

### Earth Sciences Department



## Exploring windows of opportunity at sub-seasonal time scales for extreme precipitation events

### 15th of May 2025 6th Summer School



The Abdus Salam International Centre for Theoretical Physics

## The Valencia DANA case study

Núria Pérez-Zanón, Francisco Doblas-Reyes & Albert Soret

## **Climate Services based on Climate Predictions**

#### **CLIMATE SERVICE** from evaluation to operational PRODUCT The final product from the service provide useful information for FORECAST QUALITY Parallelization in multiple nodes: specific needs **OPERATIONAL ASSESSMENT CLIMATE SERVICE** startR Several skill scores are obtained by the Once the required methodologies are comparison of the calibrated predictions evaluated using past forecasts, with observations to assess their S Parallelization in multiple cores: real-time forecast can be adequately performance **RAW CLIMATE** post-process to provide operation multiApply climate services PREDICTIONS **TAILORED CLIMATE** Predictions obtained directly Calibration: **CSTools** from different climate PREDICTIONS prediction systems. Climate predictions tailored to specific needs depending Verification: **s2dv** on the end-user including downscaling and indicators Downscaling: CSDownscale **BIAS ADJUSTMENT** Remove systematic errors and increase reliability of climate predictions Indicators: CSIndicators OBSERVATIONAL Job scheduler: Autosubmit UNCERTAINTY https://earth.bsc.es/gitlab/es/startR



Manubens et al., 2018 <u>doi:10.1016/j.envsoft.2018.01.018</u>; Pérez-Zanón et al. 2022 <u>doi:10.5194/GMD-15-6115-2022</u>; Pérez-Zanón et al., 2023 <u>https://doi.org/10.1016/j.cliser.2023.100393</u>

Set of tools

## **<u>Climate Services based on Climate Predictions</u></u>**

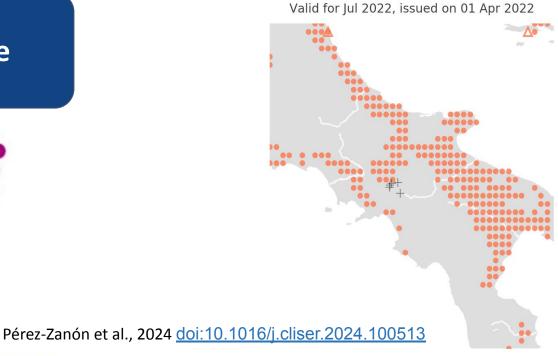


Agriculture



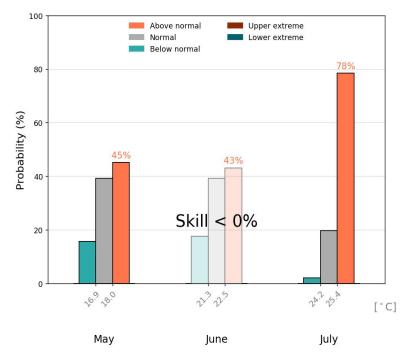
Barcelona

Supercomputing



#### **Temperature (Pietradefusi)**

Seasonal forecast issued on Apr 2022



## Showcase the Climate Services potential or limitations Case study



#### https://s2s4e.eu/climate-services/case-studies

Case Study #1 Factsheet: Cold Spell and Wind Drought in Europe
Case Study #4 Factsheet: Combined snowmelt and high precipitation in Sweden
Case Study #5 Factsheet: Icing Event in Romania
Case Study #6 Factsheet: Wind drought in USA
Case Study #7 Factsheet: The "Beast of the East" Cold Spell in Europe
Deliverable 4.1: Detailed information about the case studies from the factsheets is presented in this deliverable, under Chapter 6.
Factsheets Guide: A guide to help understand the factsheets presented



Manrique-Suñé et al., 2023 doi:10.1016/j.cliser.2023.100359.

## Showcase the Climate Services potential or limitations Case study

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The New York Times

## A Month's Worth of Rain Falls in a Single Day in Parts of Spain

The deluge flooded streets, breached rivers and destroyed crops along the Mediterranean coast. There could be more rain still to come.

#### **Comunidad Valenciana**

ESPAÑA · GENERALITAT VALENCIANA · ALICANTE · CASTELLÓN · VALENCIA · ÚLTIMAS NOTICIAS

LOS EFECTOS DE LA DANA >

#### La cifra de fallecidos por la dana de Valencia sube a 224 tras la muerte de una mujer de 79 años que estaba hospitalizada

EL PAIS

El Centro de Integración de Datos mantiene en tres el número de personas que siguen desaparecidas nueve semanas después de la catástrofe



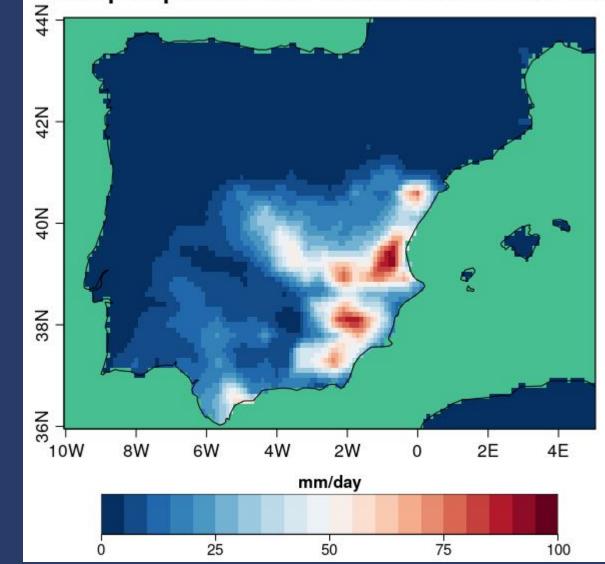
### ERA5 Land

AEMET in-situ weather station, in Turís (Valencia), recorded 185 mm in 1 hour and 621 mm in 6 hours.

https://www.aemet.es/documentos/es/conocer mas/recursos\_en\_linea/publicaciones\_y\_estudios /estudios/informe\_episodio\_dana\_29\_oct\_2024 .pdf

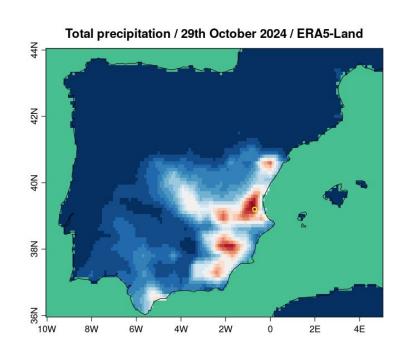


#### Total precipitation / 29th October 2024 / ERA5-Land



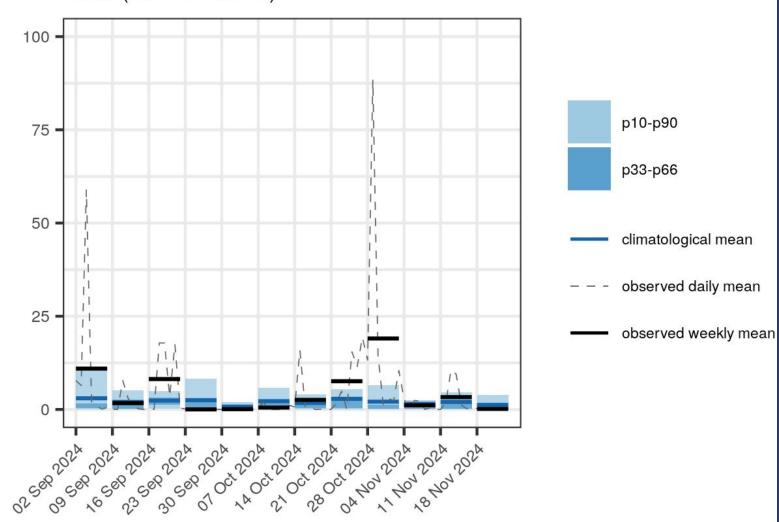
## ERA5 Land

# Was this event impacting weekly precipitation?





#### ERA5-Land observed weekly accumulation Turís (39.4ºN - 0.7ºW)



## Sub-seasonal forecast

Forecast system: NCEP-CFSv2

Reference: ERA5 interpolated to NCEP-CFSv2 gaussian grid using CDO conservative method

Nominal initialization dates (Thursdays): 03-10-2024, 10-10-2024, 17-10-2024, 24-10-2024.

- For the hindcast (1999-2016), these nominal start dates contain 12 ensemble members generated by merging the 4 daily initializations for the nominal initialization date plus 2 days before.
- For the forecast, these nominal start dates contain 48 ensemble members built in the same way.

The target week is from Monday 28th of October to the 3rd of November 2024.

The region selected is the iberian peninsula 36°N - 44°N, 10°W - 5°E



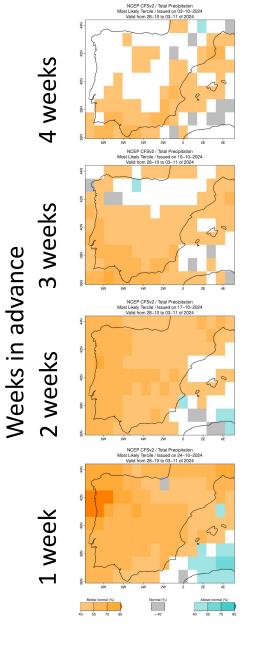
### Sub-seasonal

### forecast

#### **Calibration methods**

- bias (corrects only the bias),
- □ evmos (Leung et al., 1999),
- □ mse\_min (Doblas-Reyes et al., 2005),
- □ crps\_min (Van Schaeybroeck and Vannitsem, 2015),
- rpc-based (Eade et al., 2014),
- **quantile mapping (Gudmundsson et al.**, 2012)





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What we see:

The probability of the most probable tercile category for the weekly accumulated precipitation for the target week (Monday 28th of October to the 3rd of November 2024)

The forecast 1 and 2 weeks in advance show above normal conditions to be the most probable category in the Alboran sea.

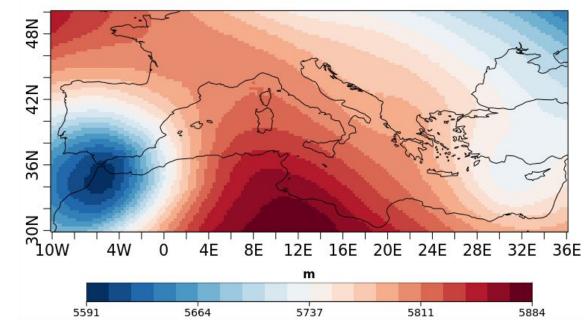
Is it a problem of predicting the correct location of precipitation? If so, could I apply any AI technique to correct the location of the predicted precipitation?



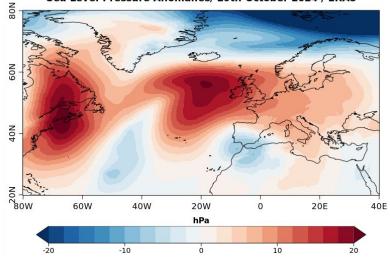
**Bias method** 

#### Z500 / ERA5 /29-Oct

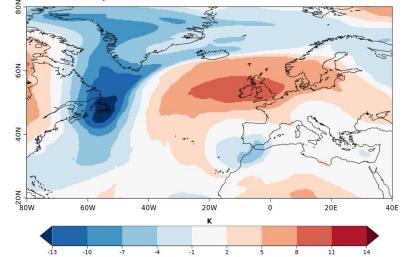
## Atmosphere



Sea Level Pressure Anomalies/ 29th October 2024 / ERA5



Air temperature at 500hPa Anomalies/ 29th October 2024 / ERA5



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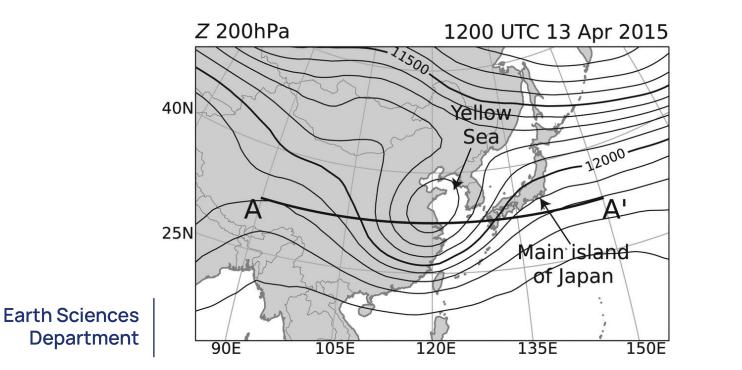
BSC Barcelona Supercomputing Center Centro Nacional de Supercomputación

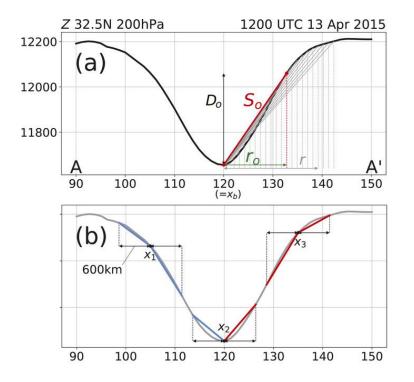
### Strategy

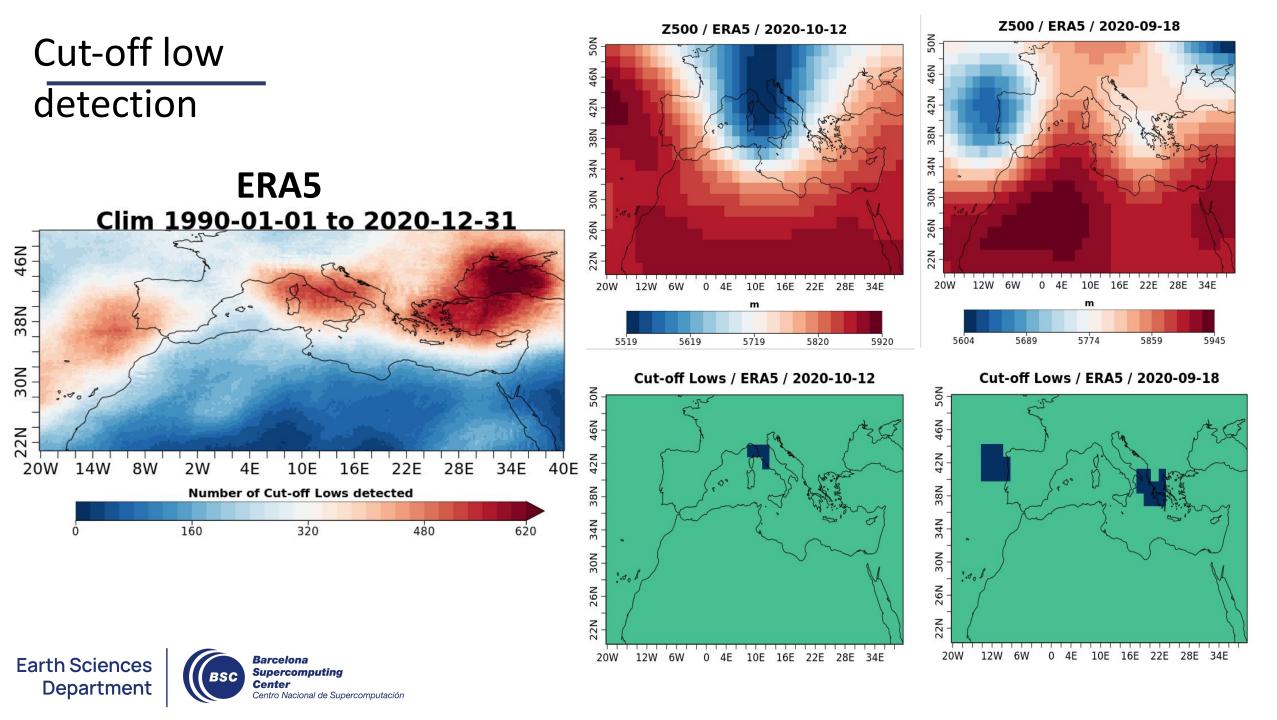
Cut-off lows detection algorithm

 $\rightarrow$  I can apply it at forecast, hindcast and reference datasets to get a probability to occur as well as to perform the forecast verification.

Kasuga et al., 2021 <u>https://doi.org/10.1175/MWR-D-20-0255.1</u>







### Next steps

> Analyse precipitation forecast from ECMWF sub-seasonal forecast

> Apply the cut-off low detection algorithm and perform the forecast verification

Could I apply an AI technique to calibrate the forecast system precipitation?

Suggestions are welcome







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Thanks for your attention

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