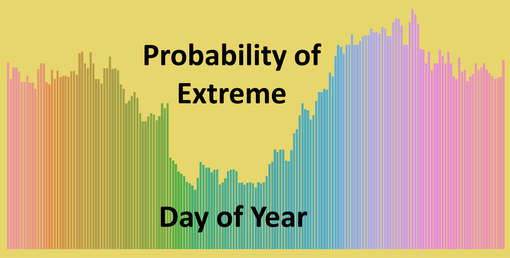
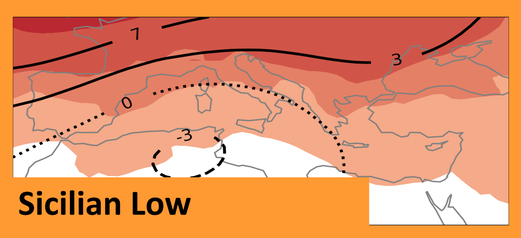
Suggested forecasting tools for predicting extreme precipitation in Calabria, southern Italy, for short-, medium-, and extended- range forecasts:

Week > 3
Climatological information



Weeks 3-2
Mediterranean patterns & moisture



Week 1
Corrected precipitation





Forecasting extreme precipitation in Calabria: different predictors for different lead-times; Mastrantonas N.[a,b,*], Furnari L.[c], Magnusson L.[a], Senatore A.[c], Mendicino G.[c], Pappenberger F.[a], Matschullat J.[b], *Contact: Nikolaos.Mastrantonas@ecmwf.int*

MOTIVATION

Extreme Precipitation Events (EPEs) have devastating consequences in society and economy. Better prediction of this hazard at different lead times can support the mitigation of their negative impacts.

DATA

E-OBS[i]	Observational precipitation
ERA5[ii]	Precipitation,
ECWMF reforecasts (cycle 46r1)	Relative humidity (RH), Water vapor flux (WVF) } **local predictors**, Mediterranean patterns (MedPat.),

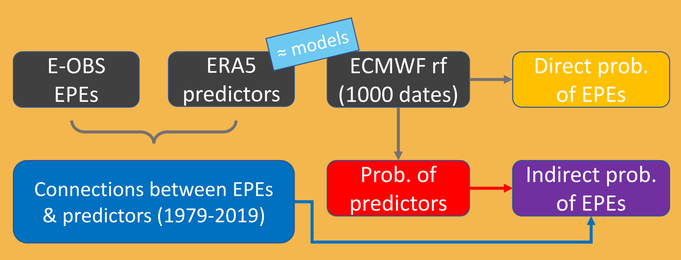


Fig. 1: Flowchart of the followed methodology.

Analysis for winter half, using 3-daily resolution for spatially aggregated data (warning areas) and P95 EPEs

METHODOLOGY (Fig1)

1. Use EOF analysis and K-means clustering of the sea level pressure (SLP) and geopotential height at 500 hPa (Z500) anomalies for deriving the nine (9) Mediterranean patterns[iii] (**Fig. 2**).
2. Connect predictors to EPEs using conditional probabilities between E-OBS and ERA5 (**Fig. 3**).
3. Allocate forecast members to the predictors' states (e.g., which MedPat.?, is RH extreme?).
4. Use Brier Skill Score to assess the performance of the ECMWF reforecasts in predicting the selected predictors when considering ERA5 as the ground truth (**Fig. 4**).
5. Use Brier Skill Score to assess EPEs forecasts for the direct method, and the indirect ones. The latter ones are derived with the use of the conditional probabilities from step 2 (**Fig. 5**).
6. Assess the methods' skill from a user perspective based on the cost-loss model[iv] (**Fig. 6**).

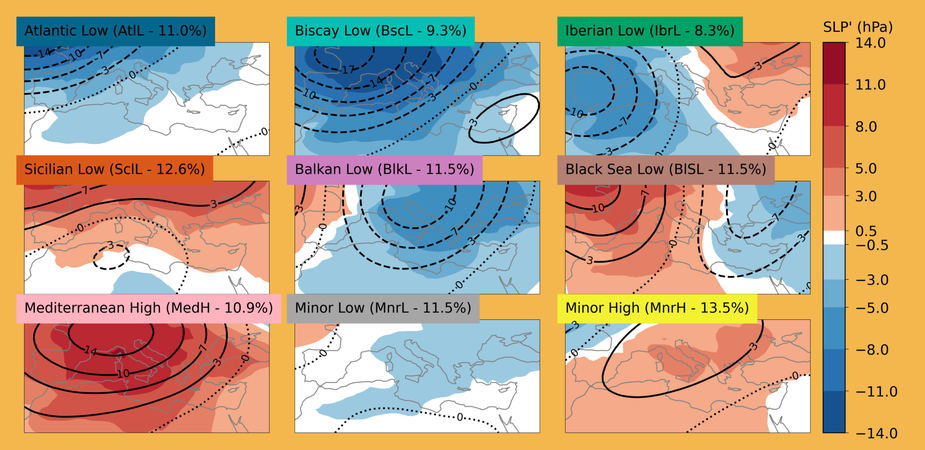


Fig. 2: The Mediterranean patterns. Colour shading refers to SLP anomalies (hPa), and contours to Z500 anomalies (dm). Percentages indicate the climatological frequencies (ERA5 winter half years; 1979-2019).

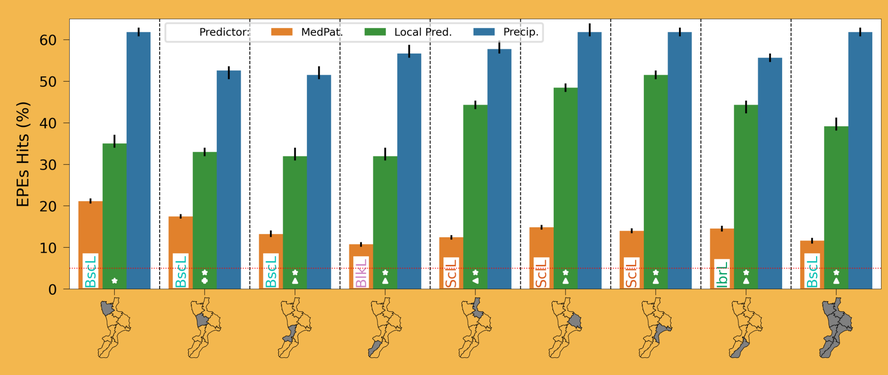


Fig. 3: Conditional probabilities of EPEs for the most connected MedPat., and the extreme state of ERA5 precipitation and the most connected local predictor. The selected MedPat. is stated on the bar (Fig1 for full-name), and the combination of local predictor is as follows: * for RH, arrow for direction of WVF, + for total WVF.

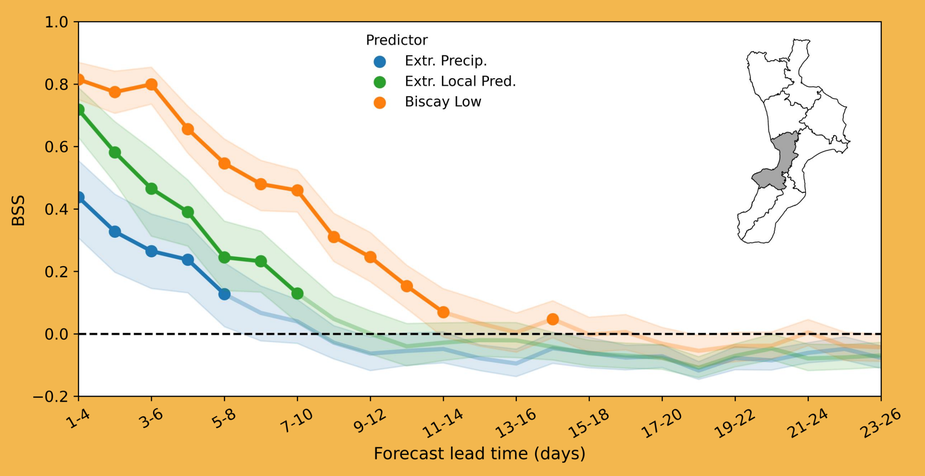


Fig. 4: Brier Skill Score of the predictors for one of the warning areas. Points and thick lines show statistically significant outperformance of reference score (90% confidence; 1,000 bootstraps). The reference scores are climatological frequencies.

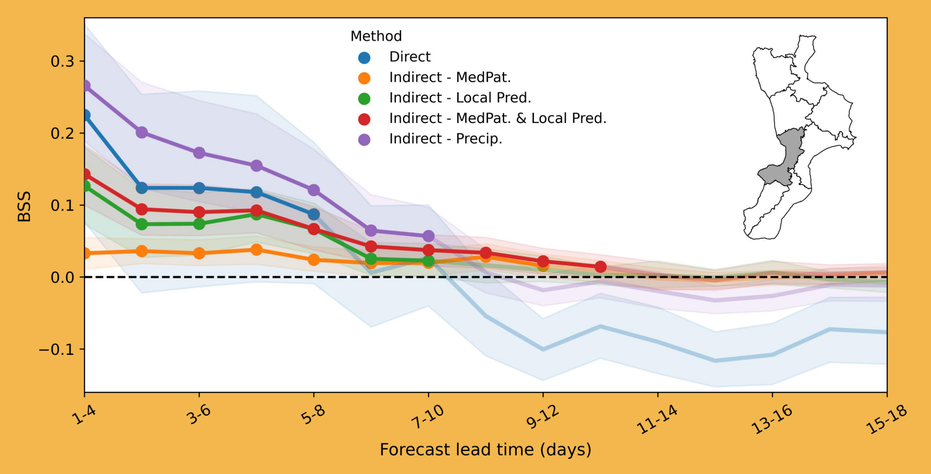


Fig. 5: Brier Skill Score of EPEs forecasting for the direct and indirect methods.

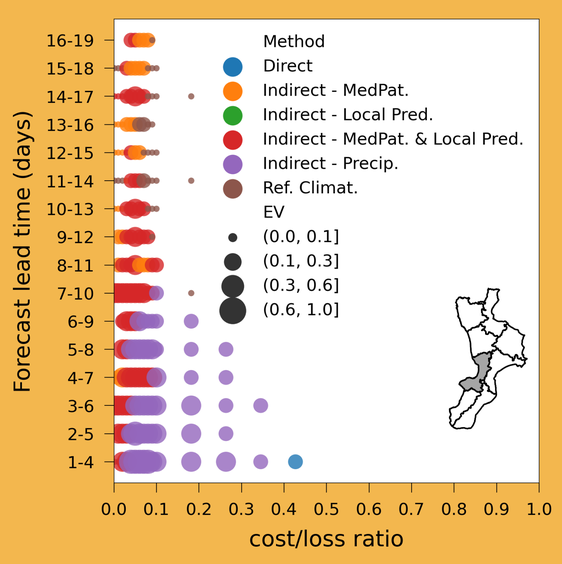


Fig. 6: Cost-loss model: best predictor and associated maximum Economic Value (EV).

REFERENCES

[i]Cornes, R.C., Schrier, G. van der, Besselaar, E.J.M. van den, Jones, P.D., 2018. An Ensemble Version of the E-OBS Temperature and Precipitation Data Sets. J. Geophys. Res. Atmospheres 123, 9391–9409. https://doi.org/10.1029/2017JD028200, [ii]Copernicus Climate Change Service (C3S) (2017): ERA5: Fifth generation of ECMWF atmospheric reanalyses of the global climate. Copernicus Climate Change Service Climate Data Store (CDS). https://cds.climate.copernicus.eu/cdsapp#!/home, [iii]Mastrantonas N, Herrera-Lormendez P, Magnusson L, Pappenberger F, Matschullat J. Extreme precipitation events in the Mediterranean: Spatiotemporal characteristics and connection to large-scale atmospheric flow patterns. Int J Climatol. 2021;. https://doi.org/10.1002/joc.6985, [iv]Richardson, D.S., 2000. Skill and relative economic value of the ECMWF ensemble prediction system. Q. J. R. Meteorol. Soc. 126, 649–667. https://doi.org/10.1002/qj.49712656313

a ECMWF EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS
b TECHNISCHE UNIVERSITÄT BERGAKADEMIE FREIBERG The University of Resources. Since 1765.
c UNIVERSITÀ DELLA CALABRIA

CAFE Climate Advanced Forecasting of sub-seasonal Extremes

This work is part of the Climate Advanced Forecasting of sub-seasonal Extremes (CAFE) project. The project receives funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 813844.