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Earth Sciences
Department



**Barcelona
Supercomputing
Center**
Centro Nacional de Supercomputación

Forecast outlook

November 2025

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Climate Services Team (CST)

Earth System Services (ESS)

Barcelona Supercomputing Center (BSC)

BOREAS project: PID2022-140673OA-I00 funded by
MICIU/AEI/10.13039/501100011033 and FEDER, EU



Outline



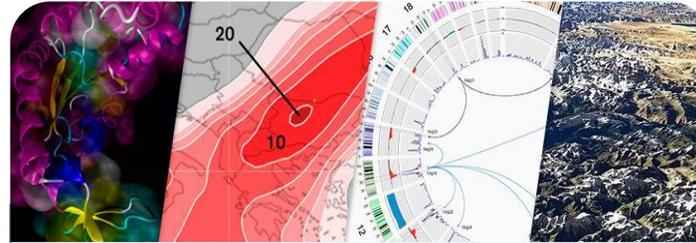
- I. The BOREAS project
- II. State of the climate
- III. Subseasonal forecasts
- IV. Seasonal forecasts
- V. Feedback

Barcelona Supercomputing Center Centro Nacional de Supercomputación

BSC-CNS objectives



Supercomputing services
to Spanish and EU researchers



R&D in Computer, Life, Earth and
Engineering Sciences



PhD programme, technology
transfer, public engagement

**BSC-CNS is
a consortium
that includes**

Spanish Government



Catalan Government

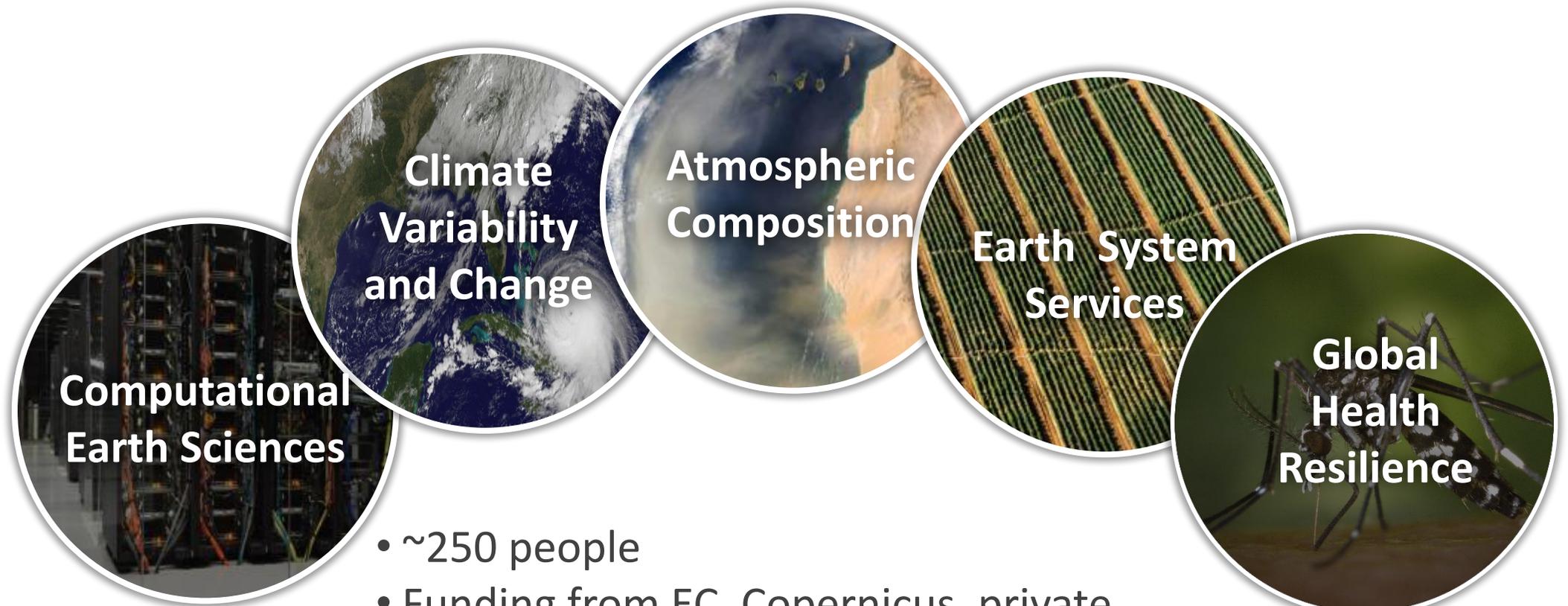


Univ. Politècnica de Catalunya (UPC)



Earth Sciences Department

Environmental modelling and forecasting using process-based and artificial intelligence models, with a particular focus on **weather, climate and air quality**. This includes **transferring solutions** to support the main societal environmental challenges through data applications



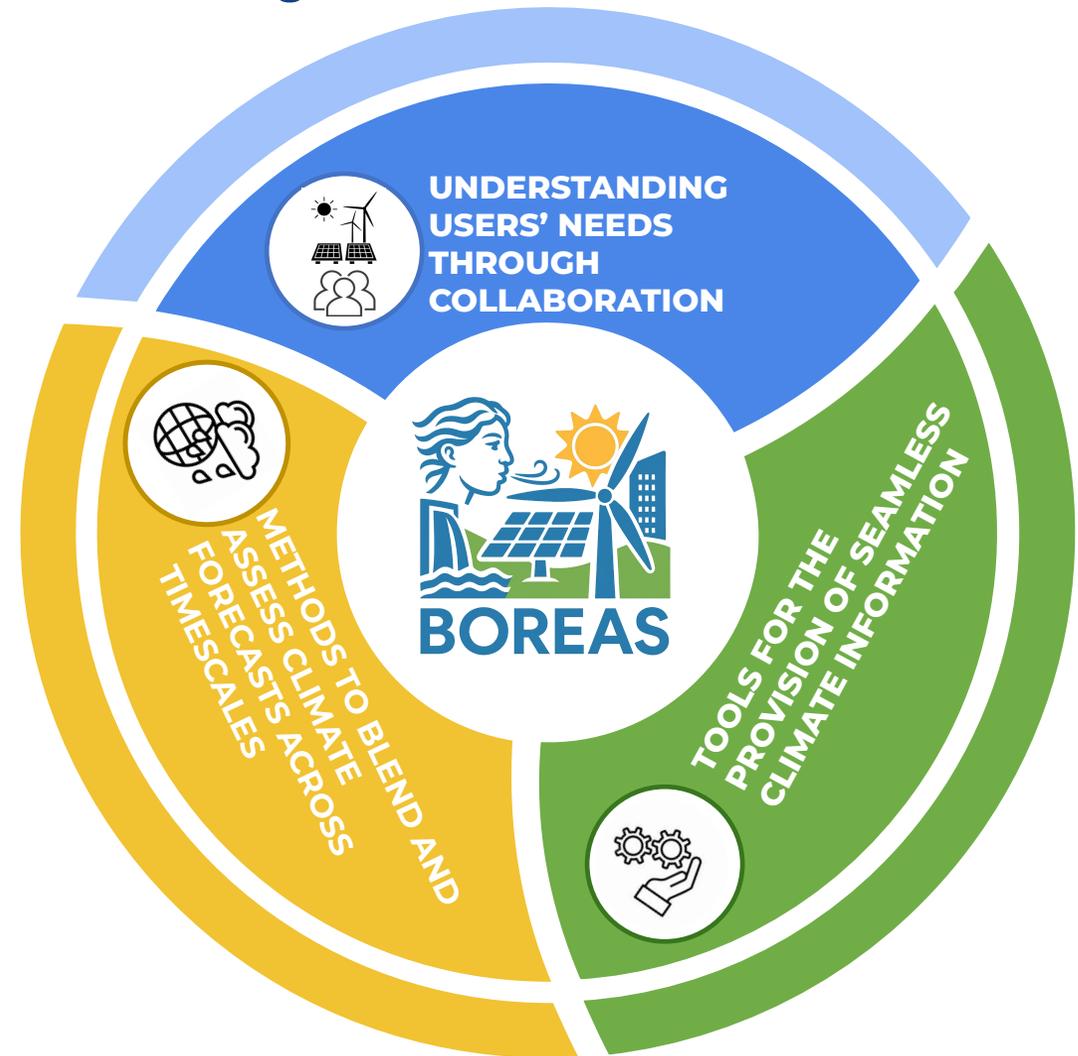
- ~250 people
- Funding from EC, Copernicus, private sector, ESA, Spanish and regional governments

BOREAS



Blending knowledge from climate predictions and projections to make the Spanish energy sector more resilient to climate variability and climate change

- The **co-development** of prototypes, operational services and case studies in the framework of European and national projects and private contracts has demonstrated the **value of climate information to help energy stakeholders** anticipate climate variability, adapt their decision-making processes, and reduce climate-related risks.
- **BOREAS** provides **coherent climate information** by integrating subseasonal, seasonal, decadal predictions, and climate projections that can be easily accessible and used within multiple decision-making contexts by the energy industry.



Forecast outlooks

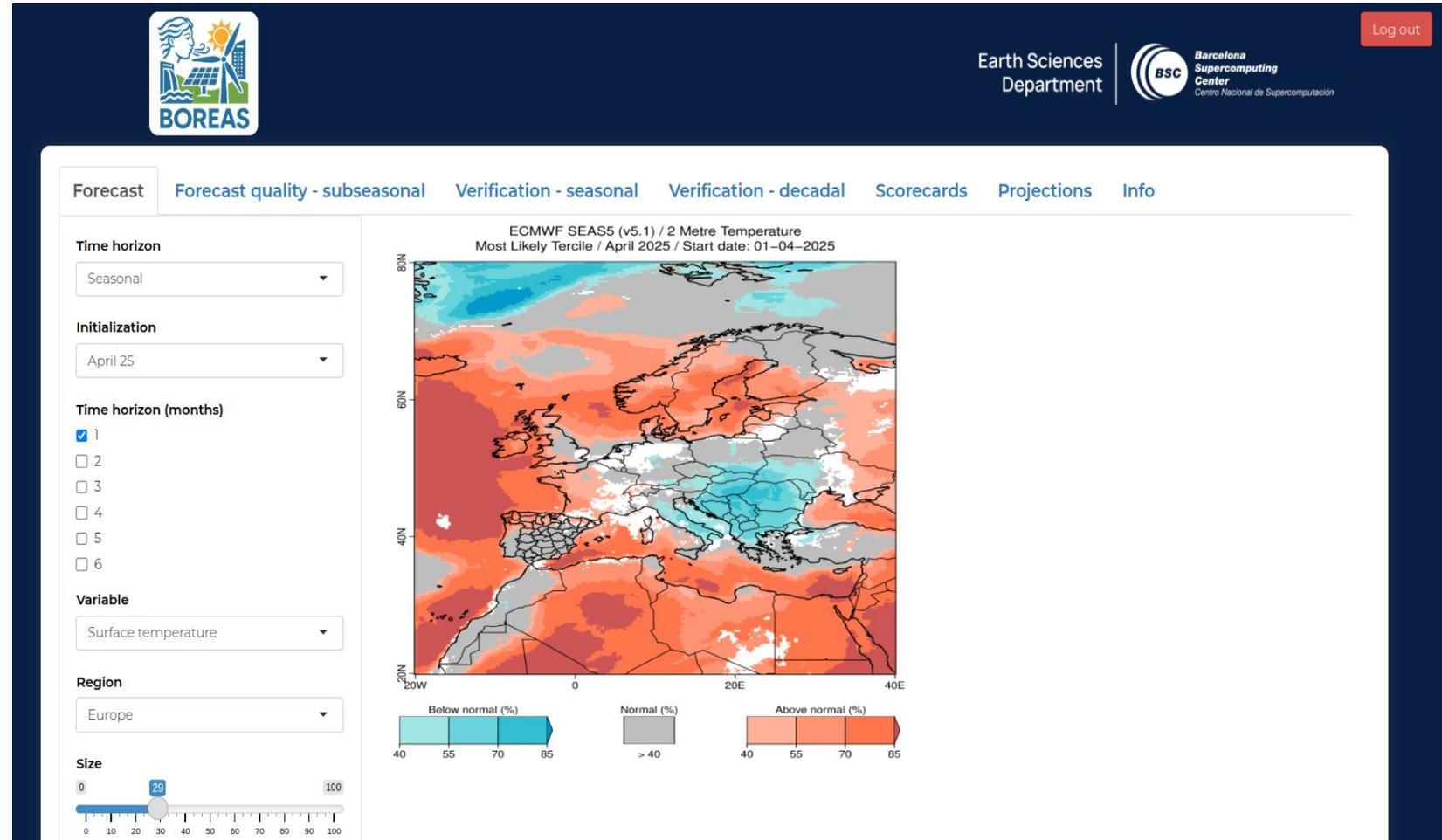


- Scientific discussion on the recent state of the climate, with a focus on Europe.
- Showcase of the latest subseasonal and seasonal **probabilistic** forecasts, post-processed at BSC.
- Aim for the energy sector, with prospective inclusion of relevant energy indicators.
- Open discussion and invited speaker
- Next forecast outlook: most likely 21st of January 2026
- Please share your feedback with us!

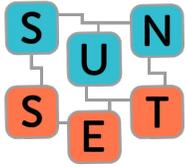
Operational climate service



Please email us to get access to the web platform: boreas@bsc.es



Data and Methods



The post-processing, calibration and visualisation of the following predictions has been performed with **SUNSET** (SUBseasonal to decadal climate forecast post-processing and asSEssmenT suite). Pérez-Zanón *et al.* (2025).



The model used for the **subseasonal forecast** is the NCEP CFSv2 (Saha, 2014), with 48 forecast and 12 hindcast members. The reference period for calibration and computation of skill is 1999-2016.



For the **seasonal forecast**, we are using the ECMWF SEAS5 (Johnson *et al.* 2019) model, with 51 forecast and 25 hindcast ensemble members. The reference period is from 1993 to 2016.

ERA5

To **analyse the state of the recent climate** we compute the anomalies of diverse variables and the Euro-Atlantic **Weather Regimes** classification using ERA5.



I. Recent state of the climate - October 2025

II. Subseasonal forecasts

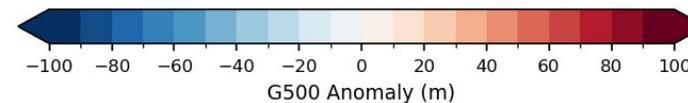
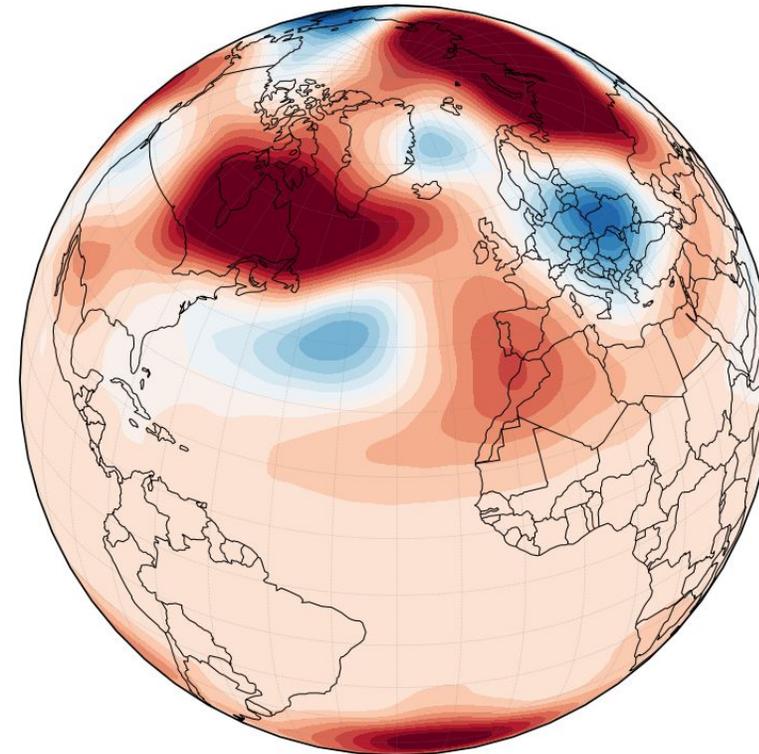
III. Seasonal forecasts

IV. Feedback and wishlist

Atmospheric circulation

500hPa Geopotential height

G500 Anomaly — October 2025
Ref: 1991-2020



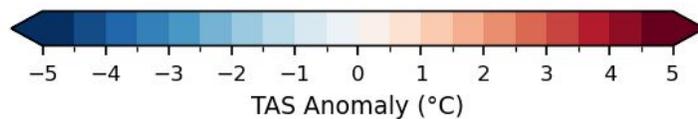
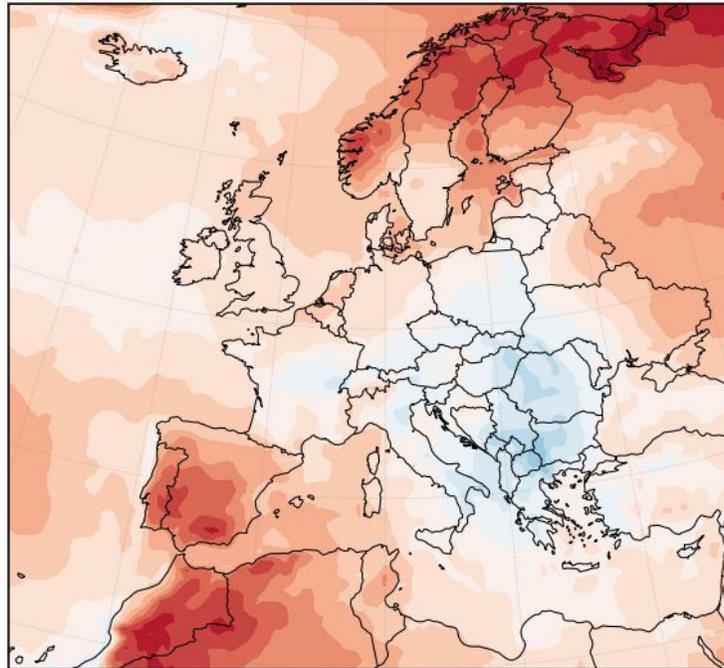
Globally, October was the **third warmest** on record, with a temperature anomaly of 0.7°C above the 1991-2020 average. (ERA5)

Atlantic ridge-like conditions dominated over the North Atlantic-European sector in October

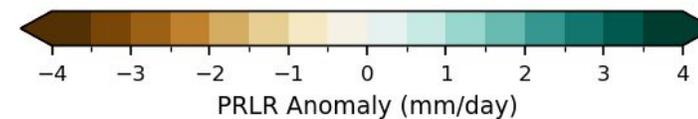
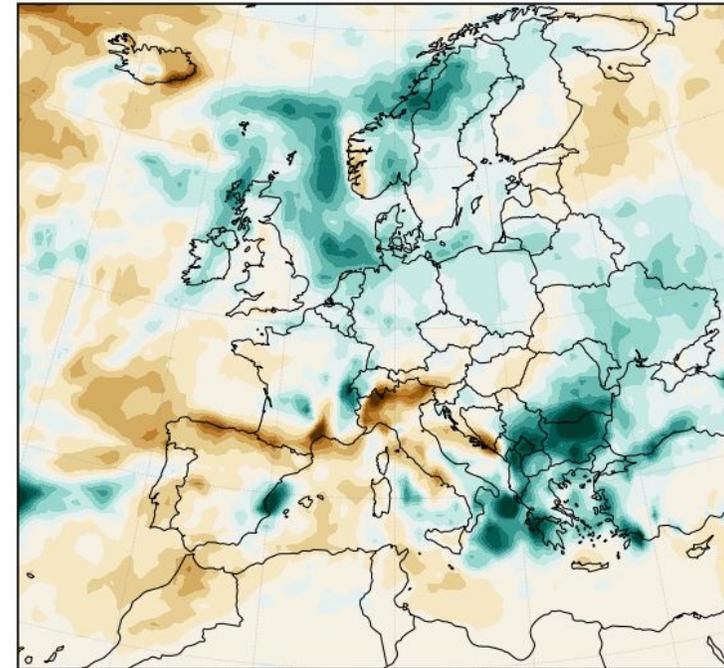


Surface climate anomalies

TAS Anomaly — October 2025
Ref: 1991-2020



PRLR Anomaly — October 2025
Ref: 1991-2020



Temperature

Data source: ERA5

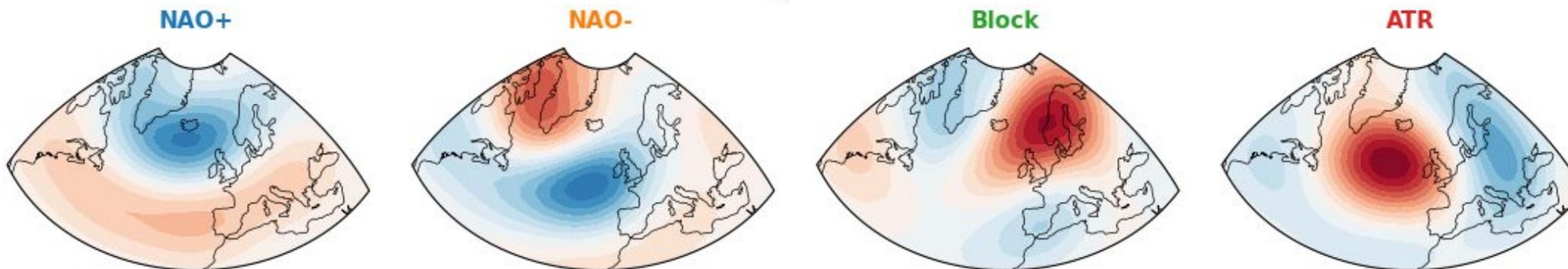
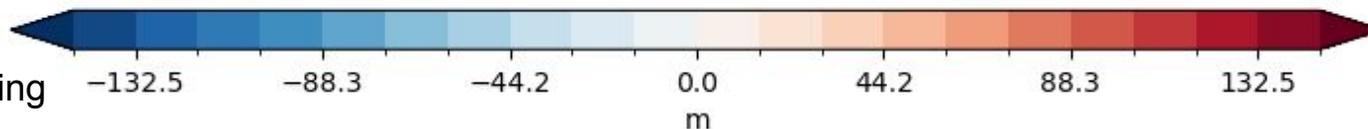


Precipitation

Data source: ERA5

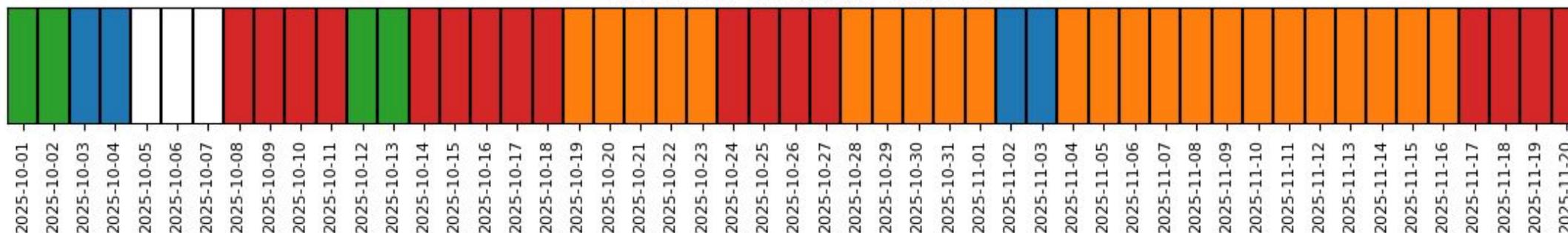
Weather regimes

Geopotential Height anomaly
composites @ 500 hPa
1980:2008
ONDJFMA k-means clustering



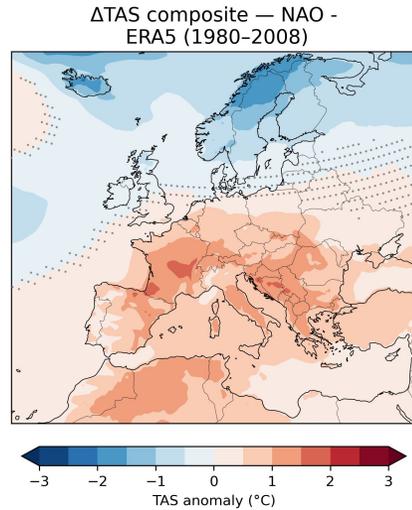
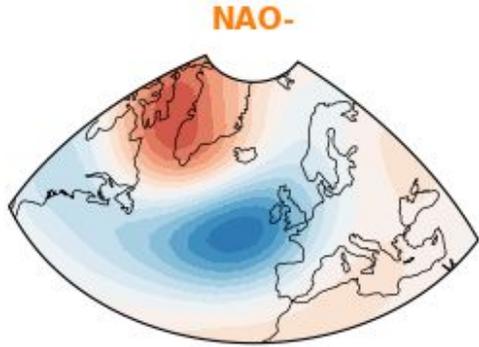
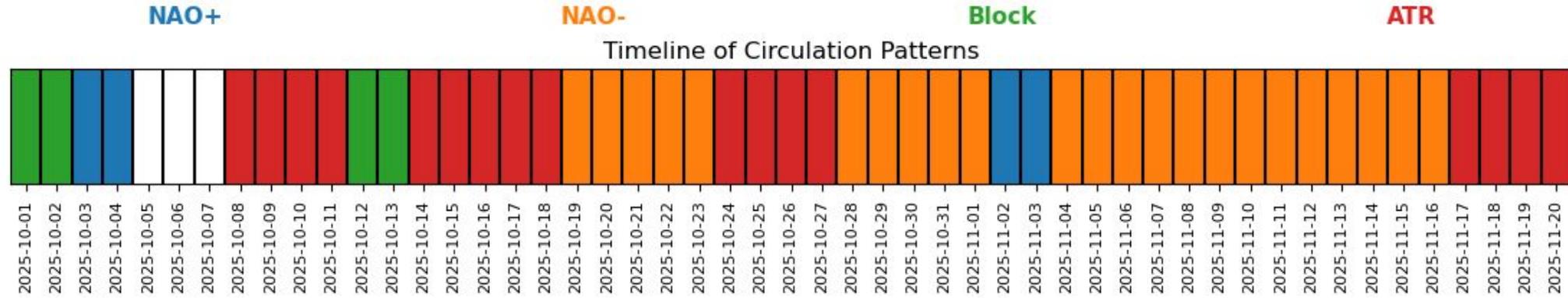
Data source: ERA5

Timeline of Circulation Patterns

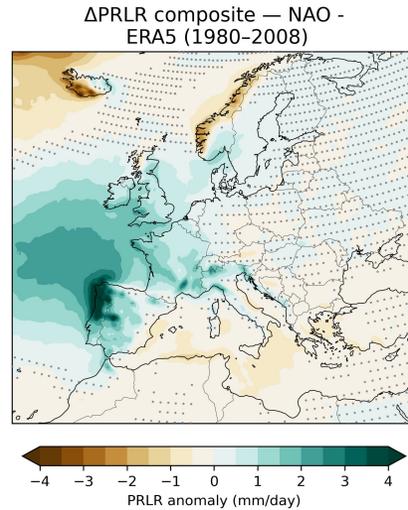


The dominant weather regime in late October through November is a **negative NAO**

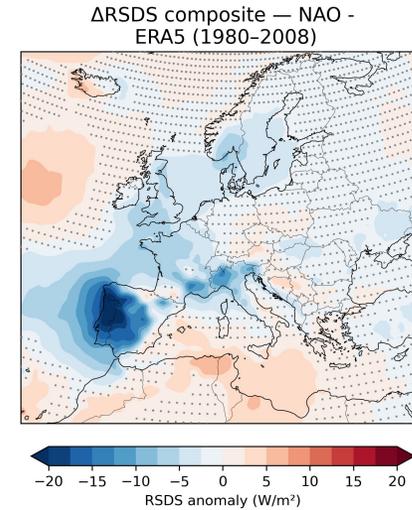
Weather regimes



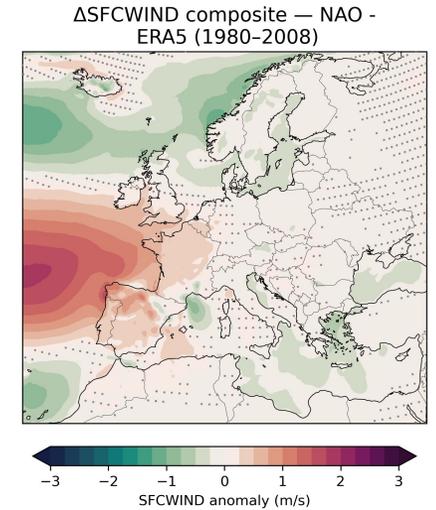
Temperature



Precipitation



Solar radiation

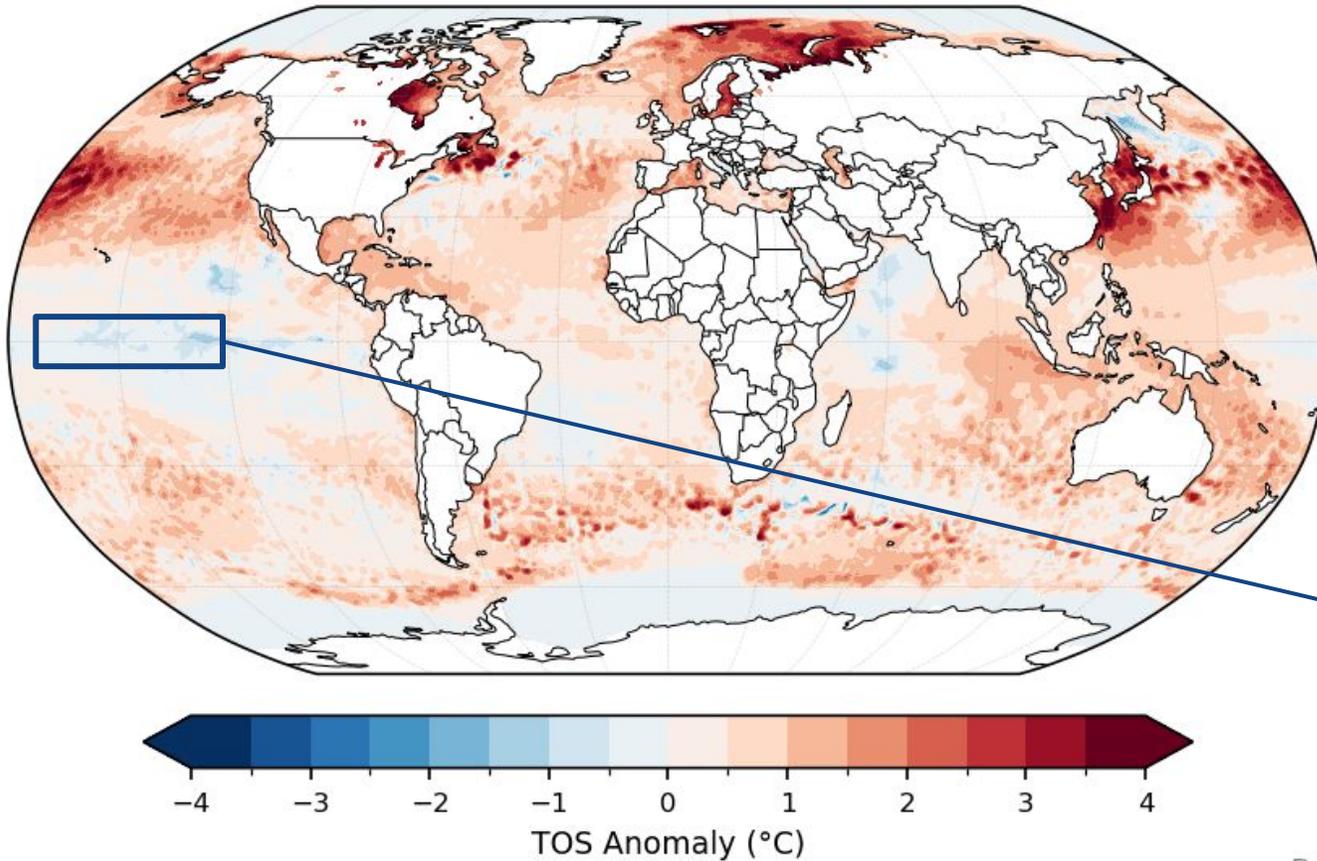


Surface wind

A negative NAO is characterised by a **southward shift of the jet stream**, that brings positive wind and precipitation anomalies to western Europe, alongside milder temperatures and reduced incoming solar radiation.

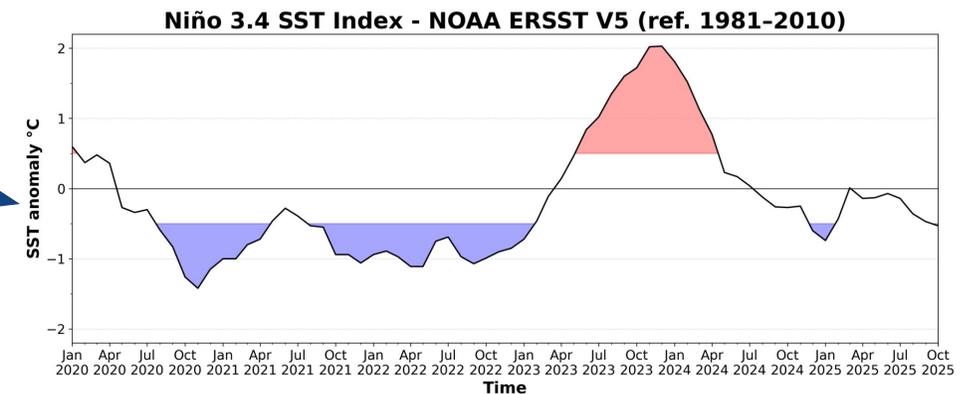
Sea surface temperature

TOS Anomaly — October 2025
Ref: 1991-2020



- The average SST anomaly between 60°S-60°N was 20.54°C, the third-highest value on record.

- La Niña advisory



Data source: ERA5

I. Recent state of the climate

II. Subseasonal forecasts

III. Seasonal forecasts

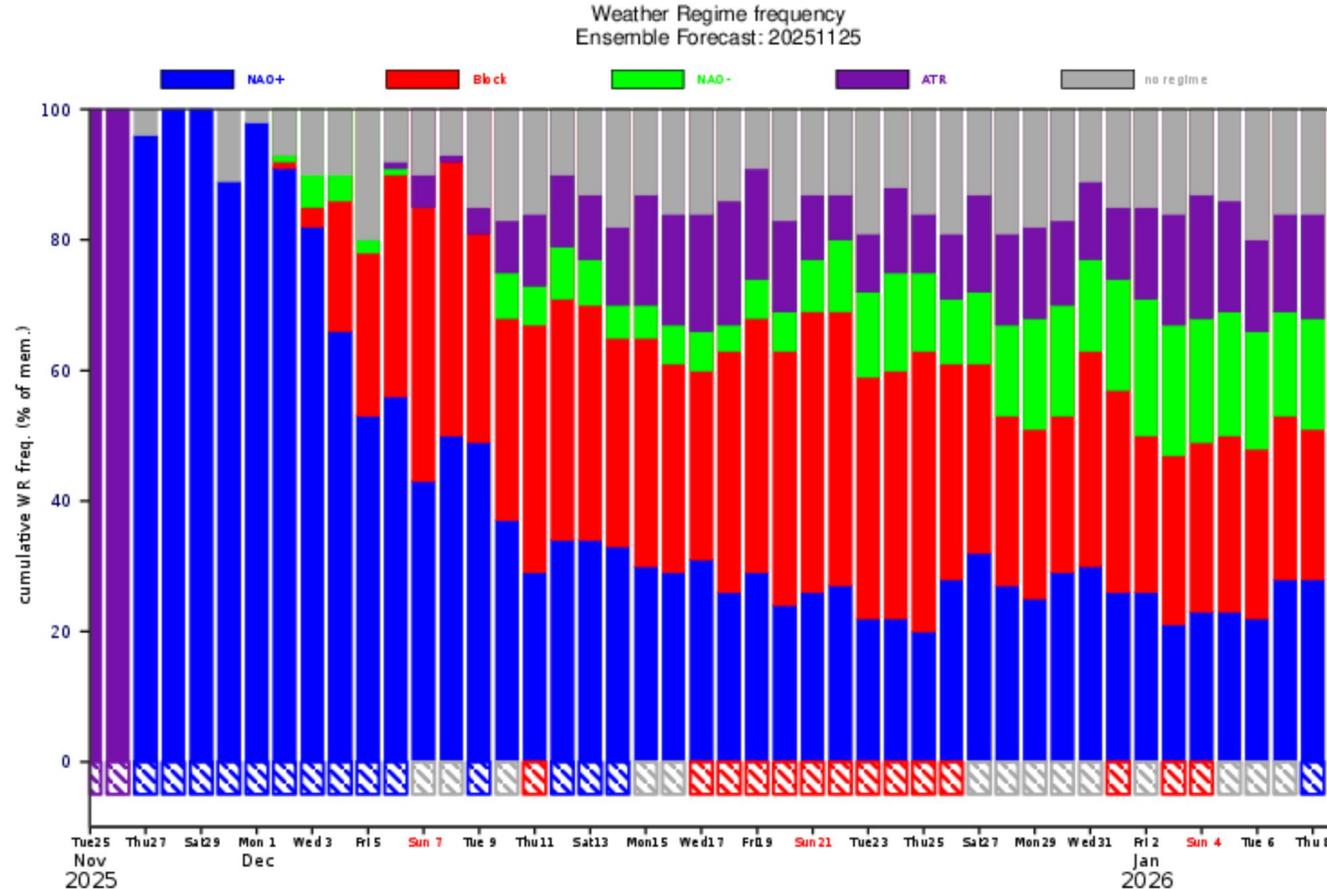
IV. Feedback and wishlist

Subseasonal forecasts

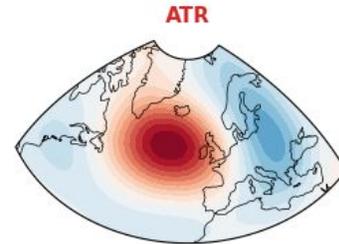
Weather regimes probabilities - Sub-seasonal range forecast



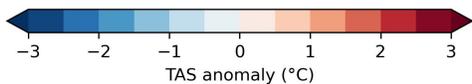
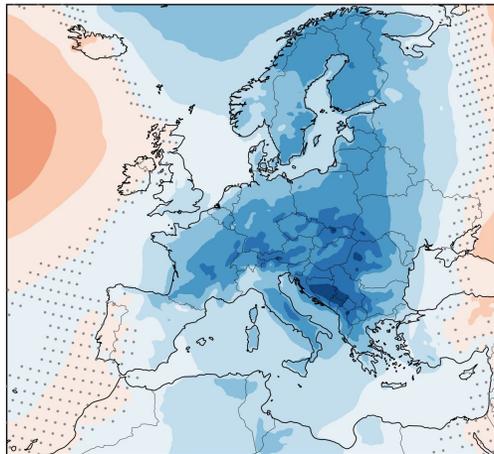
Atlantic ridge conditions are present. Positive North Atlantic Oscillation conditions are expected to dominate until the end of next week.



Composite of Atlantic ridge surface climate

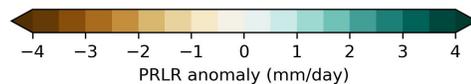
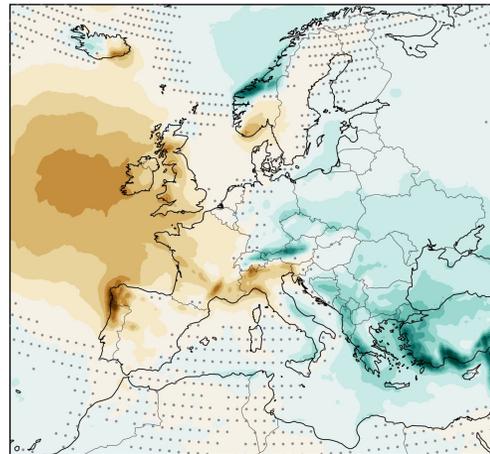


Δ TAS composite — Atlantic Ridge
ERA5 (1980–2008)



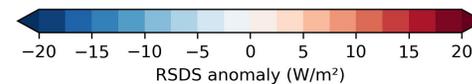
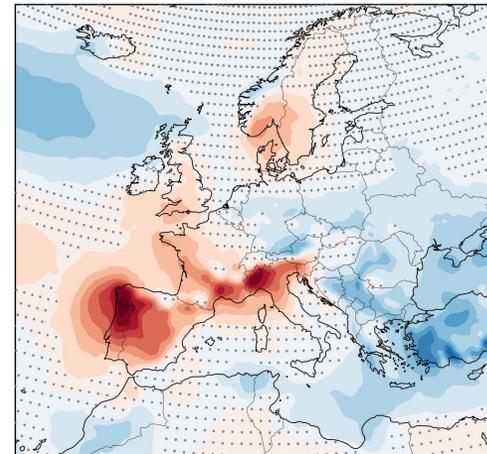
Temperature

Δ PRLR composite — Atlantic Ridge
ERA5 (1980–2008)



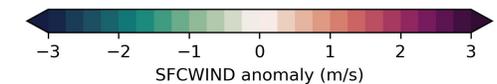
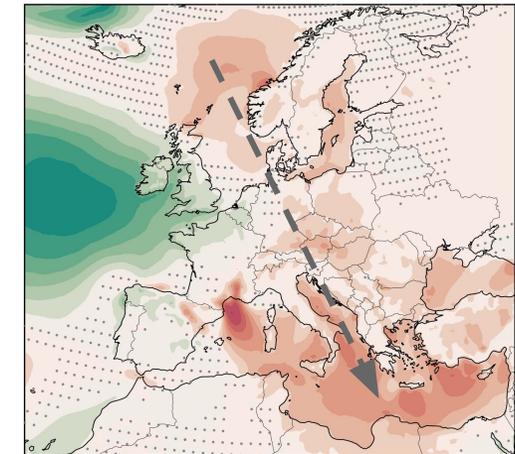
Precipitation

Δ RSDS composite — Atlantic Ridge
ERA5 (1980–2008)



Solar radiation

Δ SFCWIND composite — Atlantic Ridge
ERA5 (1980–2008)



Surface wind

The Atlantic ridge pattern entails strong winds coming from polar latitudes, bringing very cold temperatures to almost all Europe, and increased precipitation over eastern Europe.

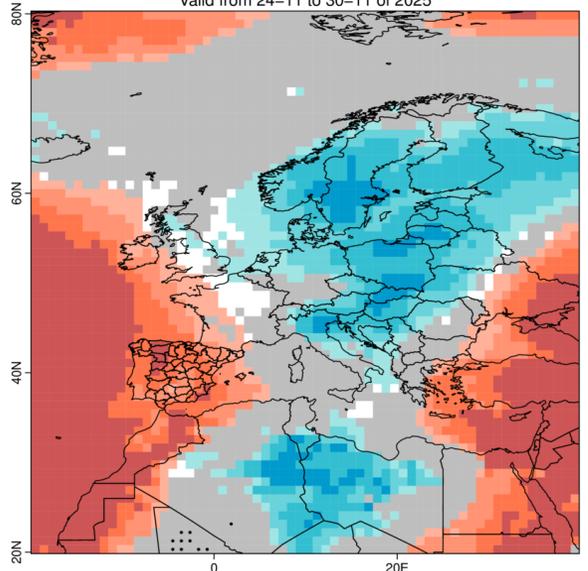
Subseasonal forecasts

Ft1 (24 to 30 Nov 2025)



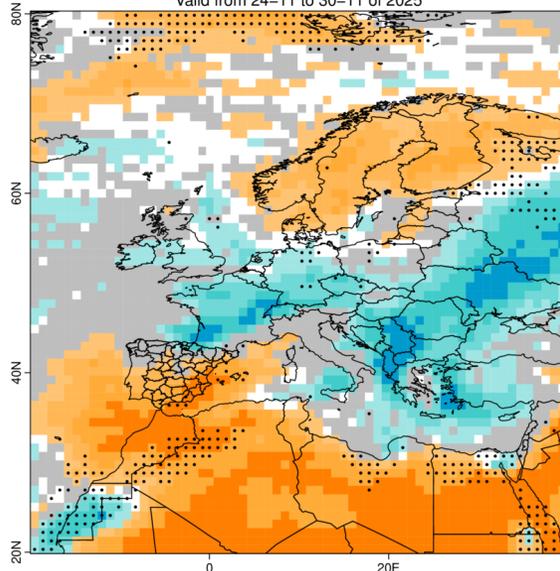
Hindcast period: 1999 - 2016

NCEP CFSv2 / 2 Metre Temperature
Most Likely Tercile / Issued on 20-11-2025
Valid from 24-11 to 30-11 of 2025



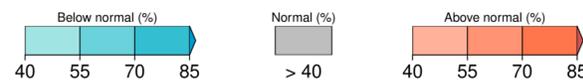
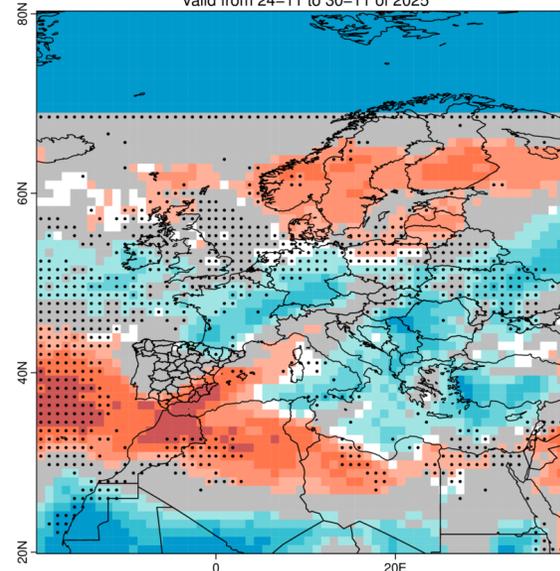
Temperature

NCEP CFSv2 / Total Precipitation
Most Likely Tercile / Issued on 20-11-2025
Valid from 24-11 to 30-11 of 2025



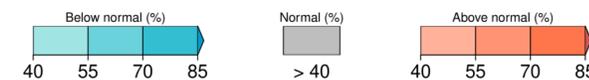
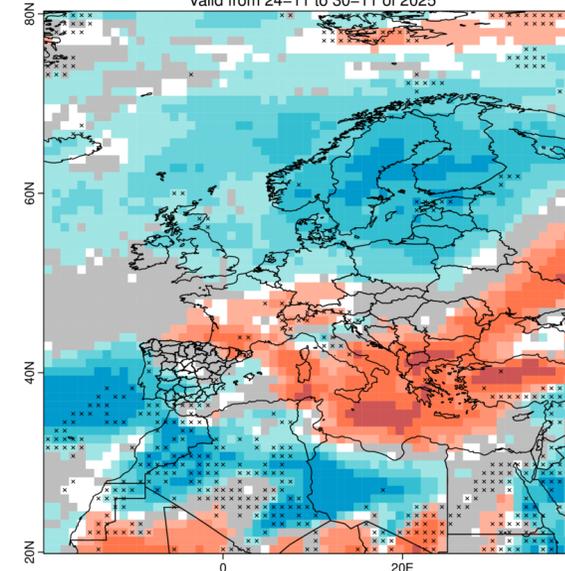
Precipitation

NCEP CFSv2 / Surface Solar Radiation Downwards
Most Likely Tercile / Issued on 20-11-2025
Valid from 24-11 to 30-11 of 2025



Solar radiation

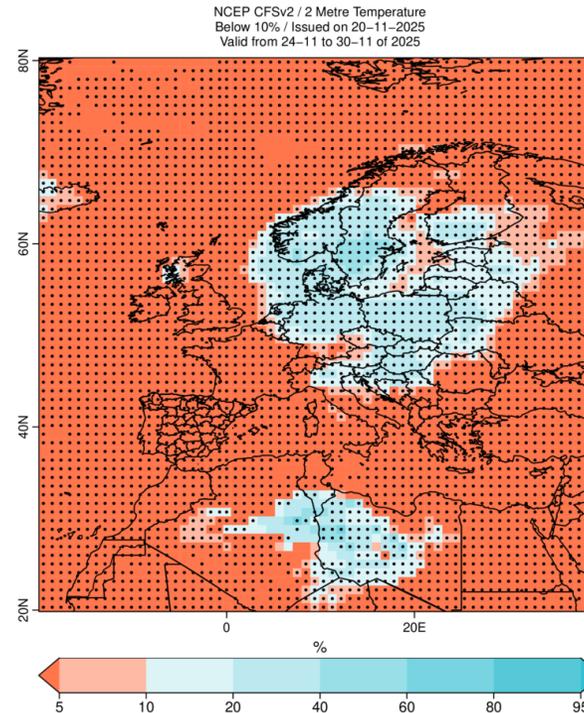
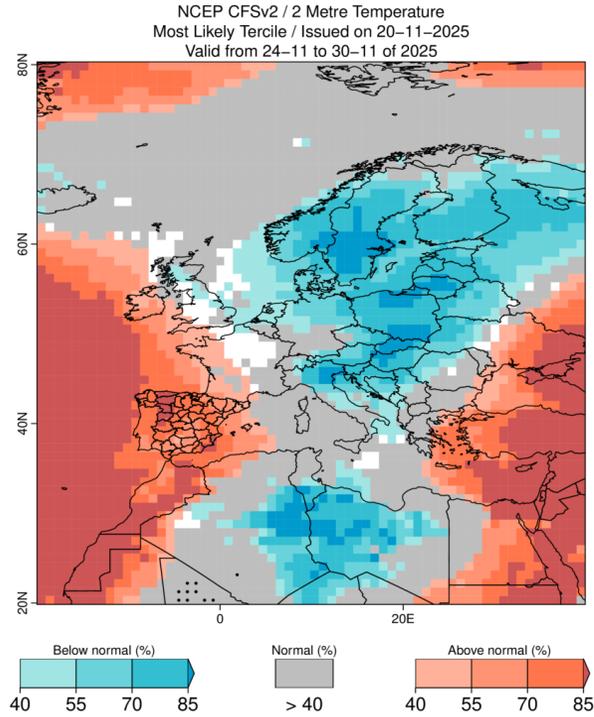
NCEP CFSv2 / 10 Meter Windspeed
Most Likely Tercile / Issued on 20-11-2025
Valid from 24-11 to 30-11 of 2025



Surface wind

Subseasonal forecasts

Ft1 (24 to 30 Nov 2025)



High probability (low skill) of extremely low temperatures over Central and Northern Europe.



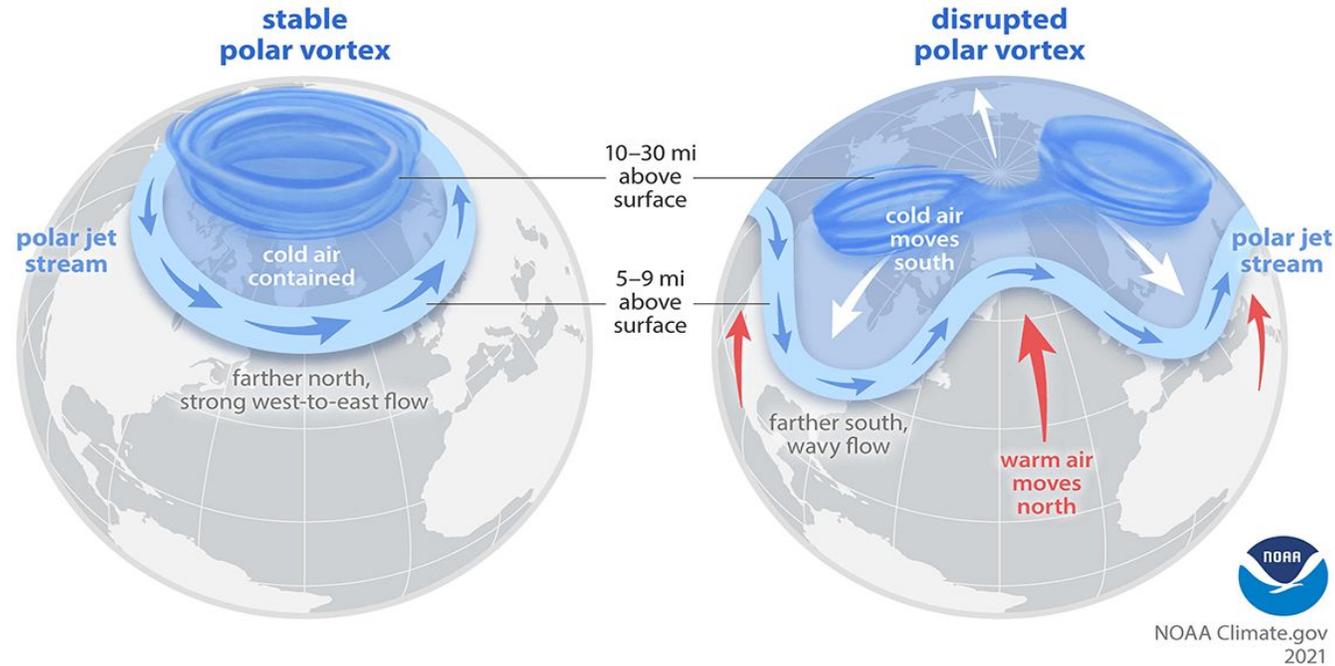
Temperature

Temperature below the 10th percentile

Sudden stratospheric warming

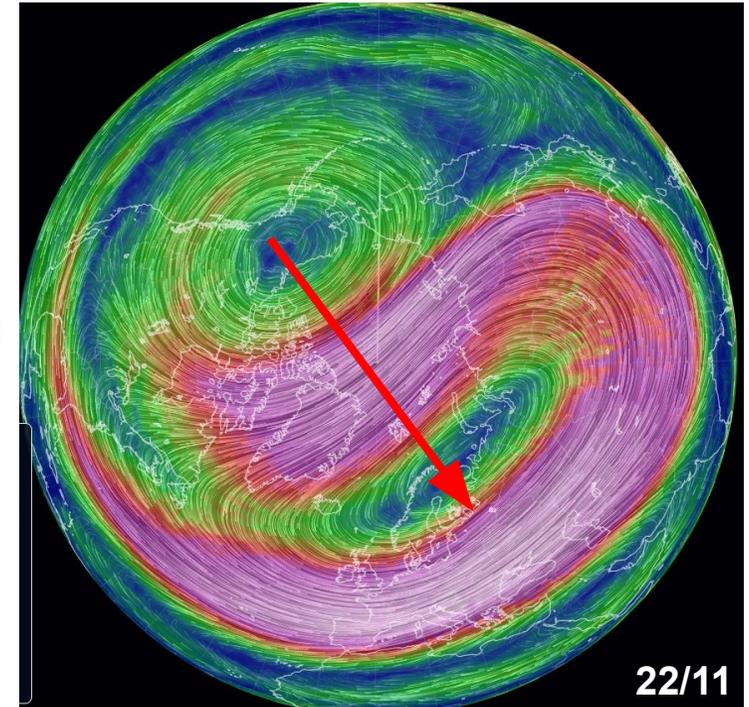
Understanding the polar vortex

The Arctic polar vortex is a strong band of winds in the stratosphere, surrounding the North Pole 10–30 miles above the surface.



Consistent with **+NAM**

Consistent with **-NAM**



Sudden stratospheric warming

GFS Stratospheric Polar Vortex Structure
Valid: 03 Dec 2025-00Z (17 Nov 2025-00Z, FH384)

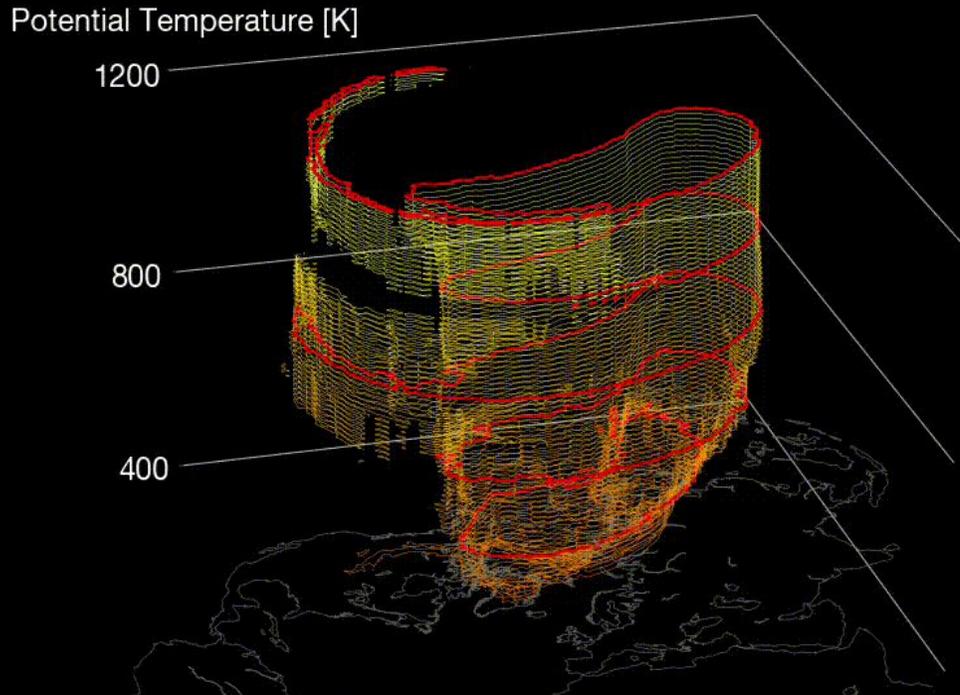
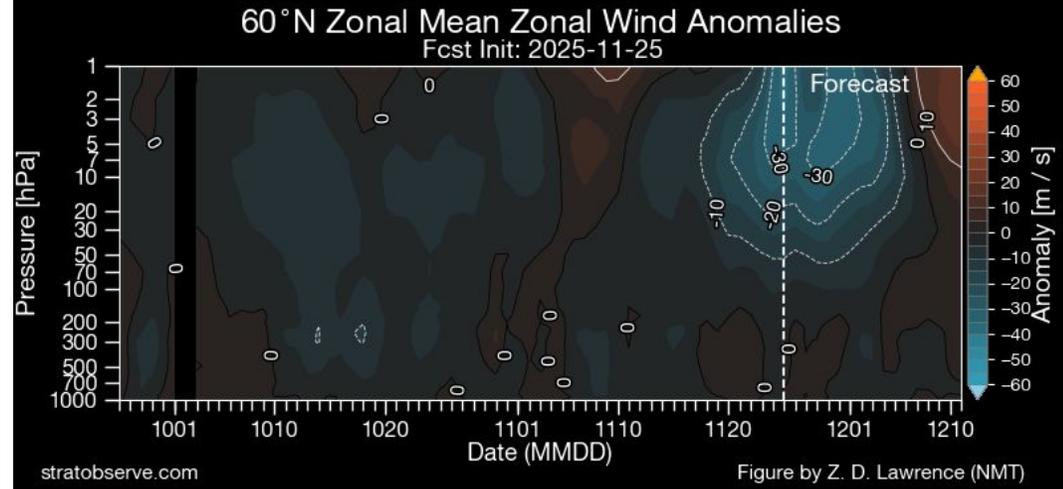
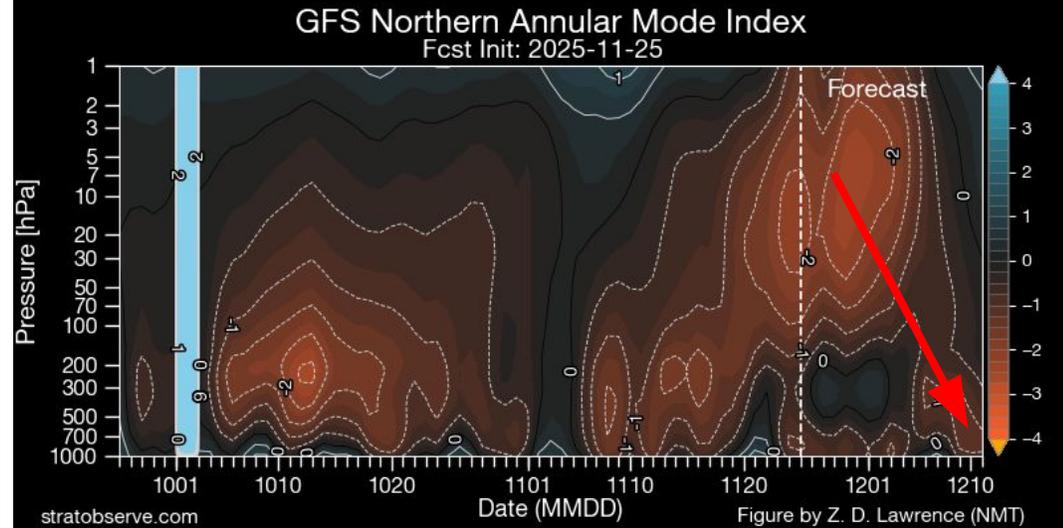


Figure by Z. D. Lawrence (NMT)
stratobserve.com
Data source: GFS, http://nomads.ncep.noaa.gov:9090/dods/gfs_0p50/



stratobserve.com Figure by Z. D. Lawrence (NMT)



stratobserve.com Figure by Z. D. Lawrence (NMT)

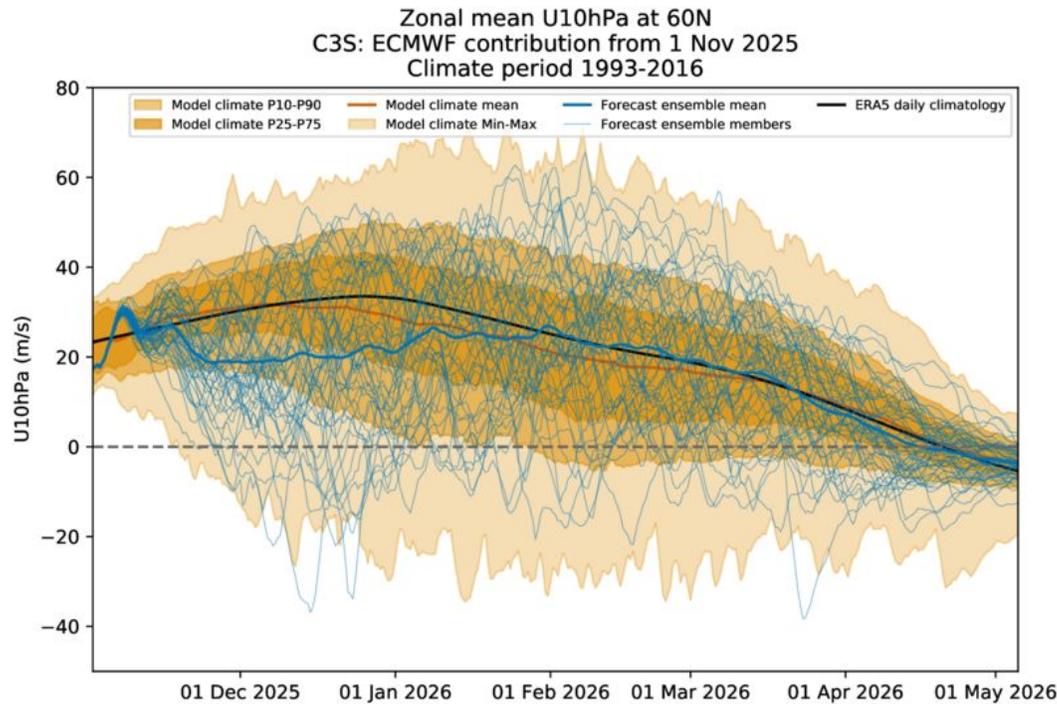
The onset of the event started around the 20th of Nov. If the SSW affects the polar jet structure, it will become evident during this week and the following ones. This could imply cold and warm intrusions in the NH mid-latitudes

Sudden stratospheric warming

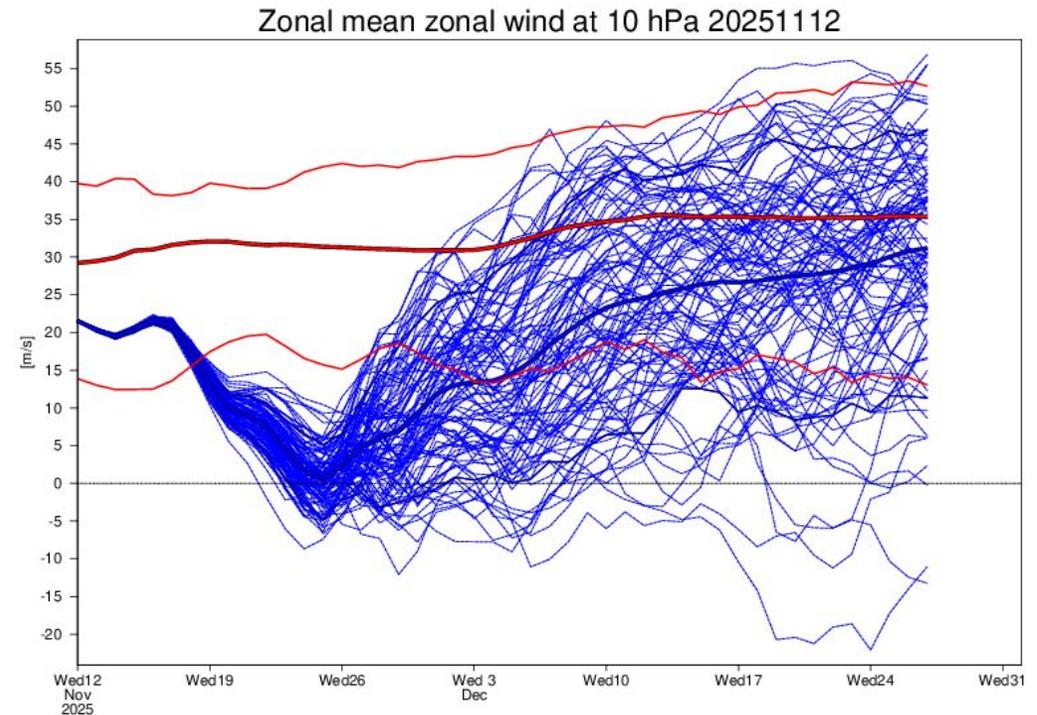
Was it predicted?



Not by the seasonal forecast

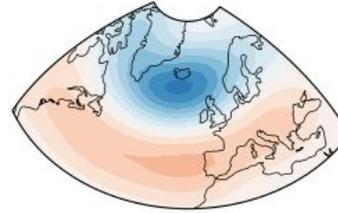


Subseasonal forecasted it from the 12th of November

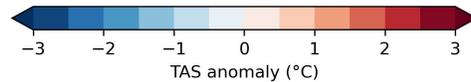
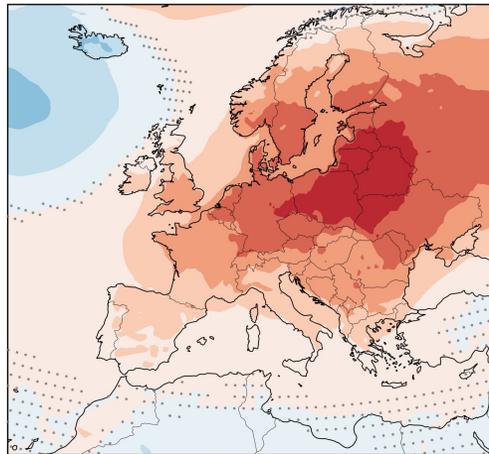


Composite of NAO + surface climate

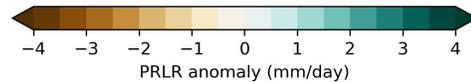
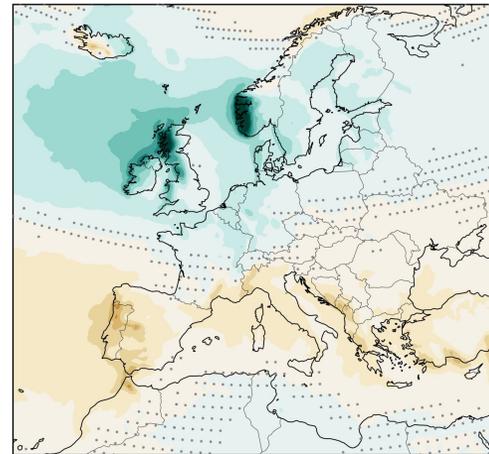
NAO+



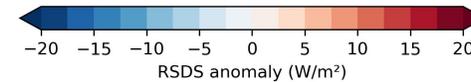
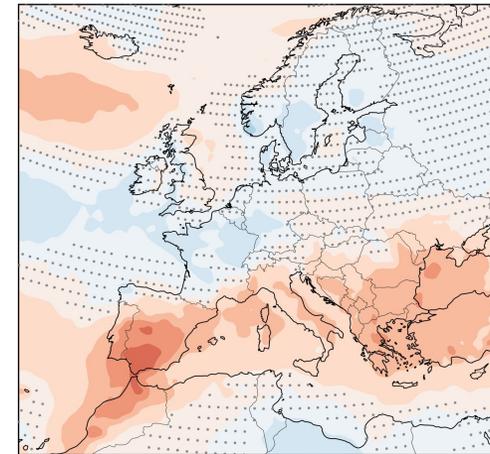
Δ TAS composite — NAO + ERA5 (1980–2008)



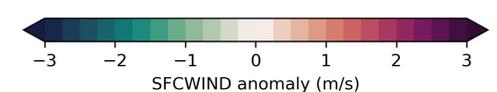
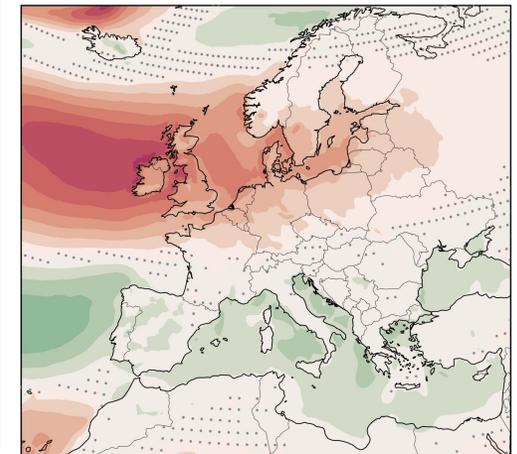
Δ PRLR composite — NAO + ERA5 (1980–2008)



Δ RSDS composite — NAO + ERA5 (1980–2008)



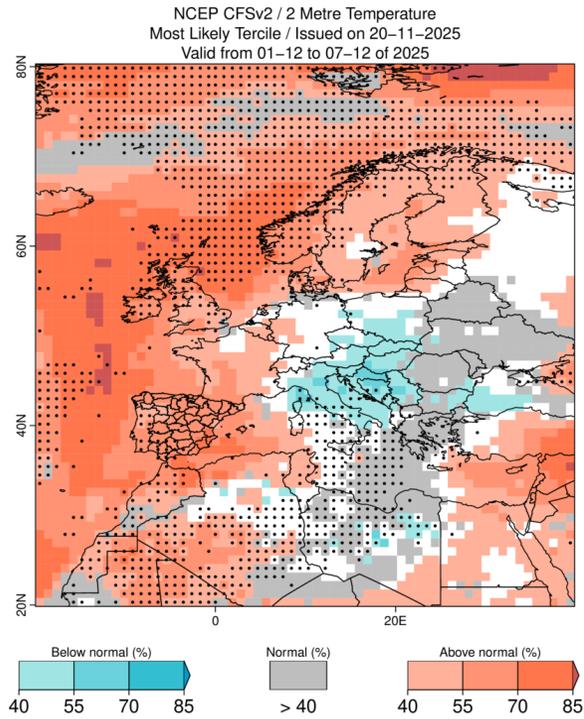
Δ SFCWIND composite — NAO + ERA5 (1980–2008)



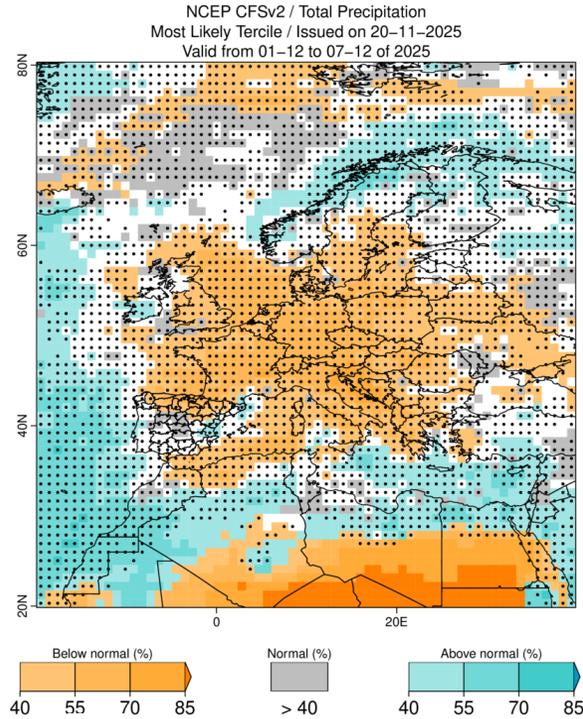
A positive NAO is characterised by **stronger pressure gradient between the Azores high and the Icelandic low**. This strengthens the **jet stream** and displaces it **northwards**, bringing **milder and wetter winters** to northern Europe and **drier winters** to southern Europe.

Subseasonal forecasts

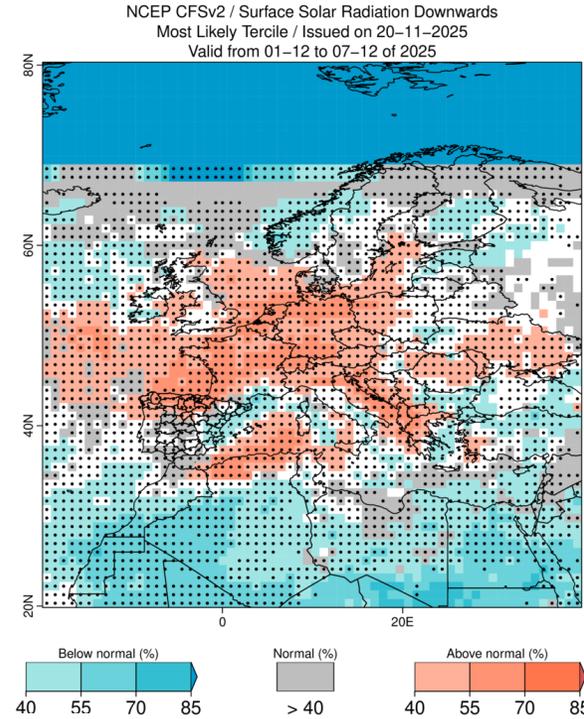
Ft2 (1 to 7 Dec 2025)



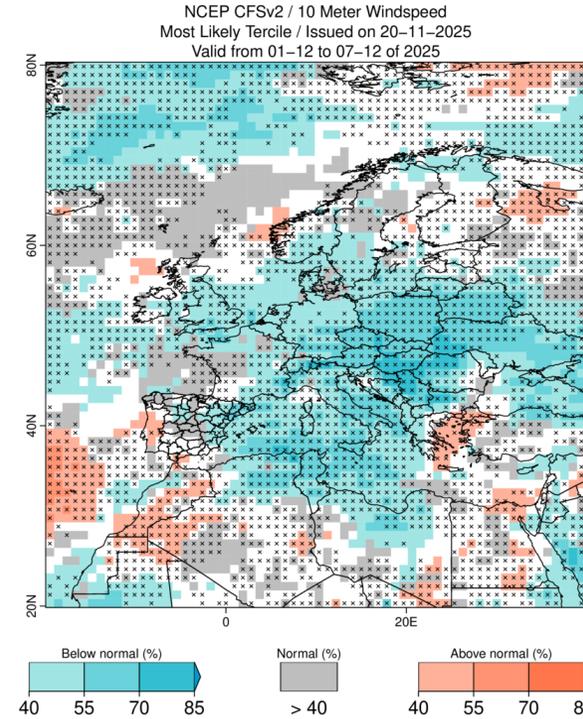
Temperature



Precipitation



Solar radiation



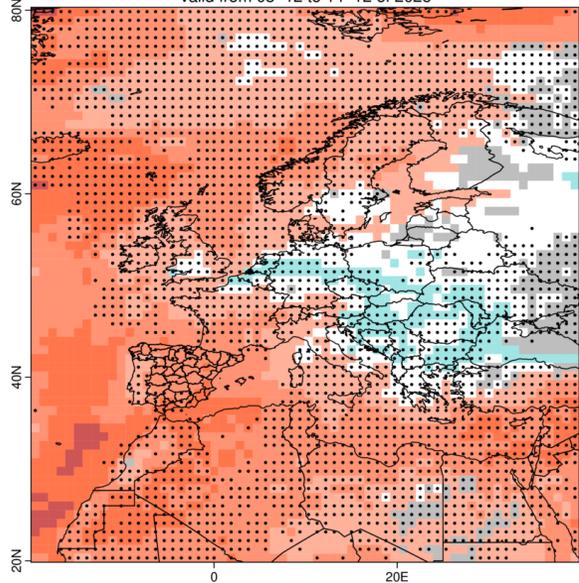
Surface wind

Subseasonal forecasts

Ft3 (8 to 14 Dec 2025)

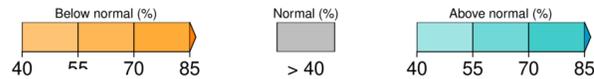
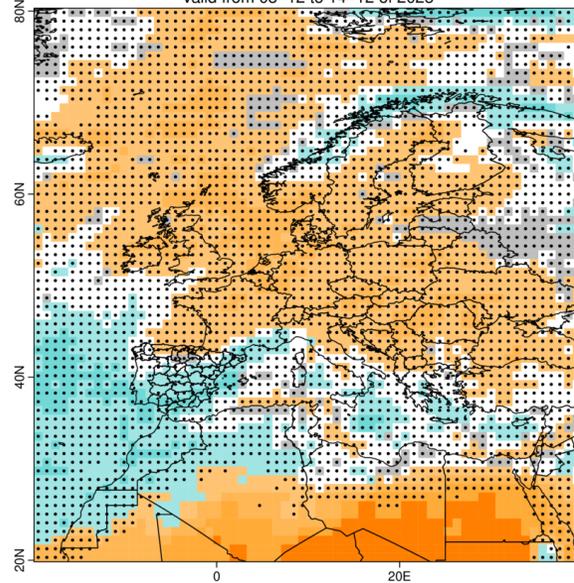


NCEP CFSv2 / 2 Metre Temperature
Most Likely Tercile / Issued on 20-11-2025
Valid from 08-12 to 14-12 of 2025



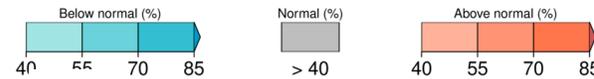
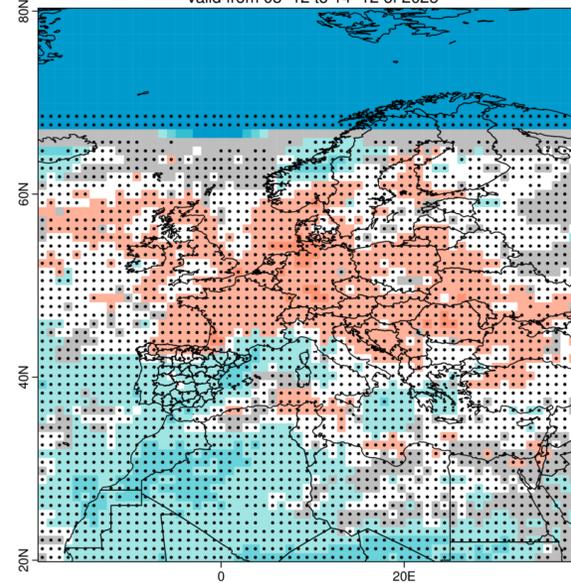
Temperature

NCEP CFSv2 / Total Precipitation
Most Likely Tercile / Issued on 20-11-2025
Valid from 08-12 to 14-12 of 2025



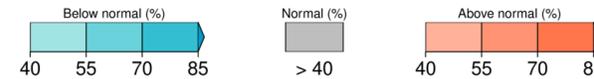
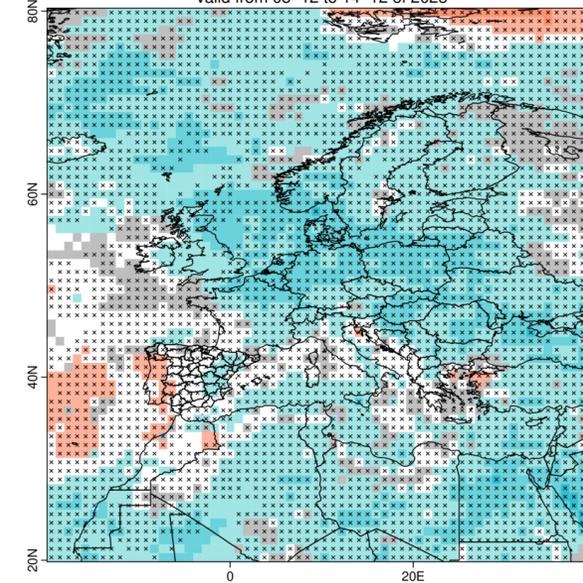
Precipitation

NCEP CFSv2 / Surface Solar Radiation Downwards
Most Likely Tercile / Issued on 20-11-2025
Valid from 08-12 to 14-12 of 2025



Solar radiation

NCEP CFSv2 / 10 Meter Windspeed
Most Likely Tercile / Issued on 20-11-2025
Valid from 08-12 to 14-12 of 2025



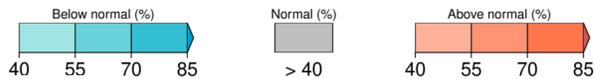
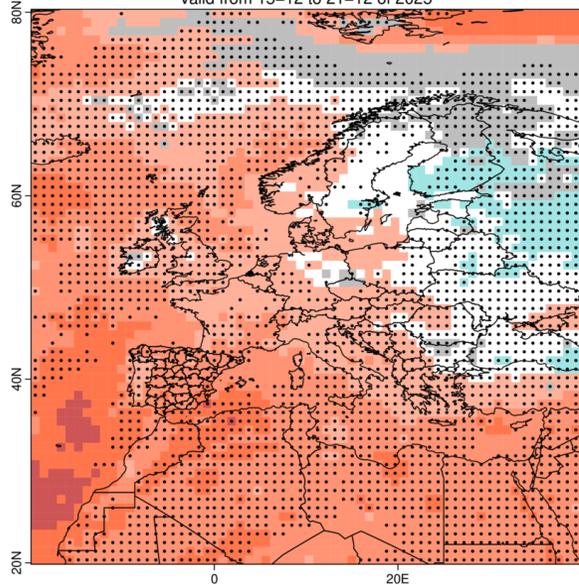
Surface wind

Subseasonal forecasts

Ft4 (15 to 21 Dec 2025)

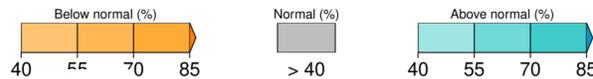
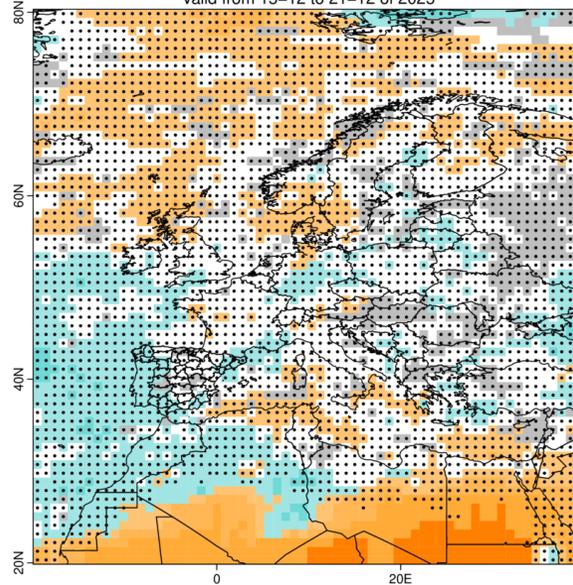


NCEP CFSv2 / 2 Metre Temperature
Most Likely Tercile / Issued on 20-11-2025
Valid from 15-12 to 21-12 of 2025



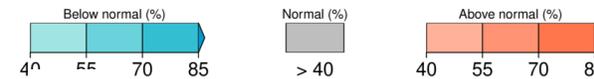
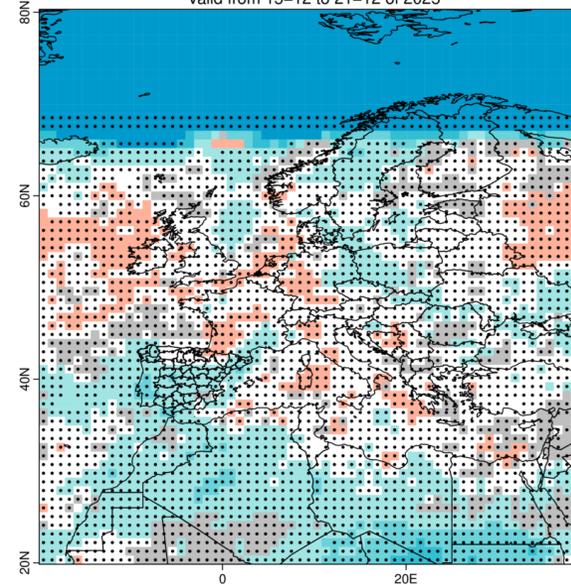
Temperature

NCEP CFSv2 / Total Precipitation
Most Likely Tercile / Issued on 20-11-2025
Valid from 15-12 to 21-12 of 2025



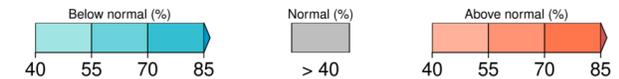
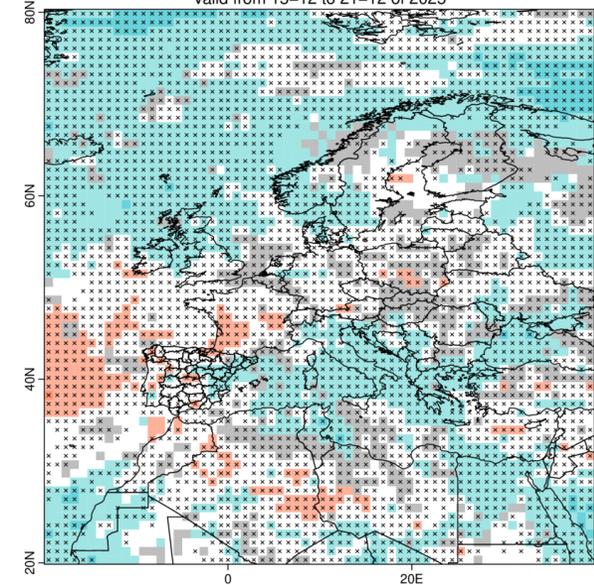
Precipitation

NCEP CFSv2 / Surface Solar Radiation Downwards
Most Likely Tercile / Issued on 20-11-2025
Valid from 15-12 to 21-12 of 2025



Solar radiation

NCEP CFSv2 / 10 Meter Windspeed
Most Likely Tercile / Issued on 20-11-2025
Valid from 15-12 to 21-12 of 2025



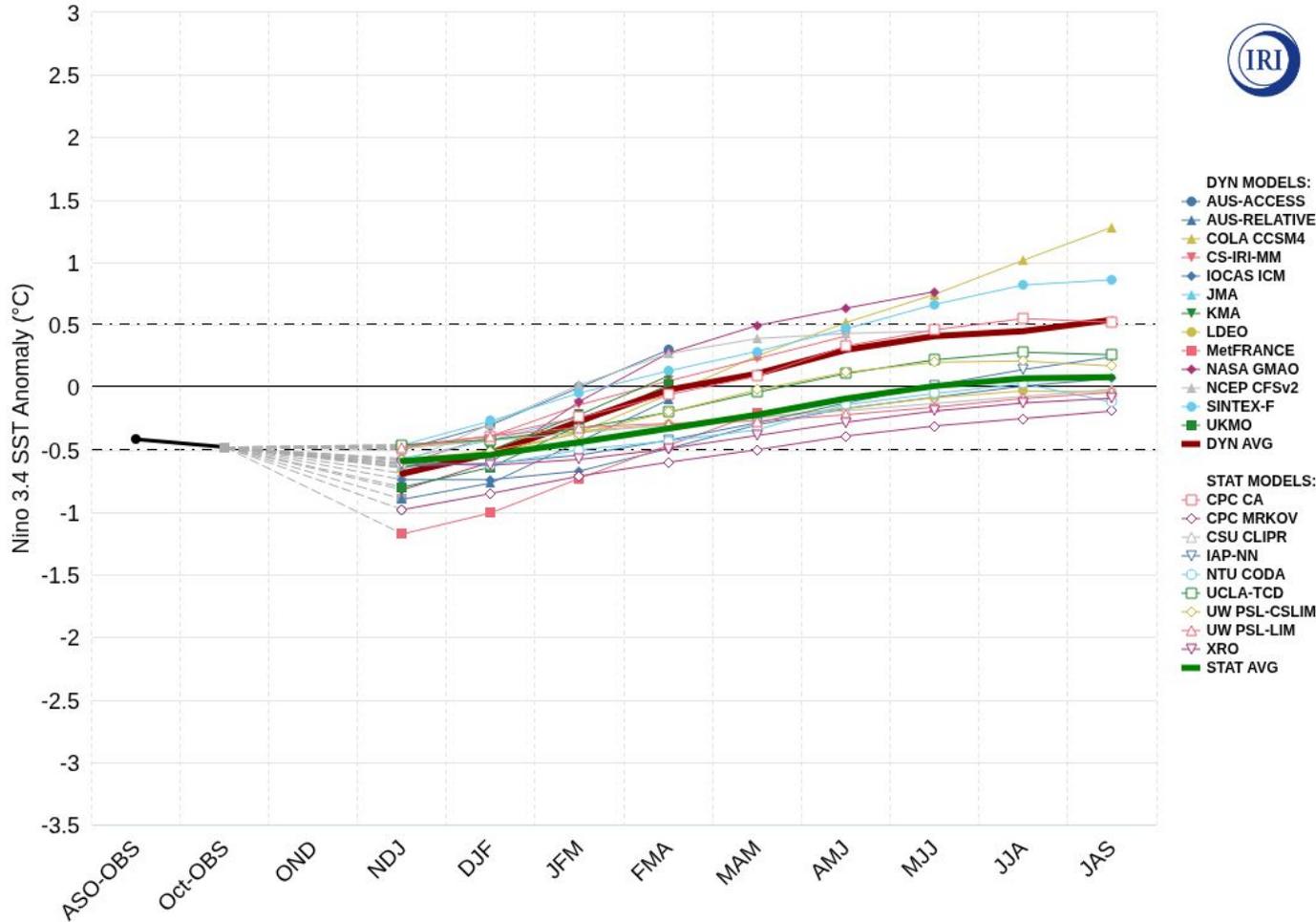
Surface wind

- I. Recent state of the climate
- II. Subseasonal forecasts
- III. Seasonal forecasts**
- IV. Feedback and wishlist

ENSO forecast



Model Predictions of ENSO from Nov 2025



Weak La Niña conditions are expected to continue through boreal winter, with a transition to ENSO - neutral conditions expected in JFM.

Seasonal forecasts

Ft2 (December 2025)



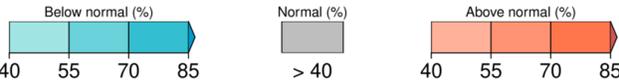
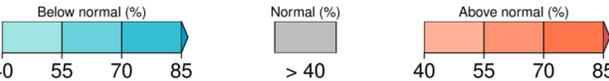
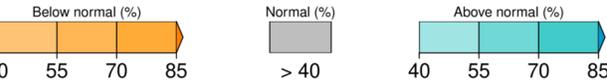
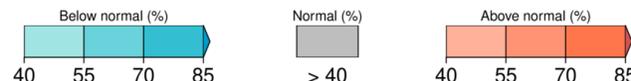
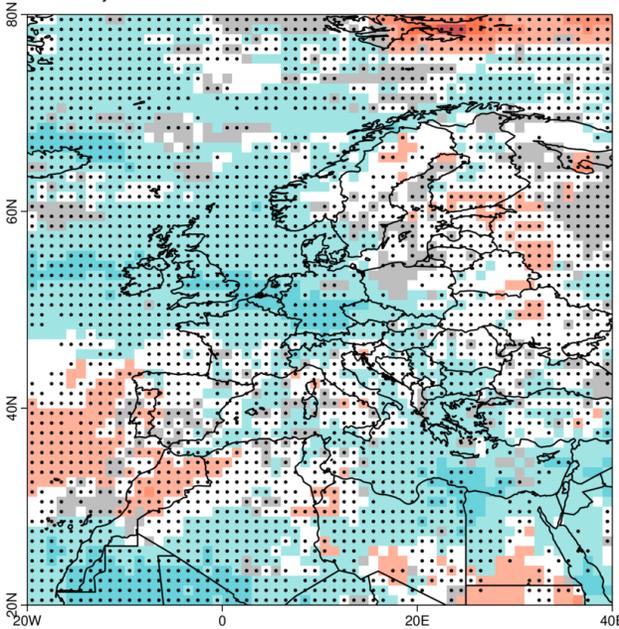
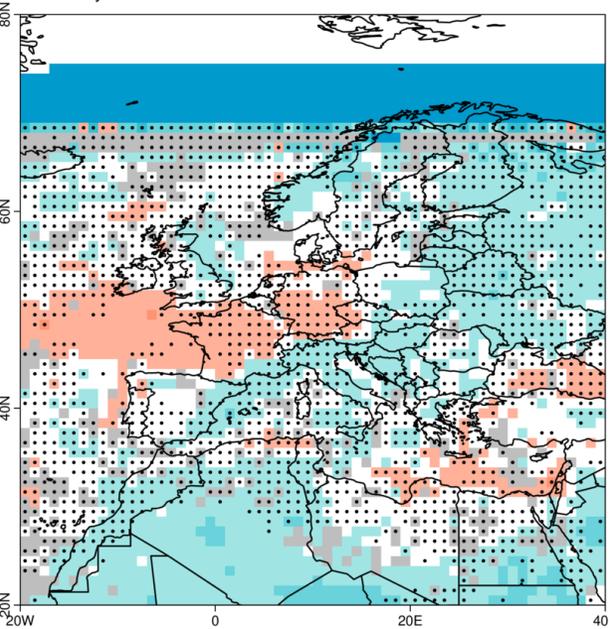
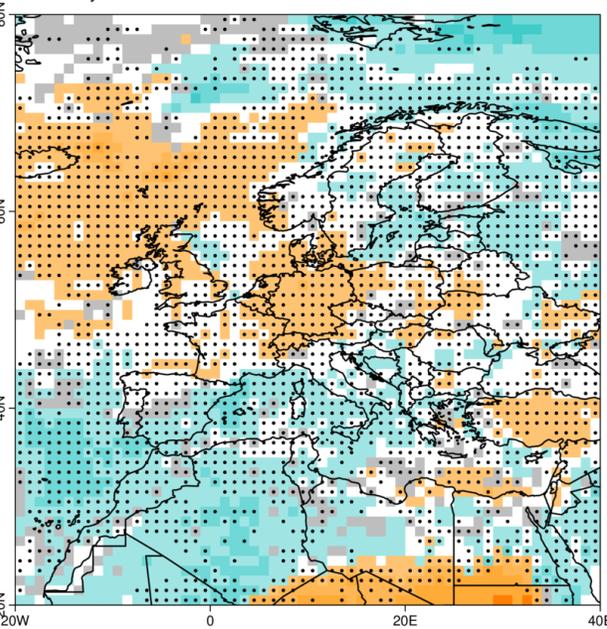
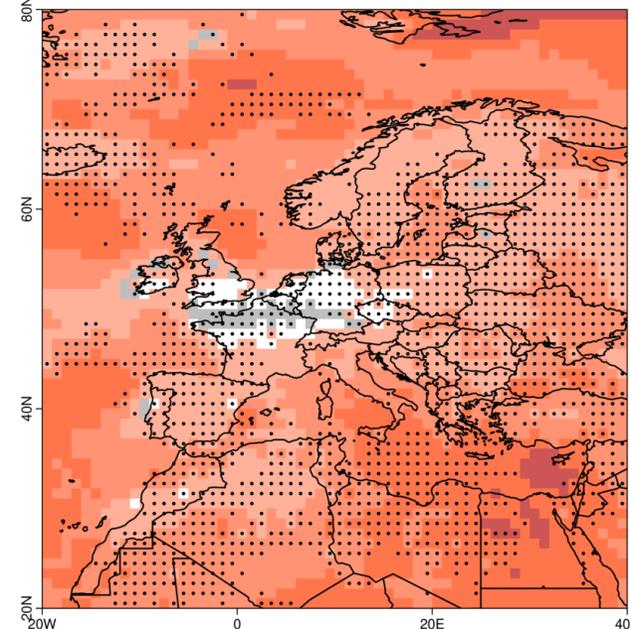
Hindcast period: 1993 - 2016

ECMWF SEAS5 (v5.1) / 2 Metre Temperature
Most Likely Tercile / December to December 2025 / Start date: 01-11-2025

ECMWF SEAS5 (v5.1) / Total Precipitation
Most Likely Tercile / December to December 2025 / Start date: 01-11-2025

ECMWF SEAS5 (v5.1) / Surface Solar Radiation Downwards
Most Likely Tercile / December to December 2025 / Start date: 01-11-2025

ECMWF SEAS5 (v5.1) / 10 Meter Windspeed
Most Likely Tercile / December to December 2025 / Start date: 01-11-2025



Temperature



Precipitation



Solar radiation



Surface wind

Seasonal forecasts

Ft3 (January 2026)



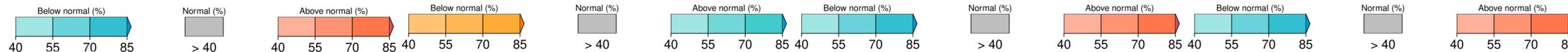
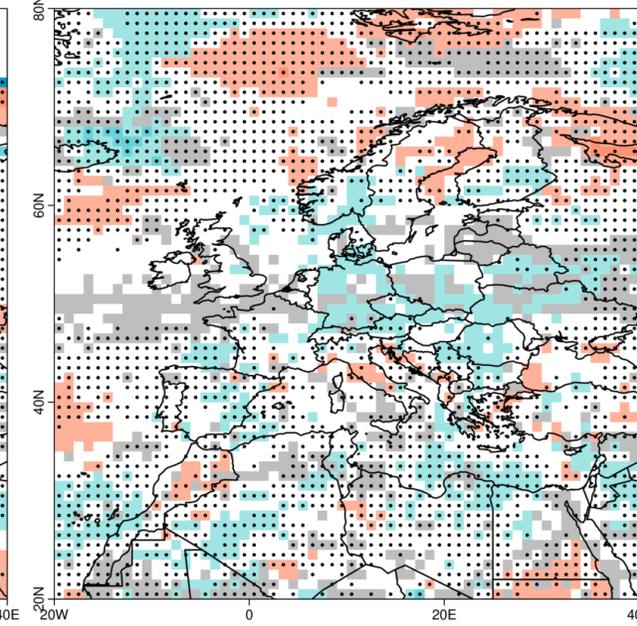
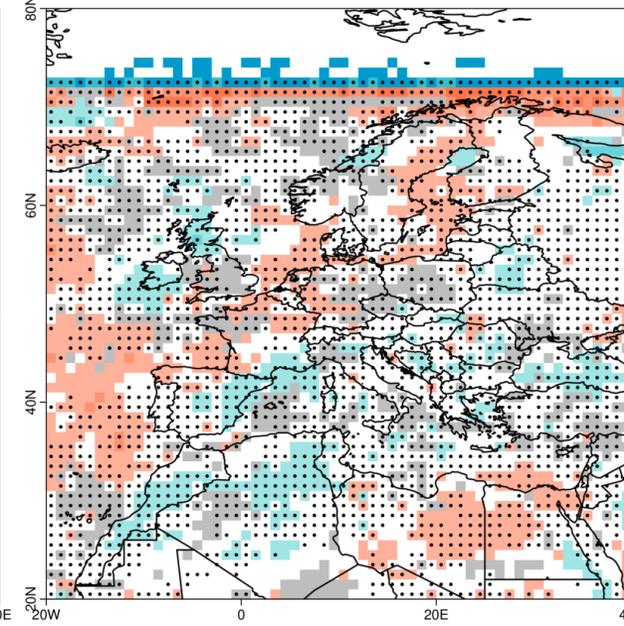
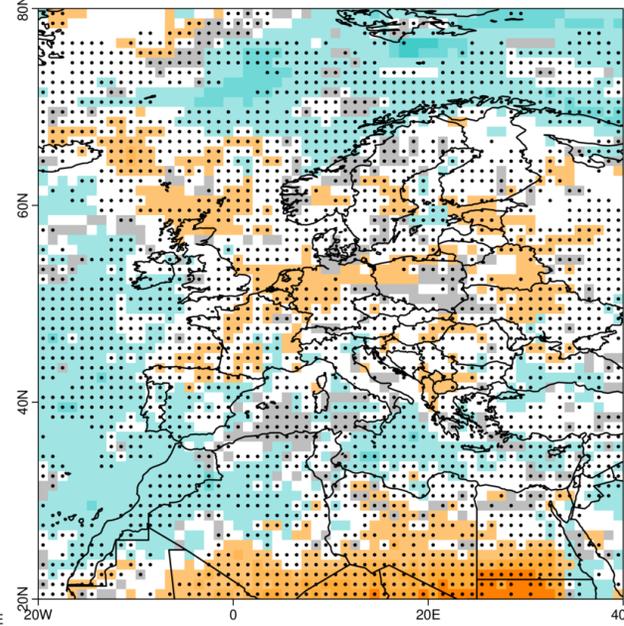
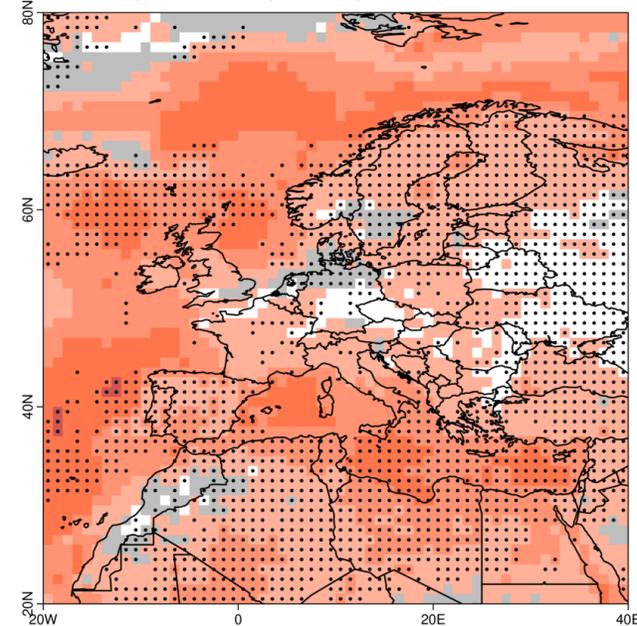
Hindcast period: 1993 - 2016

ECMWF SEAS5 (v5.1) / 2 Metre Temperature
Most Likely Tercile / January to January 2026 / Start date: 01-11-2025

ECMWF SEAS5 (v5.1) / Total Precipitation
Most Likely Tercile / January to January 2026 / Start date: 01-11-2025

ECMWF SEAS5 (v5.1) / Surface Solar Radiation Downwards
Most Likely Tercile / January to January 2026 / Start date: 01-11-2025

ECMWF SEAS5 (v5.1) / 10 Meter Windspeed
Most Likely Tercile / January to January 2026 / Start date: 01-11-2025



Temperature



Precipitation



Solar radiation



Surface wind

Seasonal forecasts

Ft4 (February 2026)



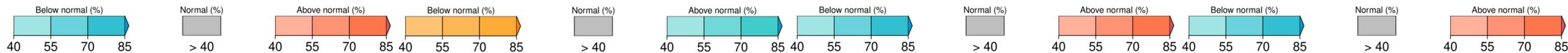
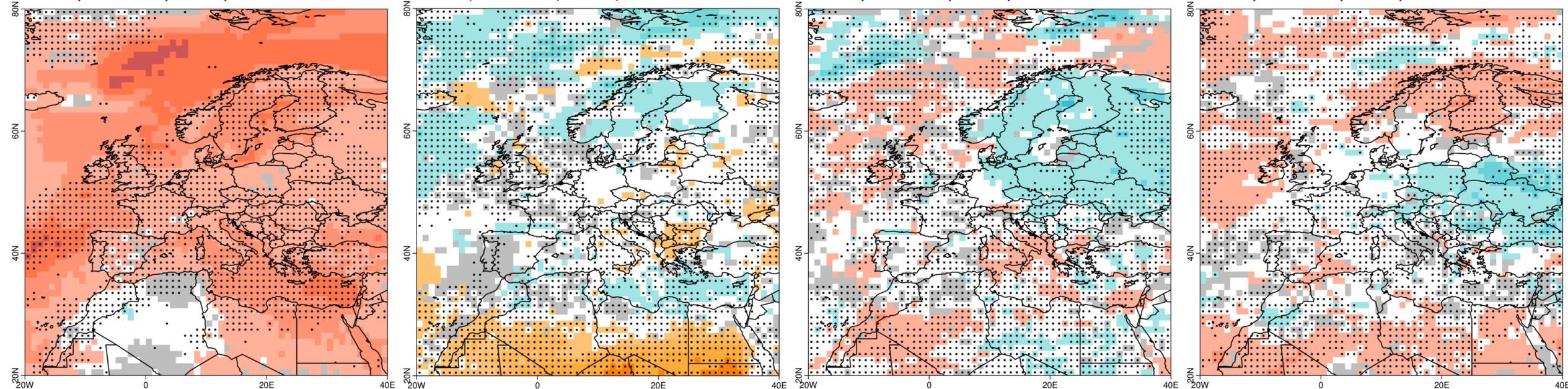
Hindcast period: 1993 - 2016

ECMWF SEAS5 (v5.1) / 2 Metre Temperature
Most Likely Tercile / February to February 2026 / Start date: 01-11-2025

ECMWF SEAS5 (v5.1) / Total Precipitation
Most Likely Tercile / February to February 2026 / Start date: 01-11-2025

ECMWF SEAS5 (v5.1) / Surface Solar Radiation Downwards
Most Likely Tercile / February to February 2026 / Start date: 01-11-2025

ECMWF SEAS5 (v5.1) / 10 Meter Windspeed
Most Likely Tercile / February to February 2026 / Start date: 01-11-2025



Temperature



Precipitation



Solar radiation



Surface wind

Seasonal forecasts

Ft5-6 (Mar-Apr 2026)



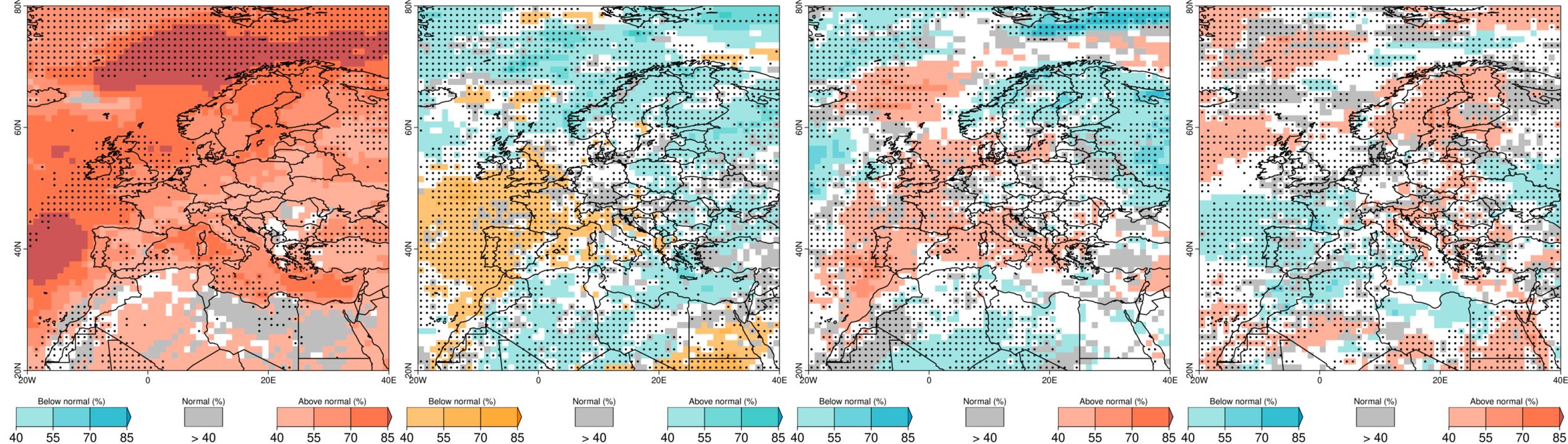
Hindcast period: 1993 - 2016

ECMWF SEAS5 (v5.1) / 2 Metre Temperature
Most Likely Tercile / March to April 2026 / Start date: 01-11-2025

ECMWF SEAS5 (v5.1) / Total Precipitation
Most Likely Tercile / March to April 2026 / Start date: 01-11-2025

ECMWF SEAS5 (v5.1) / Surface Solar Radiation Downwards
Most Likely Tercile / March to April 2026 / Start date: 01-11-2025

ECMWF SEAS5 (v5.1) / 10 Meter Windspeed
Most Likely Tercile / March to April 2026 / Start date: 01-11-2025



Temperature



Precipitation



Solar radiation



Surface wind

- I. Recent state of the climate
- II. Subseasonal forecasts
- III. Seasonal forecasts

IV. Feedback and wishlist

Summary



- **NAO-** and **Atlantic ridge** have been dominating during the last weeks. **NAO-** brings positive wind anomalies to western Europe, alongside reduced incoming solar radiation. **Atlantic ridge** brings cold air masses from the Arctic, surface wind increases and rds decreases in northern Europe, and the opposite response in southern Europe.
- **NAO+** is predicted for the coming days, but the surface impacts of the **sudden stratospheric warming** might alter the expected wind, temperature, radiation and precipitation anomalies over Europe.
- Mostly non-significant precipitation, radiation and surface winds at **sub-seasonal** timescales, with some significant **above normal temperature anomalies over most Europe** and some **below normal over central Europe**.
- Below normal wind conditions expected in the following months over Europe (low skill). In February, above normal precipitation and winds are expected over northern Europe
- In late winter - early spring, below normal precipitation and wind are expected over southern Europe, whereas opposite conditions are expected over Northern Europe.
- Weak la Niña conditions expected to transition to Neutral

Feedback on the forecast outlook



- ★ Was the overview of the state of the climate **interesting** and relevant?
- ★ **Did you miss anything** in the discussion?
- ★ Were the figures **easy** to understand and interpret?
- ★ Were the subseasonal and seasonal forecasts **useful**?
- ★ Do you find the information on the forecast skill **relevant**?
- ★ Were the explanations overall **clear** and **sound**?

Get in touch!  boreas@bsc.es

Additional information wishlist



- ★ Is there any additional **information** that you would like to see in the next forecast outlook?
- ★ Are you interested in a particular **region** other than the ones shown here?
- ★ Would you like to see forecasts of any specific **indicators**? Which one/s?

Get in touch!  boreas@bsc.es



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Earth Sciences
Department



**Barcelona
Supercomputing
Center**
Centro Nacional de Supercomputación

Thank you!

BOREAS project: PID2022-140673OA-I00 funded by
MICIU/AEI/10.13039/501100011033 and FEDER, EU



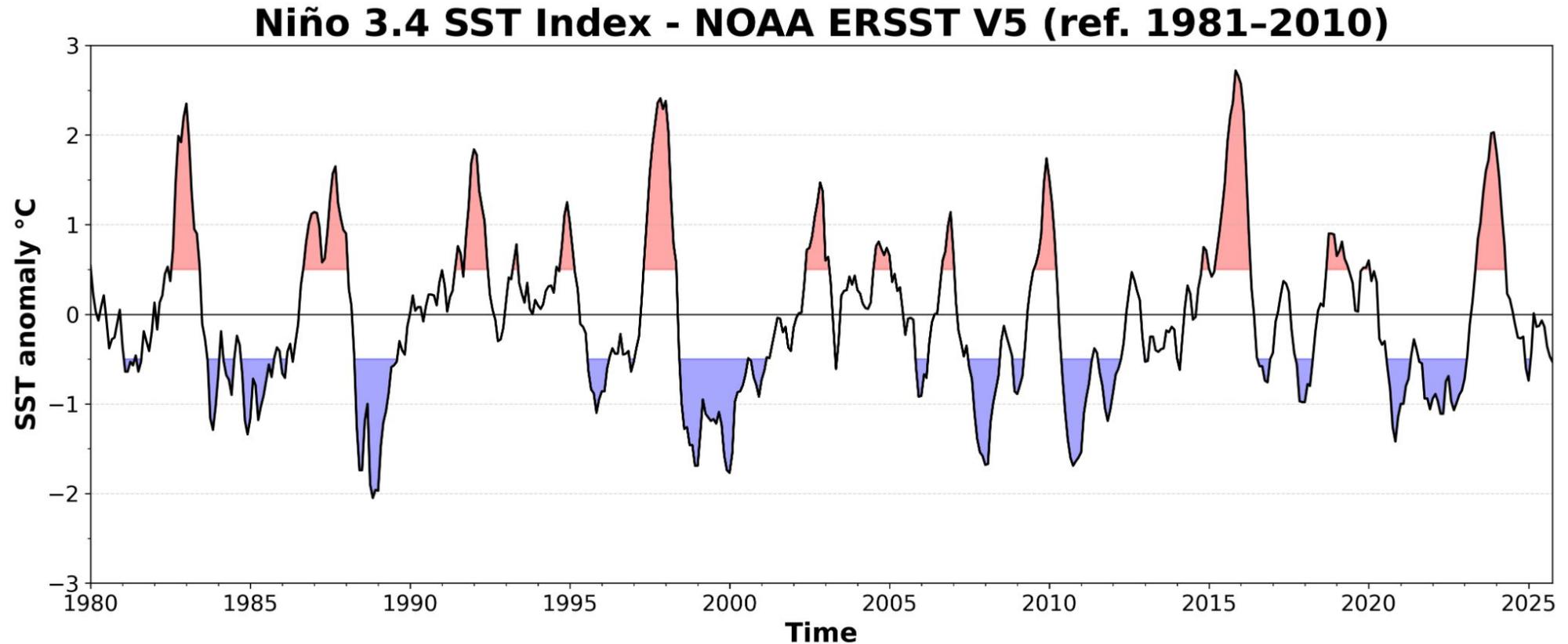
Climate Services Team (CST)

Earth System Services (ESS)

Barcelona Supercomputing Center (BSC)

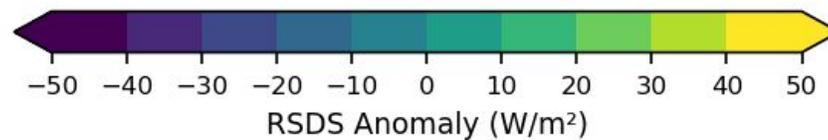
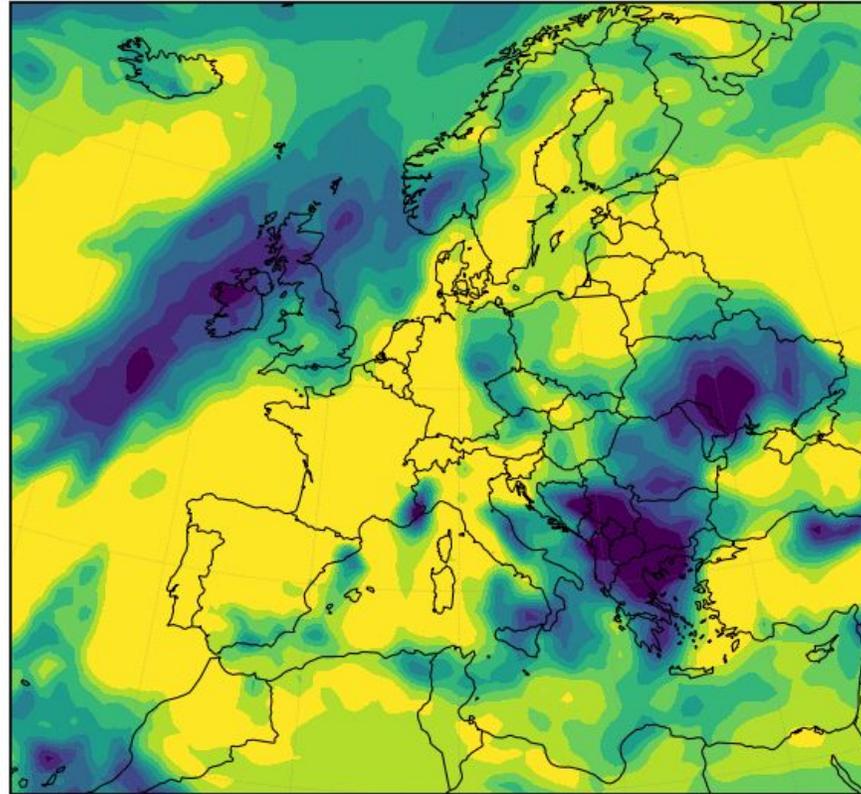
Extra resources

Historical Niño3.4 index



October 2025 Incoming solar radiation anomaly

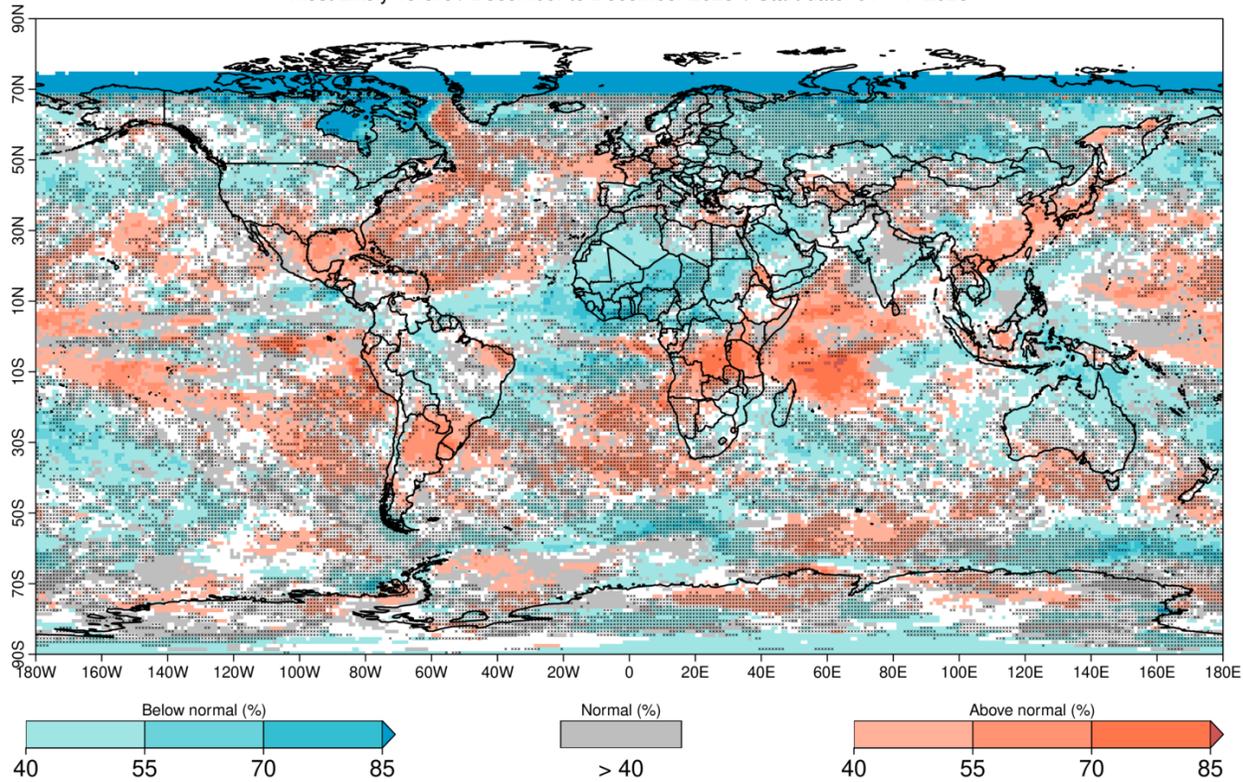
RSDS Anomaly — October 2025
Ref: 1991-2020



Seasonal forecasts

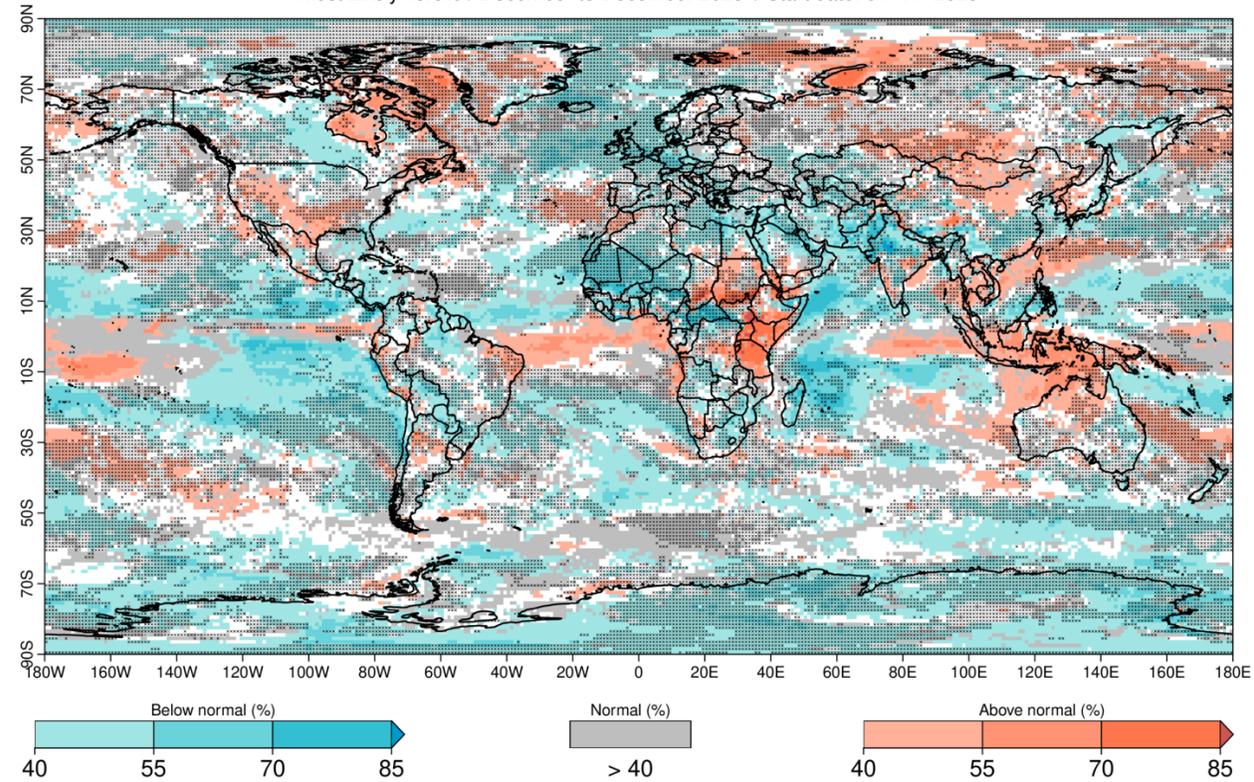
Ft2-2 (December 2025)

ECMWF SEAS5 (v5.1) / Surface Solar Radiation Downwards
Most Likely Tercile / December to December 2025 / Start date: 01-11-2025



rsds

ECMWF SEAS5 (v5.1) / 10 Meter Windspeed
Most Likely Tercile / December to December 2025 / Start date: 01-11-2025

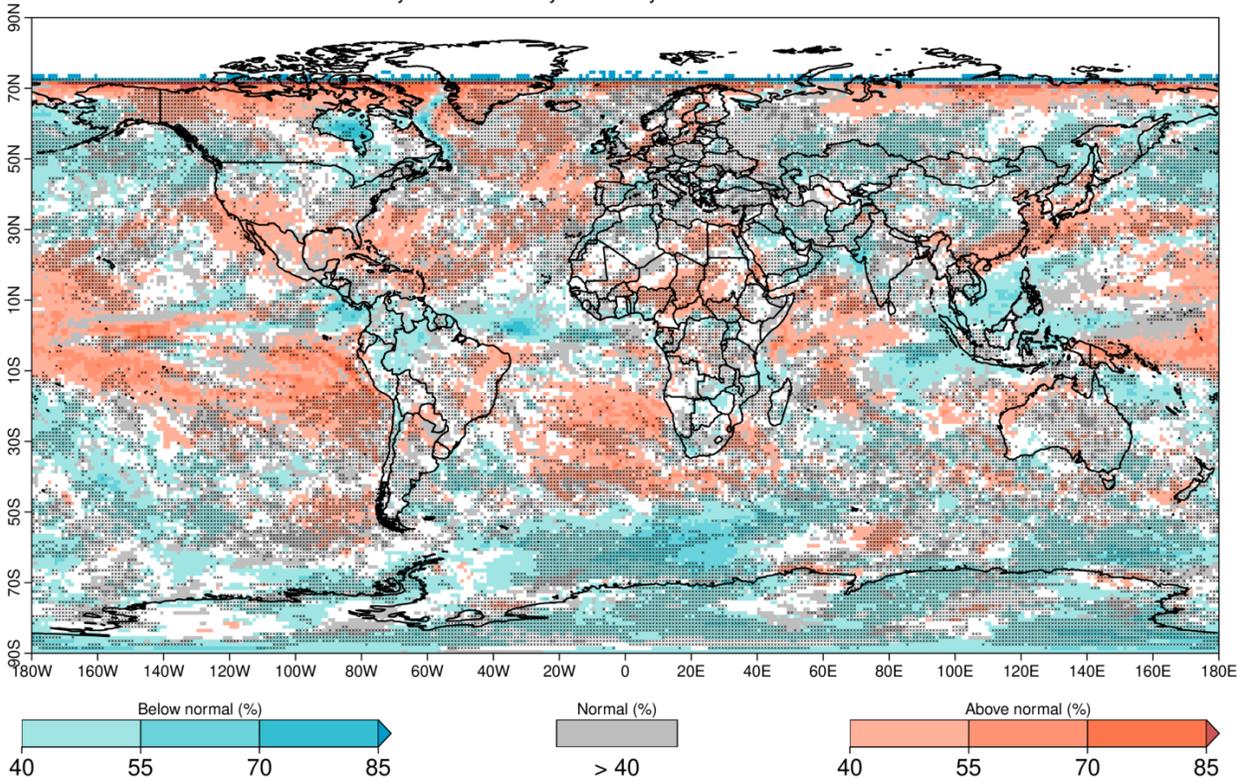


sfcWind

Seasonal forecasts

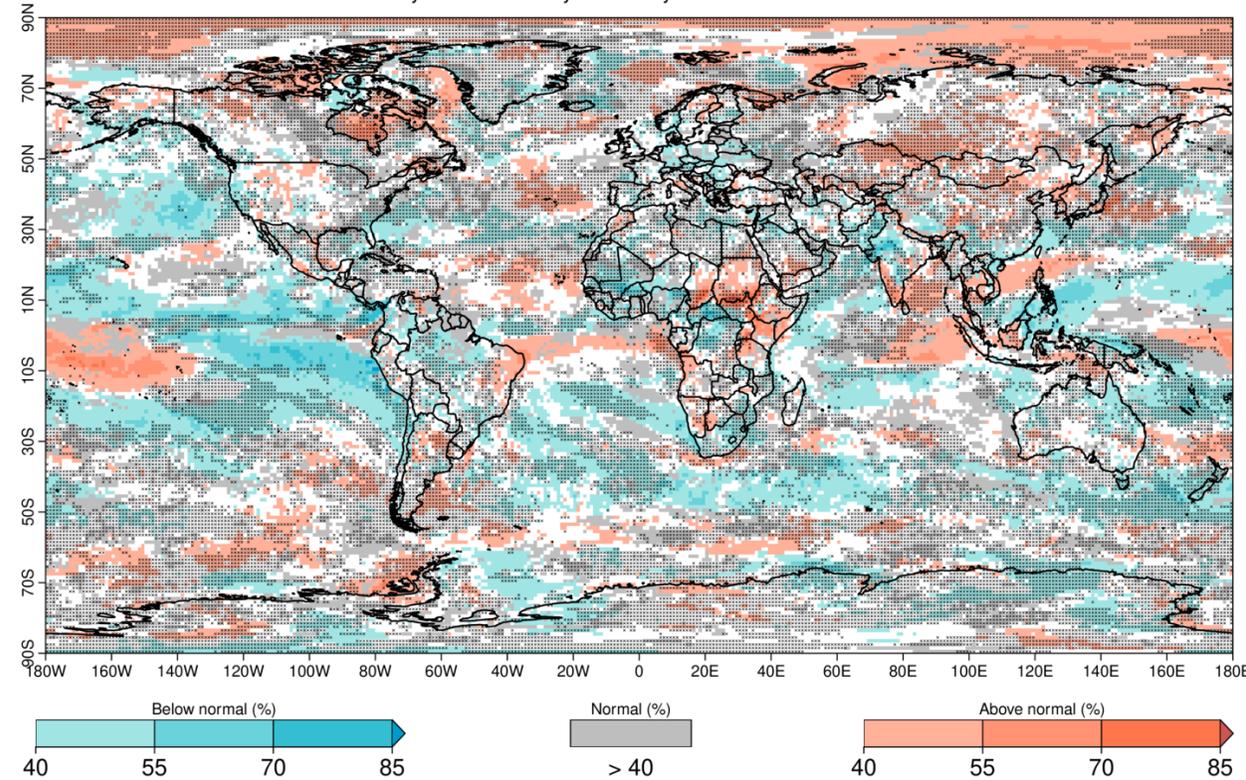
Ft3-3 (January 2026)

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Most Likely Tercile / January to January 2026 / Start date: 01-11-2025



rsds

ECMWF SEAS5 (v5.1) / 10 Meter Windspeed
Most Likely Tercile / January to January 2026 / Start date: 01-11-2025

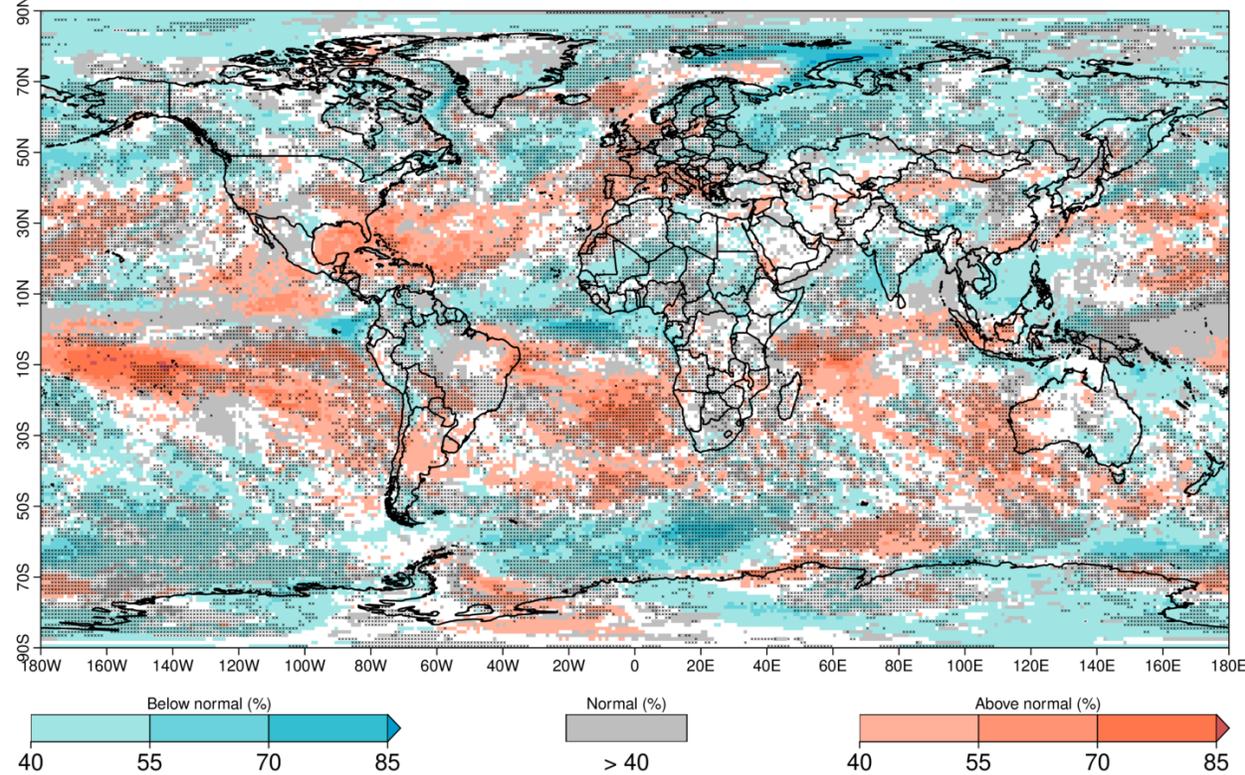


sfcWind

Seasonal forecasts

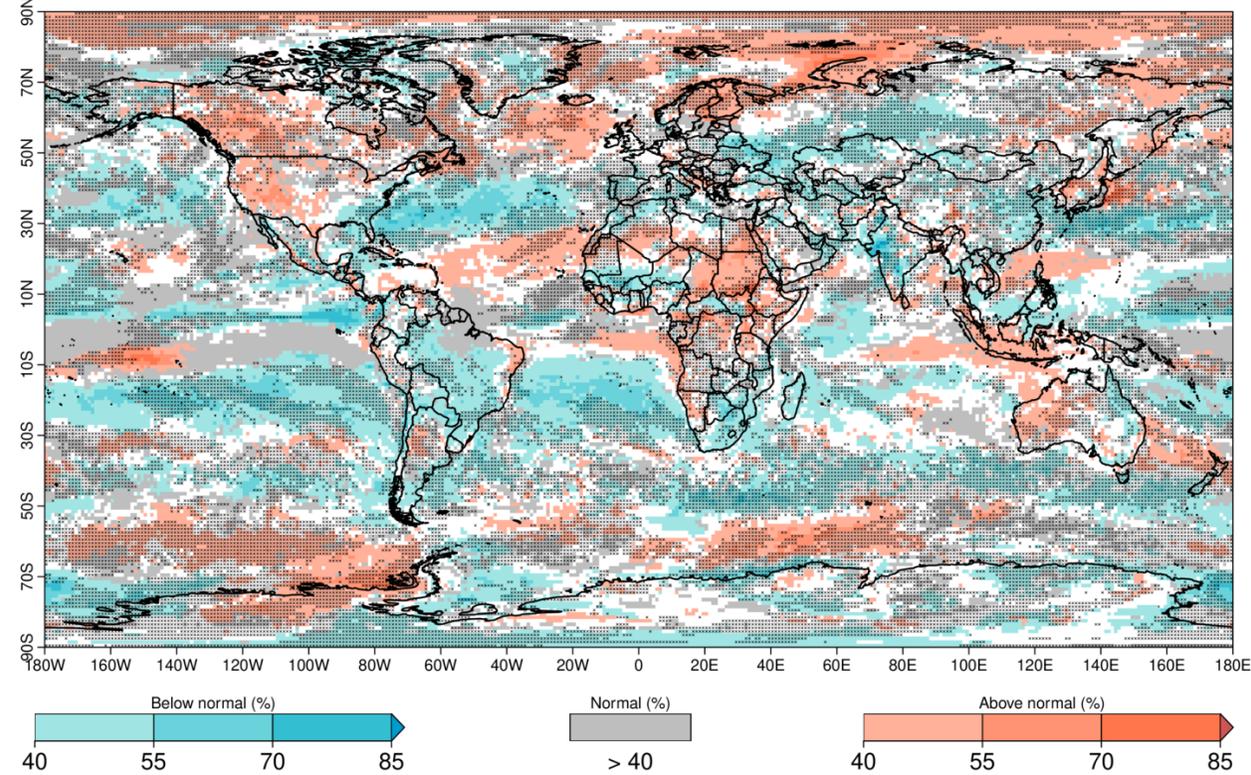
Ft4-6 (Feb-Apr 2026)

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rsds

ECMWF SEAS5 (v5.1) / 10 Meter Windspeed
Most Likely Tercile / February to April 2026 / Start date: 01-11-2025



sfcWind