



ECMWF use of TIGGE and S2S data

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With thanks to ECMWF Colleagues

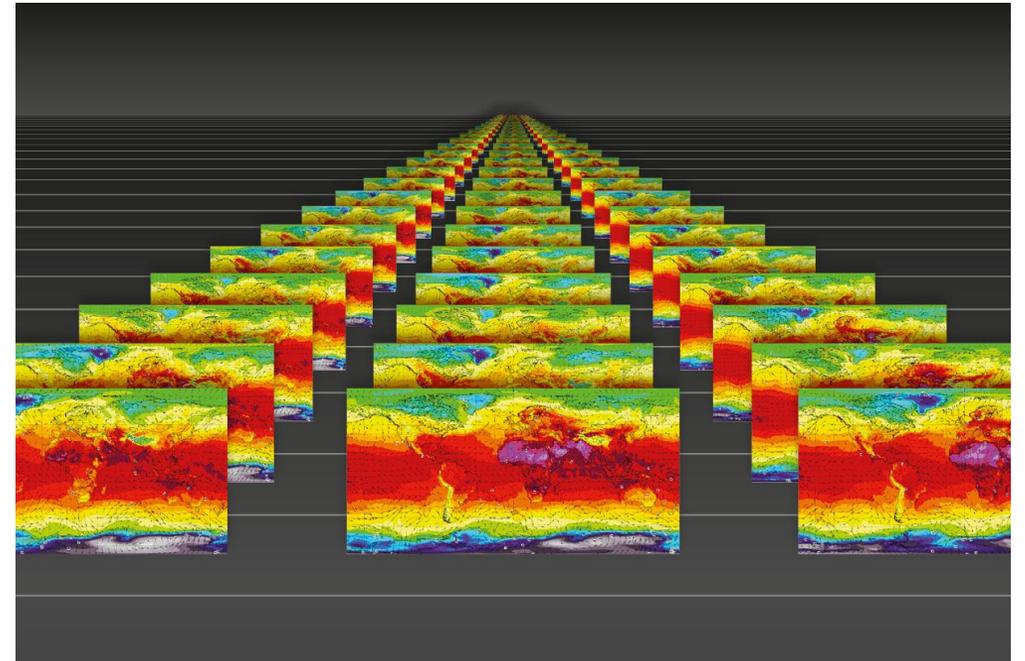
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Workshop on

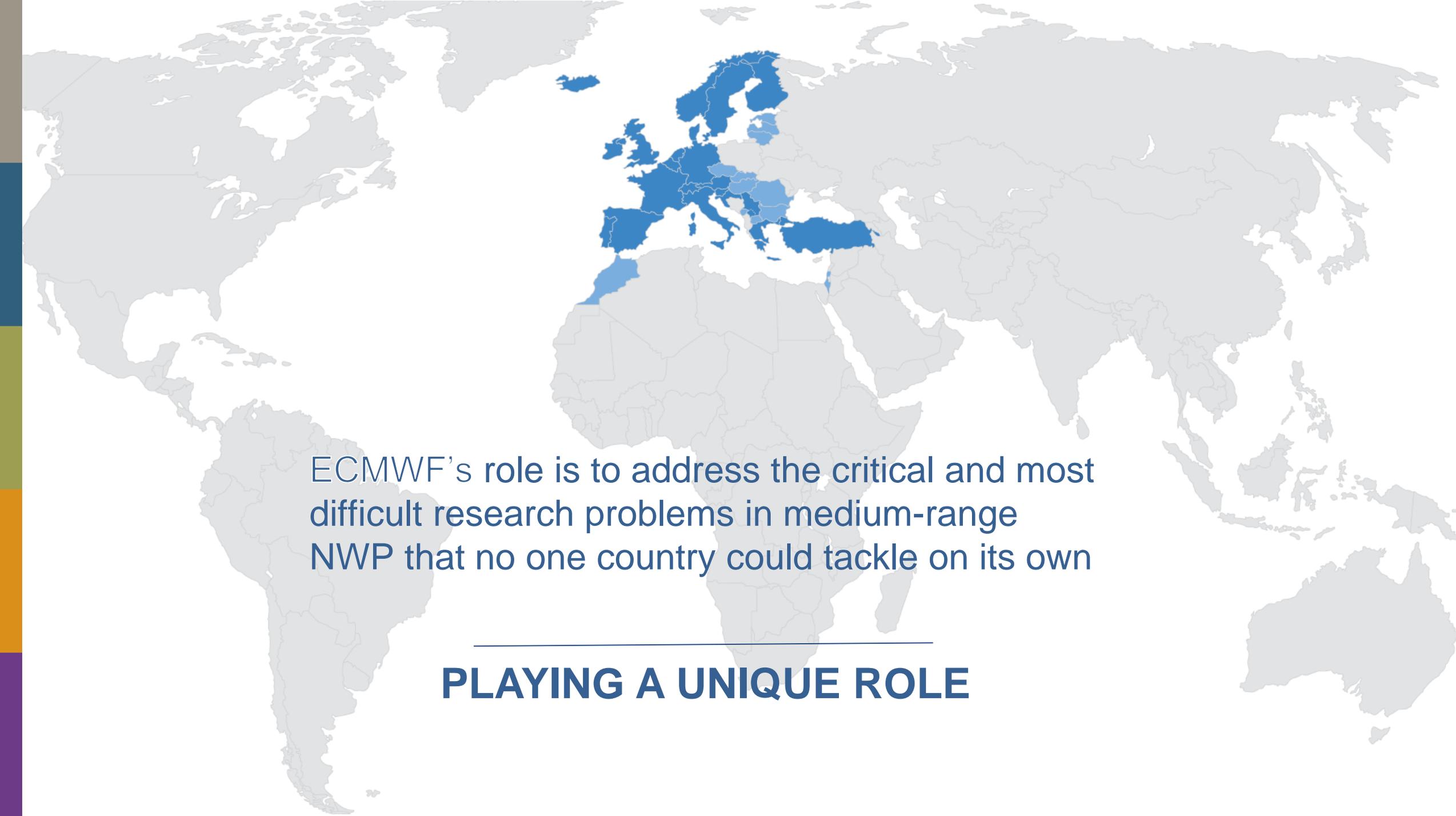
Predictability, dynamics and applications research using the TIGGE and S2S ensembles

Provide an opportunity to **review the main scientific advances** in predictability, dynamical process studies and applications of ensemble forecasts across the medium and S2S forecast ranges





The strength of a common goal

A world map with a light gray background. The continent of Europe is highlighted in a dark blue color, including all major European countries and Turkey. The rest of the world, including North America, South America, Africa, Asia, and Australia, is shown in light gray.

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

PLAYING A UNIQUE ROLE

European co-operation at its best: **deliverables**

- Global numerical weather forecasts
- Supercomputing & data archiving
- Education & training programme

- EU activities: *Operating the Copernicus Climate and Atmosphere Services, and contributing EFAS and FIRE to the Copernicus Emergency Management Service*

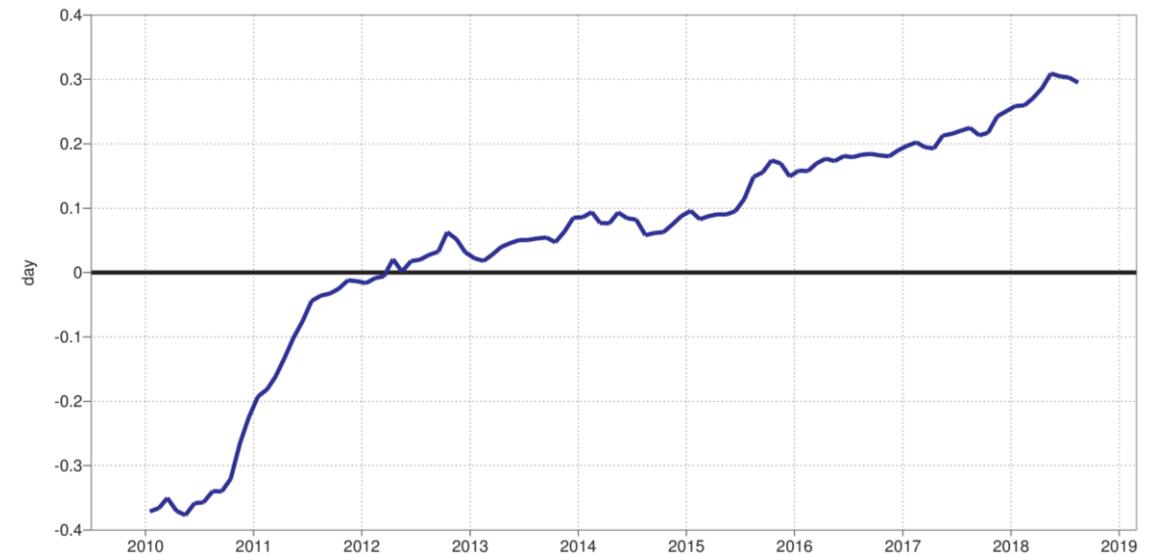
Benchmarking of forecast skill

- Year-to-year variations in atmospheric flow can affect verification scores
- For high-resolution forecast, fixed ERA5 reanalysis system provides valuable benchmark mitigating some of this external variability
- No direct equivalent for ensemble forecasts – TIGGE and S2S important alternative reference

Precipitation headline score (SEEPS) Extratropics



HRES – ERA5



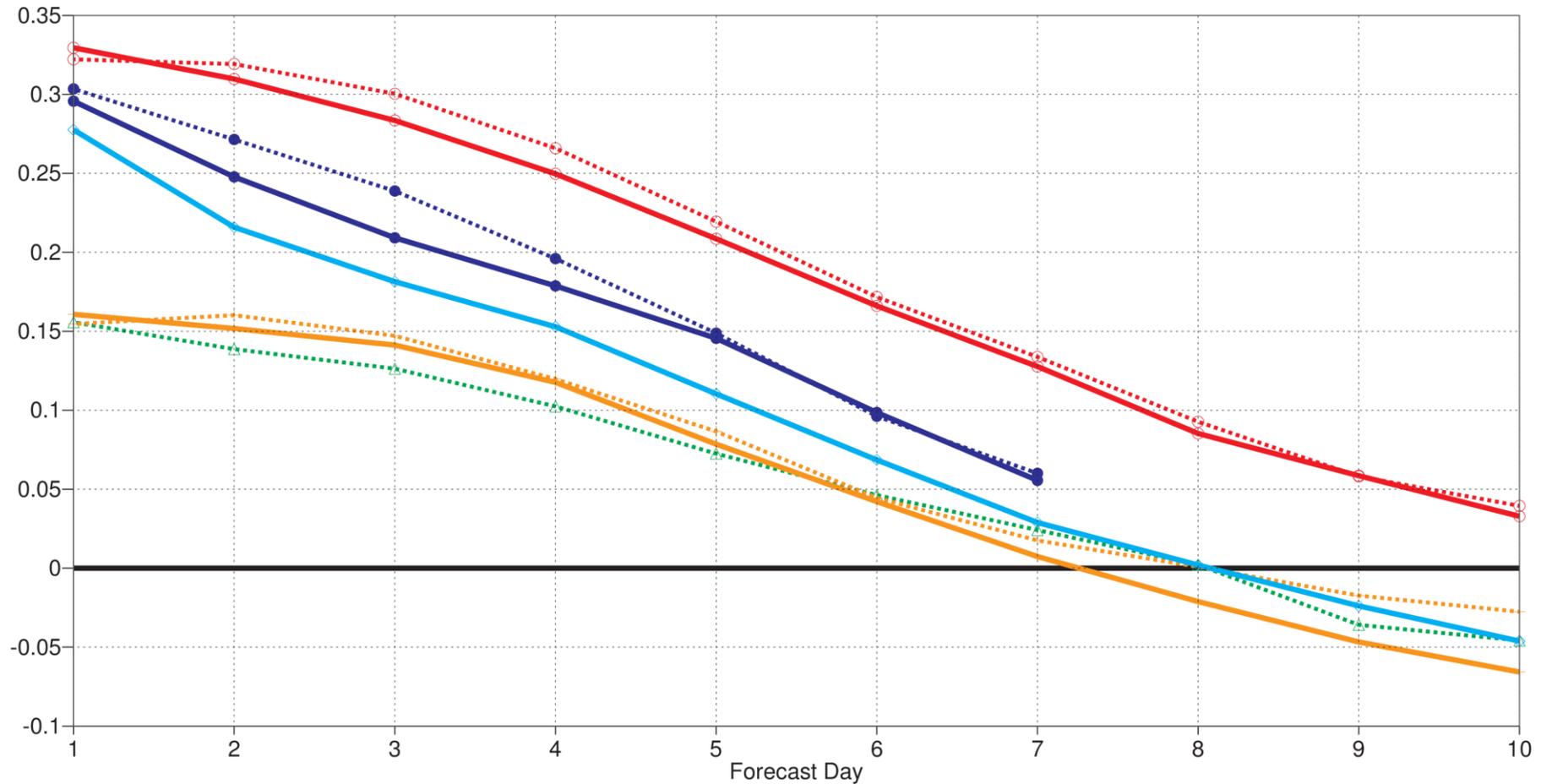
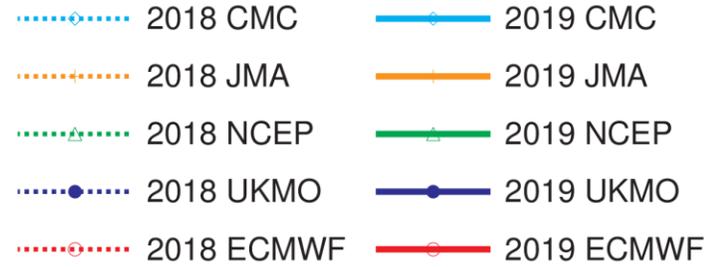
Precipitation – other centres (TIGGE)

season:DJF

total precipitation

Continuous ranked probability skill score

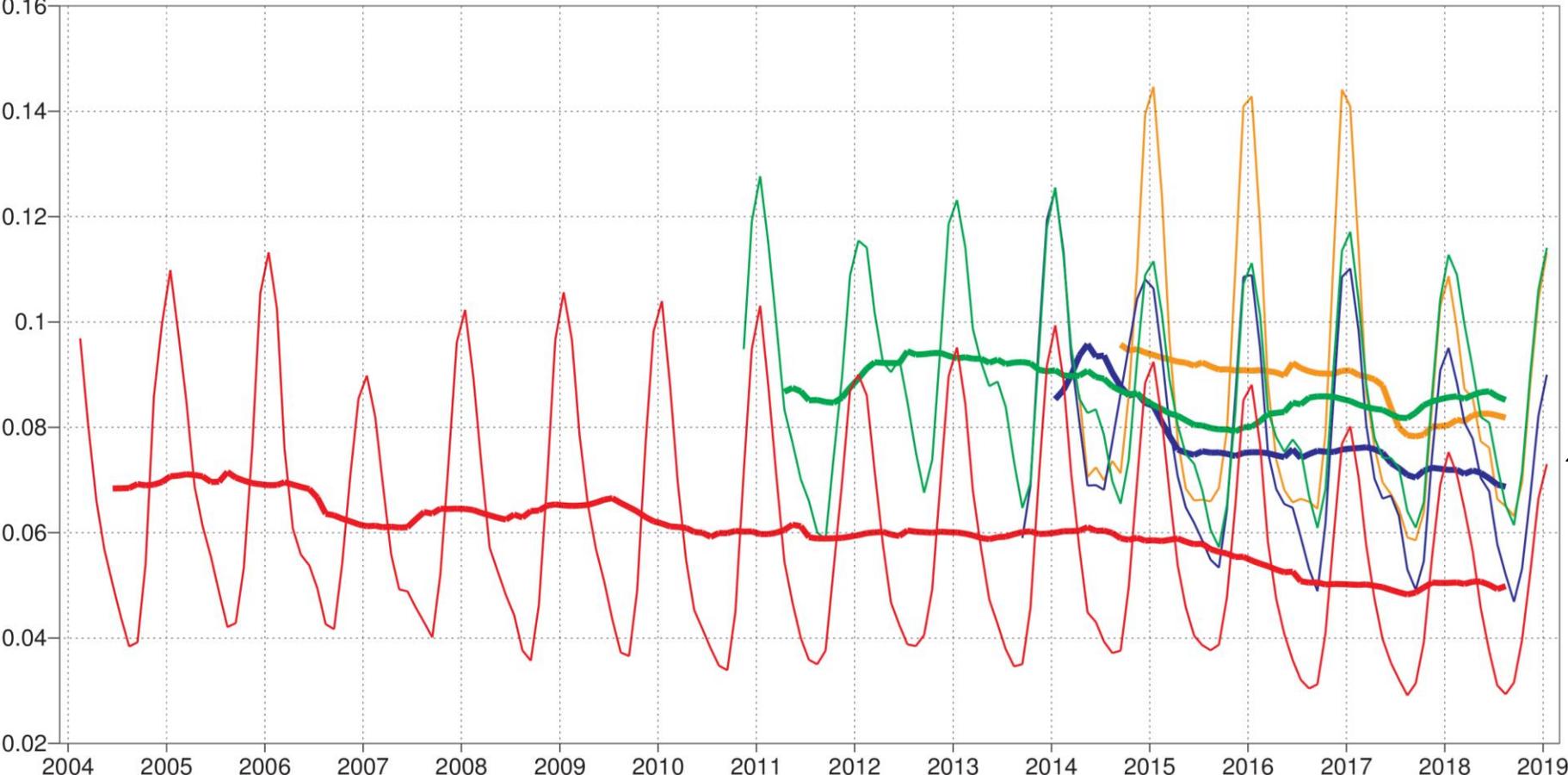
Extratropics (lat -90 to -30.0 and 30.0 to 90, lon -180.0 to 180.0)



Fraction of large T2M errors (ensemble)

2 meter temperature
Fraction of large CRPS value >5.0
Extratropics (lat -90 to -30.0 and 30.0 to 90, lon -180.0 to 180.0)
T+120
oper_ob enfo

- ECMWF
- NCEP
- UKMO
- JMA

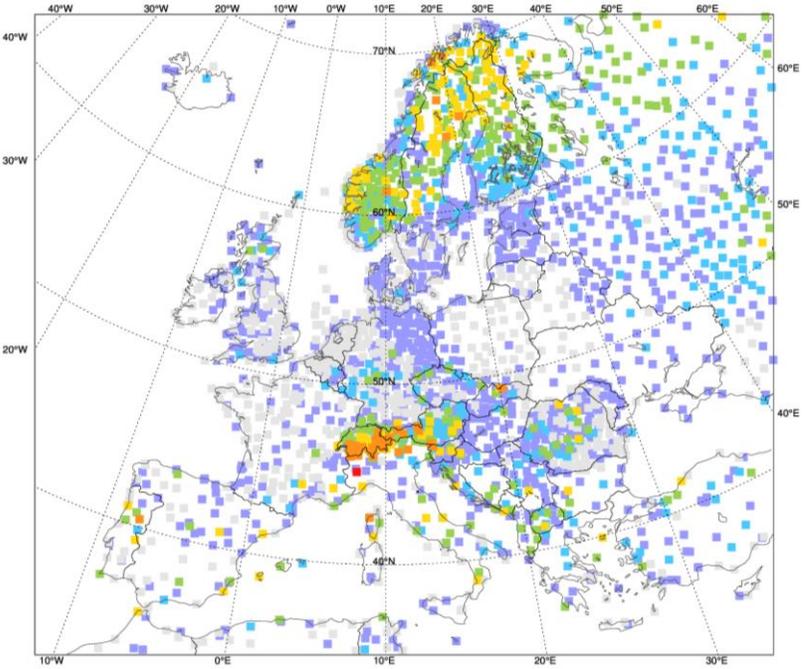


DJF 2018-19

Fraction of large T2M errors: DJF 2019

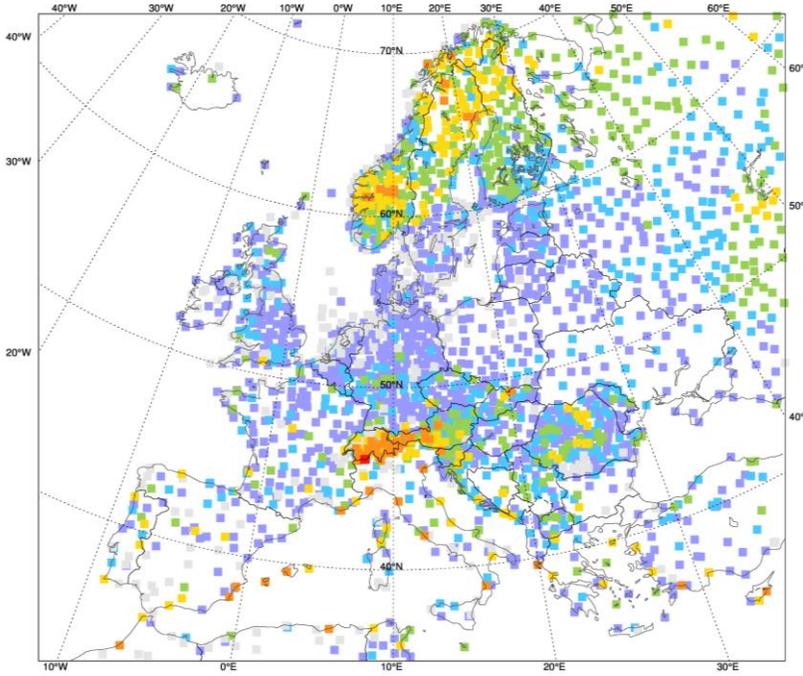
ECMWF

T2M, RUN=00, STEP=120, CRPS>5K (%), expv=1



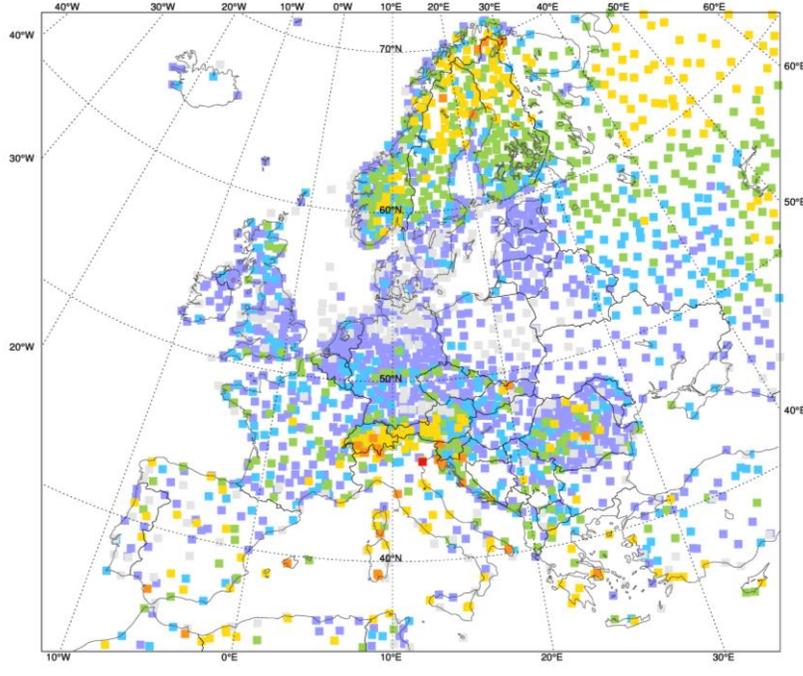
UKMO

T2M, RUN=00, STEP=120, CRPS>5K (%), expv=1



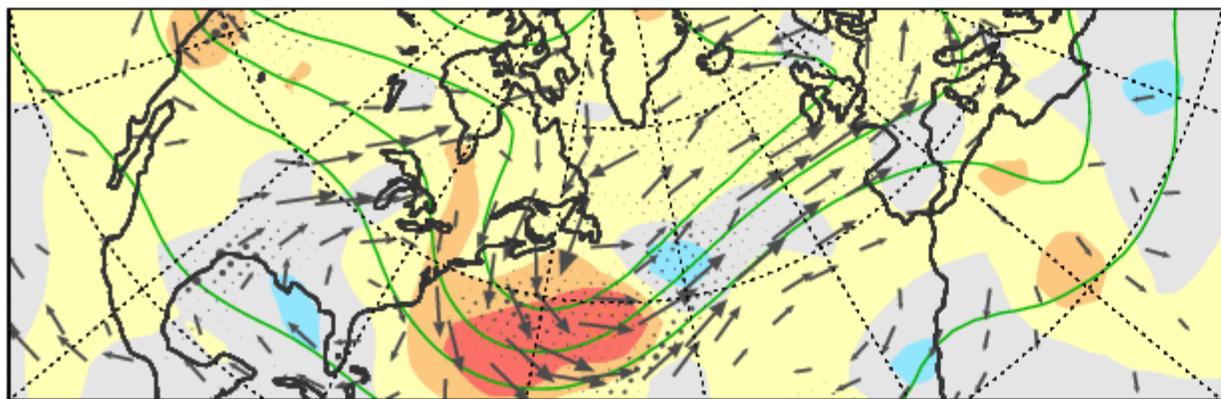
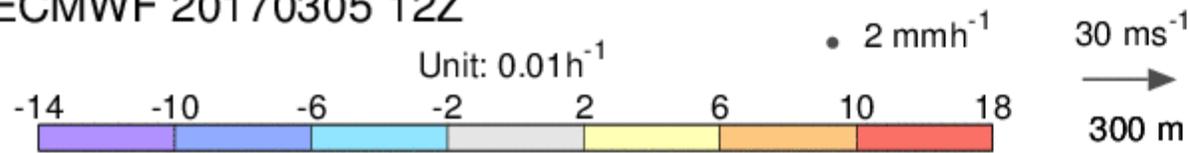
JMA

T2M, RUN=00, STEP=120, CRPS>5K (%), expv=1

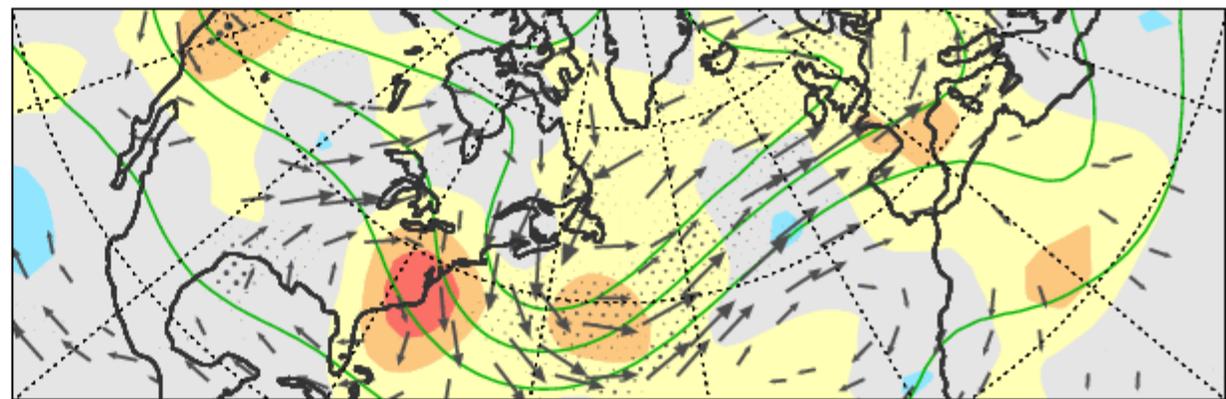
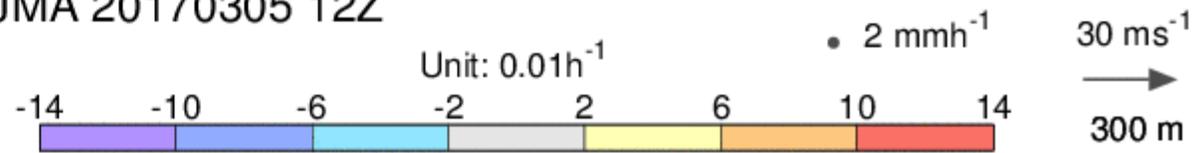


TIGGE model uncertainty growth rate for Z_{250} (shaded). CNTL \underline{v}_{850} , Z_{250} . EM: precip.

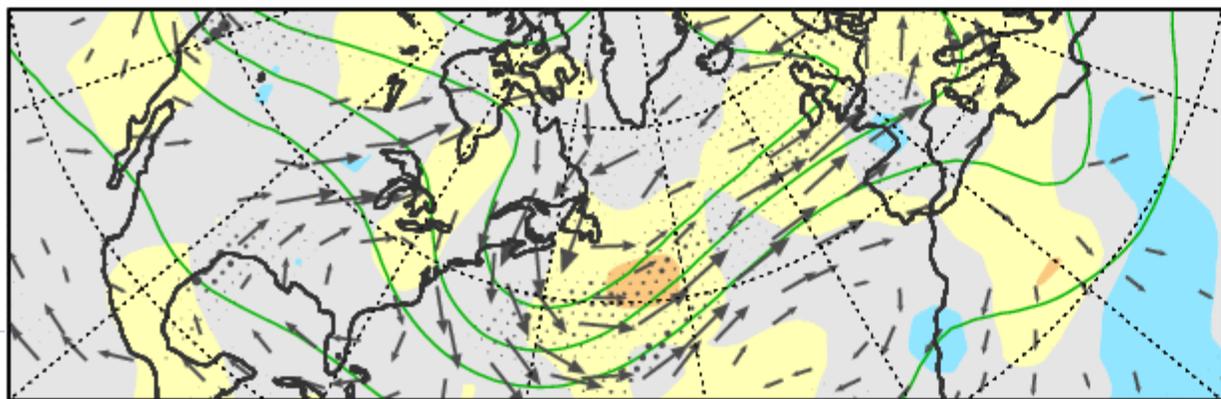
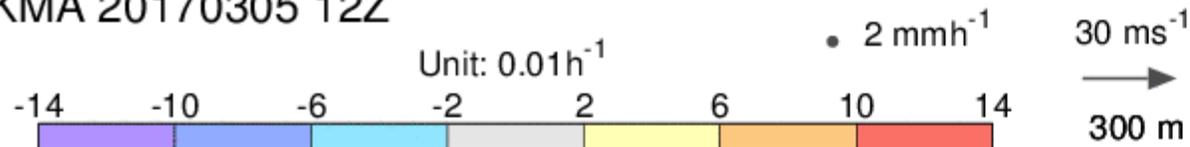
ECMWF 20170305 12Z



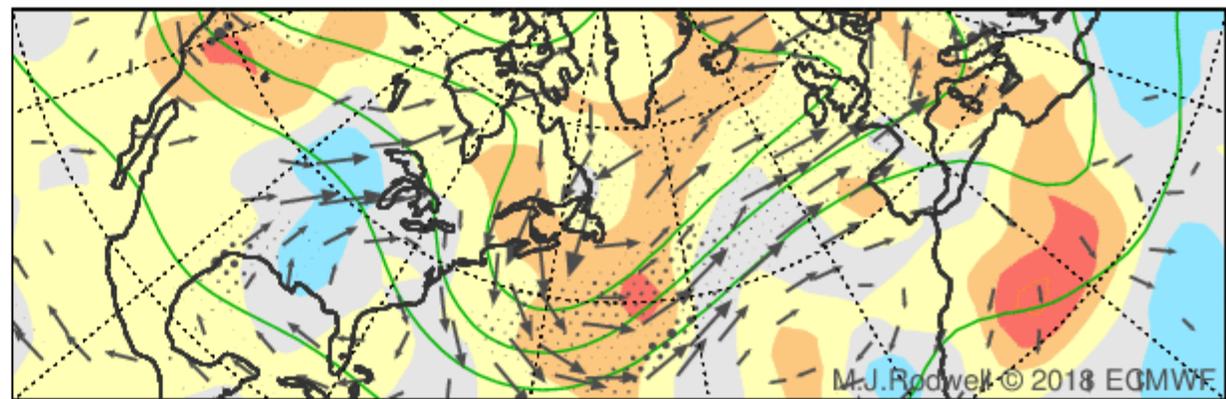
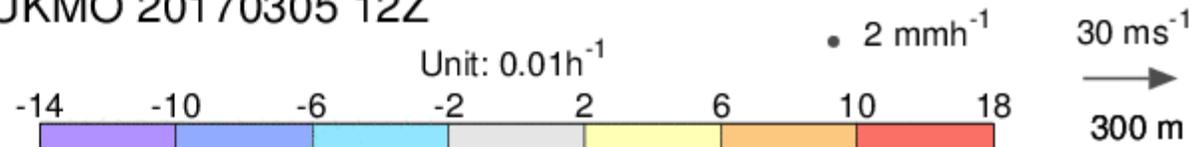
JMA 20170305 12Z



KMA 20170305 12Z

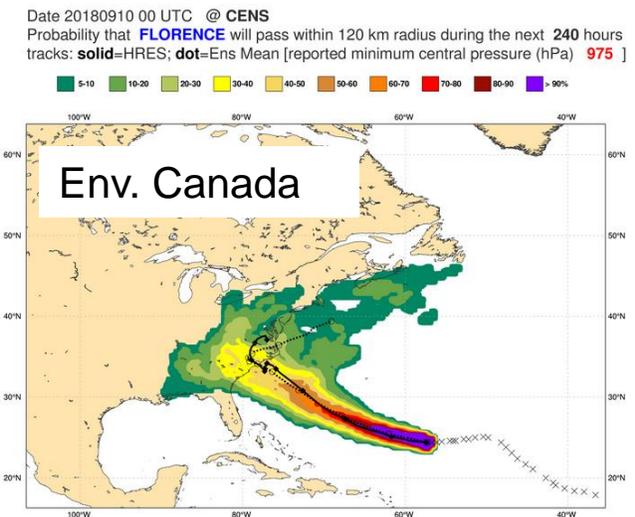
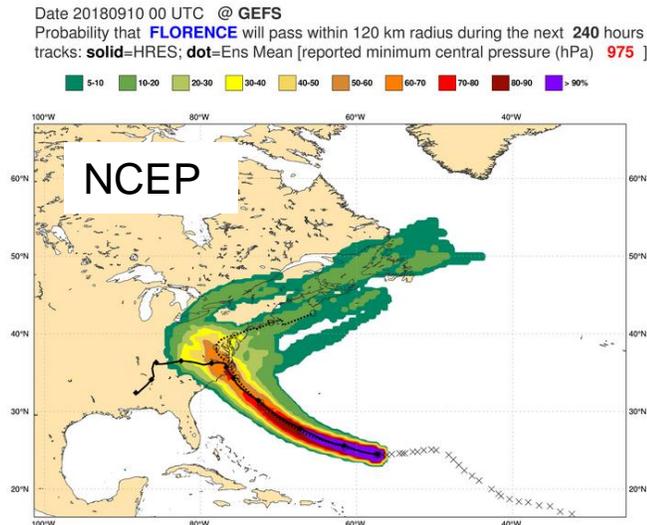
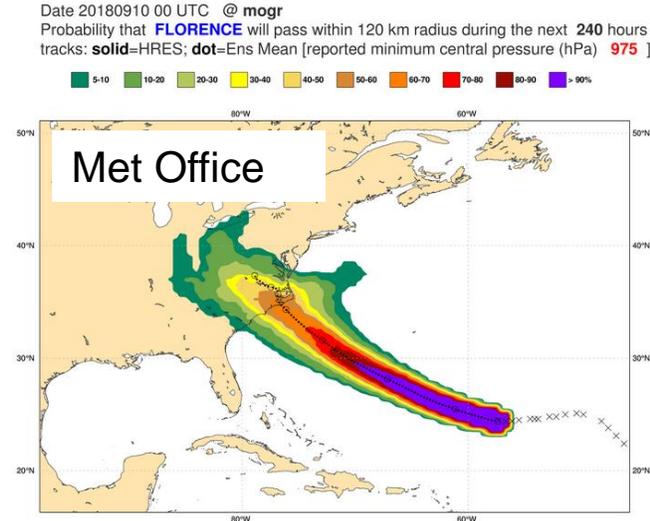
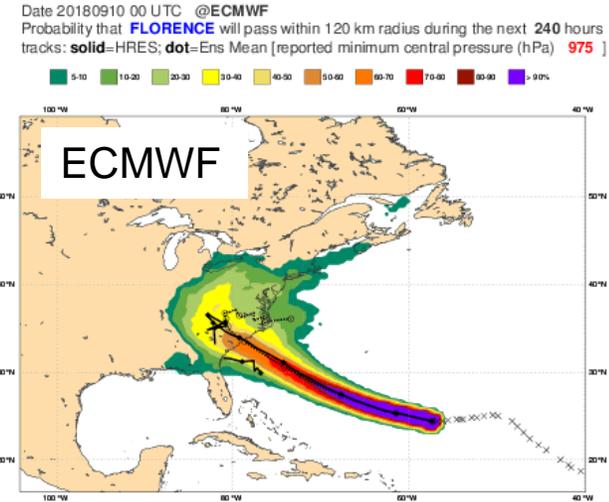


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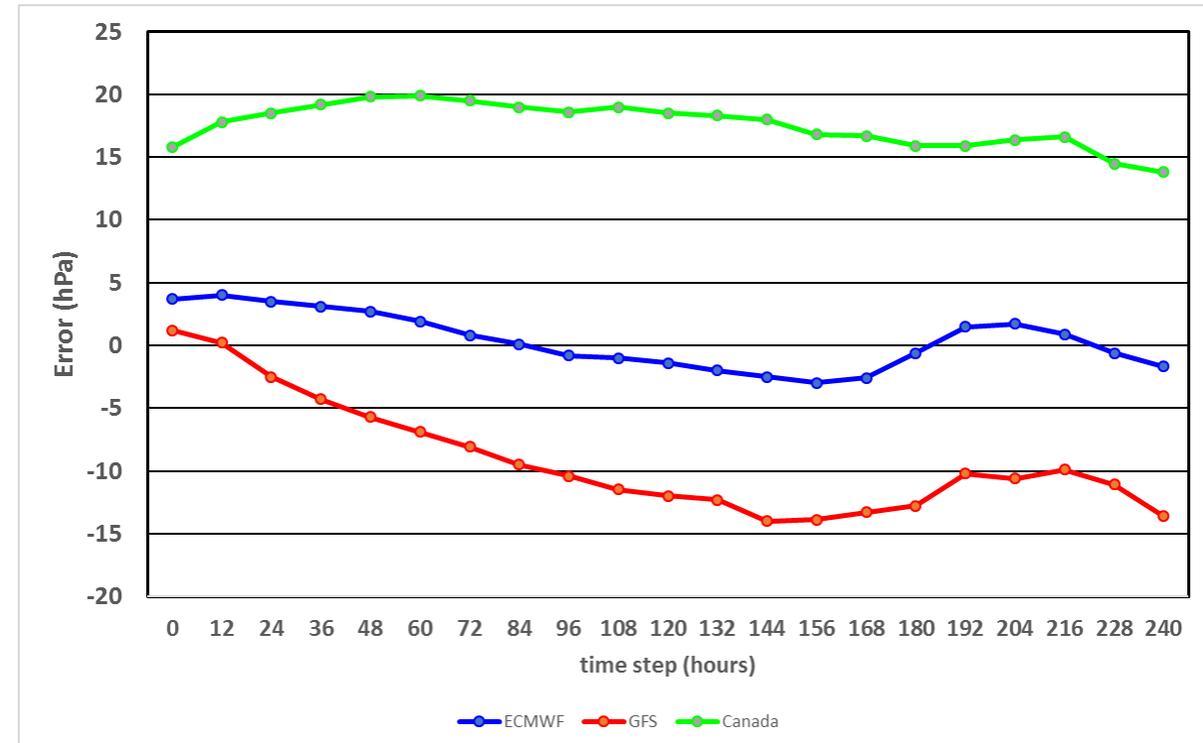
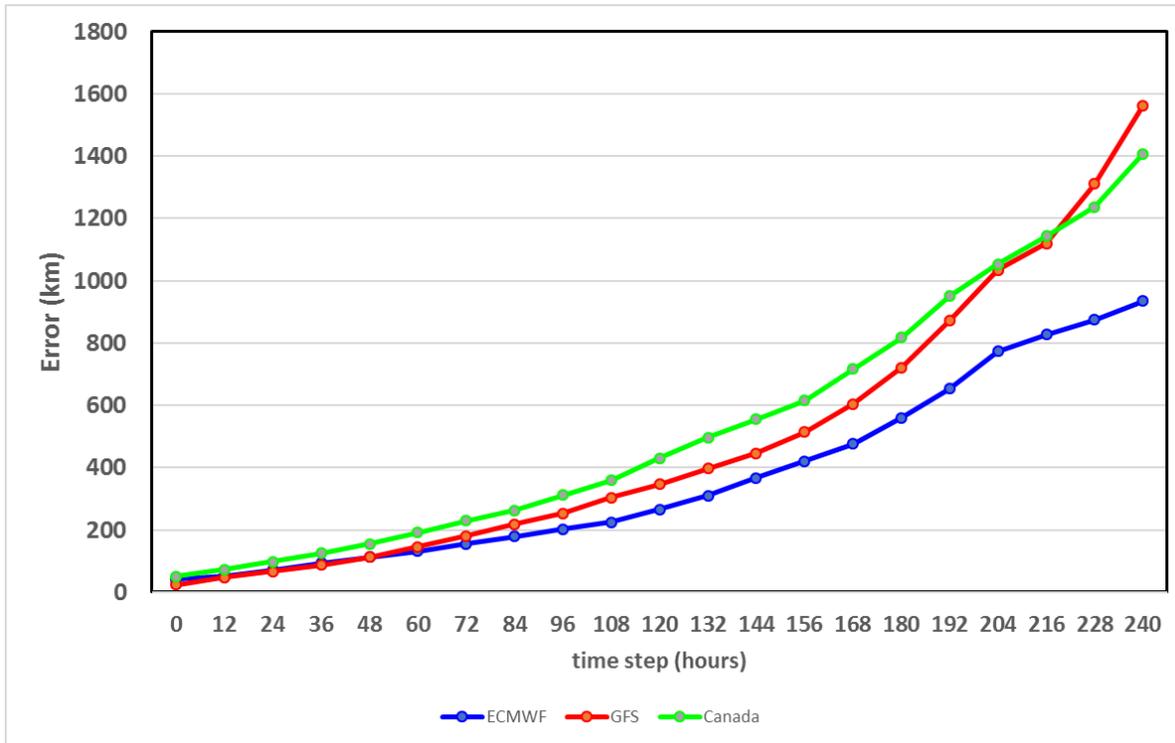
TIGGE for tropical cyclones

- TC tracks from TIGGE are used for diagnostics and verification
 - Case-by-case comparison of the ECMWF ENS with the other centres ensembles
 - Evaluation of forecast performance
- TC tracks produced by each centre are retrieved from TIGGE archive on a daily basis (CXML)



Verification of TC tracks from TIGGE

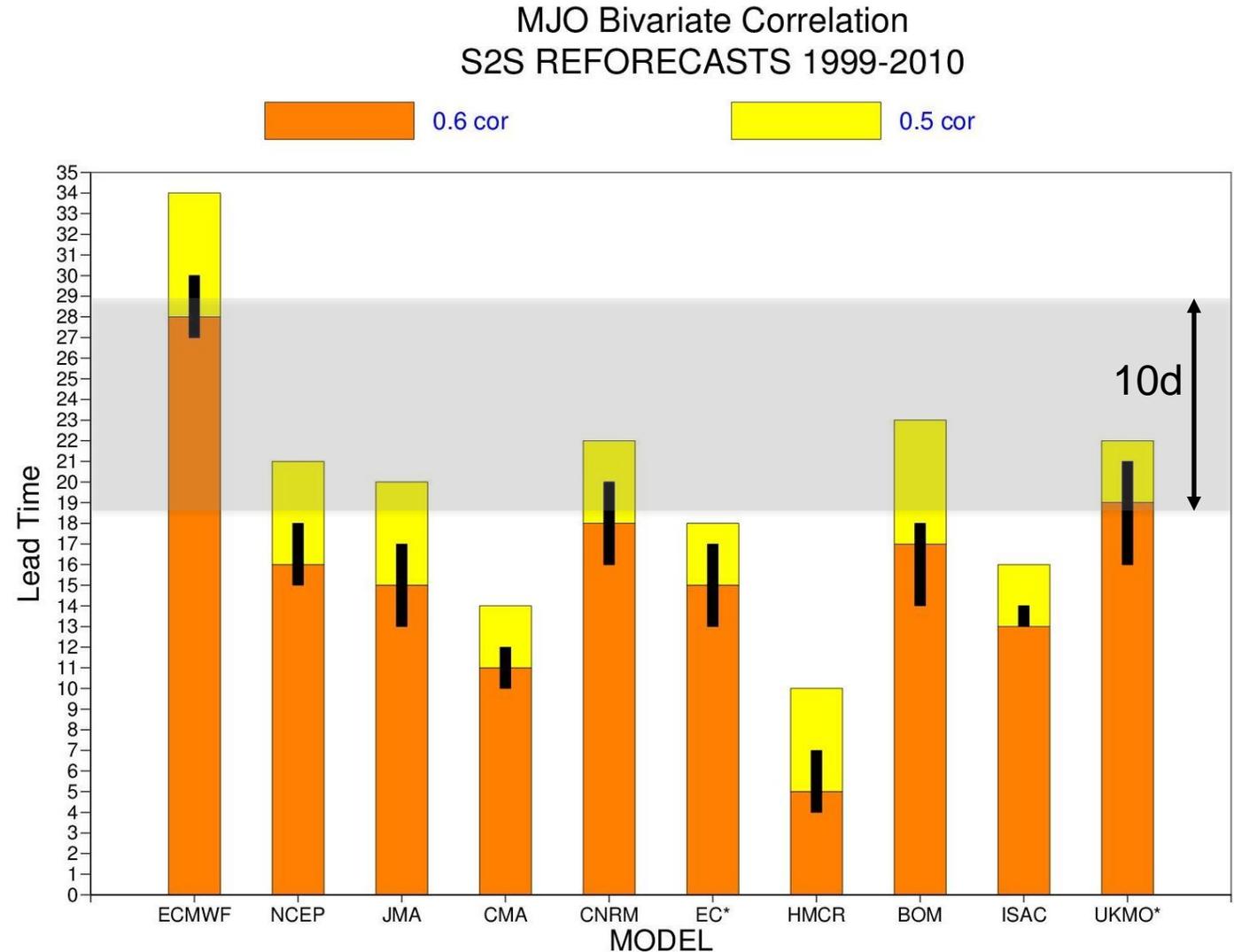
- Verification of track and intensity error
- all basins; homogeneous samples; high resolution global models
- VT: January-November 2018



Extended-range performance - MJO

Comparison of the forecast lead-time (in days) when the prediction of the MJO reaches 0.6 correlation (orange) and 0.5 correlation (yellow).

The data are from the Sub-seasonal to Seasonal (S2S) WWRP/WCRP WMO project.



Predictability – weather regimes

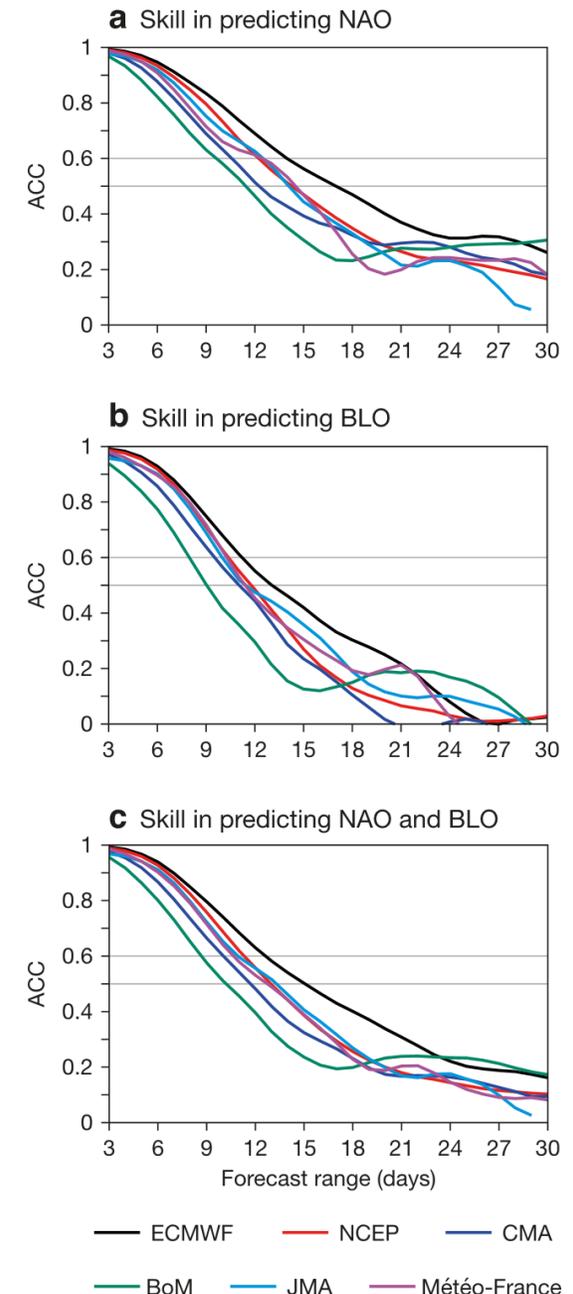
- Extended-range forecasts of large-scale weather regimes
 - DJF – associated with cold spells over Europe
- Reforecasts from S2S models
- Higher predictability for NAO than blocking
- Skill in predicting transitions between regimes (potential to predict the onset of cold spells over Europe beyond the medium range)

Ensemble mean anomaly correlation coefficient (ACC)

- (a) NAO+/NAO- pattern (westerly/easterly flow across N Atlantic)
- (b) the blocking/anti-blocking pattern
- (c) bivariate correlation for the prediction of the combined pattern

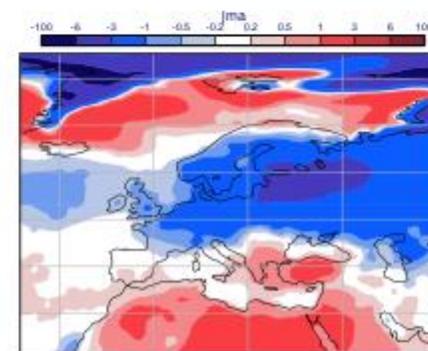
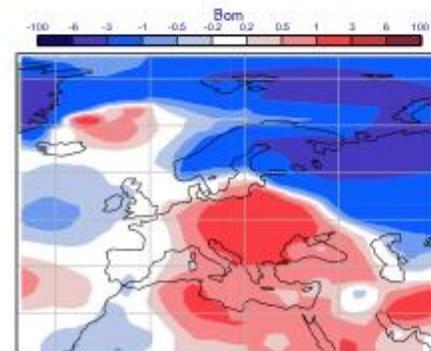
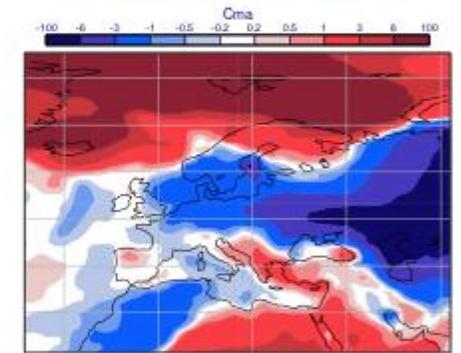
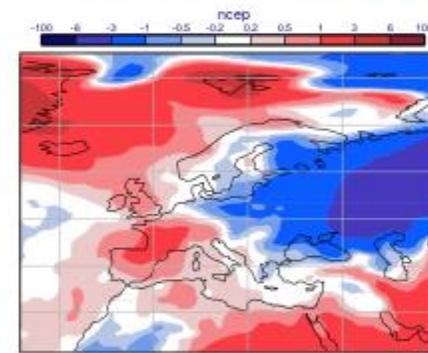
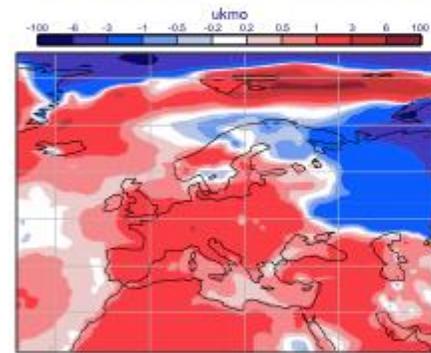
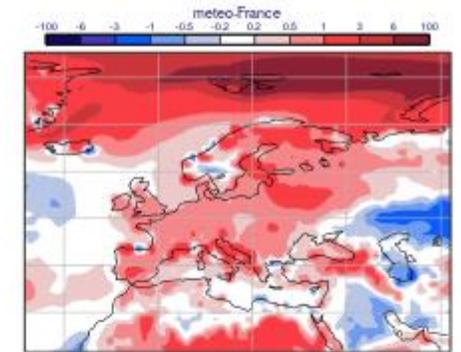
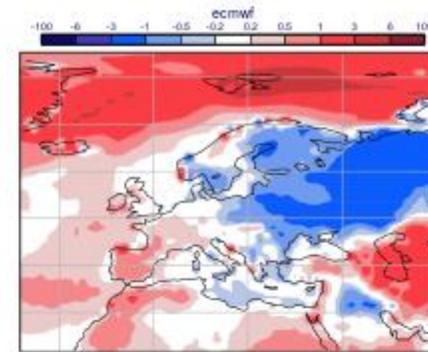
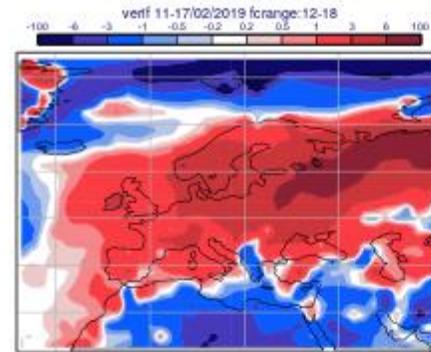
ACC based on a 5-day running mean applied to the forecasts and verifying analysis data

Ferranti et al 2018 (QJRMetS)



Extended-range forecast of warm event Feb 2019

- S2S forecasts of 2m temperature anomaly
- 7-day mean 11-18 Feb
- Forecast from 31 Jan



S2S products

Sub-seasonal to seasonal forecast

Filters

Filter

Product

- Anomaly (21)
- EFI (7)
- Hovmoller (21)
- Indices (55)
- Madden-Julian Oscillation(MJO)...

Parameters

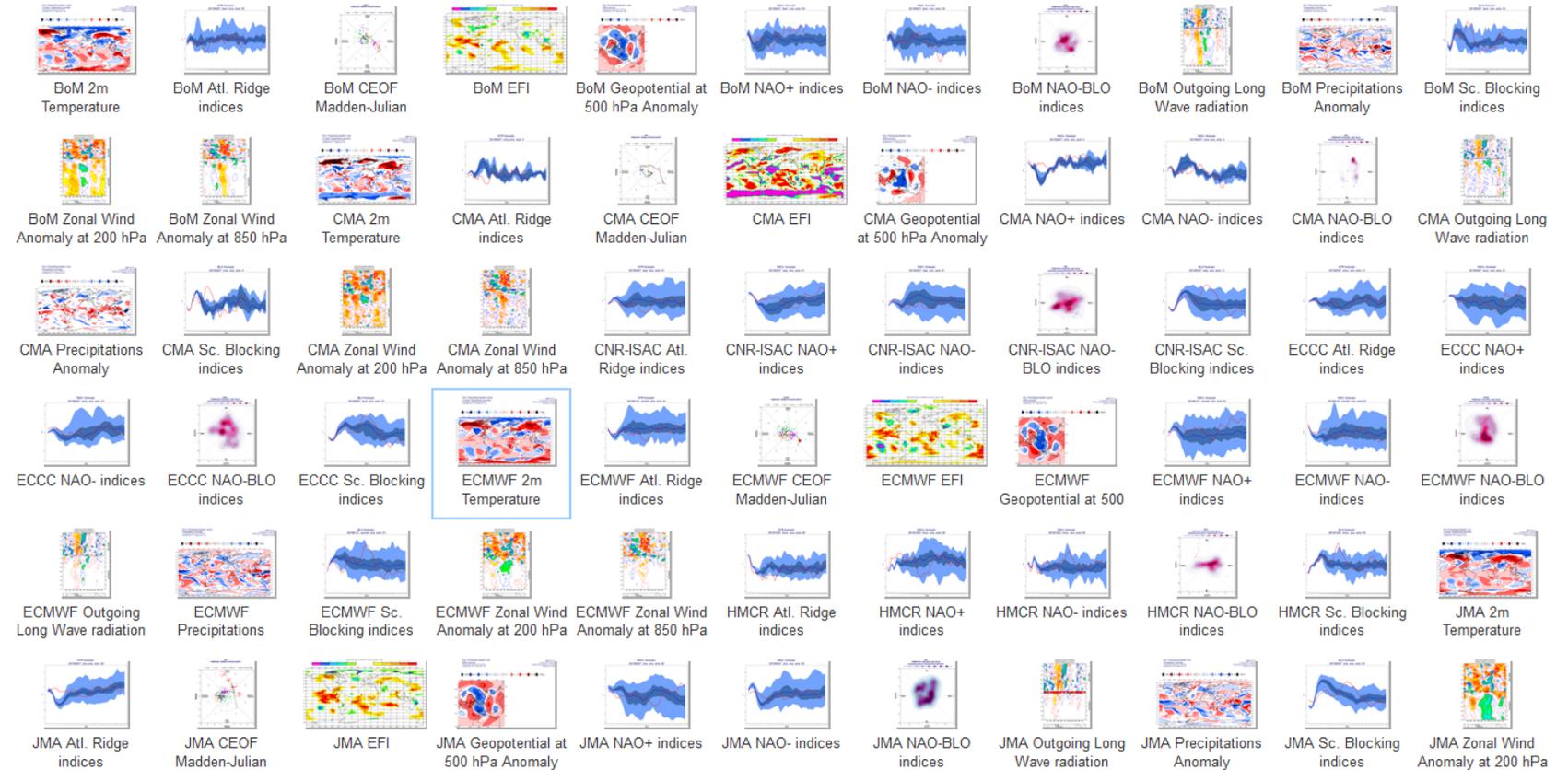
- 2m Temperature (7)
- Atl. Ridge (11)
- CEOF (6)
- Geopotential at 500 hPa (7)
- NAO+ (11)
- NAO- (11)
- NAO-BLO (11)
- Outgoing Long Wave radiation (7)
- Precipitations (7)
- Sc. Blocking (11)
- Zonal Wind Anomaly at 200 hPa...
- Zonal Wind Anomaly at 850 hPa...

Centre

- BoM (13)
- CMA (13)
- CNR-ISAC (5)
- ECCC (5)
- ECMWF (13)

111 matching items

No filters applied



Summary

- TIGGE and S2S data are valuable resource for evaluation and diagnostics of ECMWF forecast performance
- Benchmarks for evaluation and diagnostics of forecast performance
- Help to account for year-to-year variations in atmospheric flow in verification statistics
- Diagnostics of systematic errors (flow-dependent uncertainty)
- Case study investigations

Questions?

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