

# 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

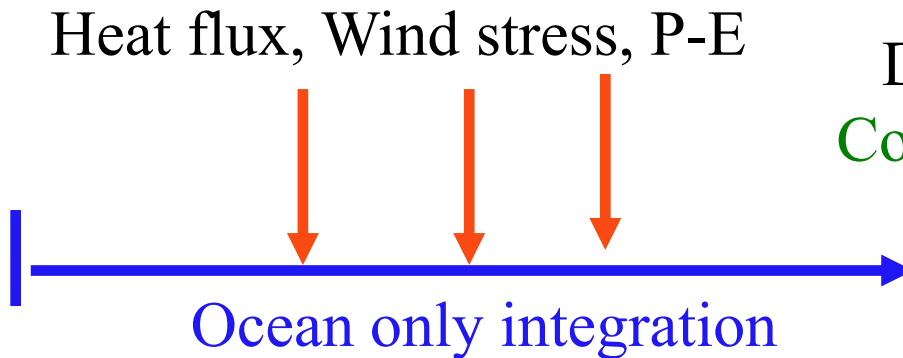
# Bridging the gap between seasonal forecasting and NWP

**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**

# Extended range forecast / **EPS extension**

Initial condition



## MODEL BIAS: 2m Temperature

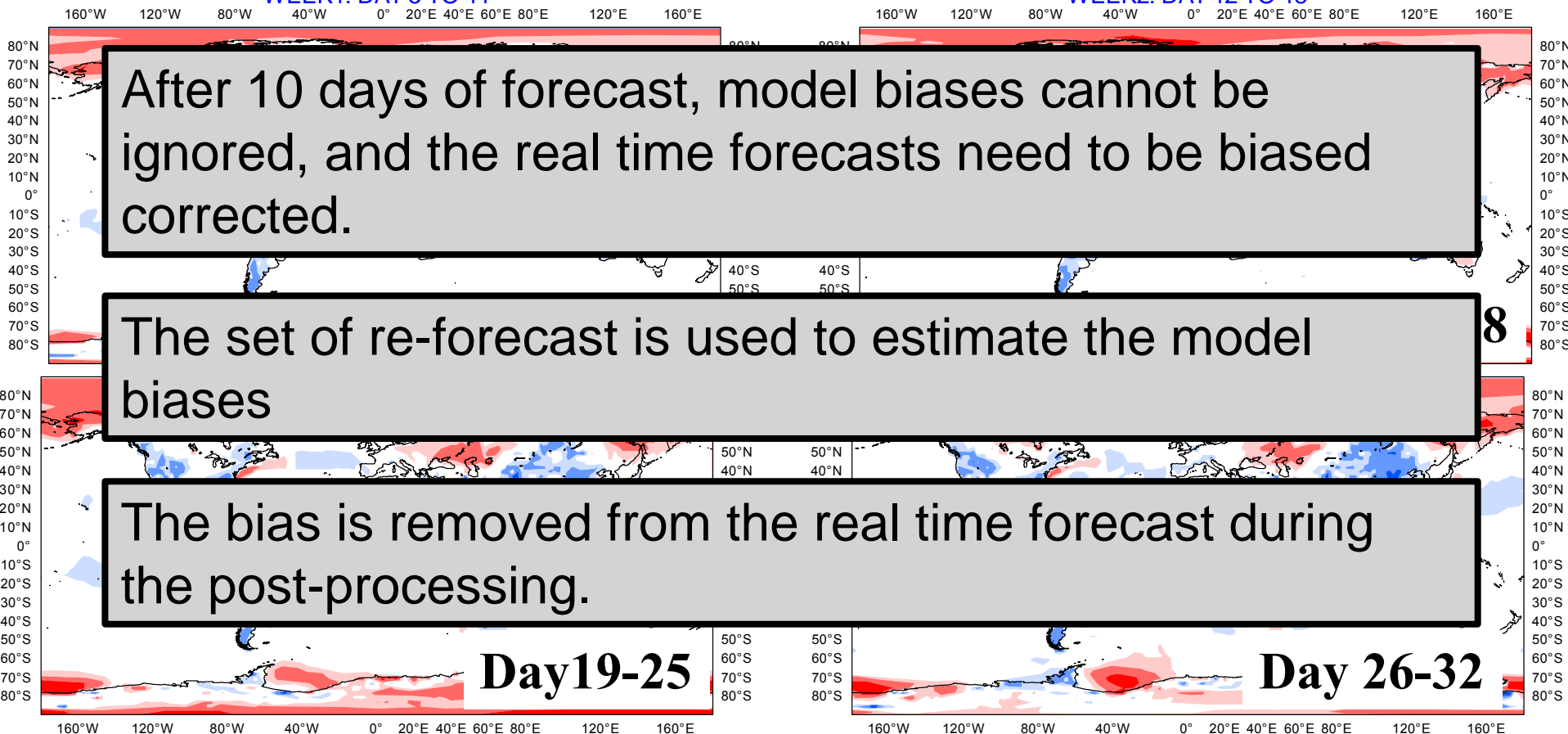
Forecast start reference is 05/03/1991-2008

ensemble size = 5



WEEK1: DAY 5 TO 11

WEEK2: DAY 12 TO 18



# 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 18 Feb 2013 UTC to Sun 24 Feb 2013 UTC) ▾

Area ▲▼▶

[Global](#)

[Europe](#)

[North America](#)

[South America](#)

[Africa](#)

[India](#)

[East Asia](#)

[Indonesia](#)

[West Pacific](#)

Date ▲▼▶

[Mon 11 Feb 2013](#)

[Thu 7 Feb 2013](#)

[Mon 4 Feb 2013](#)

[Thu 31 Jan 2013](#)

[Mon 28 Jan 2013](#)

[Thu 24 Jan 2013](#)

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Parameter

Valid calendar week

Area

Date

ECMWF EPS-Monthly Forecasting System

2-meter Temperature anomaly

Forecast start reference is 07-02-2013

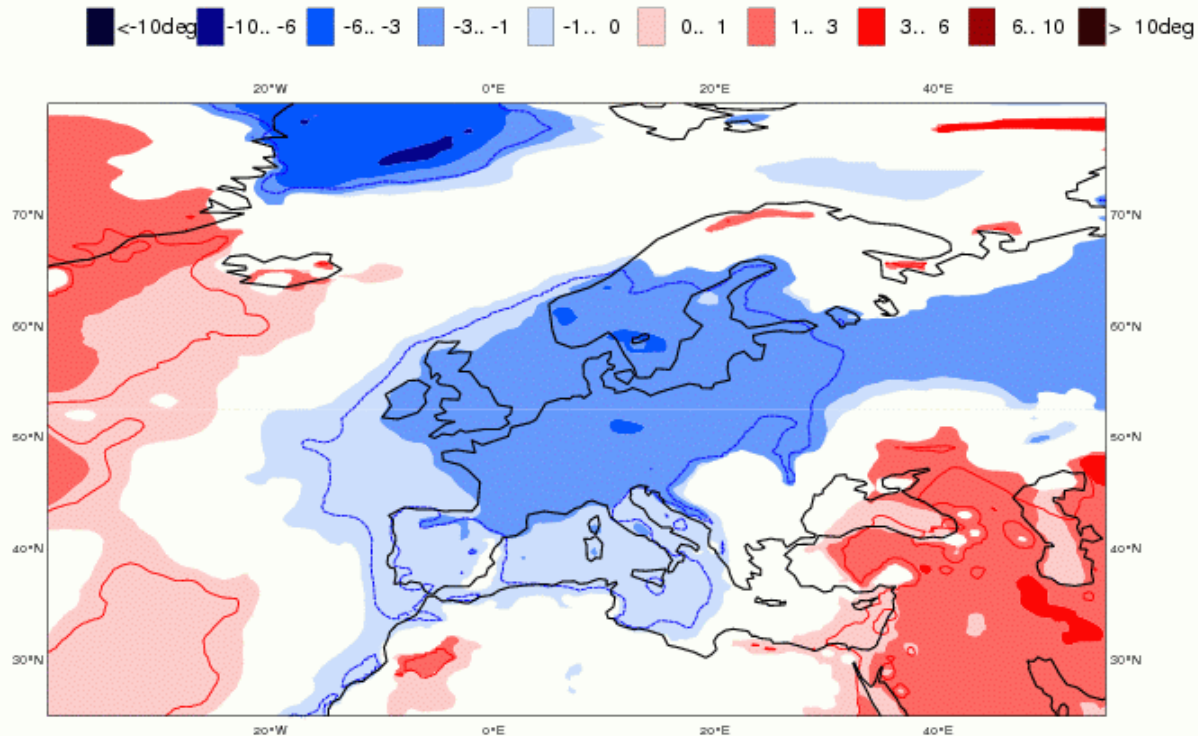
ensemble size = 51, climate size = 100

Day 12-18

18-02-2013/TO/24-02-2013

Shaded areas significant at 10% level

Contours at 1% level



# Probabilities (temperature)

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## Weekly terciles

Parameter ▲▼▶

[precipitation](#)

[temperature](#)

[2m temperature](#)

[mean sea level](#)

[pressure](#)

Valid calendar week ▲▼▶

(Mon 18 Feb 2013 UTC to Sun 24 Feb 2013 UTC) ▾

Tercile ▲▼▶

[lower](#)

[upper](#)

Area ▲▼▶

[Global](#)

[Europe](#)

[North America](#)

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[India](#)

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[Mon 11 Feb 2013](#)

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[Thu 31 Jan 2013](#)

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ECMWF EPS-Monthly Forecasting System

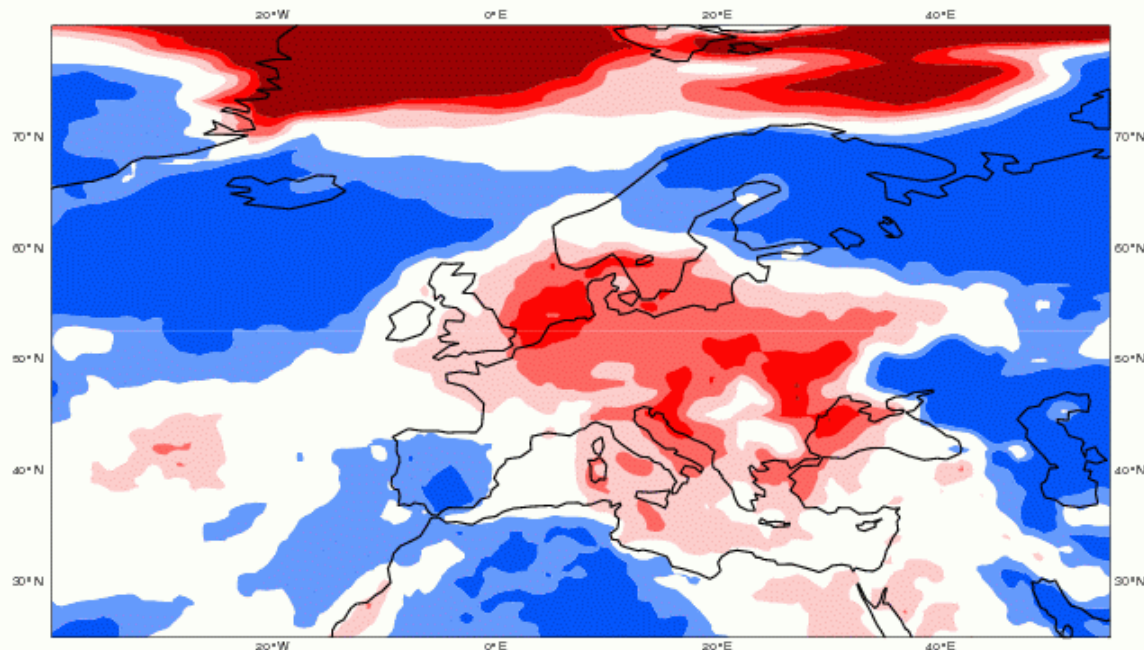
(Prob 2m Temp. anom below 33%)

Forecast start reference is 11-02-2013

ensemble size = 51 climate size = 100

Day 8-14

18-02-2013/TO/24-02-2013





# Cold spell over Europe Nov-Dec 2012

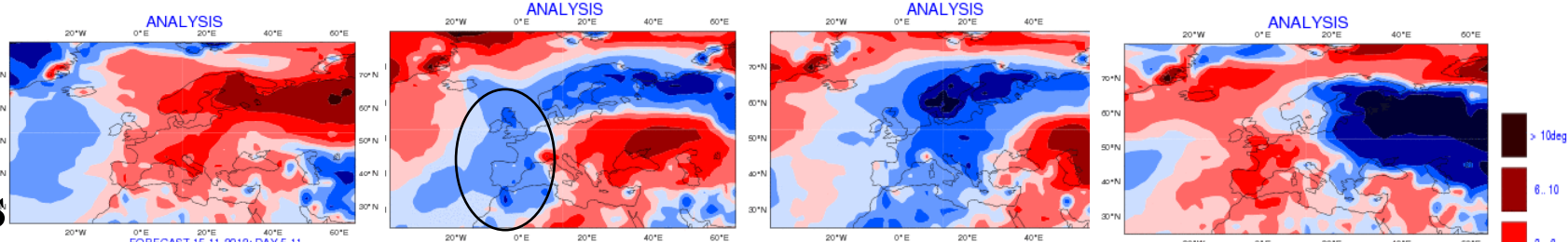
19 -25 /11/2012

26 /11 -2/12 2012

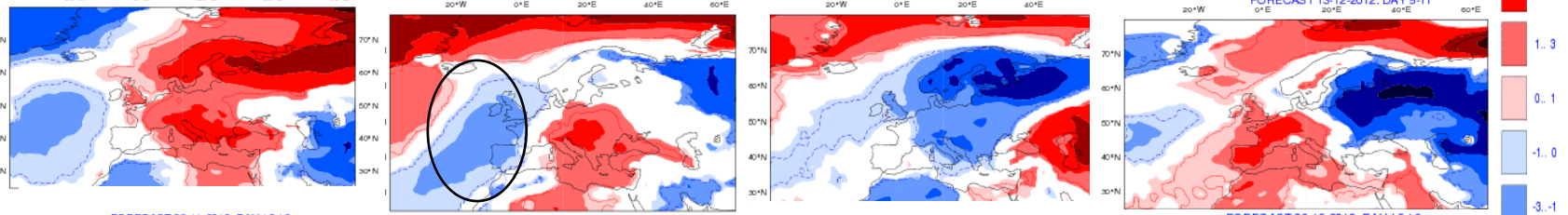
3-9/ 12 /2012

19 -11 25-11 2012

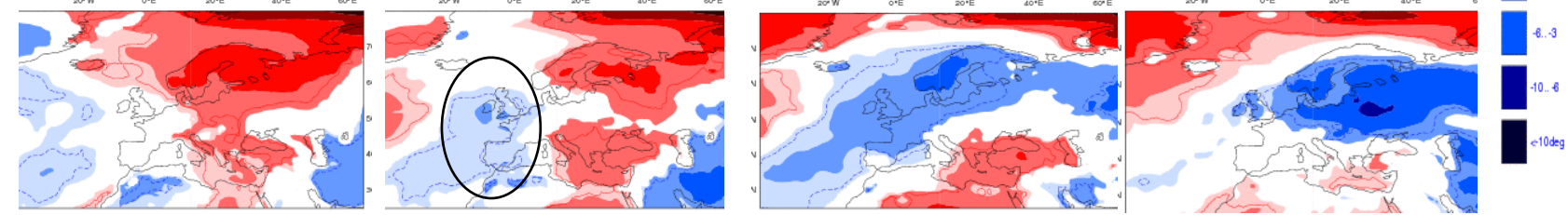
analysis



5-11d



12-18 d

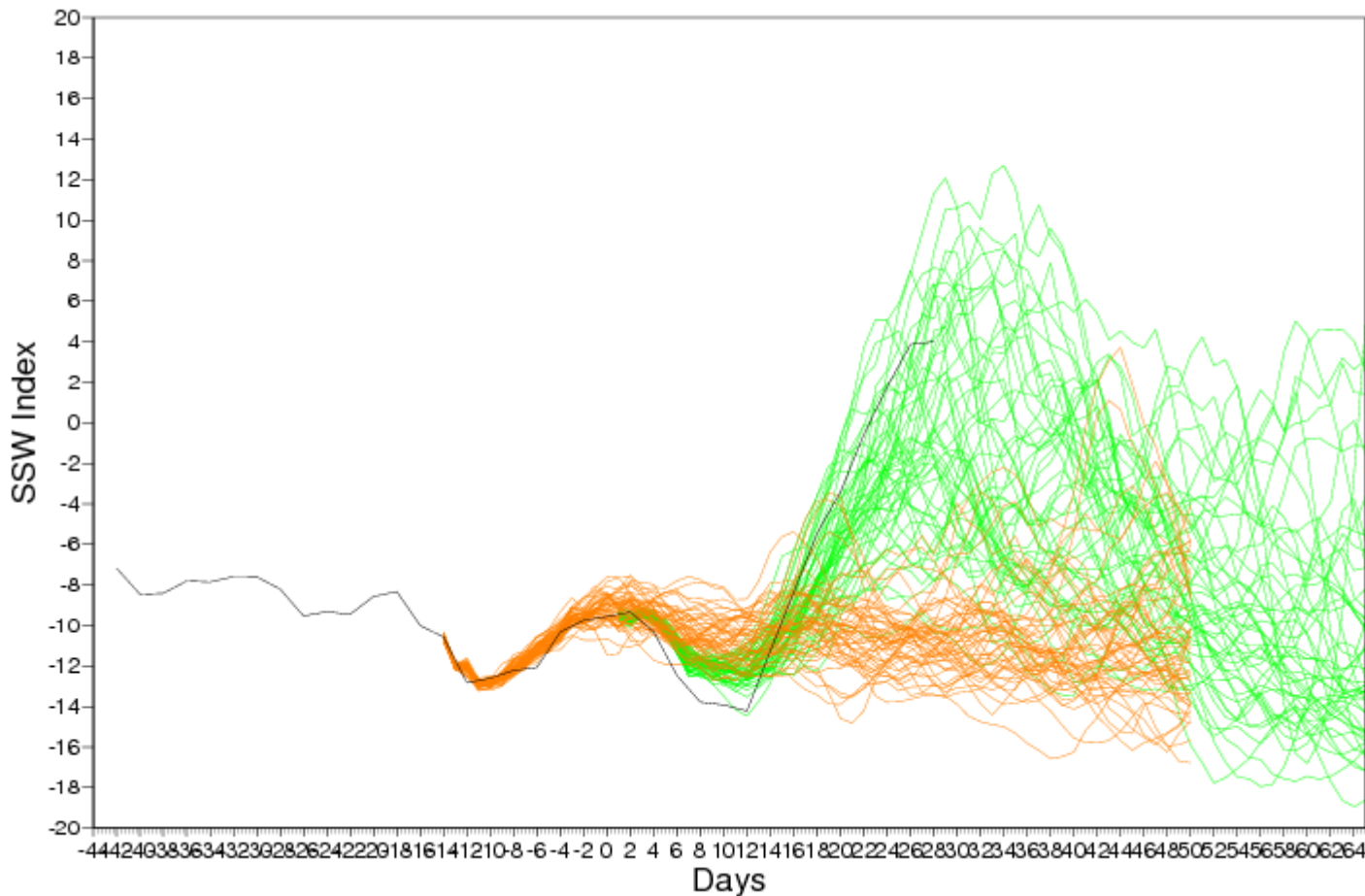


# Cold Weather over Europe: SSW Index

Forecast starting on :

22/11/2012 ———

15/11/2012 ———



# Cold Weather over Europe

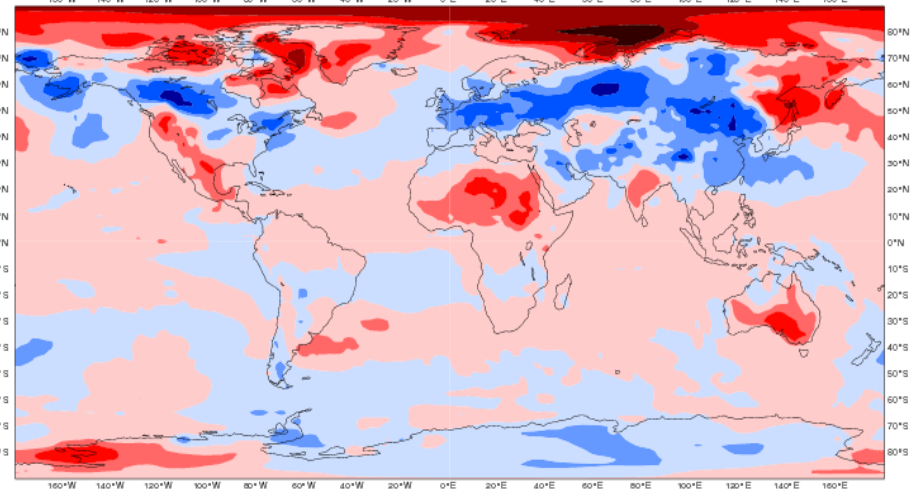
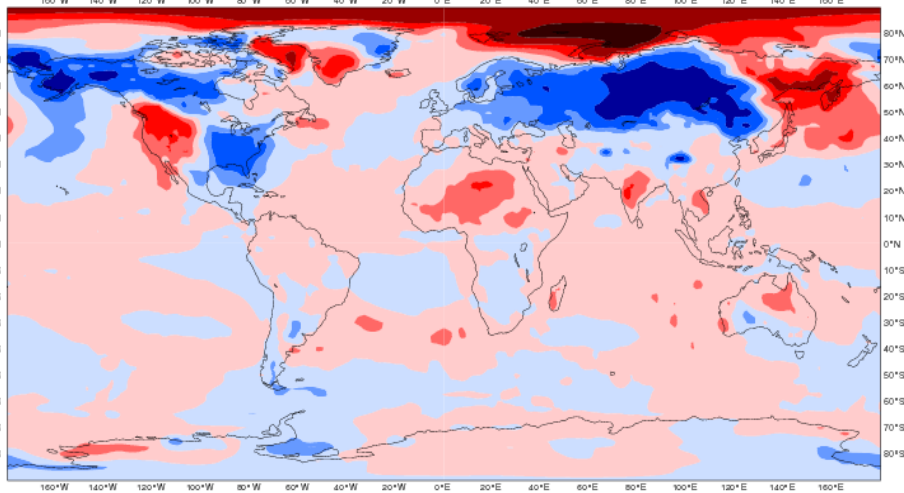
## SSW Index - Forecast starting on 22/11/2012

### Strong SSW

### Weak SSW

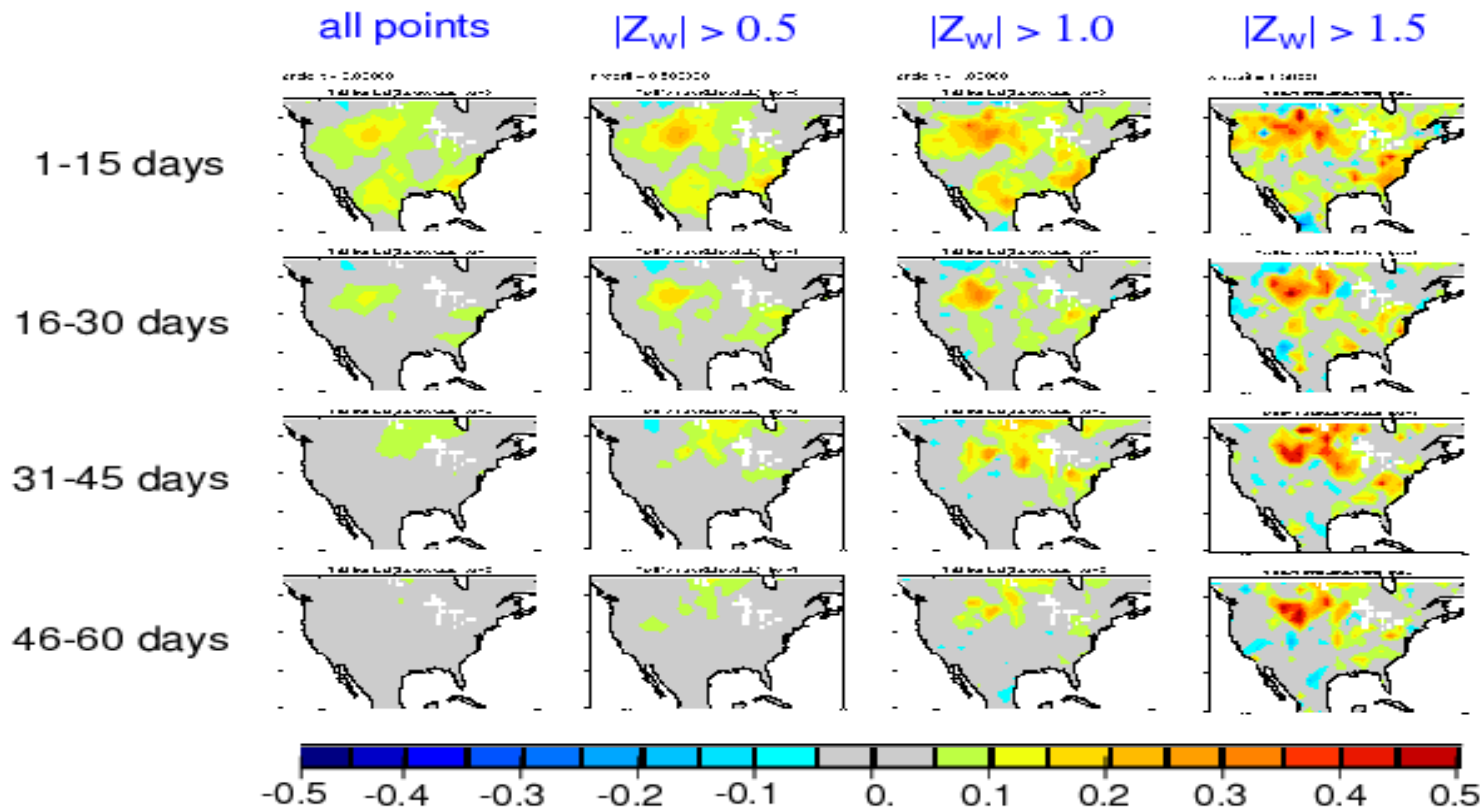
■ #074-8de ■ -8..-4 ■ -4..-2 ■ -2..-1 ■ -1..0 ■ 0..1 ■ 1..2 ■ 2..4 ■ 4..8 ■ #076 8deg

■ #074-8de ■ -8..-4 ■ -4..-2 ■ -2..-1 ■ -1..0 ■ 0..1 ■ 1..2 ■ 2..4 ■ 4..8 ■ #076 8deg



# Impact of soil moisture:

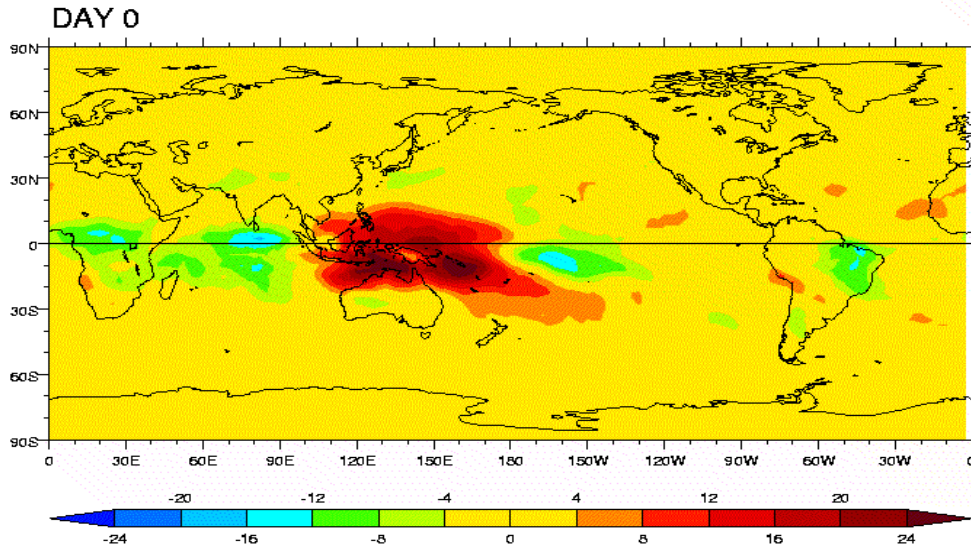
**Temperature forecasts: Increase in skill due to land initialization (JJA)**  
(conditioned on Z-score of initial soil moisture anomaly)



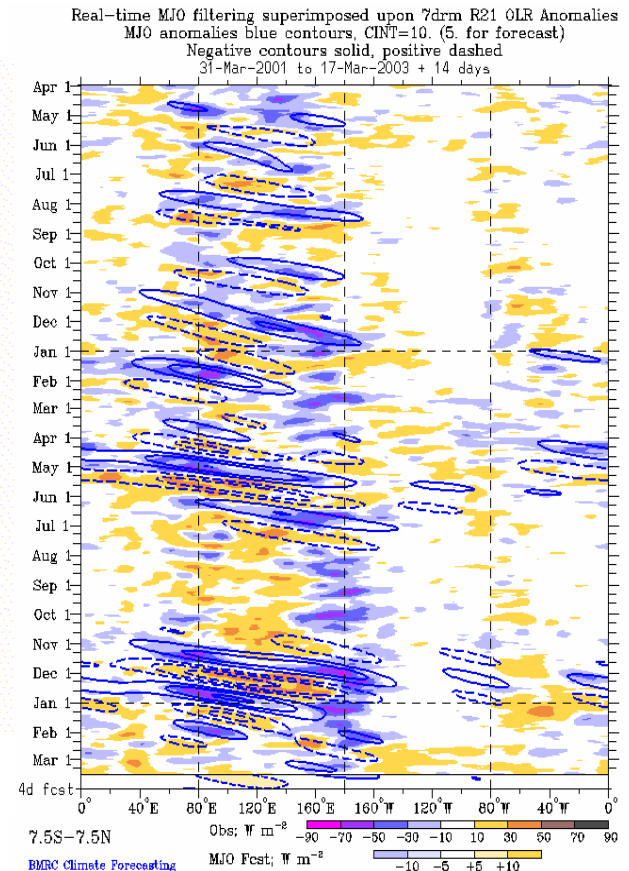
Koster et al, GRL 2010

# The Madden Julian Oscillation (MJO)

## MJO life cycle



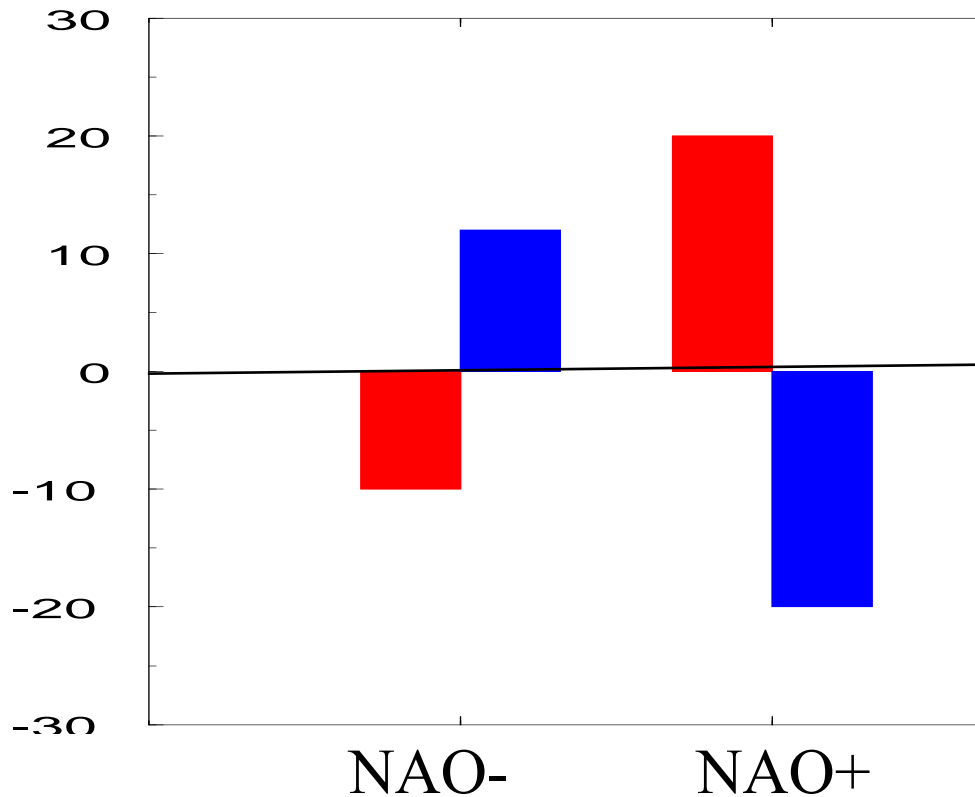
(From NASA)



From

<http://www.bom.gov.au/bmrc/clf>

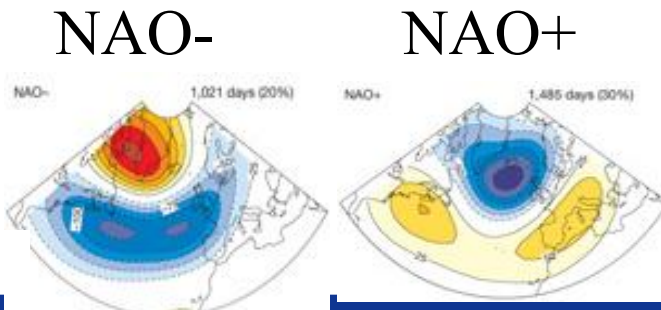
# MJO impact on European weather:



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

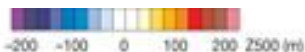
- enhanced convection over Indian Ocean
- enhanced convection over Western Pacific

Cassou (2008) Lin et al (2008)



 Conv. Over Indian Ocean +10 days

 Conv. Over Western Pacific +10 days



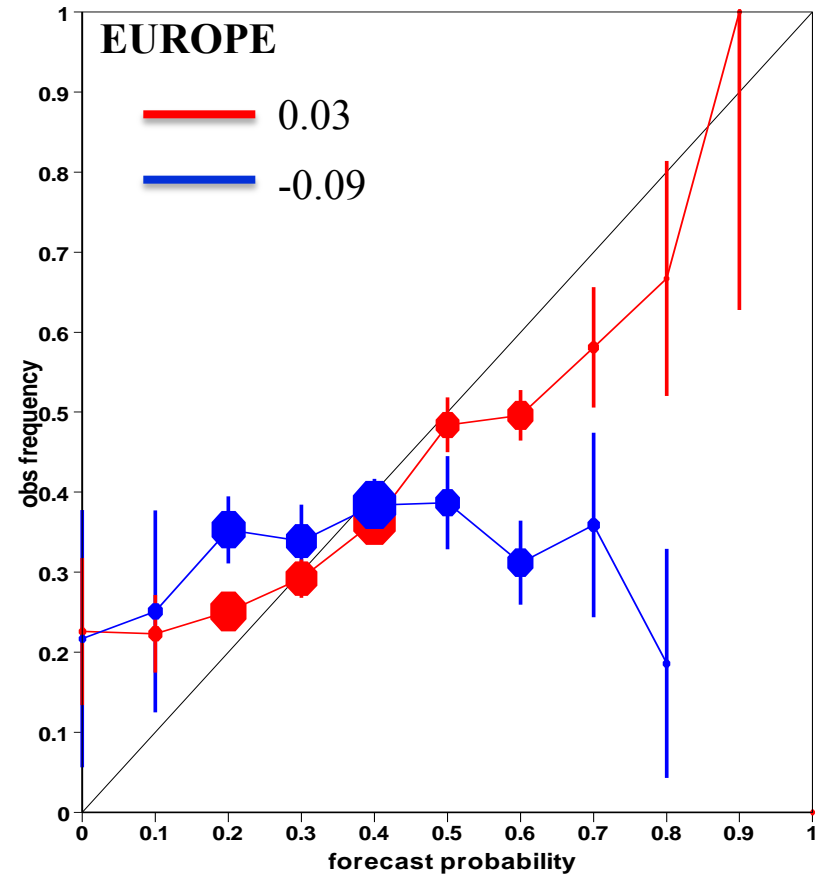
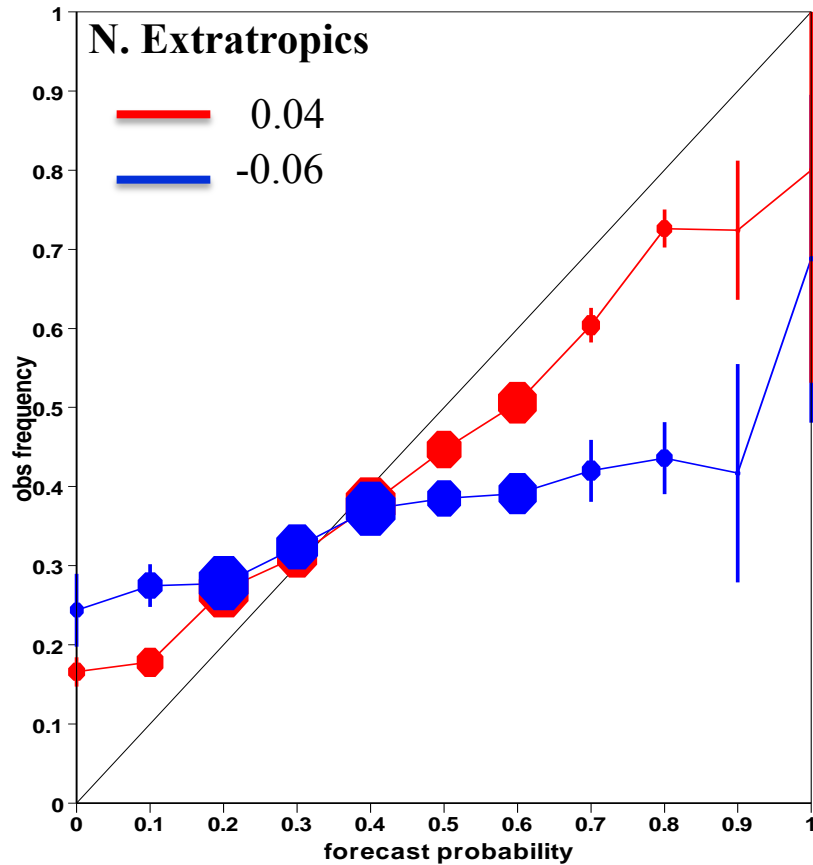


# Probabilistic skill scores – NDJFMA 1989-2008

Reliability Diagram

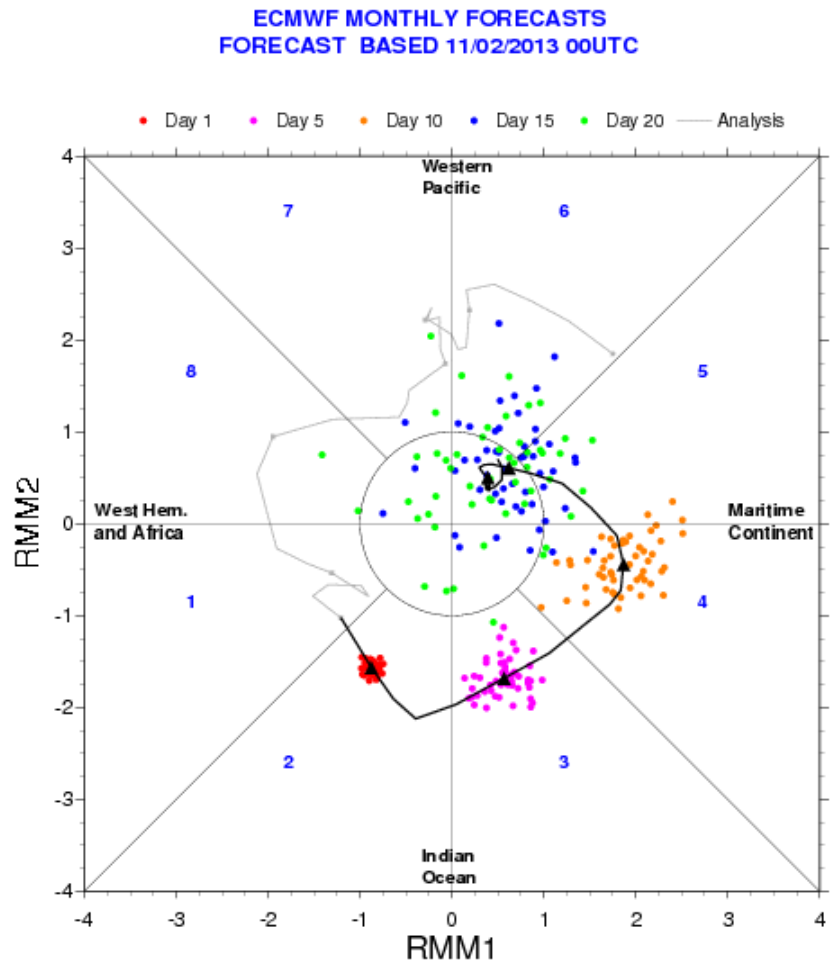
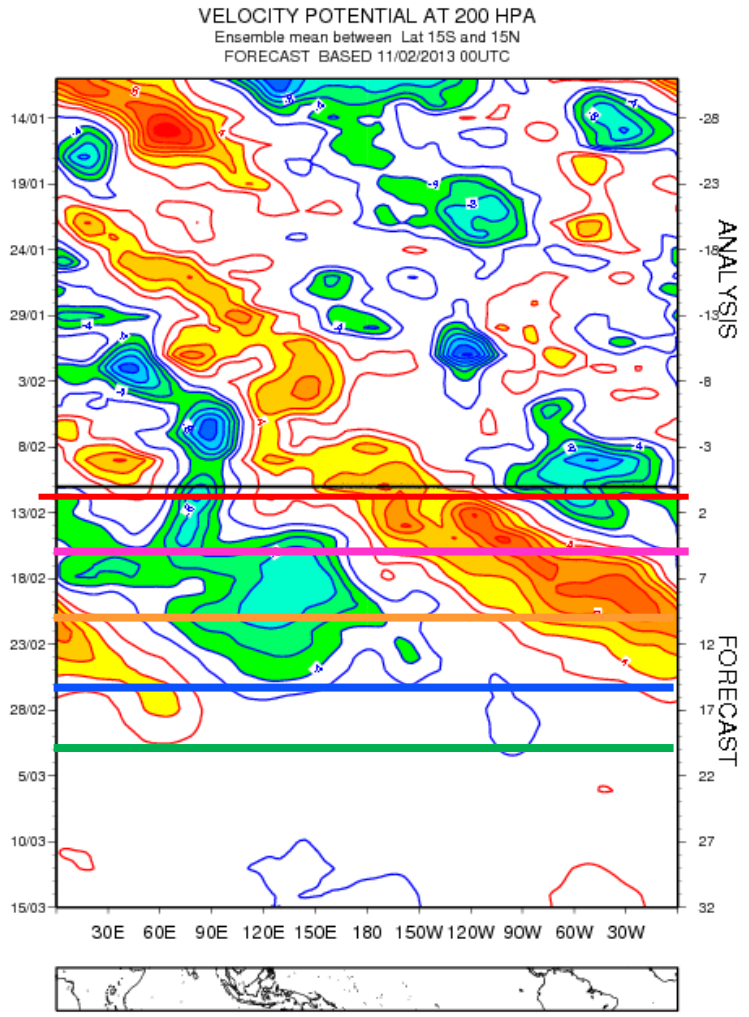
Probability of 2-m temperature in the upper tercile

Day 19-25



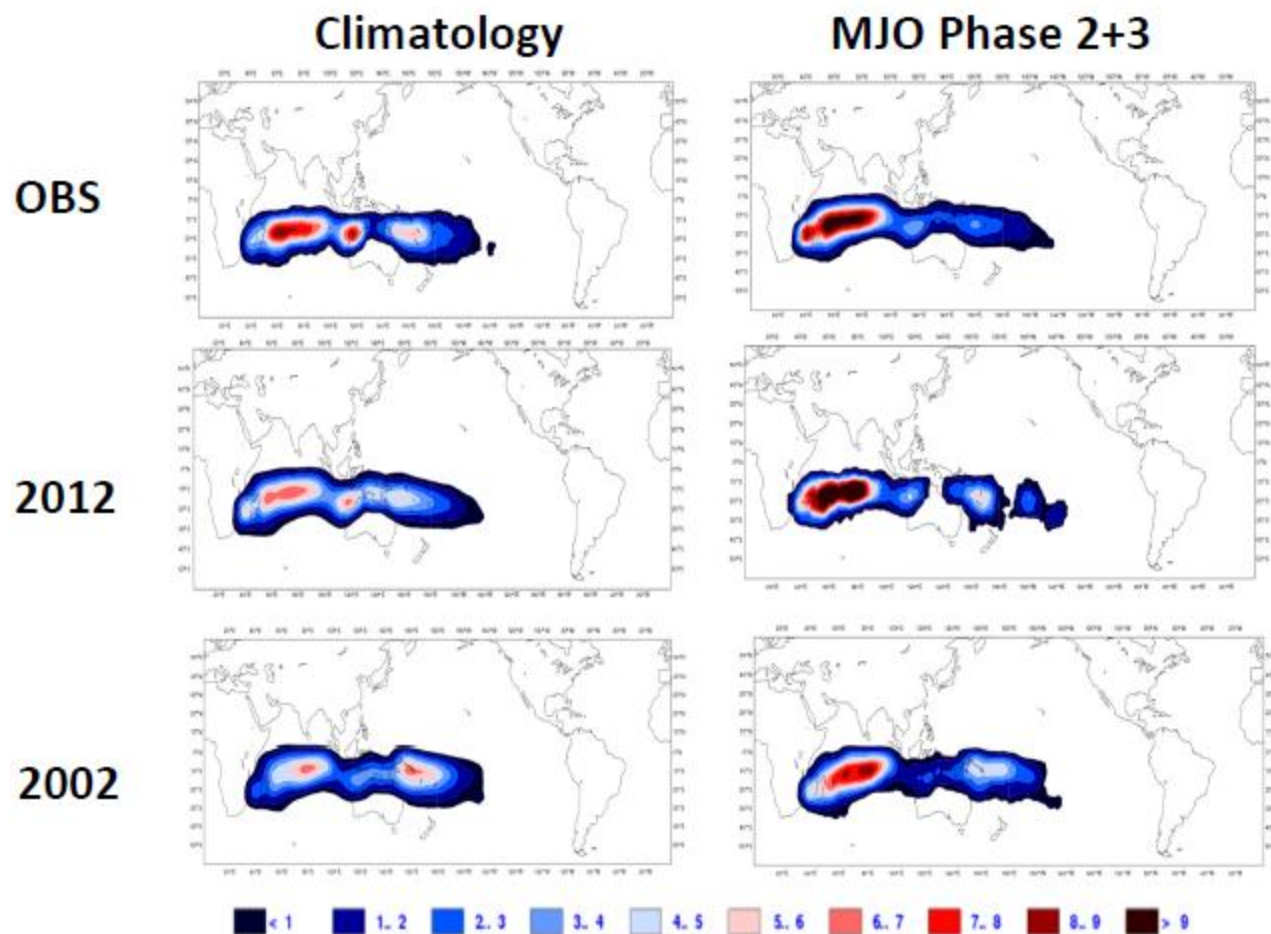
— MJO in IC      — NO MJO in IC

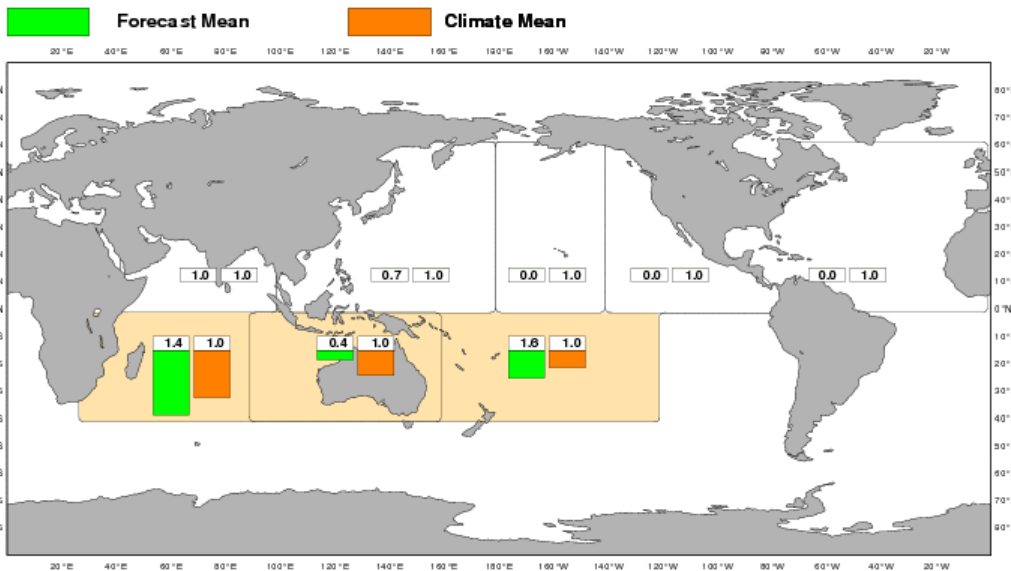
# MJO latest forecast:



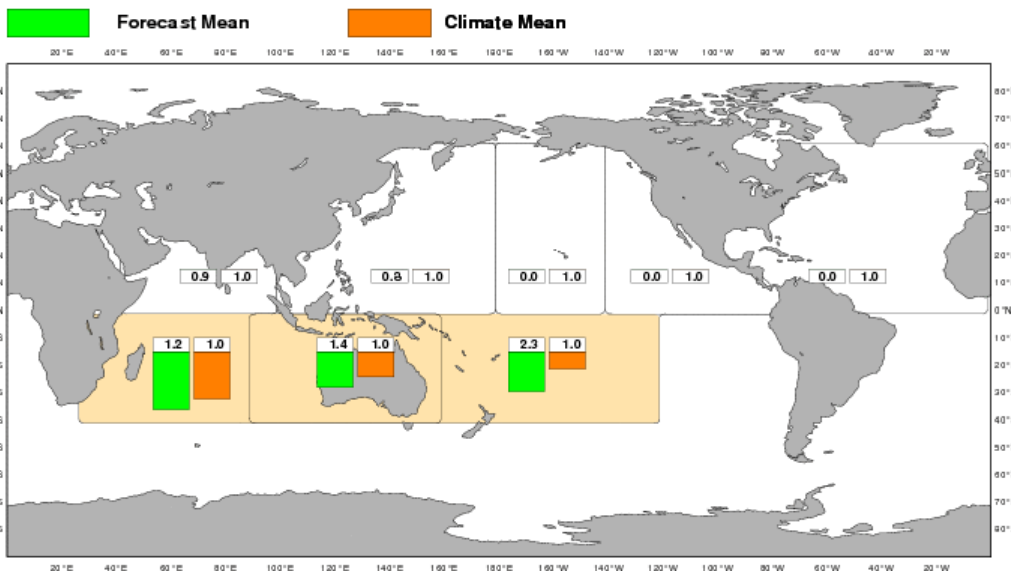


# Tropical storm density





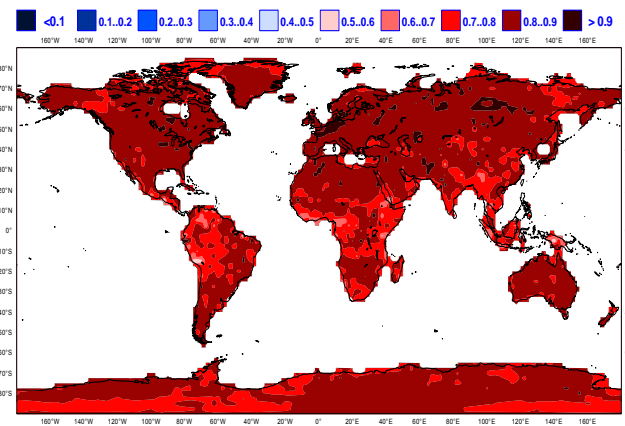
# Weekly mean Accumulated Cyclone Energy (ACE)



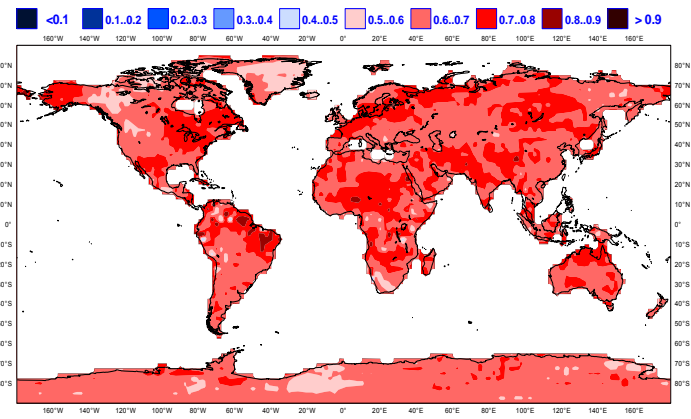
# Skill of the ECMWF Monthly Forecasting System

ROC score: 2-meter temperature in the upper tercile

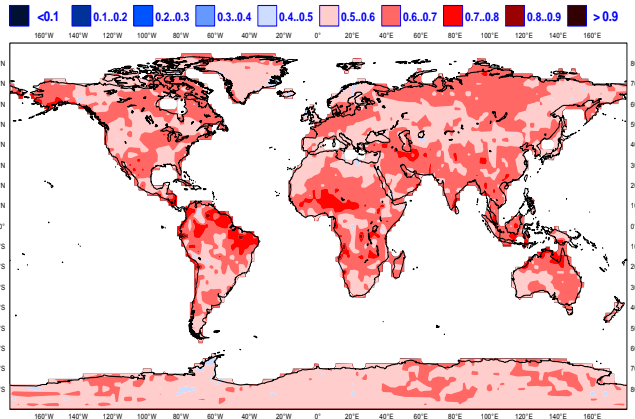
Day 5-11



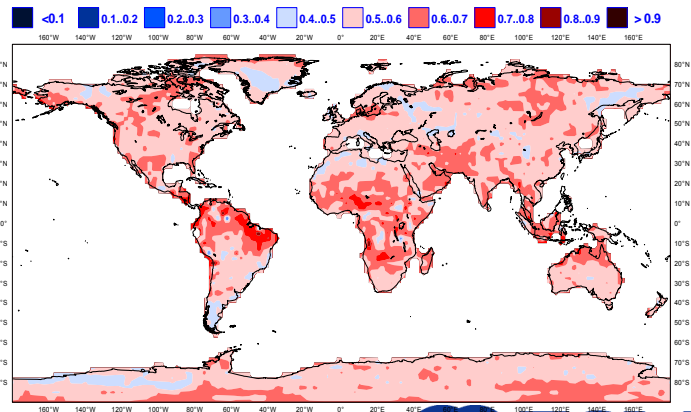
Day 12-18



Day 19-25



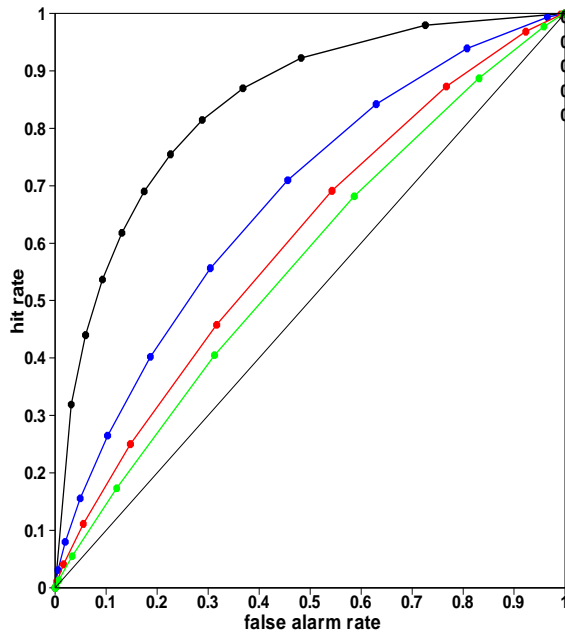
Day 26-32



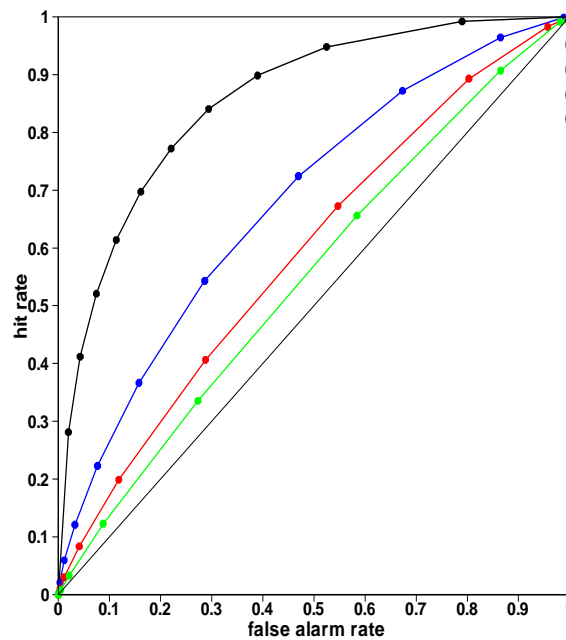
# Skill of the ECMWF Monthly Forecasting System

## ROC scores over the Northern extratropics

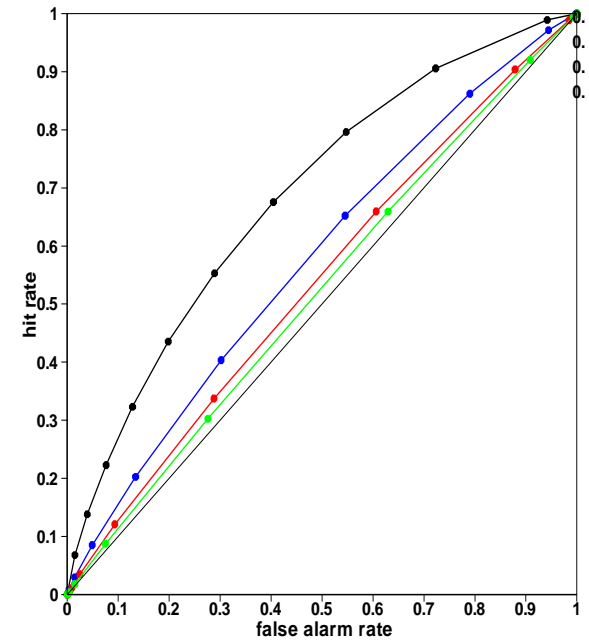
2-metre  
temperature



Mean sea-level  
pressure



Precipitation



Day 5-11

Day 12-18

Day 19-25

Day 26-32

# Monthly Forecast: Performance over the Northern Extratropics

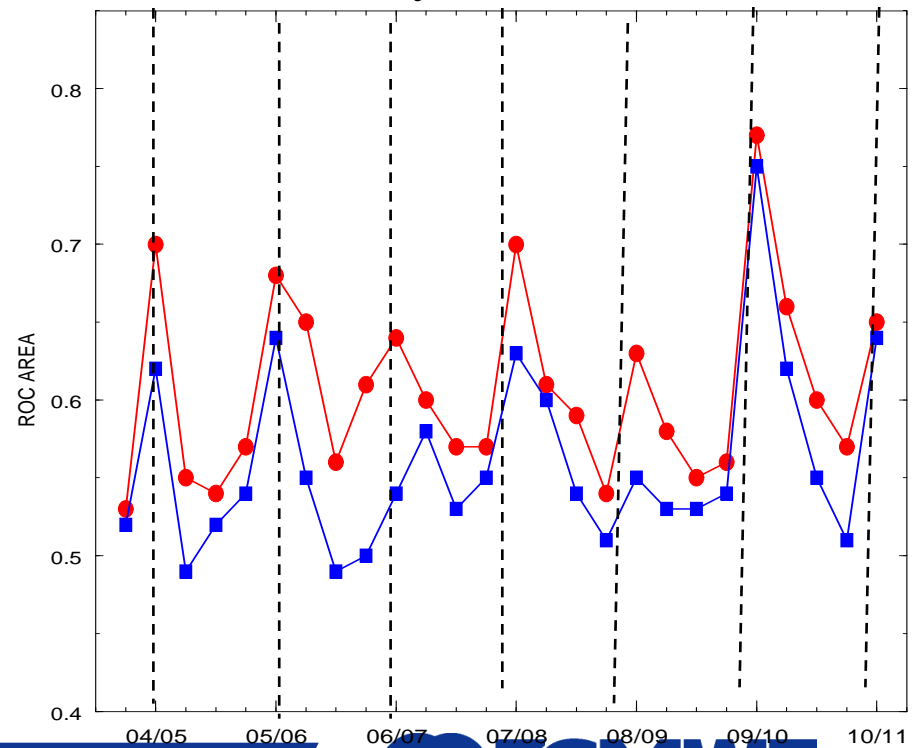
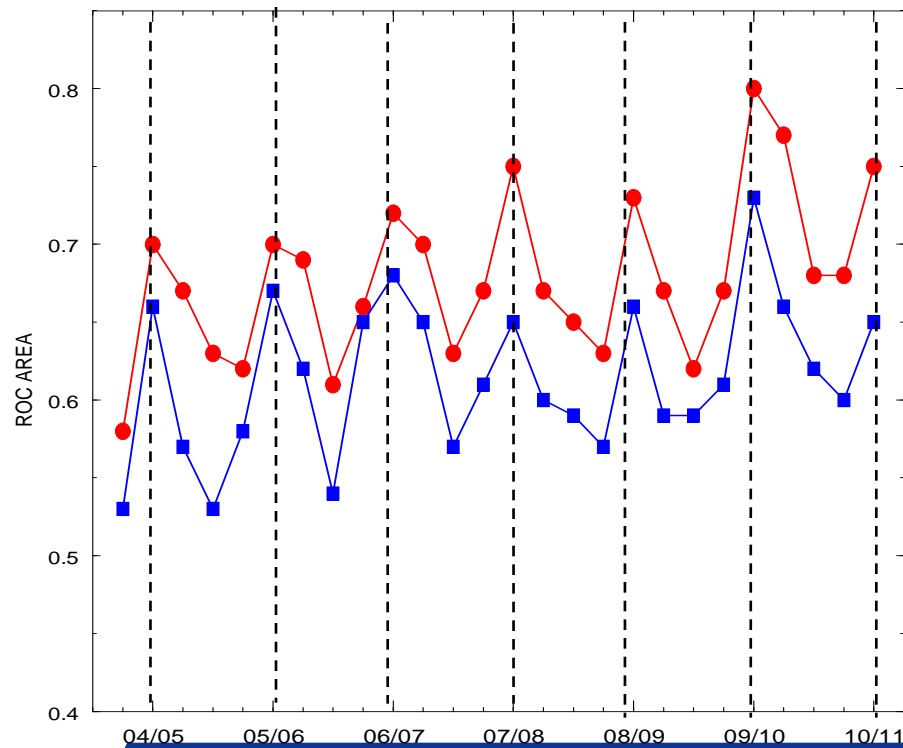
ROC score: 2-meter temperature in the upper tercile

Monthly Forecast  
Persistence of day 5-11

Day 12-18

Monthly Forecast  
Persistence of day 5-18

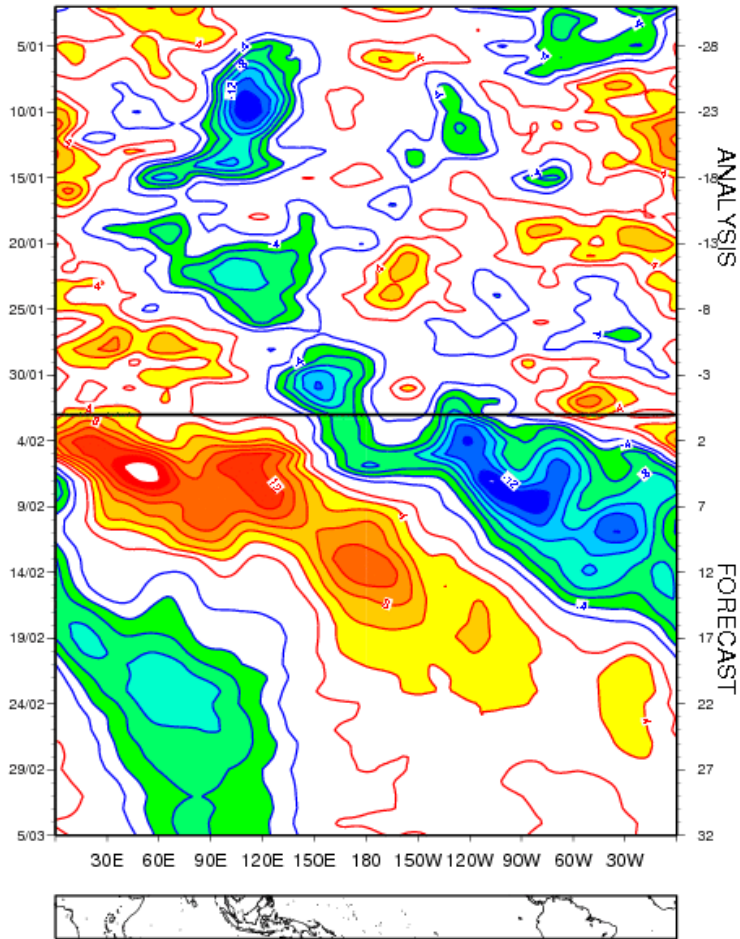
Day 19-32



# 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



ECMWF MONTHLY FORECASTS  
 FORECAST BASED 02/02/2012 00UTC

