

# Services across time scales and Earth System components

An ECMWF perspective

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ECMWF Forecasts and Services Department

2025 Annual Seminar – Wednesday 9<sup>th</sup> April 2025

Contributions from many ECMWF colleagues – thank you.

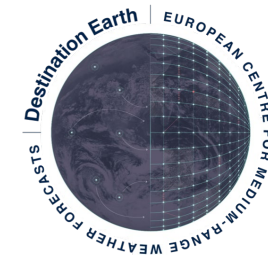


# ECMWF's role

**ECMWF's role is to address the critical and most difficult research problems in medium-range NWP that no one country could tackle on its own.**

- Provision of Numerical Weather Prediction products from medium- to long-range.
- Provision of services (24/7) to support and enable Member & Co-operating States in their day-to-day operations and activities.
- Provision of support to WMO activities including training and access to products.

## Entrusted entity of



## Contributing to





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# Services across time scales and Earth system component

A few examples (“Success stories”):

- IFS forecast products
- NWP verification/performance monitoring
- Multi-system predictions – focus on Sub-seasonal
- Applications

It is not exhaustive – see ECMWF colleagues’ presentations during this Seminar and today’s session.

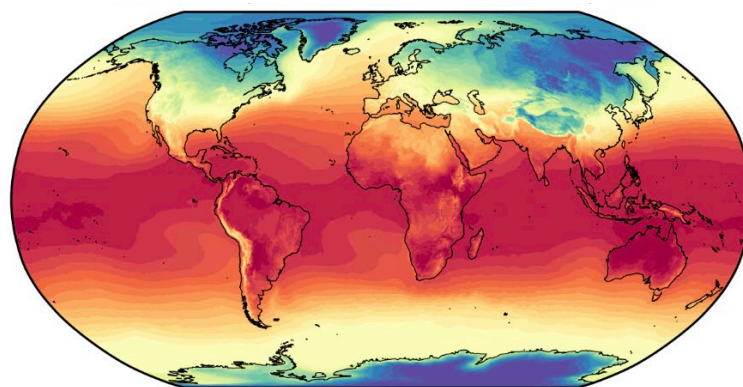


# An ecosystem of IFS Products

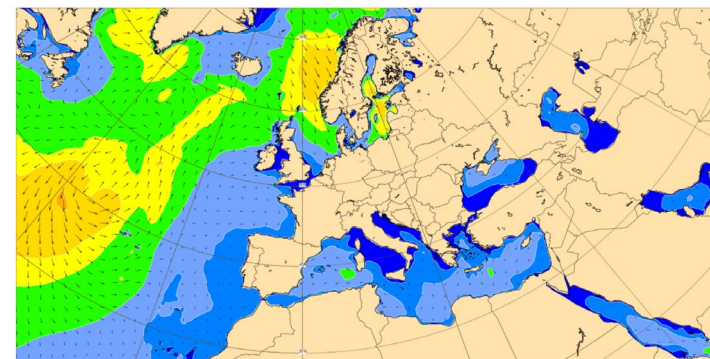
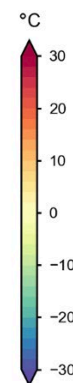


# Forecast data provision across multiple timescales

ERA5 monthly  
mean  
2m temperature  
– Jan 2016



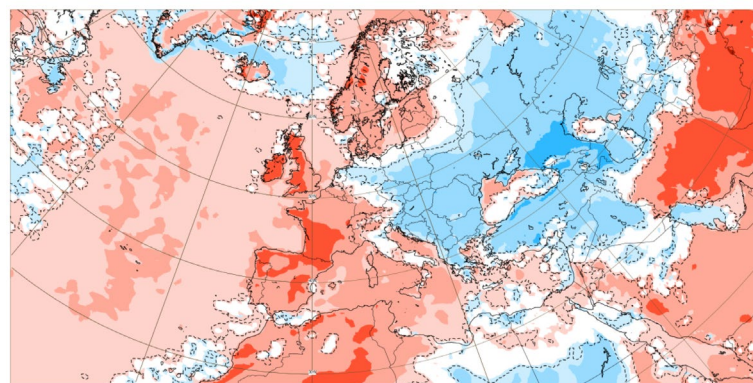
Reanalysis – 1940-now – 36km



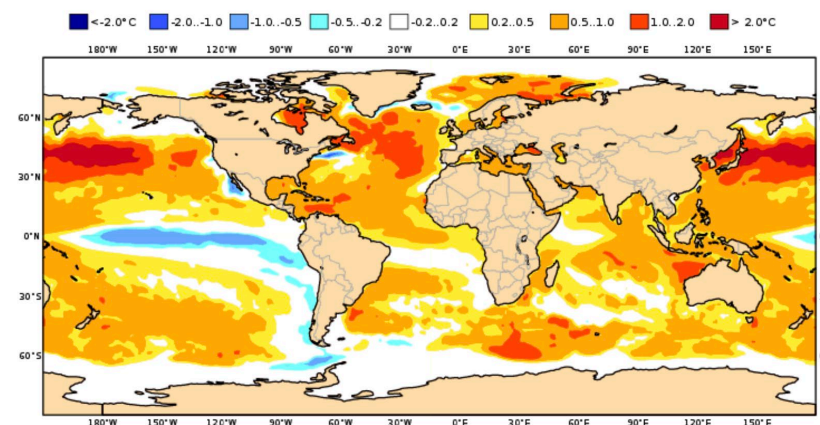
Significant Wave  
Height (m)  
– 04 Nov 2024

Medium-range - 15 days - 9km

2m temperature  
anomaly  
– 04-11 Nov  
2024



Sub-seasonal - 46 days - 36km



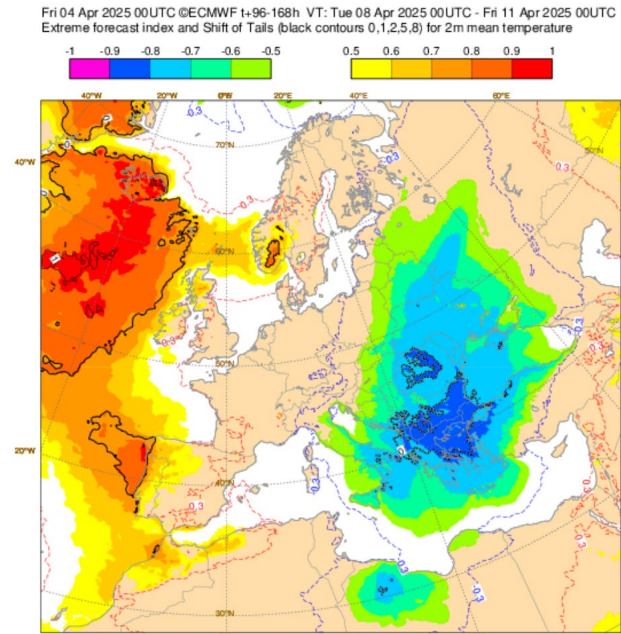
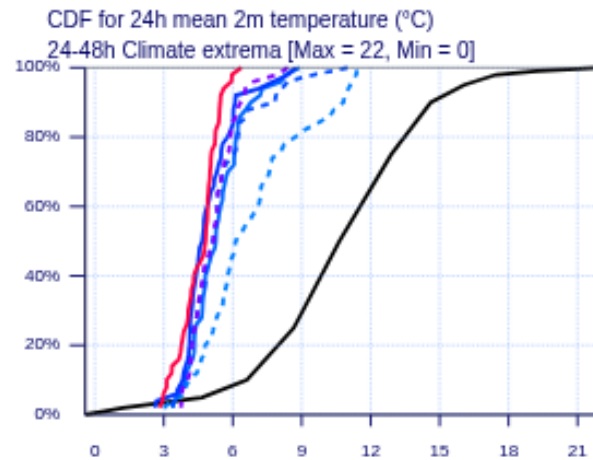
Mean SST  
anomaly  
– Nov 2024

Seasonal Forecast - 7 months - 36km

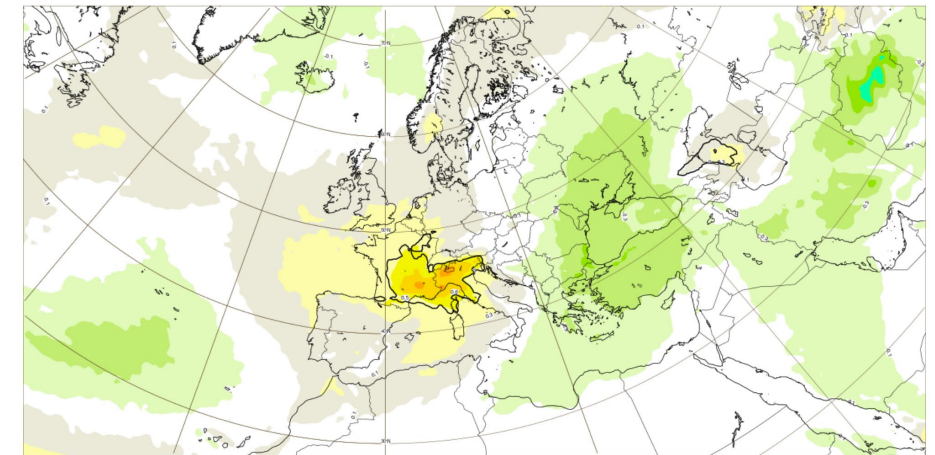
# NWP ensemble products

## Extreme Forecast Index (EFI)

Specialized guidance for anomalous, extreme or severe weather events



Medium-range (2mT)



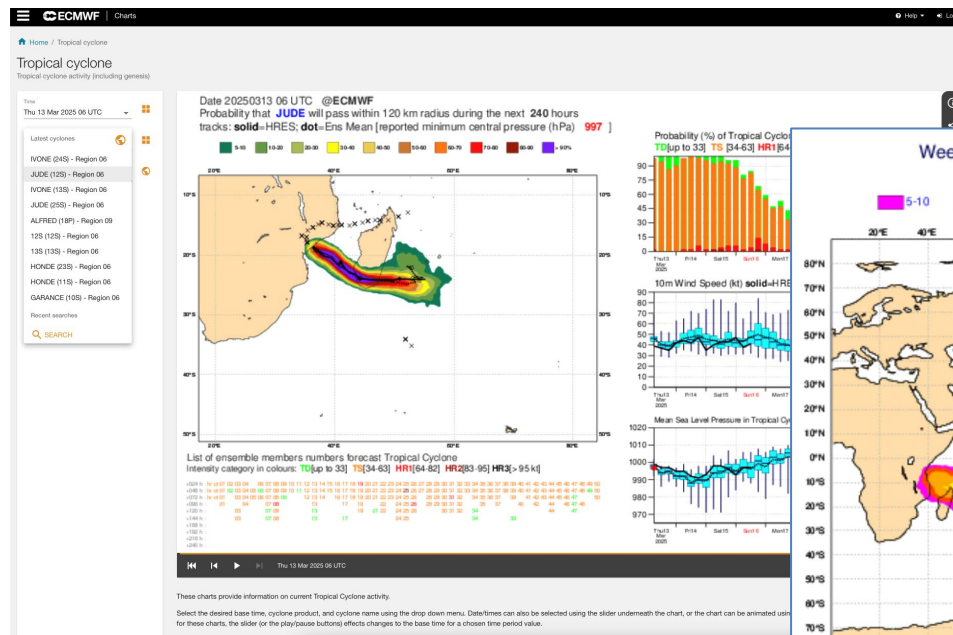
Sub-seasonal (precipitation)



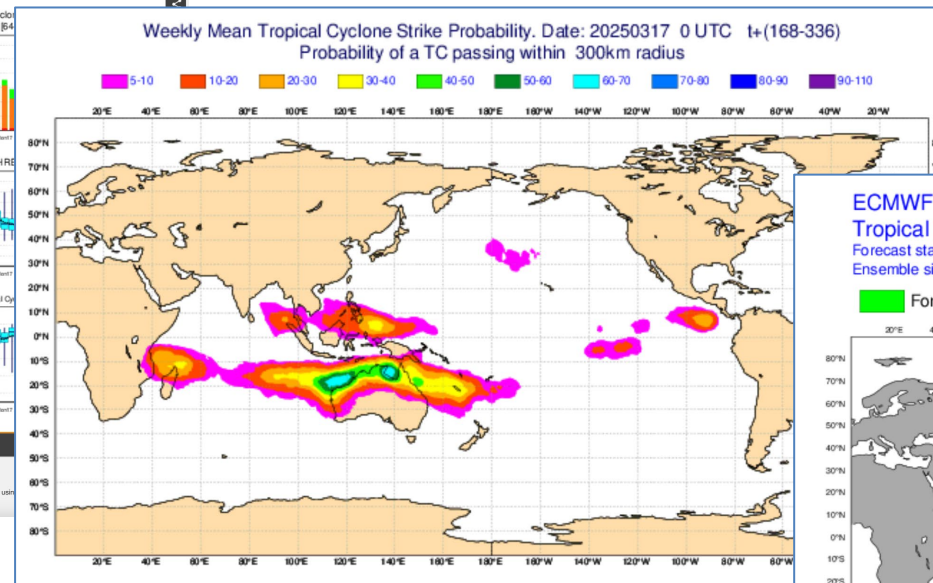
# NWP ensemble products

## Tropical cyclones products – across timescales

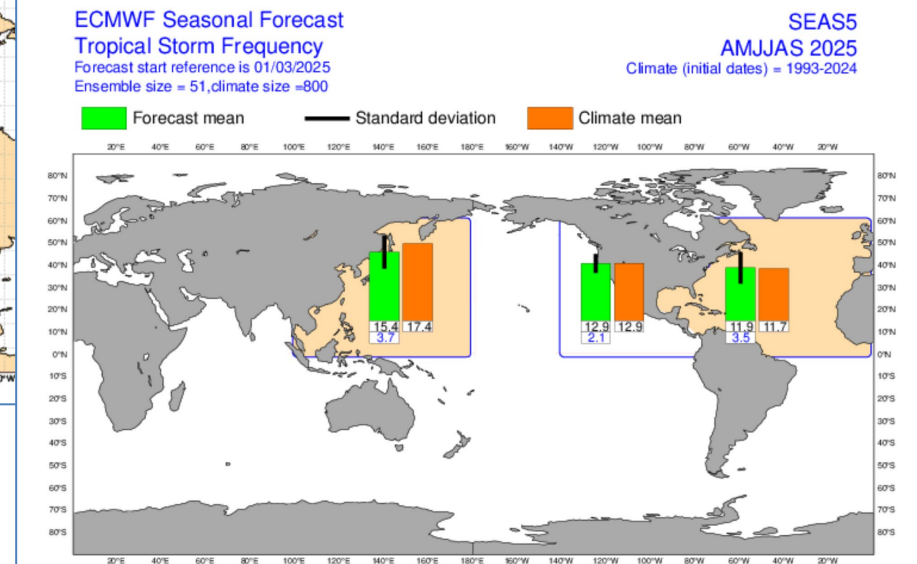
### Medium range (named systems)



### Sub-seasonal

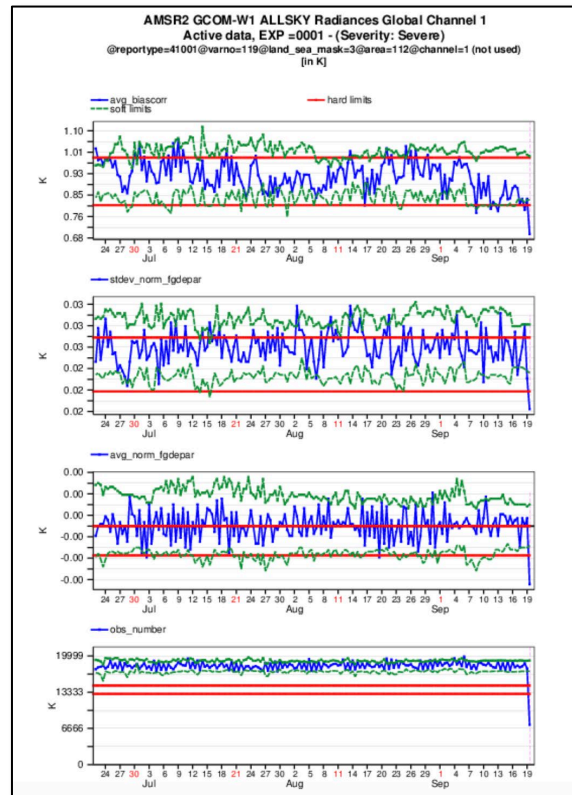
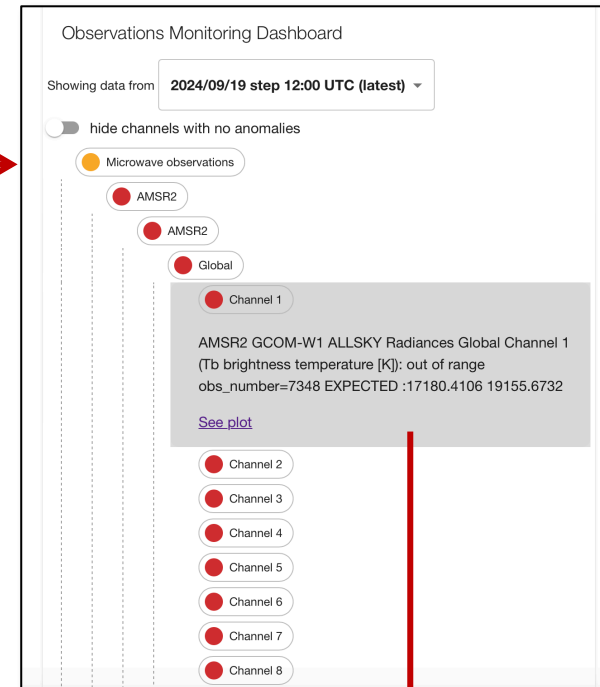
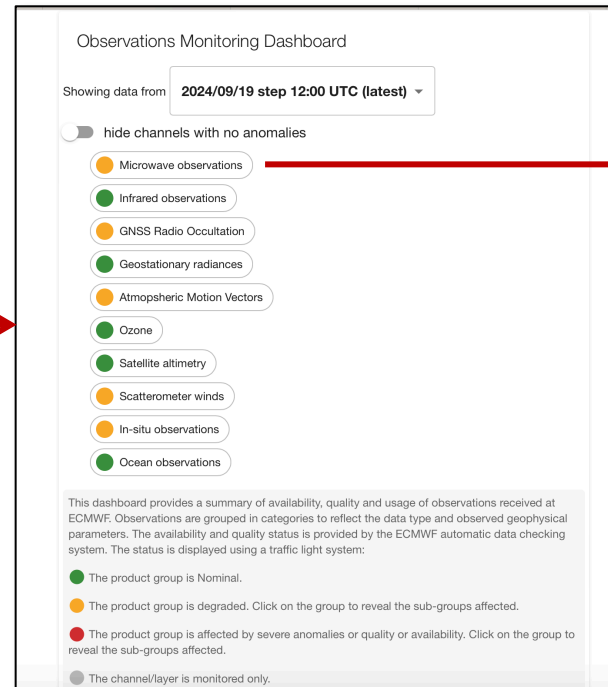
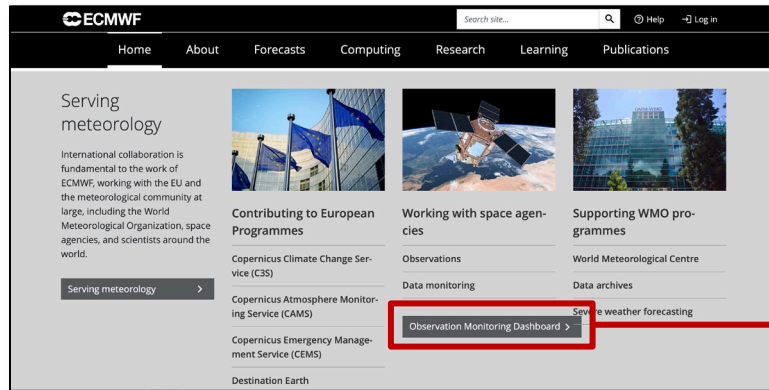


### Seasonal





# Observation monitoring – alarm dashboard



**A quick near-real time access to the configuration and health status of the observations used and monitored at ECMWF.**  
A system designed to serve expert and non-expert users.

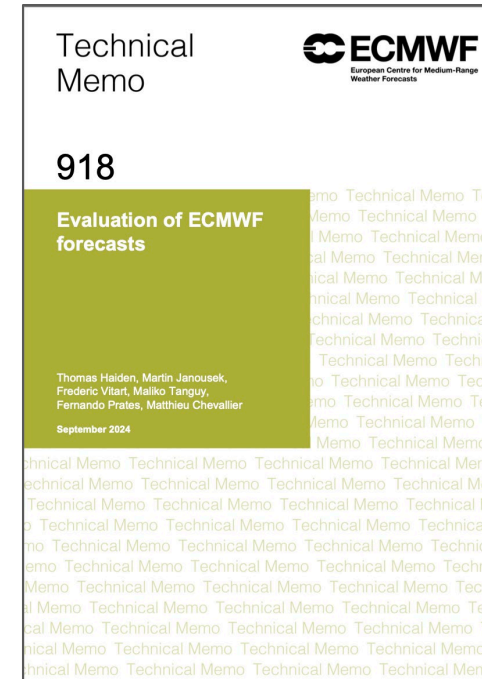
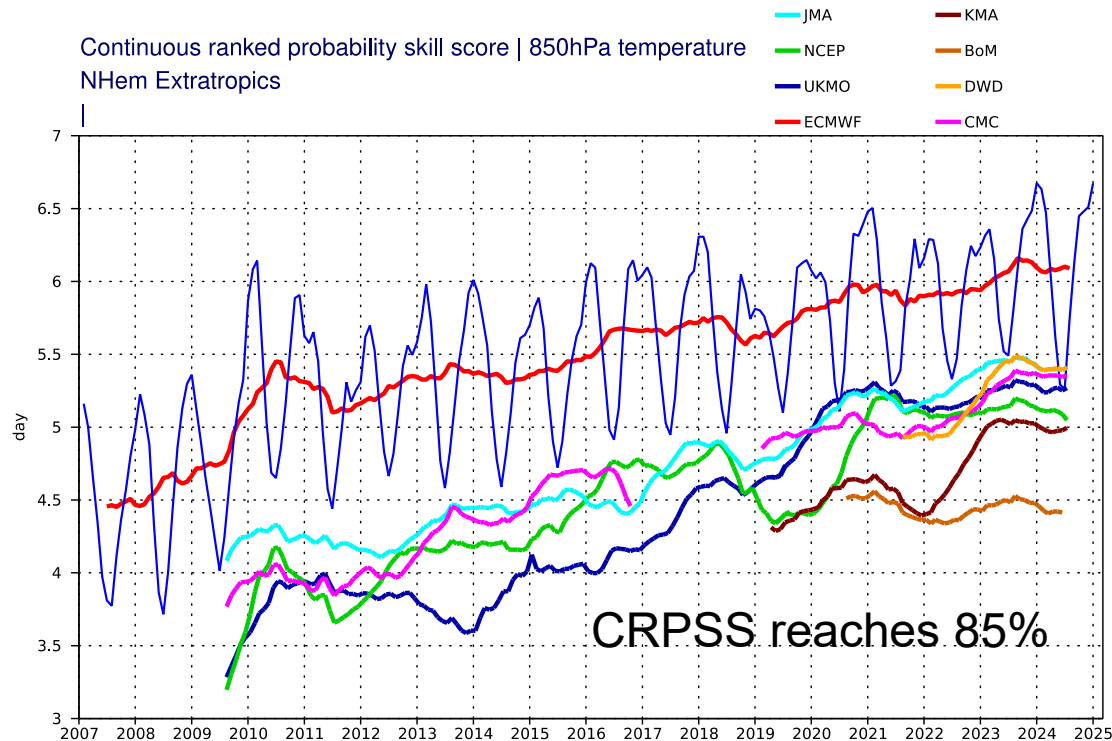
<https://obsstatus.ecmwf.int>

# NWP verification and performance monitoring



# Verification

## Documenting forecast systems' performance

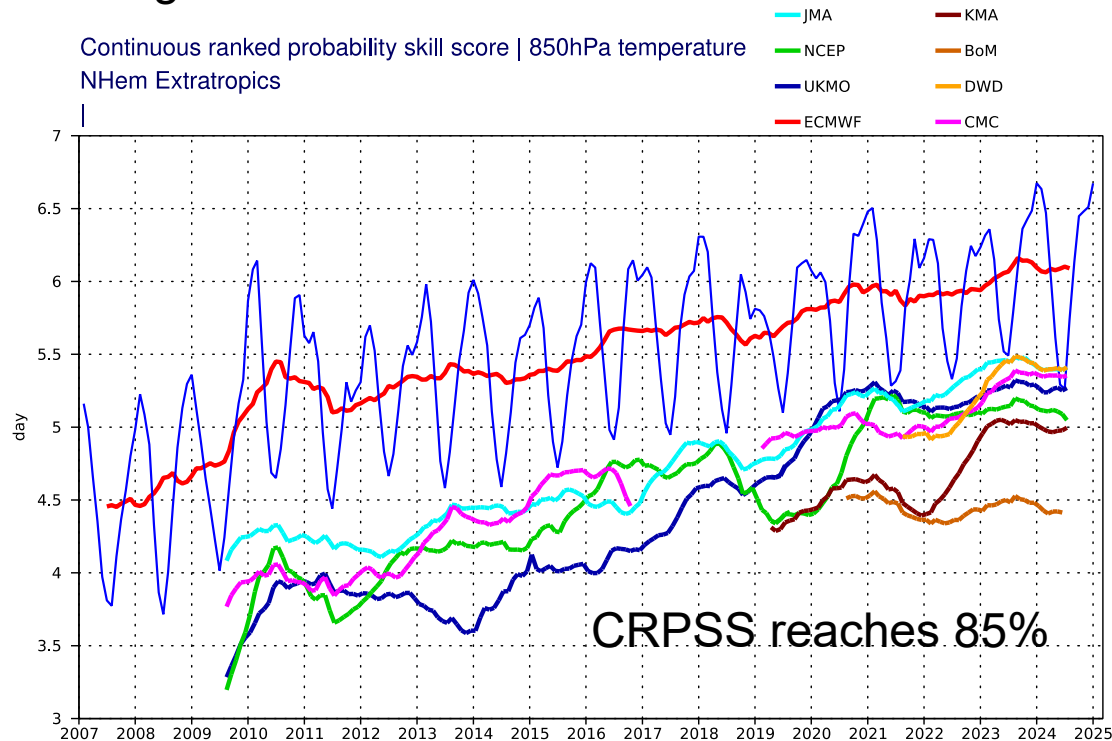


IFS medium-range, sub-seasonal, seasonal  
C3S seasonal multi-system  
AIFS (and other experimental AI models)  
Destination Earth Extremes DT prototype  
CAMS atmosphere composition (global)  
CEMS EFAS

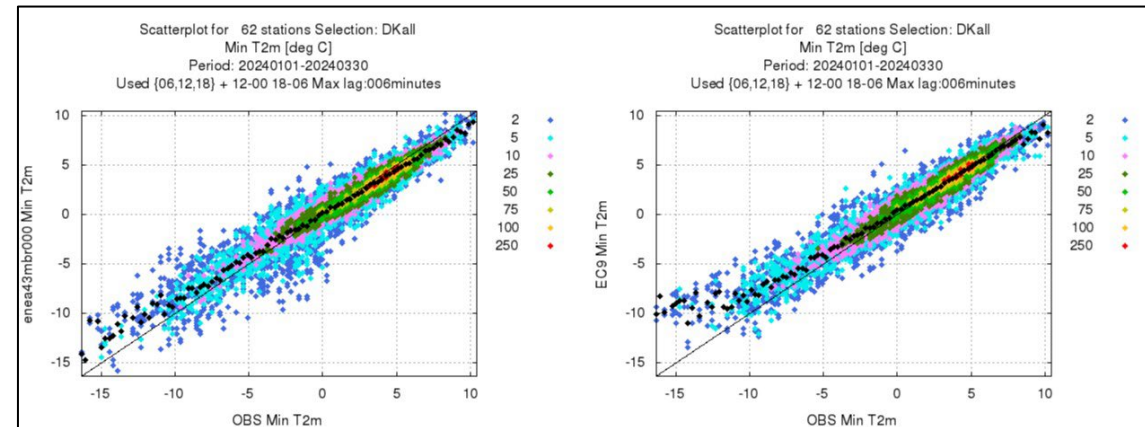
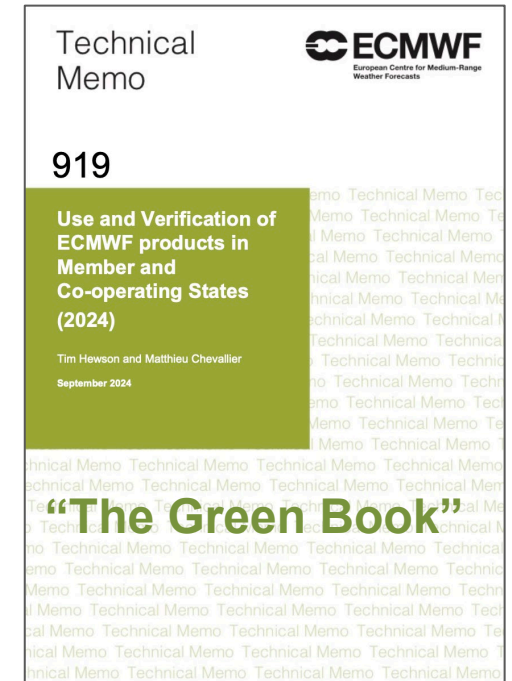
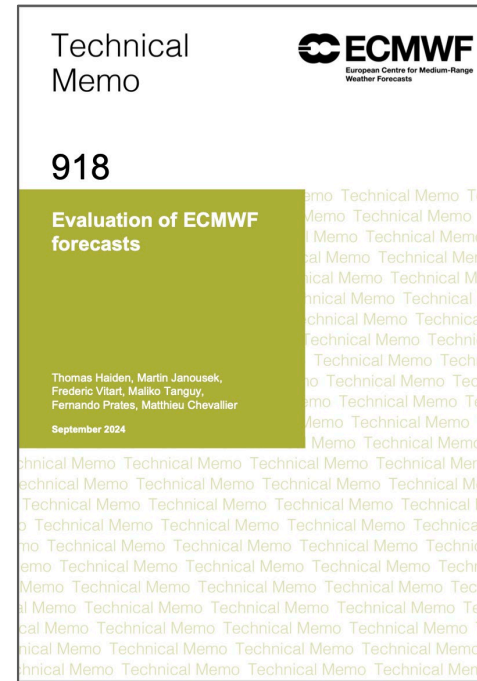
...

# Verification

## Documenting forecast systems' performance Getting feedback from forecasts' users



**Continuous dialogue with users in  
Member/Co-operating States is key !**






From FMI's contribution to the Green Book



# Performance monitoring


## Evaluating performance of (all) ECMWF forecasting systems on specific weather events

Pages / Forecast User Portal   

### Severe Event Catalogue

Created by Florian Pappenberger, last modified by Timothy Hewson on Nov 09, 2022

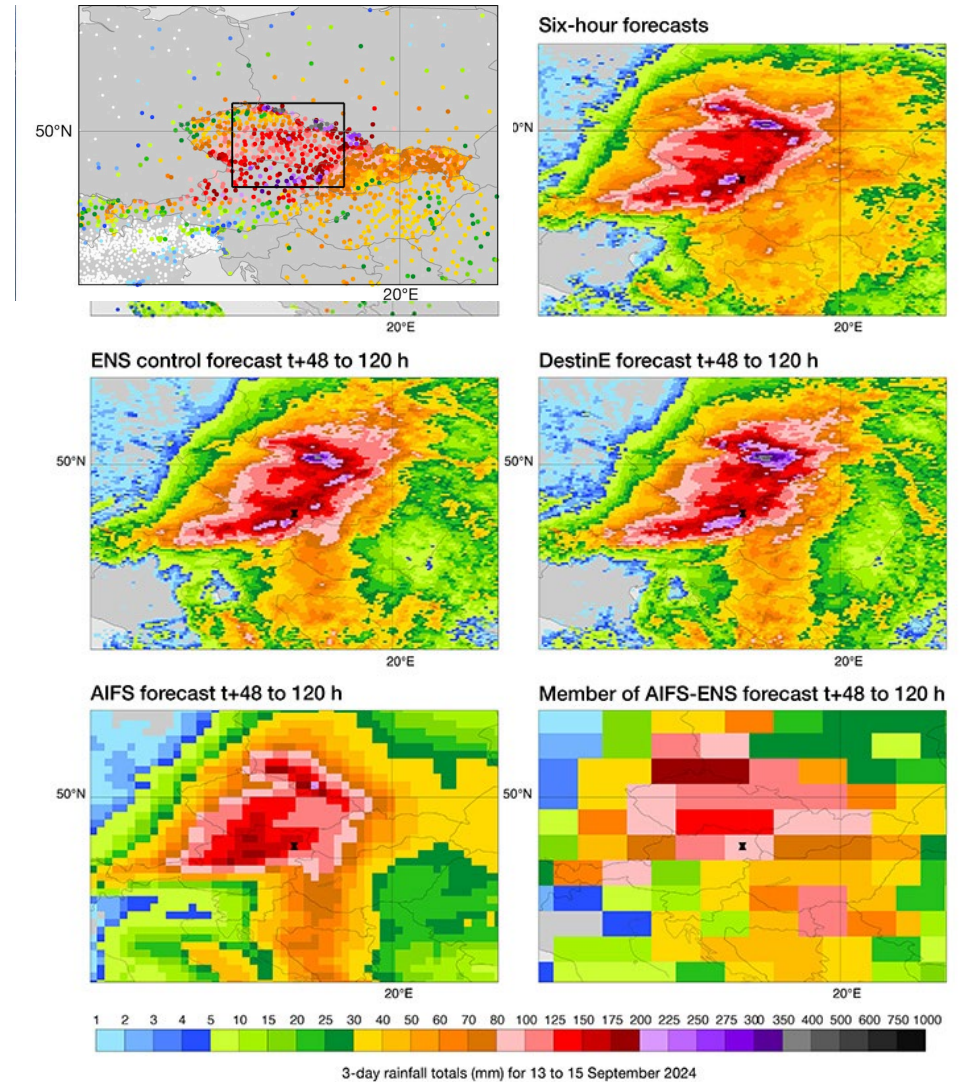
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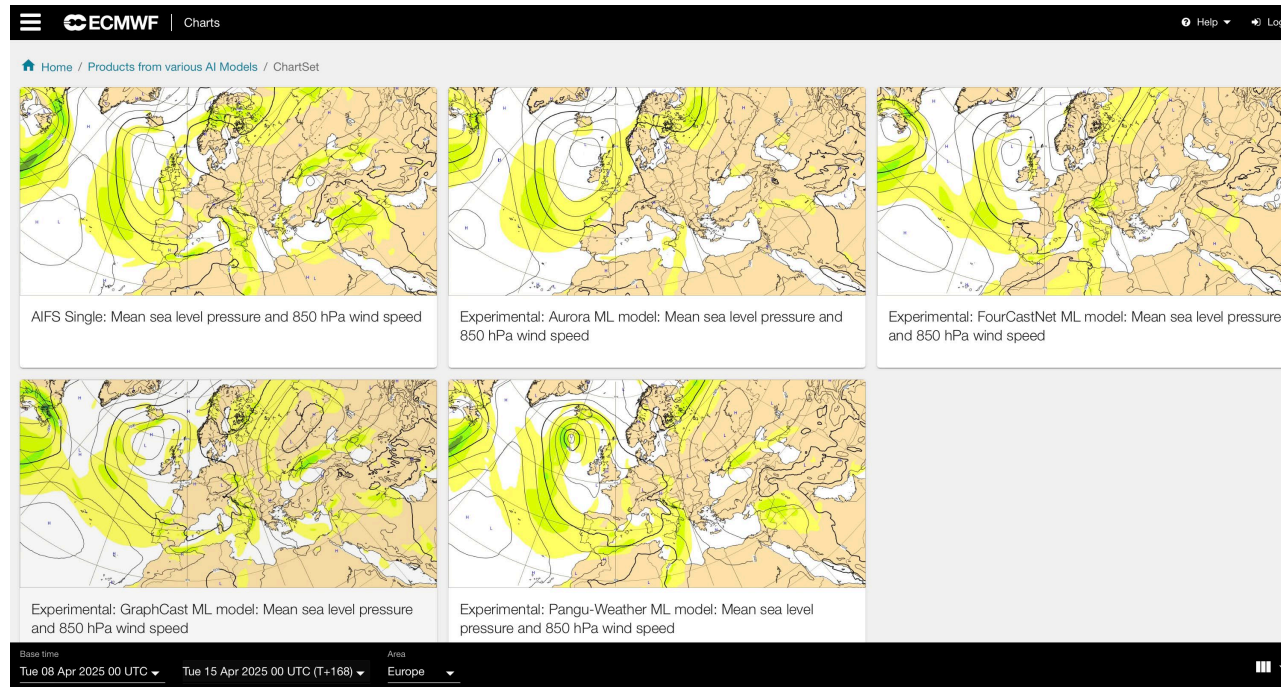
(Please note t ECMWF.)



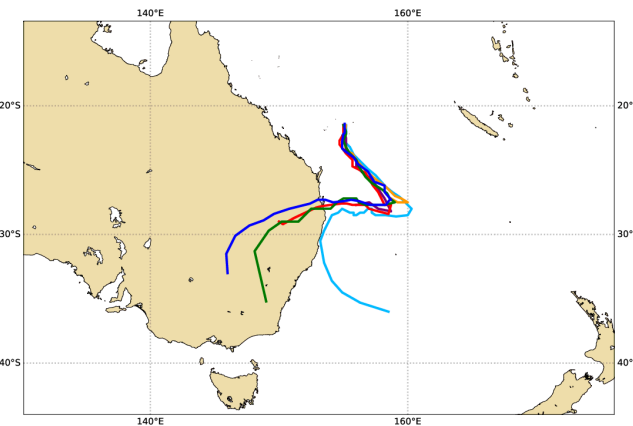
ECMWF Newsletter, website...

# Experimental products on OpenCharts

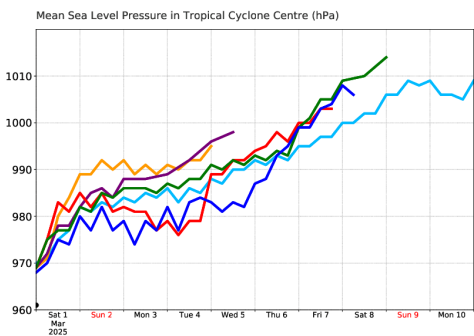
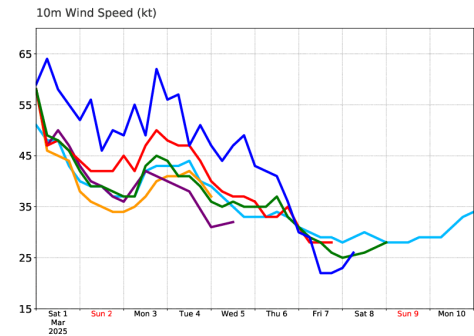
## Experimental AI-models on OpenCharts



Date 20250301 00 UTC @ECMWF  
Individual trajectories for **ALFRED** during the next 240 hours  
tracks in **solid**: AIFS SFNO AURO PGUW DMGC IFS  
[reported minimum central pressure (hPa) **961**]



List of ensemble members numbers forecast Tropical Cyclone  
Intensity category in colours: **TD** [up to 33] **TS** [34-63] **HR1** [64-82] **HR2** [83-95] **HR3** [> 95 kt]  
+024 h : AIFS SFNO AURO PGUW DMGC IFS  
+048 h : AIFS SFNO AURO PGUW DMGC IFS  
+072 h : AIFS SFNO AURO PGUW DMGC IFS  
+096 h : AIFS SFNO AURO PGUW DMGC IFS  
+120 h : AIFS PGUW DMGC IFS  
+144 h : AIFS PGUW DMGC IFS  
+168 h : AIFS DMGC IFS  
+192 h : AIFS DMGC  
+216 h : AIFS  
+240 h : AIFS



<https://charts.ecmwf.int>



# Access to multi-model/system data

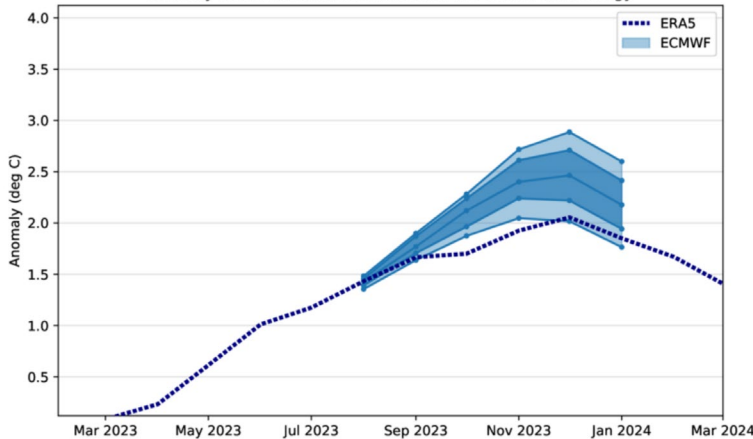




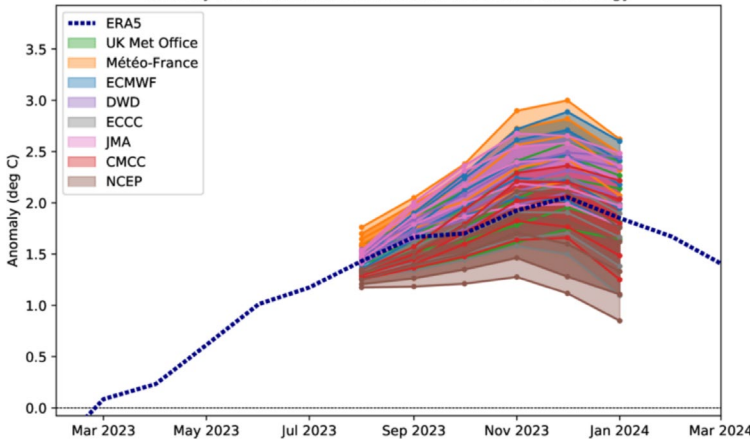
# Seasonal multi-system forecasts



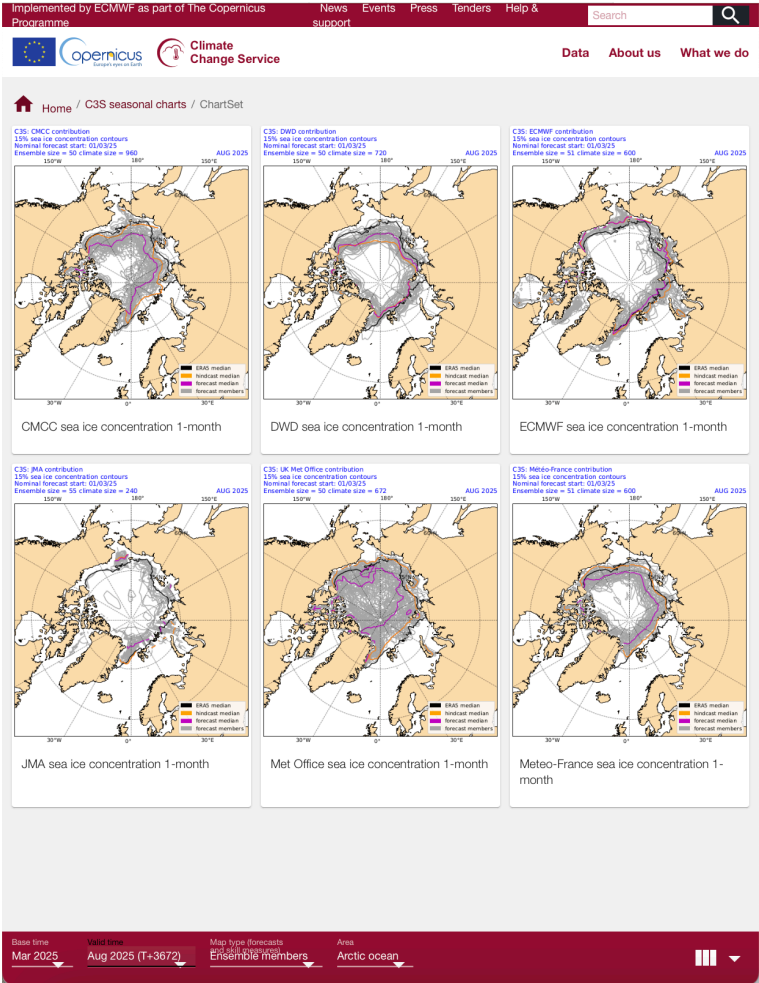
NINO3.4 SST anomaly percentiles 10, 25, 50, 75, 90  
C3S: ECMWF contribution from 1 August 2023  
monthly mean anomalies relative to 1981-2010 climatology



NINO3.4 SST anomaly percentiles 10, 25, 50, 75, 90  
C3S: Multi-system forecast from 1 August 2023  
monthly mean anomalies relative to 1981-2010 climatology




<https://climate.copernicus.eu/seasonal-forecasts>






# Sub-seasonal multi-model – WMO Lead Centre

- **ECMWF hosts WMO Lead Centre for Sub-seasonal Predictions Multi-Model Ensemble.**
- Built on the legacy of the WWRP/WCRP S2S project and relies on S2S archive infrastructure.

 WORLD METEOROLOGICAL ORGANIZATION

WMO Lead Centre for Sub-seasonal Prediction Multi-Model Ensemble



The Lead Centre for Sub-seasonal Predictions Multi-Model Ensemble (LC-SSPMME) coordinates multi-model ensembles of sub-seasonal forecasts by maintaining an archive containing a set of model fields, by creating graphical products from individual and multi-model ensembles under an agreed format and by creating verification statistics. To provide WMO Members with reliable multi-model ensembles in real time, the LC-SSPMME uses forecast data from several sub-seasonal prediction systems. Forecast data is provided by WMO Global Producing Centres for Sub-seasonal Predictions and by Contributing Centres.

FORECAST CHARTS

VERIFICATION STATISTICS

Further information on forecast products and forecast digital data is [here](#).

## Global producing centre for Sub-Seasonal Predictions (GPC-SSP)



Beijing



CPTEC



ECMWF



Moscow



Tokyo

## Contributing centres



Exeter



Government of Canada

Montreal



KMA Korea Meteorological Administration

Seoul



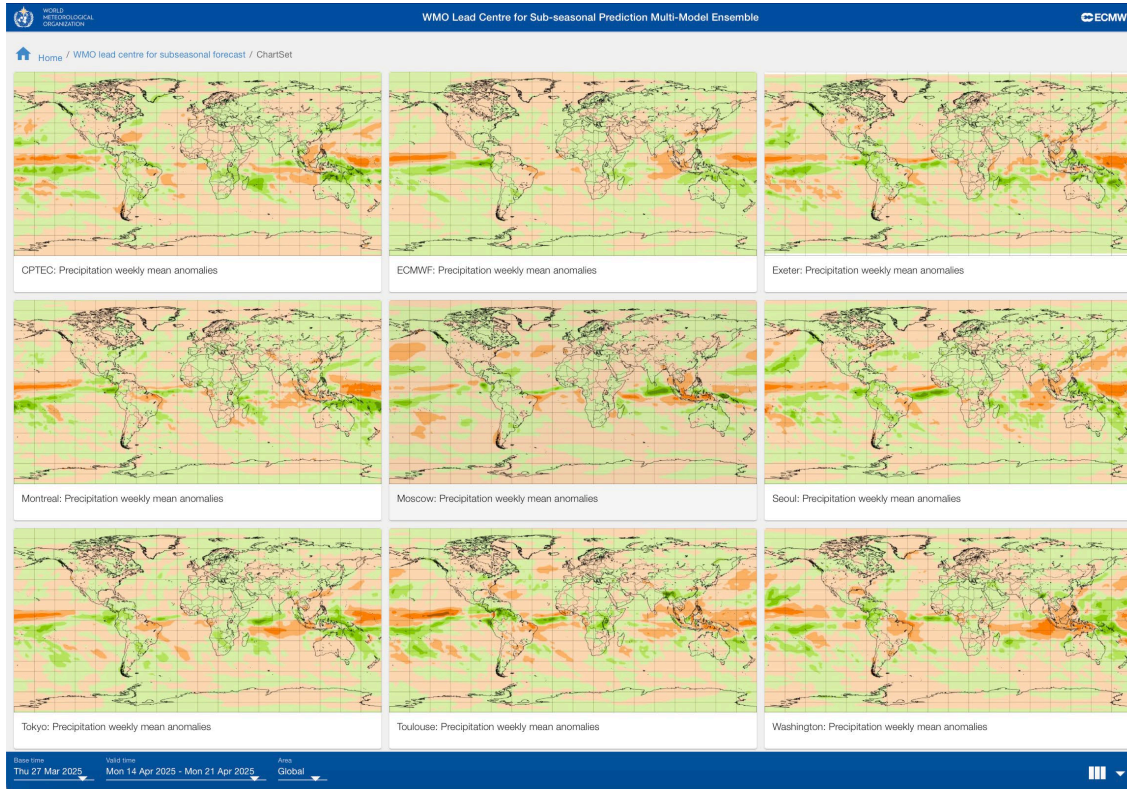
Toulouse



Washington

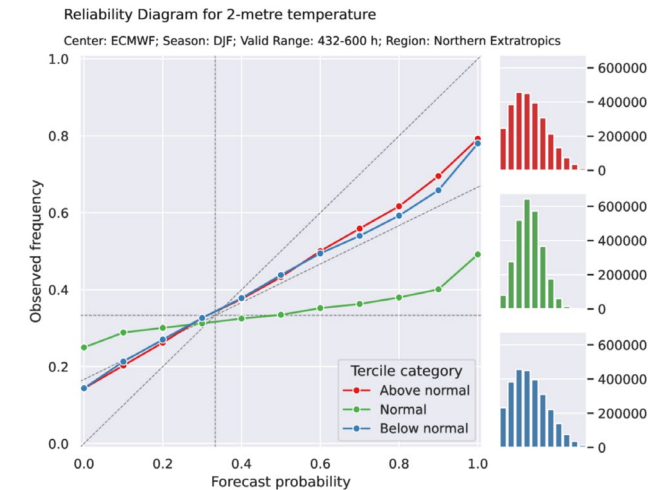
# Sub-seasonal multi-model – WMO Lead Centre

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Near real-time forecast charts (updated weekly)

ECMWF - Reliability of tercile category forecasts



Verification statistics from reforecasts

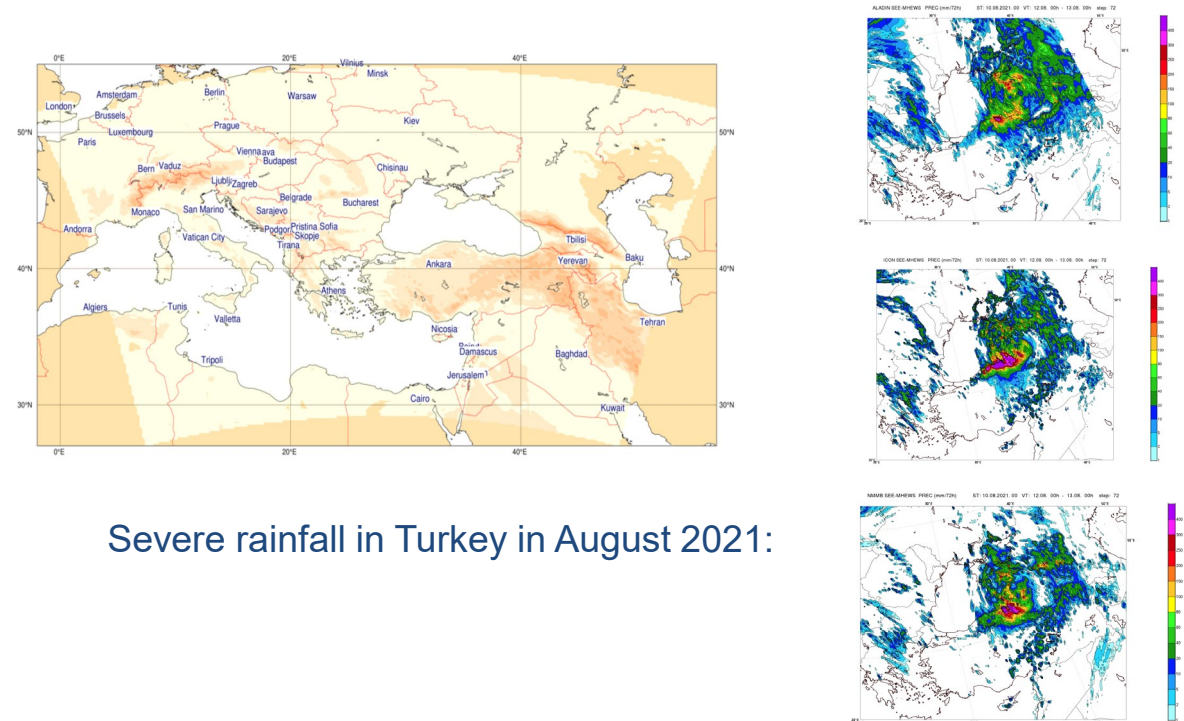
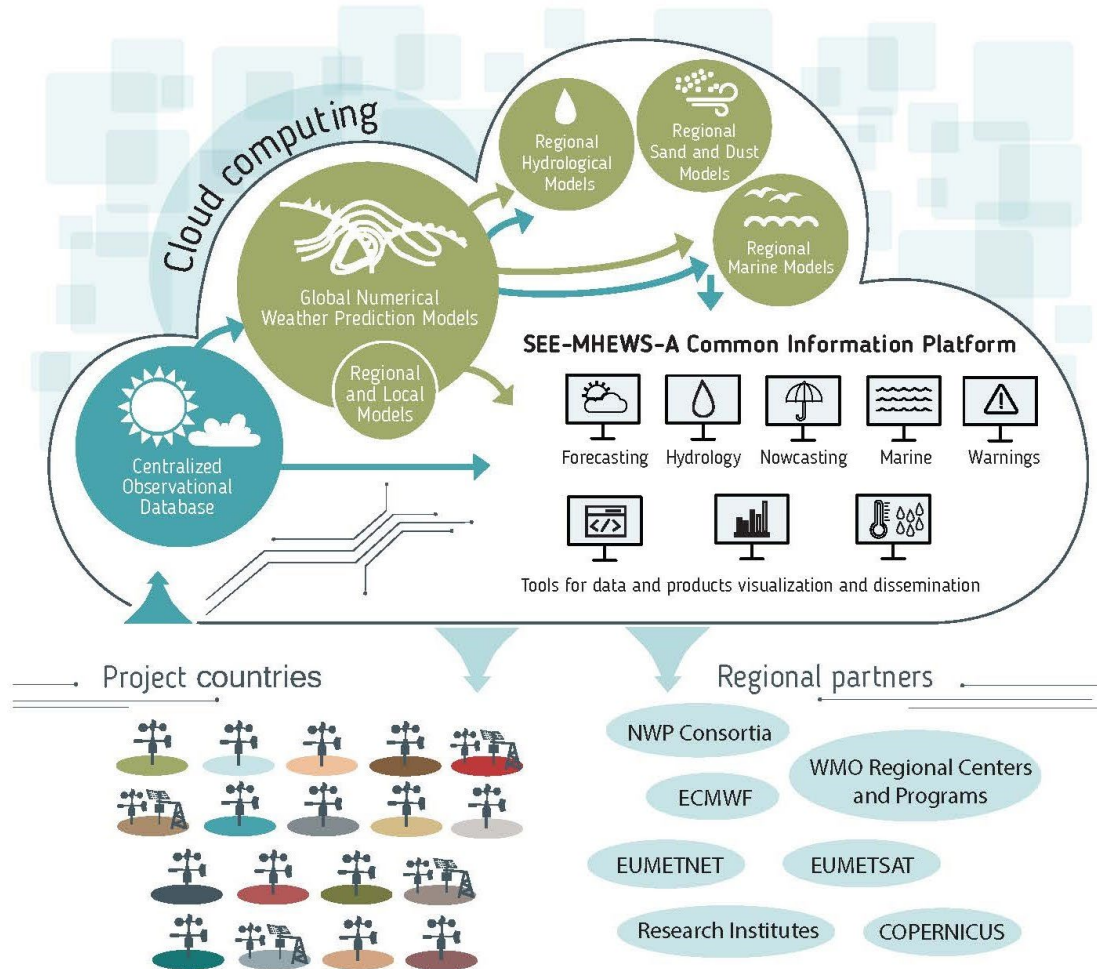
Available at <https://charts.ecmwf.int/wmo/>

# Applications



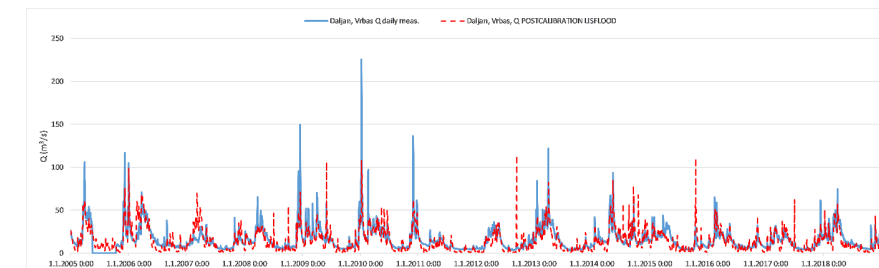
# Accessing and exploring forecast data on European Weather Cloud

## SEE-MHEWS-A South-East European Multi-Hazard Early Warning Advisory System



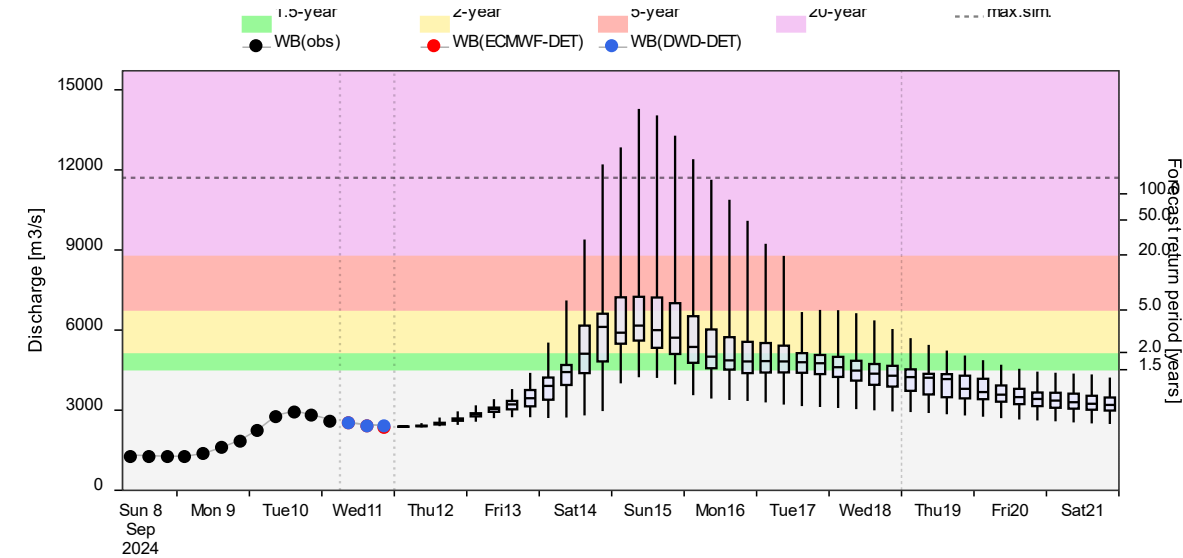
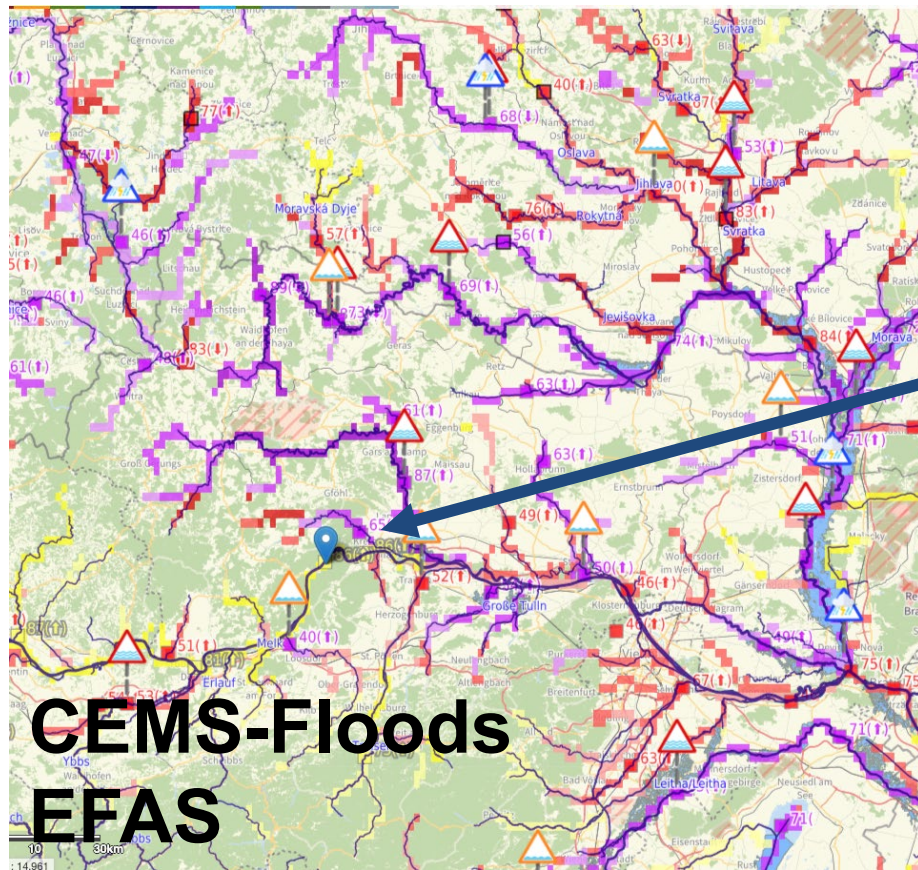
Severe rainfall in Turkey in August 2021:

Observed (blue) vs. calibrated discharge (red) at station in Vrbas river

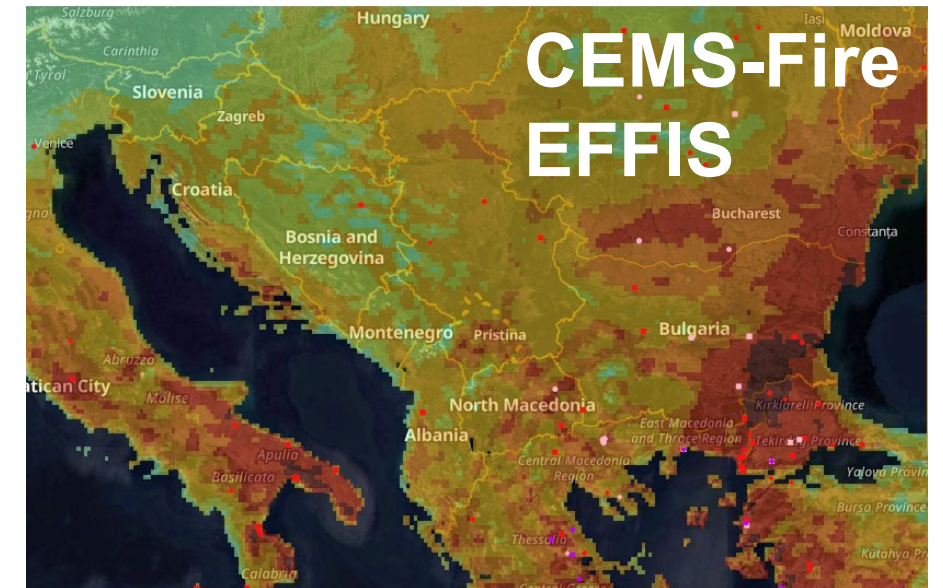




# Floods and fire forecasts – Early Warning Systems

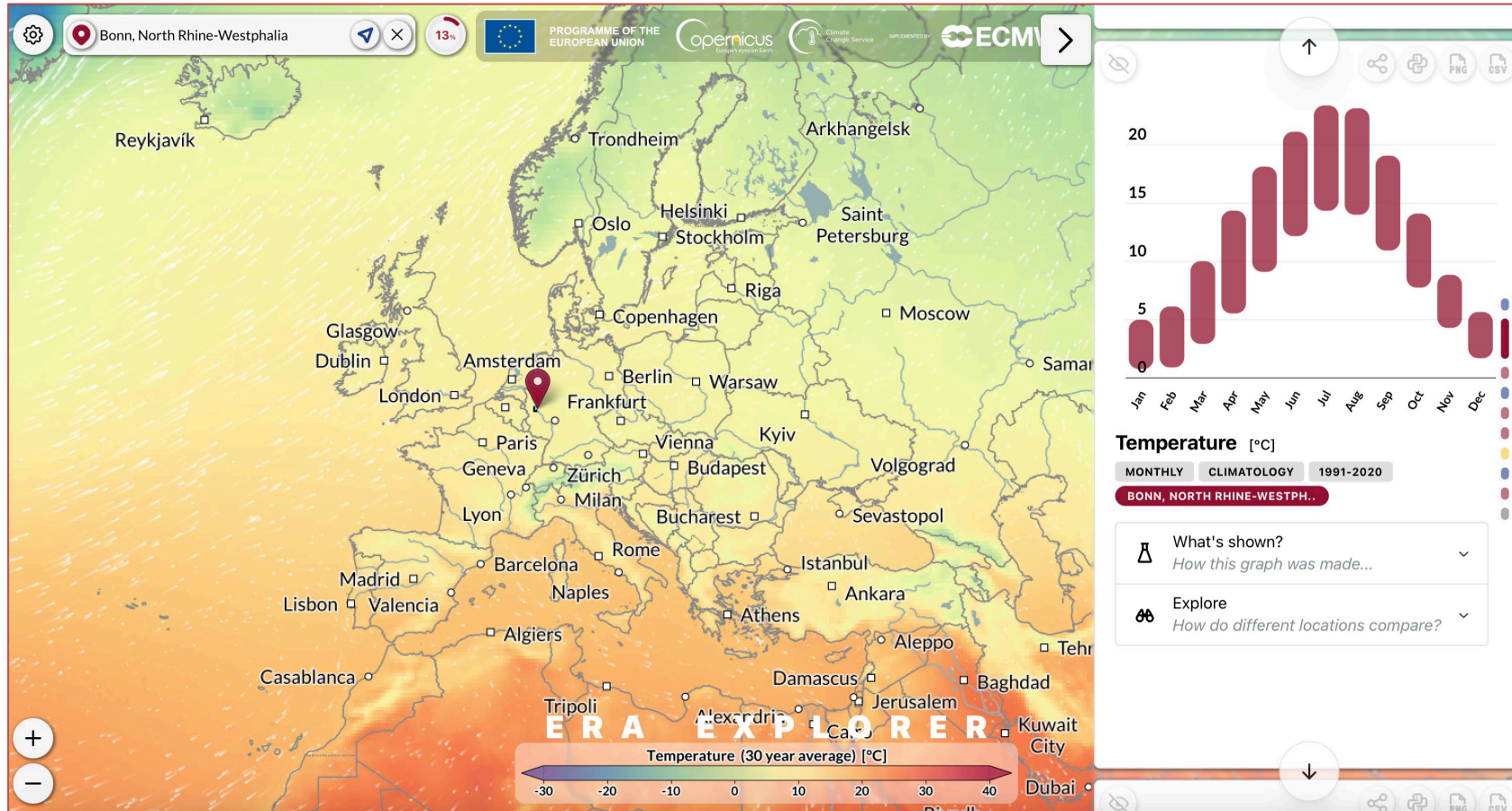


CEMS operated by EC Joint Research Centre (JRC)  
ECMWF computational centre for Floods and Fire





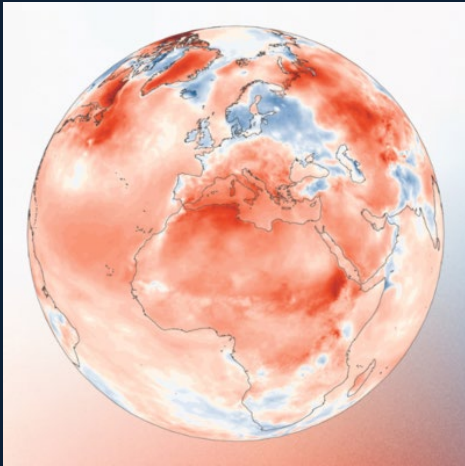
# Accessing and exploring data on the Climate Data Store



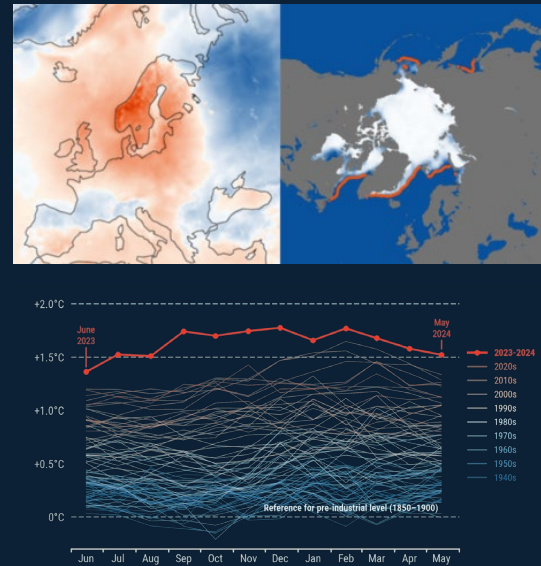
Built on a new ZARR archive of selected ERA5 variables

<https://era-explorer.climate.copernicus.eu/>

# Climate Intelligence



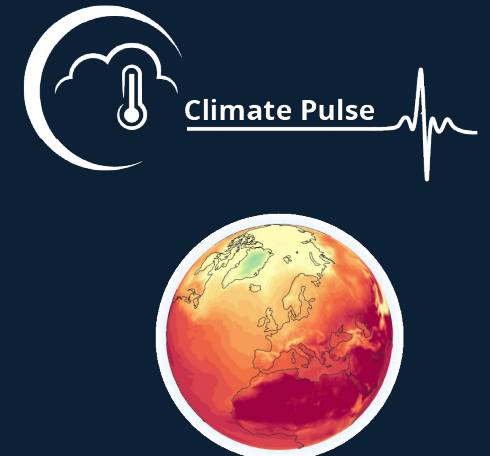
Global Climate Highlights



Monthly Bulletins



ESOTC



Climate Pulse

# Conclusions

- A comprehensive ecosystem of forecast and analysis products spanning multiple time scales and Earth system components.
- ECMWF infrastructure plays a vital role in enhancing data accessibility and supporting data exploration for diverse applications.
- Programmes (e.g., Copernicus, Destination Earth), projects, and collaborations (with Member and Co-operating States, WMO) support these developments and act as value multipliers.
- Engagement with Member and Co-operating States is instrumental in expanding the product portfolio and improving forecast quality – it will be even more in the future!



Thank you!





# Open Data at ECMWF



Free and open charts including  
meteograms (Open Charts)



Free and open data available on  
ECMWF Data Portal and in Microsoft  
Azure, Google & Amazon AWS



Contents of the ECMWF real-time  
catalogue provided with an open licence  
(CC-BY-4) for data  $\geq 0.4$  degrees



Reduced fees for some  
licence types



# Open Data Roadmap

