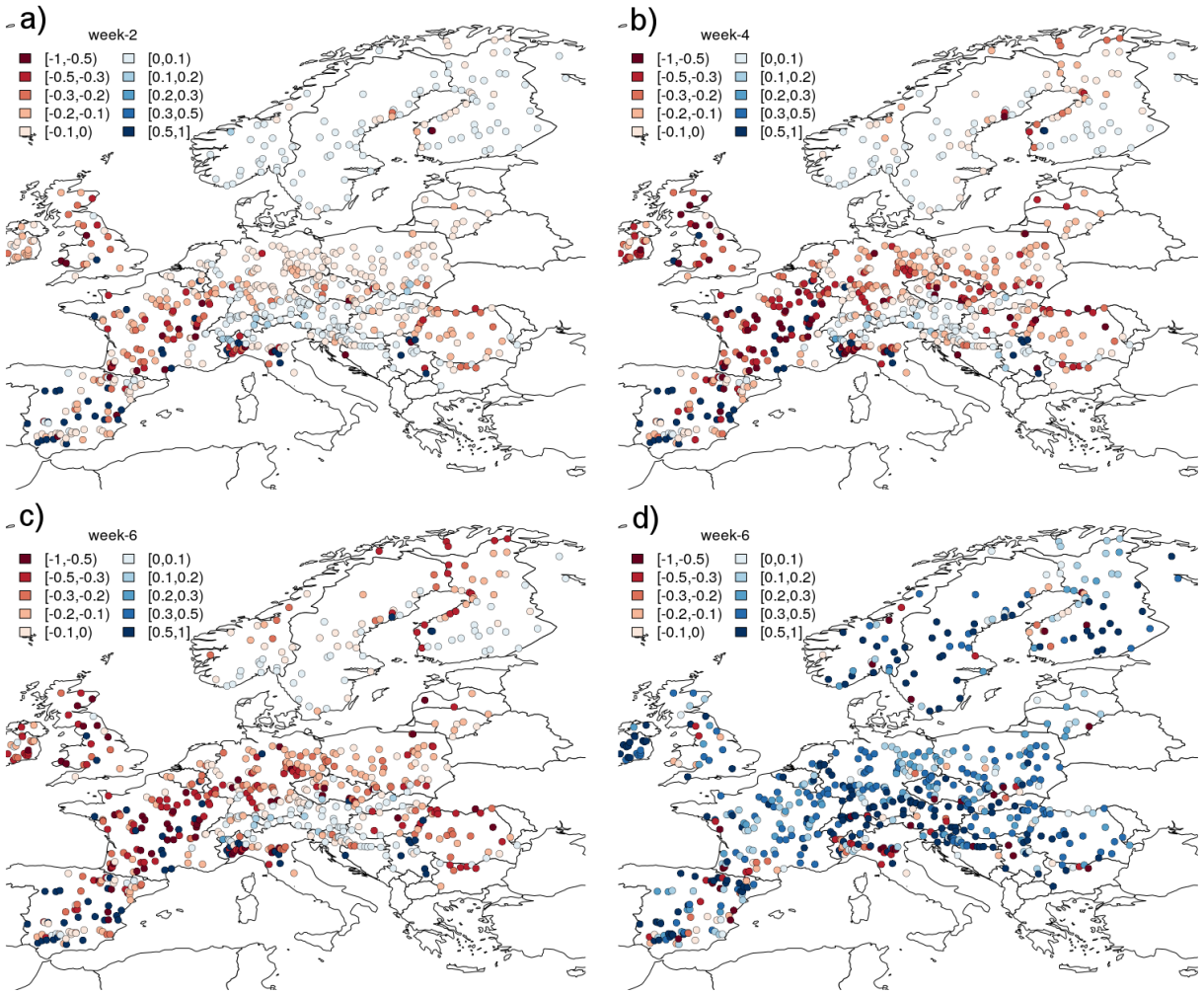
Mean relative error



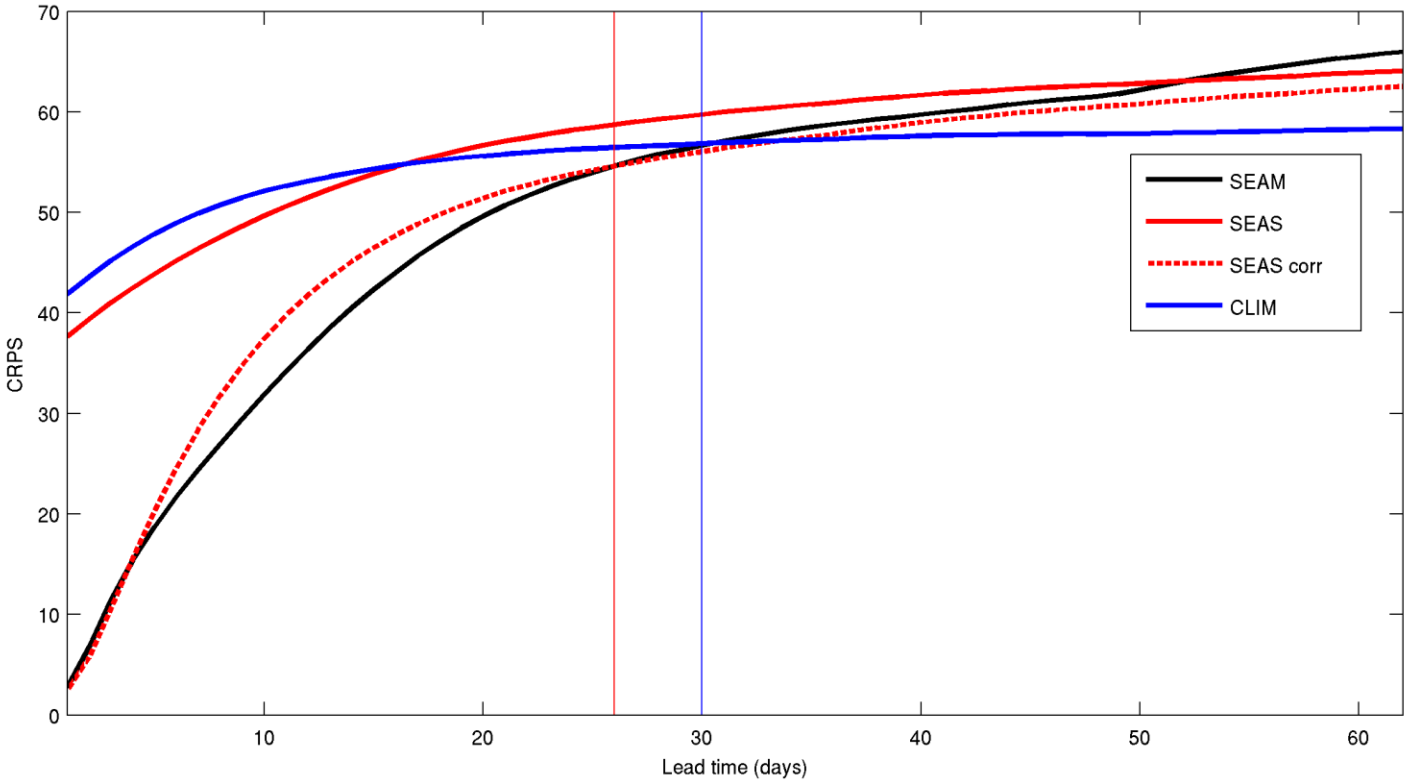
Main problem: Drift in bias, not closing the water balance

Sources of bias: + Precipitation, - Evapotranspiration, +/- Other?

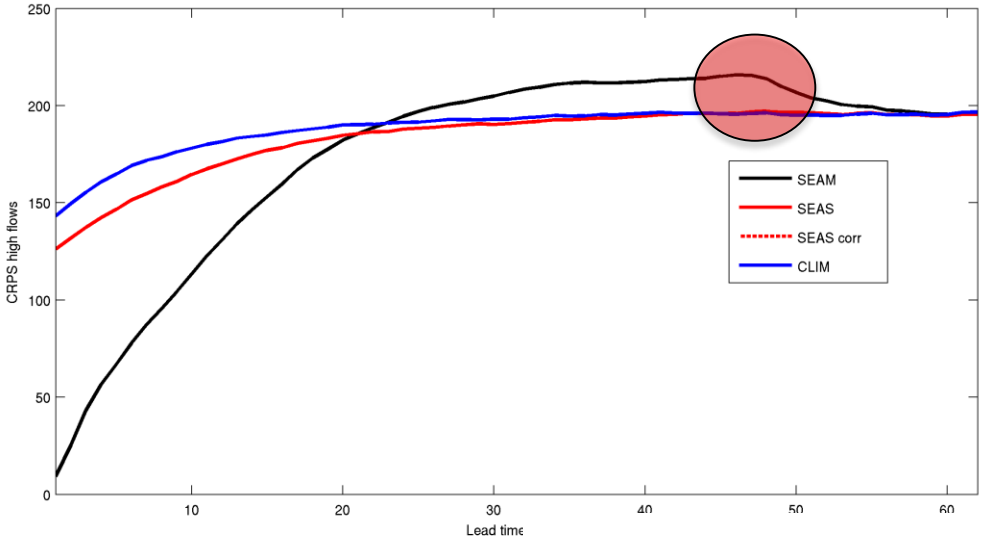
Spatial variability of bias



Limits of predictability, CRPS daily values



Performance differs depending on flow regime

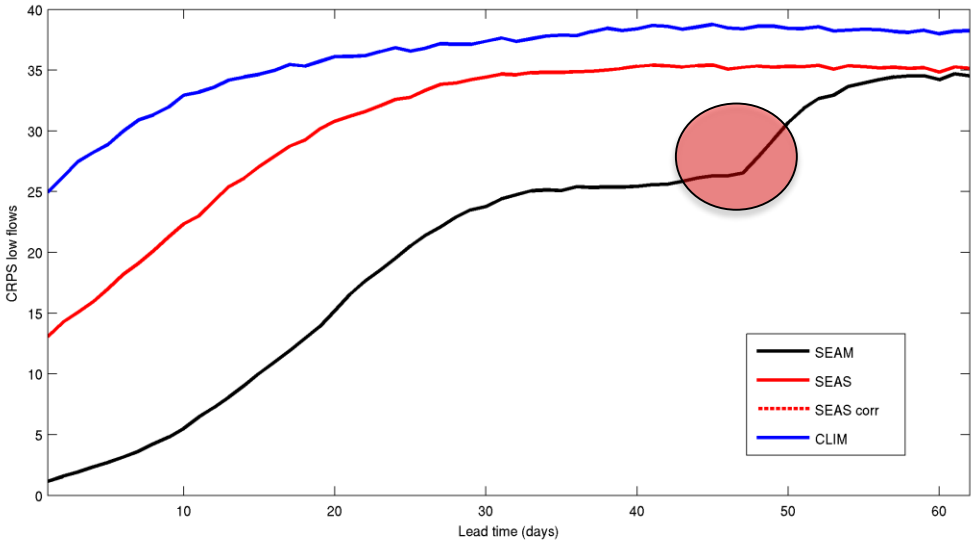


High flow

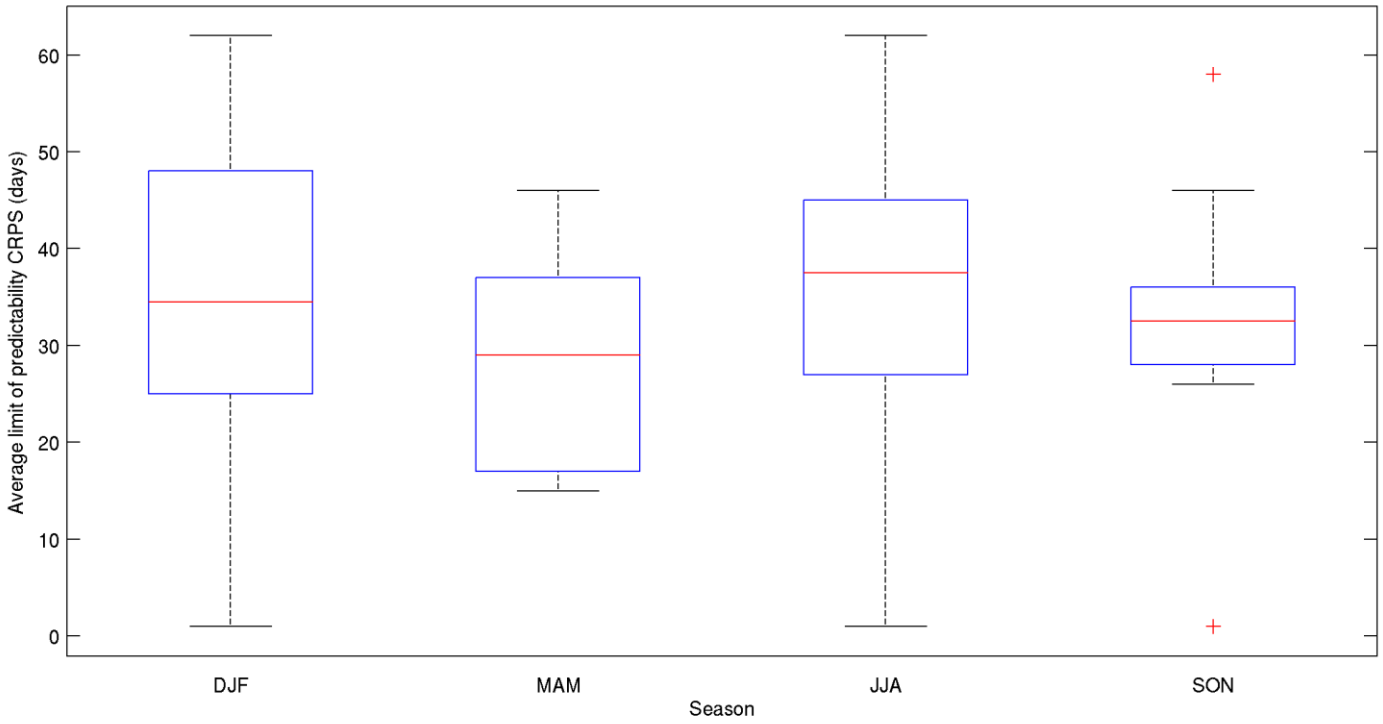
Q>90%

Low flow

Q<10%



Seasonality, which season has greater skill?



Number of days until CRPSS<0 (skilful)

Conclusions and future work

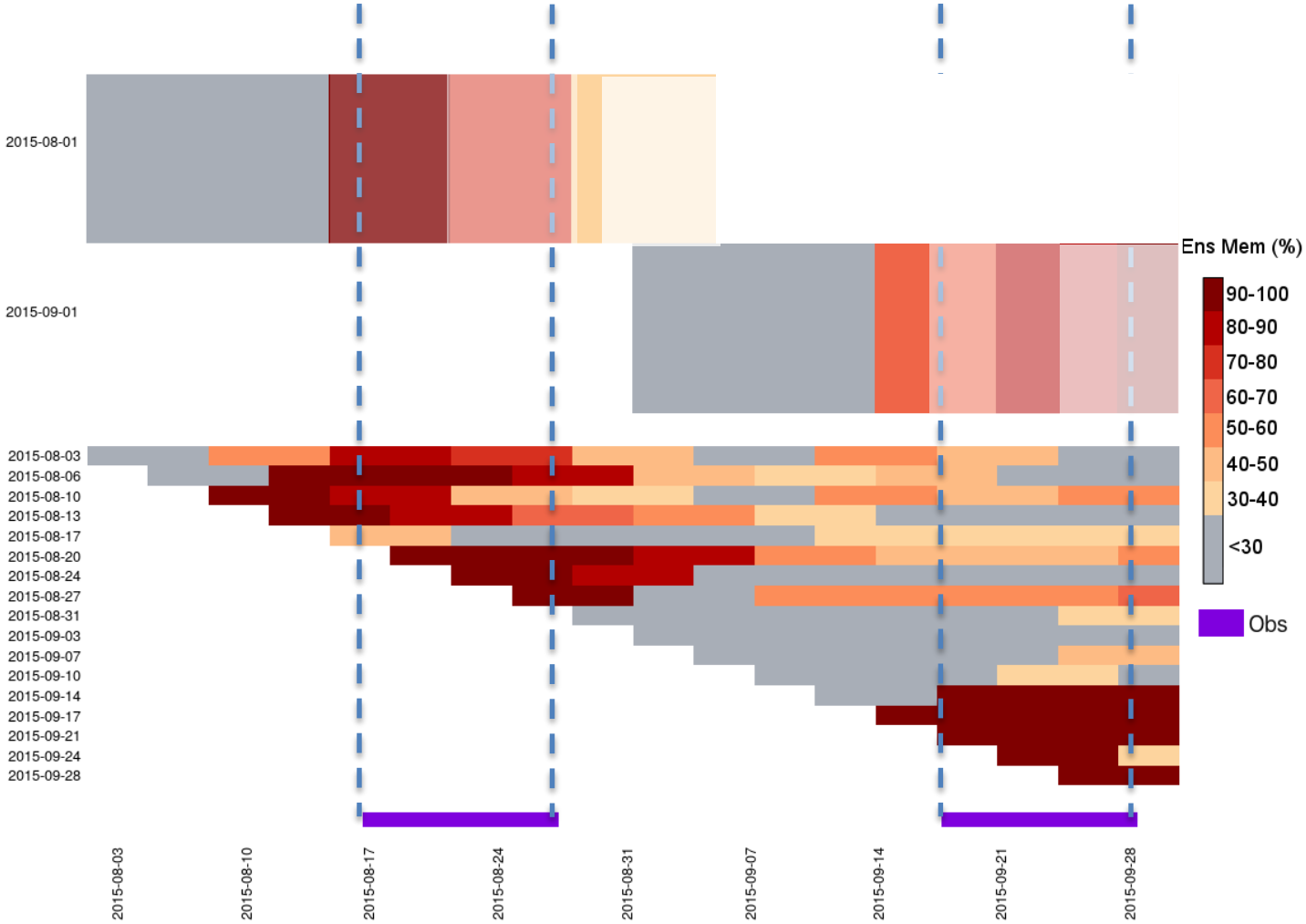
Conclusions

- ✓ Merged forecast has higher skill than SYS4, on average up to 4 weeks.
- ✓ Best skill for winter, low flow, northern Europe
- ✓ Hydrological initial conditions very dominant
- ✓ Bias increasing with lead time
- ✓ Forecasts are over-confident, not fully reliable
- ✓ Actionable forecasts on S2S range potentially useful

Future work

- ➢ Sensitivity study on cause of bias
- ➢ Bias correction (post-or preprocessing?)
- ➢ Model improvements (new seasonal fc, LSM and hydrological model)
- ➢ Develop decision support tool where forecasts are reliable and skilful

Actionable forecasts, ex. low flow in the Rhein



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Summary

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State updating and calibration period selection to improve dynamic monthly streamflow forecasts for an environmental flow management application
Matthew S. Gibbs, David McInerney, Greer Humphrey, Mark A. Thyer, Holger R. Maier, Graeme C. Dandy, and Dmitri Kavetski
Hydrol. Earth Syst. Sci., 22, 871-887, https://doi.org/10.5194/hess-22-871-2018, 2018
Summary

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