The ECMWF sub-seasonal and seasonal range forecasts

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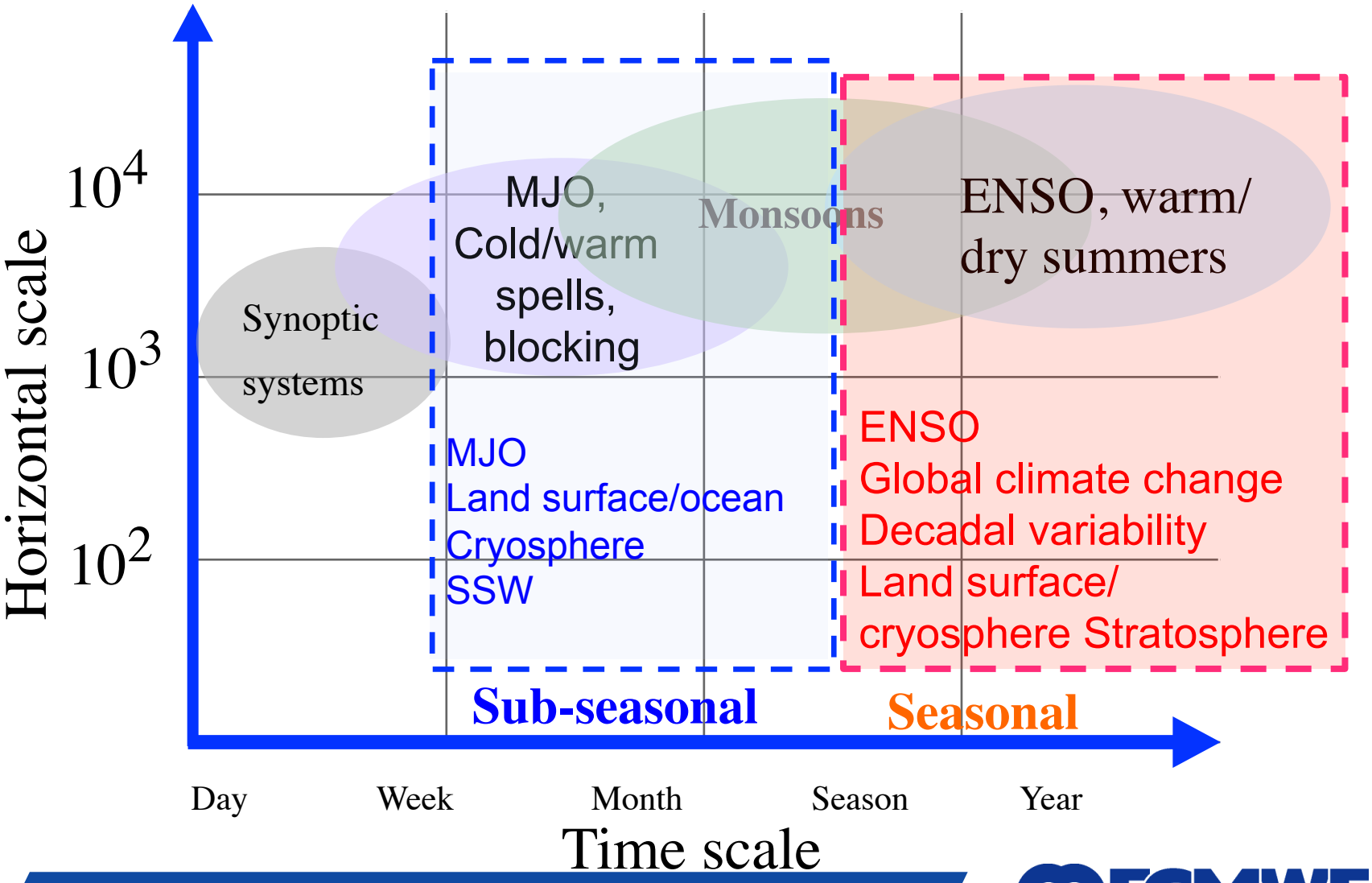
Sources of predictability at extended range :



The operational ensemble forecasting system

Coupled atmosphere-ocean system

Ensemble Prediction System (ENS): twice daily TI 639/319 32/64 km 91-level, 51 members to 15 days ahead (next update Tco639 – 18Km)

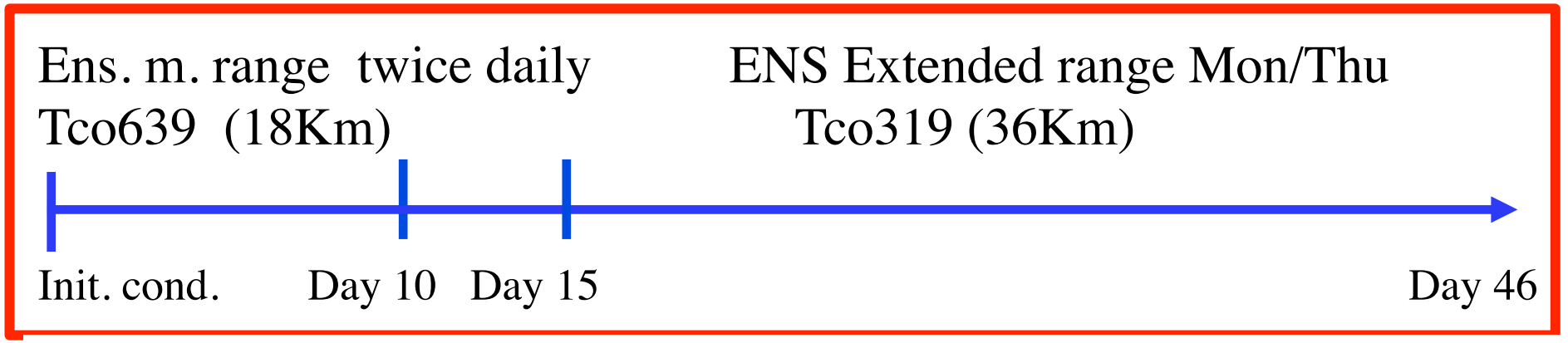
Extended range forecasts /ENS extension: twice a week (Mon/Thu)

Tco 639/319 ~ 18/36 km 91 levels, 51 members to 46 days ahead

Long range forecasts: once a month 51 members, ~80 km 91 levels, to 7 months ahead an upgraded system (S5) will be implemented in Nov.2017

ECMWF

Extended range forecast /ENS extension



Atmosphere

Initial uncertainties SVs+ EDA perturbations

Model uncertainties Stochastic physics (SPPT and SKEB schemes).

The central analysis is the Tco1279L137 4DVAR coupled to wave model (WAM) every time step

Ocean

NEMO (about 0.25 degree resolution) coupled to IFS.

Ocean initial conditions provided by 5-member NEMOVAR analysis

Bridging the gap between seasonal forecasting and NWP

- **Extended-range weather forecasting: Beyond 10 days and up to 30 days description of weather parameters, usually averaged over a period of 5-7 days and expressed as a departure from climate values for that period.**

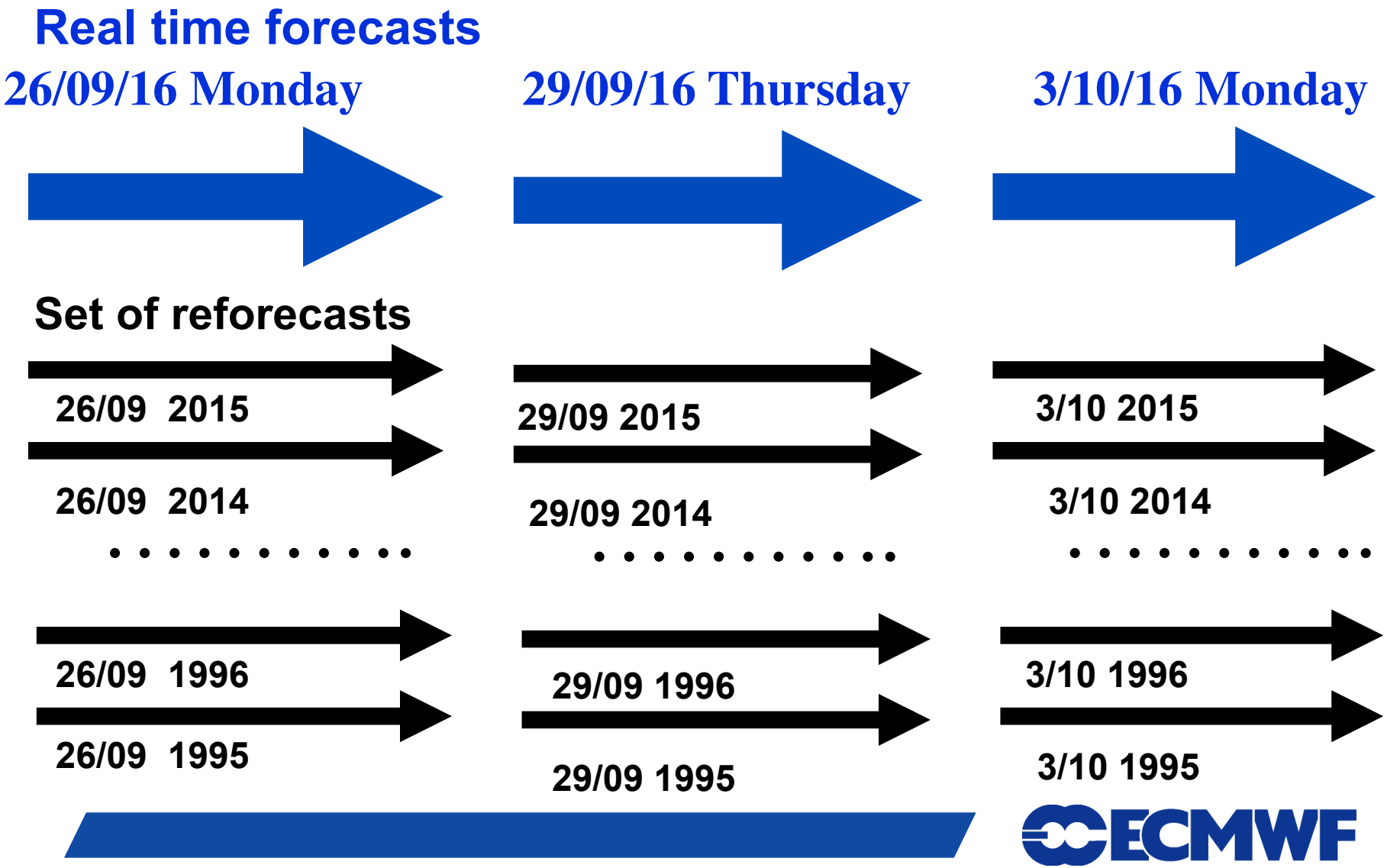
- **A particularly difficult time range: In fact at this time range is generally too long for the atmosphere to keep a memory of its initial conditions, and too short for the ocean variability to have an impact on the atmospheric circulation.**

The ECMWF extended forecasts consists of 2 elements:

- **Real time forecasts**

- **A set of re-forecasts covering the most recent 20 years period**
  - the same configuration of the real time forecasts
  - 11-member ensemble integrated at the same day and same month as the real-time time forecast
  - It runs twice every week as the real-time forecast
  - Used to estimate the model drift

The ECMWF extended forecasts consists of 2 elements:

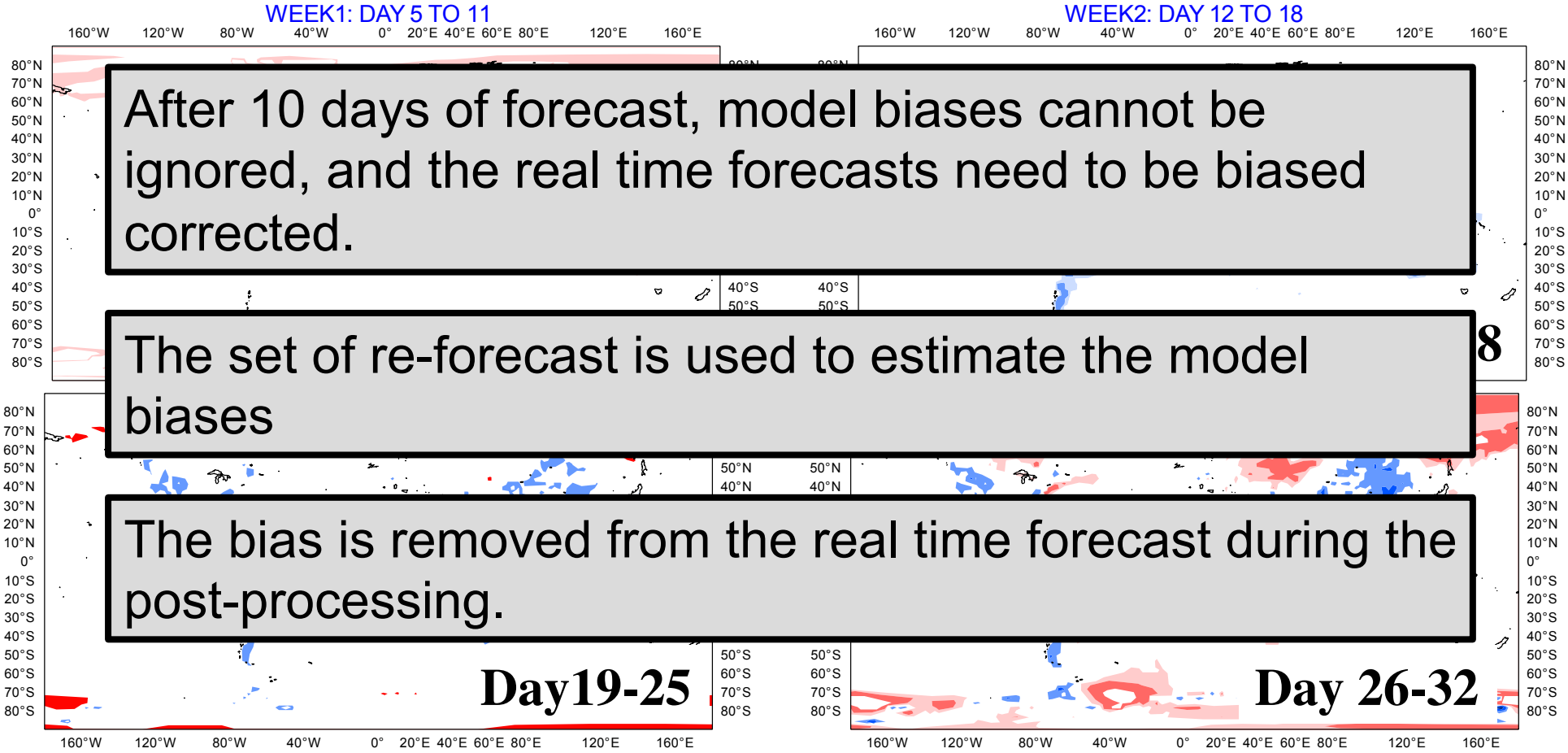


Model Bias:

ECMWF Monthly Forecasting System
MODEL BIAS: 2m Temperature
Forecast start reference is 05/03/1991-2008
ensemble size = 5

WEEK1-4

<-8K | -8..-4 | -4..-2 | -2..-1 | -1..1 | 1..2 | 2..4 | 4..8 | > 8K



After 10 days of forecast, model biases cannot be ignored, and the real time forecasts need to be biased corrected.

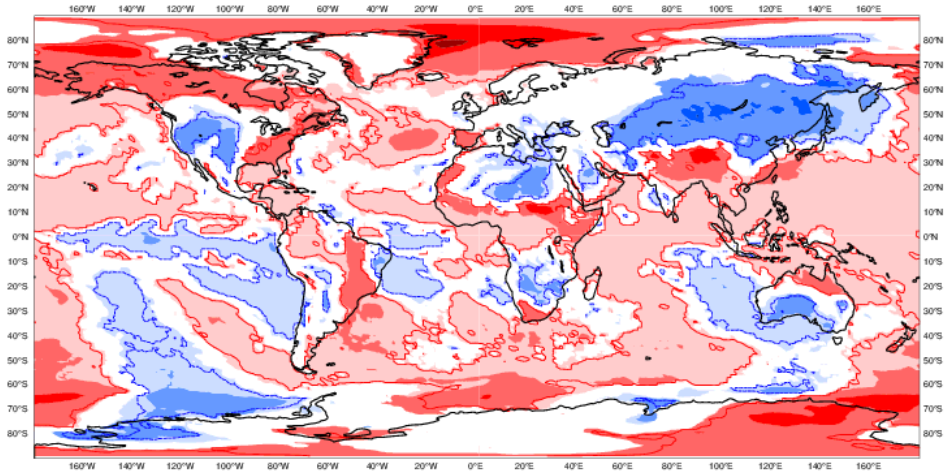
The set of re-forecast is used to estimate the model biases

The bias is removed from the real time forecast during the post-processing.

ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 28-09-2017
ensemble size = 51 ,climate size = 660

Day 12-18
09-10-2017/TO/15-10-2017
Shaded areas significant at 10% level
Contours at 1% level

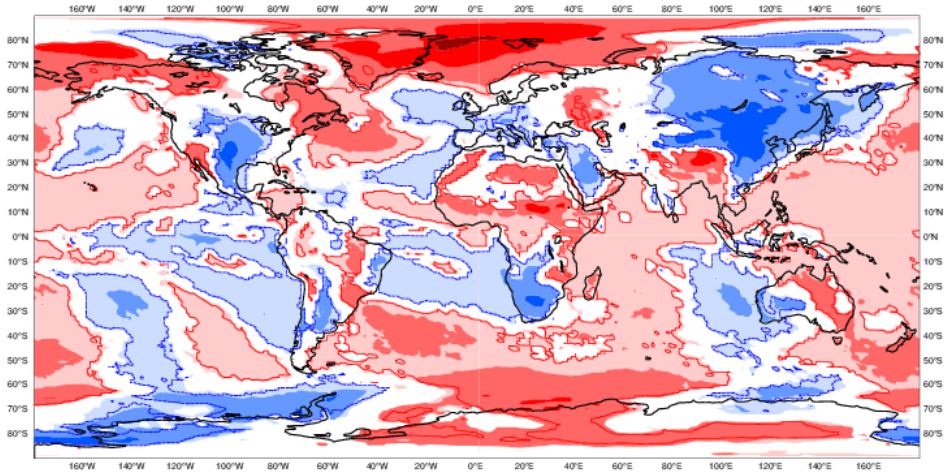
<-10deg -10.. -6 -6.. -3 -3.. -1 -1.. 0 0.. 1 1.. 3 3.. 6 6.. 10 > 10deg



ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 02-10-2017
ensemble size = 51 ,climate size = 660

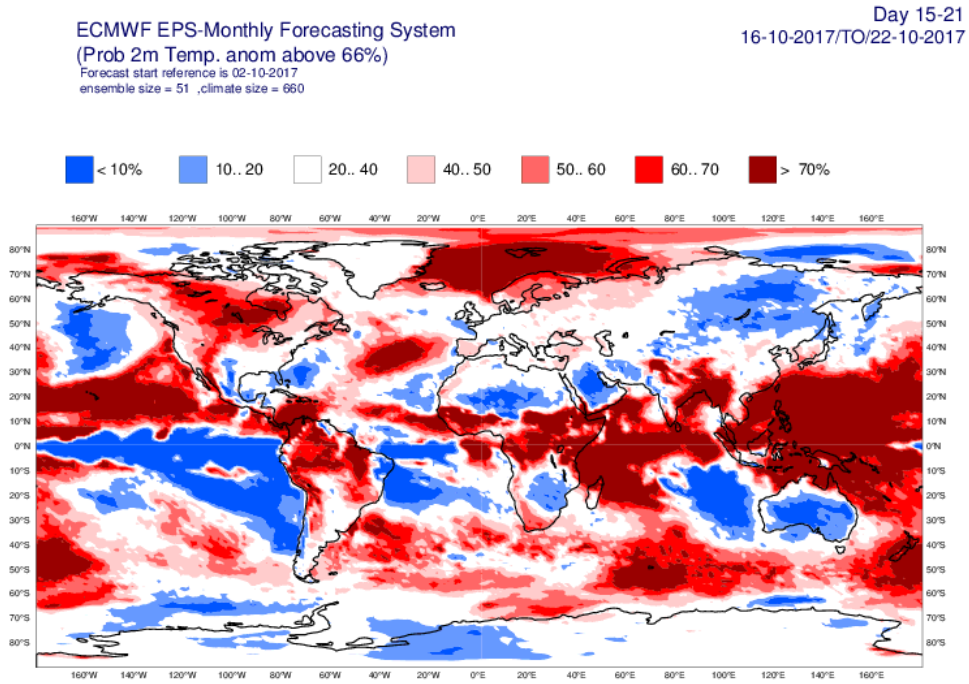
Day 8-14
09-10-2017/TO/15-10-2017
Shaded areas significant at 10% level
Contours at 1% level

<-10deg -10.. -6 -6.. -3 -3.. -1 -1.. 0 0.. 1 1.. 3 3.. 6 6.. 10 > 10deg

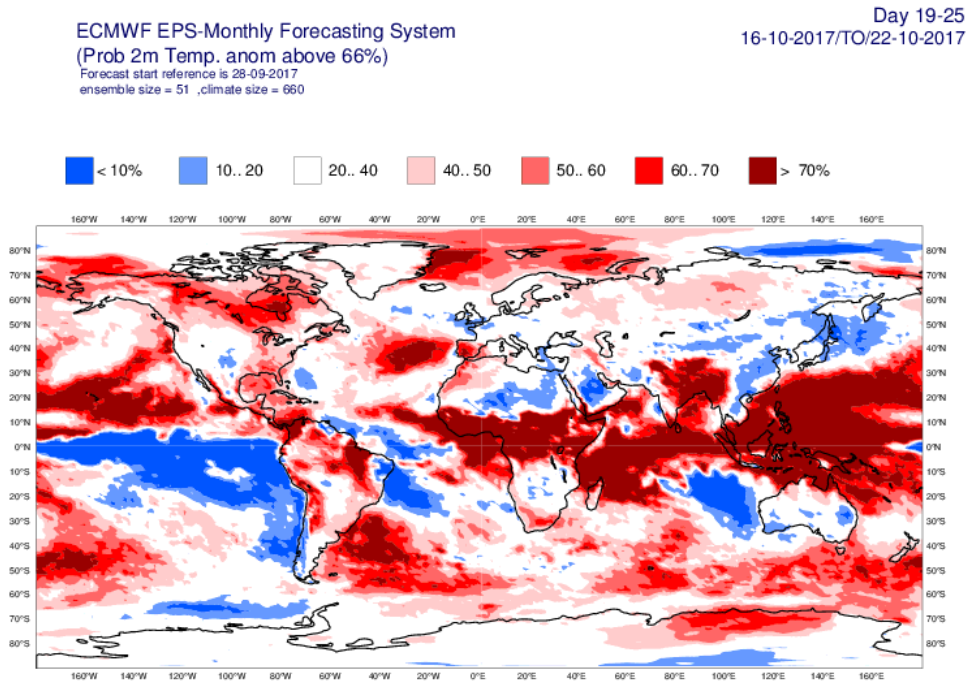


Ens. mean weekly anomalies :

ECMWF



Probabilities of weekly mean 2m temp.



Probabilities of exceeding the upper third of the climate distribution

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Bridging the gap between seasonal forecasting and NWP

Sources of predictability for the extended forecasts :

- **Land Surface conditions: Snow cover, Soil Moisture**

- **Ocean conditions: Sea surface temperature, Sea ice**

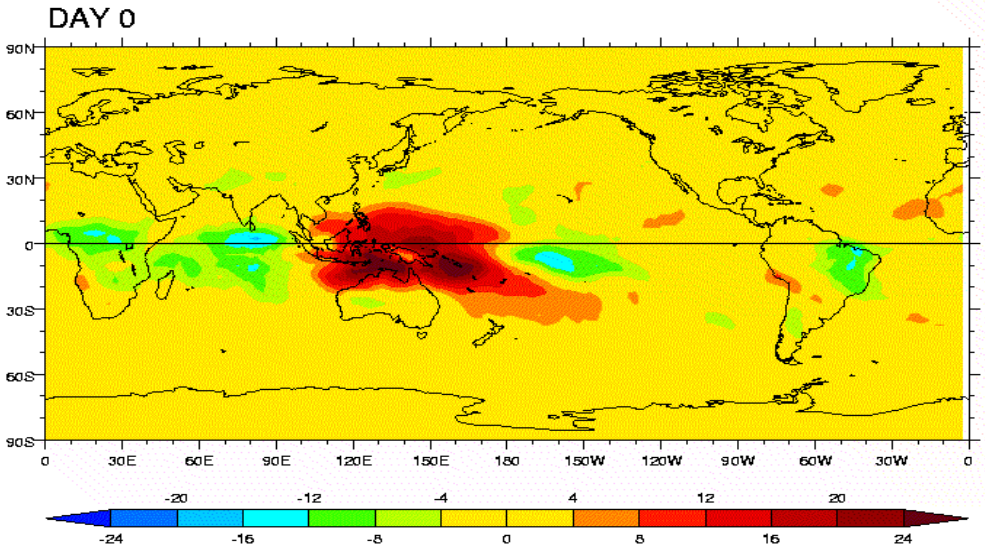
- **Stratospheric Initial conditions**

- **The Madden-Julian oscillation**

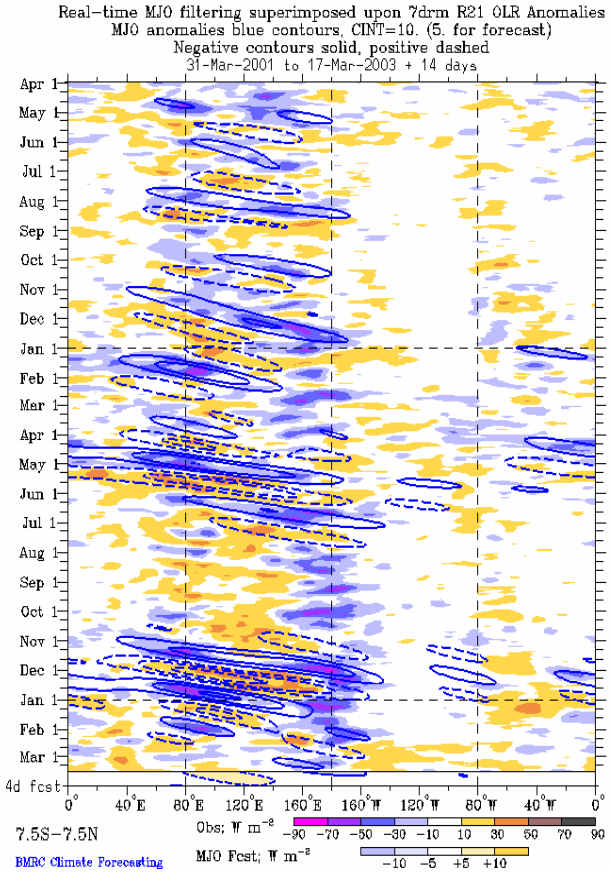
- **Atmospheric dynamical processes (Rossby wave propagations, weather regimes…)**

The Madden Julian Oscillation (MJO)

MJO life cycle

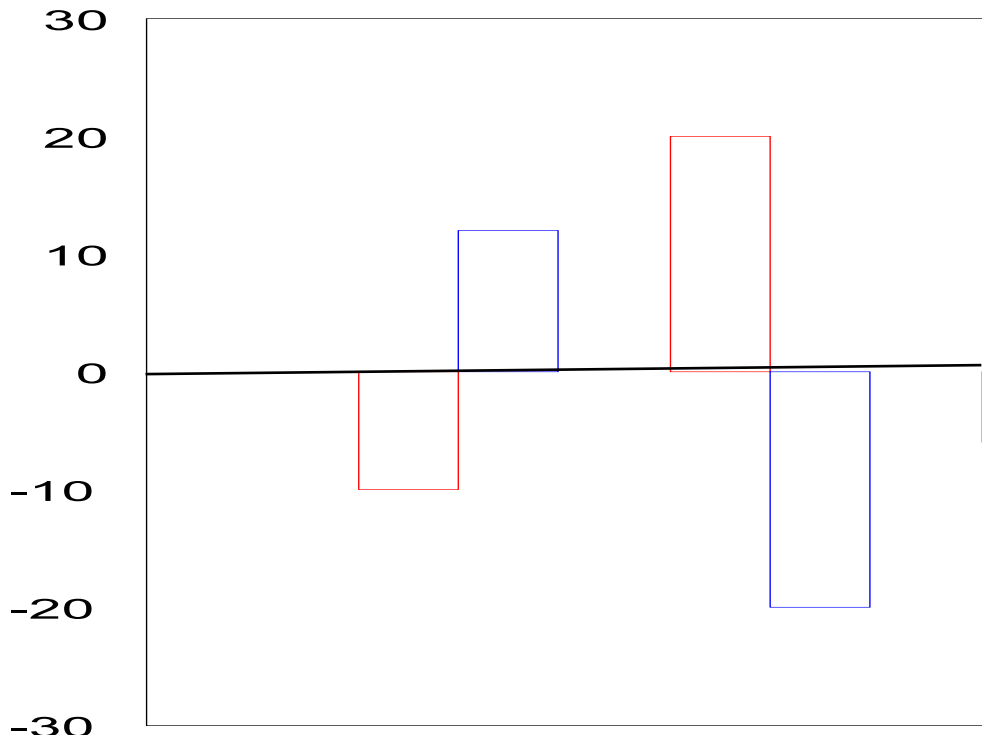


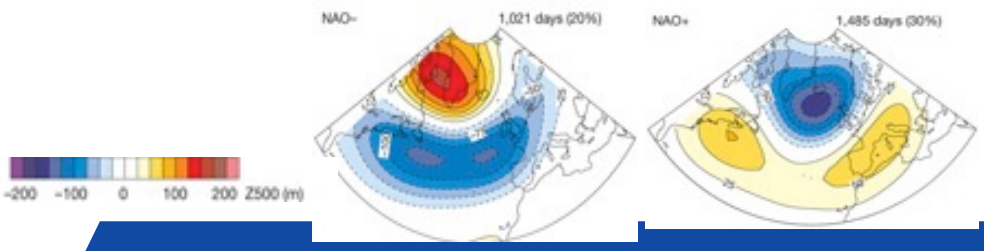
(From NASA)



From http://www.bom.gov.au/bmrc/clf

MJO impact on European weather:





The MJO impact is the strongest about 10 days after the MJO is in the phase with:

- suppressed convection over Indian Ocean
- enhanced convection over Western Pacific are conducive to negative NAO

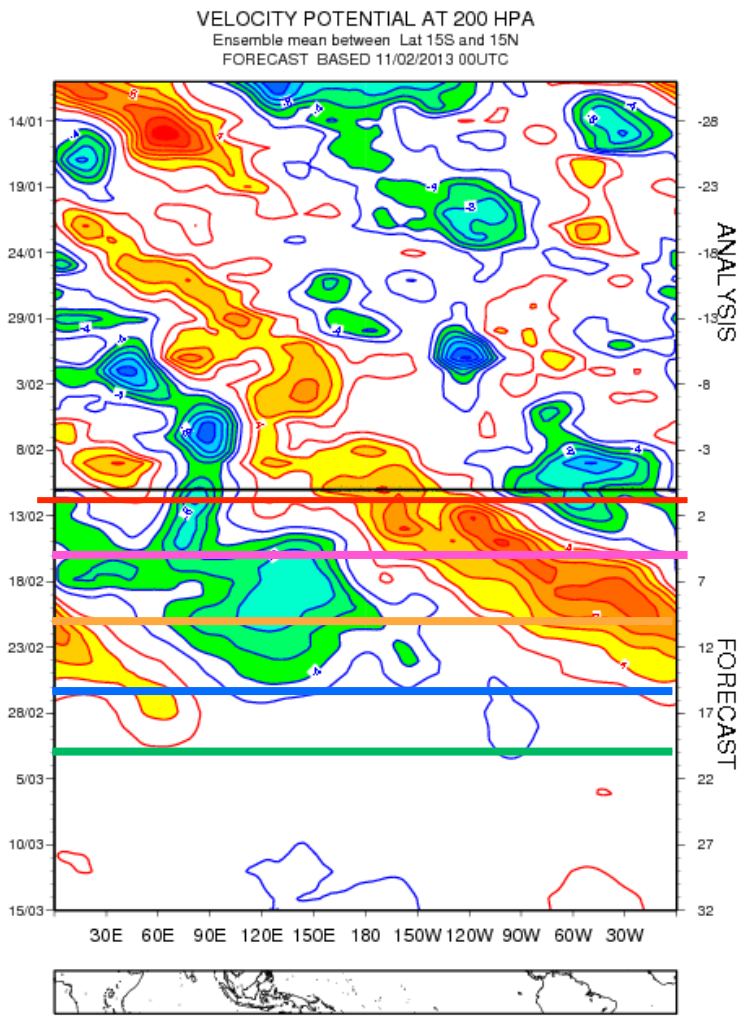
Cassou (2008) Lin et al (2008)

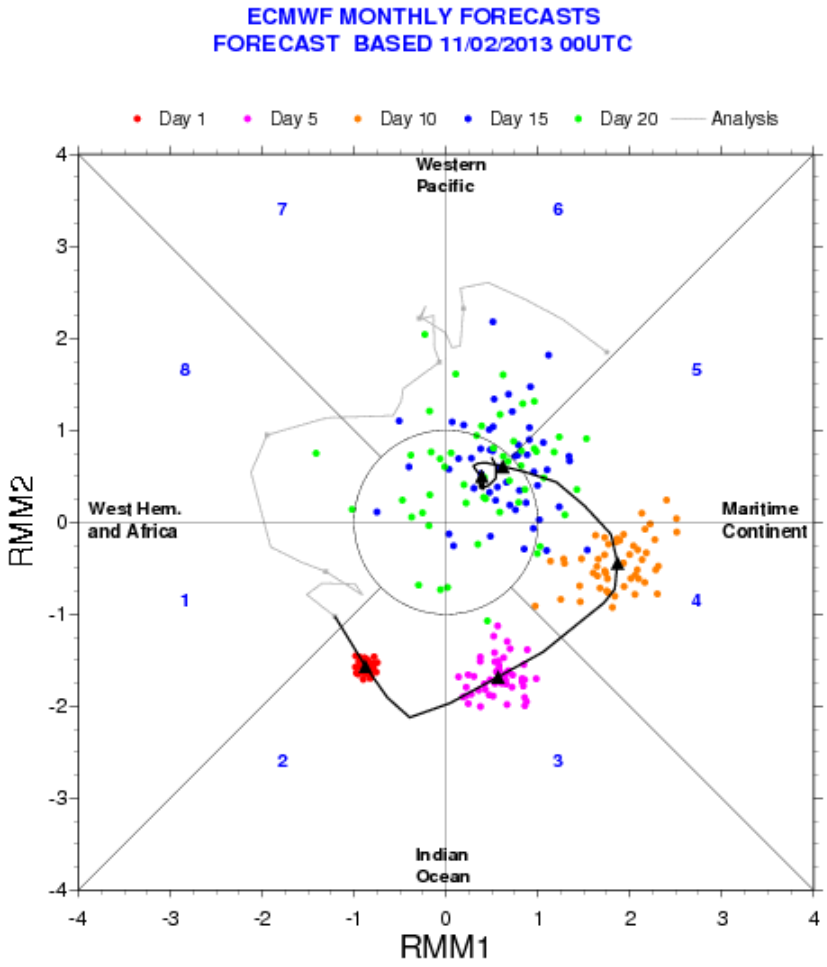
Conv. Over Indian Ocean +10 days

Conv. Over Western Pacific+10 days

ECMWF

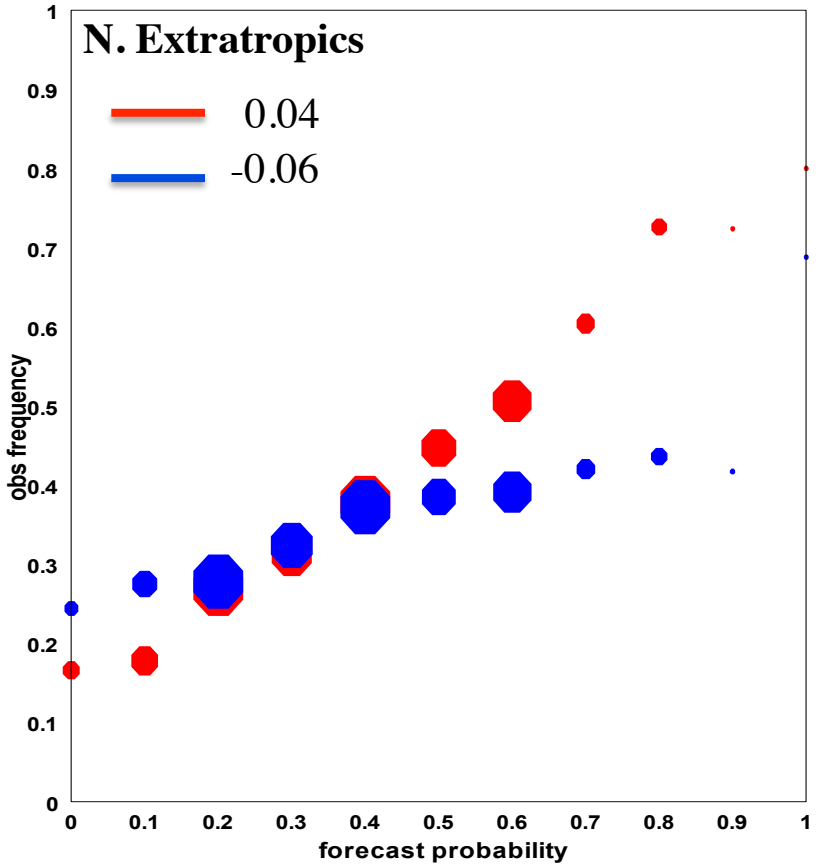
MJO forecast:

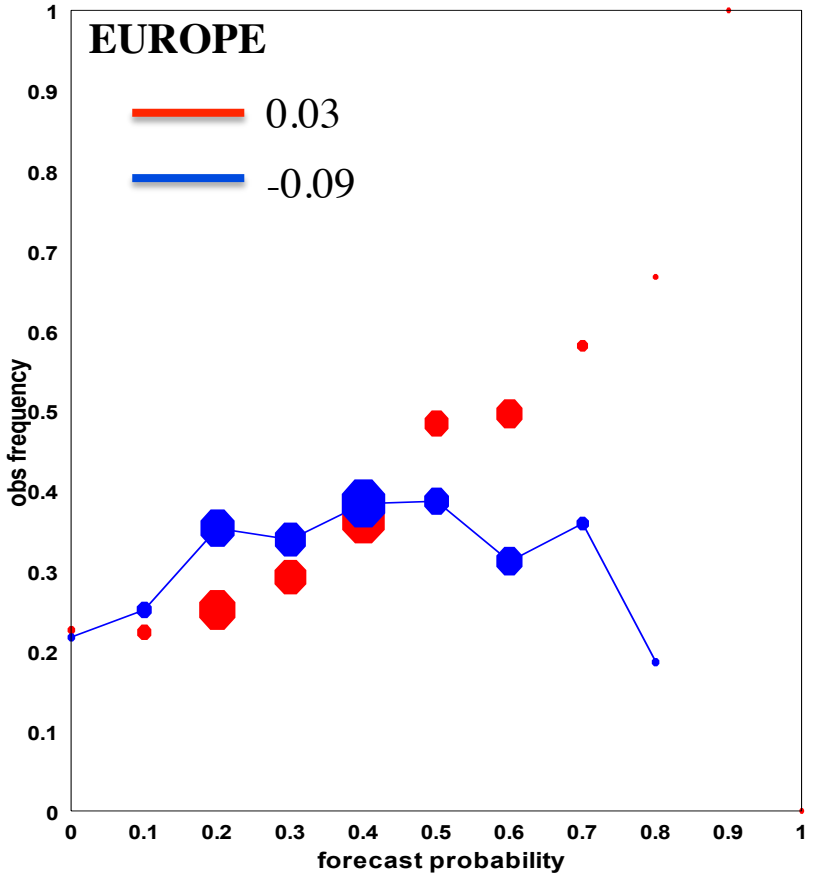




Probabilistic skill scores – NDJFMA 1989-2008

Reliability Diagram
Probability of 2-m temperature in the upper tercile
Day 19-25



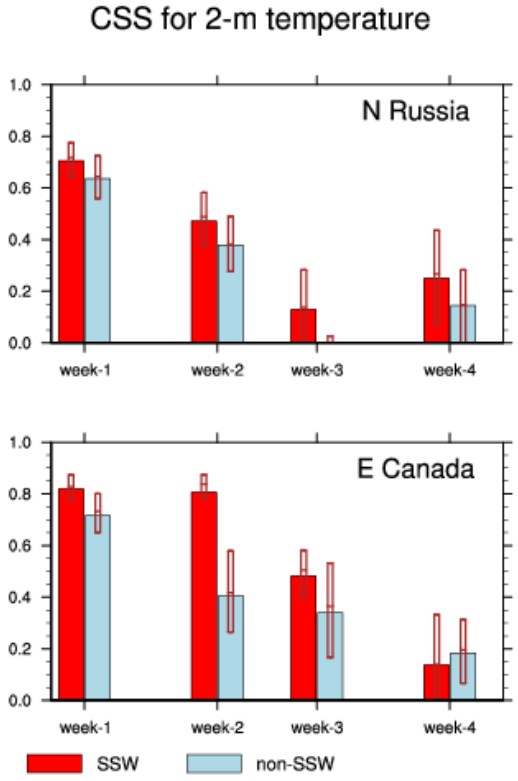


MJO in IC NO MJO in IC

ECMWF

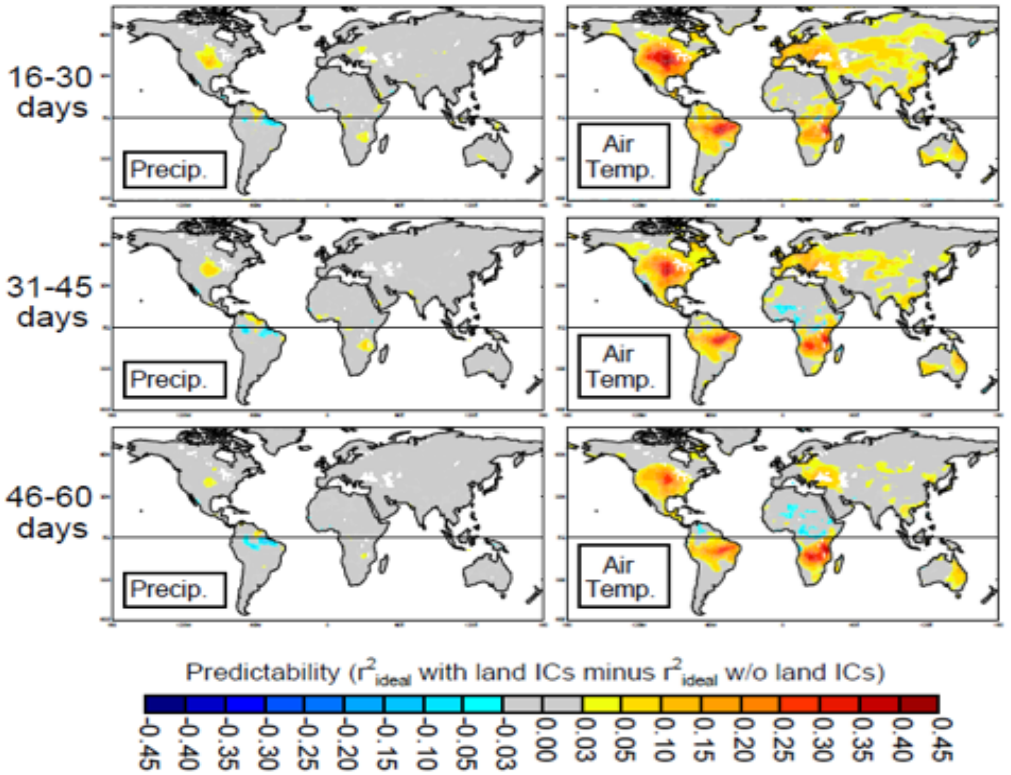
Stratospheric variability: Impact of SSWs on skill scores

Impact of SSWs on forecast skill scores



From Tripathi et al. (2015)

Land surface conditions: Impact of soil moisture

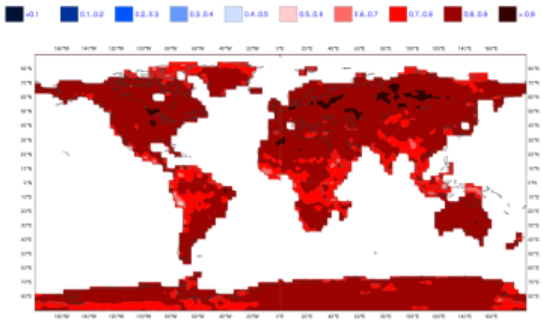


Koster et al, GRL 2011

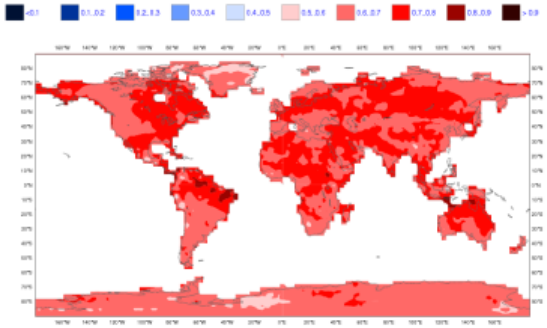
Skill of the ECMWF Extended range Forecasts

ROC score: 2-meter temperature in the upper tercile

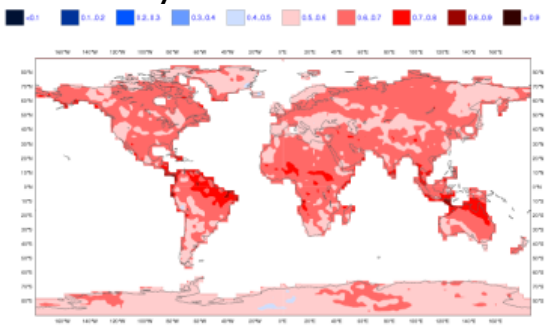
Day 5-11



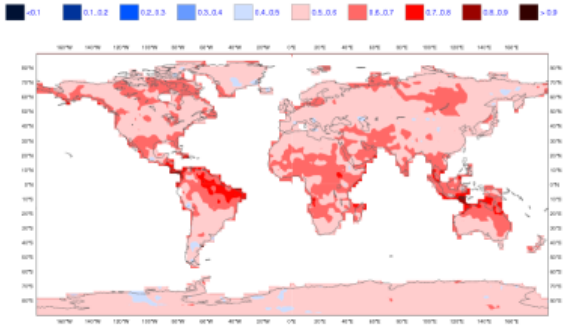
Day 12-18



Day 19-25



Day 26-32

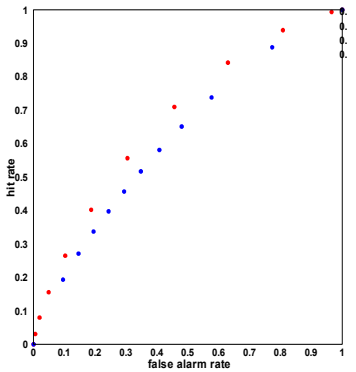


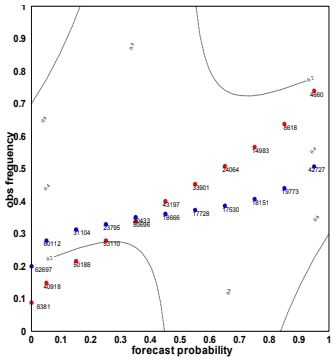
How Skilful are the ECMWF Extended range Forecasts ?

2-meter temperature in upper tercile - Day 12-18

ROC score | Reliability diagram

Day 12-18

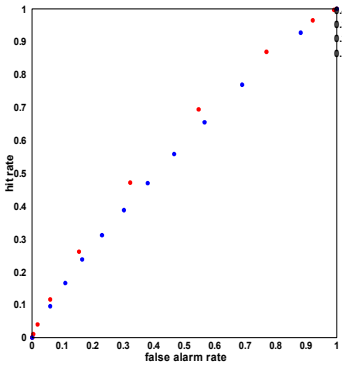


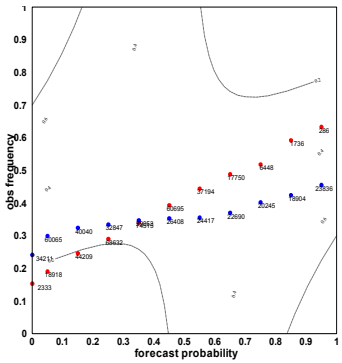


Persistence of day 5-11

Monthly forecast day 12-18

Day 19-25



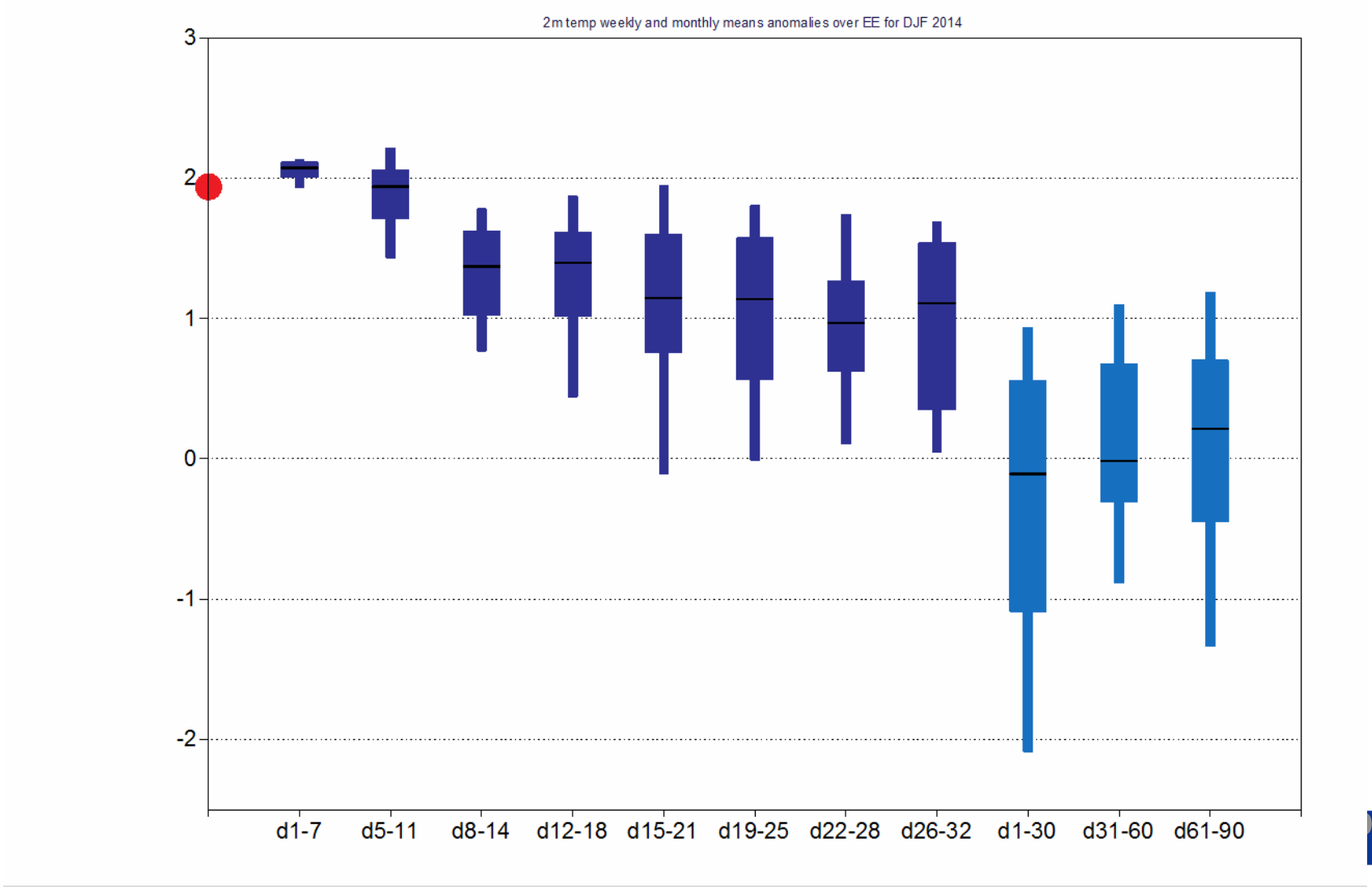


Persistence of day 5-18

Monthly forecast day 19-32

ECMWF

Predictability of seasonal mean anomalies: 2m temp anomalies averaged over Eastern Europe for DJF 2014

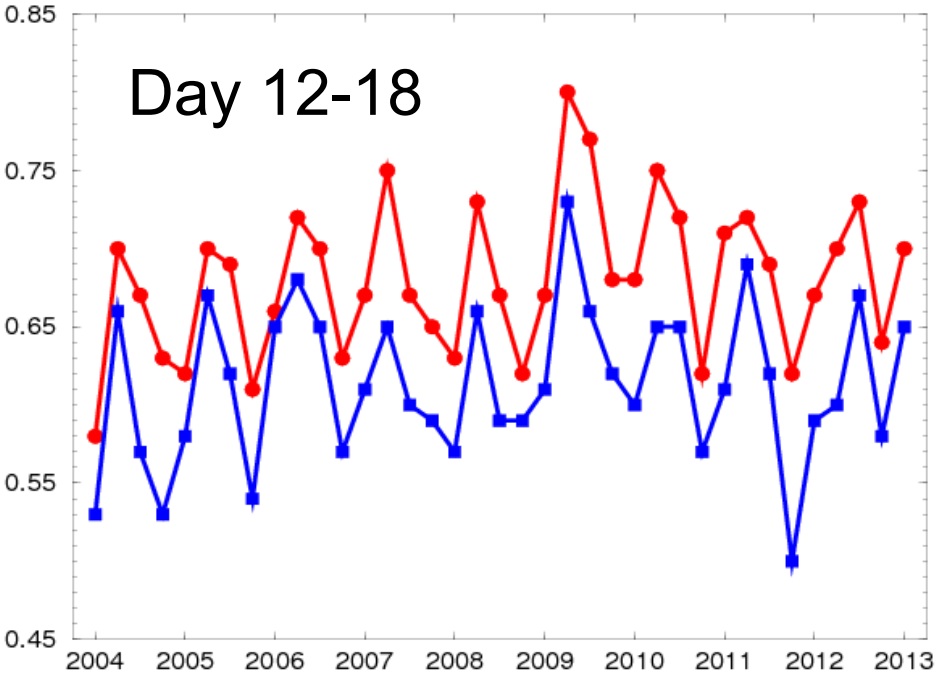


Monthly Forecast: Northern extratropics

ROC score: 2-metre temperature in the upper tercile

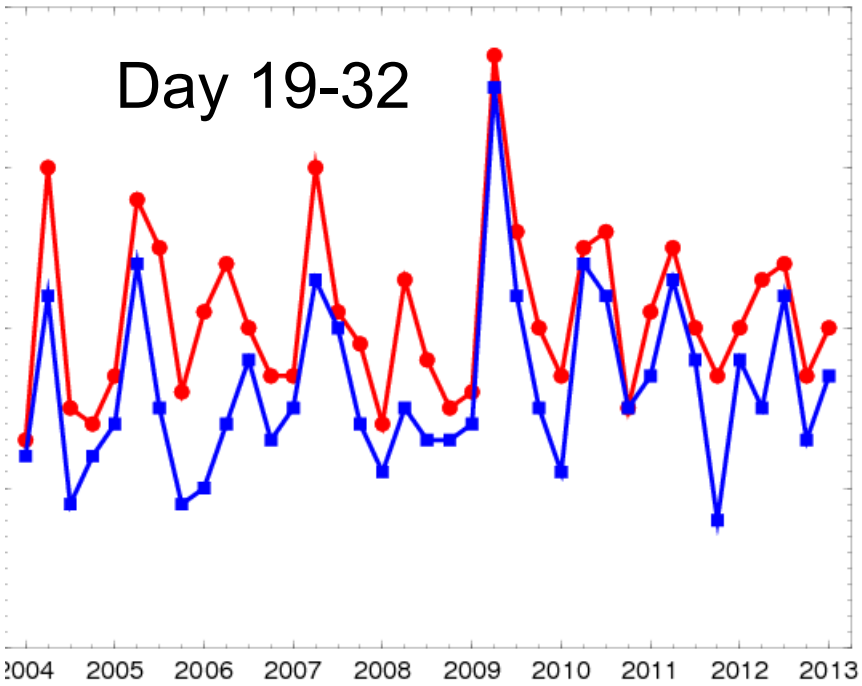
Monthly Forecast

Persistence of day 5-11



Monthly Forecast

Persistence of day 5-18

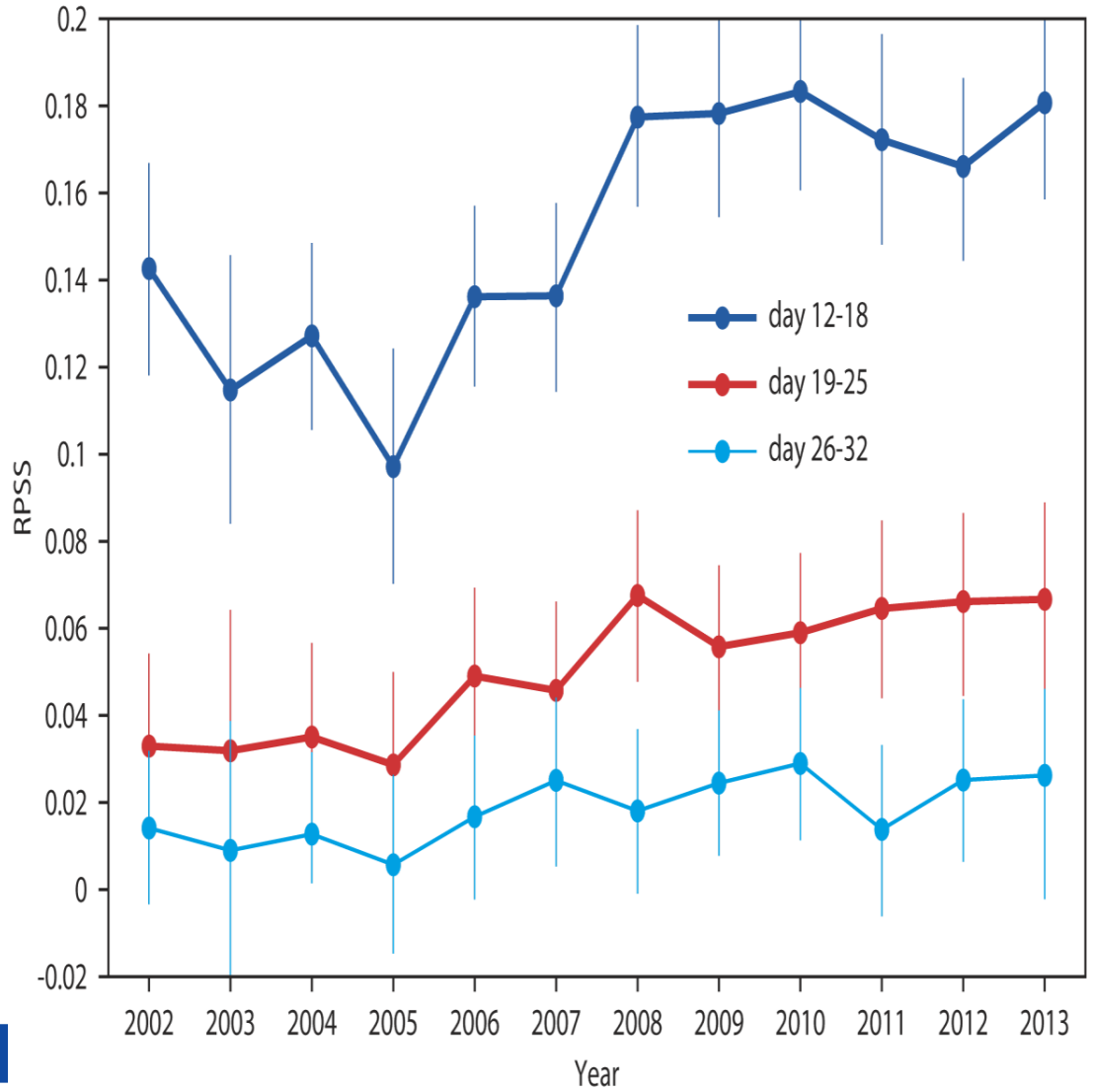


Evolution of skill scores based on the re-forecasts

RPSS – Probability of 2mt in upper tercile NDJFM

All the re-forecasts produced since 2002 have the period 1995-2001 in common.

RPSS scores have been computed for all the re-forecasts produced between April of a given year and March of the following year and covering the period 1995-2001 (once a week, 5-member ensemble).



Conclusion

- SSTs, Soil moisture, stratospheric initial conditions and MJO are source of predictability at the intra-seasonal time scale. In particular the MJO has a significant impact on the forecast skill scores beyond day 20.

- The ENS produces forecasts for days 12-18 that are generally better than climatology and persistence of day 5-11. Beyond day 20, the skill is marginal but for some applications and some regions has some interest.

- Making improvements to sub-seasonal predictions, assessing their skill and uncertainty, and exploring ways to communicate their benefits to decision-makers are significant challenges. The S2S WWRP/THORPEX-WCRP joint project (http://s2sprediction.net) is embracing all these challenges and, to promote this research, has created a new database with a set of multi-model S2S reforecasts and forecasts freely available to the community.

Upgraded seasonal forecast system (S5):

In November 2017 will become operational and will replace the current S4

•Broadly, model climate improves, except in the stratosphere.

•Global SST biases improve, especially in the ENSO regions. Cold-tongue bias almost disappears. Improved ENSO variability.

•Introduction of interactive sea-ice improves predictability of the sea ice cover, but introduces sea ice cover biases, especially in summer.

• In the tropics the SEAS5 skill is significantly higher than SEAS4.

•Over the Northern extra-tropics and Europe the skill difference is not highly significant.

•We have carried out a comprehensive evaluation of system 5 and the results will be published in a technical memo.

SEAS5 main characteristics:

	SEAS4 (2011)	SEAS5 (2017)
Atmosphere	Cycle 36r4 ~ 80Km, L91	Cycle 43r1 ~36 km, L91
Ocean	NEMO v3.0 ORCA 1.0-L42	NEMO v3.4 ORCA 0.25-L75
Sea ice model	Sampled climatology	LIM2
Non-orographic GWD	Altered	Altered
Ozone scheme	Cariolle	BMS
Ozone interactive	Yes	No

- Updated IFS cycle with many improvements to model physics
- Increased horizontal resolution in atmosphere and ocean, increased vertical resolution in the ocean
- Introduction of the LIM2 interactive sea ice model
- Ozone scheme non-interact.

ERA5 forcings adopted for SEAS5

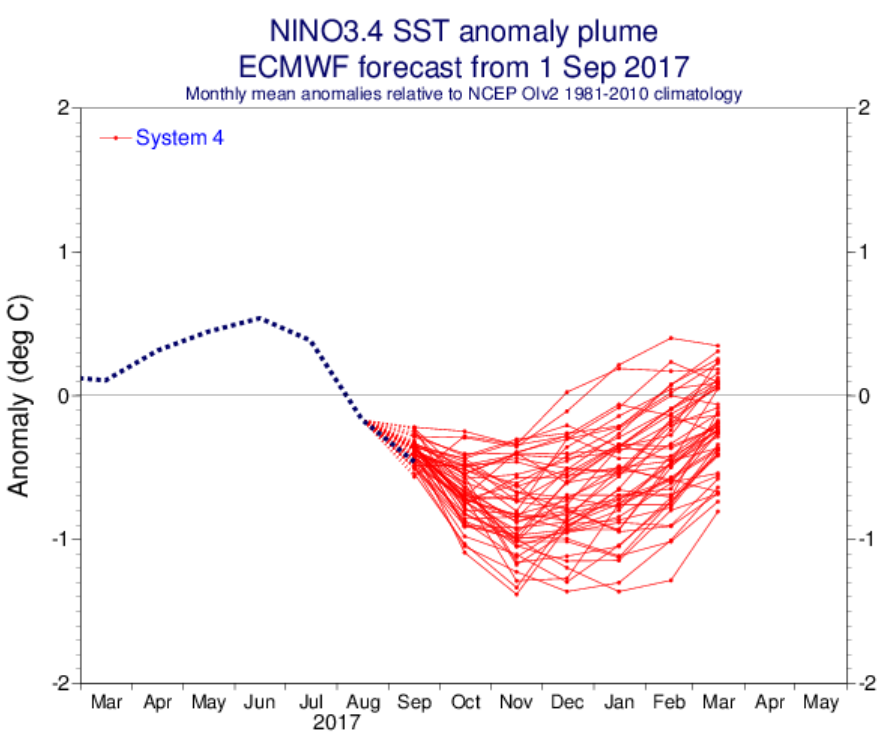
- Decadally varying tropospheric sulphate aerosol from CMIP5
- Time varying stratospheric volcanic aerosol from GISS
- GHG forcings from CMIP5 as in 43r1

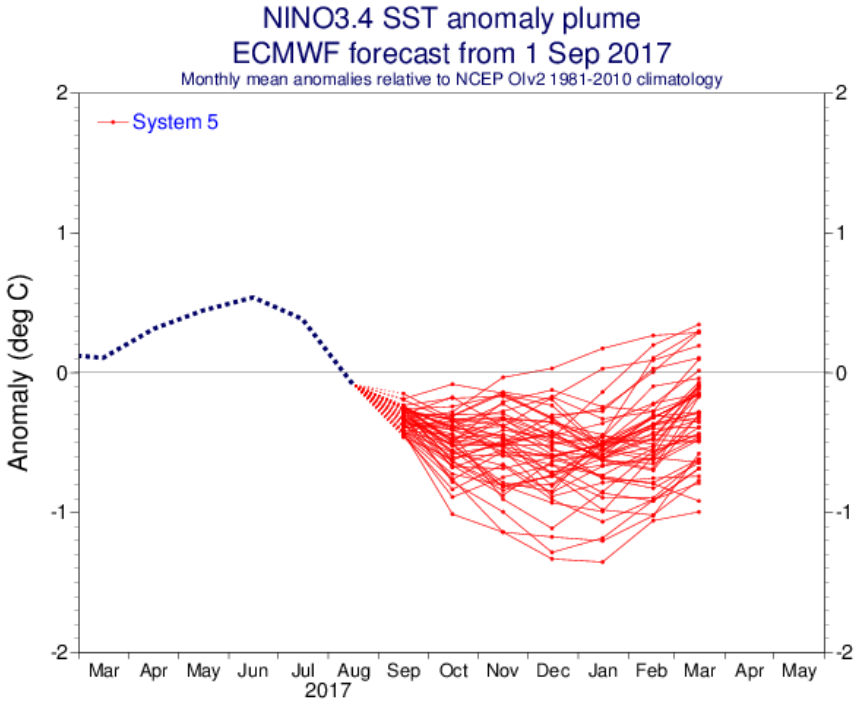
Initialization and forecast strategy

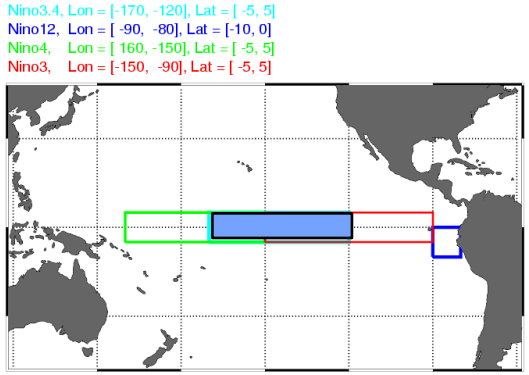
	SEAS4	SEAS5
Atm. Initialization	ERA-Interim	ERA-Interim
Land initialization	ERA-Interim Land 32r3	ERA-Interim Land 43r1
Ocean initialization	ORA-S4	ORA-S5
Ensemble spread	SPPT & SKEB	SPPT& SKEB
Forecast members	51	51
Reforecast members	15	25
Calibration period	1981-2010	1993-2016
Reforecasts period	1981-2010	1981-2016

- Updated ocean and land initial conditions
- Updated atmosphere and ocean initial condition perturbations
- Larger reforecast ensemble size
- Calibration period set by C3S

NINO3.4 plumes



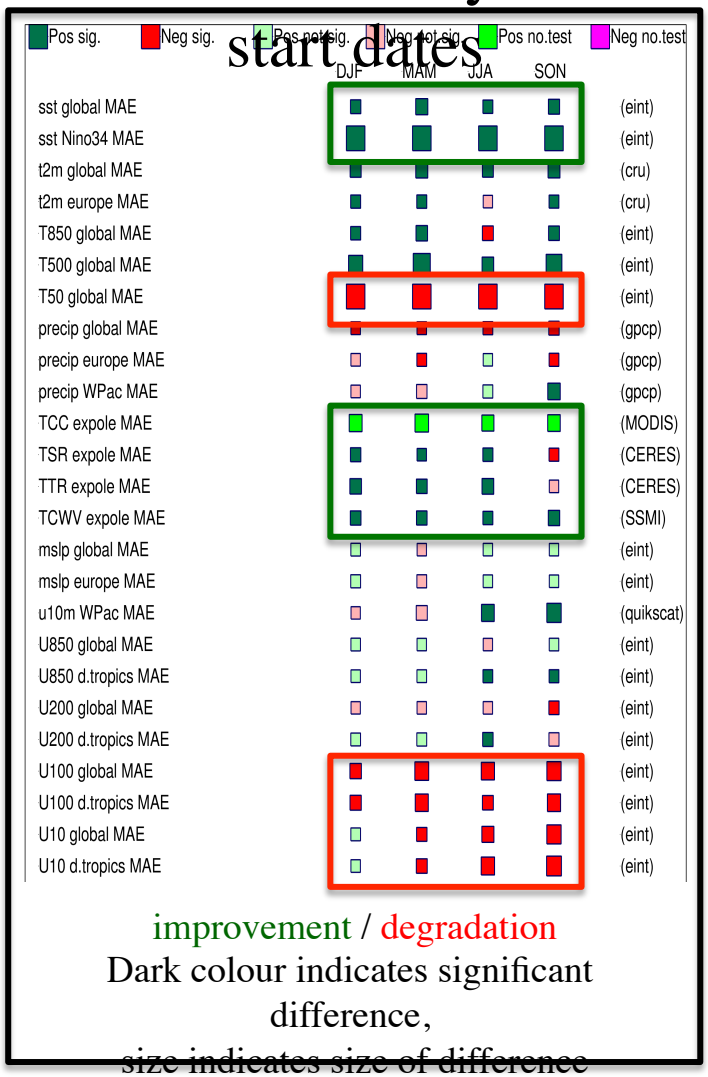




Forecast from system 5 is made available on the 5h of each month *3 days earlier than system 4*

SEAS5 vs. SEAS4 mean state summary

1993-2015: May/Nov start dates



improvement / degradation
Dark colour indicates significant difference,
size indicates size of difference

- Global SST biases improve, especially in the ENSO regions
- Changes in model physics lead to better tropical cloud cover and surface temperatures, but this doesn't always lead to better tropical precipitation
- Stratospheric temperature and winds biases increase

In general, the climate mean is improved in SEAS5 compared to SEAS4, except for the stratosphere.

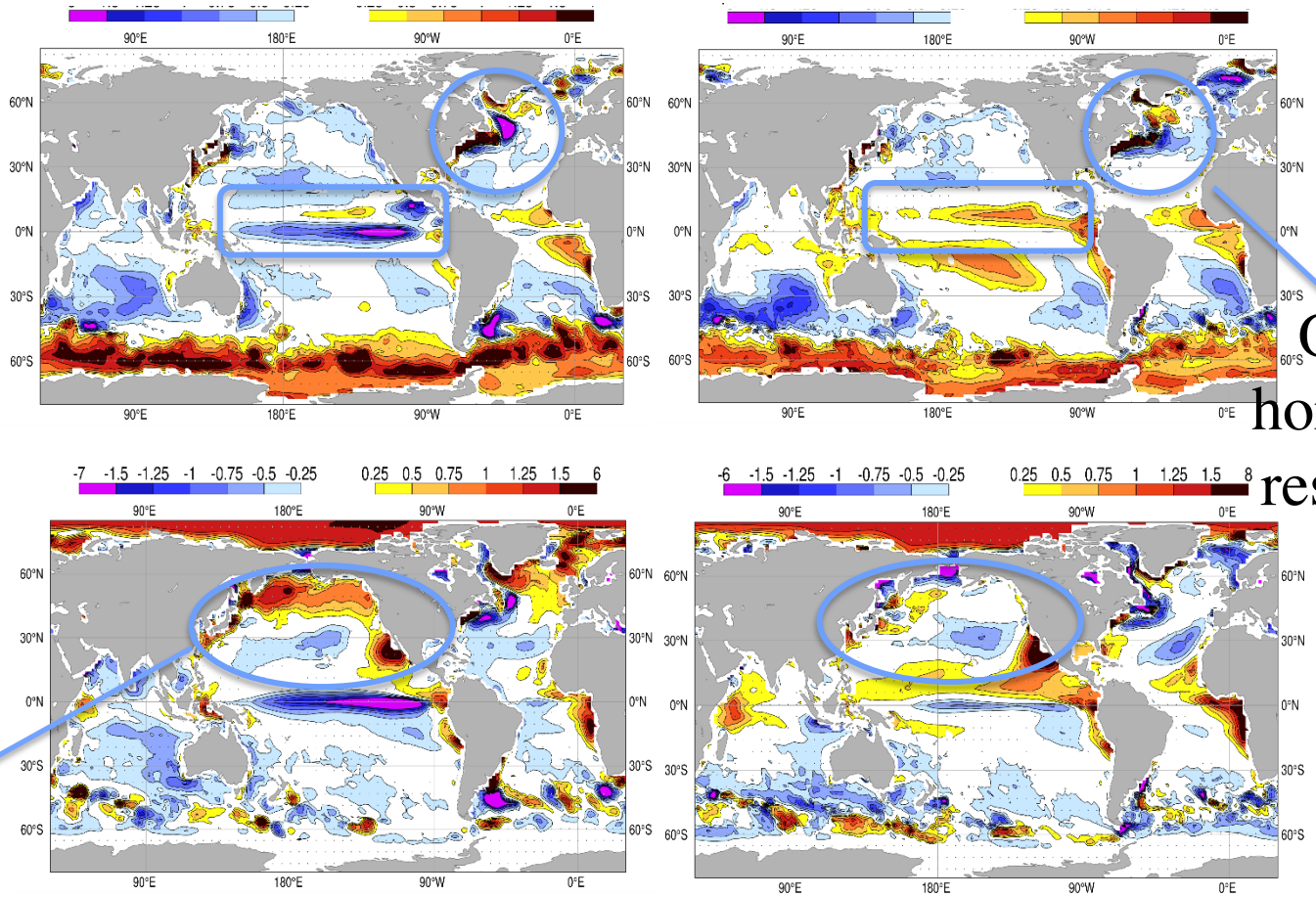
Global SST biases improve, especially in the ENSO regions

SEAS4 - ERAI

SEAS5 - ERAI

DJF

JJA



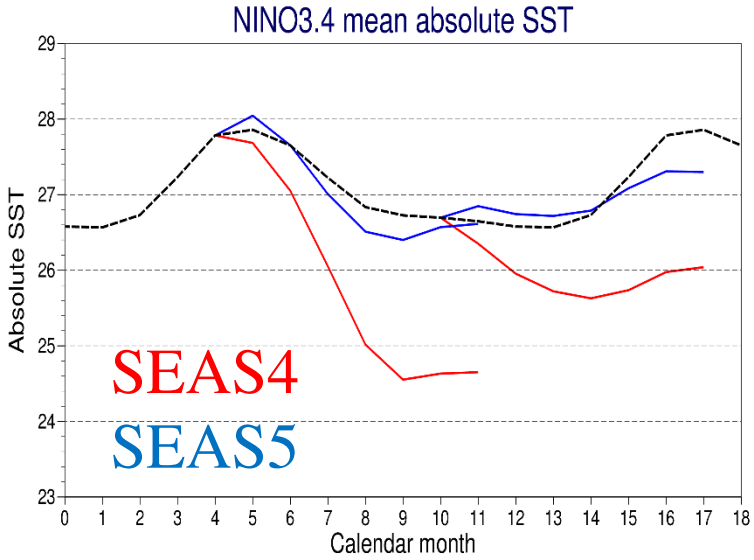
Ocean horizontal resolution

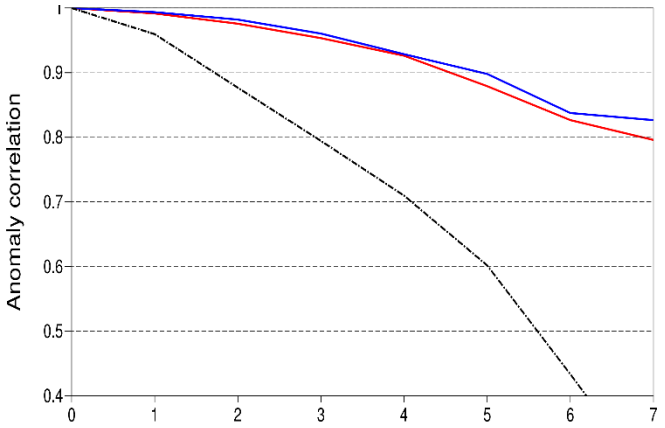
Ocean vertical mixing

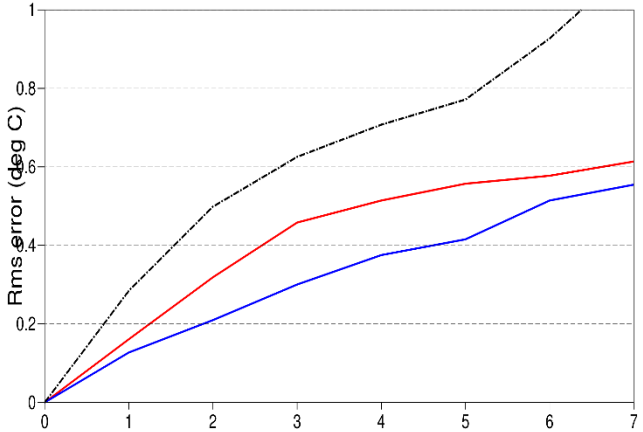
Particular improvement in the ENSO regions, much better foundation for ENSO teleconnections

ECMWF

Global SST biases improve, especially in the ENSO regions







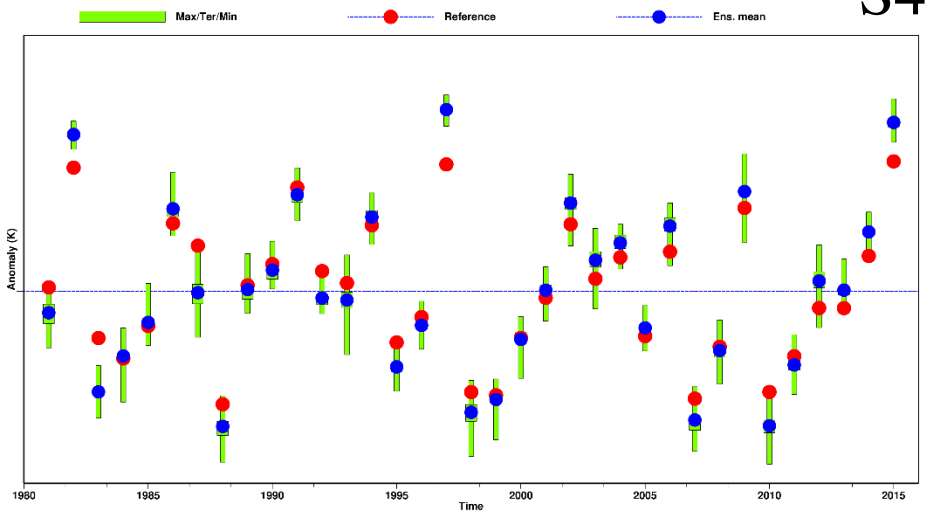
ENSO SST drift improves markedly. Also a small increase in ENSO correlation scores, an improvement in ENSO variance, and a decrease in RMS error.

NINO3.4 predictions
S4 vs S5

Nino3.4 SST (ocean only)
ORecmfEX0001SY04M1 with 25 ensemble members
Hindcast period 1981-2015
Start date November and fcst. time 2 to 4

Ratio of sd (model/ref): 1.24
Ratio spread/RMSE: 0.56
Ens. mean correlation: 0.97 (0.00)
SNR: 5.43 (0.00)
RPSS: 0.89 (0.00)
RPSSd: 0.90 (0.00)

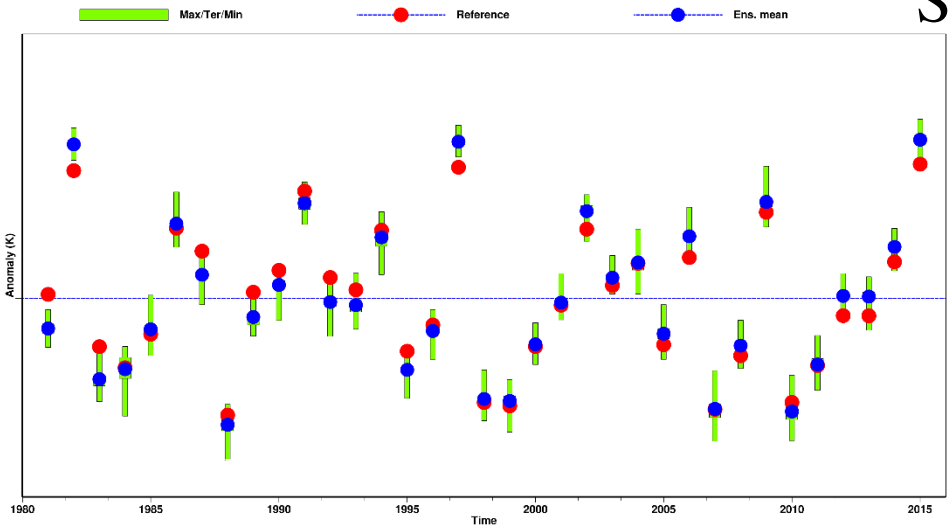
S4



Nino3.4 SST (ocean only)
ORecmfEXgl82SY04M1 with 25 ensemble members
Hindcast period 1981-2015
Start date November and fcst. time 2 to 4

Ratio of sd (model/ref): 1.09
Ratio spread/RMSE: 0.62
Ens. mean correlation: 0.98 (0.00)
SNR: 6.16 (0.00)
RPSS: 0.93 (0.00)
RPSSd: 0.94 (0.00)

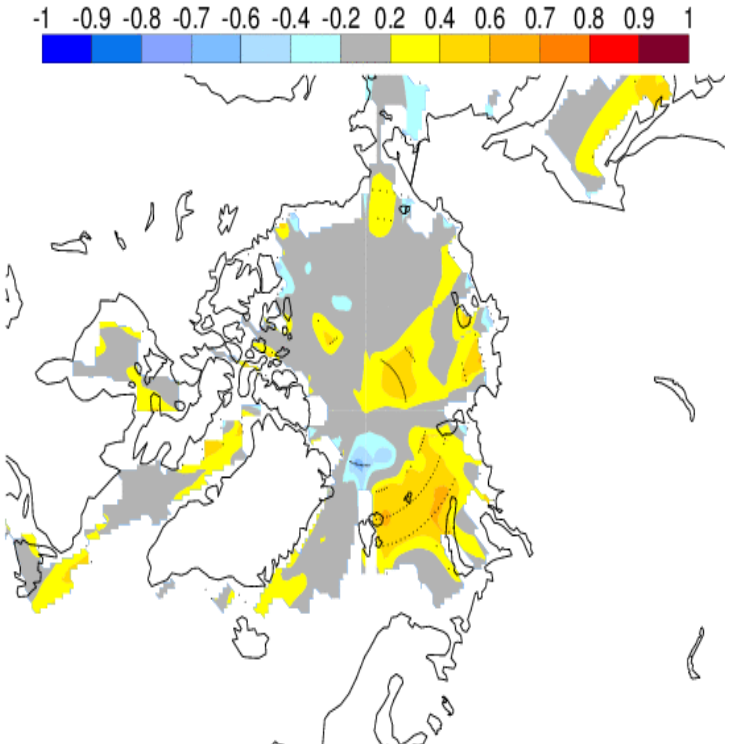
S5



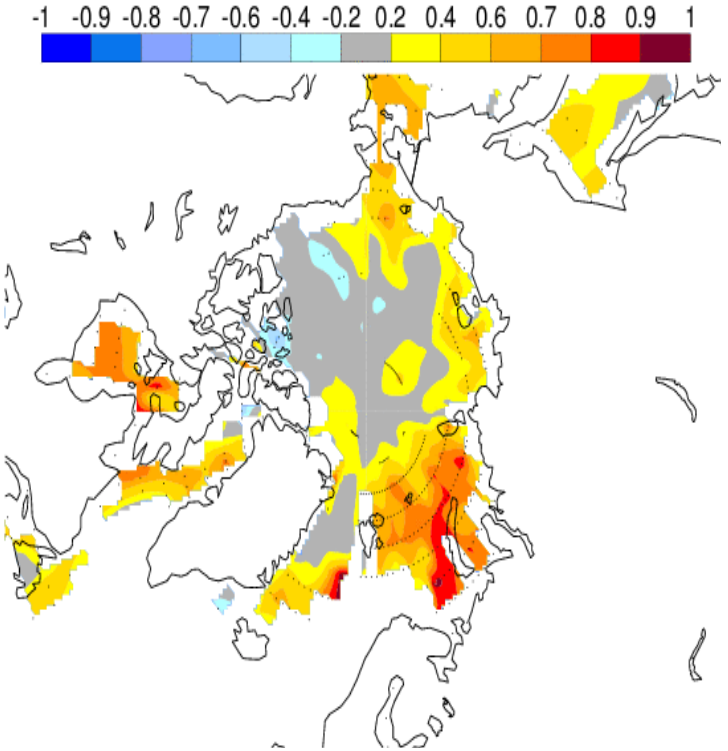
ECMWF

Sea ice cover - DJF anomaly correlations

SEAS4

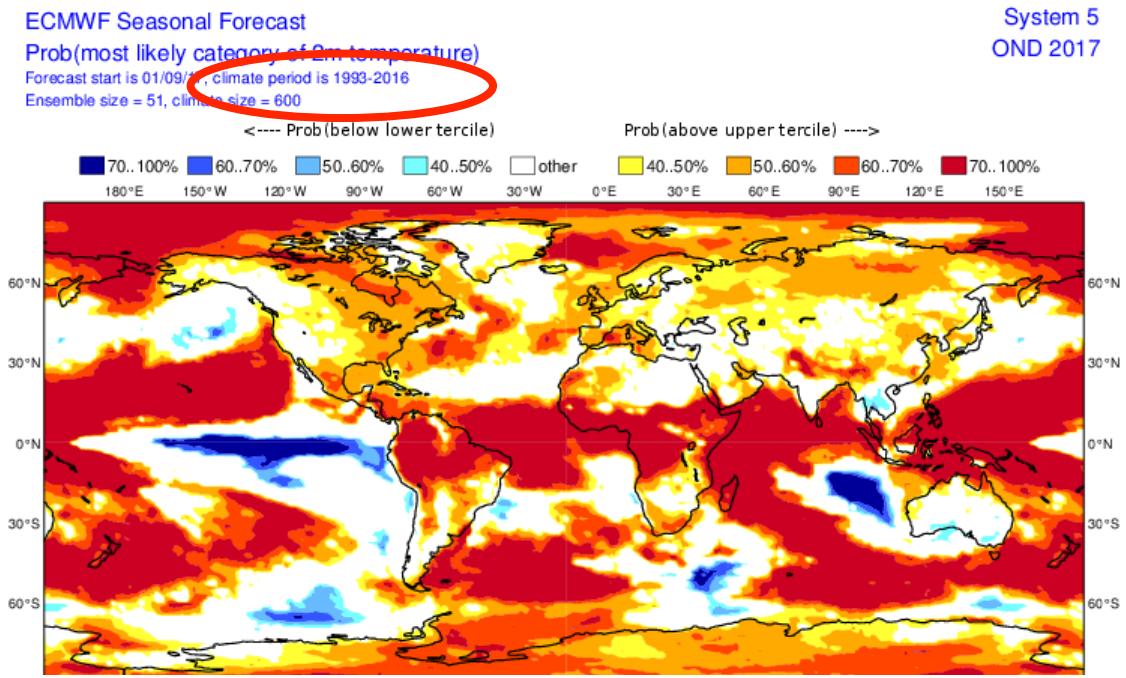


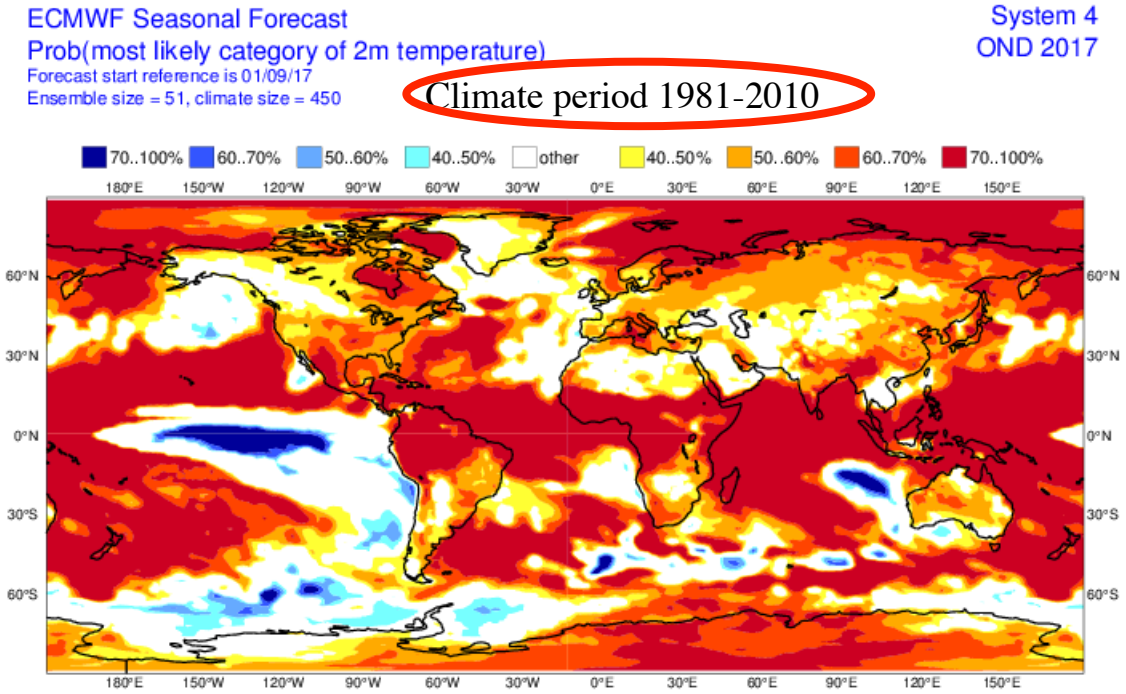
SEAS5



Sea ice cover predictability improves when we include the interactive sea ice model….

Seasonal forecast charts:





Climate period is different!

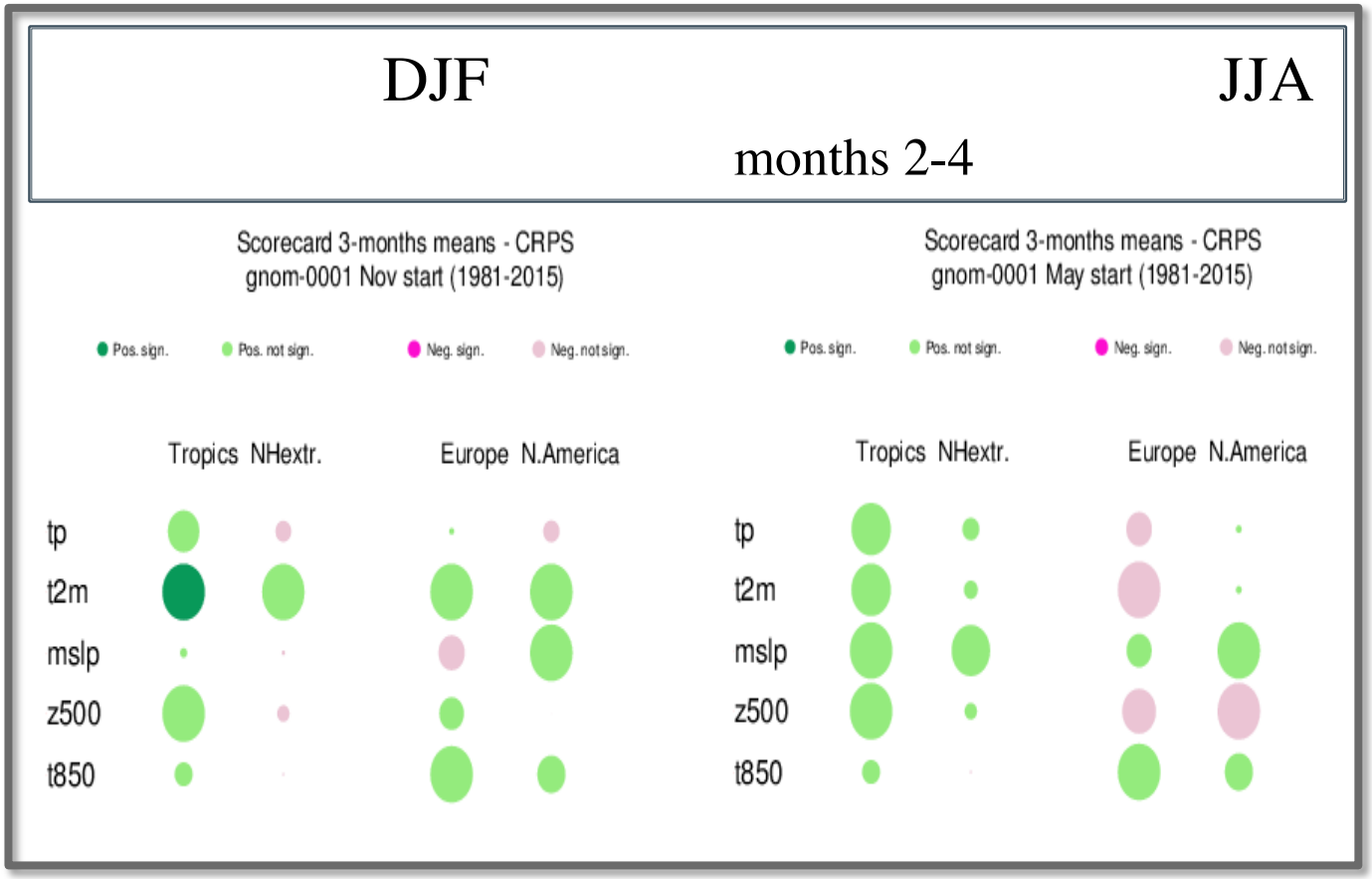
ECMWF

Summary:

System 5:	More recent model cycle. High resolution (ocean and atmosphere) Sea-Ice New ocean reanalysis ORAS5

- Broadly, model climate improves, except in the stratosphere.
- Global SST biases improve, especially in the ENSO regions. Cold-tongue bias almost disappears. Improved ENSO variability.
- Introduction of interactive sea-ice improves predictability of the sea ice cover, but introduces sea ice cover biases, especially in summer.
- In the tropics the SEAS5 skill is significantly higher than SEAS4.
- Over the Northern extra-tropics and Europe the skill difference is not highly significant.
- We have carried out a comprehensive evaluation of system 5 and the results will be published in a technical memo.

SEAS5 vs SEAS4 score cards:



Green System 5 is better

Pink System 5 is worse

ECMWF

Products:

Digital Data:

Surface data: several fields are upgraded to 6 hourly output, (SST, precipitation, snowfall, downward solar and downward thermal radiation).

New addition:

- 6 hourly instantaneous surface stresses (2 new fields, x and y).
- 24h incoming TOA solar radiation, lake mixed layer temperature, lake ice thickness
- Lake cover and Lake depth at step 0.

Model level data: the forecast length for which this is available is extended from 5 months to 6 months; the number of ensemble members with ml data remains unchanged.

Graphical products:

Same as the current but the anomalies will be with respect to a 1993-2016 climate.

SEAS5 scores are significantly better than SEAS4 in the tropics.

Over the Northern extra-tropics the impact on the scores is not highly significant (<95%), SEAS5 performance is better than SEAS4 in winter but worse in summer.

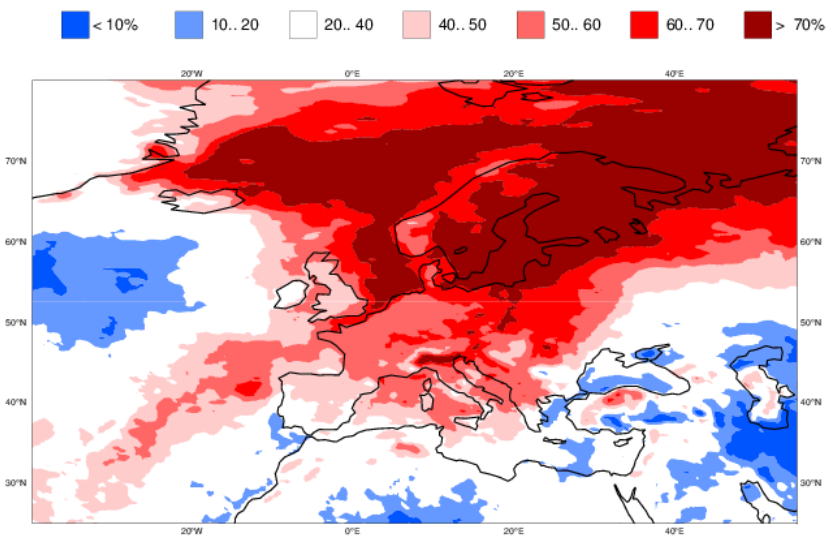
At longer ranges (5-7m) there is slight degradation, although no significant.

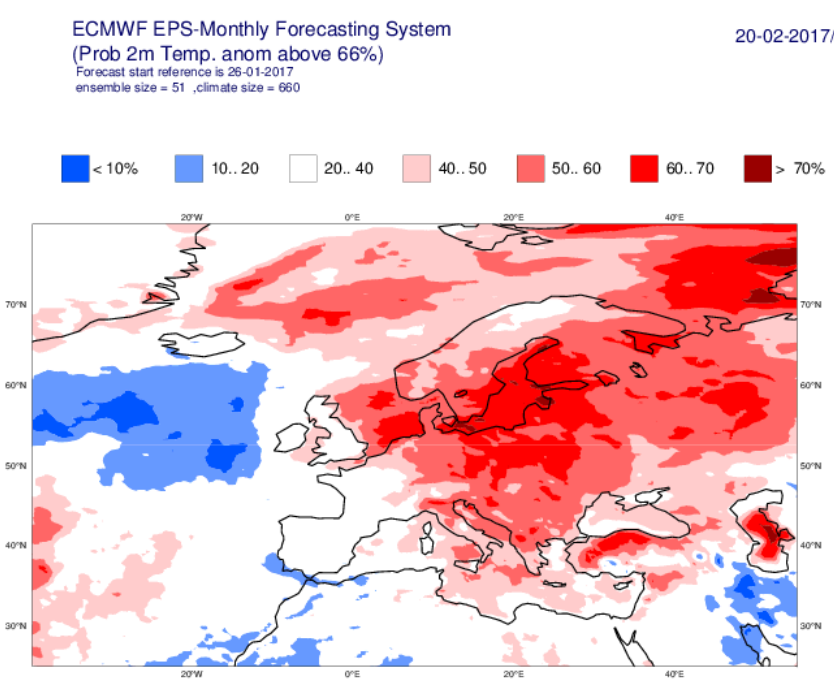
The decadal variability over N.W . Atlantic is not correctly simulated by SEAS5 (investigation in progress).

SST winter predictions over Western Trop. Indian Ocean and Nino3 areas have significantly improved.

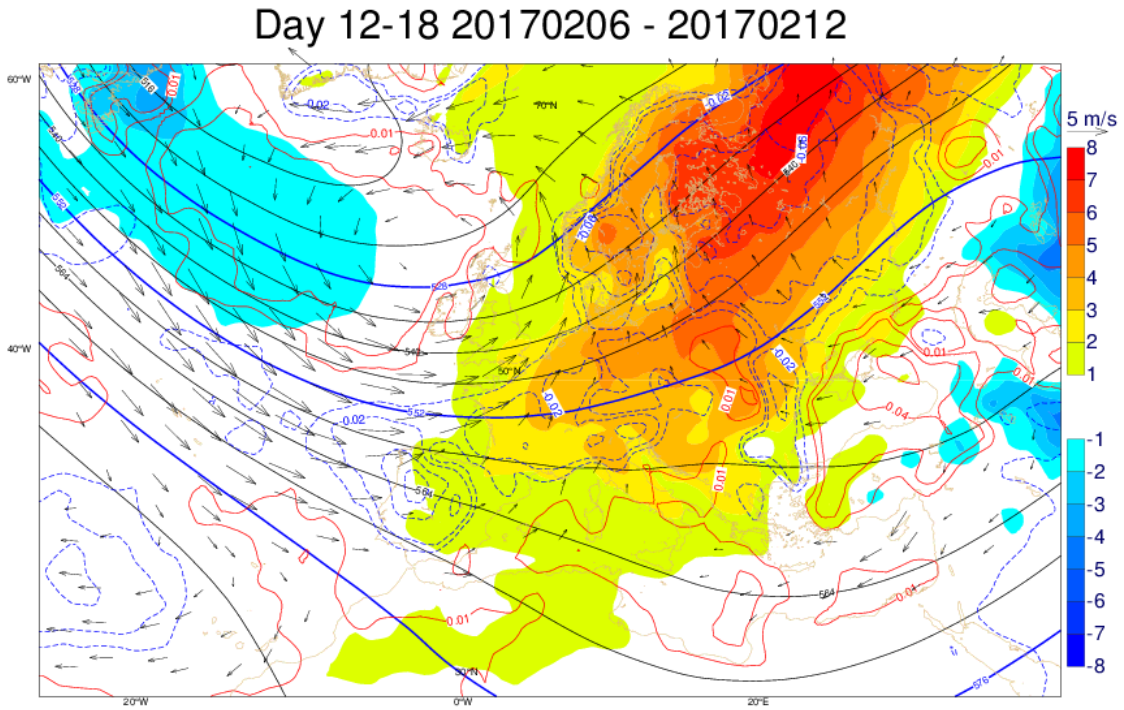
SST summer predictions over Eastern Trop. Indian Ocean have degraded mainly due the increase of spread.

Probabilities for weekly mean anomalies:

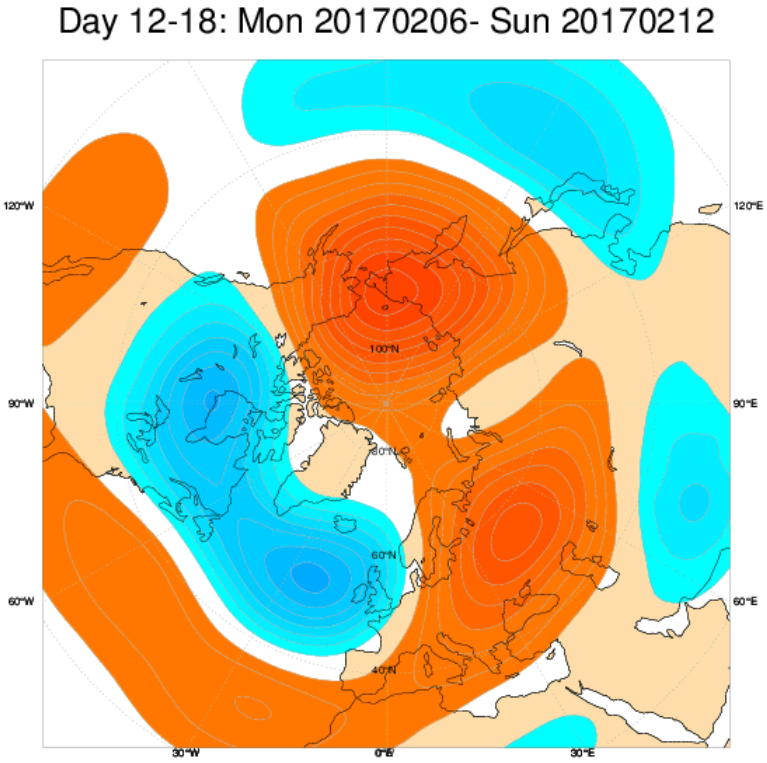


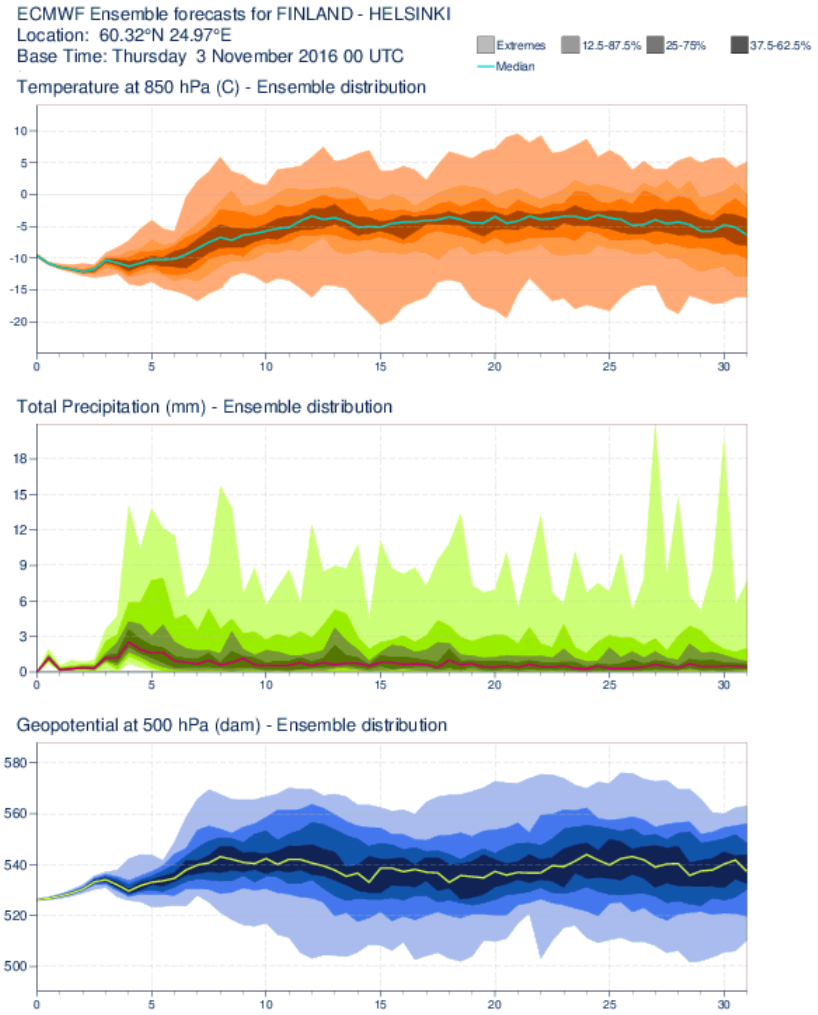


Weekly mean multiparameter outlook:

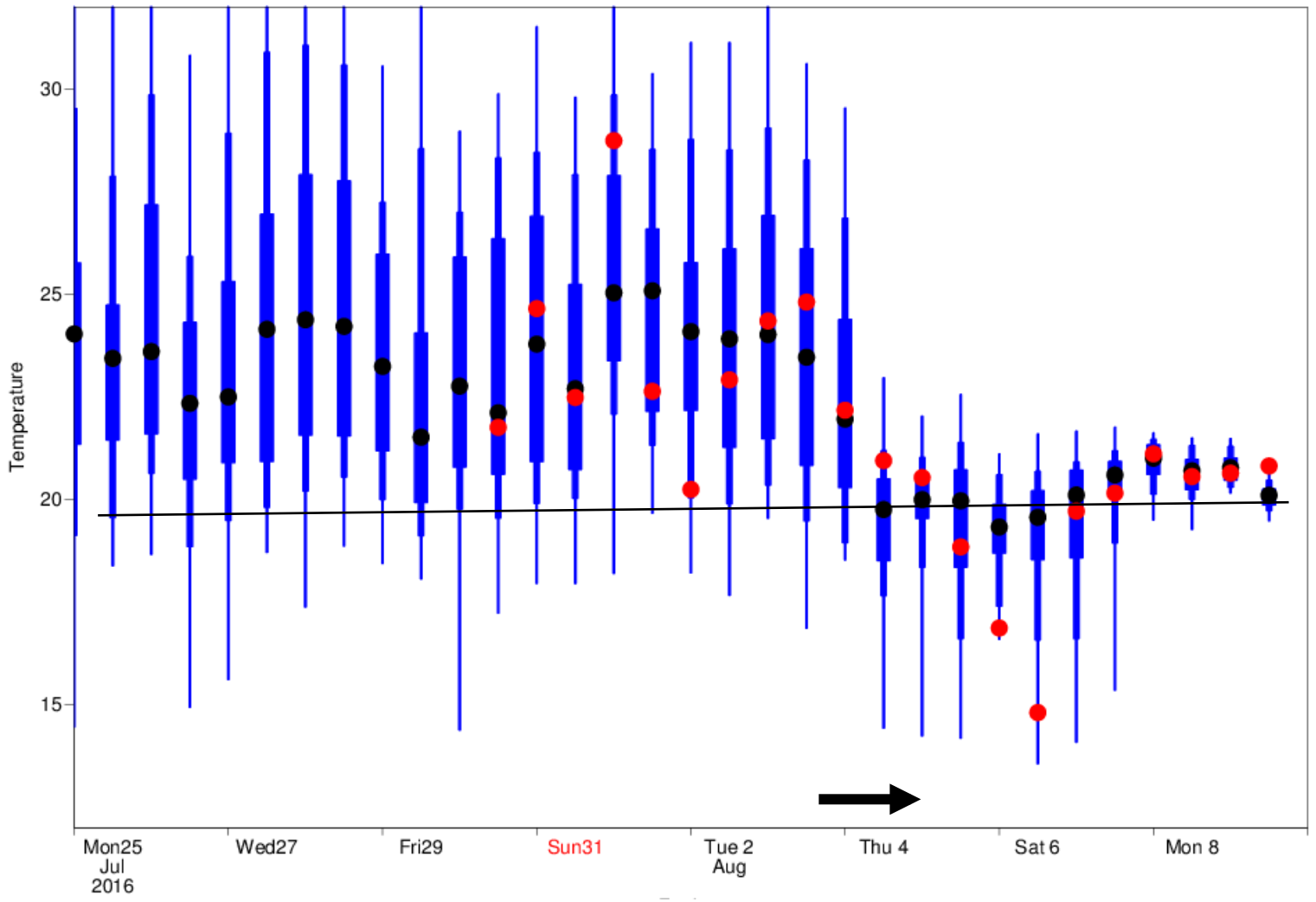


Weekly mean Geop. 500



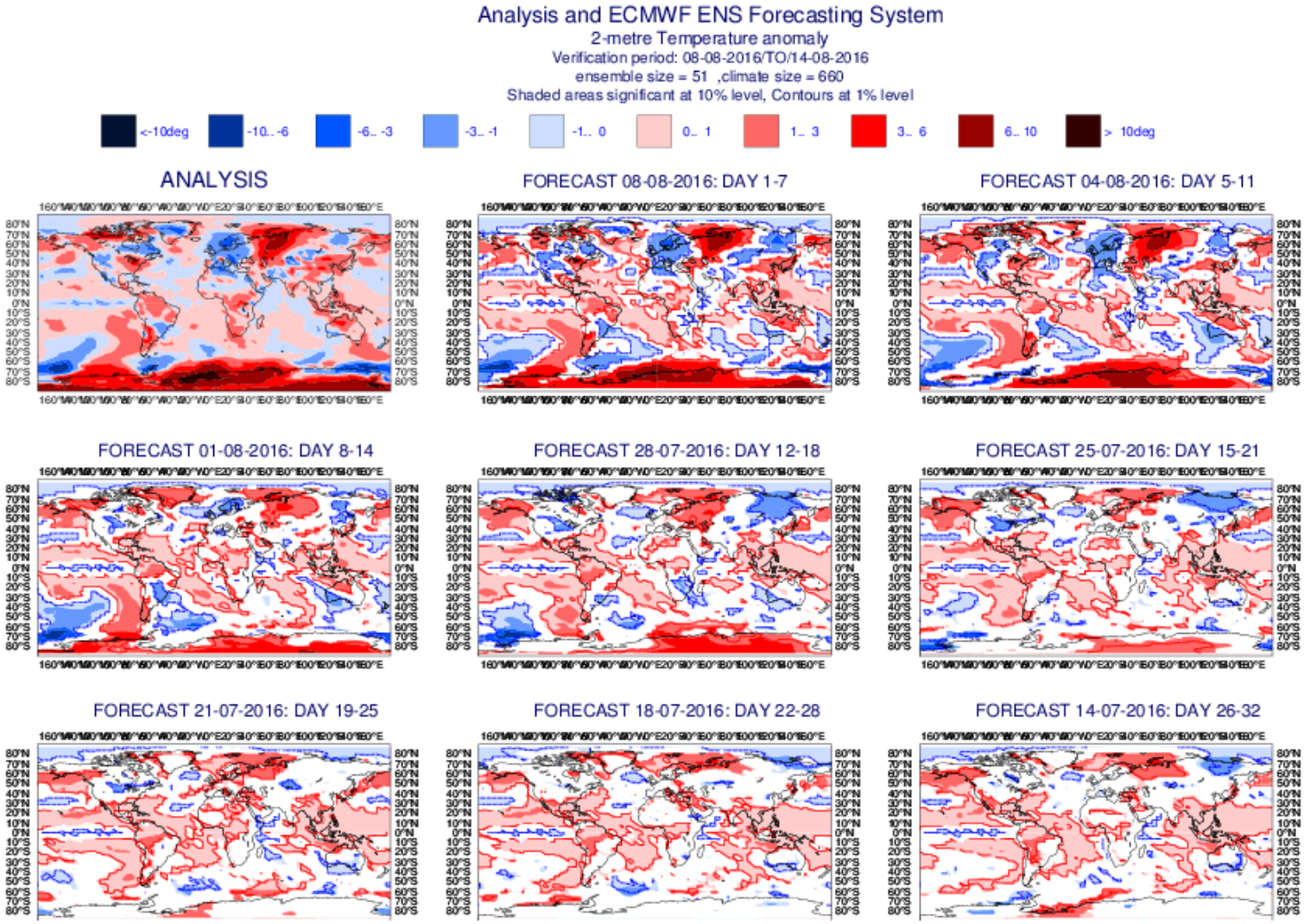

ECMWF Ensemble forecasts for FINLAND - HELSINKI
Location: 60.32°N 24.97°E
Base Time: Thursday 3 November 2016 00 UTC
Extremes
12.5-87.5%
25-75%
37.5-62.5%
Median
Temperature at 850 hPa (C) - Ensemble distribution
Total Precipitation (mm) - Ensemble distribution
Geopotential at 500 hPa (dam) - Ensemble distribution

2-metre temperature Paris 9 August 12z

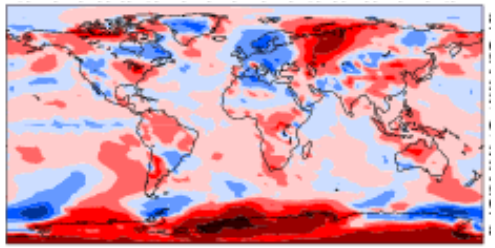


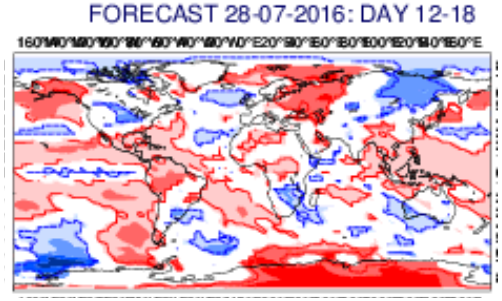
From Linus ‘s weather discussion 2016-08-12

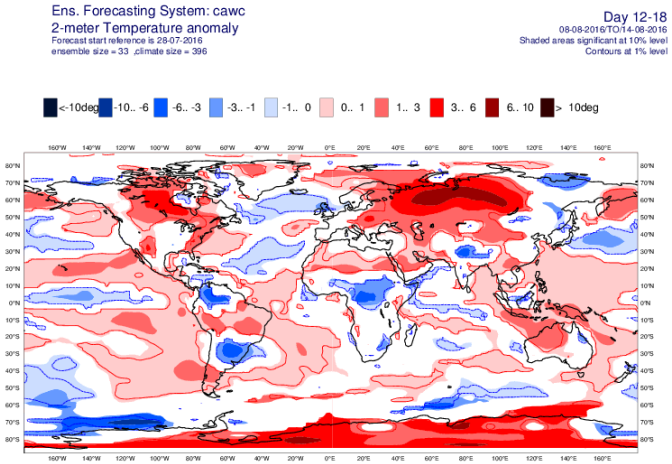
ECMWF

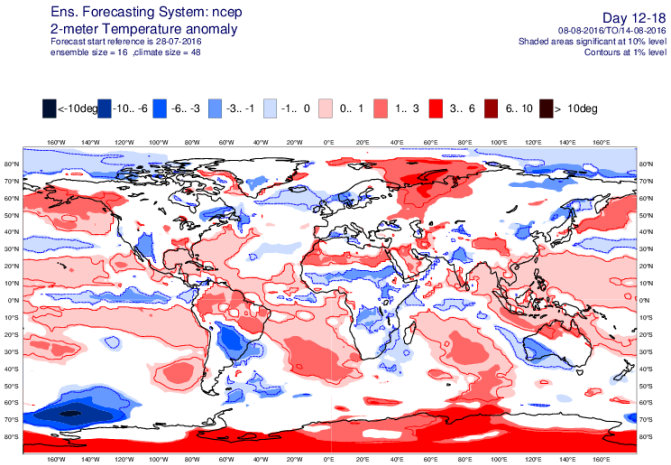

Analysis and ECMWF ENS Forecasting System
2-metre Temperature anomaly
Verification period: 08-08-2016/TO/14-08-2016
ensemble size = 51 ,climate size = 660
Shaded areas significant at 10% level, Contours at 1% level
<-10deg
-10.. -6
-6.. -3
-3.. -1
-1.. 0
0.. 1
1.. 3
3.. 6
6.. 10
> 10deg
ANALYSIS
FORECAST 08-08-2016: DAY 1-7
FORECAST 04-08-2016: DAY 5-11
FORECAST 01-08-2016: DAY 8-14
FORECAST 28-07-2016: DAY 12-18
FORECAST 25-07-2016: DAY 15-21
FORECAST 21-07-2016: DAY 19-25
FORECAST 18-07-2016: DAY 22-28
FORECAST 14-07-2016: DAY 26-32

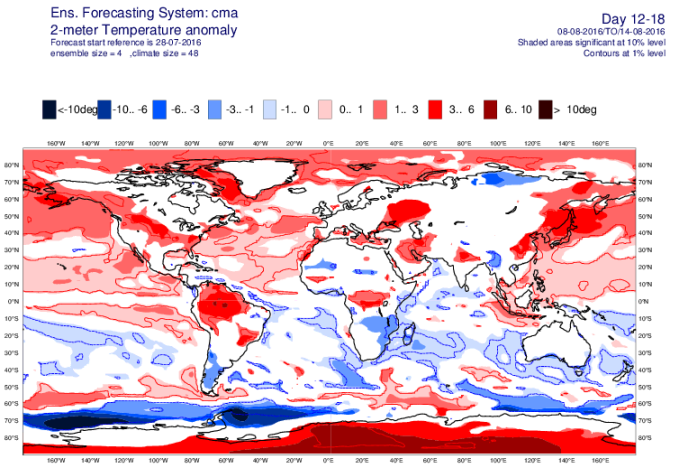
S2S products:

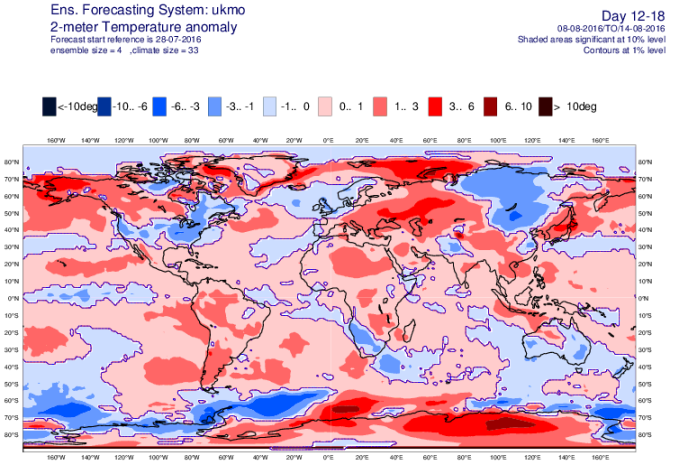


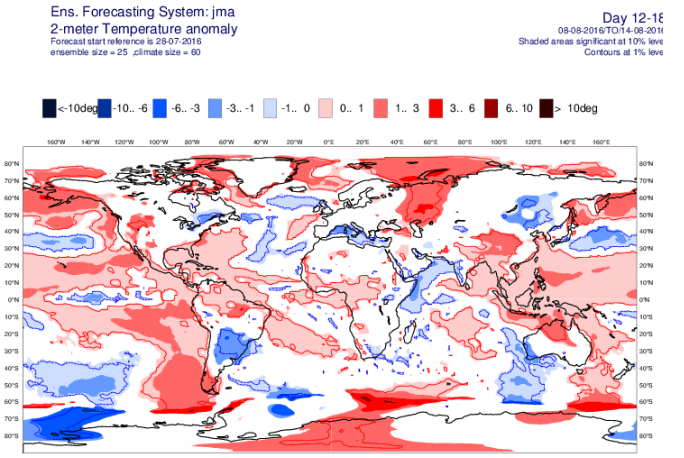






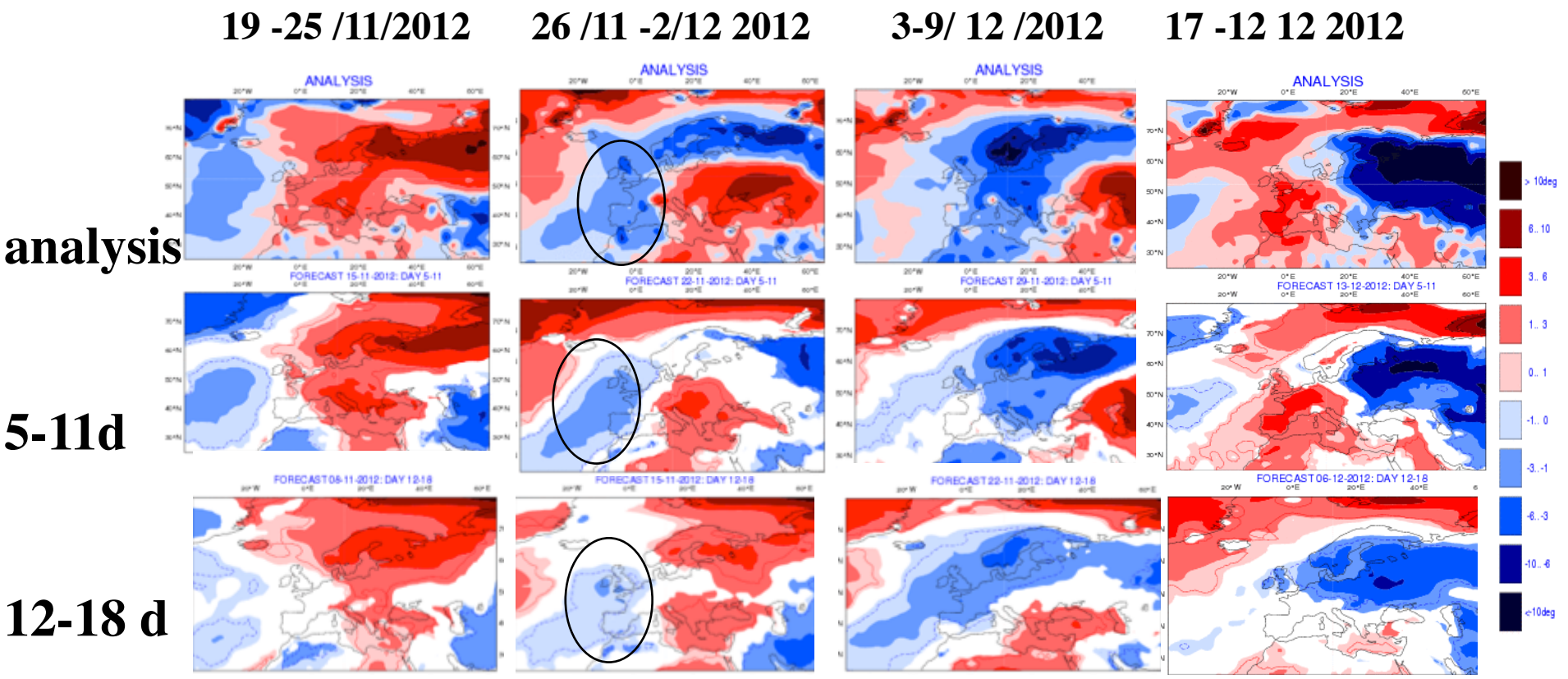






http://www.ecmwf.int/en/research/projects/s2s/charts/s2s

Cold spell over Europe Nov-Dec 2012

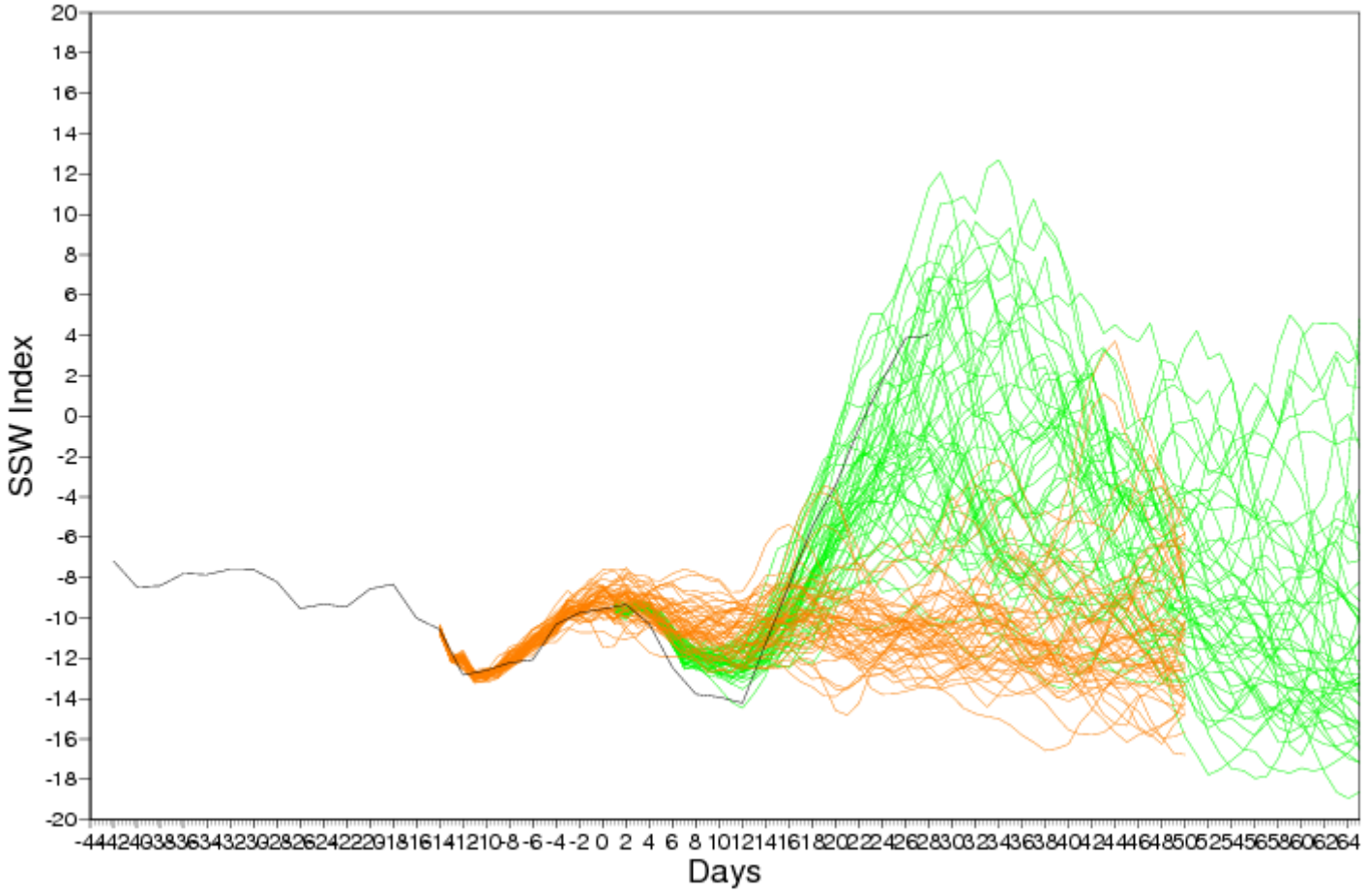


Cold Weather over Europe: SSW Index

Forecast starting on :

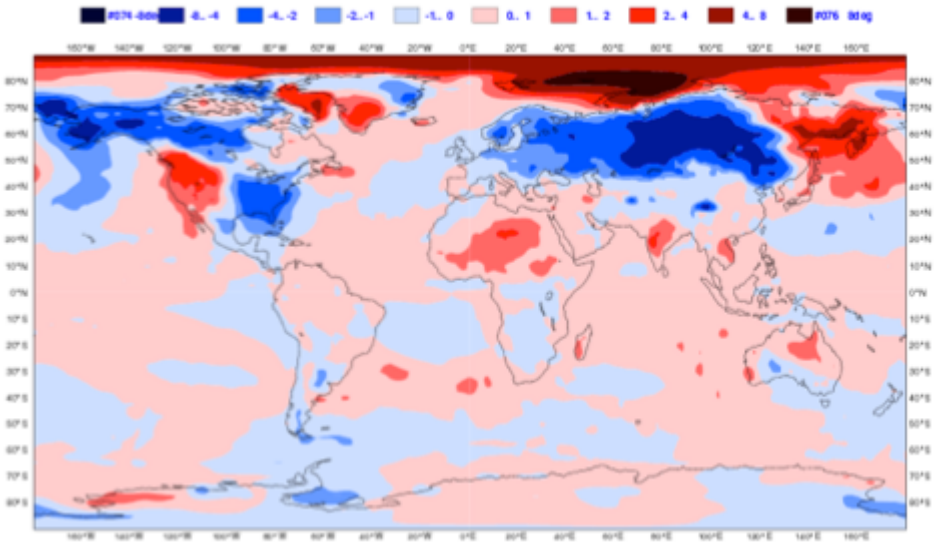
22/11/2012

15/11/2012

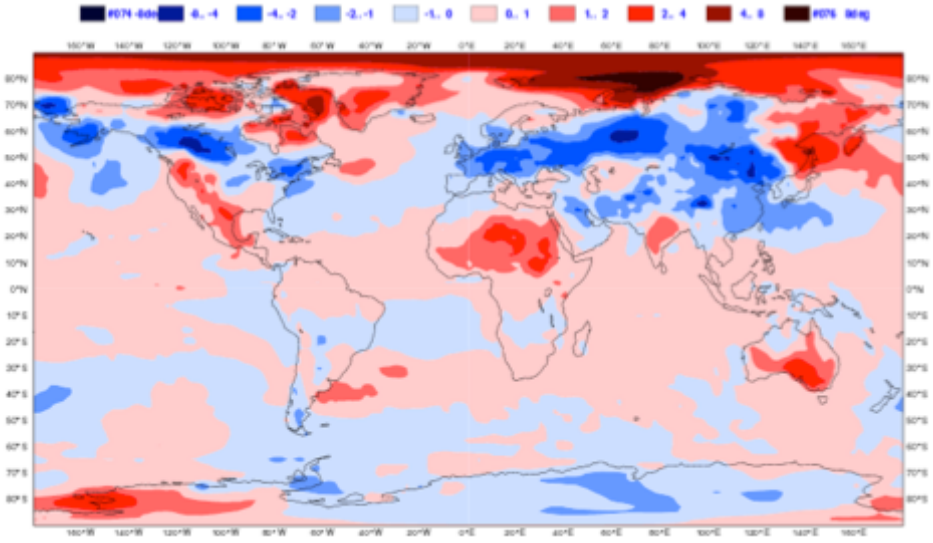


Cold Weather over Europe
SSW Index - Forecast starting on 22/11/2012

Strong SSW



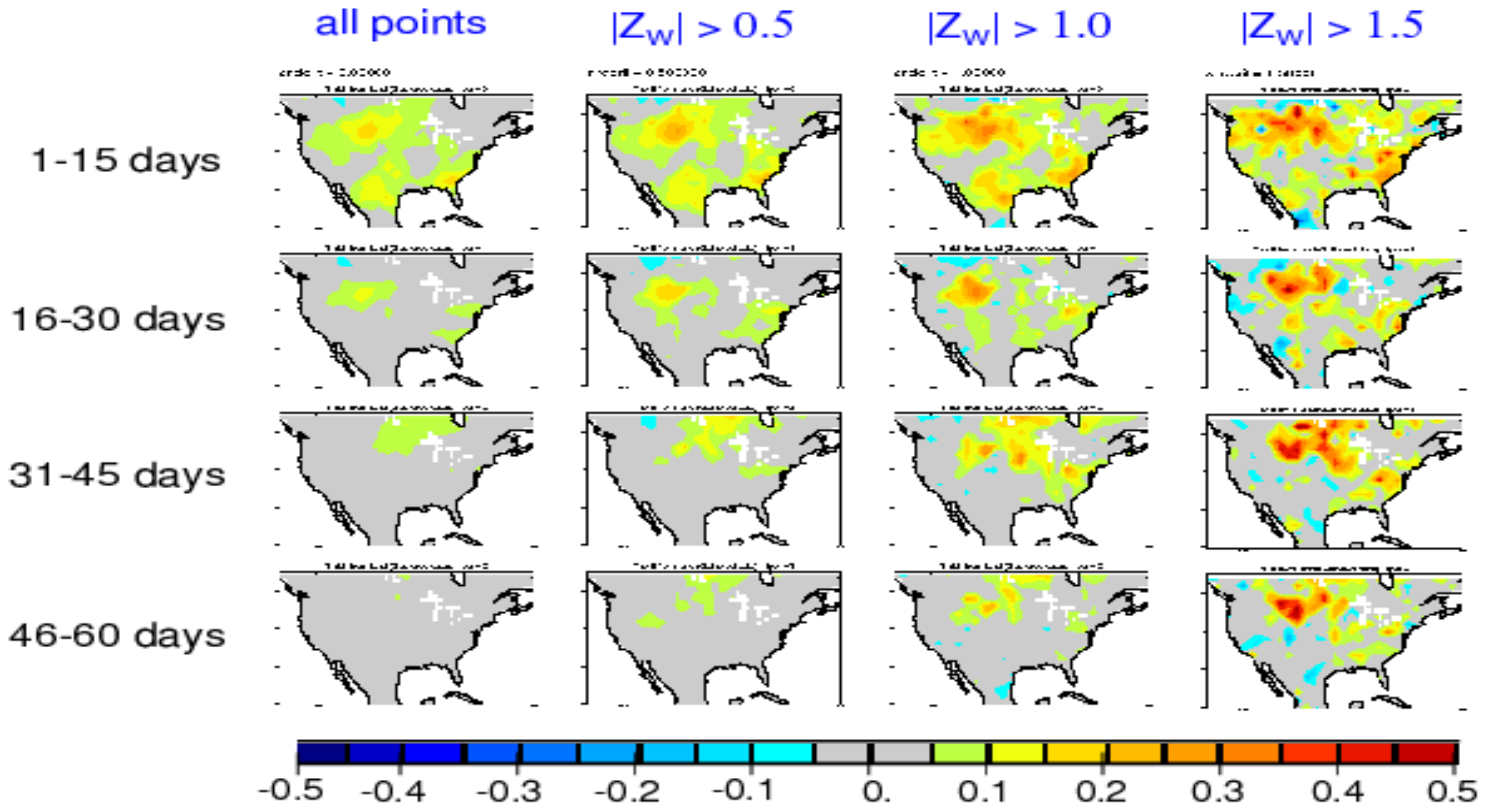
Weak SSW



ECMWF

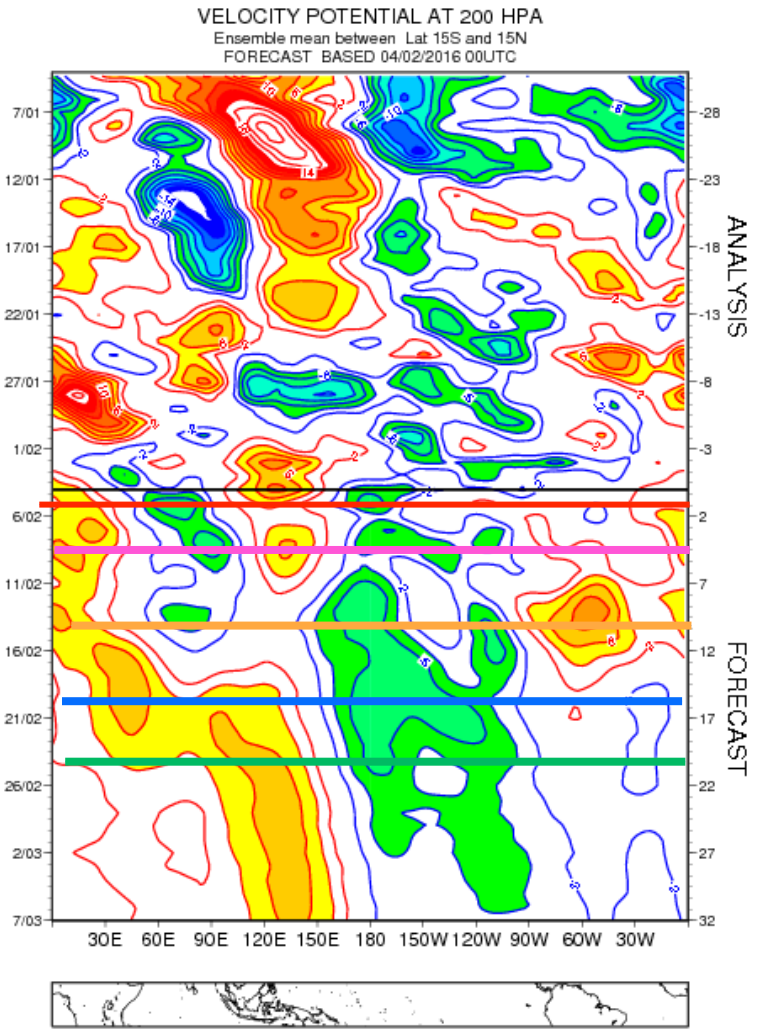
Impact of soil moisture:

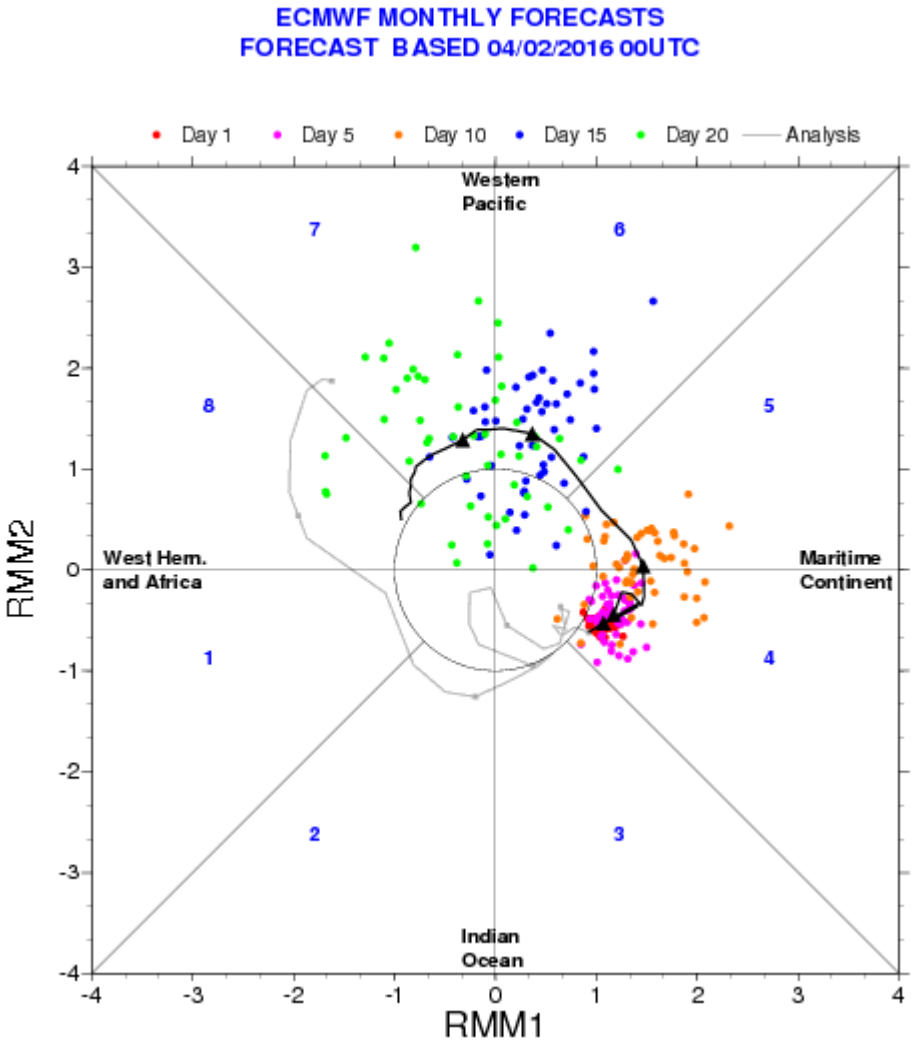
Temperature forecasts: Increase in skill due to land initialization (JJA)
(conditioned on Z-score of initial soil moisture anomaly)

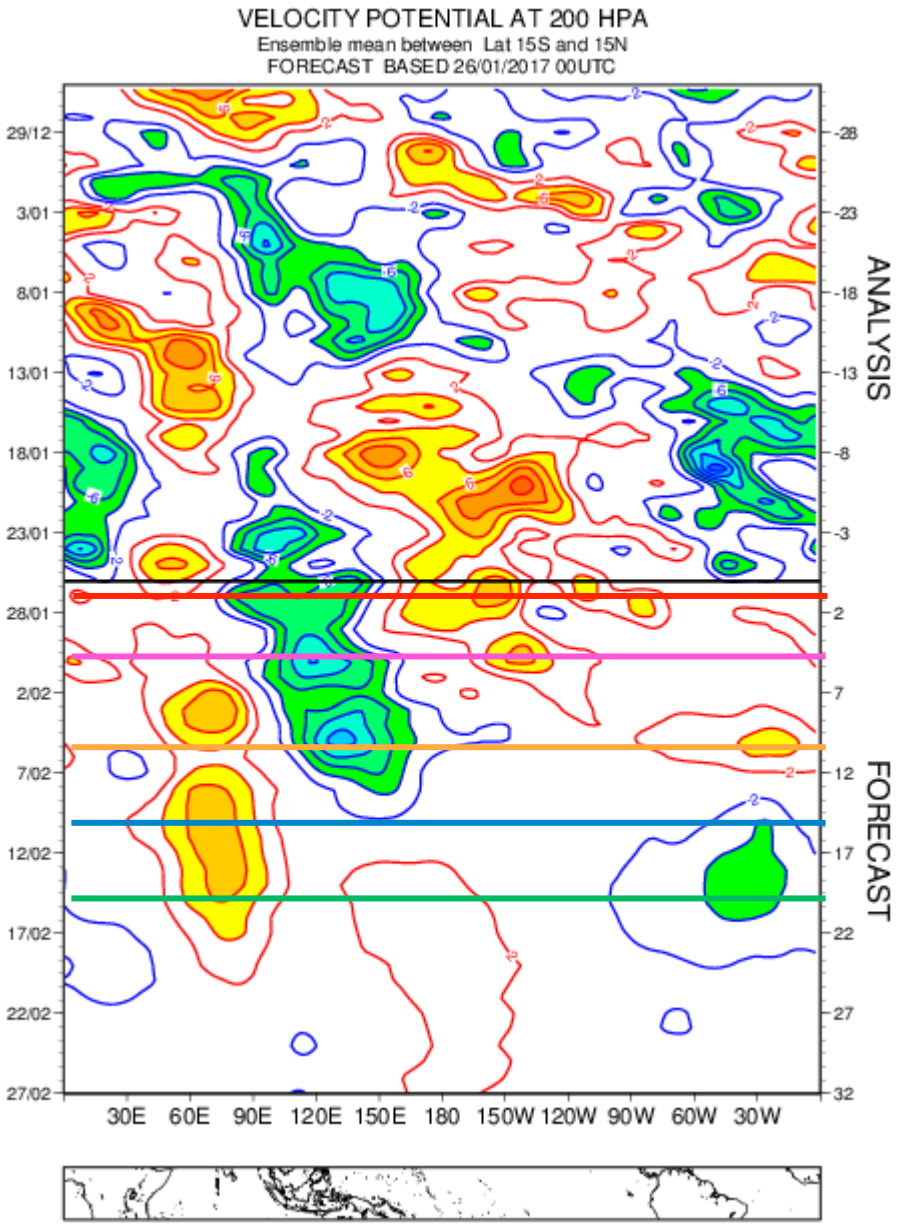


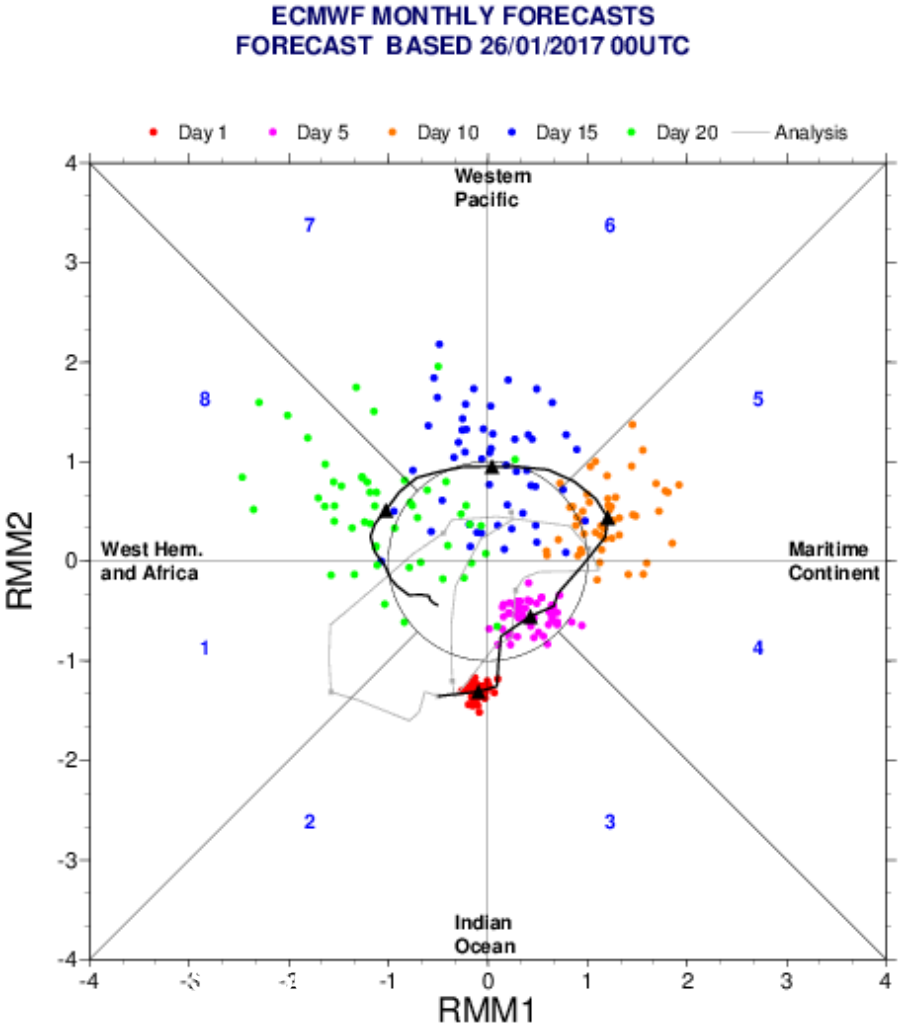
Koster et al, GRL 2010

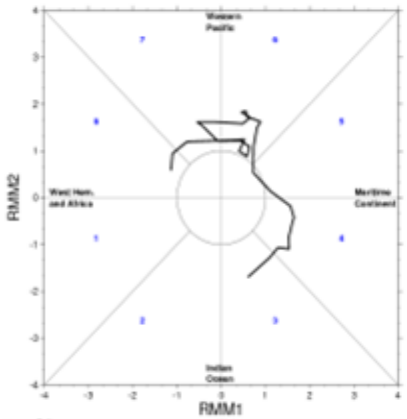
MJO forecast:

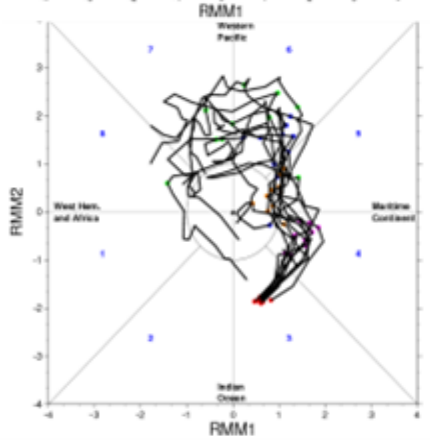


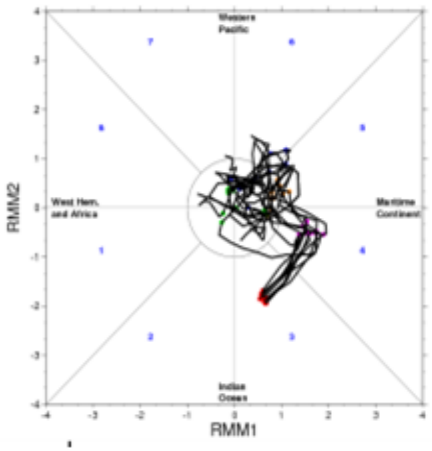



VELOCITY POTENTIAL AT 200 HPA
Ensemble mean between Lat 15S and 15N
FORECAST BASED 26/01/2017 00UTC
29/12
3/01
8/01
13/01
18/01
23/01
28/01
2/02
7/02
12/02
17/02
22/02
27/02
-28
-23
-18
-13
-8
-3
2
7
12
17
22
27
32
ANALYSIS
FORECAST
30E 60E 90E 120E 150E 180 150W 120W 90W 60W 30W

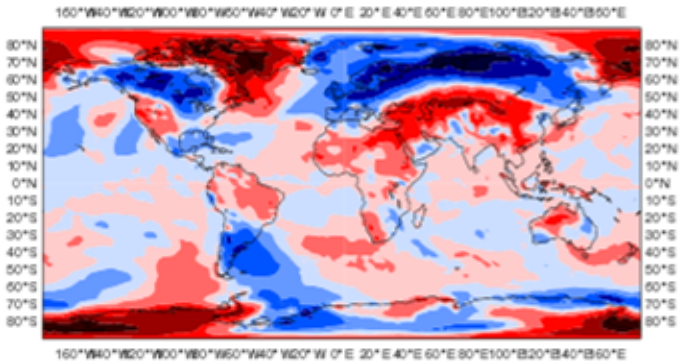

ECMWF MONTHLY FORECASTS
FORECAST BASED 26/01/2017 00UTC
Day 1
Day 5
Day 10
Day 15
Day 20
Analysis
Western Pacific
Maritime Continent
West Hem. and Africa
Indian Ocean
1
2
3
4
5
6
7
8
RMM1
RMM2



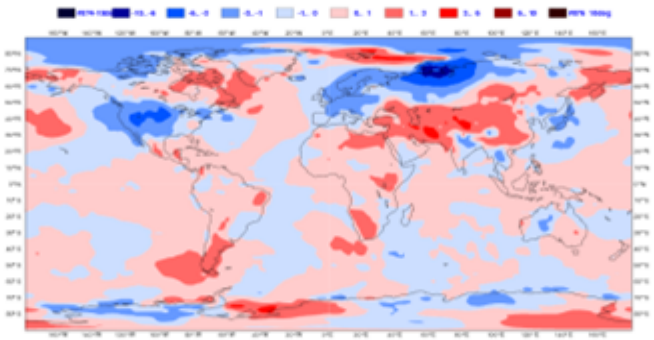




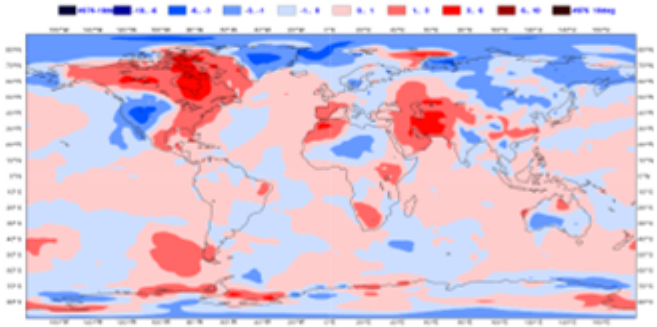
Cold March 2013 – 14 Feb 2013 -Day 26-32



Analysis

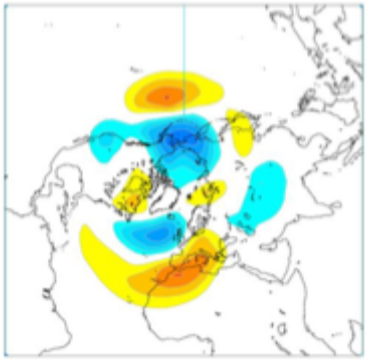


10 best MJO forecasts

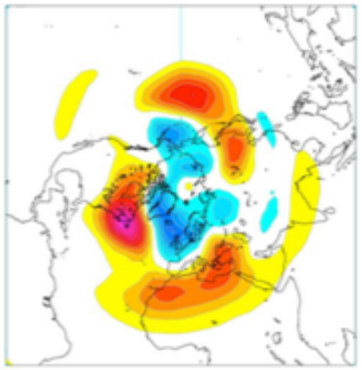


10 worse MJO forecasts

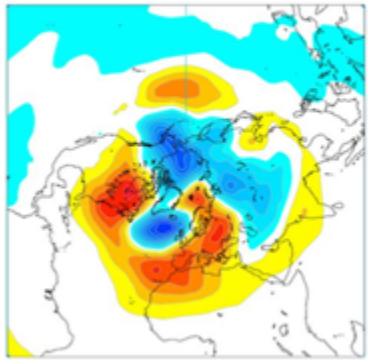
2002 MOFC hindcasts



2013 MOFC hindcasts



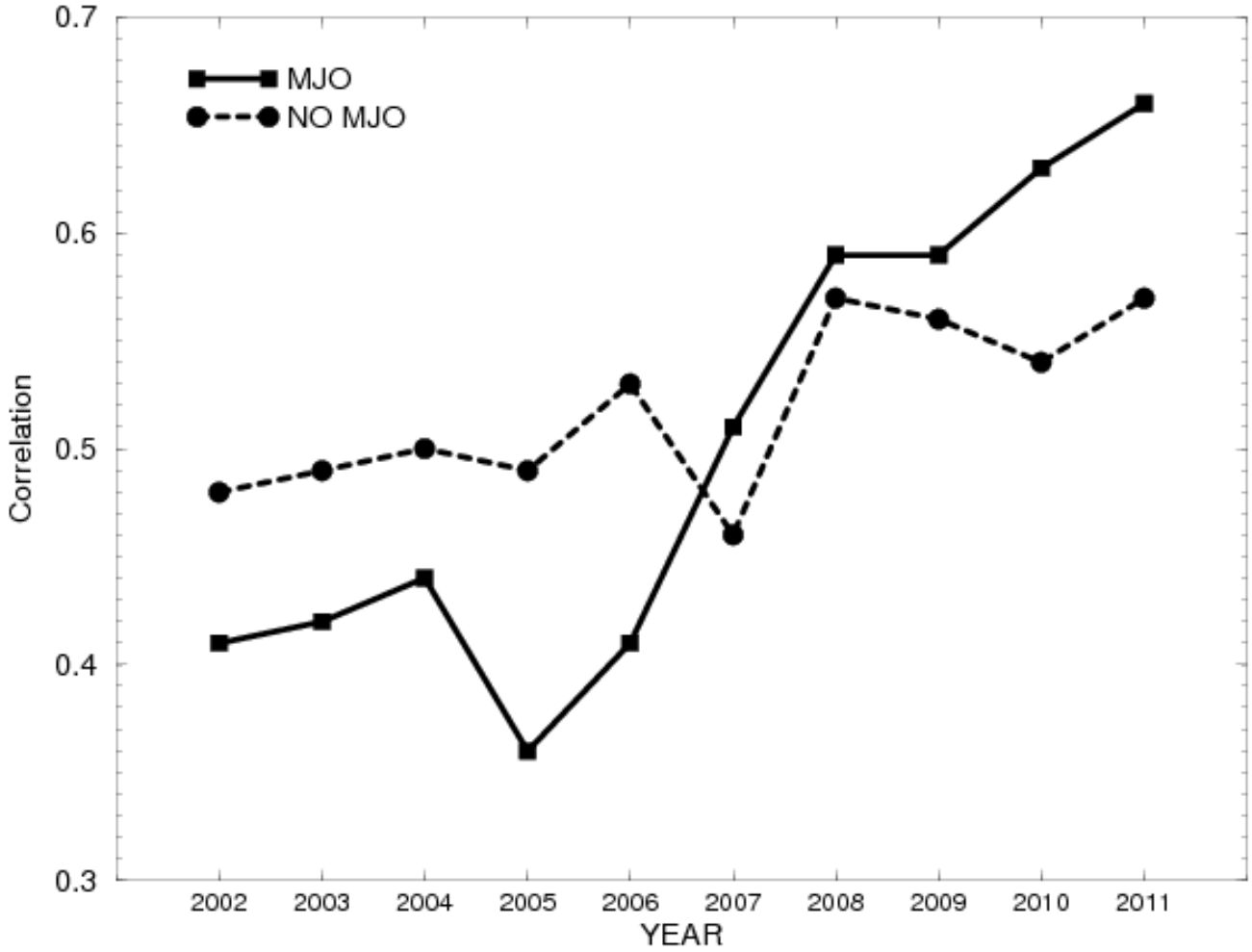
ERA Interim



MJO Teleconnections

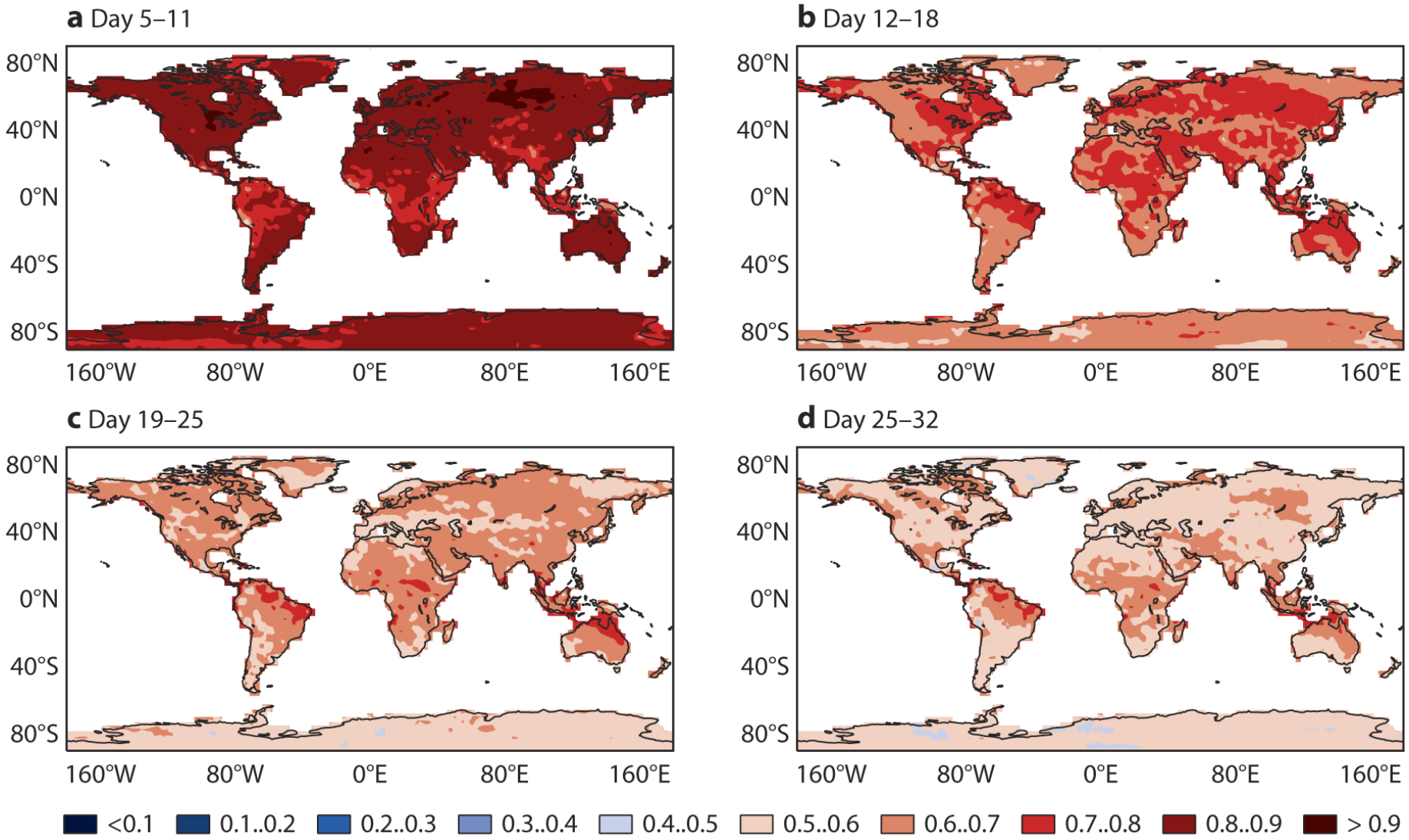
Evolution of NAO skill scores day 19-25

NAO index is computed as projection onto a reference pattern

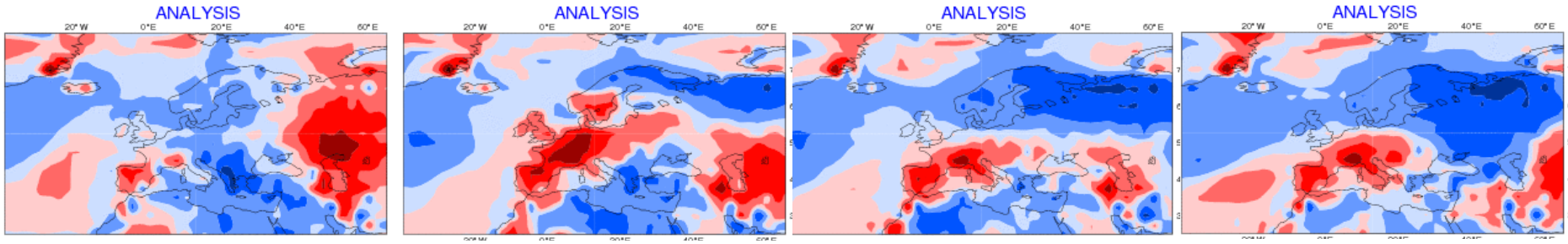


ROC for 2mt in the upper tercile

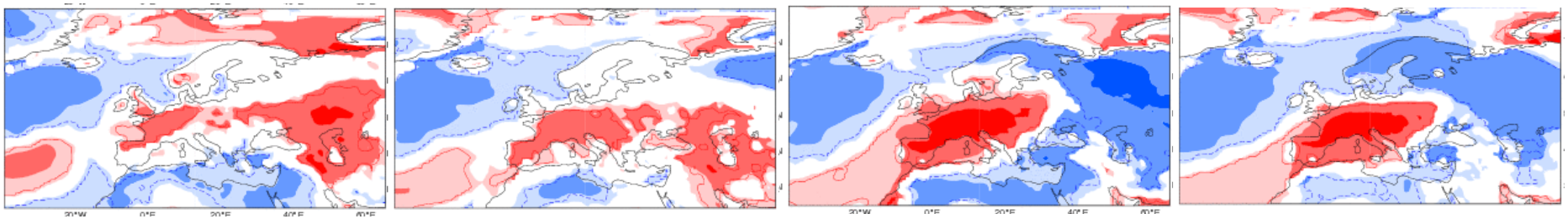
since Oct 2004



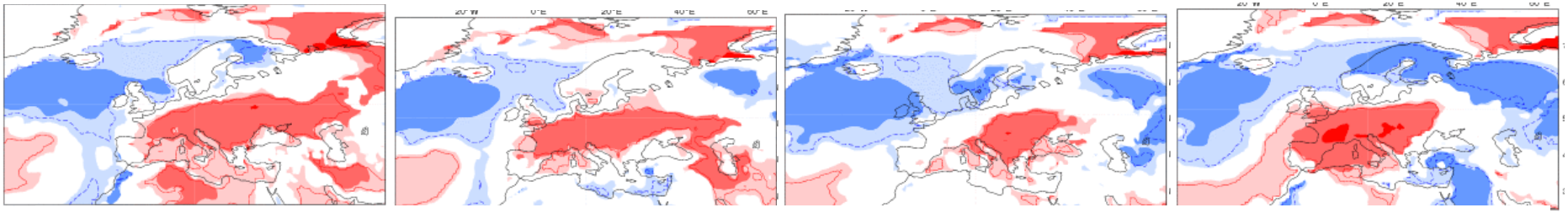
Heat wave over Central-southern Europe: 2mt weekly mean anomalies



22-28 Jun 29-5Jul 6-12Jul 13-19Jul



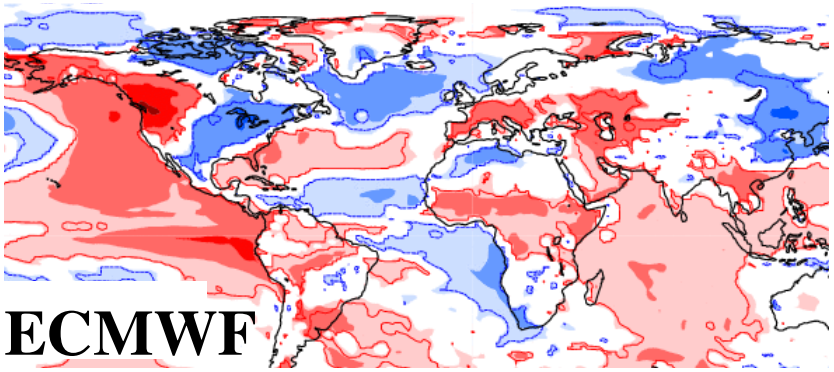
Forecasts: 12-18 days

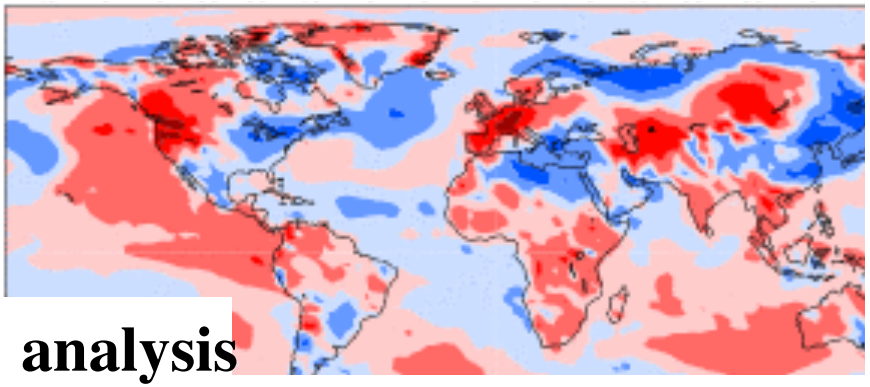


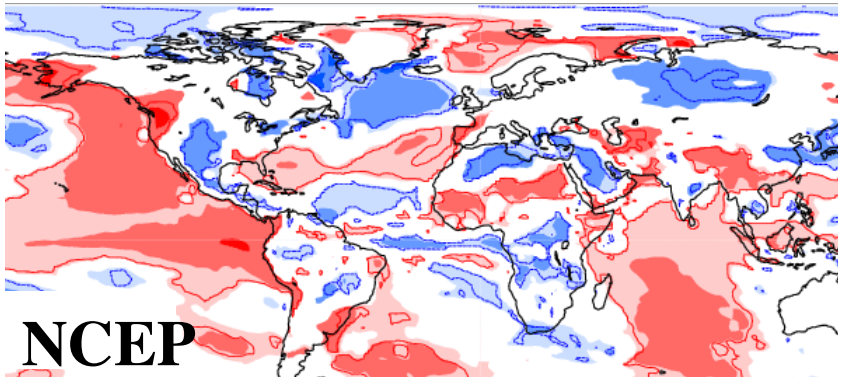
Forecasts: 19-25 days

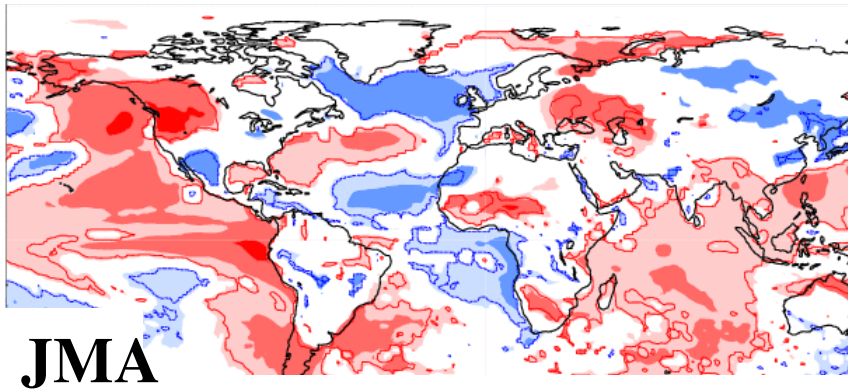
S2S 2mt anomalies:

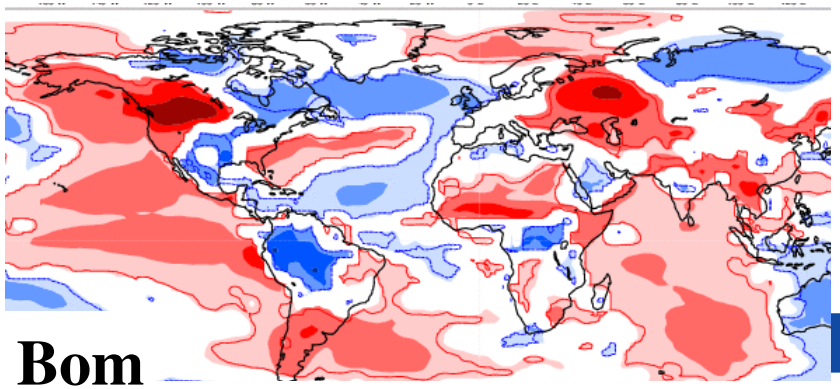
days 12-18 - verifying 29-06 to 05-07 2015

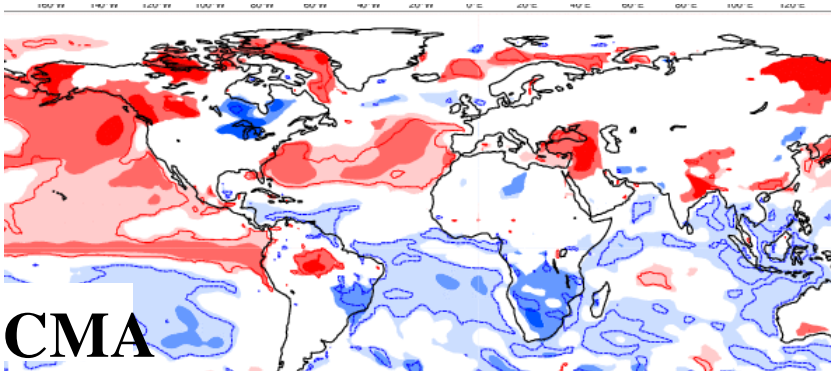












The Sub-seasonal to Seasonal (S2S) Prediction Project

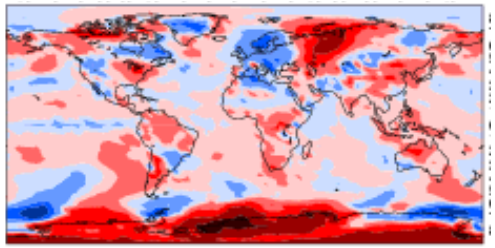
- improve forecast skill and understanding on the sub-seasonal to seasonal time scale

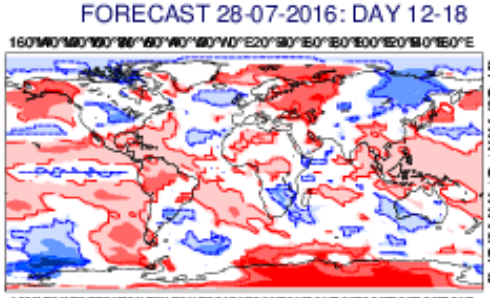
- promote its uptake by operational centres and exploitation by the applications community

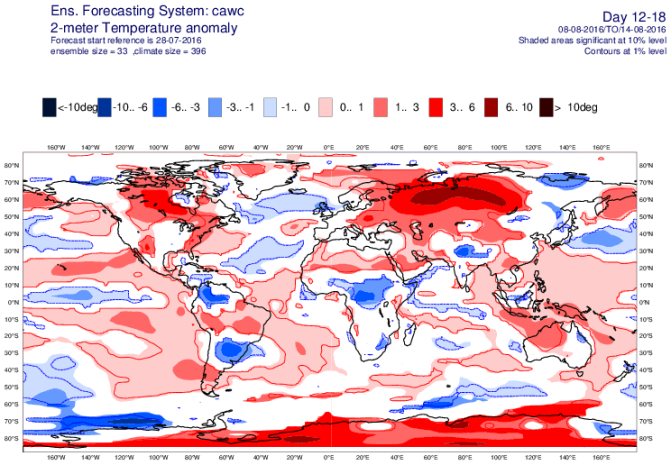
- special emphasis on high-impact weather events

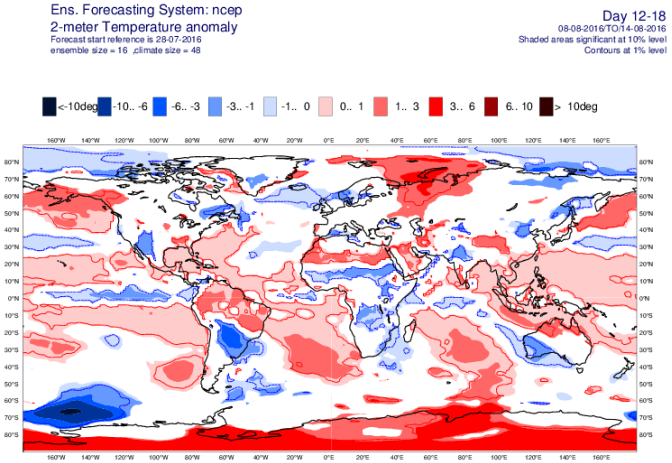
- S2S data is available to everyone https://software.ecmwf.int/wiki/display/S2S/Models

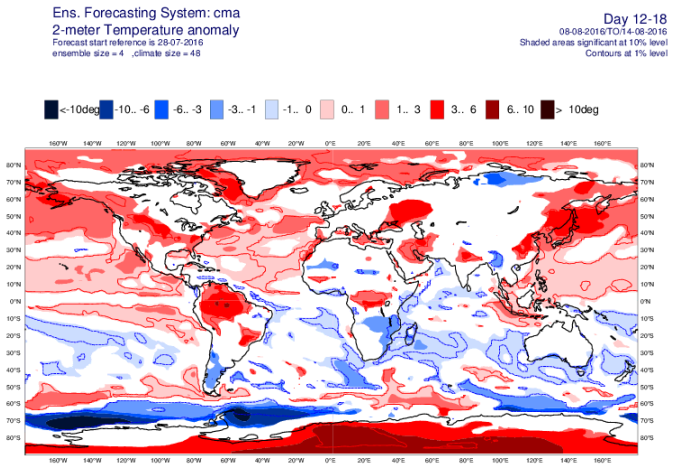
S2S products:

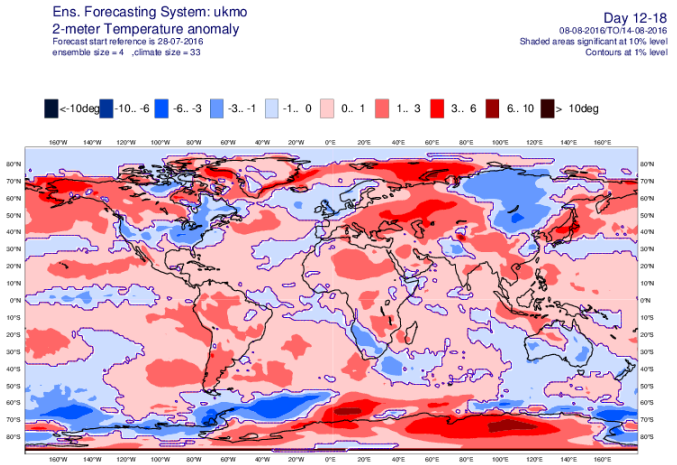


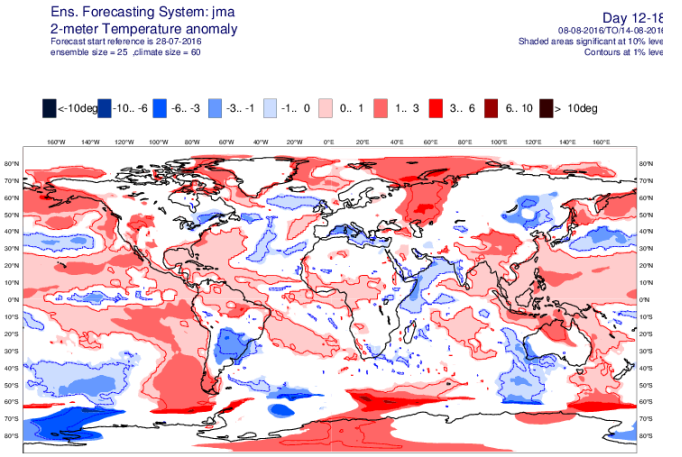










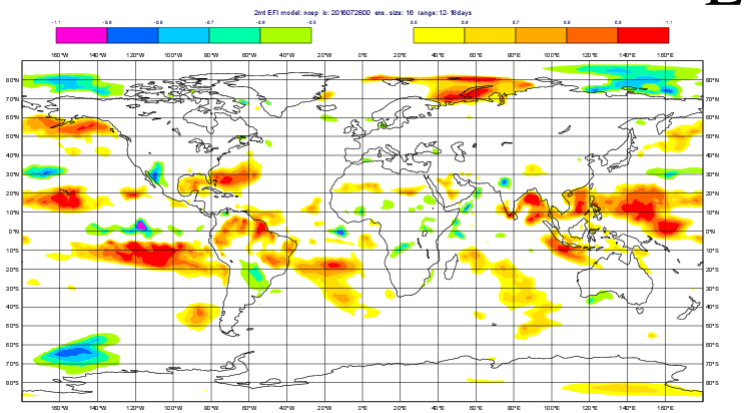


http://www.ecmwf.int/en/research/projects/s2s/charts/s2s

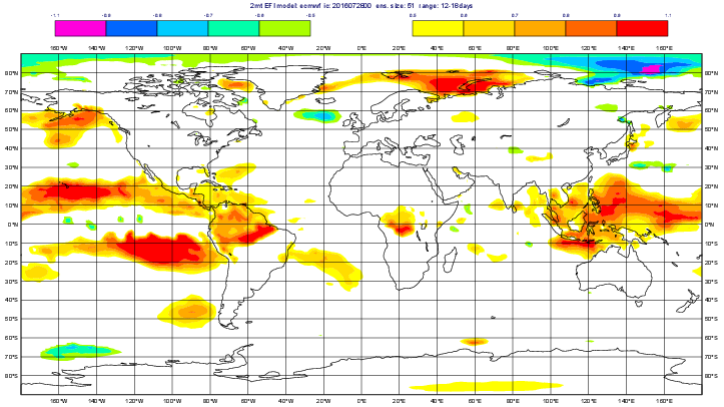
S2S products: 2m temp EFI forecast range:12-18days verifying 8-14 August 2016

3 weeks of delay

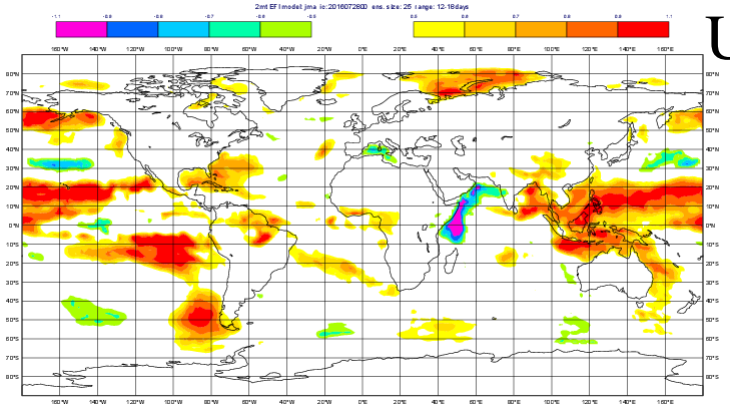
Ncep



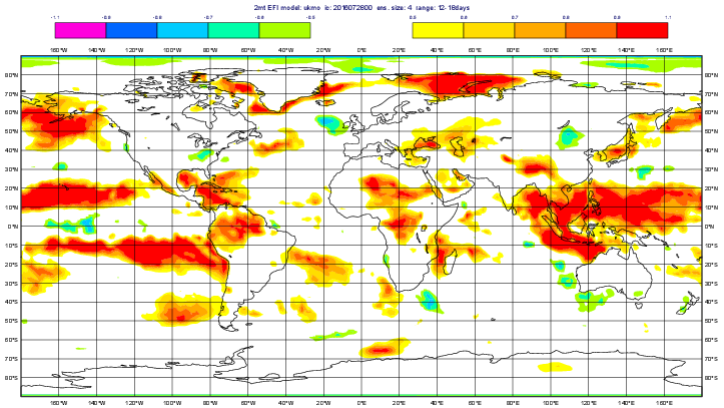
Ecmwf



Jma



Ukmo



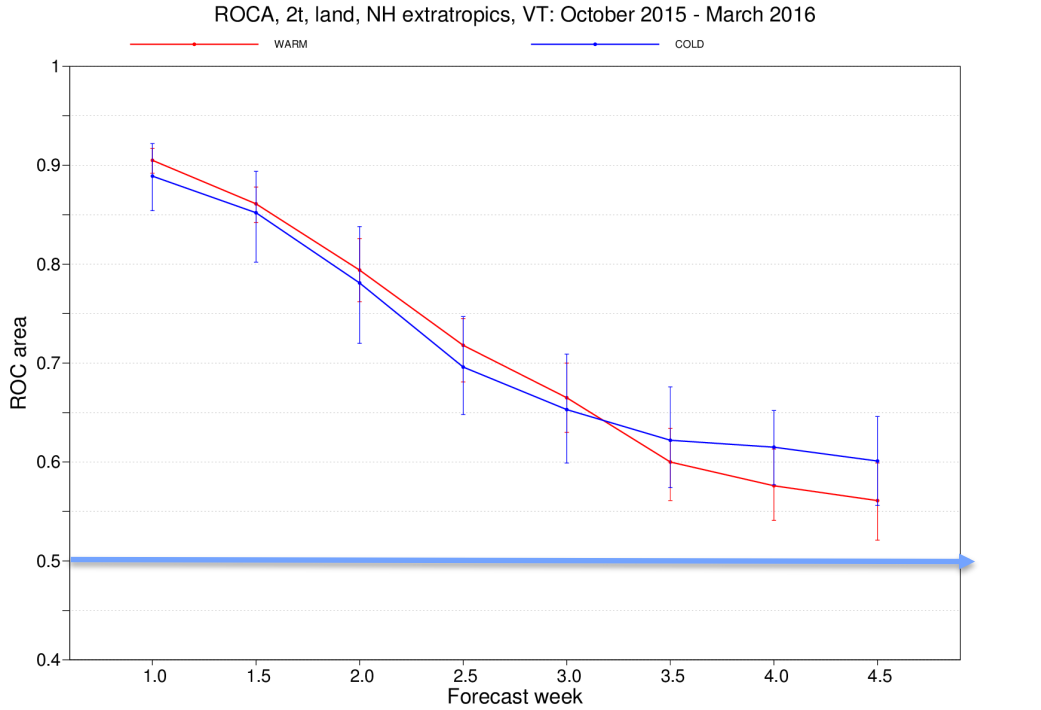
http://www.ecmwf.int/en/research/projects/s2s/charts/s2s/

TIGGE-S2S database

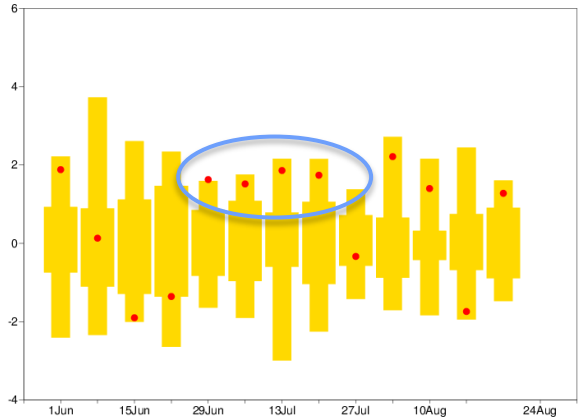
Sub-seasonal real-time Operational Forecasts

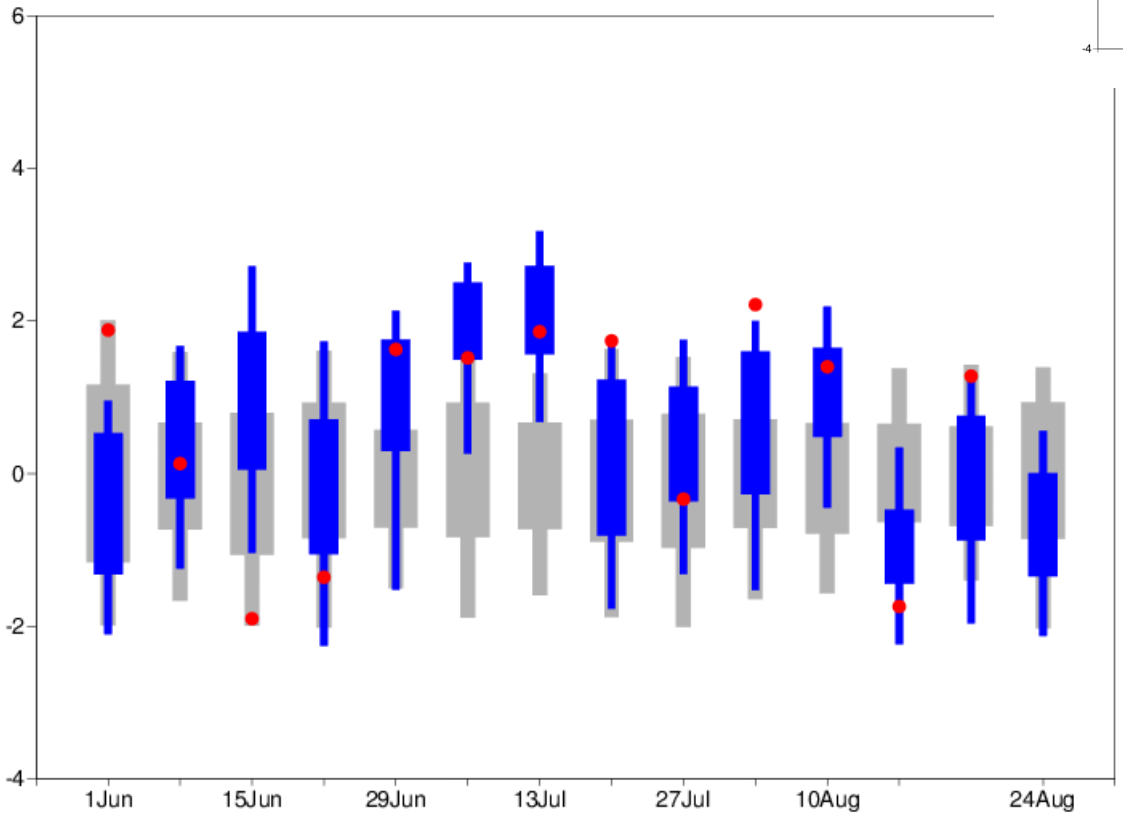
	Time-range	Resol.	Ens. Size	Freq.	Hcsts	Hcst length	Hcst Freq	Hcst Size
ECMWF	D 0-32	T639/319L62	51	2/week	On the fly	Past 18y	weekly	5
UKMO	D 0-60	N96L85	4	daily	On the fly	1989-2003	4/month	3
NCEP	D 0-60	N126L64	16	daily	Fix	1999-2010	daily	4
EC	D 0-35	0.6x0.6L40	21	weekly	On the fly	Past 15y	weekly	4
CAWCR	D 0-120	T47L17	33	weekly	Fix	1989-2010	3/month	33
JMA	D 0-34	T159L60	50	weekly	Fix	1979-2009	3/month	5
KMA	D 0-30	T106L21	20	3/month	Fix	1979-2010	3/month	10
CMA	D 0-45	T63L16	40	6/month	Fix	1982-now	monthly	48
Met.Fr	D 0-60	T63L91	41	monthly	Fix	1981-2005	monthly	11
SAWS	D 0-60	T42L19	6	monthly	Fix	1981-2001	monthly	6
HMCR	D 0-60	1.1x1.4 L28	10	monthly	Fix	1979-2003	monthly	10

EFI skill assessment
Preliminary results based on ECMWF system:

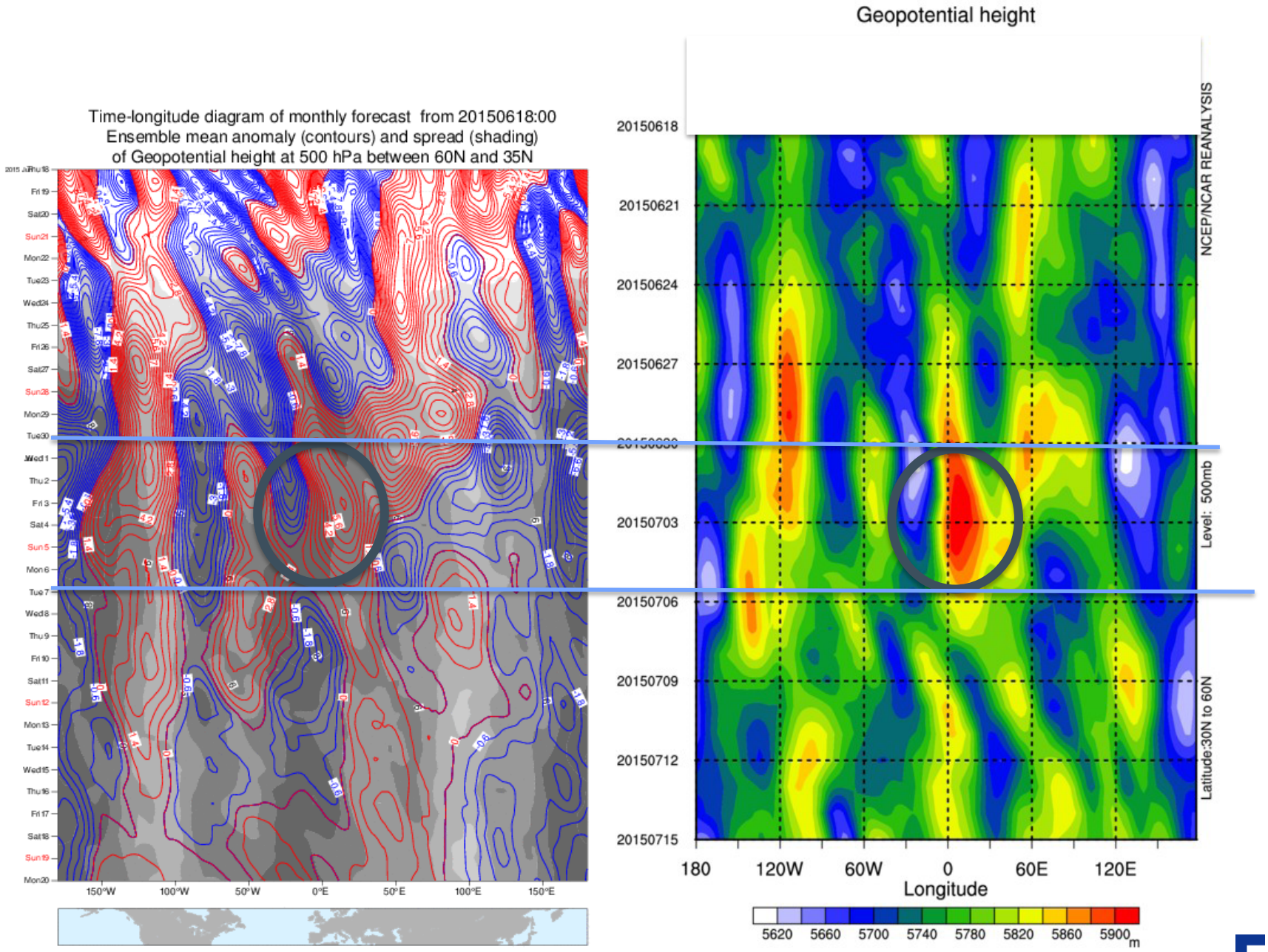


weekly mean anomalies over Southern Europe: 2mt forecast 12-18



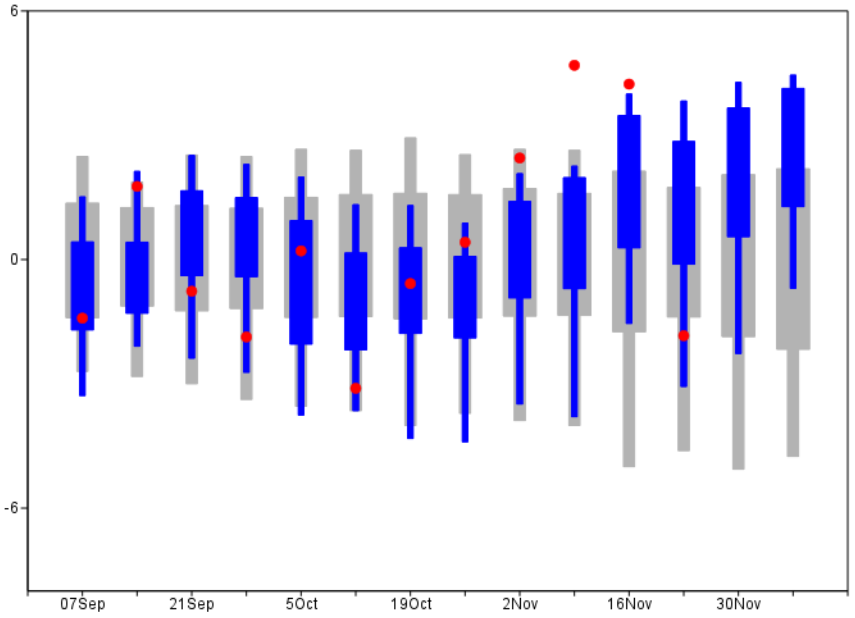


ECMWF

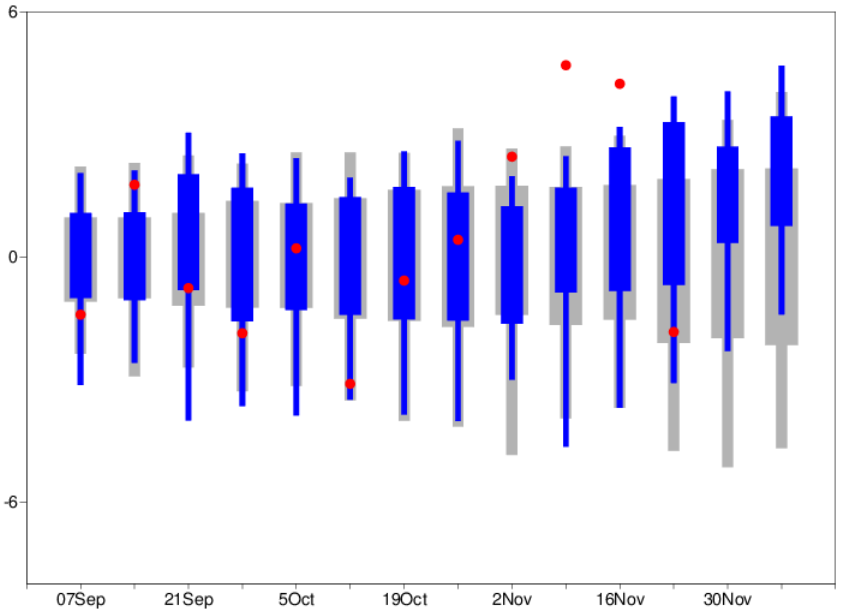

Time-longitude diagram of monthly forecast from 20150618:00
Ensemble mean anomaly (contours) and spread (shading)
of Geopotential height at 500 hPa between 60N and 35N
150°W
100°W
50°W
0°E
50°E
100°E
150°E
Geopotential height
20150618
20150621
20150624
20150627
20150703
20150706
20150709
20150712
20150715
180
120W
60W
0
60E
120E
Longitude
NCEP/NCAR REANALYSIS
Level: 500mb
Latitude:30N to 60N
5620
5660
5700
5740
5780
5820
5860
5900 m

September to December 2015 2m temp weekly anomalies (55-45N 5-15E):

For. range 12-18 days



For. range 19-25 days

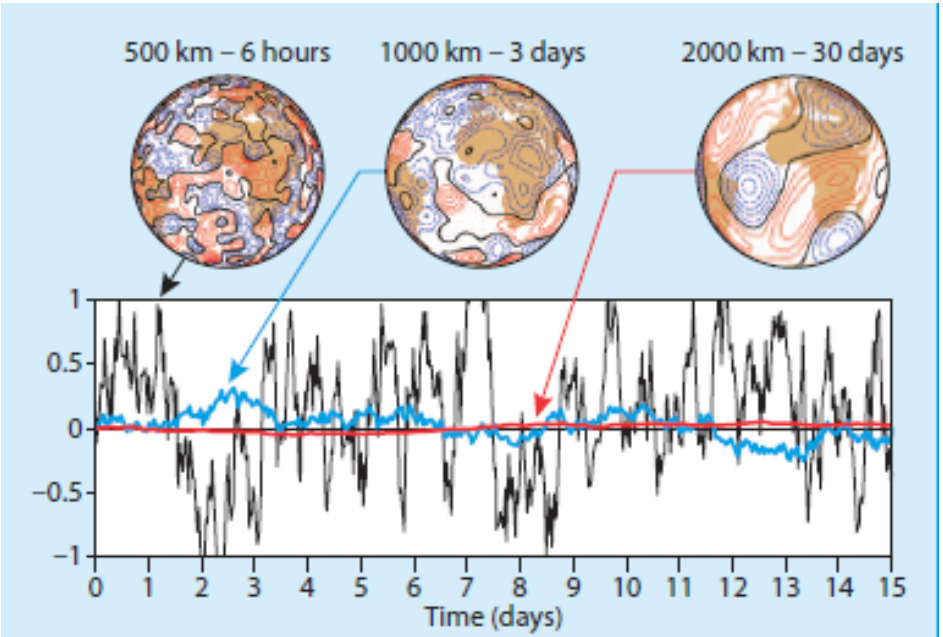


ECMWF

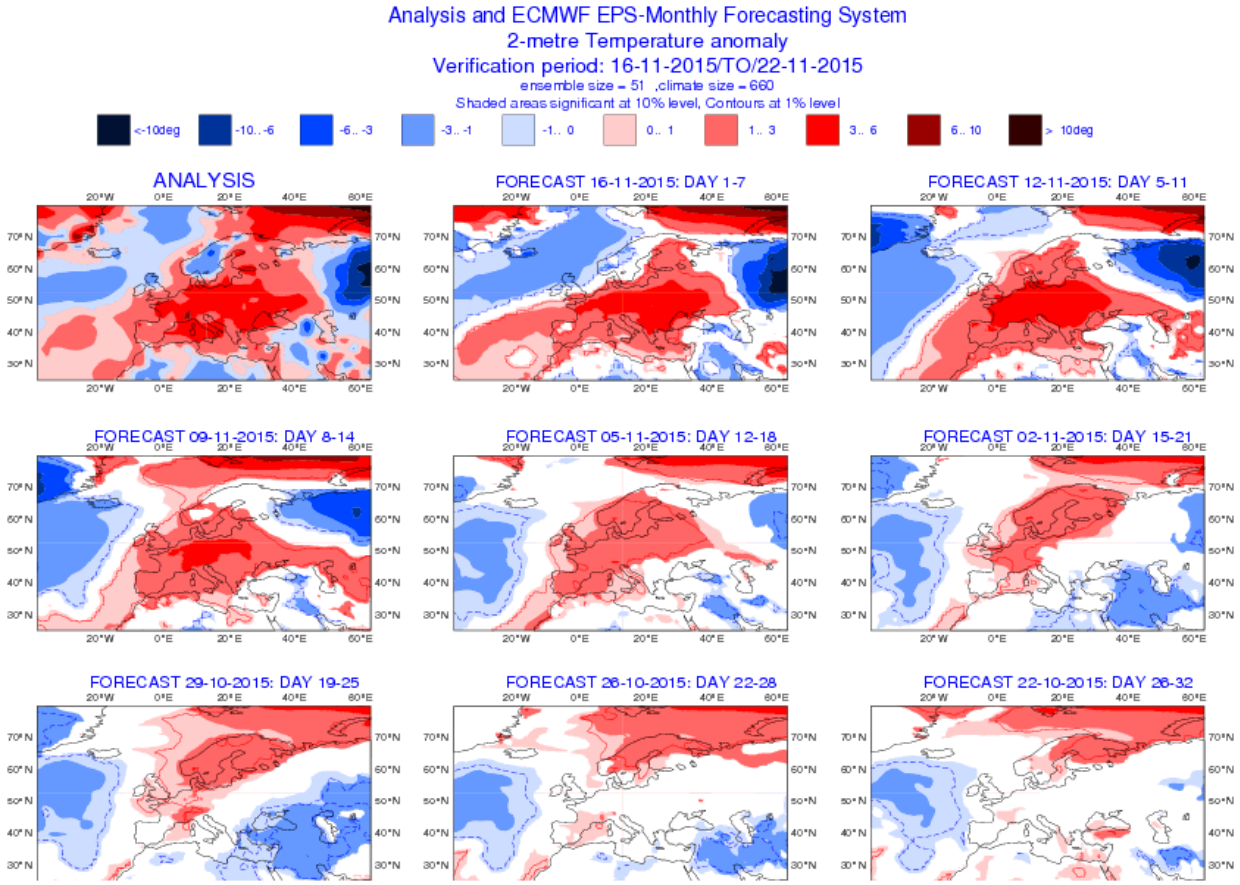
Stochastic Perturbed Parametrization Tendency (SPPT) scheme

Uncertainties in the model physical parametrizations can be a significant source of random error. This led to the development SPPT. It has been used in the since October 1998 there has been an increase in ensemble spread in the EPS and improved probability skill scores.

ECMWF Newletter 129



The three patterns underlying the SPPT3 scheme. The numbers next to the spheres indicate the horizontal spatial and temporal correlation scales in kilometres and hours. The three curves on the graph show time series of the pattern values at a point employed in the operational scheme The colour of the arrows relates the patterns to the time series.

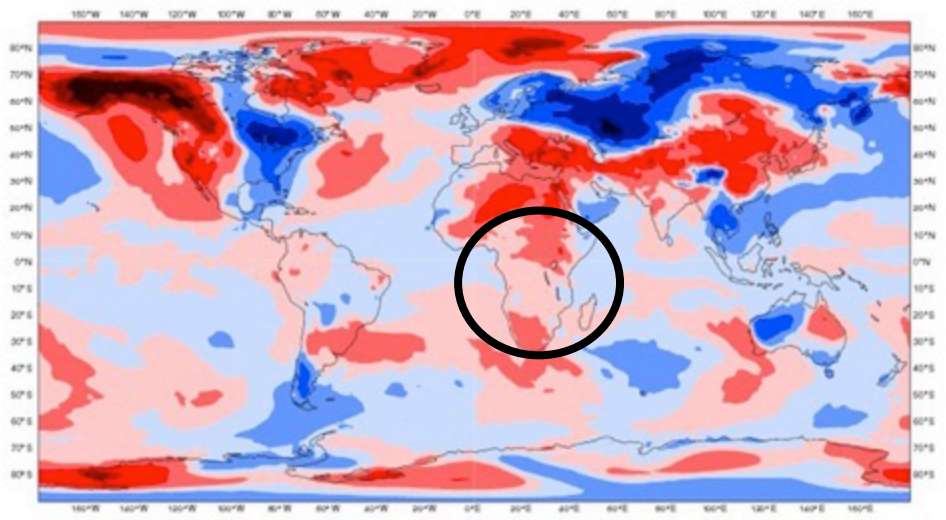

Analysis and ECMWF EPS-Monthly Forecasting System
2-metre Temperature anomaly
Verification period: 16-11-2015/TO/22-11-2015
ensemble size = 51 ,climate size = 660
Shaded areas significant at 10% level, Contours at 1% level
<-10deg
-10.. -6
-6.. -3
-3.. -1
-1.. 0
0.. 1
1.. 3
3.. 6
6.. 10
> 10deg
ANALYSIS
FORECAST 16-11-2015: DAY 1-7
FORECAST 12-11-2015: DAY 5-11
FORECAST 09-11-2015: DAY 8-14
FORECAST 05-11-2015: DAY 12-18
FORECAST 02-11-2015: DAY 15-21
FORECAST 29-10-2015: DAY 19-25
FORECAST 26-10-2015: DAY 22-28
FORECAST 22-10-2015: DAY 26-32

Stochastic backscatter scheme (SKEB)

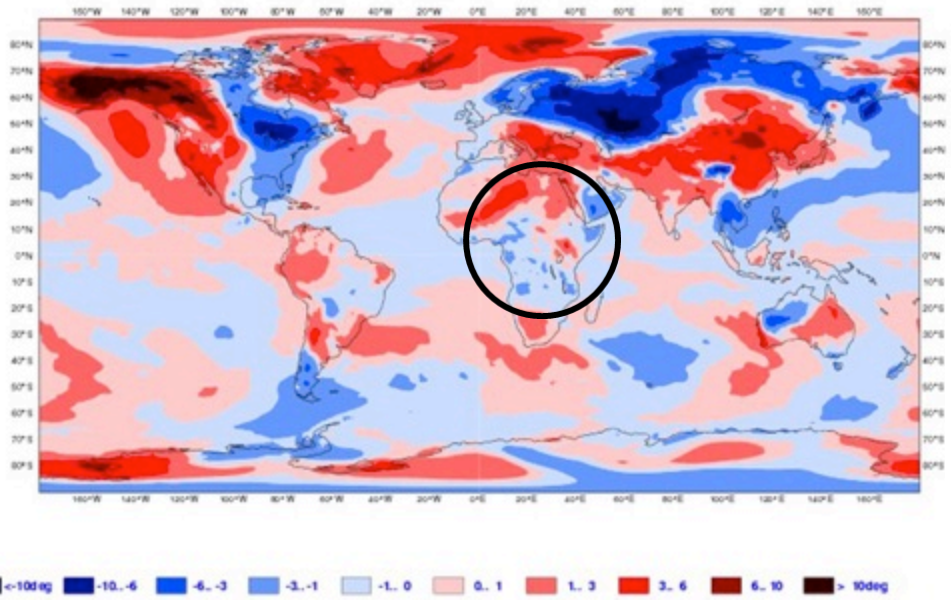
It compensate for the loss of energy in the model due to the Mis-representation of processes at sub-gridscale.

New re-forecast twice a week 11 members

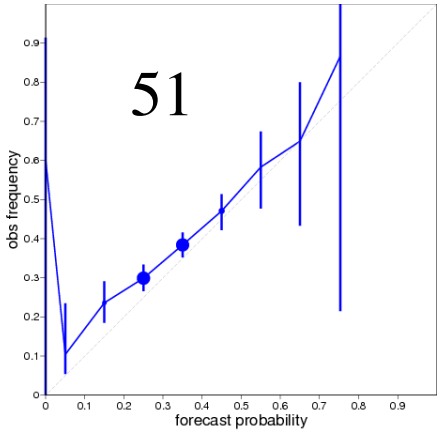
a) Current Re-forecast configuration

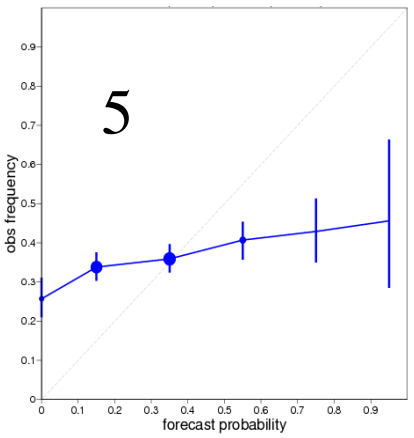


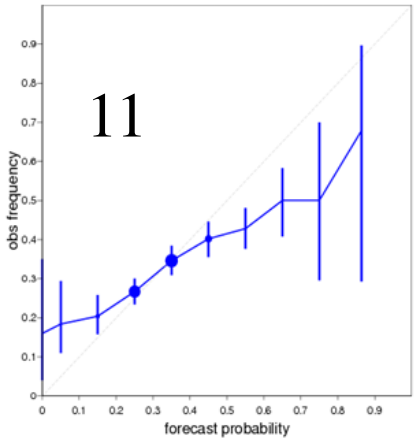
b) New Re-forecast configuration

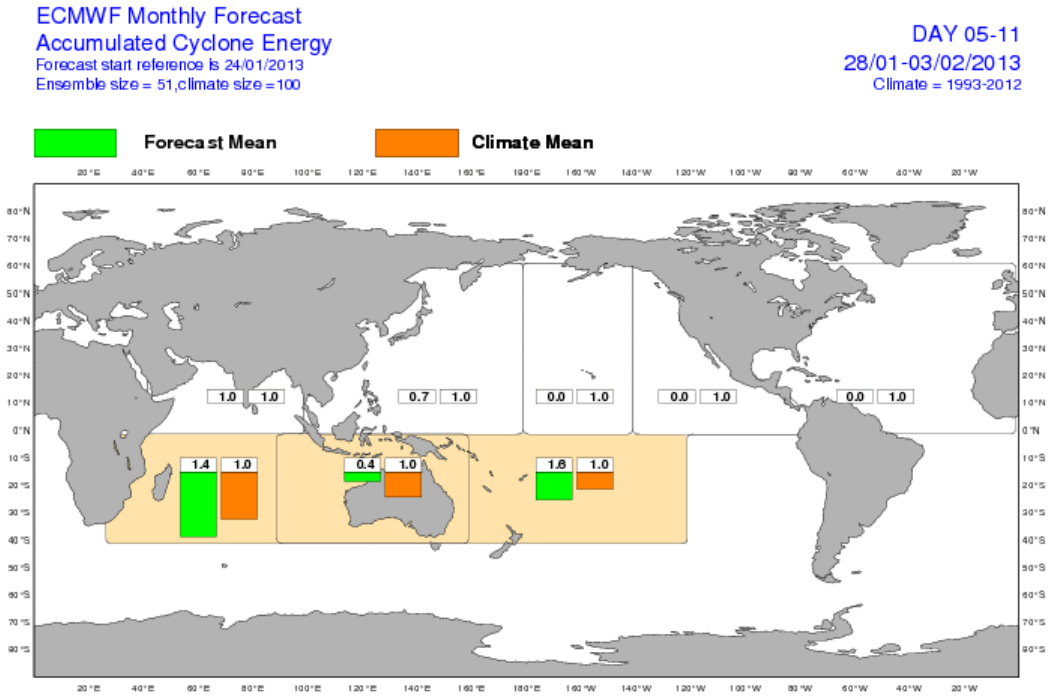


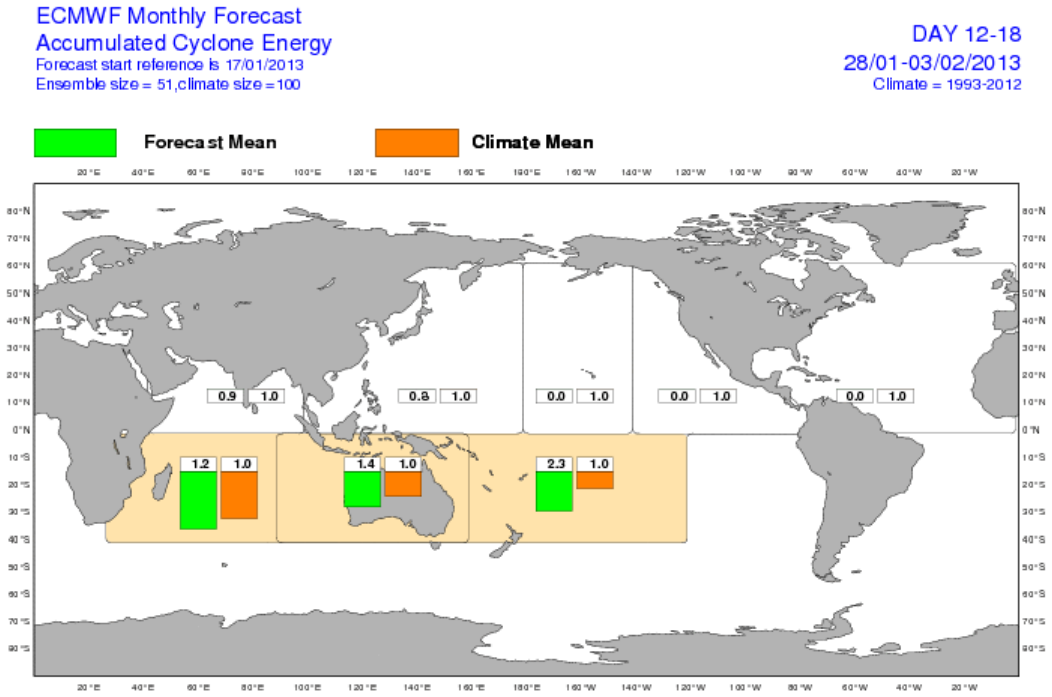
Impact on verification
T850- Upper terciles – Week 4







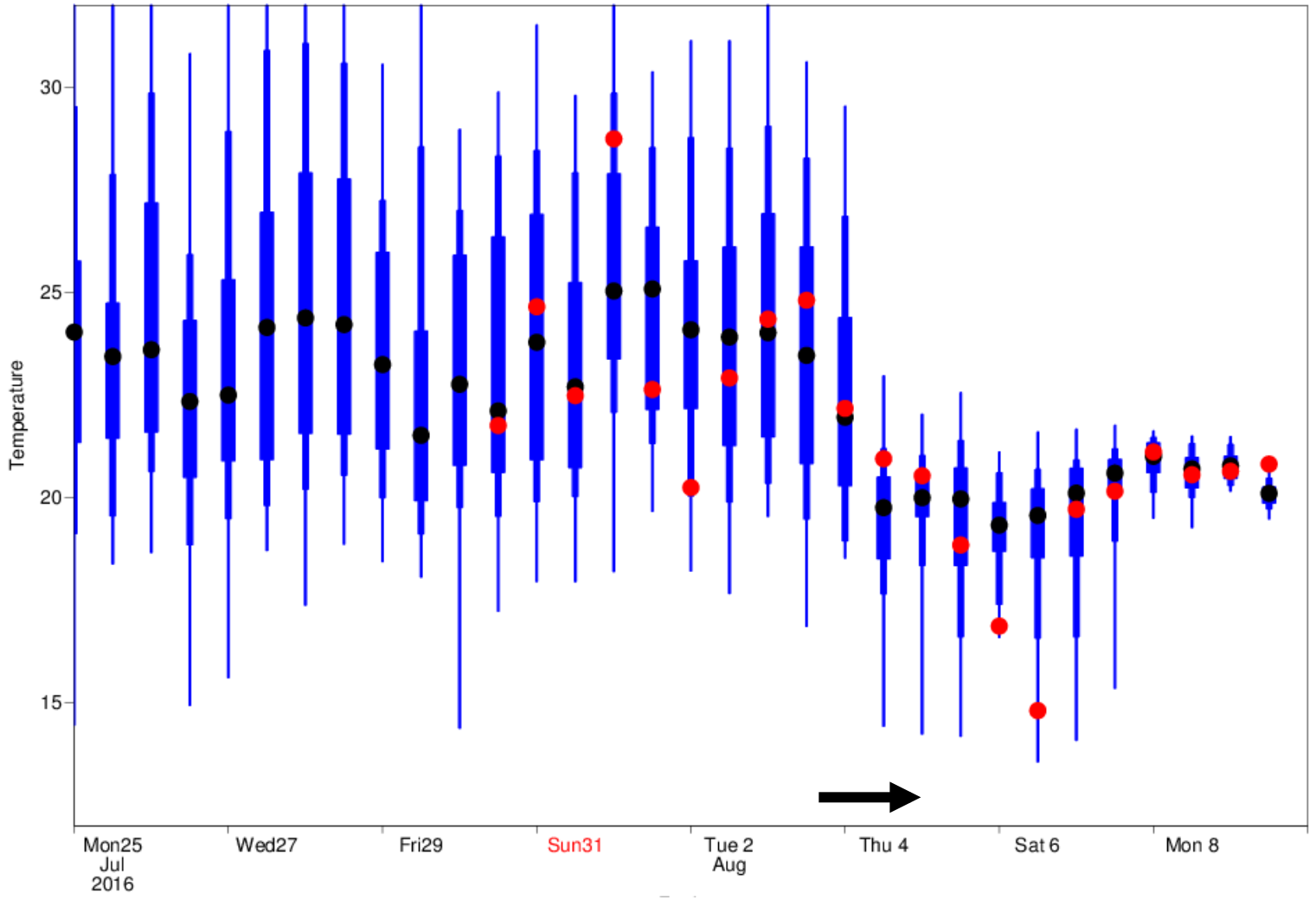




Weekly mean Accumulated Cyclone Energy (ACE)

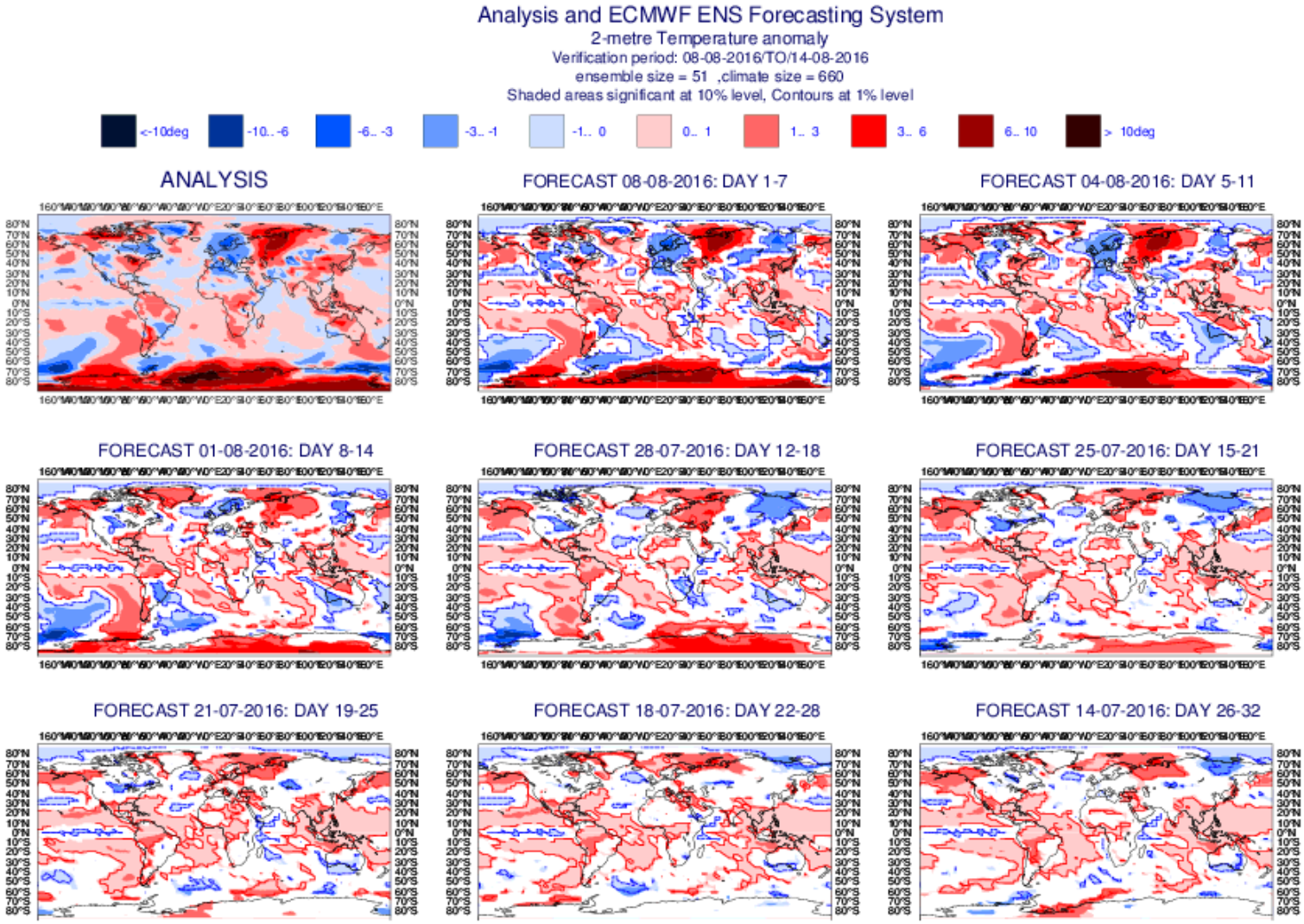
ECMWF

2-metre temperature Paris 9 August 12z



From Linus ‘s weather discussion 2016-08-12

ECMWF


Analysis and ECMWF ENS Forecasting System
2-metre Temperature anomaly
Verification period: 08-08-2016/TO/14-08-2016
ensemble size = 51 ,climate size = 660
Shaded areas significant at 10% level, Contours at 1% level
<-10deg
-10.. -6
-6.. -3
-3.. -1
-1.. 0
0.. 1
1.. 3
3.. 6
6.. 10
> 10deg
ANALYSIS
FORECAST 08-08-2016: DAY 1-7
FORECAST 04-08-2016: DAY 5-11
FORECAST 01-08-2016: DAY 8-14
FORECAST 28-07-2016: DAY 12-18
FORECAST 25-07-2016: DAY 15-21
FORECAST 21-07-2016: DAY 19-25
FORECAST 18-07-2016: DAY 22-28
FORECAST 14-07-2016: DAY 26-32

Extended range ensemble system

ENS includes 51 forecasts with resolution: TL639L91 from day 0 to 10 and TL319L91 from day 10 to 15.

Atmosphere
Initial uncertainties **T42L91 SVs+ T399L137 EDA perturbations**
Model uncertainties **Stochastic physics (SPPT and SKEB schemes). The central analysis is the TL1279L137 4DVAR. coupled to wave model (WAM) every time step**

Ocean
NEMO (about 1 degree resolution) coupled to IFS every 3 hours. Ocean initial conditions provided by 5-member NEMOVAR analysis

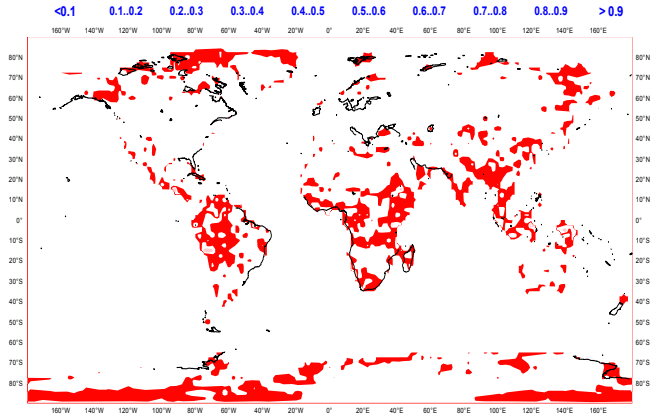
The ECMWF monthly forecasting system

- **Atmospheric initial conditions:** ECMWF operational analysis
- **Oceanic initial conditions:** "Accelerated" ocean analysis
- **Perturbations:**
  - Atmosphere: Singular vectors + stochastic physics
  - Ocean: Wind stress perturbations during the data assimilation

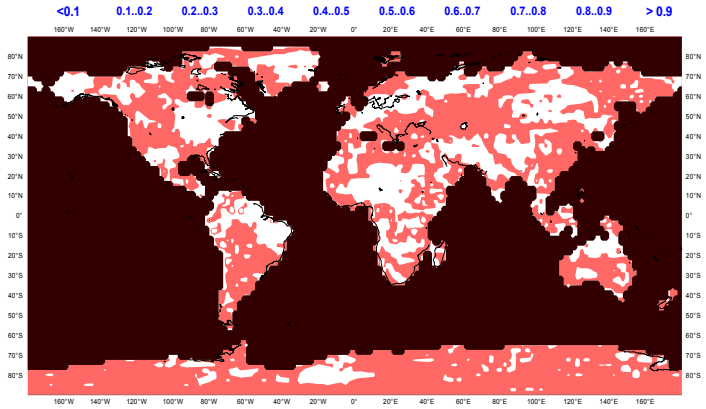
Skill of the ECMWF Monthly Forecasting System

ROC score: 2-meter temperature in the upper tercile

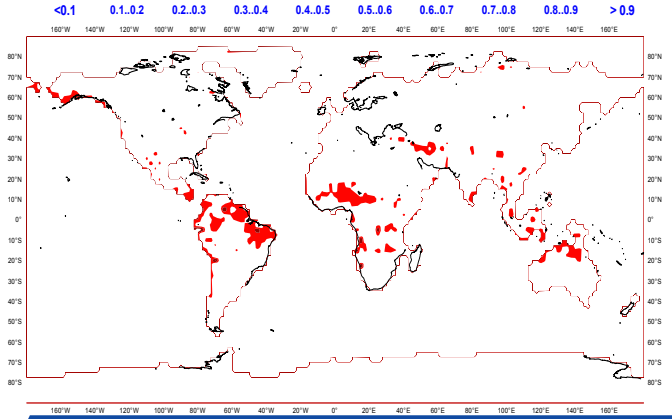
Day 5-11



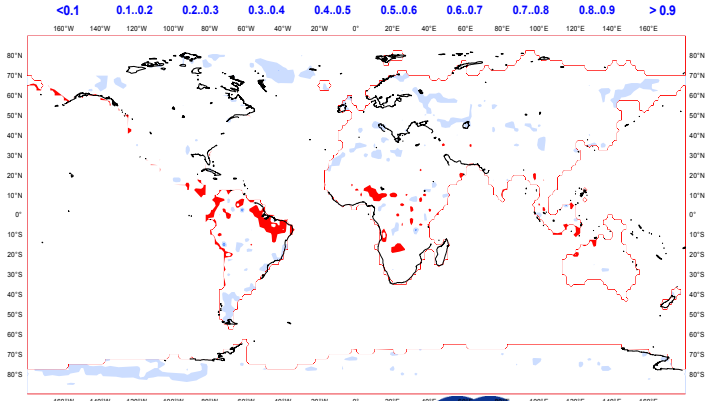
Day 12-18



Day 19-25



Day 26-32

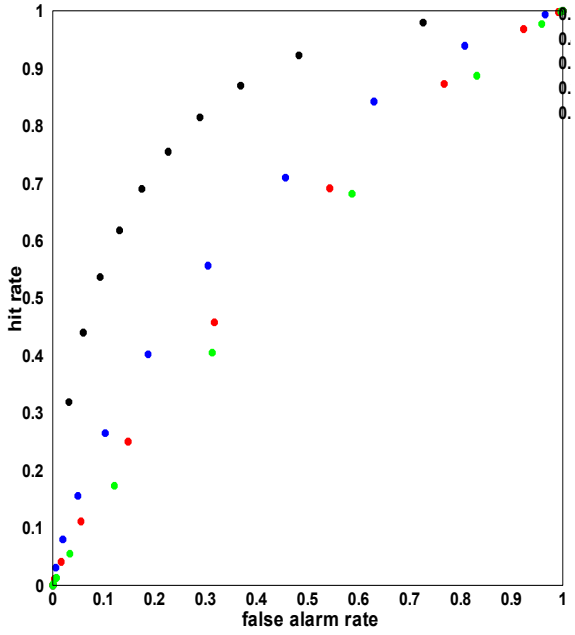


ECMWF

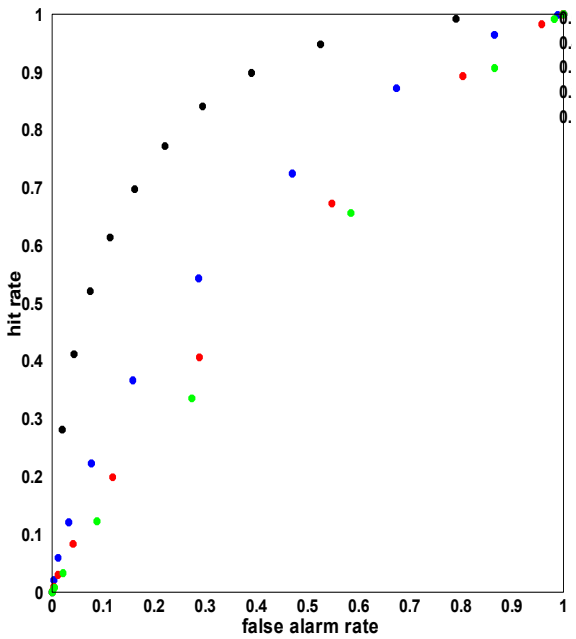
Skill of the ECMWF Monthly Forecasting System

ROC scores over the Northern extratropics

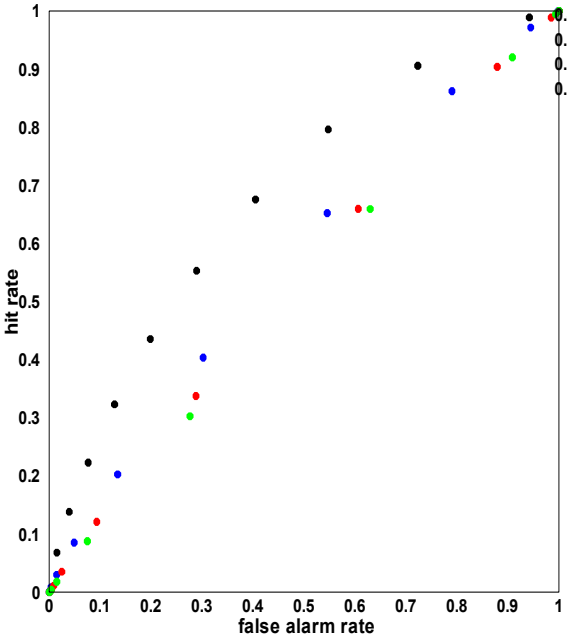
2-metre temperature



Mean sea-level pressure



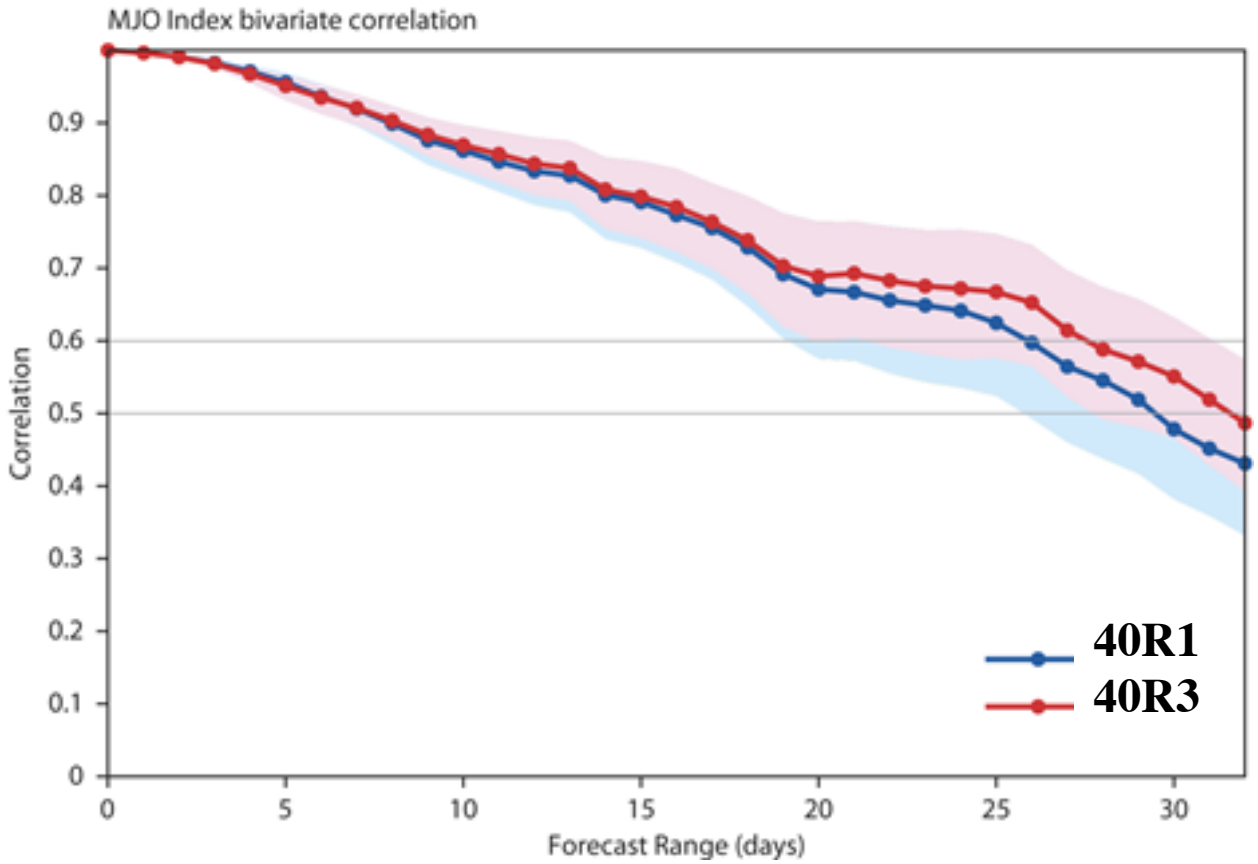
Precipitation



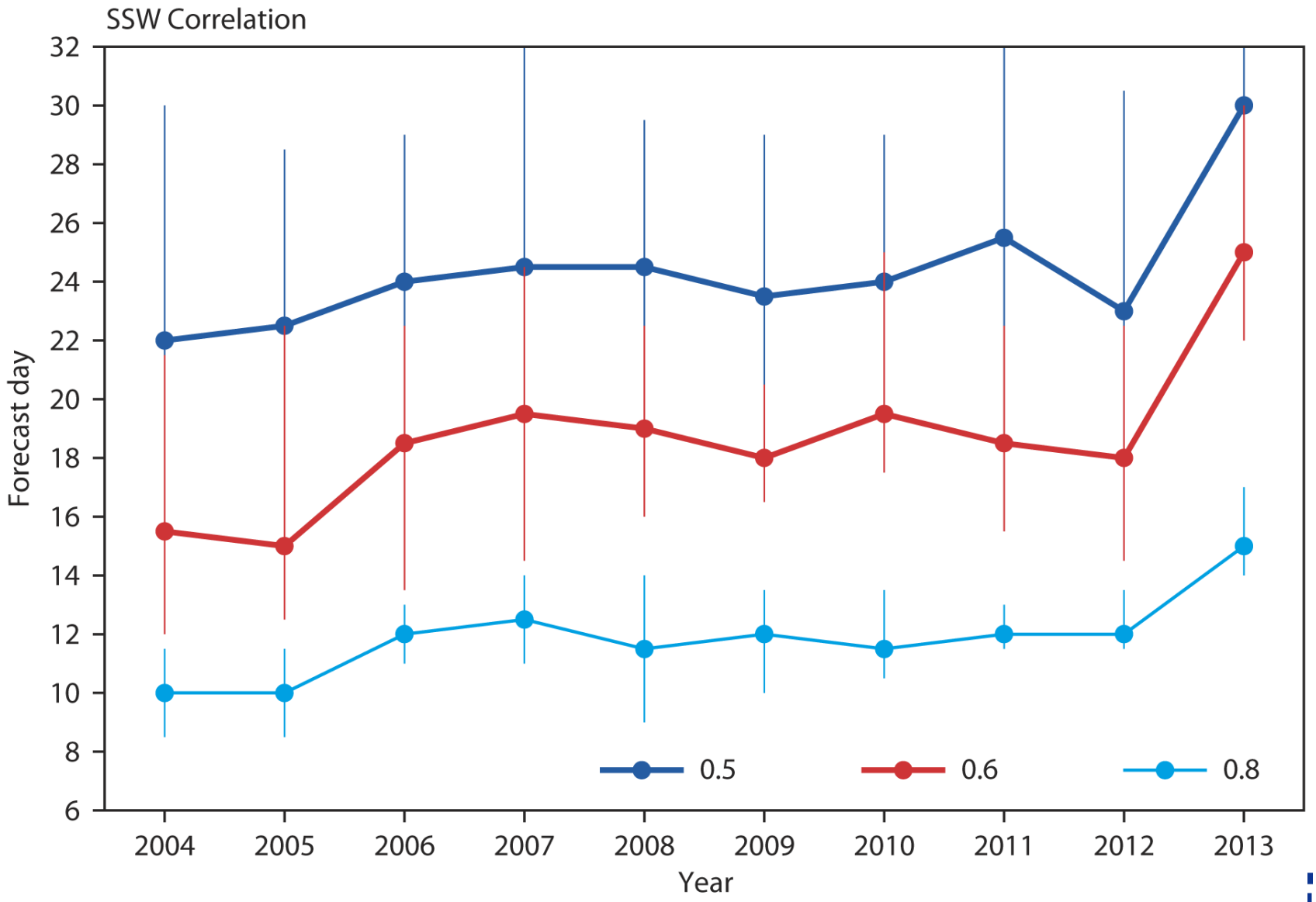
Day 5-11 Day12-18 Day19-25 Day 26-32

ECMWF

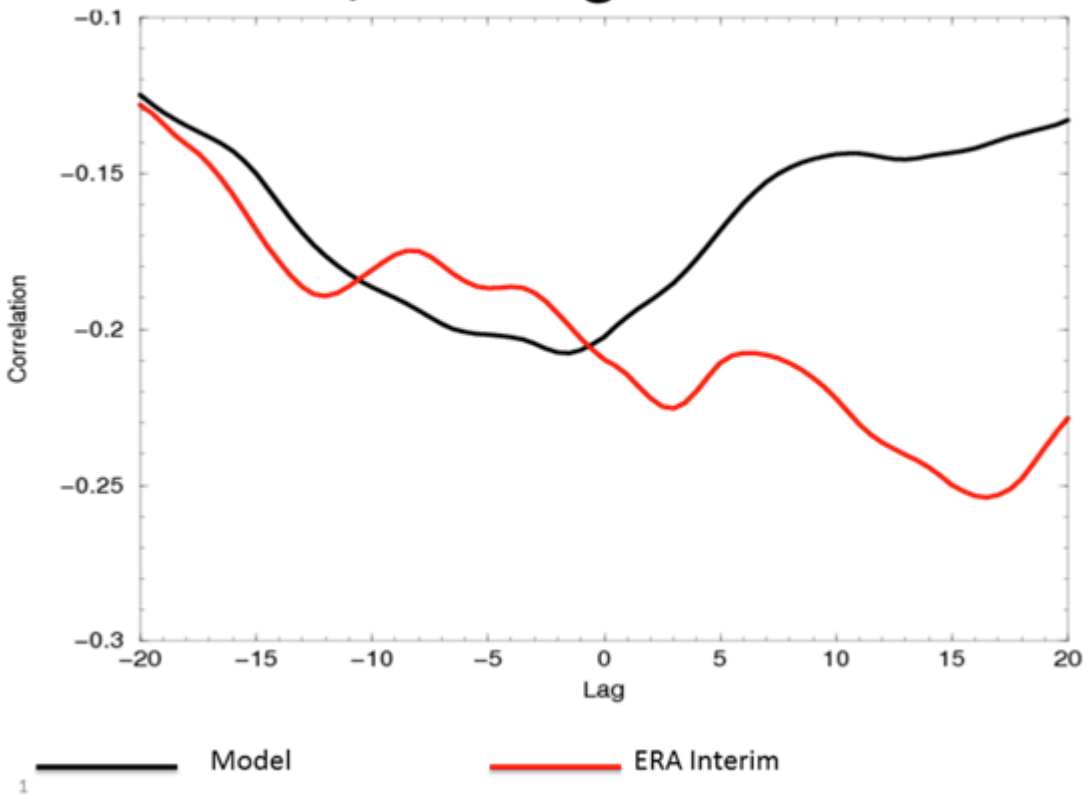
Madden Julian Oscillation



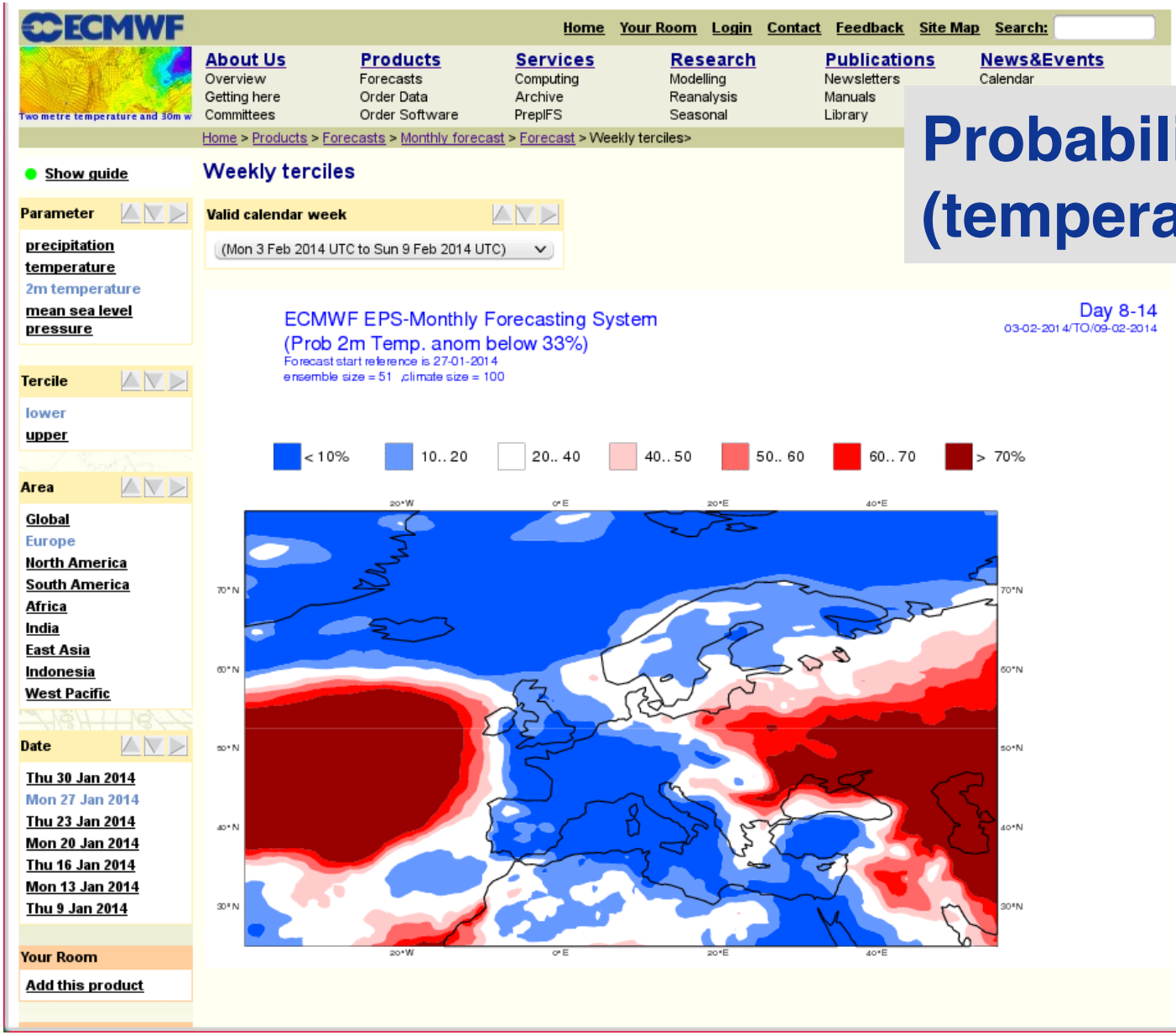
Improvement due to revised organised convective detrainment term and the revised convective momentum transport.


SSW Correlation
Forecast day
Year
32
30
28
26
24
22
20
18
16
14
12
10
8
6
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
0.5
0.6
0.8

NAO/SSW lag-correlation



Probabilities (temperature)



Weekly anomaly - Mozilla Firefox

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International Conference o... | Zimbra: Inbox (4) | http://eceart...gReading2014 | Weekly News - Intranet - E... | http://www.es...ion/qbo.data | Weekly anomaly

Back Forward www.ecmwf.int/products/forecasts/d/charts/mofc_multi/forecast/anomaly/anomaly!2m temperature!week 1!Europe!mofc!2!anoma Reload Stop QBO time serie Home

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Committees	Order Software	PrepIFS	Seasonal	Library	Open Tenders

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Show guide

Weekly anomaly

Parameter

precipitation
temperature
2m temperature
mean sea level pressure

Valid calendar week

(Mon 3 Feb 2014 UTC to Sun 9 Feb 2014 UTC)

Area

Global
Europe
North America
South America
Africa
India
East Asia
Indonesia
West Pacific

Date

Thu 30 Jan 2014
Mon 27 Jan 2014
Thu 23 Jan 2014
Mon 20 Jan 2014
Thu 16 Jan 2014
Mon 13 Jan 2014
Thu 9 Jan 2014

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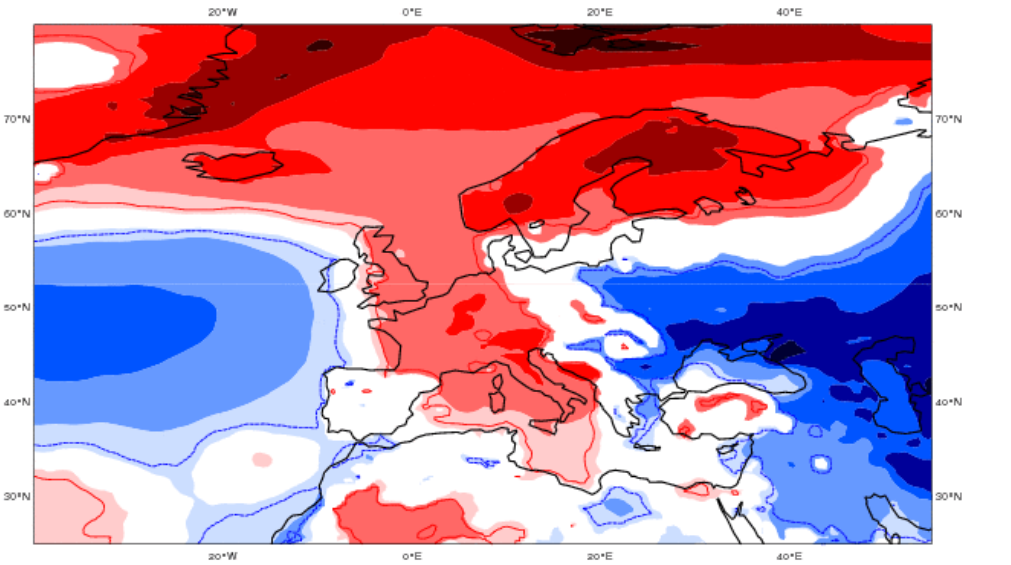
Show overview

Parameter
Valid calendar week
Area
Date

ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 30-01-2014
ensemble size = 51 ,climate size = 100

Day 5-11
03-02-2014/TO/09-02-2014
Shaded areas significant at 10% level
Contours at 1% level



Tropical storm density