The ECMWF Extended range forecasts

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The operational forecasting system

- High resolution forecast: twice per day
  16 km 91-level, to 10 days ahead

- Ensemble Prediction System (EPS): twice daily
  51 members, 30/60 km 62-level, to 15 days ahead

- **Extended range forecasts /EPS extension: twice a week (Mon/ Thursdays)**
  51 members, 30/60 km 62 levels, to 1 month ahead

- Long range forecasts: once a month (coupled to ocean model)
  51 members, ~80 km 91 levels, to 7 months ahead

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 and expressed as a departure from climate values for that period.

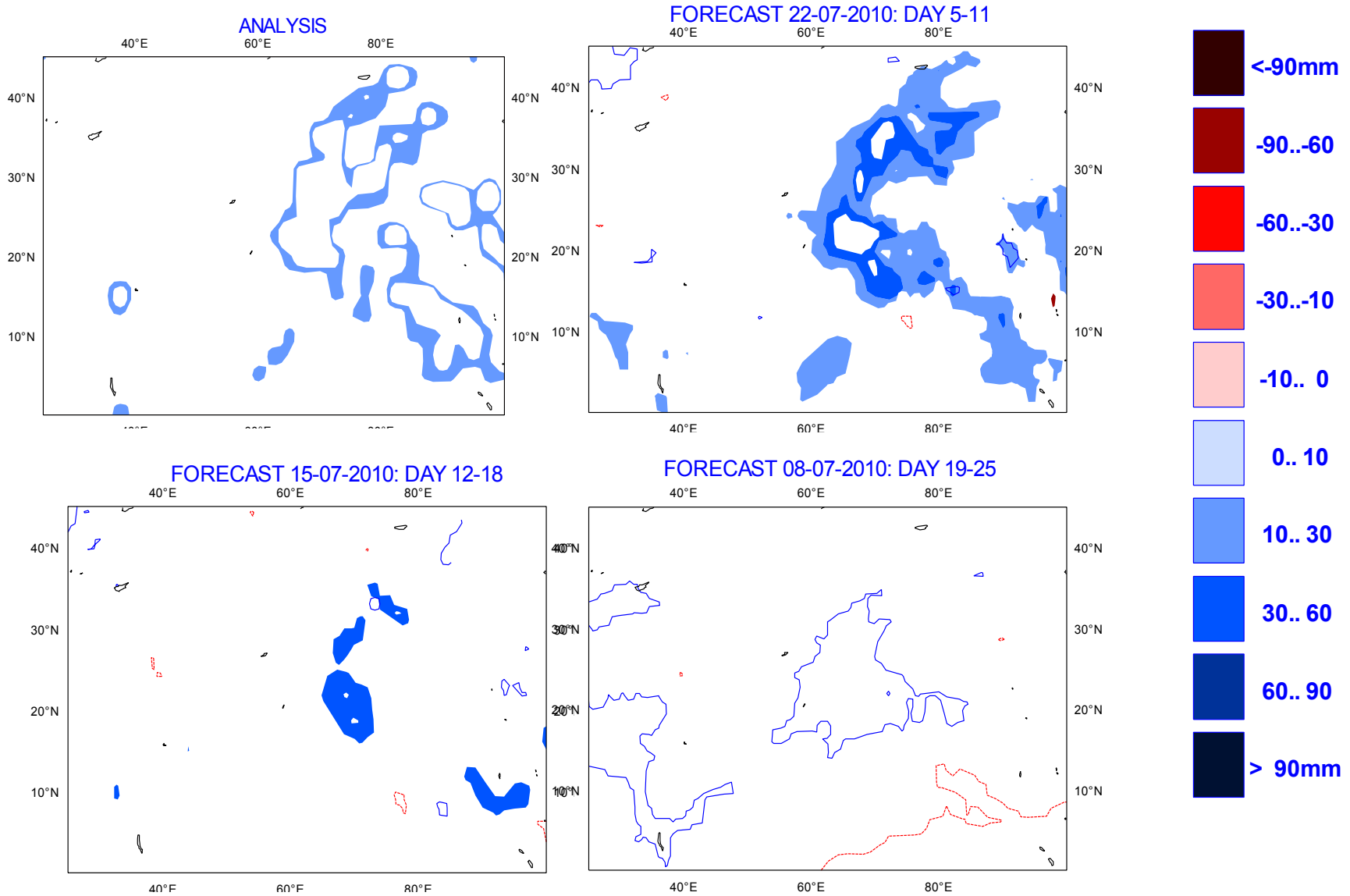
- **A particularly difficult time range: Is it an atmospheric initial condition problem as medium-range forecasting or is it a boundary condition problem as seasonal forecasting?**

- **Sources of predictability for this time scale :**
  - **Surface initial conditions: Sea surface temperature/Sea ice, Snow cover, Soil Moisture**
  - **Stratospheric Initial conditions**
  - **The Madden-Julian oscillation**

Predictions on the intra-seasonal time scale (from 10 to 30 days ahead) :

Great potential for predictions of : onset/demise of rain seasons, probabilities of heat waves, floods etc.

Precip anomalies : 26 July 2010 – 01 August 2010

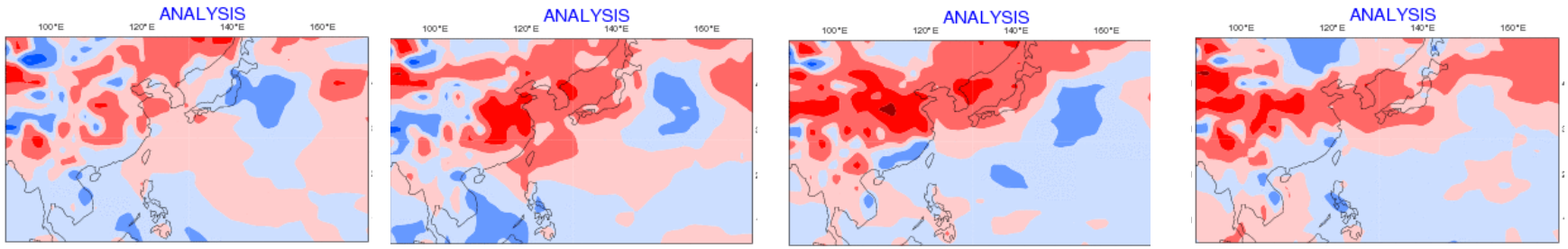


SE China Heat Wave: July- August 2013

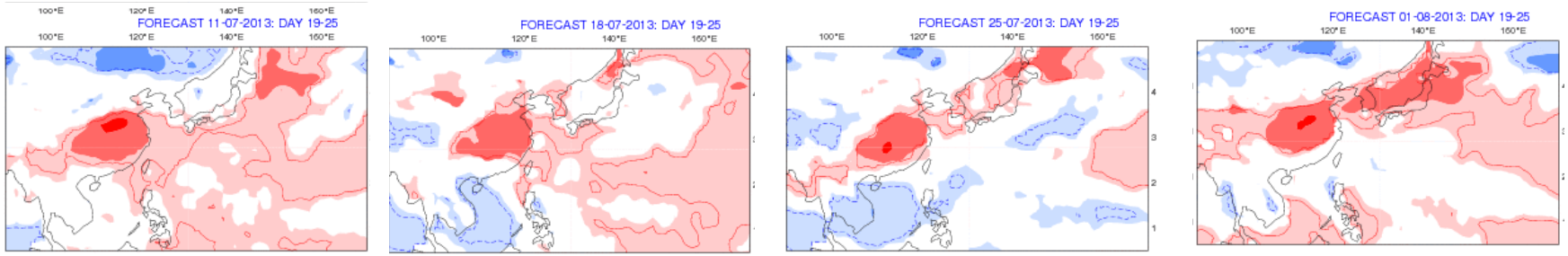
2mtemp. Weekly mean anomalies

verification

29/7-04/8 **05-11 /8** **12-18 /8** **19-25 /8**



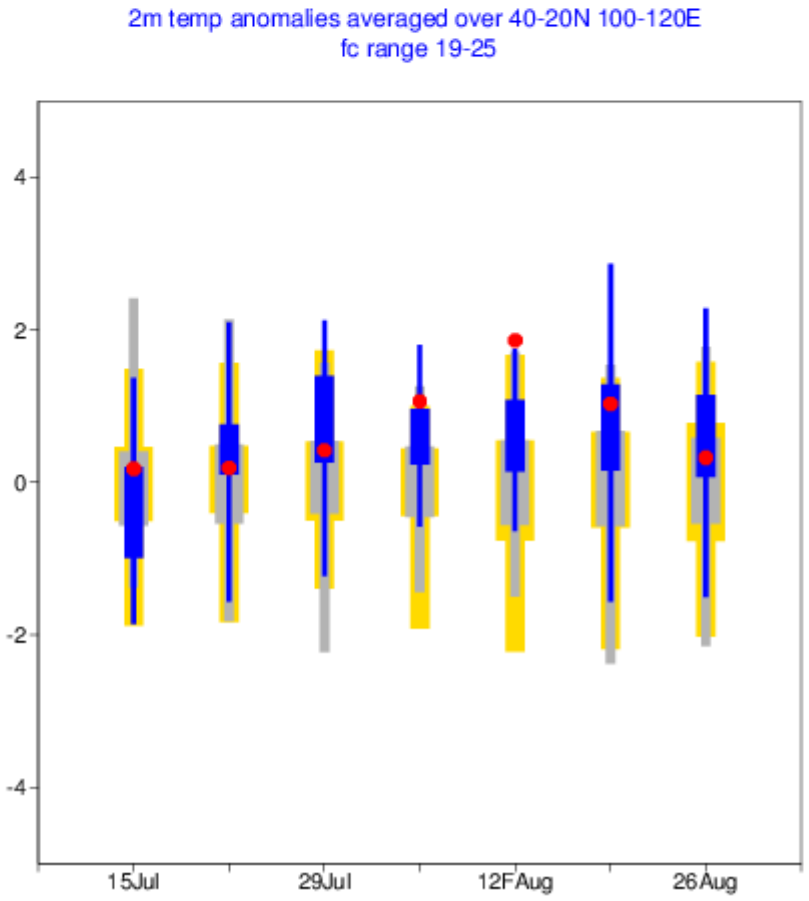
Forecasts days 19-25



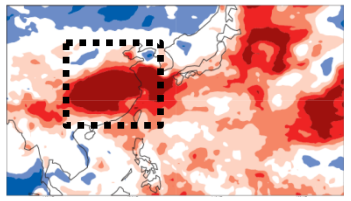
ECMWF

SE China Heat Wave: July- August 2013

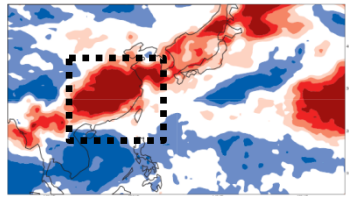
Probability 2MT anomaly above 66% M-Climate days 19-25



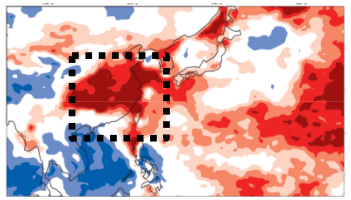
29-04/8



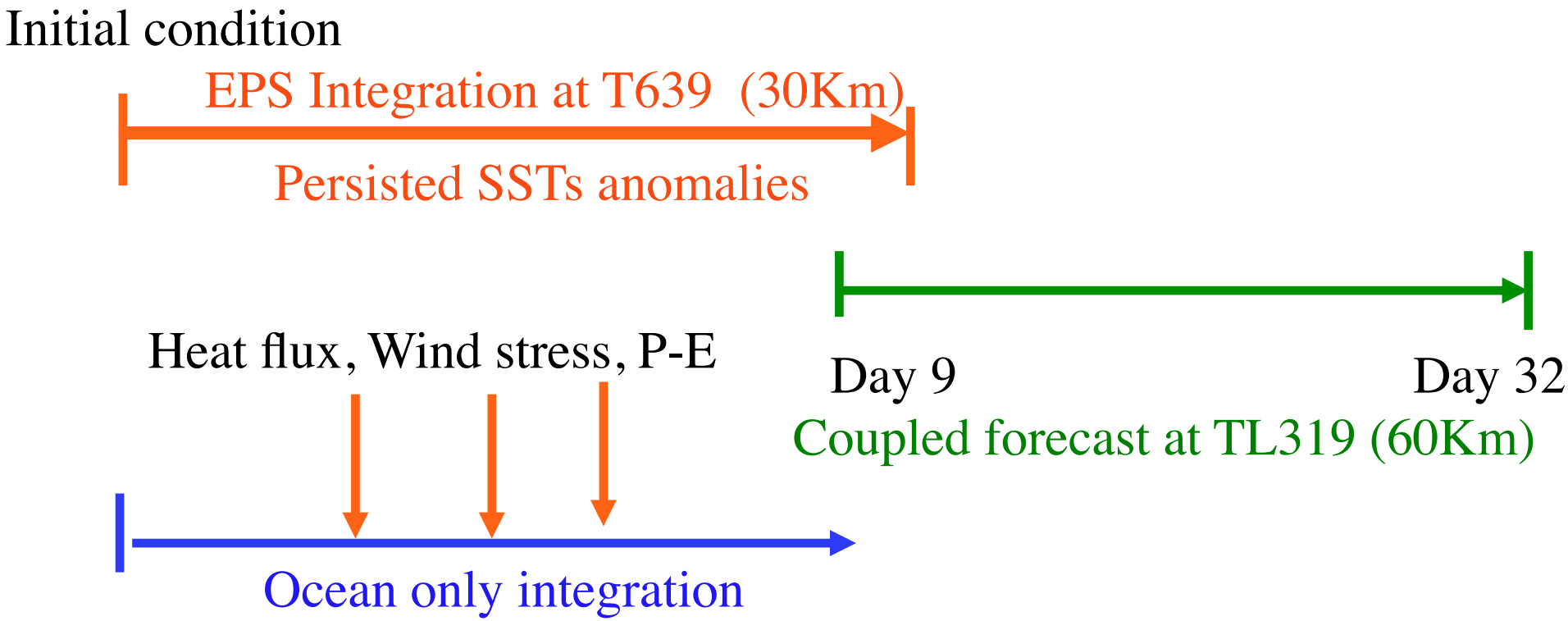
5-11/8



12-18/8



Extended range forecast /EPS extension



The ECMWF monthly forecasting system

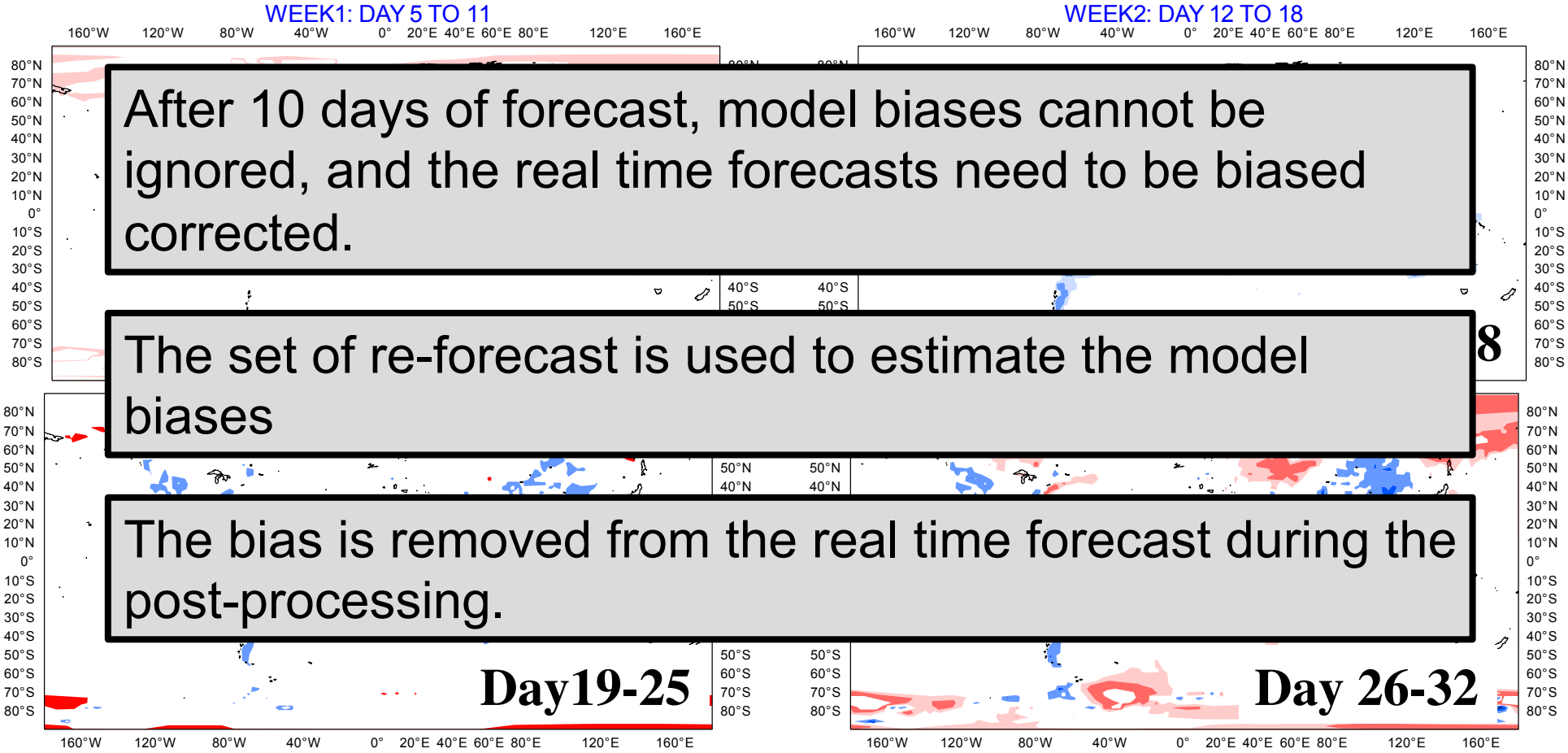
- **Atmospheric initial conditions:** ECMWF operational analysis
- **Oceanic initial conditions:** "Accelerated" ocean analysis
- **Perturbations:**
  - Atmosphere: Singular vectors + stochastic physics
  - Ocean: Wind stress perturbations during the data assimilation

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.

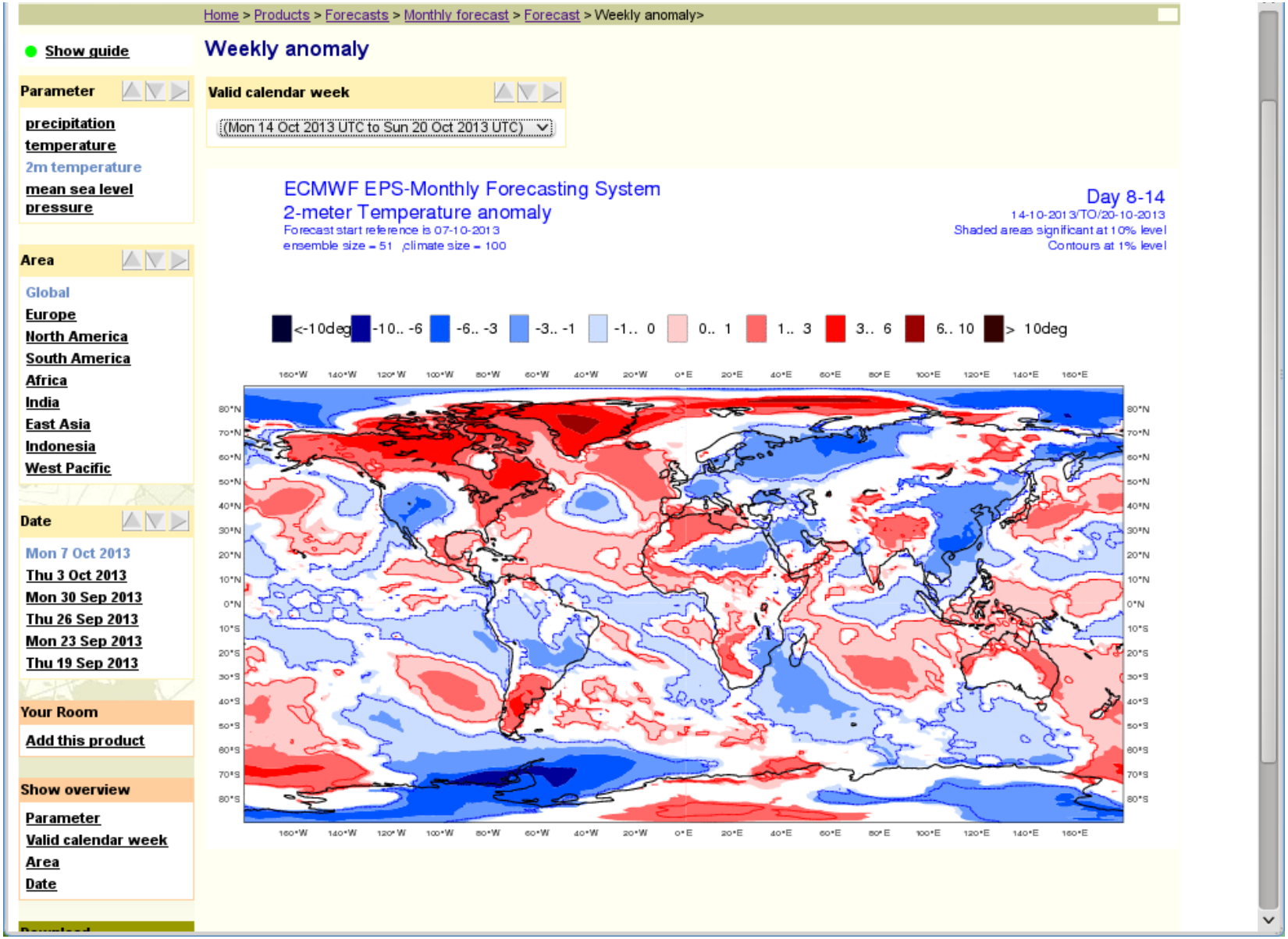
The set of re-forecast is used to estimate the model biases

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

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
  - 5-member ensemble integrated at the same day and same month as the real-time time forecast
  - It runs once every week
  - Used to estimate the model drift


Home > Products > Forecasts > Monthly forecast > Forecast > Weekly anomaly>
Show guide
Weekly anomaly
Parameter
precipitation
temperature
2m temperature
mean sea level pressure
Valid calendar week
(Mon 14 Oct 2013 UTC to Sun 20 Oct 2013 UTC)
Area
Global
Europe
North America
South America
Africa
India
East Asia
Indonesia
West Pacific
Date
Mon 7 Oct 2013
Thu 3 Oct 2013
Mon 30 Sep 2013
Thu 26 Sep 2013
Mon 23 Sep 2013
Thu 19 Sep 2013
Your Room
Add this product
Show overview
Parameter
Valid calendar week
Area
Date
ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 07-10-2013
ensemble size = 51 ,climate size = 100
Day 8-14
14-10-2013/TO/20-10-2013
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

Home > Products > Forecasts > Monthly forecast > Forecast > Weekly anomaly>

Show guide

Weekly anomaly

Parameter

precipitation
temperature
2m temperature
mean sea level pressure

Valid calendar week

(Mon 21 Oct 2013 UTC to Sun 27 Oct 2013 UTC)

Area

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

Date

Mon 7 Oct 2013
Thu 3 Oct 2013
Mon 30 Sep 2013
Thu 26 Sep 2013

Your Room

Add this product

Show overview

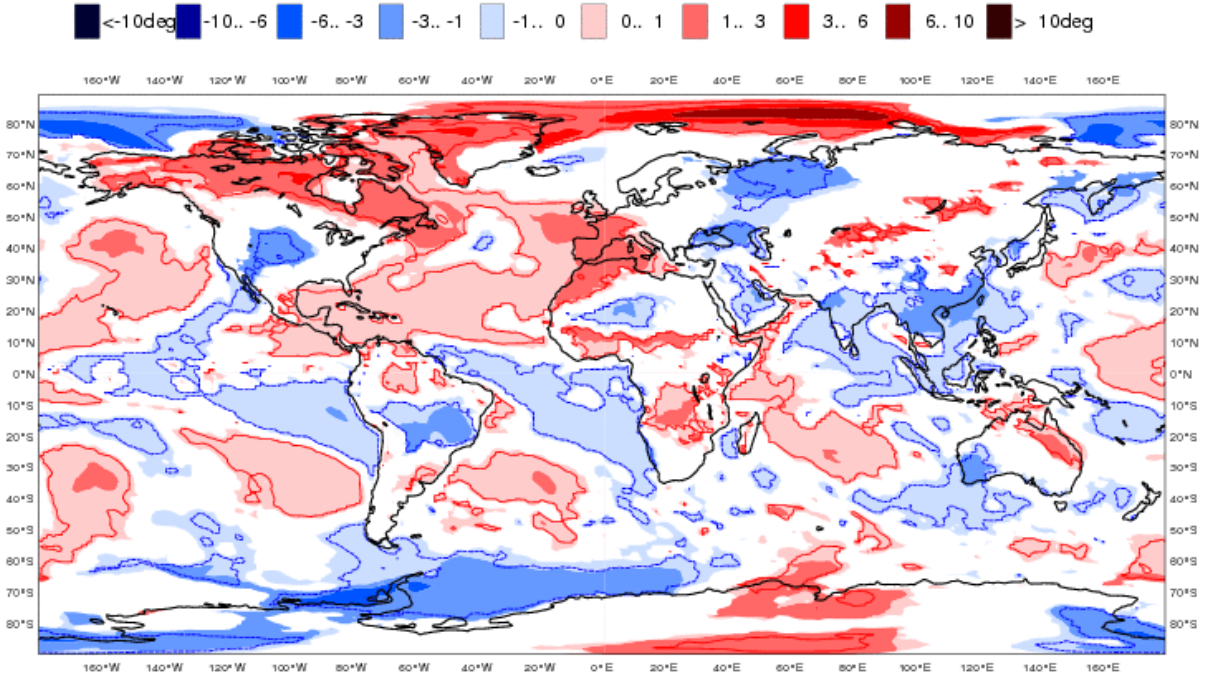
Parameter
Valid calendar week
Area
Date

Download...

PDF (497.6 Kbytes)

ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 07-10-2013
ensemble size = 51 ,climate size = 100

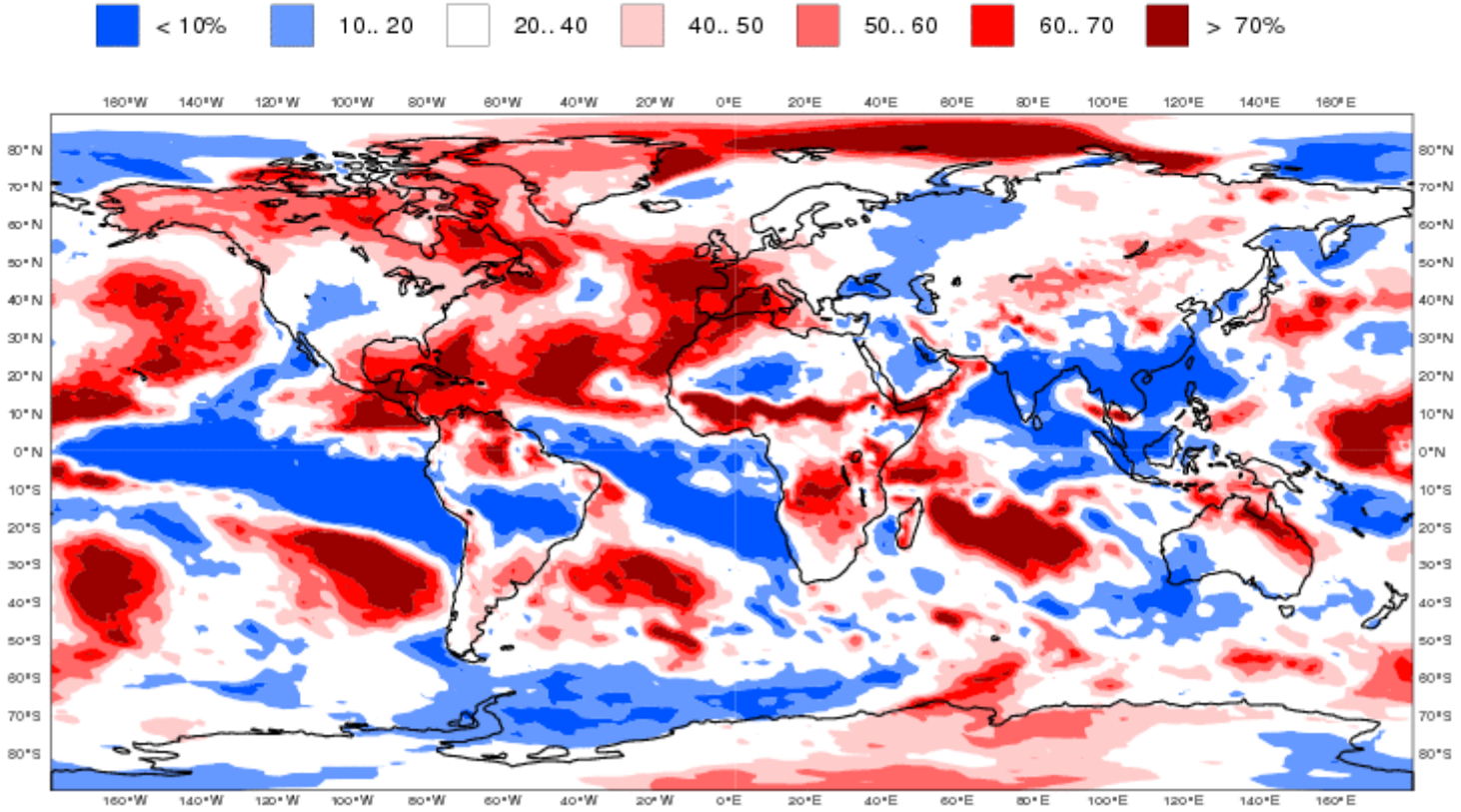
Day 15-21
21-10-2013/TO/27-10-2013
Shaded areas significant at 10% level
Contours at 1% level



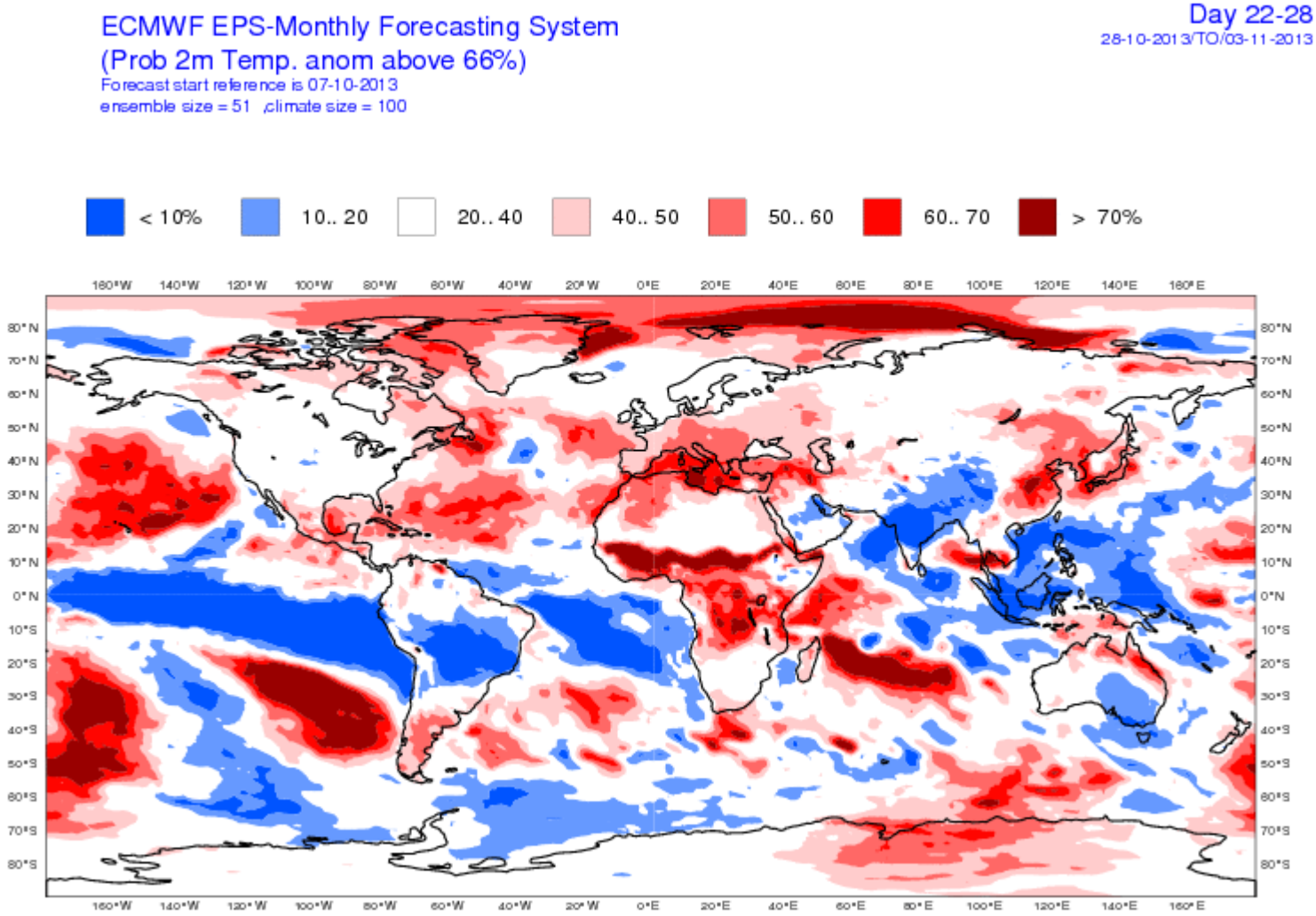
Probabilities (temp.)

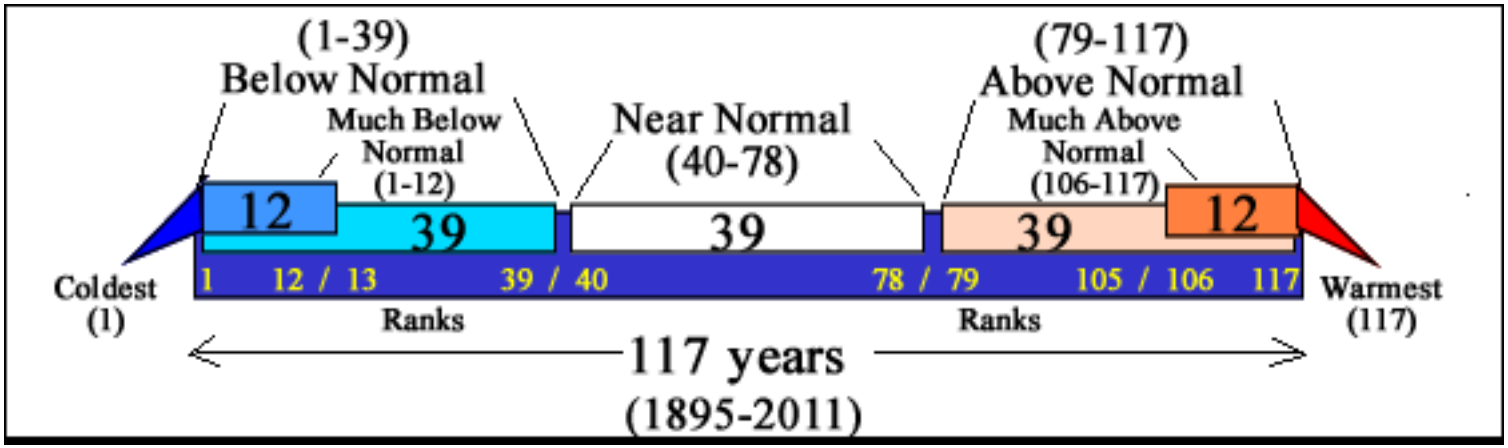
ECMWF EPS-Monthly Forecasting System
(Prob 2m Temp. anom above 66%)
Forecast start reference is 07-10-2013
ensemble size = 51 ,climate size = 100

Day 15-21
21-10-2013/TO/27-10-2013



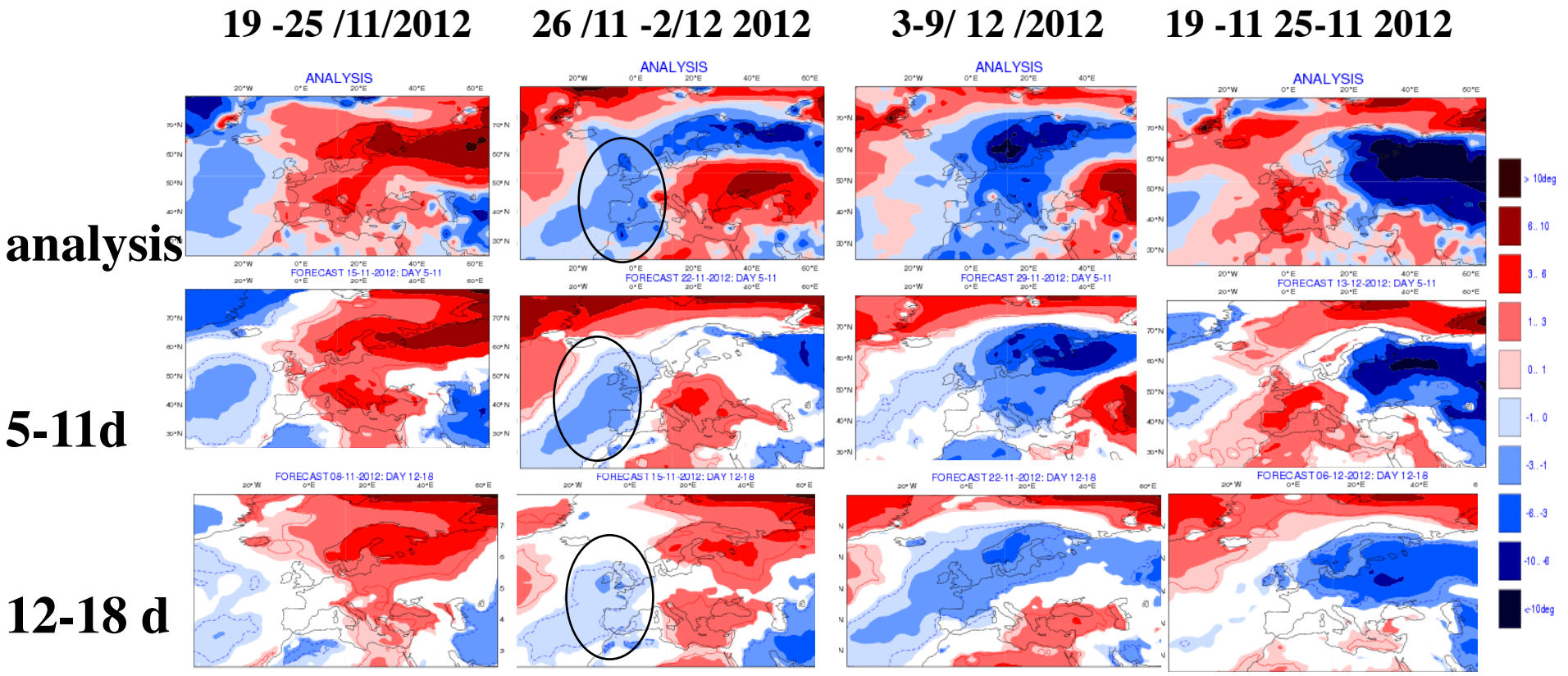
Probabilities (temp)





The "Below Normal", "Near Normal", "Above Normal"
corresponds to
the lower tercile, middle tercile, upper tercile of the distribution, respectively. (three equal portions)

Cold spell over Europe Nov-Dec 2012

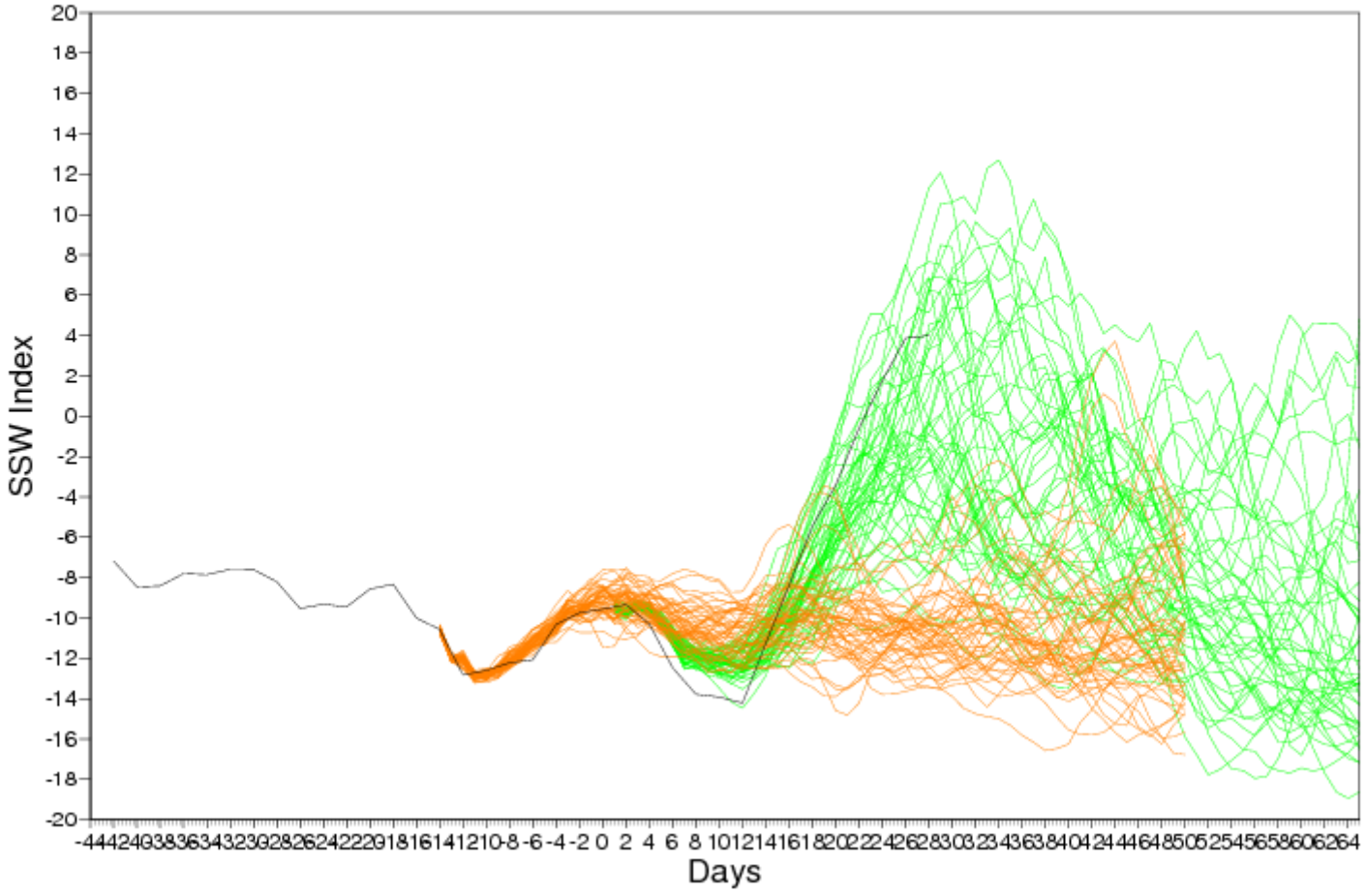


Cold Weather over Europe: SSW Index

Forecast starting on :

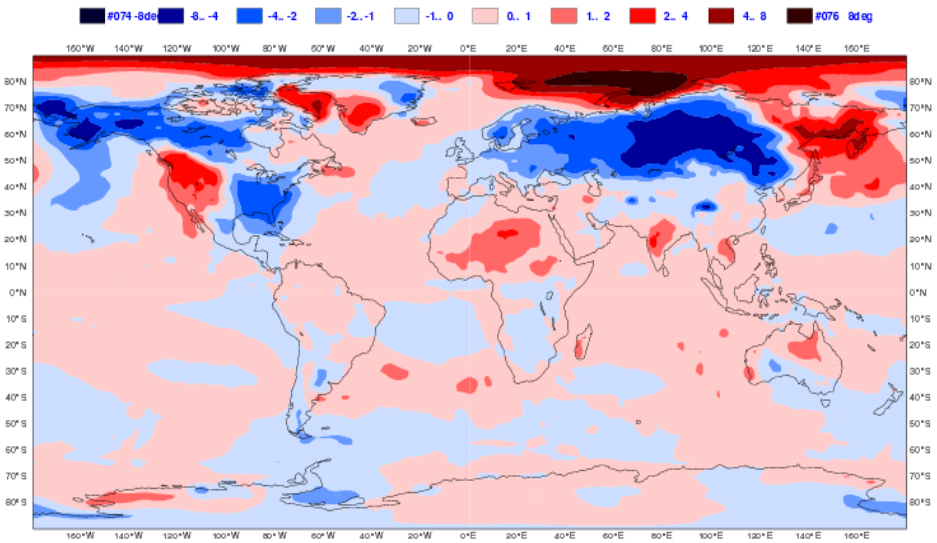
22/11/2012

15/11/2012

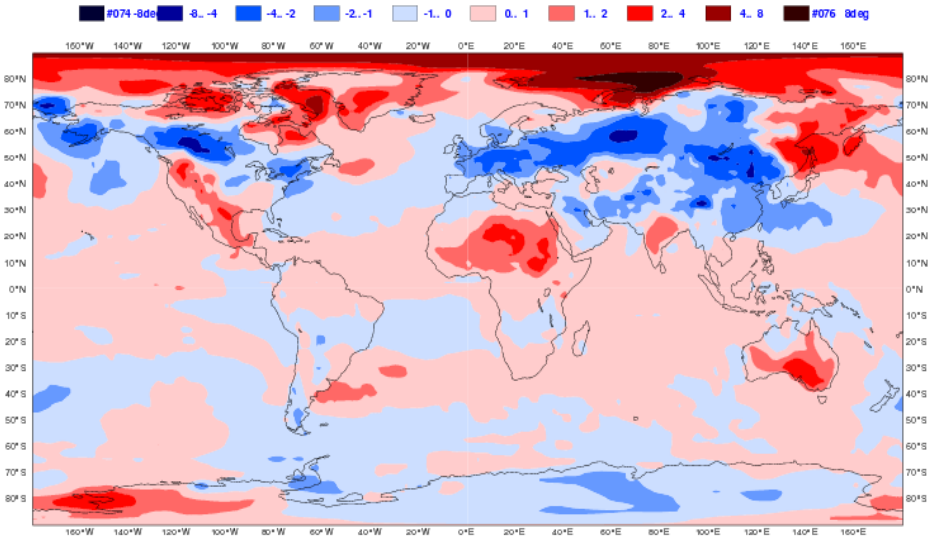


Cold Weather over Europe
SSW Index - Forecast starting on 22/11/2012

Strong SSW



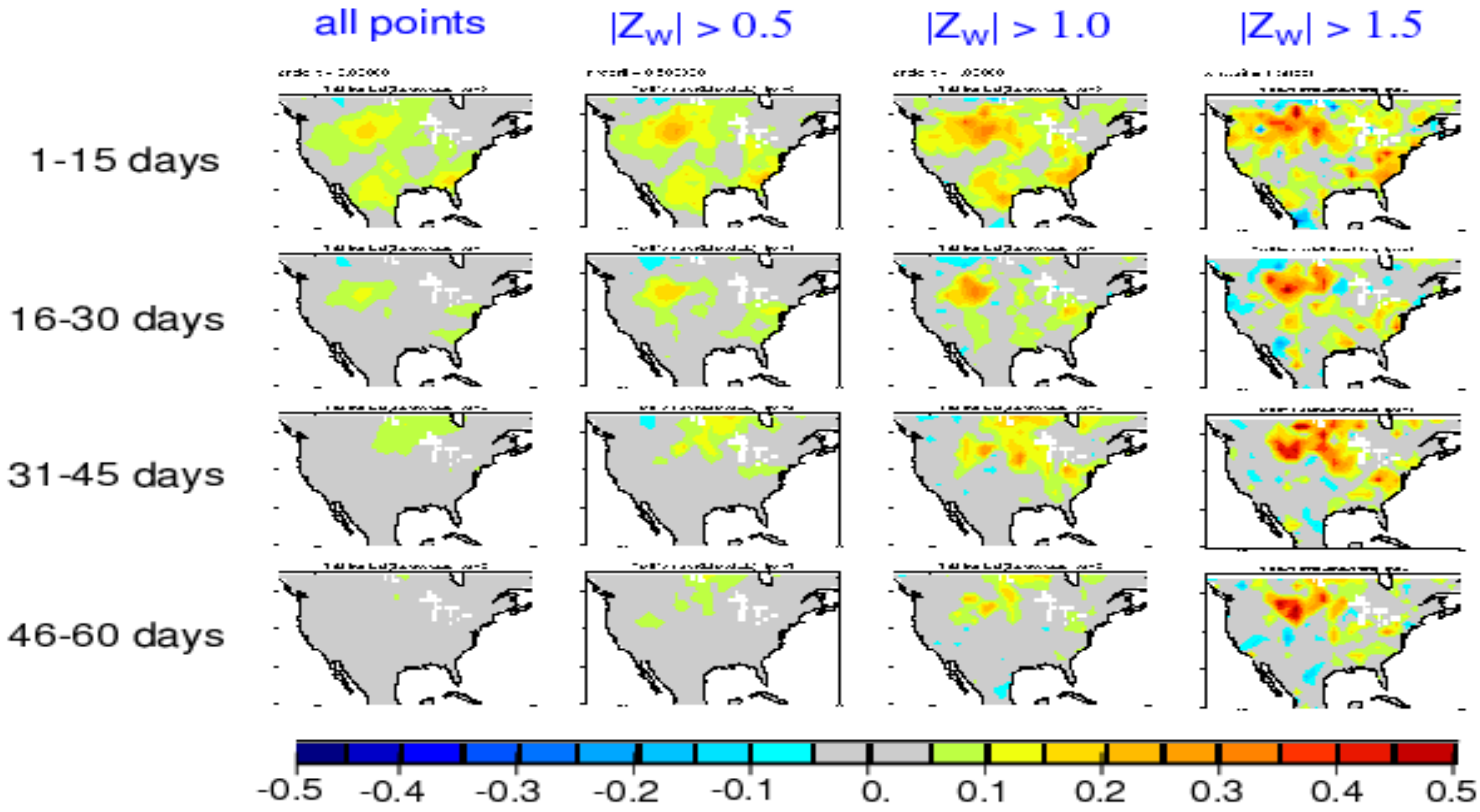
Weak SSW



ECMWF

Impact of soil moisture:

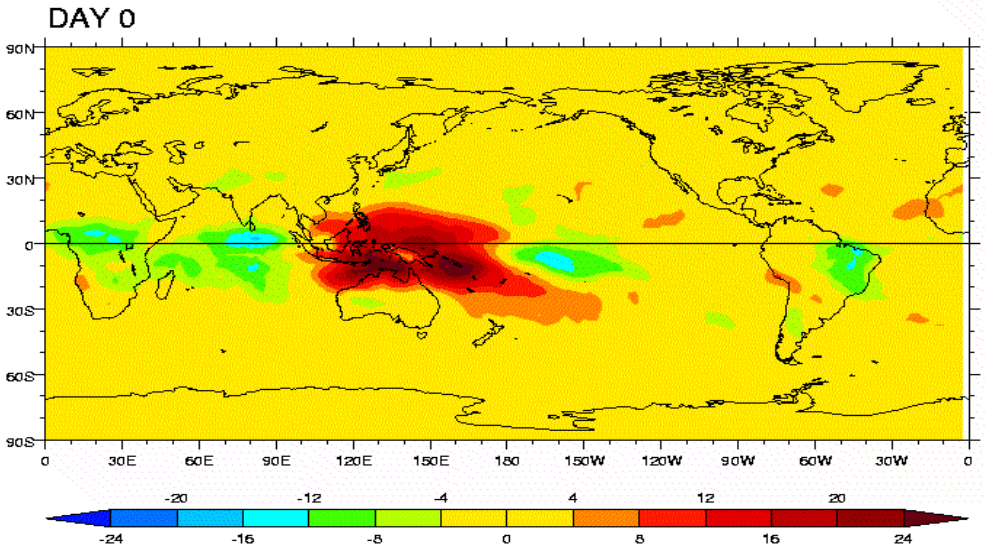
Temperature forecasts: Increase in skill due to land initialization (JJA)
(conditioned on Z-score of initial soil moisture anomaly)



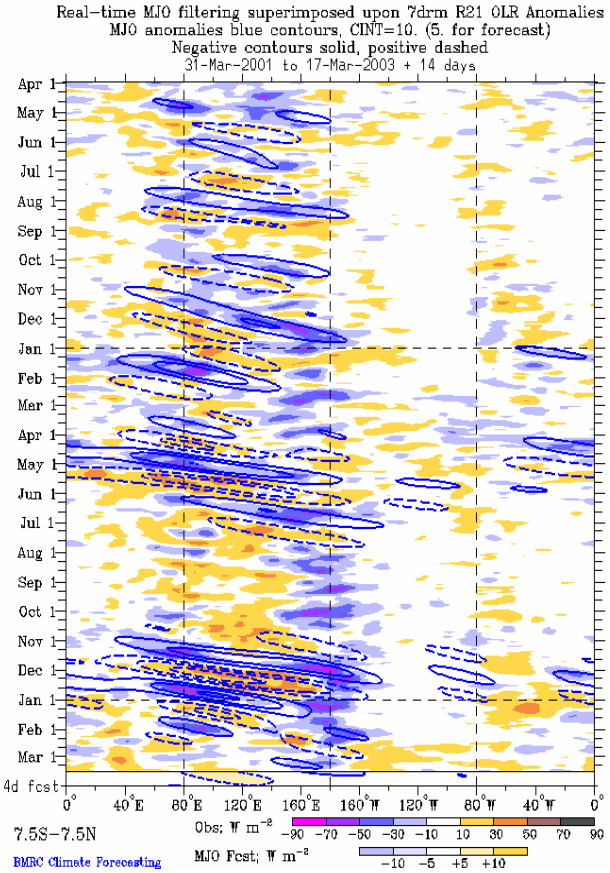
Koster et al, GRL 2010

The Madden Julian Oscillation (MJO)

MJO life cycle

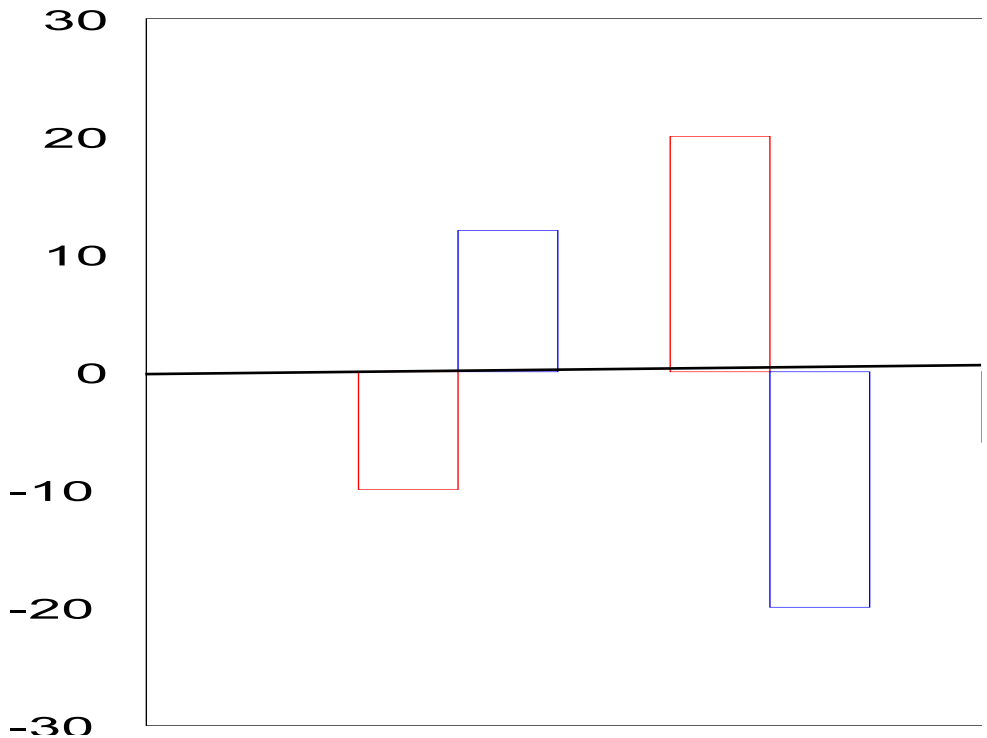


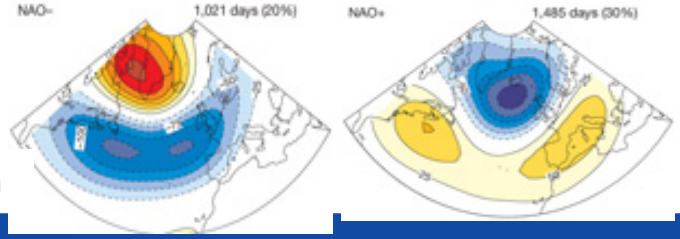
(From NASA)



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:

- enhanced convection over Indian Ocean
- enhanced convection over Western Pacific

Cassou (2008) Lin et al (2008)

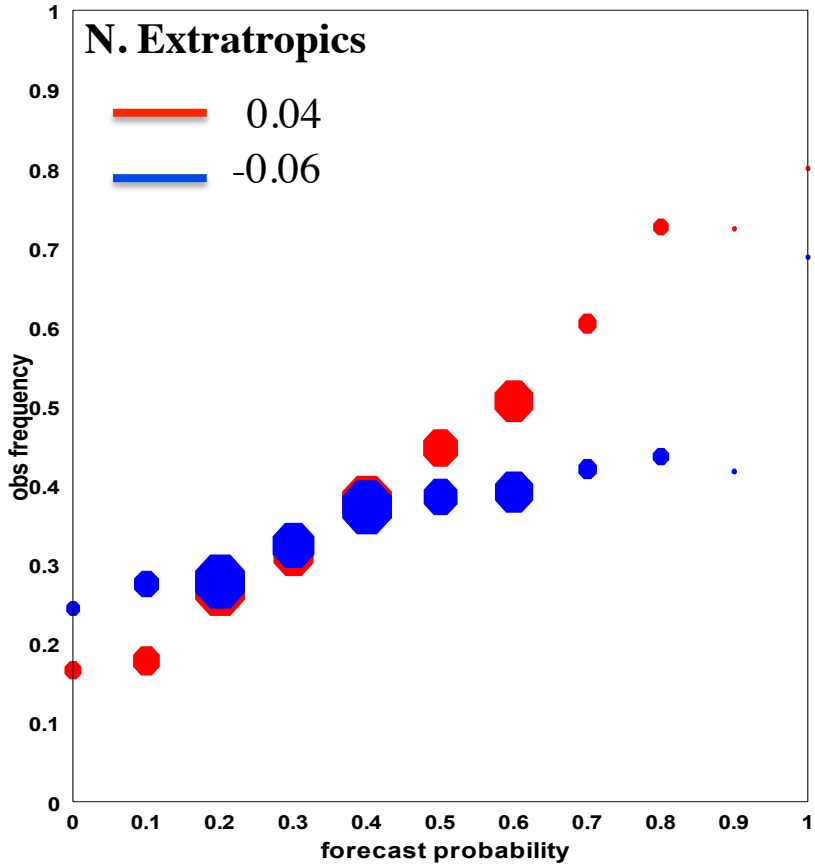
Conv. Over Indian Ocean +10 days

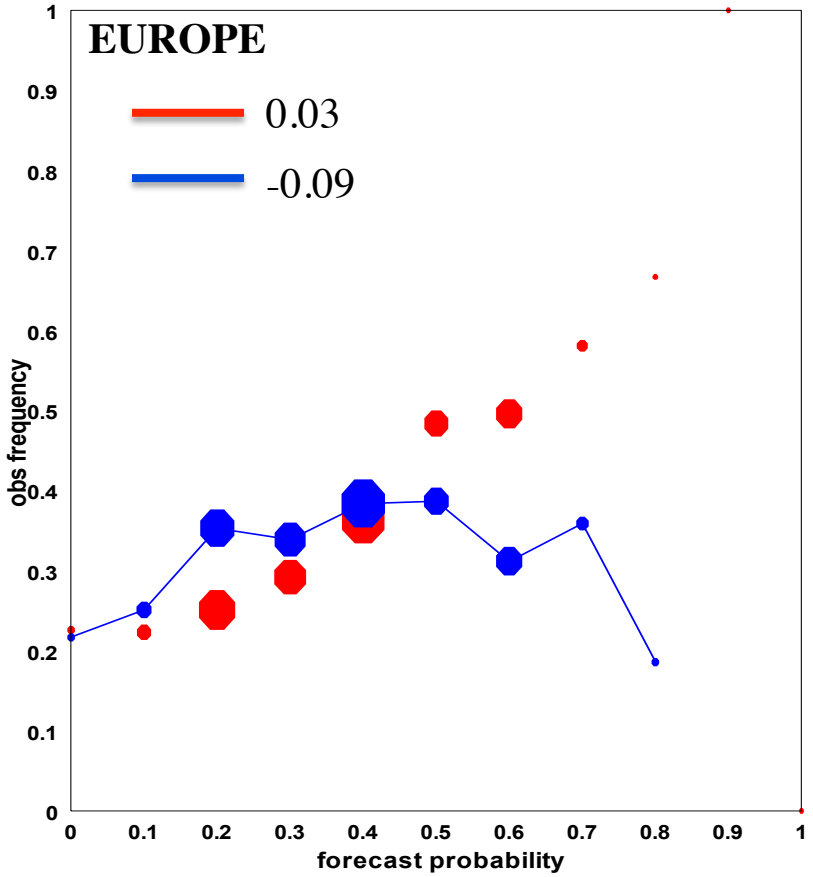
Conv. Over Western Pacific+10 days

ECMWF

Probabilistic skill scores – NDJFMA 1989-2008

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

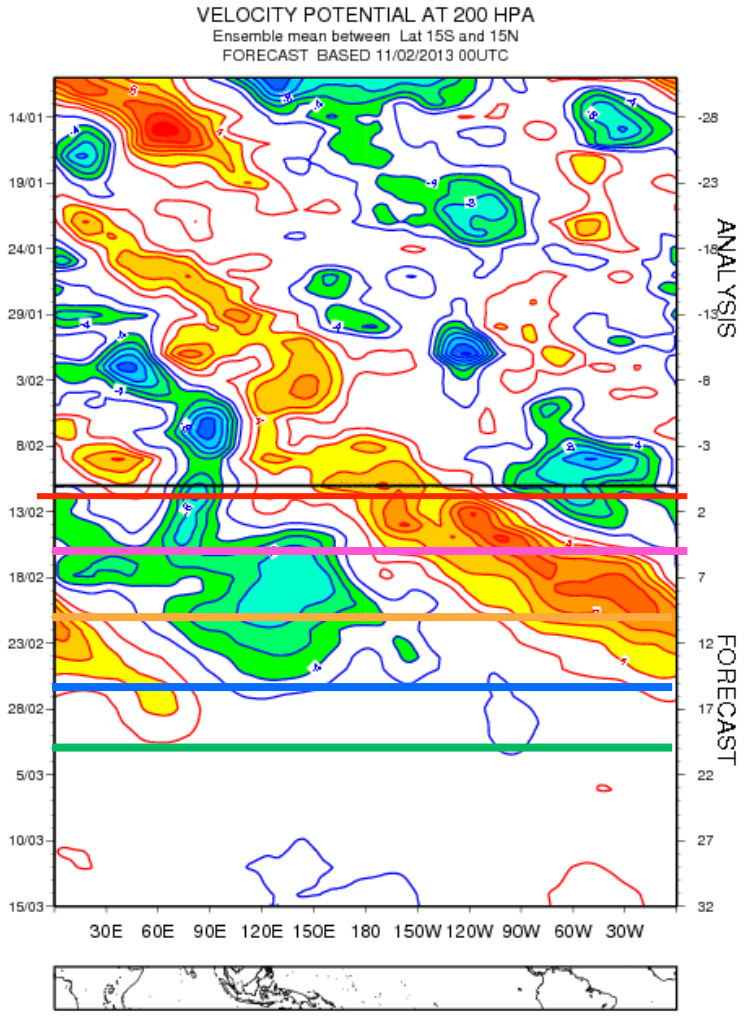


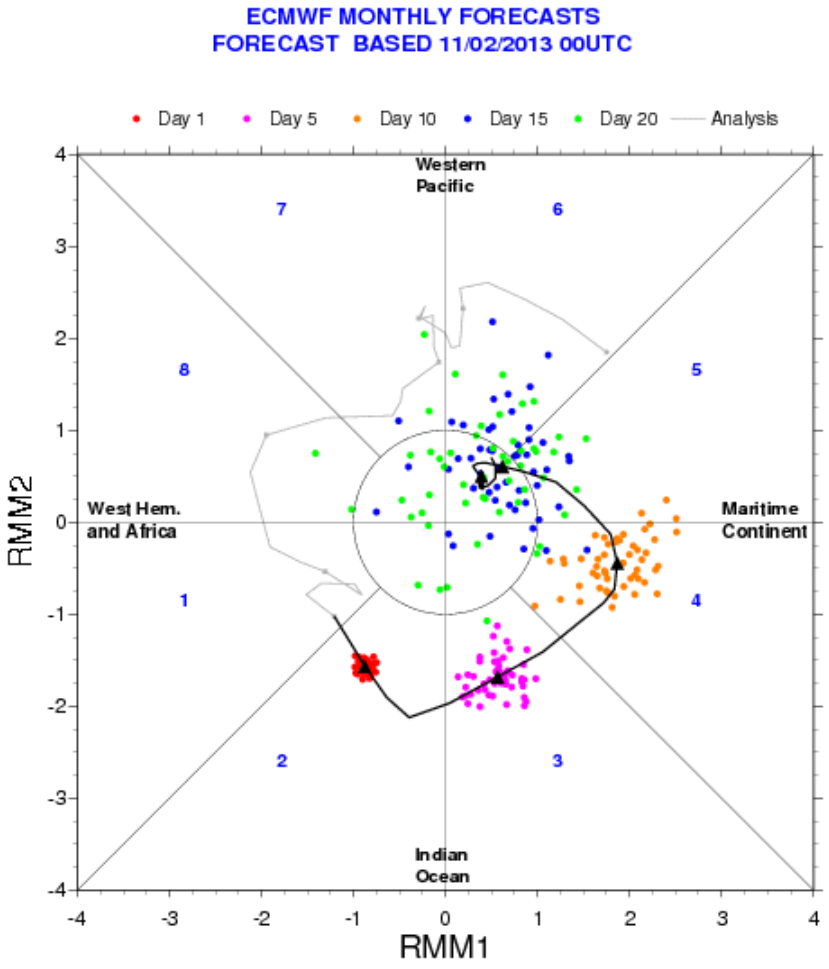


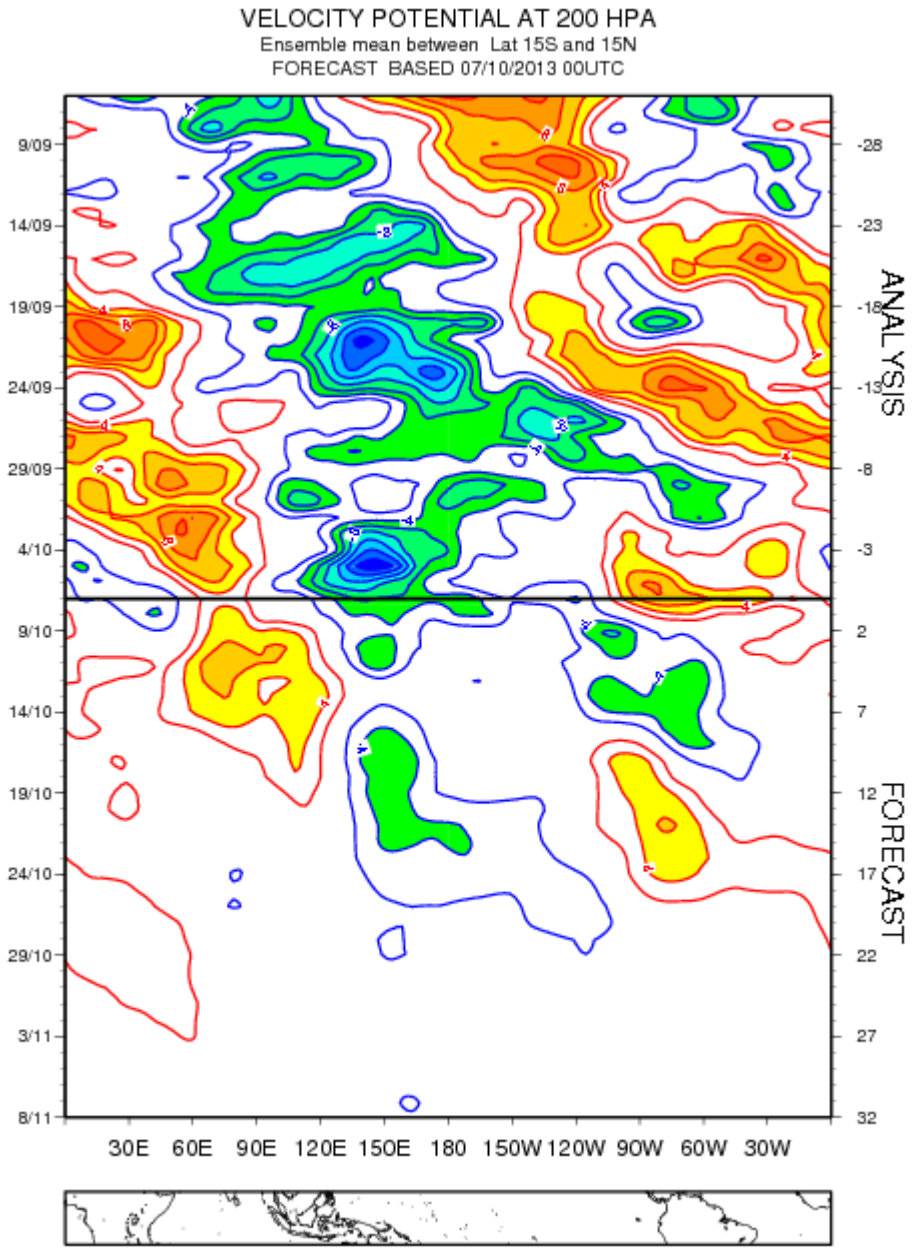
MJO in IC NO MJO in IC

ECMWF

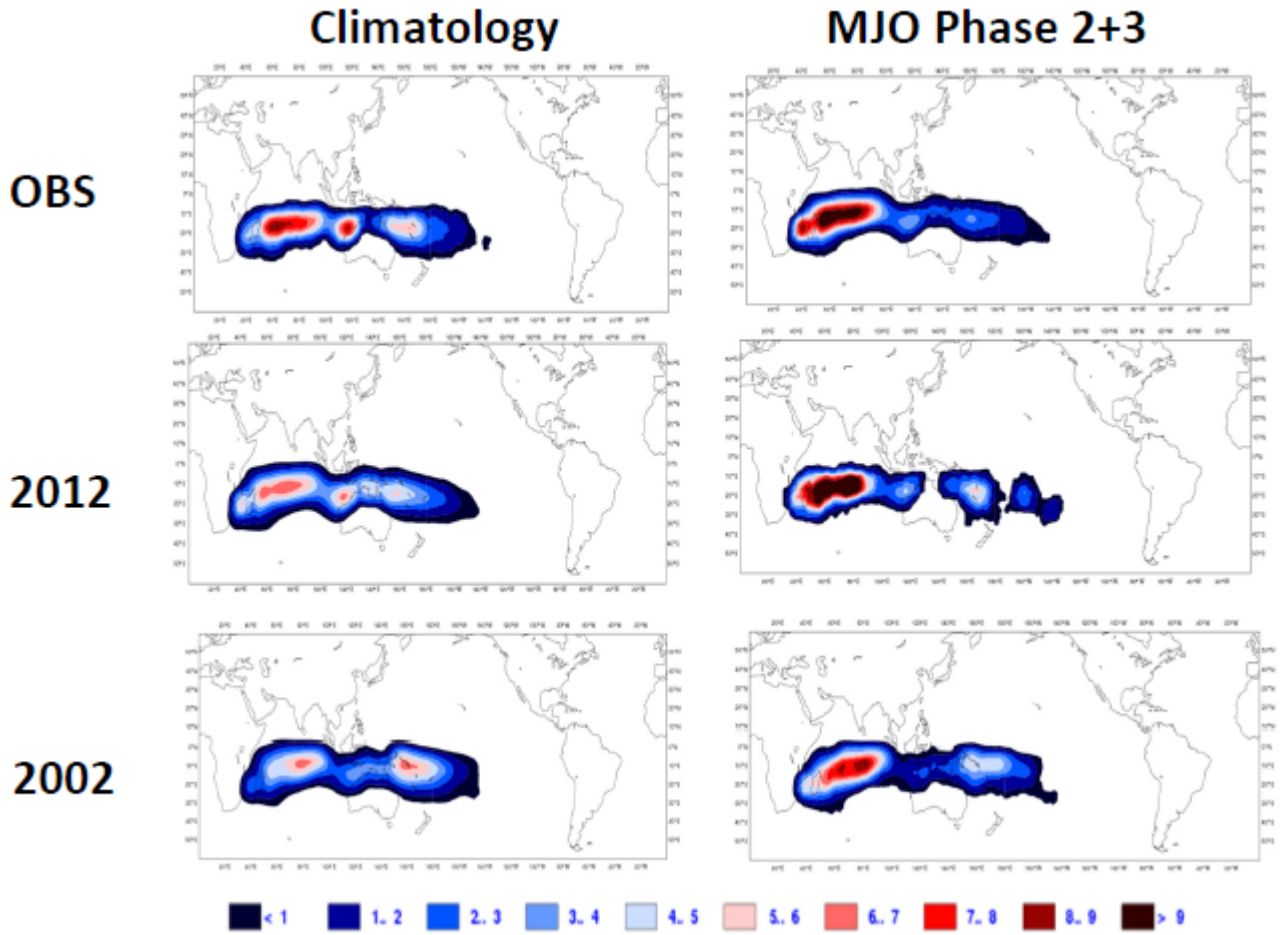
MJO latest forecast:

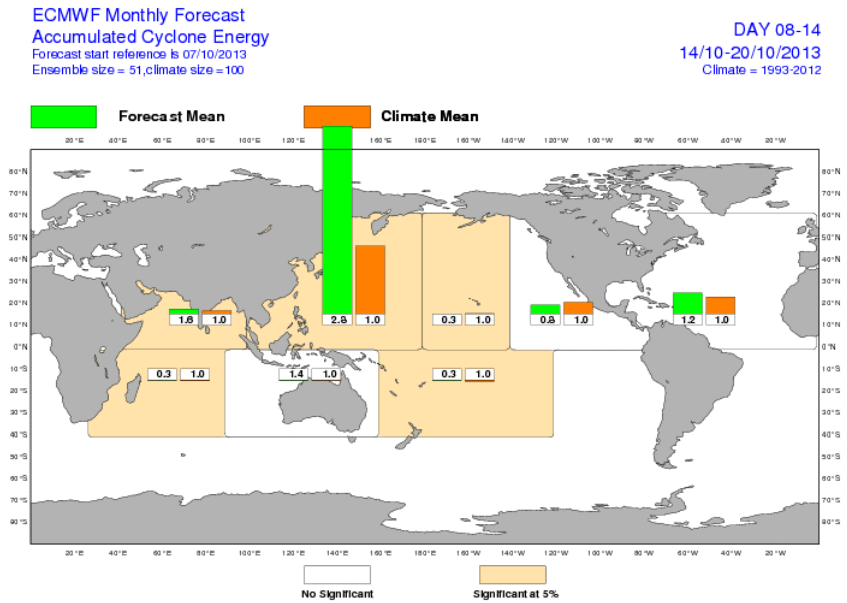




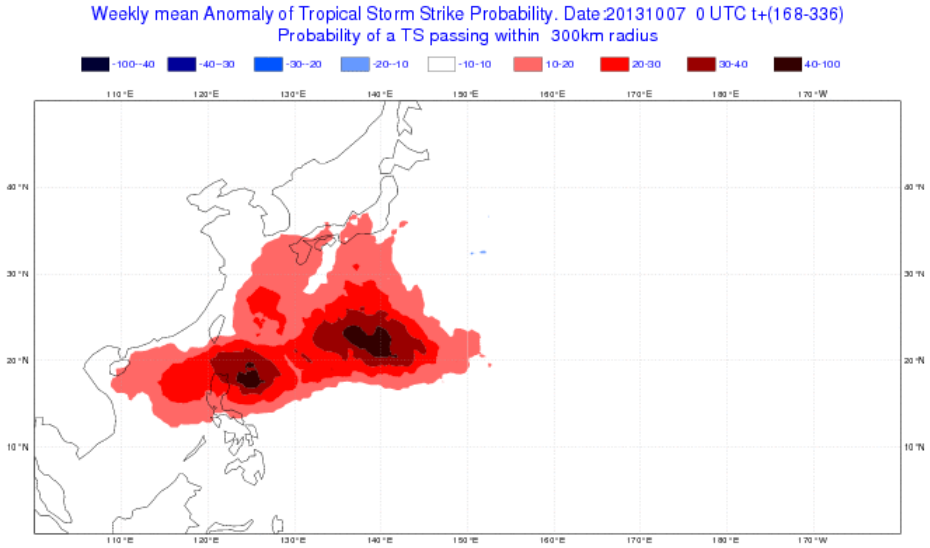

VELOCITY POTENTIAL AT 200 HPA
Ensemble mean between Lat 15S and 15N
FORECAST BASED 07/10/2013 00UTC
9/09
14/09
19/09
24/09
29/09
4/10
9/10
14/10
19/10
24/10
29/10
3/11
8/11
-28
-23
-18
-13
-8
-3
2
7
12
17
22
27
32
ANALYSIS
FORECAST
30E 60E 90E 120E 150E 180 150W 120W 90W 60W 30W

Tropical storm density





Weekly mean
Accumulated Cyclone Energy (ACE)

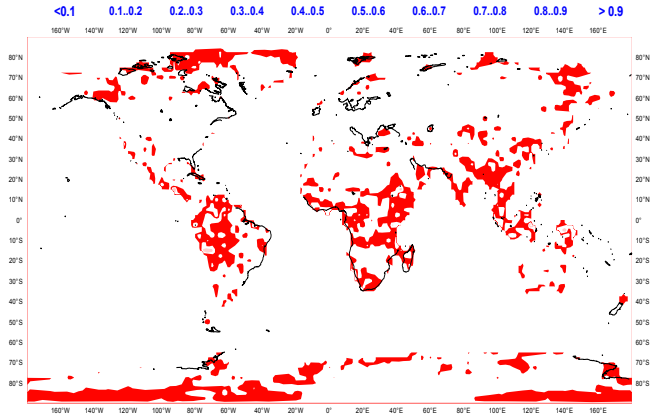


Probability of Trop. Storm
Forecast anomalies

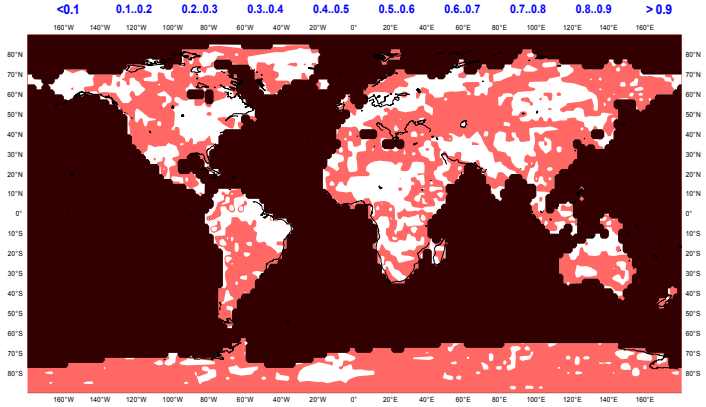
Skill of the ECMWF Monthly Forecasting System

ROC score: 2-meter temperature in the upper tercile

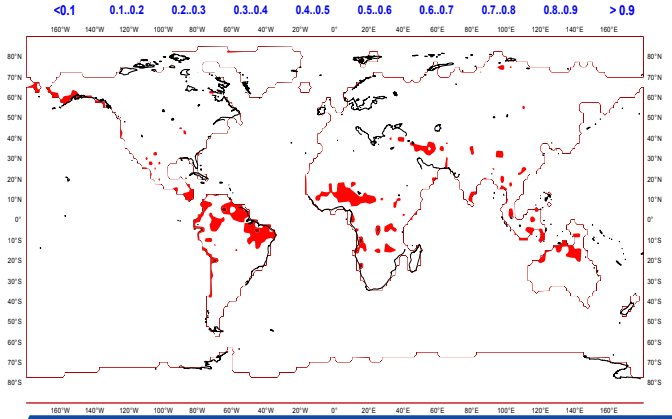
Day 5-11



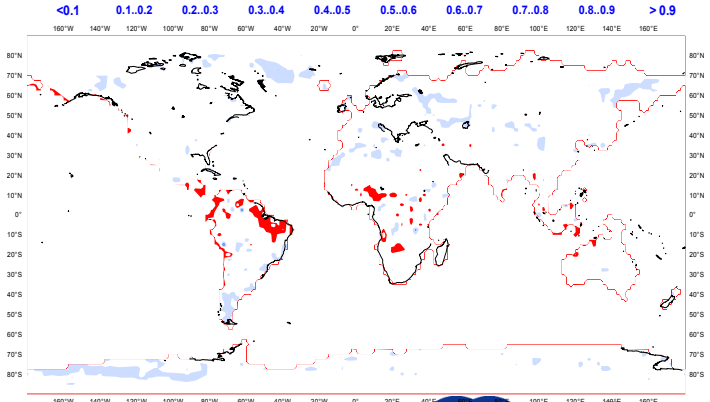
Day 12-18



Day 19-25



Day 26-32

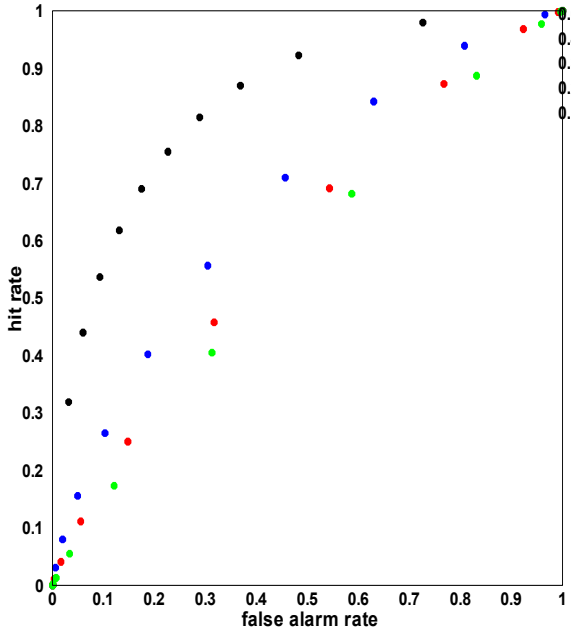


ECMWF

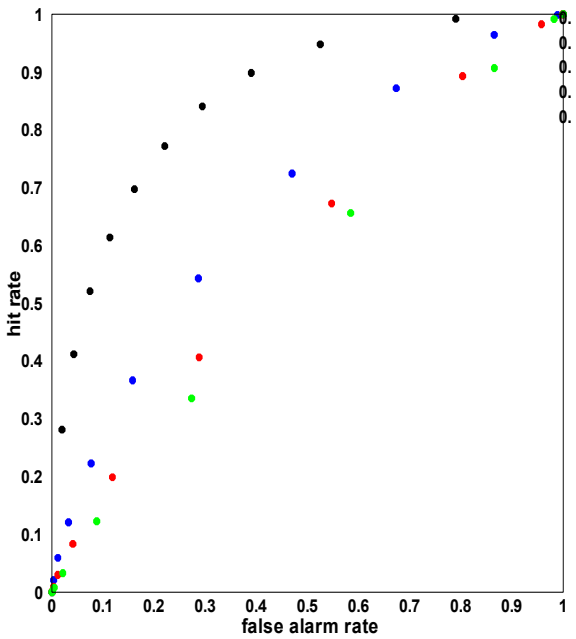
Skill of the ECMWF Monthly Forecasting System

ROC scores over the Northern extratropics

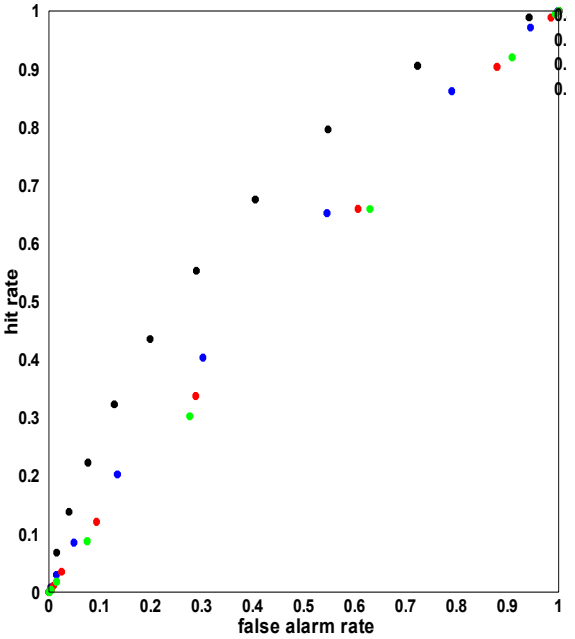
2-metre temperature



Mean sea-level pressure



Precipitation

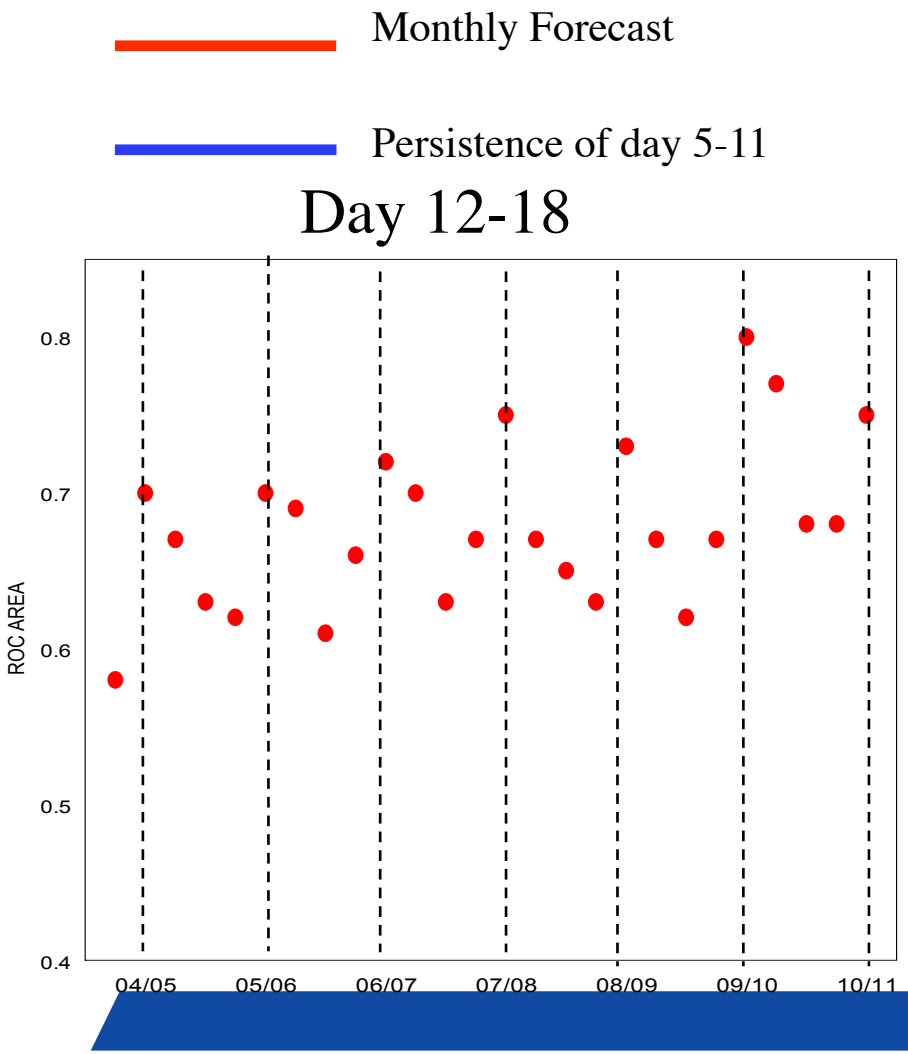


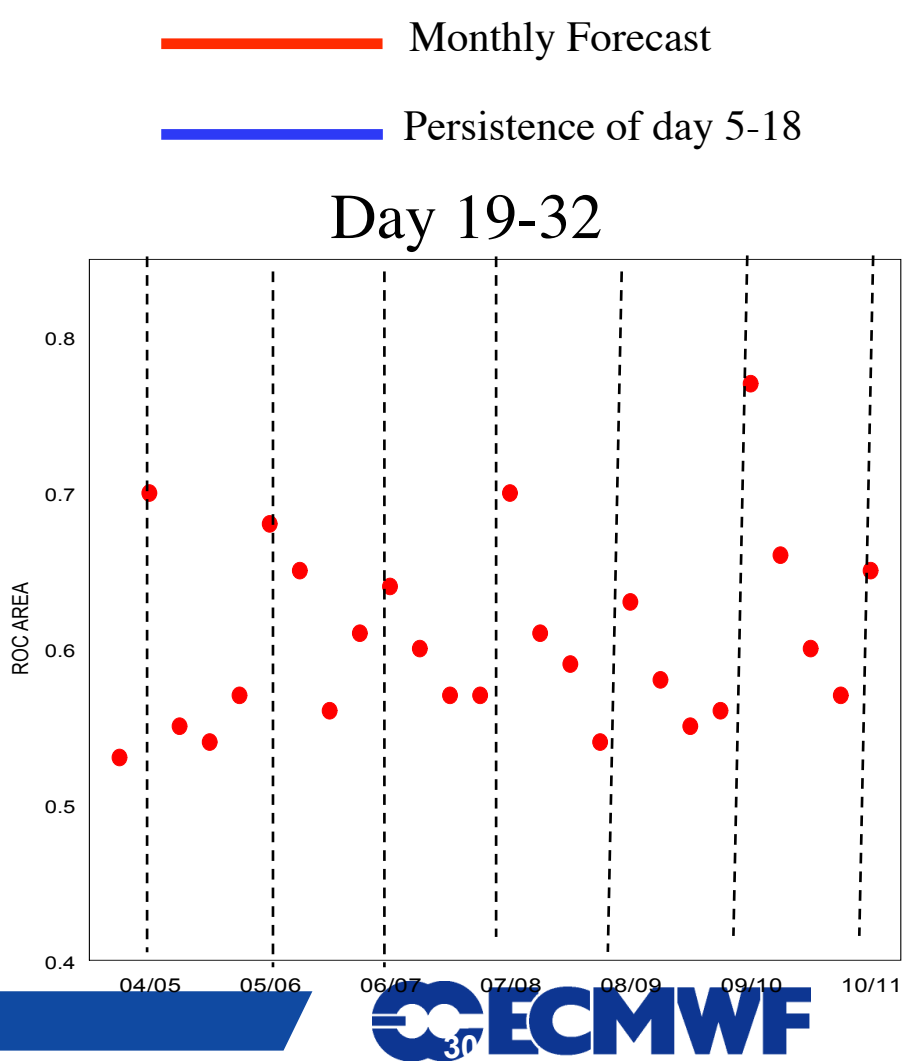
Day 5-11 Day12-18 Day19-25 Day 26-32

ECMWF

Monthly Forecast: Performance over the Northern Extratropics

ROC score: 2-meter temperature in the upper tercile



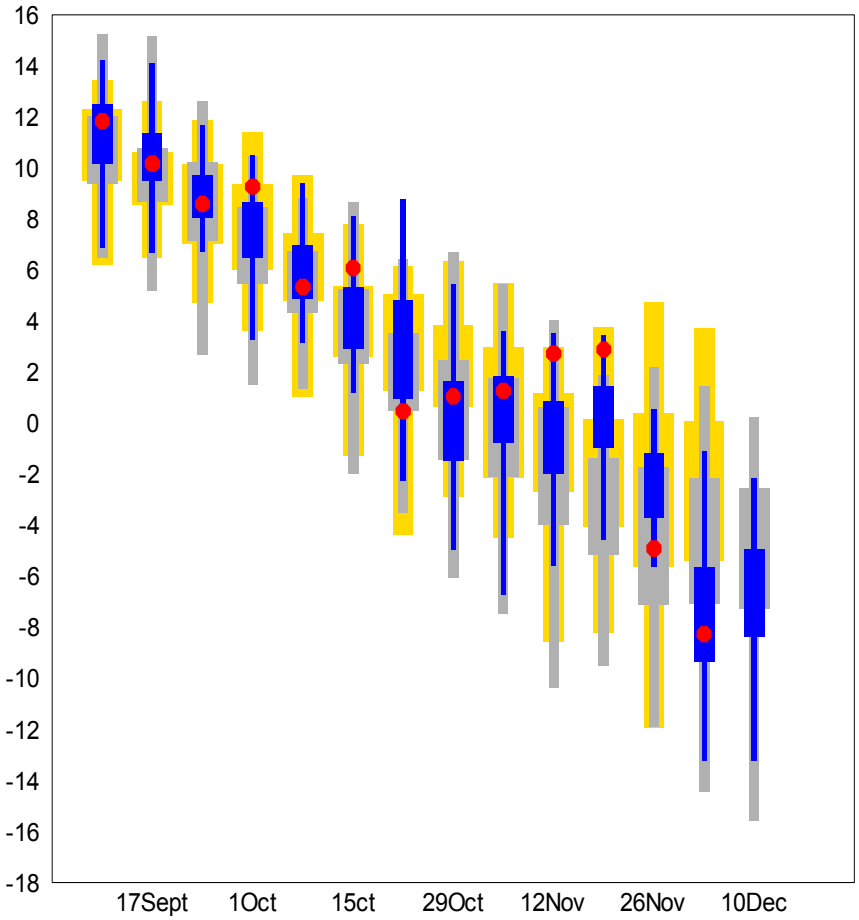


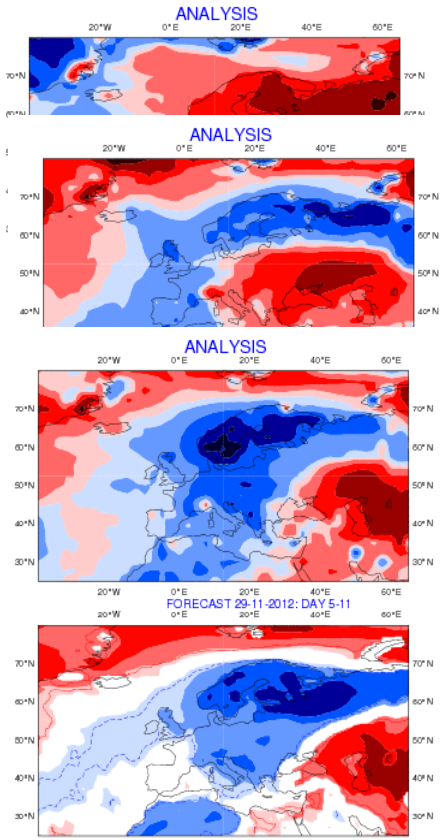
Conclusion

- 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. Model improvements, particularly in simulating the MJO activity are likely to be beneficial for monthly forecasting.

- The monthly forecasting system produces forecasts for days 12-18 that are generally better than climatology and persistence of day 5-11. Beyond day 20, the monthly forecast is marginally skilful. For some applications and some regions, these forecasts could however be of some interest.

MOFC 12-18 days2m temperature over Scandinavia

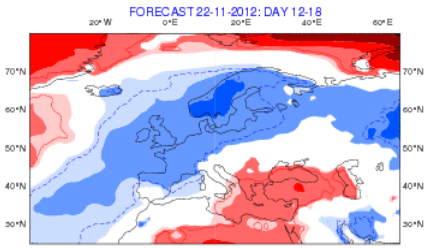


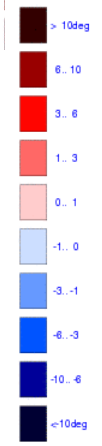


Analysis and ECMWF EPS-Monthly Forecasting Syste
2-metre Temperature anomaly

Analysis and ECMWF EPS-Monthly Forecasting Syste
2-metre Temperature anomaly
Verification period: 26-11-2012/TO/02-12-2012
ensemble size = 51 ,climate size = 100
Shaded areas significant at 10% level
Contours at 1% level

Analysis and ECMWF EPS-Monthly Forecasting Syste
2-metre Temperature anomaly
Verification period: 03-12-2012/TO/09-12-2012
ensemble size = 51 ,climate size = 100
Shaded areas significant at 10% level
Contours at 1% level



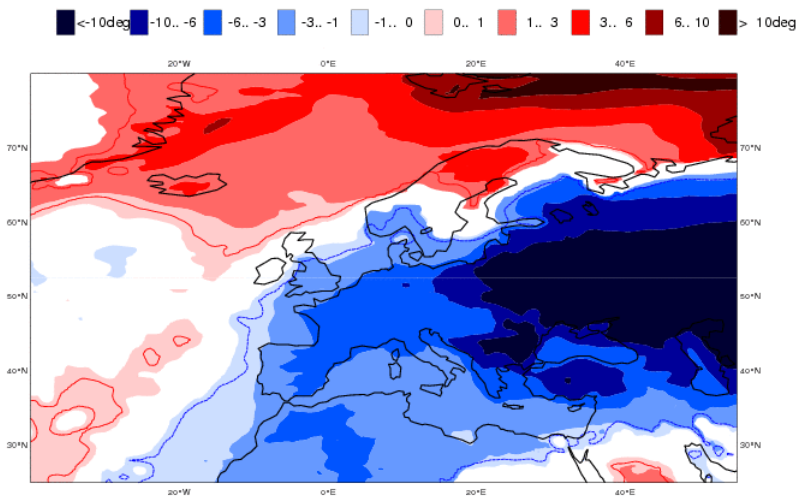


ECMWF

The ECMWF monthly forecasting system

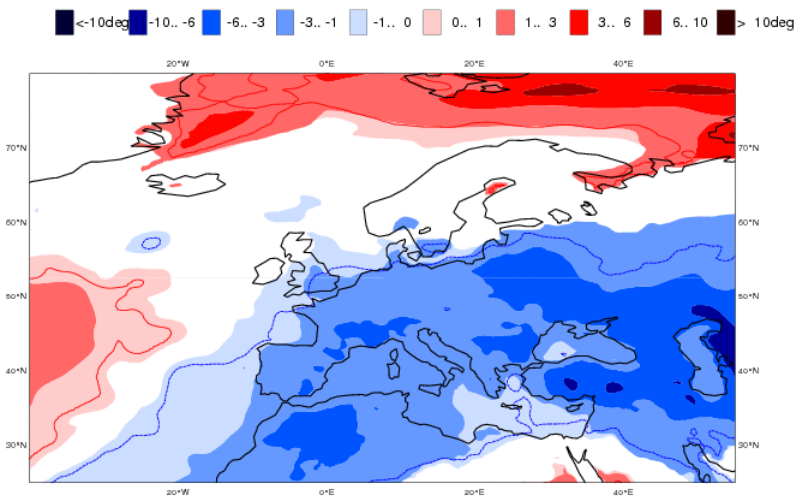
ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 26-01-2012
ensemble size = 51 ,climate size = 90

Day 5-11
30-01-2012/TO/05-02-2012
Shaded areas significant at 10% level
Contours at 1% level



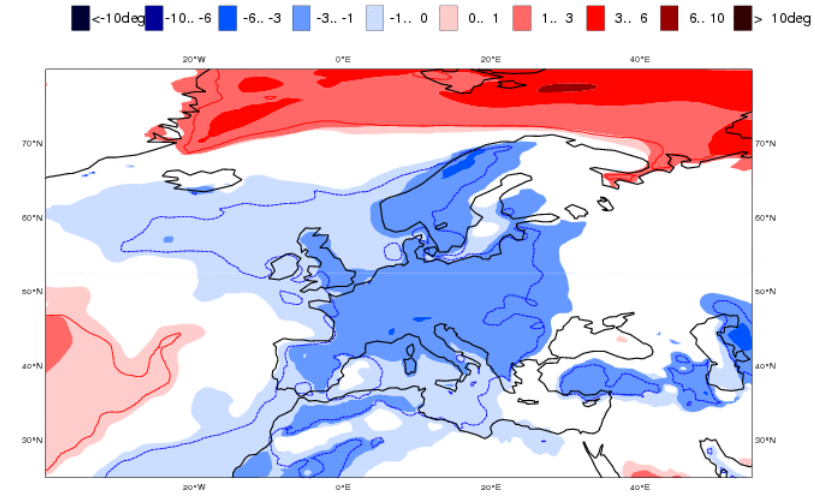
ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 26-01-2012
ensemble size = 51 ,climate size = 90

Day 12-18
06-02-2012/TO/12-02-2012
Shaded areas significant at 10% level
Contours at 1% level



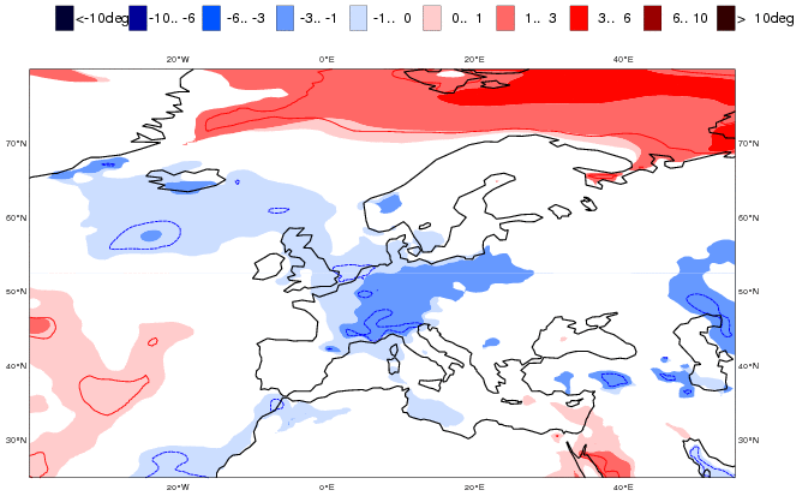
ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 26-01-2012
ensemble size = 51 ,climate size = 90

Day 19-25
13-02-2012/TO/19-02-2012
Shaded areas significant at 10% level
Contours at 1% level



ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 26-01-2012
ensemble size = 51 ,climate size = 90

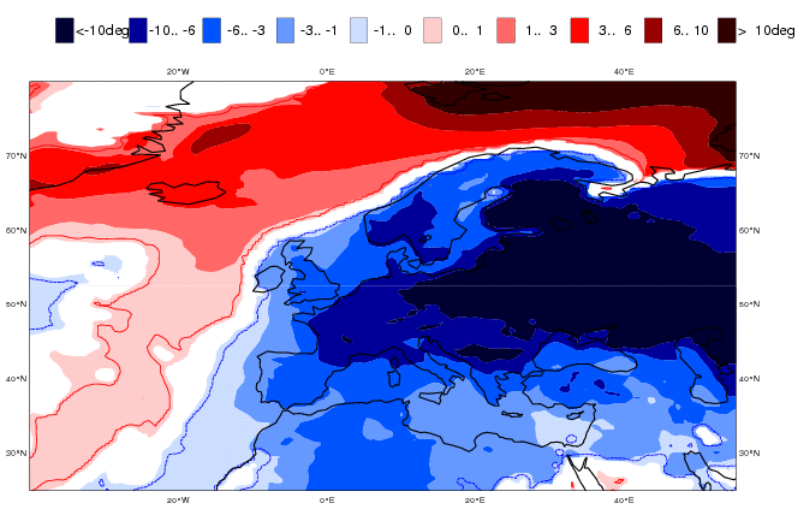
Day 26-32
20-02-2012/TO/26-02-2012
Shaded areas significant at 10% level
Contours at 1% level



The ECMWF monthly forecasting system

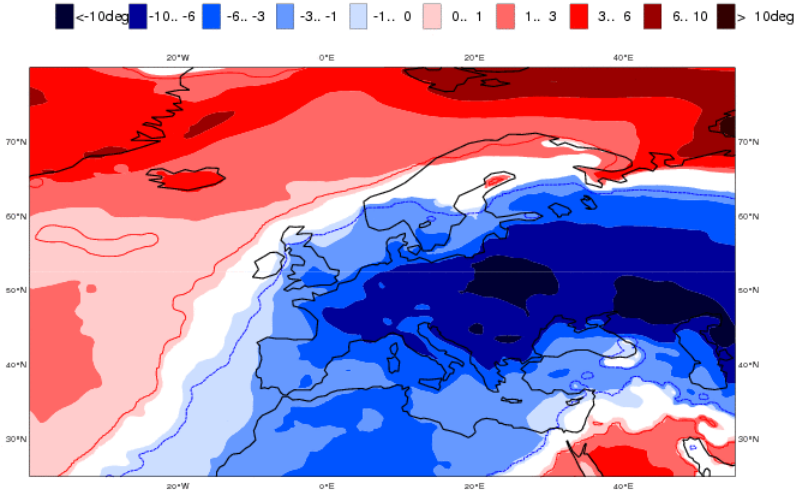
ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 30-01-2012
ensemble size = 51 ,climate size = 90

Day 1-7
30-01-2012/TO/05-02-2012
Shaded areas significant at 10% level
Contours at 1% level



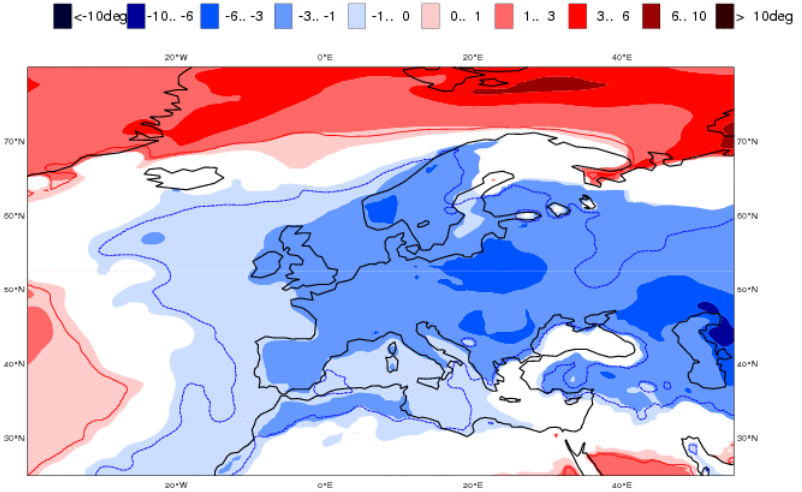
ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 30-01-2012
ensemble size = 51 ,climate size = 90

Day 8-14
06-02-2012/TO/12-02-2012
Shaded areas significant at 10% level
Contours at 1% level



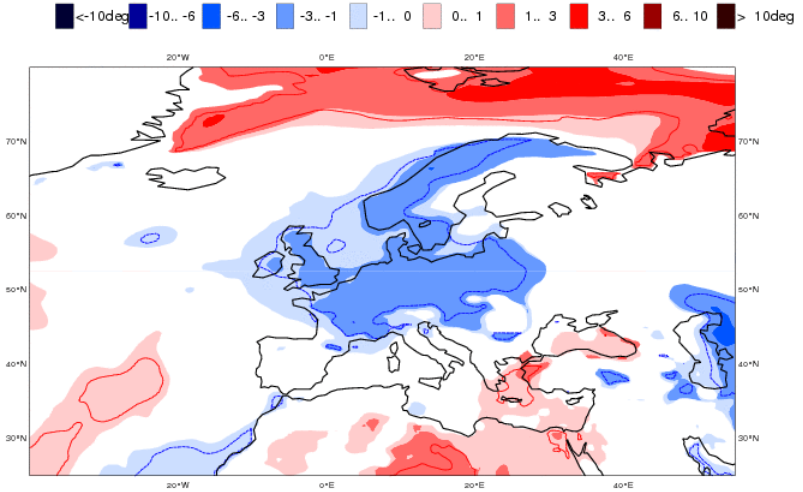
ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 30-01-2012
ensemble size = 51 ,climate size = 90

Day 15-21
13-02-2012/TO/19-02-2012
Shaded areas significant at 10% level
Contours at 1% level

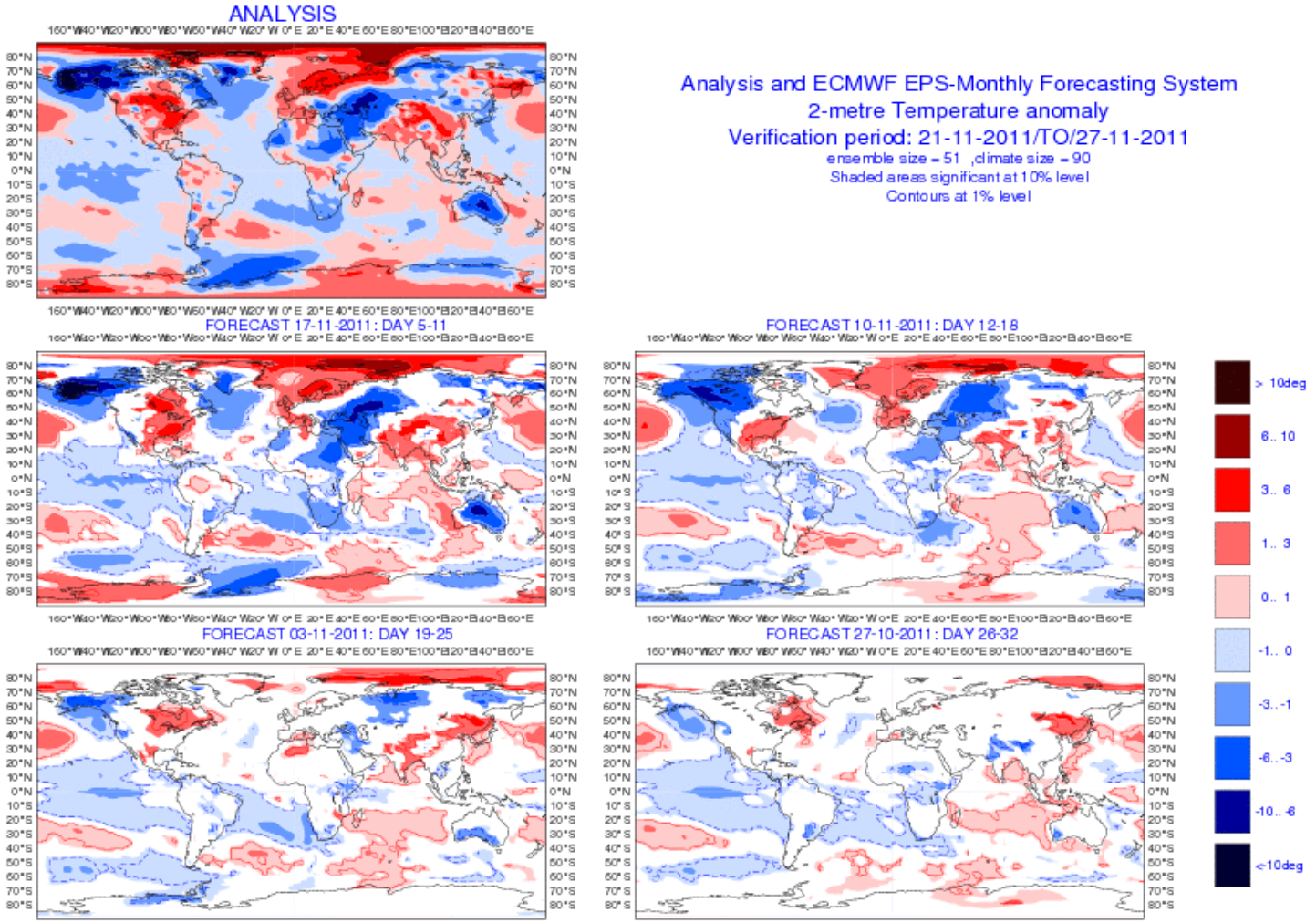


ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly
Forecast start reference is 30-01-2012
ensemble size = 51 ,climate size = 90

Day 22-28
20-02-2012/TO/26-02-2012
Shaded areas significant at 10% level
Contours at 1% level



Monthly forecast /EPS extension weekly T anomalies



Stratospheric Sudden warming- January 2009

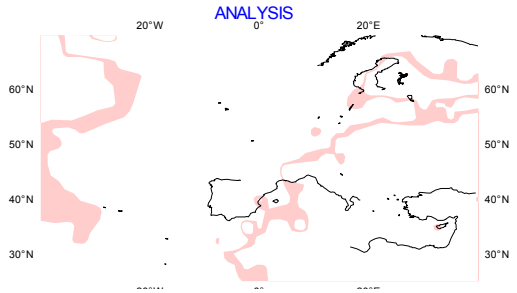
15/1/2009 2mtm anomaly Forecast

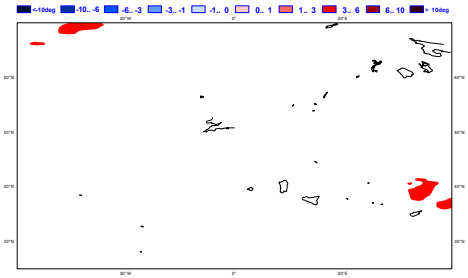
Analysis

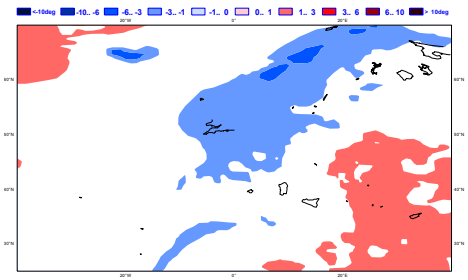
Composite Bad SW

Composite Good SW

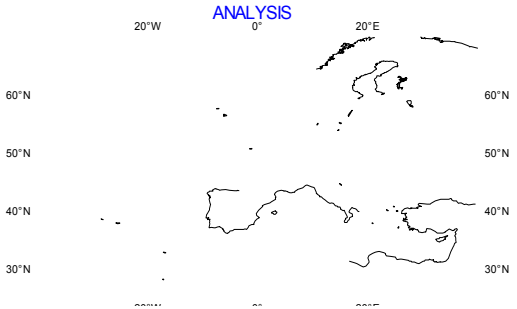
Day 19-25

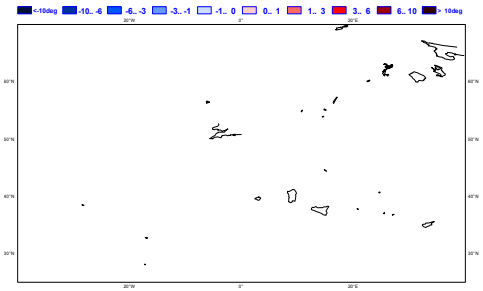


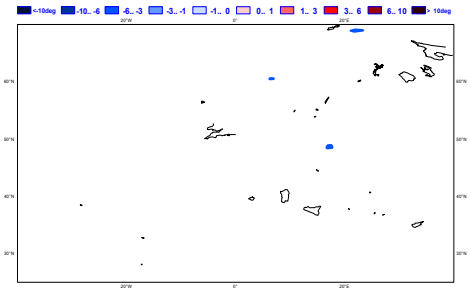




Day 26-32







<-10deg

-10.. -6

-6.. -3

-3.. -1

-1.. 0

0.. 1

1.. 3

3.. 6

6.. 10

> 10deg

ECMWF

The Madden Julian Oscillation (MJO)

- The MJO is a 40-50-day oscillation

- The MJO is a near-global scale, quasi-periodic eastward moving disturbance in the surface pressure, tropospheric temperature and zonal winds over the equatorial belt.

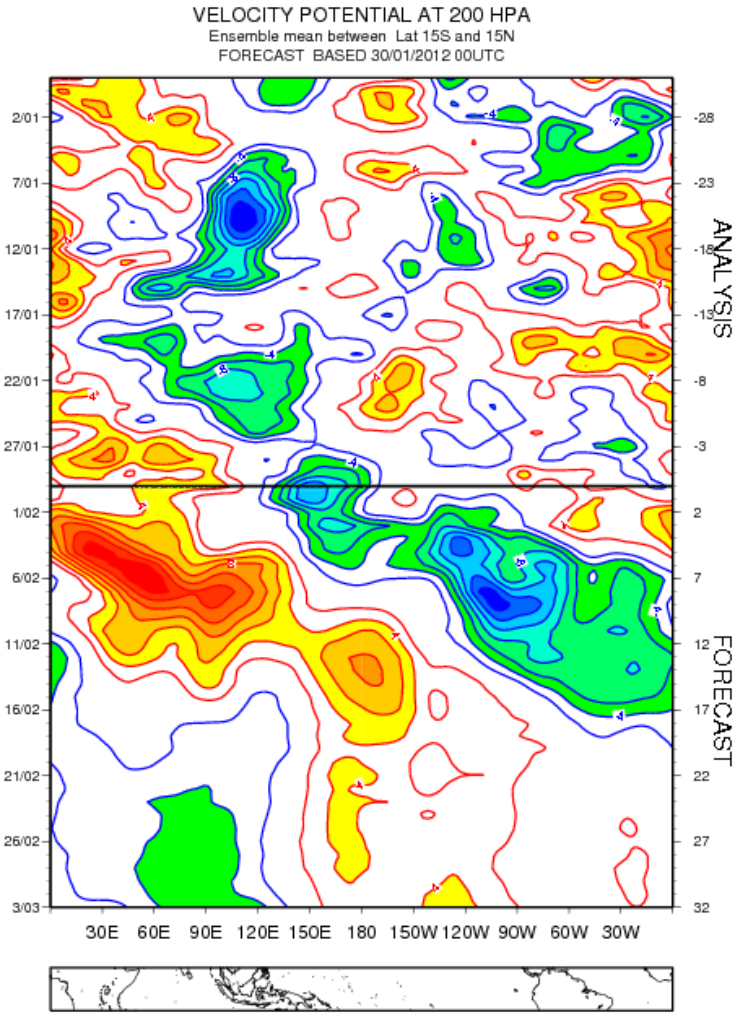
- The Madden-Julian Oscillation (MJO) is the dominant mode of variability in the tropics in time scales in excess of 1 week but less than 1 season.

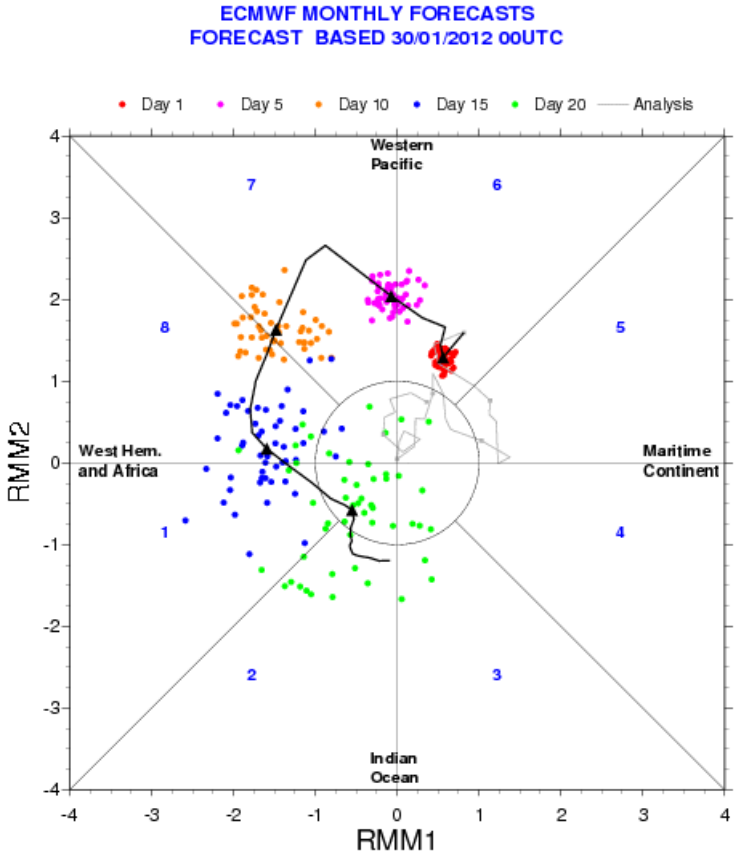
- The MJO has its peak activity during Northern winter and spring.

The Madden Julian Oscillation (MJO)

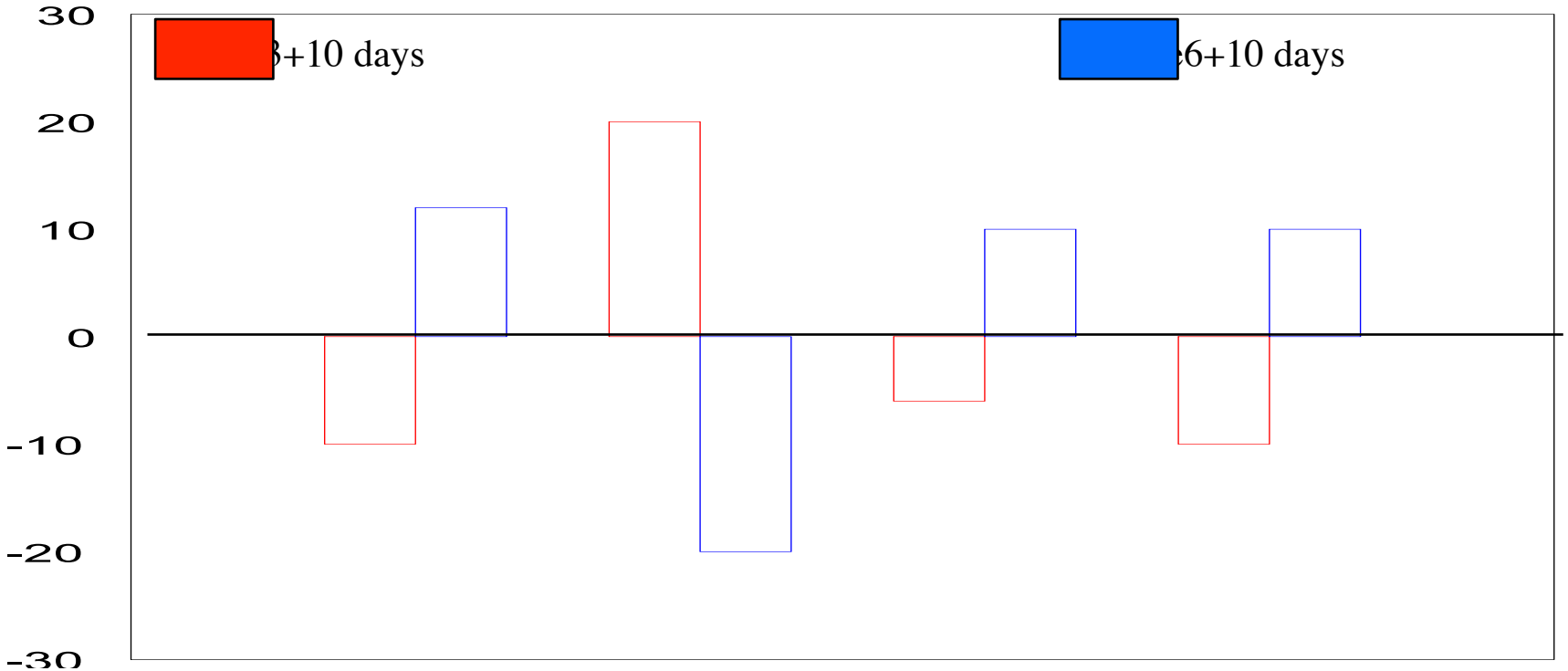
Why is the MJO so important?

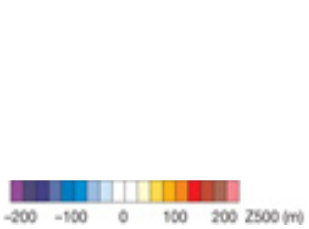
- **Impact on the Indian and Australian summer monsoons (Yasunari 1979), Hendon and Liebman (1990)**
- **Impact on ENSO. Westerly wind bursts produce equatorial trapped Kelvin waves, which have a significant impact on the onset and development of an El-Niňo event. Kessler and McPhaden (1995)**
- **Impact on tropical storms (Maloney et al, 2000; Mo, 2000)**
- **Impact on Northern Hemisphere weather**

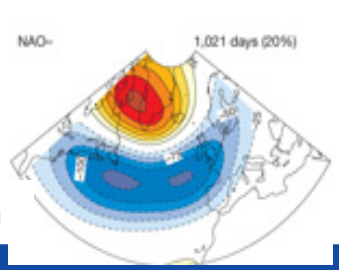

VELOCITY POTENTIAL AT 200 HPA
Ensemble mean between Lat 15S and 15N
FORECAST BASED 30/01/2012 00UTC
2/01
7/01
12/01
17/01
22/01
27/01
1/02
6/02
11/02
16/02
21/02
26/02
3/03
-28
-23
-18
-13
-8
-3
2
7
12
17
22
27
32
ANALYSIS
FORECAST
30E 60E 90E 120E 150E 180 150W 120W 90W 60W 30W

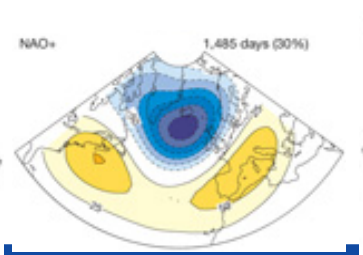

ECMWF MONTHLY FORECASTS
FORECAST BASED 30/01/2012 00UTC
Day 1
Day 5
Day 10
Day 15
Day 20
Analysis
Western Pacific
West Hem. and Africa
Maritime Continent
Indian Ocean
1
2
3
4
5
6
7
8
RMM1
RMM2

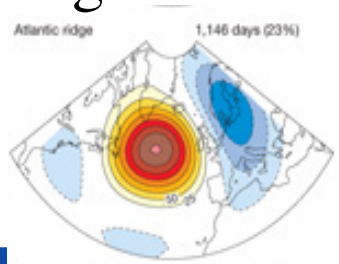
Impact on weather regimes in hindcasts

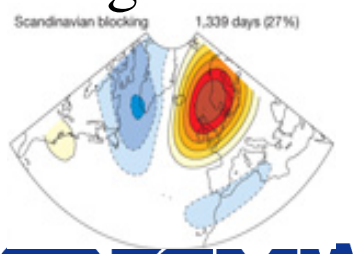






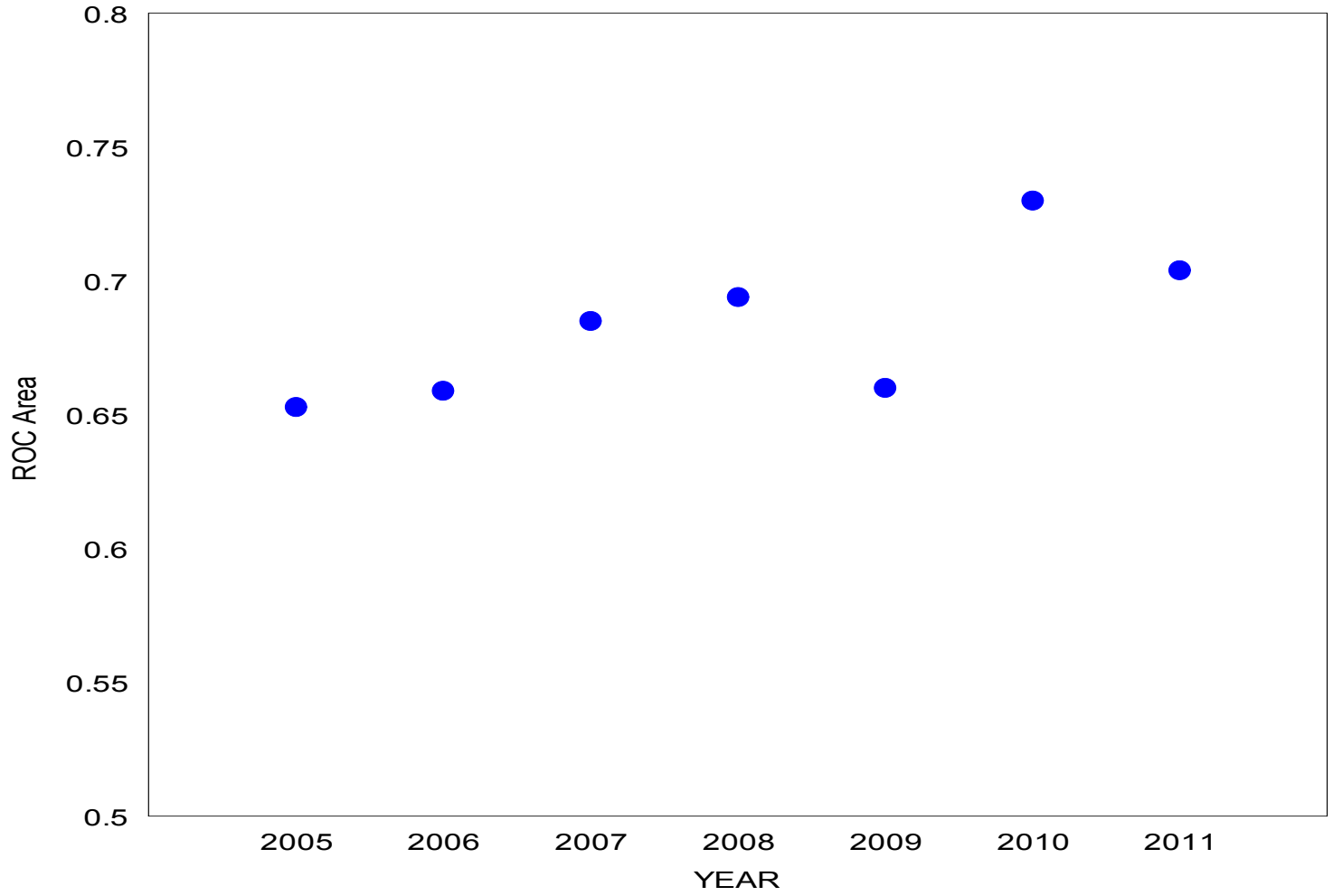






ECMWF

Performance of the Monthly forecast /EPS extension

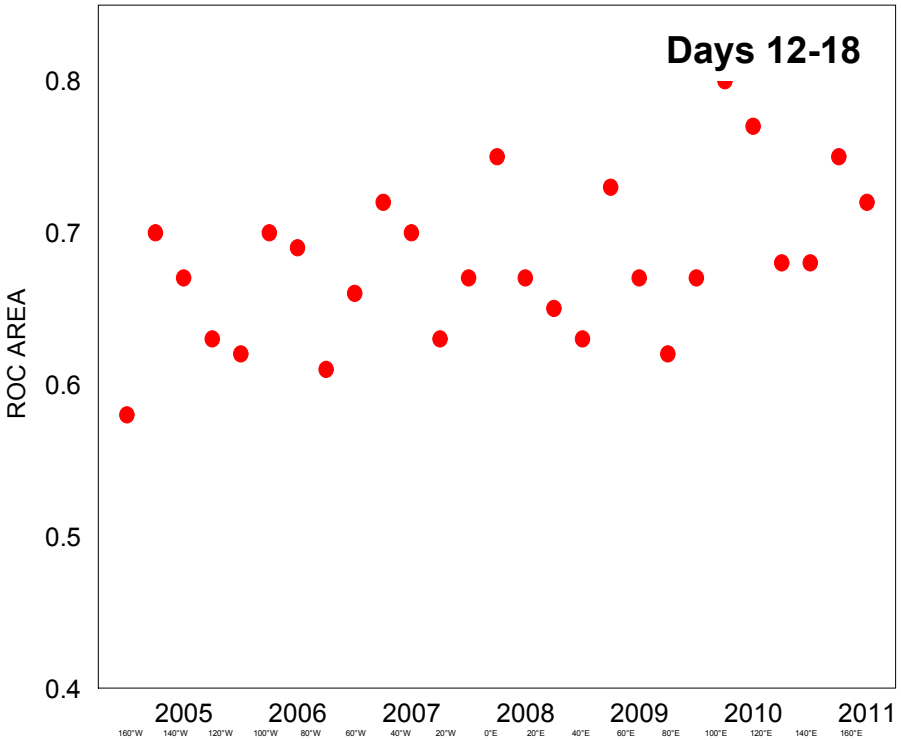


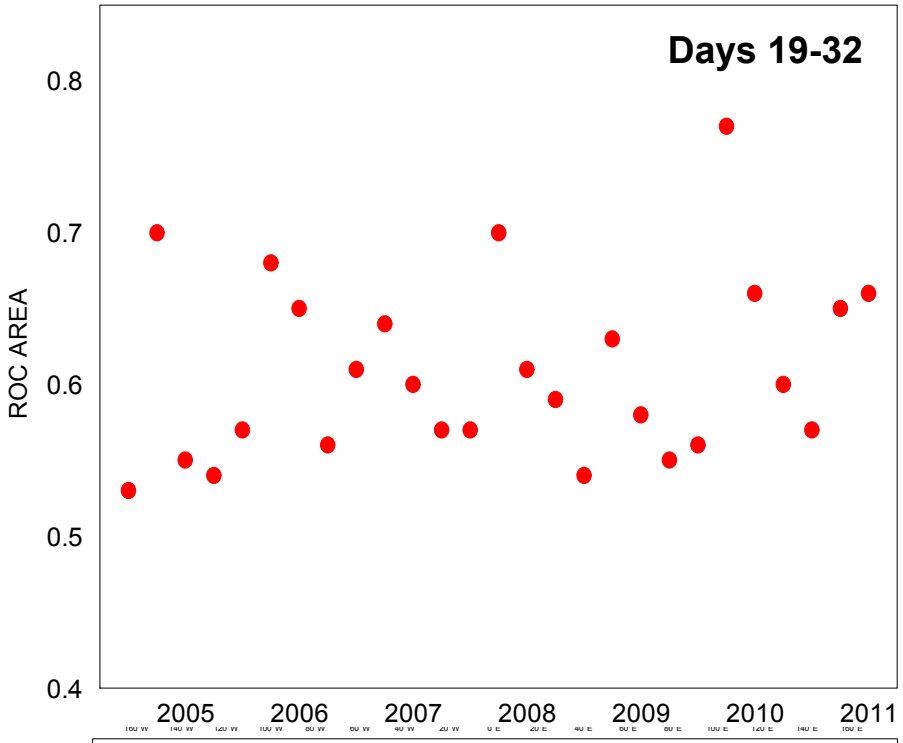
Day 12-18 Day 19-25 Day 26-32

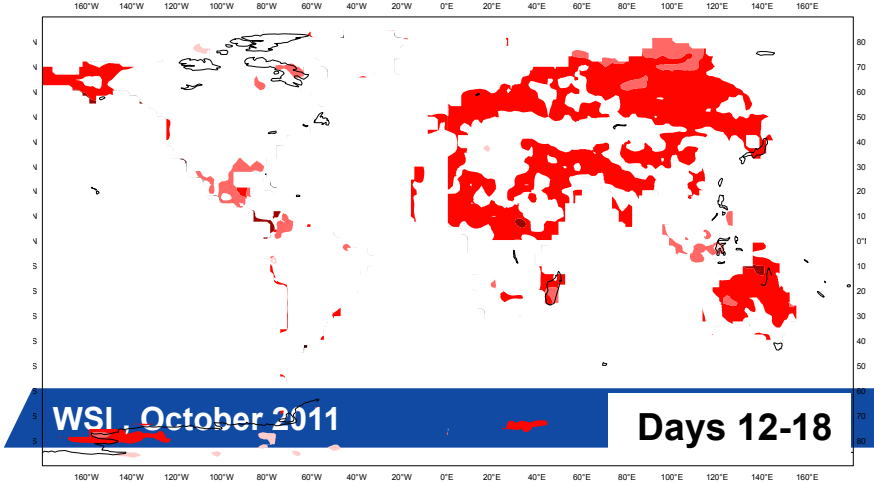
ECMWF

Monthly forecasts – verification (T2m)

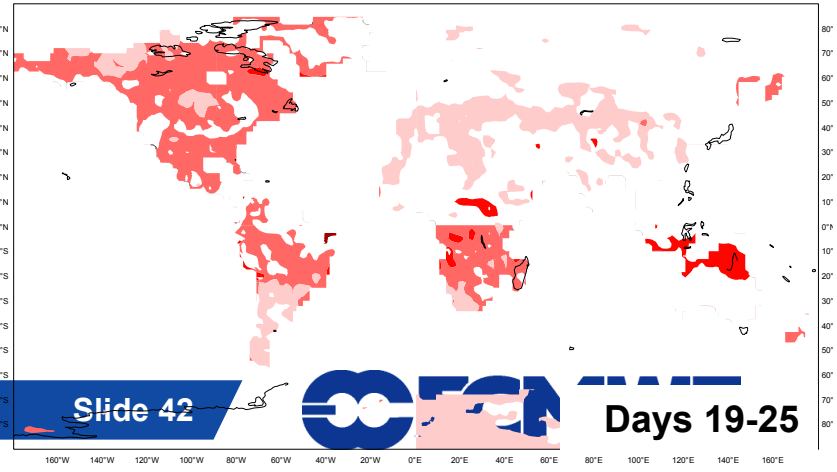
skill in terms of weekly means







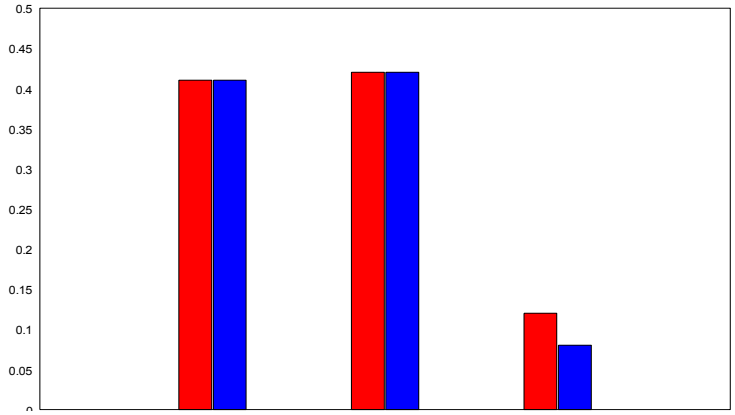
WSI , October 2011 Days 12-18



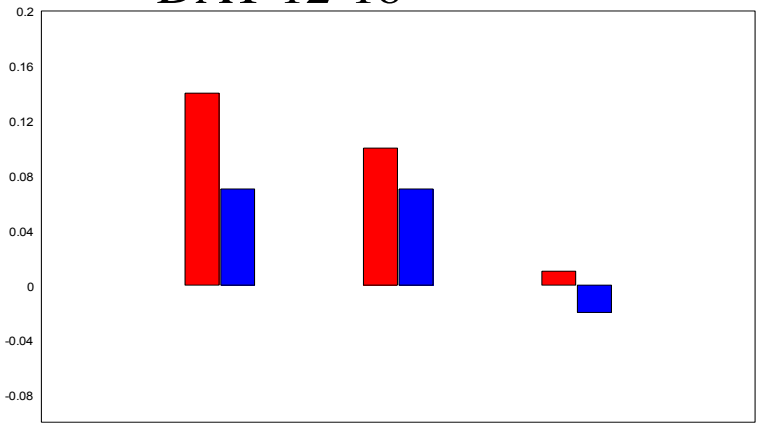
Slide 42 Days 19-25

Impact of the MJO on Brier Skill Scores
NDJFMA 1989-2008- N. Extratropics

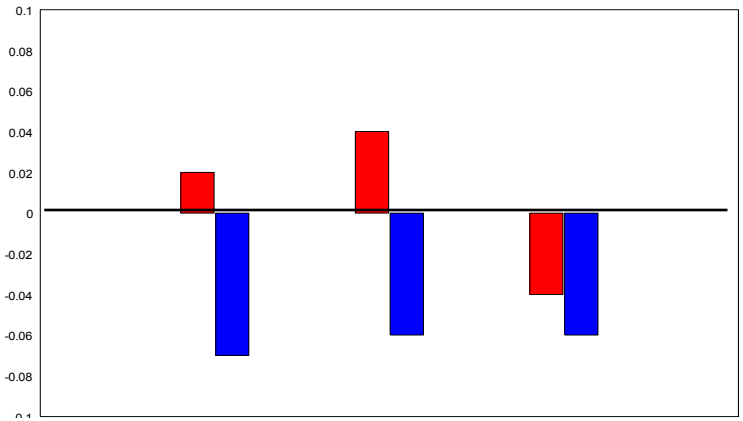
DAY 5-11



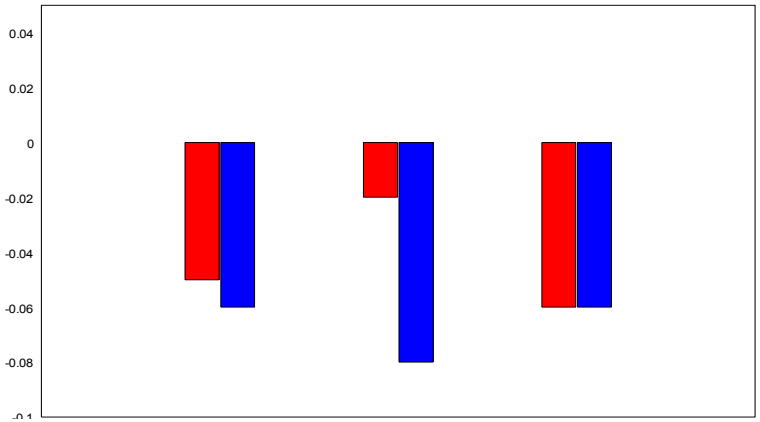
DAY 12-18



DAY 19-25



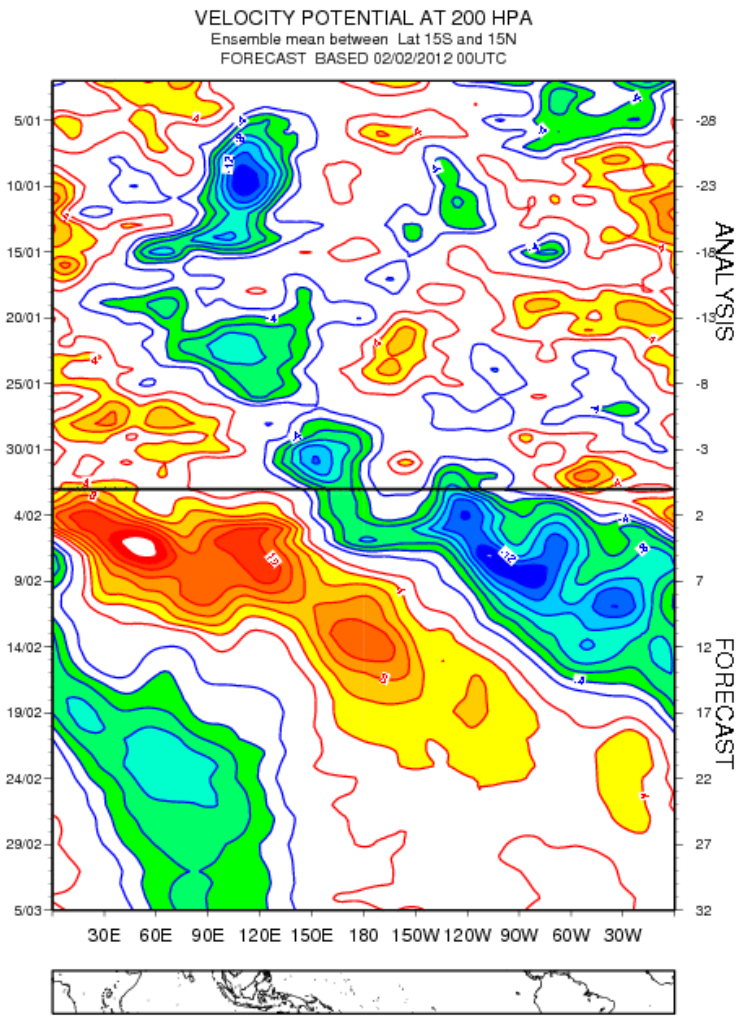
DAY 26-32



MJO in IC

NO MJO in IC

ECMWF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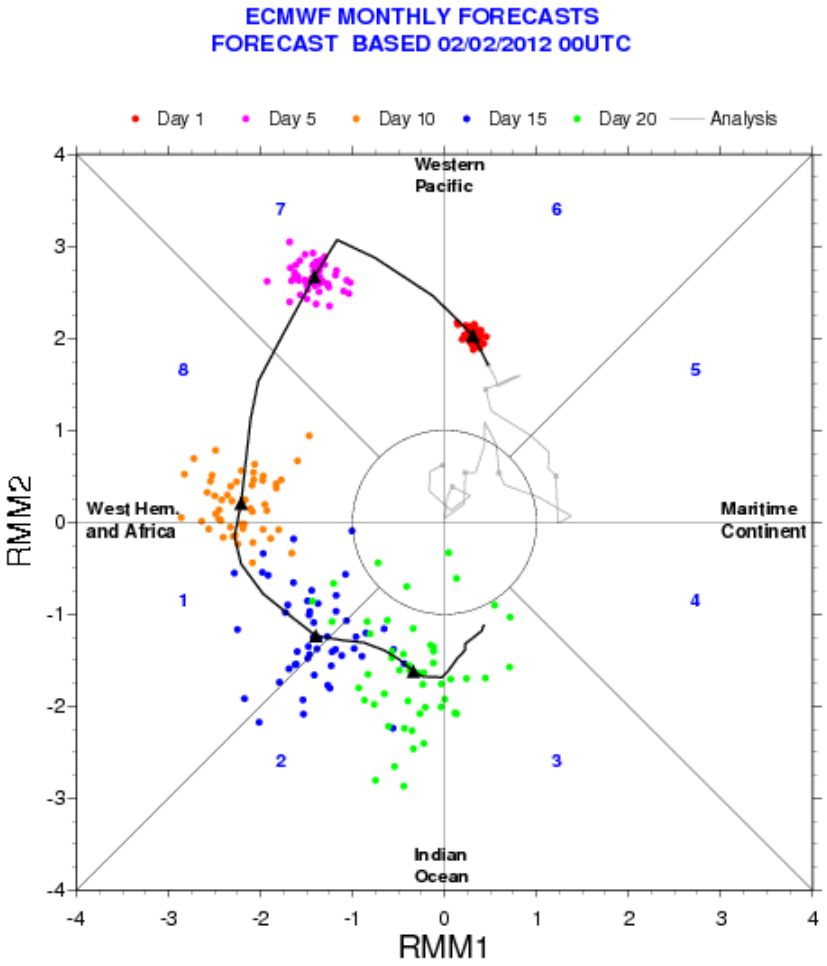
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FORECAST BASED 02/02/2012 00UTC
Day 1
Day 5
Day 10
Day 15
Day 20
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West Hem. and Africa
Maritime Continent
Indian Ocean
RMM1
RMM2