Met Office
Hadley Centre

# GPC Exeter forecast for winter 2015-2016

# Global Seasonal Forecast System version 5 (GloSea5)

- ensemble prediction system
- the source for Met Office monthly and seasonal forecasts
- uses a coupled model (atmosphere—land-surface—ocean—sea-ice)
- regular updates
- linked to model development cycle (~ yearly)
- hindcasts computed in near-real time

# GloSea5 operational system

Model version: **HadGEM3 GC2.0 (UM / NEMO / CICE / OASIS)**

Resolution: **N216L85 O0.25L75** (mid-lat: ~60 km atm.)

Forecast length: **7 months (seasonal), 2 months (sub-seasonal)**

Hindcast period: **1996-2009 (14 years)**

Model uncertainties represented by stochastic physics

Initial conditions uncertainties represented by a lagged ensemble

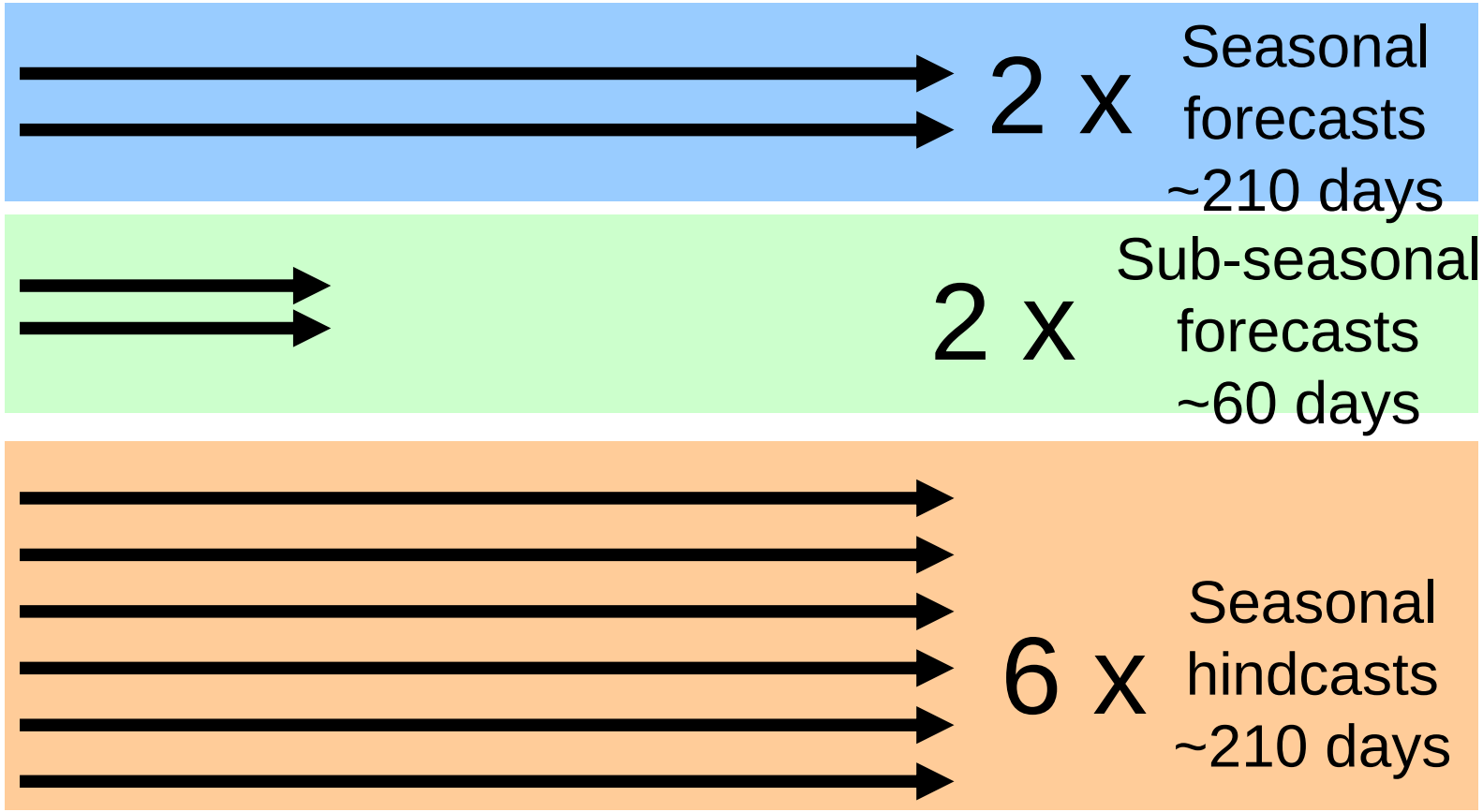
# Initialisation of the system

Forecast (initialised daily):
- Atmosphere & land surf*: Met Office NWP analysis (4d-Var)
- Ocean & sea-ice: NEMOVAR (3d-Var joint system for ocean, med-range, monthly and seasonal)

14-year hindcast (1996-2009):
- Atmosphere & land surf*: ERA-interim
- Ocean & sea-ice: NEMOVAR
- Fixed start dates of 1st, 9th, 17th, 25th of each month
- 3 members per start date

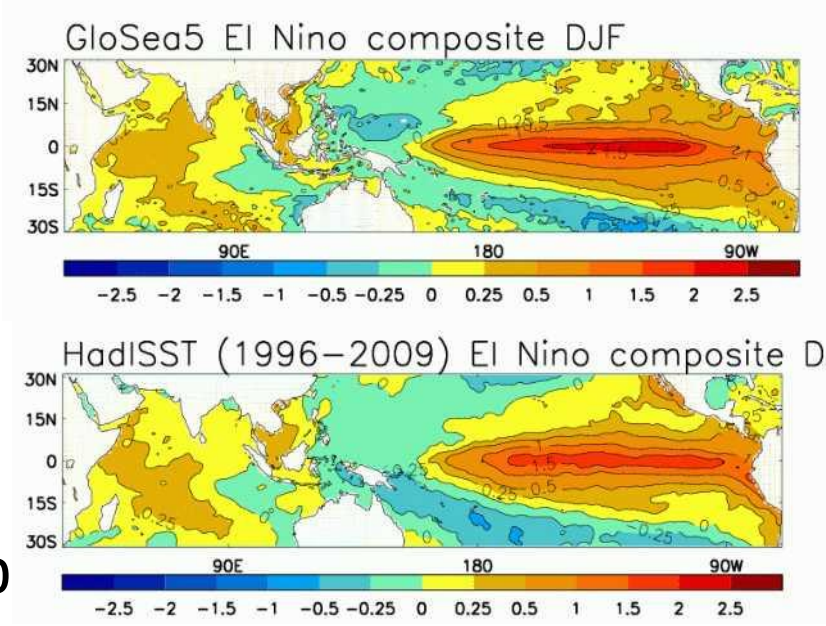
* Soil moisture set to climatological average

# A day in the life of GloSea5



# Skill of forecasting system

- ENSO
  - high correlations of ensemble mean forecasts and observations
  - much improved westward extension
  - good representation of teleconnections




- NAO
- West Pacific Subtropical High
- rainfall over Yangtze river catchment
- tropical storm numbers and ACE (esp Australia); landfall frequency in Caribbean

# Sources of predictability

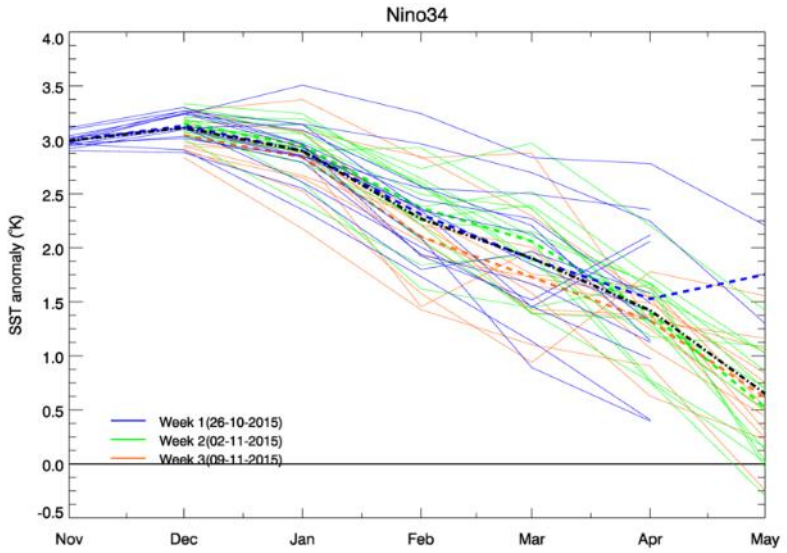
- ENSO (seasonal)
- QBO (seasonal)
- ATLANTIC SST (seasonal)
- SEA ICE (interannual)
- SNOW (seasonal)
- VOLCANOES (interannual) – not expected to contribute this year
- SOLAR (interannual) – not expected to contribute this year

# Sources of predictability

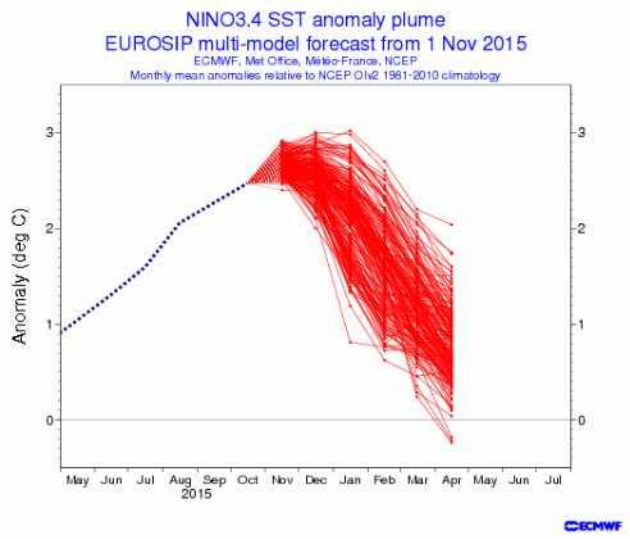
- ENSO (seasonal) – strong El Niño → positive NAO early winter, high chance of SSW late winter
  - observations, models
- QBO (seasonal) – westerly phase → positive NAO early winter
  - observations, models (to a certain extent)
- ATLANTIC SST (seasonal) – tripole in May SST → DJF NAO
  - observations, models
- SEA ICE (interannual) – low September sea-ice → negative DJF NAO
  - observations, models ; not yet well established
- SNOW (seasonal) – Eurasian snow cover or advance of snow in October → negative correlation with AO;
  - observations (no consensus), not in models

# ENSO forecasts Nov 2015 – Apr 2016
# Nino 3.4

GloSea5 (26 Oct-15 Nov)

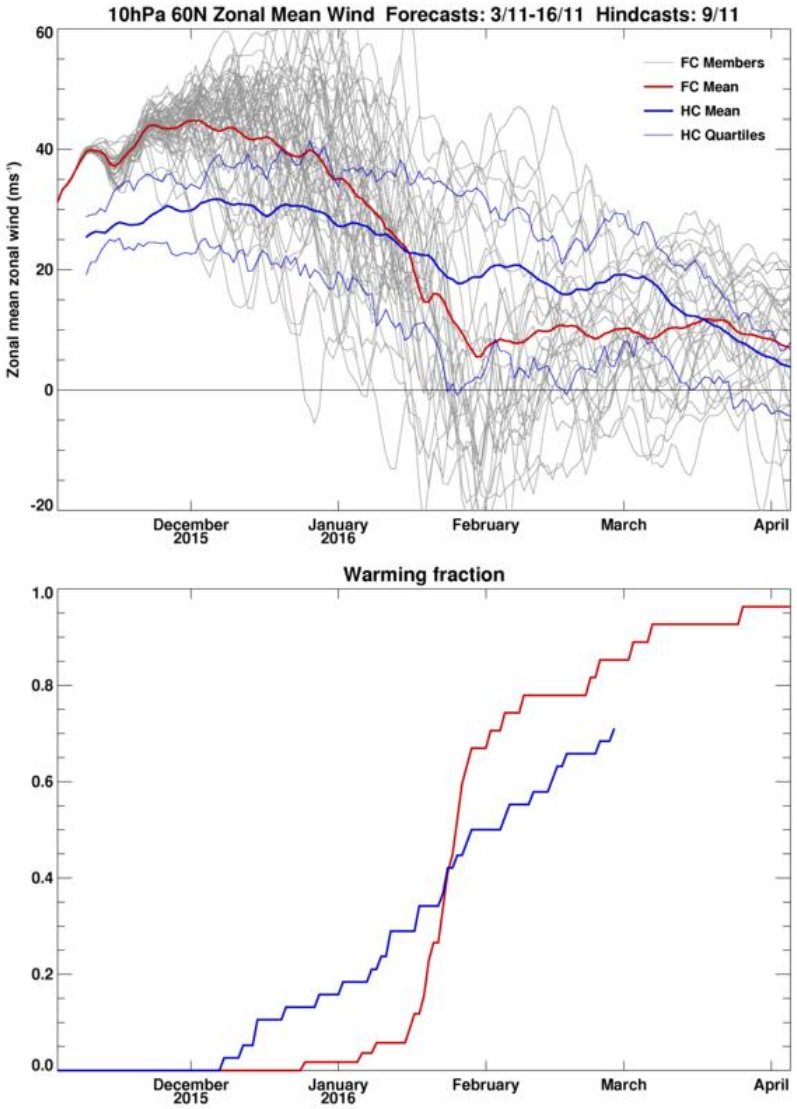



Euro-SIP



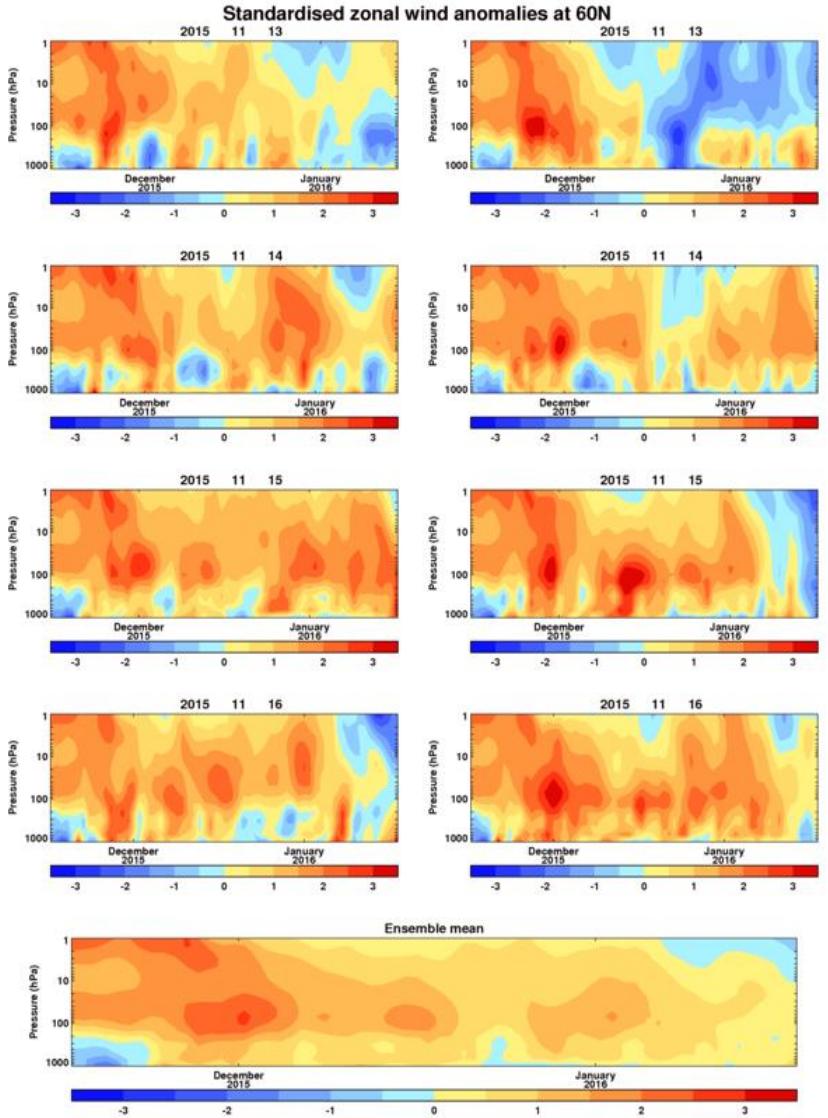
# Stratosphere 60N
# Mean 10 hpa Zonal Wind Anomalies

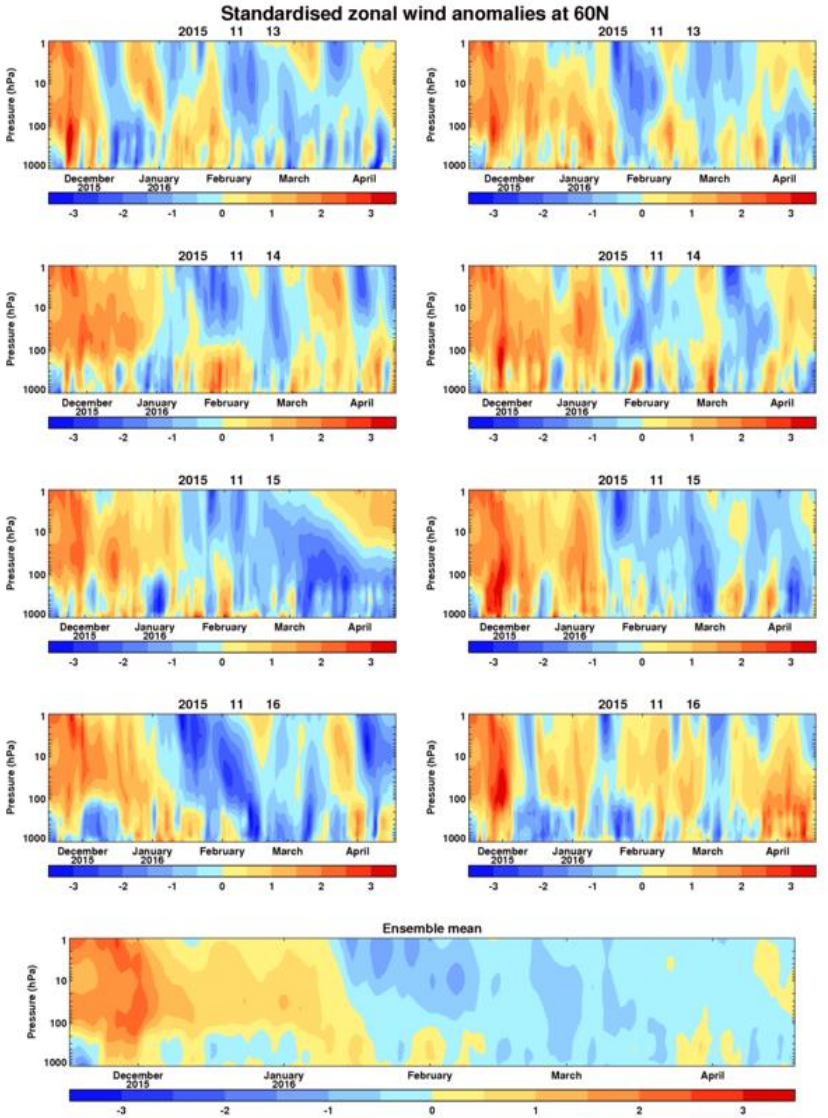
***Initial cond: 3-16 Nov***



# Stratosphere 60N – Mean zonal wind anomalies

***Monthly*** ***Initial cond: 13-16 Nov*** ***Seasonal***



# Summary – sources of predictability

- ENSO – strong El Niño → positive NAO early winter, increased risk of SSW late winter
- QBO – westerly phase → positive NAO early winter

# December-January-February Forecast

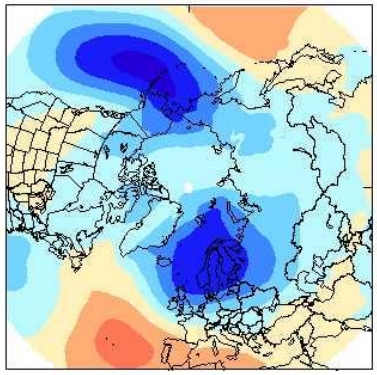
***GloSea5 initialised  around early November***

# Ensemble mean PMSL DJF

## GloSea 5 (1996-2009)

Initial conditions:
**26 Oct-15 Nov**
40 members

GloSea : Ensemble mean anomaly : mean sea level pressure : Dec/Jan/Feb

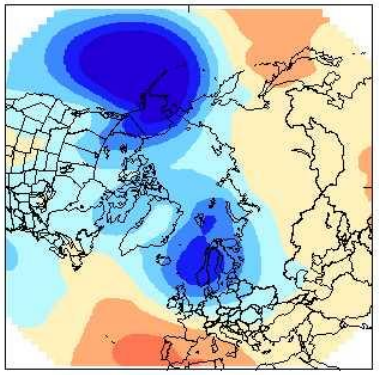


hpa

## ECMWF (1981-2010)

Initial conditions:
**1 Nov**

ECMWF : Ensemble mean anomaly : mean sea level pressure : Dec/Jan/Feb

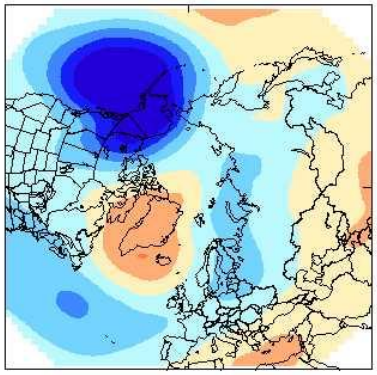


hpa

## Met France (1991-2010)

Initial conditions:
**1 Nov**

Meteo France : Ensemble mean anomaly : mean sea level pressure : Dec/Jan/Feb

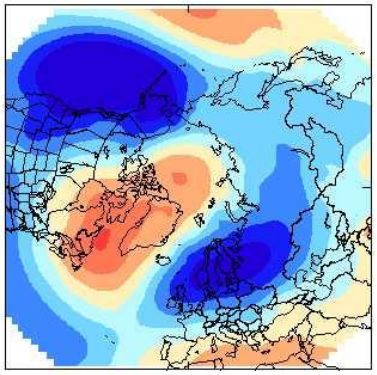


hpa

## NCEP (1982-2011)

Initial conditions:
**26 Oct-5 Nov**

NCEP : Ensemble mean anomaly : mean sea level pressure : Dec/Jan/Feb

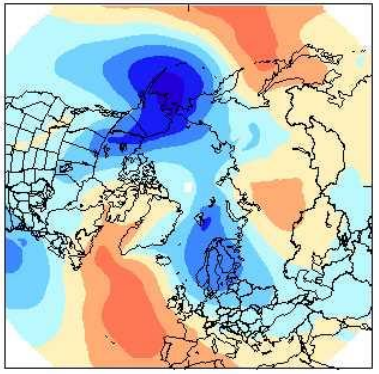


hpa

## KMA (1996-2009)

Initial conditions:
**26 Oct-15 Nov (37 members)**

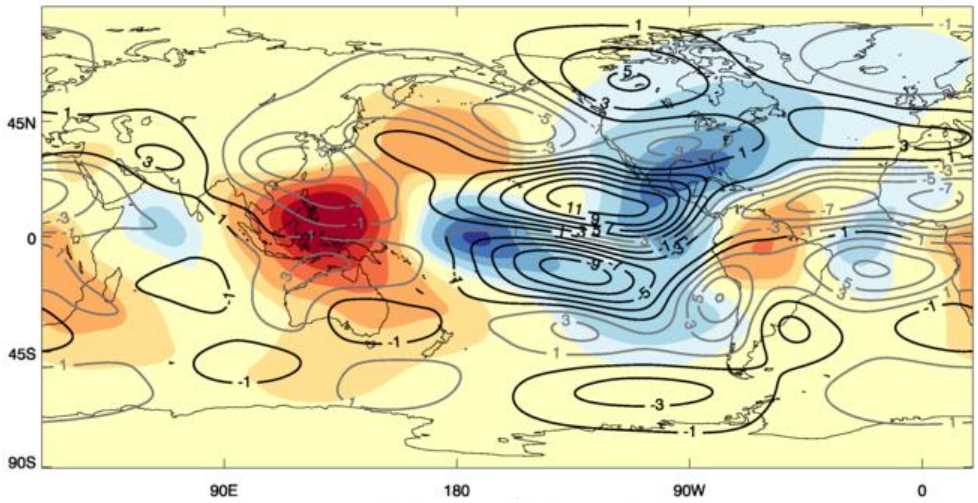
: Ensemble mean anomaly : mean sea level pressure : Dec/Jan/Feb



hpa

# Upper Troposphere (200hPa) Circulation Anomalies – DJF

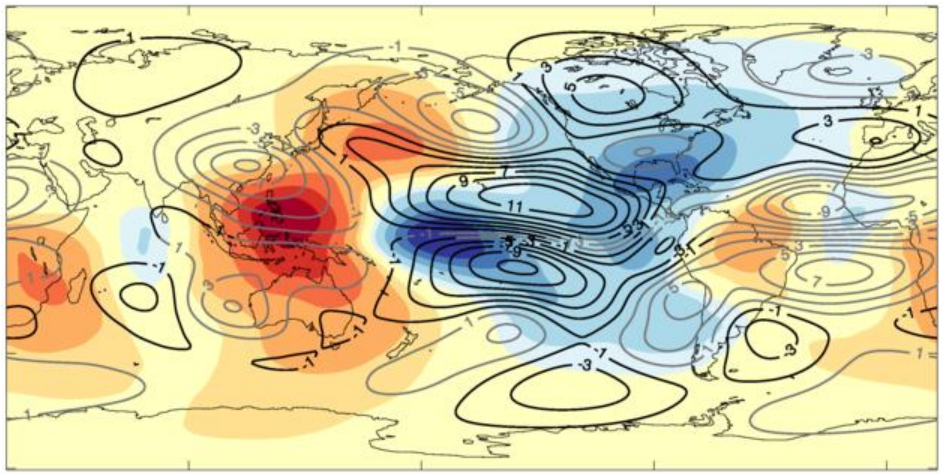
**GloSea5**



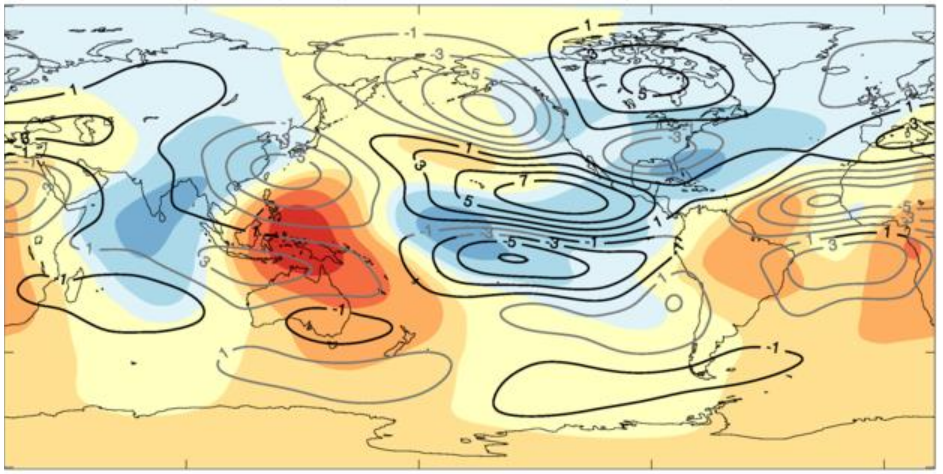

**Contours: streamfunction**
grey = cyclonic; black = anticyclonic;
zonal mean removed; units = $km^2\ s^{-1}$

**Colours: velocity potential**
(divergent winds are gradient of vp)

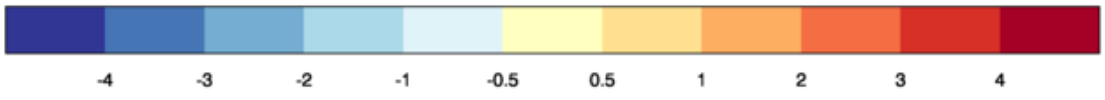
**ECMWF**



**Meteo-France**



Divergence

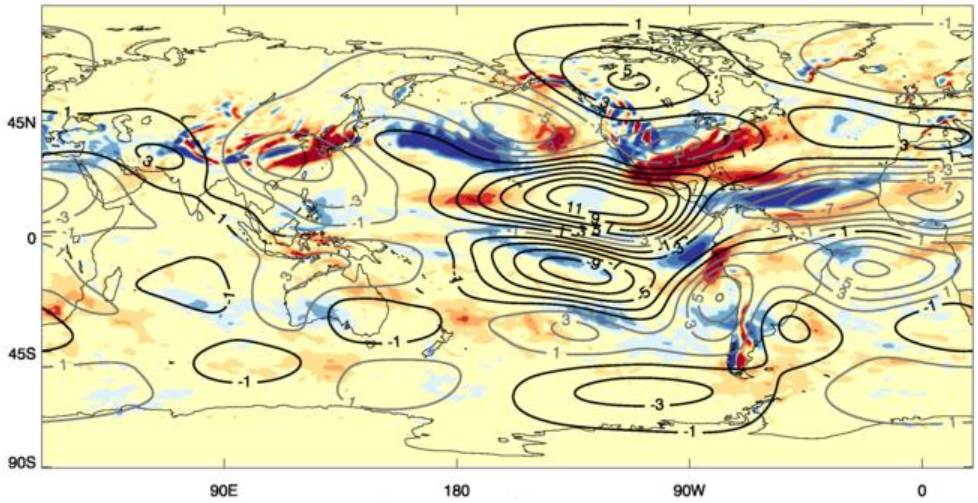



$km^2\ s^{-1}$

Convergence

# Upper Troposphere (200hPa) Circulation Anomalies – DJF

**GloSea5**




**Contours: streamfunction**
grey = cyclonic; black = anticyclonic;
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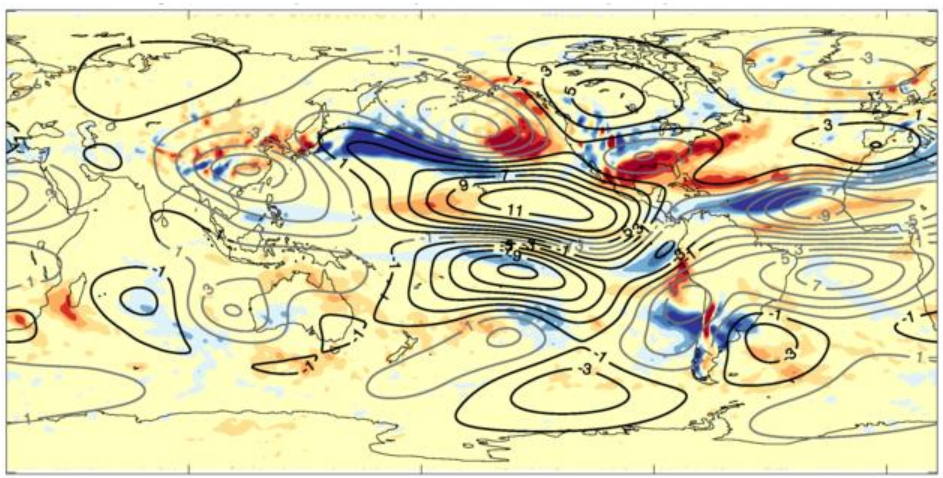
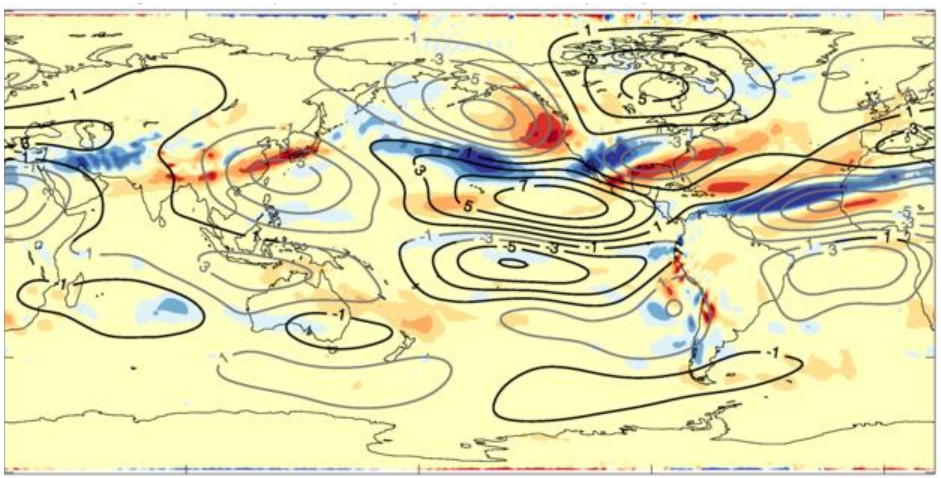
**Colours: Rossby wave source** =

Rate of change of vorticity due to divergence and divergent wind

**ECMWF**



**Meteo-France**

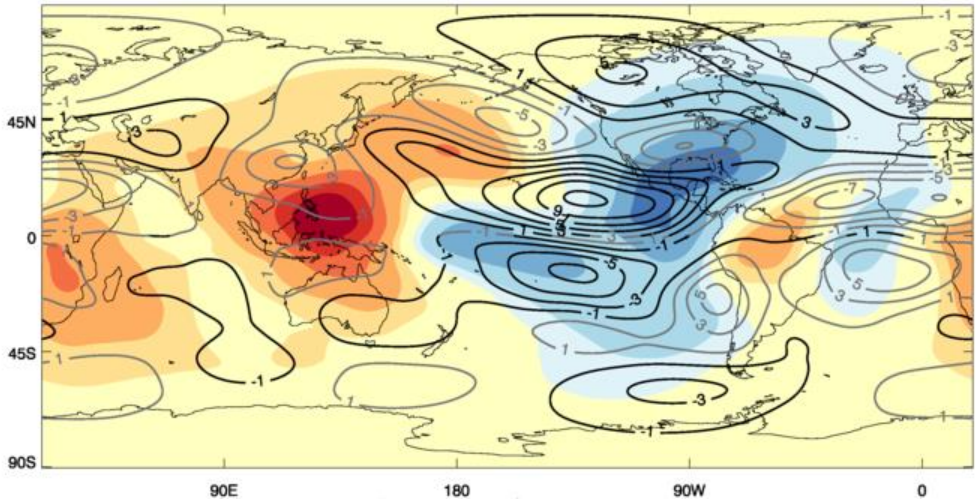


decreasing vorticity <=


⇒increasing vorticity
($10^{-11}\ s^{-2}$)

# Upper Troposphere (200hPa) Circulation Anomalies – JFM

**GloSea5**

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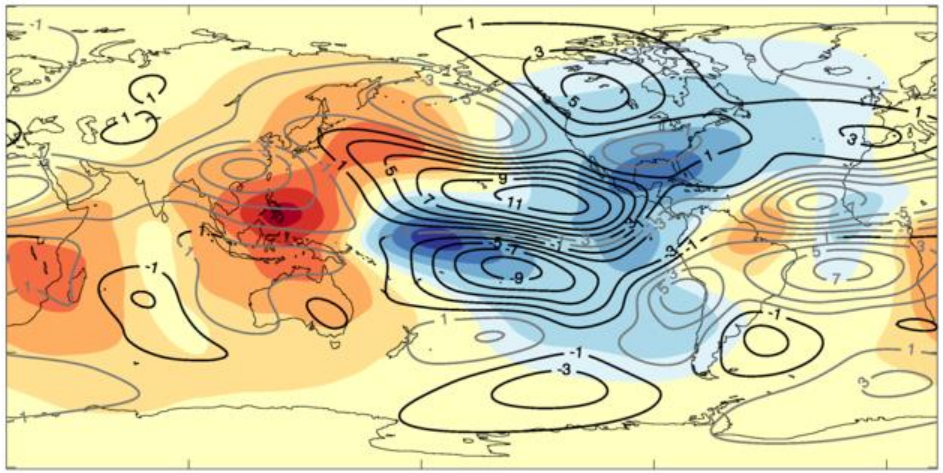
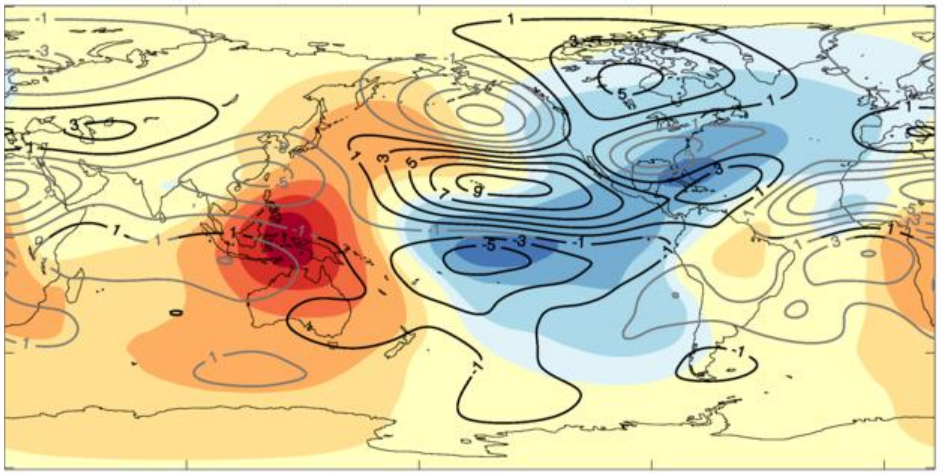
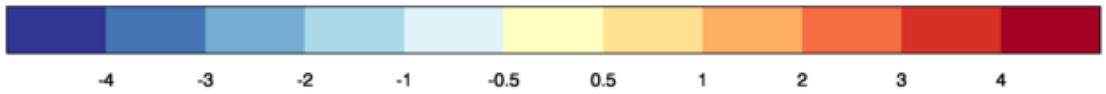
**ECMWF**



**Meteo-France**



Divergence

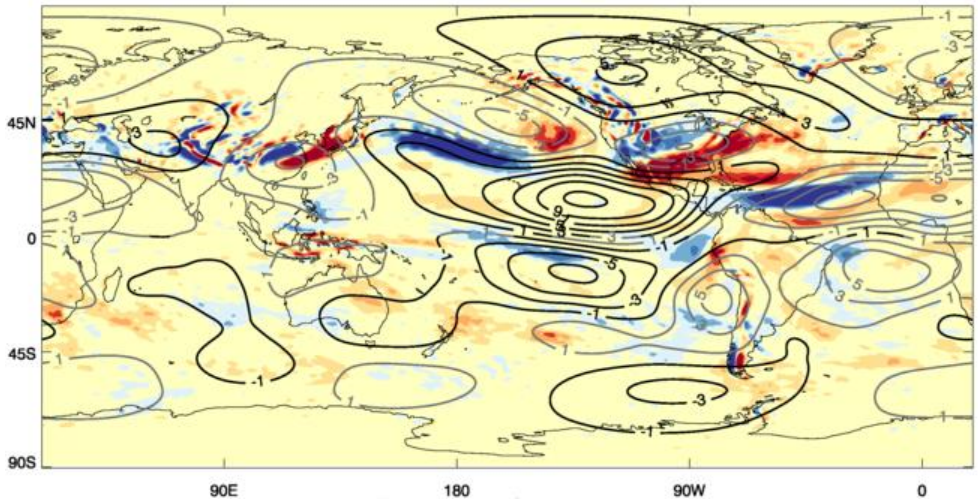



$km^2\ s^{-1}$

Convergence

# Upper Troposphere (200hPa) Circulation Anomalies – JFM

**GloSea5**

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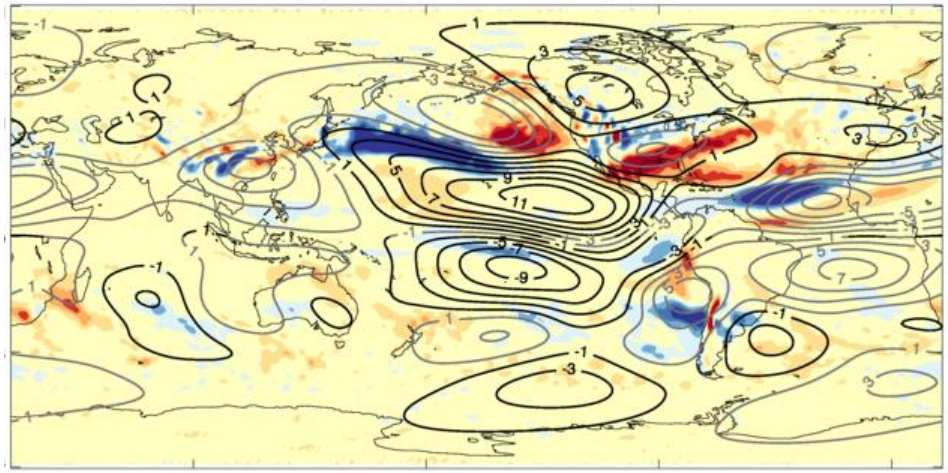
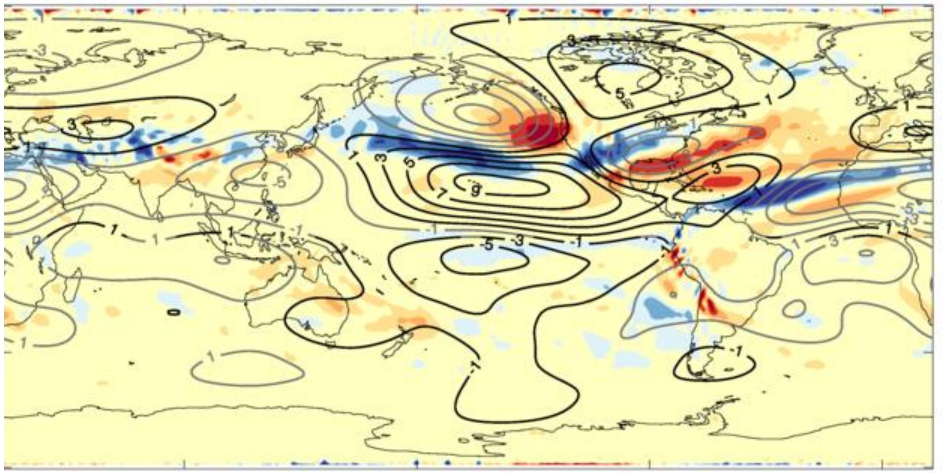


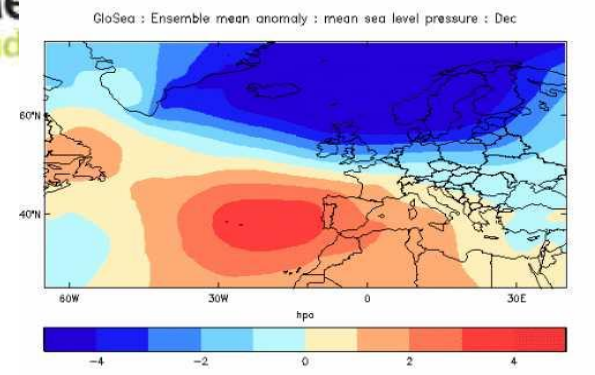
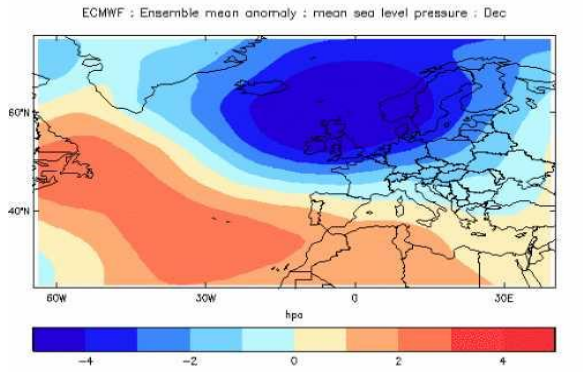
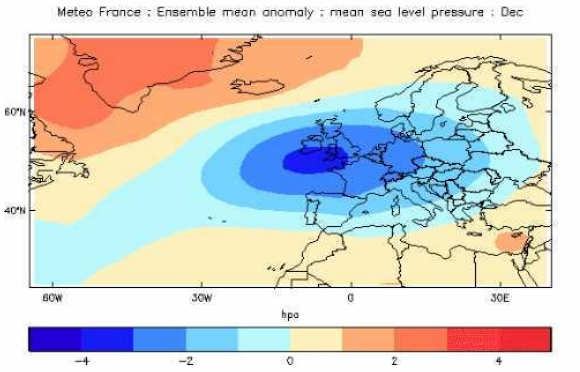
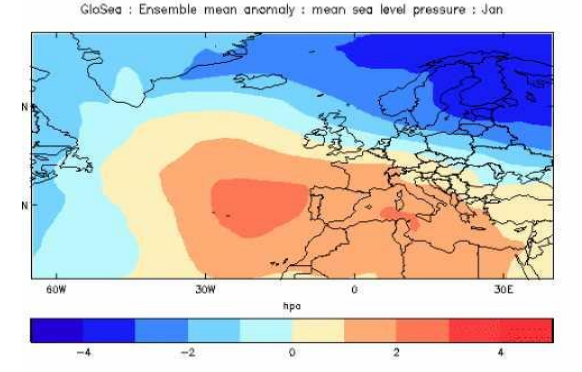
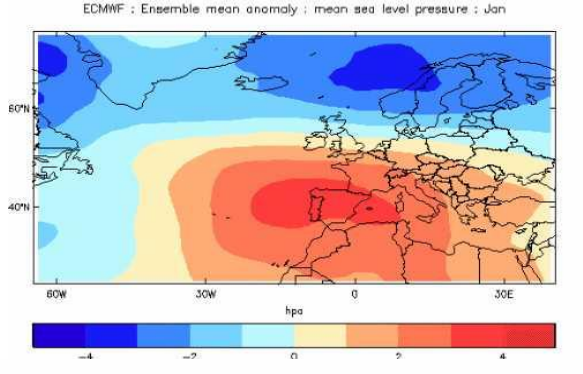
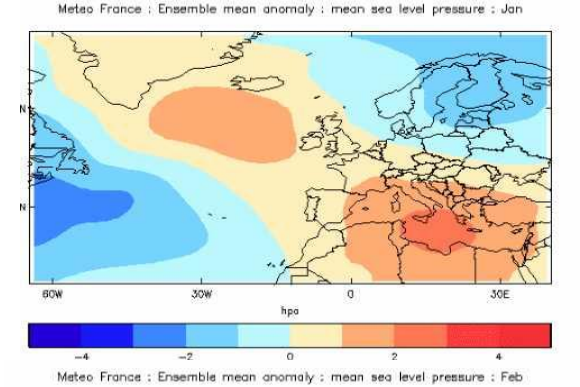
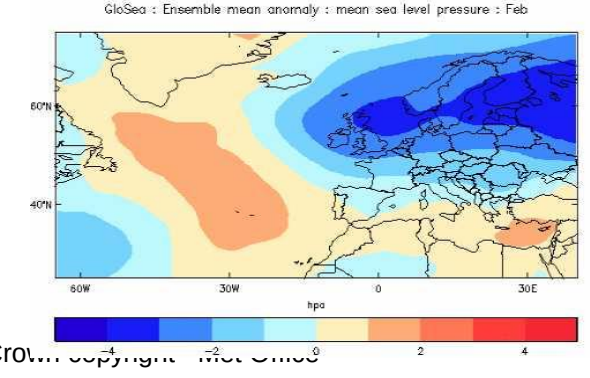
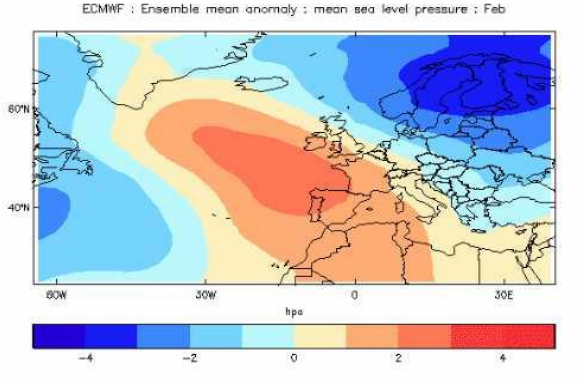
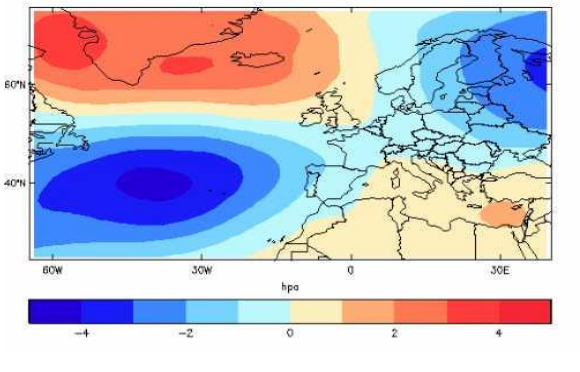
**Meteo-France**



decreasing vorticity <=

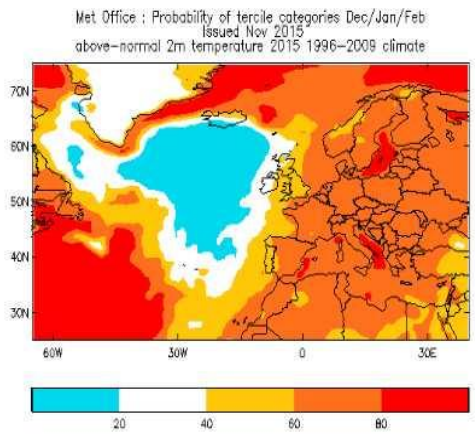
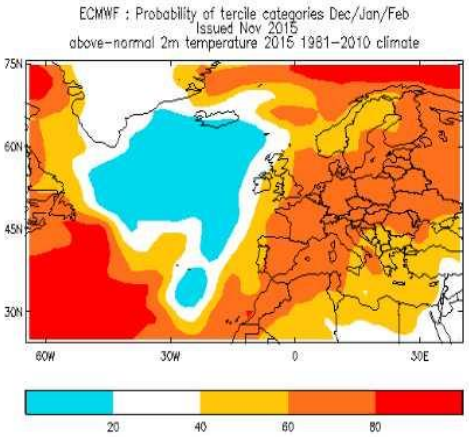
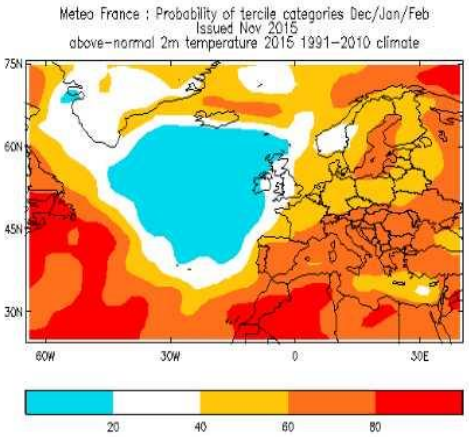
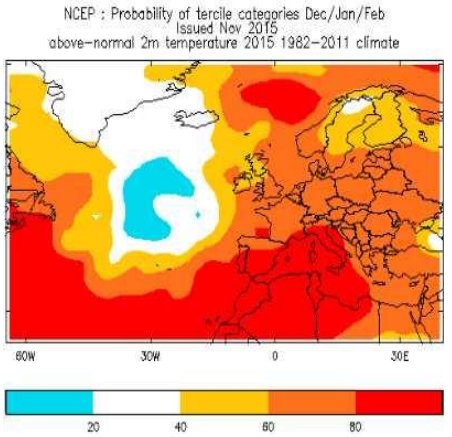
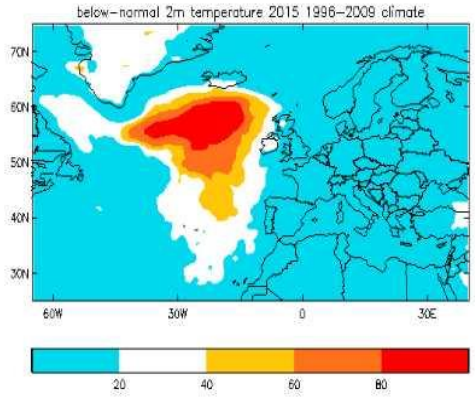
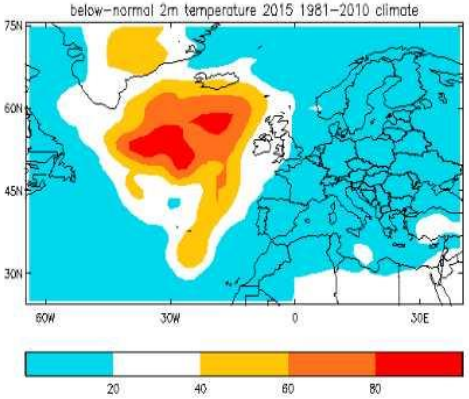
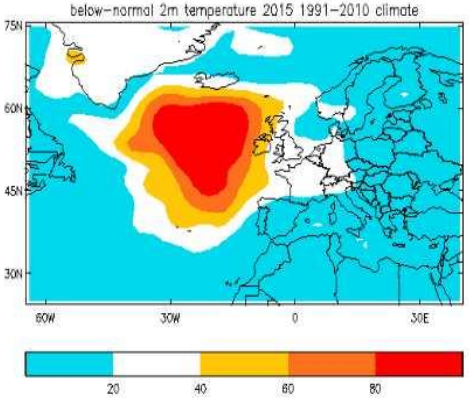
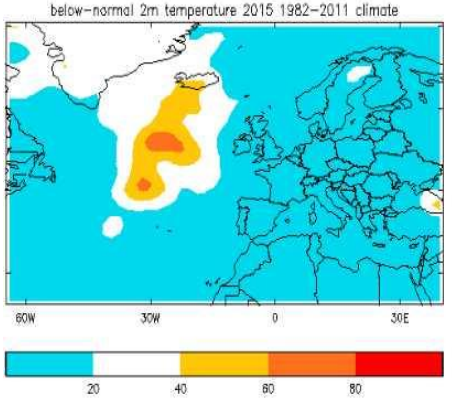

⇒increasing vorticity
($10^{-11}\ s^{-2}$)

# PMSL anom by month

| | GloSea 5 1996-2009 | ECMWF 1981-2010 | Met France 1991-2010 |
|---|---|---|---|
| Dec |  |  |  |
| Jan |  |  |  |
| Feb |  |  |  |

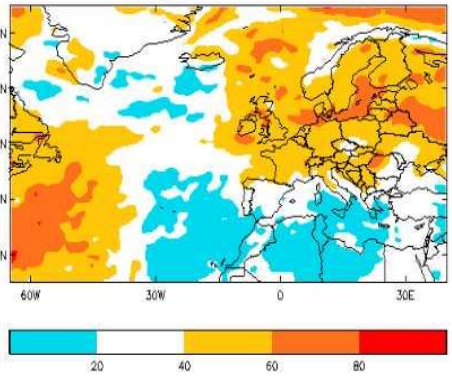
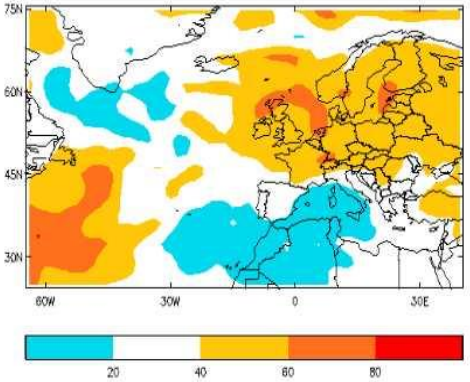
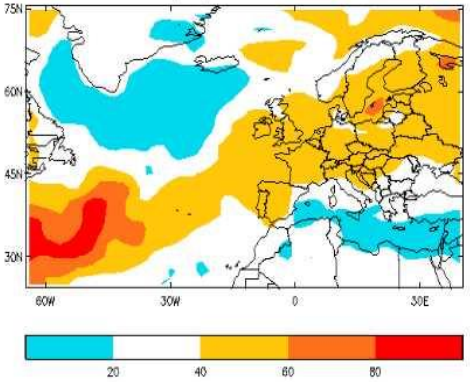
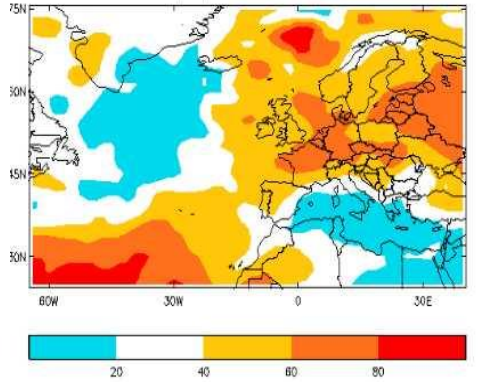
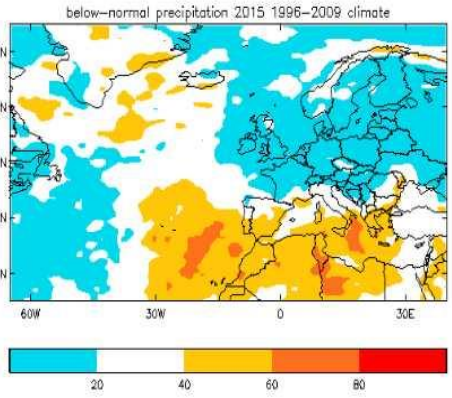
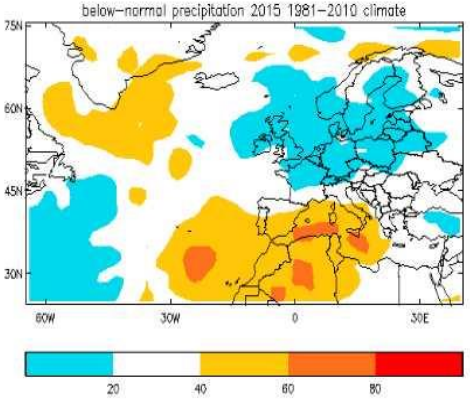
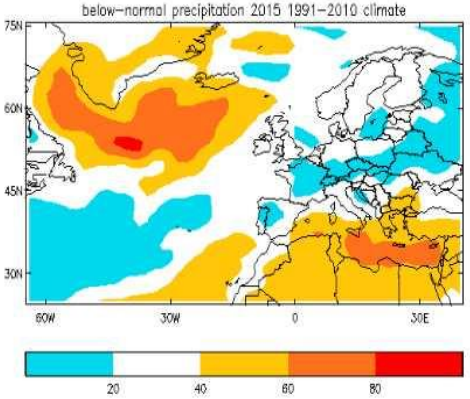
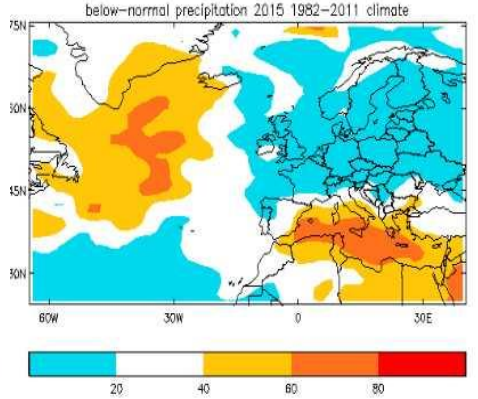
# Multi-Model DJF
# 2m temperature tercile probabilities

Met Office
Hadley Centre

| | GloSea 5 | ECMWF | Meteo France | NCEP |
|---|---|---|---|---|
| | **1996-2009 climate** | **1981-2010 climate** | **1991-2010 climate** | **1982-2011 climate** |
| Above |  |  |  |  |
| Below |  |  |  |  |

# Multi-Model DJF
# Precipitation tercile probabilities

Met Office
Hadley Centre

| | GloSea 5 | ECMWF | Meteo France | NCEP |
|---|---|---|---|---|
| | **1996-2009 climate** | **1981-2010 climate** | **1991-2010 climate** | **1982-2011 climate** |
| Above |  |  |  |  |
| Below |  |  |  |  |

# Summary

•There is currently a strong signal, consistent across models, for positive NAO in early winter. This is consistent with the known drivers (see below). In late winter, there is a heightened risk of sudden stratospheric warming but with a large uncertainty in the timing of the impact.

Expected influences this year:
•strong El Niño
•strong influence from the stratosphere (QBO)


# The end