

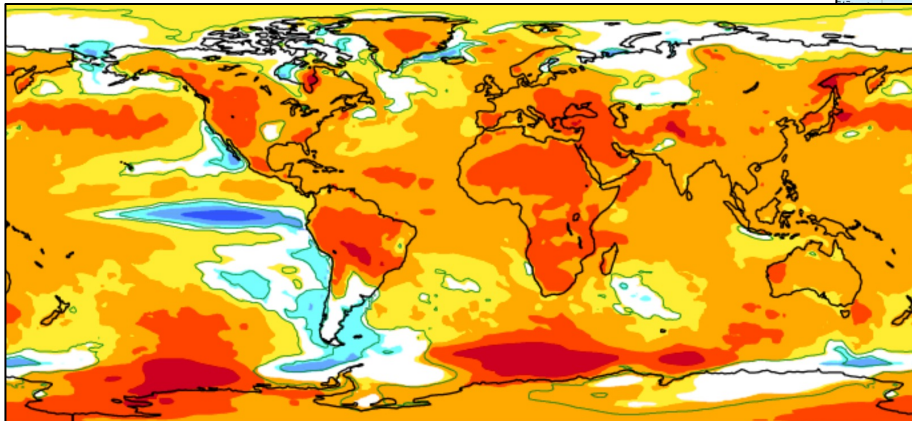
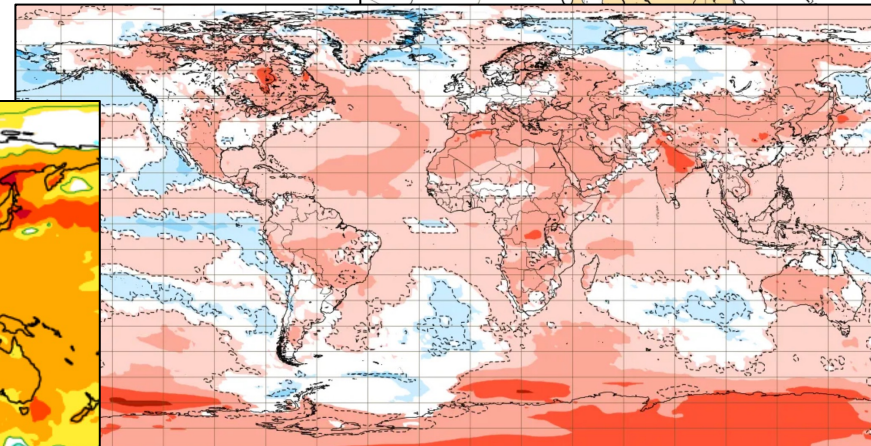
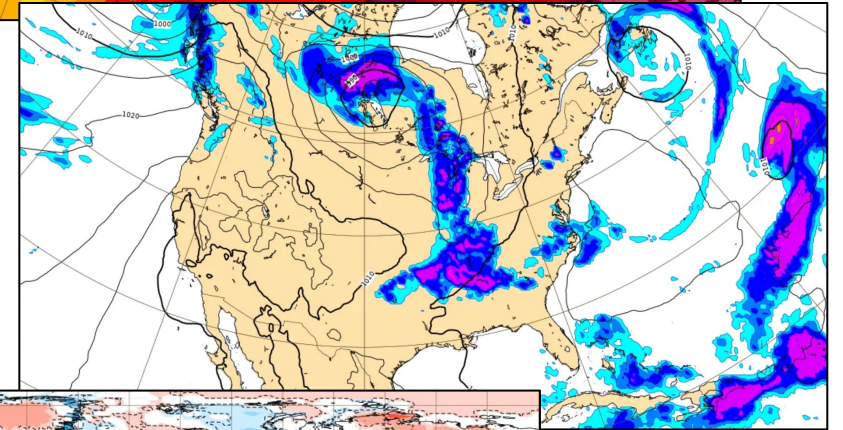
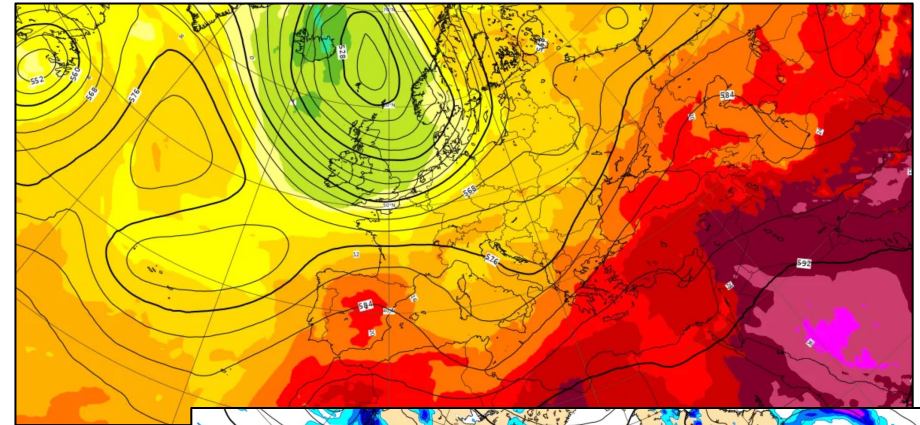
ECMWF forecast performance

UEF 2024

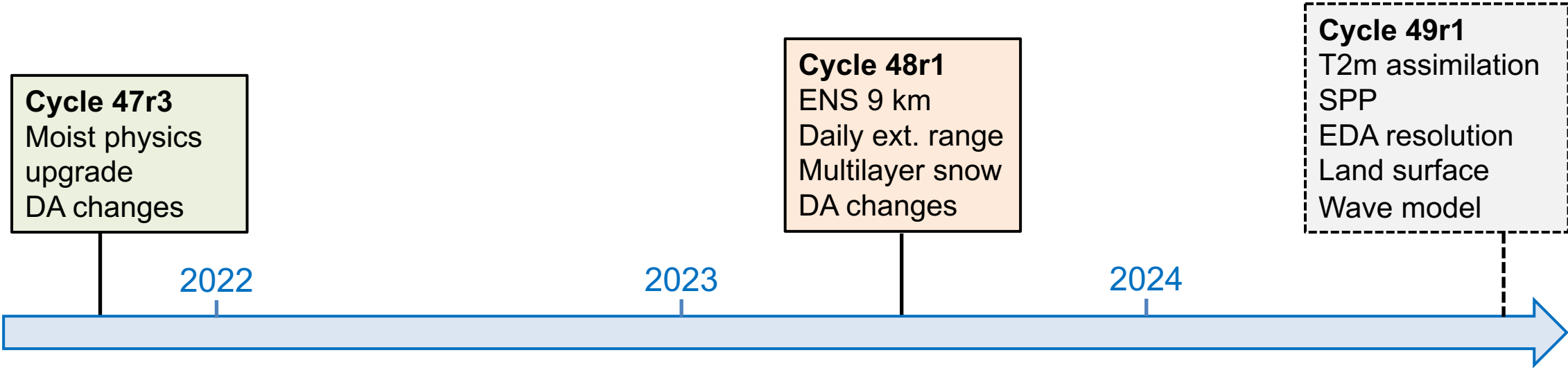
Thomas Haiden

Overview

- Upper-air forecast skill
- Weather parameters
- Extended-range forecast skill
- Seasonal forecast



Model upgrades - timeline

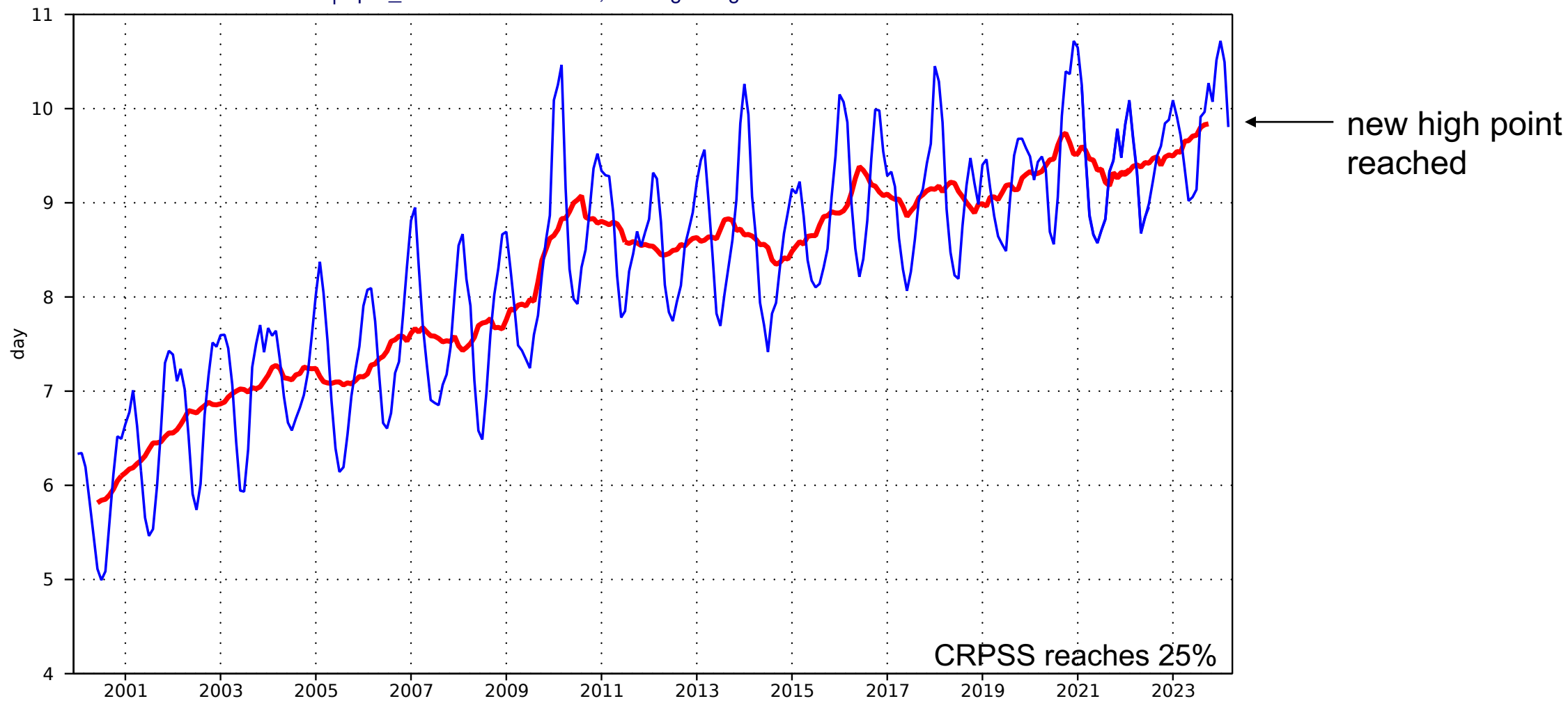


ENS upper-air headline score: T850 CRPSS

Continuous ranked probability skill score | 850hPa temperature

NHem Extratropics

T+12 T+24 ... T+360 | oper_ano d enfo 0001 00z,12z beginning

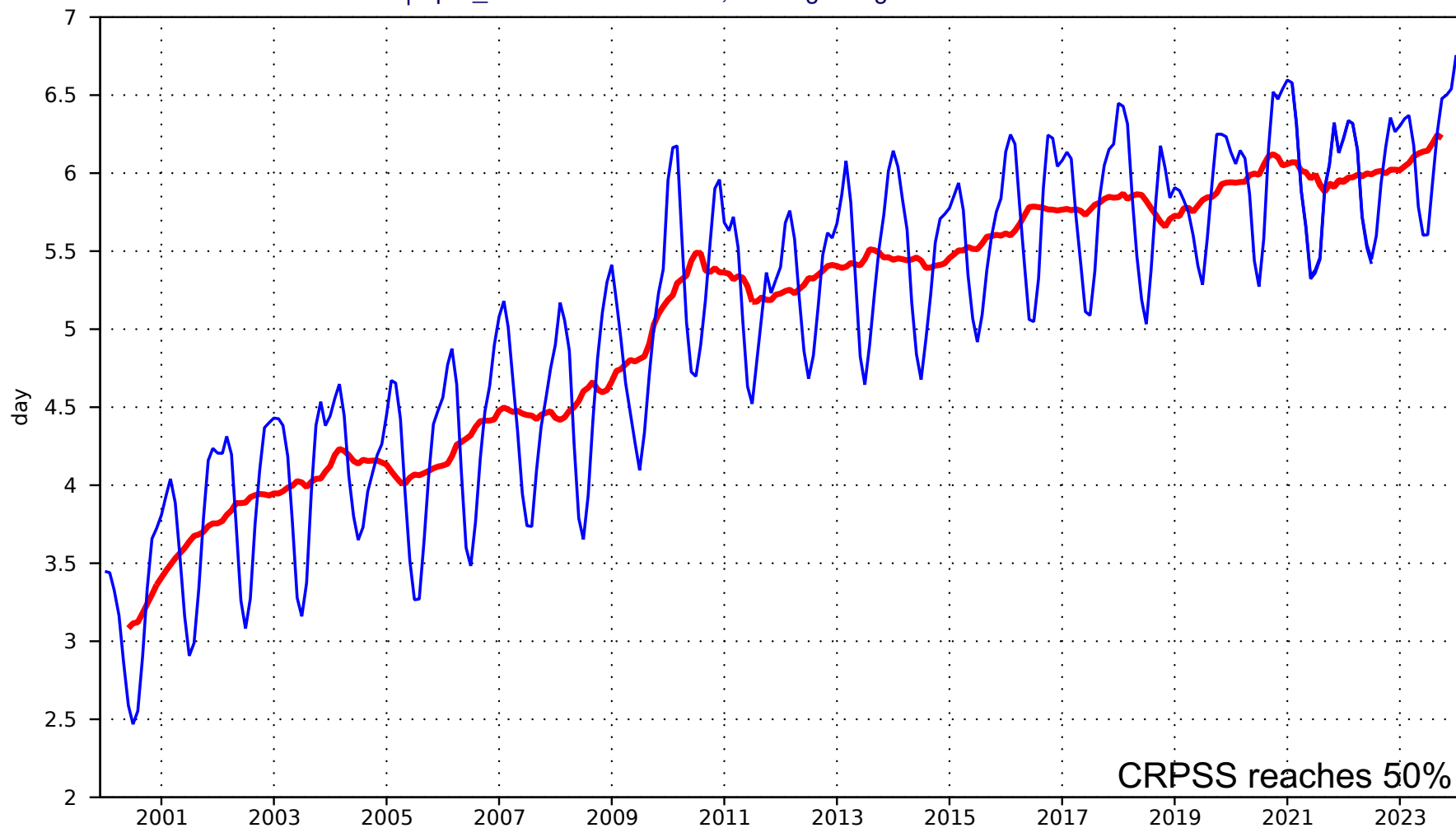


ENS upper-air headline score: T850 CRPSS

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T+12 T+24 ... T+360 | oper_ano d enfo 0001 00z,12z beginning

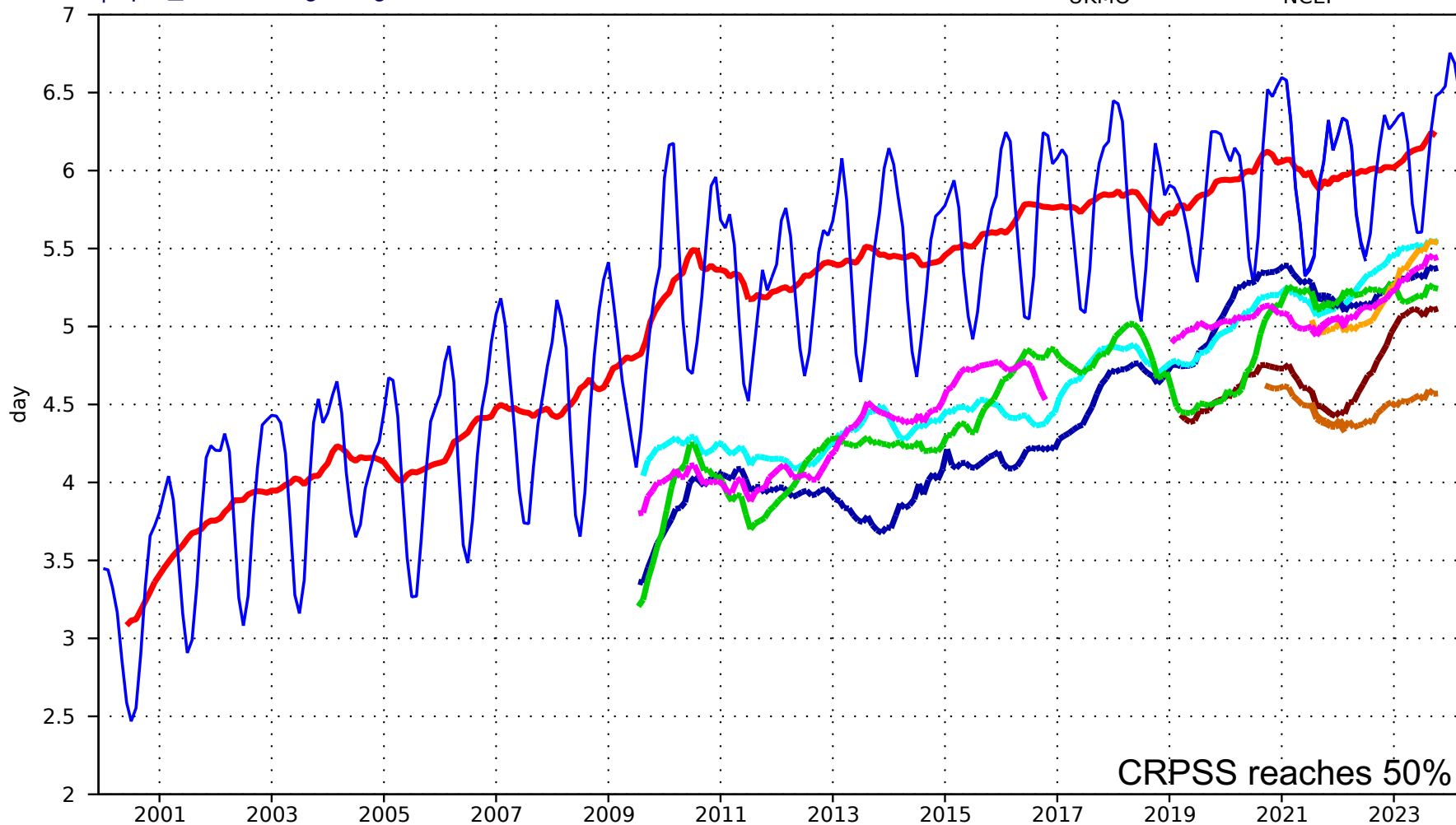


← new high point reached

ENS upper-air headline score: T850 CRPSS

Continuous ranked probability skill score | 850hPa temperature
NHem Extratropics
| oper_an enfo beginning

BoM
KMA
JMA
UKMO
CMC
DWD
NCEP

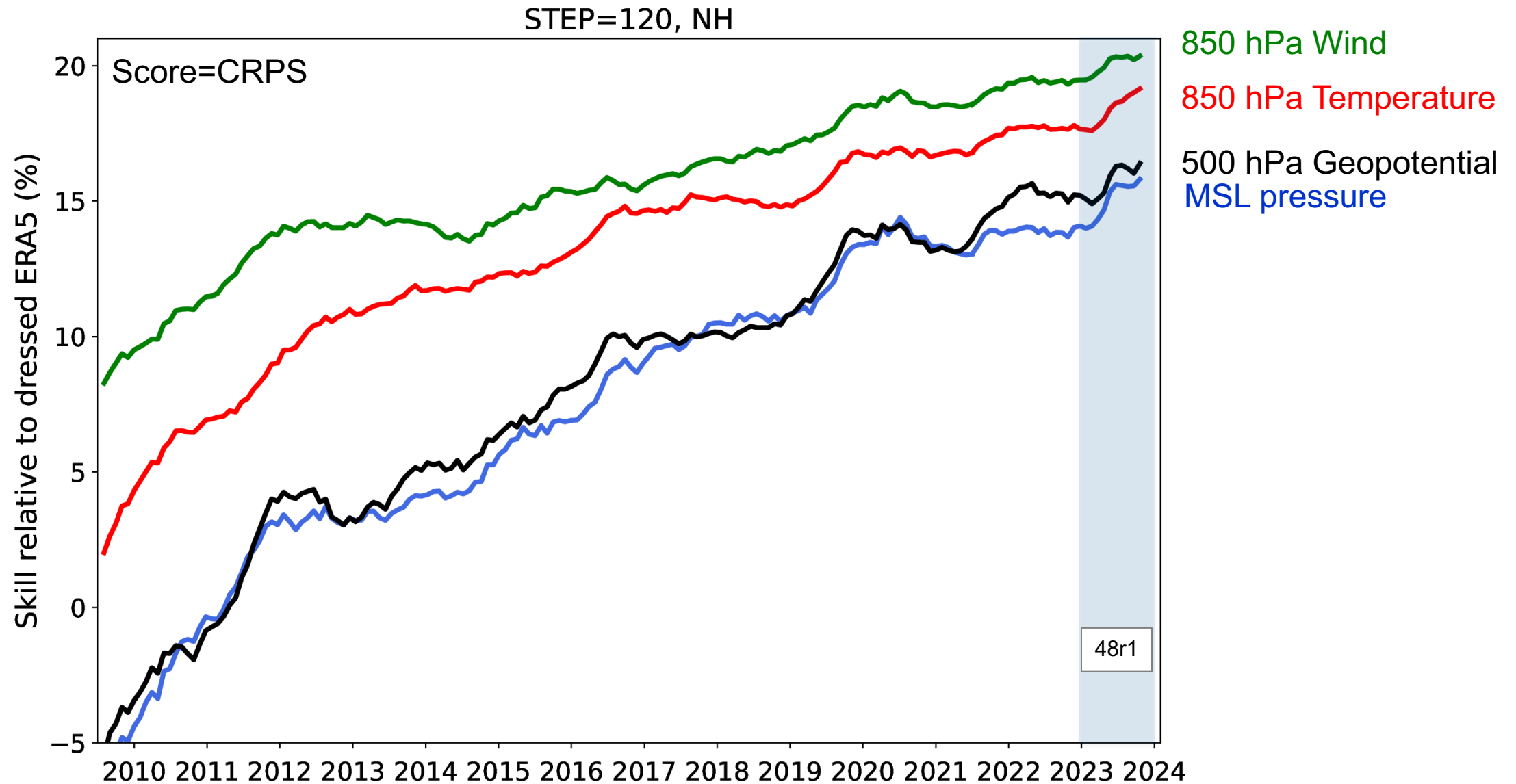


← new high point reached

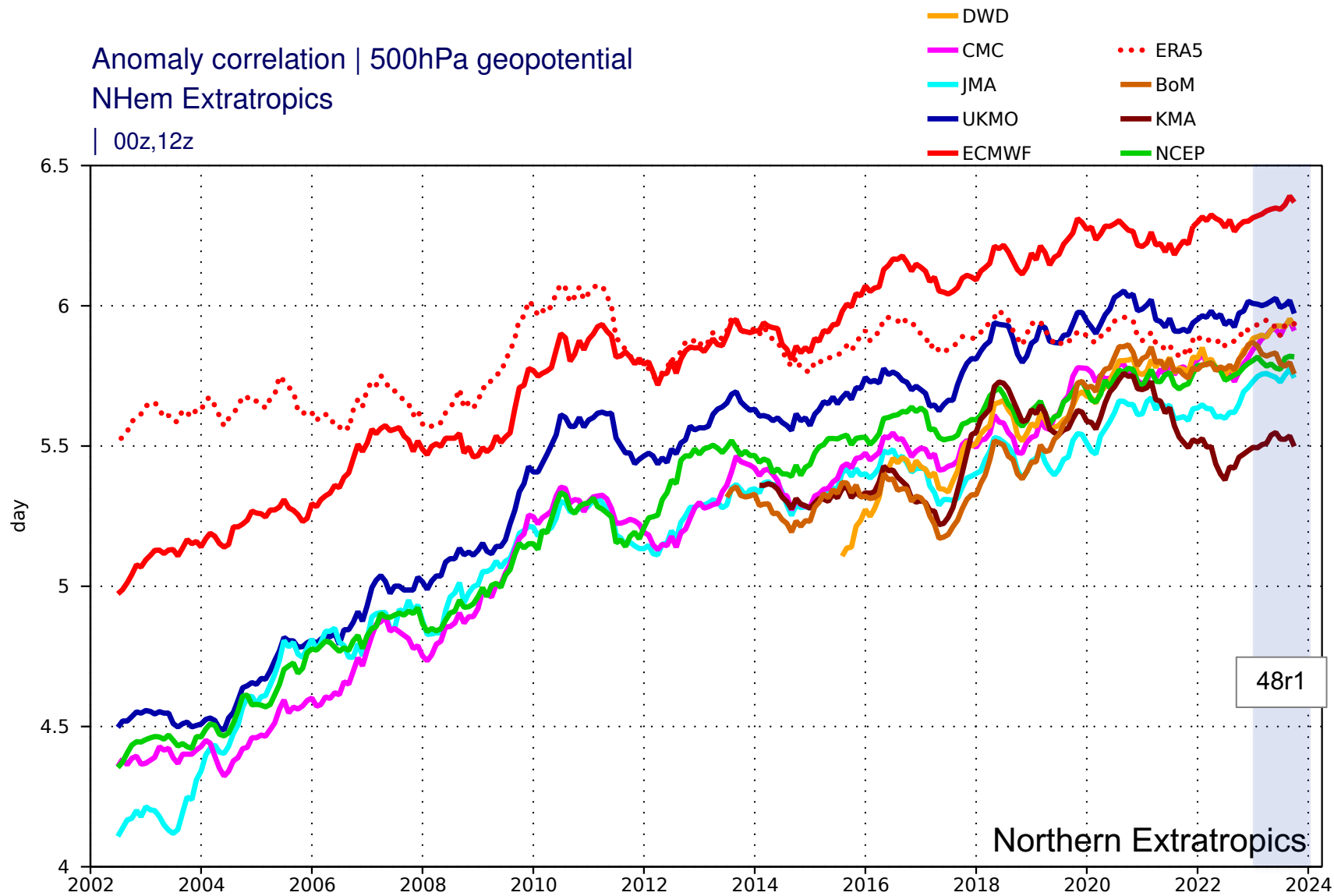
other centres

CRPSS reaches 50%

ENS skill relative to dressed ERA5 – Day 5



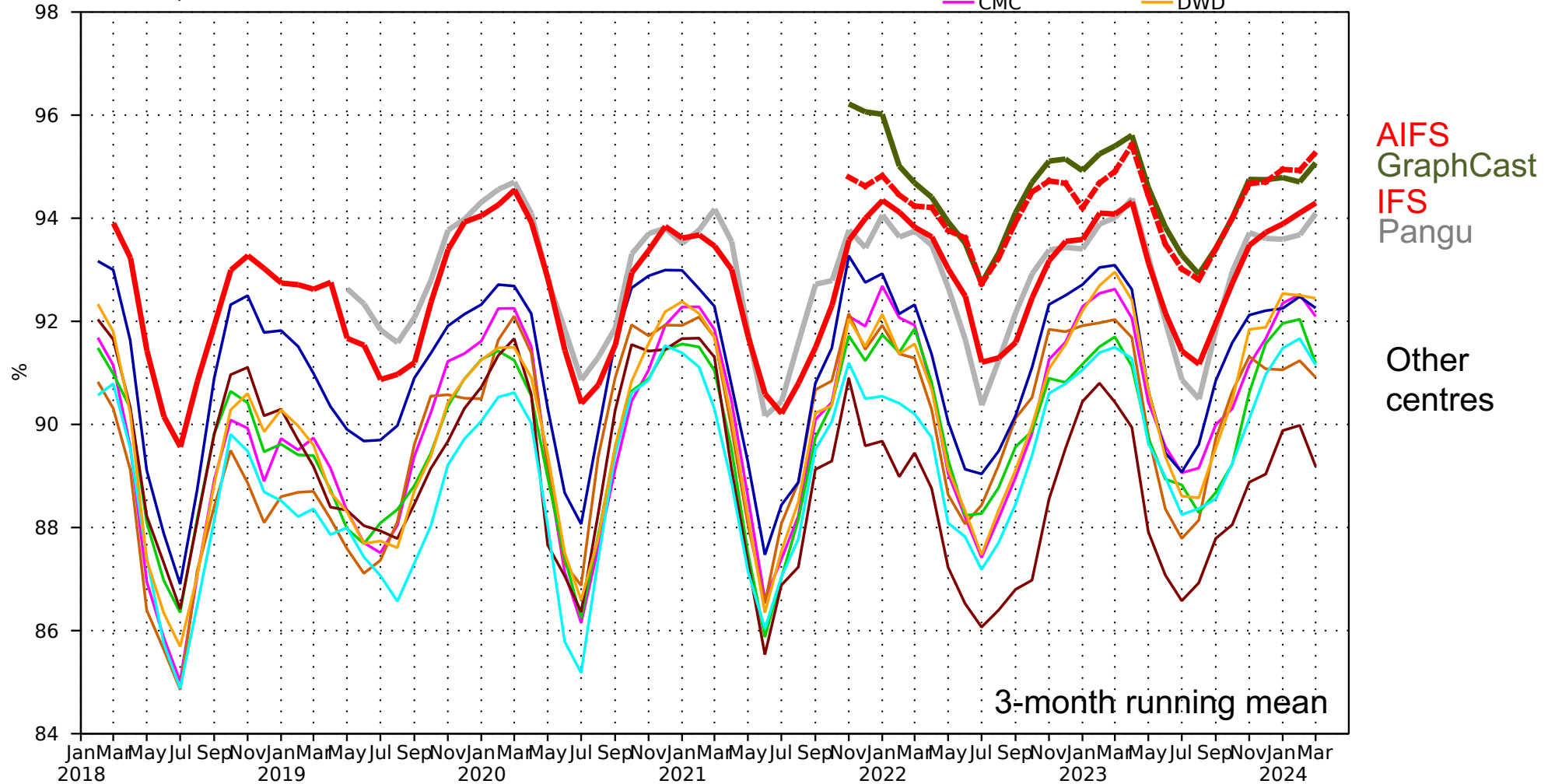
Anomaly correlation of 500 hPa geopotential reaching 85%



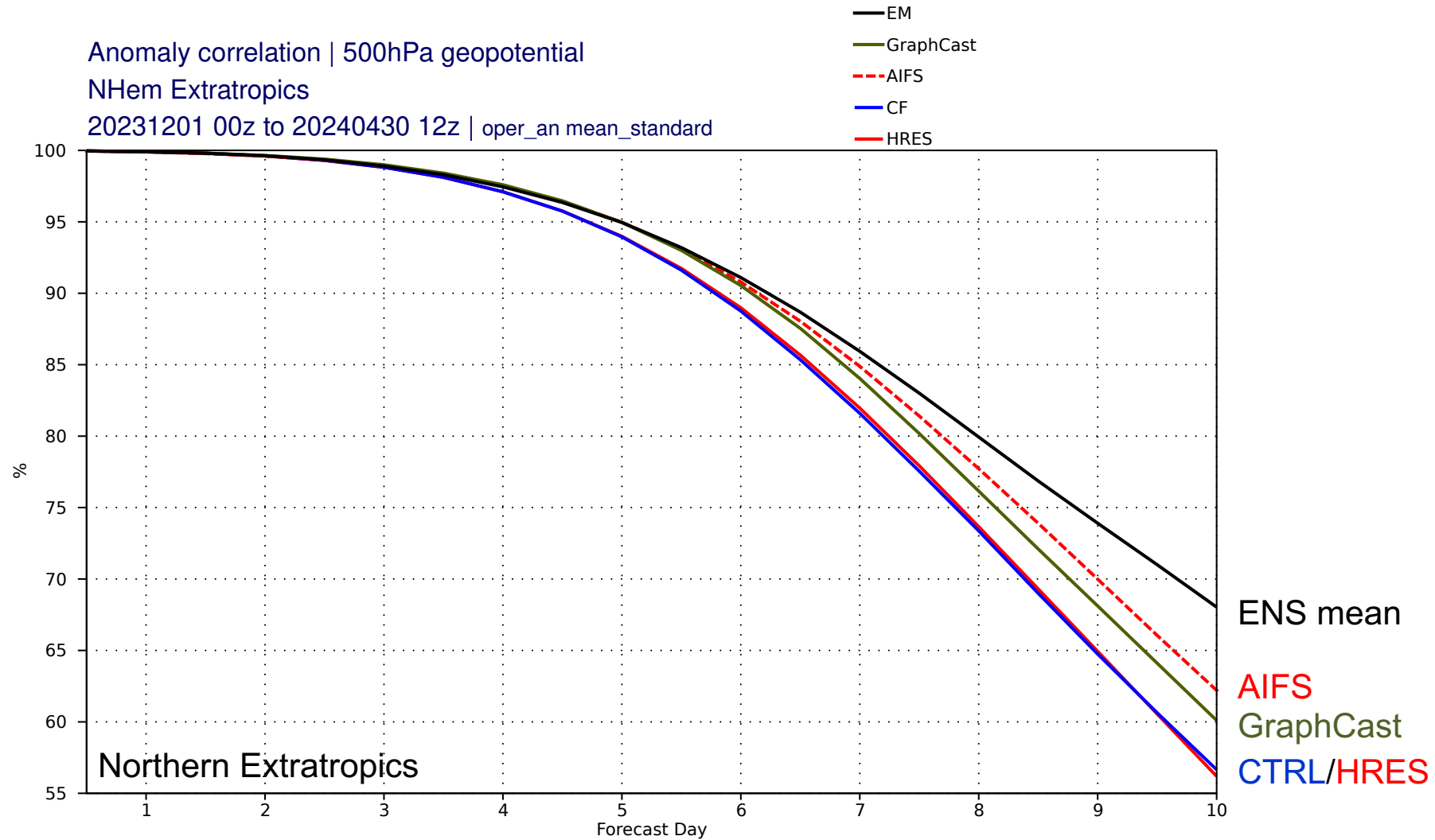
ML models vs classical (physical) NWP

Anomaly correlation | 500hPa geopotential
NHem Extratropics
T+120 |

- JMA
- KMA
- NCEP
- UKMO
- BoM
- CMC
- AIFS
- HRES
- Pangu
- GraphCast
- DWD



Drop of skill with forecast range

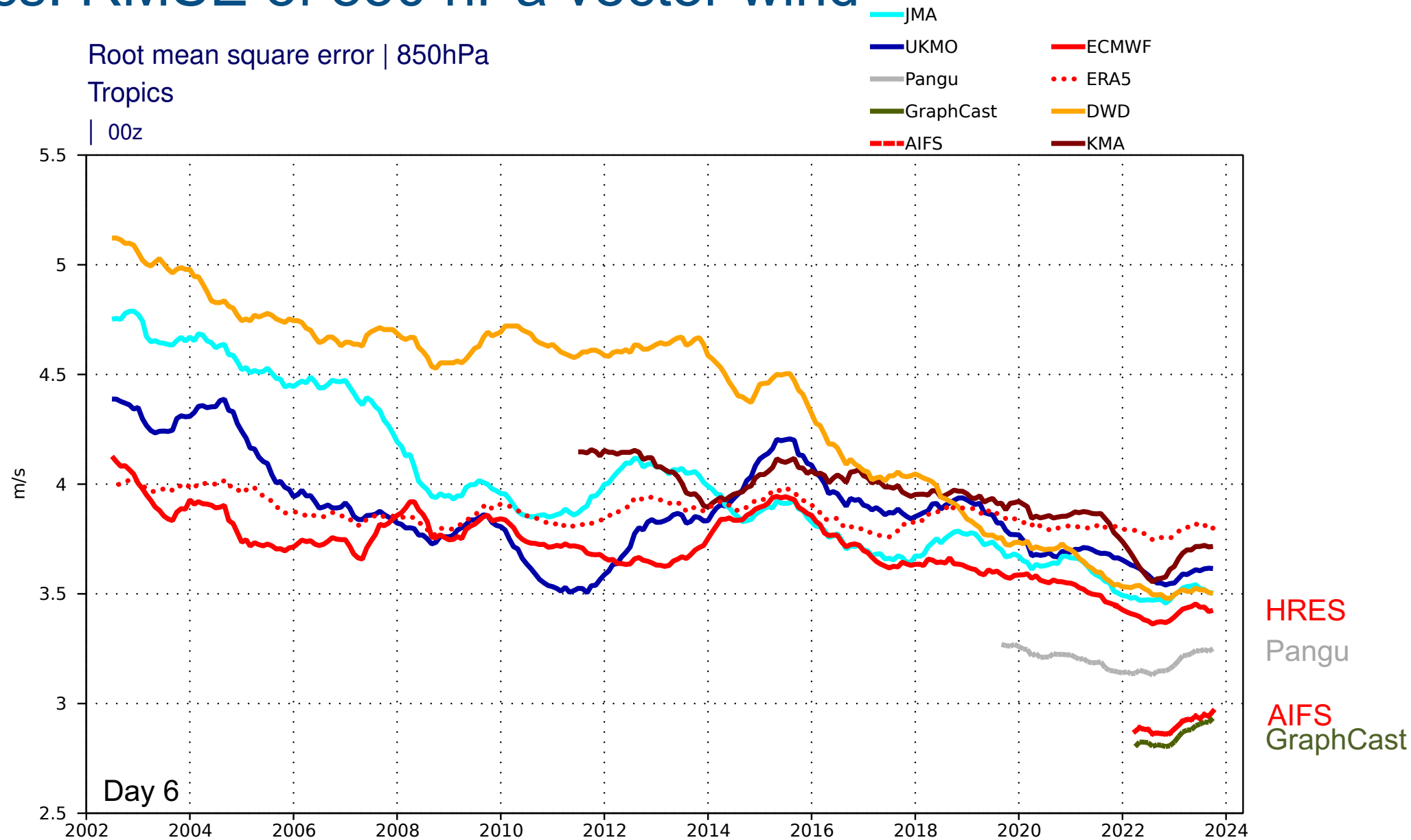


Tropics: RMSE of 850 hPa vector wind

Root mean square error | 850hPa

Tropics

| 00z

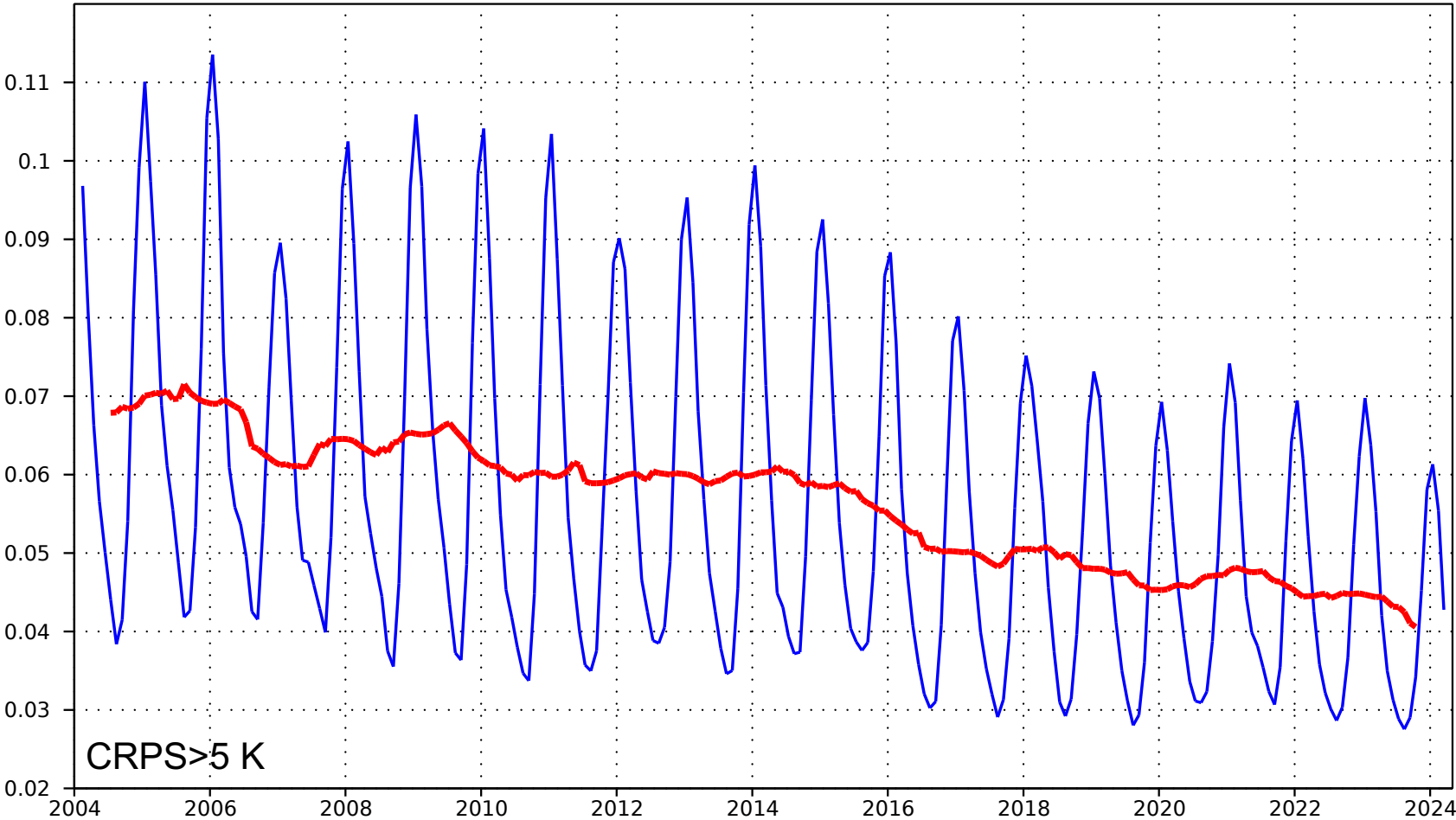


Fraction of large ENS 2m temperature errors

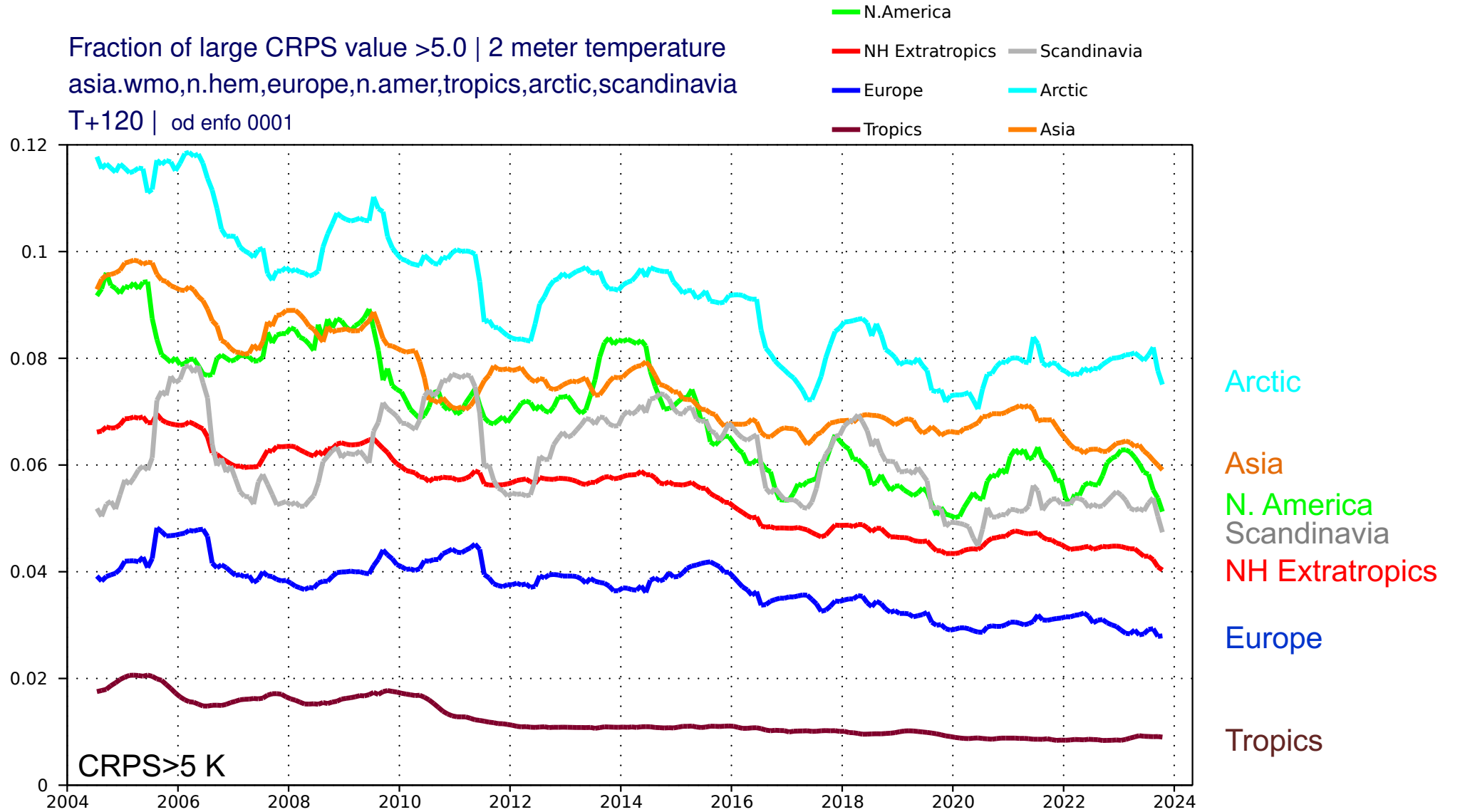
Fraction of large CRPS value >5.0 | 2 meter temperature
Extratropics
T+120 | oper_ob od enfo 0001

00z,12z

00z,12z



Fraction of large ENS 2m temperature errors: regions

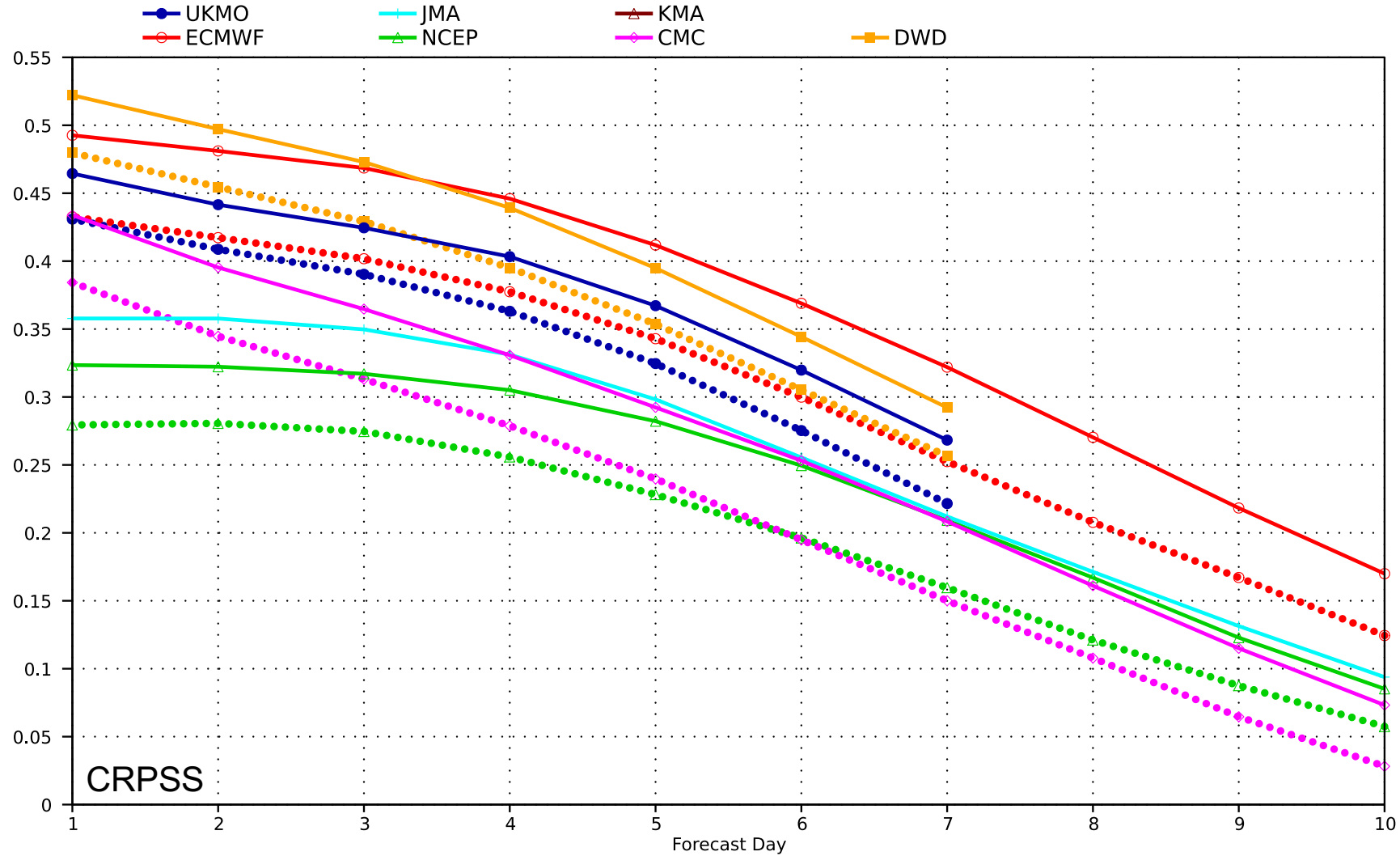


ENS 2m Temperature (TIGGE)

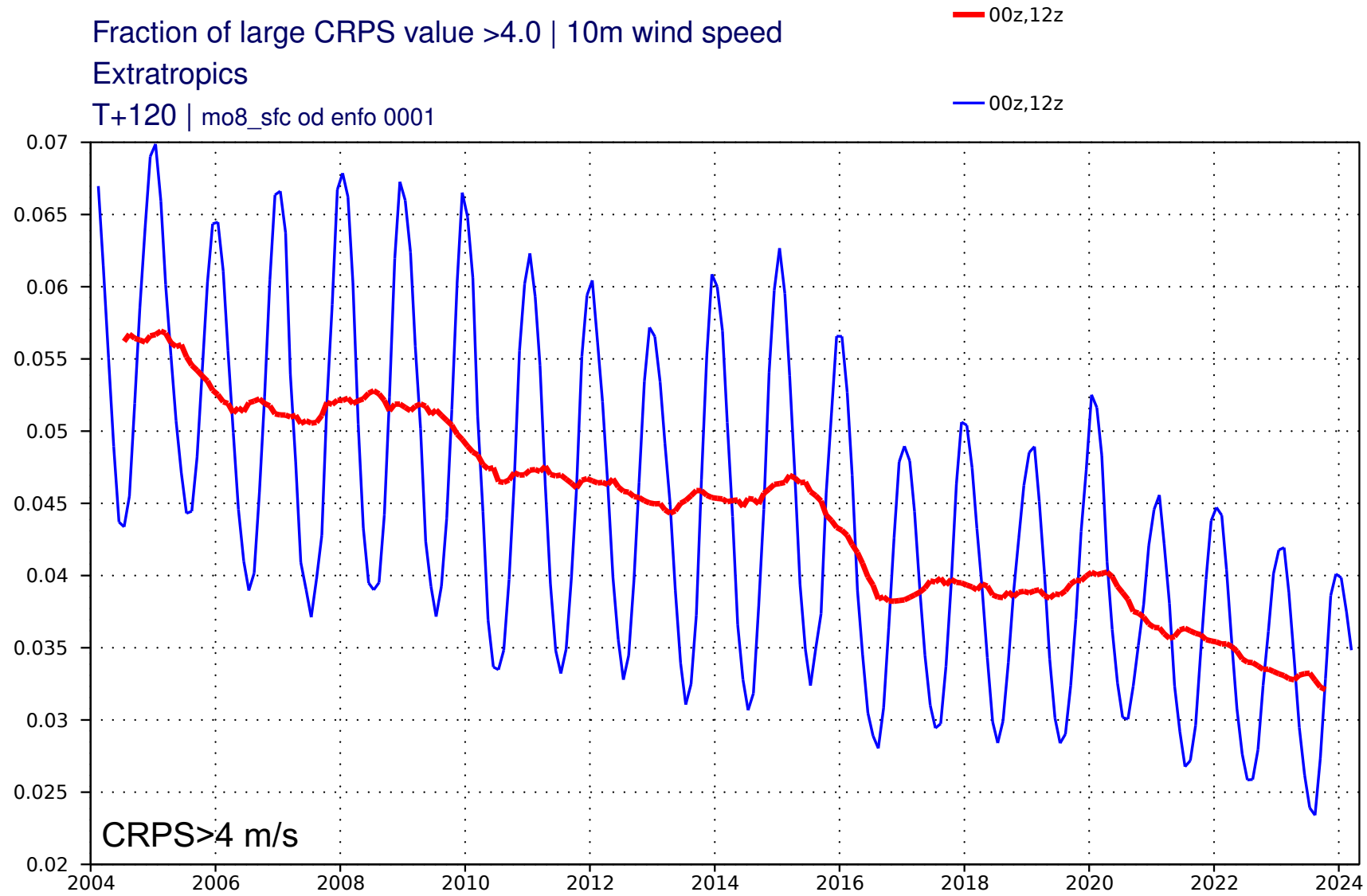
season:DJF (2024 solid, 2023 dot)

Continuous ranked probability skill score

2 meter temperature | Extratropics



Fraction of large ENS 10m wind speed errors



ENS precipitation forecast skill

ECMWF EPS 12UTC forecast skill

Continuous ranked probability skill score | total precipitation
Extratropics

| 12z

— 12mMA of CRPSS reaches 0.10

— 12mMA of CRPSS reaches 0.10

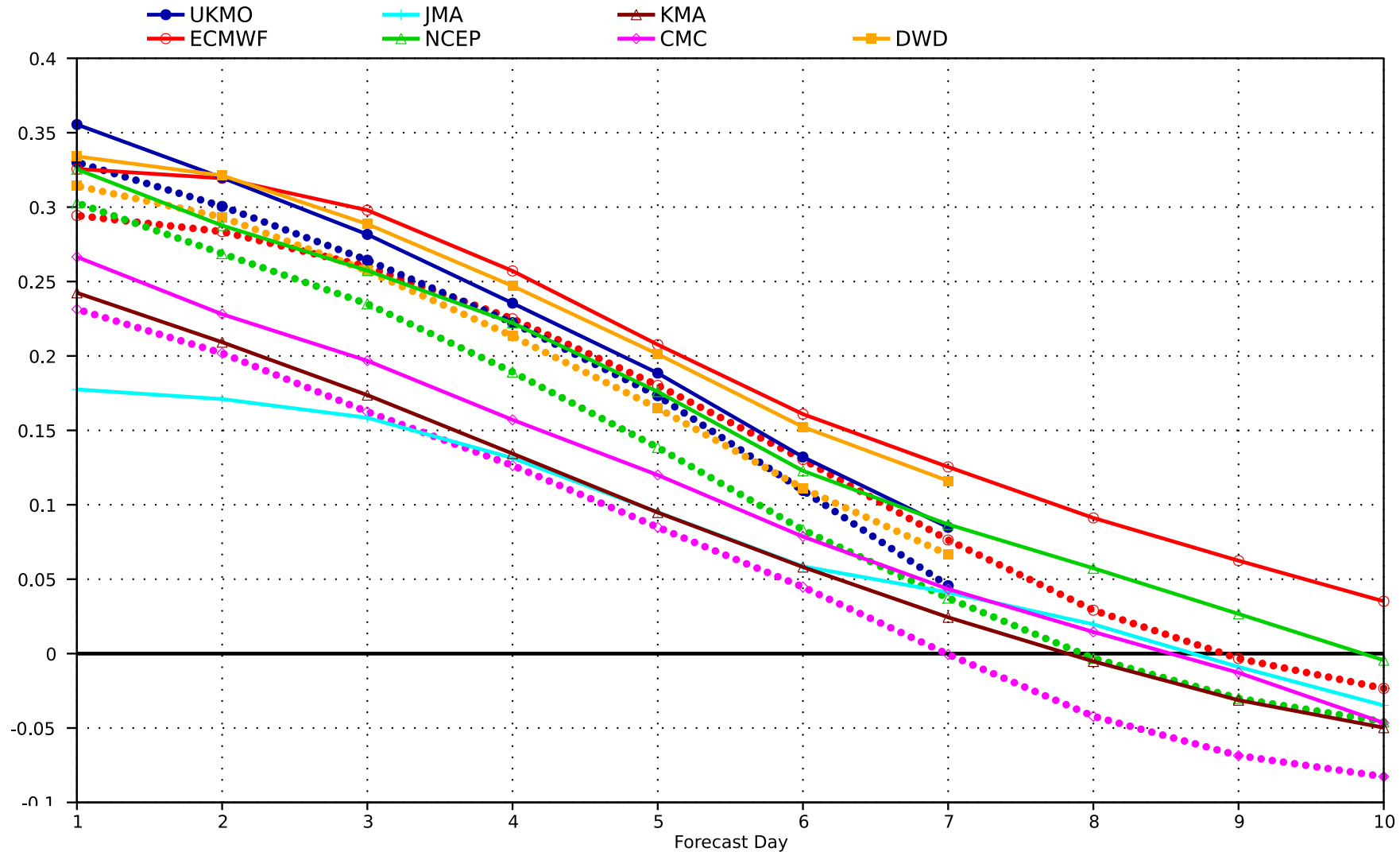


ENS precipitation model intercomparison (TIGGE)

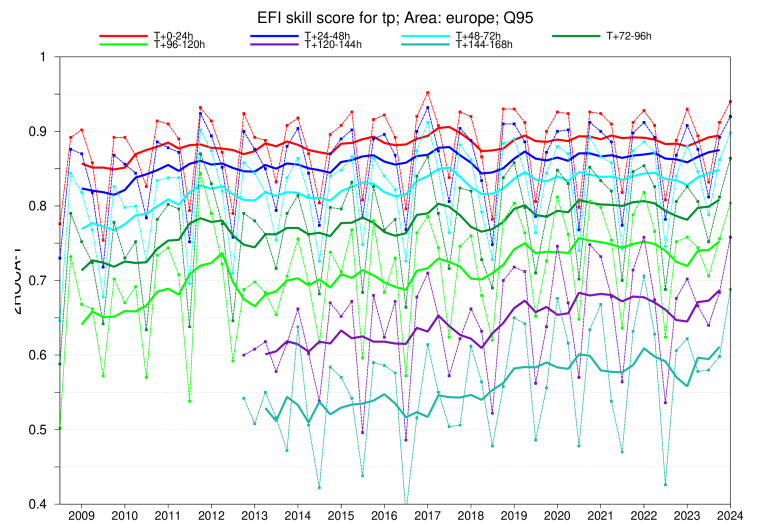
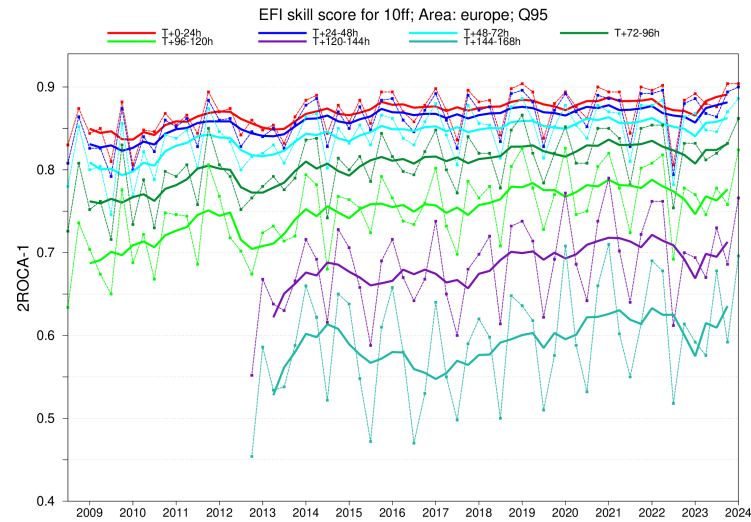
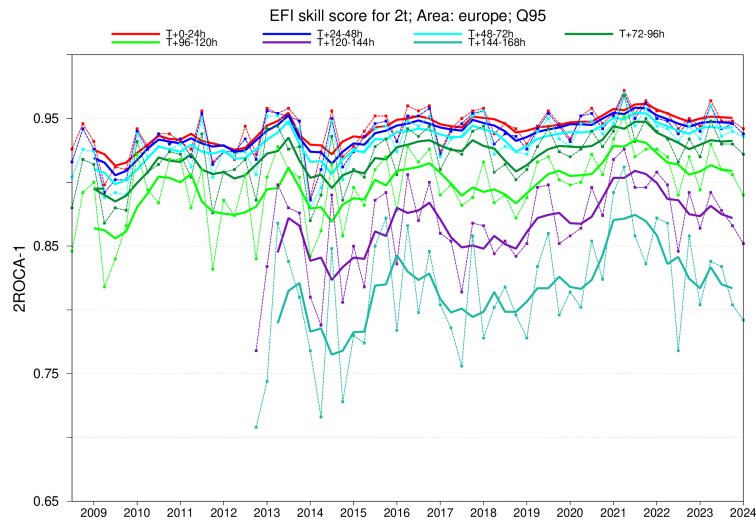
season:DJF (2024 solid, 2023 dot)

Continuous ranked probability skill score

total precipitation | Extratropics



Verification of extremes: EFI ROC area

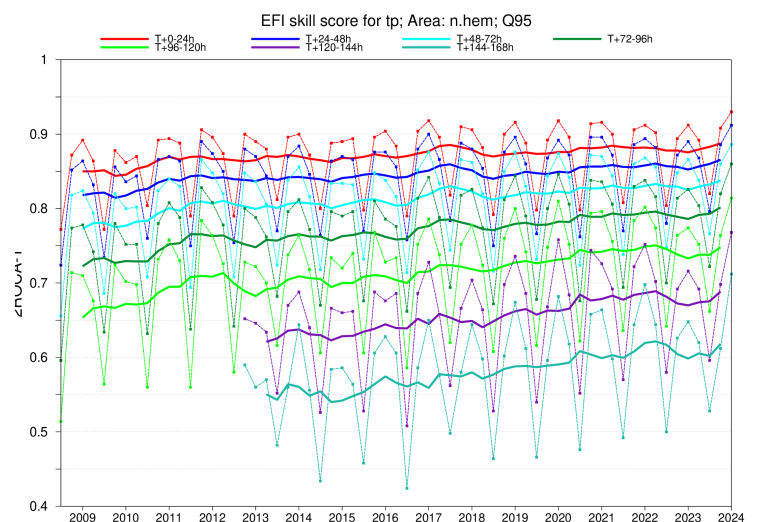
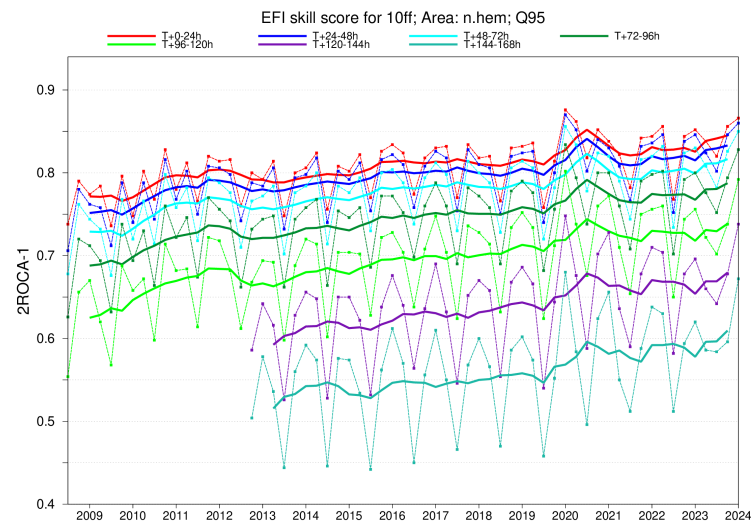
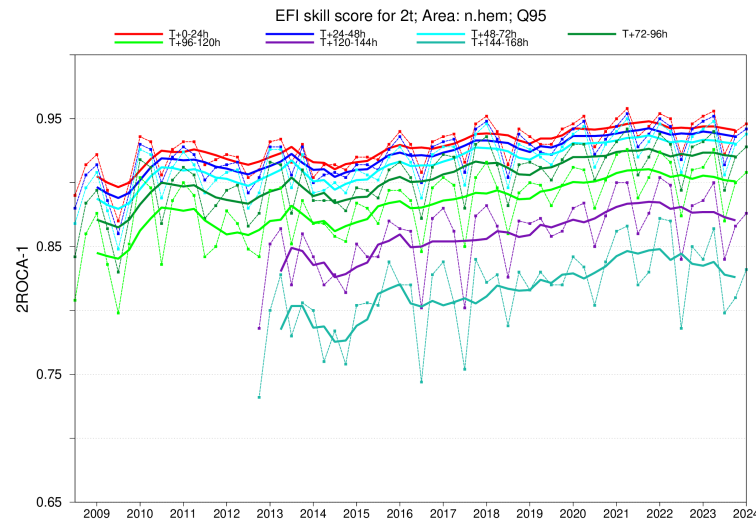


Europe

2m temperature

10m wind speed

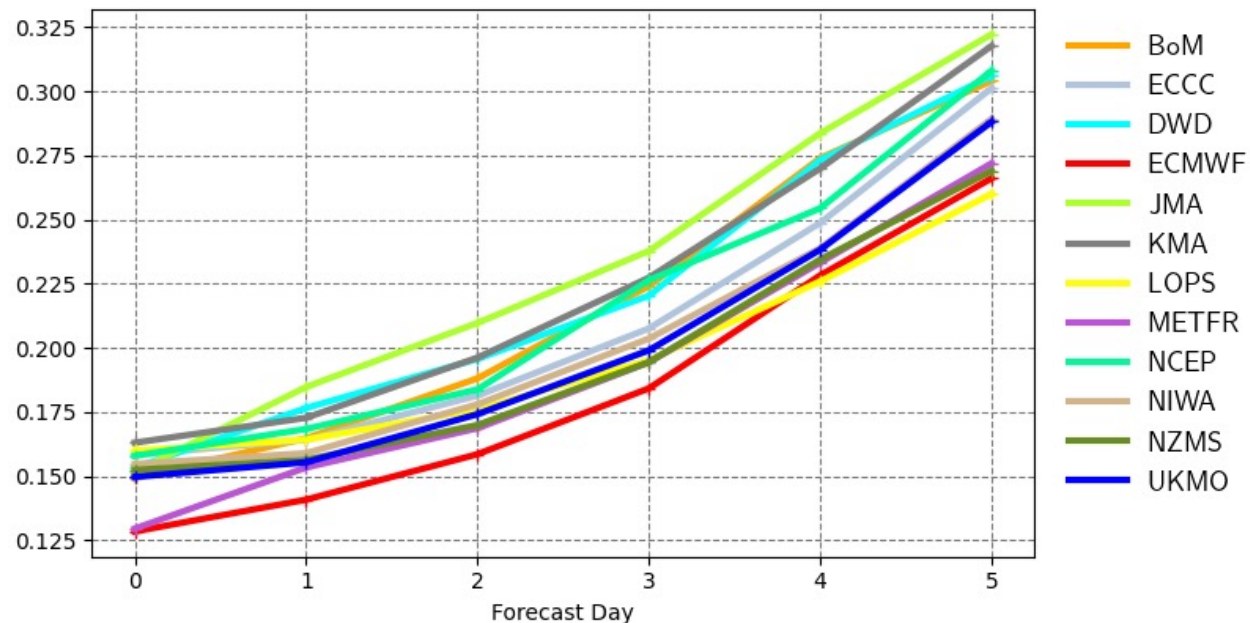
24h precipitation



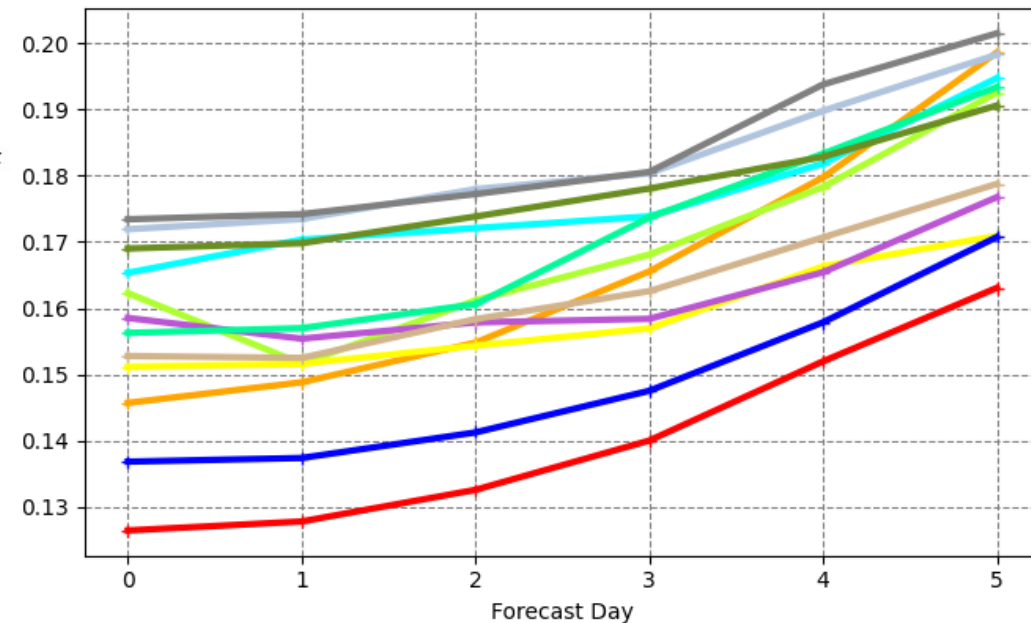
N.Hem

Ocean wave forecast – N. Extratropics

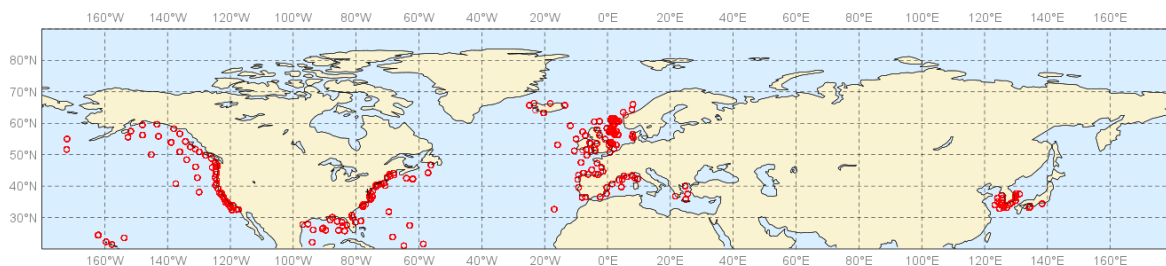
Scatter index | significant wave height | NHem Extratropics
20231201 00z to 20240229 00z | waveapi lw wave prod 00z mean_fair



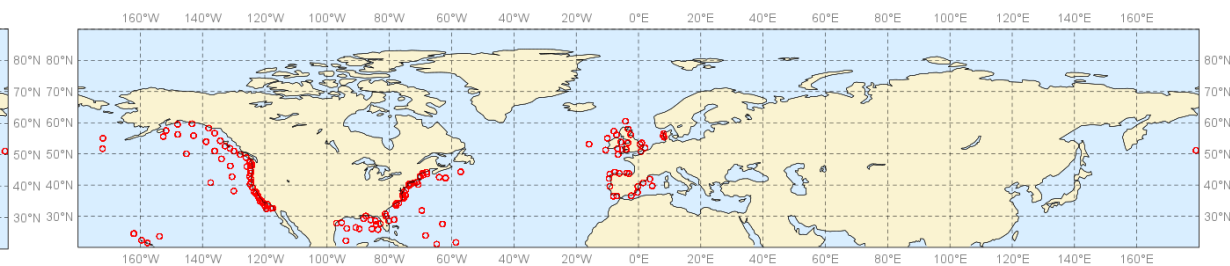
Scatter index | pp1d | NHem Extratropics
20231201 00z to 20240229 00z | waveapi lw wave prod 00z n



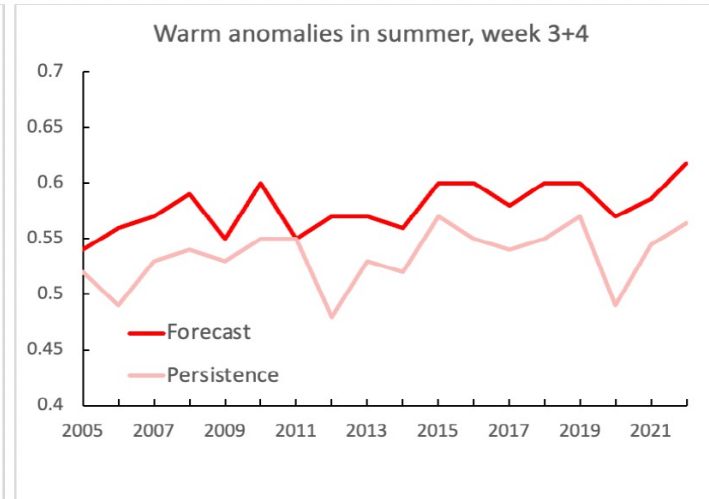
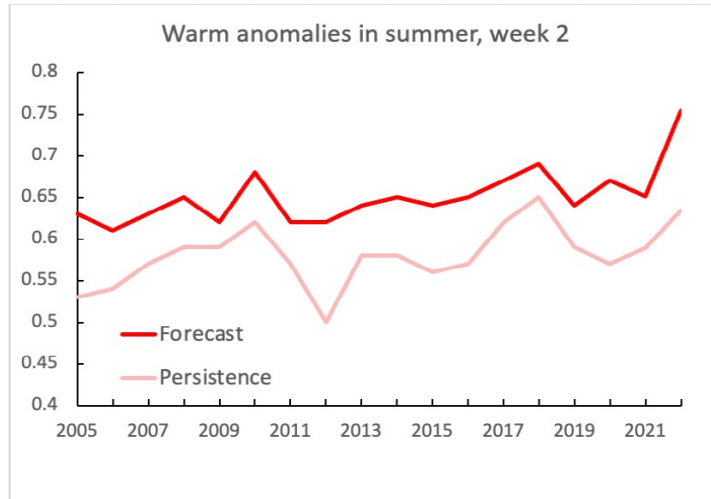
Significant wave height



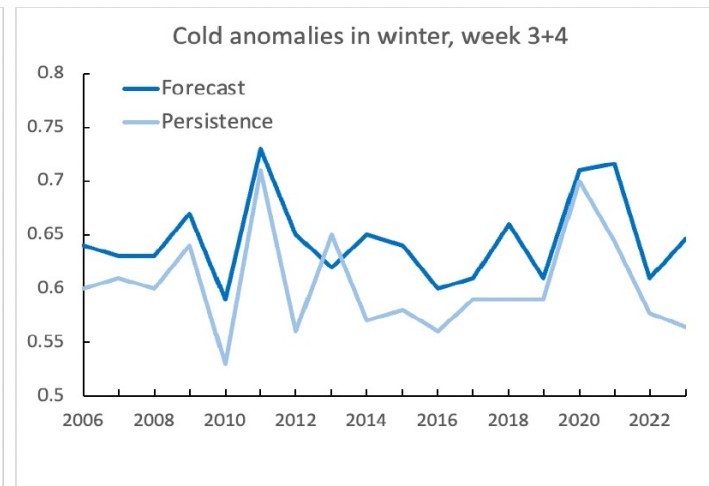
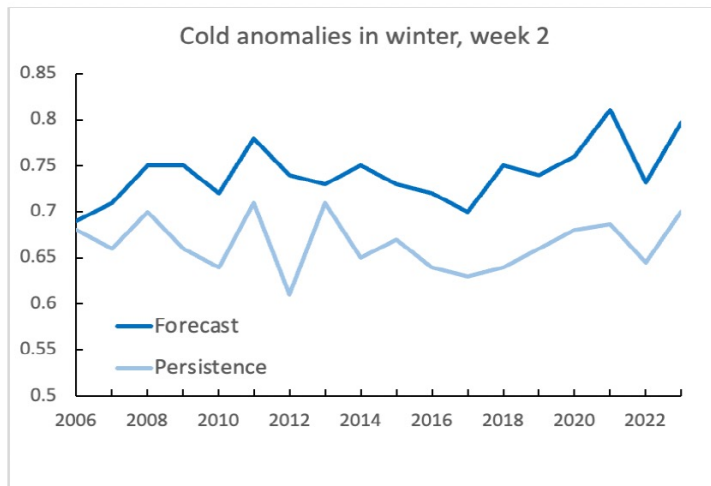
Peak period



Extended range: T2m anomalies (ROC area)



Summer

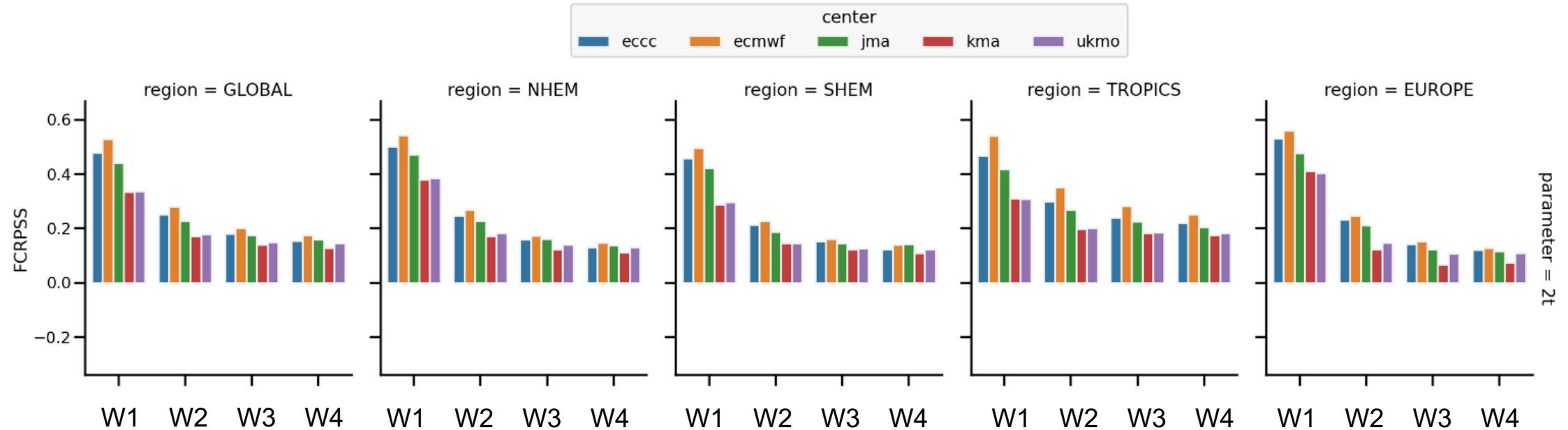


Winter

Week 2

Weeks 3+4

Extended range: S2S model intercomparison



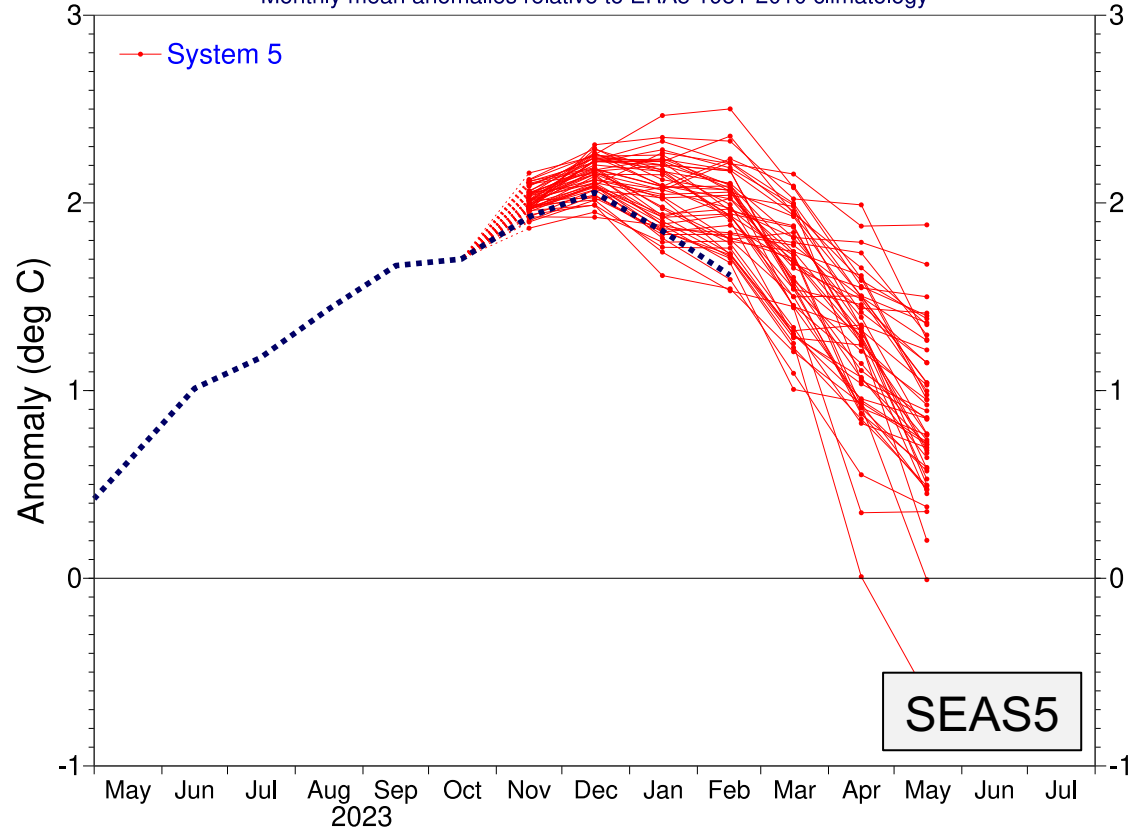
- Common re-forecast verification period: 2003-2016
- Fair CRPSS: corrected for ensemble size
- ECMWF generally leading (surface and upper-air)
- Skill drops from 0.5 to 0.2 over first two weeks

W1 = Days 5-11
W2 = Days 12-18
W3 = Days 19-25
W4 = Days 26-32

Tropical Pacific SST forecast (up to 7 months ahead)

NINO3.4 SST anomaly plume
ECMWF forecast from 1 Nov 2023

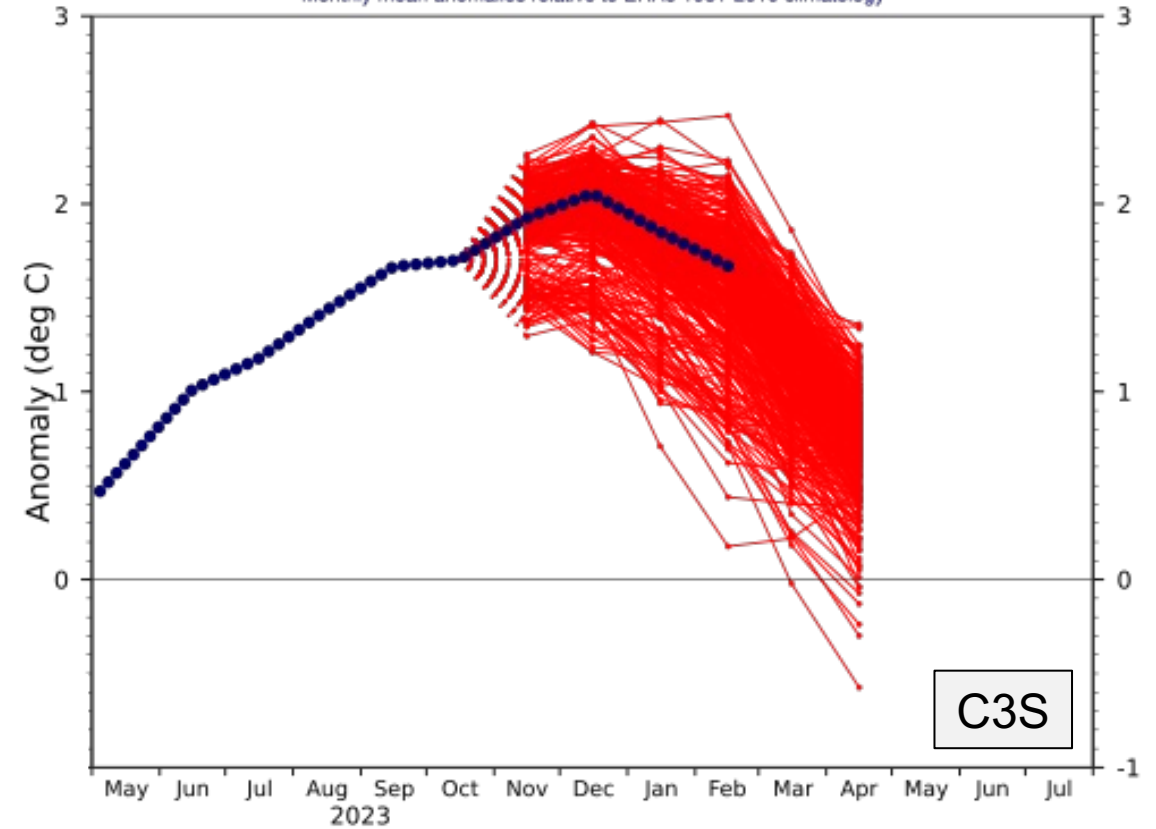
Monthly mean anomalies relative to ERA5 1981-2010 climatology



ECMWF forecast

NINO3.4 SST anomaly plume
C3S multi-system forecast from 1 Nov 2023

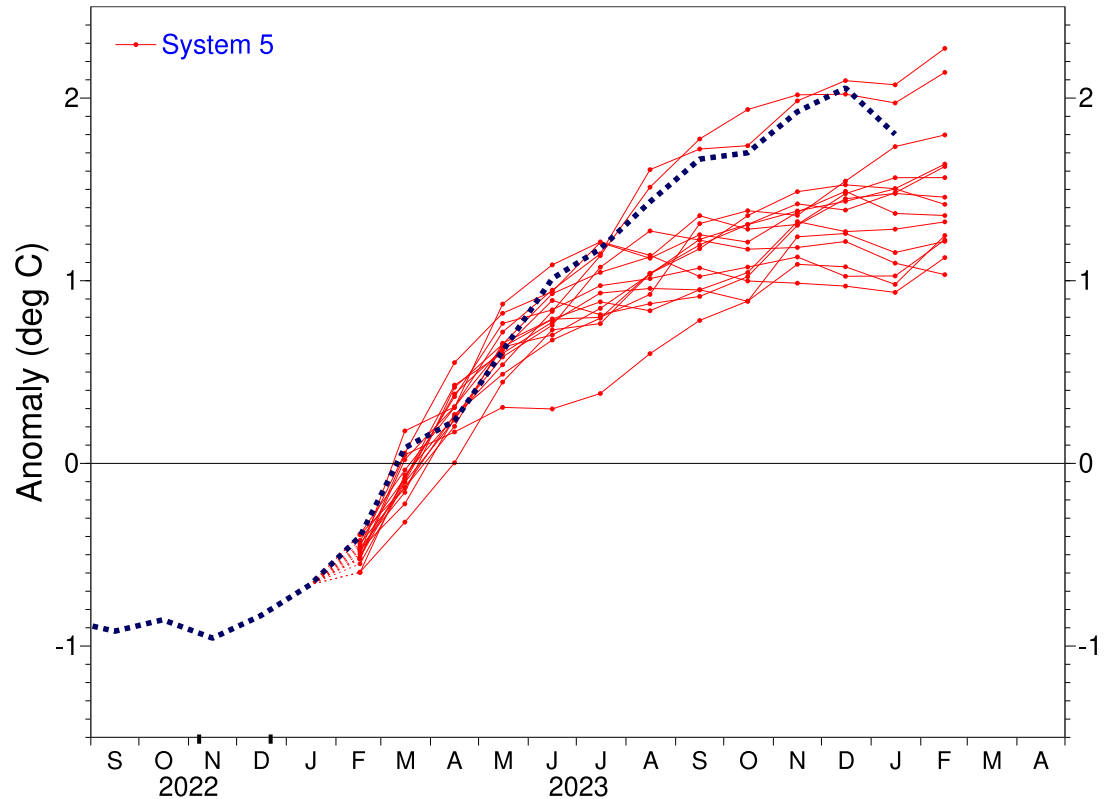
ECMWF, Met Office, Météo-France, CMCC, DWD, NCEP, JMA, ECCO
Monthly mean anomalies relative to ERA5 1981-2010 climatology



C3S multi-model forecast

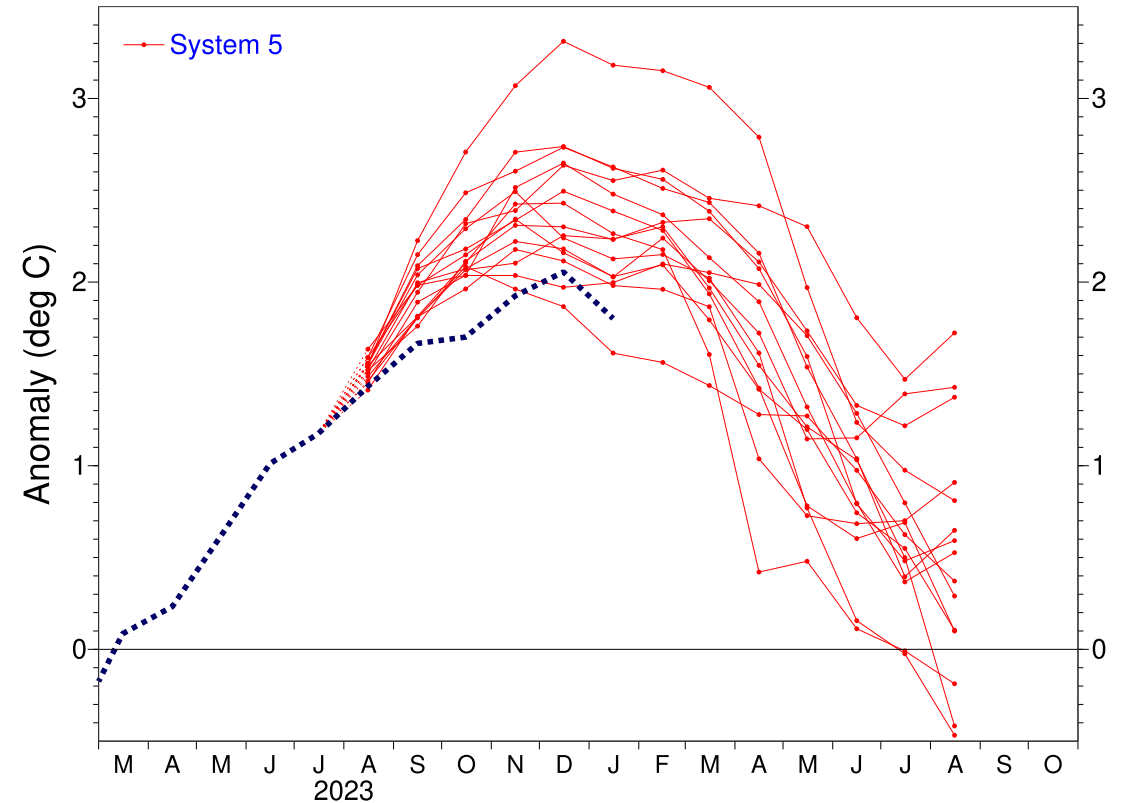
Tropical Pacific SST forecast (up to 13 months ahead)

NINO3.4 SST anomaly plume
ECMWF forecast from 1 Feb 2023
Monthly mean anomalies relative to ERA5 1981-2010 climatology



Forecast from Feb 2023

NINO3.4 SST anomaly plume
ECMWF forecast from 1 Aug 2023
Monthly mean anomalies relative to ERA5 1981-2010 climatology



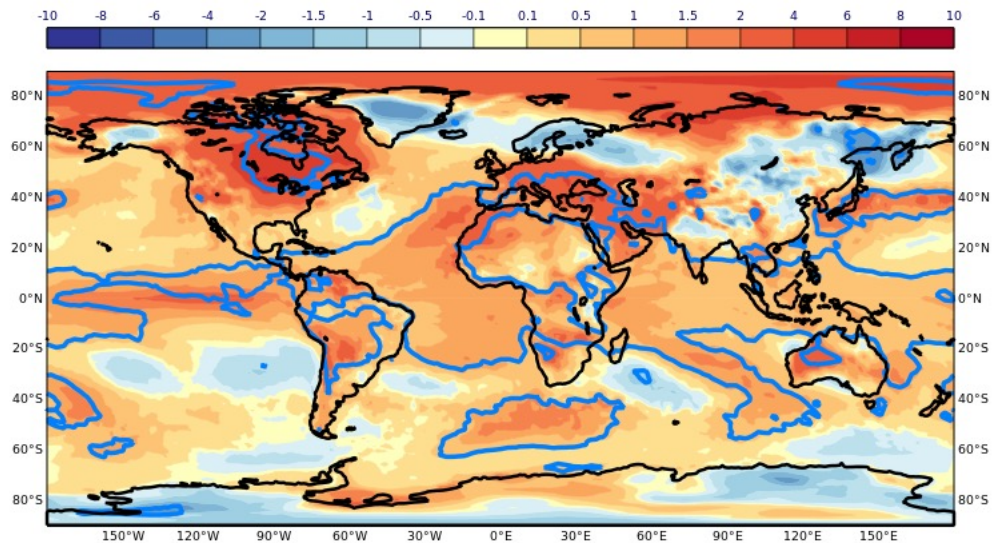
Forecast from Aug 2023

ERA5

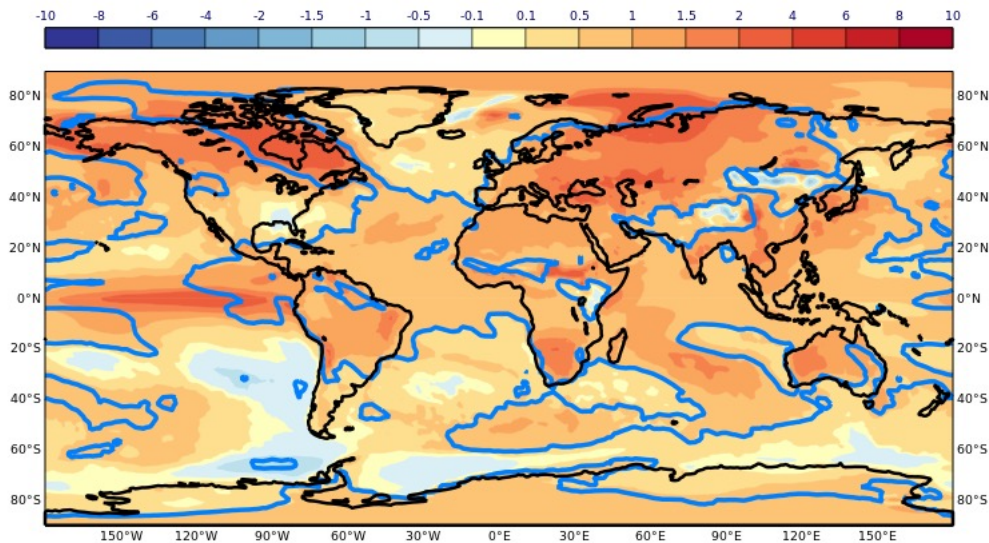
DJF 2024 T2m anomalies (K)

SEAS5 (ensemble mean)

ERA5 DJF 2023/24 T2m anomaly (contour: 95% significance)

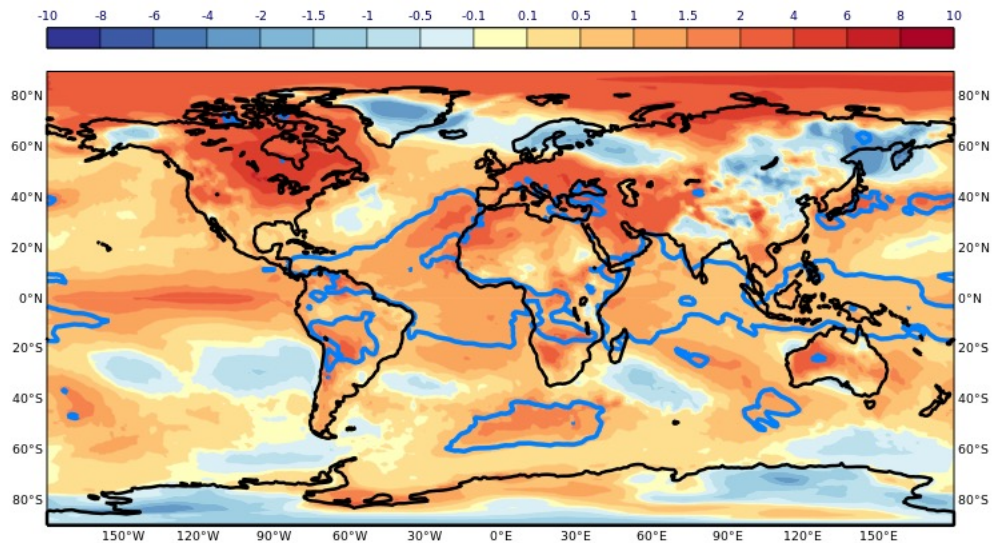


SEAS5 DJF 2023/24 T2m anomaly (contour: 95% significance)

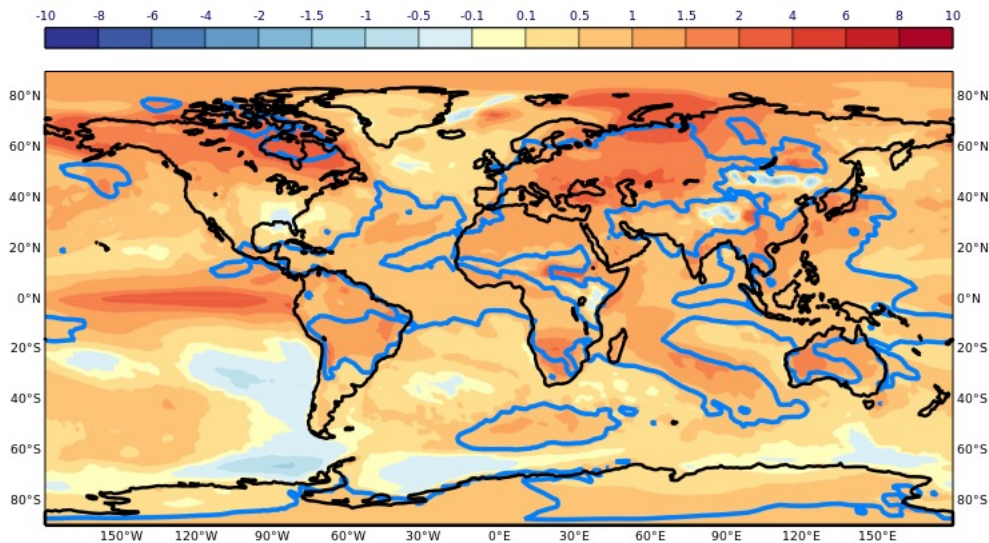


2σ significance

ERA5 DJF 2023/24 T2m anomaly (contour: 99% significance)



SEAS5 DJF 2023/24 T2m anomaly (contour: 99% significance)

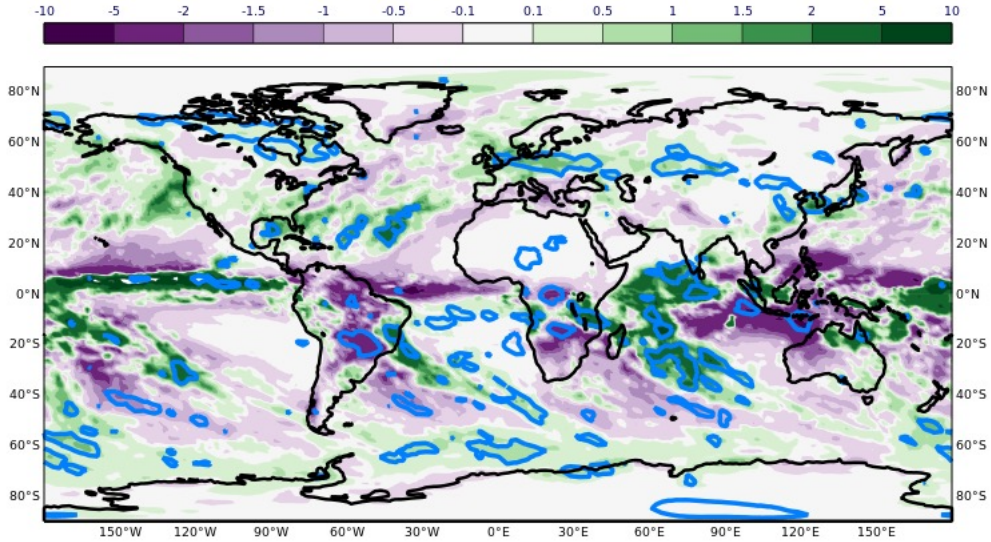


3σ significance

DJF 2024 precipitation anomalies (mm/day)

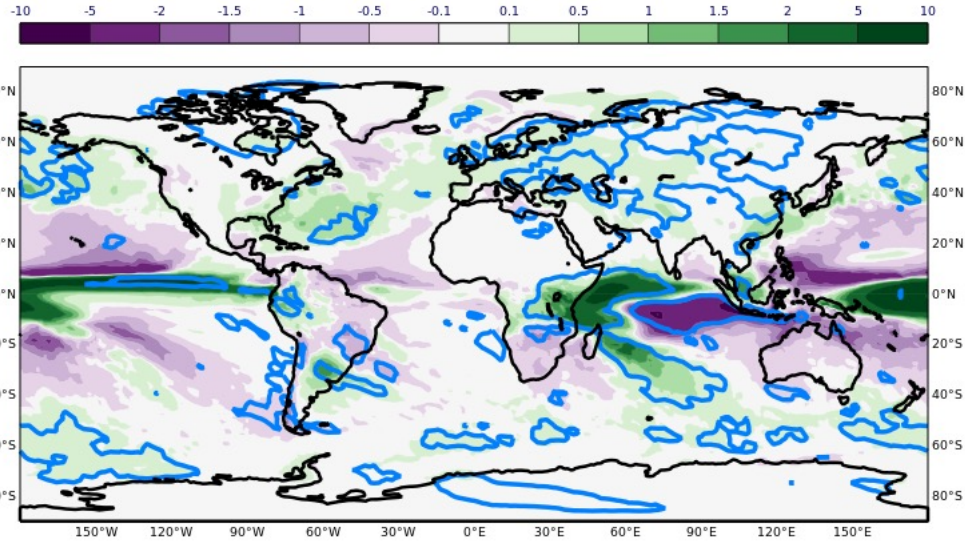
ERA5

ERA5 DJF 2023/24 precipitation anomaly (contour: 95% significance)



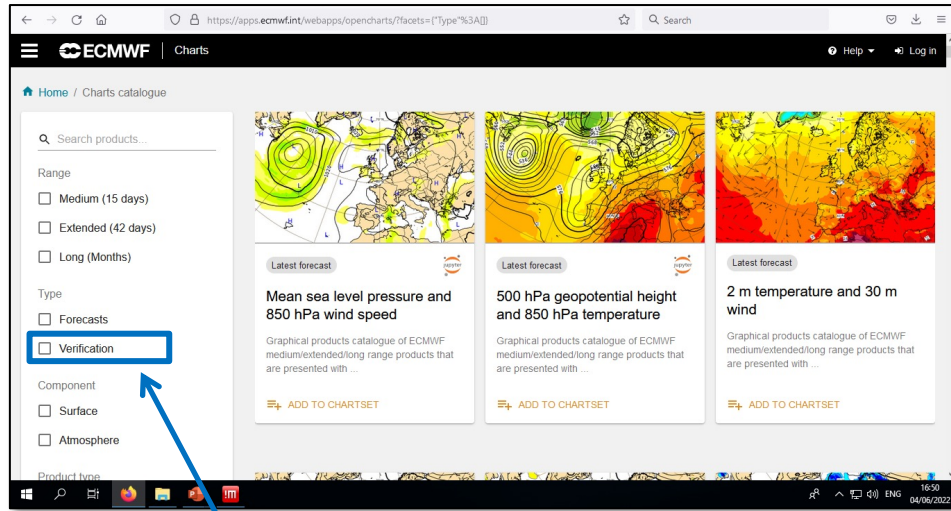
SEAS5 (ensemble mean)

SEAS5 DJF 2023/24 precipitation anomaly (contour: 95% significance)



2 σ significance

More verification results



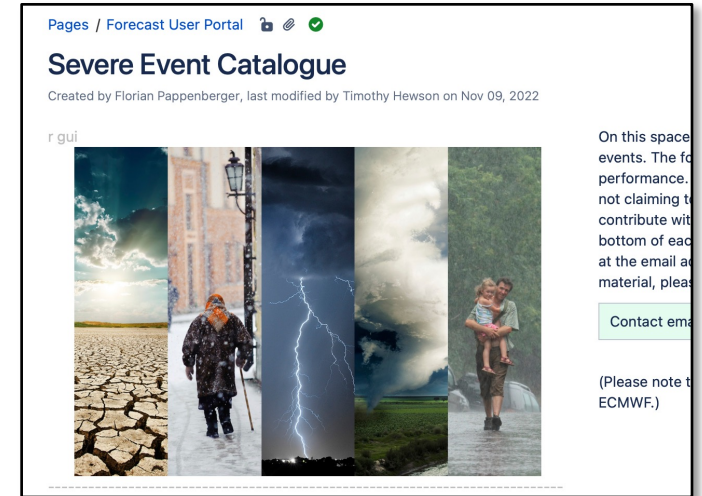
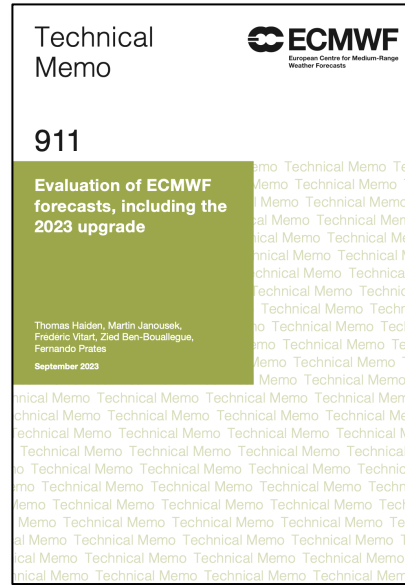
Verification of ECMWF IFS in Charts

Annual review of forecast performance (TechMemo)

Severe Event Catalogue

Active engagement with MS/CS and beyond

WMO Lead Centre verification



Your feedback is welcome!

WMO Lead Centre for Deterministic NWP Verification (LC-DNV)
WMO Lead Centre for Wave Forecast Verification (LC-WFV)
WMO Lead Centre for Sub-Seasonal Forecasts (LC-SSFMME)