Services across time scales and Earth System components

An ECMWF perspective

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2025 Annual Seminar – Wednesday 9th 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

Atmosphere Monitoring Service
atmosphere.copernicus.eu

Climate Change Service
climate.copernicus.eu

Destination Earth | EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

Contributing to

Emergency Management Service

G
serv

PUs

Services across time scales and Earth system component

A few examples (“Success stories”):

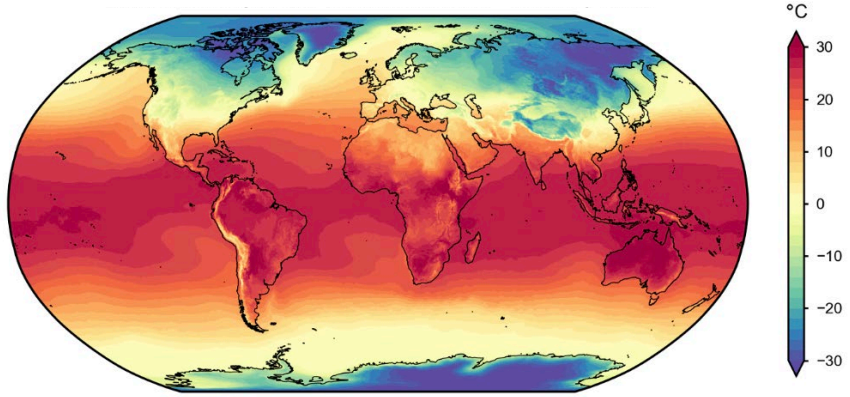
- IFS forecast products
- NWP verification/performance monitoring
- Multi-system predictions – focus on Sub-seasonal
- Applications

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

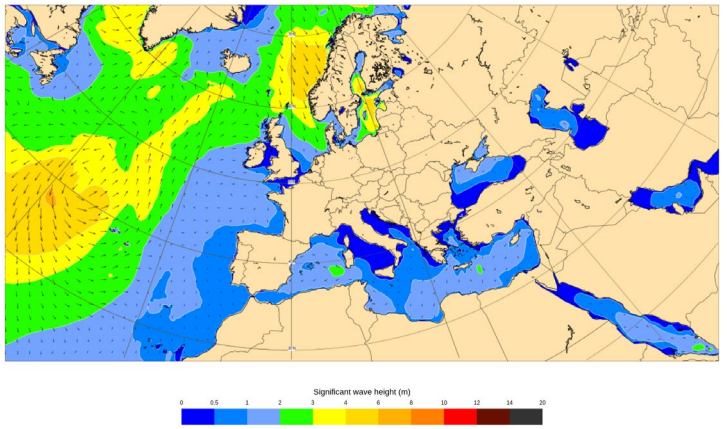
An ecosystem of IFS Products

Forecast data provision across multiple timescales

ERA5 monthly mean 2m temperature – Jan 2016



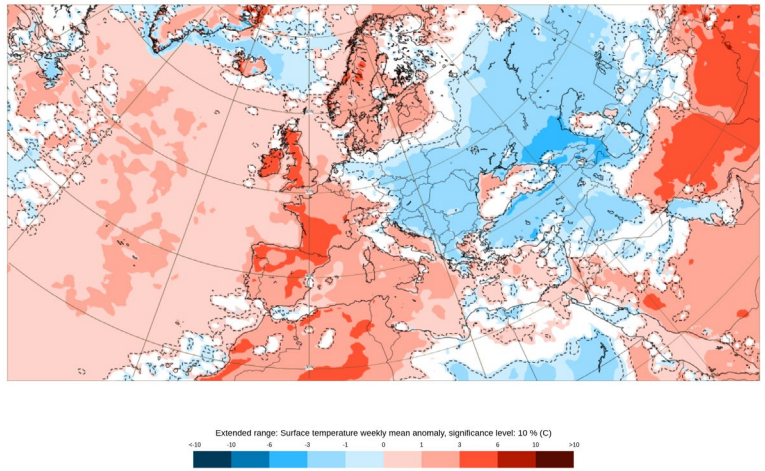
Reanalysis – 1940-now – 36km



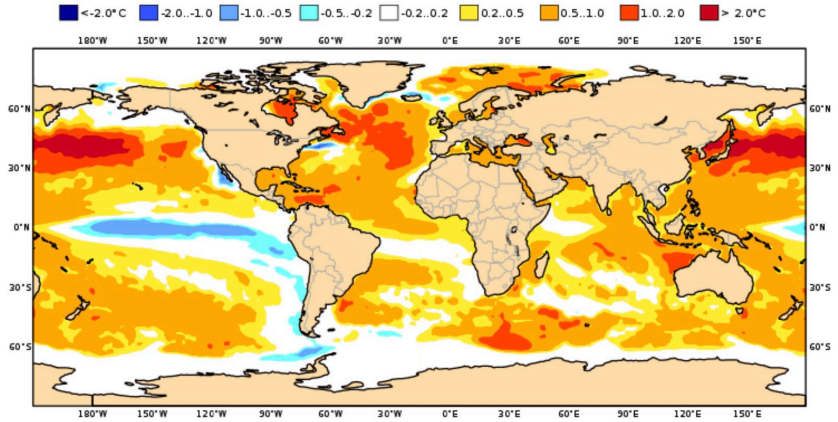
Significant Wave Height (m) – 04 Nov 2024

Medium-range - 15 days - 9km

2m temperature anomaly – 04-11 Nov 2024



Sub-seasonal - 46 days - 36km



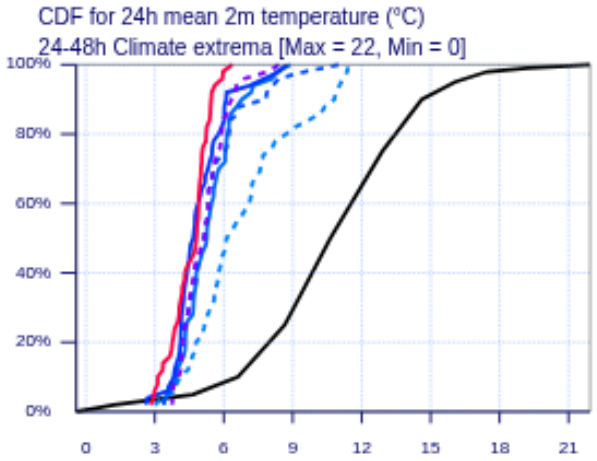
Mean SST anomaly – Nov 2024

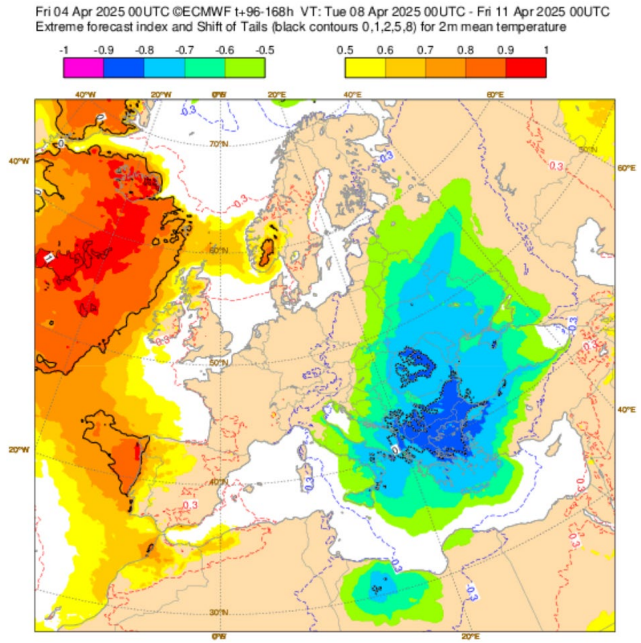
Seasonal Forecast - 7 months - 36km

ECMWF

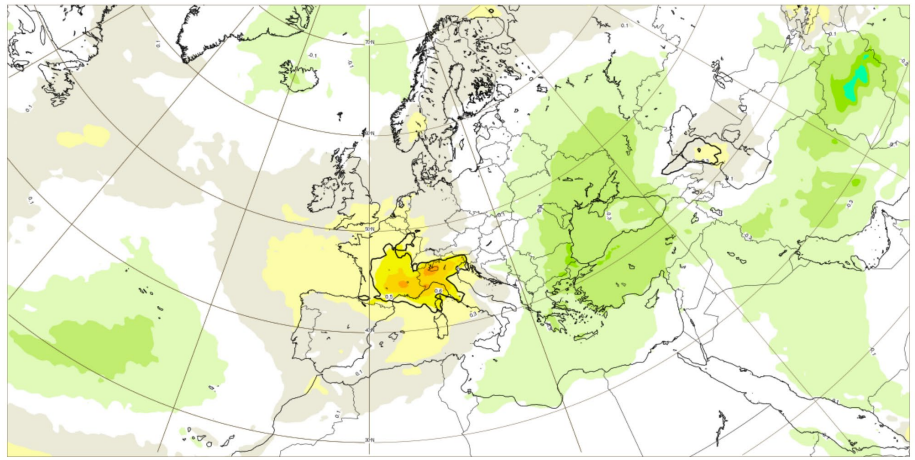
NWP ensemble products

Extreme Forecast Index (EFI)
Specialized guidance for anomalous, extreme or severe weather events





Medium-range (2mT)

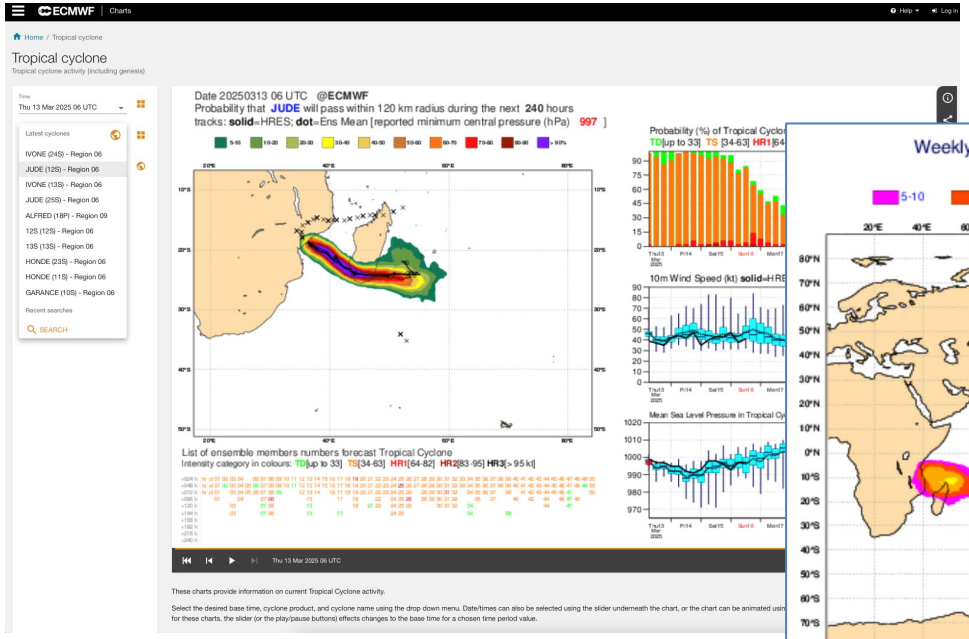


Sub-seasonal (precipitation)

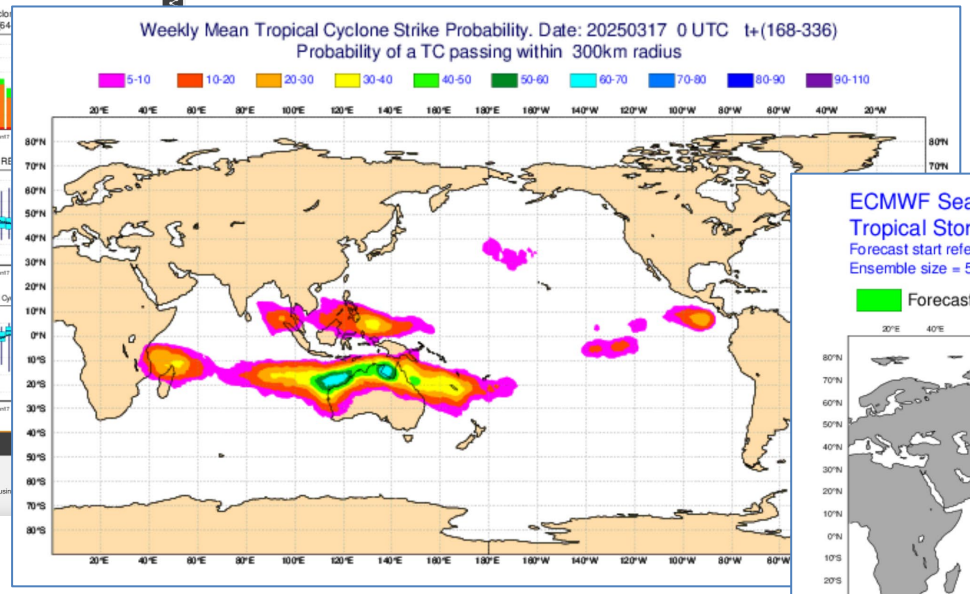
NWP ensemble products

Tropical cyclones products – across timescales

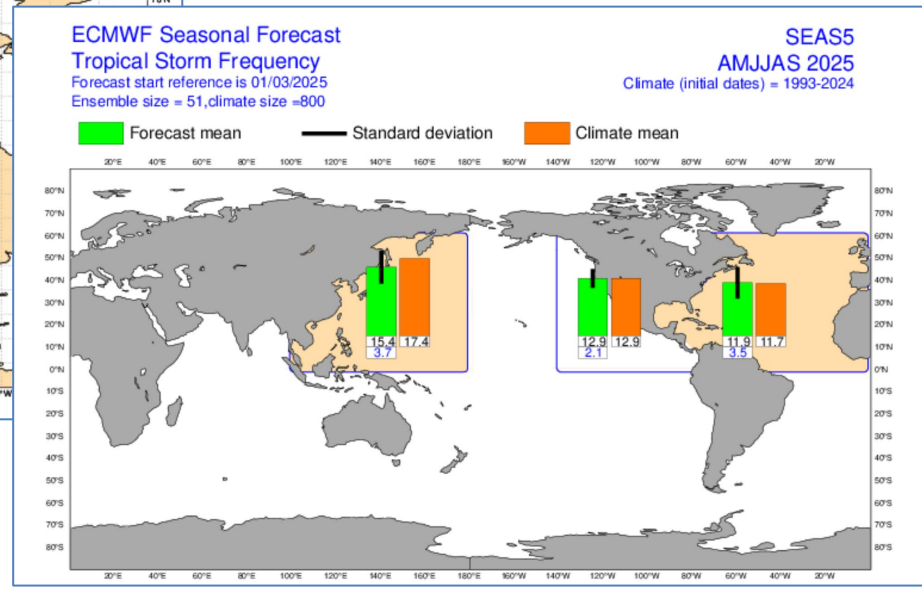
Medium range (named systems)



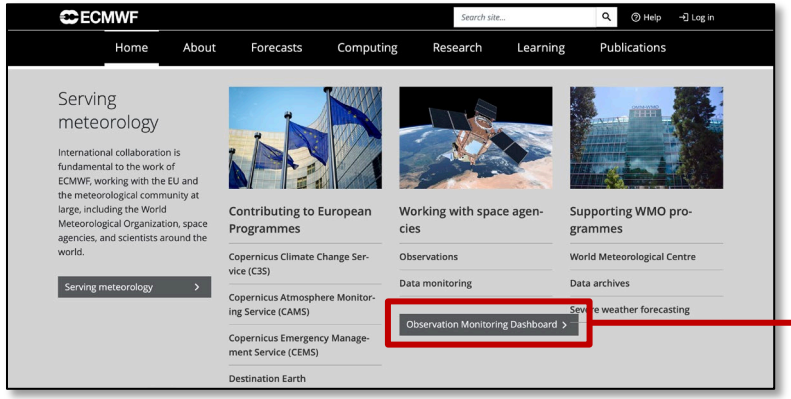
Sub-seasonal

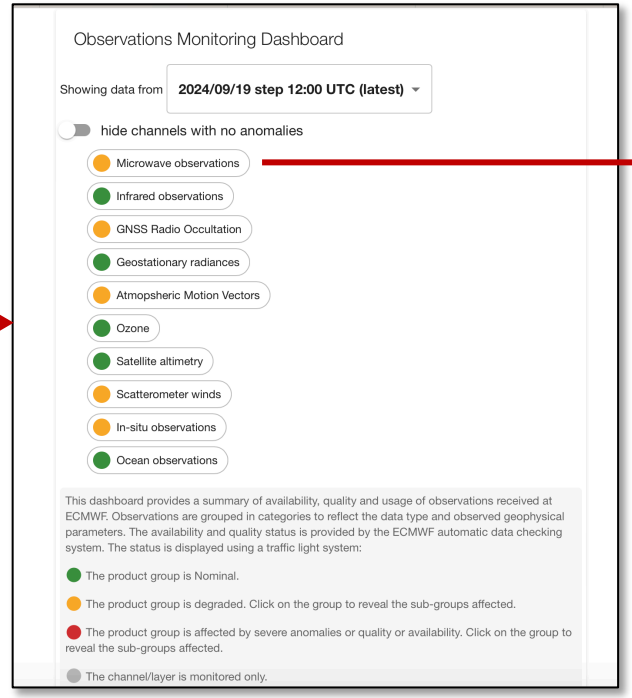


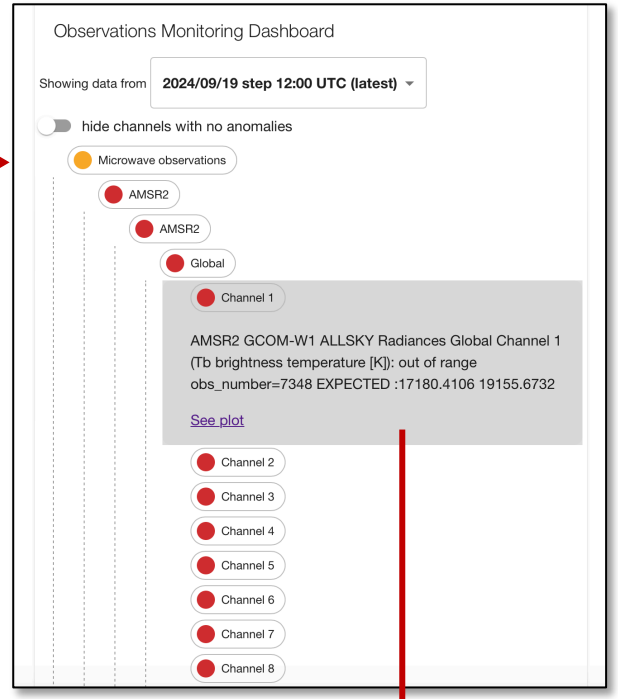
Seasonal

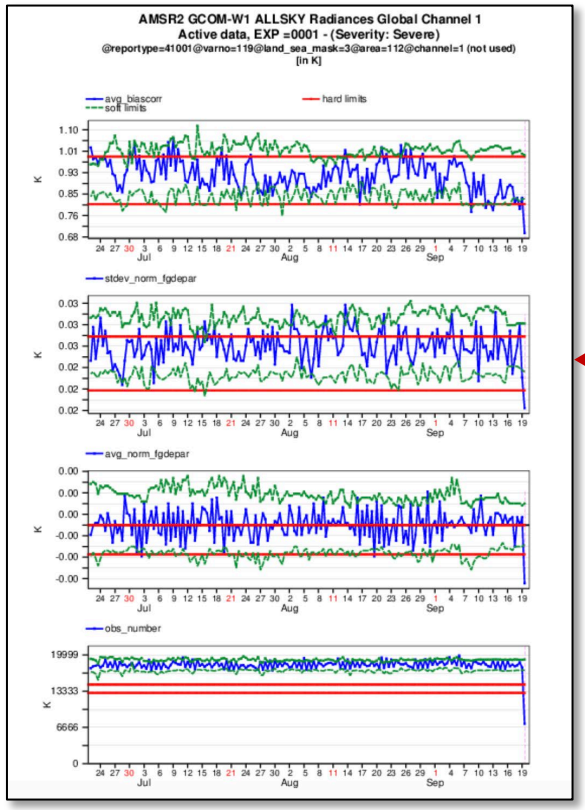


Observation monitoring – alarm dashboard









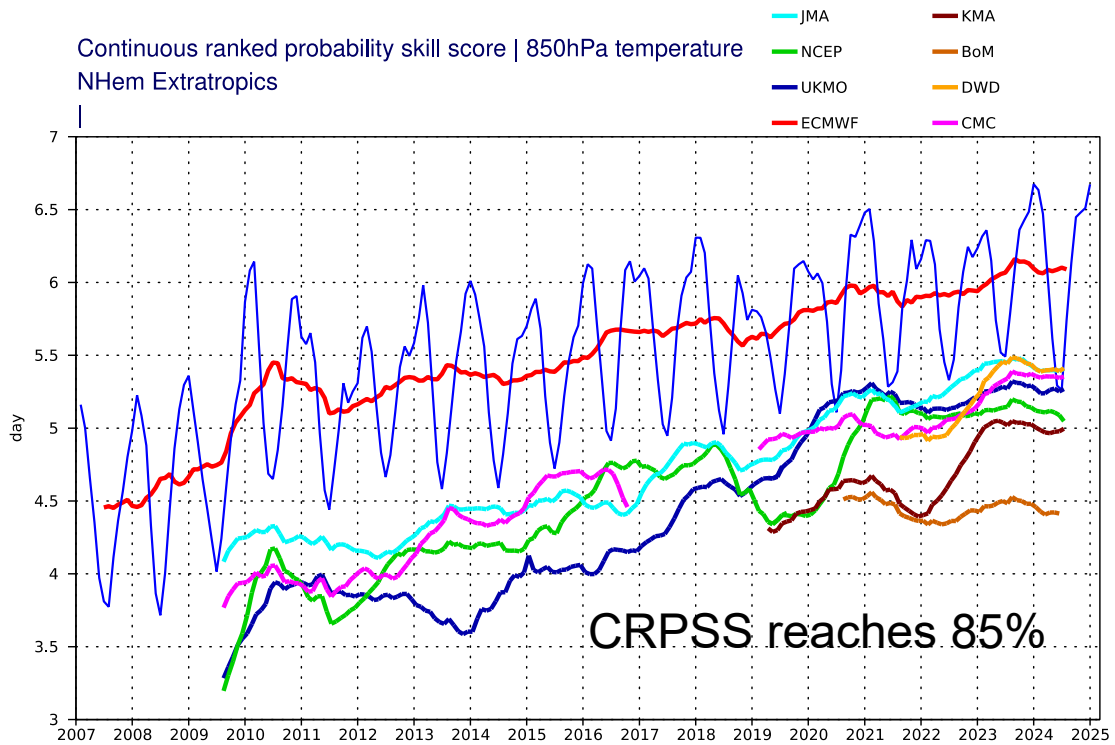
A quick near-real time access to the configuration and health status of the observations used and monitored at ECMWF.
A system designed to serve expert and non-expert users.

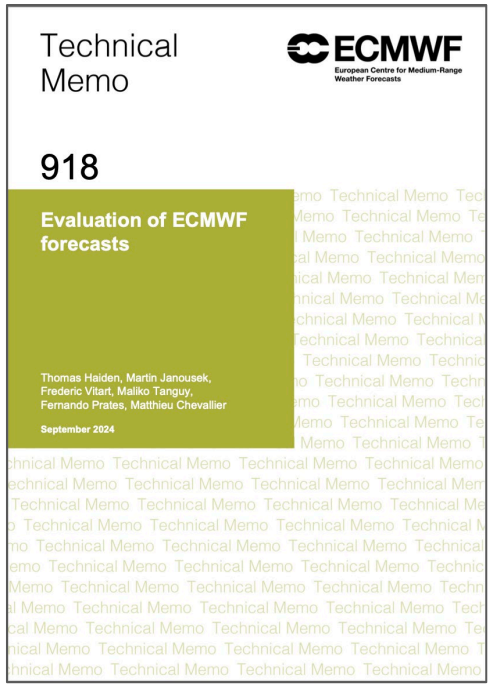
https://obsstatus.ecmwf.int

NWP verification and performance monitoring

Verification

Documenting forecast systems' performance

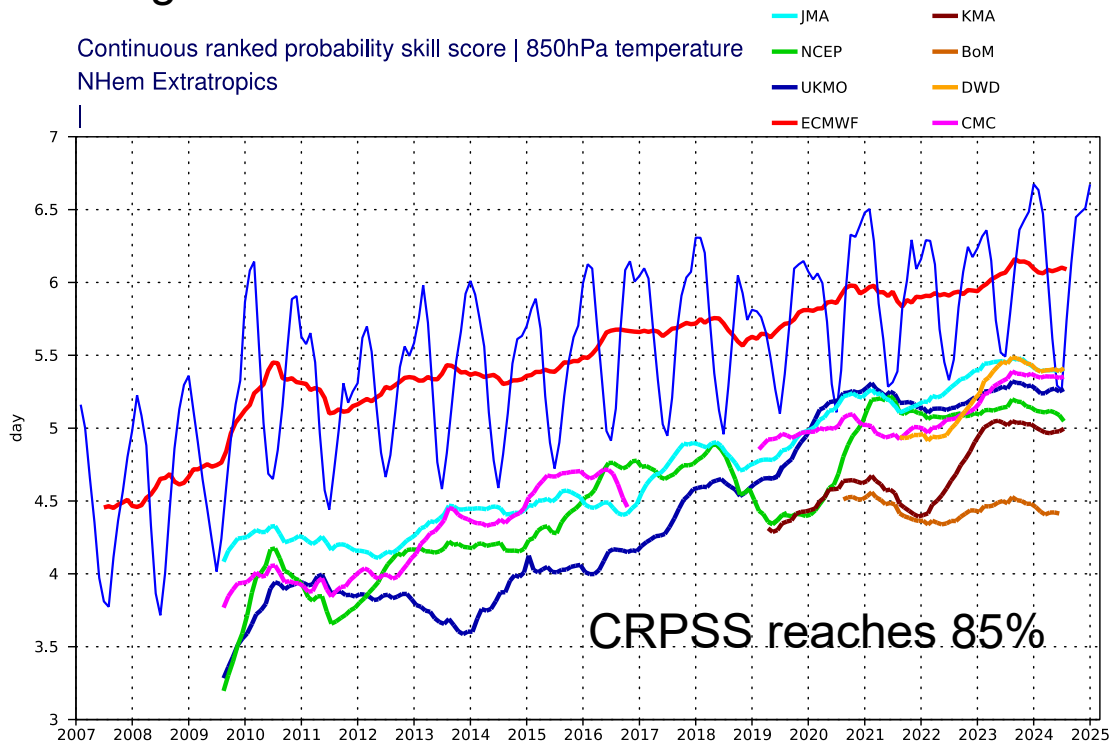




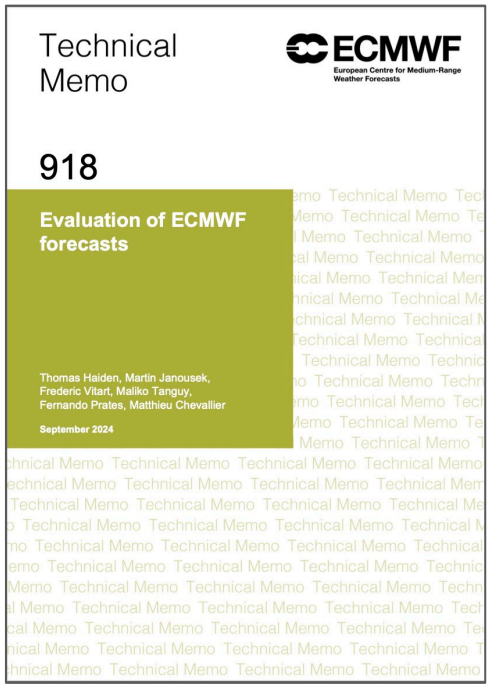
IFS medium-range, sub-seasonal, seasonal
C3S seasonal multi-system
AIFS (and other experimental AI models)
Destination Earth Extremes DT prototype
CAMS atmosphere composition (global)
CEMS EFAS
…

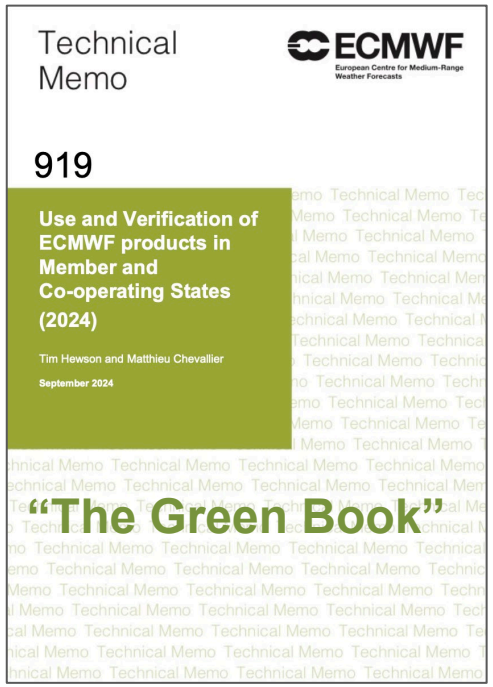
Verification

Documenting forecast systems' performance
Getting feedback from forecasts' users

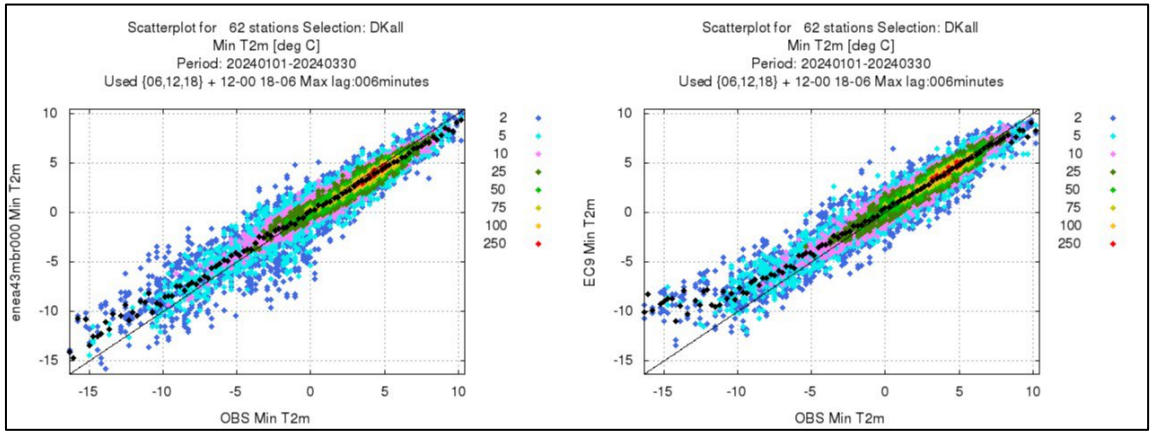


Continuous dialogue with users in Member/Co-operating States is key !





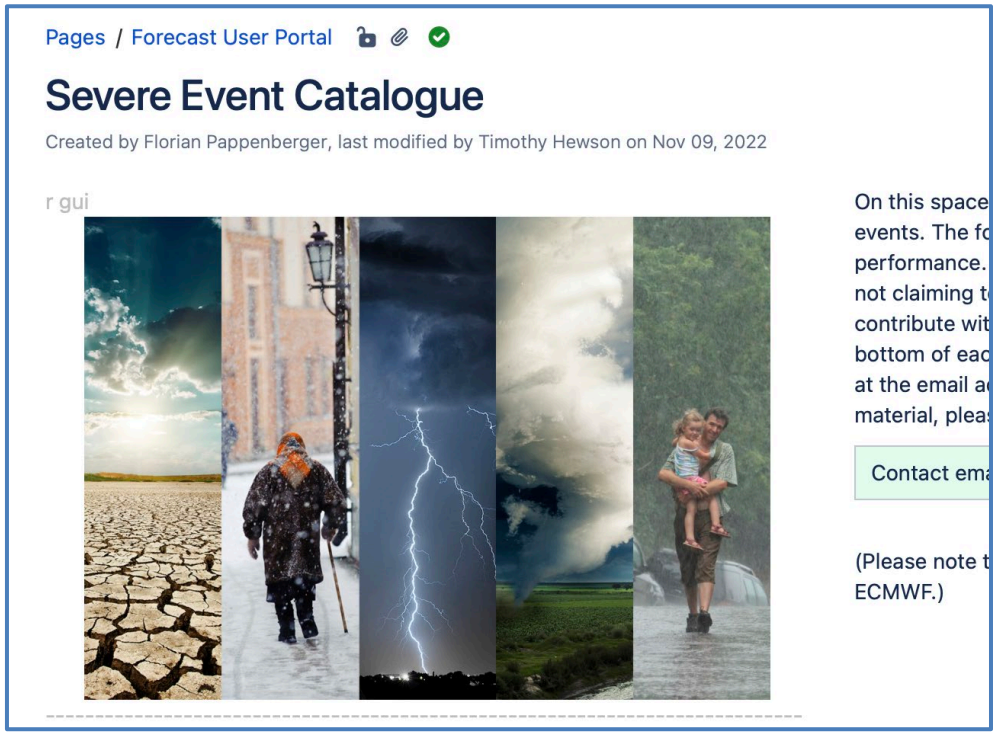
"The Green Book"

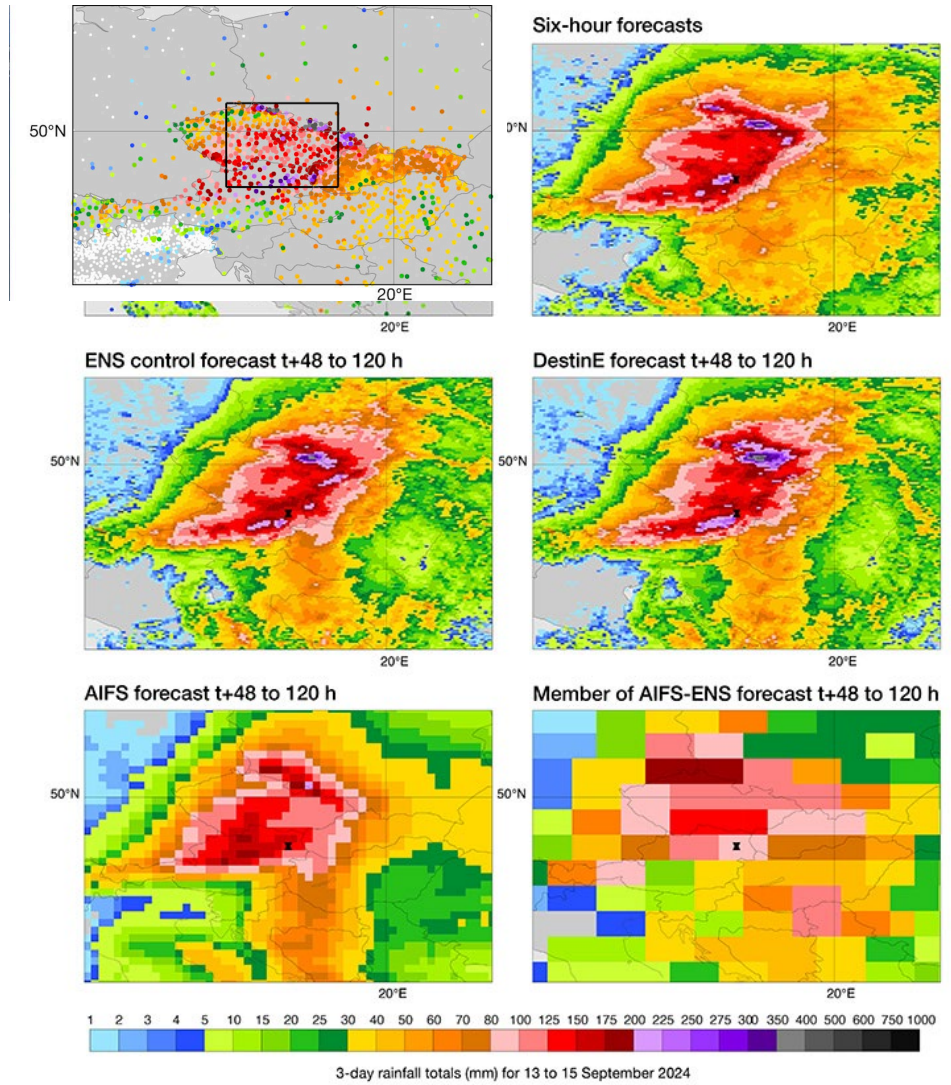


From FMI's contribution to the Green Book

Performance monitoring

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

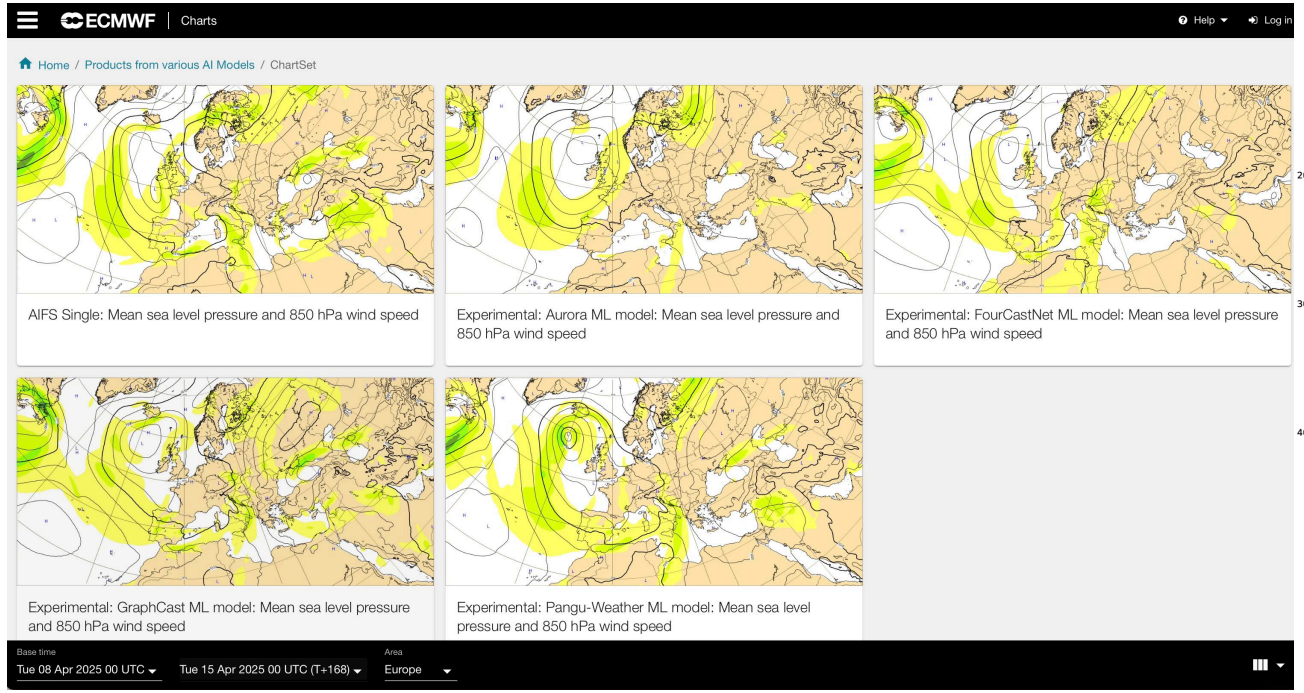


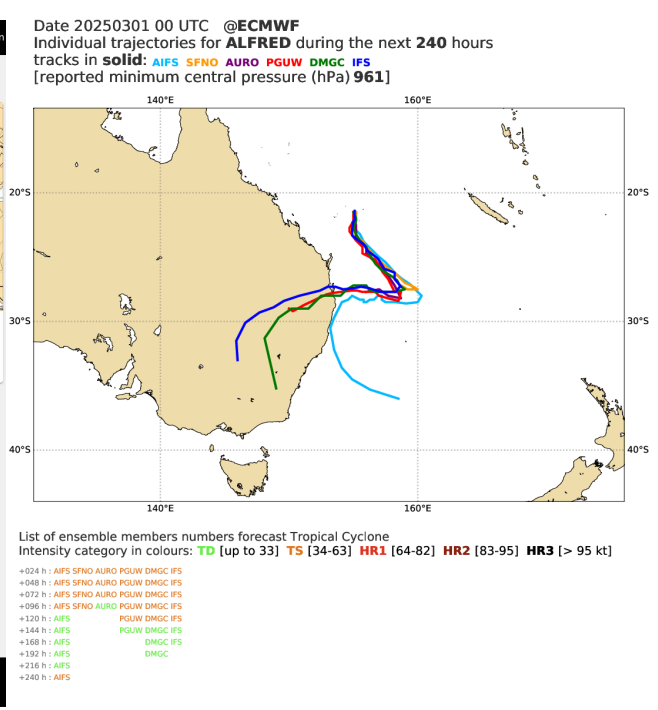


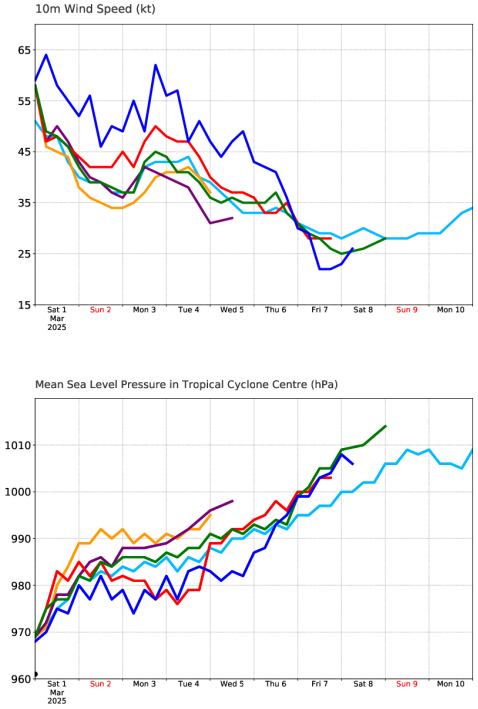
ECMWF Newsletter, website…

Experimental products on OpenCharts

Experimental AI-models on OpenCharts





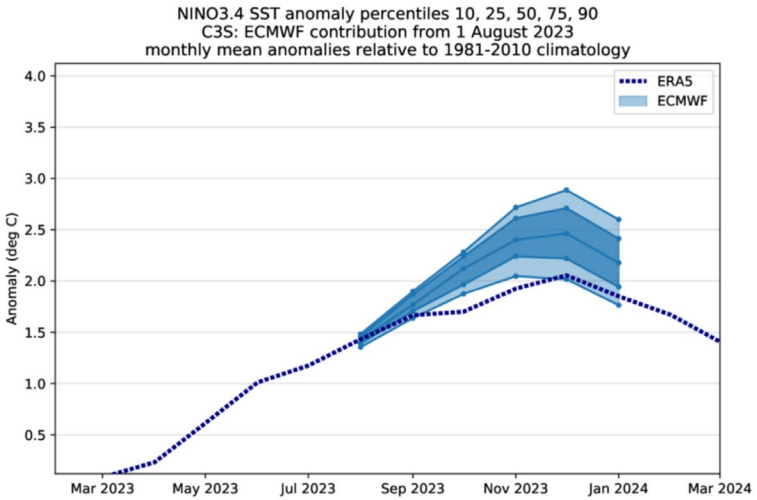


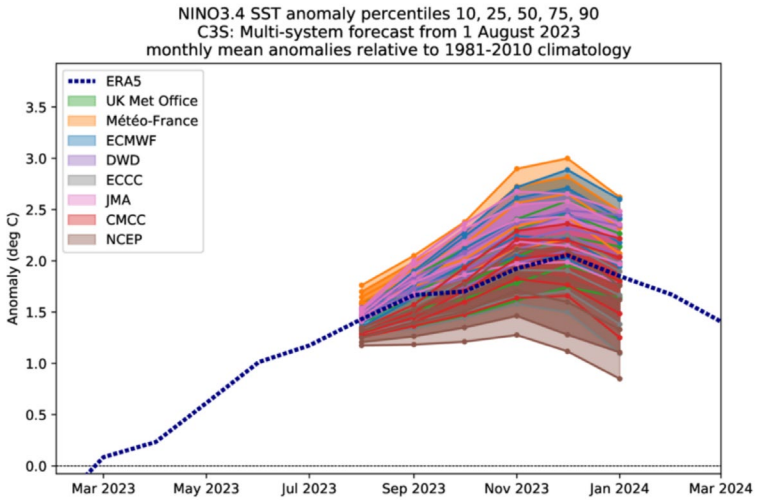
https://charts.ecmwf.int

Access to multi-model/system data

Seasonal multi-system forecasts

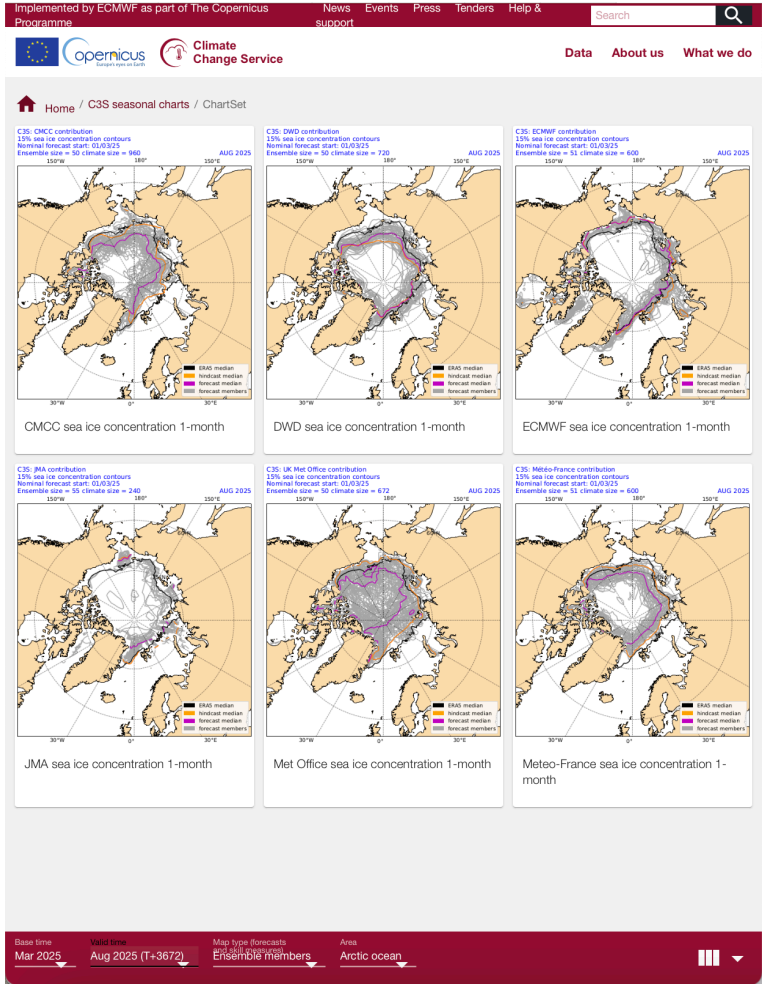
Climate Change Service
climate.copernicus.eu





PROGRAMME OF THE EUROPEAN UNION · opernicus · Climate Change Service · IMPLEMENTED BY ECMWF

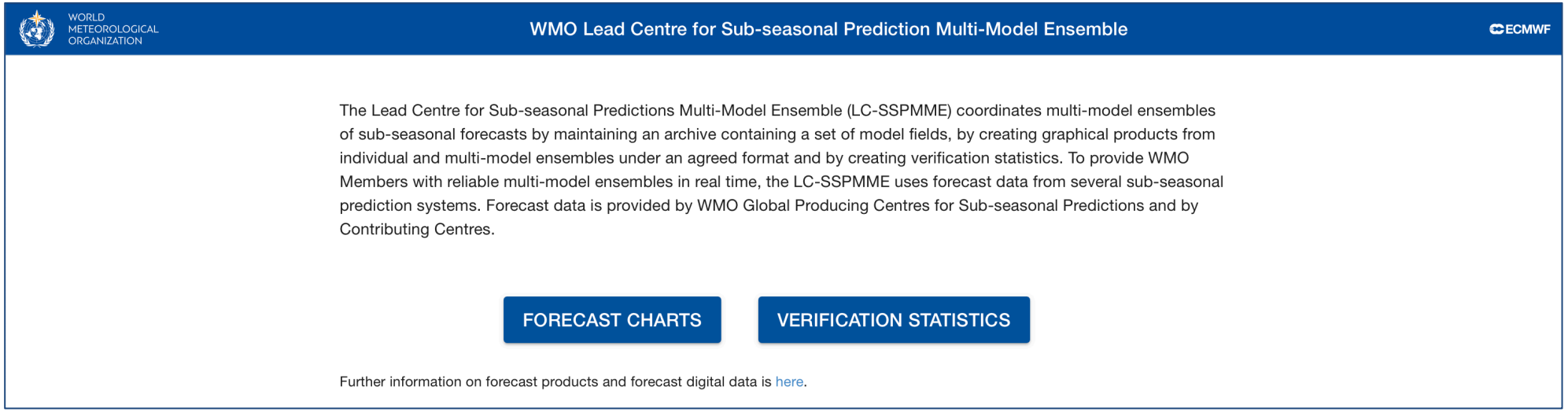
PROGRAMME OF THE EUROPEAN UNION · opernicus · Climate Change Service · IMPLEMENTED BY ECMWF



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.



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

Beijing

CPTEC

ECMWF

Moscow

Tokyo

Contributing centres

Exeter

Montreal

Seoul

Toulouse

Washington

Sub-seasonal multi-model – WMO Lead Centre

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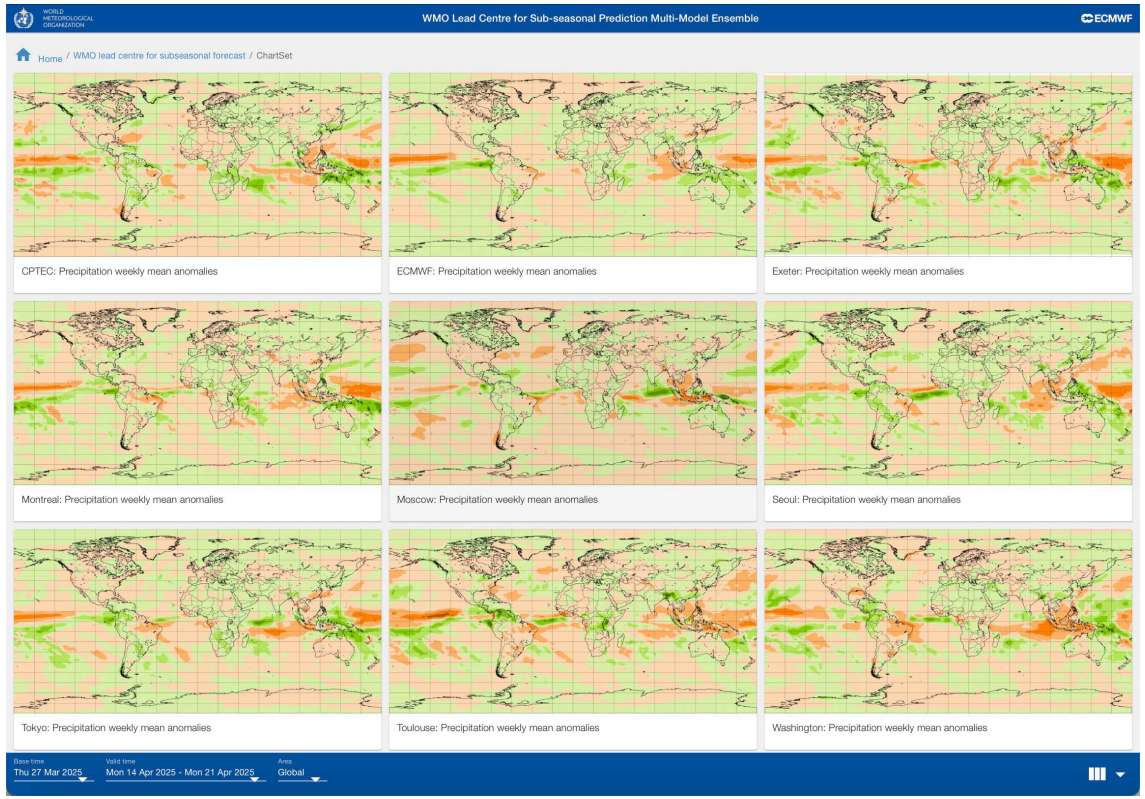
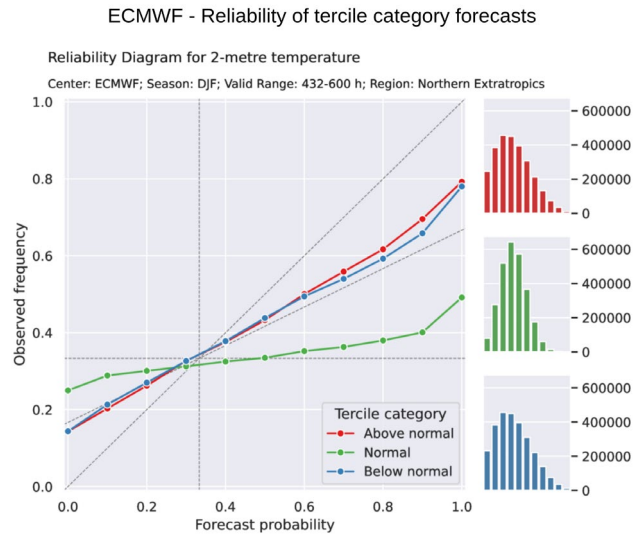


Near real-time forecast charts (updated weekly)



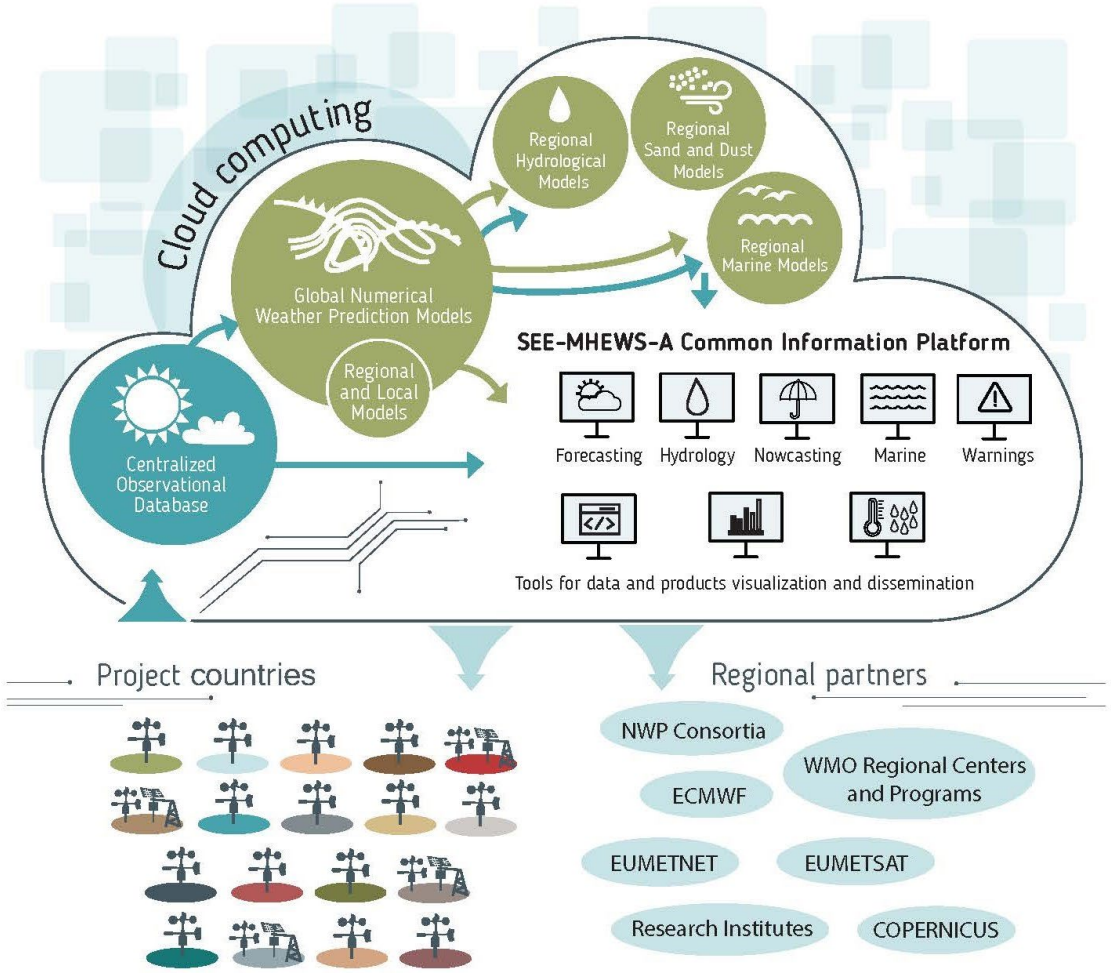
Verification statistics from reforecasts

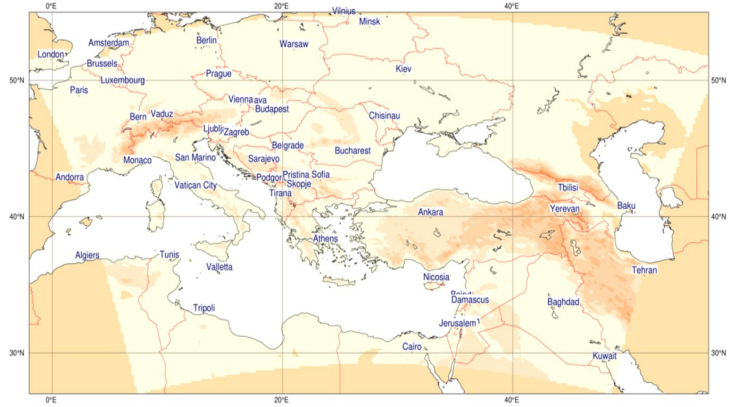
[Available at https://charts.ecmwf.int/wmo/](https://charts.ecmwf.int/wmo/)

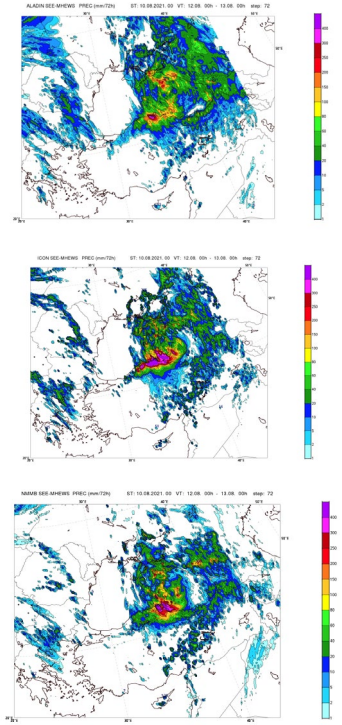
Applications

Accessing and exploring forecast data on European Weather Cloud

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

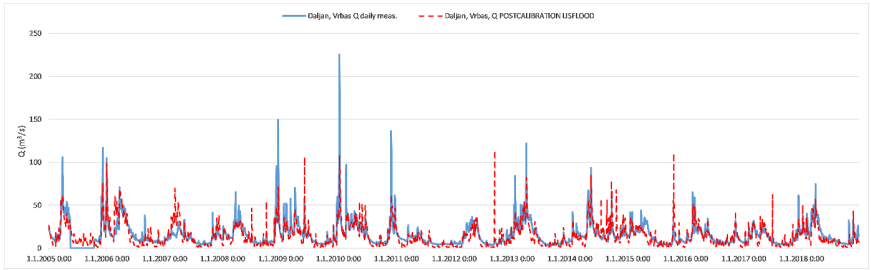






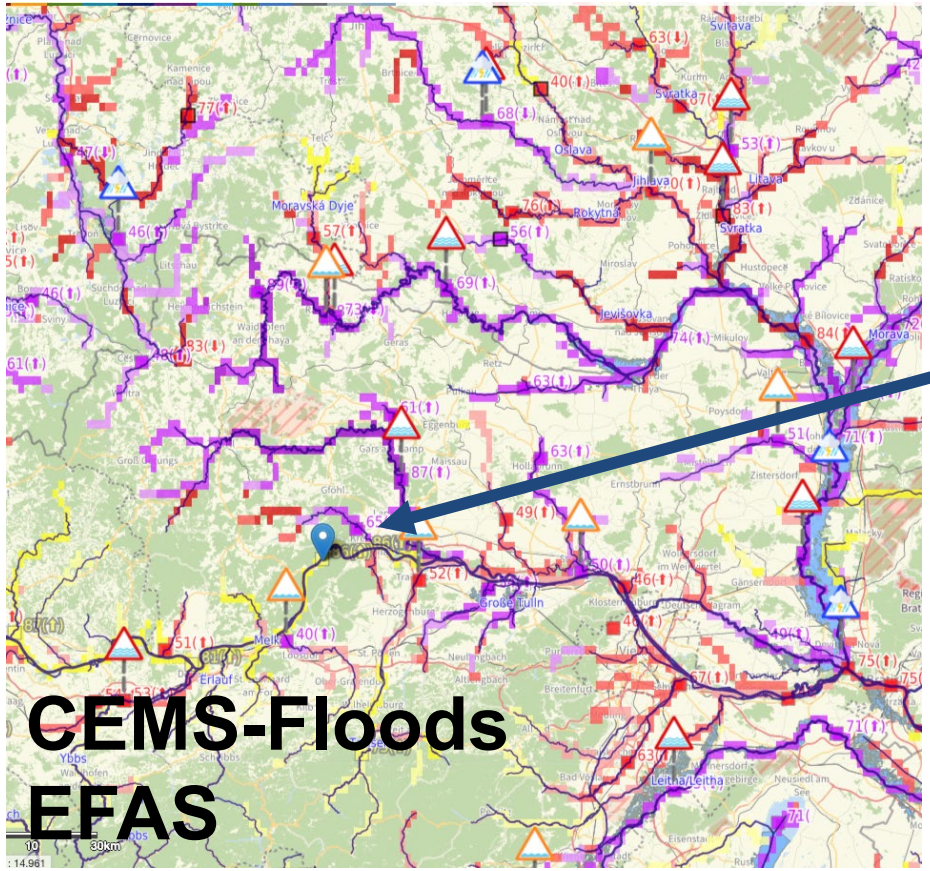
Severe rainfall in Turkey in August 2021:

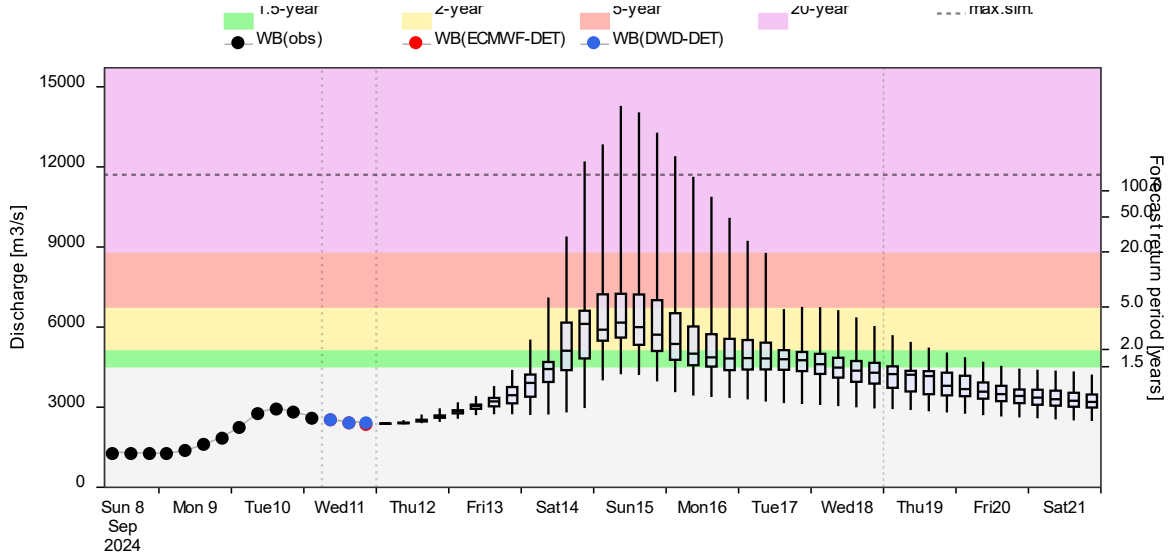
Observed (blue) vs. calibrated discharge (red) at station in Vrbas river

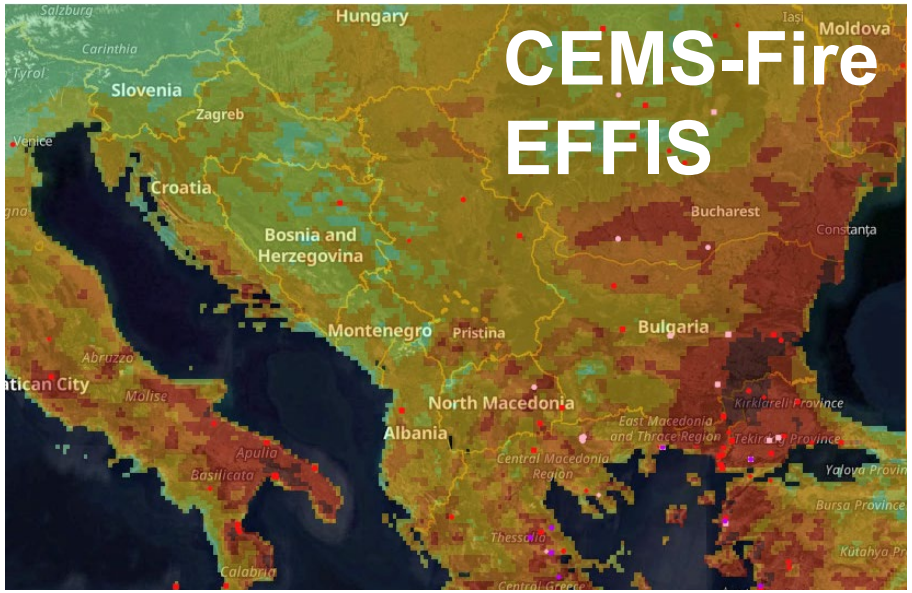


Floods and fire forecasts – Early Warning Systems

Emergency Management Service





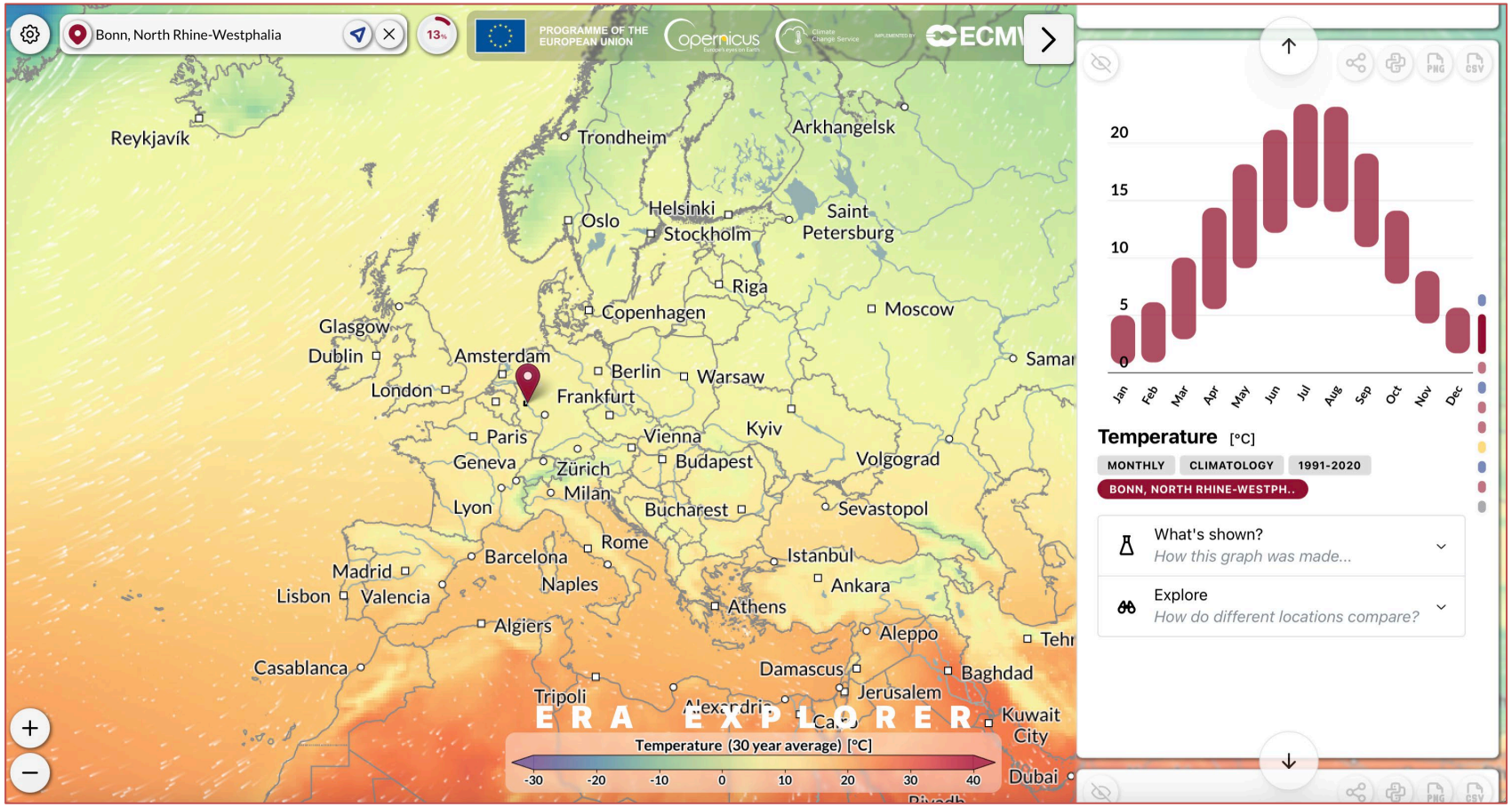


CEMS operated by EC Joint Research Centre (JRC)
ECMWF computational centre for Floods and Fire

Accessing and exploring data on the Climate Data Store

Climate Change Service
climate.copernicus.eu

ASPECT

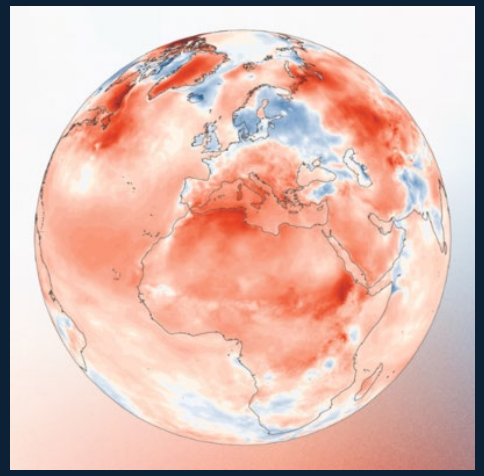


Built on a new ZARR archive of selected ERA5 variables

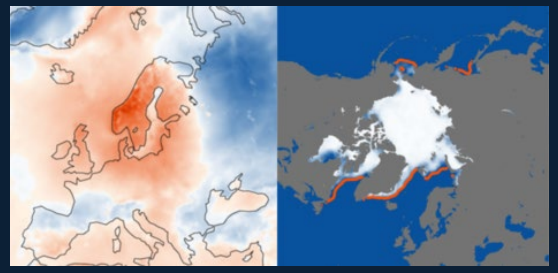
https://era-explorer.climate.copernicus.eu/

Climate
Change Service
climate.copernicus.eu

Climate Intelligence



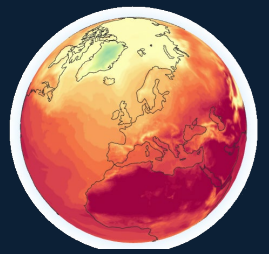
Global Climate Highlights



Monthly Bulletins

ESOTC

Climate Pulse



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 >= 0.4 degrees

Reduced fees for some licence types

Open Data Roadmap