



# Evaluating skill and robustness of seasonal meteorological and hydrological drought forecasts at the catchment scale: Case Catalonia (Spain)

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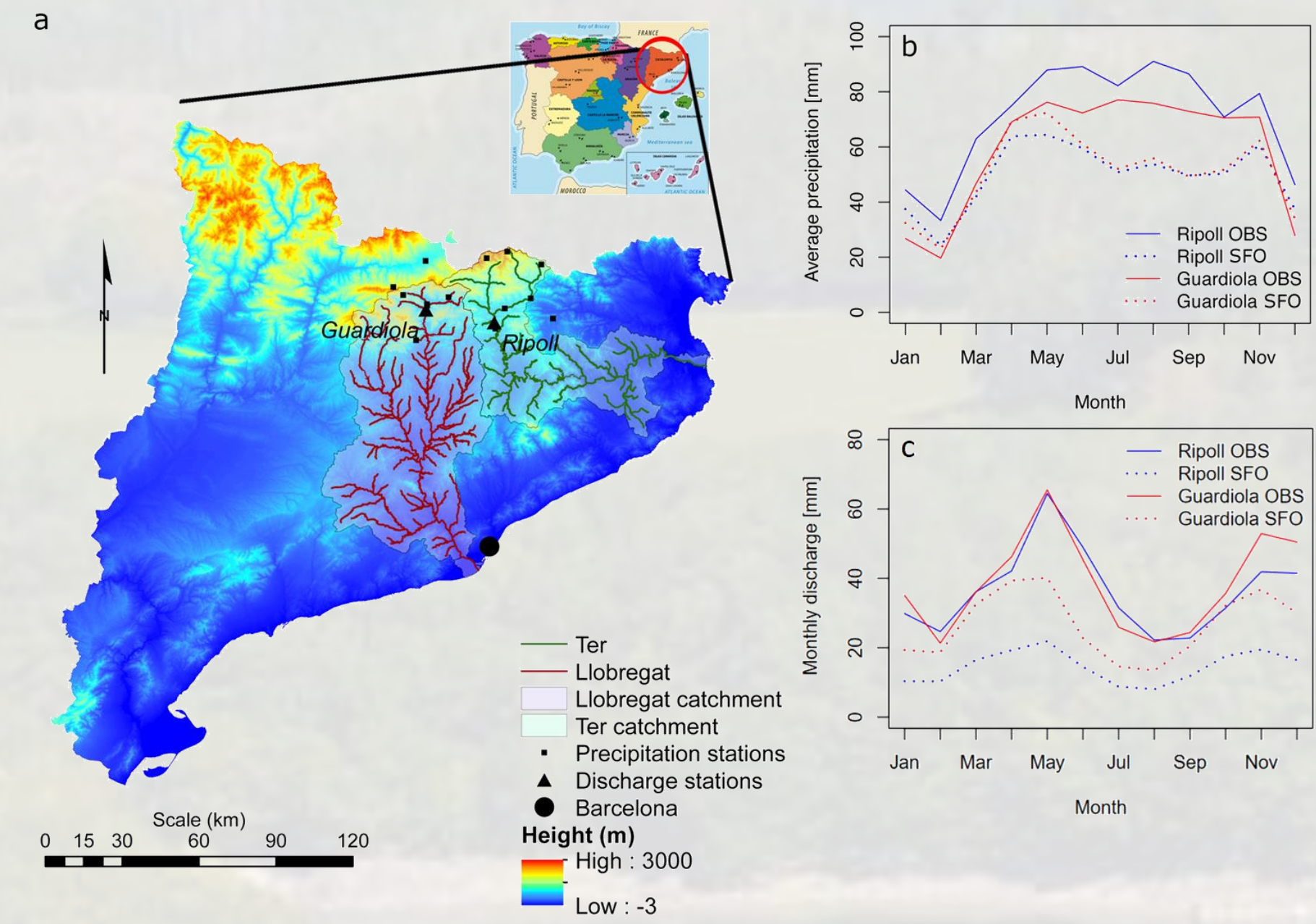
## 1. CONTEXT & AIM

- Drought events are costly and their effects can be widespread and long-lasting;
- Climate change will likely lead to drier conditions in many regions and river basins, leading to more frequent occurrence of drought events and an increase of their impacts;
- Accurate prediction of hydrological droughts, including water deficits, which is not directly provided by low flow forecasting, is therefore of prime importance to water managers in drought-prone regions, who can take accurate measures to alleviate drought impacts;
- Though hydro- and meteorological drought forecasts are both available, so far, they were mostly discussed separately

AIM: Investigate the skill and robustness of **ANYWHERE** hydrological and meteorological drought forecasts at the catchment scale

## 2. METHODS

**Study area:** Guardiola (GU, Llobregat) & Ripoll (RI, Ter) catchments (Catalonia, ES)

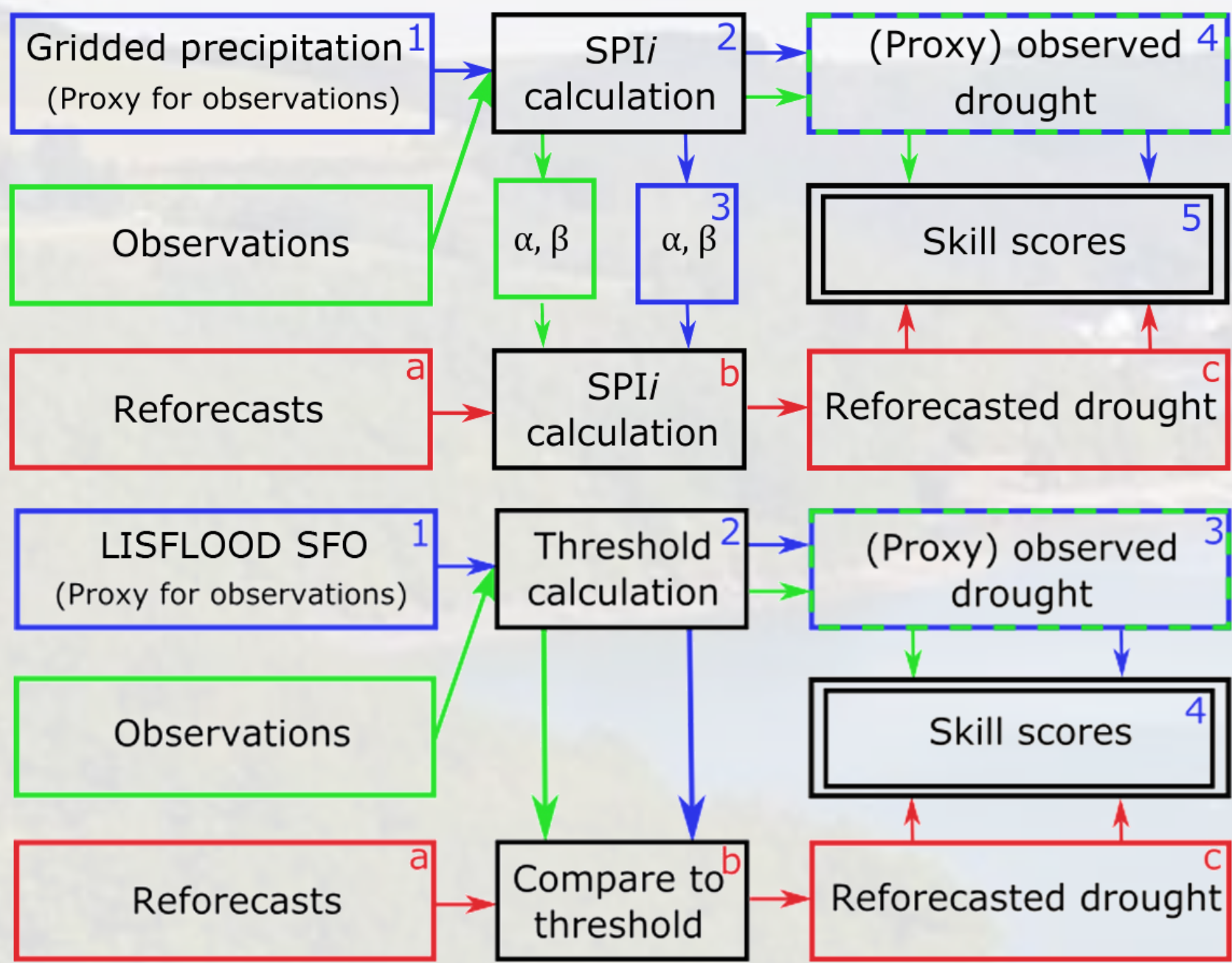


### Datasets

- Gridded Simulations Forced with Observations (SFO) from the LISFLOOD model : P, Q (2002-2010)
- In situ observations : P (1996-present), Q (1916-present)
- ECMWF-SEAS4 7 month hydro-meteorological reforecasts (2002-2010)

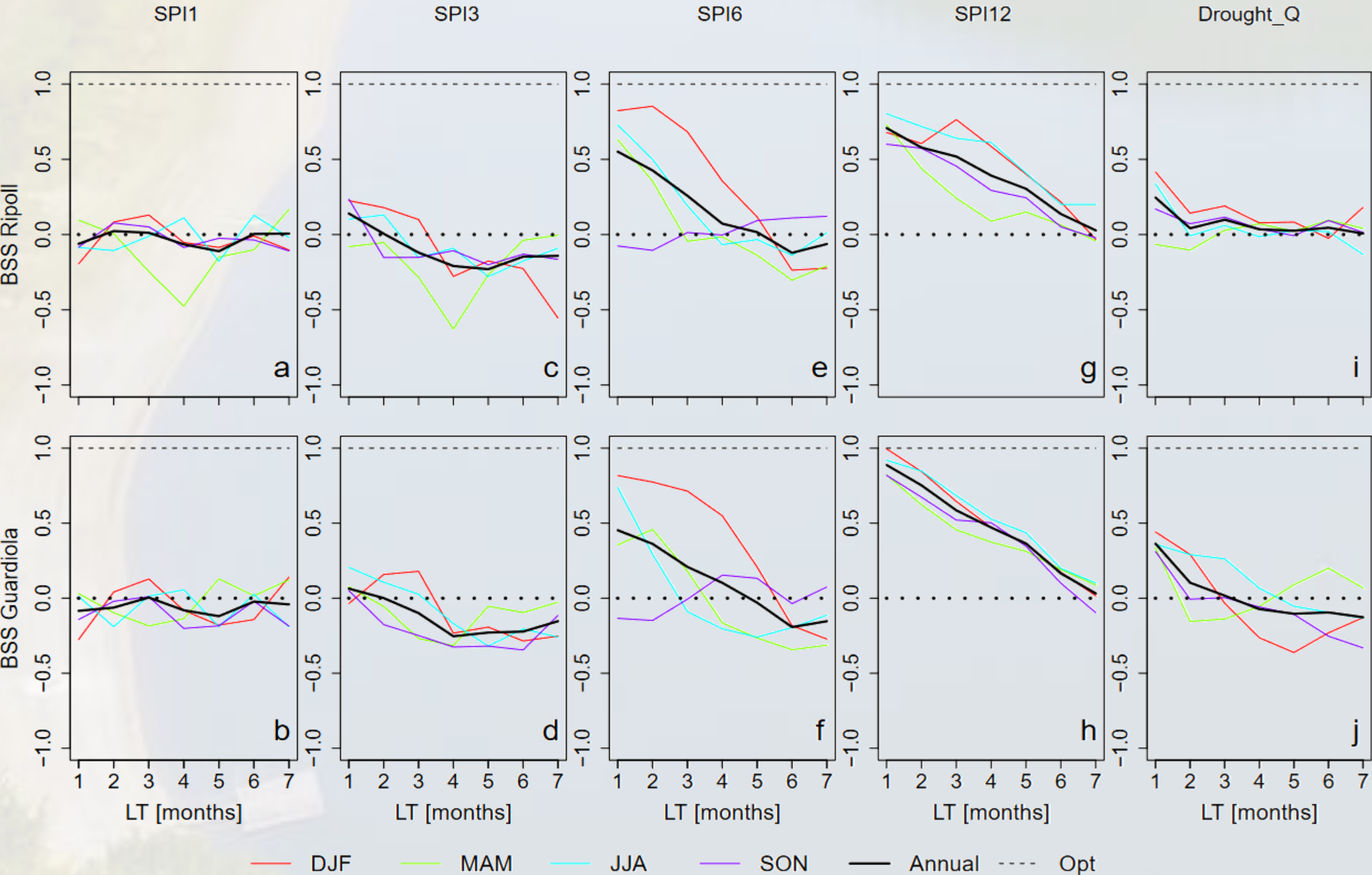
SFO vs. In situ observations		R <sup>2</sup>	NSE	KGE
Precipitation	RI	0.49	-0.04	0.25
	Mov. av. RI	0.60	-0.45	0.30
	GU	0.49	0.14	0.52
	Mov. av. GU	0.62	0.39	0.65
Discharge	RI	0.37	-6.25	-1.61
	Mov. av. RI	0.58	-0.25	0.03
	GU	0.28	-0.13	0.25
	Mov. av. GU	0.57	0.41	0.44

### Data processing



## 3. RESULTS

**Seasonal (coloured) and annual (black) Brier Skill Scores (BSS)** in SPI1(a,b), 3(c,d), 6(e,f) & 12(g,h) and in discharge drought (i,j) for the Ripoll (a-i) and the Guardiola (b-j) catchments.



**Sensitivity analysis of the forecast skill** of meteorological drought (SPIx) and hydrological drought (Drought\_Q) for the Ripoll (top) and Guardiola (bottom) catchments

		SPI=-0.5, SFO (reference)				SPI=-0.5, OBS				SPI=0, SFO				SPI=-1, SFO				Drought_Q			
LT		SPI1	SPI3	SPI6	SPI12	SPI1	SPI3	SPI6	SPI12	SPI1	SPI3	SPI6	SPI12	SPI1	SPI3	SPI6	SPI12	Q80, SFO (reference)	Q80, OBS	Q70, SFO	Q90, SFO
		1-3	4-7	1-3	4-7	1-3	4-7	1-3	4-7	1-3	4-7	1-3	4-7	1-3	4-7	1-3	4-7	1-3	4-7	1-3	4-7
RI	1-3	-0.01	0.01	0.41	0.60	-0.39	-0.29	-0.23	0.62	0.17	0.28	0.52	0.80	-0.08	-0.06	0.36	0.50	0.13	-1.15	0.08	0.16
	4-7	-0.04	-0.18	-0.02	0.21	-0.52	-0.65	-0.63	0.16	0.11	0.06	0.23	0.50	-0.07	-0.23	-0.05	0.02	0.03	-0.99	0.06	0.01
GU	1-3	-0.05	-0.01	0.34	0.74	-0.10	-0.12	-0.24	0.64	0.19	0.35	0.53	0.80	-0.10	-0.02	0.26	0.56	0.16	0.10	0.05	0.22
	4-7	-0.07	-0.21	-0.07	0.26	-0.10	-0.26	-0.21	0.21	0.14	0.16	0.14	0.46	-0.14	-0.24	-0.17	0.02	-0.10	-0.04	-0.25	-0.02

- Higher efficiencies are found in the Guardiola catchment than in the Ripoll catchment
- Meteorological drought forecasts (SPI1, SPI3), as compared to the SFO data, do generally not outperform the climatology for these short accumulation times (shown by BSS<0).
- Winter (DJF, red) often has a higher BSS than the annual skill for almost all SPIs and LTs, whereas Spring (MAM, green) often shows lower values than the annual BSS
- Hydrological drought reforecasts outperform climatology up to 3–4 months LT (shown by BSS>0 in i,j).

## 4. CONCLUSIONS

- Seasonal hydro-meteorological forecasts show highest skill when performed in winter and lowest skill when performed in spring;
- Hydrological drought forecasts show skill up to 3-4 months lead time;
- Meteorological drought forecasts show a higher uncertainty than hydrological drought forecasts and outdo climatology only for long accumulation times;
- Catalonian water resources managers could benefit from hydrological drought forecasts.

### ACKNOWLEDGEMENTS

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### FURTHER READING

Van Hateren, T. C., Sutanto, S. J. & Van Lanen, H. A. J. (2019) Evaluating skill and robustness of seasonal meteorological and hydrological drought forecasts at the catchment scale – Case Catalonia (Spain). Environ. Int. 133B, 105206. doi: 10.1016/j.envint.2019.105206