AI4S
BSC AI4Science Fellowships

Earth Sciences Department

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

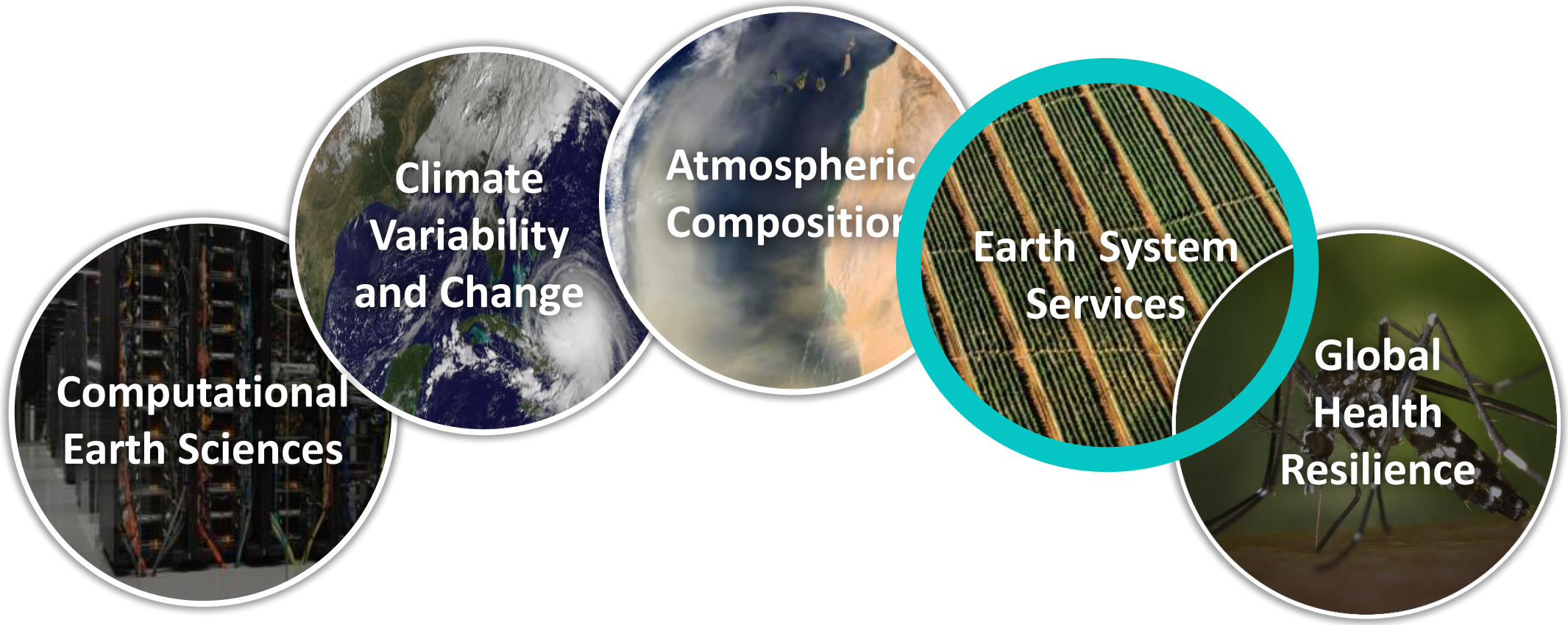
Climate Service for DANA events: a case study

10 April 2026

Núria Pérez-Zanón
Diego Campos, Ramiro Saurral Albert Soret & Francisco Doblas Reyes

Earth Sciences Department

Barcelona Supercomputing Center
Centro Nacional de Supercomputación



20 YEARS

Earth System Services

Co-producing climate and air quality services

Air Quality Services

Developing air quality services from global/regional to local urban scale

Climate Services

Providing services for climate adaptation to key sectors using state-of-the-art climate knowledge

Knowledge Integration

Integrating scientific and societal knowledge through co-production methodologies

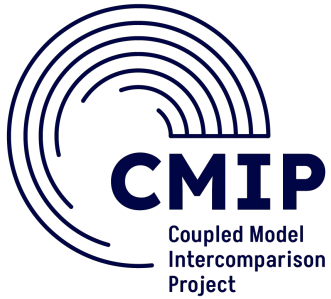
20 BSC YEARS

Introduction to Climate Services

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

Climate Services

- **Data availability** does not directly imply the access to **climate information**, e.g.:



- **Climate services** include **post-processing** climate techniques to **tailor** climate data to **user needs and applications**.

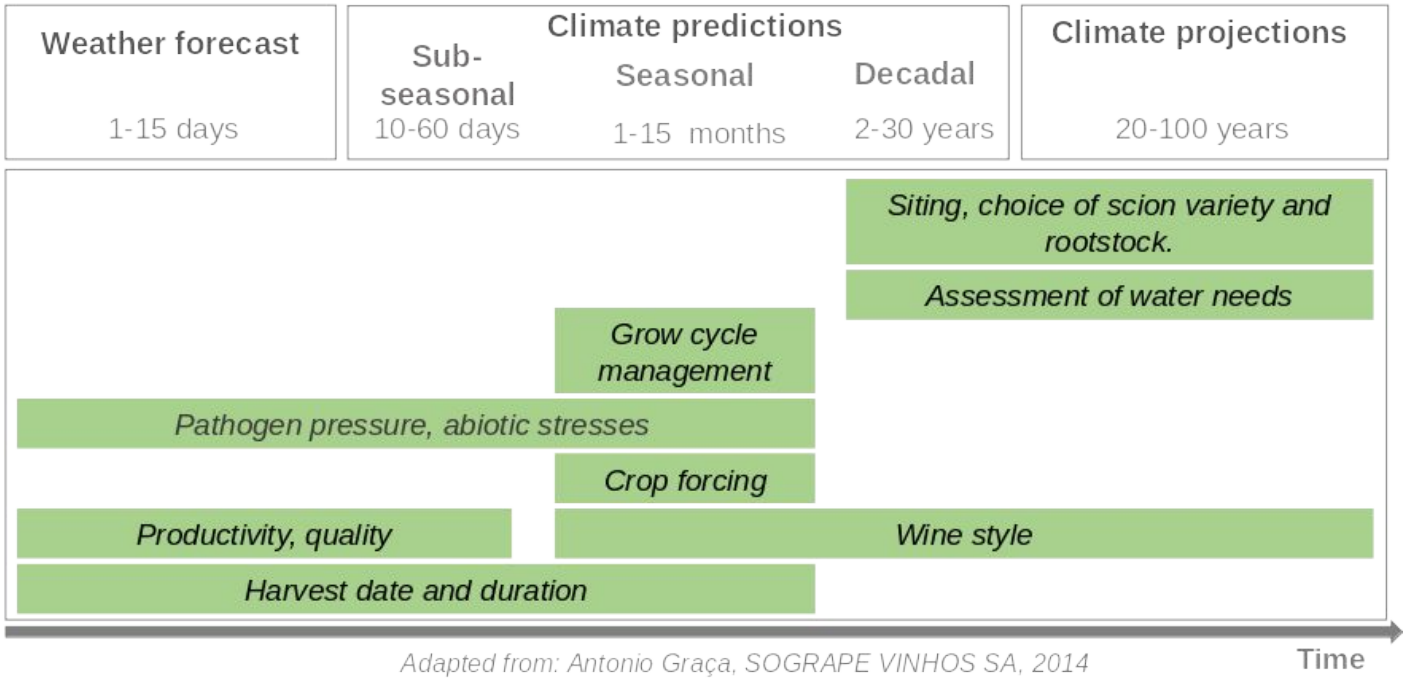
Climate Services

- **Data availability** at different time scales

Climate Services for the agriculture sector

Sub-seasonal and seasonal forecast service for vineyard managment

Pérez-Zanón et al. 2024
https://doi.org/10.1016/j.cliser.2024.100513



Adapted from: Antonio Graça, SOGRAPE VINHOS SA, 2014

The target regions correspond to the vineyard plots of the wine producers in the project:

- Campania region (MASTROBERARDINO)
- Douro Valley (SYMINGTON)
- Catalonia (TORRES)

Earth Sciences Department
Barcelona Supercomputing Center
Centro Nacional de Supercomputación

Climate Services for the agriculture sector

Sub-seasonal and seasonal forecast service for vineyard managment

Pérez-Zanón et al. 2024
https://doi.org/10.1016/j.cliser.2024.100513

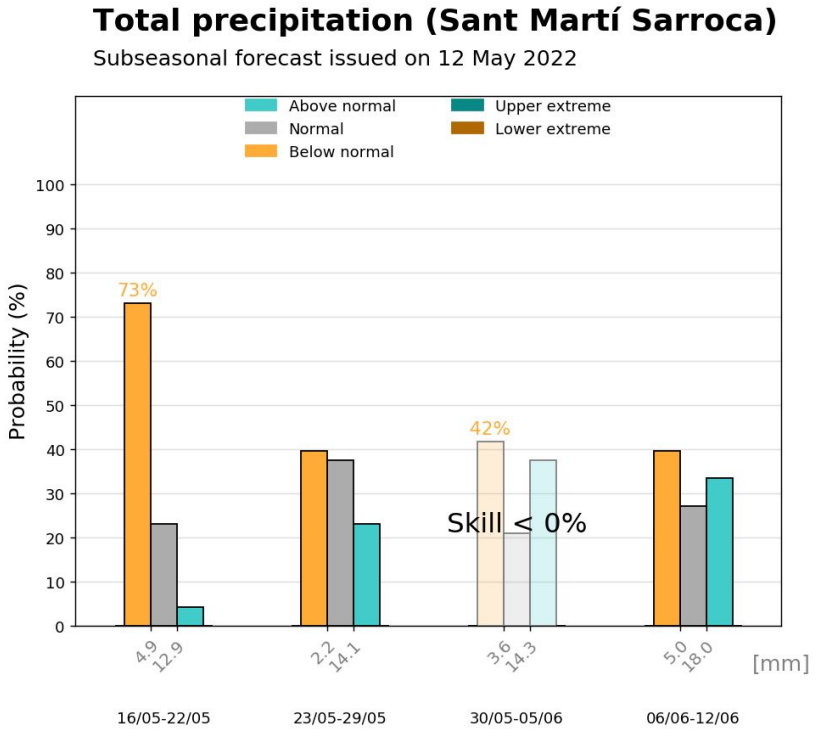
Select Forecast

Select the site

Select the variable

Temperature
Shortwave radiation
Precipitation

Subseasonal Forecast



Weekly forecast

Up to the next 4 weeks

Weekly updated

Earth Sciences Department
Barcelona Supercomputing Center
Centro Nacional de Supercomputación

Climate Services for the agriculture sector

Sub-seasonal and seasonal forecast service for vineyard managment

Pérez-Zanón et al. 2024
https://doi.org/10.1016/j.cliser.2024.100513

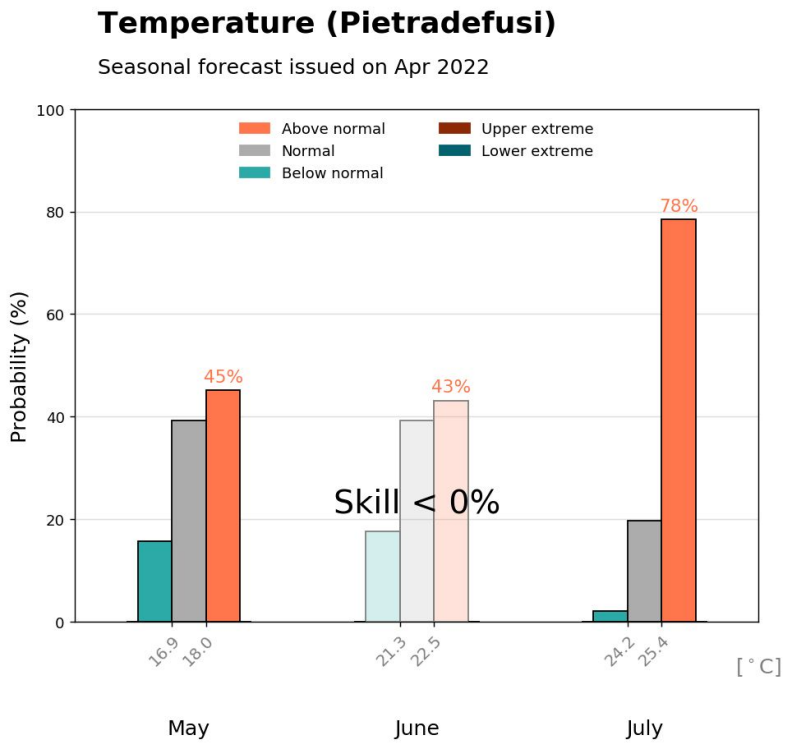
Select Forecast

Select the site

Select the variable

Temperature
Shortwave radiation
Precipitation

Seasonal Forecast



Monthly forecast

Up to the next 3 months

Monthly updated

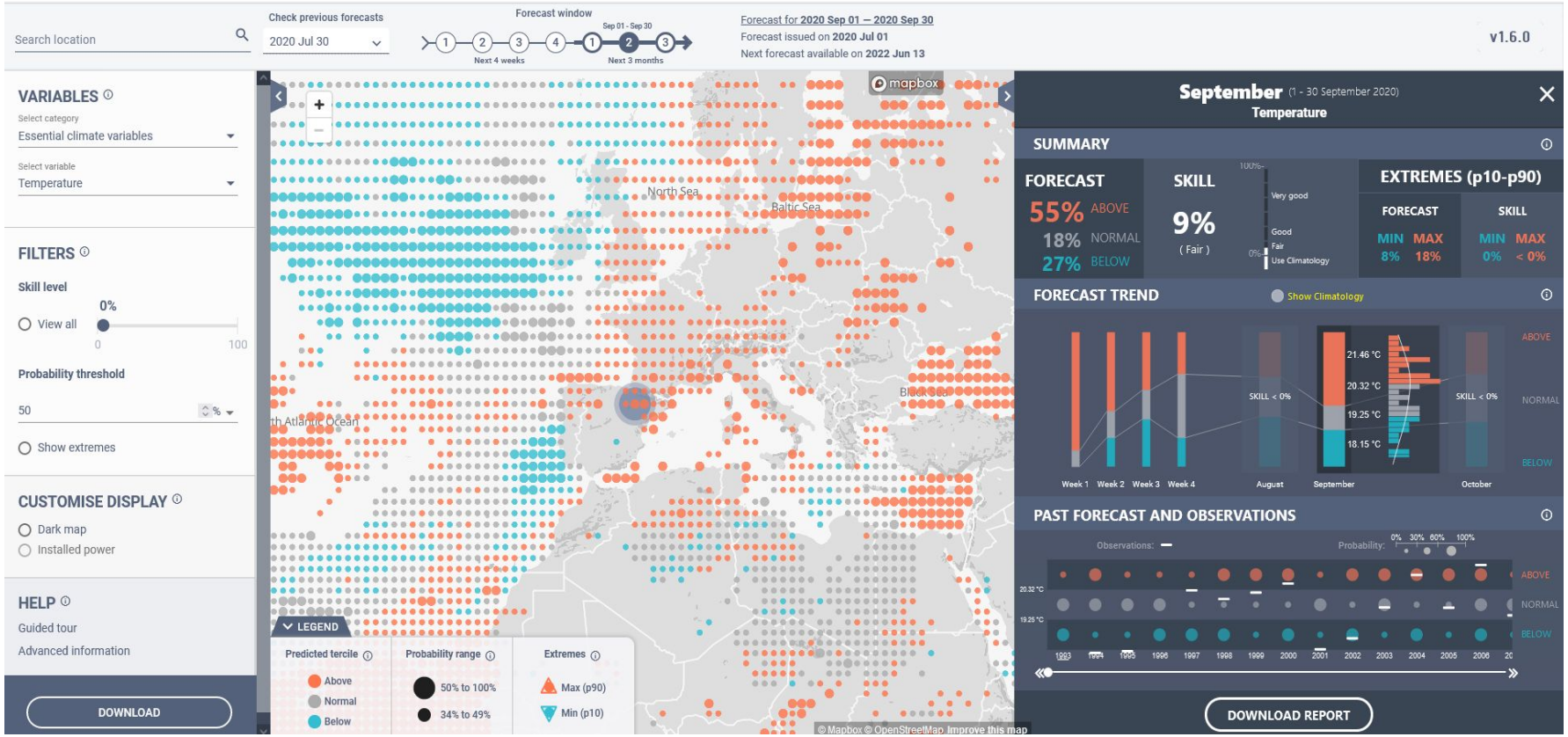
Climate Services for the renewable energy sector

S2S4E Climate Services for Clean Energy

Sub-seasonal and seasonal forecast service for wind and solar energy production

Manrique-Suñén et al. 2023
https://doi.org/10.1016/j.cliser.2023.100359

> Interactive web application delivering operational predictions of key atmospheric variables and **climate indicators.**



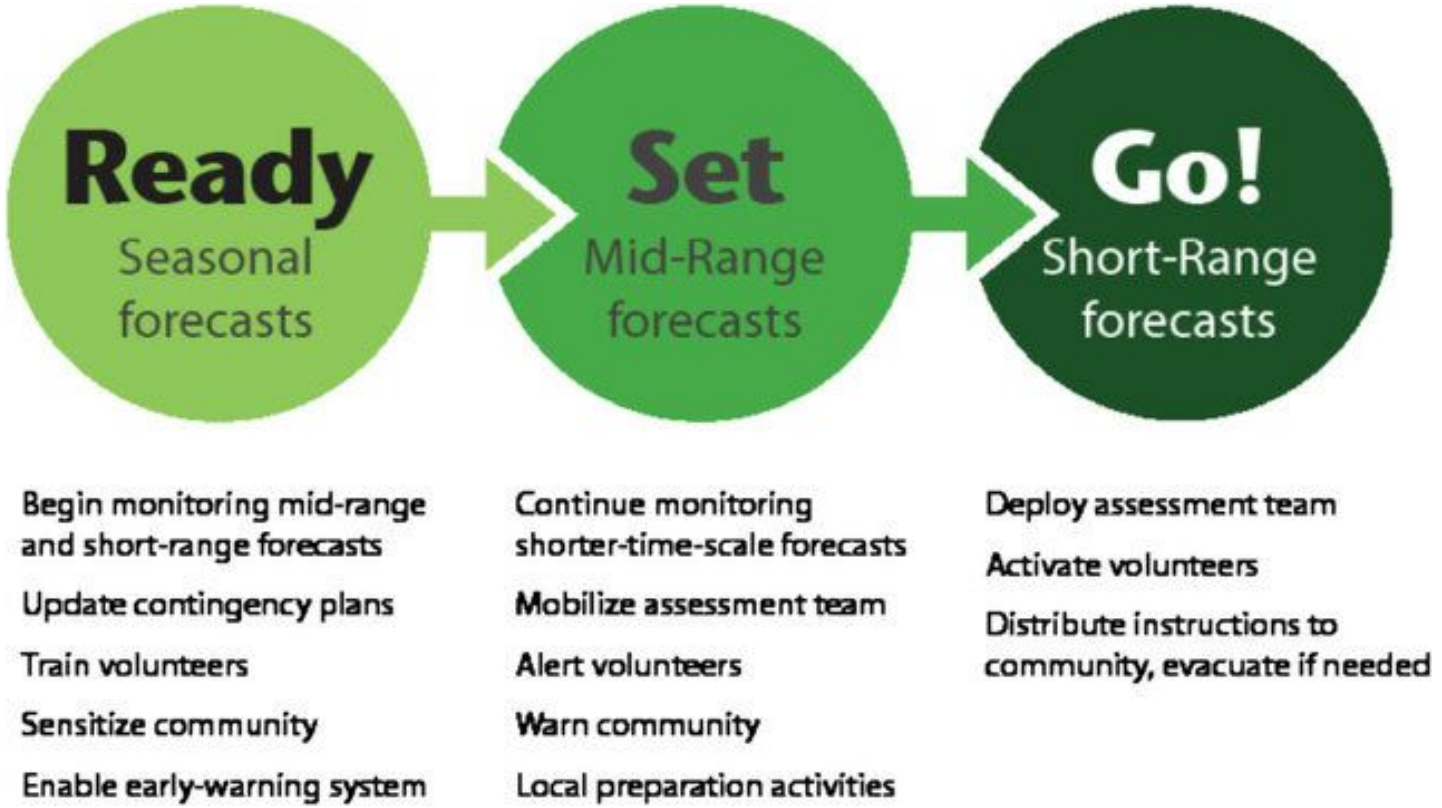
Earth Sciences Department
BSC Barcelona Supercomputing Center
Centro Nacional de Supercomputación

Climate Services aim

> Climate services aim at **anticipating** climate conditions that help trigger anticipatory actions:

a) to mitigate negative climate impacts or

b) or take advantage of favorable conditions.



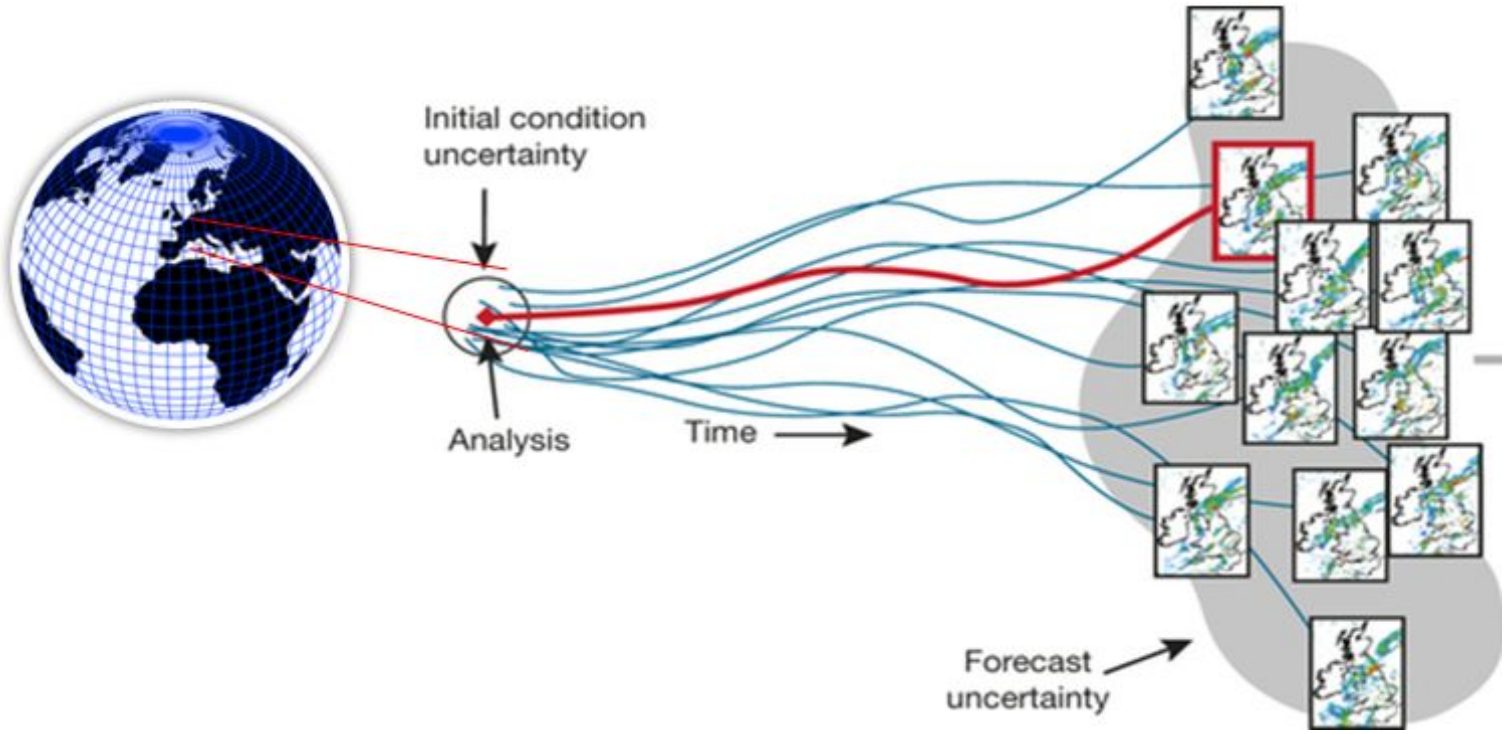
Goddard et al. 2014
https://doi.org/10.1186/2194-6434-1-10

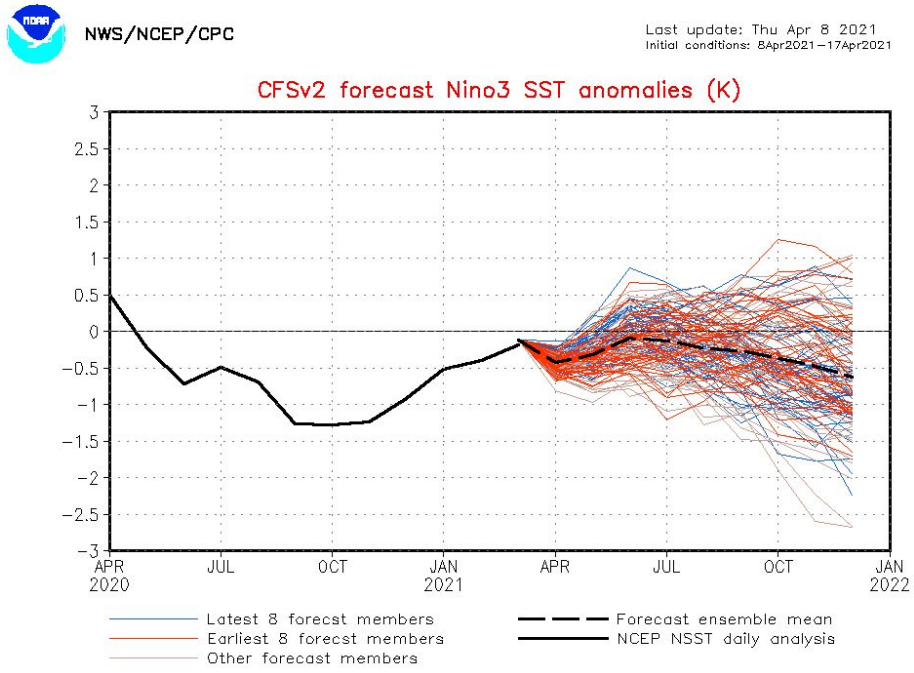
Climate Services co-production

Co-design	Co-development	Co-evaluation
e.g.: Common language, expertise, past experiences, needs, requirements, limitations and expectations,...	e.g.: data availability, state-of-the-art methodologies, visualisation, communication, ...	e.g.: usability, up-taken, applications, case studies, …

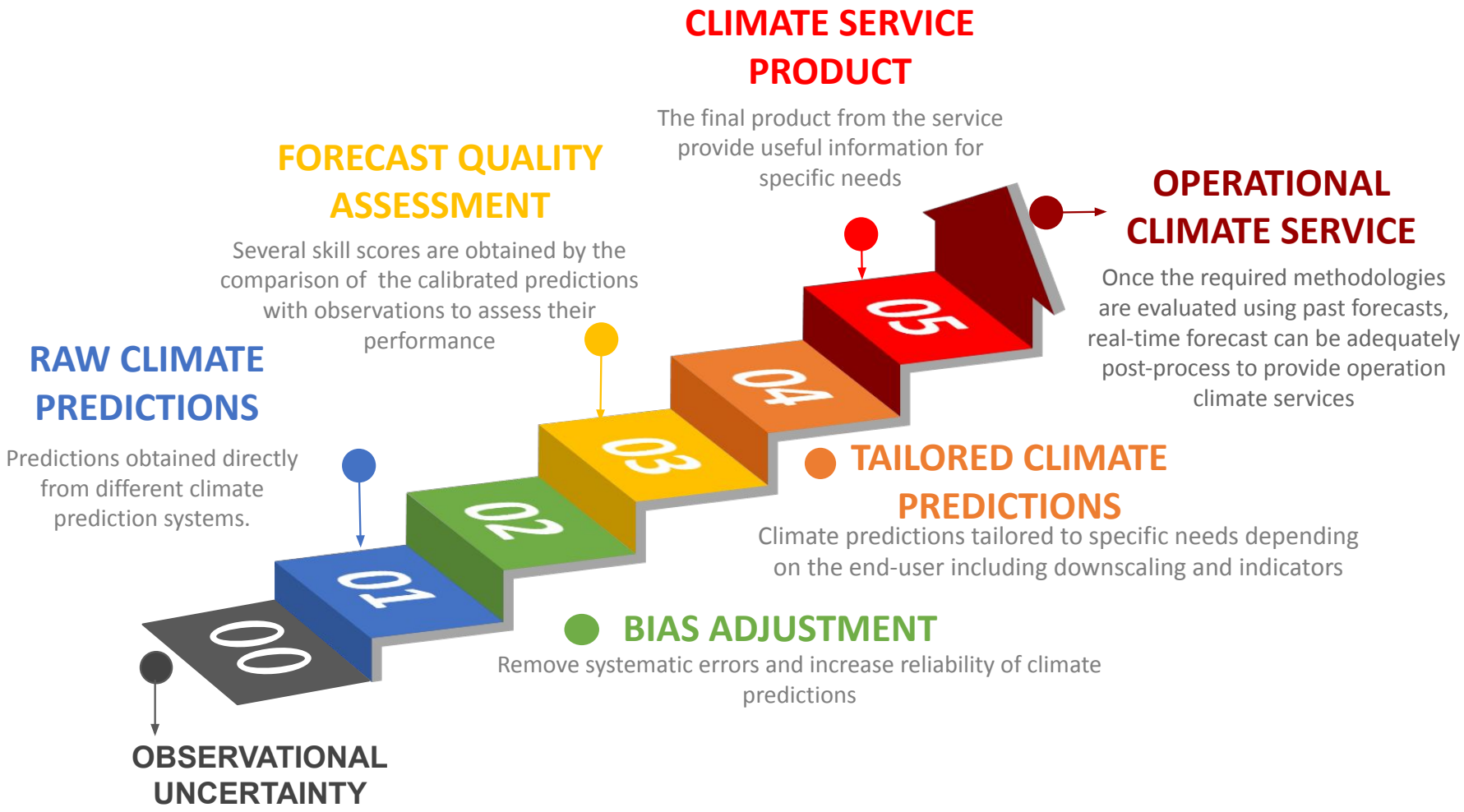
\+ user selection, user engagement, workshops, interviews, survey design, UX, …

Climate Services co-production





Climate Services co-production



The Valencia DANA event

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

Publication submitted to
Environmental Research Letters

Objectives

1) Use the **case study** approach to evaluate the sub-seasonal climate forecast ability to predict the precipitation records during the Valencia's DANA.

2) Use all calibration methods available.

3) Exploration of the synoptic configuration, led us to use a cut-off low detection algorithm.

4) Design a new forecast product for DANA events.

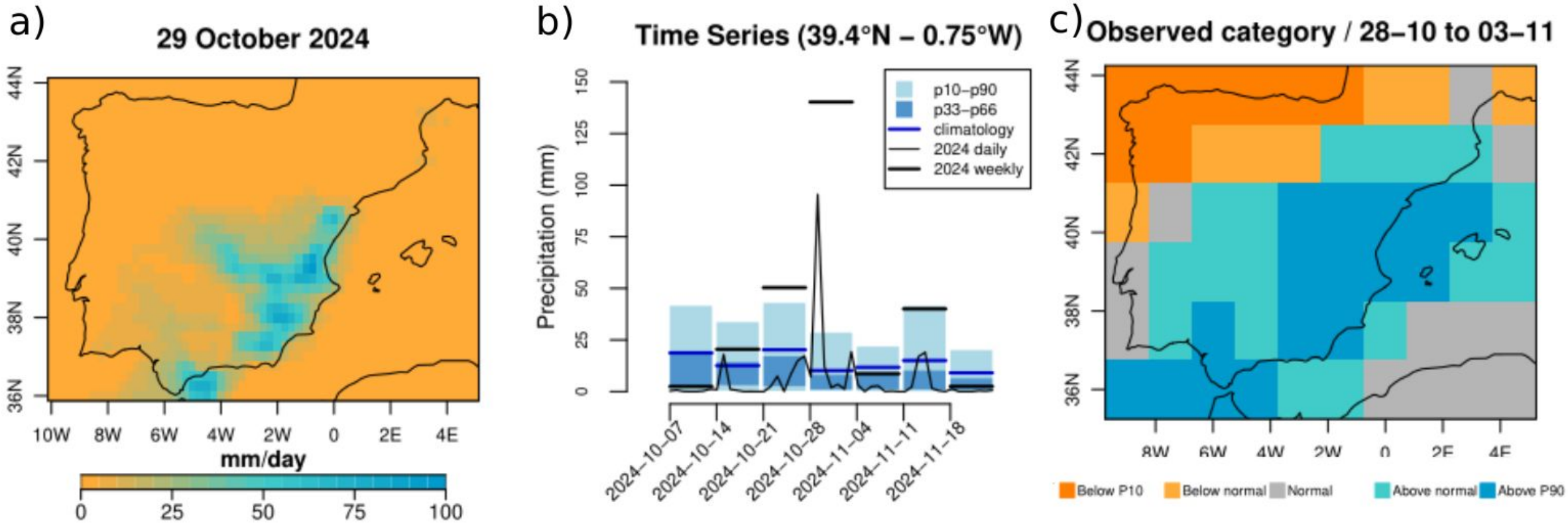


Figure 1. Spatial distribution of total precipitation on 29 October 2024 as recorded in ERA5 (a). The daily and weekly temporal evolution from 7 October to 24 November 2024 in the ERA5 grid point where maximum precipitation was recorded (b) on the date of the cut-off low event (i.e. 39.25 ºN - 0.75ºW) compared to the weekly climatological terciles and extreme probabilities (i.e. 10th and 90th percentiles for the period 1991-2020. The spatial distribution of the observed tercile or extreme categories during the target week using the model spatial resolution 1.5ºx1.5º (c).

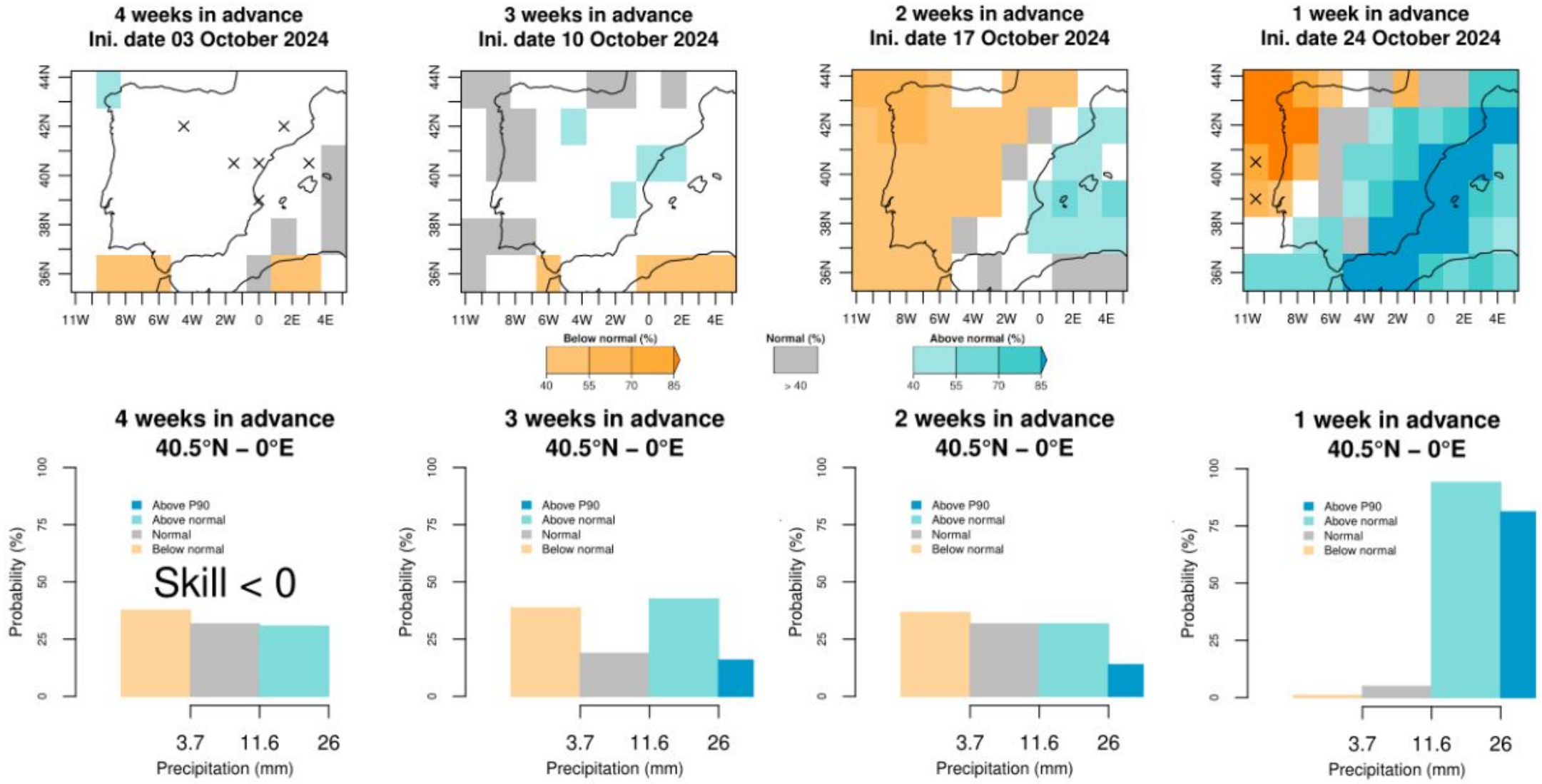
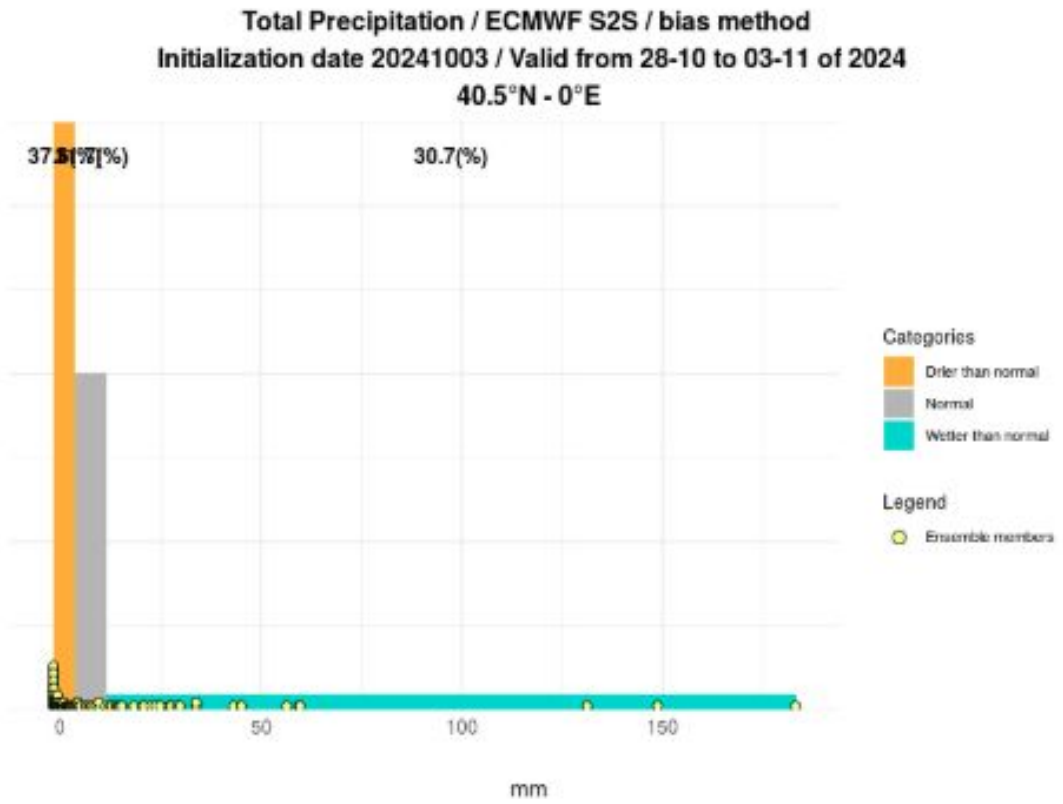
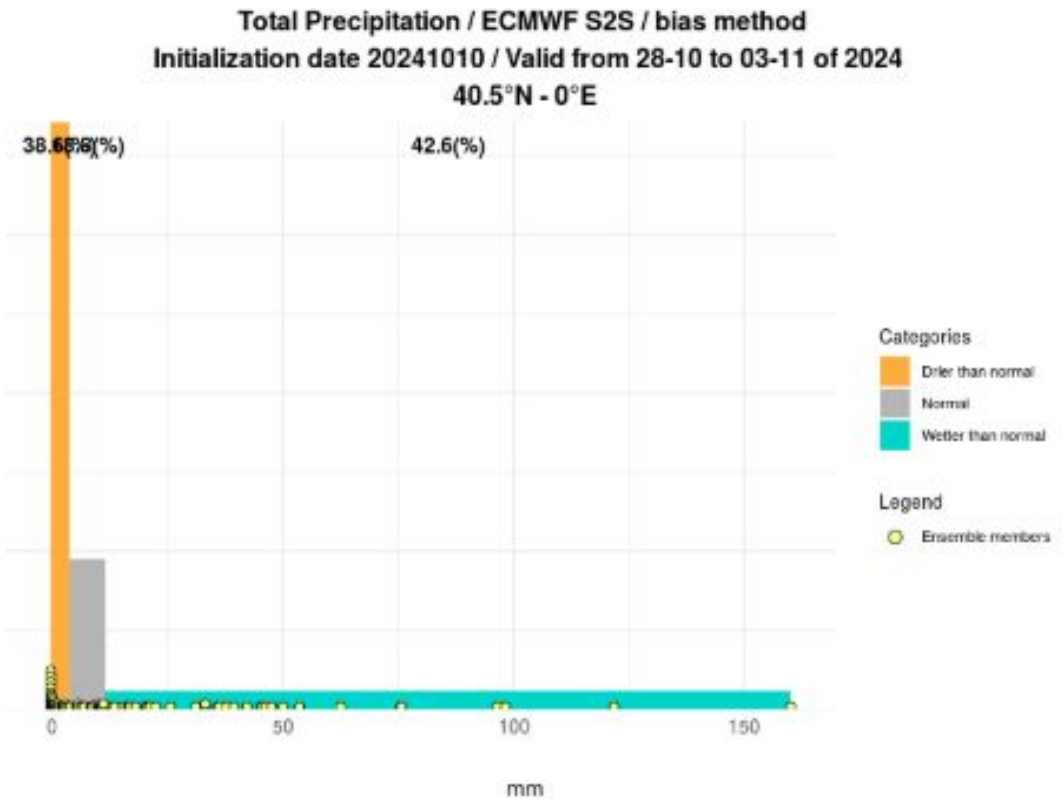


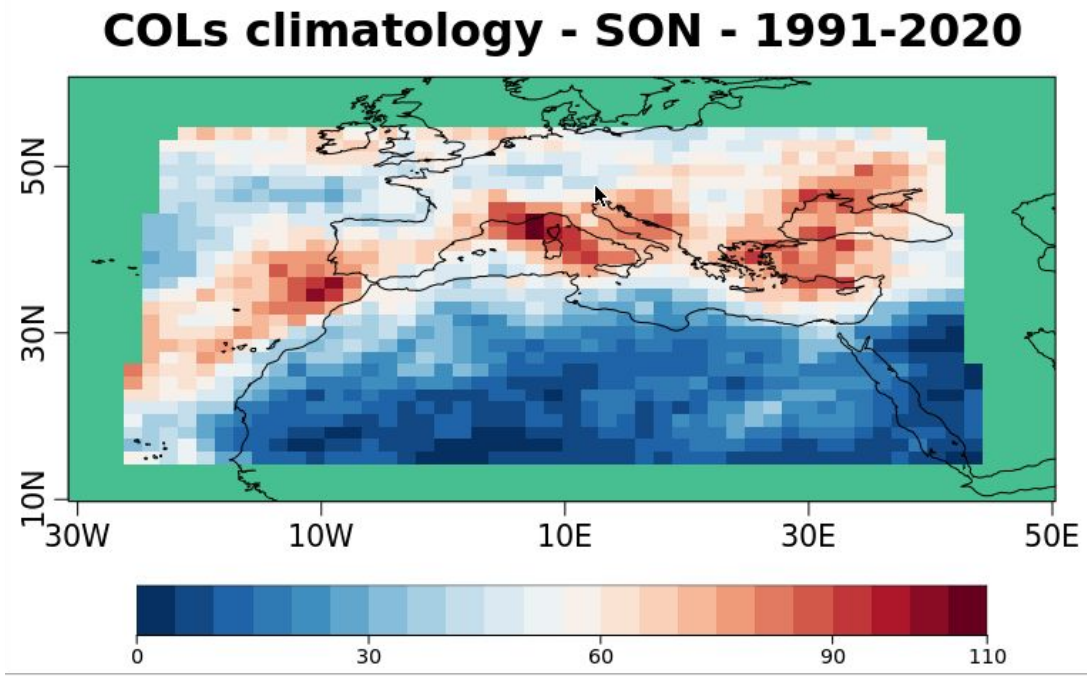
Figure 2: Total accumulated precipitation forecast based on tercile categories (top row) for the target week predicted four, three, two and one weeks in advance (from left to right) for the Iberian Peninsula and the Balearic Islands and for a grid point at 40.5ºN-0ºE (bottom row). Crosses in the maps and the label "Skill < 0" indicate that the climatological forecast significantly outperforms the climate forecast, as determined by the Random Walk test applied to the RPSS. White grid cells indicate probabilities are below 40 % for all categories. Probabilities above P90 are only shown when they exceed 10 % in the bar charts.





Up to 4 weeks in advance, 3 ensemble members predicted precipitation above 100 mm.

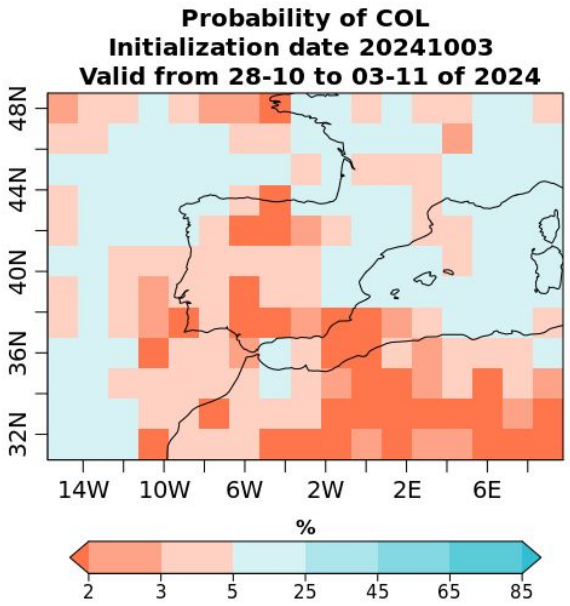
Cut-off low forecasts

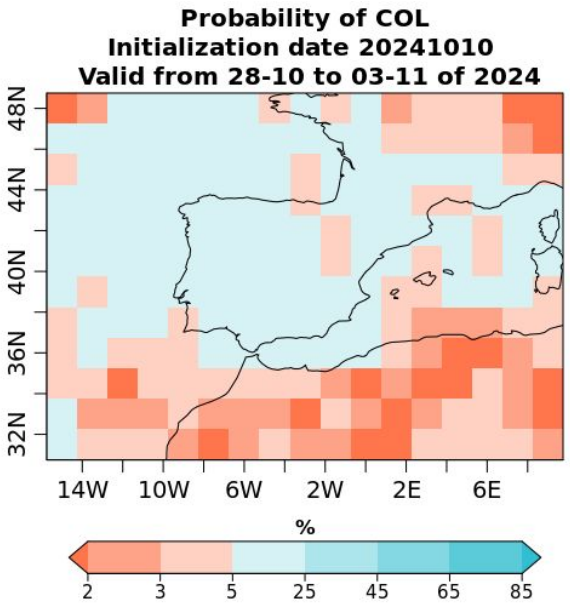


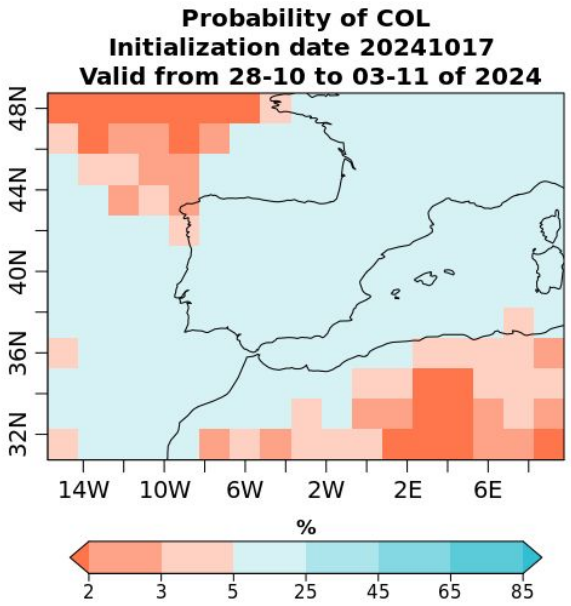
Kasuga et al., 2021
https://doi.org/10.1175/MWR-D-20-0255.1

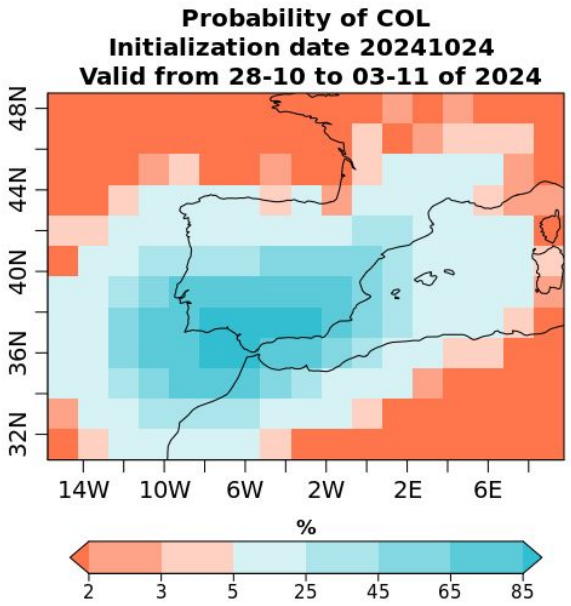
> What the algorithm detects versus what product we deliver

Non-calibrated Z500

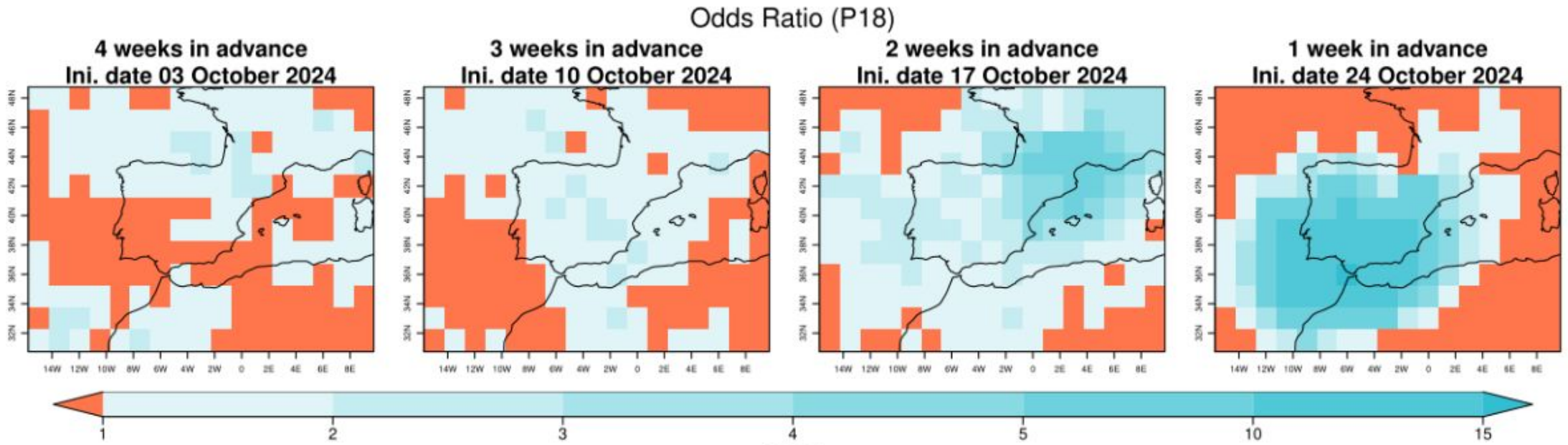


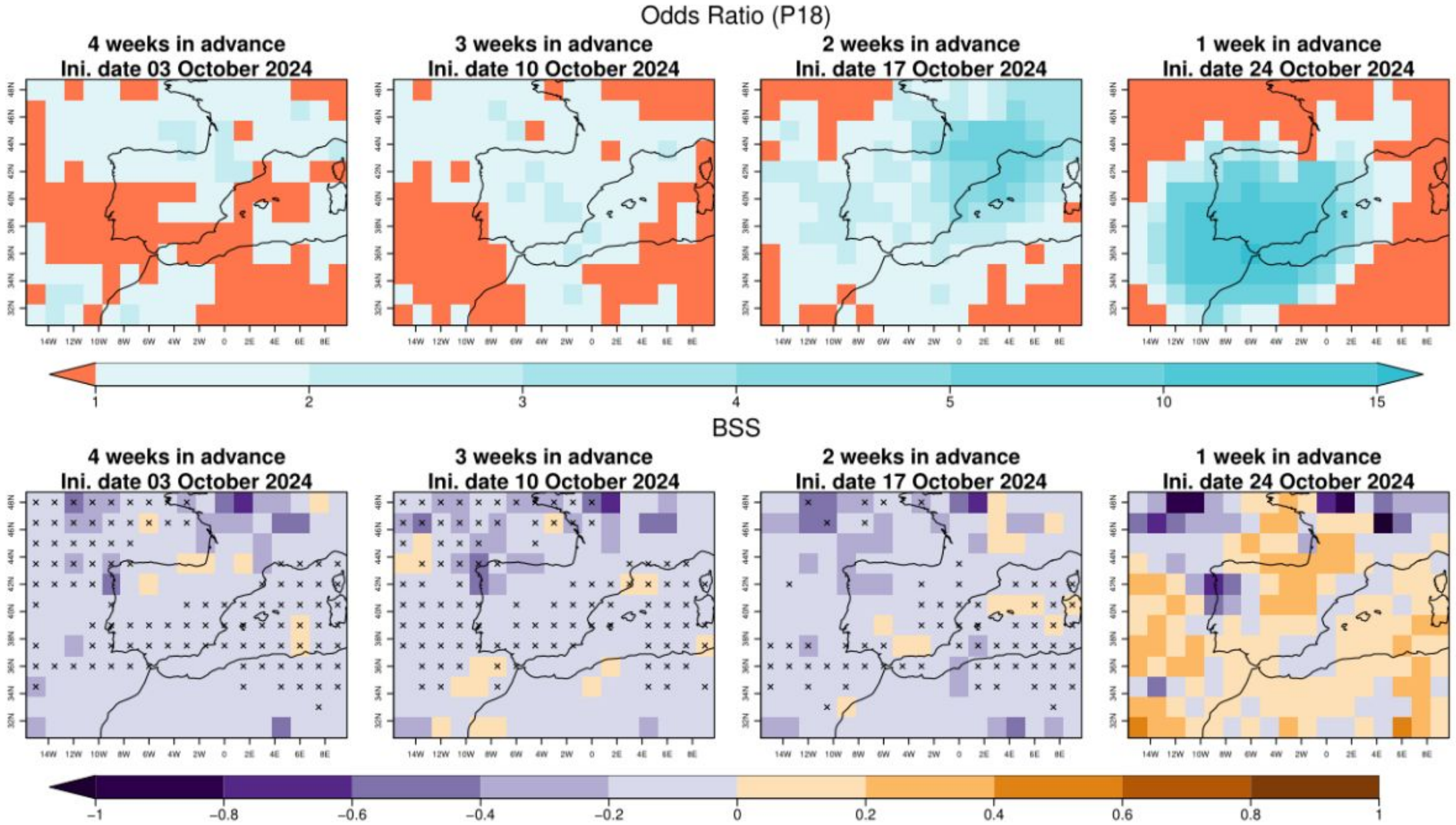






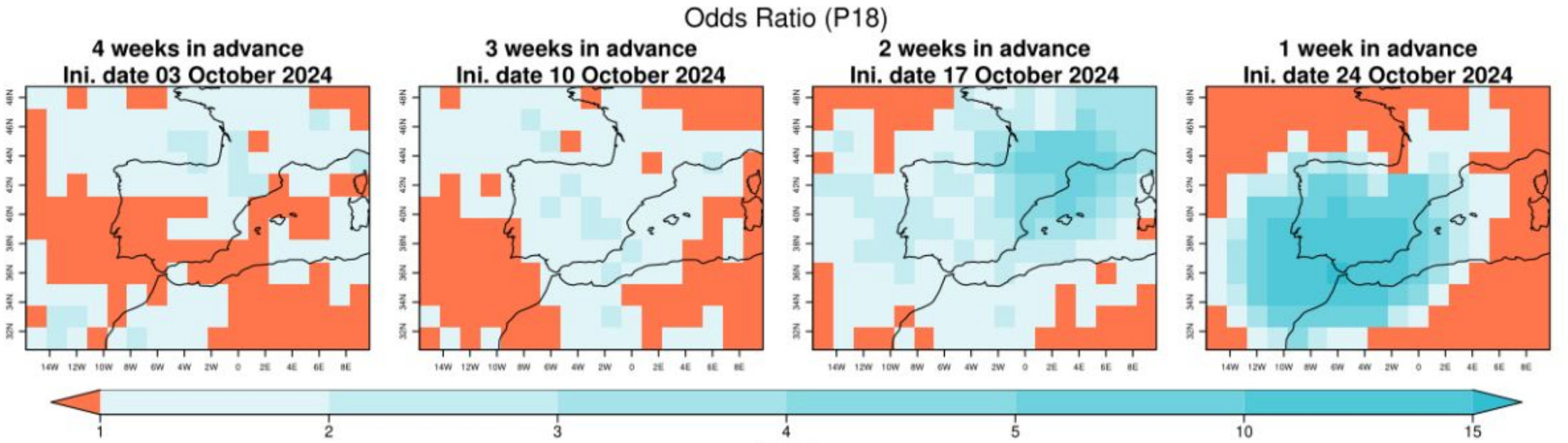
> 5 % probability is high or low?

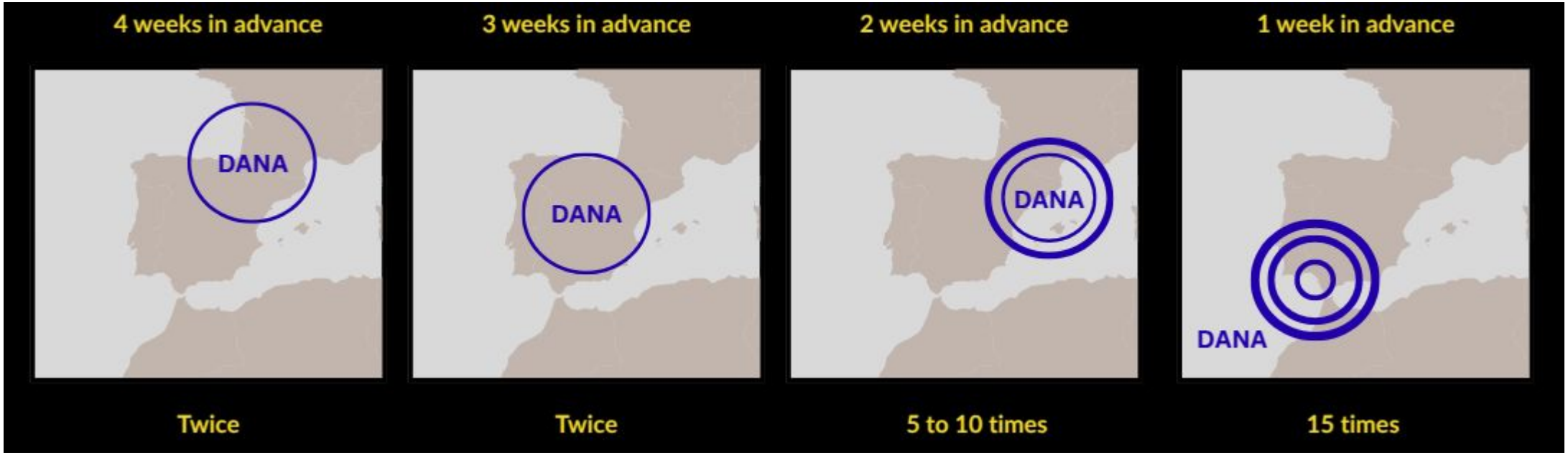

Odds Ratio (P18)
4 weeks in advance
Ini. date 03 October 2024
3 weeks in advance
Ini. date 10 October 2024
2 weeks in advance
Ini. date 17 October 2024
1 week in advance
Ini. date 24 October 2024
1
2
3
4
5
10
15



Earth Sciences Department

Barcelona Supercomputing Center
Centro Nacional de Supercomputación


Odds Ratio (P18)
4 weeks in advance
Ini. date 03 October 2024
3 weeks in advance
Ini. date 10 October 2024
2 weeks in advance
Ini. date 17 October 2024
1 week in advance
Ini. date 24 October 2024
1
2
3
4
5
10
15


4 weeks in advance
3 weeks in advance
2 weeks in advance
1 week in advance
DANA
DANA
DANA
DANA
Twice
Twice
5 to 10 times
15 times

Conclusions

> Despite the limitations to predict the precipitation event, potential users of sub-seasonal precipitation forecasts could be **trained to interpret and manage the uncertainties inherent to this variable**.

> Given the strong relationship between extreme precipitation events and cut-off lows over the Iberian Peninsula and the Balearic Islands, a **dedicated cut-off-low forecast service at sub-seasonal** timescales could provide valuable early information for these events. Such a service could **complement precipitation forecasts** by providing additional insight into the uncertainty associated with the location of the cut-off low centre.

> **Prodhomme et al. (2016) simplifies the interpretation**, as it indicates directly whether the forecast suggests a higher or lower likelihood than expected from climatology, avoiding potential confusion about whether a given forecast probability should be considered ‘high’ or ‘low’.

> Further exploration of the design of the **visualisation products** is needed applying a **co-production methodology with key users**.

AI4S
BSC AI4Science Fellowships

Earth Sciences Department

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

Thank you!

Núria Pérez-Zanón acknowledges her AI4S fellowship within the “Generación D” initiative by Red.es, Ministerio para la Transformación Digital y de la Función Pública, for talent attraction (C005/24-ED CV1), funded by NextGenerationEU through PRTR.

nuria.perez@bsc.es