

ECMWF forecast performance

55th TAC, 19-20 Oct 2023

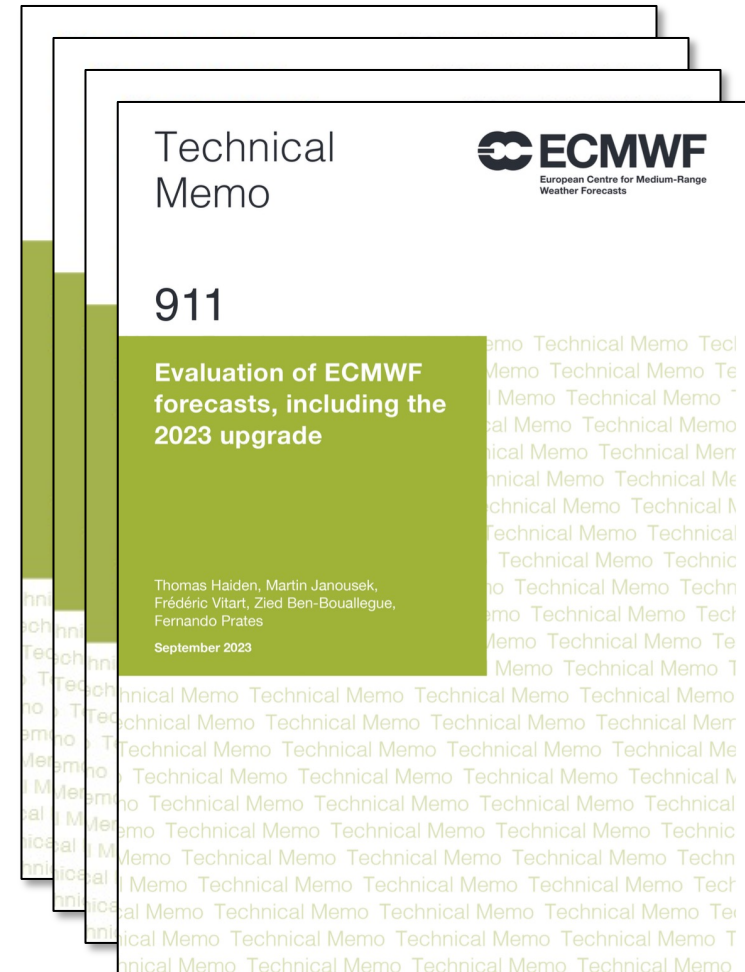
Thomas Haiden

Evaluation Section, Forecast Department

Please send feedback to: thomas.haiden@ecmwf.int

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- Medium-range forecast
 - Upper-air (11)
 - Weather parameters (18)
- Extended-range forecast (3)
- Seasonal forecast (3)

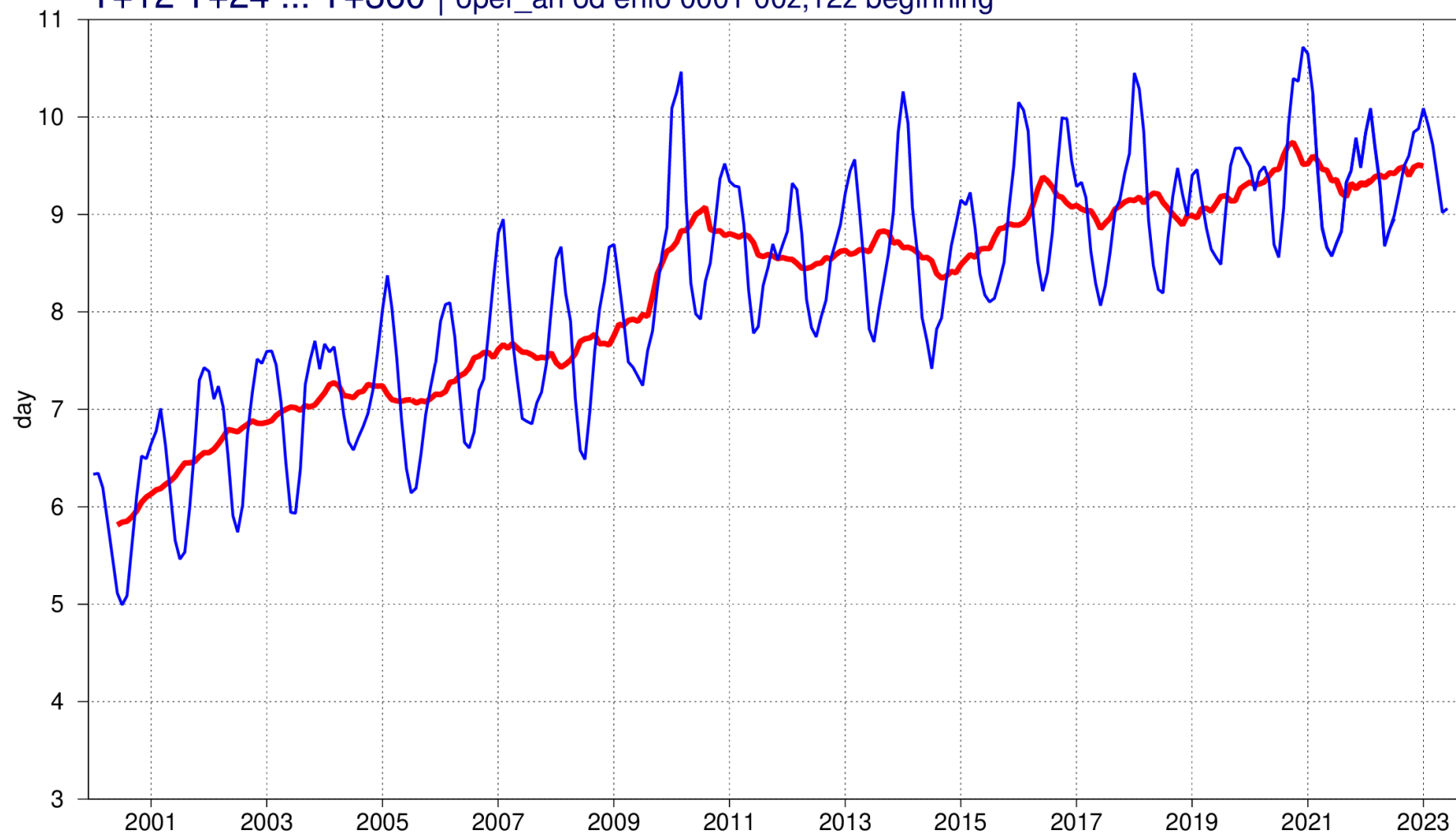


T850 hPa ENS performance

Continuous ranked probability skill score | 850hPa temp

NHem Extratropics

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

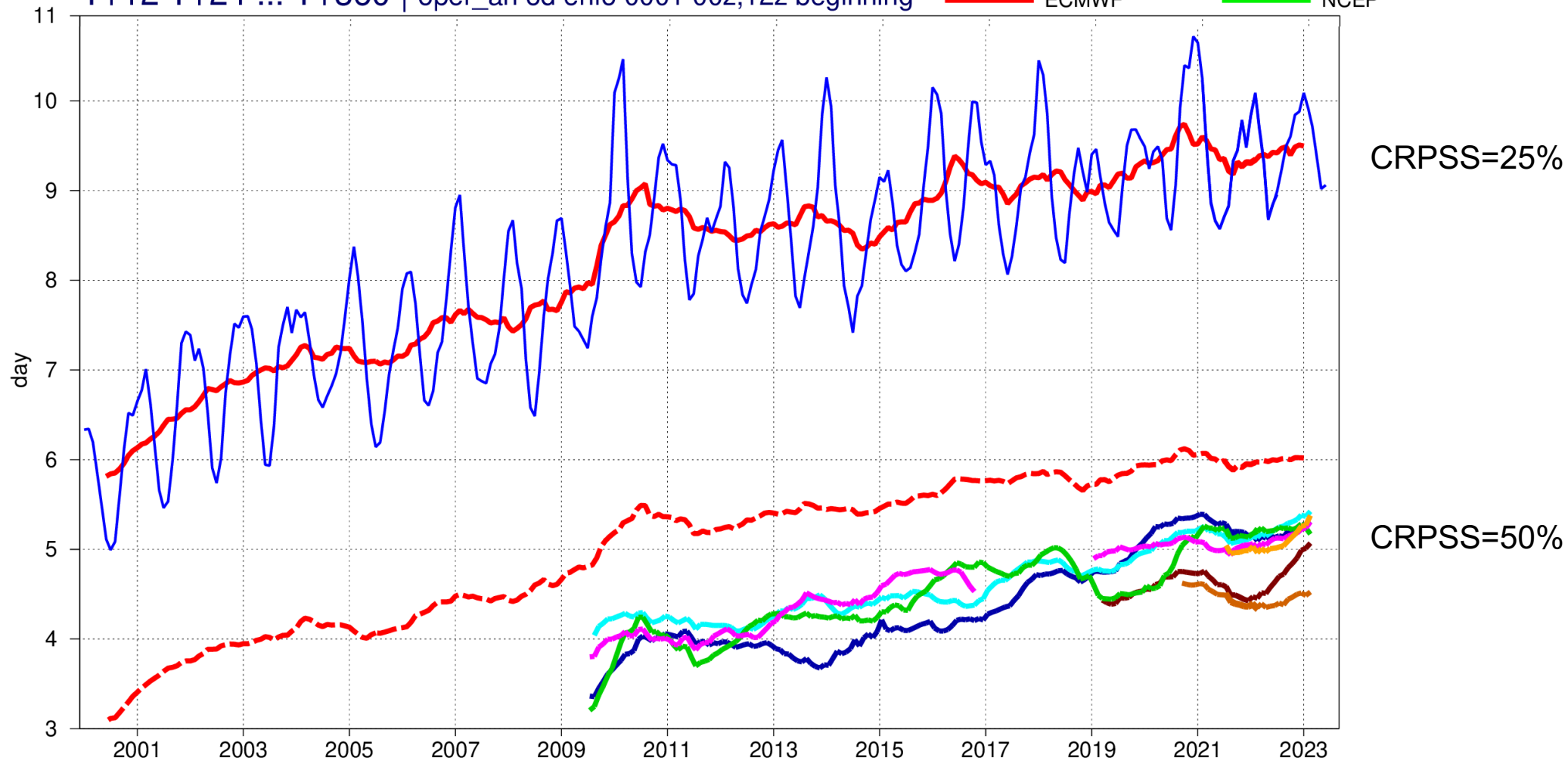


CRPSS=25%

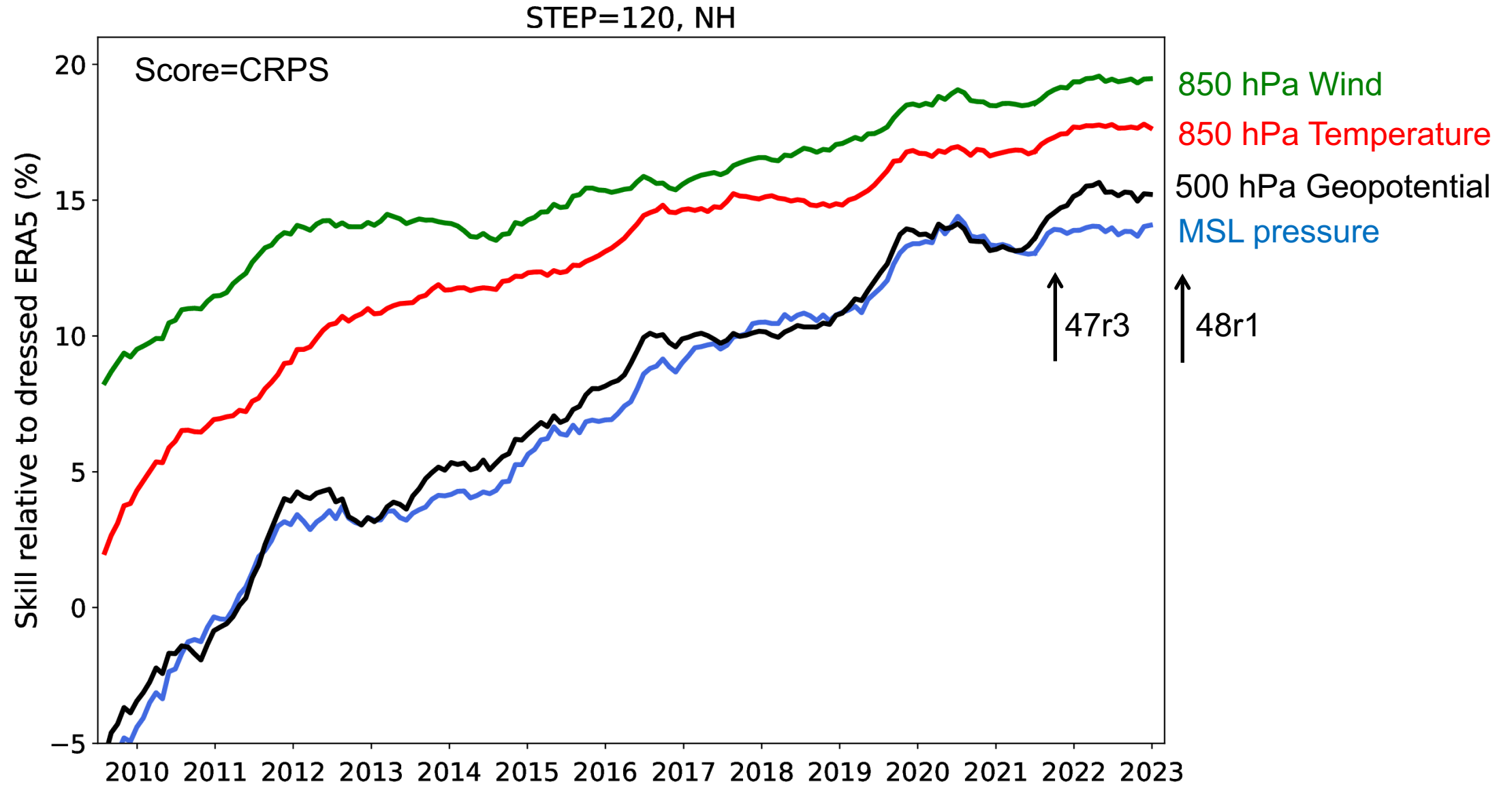
T850 hPa ENS performance

Continuous ranked probability skill score | 850hPa temp
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T+12 T+24 ... T+360 | oper_ano d enfo 0001 00z,12z beginning

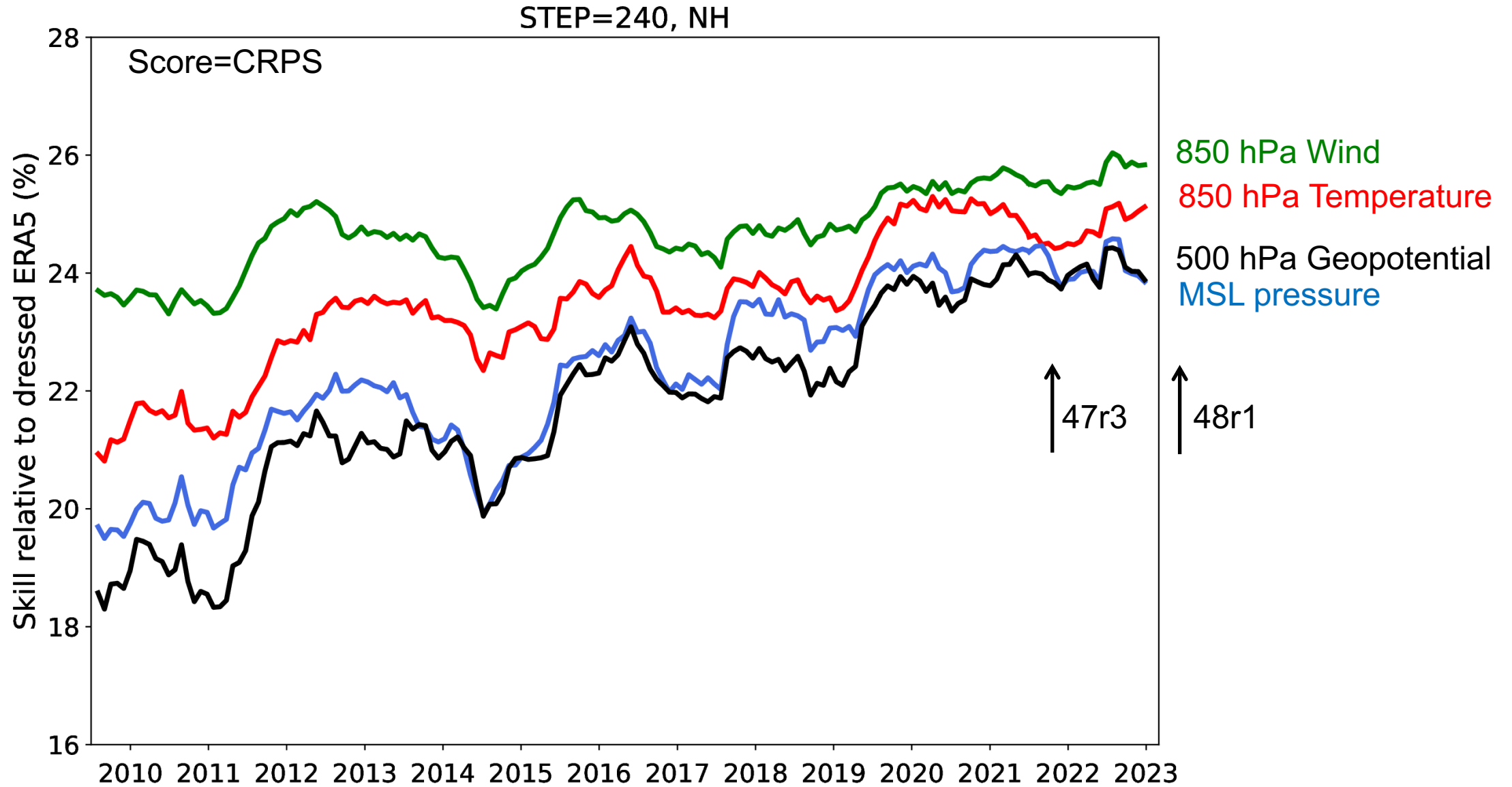
- DWD
- CMC
- JMA
- UKMO
- ECMWF
- ERA5
- BoM
- KMA
- NCEP



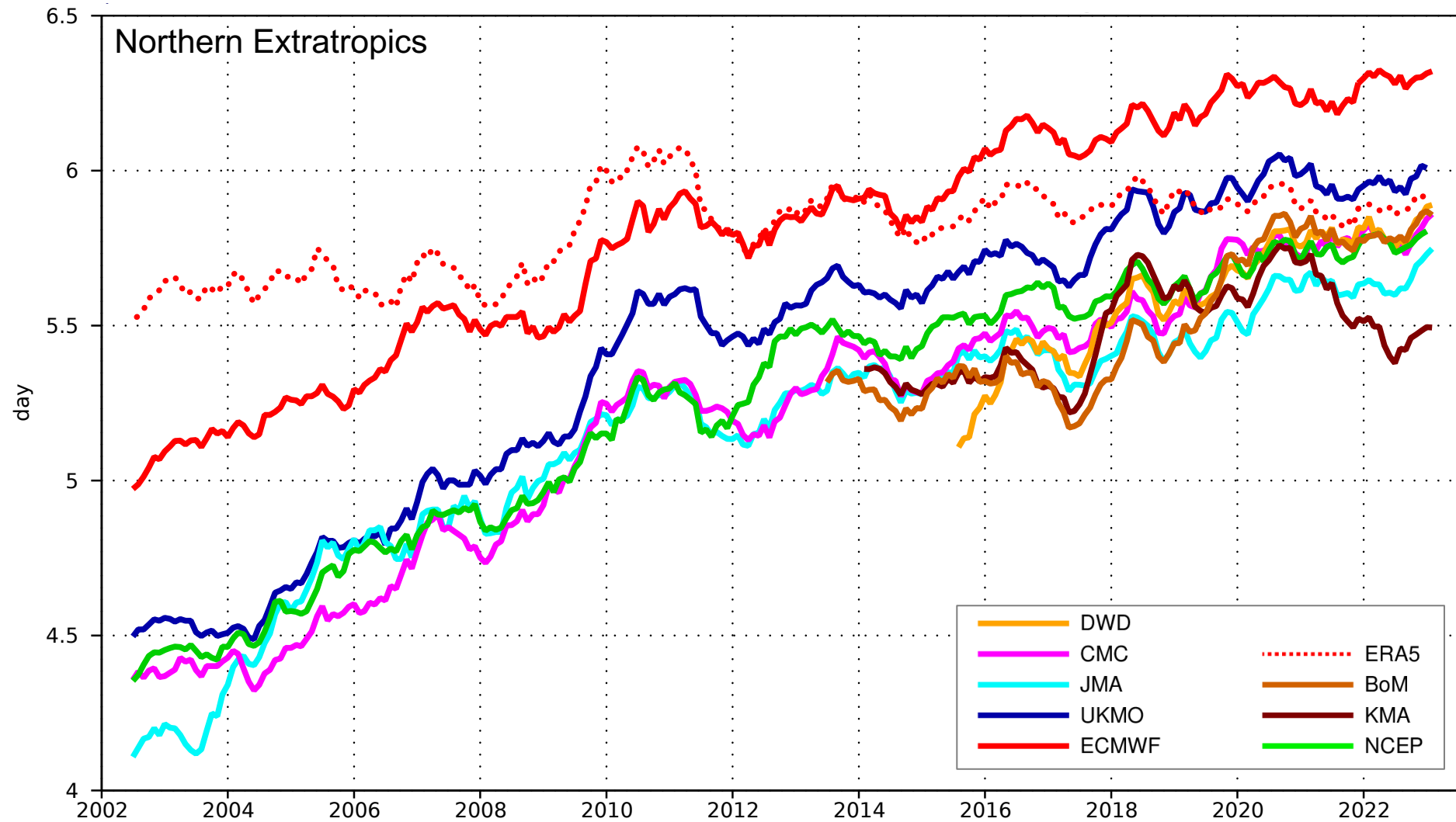
ENS skill relative to dressed ERA5 – Day 5



ENS skill relative to dressed ERA5 – Day 10



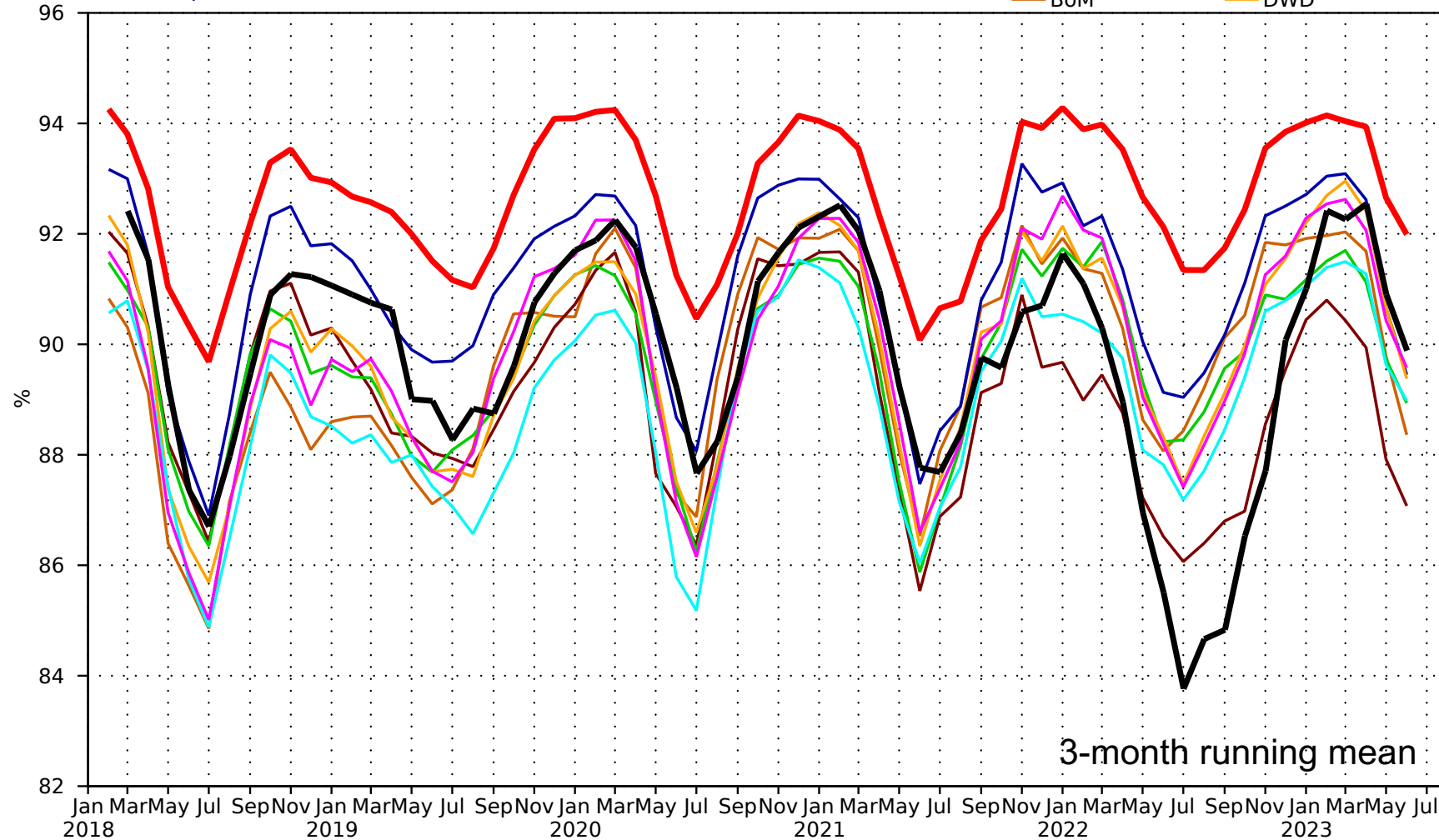
Anomaly correlation of 500 hPa geopotential reaching 85%



CAMS: 500 hPa Geopotential (ACC at Day 5)

Anomaly correlation | 500hPa geopotential
NHem Extratropics
T+120 | 0001

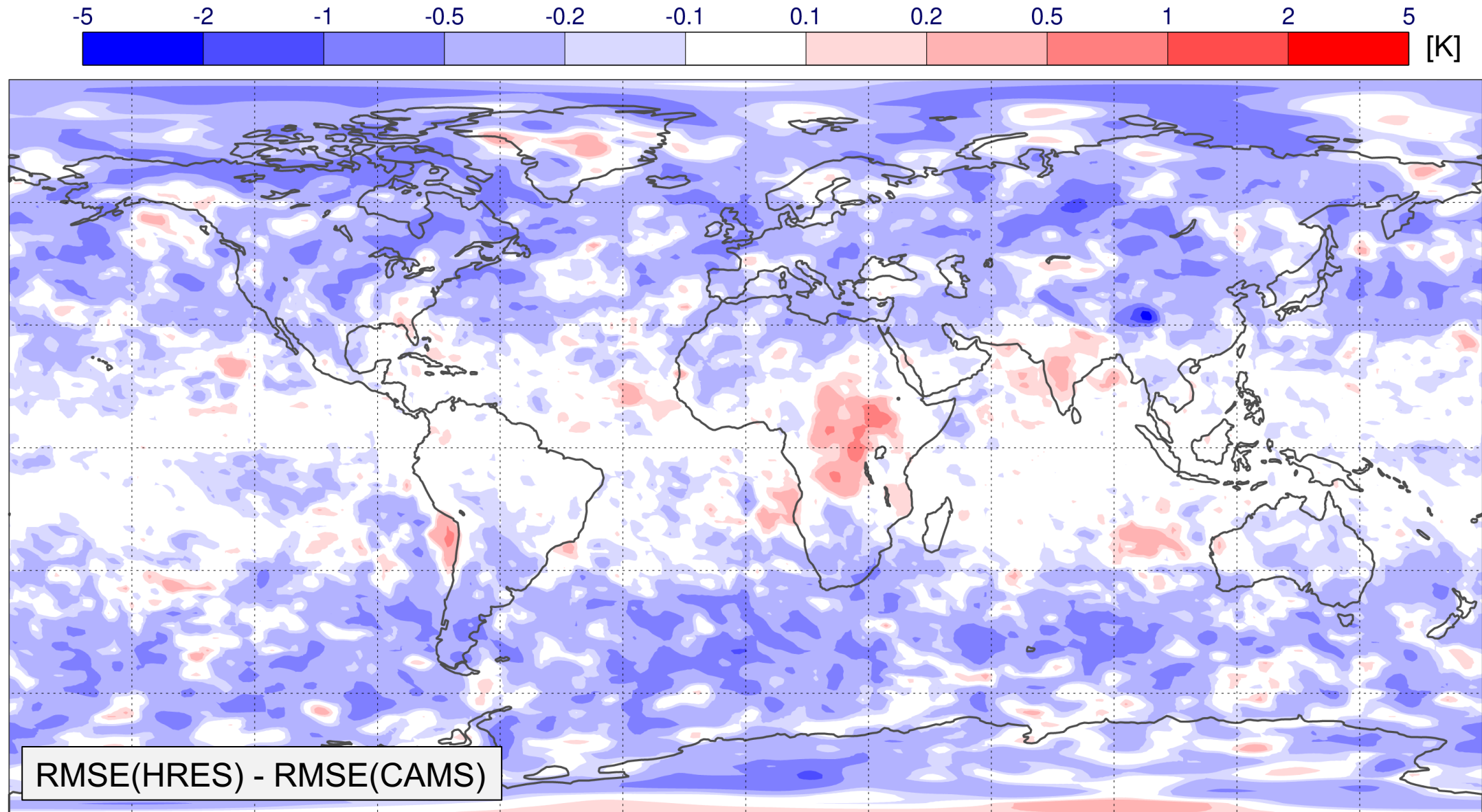
- NCEP
- UKMO
- HRES
- KMA
- BoM
- CAMS
- CMC
- JMA
- DWD



3-month running mean

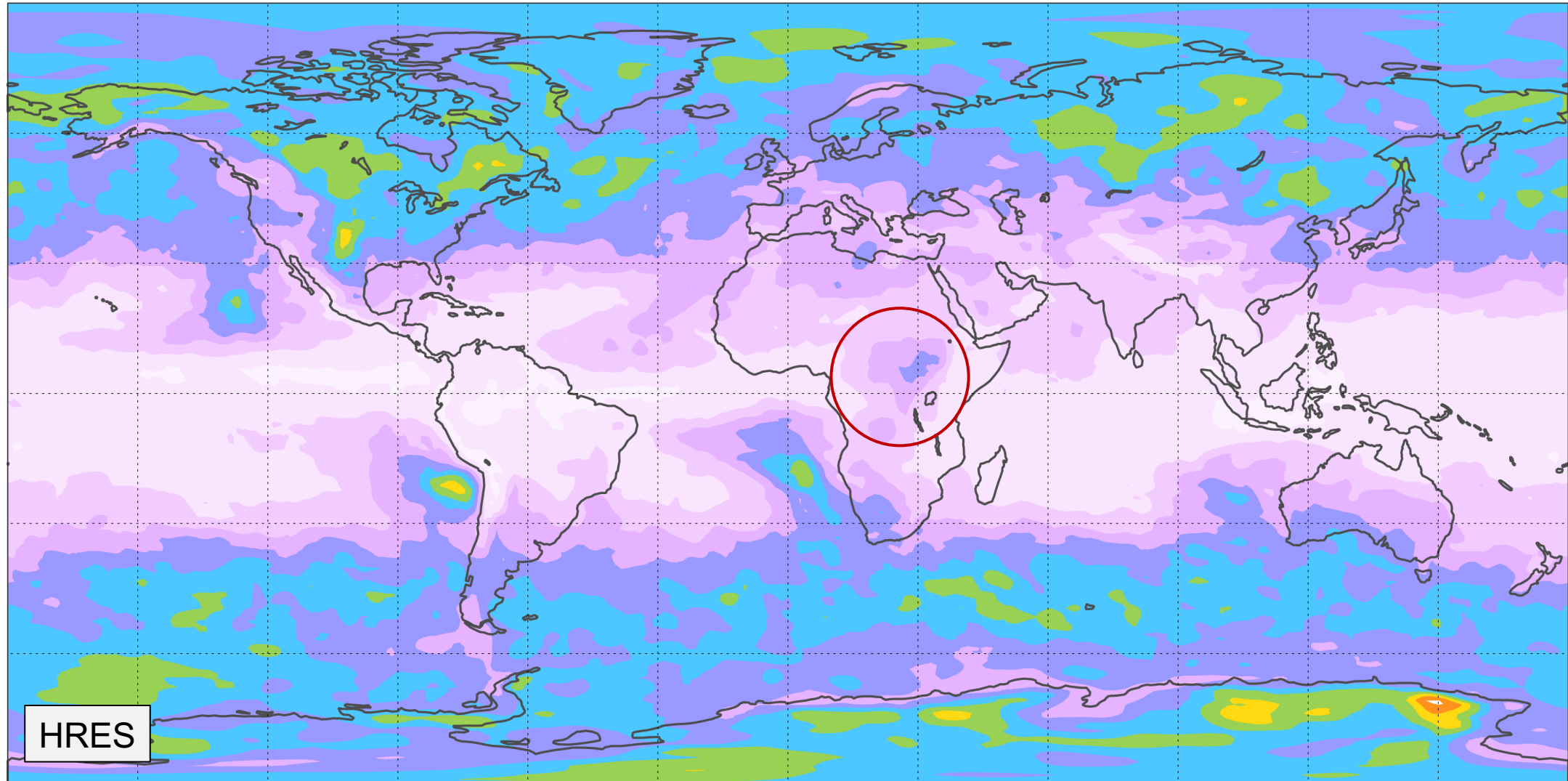
850 hPa Temperature (RMSE at Day 5)

Period: Jan-May 2023



850 hPa Temperature (RMSE at Day 5)

Period: Jan-May 2023

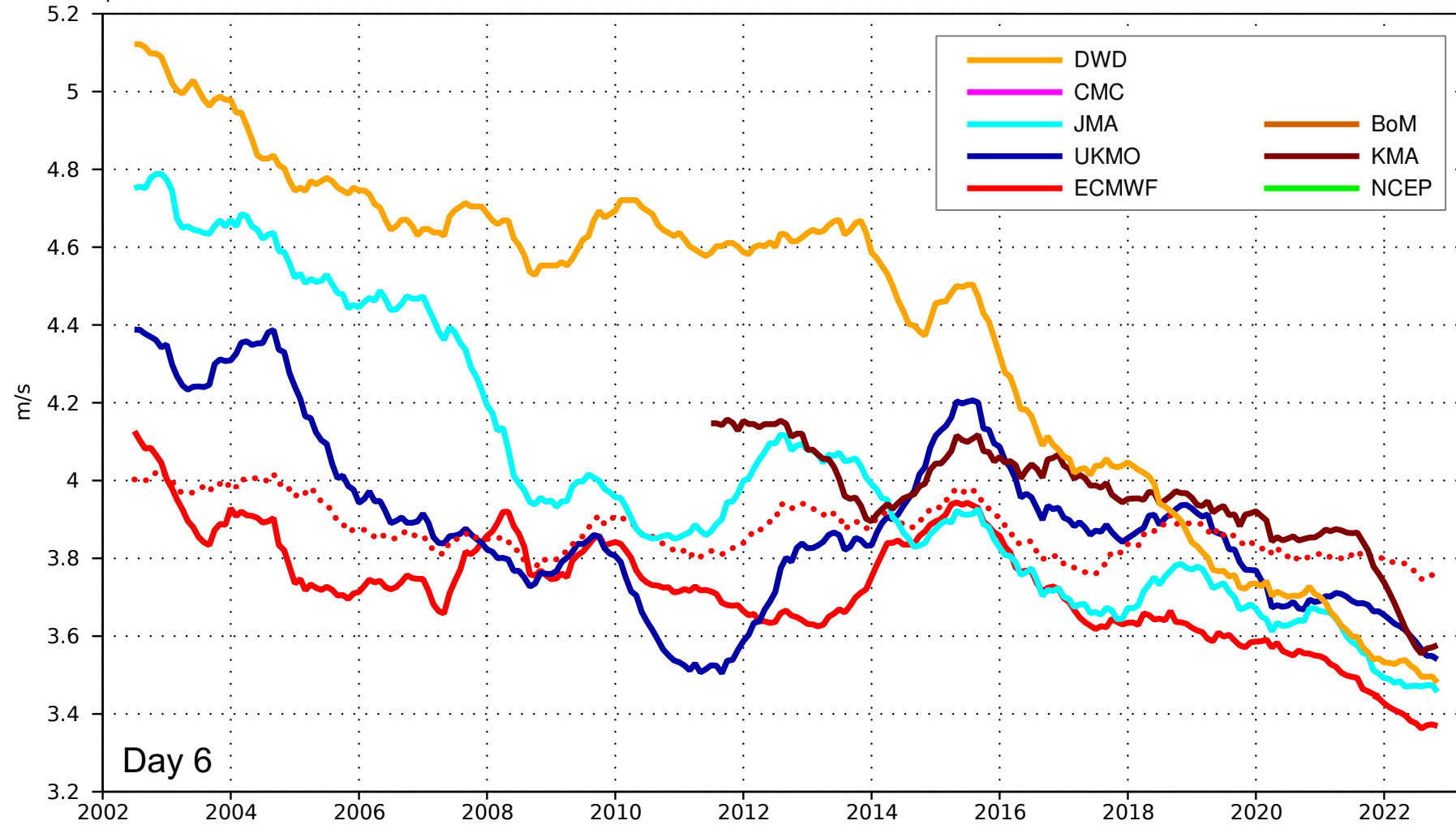


Tropics: RMSE of 850 hPa vector wind

Root mean square error | 850hPa

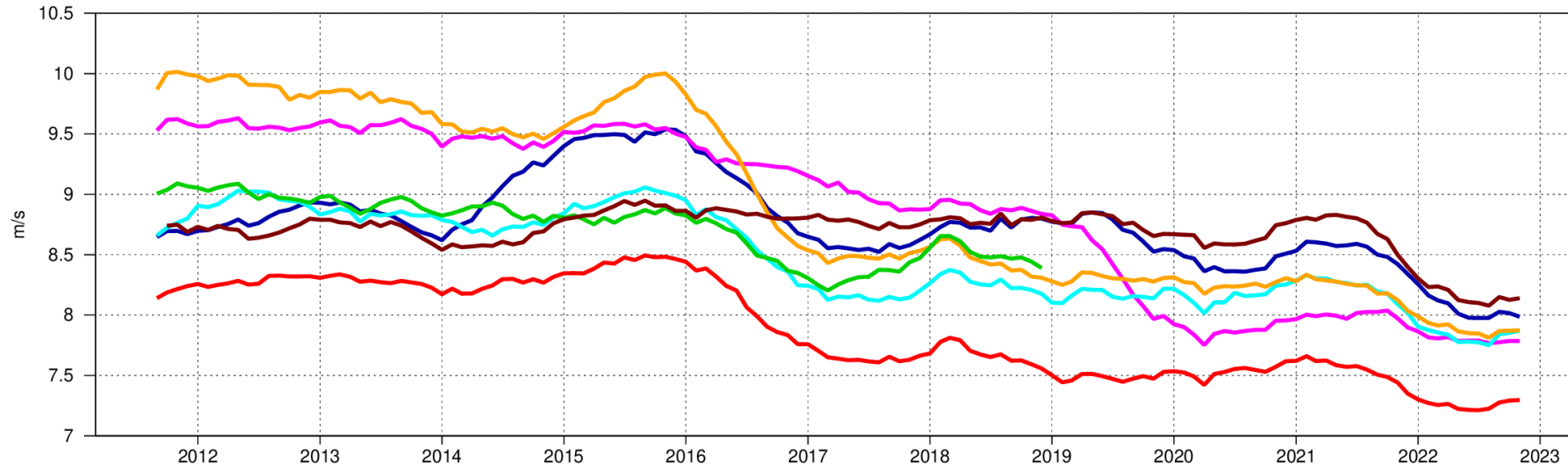
Tropics

| 00z,12z



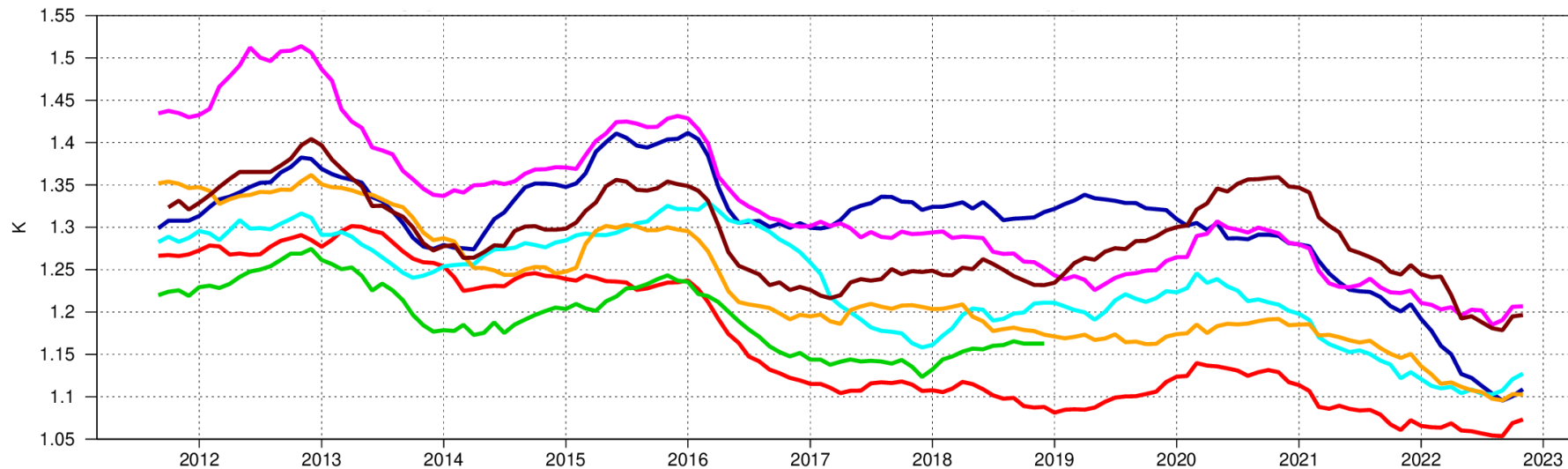
Tropics - verification against radiosondes

250hPa vector wind
Root mean square error



250 hPa wind

Day 6



850 hPa
temperature

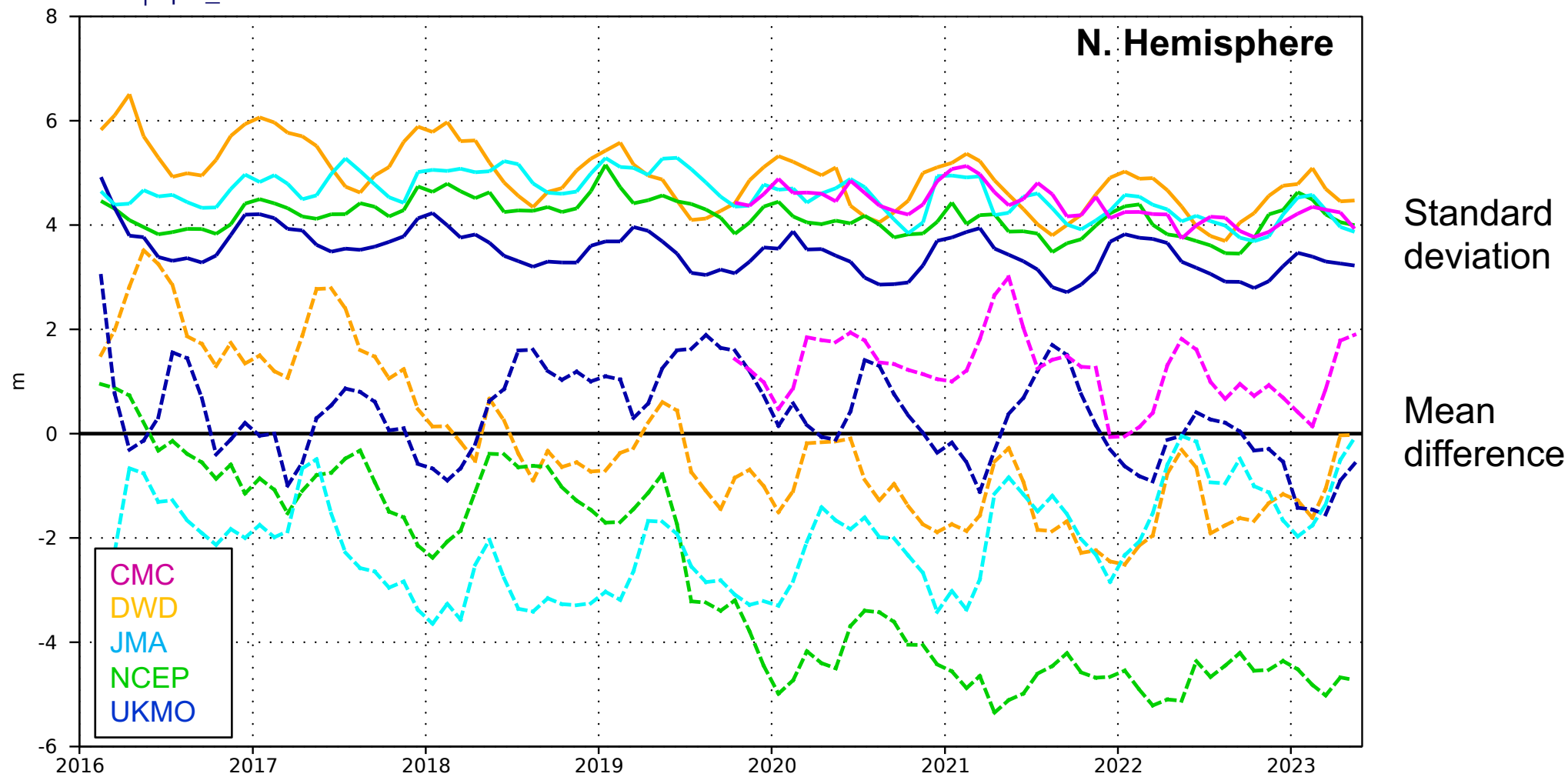
Analysis comparison

Comparison of analyses between centres: Z500

| 500hPa geopotential

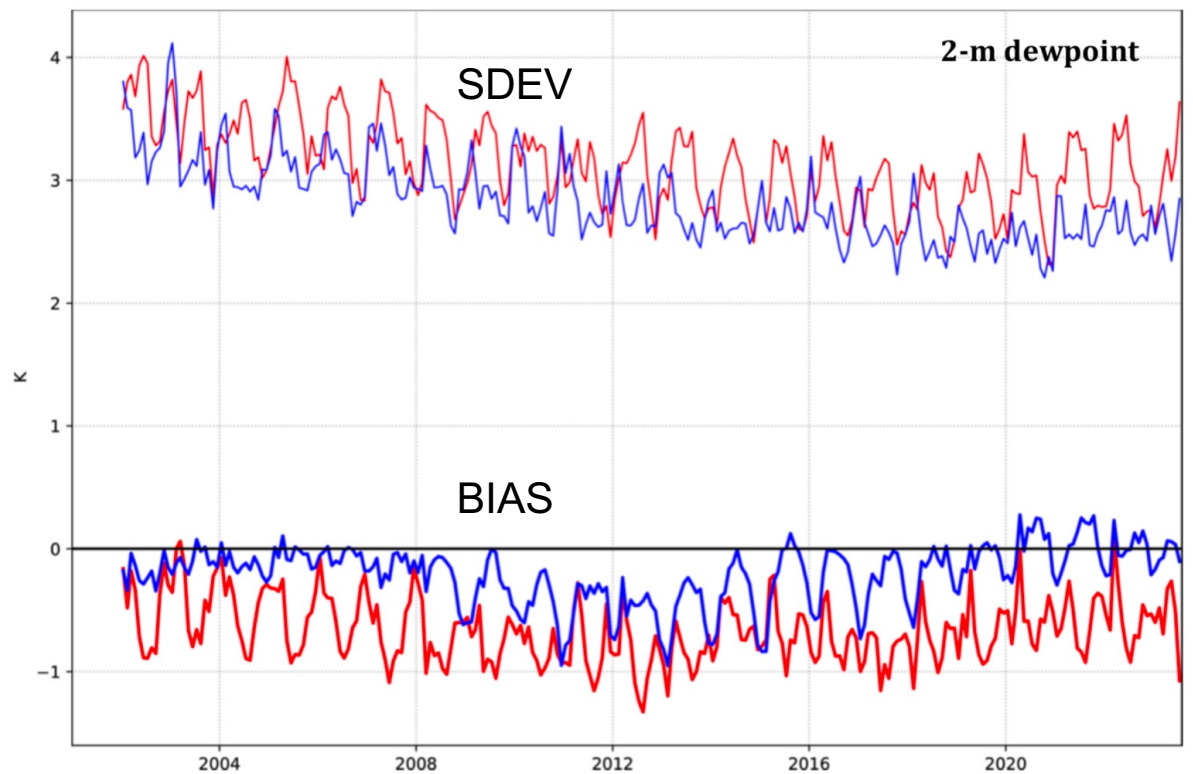
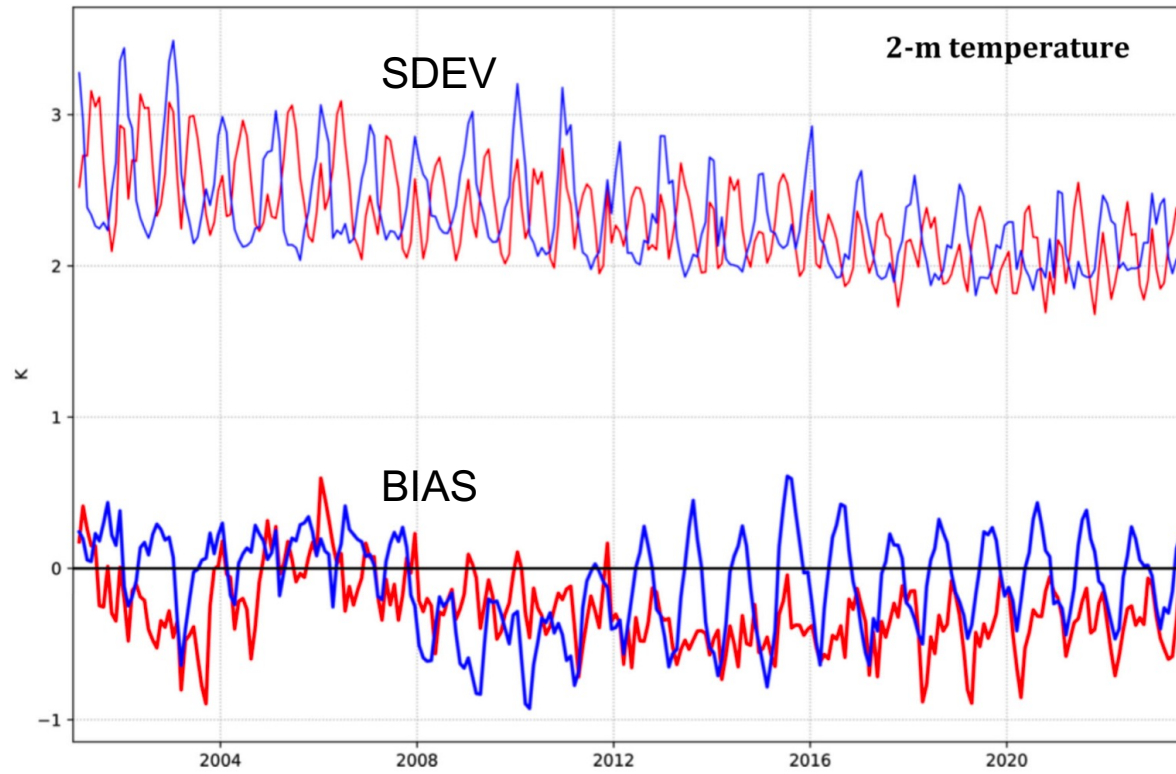
NHem Extratropics

T+0 | oper_an od 0001



Weather parameters

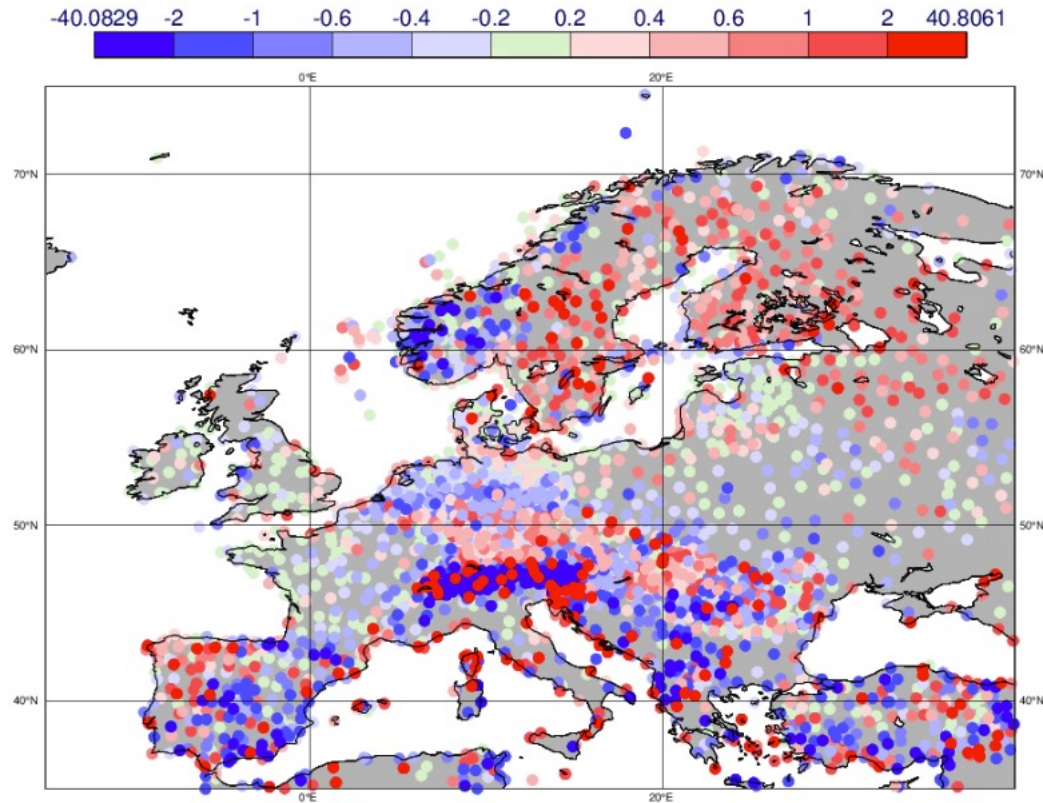
2m temperature and dewpoint



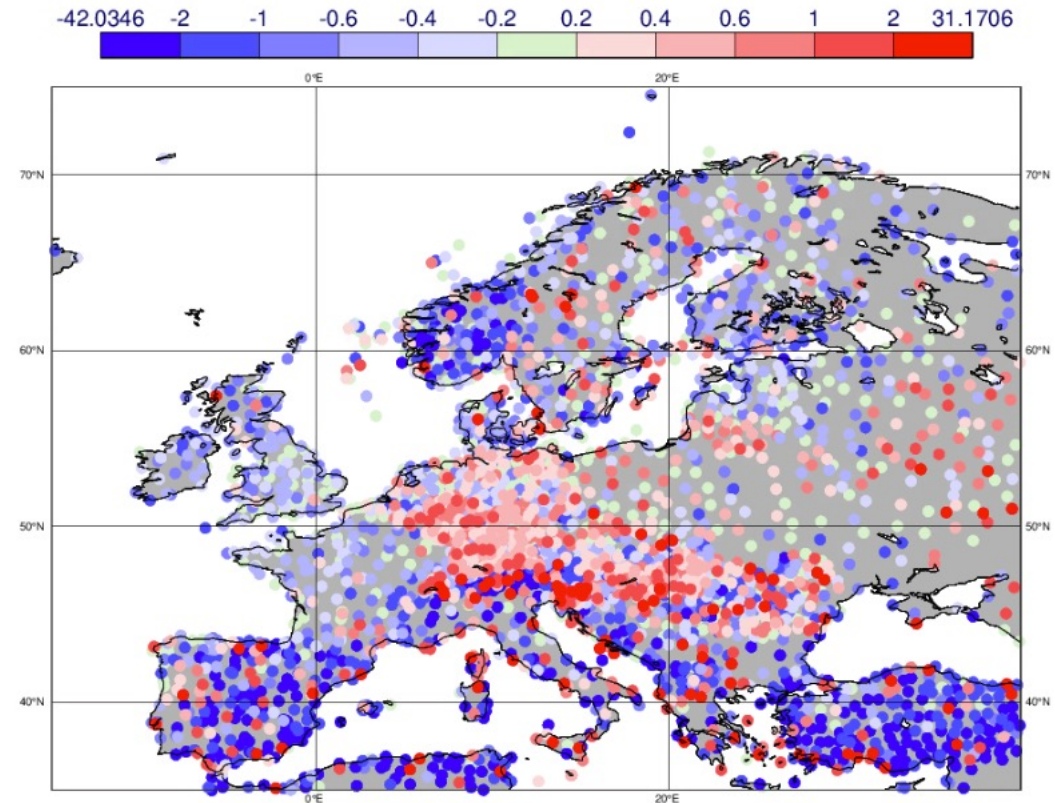
Forecast range: 60 and 72 h
Domain: Europe

2m dewpoint bias

JJA 2023, STEP=48



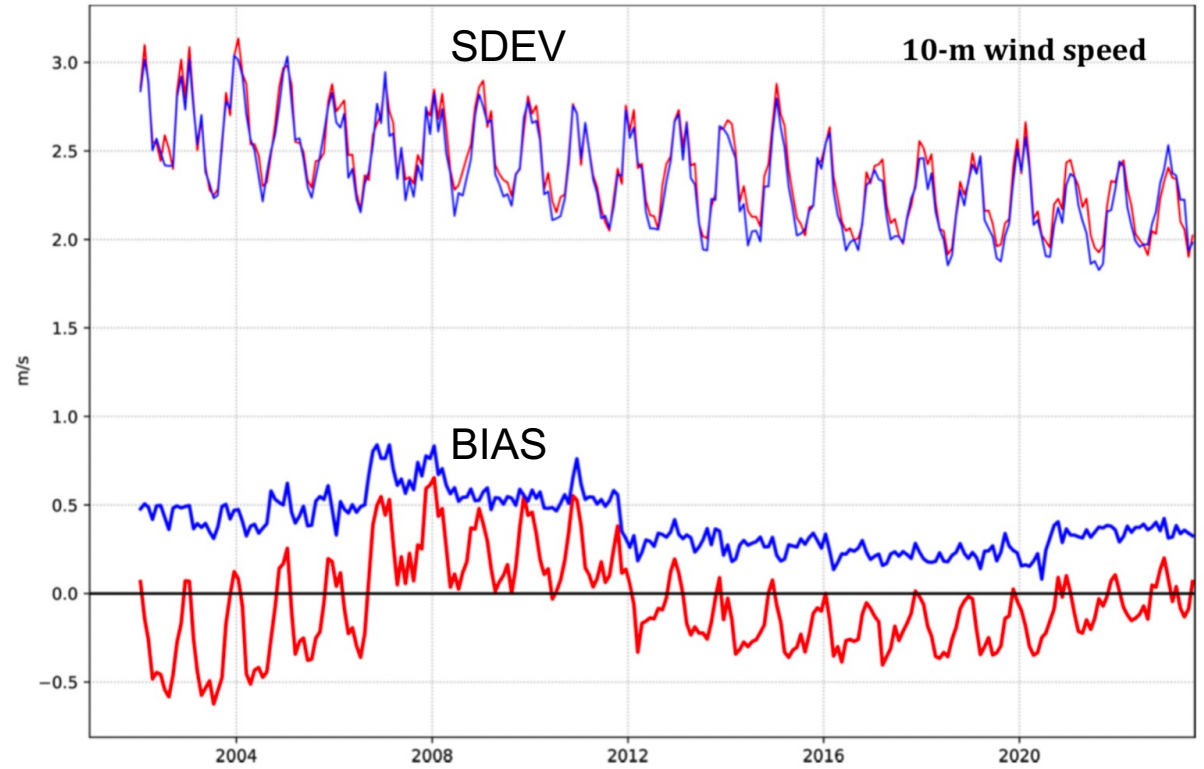
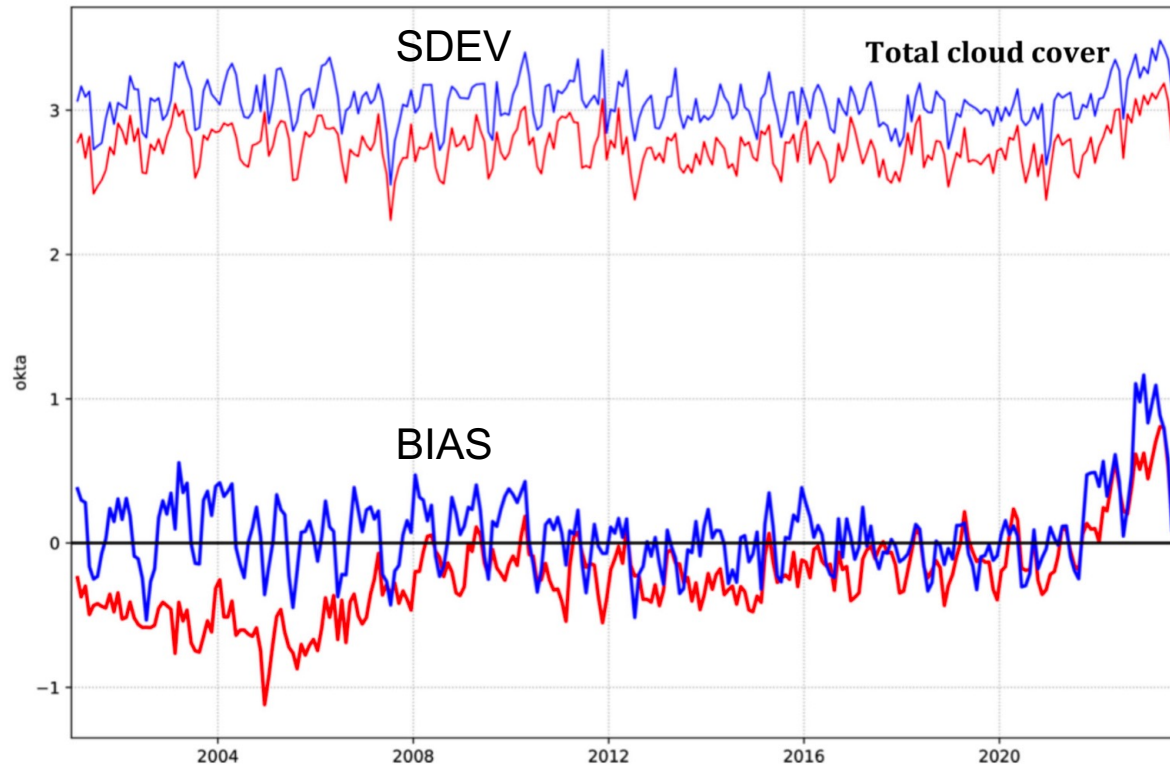
00 UTC



12 UTC

- Distinct regional-scale patterns
- Mountain valley vs mountain top stations
- Generally dry bias in southern Europe during daytime

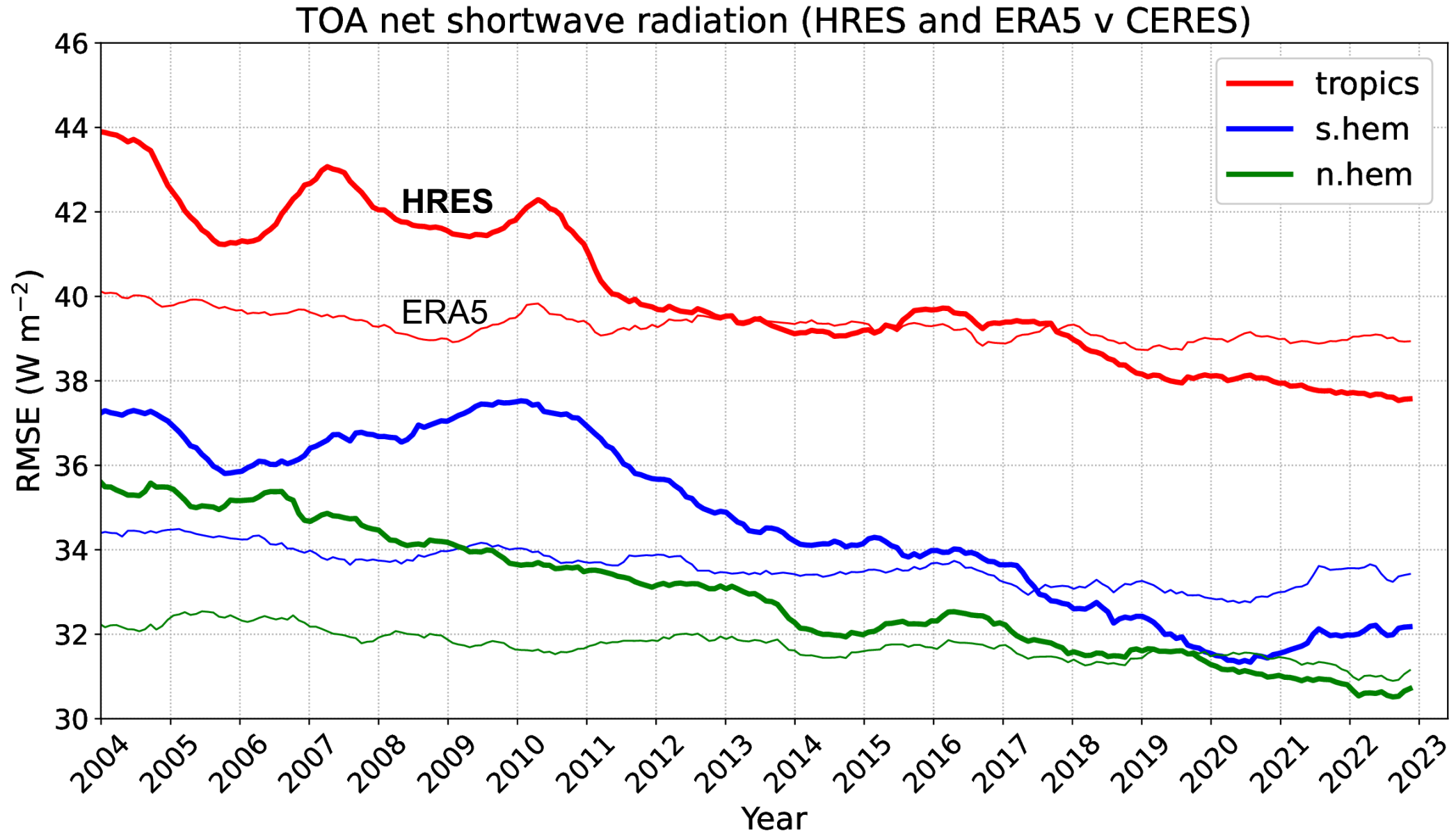
Total cloud cover and 10m wind speed



Forecast range: 60 and 72 h
Domain: Europe

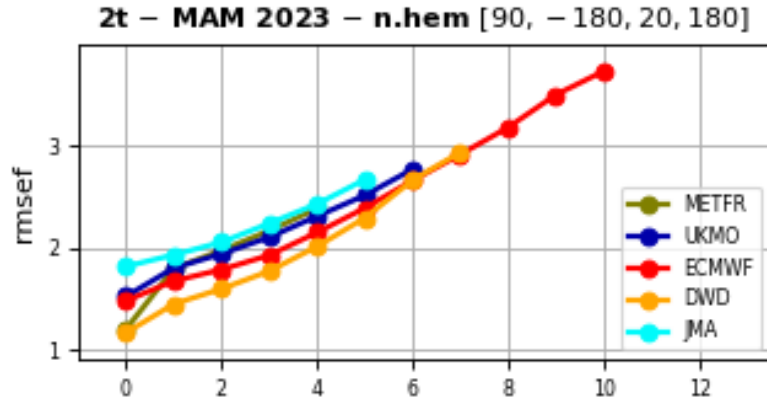
TOA net shortwave radiation (STEP=120)

Run: 00 UTC

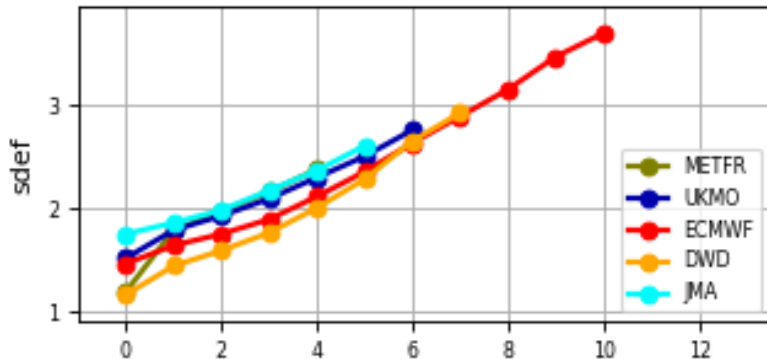


2m temperature and 10m wind in spring 2023 (WMO scores)

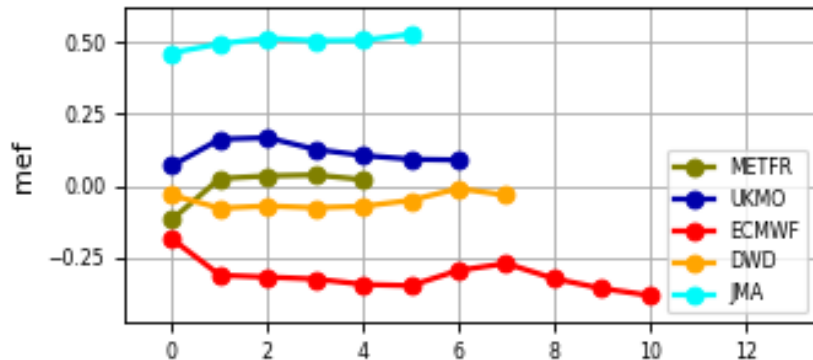
RMSE



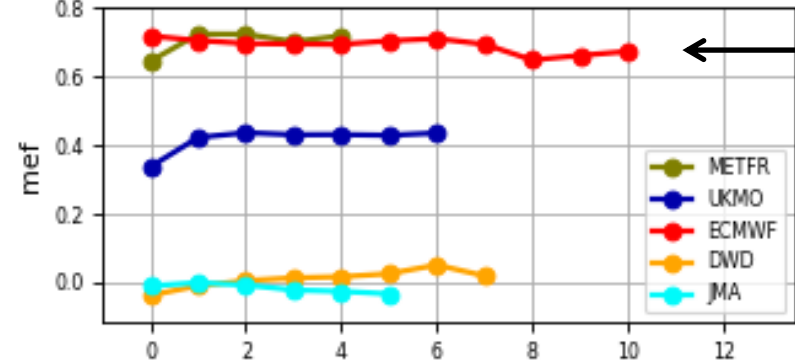
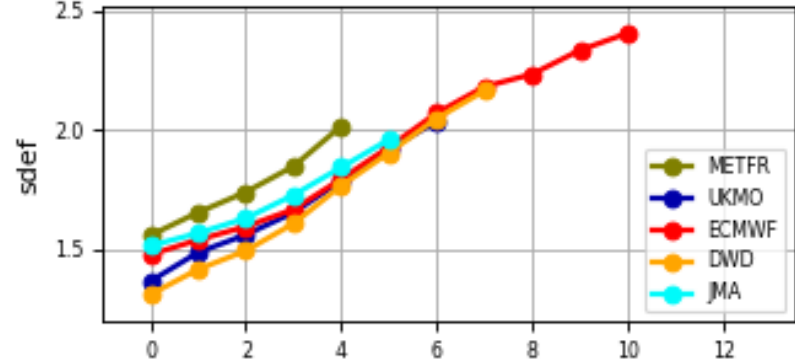
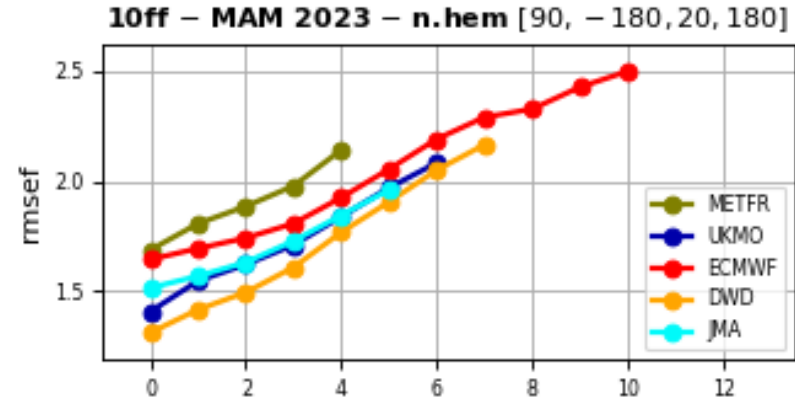
SDEV



ME



2m temperature



10m wind speed

00 UTC

Large positive bias, to be reduced in 49r1 by changing 10m wind diagnostic

Fraction of large 2m temperature errors – ENS

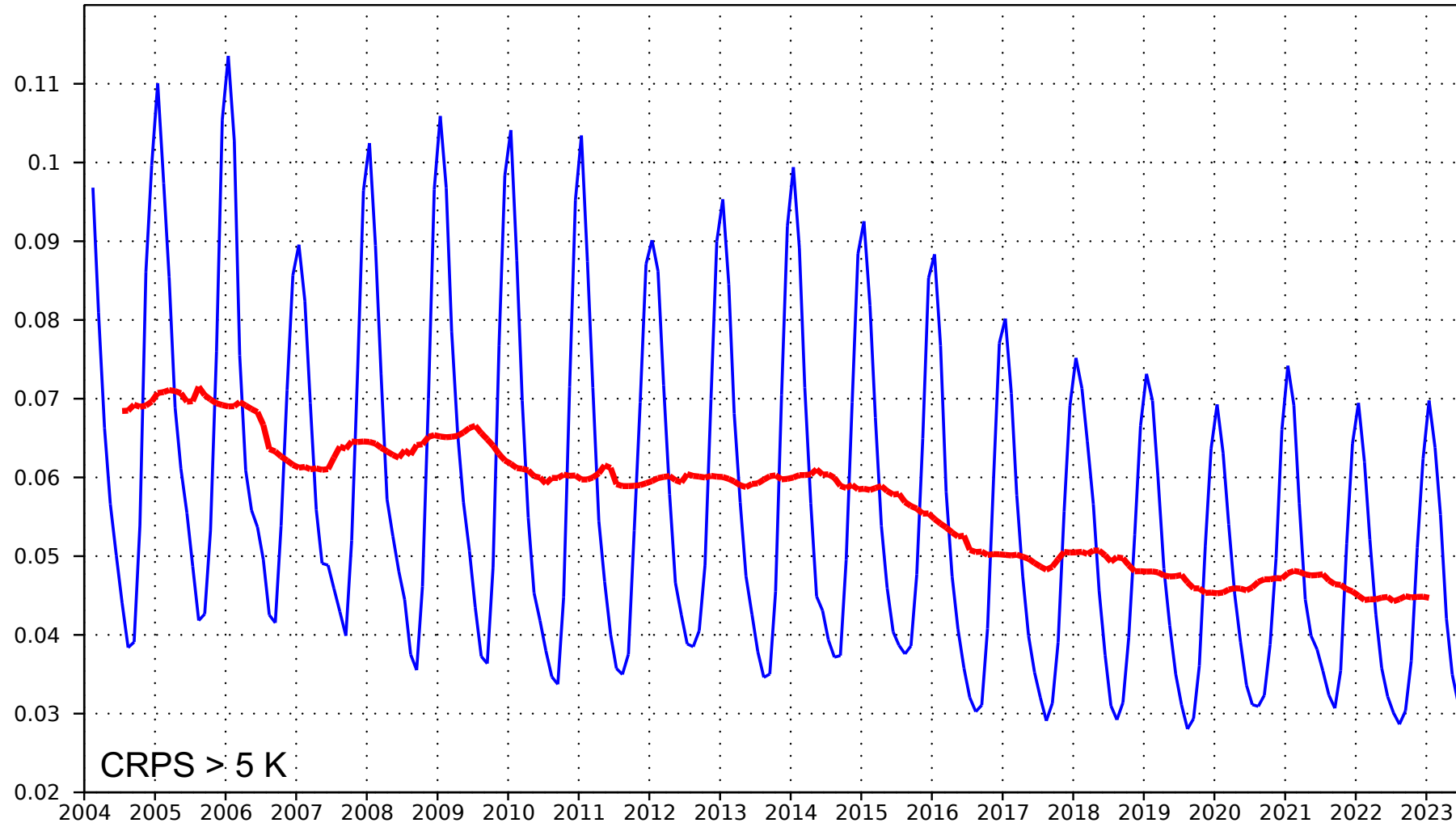
Fraction of large CRPS value >5.0 | 2 meter temperature

Extratropics

T+120 | oper_ob od enfo 0001

— 00z,12z

— 00z,12z



Fraction of large 10m wind speed errors – ENS

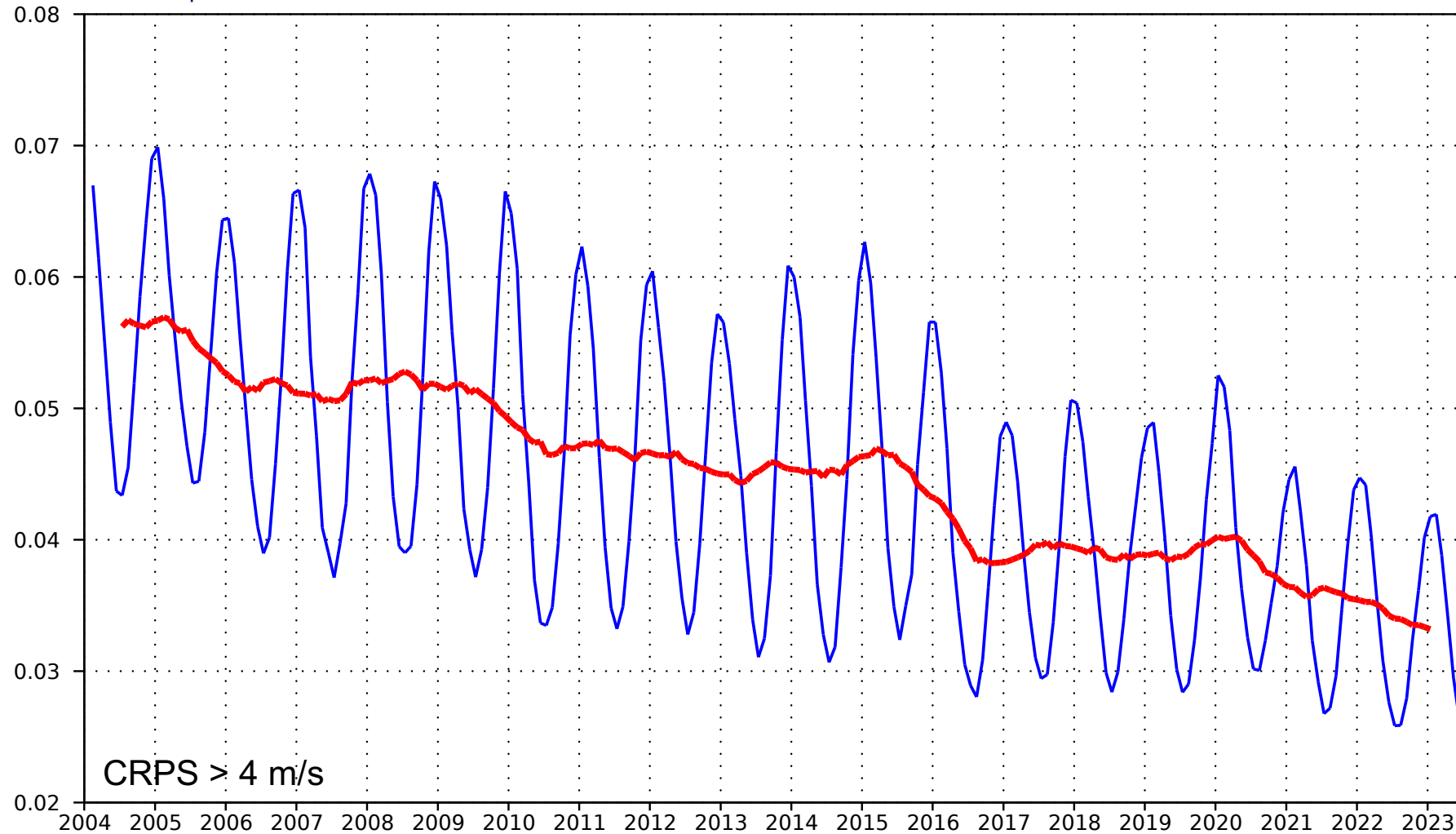
Fraction of large CRPS value >4.0 | 10m wind speed

Extratropics

T+120 | mo8_sfc od enfo 0001

— 00z,12z

— 00z,12z

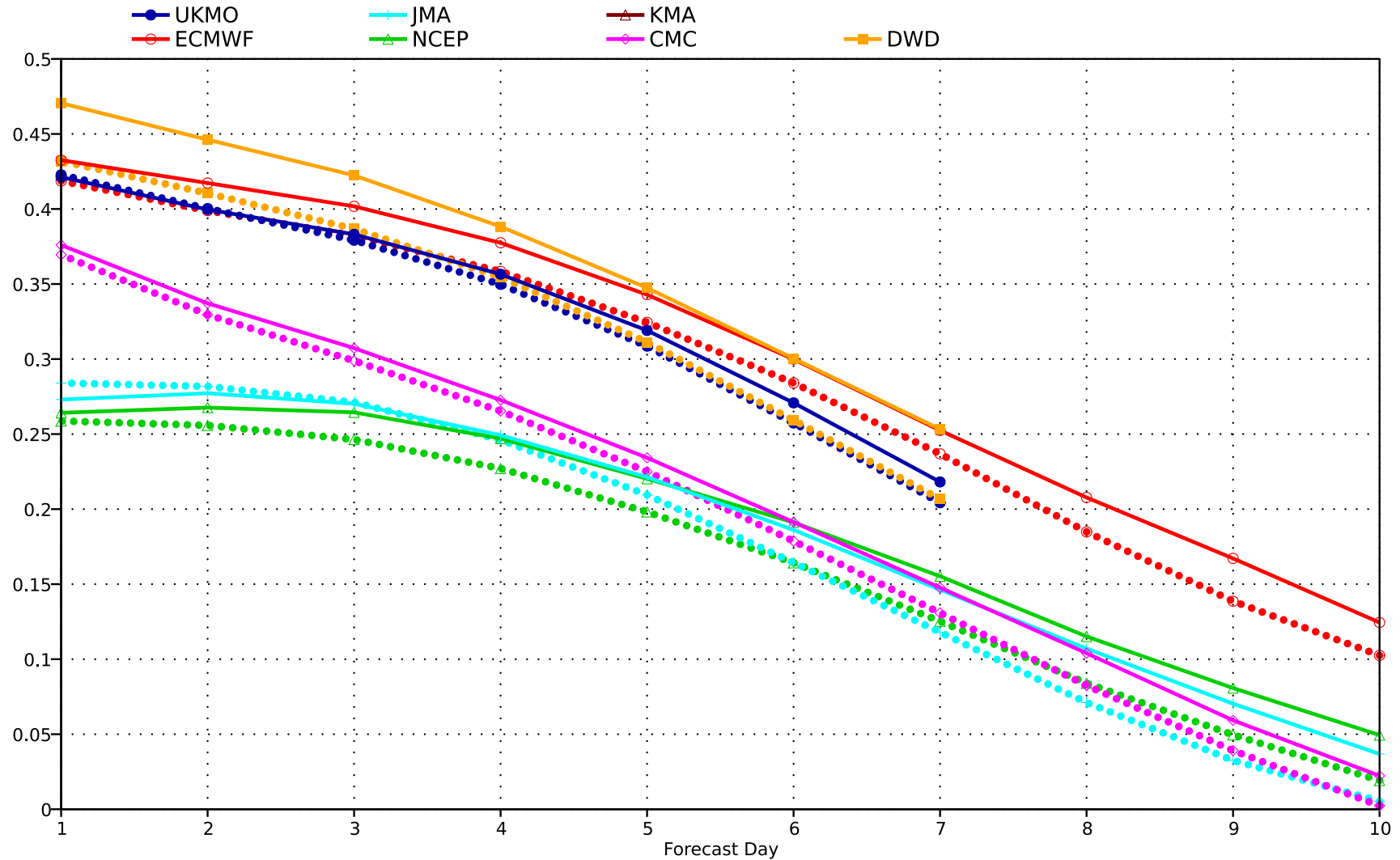


ENS 2m Temperature DJF (TIGGE)

season:DJF (2023 solid, 2022 dot)

Continuous ranked probability skill score

2 meter temperature | Extratropics

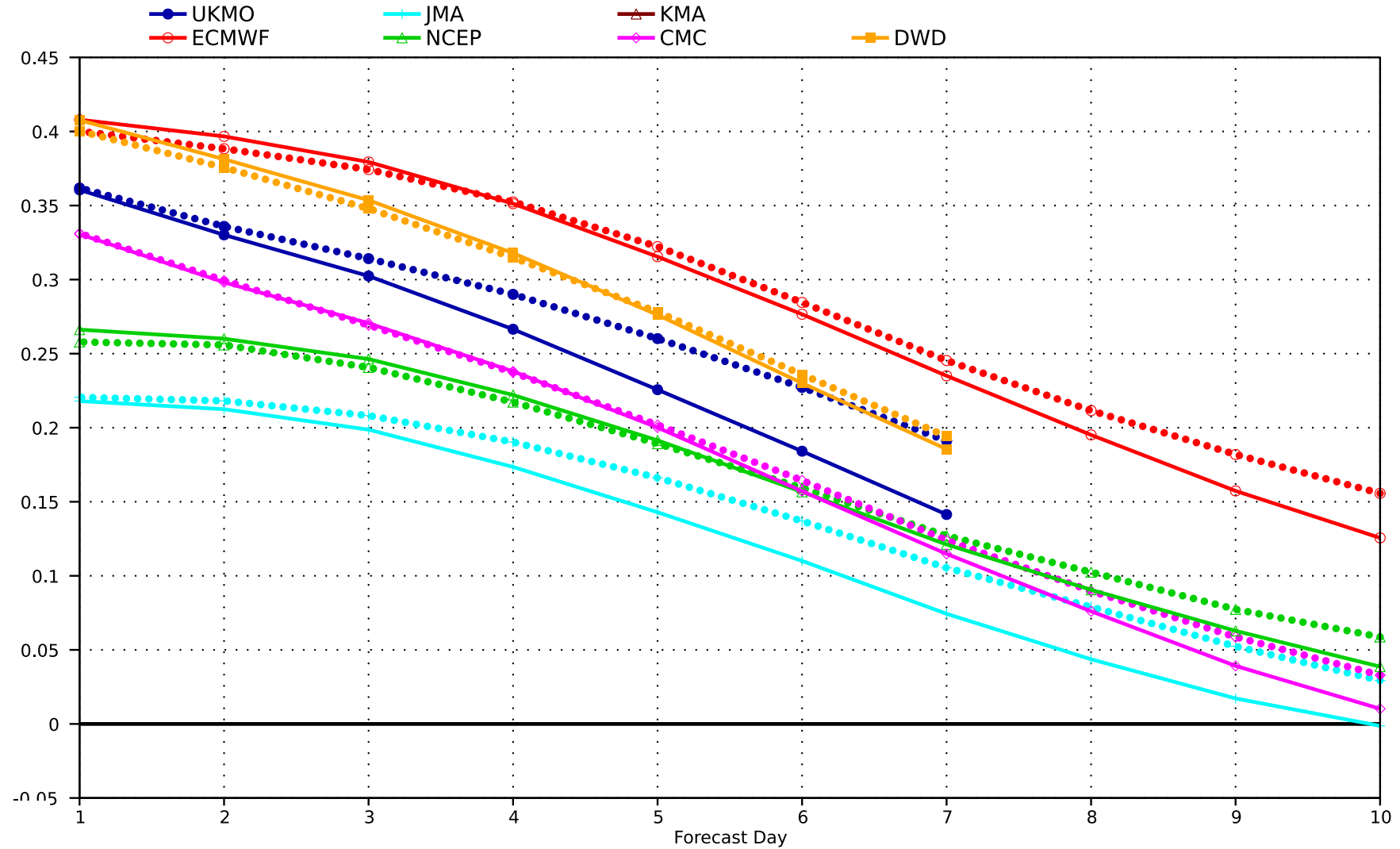


ENS 2m Temperature JJA (TIGGE)

season:JJA (2023 solid, 2022 dot)

Continuous ranked probability skill score

2 meter temperature | Extratropics



HRES precipitation headline score - SEEPS

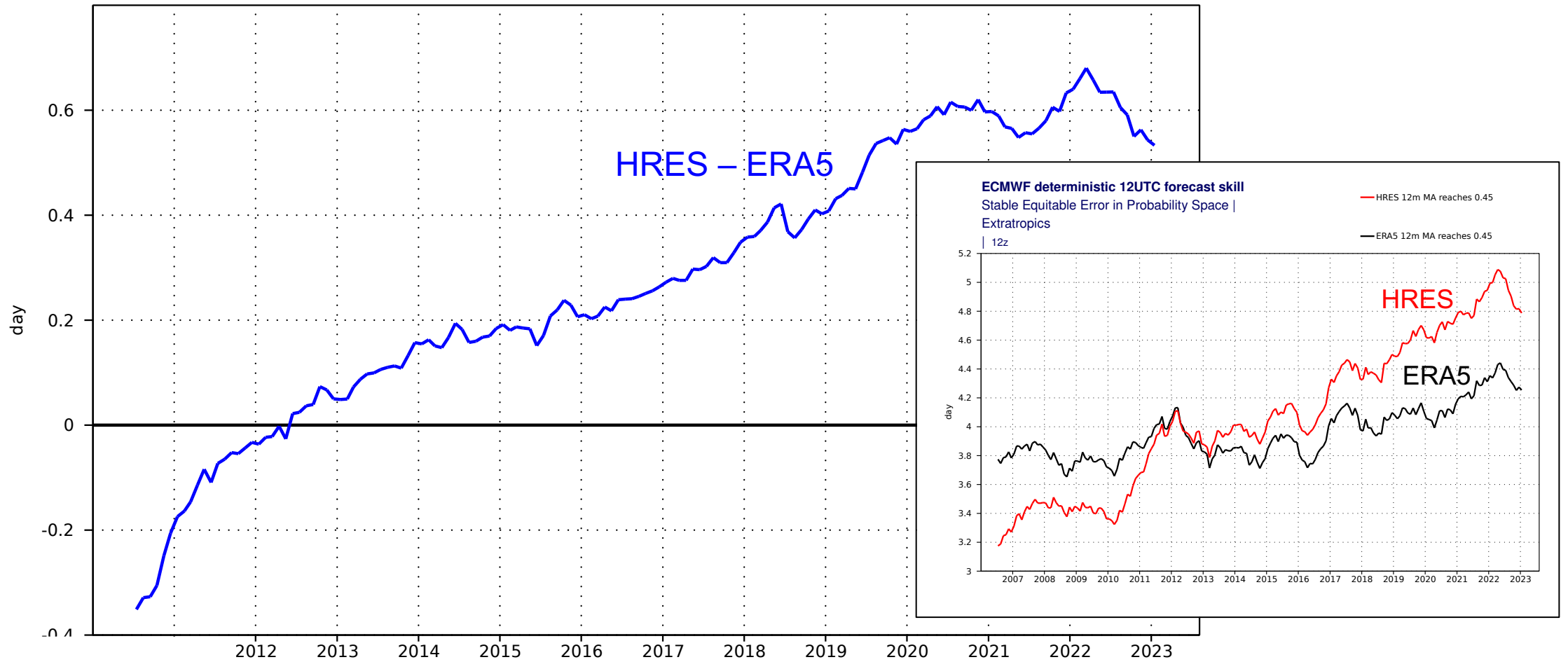
ECMWF deterministic 12UTC forecast skill

Stable Equitable Error in Probability Space | total precipitation

Extratropics

T+0 T+24 ... T+240 | oper_ob_hs-era_ob_hs+0.25 od-ea+0.25 oper-oper+0.25 0001-0001+0.25 12z

— HRES 12m MA reaches 0.45



CRPSS and CRPS of 24-h precipitation, Extratropics

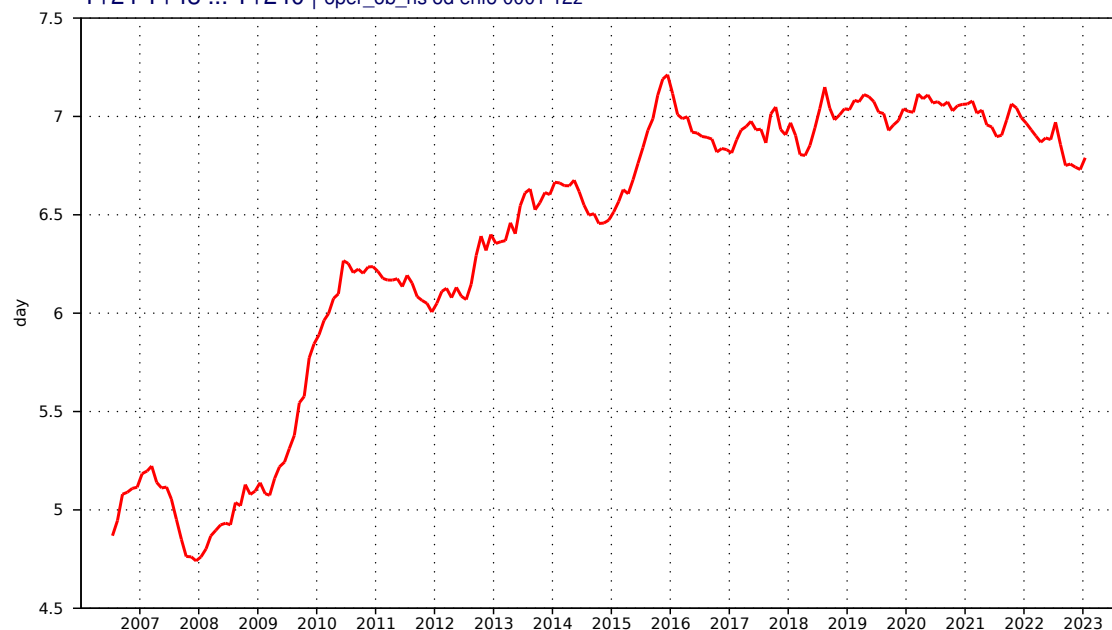
ECMWF EPS 12UTC forecast skill

Continuous ranked probability skill score | total precipitation

Extratropics

T+24 T+48 ... T+240 | oper_ob_hs od enfo 0001 12z

— 12mMA of CRPSS reaches 0.10



CRPSS reaching 10%

Continuous ranked probability score | total precipitation

Extratropics

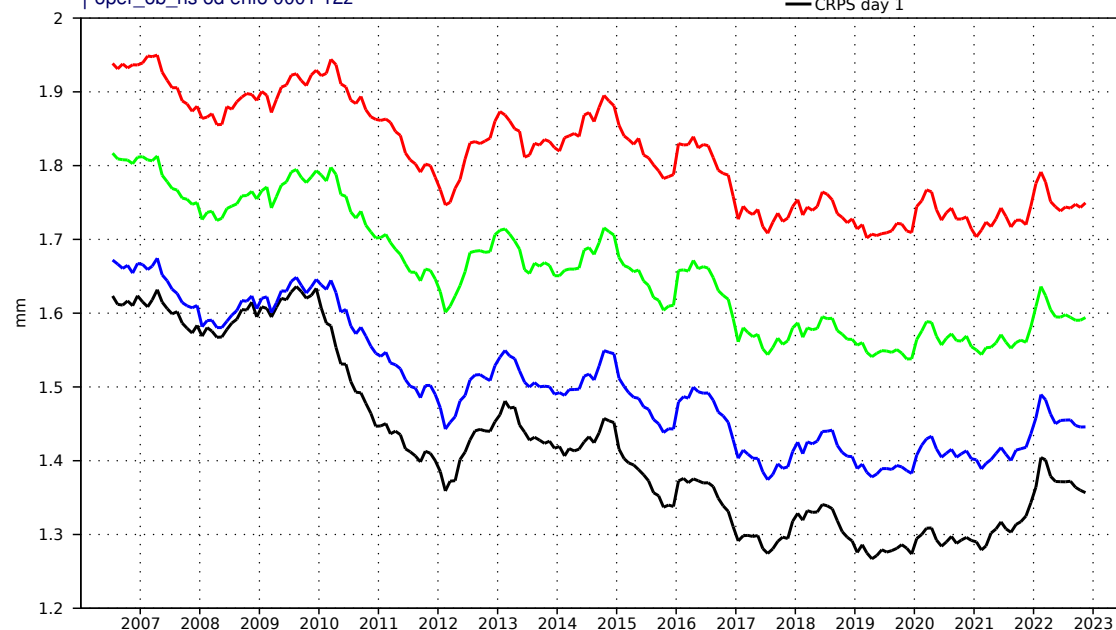
| oper_ob_hs od enfo 0001 12z

— CRPS day 7

— CRPS day 5

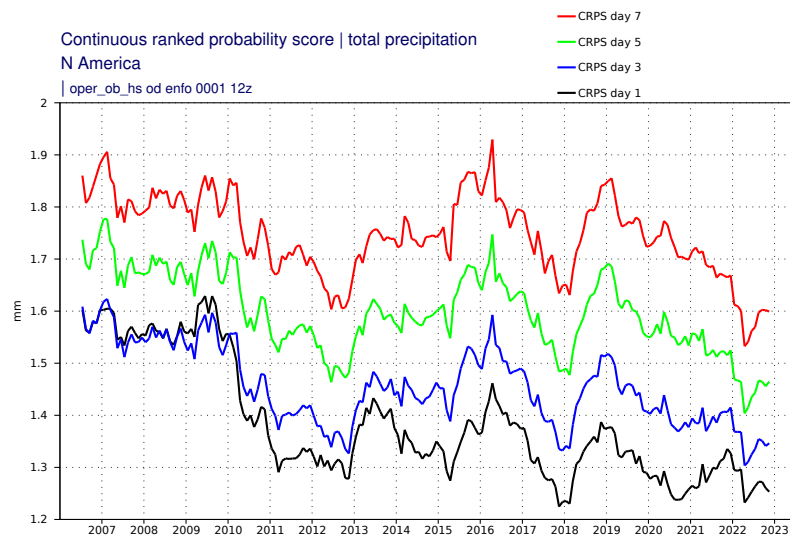
— CRPS day 3

— CRPS day 1

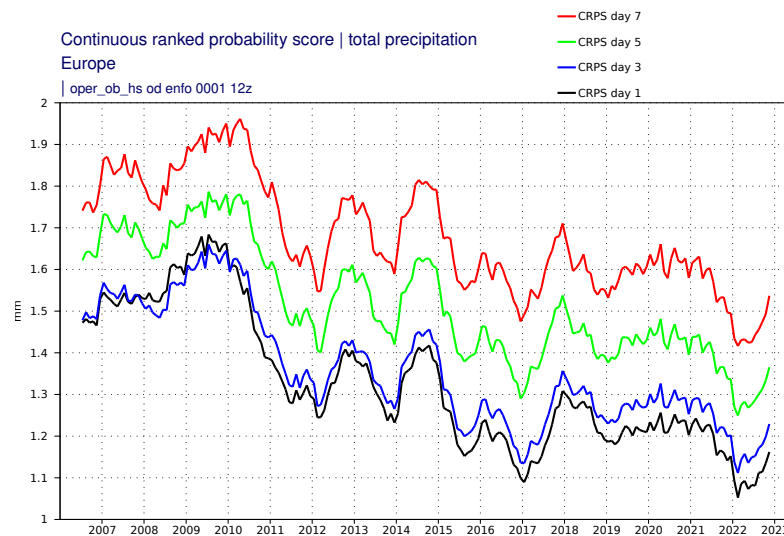


CRPS at Days 1, 3, 5, 7

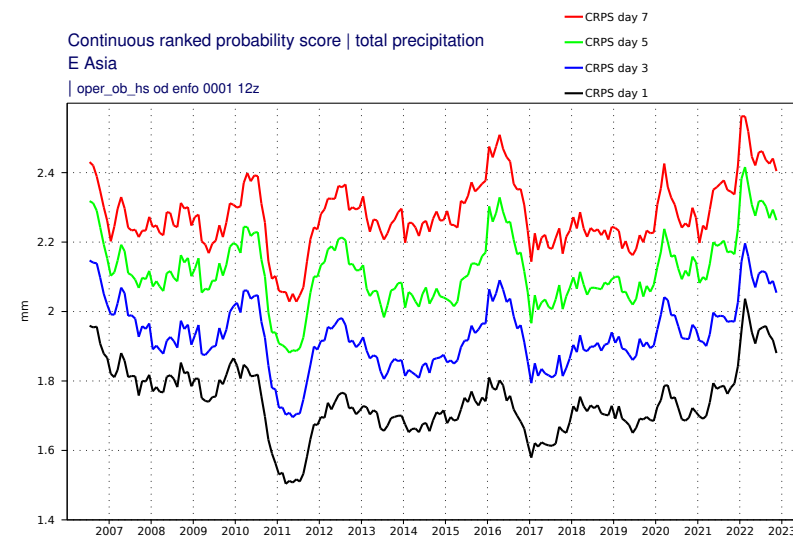
CRPS of 24-h precipitation in sub-domains



North America



Europe



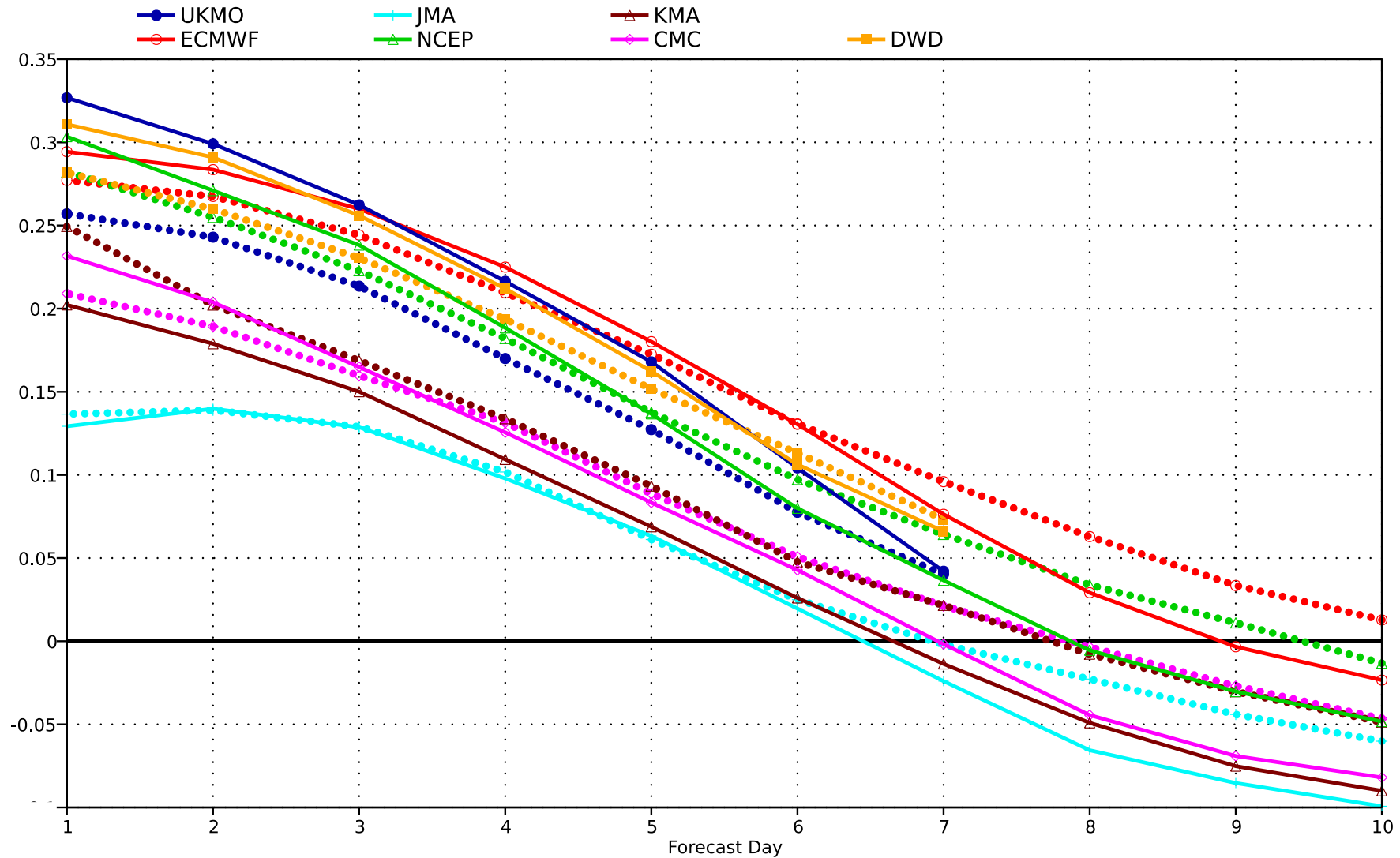
East Asia

ENS 24h Precipitation DJF (TIGGE)

season:DJF (2023 solid, 2022 dot)

Continuous ranked probability skill score

total precipitation | Extratropics

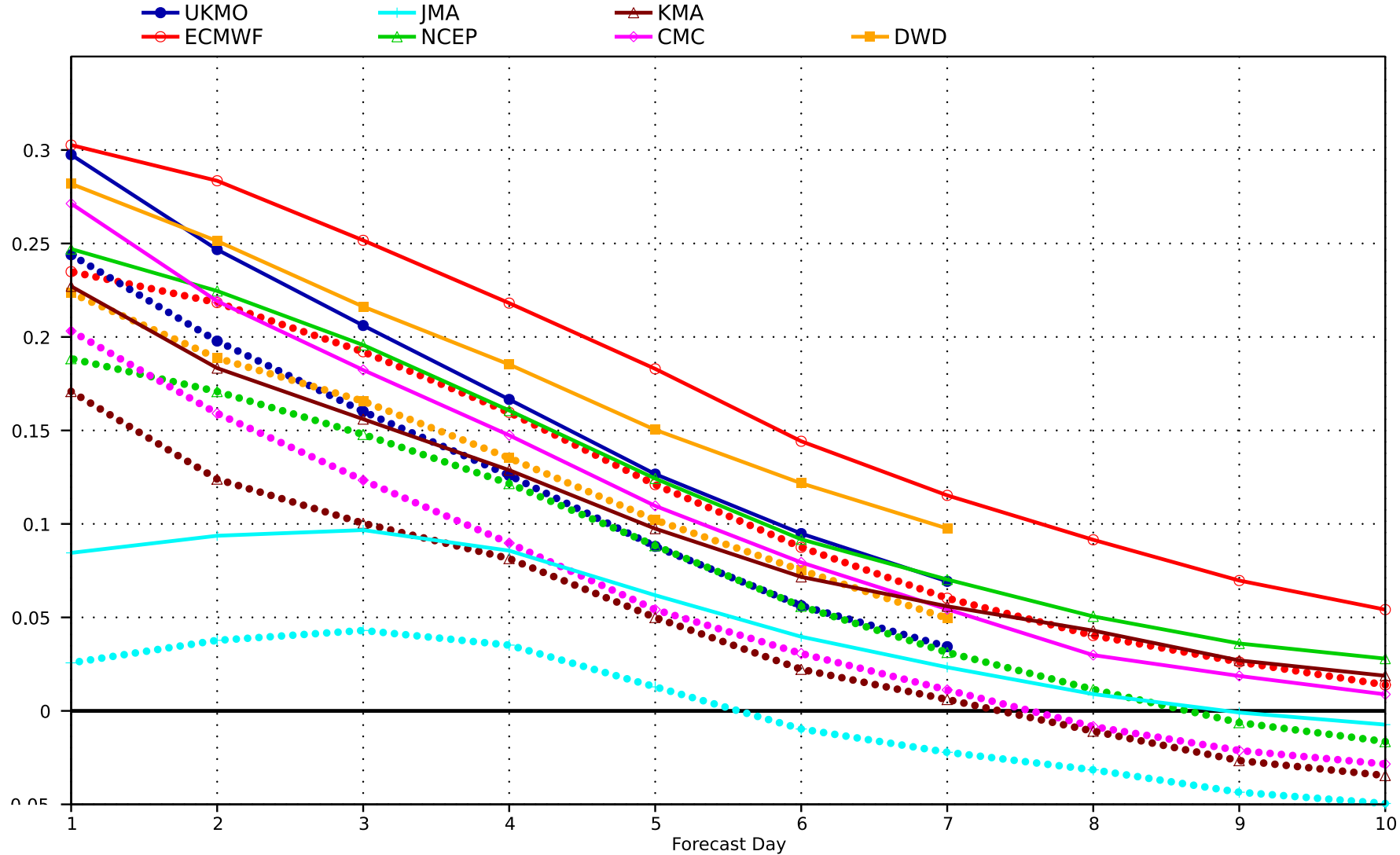


ENS 24h Precipitation JJA (TIGGE)

season:JJA (2023 solid, 2022 dot)

Continuous ranked probability skill score

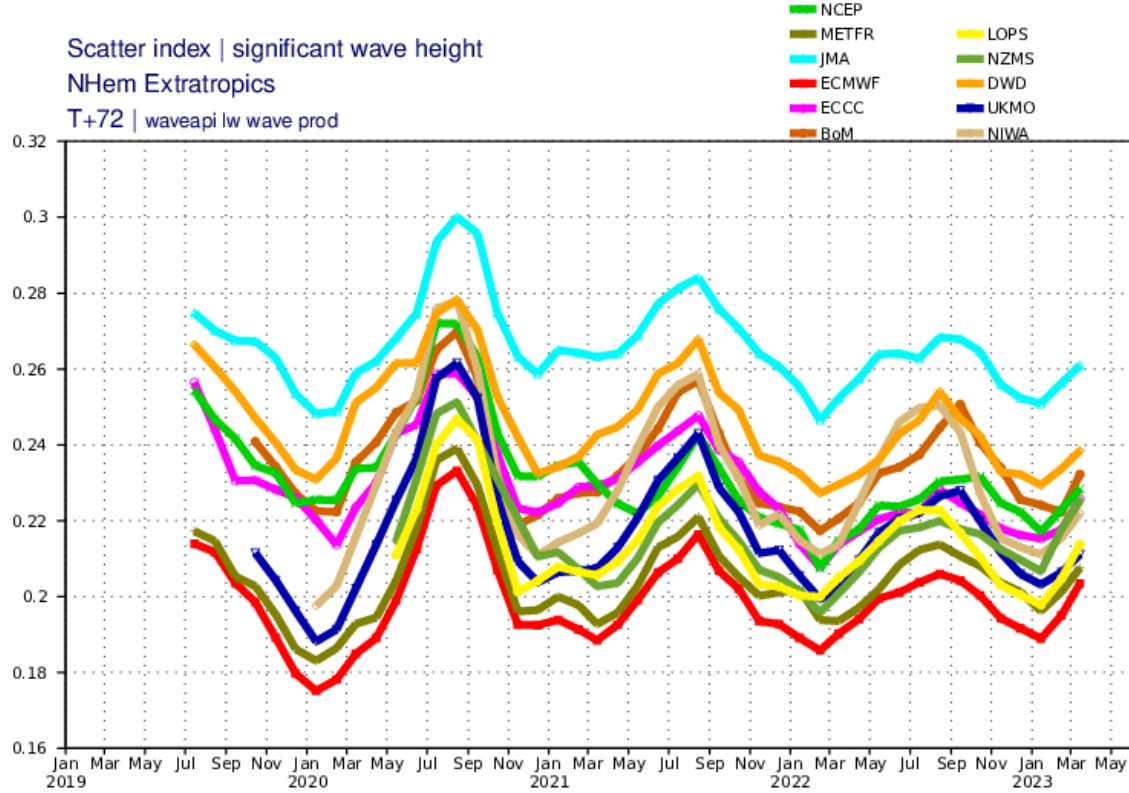
total precipitation | Extratropics



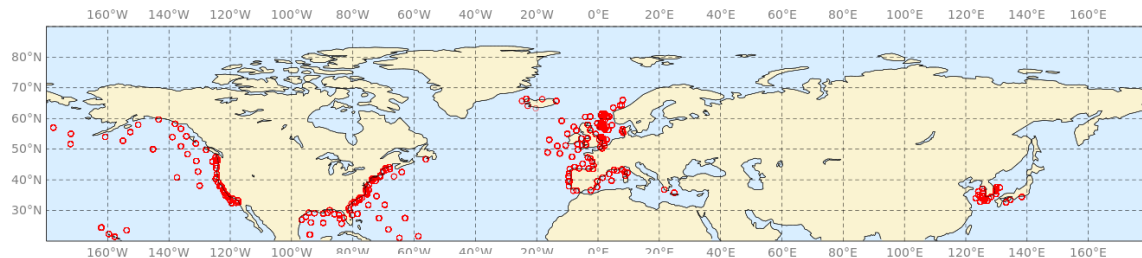
Ocean waves

Wave forecast – N.Hem Extratropics

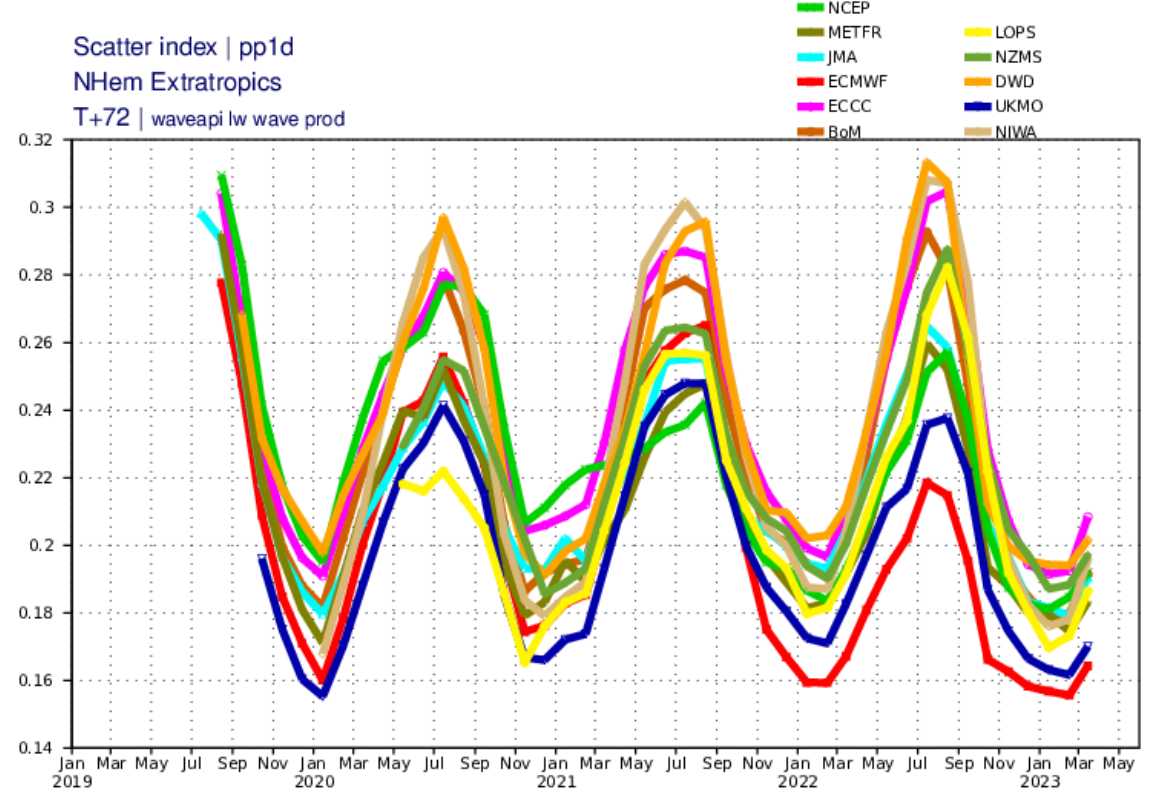
Scatter index | significant wave height
NHem Extratropics
T+72 | waveapi lw wave prod



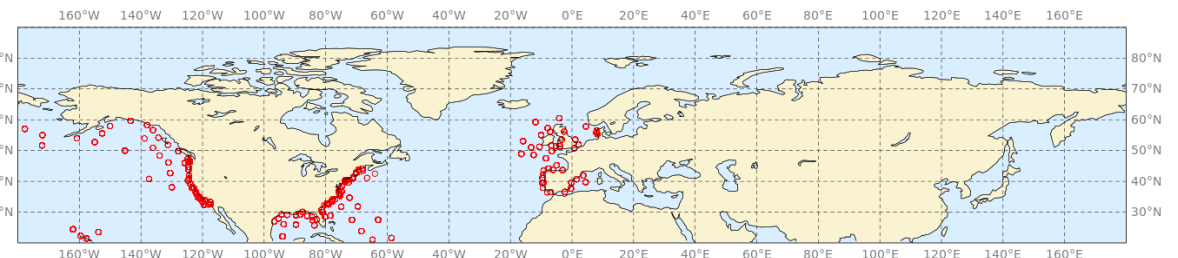
Significant wave height



Scatter index | pp1d
NHem Extratropics
T+72 | waveapi lw wave prod



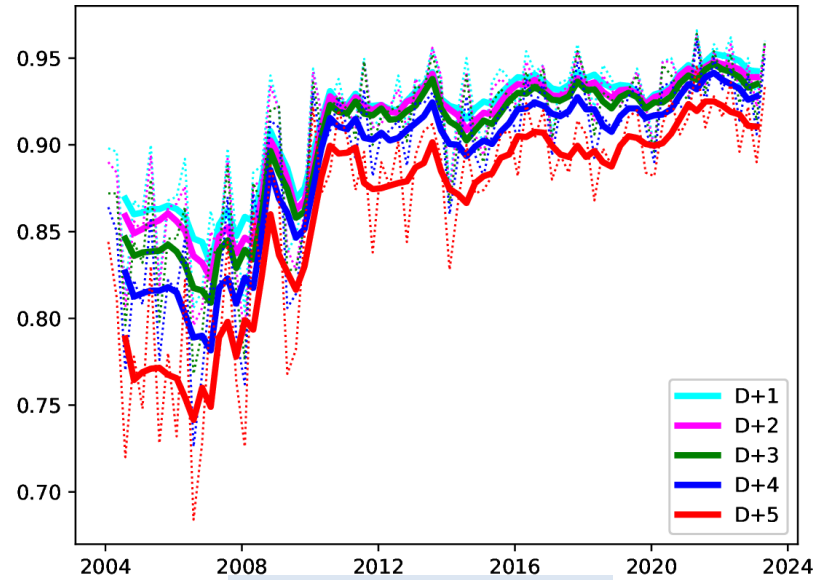
Peak period



EFI and tropical cyclones

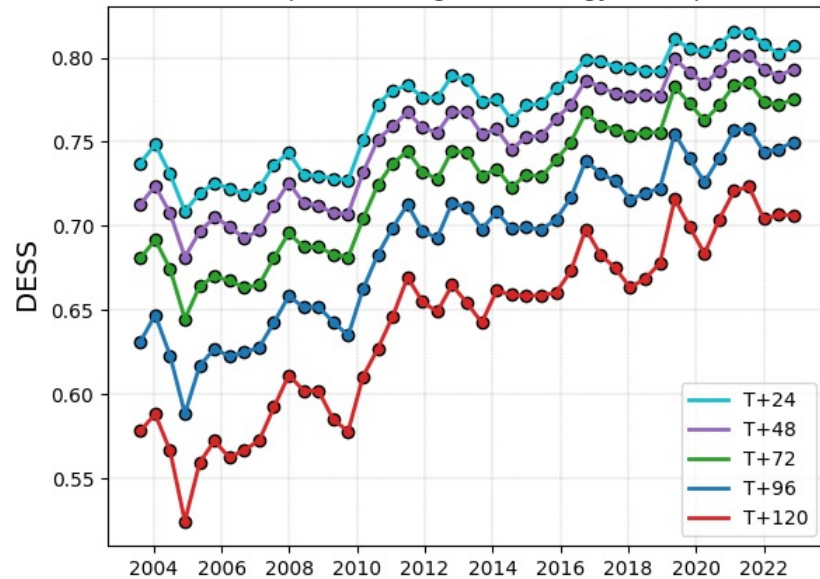
Verification of extremes: EFI ROC and Diagonal Score

ROC skill

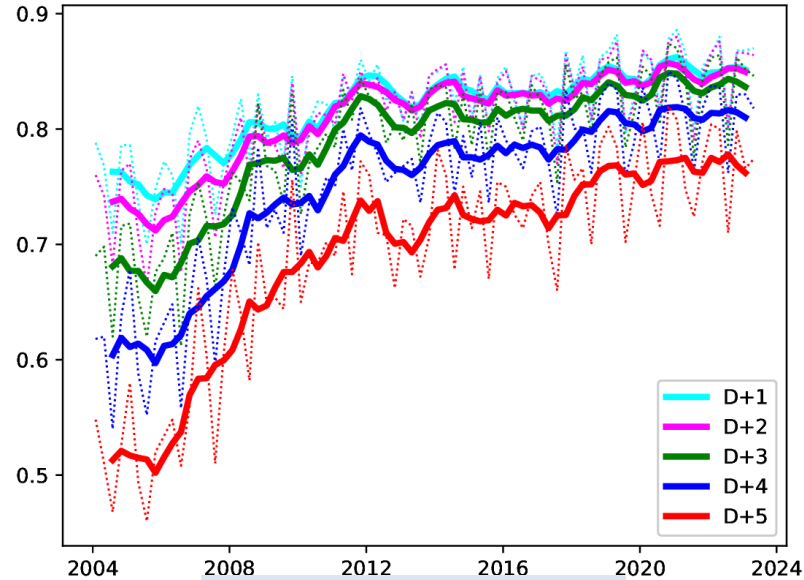


2m temperature

2 m temperature - eigenclimatology - 95% perc.

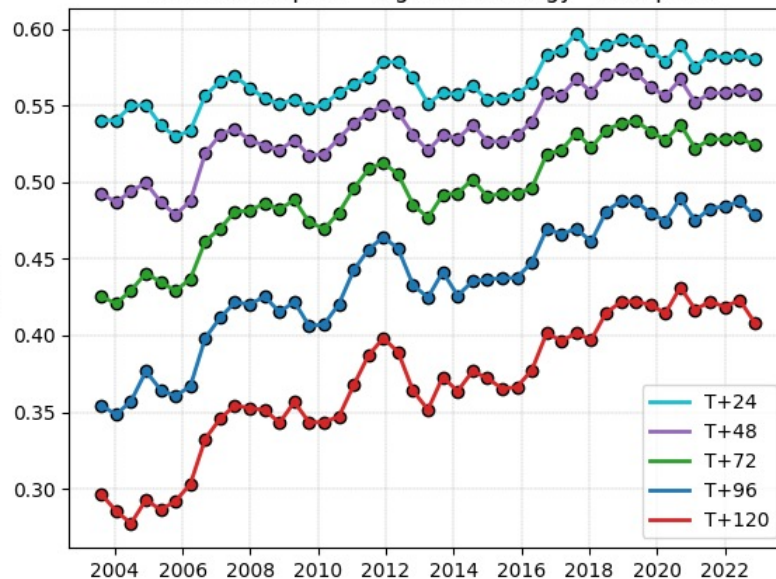


ROC skill

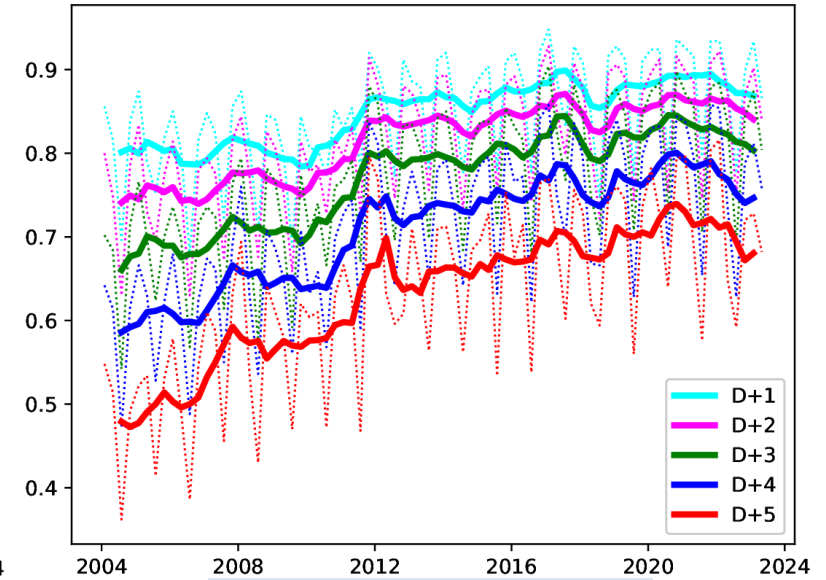


10m wind speed

10 m wind speed - eigenclimatology - 95% perc.

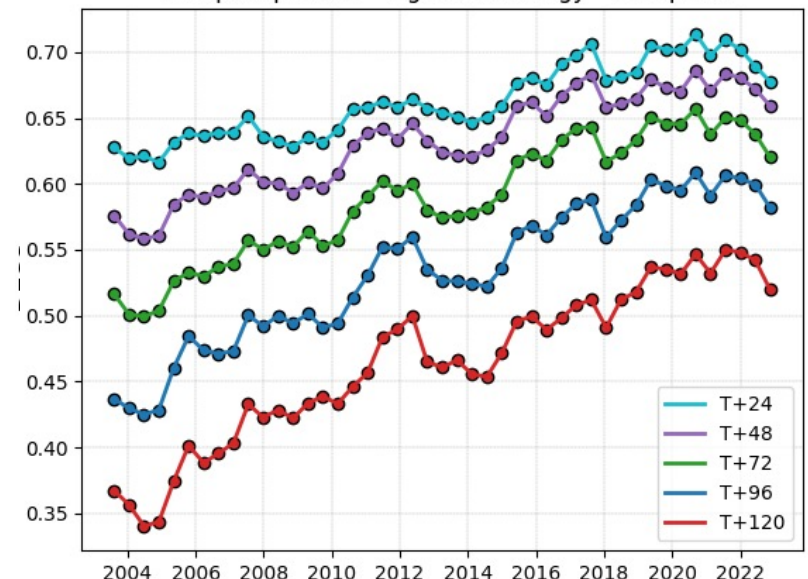


ROC skill

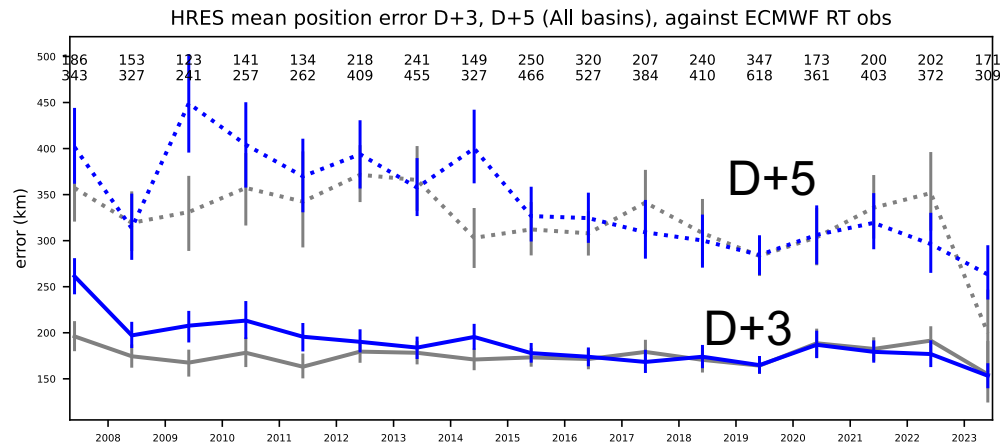


24h precipitation

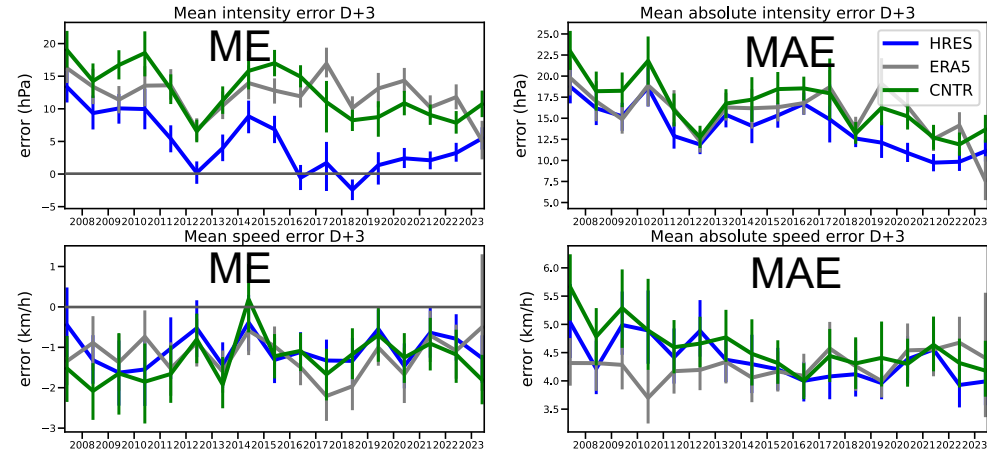
24h precipitation - eigenclimatology - 95% perc.



Tropical cyclone verification

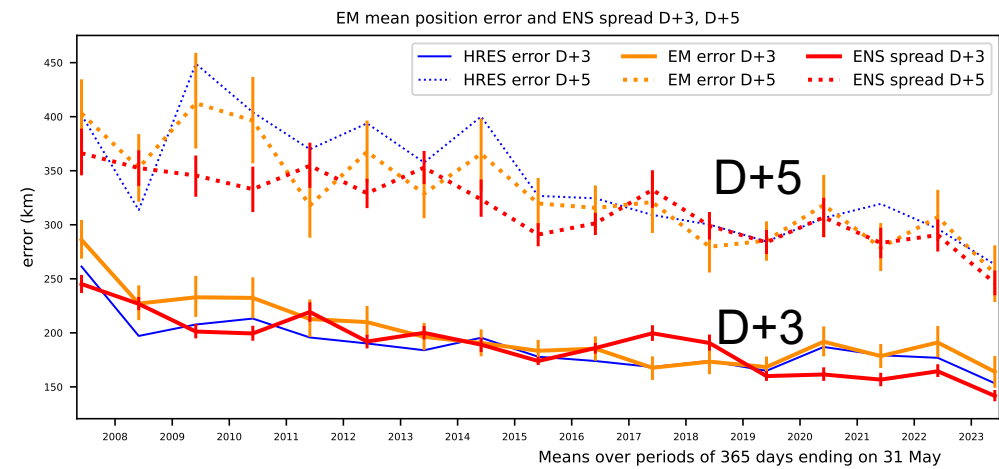


Position (HRES)



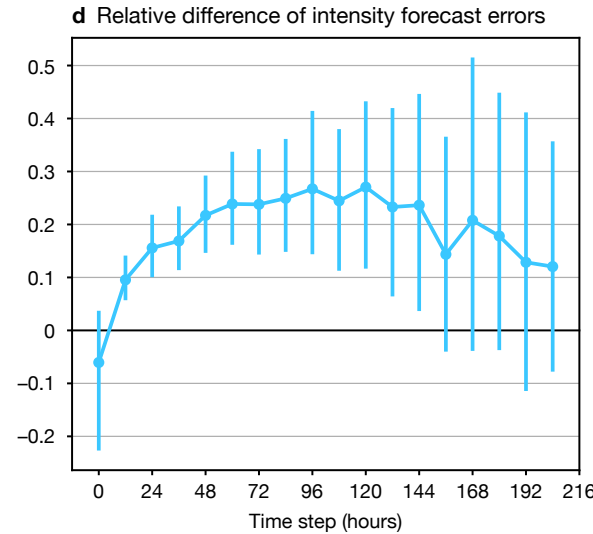
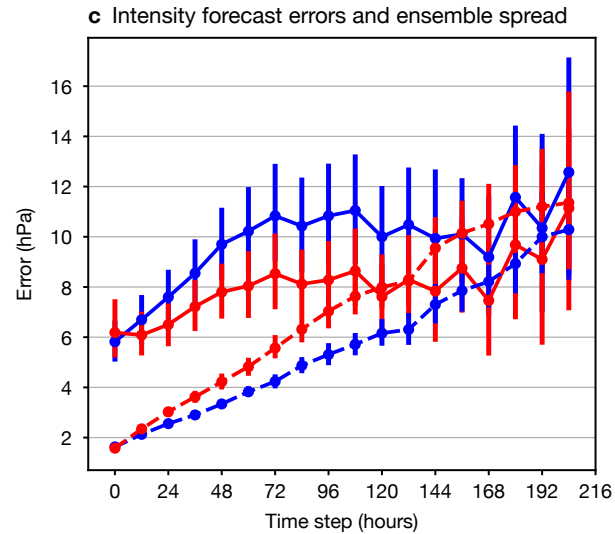
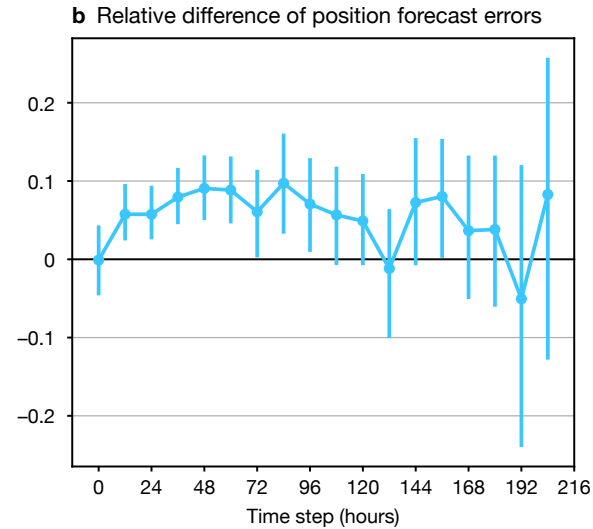
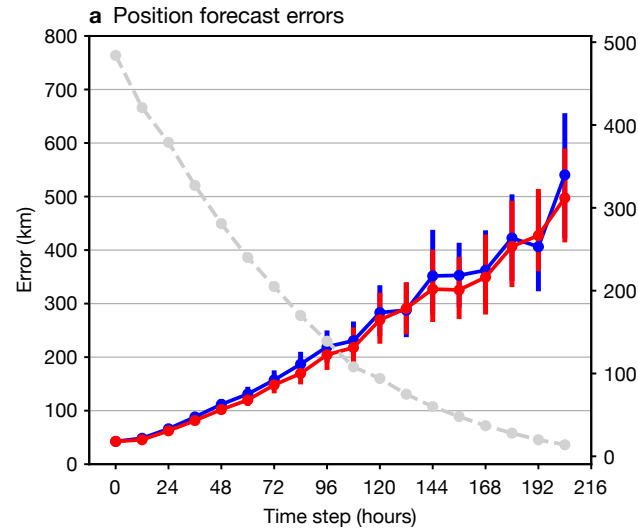
Central pressure

Speed



Position (ENS)

48r1 Tropical cyclone forecast and extended-range scorecard



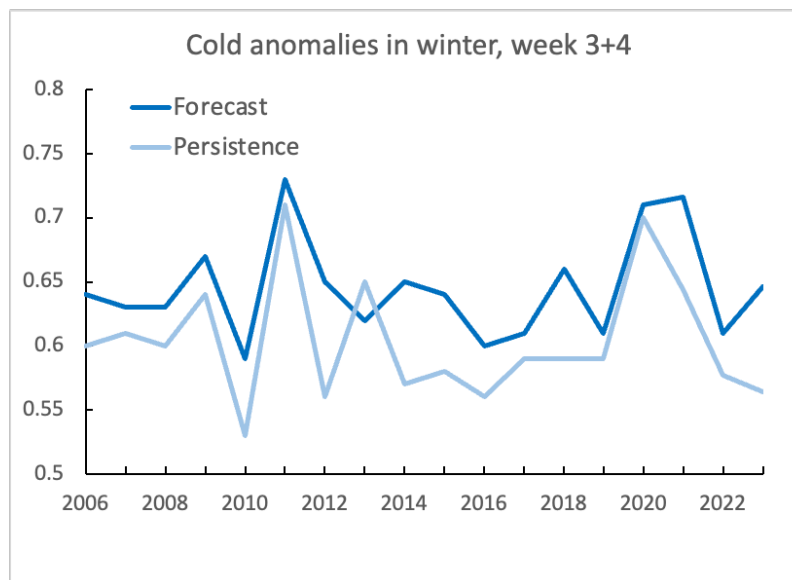
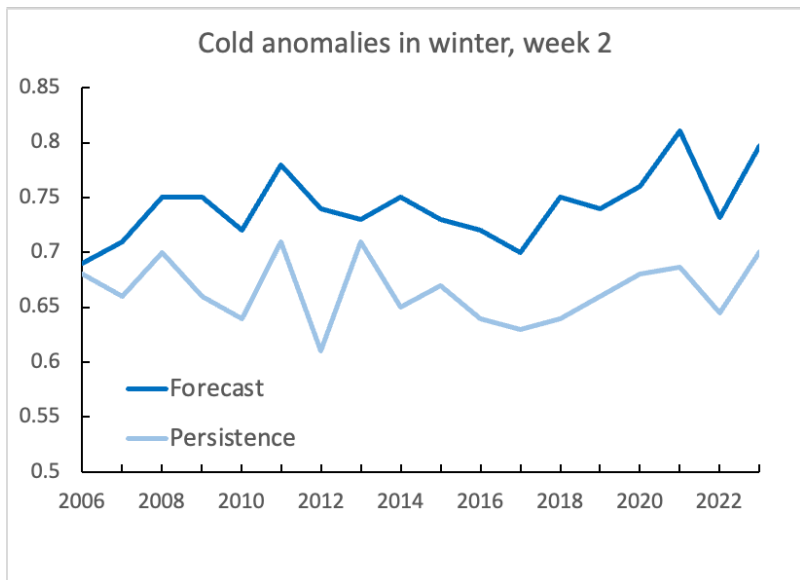
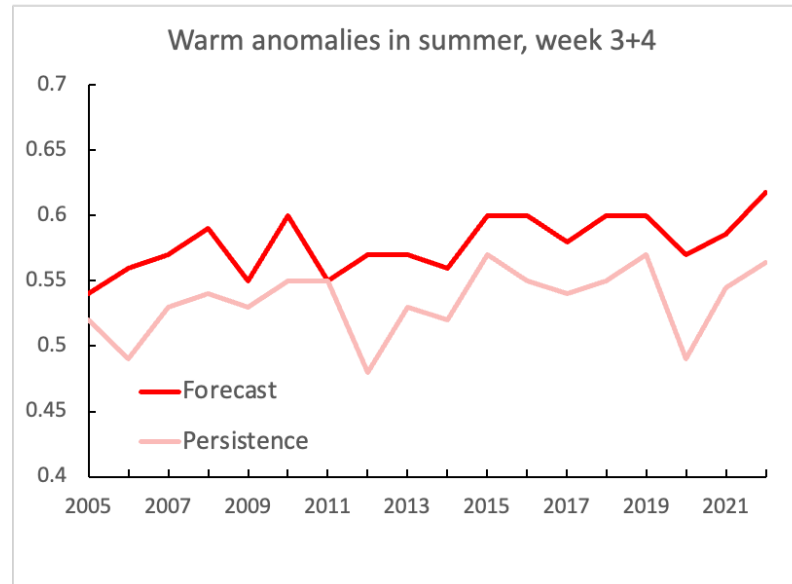
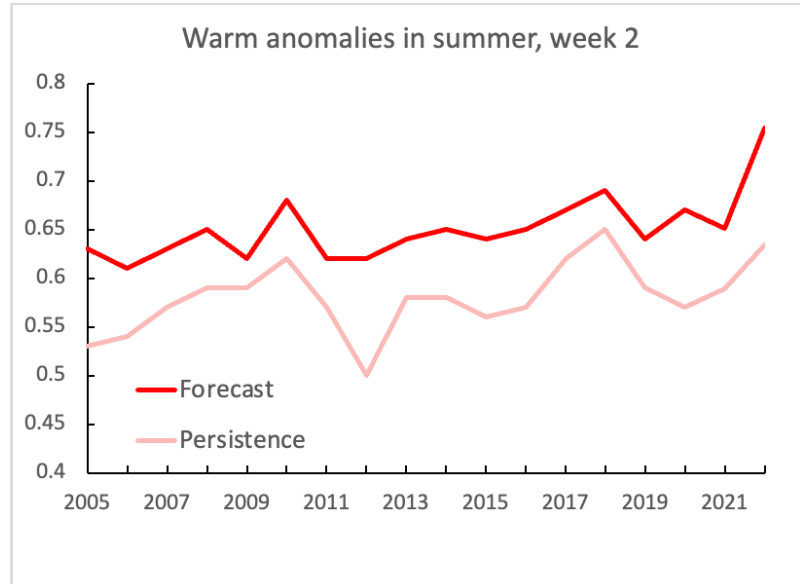
- - - Sample size
 - - - IFS Cycle 48r1 - - - IFS Cycle 47r3
 - - - Ensemble spread for IFS Cycle 48r1
 - - - Ensemble spread for IFS Cycle 47r3

- - - Relative difference of forecast errors
 (IFS Cycle 47r3 - IFS Cycle 48r1)

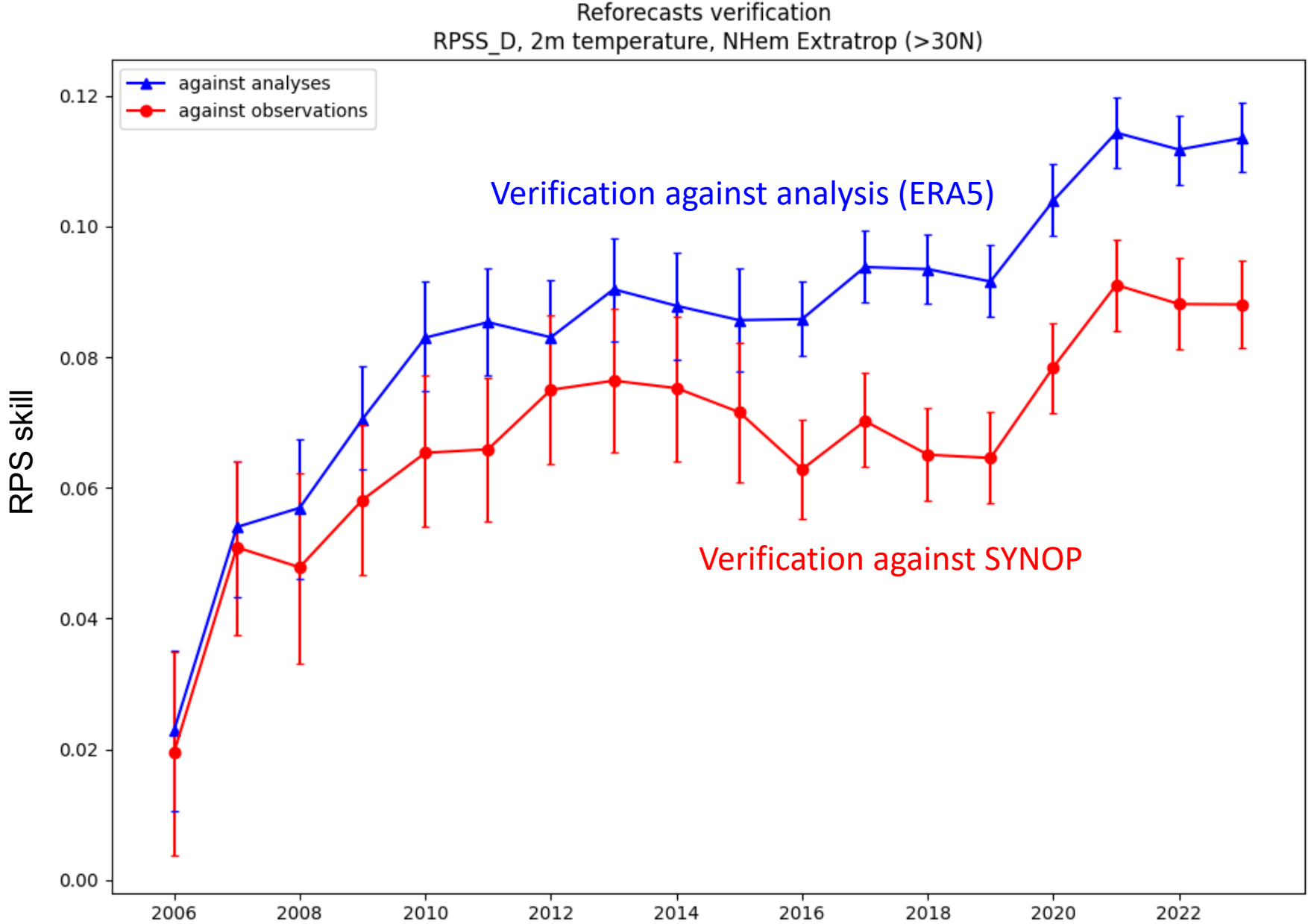


Extended range

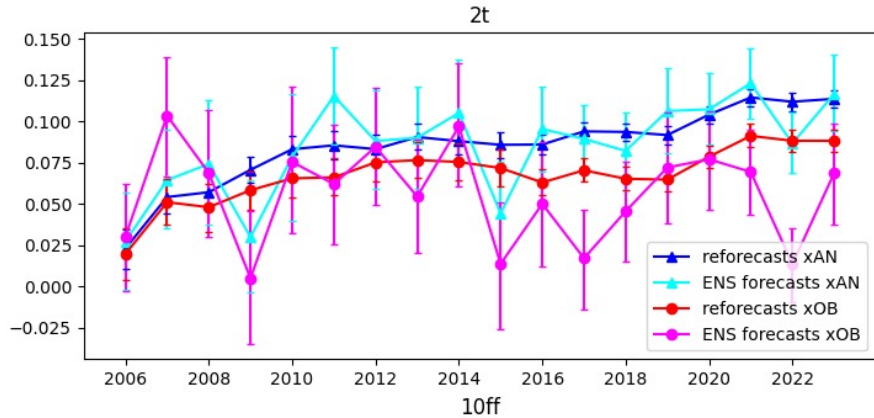
Extended range T2m anomalies



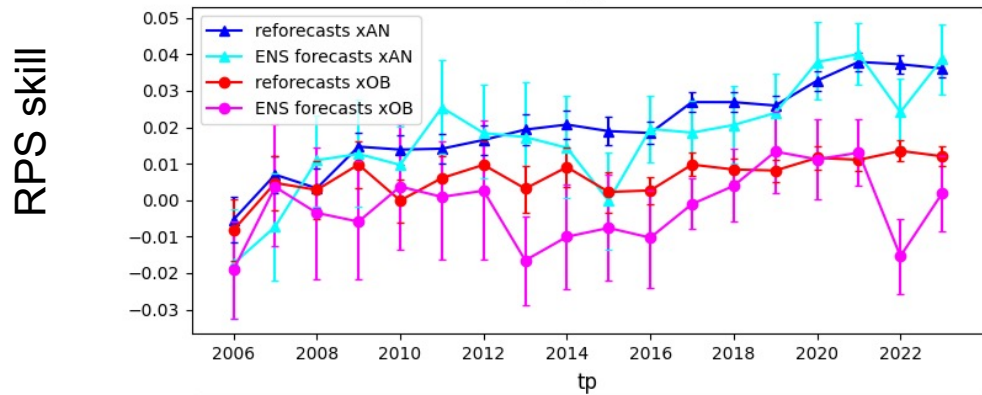
Extended range T2m anomalies – evaluation of reforecasts (week 3)



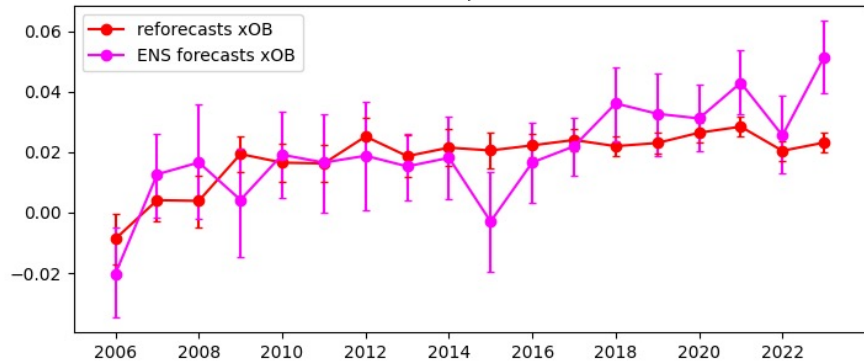
Other parameters in week 3



2m temperature



10m wind speed

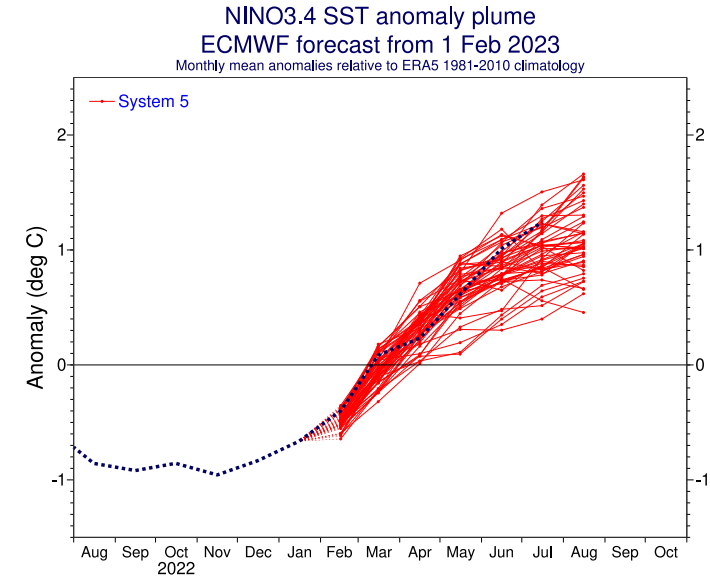
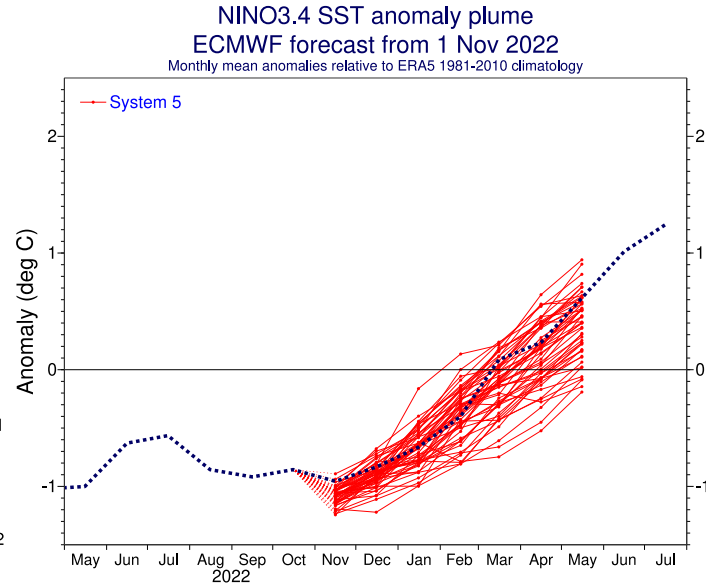
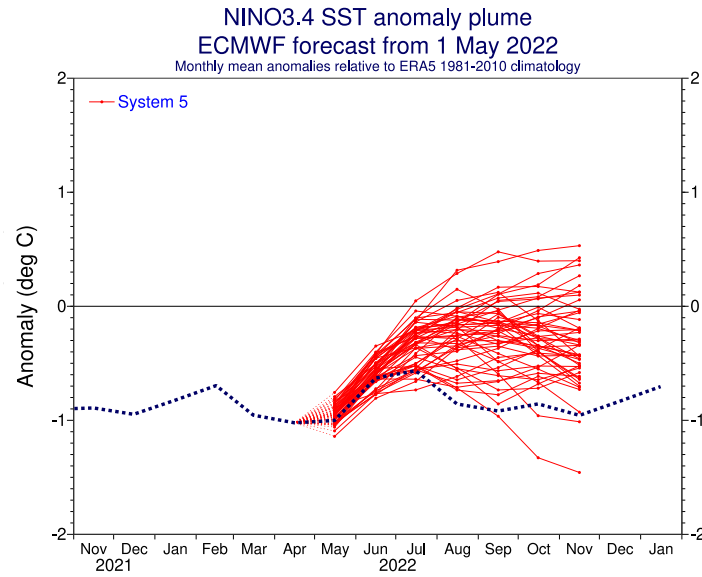


Precipitation

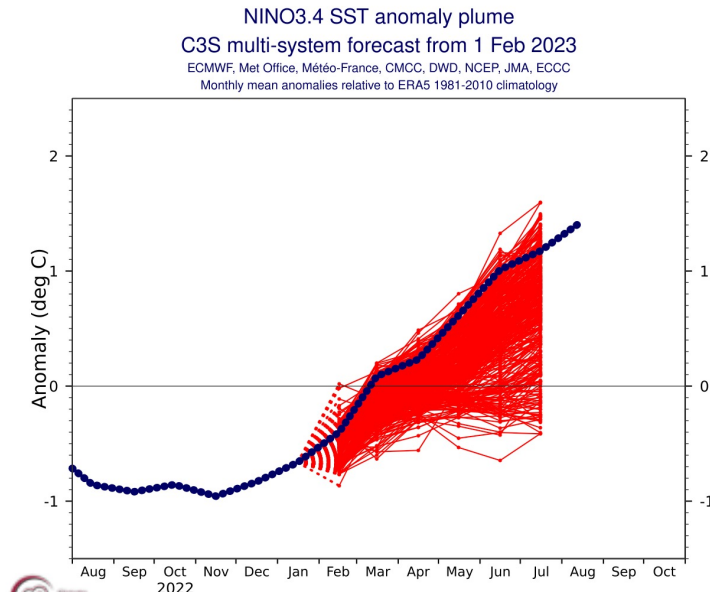
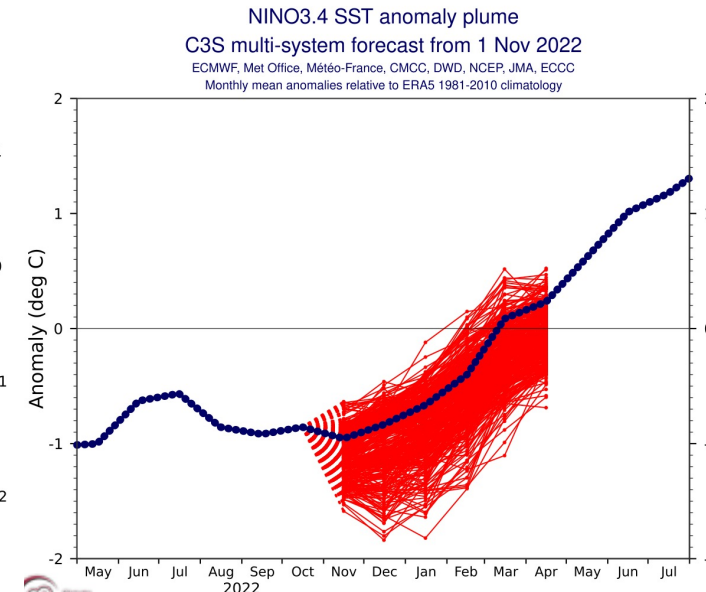
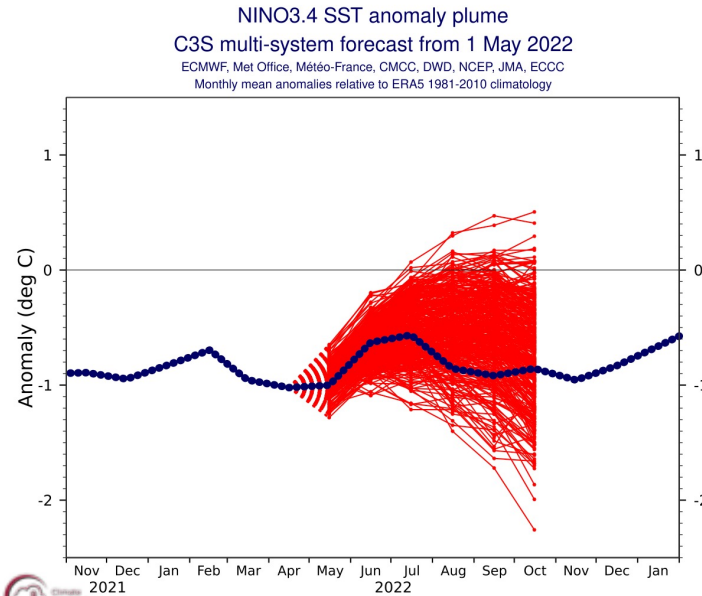
- Skill a few % above climatology
- Positive trend for all parameters
- Highest ever real-time forecast precip skill
- Large interannual variability of real-time forecast skill

Seasonal forecast

Seasonal forecast – El Nino



ECMWF



C3S
Multi-model



May 2022



Nov 2022



Feb 2023

Seasonal forecast DJF 2022-23

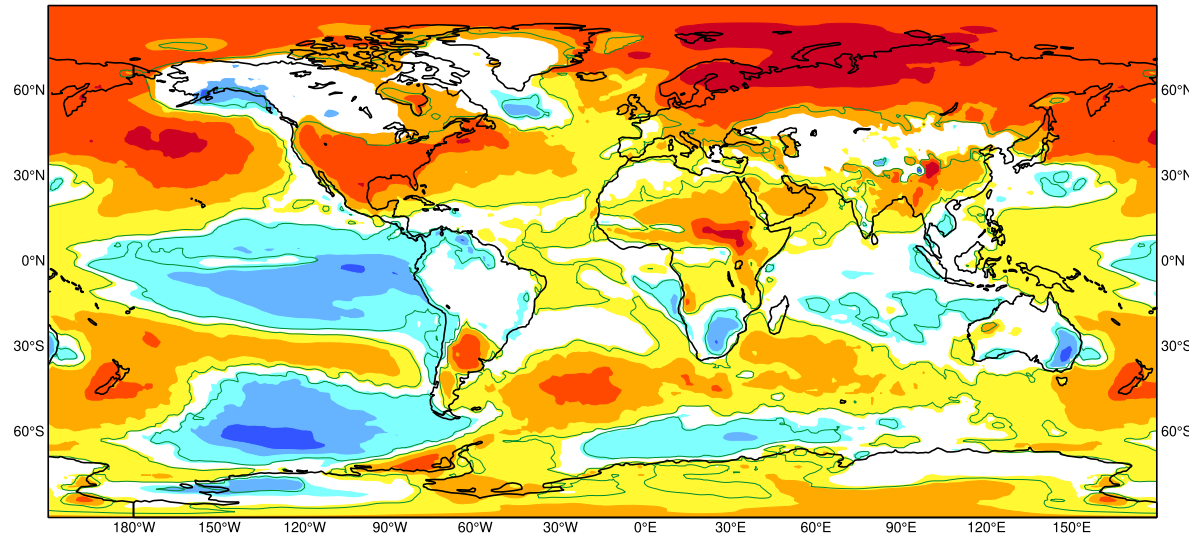
ECMWF Seasonal Forecast
Mean 2m temperature anomaly

Forecast start is 01/11/22, climate period is 1993-2016
Ensemble size = 51, climate size = 600

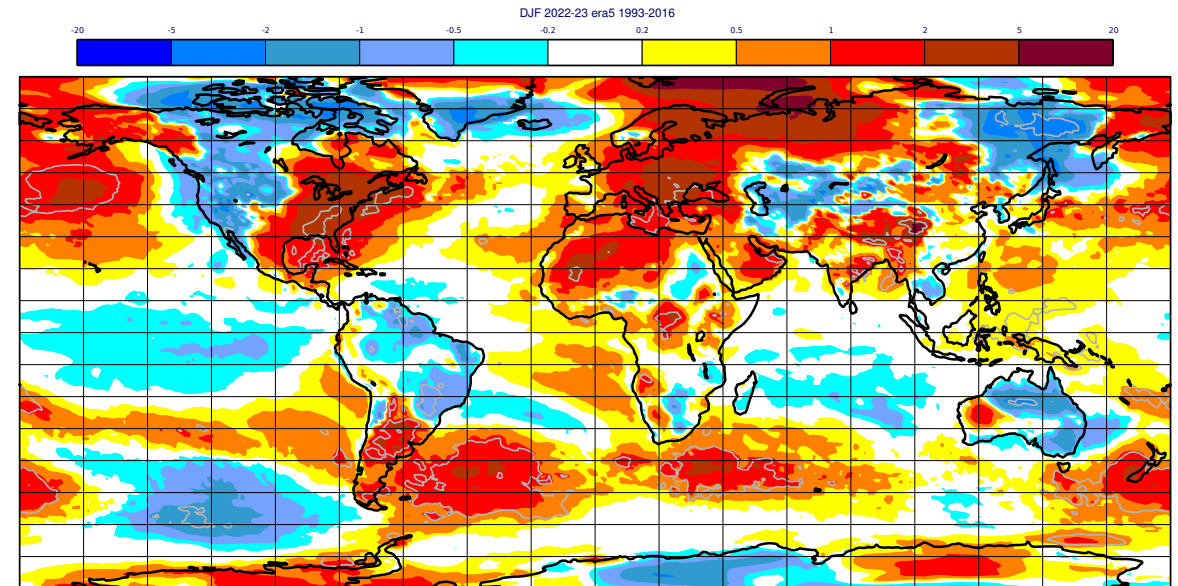
System 5

DJF 2022/23

Shaded areas significant at 10% level
Solid contour at 1% level



Forecast



Analysis

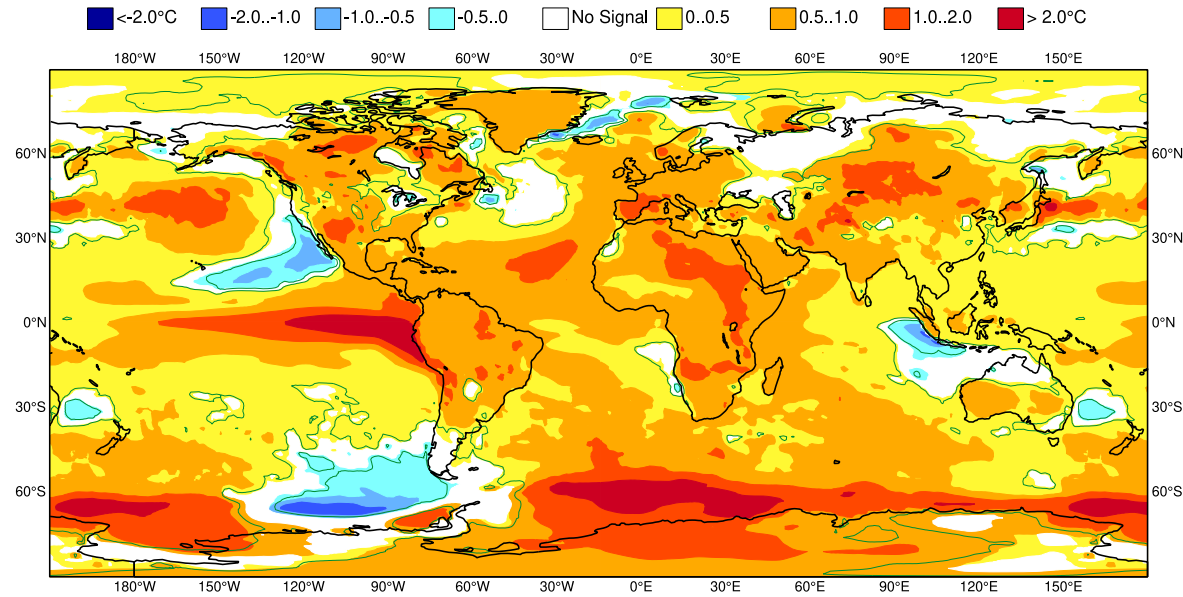
Seasonal forecast JJA 2023

ECMWF Seasonal Forecast
Mean 2m temperature anomaly

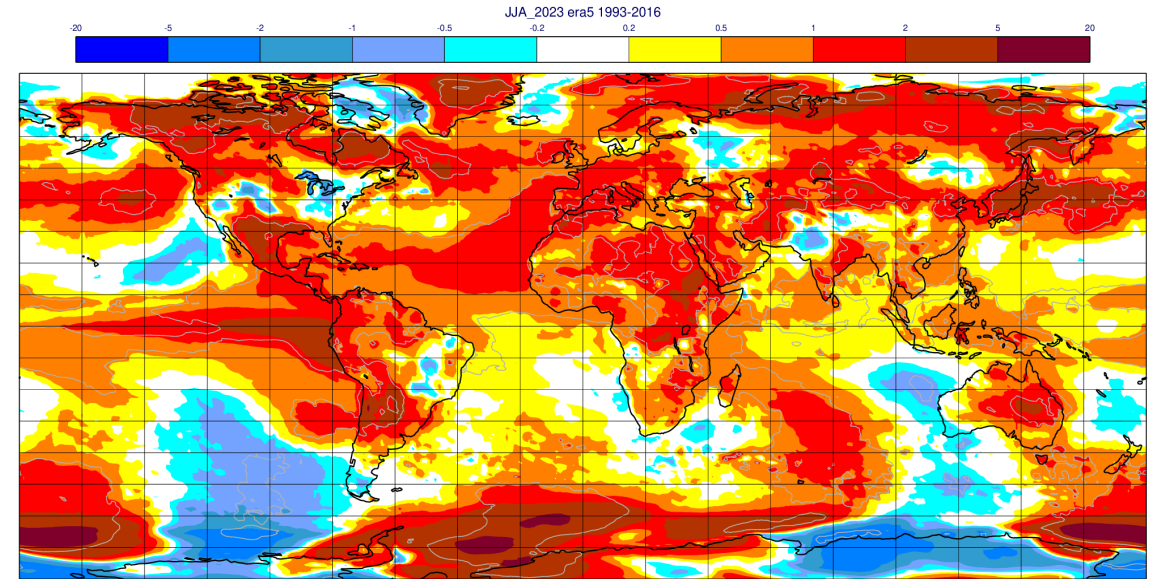
Forecast start is 01/05/23, climate period is 1993-2016
Ensemble size = 51, climate size = 600

System 5
JJA 2023

Shaded areas significant at 10% level
Solid contour at 1% level



Forecast



Analysis

Summary

- **Upper-air:** 47r3 positive effects; 48r1 effects will become apparent in 1-2 months
- **Other centres, upper-air:** ECMWF maintaining lead but gap slowly decreasing
- **CAMS:** upper-air scores back to previous levels
- **Tropics:** improved 850 hPa wind from 47r3, but degraded 850 hPa temperature
- **Analyses:** ECMWF and other centres getting closer, UKMO the closest
- **2m temperature:** behind other centres in short range, except in summer
- **Precipitation:** behind other centres in short range, except in summer
- **Total cloud cover:** increased bias and RMSE, to be addressed in future cycles
- **Ocean waves:** maintaining lead in wave height and peak period
- **Extended range:** strong trend in week 2, weaker trends in week 3
- **Seasonal:** transition to El Niño very well captured; positive T anomalies in summer 2023 indicated, but blocking transition in JJA in Europe not predicted