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 (ENS): twice daily
  51 members, 30/60 km 62-level, to 15 days ahead

- **Extended range forecasts /ENS extension: twice a week (Mon/Thursdays)**
  51 members, 30/60 km 92 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

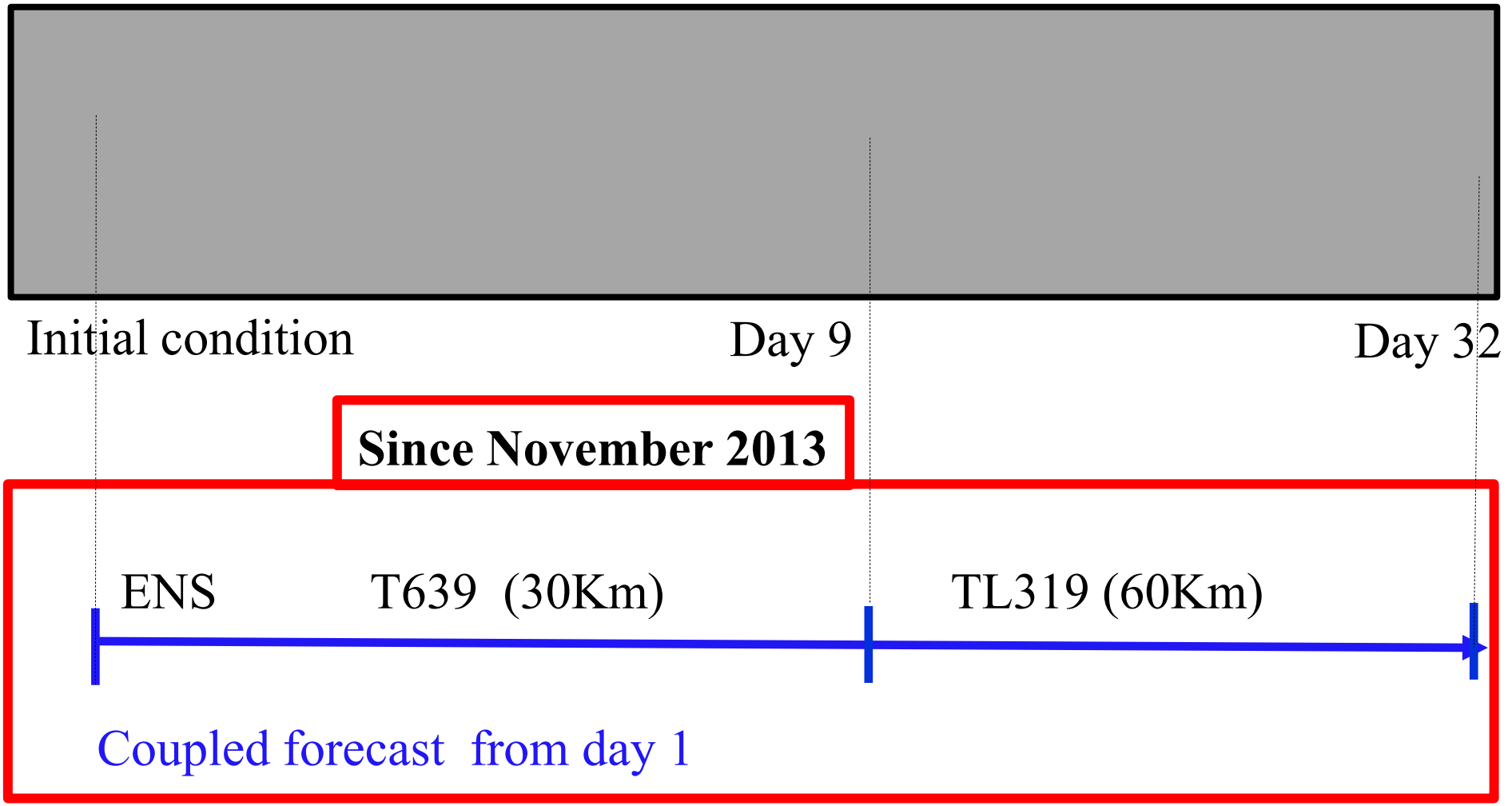
Bridging the gap between seasonal forecasting and NWP

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 :**
  - **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…)**

Extended range forecast /ENS extension



Model Bias:

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

WEEK1-4

WEEK1: DAY 5 TO 11

WEEK2: DAY 12 TO 18

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.

Day19-25

Day 26-32

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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

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

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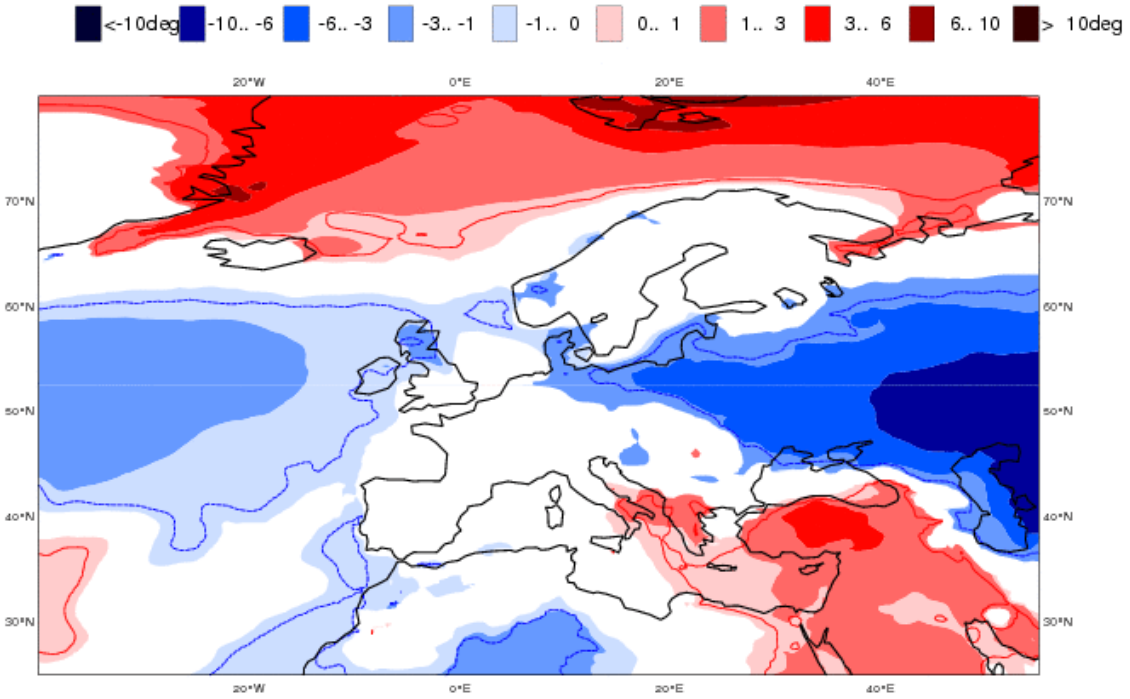
Show overview

Parameter
Valid calendar week
Area
Date

ECMWF EPS-Monthly Forecasting System
2-meter Temperature anomaly

Forecast start reference is 23-01-2014
ensemble size = 51 ,climate size = 100

Day 12-18
03-02-2014/TO/09-02-2014
Shaded areas significant at 10% level
Contours at 1% level



Probabilities (temperature)

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Show guide

Weekly terciles

Parameter

precipitation
temperature
2m temperature
mean sea level pressure

Tercile

lower
upper

Area

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

Date

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

Your Room

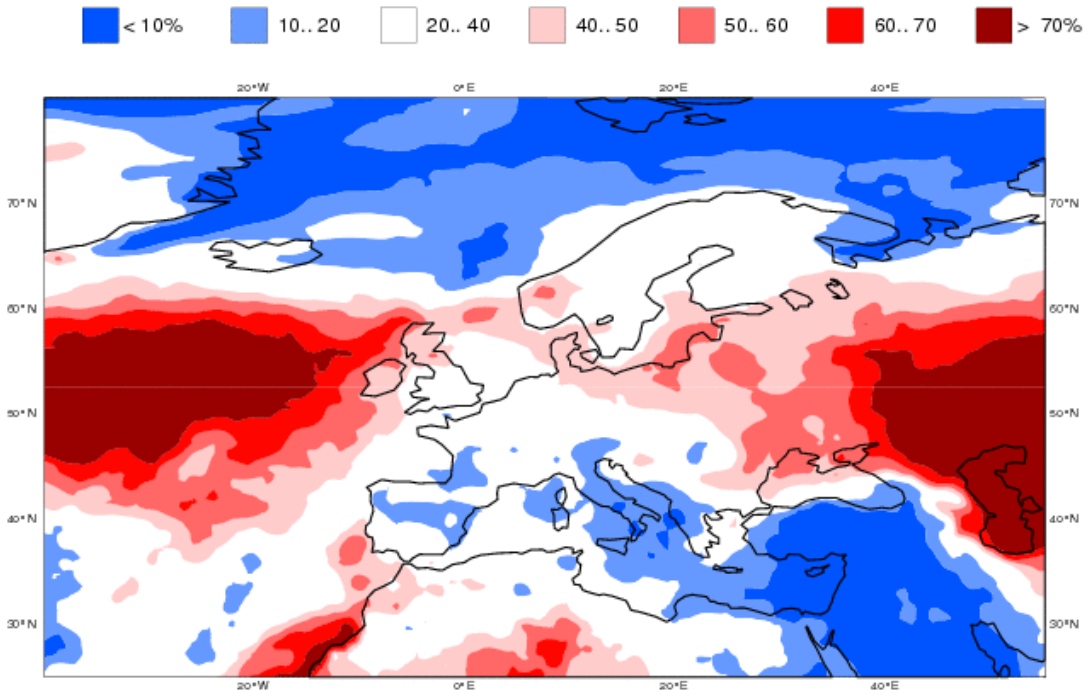
Add this product

Valid calendar week

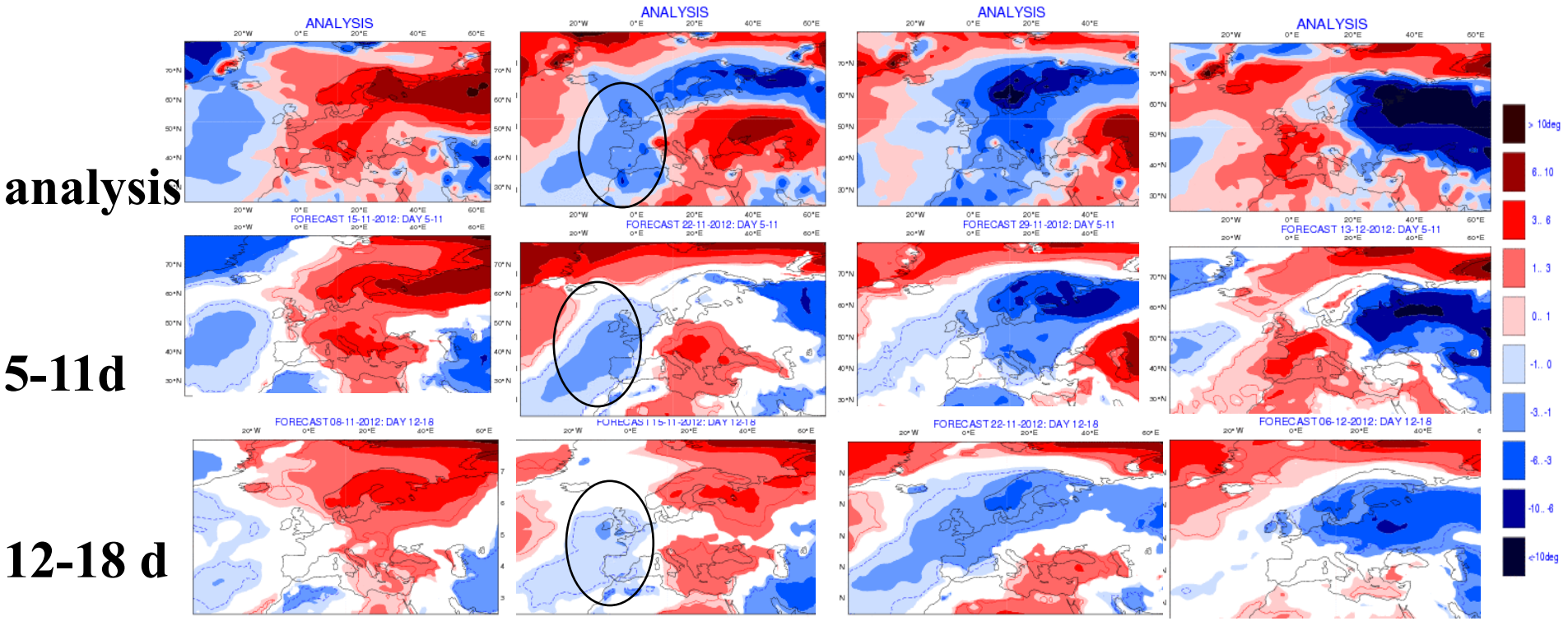
(Mon 3 Feb 2014 UTC to Sun 9 Feb 2014 UTC)

ECMWF EPS-Monthly Forecasting System
(Prob 2m Temp. anom below 33%)
Forecast start reference is 23-01-2014
ensemble size = 51 ,climate size = 100

Day 12-18
03-02-2014/TO/09-02-2014



Cold spell over Europe Nov-Dec 2012

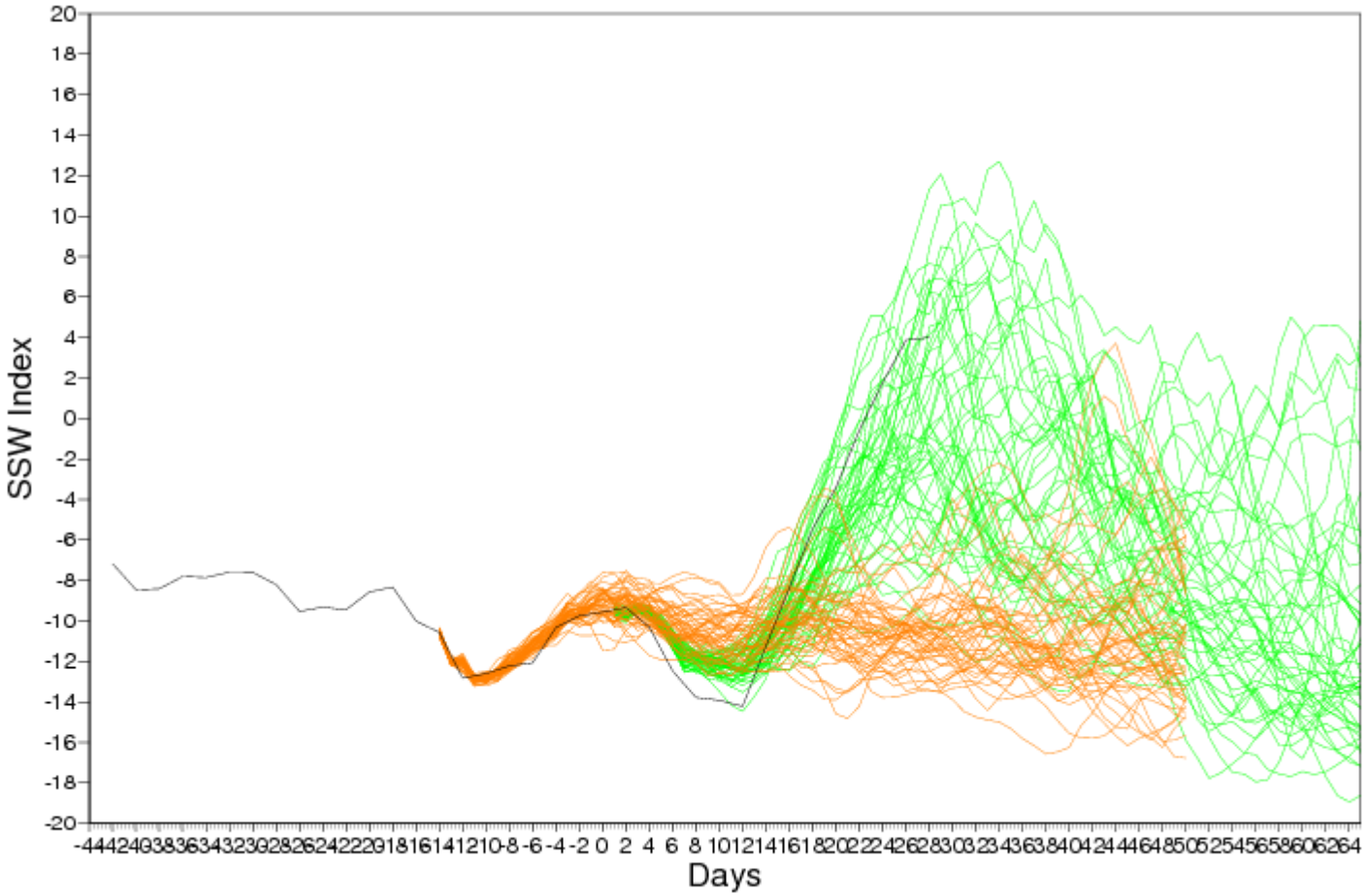


Cold Weather over Europe: SSW Index

Forecast starting on :

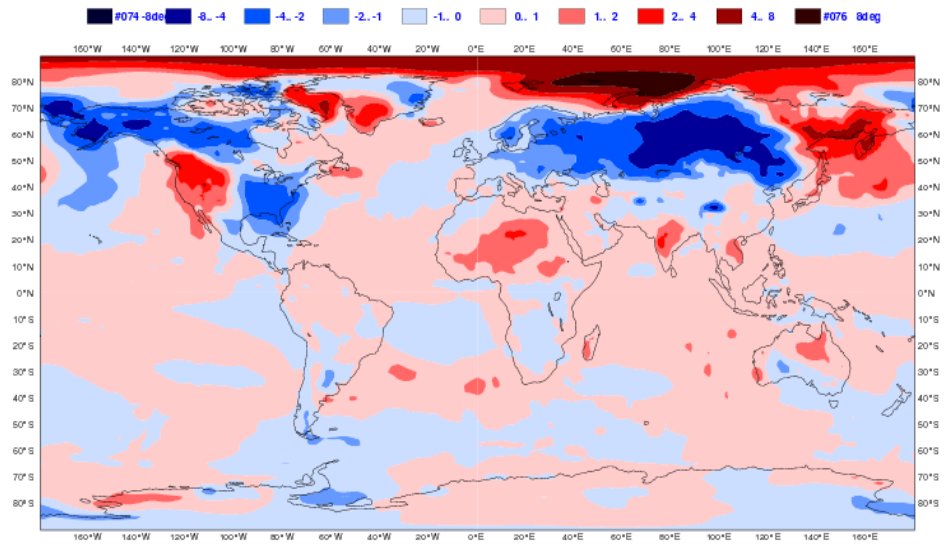
22/11/2012 ——

15/11/2012 ——

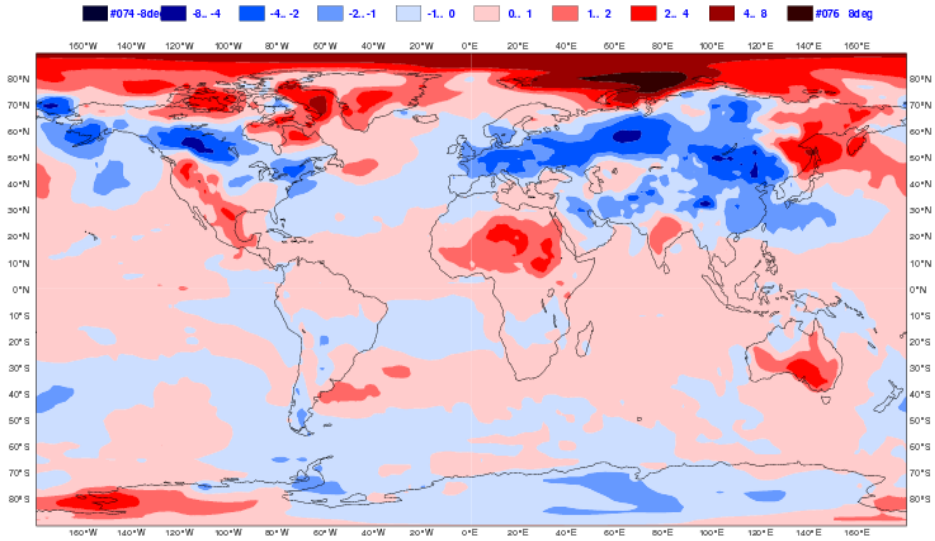


Cold Weather over Europe
SSW Index - Forecast starting on 22/11/2012

Strong SSW



Weak SSW



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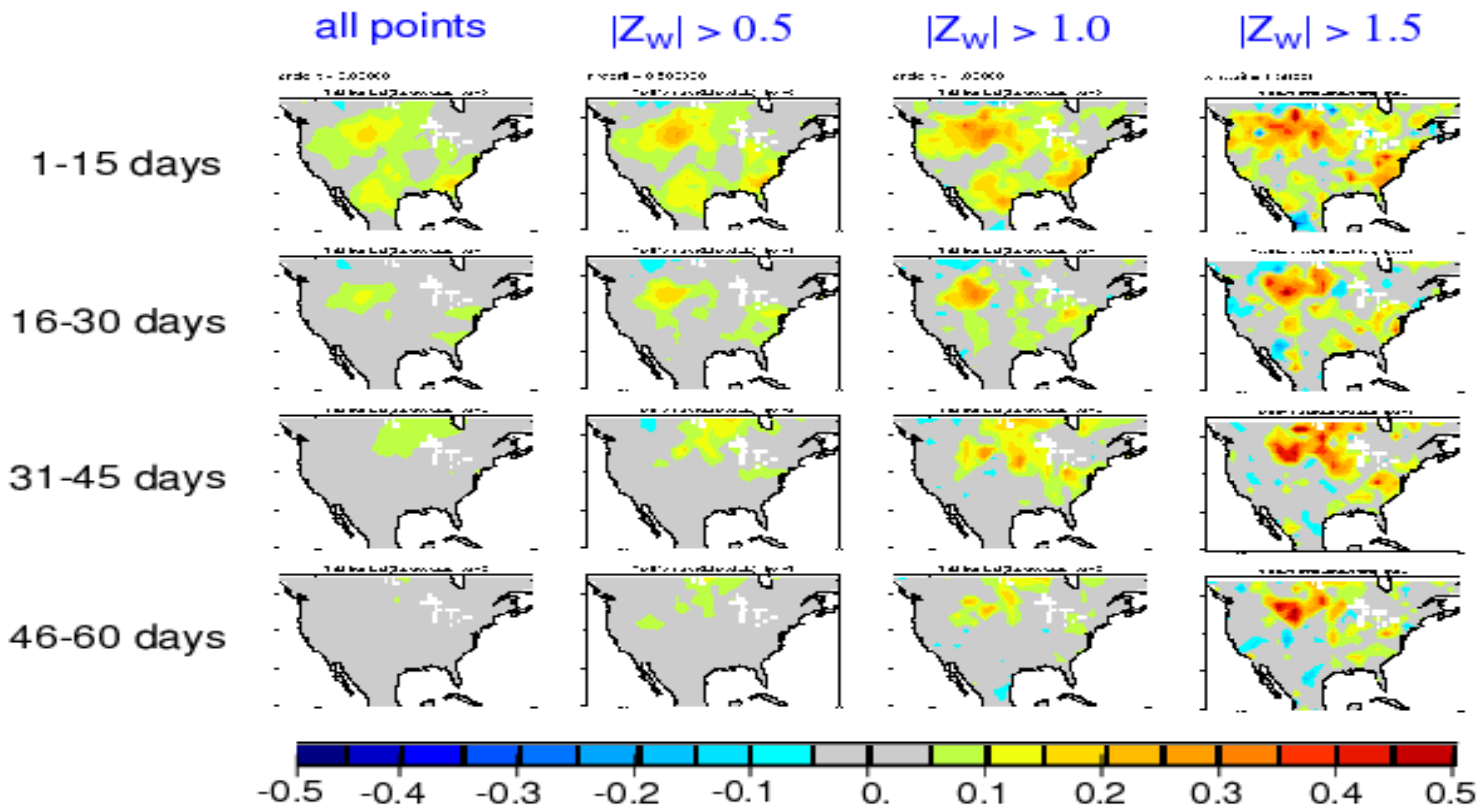
Impact of soil moisture:

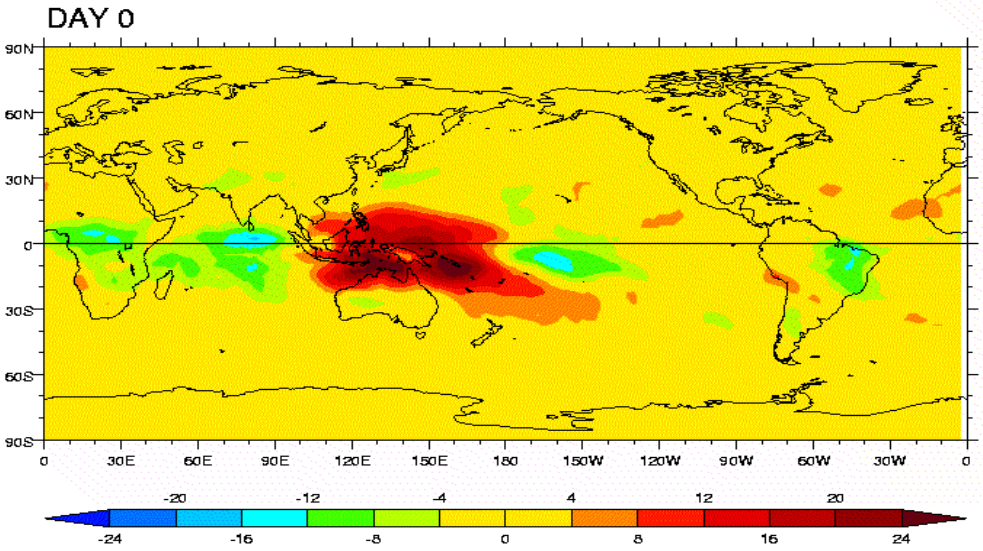
Temperature forecasts: Increase in skill due to land initialization (JJA)
(conditioned on Z-score of initial soil moisture anomaly)



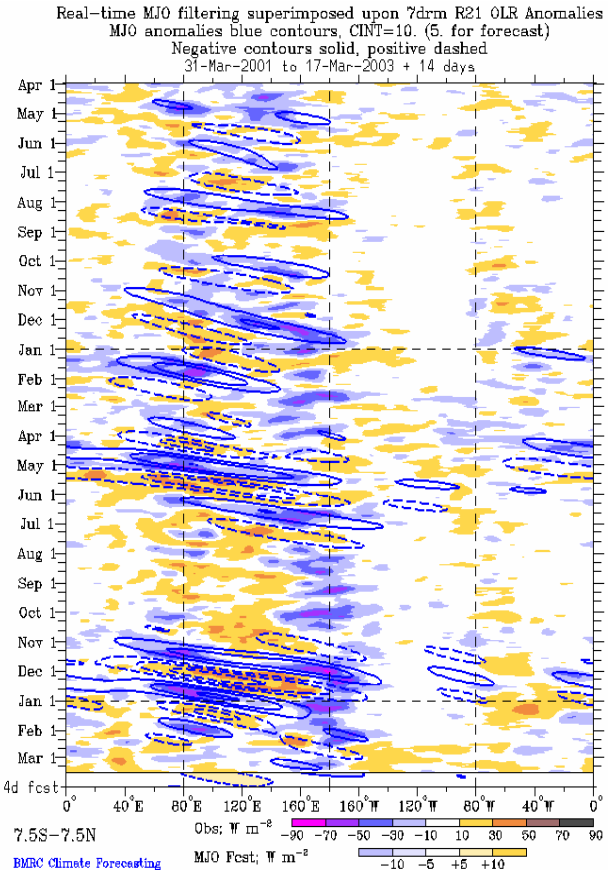
Koster et al, GRL 2010

The Madden Julian Oscillation (MJO)

MJO life cycle

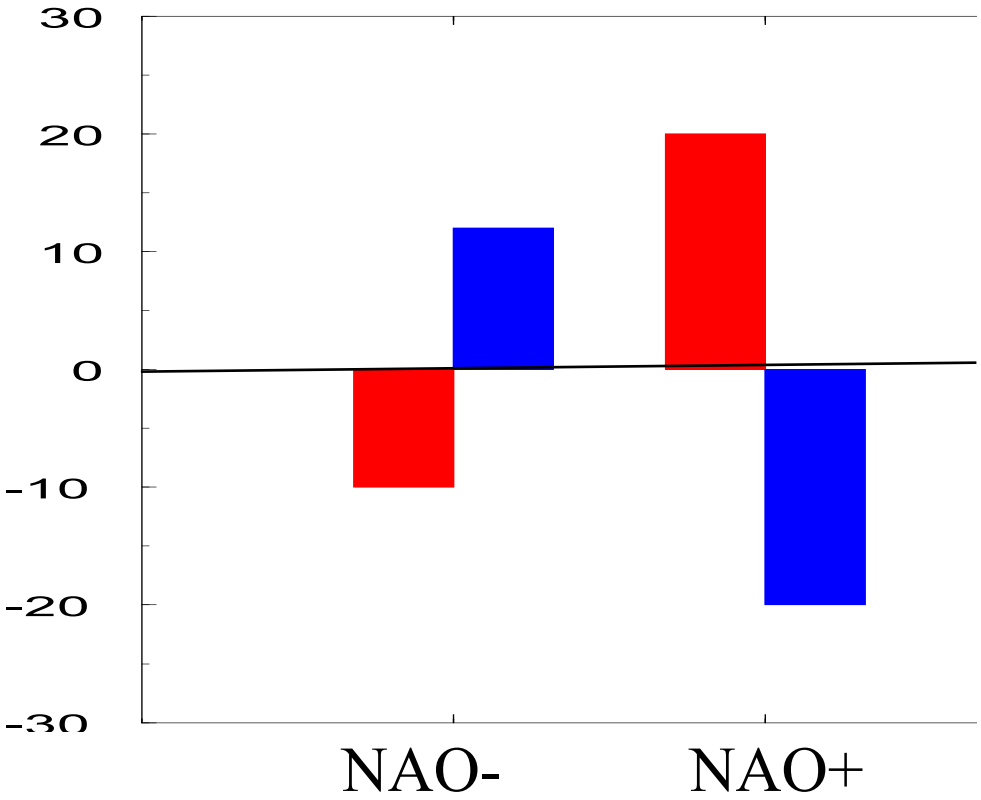


(From NASA)



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

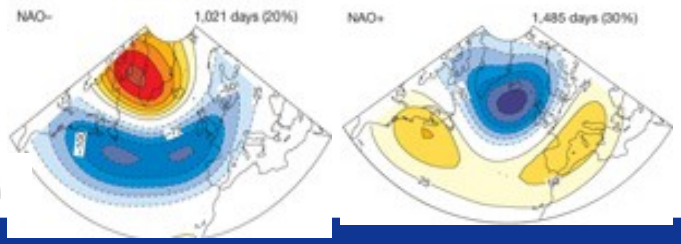
MJO impact on European weather:



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

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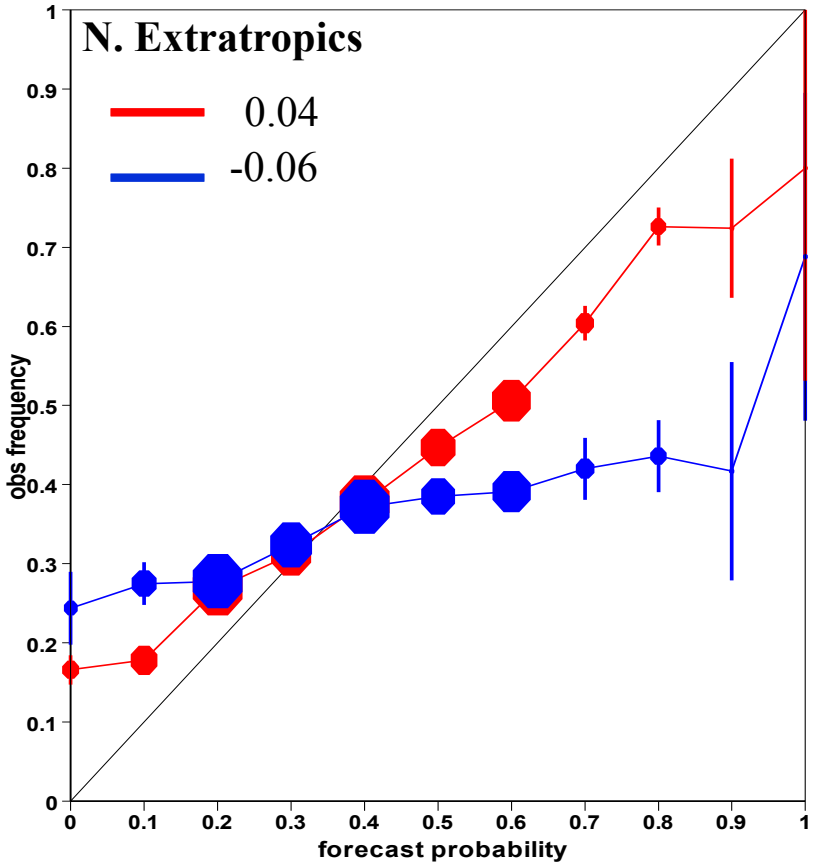
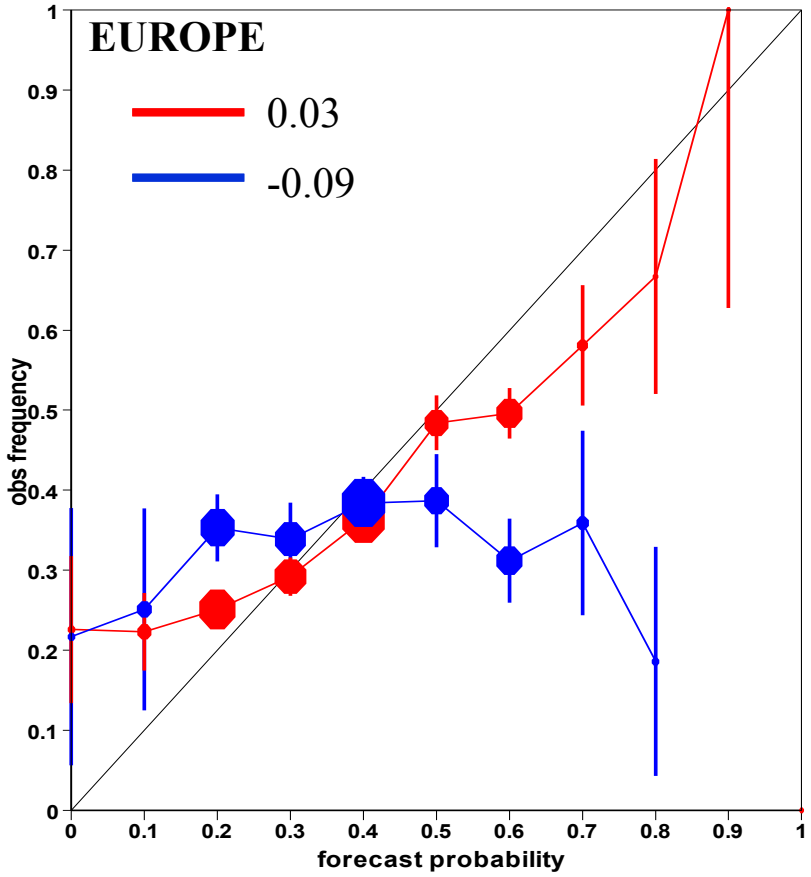
Probabilistic skill scores – NDJFMA 1989-2008

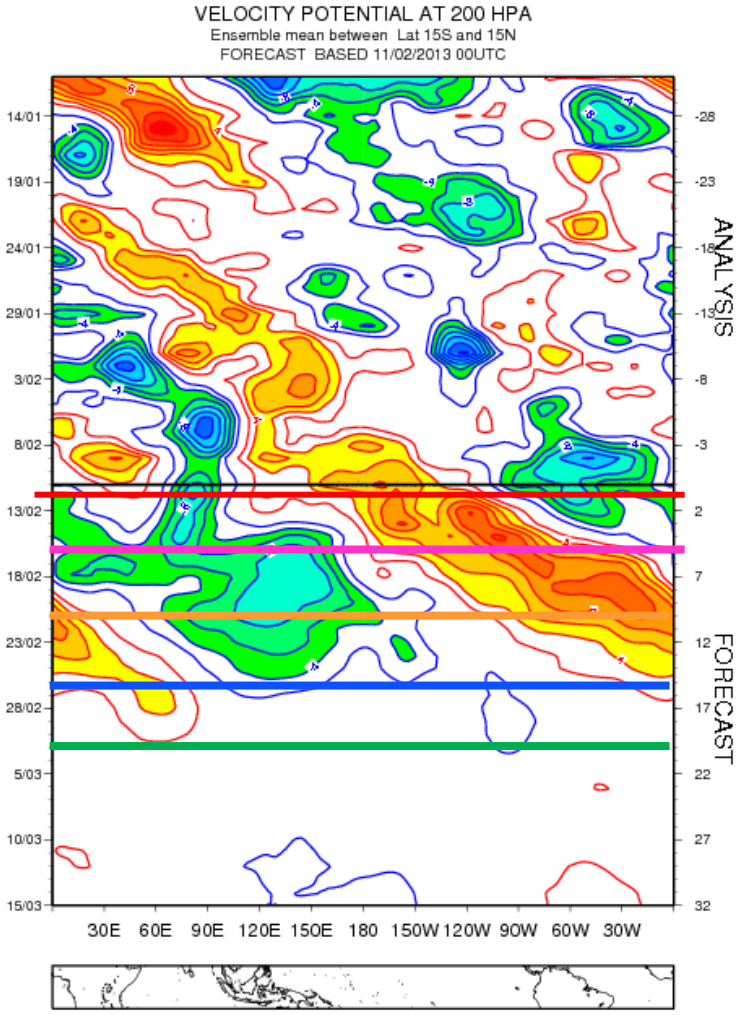
Reliability Diagram
Probability of 2-m temperature in the upper tercile
Day 19-25

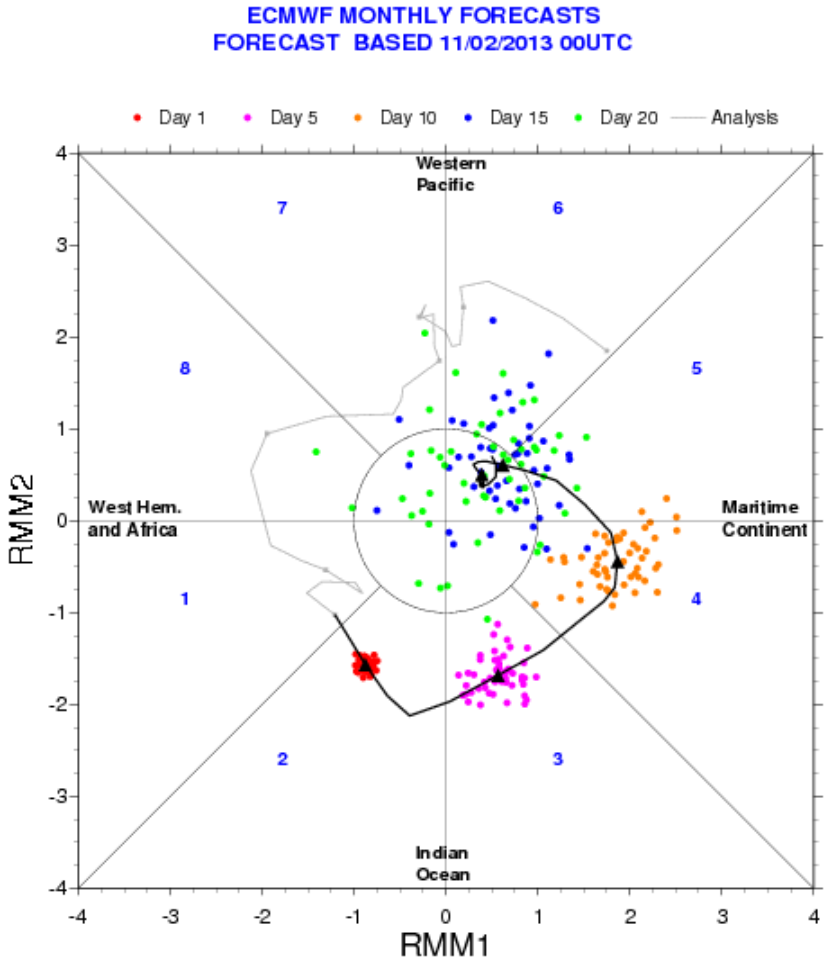




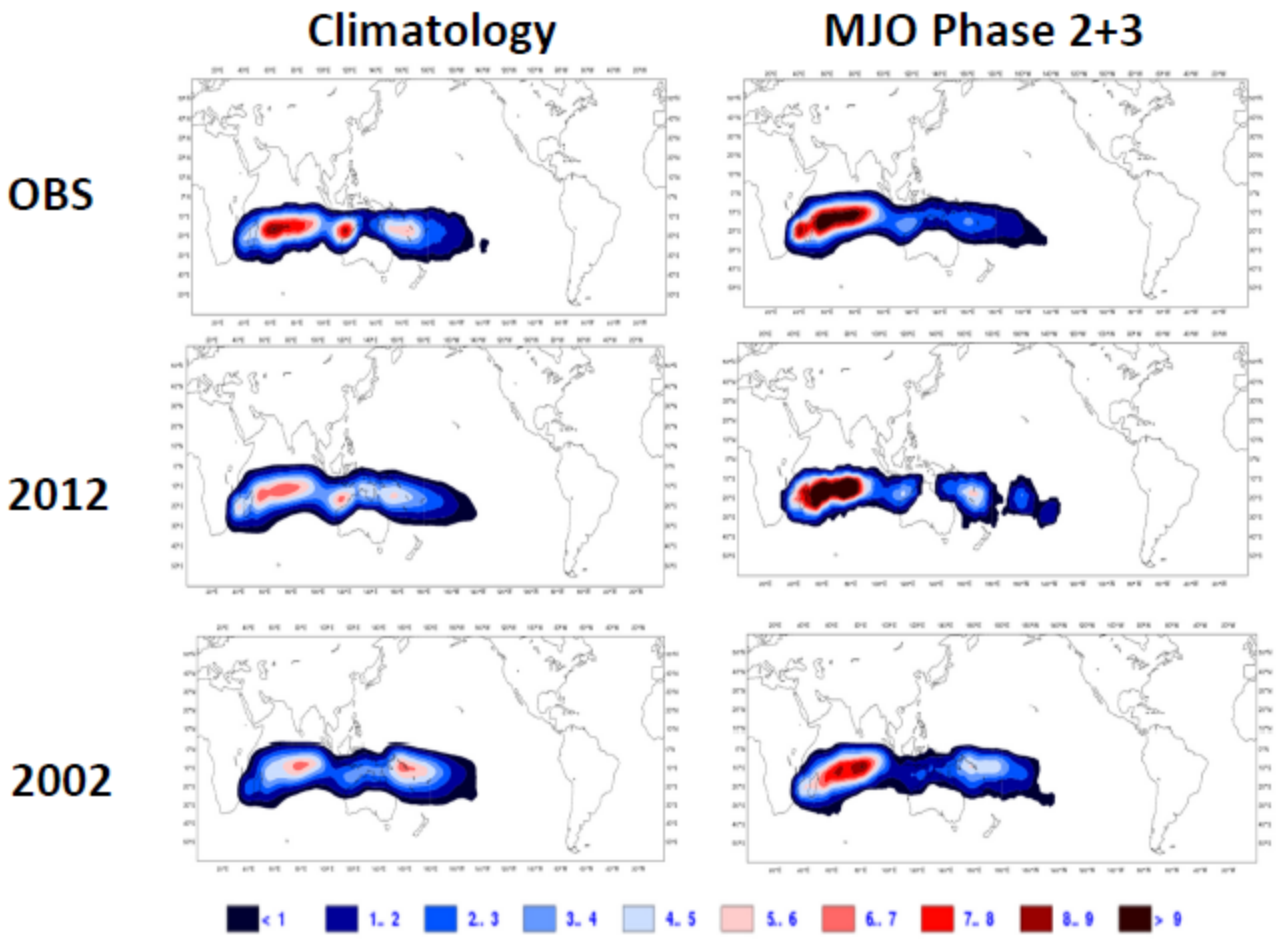
MJO in IC NO MJO in IC

MJO forecast:



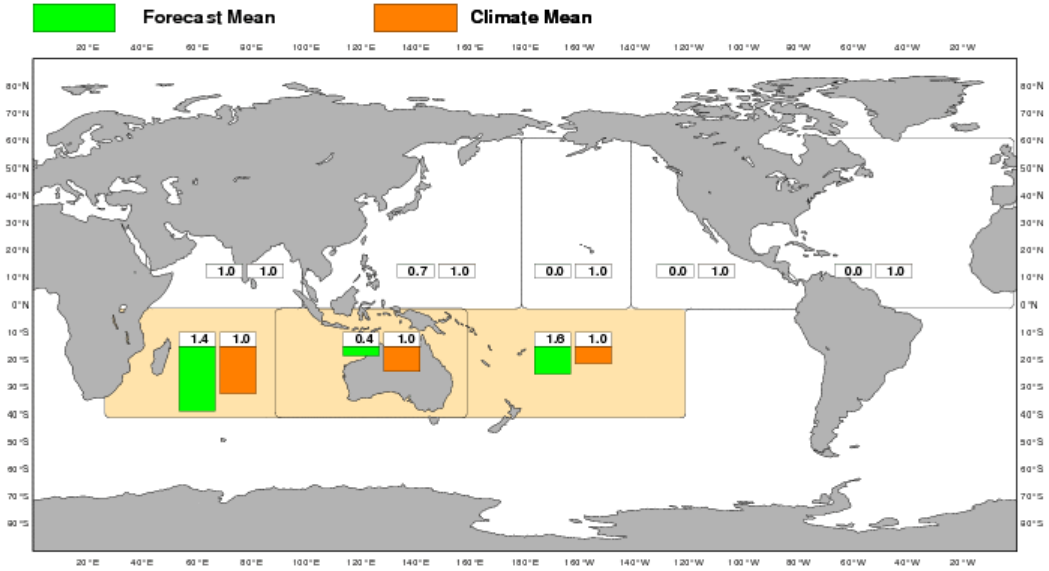


Tropical storm density



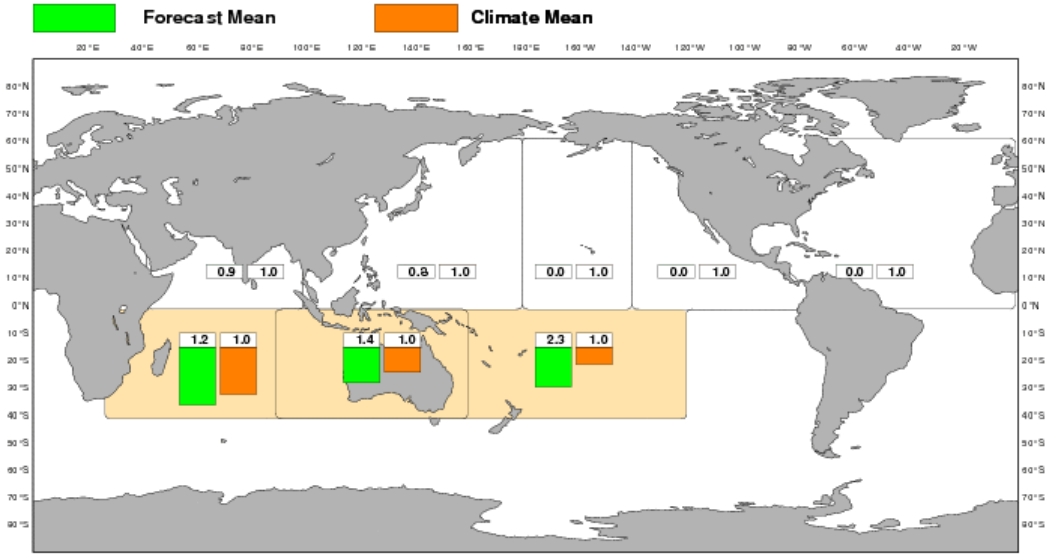
ECMWF Monthly Forecast
Accumulated Cyclone Energy
Forecast start reference is 24/01/2013
Ensemble size = 51,climate size =100

DAY 05-11
28/01-03/02/2013
Climate = 1993-2012



ECMWF Monthly Forecast
Accumulated Cyclone Energy
Forecast start reference is 17/01/2013
Ensemble size = 51,climate size =100

DAY 12-18
28/01-03/02/2013
Climate = 1993-2012



Weekly mean Accumulated Cyclone Energy (ACE)

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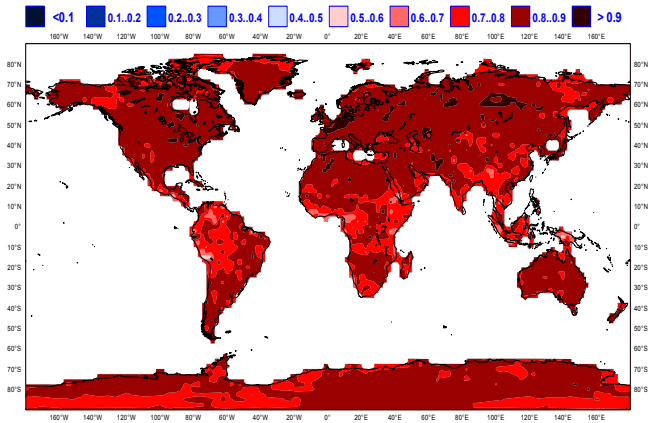
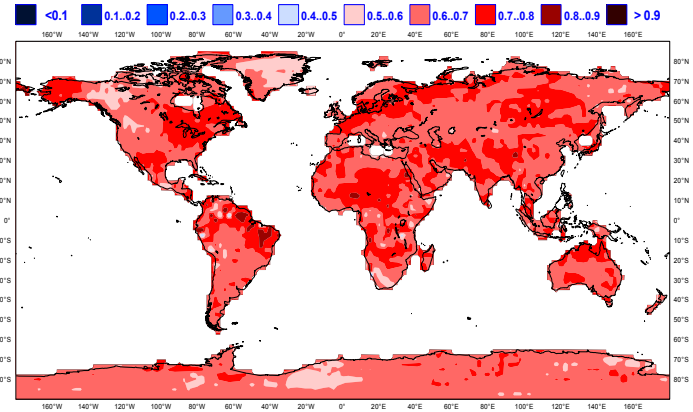
Skill of the ECMWF Monthly Forecasting System

ROC score: 2-meter temperature in the upper tercile

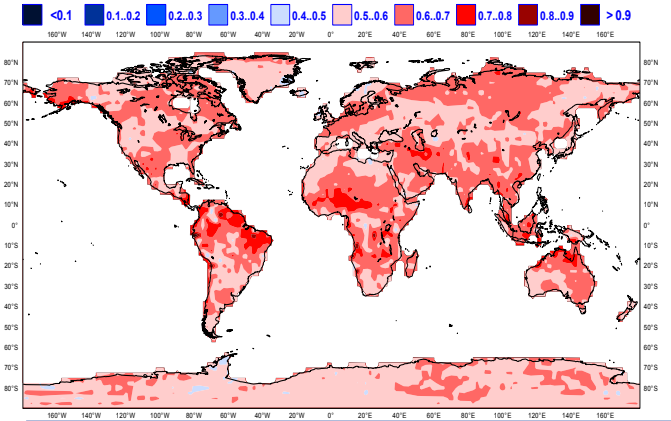
Day 5-11



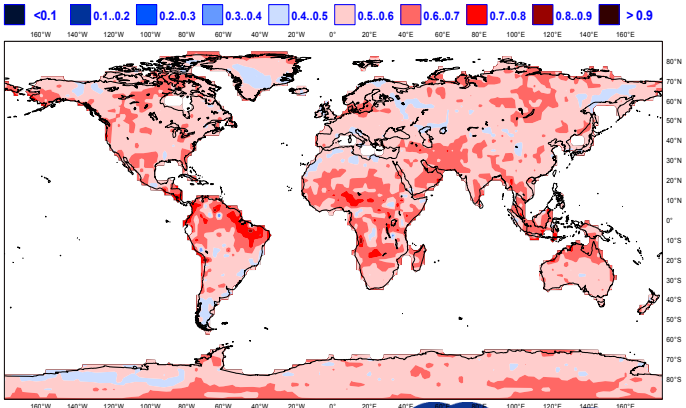
Day 12-18



Day 19-25



Day 26-32

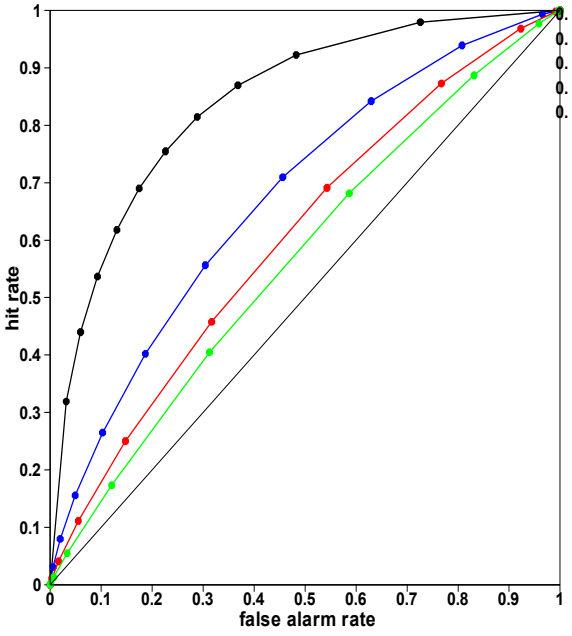


ECMWF

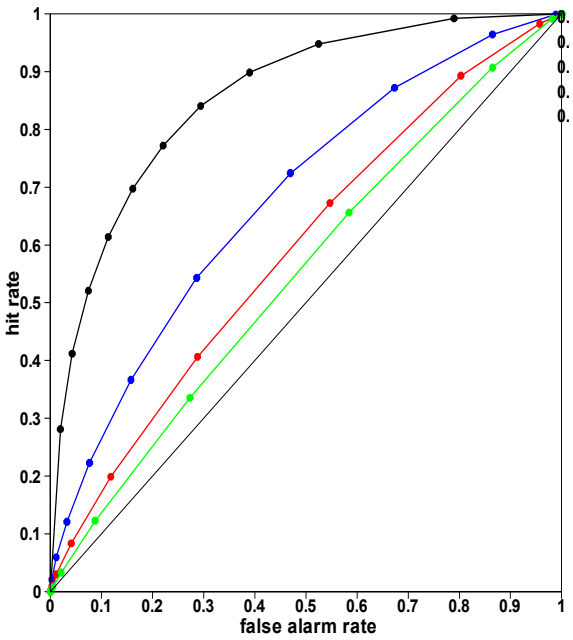
Skill of the ECMWF Monthly Forecasting System

ROC scores over the Northern extratropics

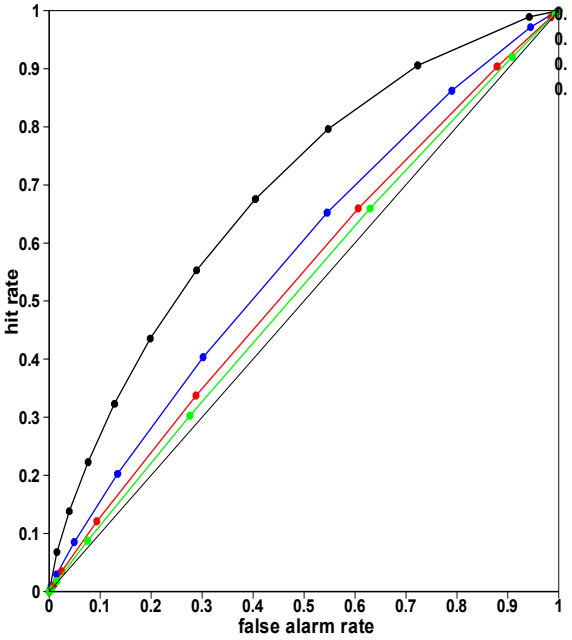
2-metre temperature



Mean sea-level pressure



Precipitation



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

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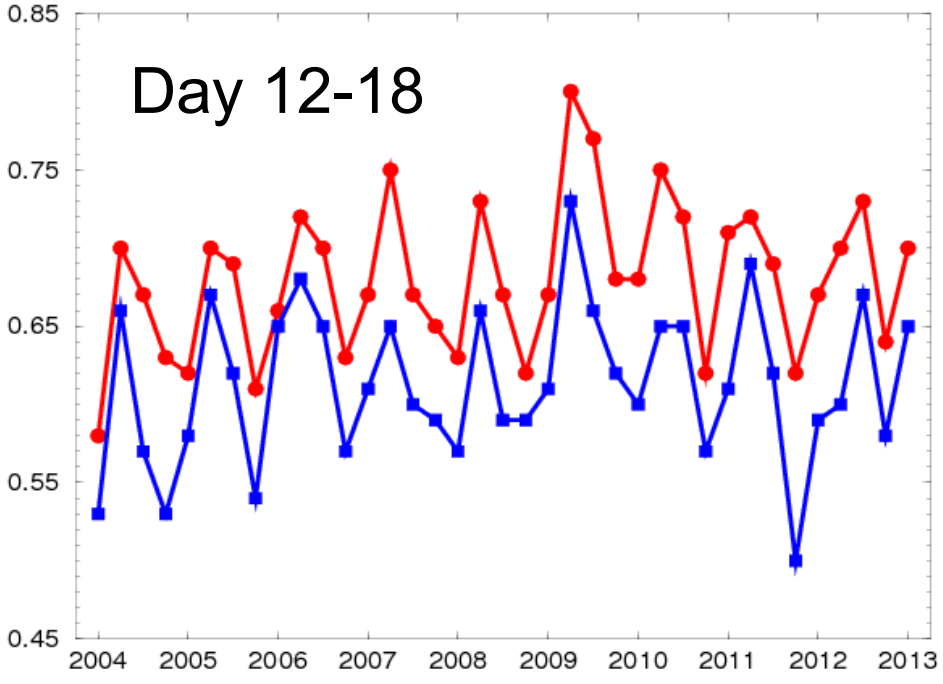
Monthly Forecast: Northern extratropics

ROC score: 2-metre temperature in the upper tercile

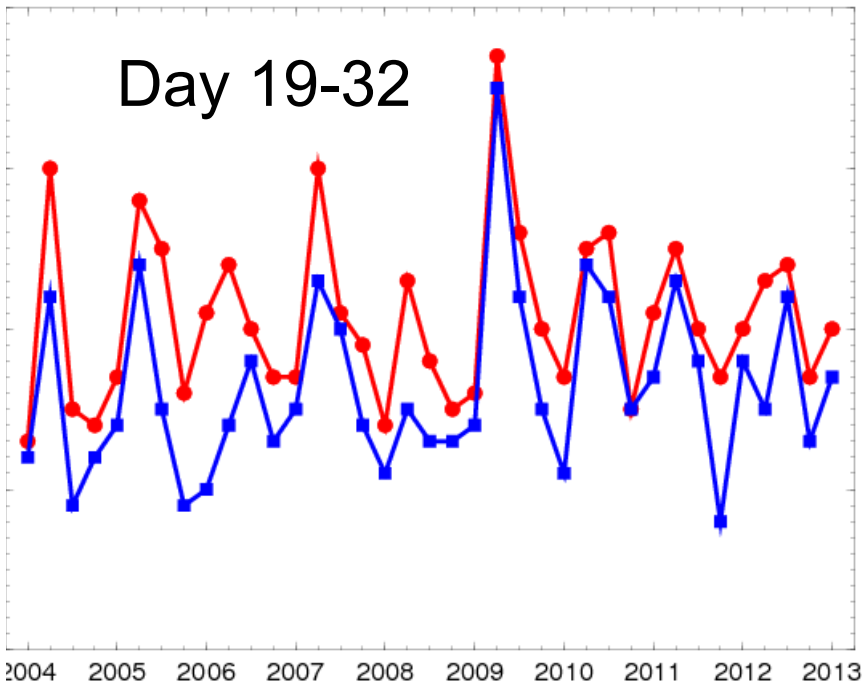
Monthly Forecast

Persistence of day 5-11



Monthly Forecast

Persistence of day 5-18

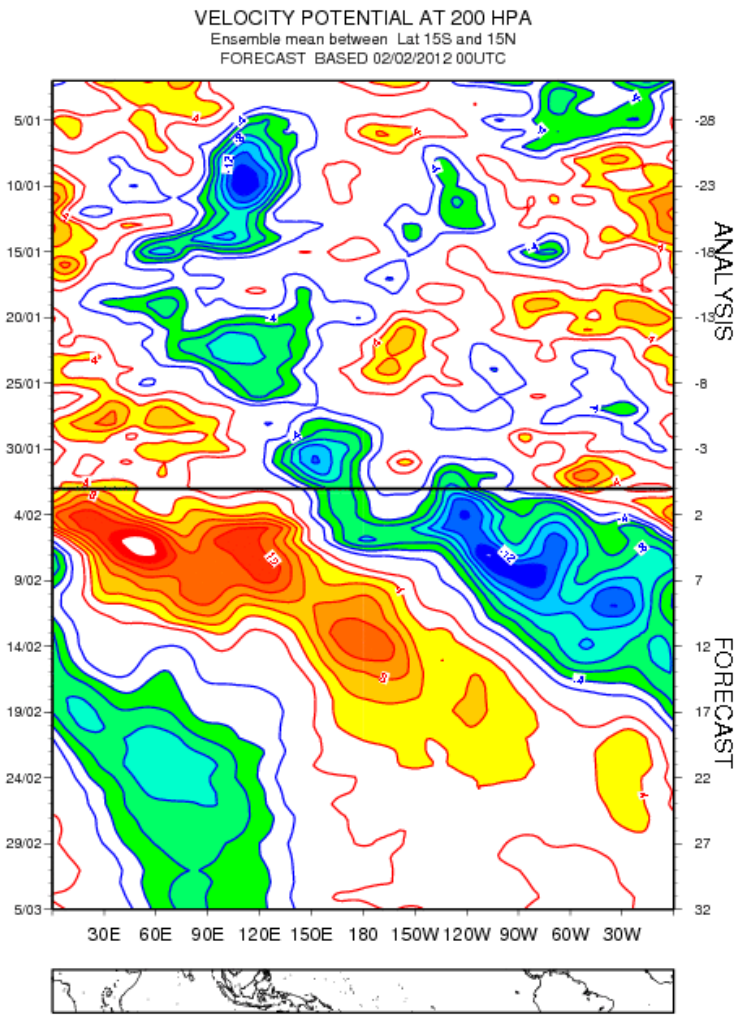


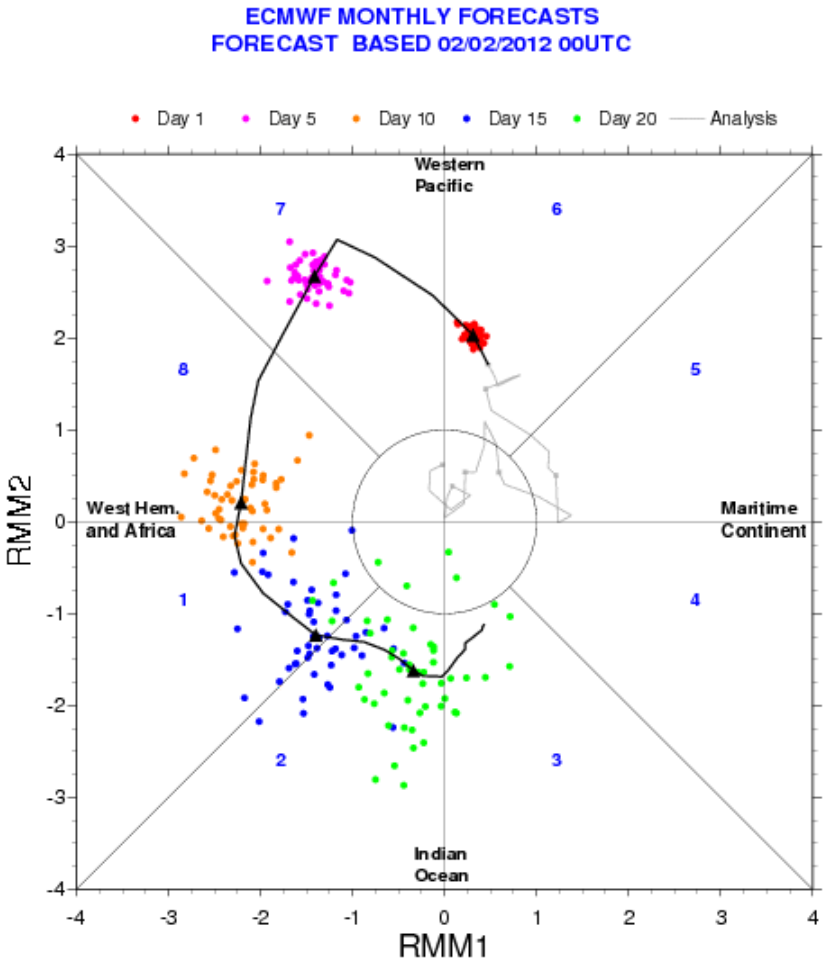
ECMWF

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.


VELOCITY POTENTIAL AT 200 HPA
Ensemble mean between Lat 15S and 15N
FORECAST BASED 02/02/2012 00UTC
ANALYSIS
FORECAST
5/01
10/01
15/01
20/01
25/01
30/01
4/02
9/02
14/02
19/02
24/02
29/02
5/03
-28
-23
-18
-13
-8
-3
2
7
12
17
22
27
32
30E 60E 90E 120E 150E 180 150W 120W 90W 60W 30W


ECMWF MONTHLY FORECASTS
FORECAST BASED 02/02/2012 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