

# ECMWF forecast performance

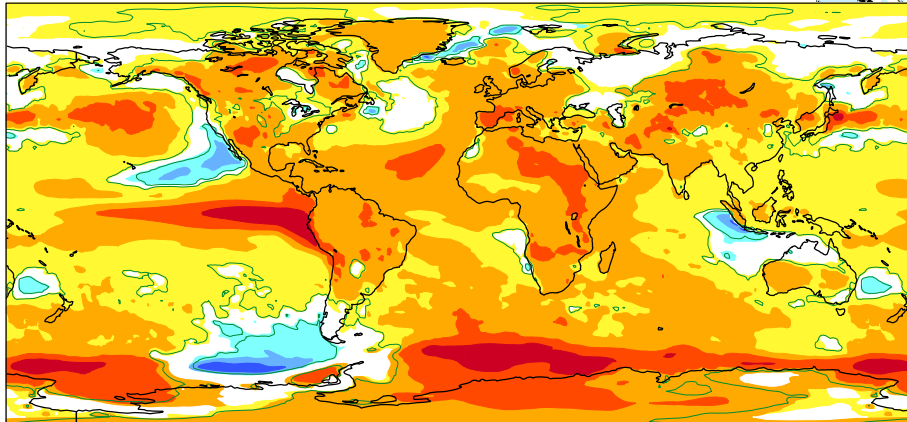
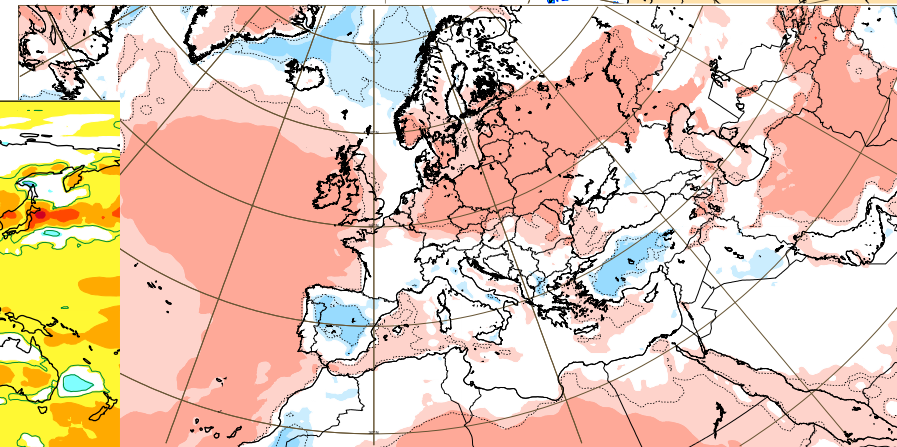
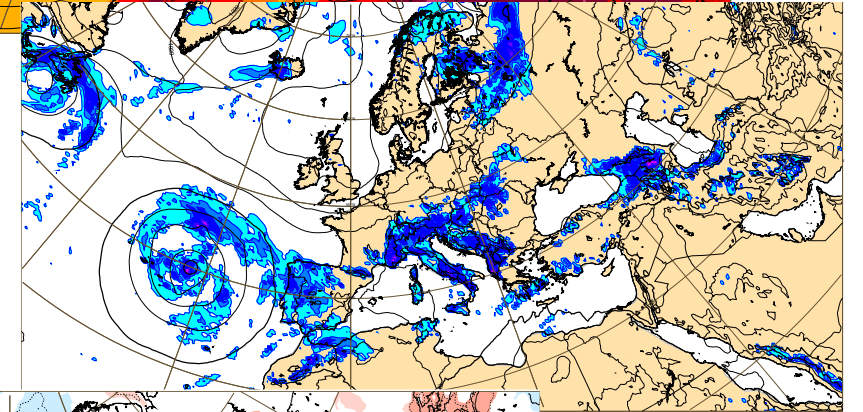
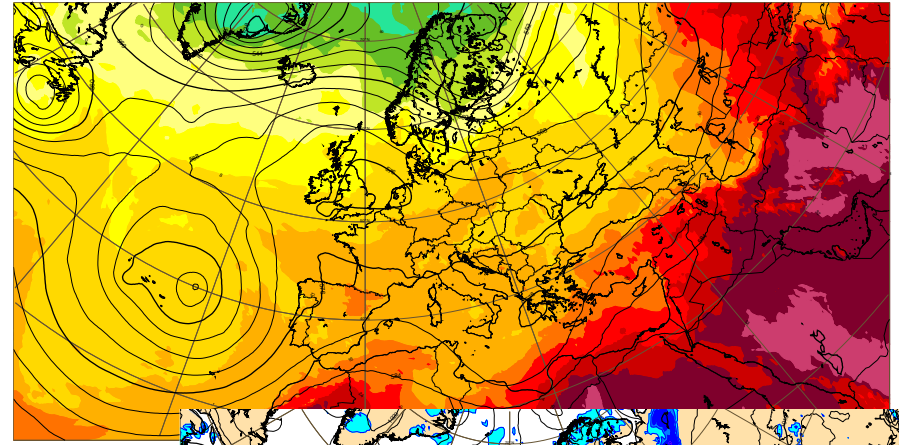
UEF 2023

Thomas Haiden

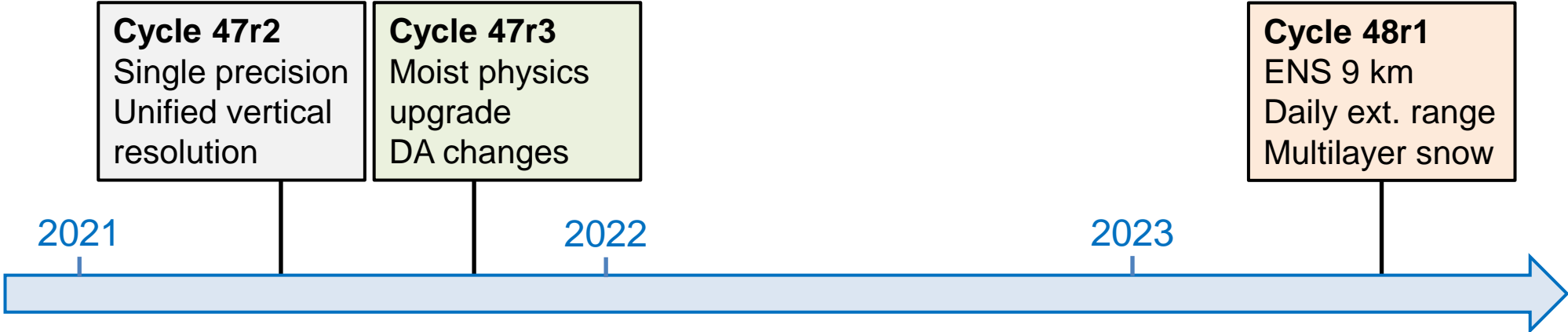
Thanks to: Martin Janousek, Zied Ben Bouallegue, Laura Ferranti,  
Frederic Vitart, Fernando Prates

# Overview

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



# Model upgrades - timeline

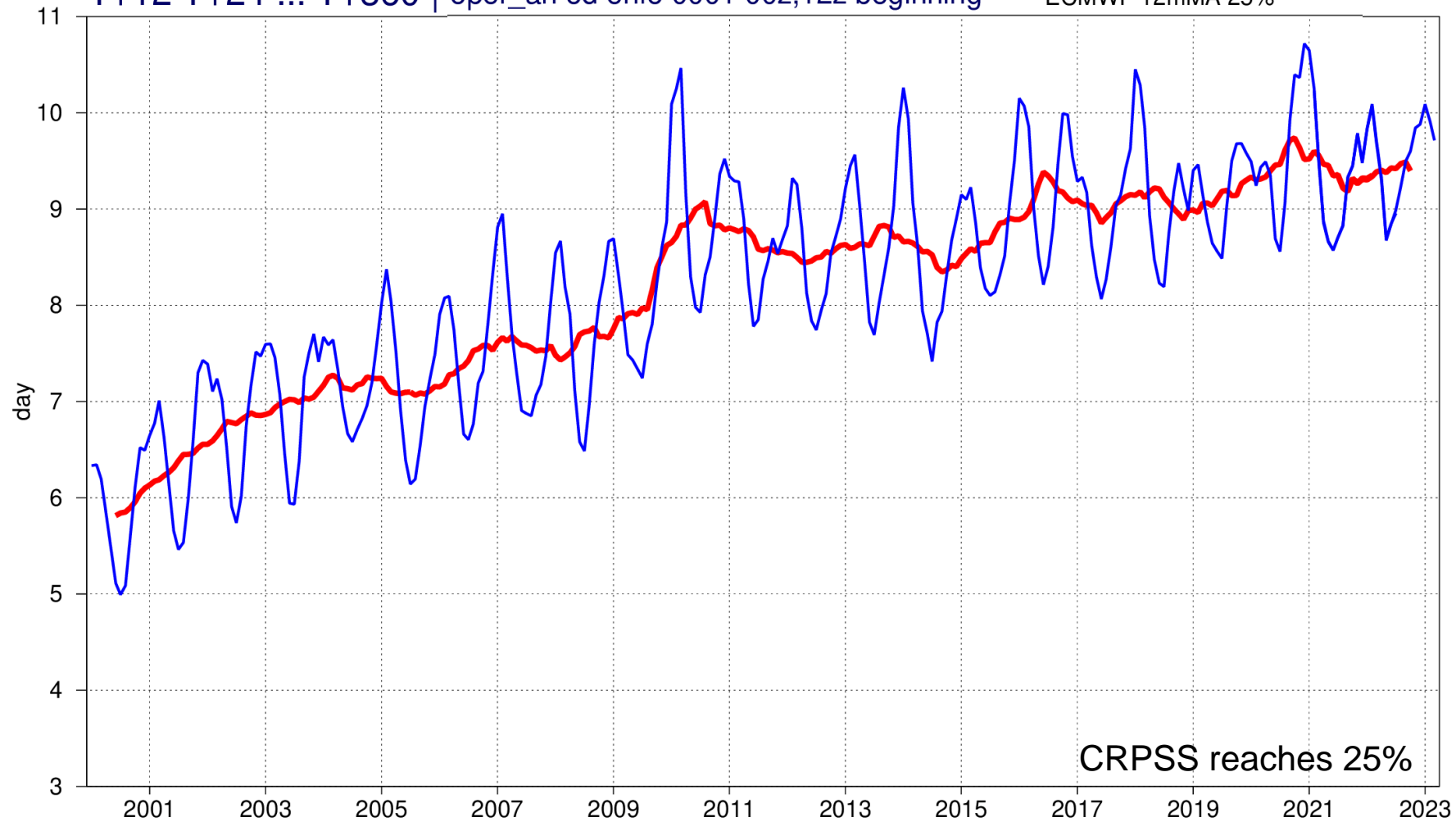


# ENS upper-air headline score: T850 CRPSS

Continuous ranked probability skill score

NHem Extratropics

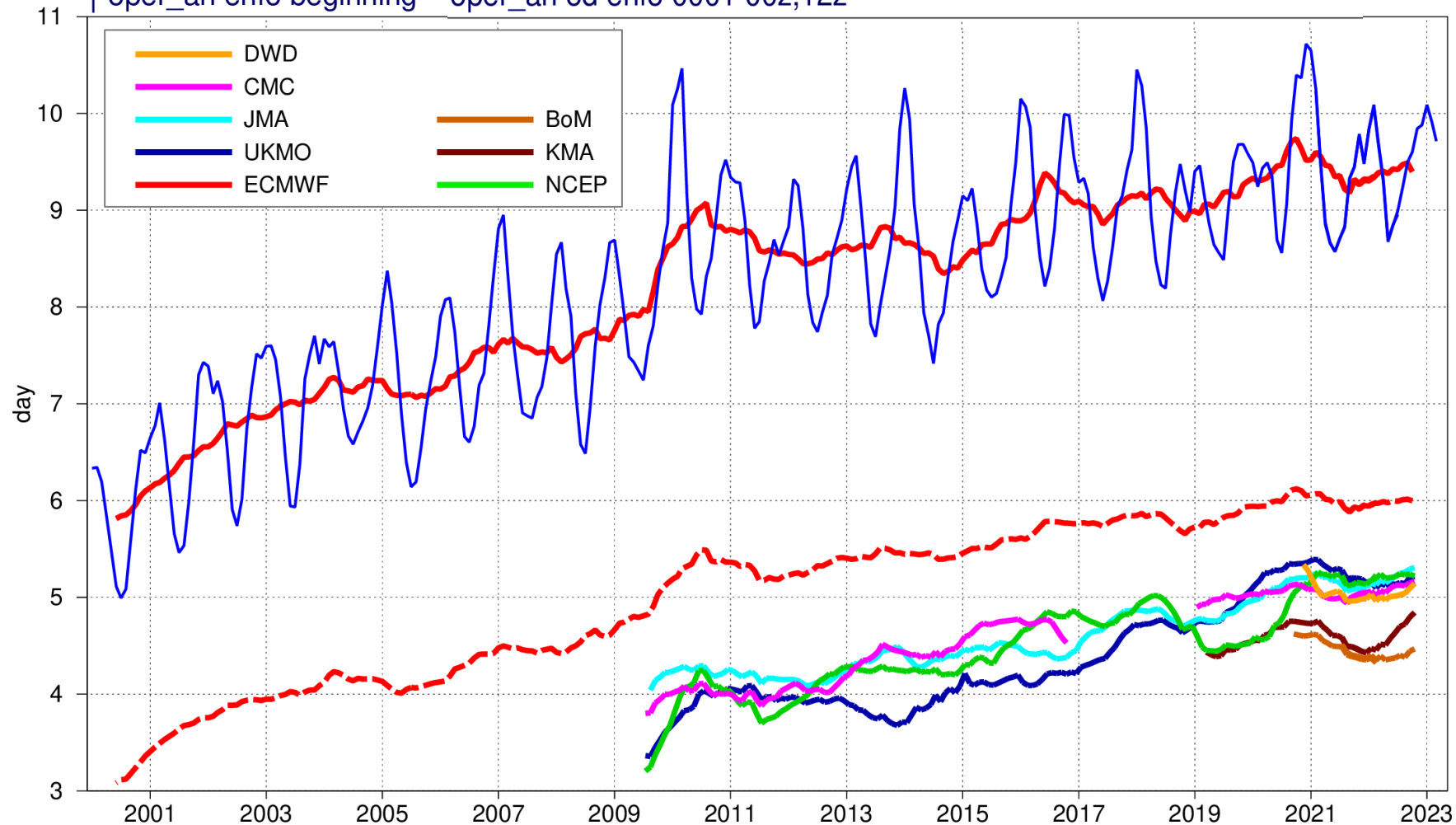
T+12 T+24 ... T+360 | oper\_ano d enfo 0001 00z,12z beginning — ECMWF 12mMA 25%



# ENS upper-air headline score: T850 CRPSS

Continuous ranked probability skill score  
NHem Extratropics

| oper\_ an enfo beginning | oper\_ an od enfo 0001 00z,12z

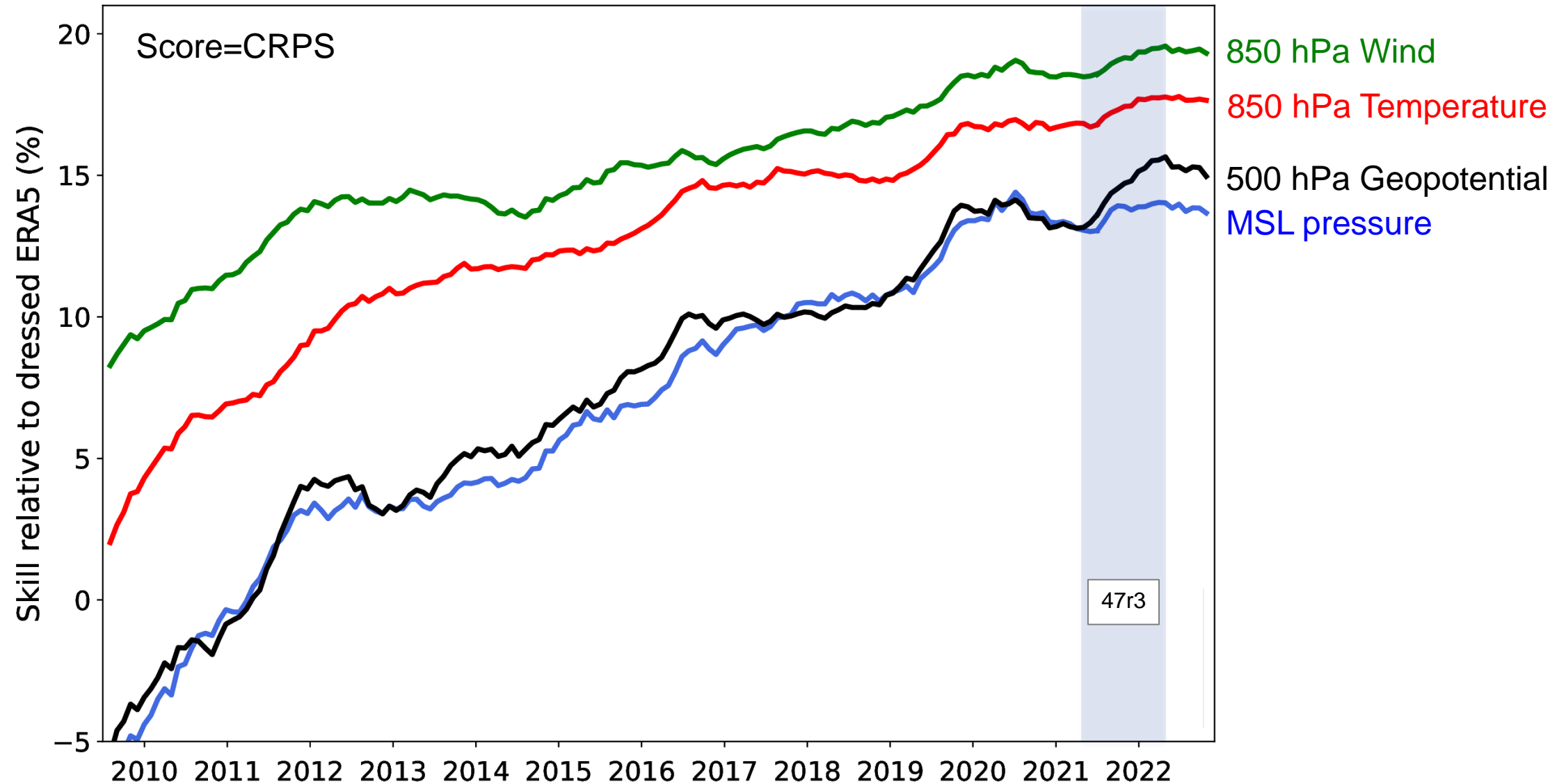


CRPSS reaches 25%

CRPSS reaches 50%

# ENS skill relative to dressed ERA5 – Day 5

STEP=120, NH

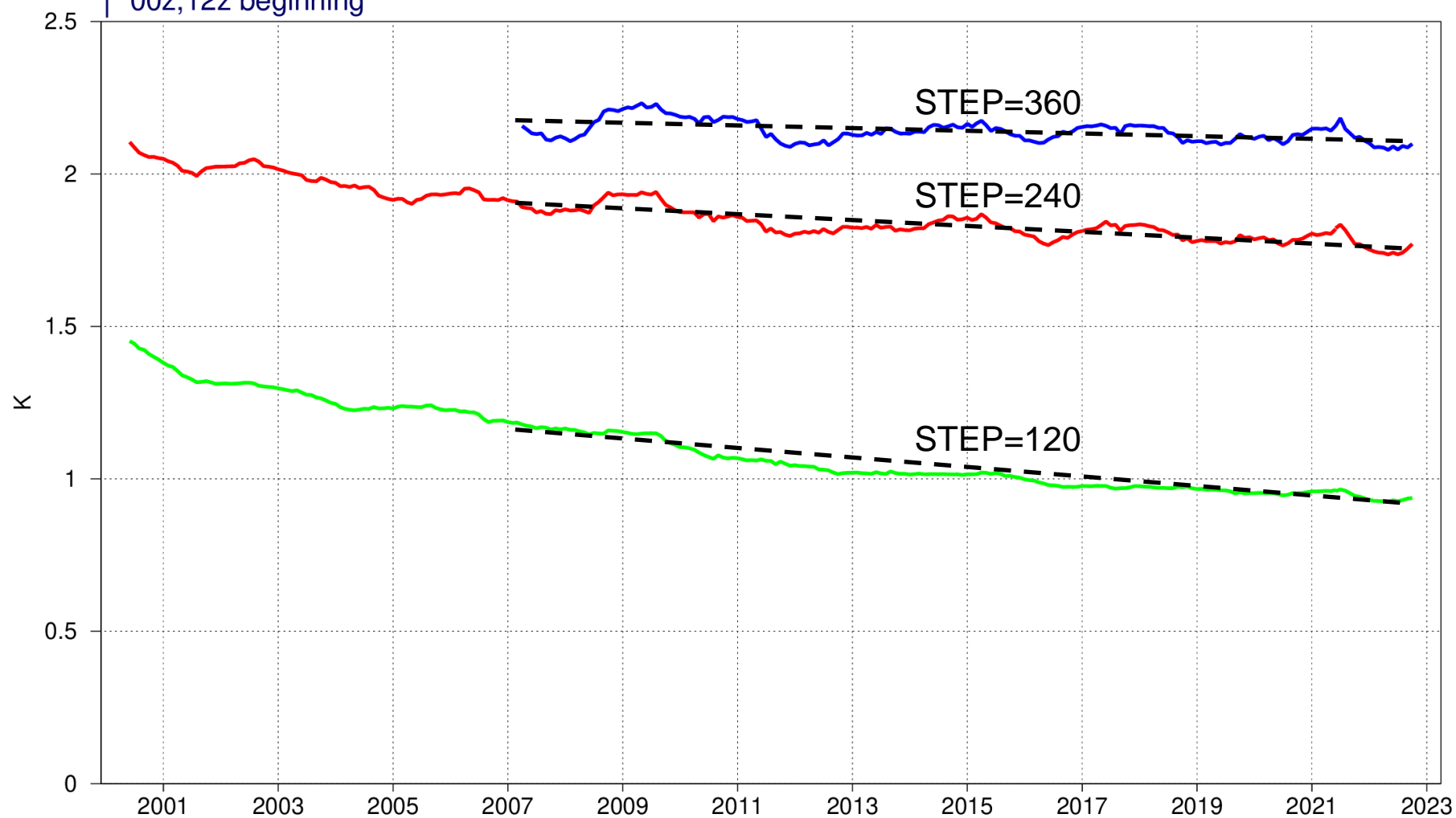


# T850 CRPS at forecast days 5, 10, 15

Continuous ranked probability score | 850hPa temperature

NHem Extratropics

| 00z,12z beginning



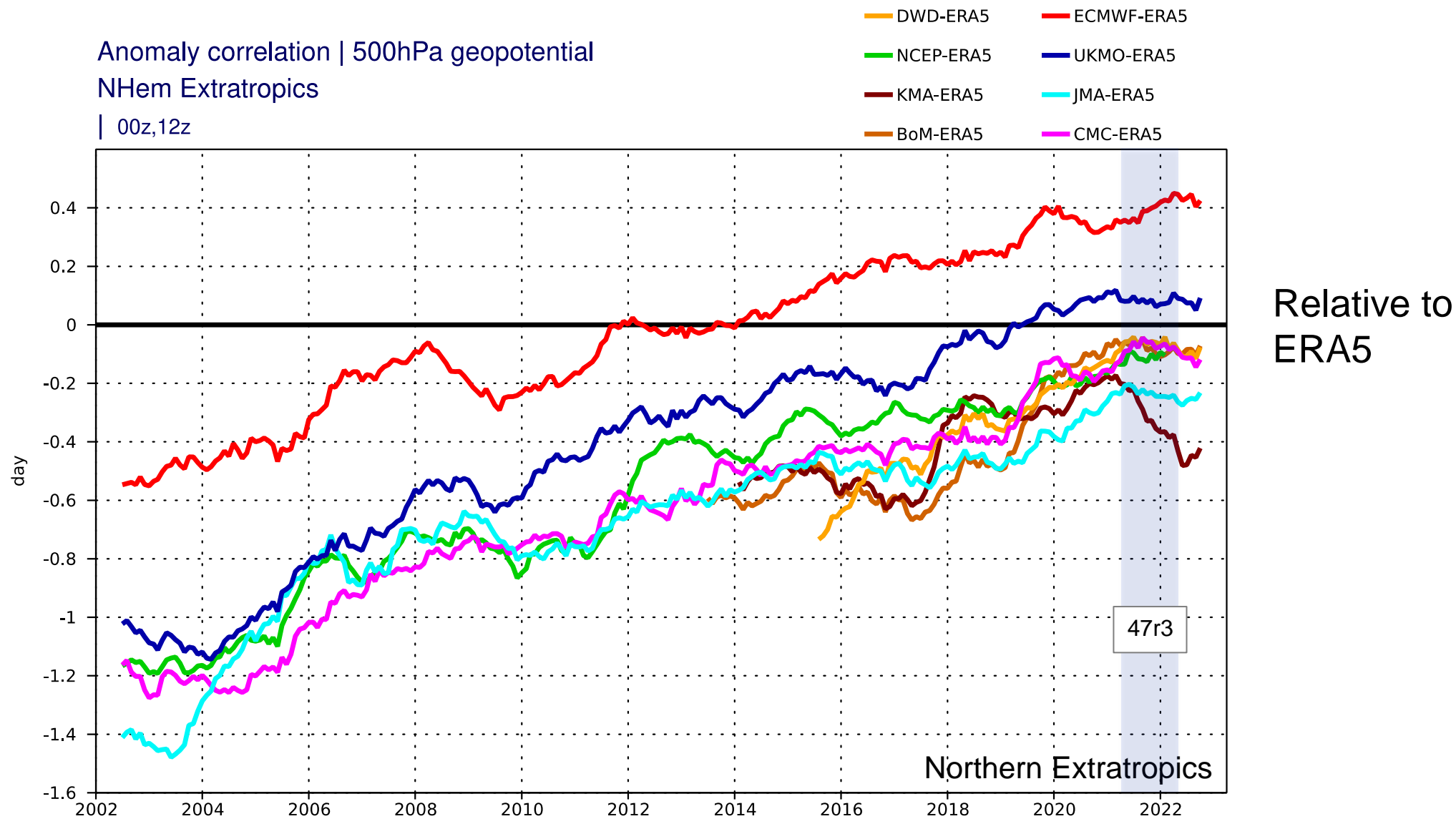
Error reduction  
over 15 years

- 4%

- 8%

- 25%

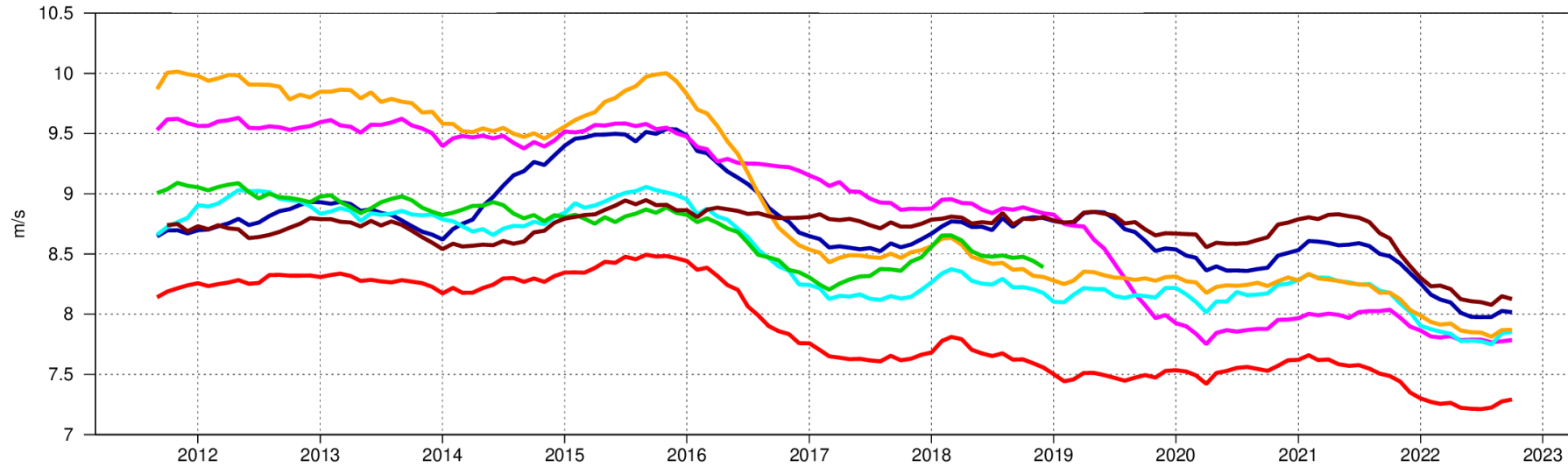
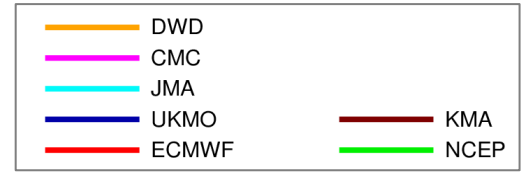
# Anomaly correlation of 500 hPa geopotential reaching 85%





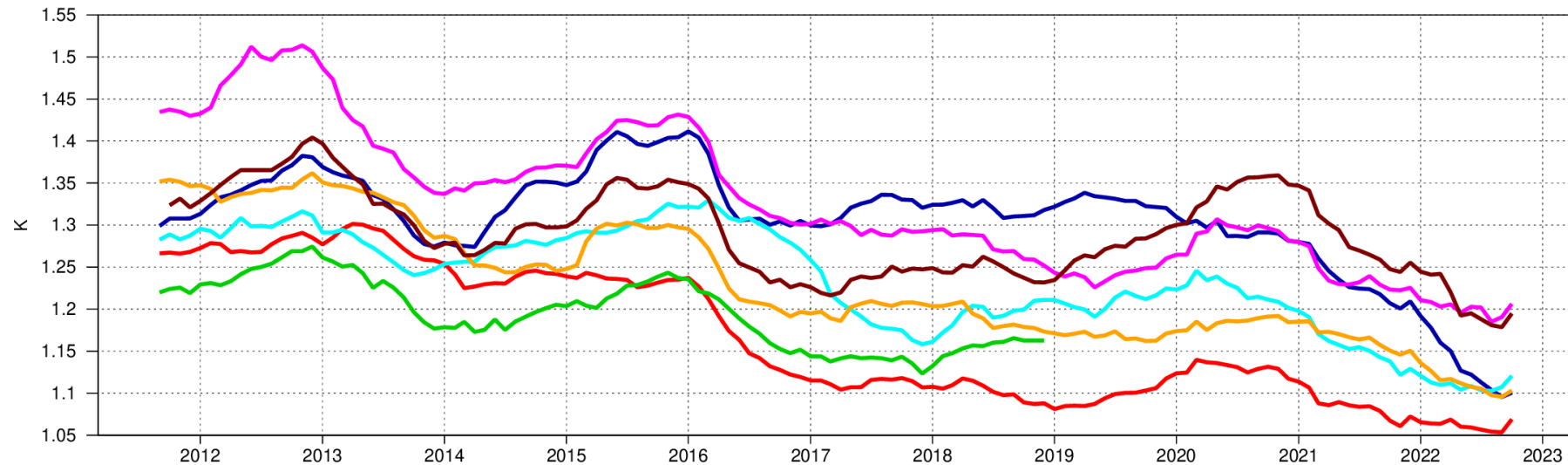
# Tropics: verification against radiosondes

Root mean square error  
Tropics  
T+144



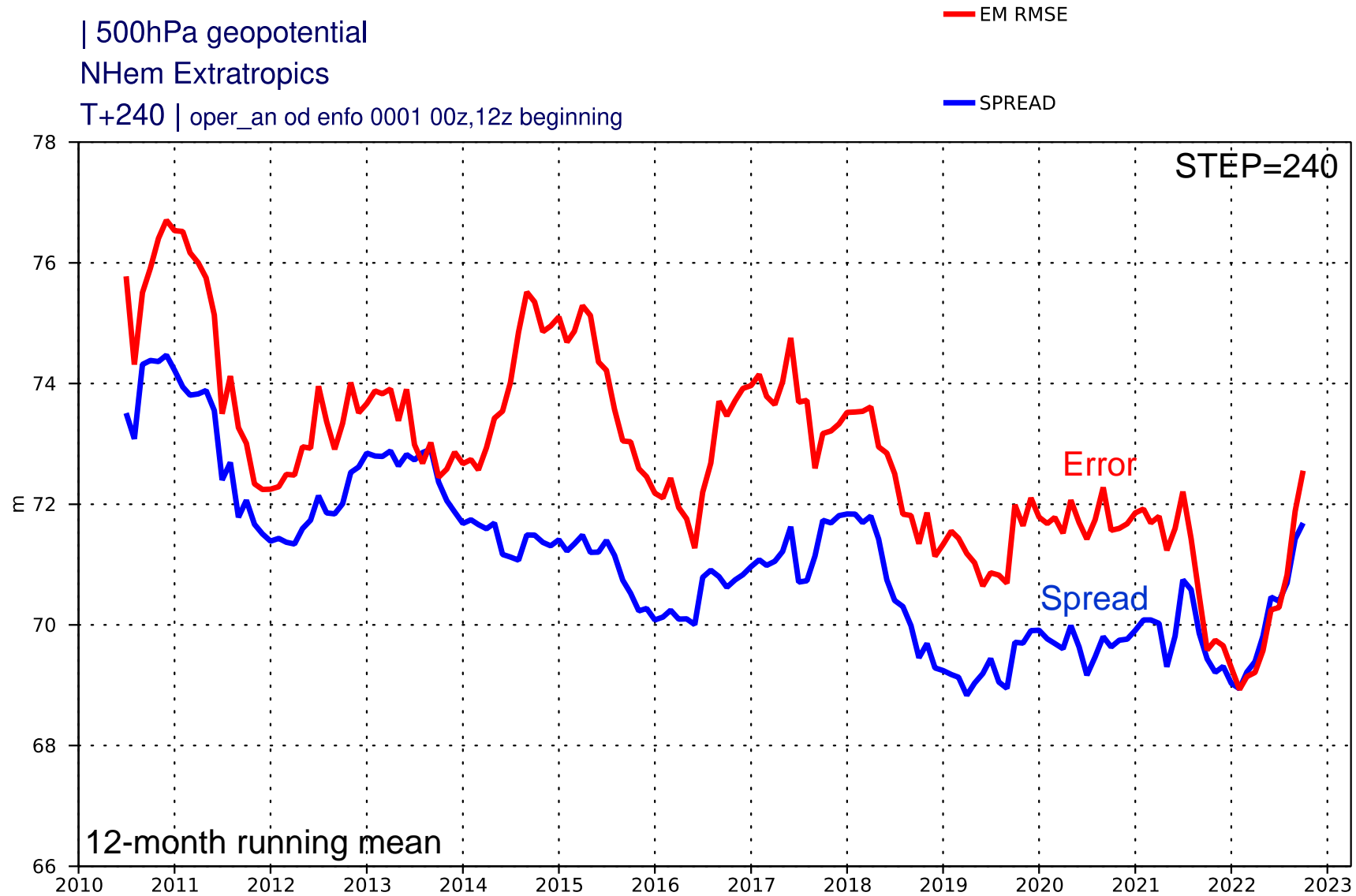
250 hPa wind

Day 6



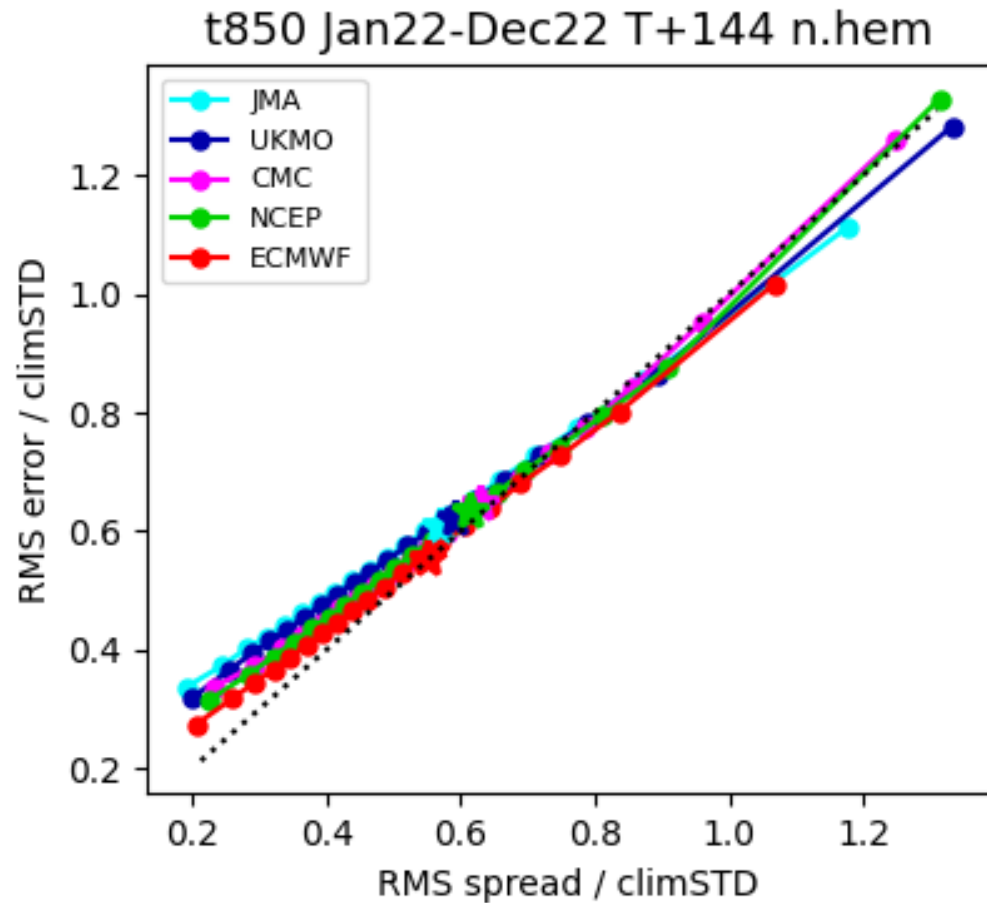
850 hPa  
temperature

# ENS: Z500 spread and error at Day 10

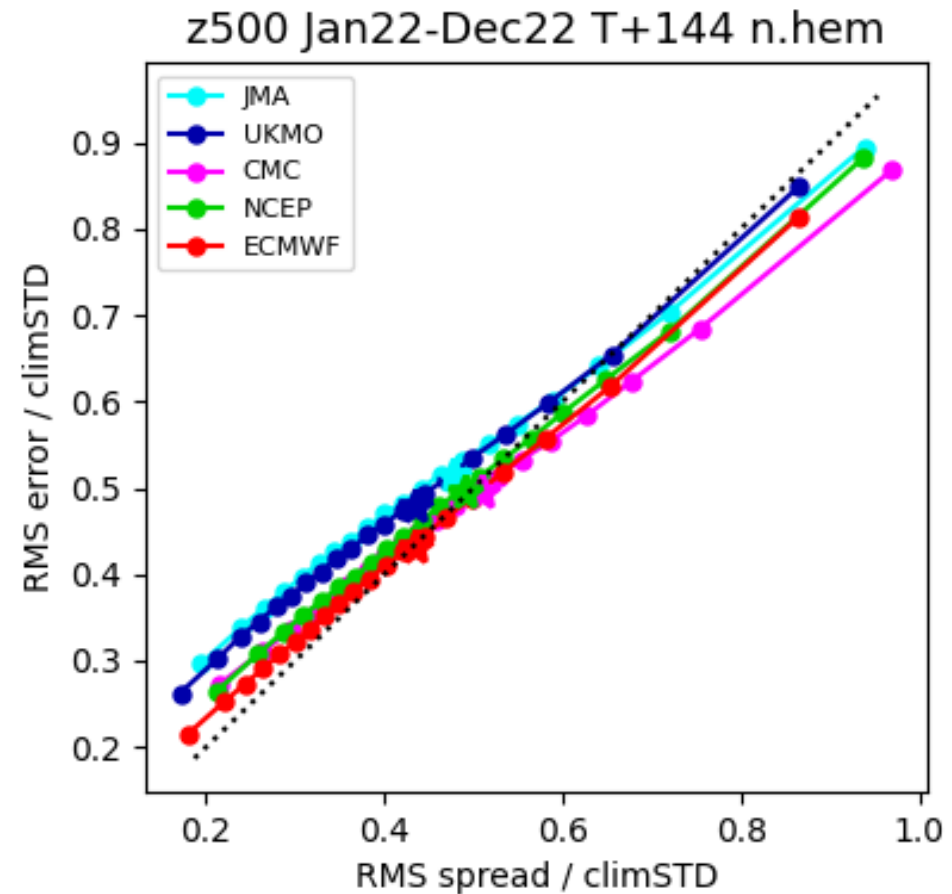




# ENS: Spread reliability (Day 6)



850 hPa Temperature

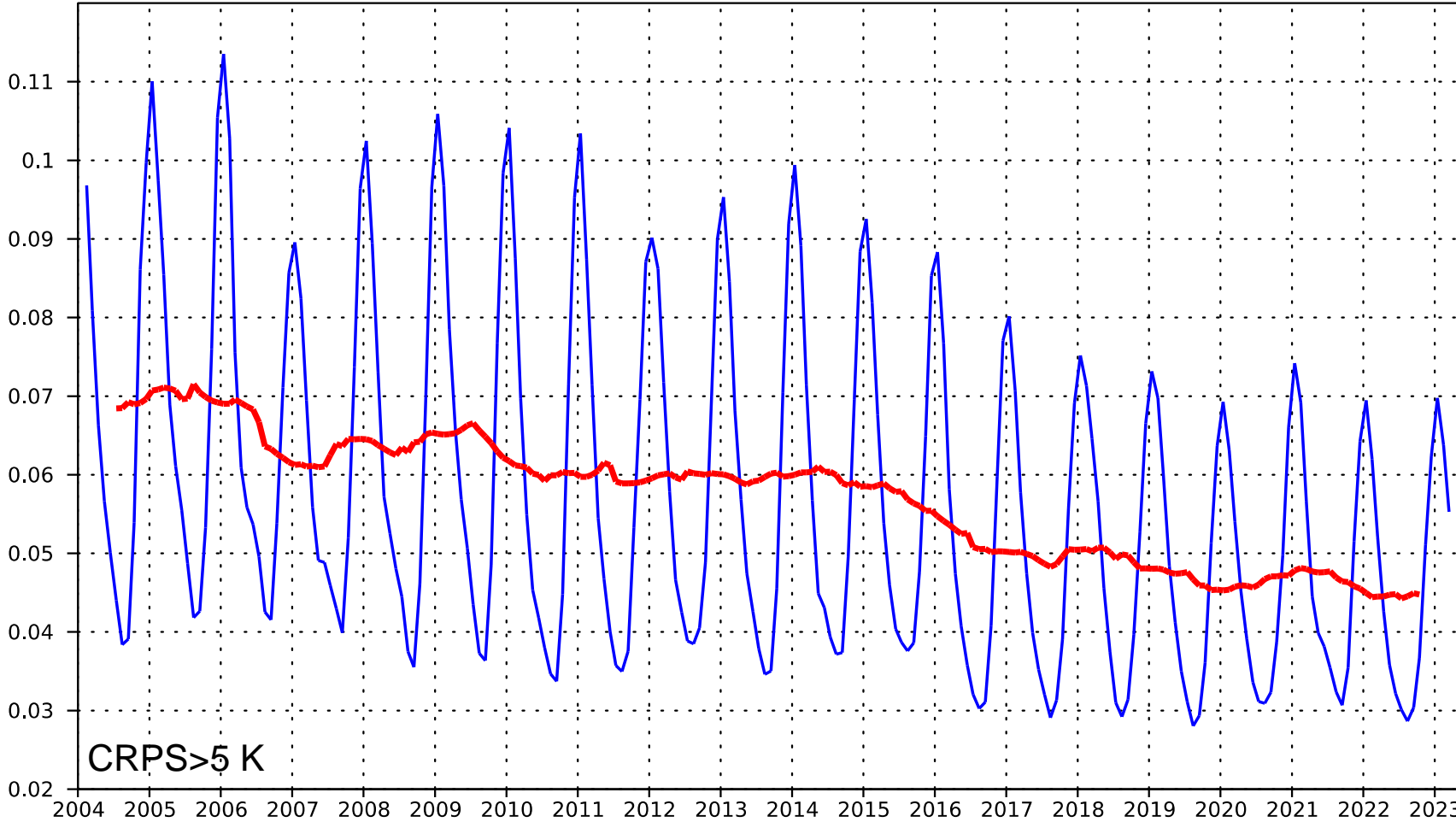


500 hPa Geopotential

# Fraction of large ENS T2m errors

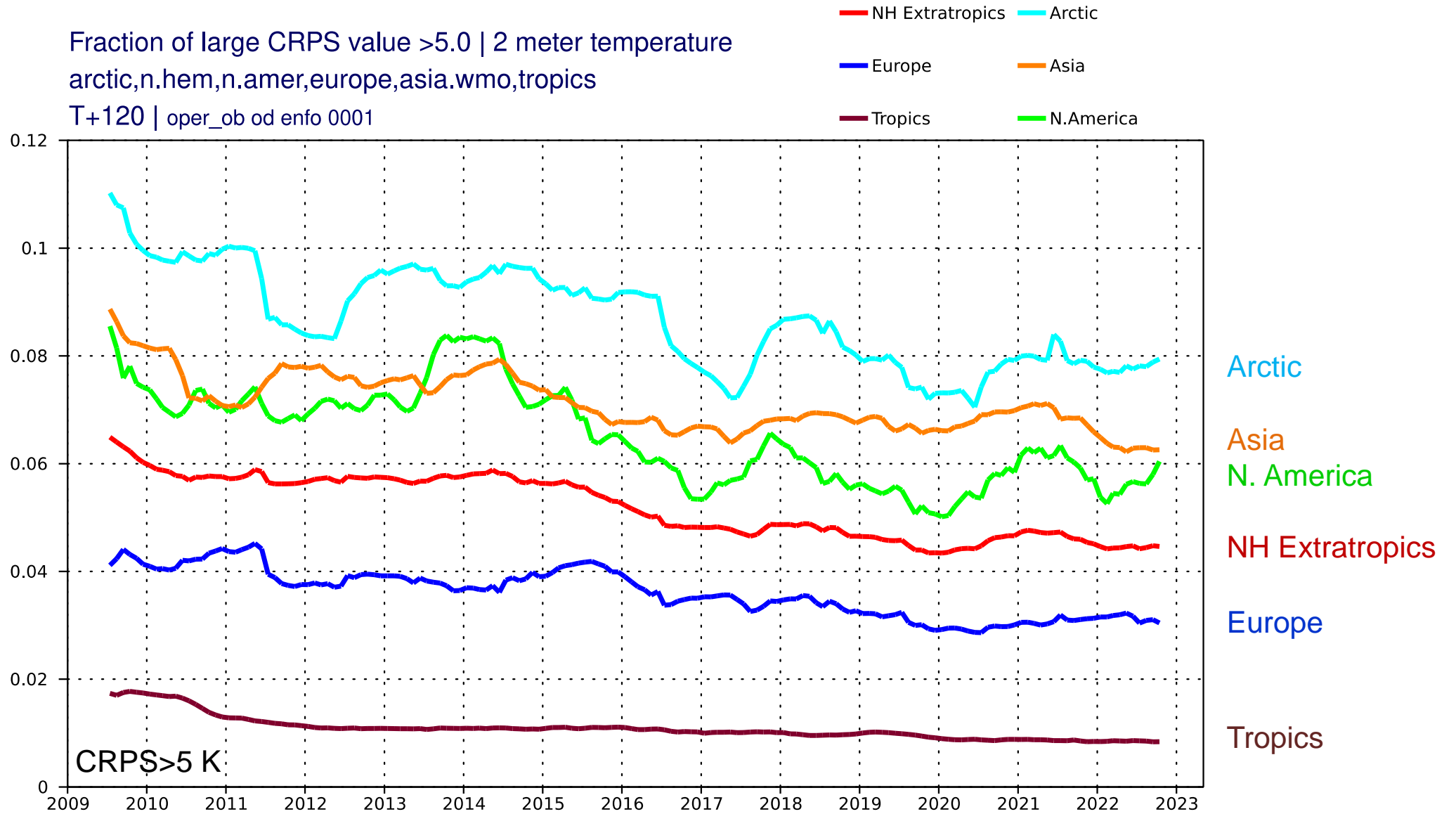
Fraction of large CRPS value >5.0 | 2 meter temperature  
Extratropics  
T+120 | oper\_ob od enfo 0001

00z,12z  
00z,12z

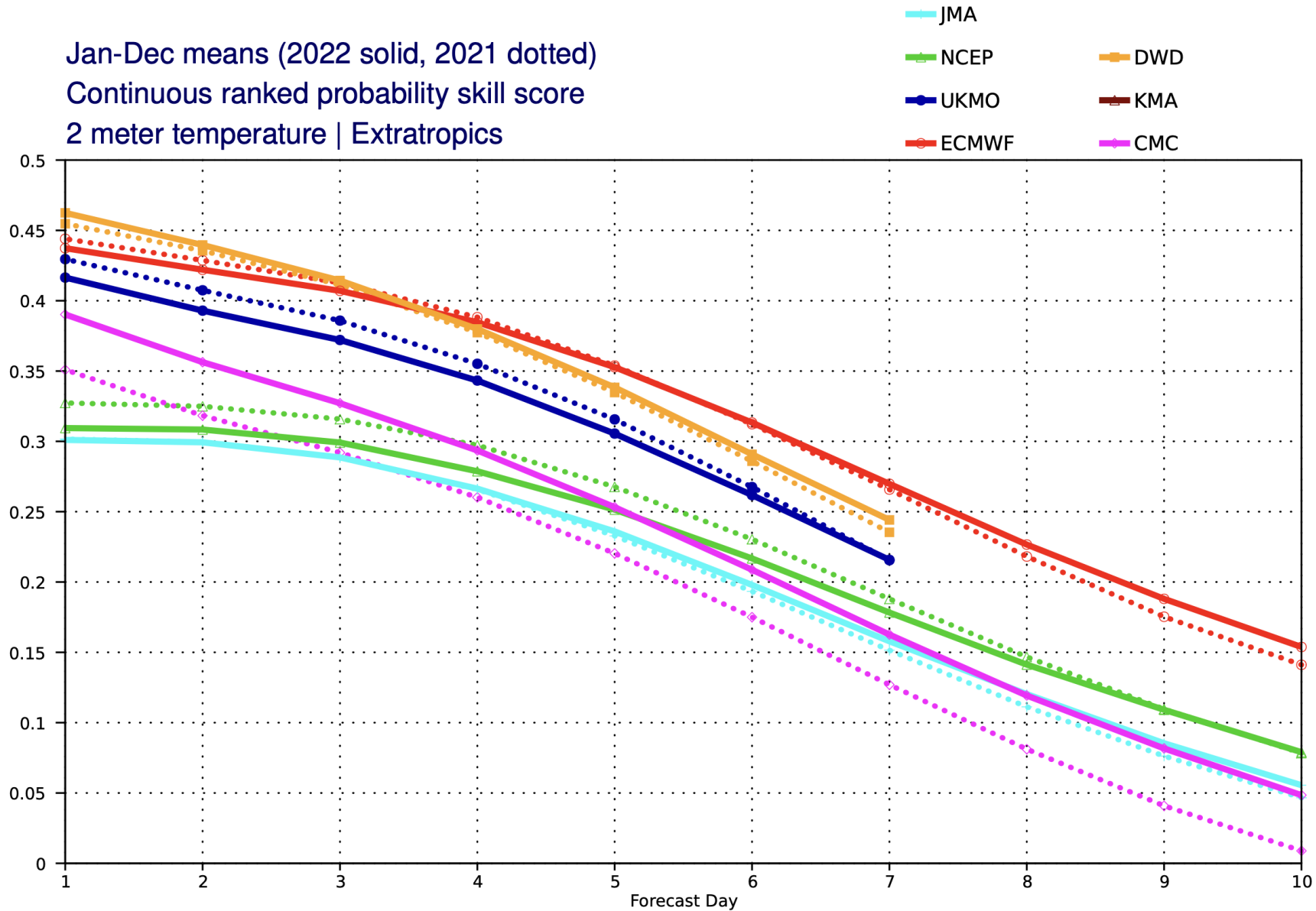


# Fraction of large ENS T2m errors

Fraction of large CRPS value >5.0 | 2 meter temperature  
arctic,n.hem,n.amer,europe,asia.wmo,tropics  
T+120 | oper\_ob od enfo 0001



# ENS 2m Temperature (TIGGE against SYNOP)

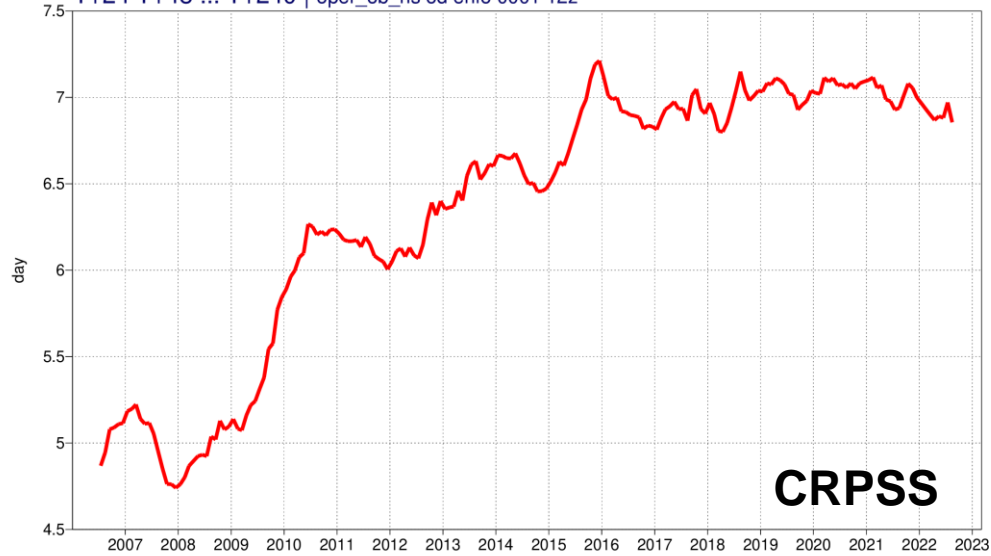


# ENS precipitation scores

## ECMWF EPS 12UTC forecast skill

Continuous ranked probability skill score | total precipitation  
Extratropics

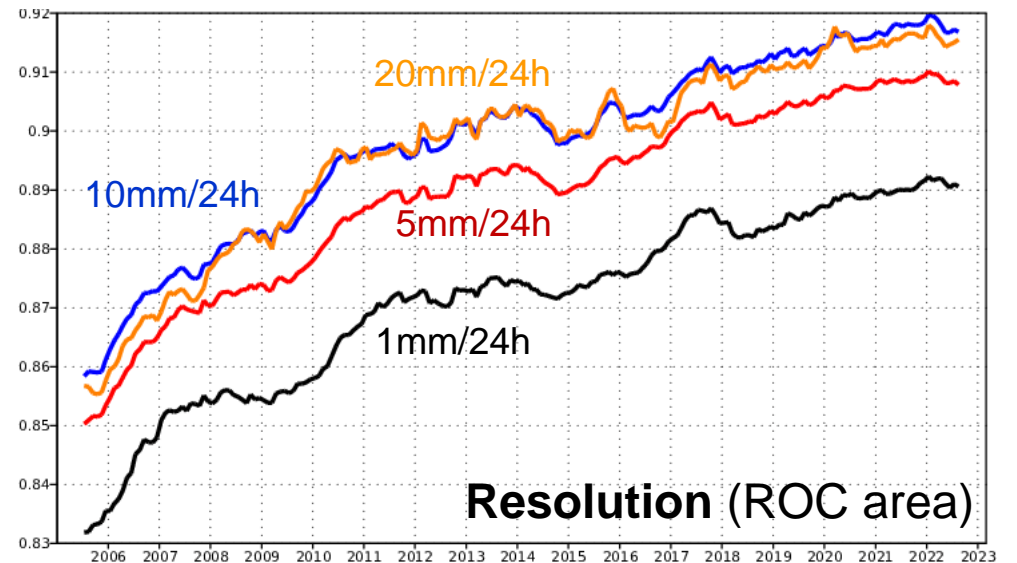
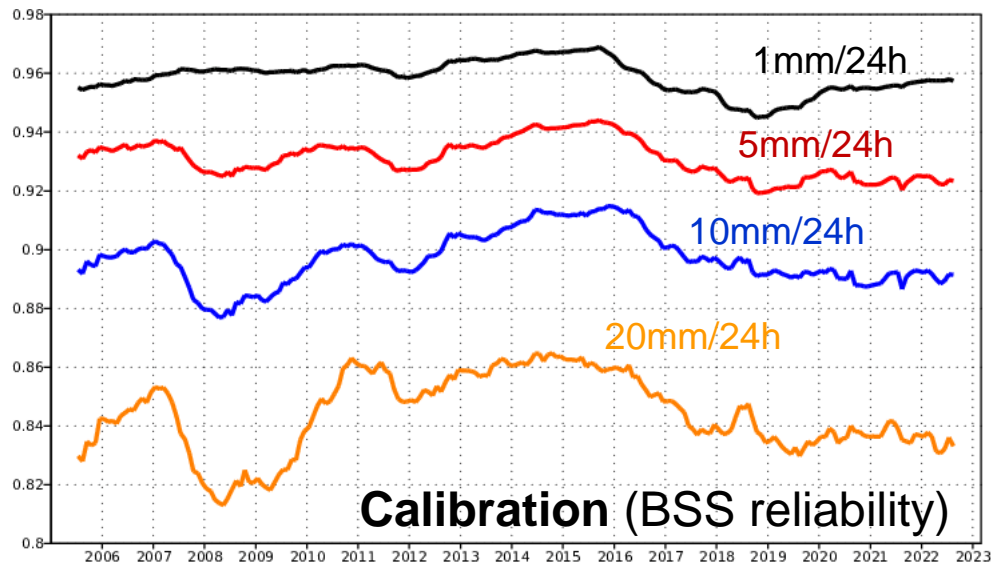
T+24 T+48 ... T+240 | oper\_ob\_hs od enfo 0001 12z



diagss | total precipitation

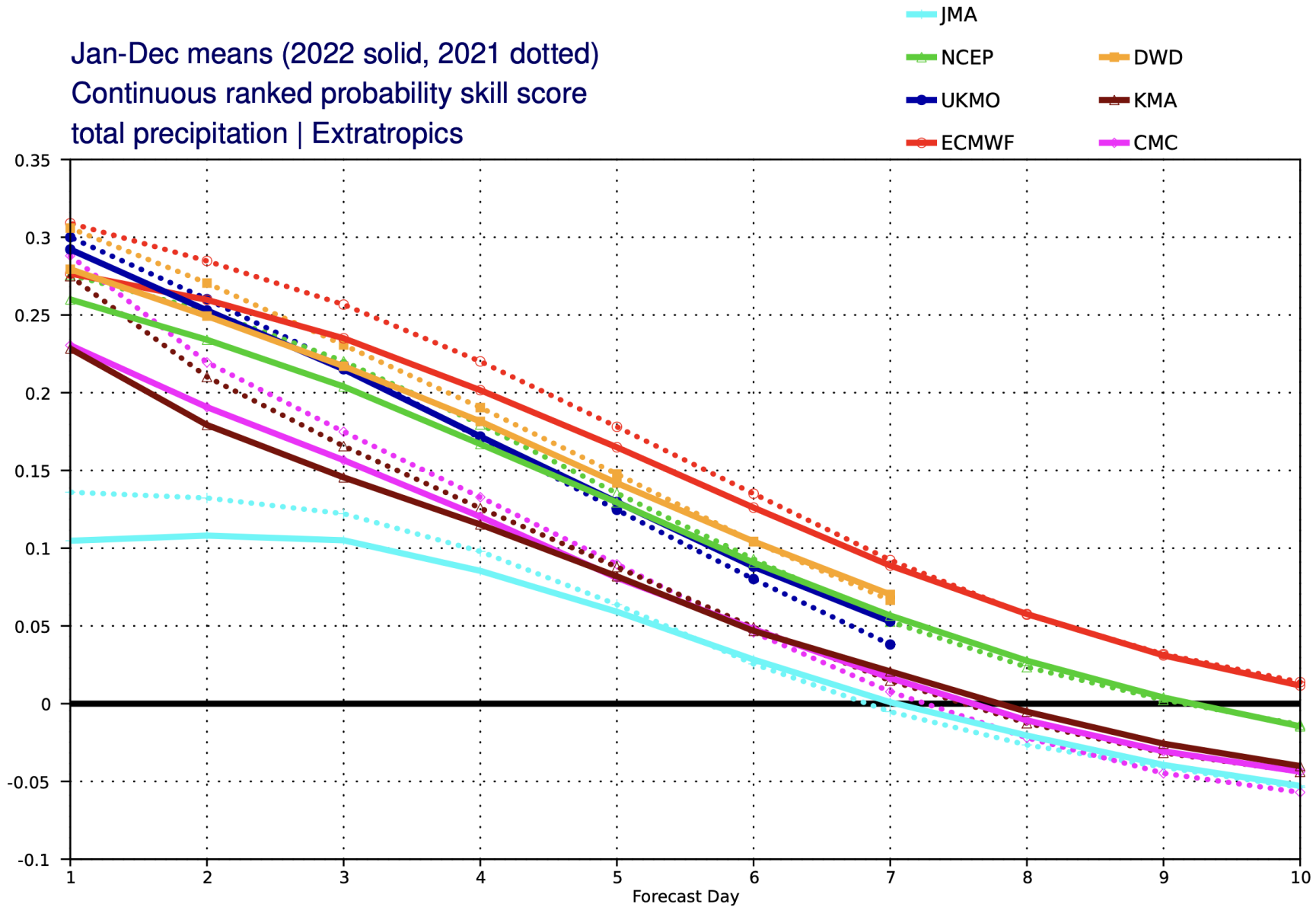
Extratropics

T+24 T+48 ... T+240 | new\_score od enfo 0001



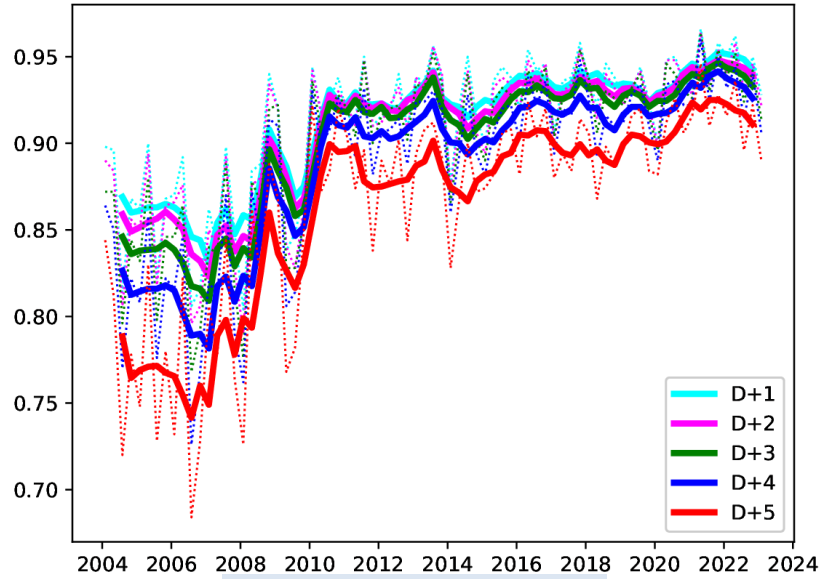


# ENS 24-h Precipitation (TIGGE against SYNOP)

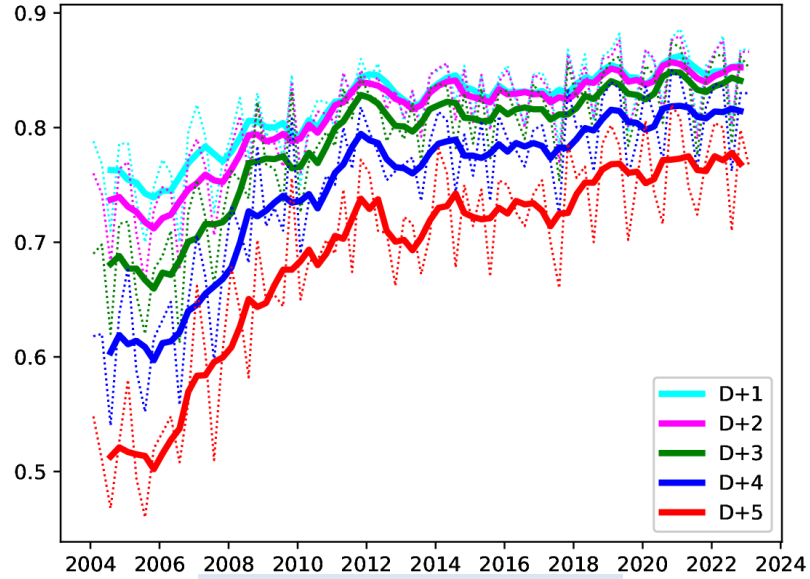


# Verification of extremes: EFI ROC and Diagonal Score

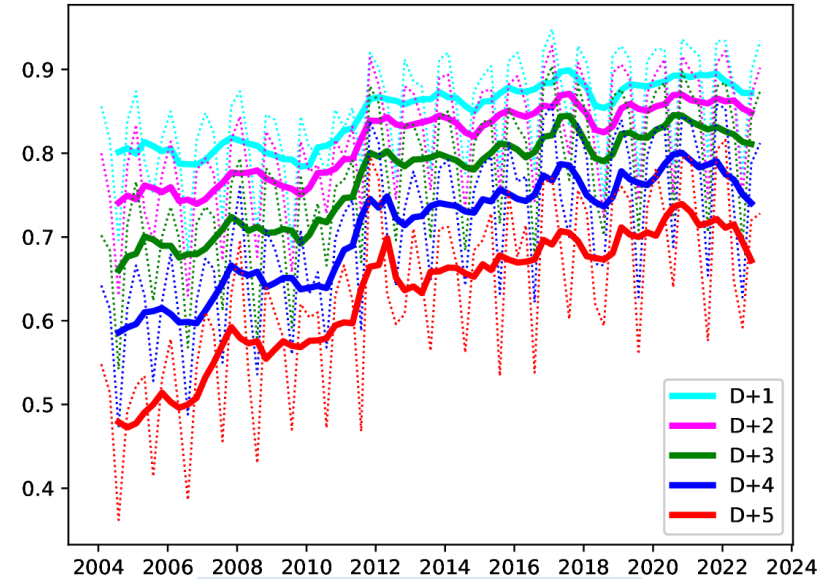
ROC skill



ROC skill

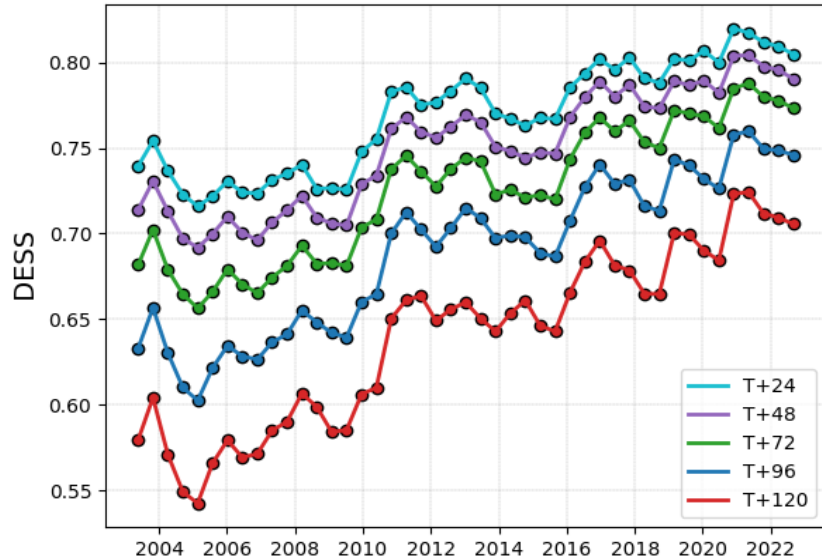


ROC skill



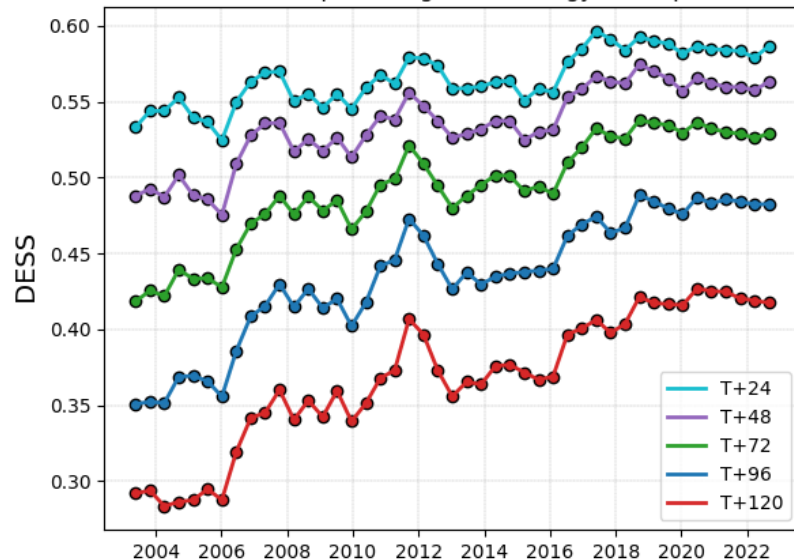
2m temperature

2 m temperature - eigenclimatology - 95% perc.



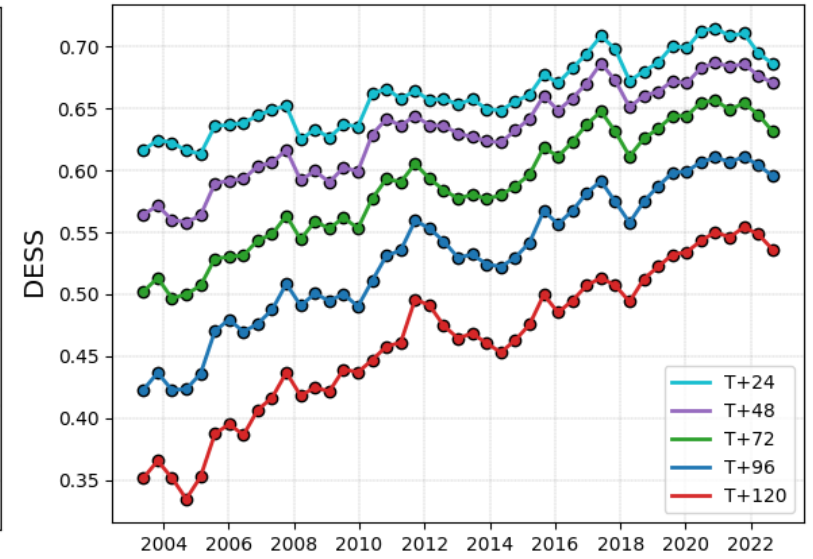
10m wind speed

10 m wind speed - eigenclimatology - 95% perc.

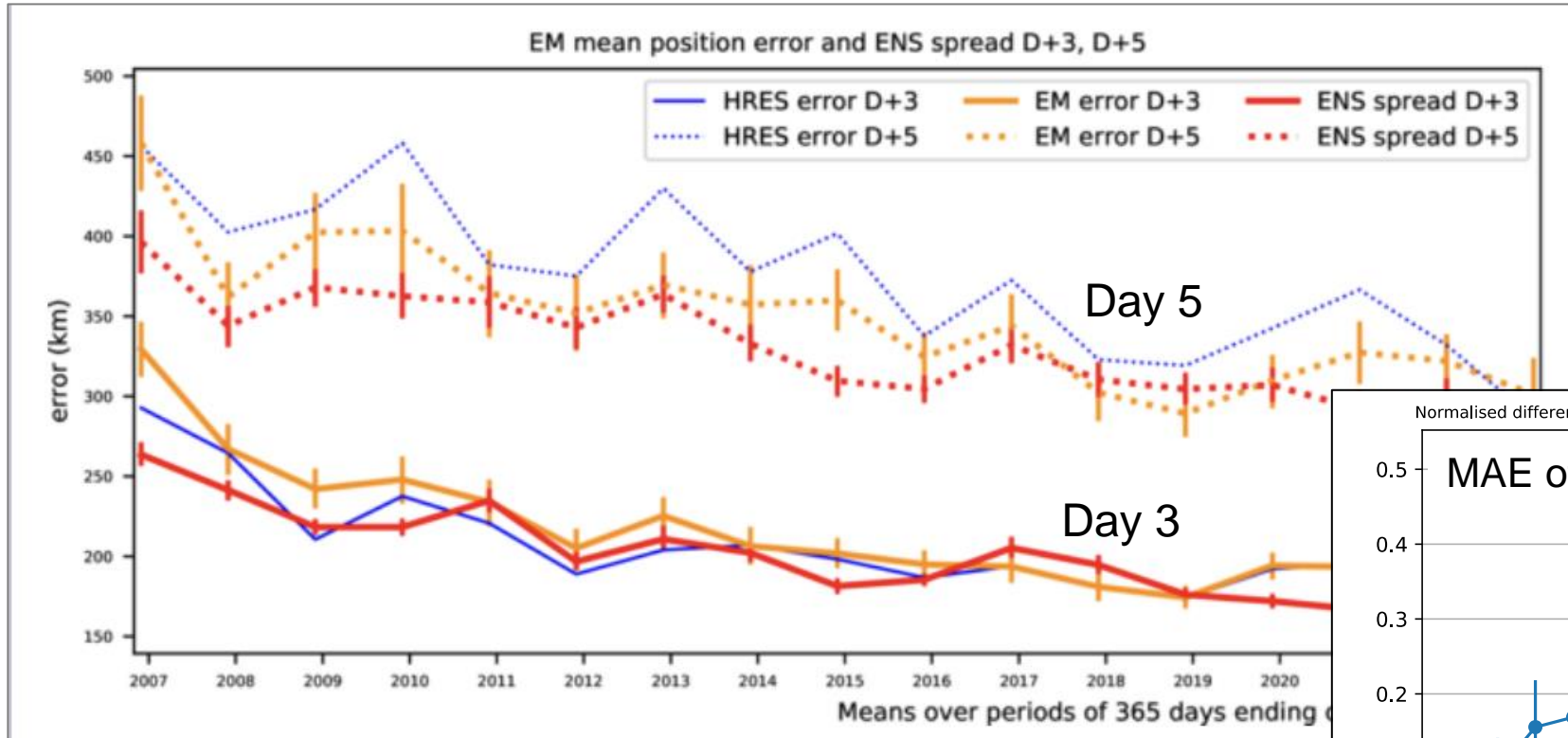


24h precipitation

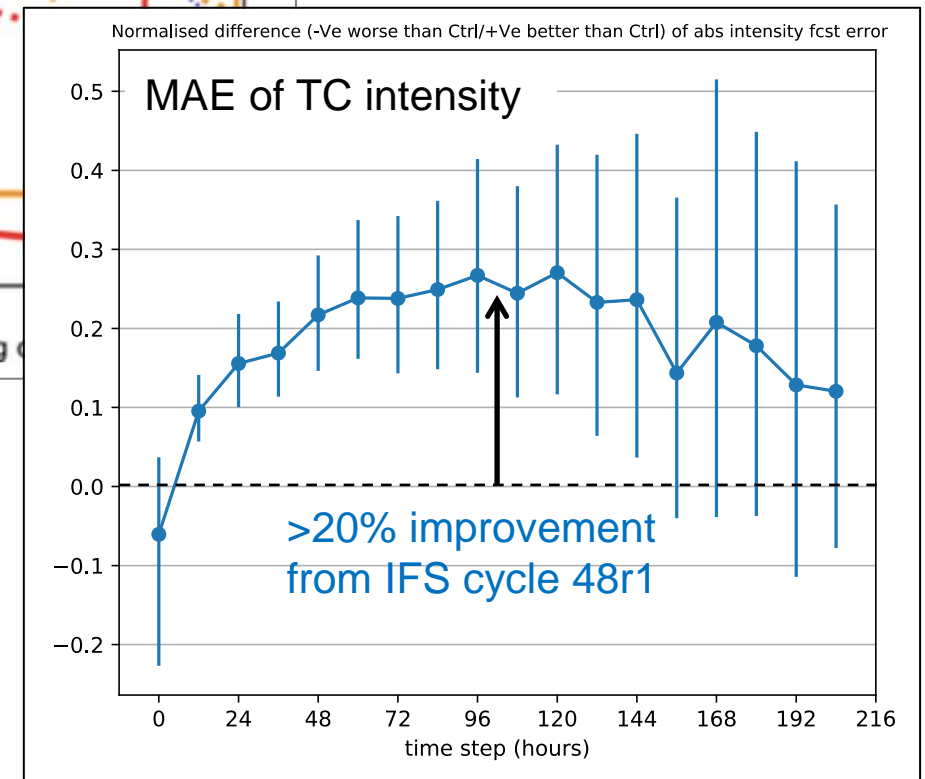
24h precipitation - eigenclimatology - 95% perc.



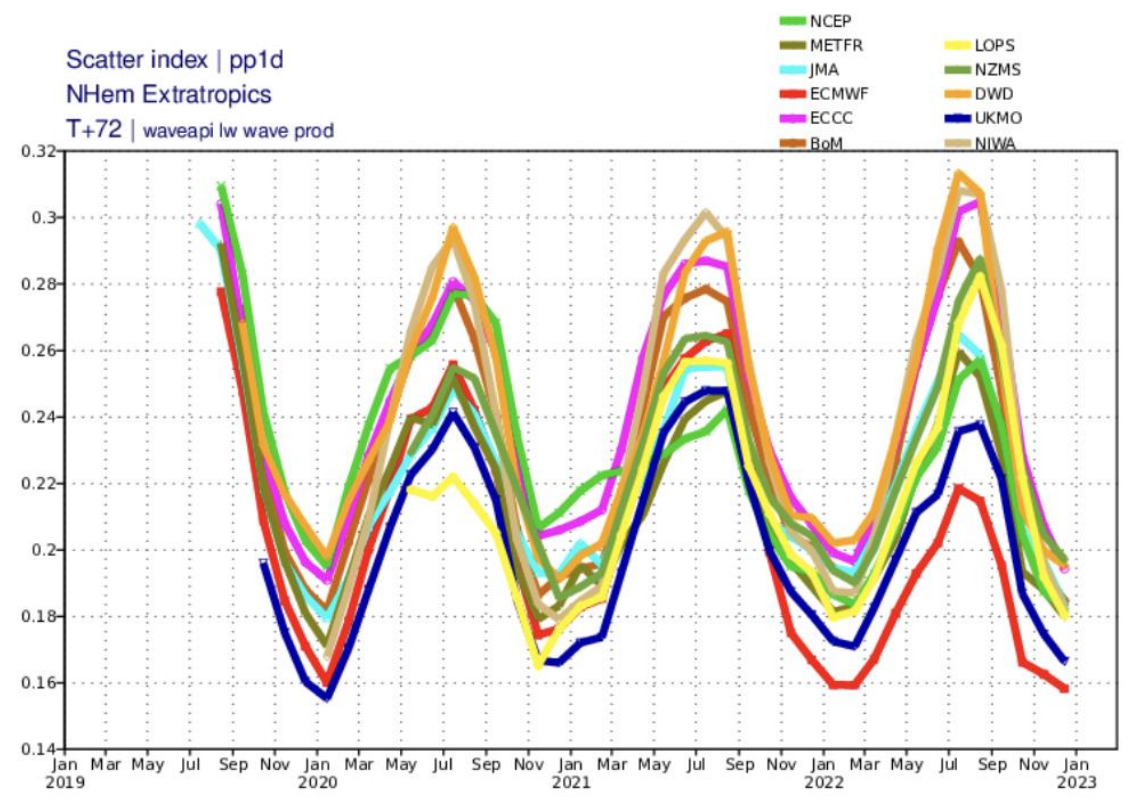
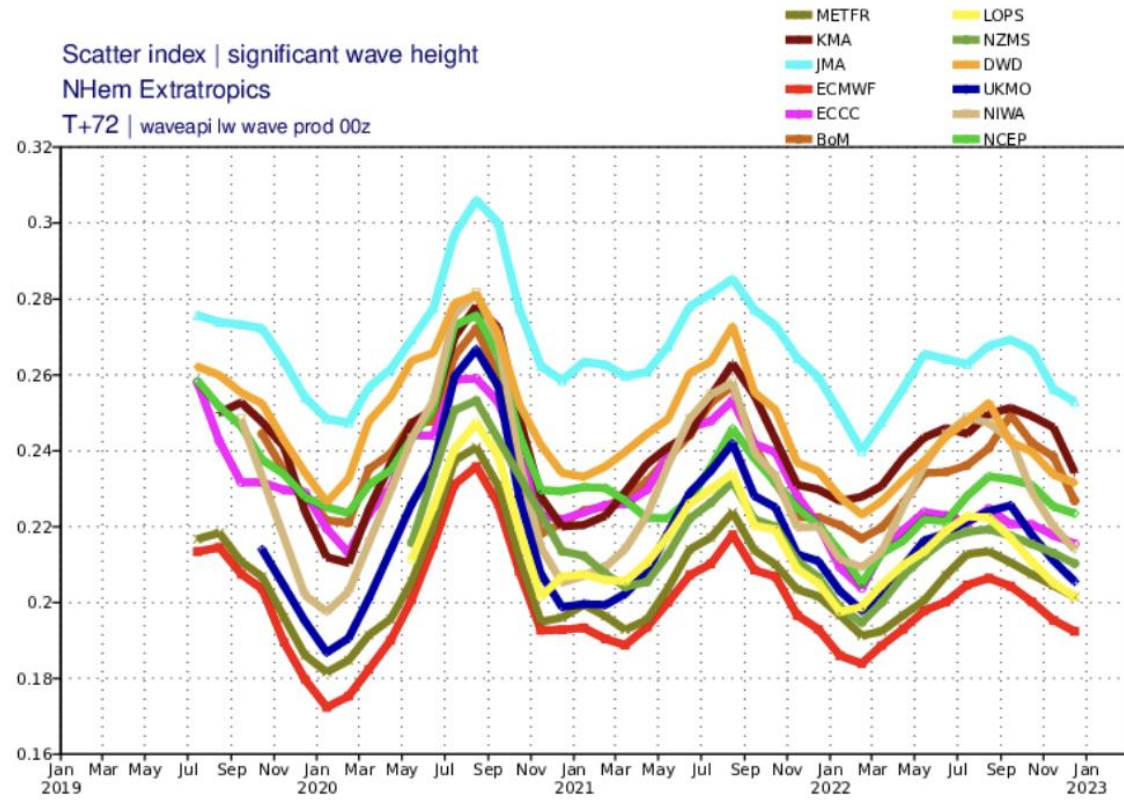
# Tropical cyclones: verification against IBTrACS



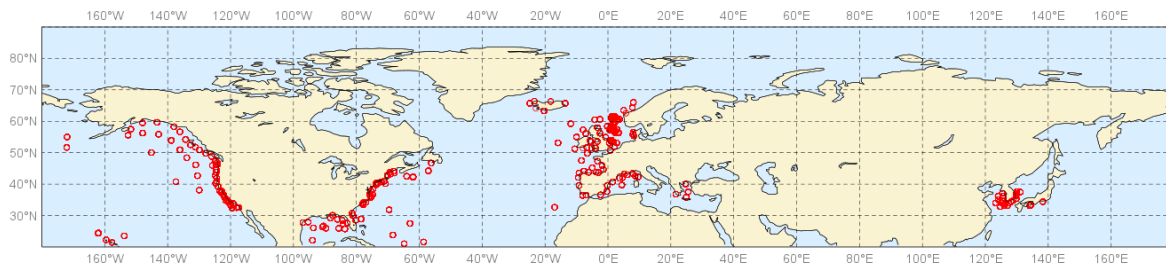
- Smallest TC position errors in the HRES so far
- ENS spread slightly too low (by about 10%)



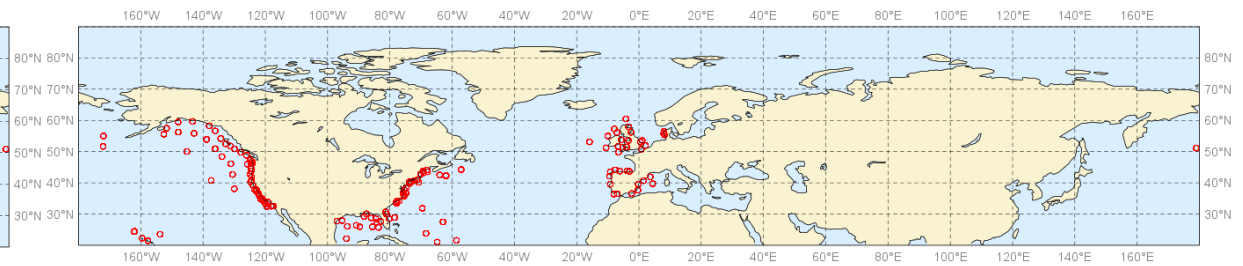
# Ocean wave forecast – N. Extratropics



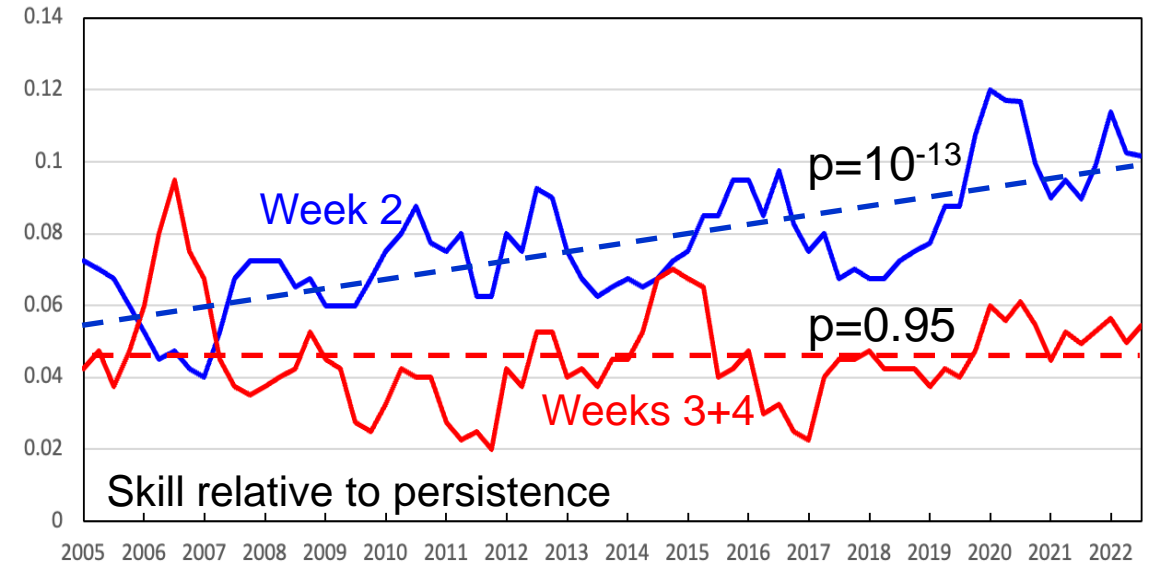
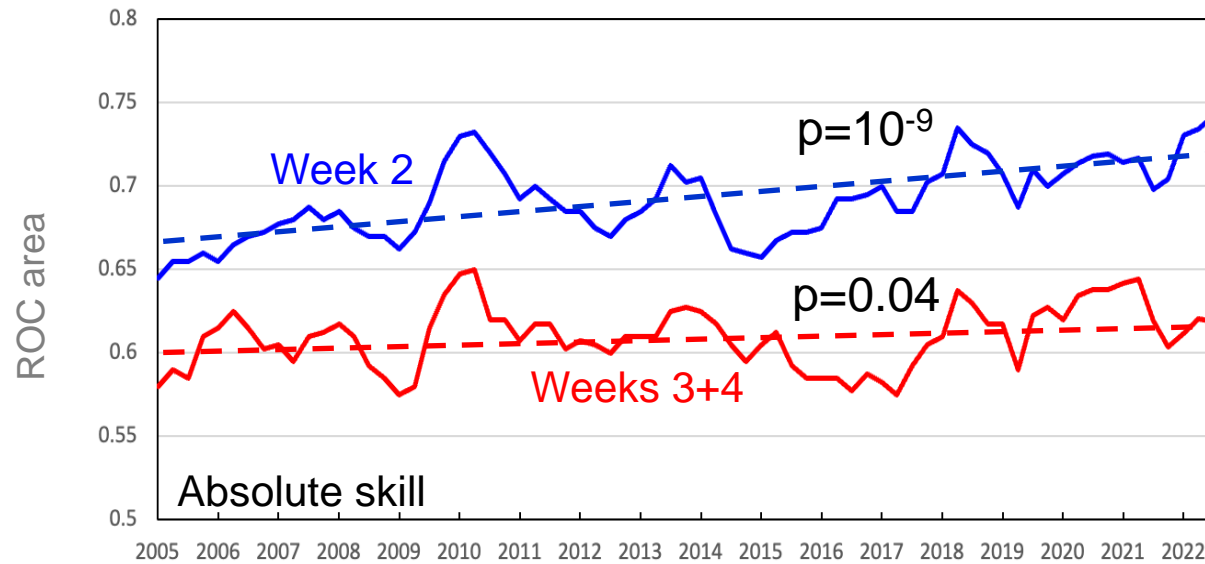
Significant wave height



Peak period



# Extended range: T2m ROC area (upper tercile)

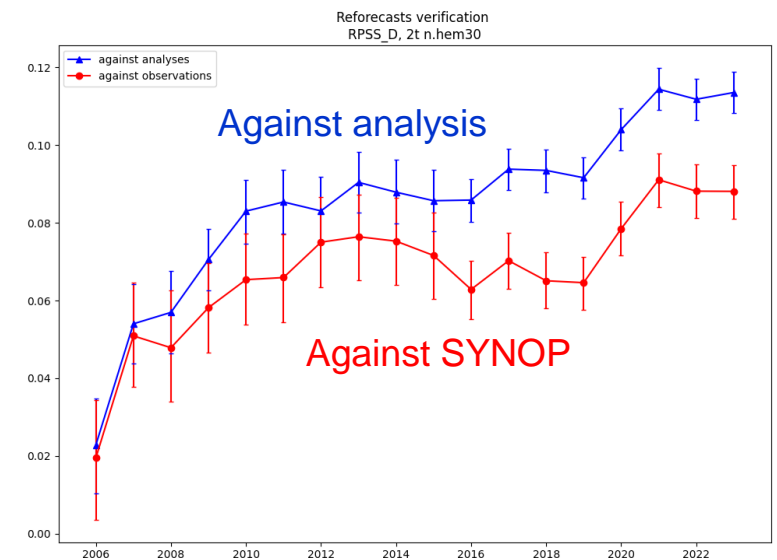


## Verification of real-time forecasts:

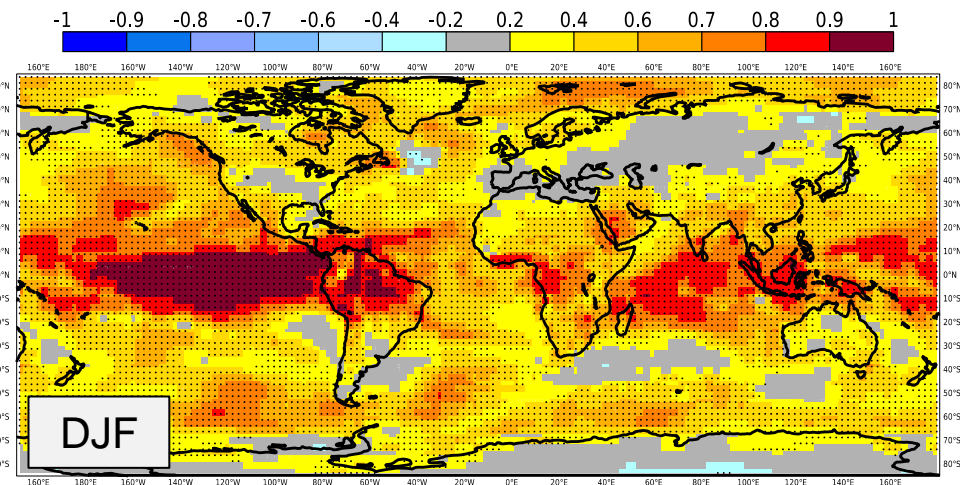
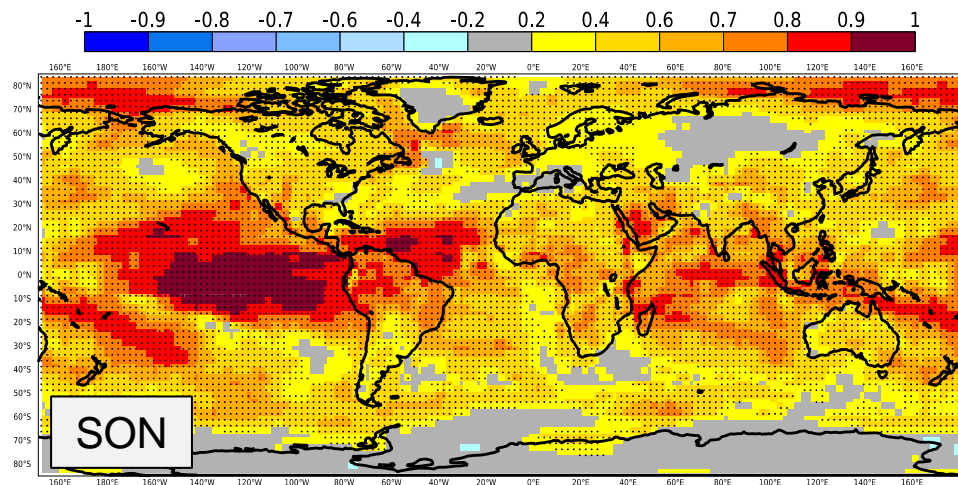
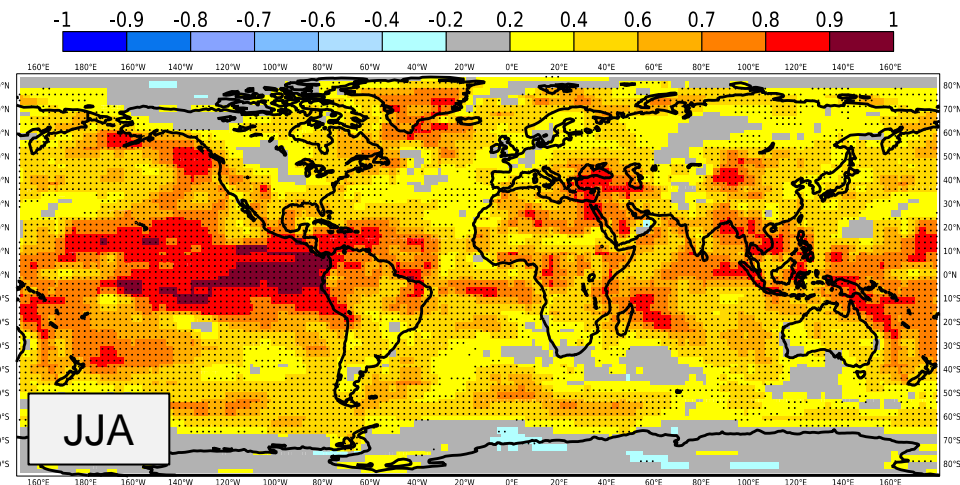
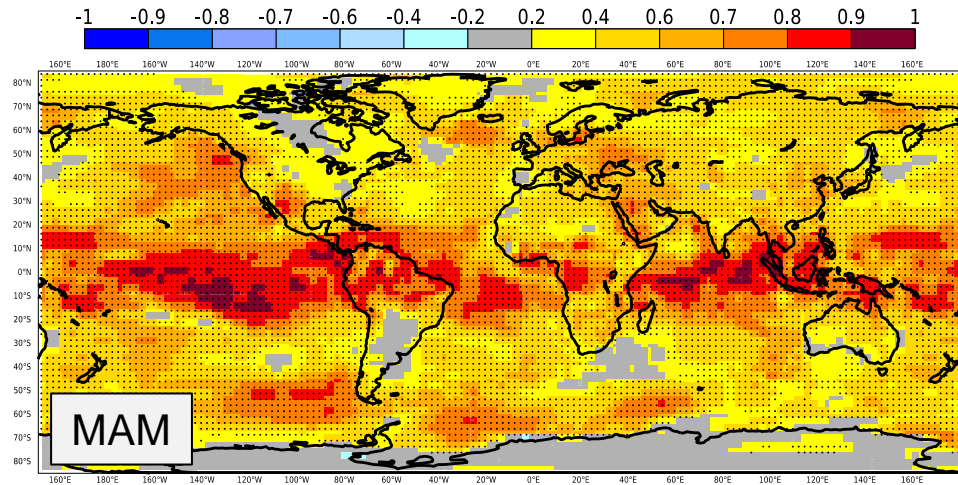
- Improving skill at week 2
- Skill in weeks 3+4 shows no significant trend

## Verification of re-forecasts:

- Improving skill at week 3



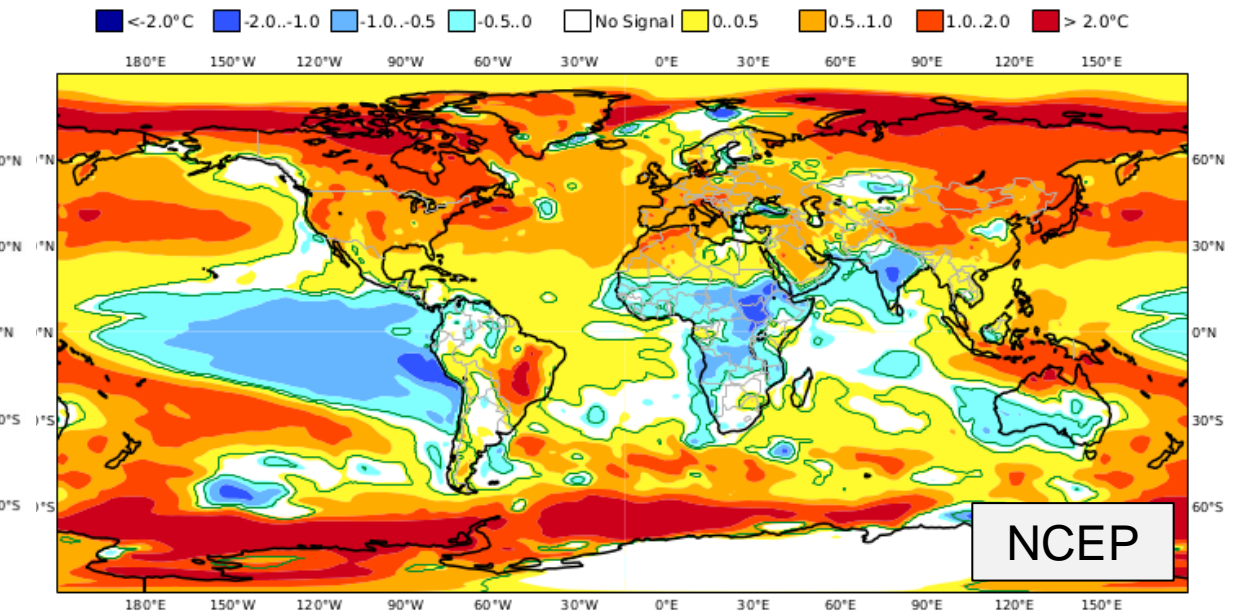
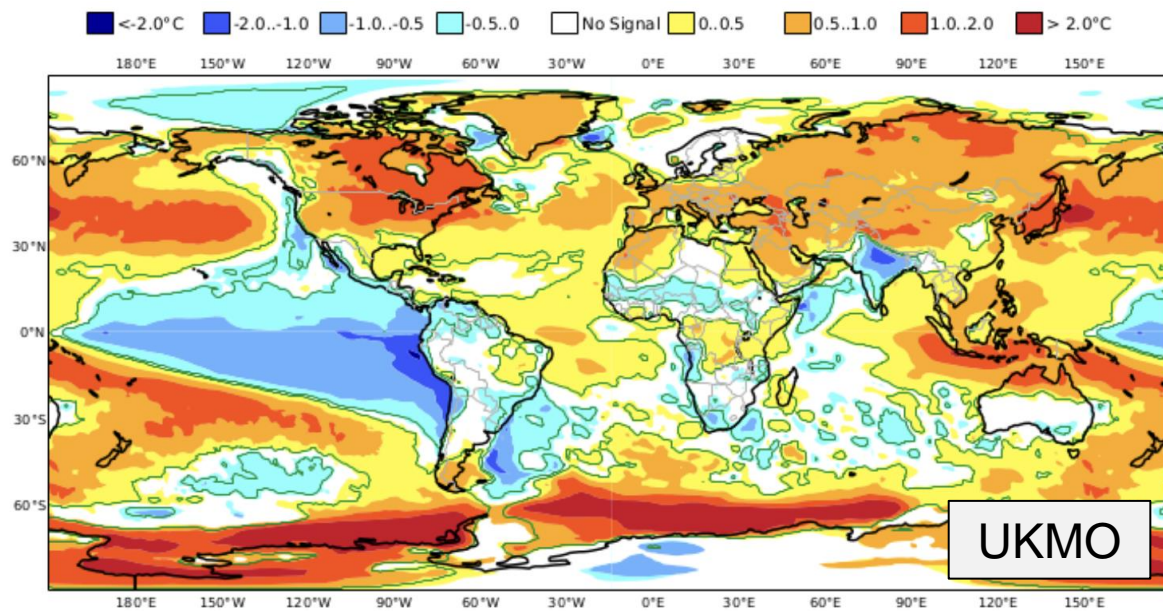
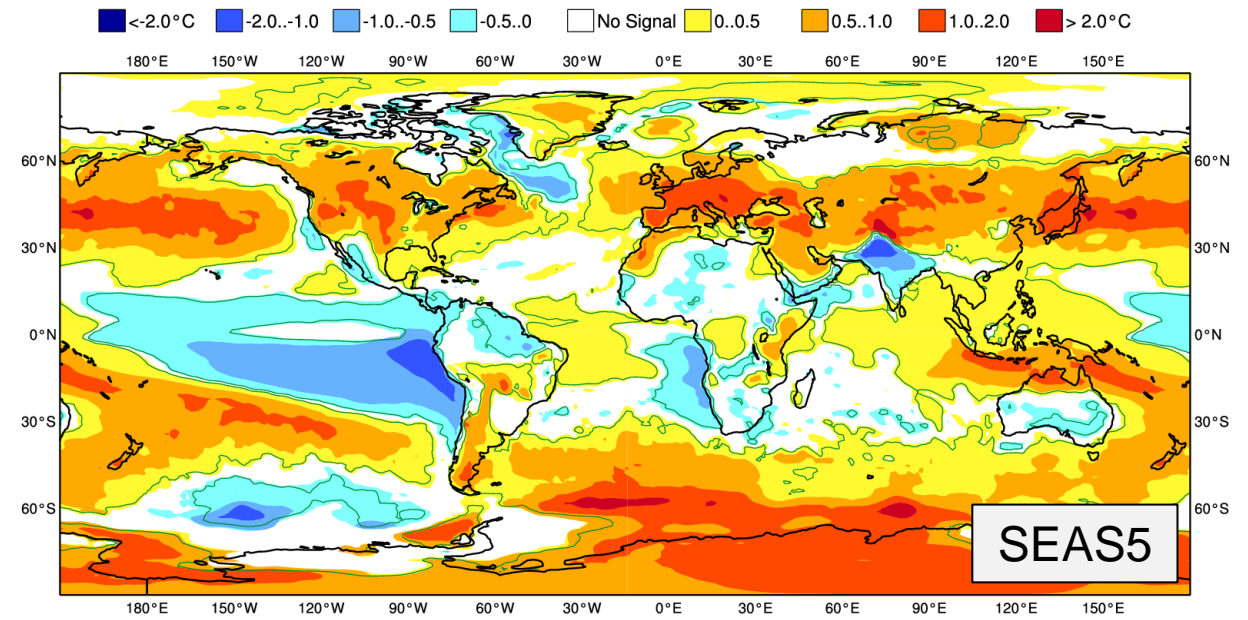
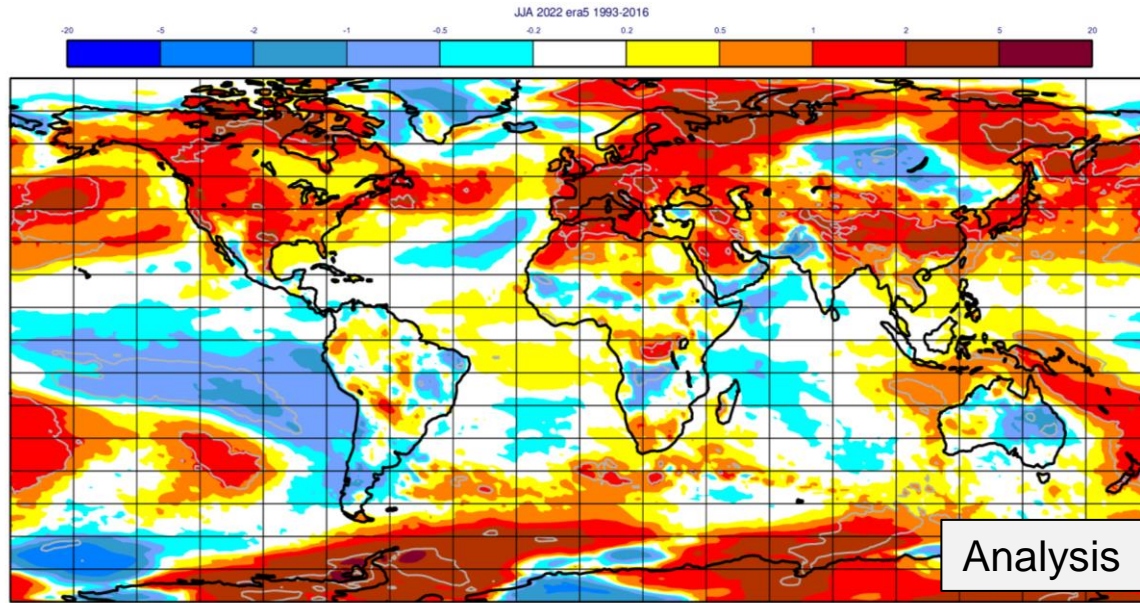
# ECMWF 2m temperature long-range forecast skill (SEAS5)



- Score: anomaly correlation of the ensemble mean
- Period: 1981-2016 hindcasts (25 members)
- Lead time: months 2-4

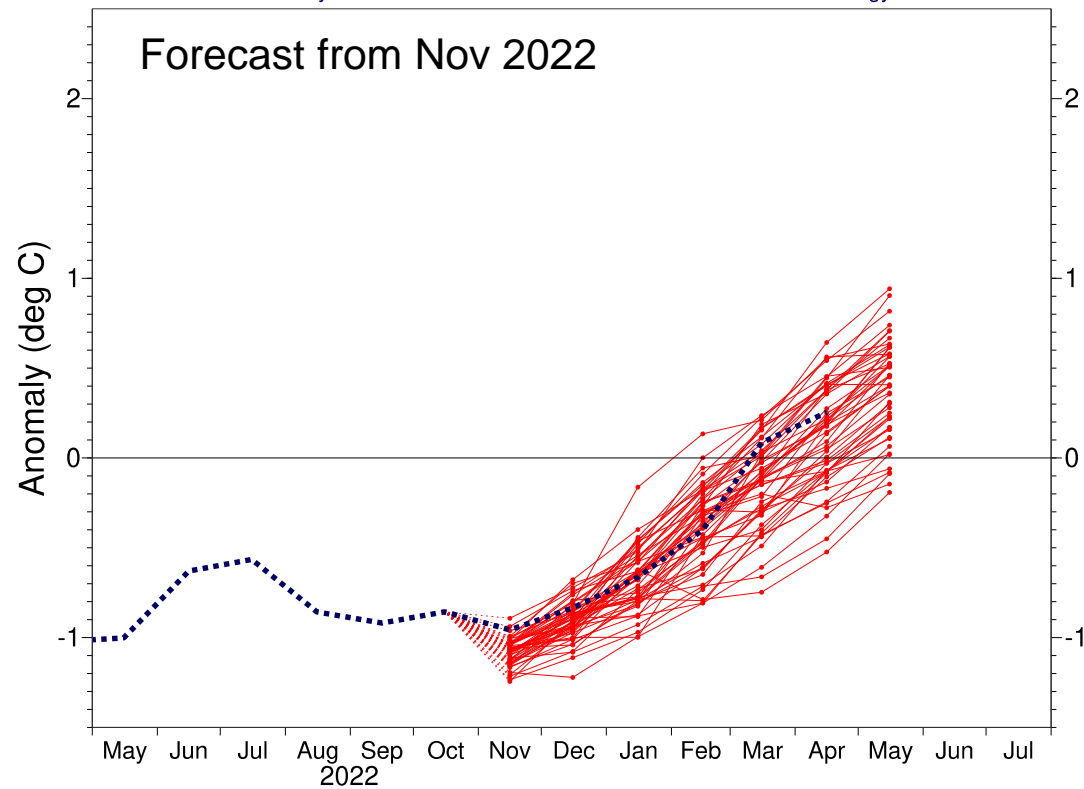
# T2m anomalies JJA 2022

relative to 1993-2016

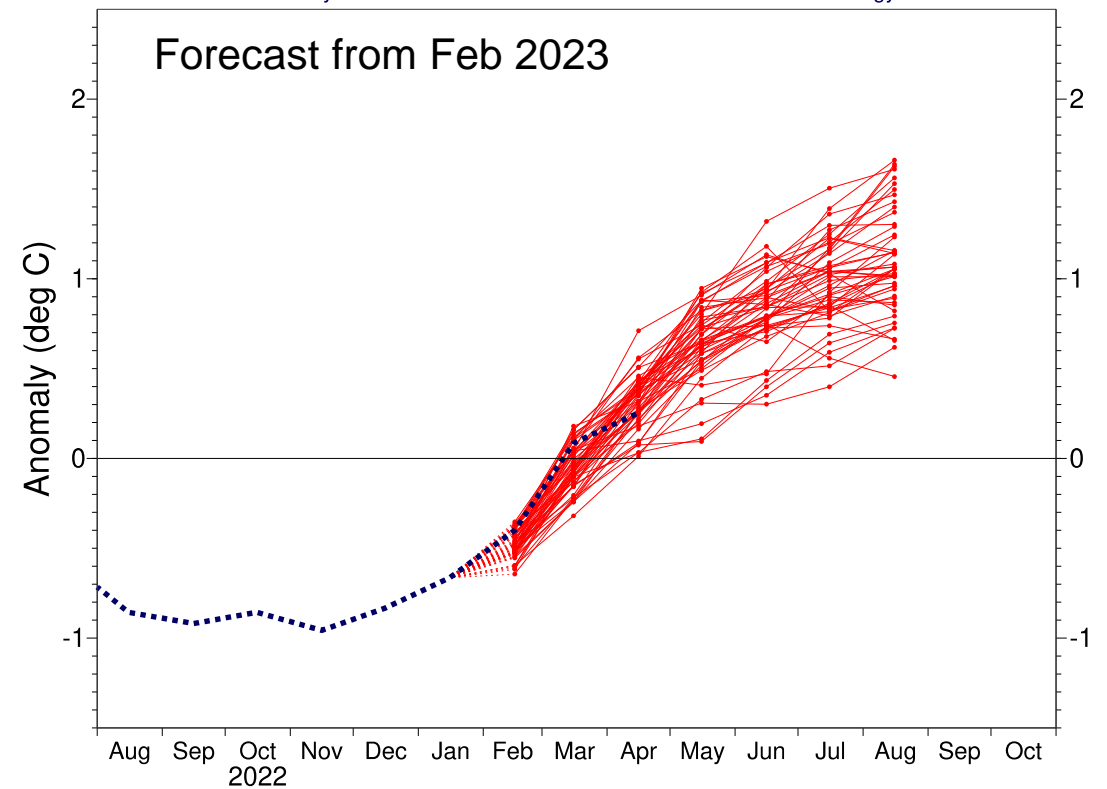


# El Nino forecast

NINO3.4 SST anomaly plume  
ECMWF forecast from 1 Nov 2022  
Monthly mean anomalies relative to ERA5 1981-2010 climatology



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



- Transition from La Nina to El Nino well predicted
- Correct timing and good ensemble sharpness
- Earlier in 2022, transition was predicted to happen too soon



# More verification results

The screenshot shows the ECMWF Charts catalogue interface. The left sidebar contains a search bar and several filter categories: Range (Medium, Extended, Long), Type (Forecasts, Verification), Component (Surface, Atmosphere), and Product type. The 'Verification' checkbox under the 'Type' category is highlighted with a red box and a red arrow. The main content area displays three product cards, each with a map thumbnail, a 'Latest forecast' label, a title, a description, and an 'ADD TO CHARTSET' button. The products are: 1. Mean sea level pressure and 850 hPa wind speed; 2. 500 hPa geopotential height and 850 hPa temperature; 3. 2 m temperature and 30 m wind.

The image shows the cover of a Technical Memo from the ECMWF. The title is '902 Evaluation of ECMWF forecasts, including the 2021 upgrade'. The authors listed are T. Haiden, M. Janousek, F. Vitart, Z. Ben Bouallegue, L. Ferranti, F. Prates, and D. Richardson. The date is September 2022. The cover features the ECMWF logo and a green background with white text.

WMO Lead Centre for Deterministic NWP Verification (LC-DNV)

WMO Lead Centre for Wave Forecast Verification (LC-WFV)