

# Deterministic (HRES) and ensemble (ENS) verification scores

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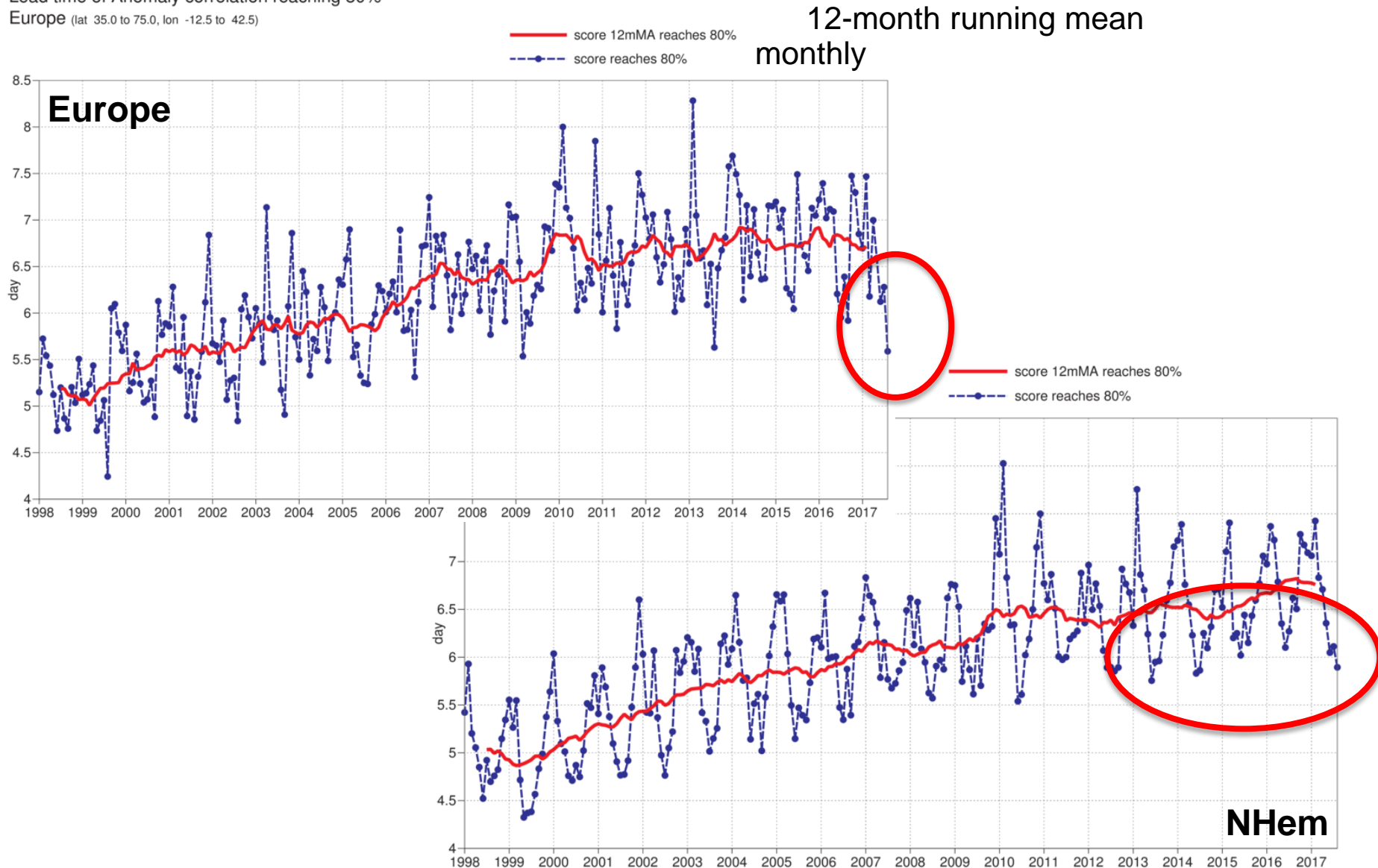
European Centre for Medium Range Weather Forecasts

# Outline

- Global HRES( deterministic) and ENS (ensemble) scores evolution between 1998 – 2017
- YOPP 2017 – Arctic and Antarctic
- SEEPS precipitation score decomposition
- Reminder on ECMWF WMO Lead Centre activities for Deterministic Forecast NWP Verification (WMO-LCDNV: <http://apps.ecmwf.int/wmolcdnv/>)

# HRES - Headline score Z500 Europe, time series of acc=0.8

500hPa geopotential  
Lead time of Anomaly correlation reaching 80%  
Europe (lat 35.0 to 75.0, lon -12.5 to 42.5)



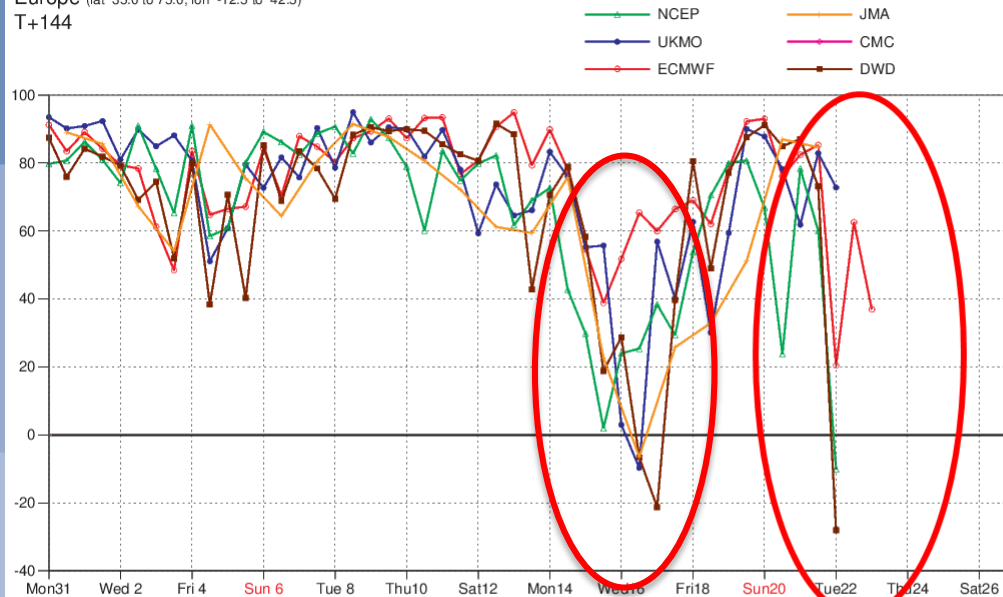
## Forecast busts over Europe – related to hurricane activity ?

### 500hPa geopotential

Anomaly correlation

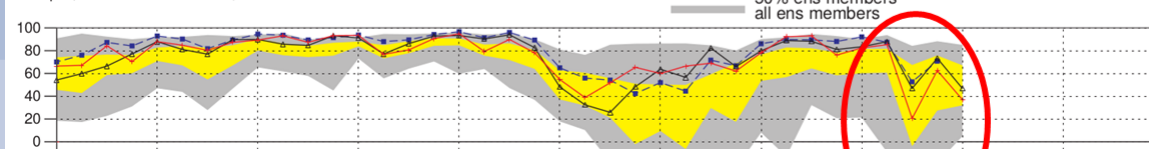
Europe (lat 35.0 to 75.0, lon -12.5 to 42.5)

T+144



### 500hPa geopotential Anomaly correlation

Europe (lat 35.0 to 75.0, lon -12.5 to 42.5)



*Does the Flap of a Butterfly's Wings in Brazil set off a Tornado in Texas? (Ed Lorenz, 1972)*

*Perhaps, but a hurricane in Texas may set off an uncertain weather forecast for Europe 6 days later ...*

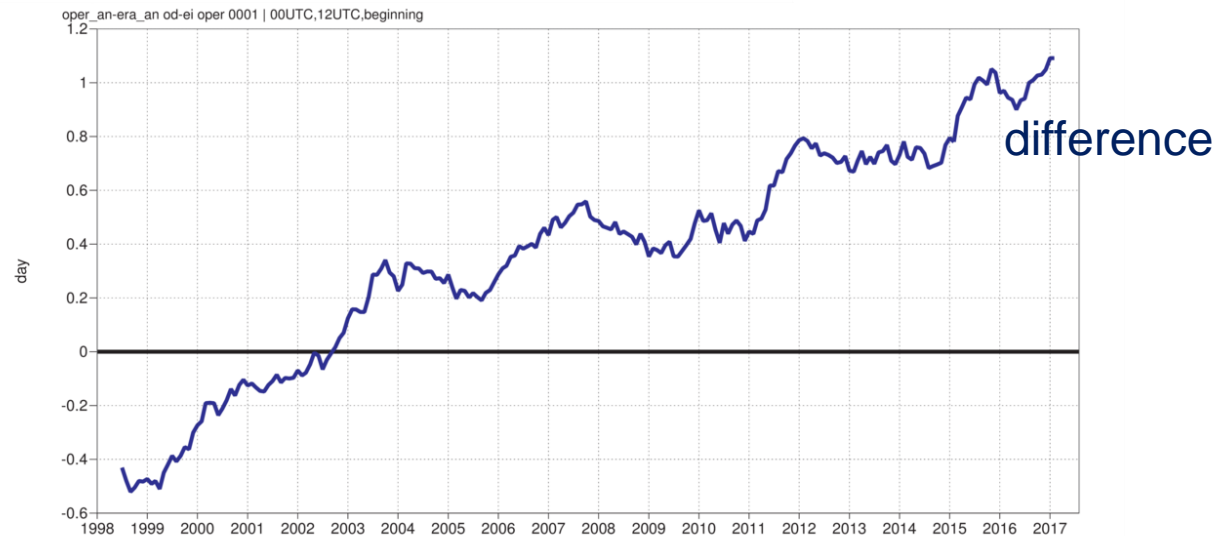
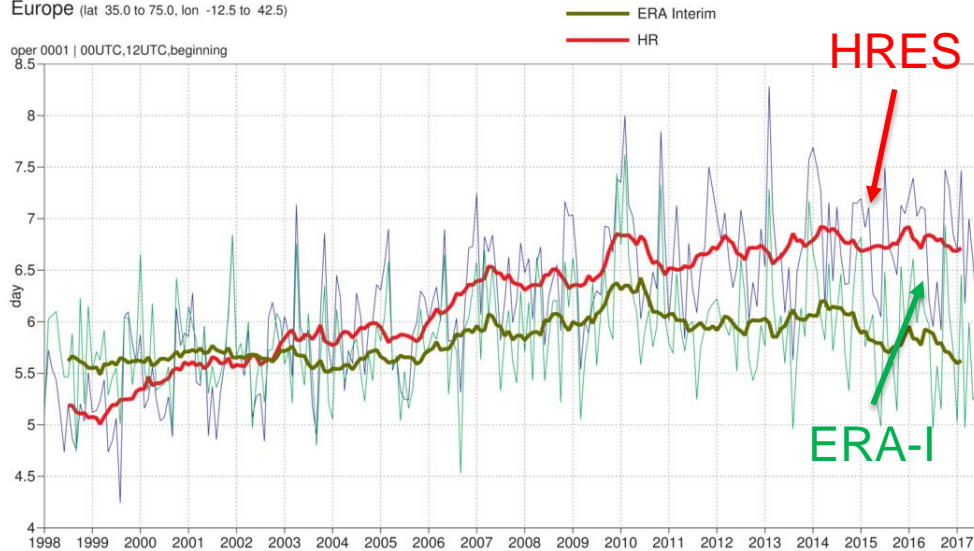
# HRES verification against ERA-I Z500 time series of acc=0.8

## HRES and ERA Interim 00,12UTC forecast skill

500hPa geopotential

Lead time of Anomaly correlation reaching 80%

Europe (lat 35.0 to 75.0, lon -12.5 to 42.5)



# ENS - Headline probabilistic score, CRPSS, T850 Europe

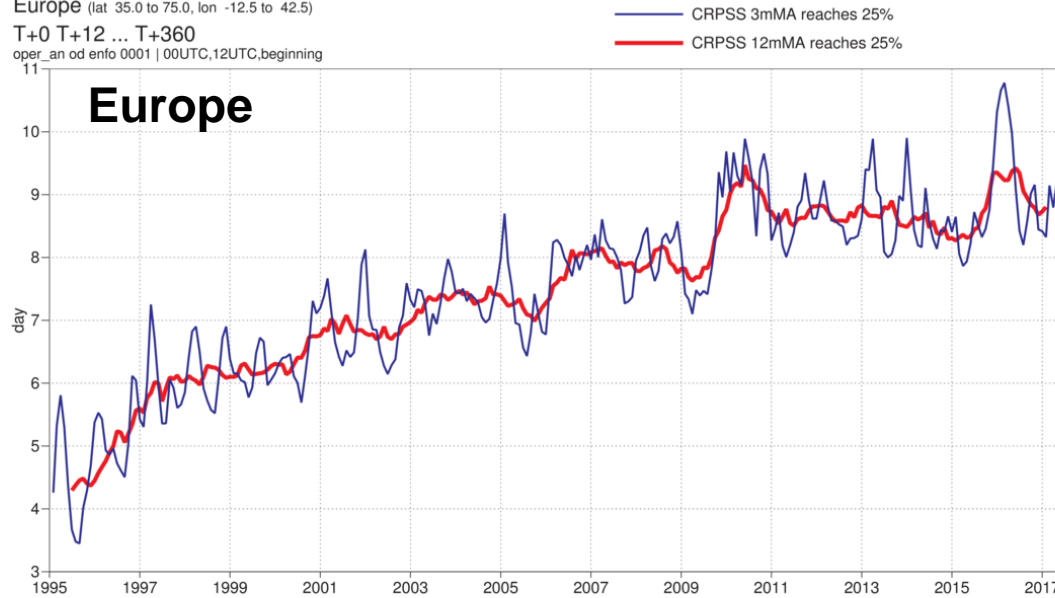
850hPa temperature

Continuous ranked probability skill score

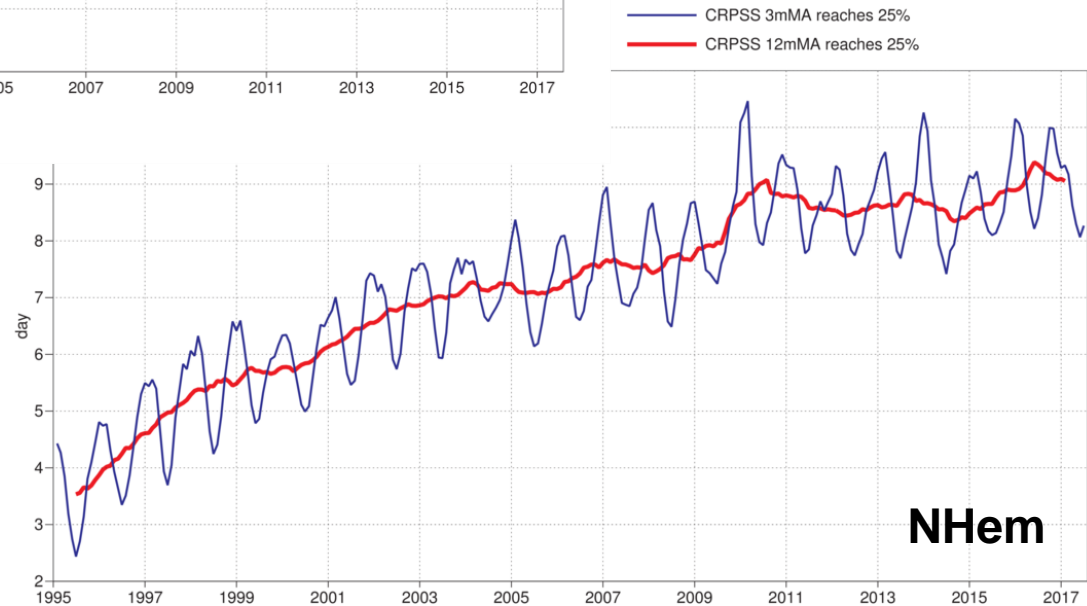
Europe (lat 35.0 to 75.0, lon -12.5 to 42.5)

T+0 T+12 ... T+360

oper\_an od enfo 0001 | 00UTC,12UTC,beginning



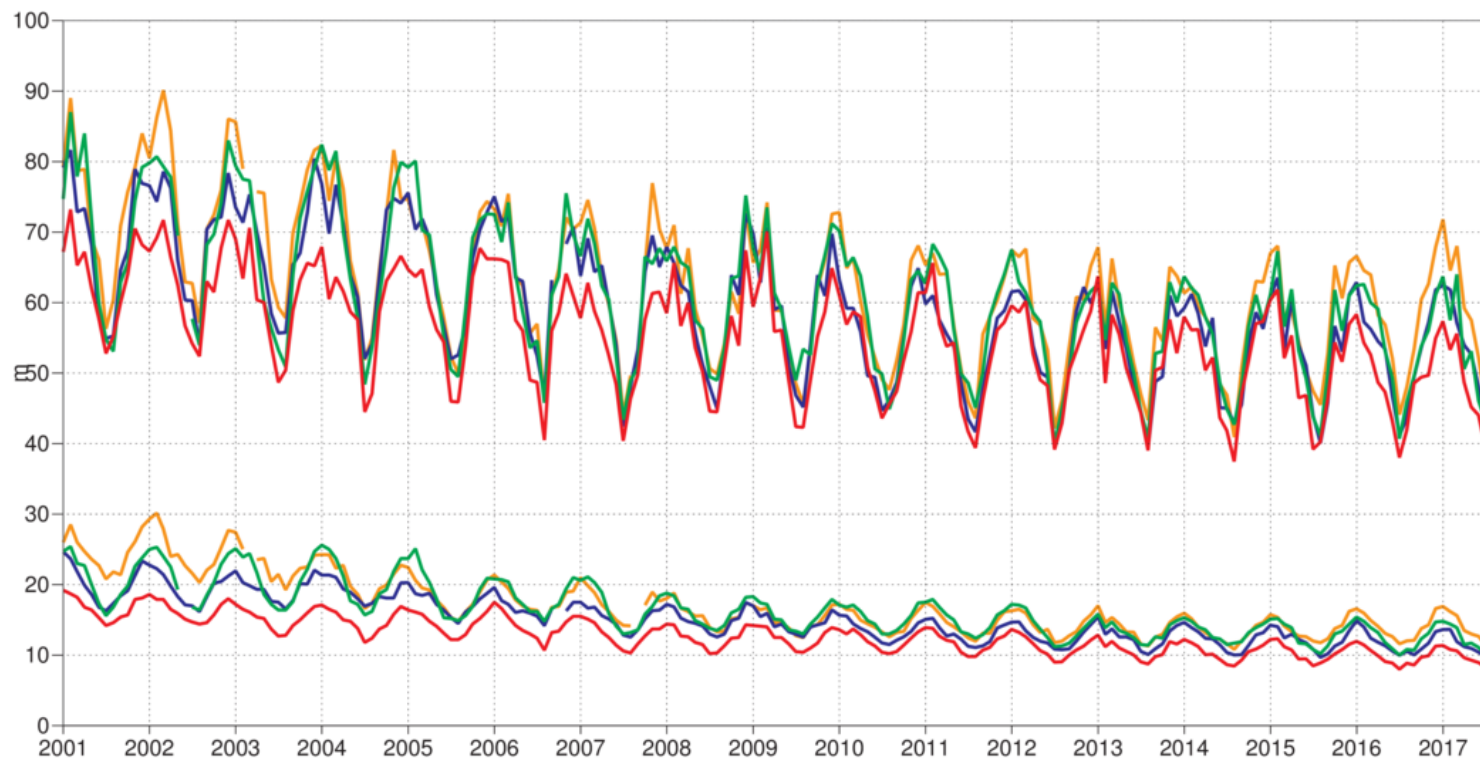
Day at which skill score reaches 25%



# HRES - WMO scores Z500 NHem

geopotential 500hPa  
Root mean square error  
NHem Extratropics (lat 20.0 to 90.0, lon -180.0 to 180.0)  
against analysis

UKMO 12utc T+144    ECMWF 12utc T+144  
UKMO 12utc T+48    ECMWF 12utc T+48  
JMA 12utc T+144    NCEP 00utc T+144  
JMA 12utc T+48    NCEP 00utc T+48

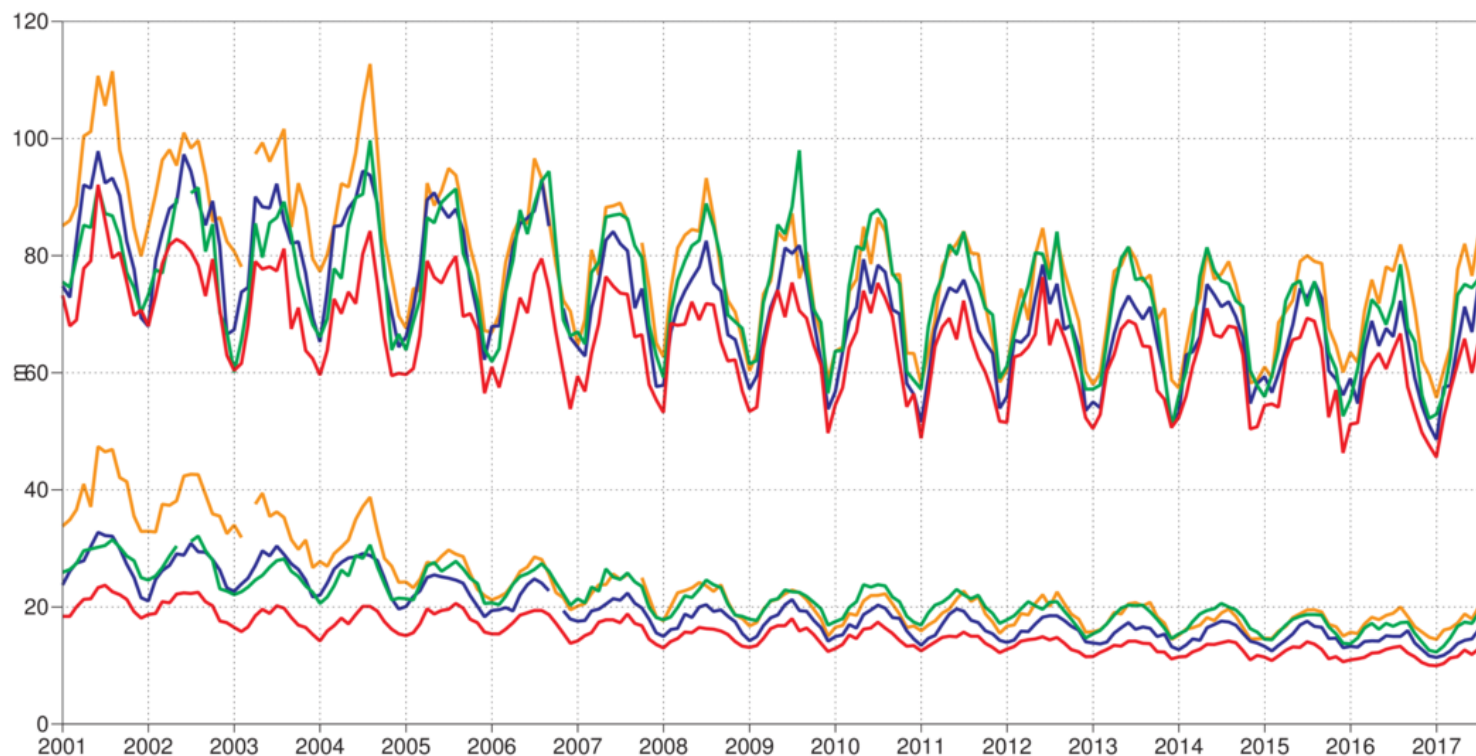




# HRES - WMO scores Z500 SHem

geopotential 500hPa  
Root mean square error  
SHem Extratropics (lat -90.0 to -20.0, lon -180.0 to 180.0)  
against analysis

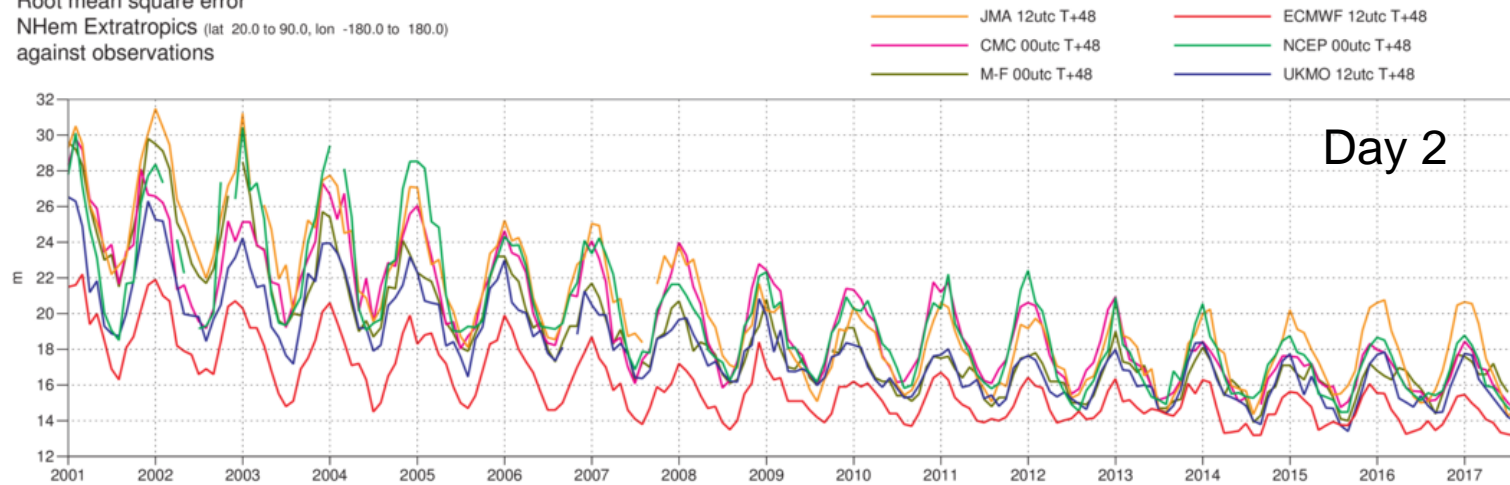
UKMO 12utc T+144    ECMWF 12utc T+144  
UKMO 12utc T+48    ECMWF 12utc T+48  
JMA 12utc T+144    NCEP 00utc T+144  
JMA 12utc T+48    NCEP 00utc T+48



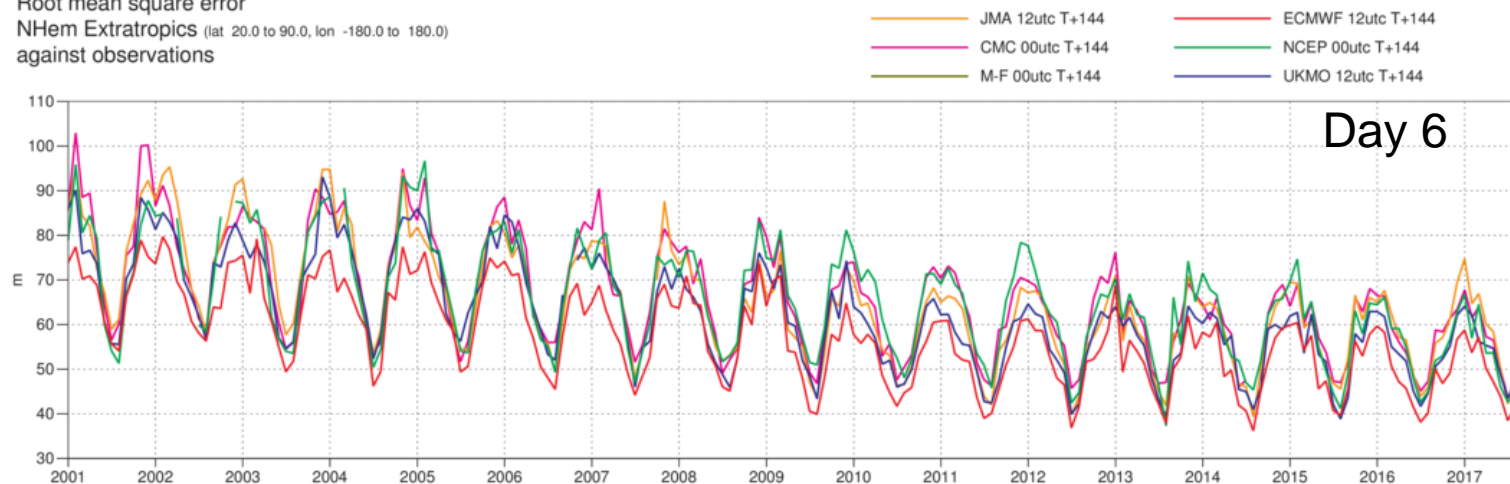


# HRES - verification against observations, Z500, NHem

geopotential 500hPa  
Root mean square error  
NHem Extratropics (lat 20.0 to 90.0, lon -180.0 to 180.0)  
against observations

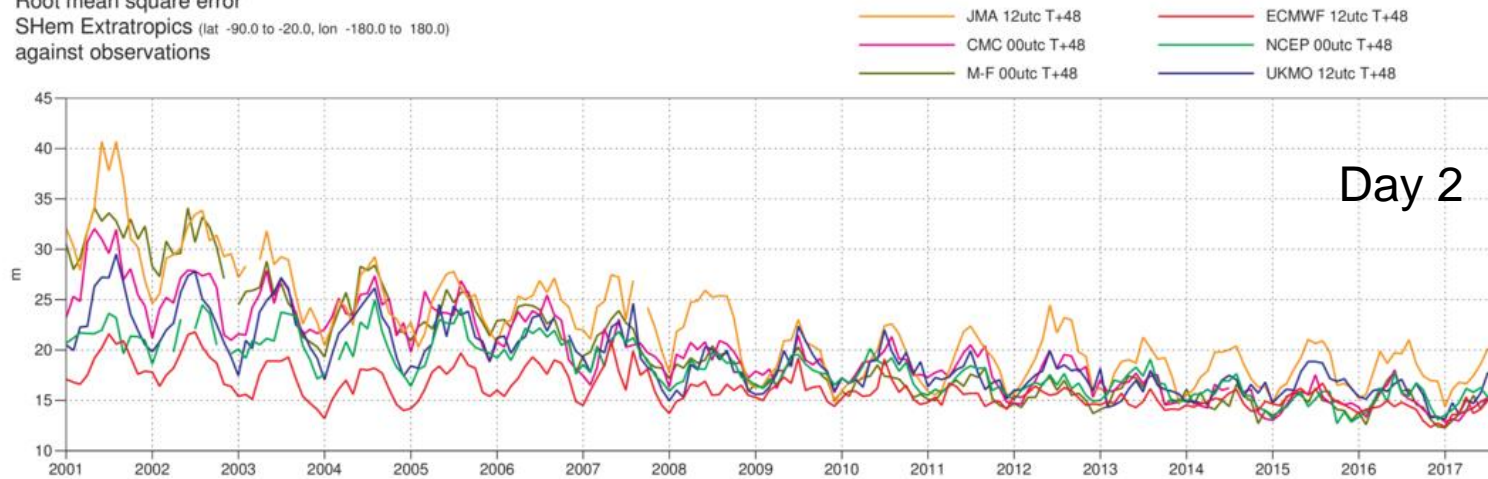


geopotential 500hPa  
Root mean square error  
NHem Extratropics (lat 20.0 to 90.0, lon -180.0 to 180.0)  
against observations

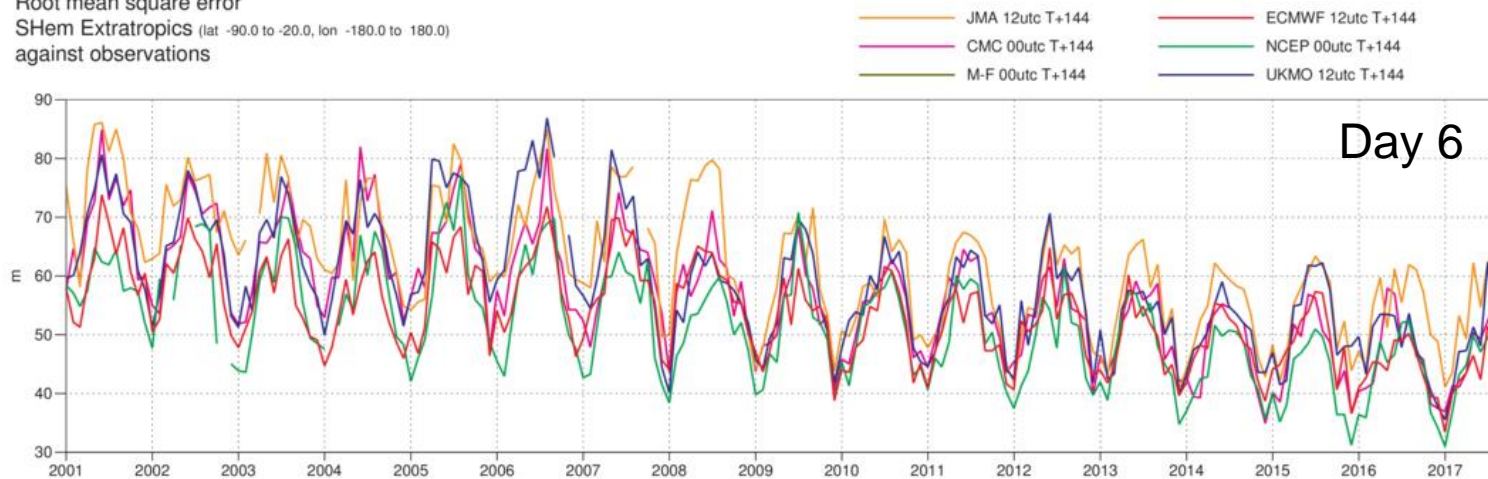


# HRES - verification against observations, Z500, SHem

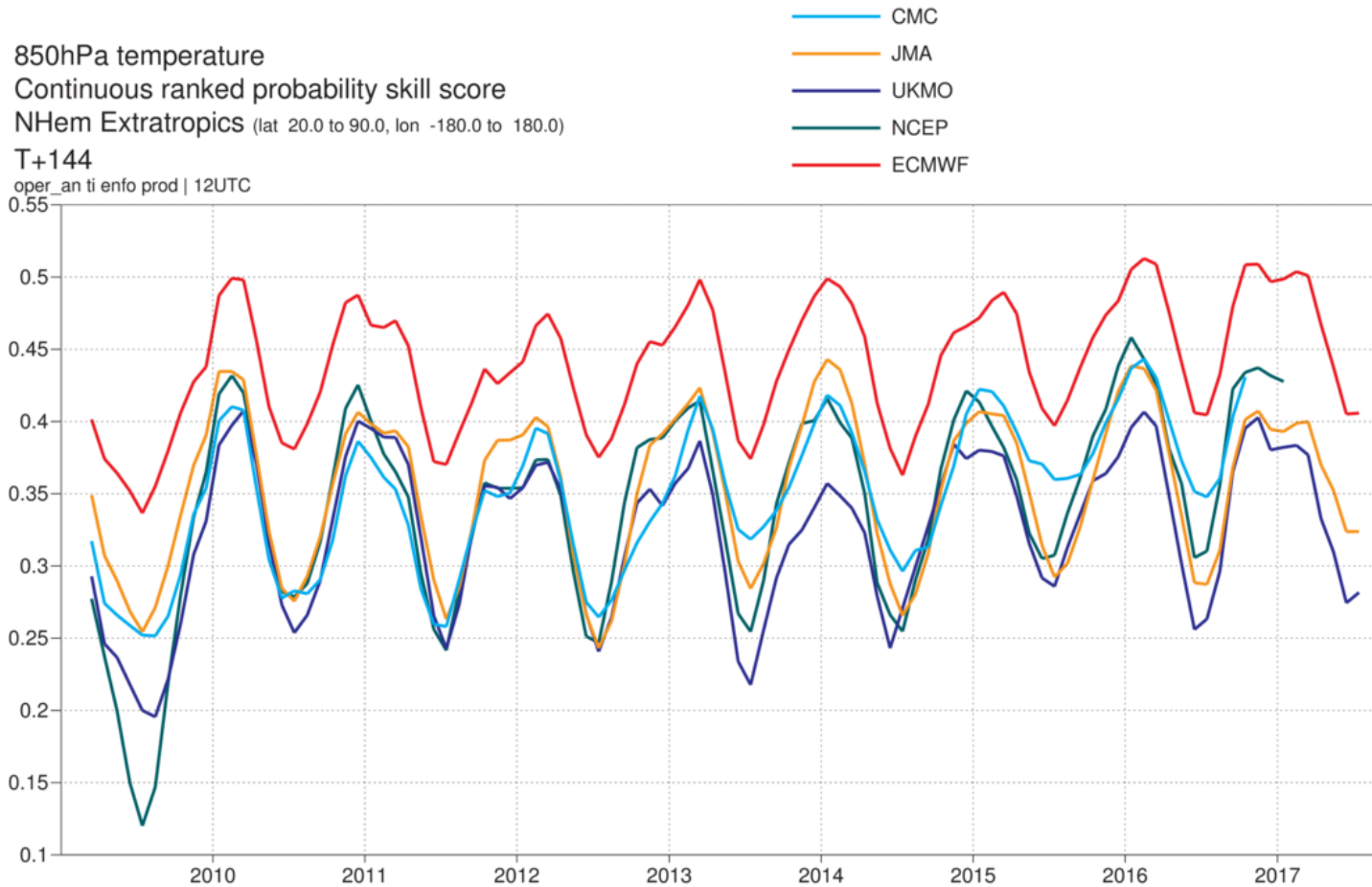
geopotential 500hPa  
Root mean square error  
SHem Extratropics (lat -90.0 to -20.0, lon -180.0 to 180.0)  
against observations



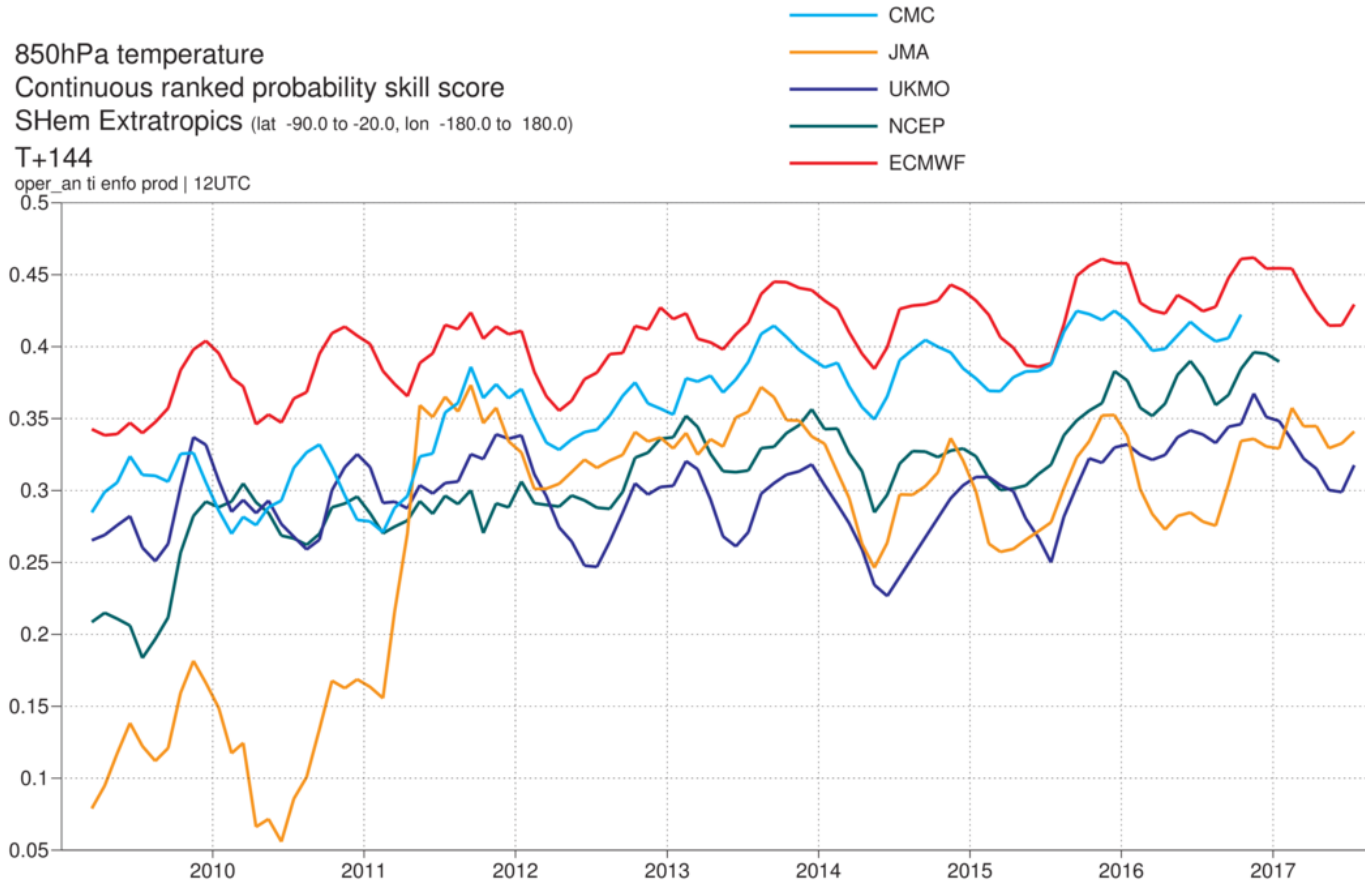
geopotential 500hPa  
Root mean square error  
SHem Extratropics (lat -90.0 to -20.0, lon -180.0 to 180.0)  
against observations



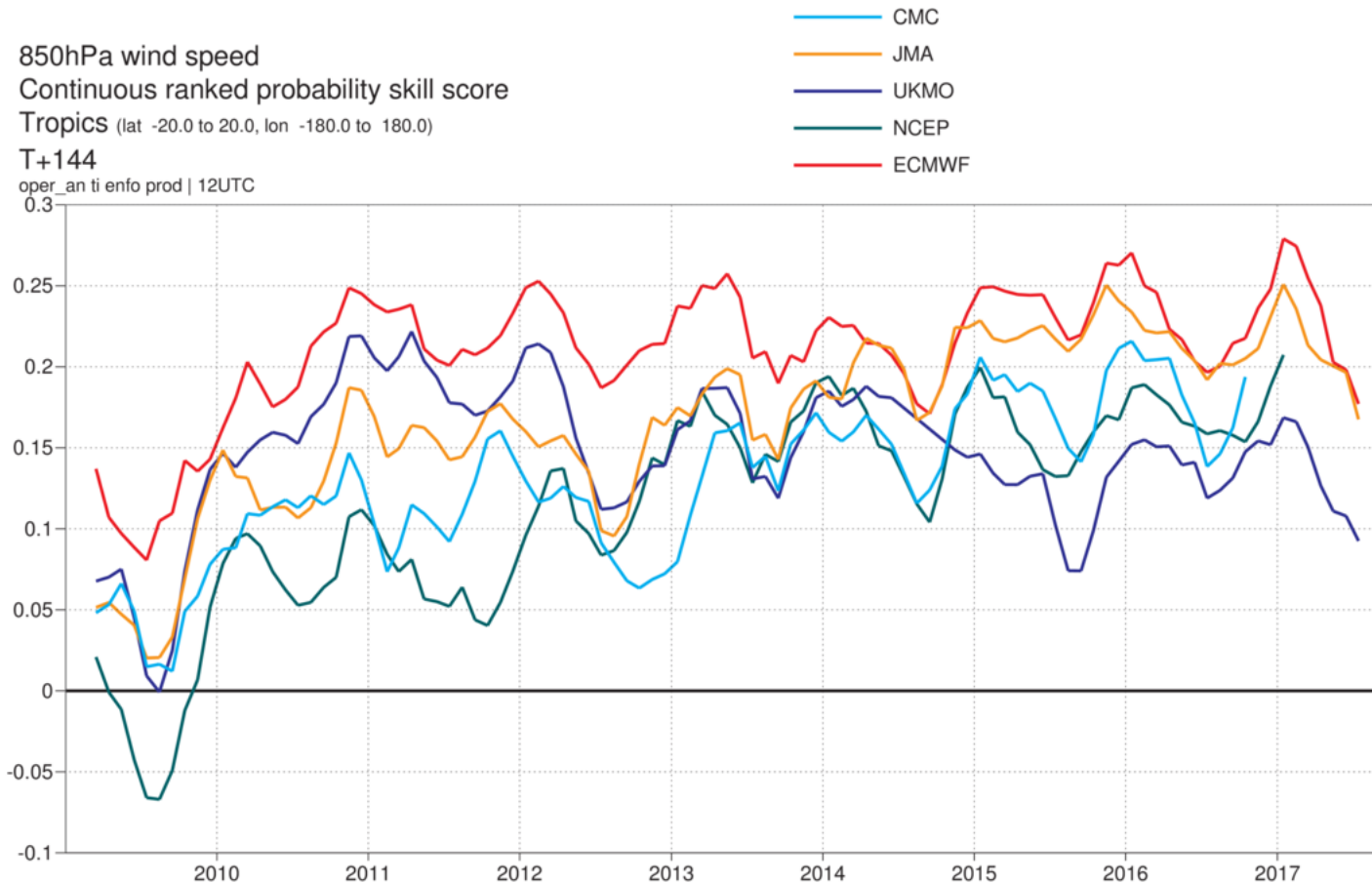
# ENS - CRPSS, T850, NHem, day 6



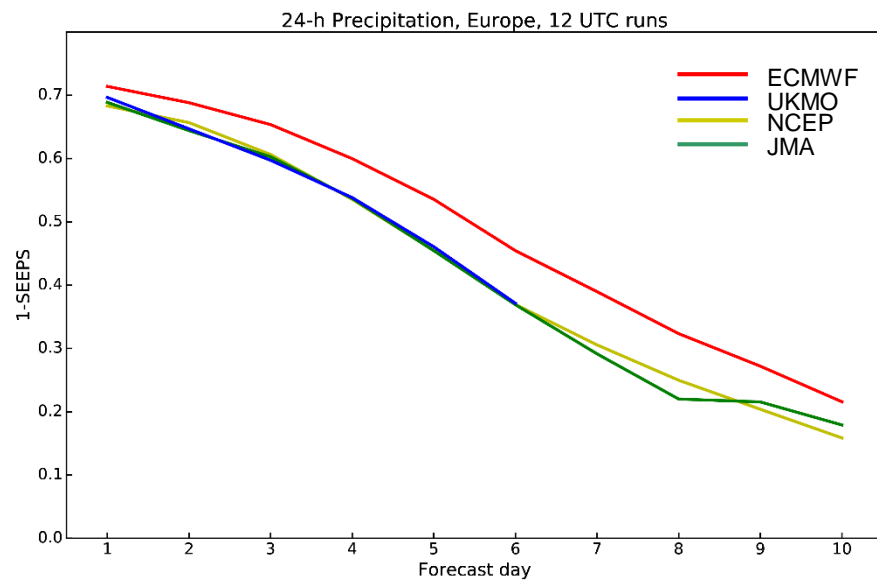
# ENS - CRPSS, T850, SHem, day 6



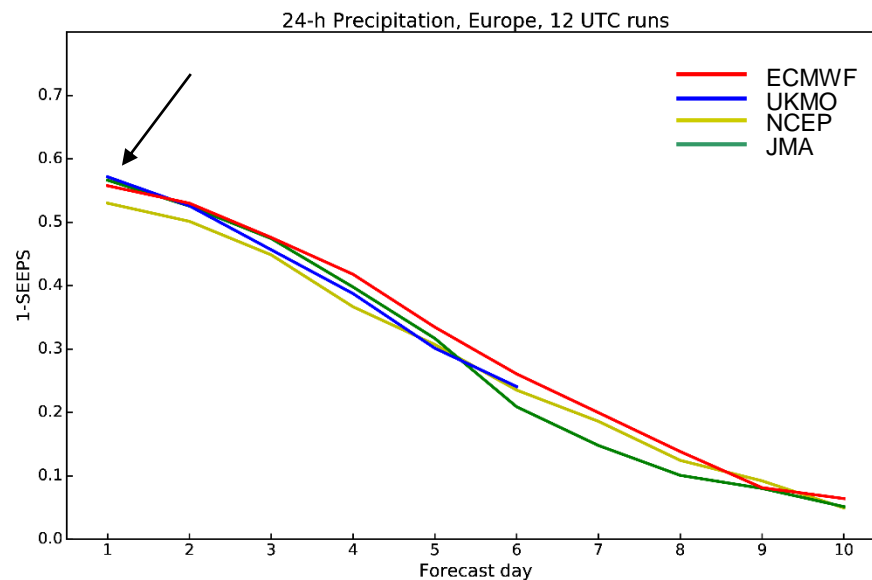
# ENS - CRPSS, T850, Tropics, day 6



## Precipitation: low skill compared to others at day 1 in summer



DJF 2016-17



JJA 2017

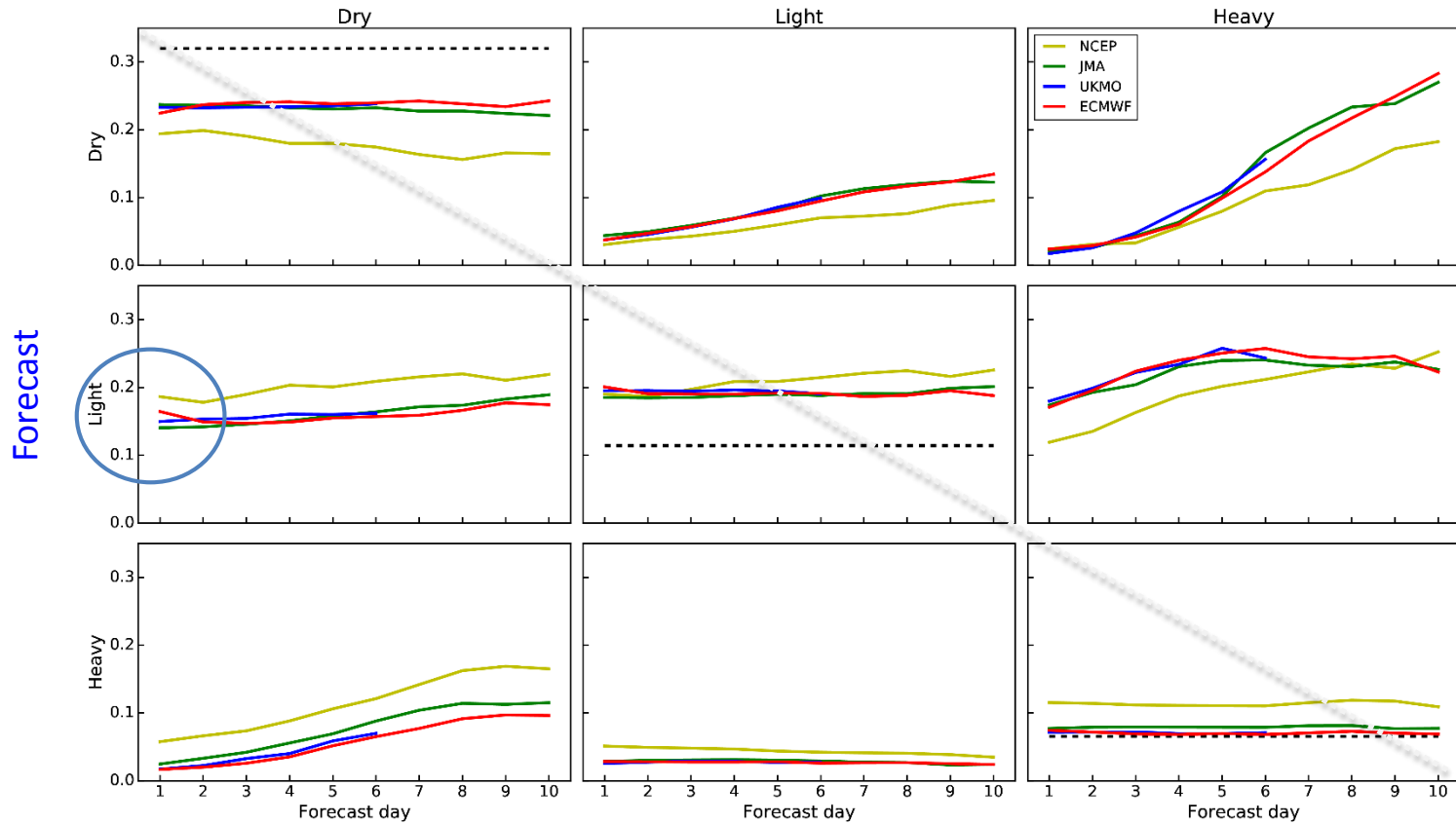
Europe



Europe

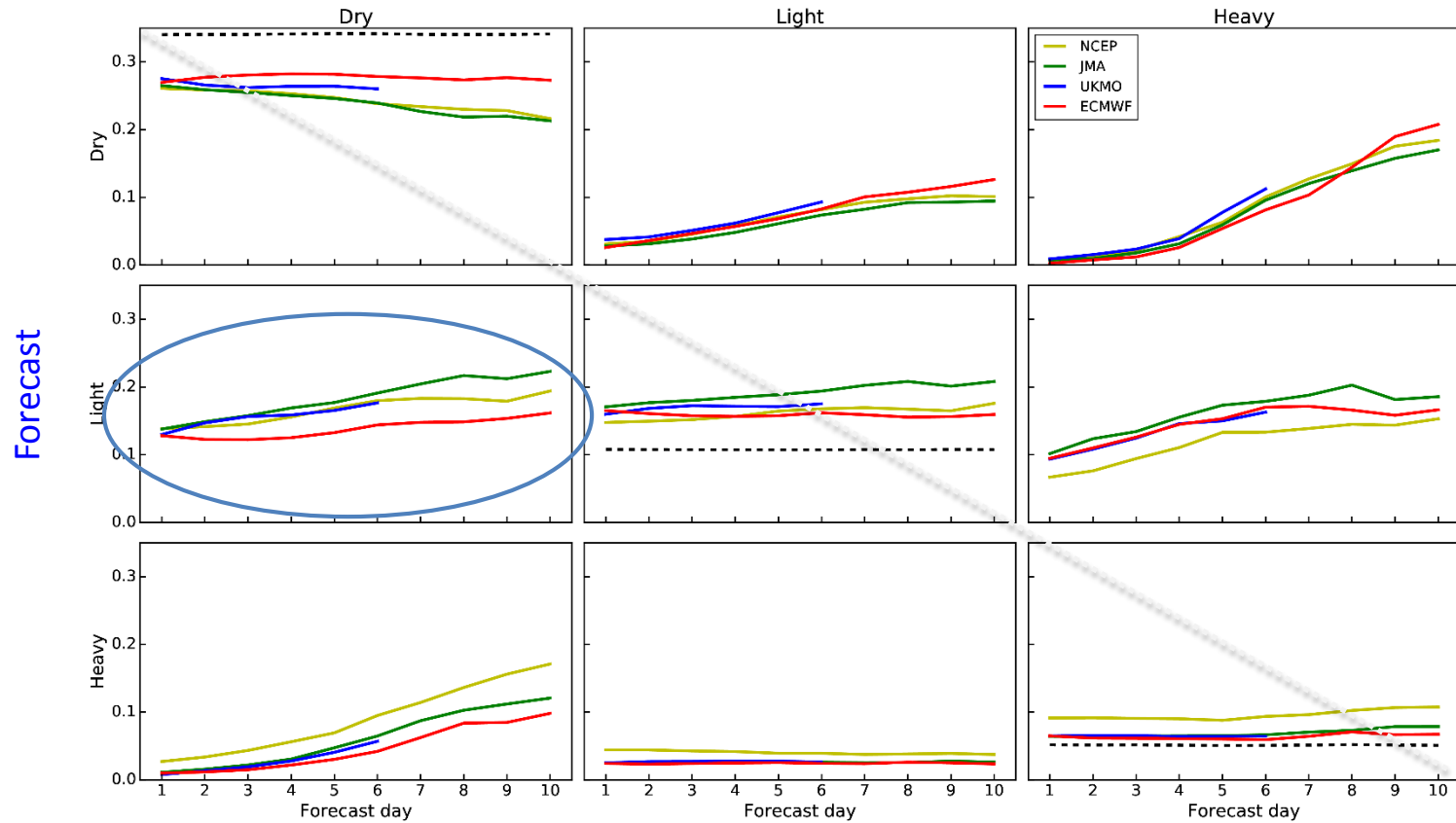
# SEEPS decomposition - summer

Observed



## SEEPS decomposition - winter

Observed



# Year Of Polar Prediction

DJF 2017

**DJF 2017**

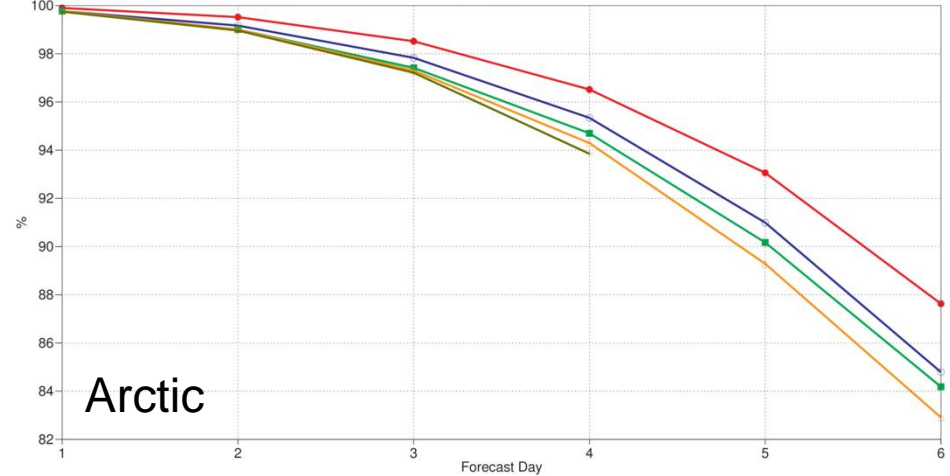
500hPa geopotential

Anomaly correlation

Arctic (lat 60.0 to 90.0, lon -180.0 to 180.0)

Date: 20161201 00UTC to 20170228 12UTC

oper\_an od 0001 | Mean method: standard | Population: 2\*156,155,130,2\*154 (averaged)



Arctic

**DJF 2017**

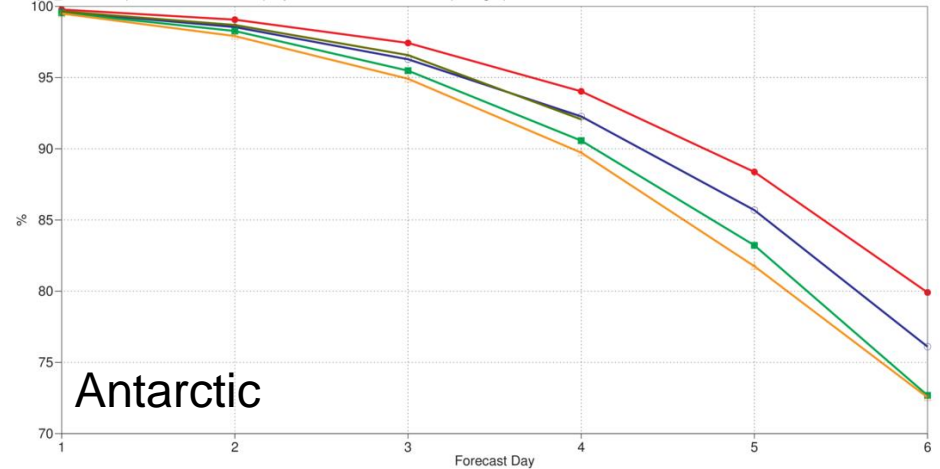
500hPa geopotential

Anomaly correlation

Antarctic (lat -90.0 to -60.0, lon -180.0 to 180.0)

Date: 20161201 00UTC to 20170228 12UTC

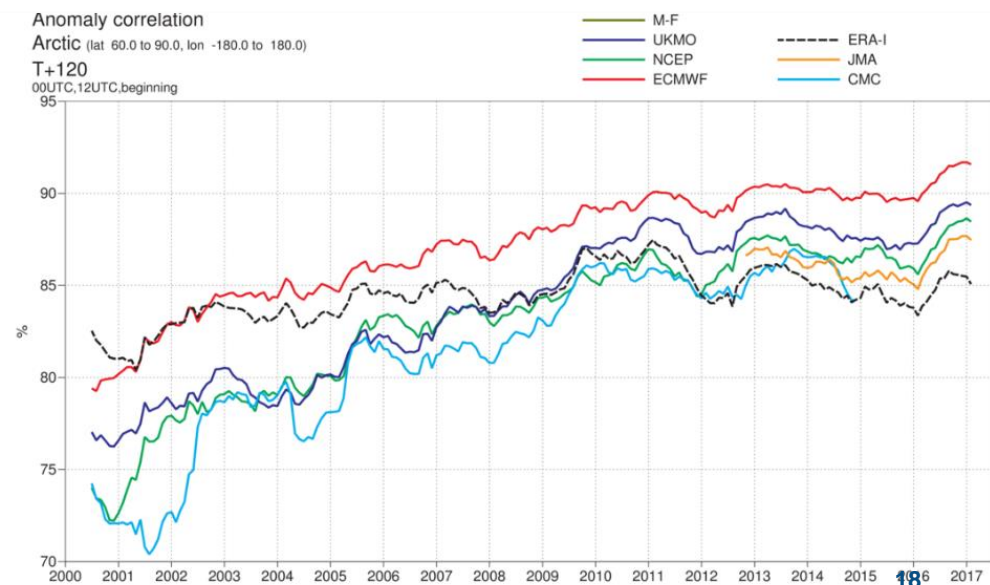
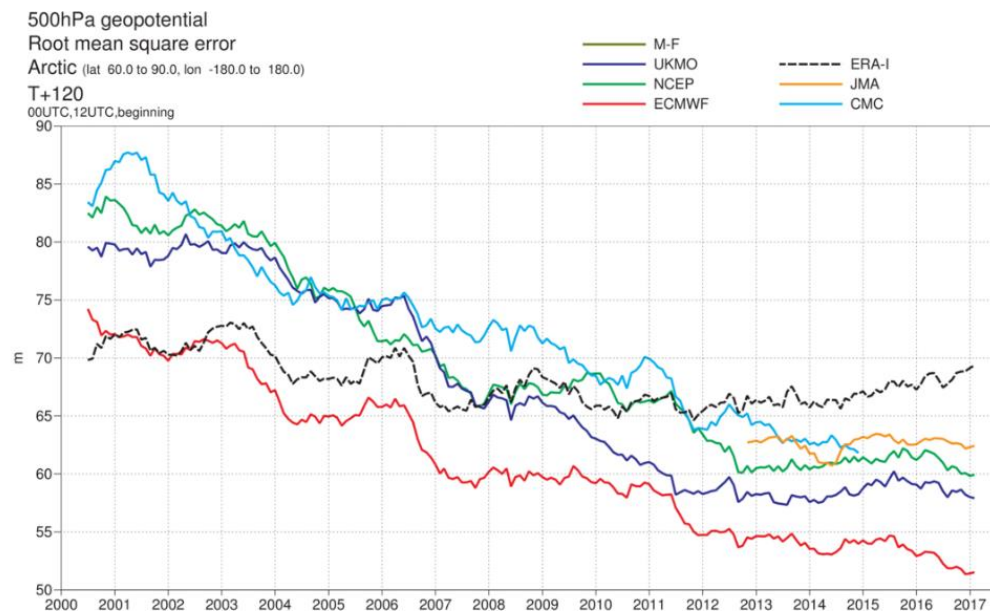
oper\_an od 0001 | Mean method: standard | Population: 2\*156,155,130,2\*154 (averaged)



Antarctic

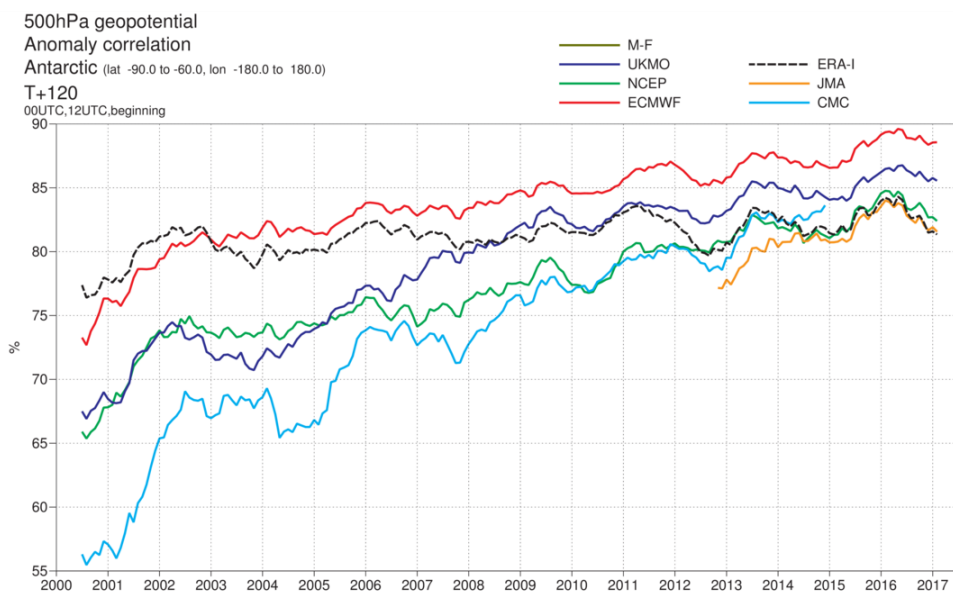
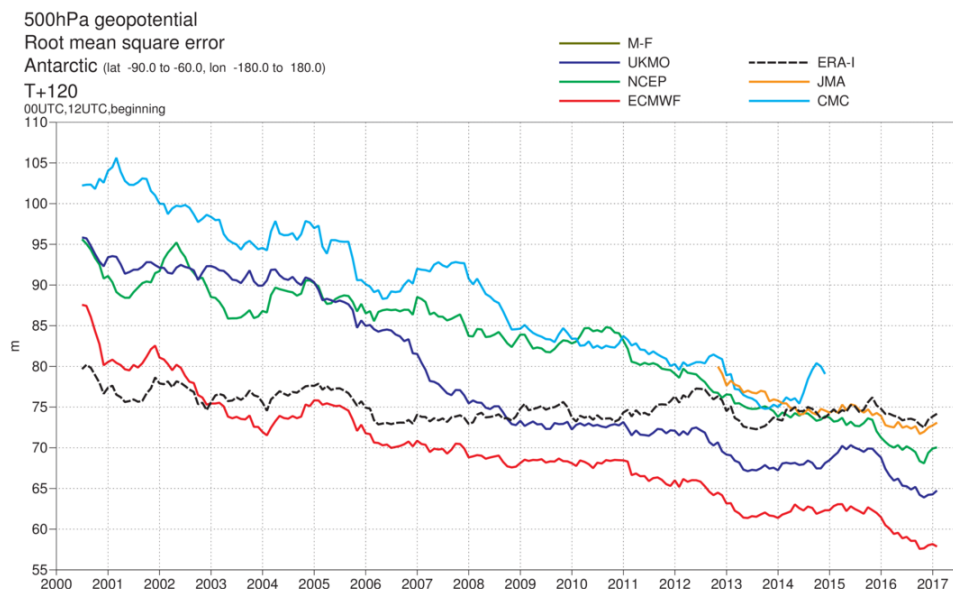
# Year Of Polar Prediction Arctic scores

Day 5



# Year Of Polar Prediction Antarctic scores

Day 5



# Arctic, analysis and model activity

Difference of stdev of  
forecast and analysis  
anomalies

500hPa geopotential  
Standard deviation of analysis anomaly

Arctic (lat 60.0 to 90.0, lon -180.0 to 180.0)

~~T+24~~  
oper\_an od 0001 | 00UTC,12UTC,beginning  
135

UKMO JMA  
NCEP CMC  
ECMWF M-F

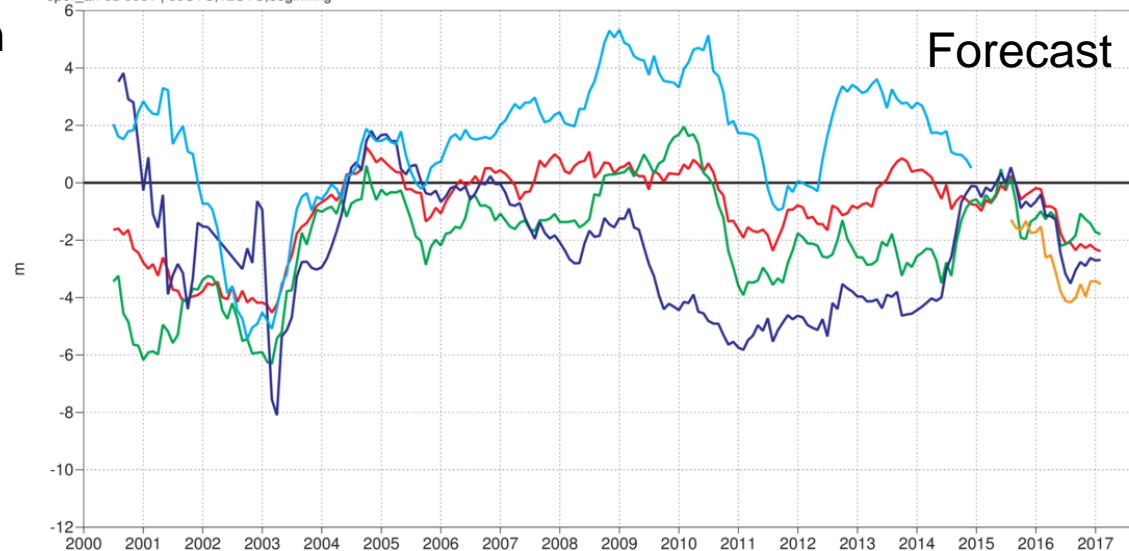


500hPa geopotential  
Standard deviation of forecast anomaly

Arctic (lat 60.0 to 90.0, lon -180.0 to 180.0)

T+144  
oper\_an od 0001 | 00UTC,12UTC,beginning

UKMO JMA  
NCEP CMC  
ECMWF M-F



gain

loss

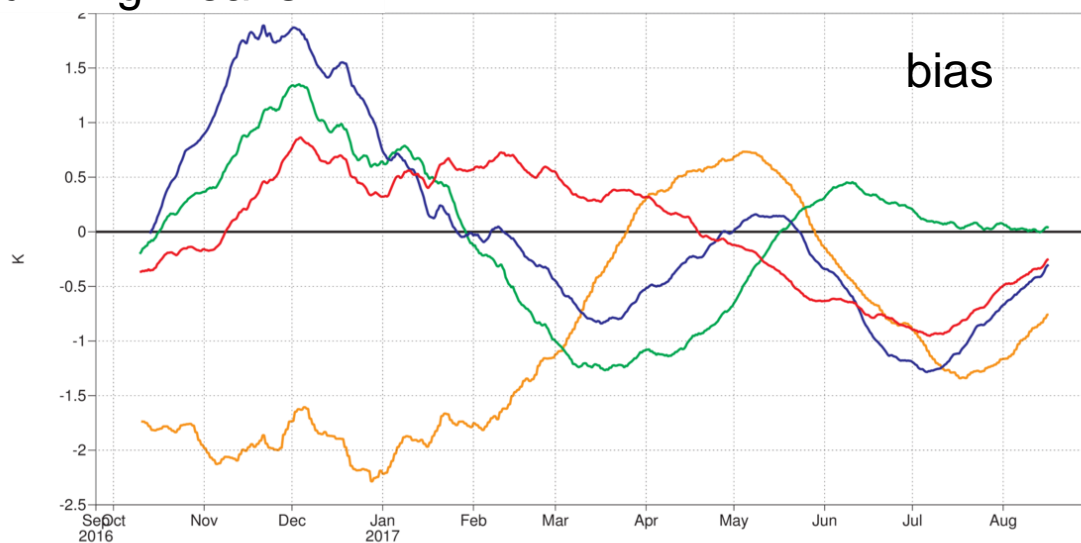
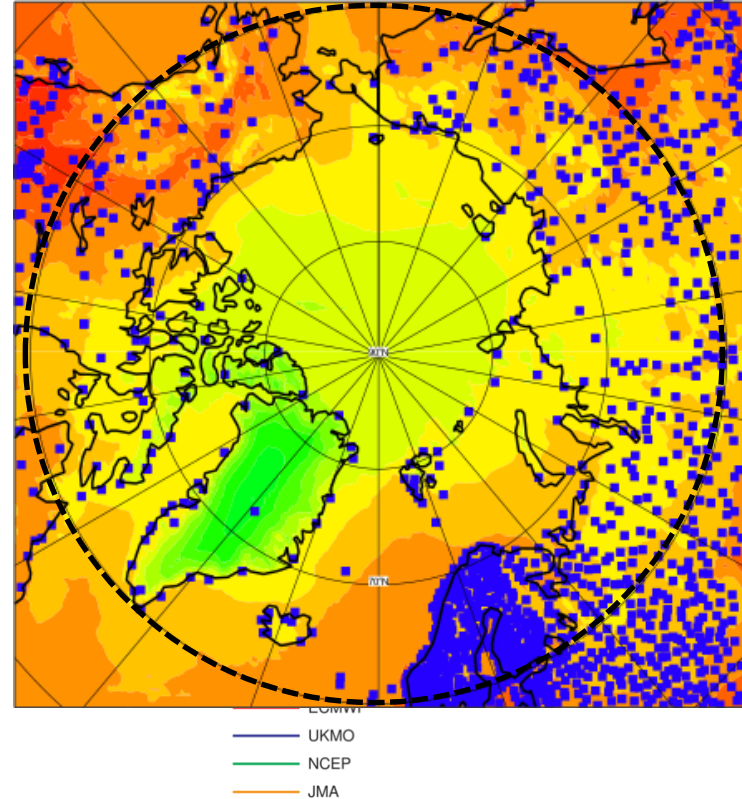
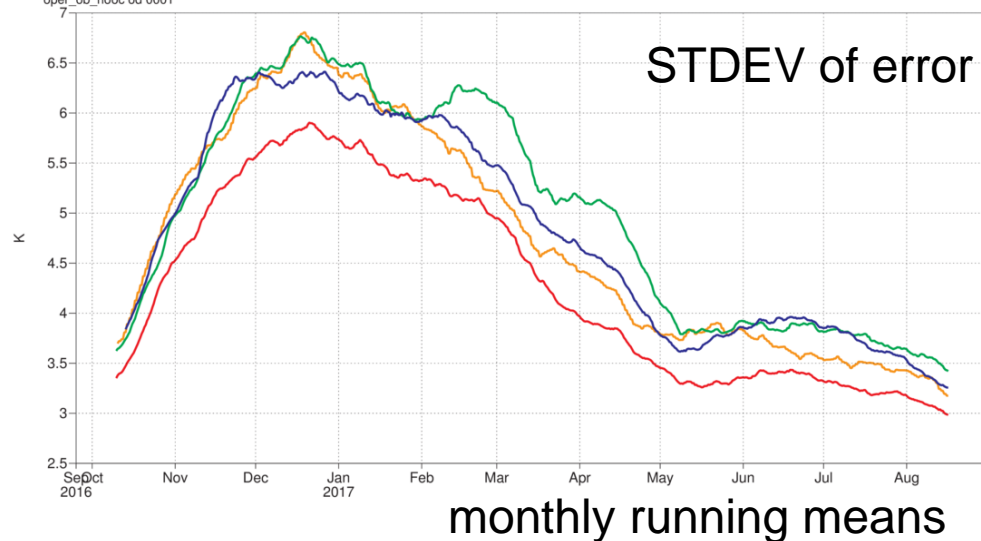


# 2m temperature, against SYNOP Arctic

2 meter temperature  
Standard deviation of forecast error  
Arctic (lat 60.0 to 90.0, lon -180.0 to 180.0)

T+120  
oper\_ob\_noooc od 0001

ECMWF  
UKMO  
NCEP  
JMA

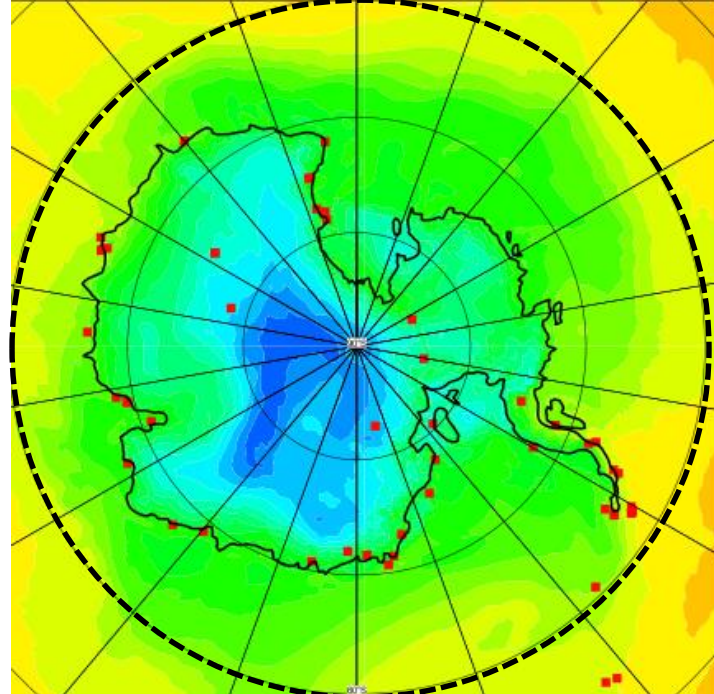
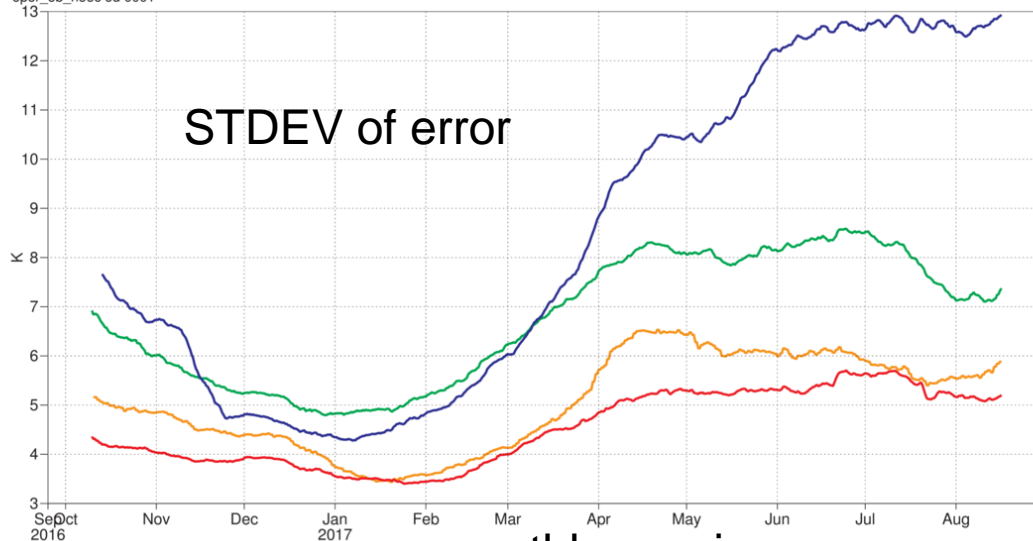


# 2m temperature, against SYNOP Antarctic

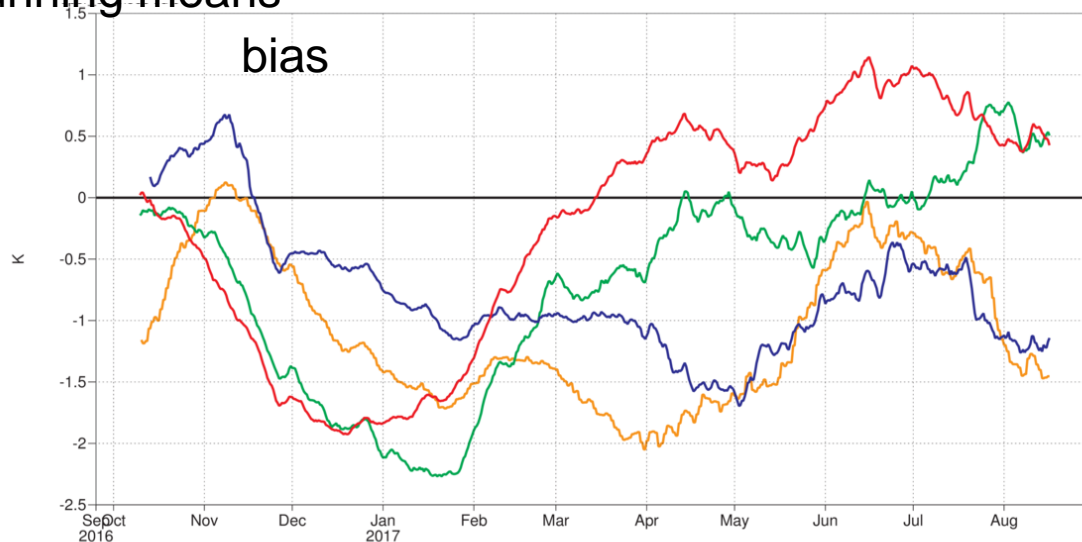
2 meter temperature  
Standard deviation of forecast error  
Antarctic (lat -90.0 to -60.0, lon -180.0 to 180.0)

T+120

oper\_ob\_nooc od 0001

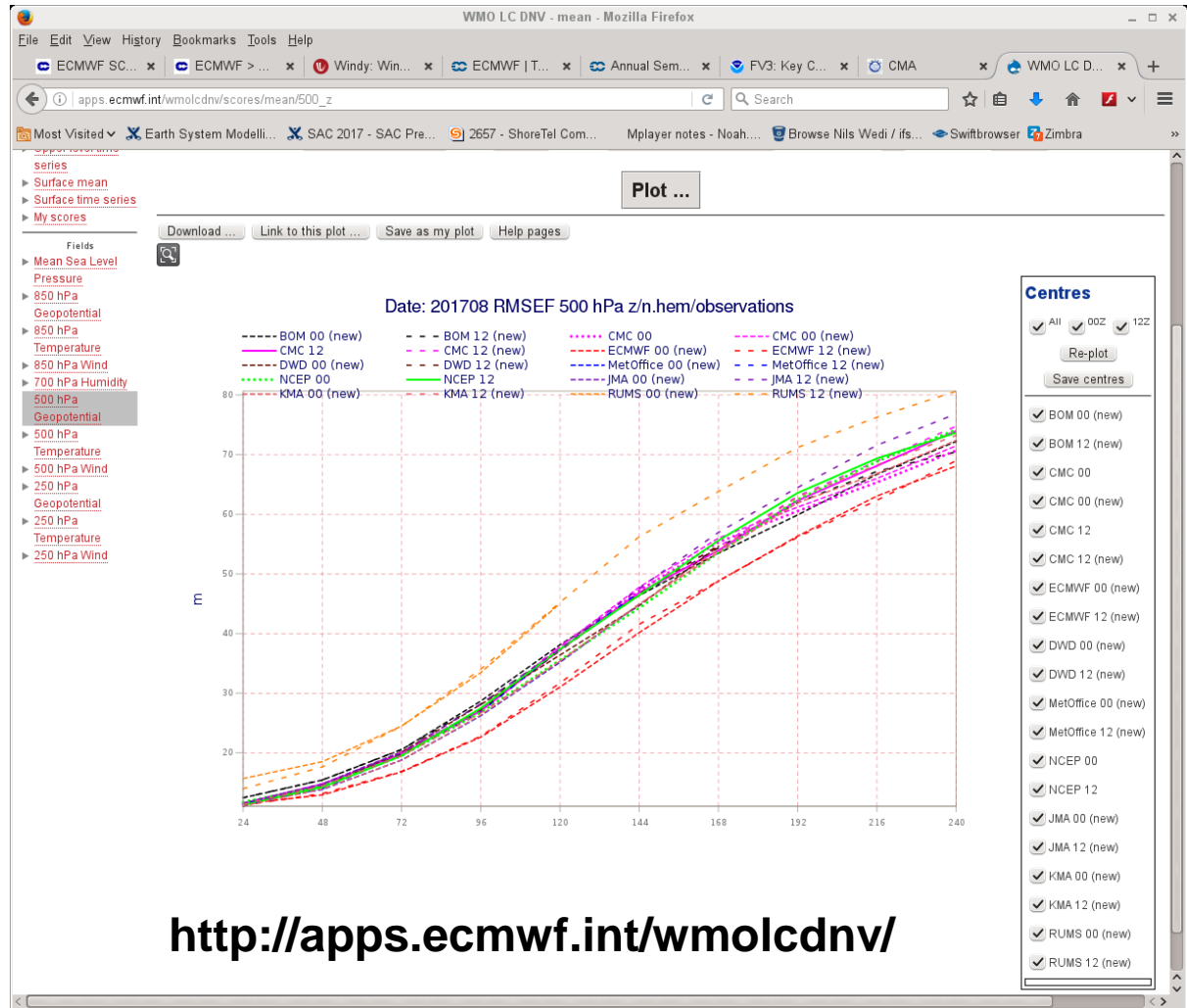


ECMWF  
UKMO  
NCEP  
JMA



# WMO Lead Centre for Deterministic Forecast NWP Verification (WMO-LCDNV)

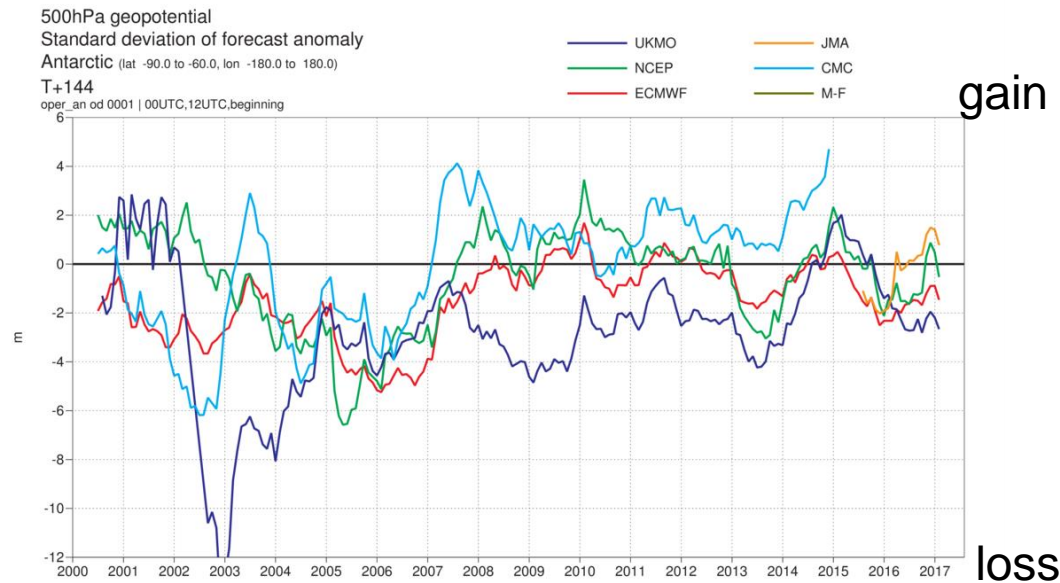
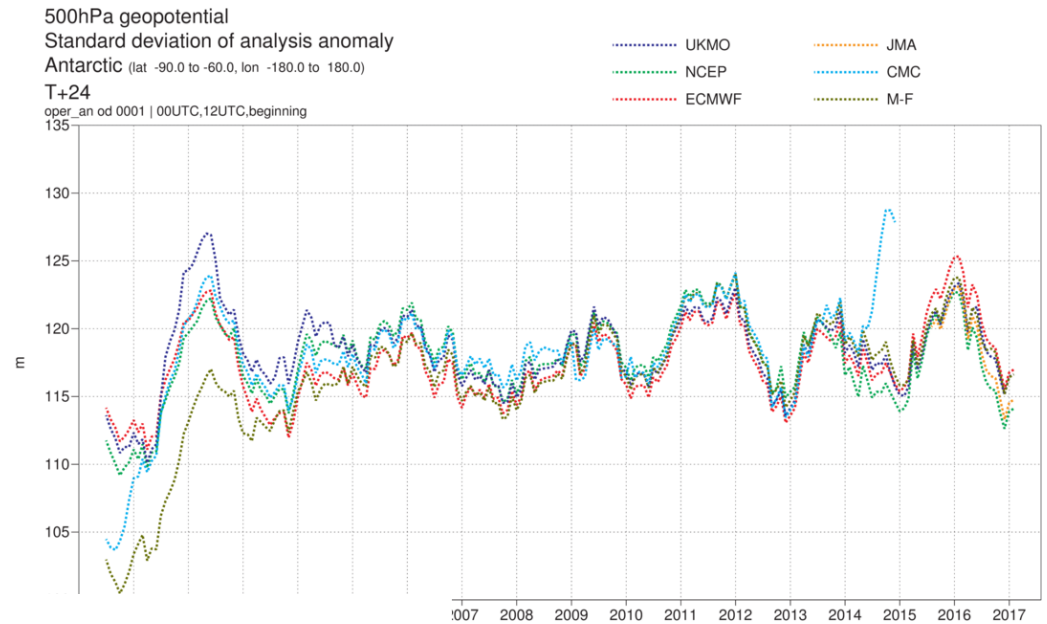
- Collecting upper-air verification reports from global centres continues, most of centres has migrated to new definition of scores and the exchange format



# Conclusions

- Era-Interim near-realtime performance worsening, verification against ERA5 in progress
- ECMWF best ever summer score in 2016 followed by less predictable 2017 summer ...
- Summer 2017 Europe + NH less predictable ? Forecast busts over Europe, connections to hurricane activity, warm SSTs, convective events in the US ...
- CRPSS notable gains for JMA in the tropics, less so in the extratropics, ECMWF gains in 2016/17 (resolution ?)
- NCEP SHem day 6 rms errors against observations compare better in 2016/17 to ECMWF, suggesting resolution increase at ECMWF helped to better fit observation locations ?
- Summer precipitation problems (drizzle)

# Antarctic, analysis and model activity

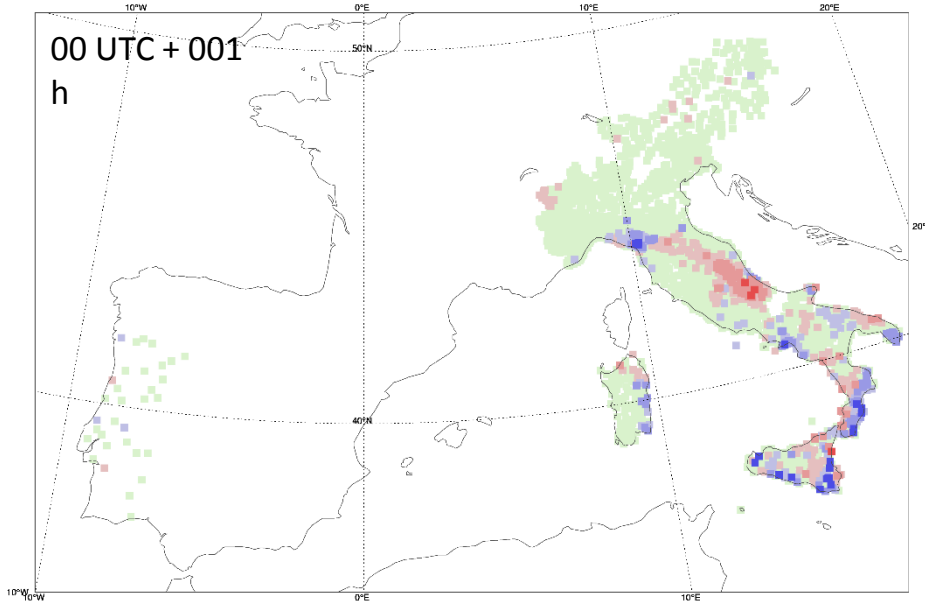


Difference of stdev of  
forecast and analysis  
anomalies

# Mean precipitation error at +001 h

PPT01, RUN=00, STEP=001, ME (mm/h), expv=1  
-3.9275 -0.5 -0.2 -0.1 0.1 0.2 0.5 1

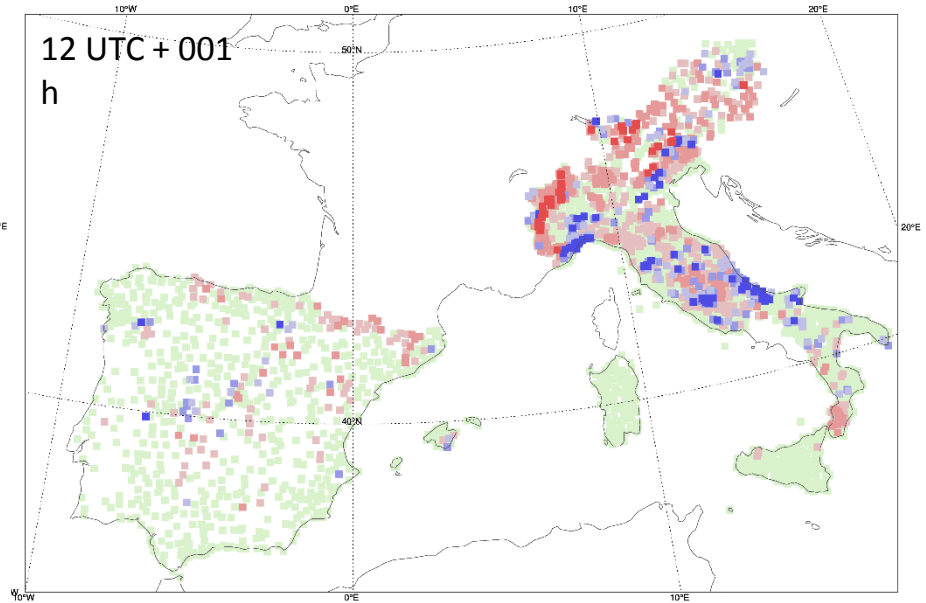
00 UTC + 001  
h



January 2017

PPT01, RUN=12, STEP=001, ME (mm/h), expv=1  
-3.4708 -0.5 -0.2 -0.1 0.1 0.2 0.5 1.0081

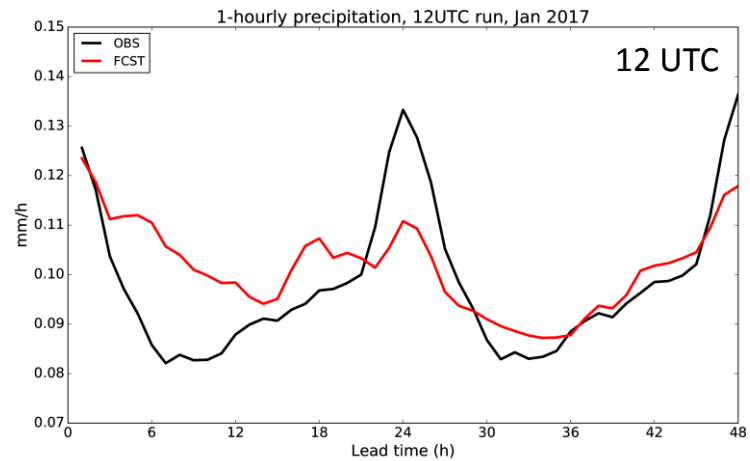
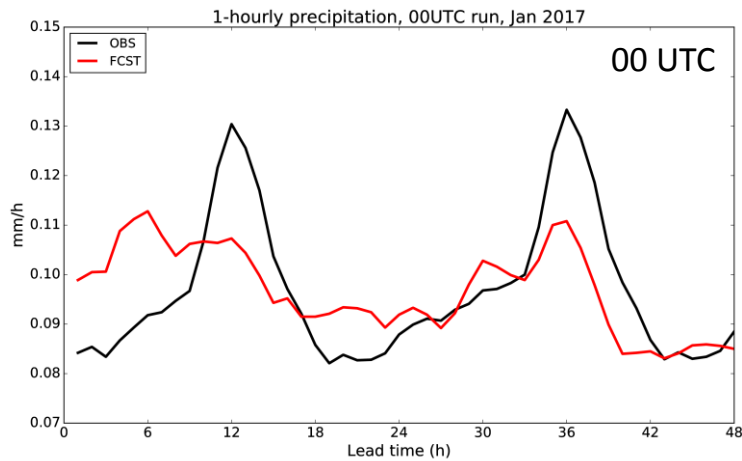
12 UTC + 001  
h



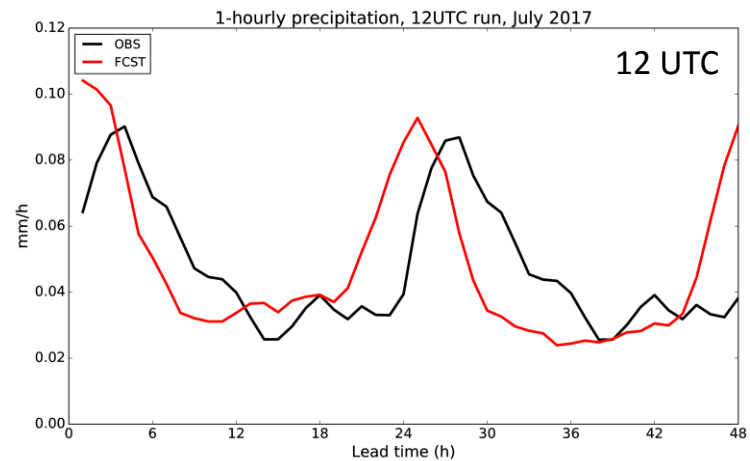
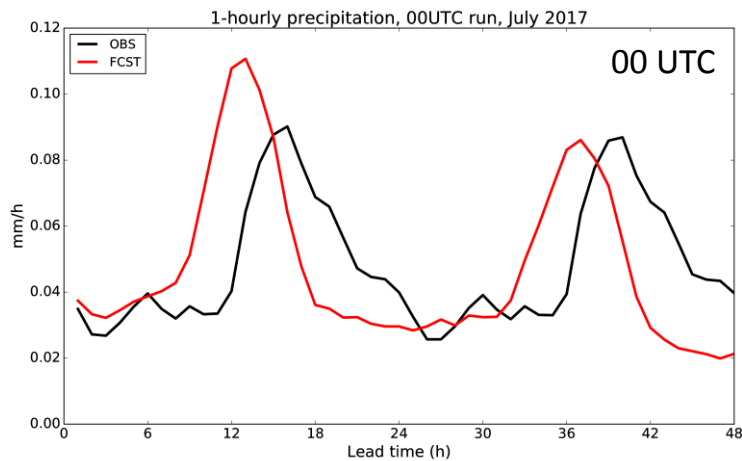
July 2017



# Observed and forecast 1-hourly precipitation

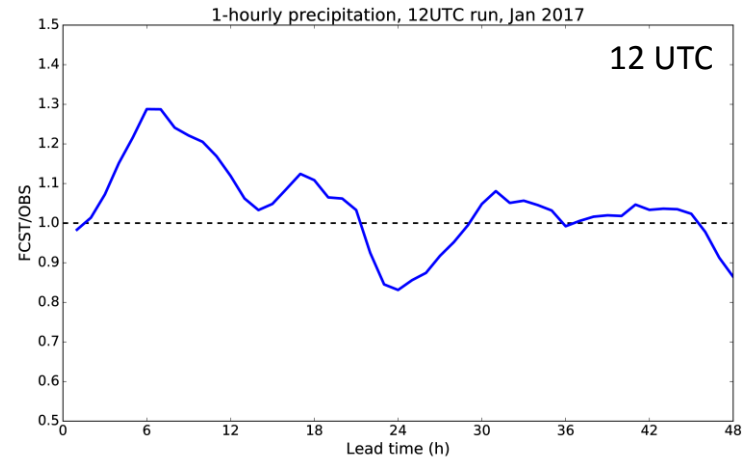
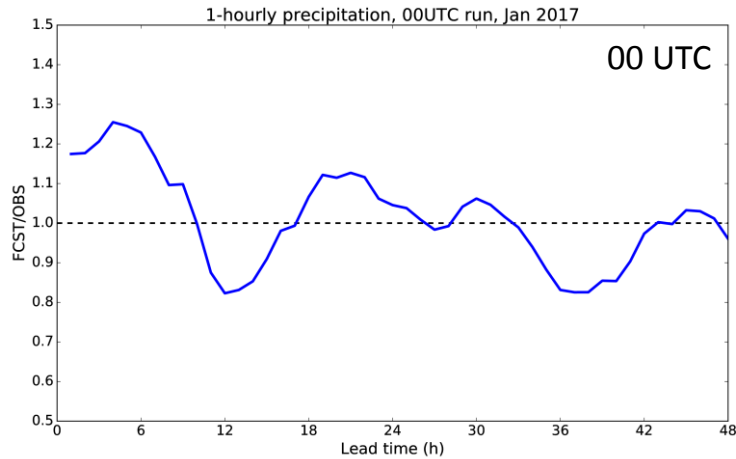


January 2017

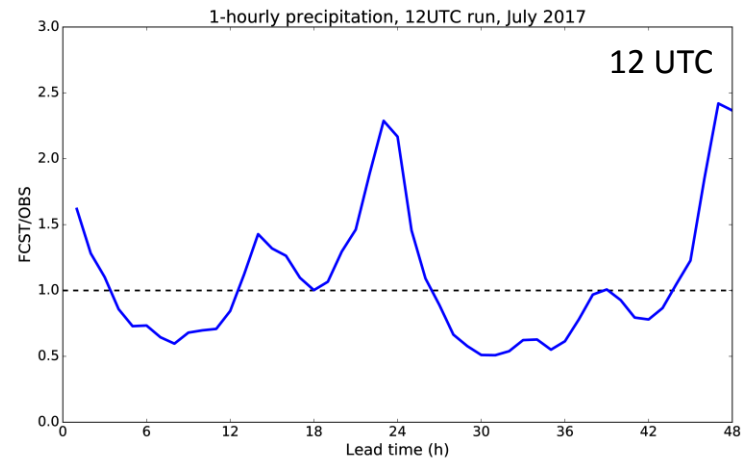
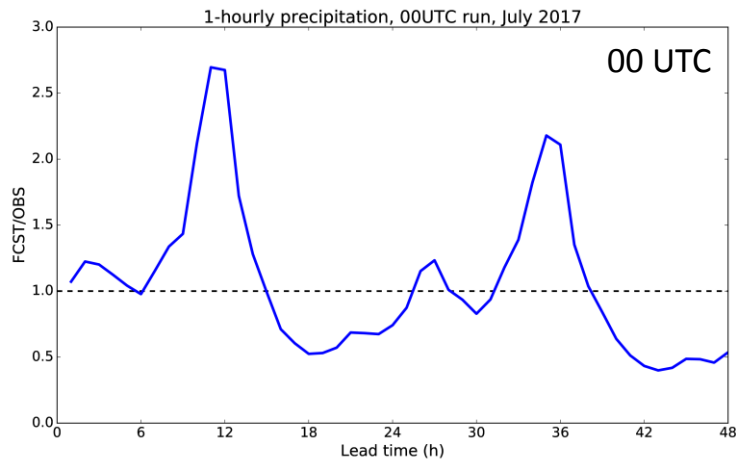


July 2017

# Ratio of forecast to observed 1-hourly precipitation

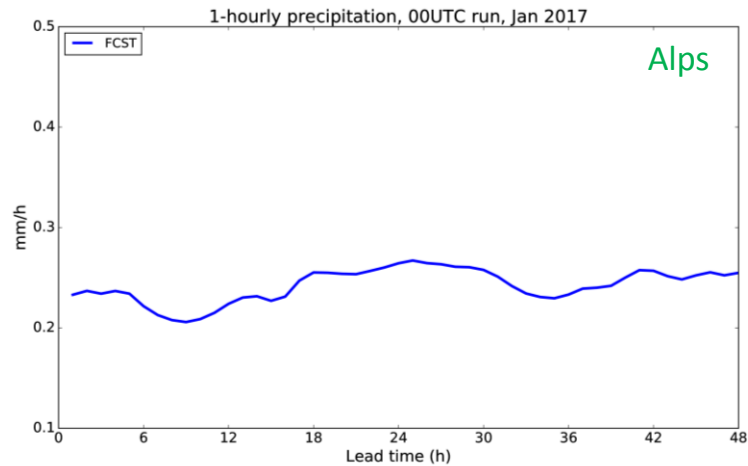
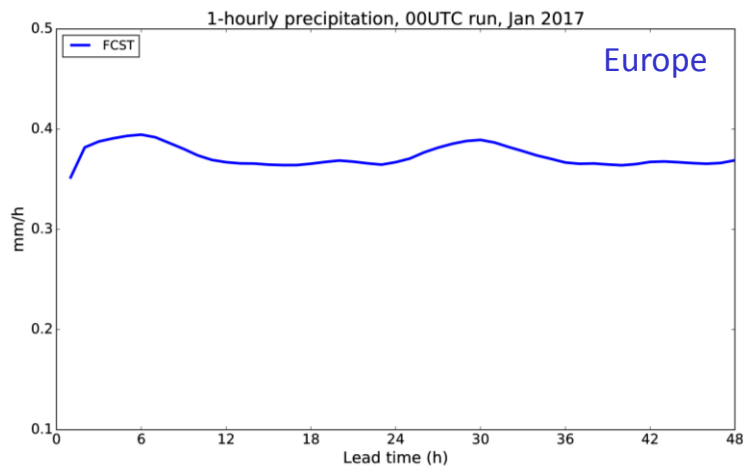


January 2017

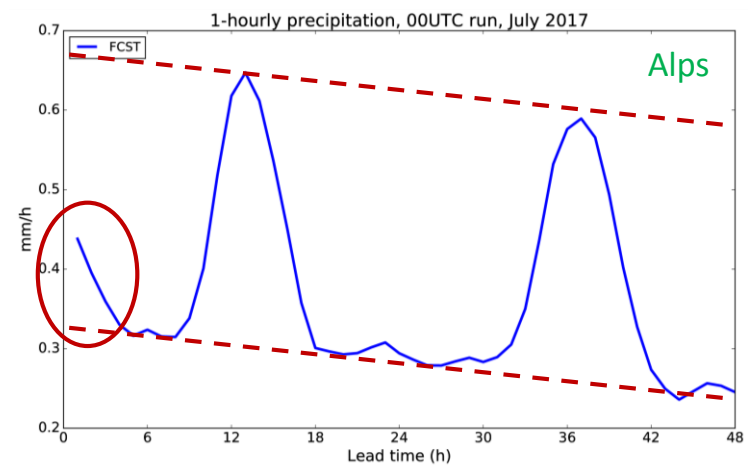
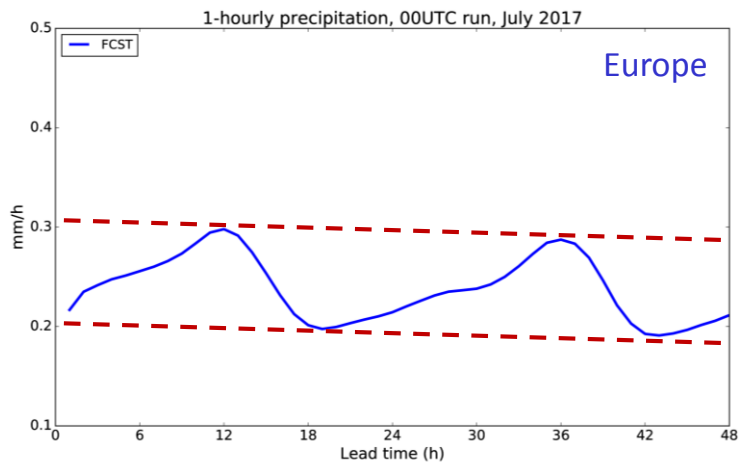


July 2017

# Precipitation spin-down

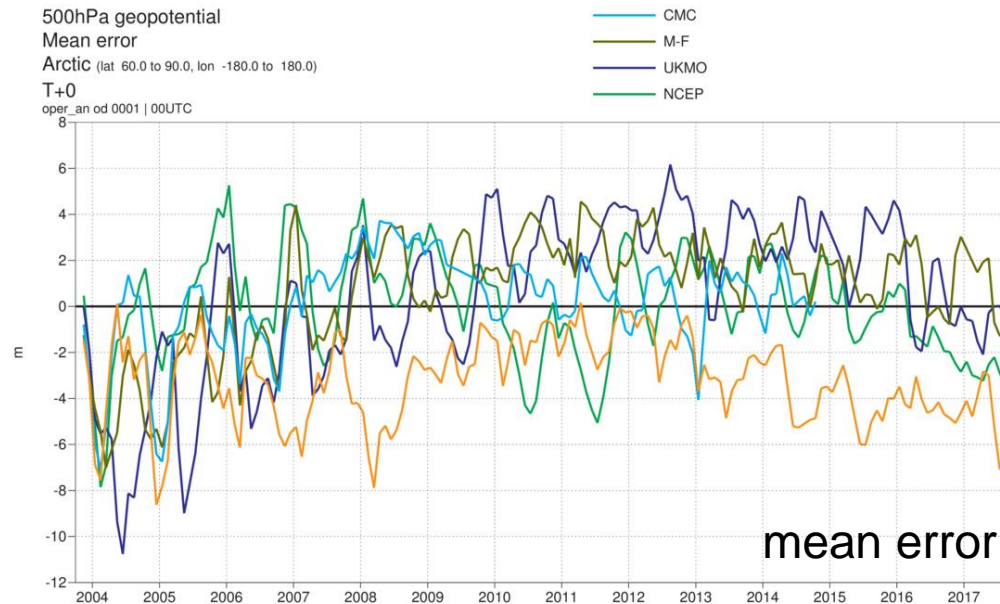
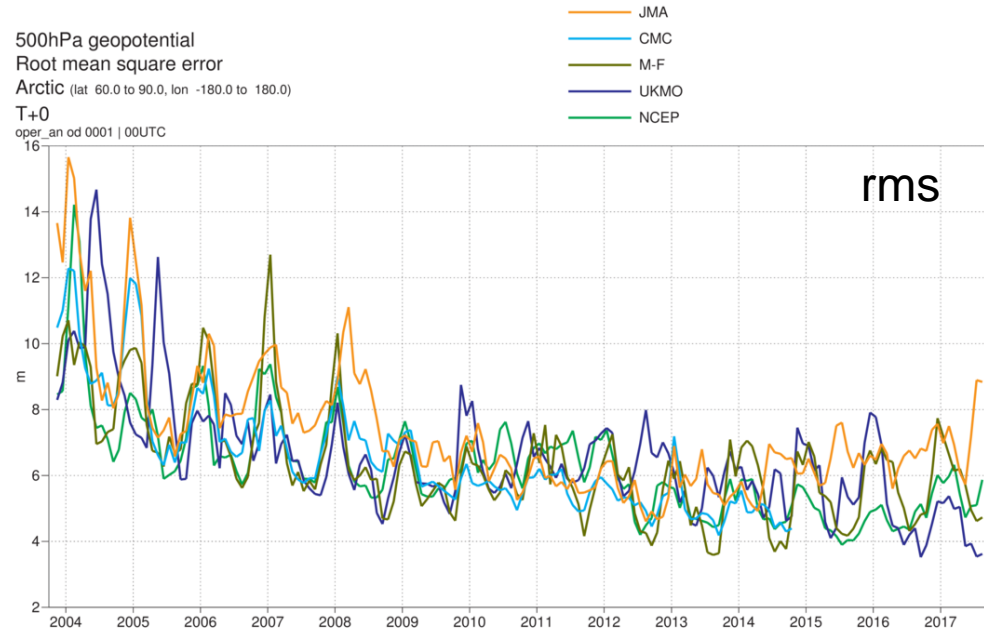


January 2017



July 2017

# Arctic, Z500 analysis difference relative to ECMWF analysis



# Antarctic, Z500 analysis difference relative to ECMWF analysis

