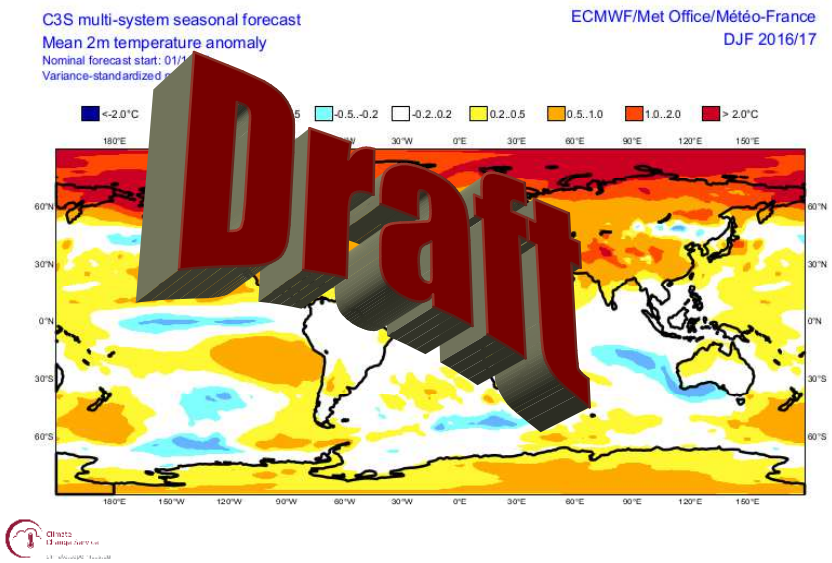
ECMWF COPERNICUS REPORT

Copernicus Climate Change Service

# VERIFICATION BULLETIN

## SEASONAL FORECAST FOR THE WINTER 2016-2017

## Initialisation November 2016

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# Background

- *This document has been prepared by Meteo-France as a contribution for C3S/433/Lot1 to the development of Multi-Model products on Seasonal Forecast*

- *This product, elaborated in the Proof of Concept Phase (PoC) of C3S , is only an experimental one and aims to assess the feasibility and the interest of a such approach for the C3S users*

- *The content of the bulletin and especially the indices and the graphical products used as support of the analysis, can evolve in a next version.*

- *In this version, this verification concerns only the three SF models selected for the PoC Phase : ECMWF System 4 , Meteo-France Arpege System 5 and Met Office GloSea5. Later, the verification will be extended to all the individual SF models contributing to C3S MM and to the MM itself.*

- *This preliminary version uses mainly first products available on the C3S website in March 2017 or in the individual Global Producing Centre (GPC) websites and especially the Meteo-France one.*

- *All products are not currently available for each model and the verification can concern the three, two or only one model referring to the analyzed parameter. One of the goal of this document is also to identify the needs of new products or functionalities (update of the forecast with recent observations) for the verification process on SF.*

- *The description of each individual SF models and their skills are not reminded here and can be consulted on the individual GPC websites (ECMWF, Meteo-France and Met Office). They will be soon available on the C3S portal.*

- *Meteo-France thanks particularly “Mercator Ocean” for their contribution to the preparation of the verification products for the oceanic analysis.*

# Objectives

- *The bulletin of verification of the seasonal forecast (SF) aims to identify and to analyze the performance of individual SF models and the C3S Multi-Model for the last winter or the last summer (main seasons on interest for applications).*

- *The objective is not to evaluate the mean skills of the SF models or C3S Multi-Model, for which scores are calculated on the whole hind-cast period but to enhance the knowledge of the behavior of the SF models for advanced users (as National Meteorological Services or Private Meteorological Company). This approach meets the need of many users, who want to know the recent real-time performances of models, over specific events.*

- *The verification process can also concern the SF providers themselves for identifying the behavior of their model in a specific climate state, regional good and bad patterns for each parameter by comparing with observational references and with other models, as a possible source of improvement.*

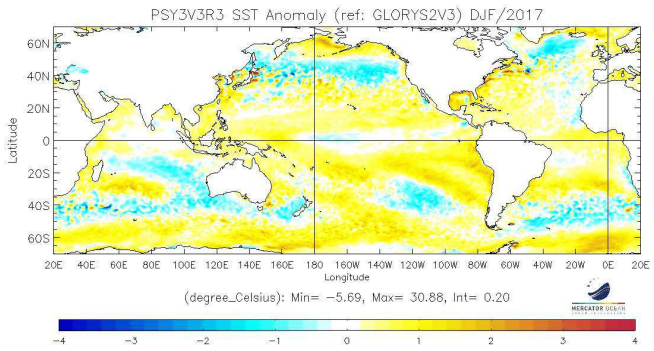
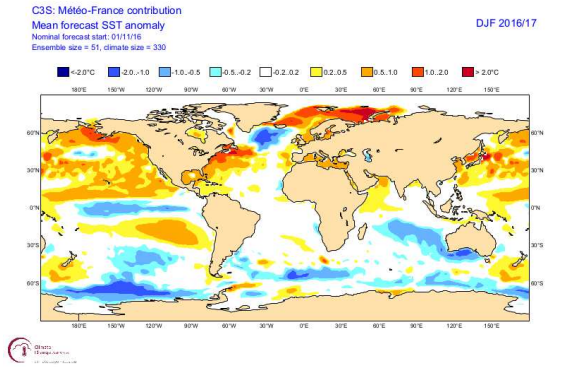
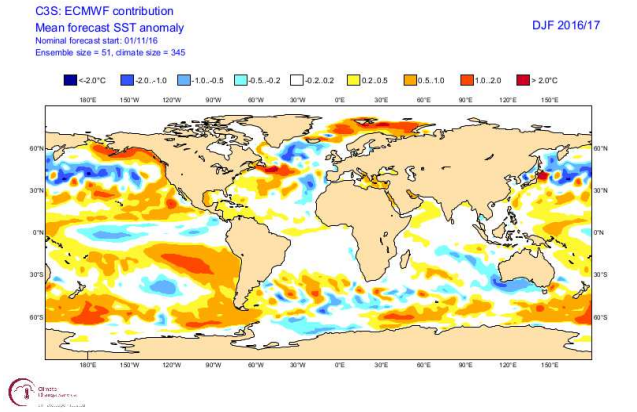
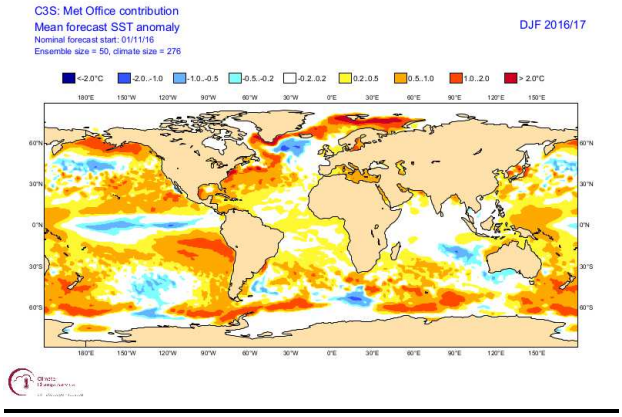
- *This bulletin concerns the whole world for the oceanic component (especially over the tropics), the Northern hemisphere large scale atmospheric circulation and focuses over Europe and surrounding regions for temperature and precipitation forecasts.*

- *The content of this bulletin has been discussed with Q4SEA project partners to verify the consistency of the methods and diagnosis applied to the SF evaluation.*

# Content

# I) Oceanic forecast :

## I-1) Global SST forecast

| A : VERIFICATION<br>MERCATOR OCEAN (Best Analysis) | B : 3 months forecast SST ARP S5 |
|---|---|
|  |  |
| **C: 3 months forecast SST ECMWF S4** | **D : 3 months forecast SST Met Office GloSea5** |
|  |  |

COMMENTS :

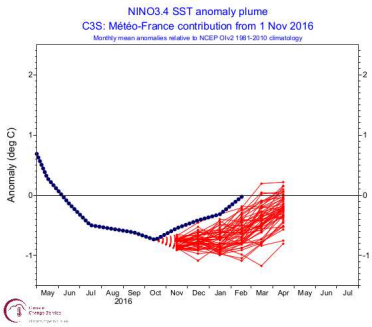
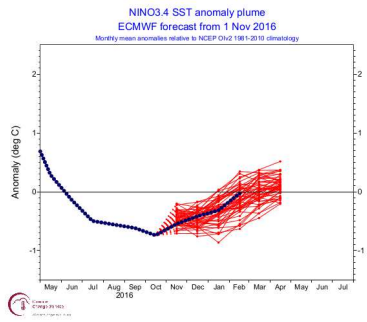
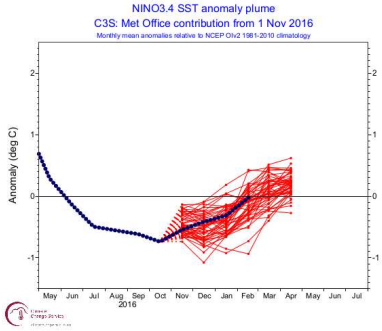
- A: OBSERVATION : The observational reference used for the 3-month mean of Oceanic Sea Surface Temperature Anomaly has been provided by Mercator Ocean (Lead of the Copernicus Marine Environment Monitoring Service) . Note that the climate reference used here is 1993-2014.
- B: ARP Syst 5 SST Anomalies reveal too cold on the middle East Equatorial Pacific (Niña event phase) while positive SST anomalies are not forecasted on the Pacific South American Coasts and warm anomaly at the South Alaska are too strong. Quite good forecast on the Atlantic Basin and also Indian Basin except warm anomaly at the South East of Madagascar Island.
- C : ECMWF S4 : Correct forecast on the Pacific Basin (except warm anomalies between Equator and Galapagos Island.) and the Atlantic Basin except a negative anomaly near the Açores Islands

- D : Met Office GloSea5 : Too cold on the middle East Equatorial Pacific but good forecast of positive anomalies on the Pacific South American Coasts. Bad forecasts around New Zealand, with warm anomalies expected and cold anomalies observed. Like Arp S5, GloSea5 reveals too warm anomalies in the South Alaska. Good forecast in the Indian Ocean and the Atlantic Basin except in mid latitude of the South Hemisphere.

## I-2) Ocean Indices

Selection of the parameters : The chosen indices to represent the oceanic dynamic are the more frequently indices used over each main basin : Niño 3.4 for the Pacific, TNA for Atlantic and DMI for Indian. The definitions of each index are available on the MF website (http://seasonal.meteo.fr/). The forecast products come from the C3S, Meteo-France and ECMWF websites.

- Niño 3.4 Index

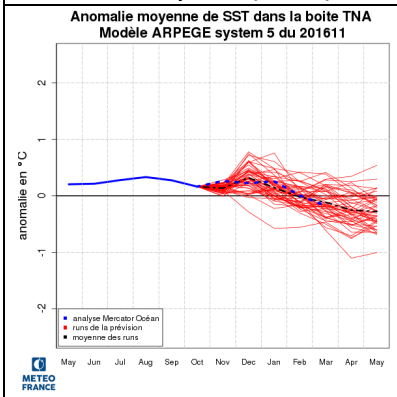
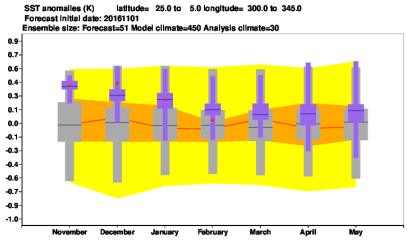
| A : Niño 3.4 VERIFICATION | B : Arp S5 |
|---|---|
| **See blue line on curves.** |  |
| C : ECMWF S4 | D : GloSea5 |
|  |  |

COMMENTS :

- B : ARP S5 : Overestimation of the intensity/duration of the Niña event (as seen on the previous map but the trend was more and less correct).
- C : ECMWF S4 : Good Forecast for the three months
- D: Met Office GloSea5 : Good Forecast for the three months

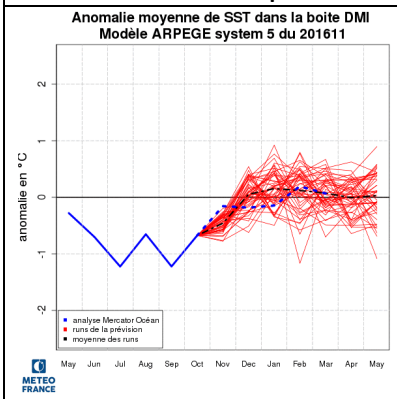
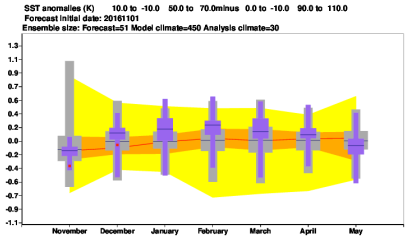
- TNA and DMI Index :

Note that for TNA and DMI Indices, the verification products come from the specific production of ECMWF and Meteo-France (No information available from C3S or Met Office)

| A : Arp S5 (TNA) | B : ECMWF S4 (TNA) |
|---|---|
|  |  |





| C : DMI : Arp S5 | D : DMI : ECMWF S4 |
|---|---|
|  |  |





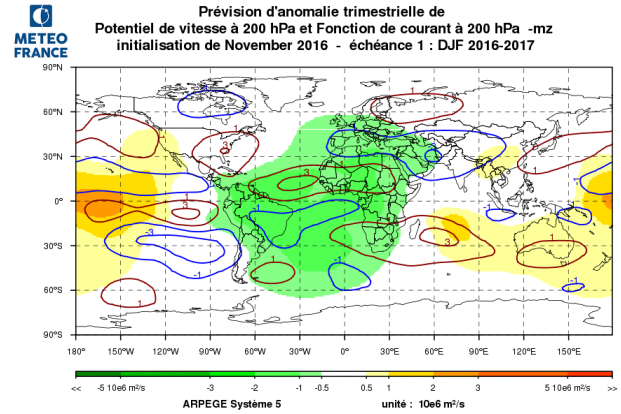
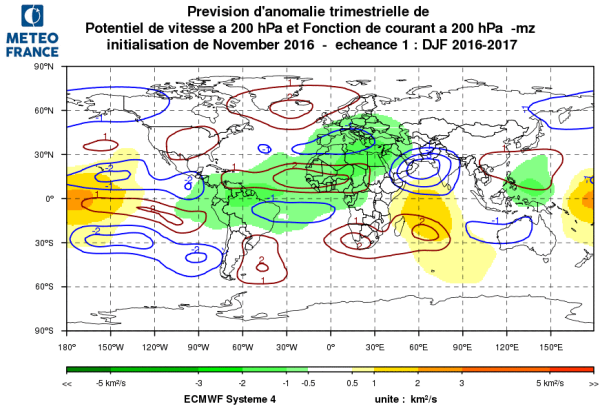
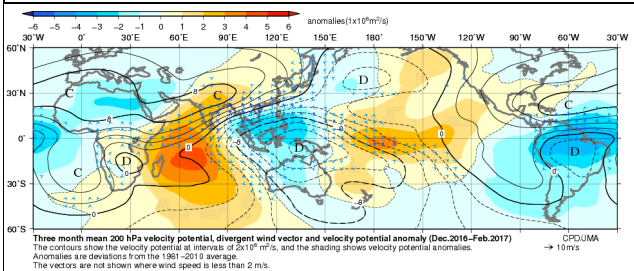
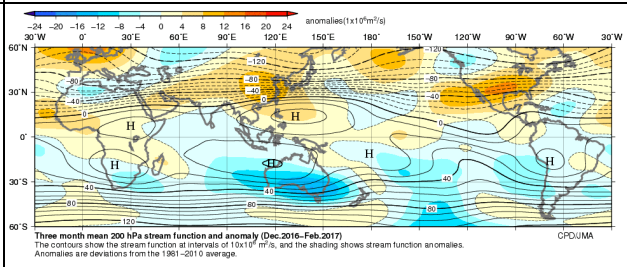
COMMENTS :

- A and C : ARP S5 : Correct long term trend for the TNA index for the winter; Very slight overestimation of the DMI index but the trend was correct
- B and D : ECMWF S4 : Good forecast of the evolution of the TNA index for the winter; Very slight overestimation of the intensity of the DMI but the trend was correct

# II) Atmospheric circulation forecast

## II-1) Global Teleconnection

Selection of the parameter: Two parameters have been selected to represent the atmospheric teleconnection between tropical and mid-latitude areas : Velocity Potential (PV) and Stream Function (SF) .
The definitions of these two parameters are available on the MF website http://seasonal.meteo.fr/.
The verification used comes from the JMA analysis :
http://ds.data.jma.go.jp/tcc/tcc/products/clisys/figures/db_hist_3mon_tcc.html
Note also that the PV and SF forecast products (here from the MF website) are currently available only for Arp S5 and ECMWF S4.

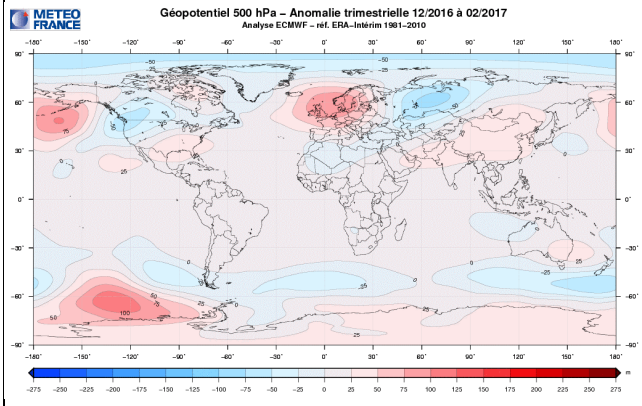
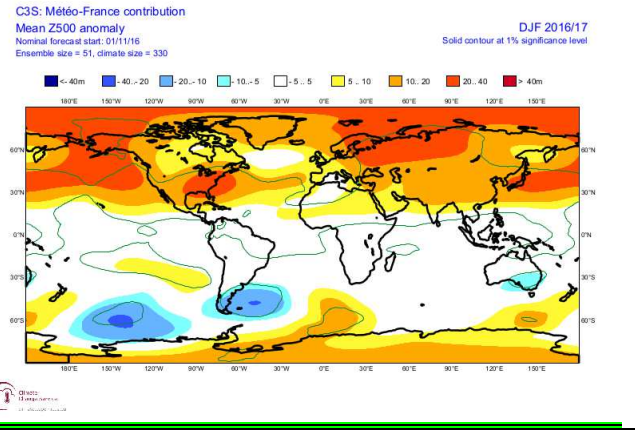
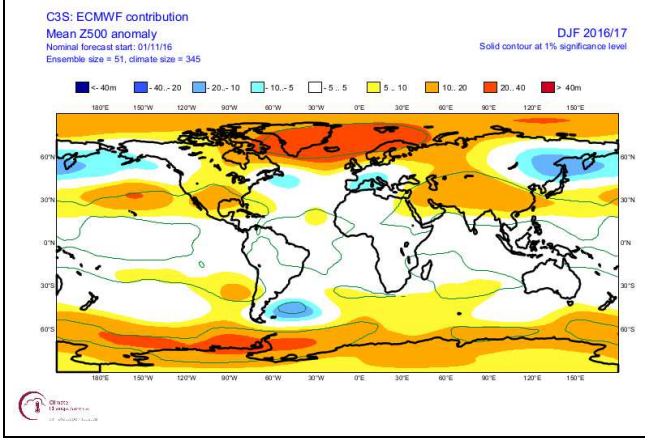
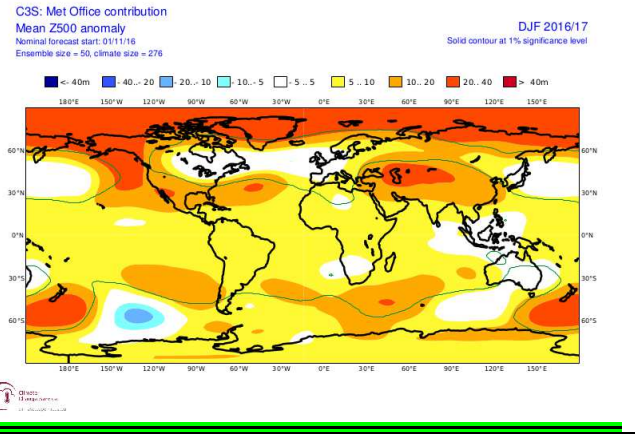
| A : Arp S5 | B : ECMWF S4 |
|---|---|
|  |  |
| Legend : PV = shading, SF = contours | Legend : PV = shading, SF = contours |
| Verification PV (from JMA) | Verification CF (from JMA) |
|  |  |

COMMENTS :

- A : ARP S5 : Good forecast for the negative anomaly of PV over South America and Africa, underestimation of the positive anomaly over Indian Ocean, good forecast on the whole Pacific except the negative anomaly on the Maritime Continent. The patterns of CF are quite well forecasted, especially on the Southern US and Tropical Atlantic. Some spatial gaps of CF anomalies on the Mediterranean Basin and the Northern Europe while the global patterns are not so bad

- B: ECMWF S4 : Good forecast for the PV anomalies except an underestimation over Indian Ocean. As for ARP S5, the patterns of CF are quite well forecasted, especially on the Southern US and Tropical Atlantic. Strong spatial gaps of CF anomalies are also observed on the Mediterranean Basin and the Northern Europe

## II-2) Geopotential height 500 hPa anomalies

| A : Verification from ERA I analysis (MF website) | B : Arp S5 (C3S website) |
|---|---|
|  |  |
| **C: ECMWF S4 (C3S website)** | **D : GloSea5 (C3S website)** |
|  |  |



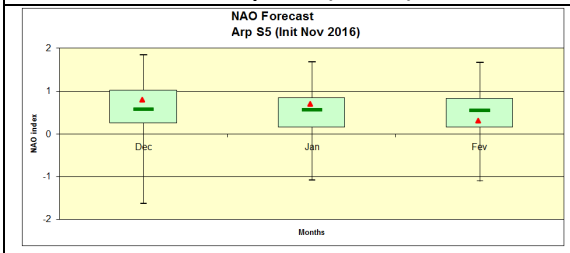
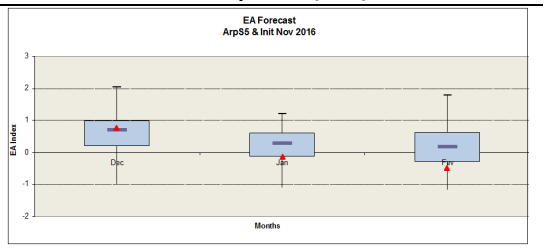
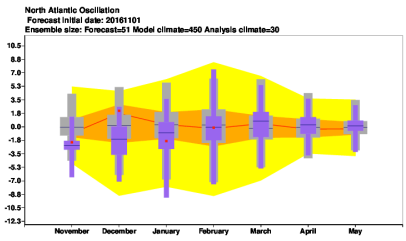
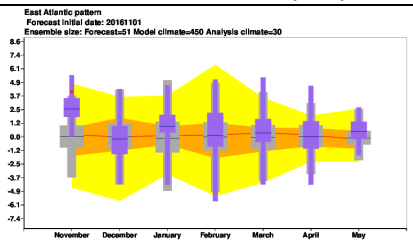
COMMENTS :

- A : Observation : Positive anomalies have been observed over northern Europe and to the south of Alaska, while Western Siberia and north western of USA and Pacific Canadian coast have experienced negative anomalies. The global patterns correspond to the negative phase of the Pacific North American mode (PNA) and the positive phase of the Artic Oscillation(AO)
- B : Arp S5 : Good forecast over North America (PNA- pattern). Spatial gaps of the high values over the Northern Europe and low value over Siberia not forecasted. Bad projection on AO mode (AO- expected and AO+ observed).
- C : ECMWF S4 : Bad forecast from North Atlantic to the Western Europe and the Western Siberia. Bad projection on the AO mode.

- D: Met Office GloSea5 : Forecast quite similar to ARP S5 (see ARP S5 comments)

## II-3) Variability modes and weather regimes

Selection of the parameter: Two monthly variability modes have been selected to represent the large scale circulation over North Atlantic and Europe: North Atlantic Oscillation (NAO) and East Atlantic Mode (EA). Four daily weather regimes are also considered : Positive NAO (NAO+), Negative NAO (NAO-), Atlantic Ridge (AR) and Scandinavian Blocking (BL).
The definitions of these indices are available on the MF website http://seasonal.meteo.fr/.
The verifications are included in each product and come from MF and ECMWF website with significant differences (to pay attention).
Note also that these products are not currently available for the GloSea5 model.

| A : Arp S5 (NAO) | B: Arp S5 (EA) |
|---|---|
|  |  |
| **C : ECMWF S4 (NAO)** | **D : ECMWF S4 (EA)** |
|  |  |



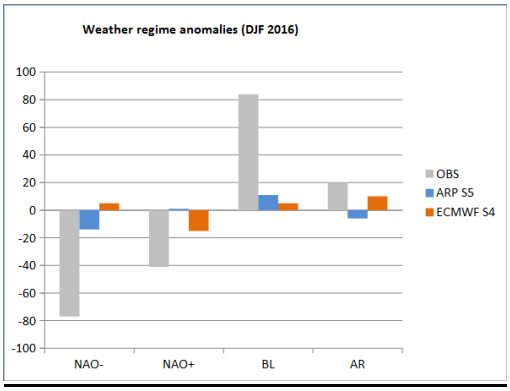






COMMENTS :

- A and B : Arp S5 : Good forecast of the NAO mode (especially in Dec and Jan). Change of the sign for the EA mode during the winter not well anticipated even the trend was correct
- C and D : ECMWF S4 : Bad forecast of the NAO mode in Dec, better after.




COMMENTS :

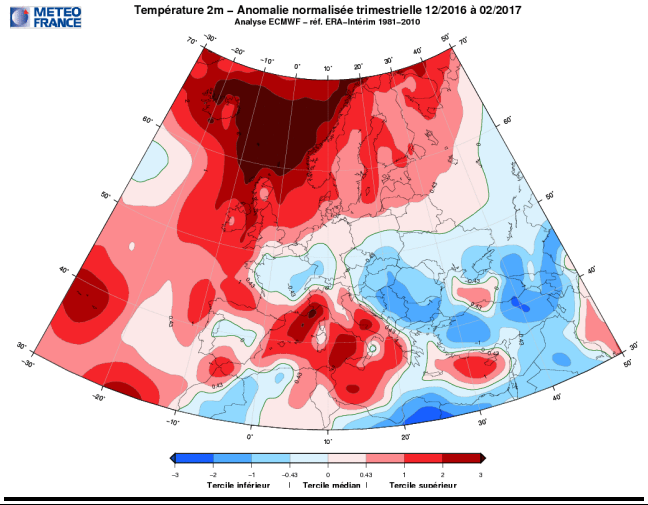
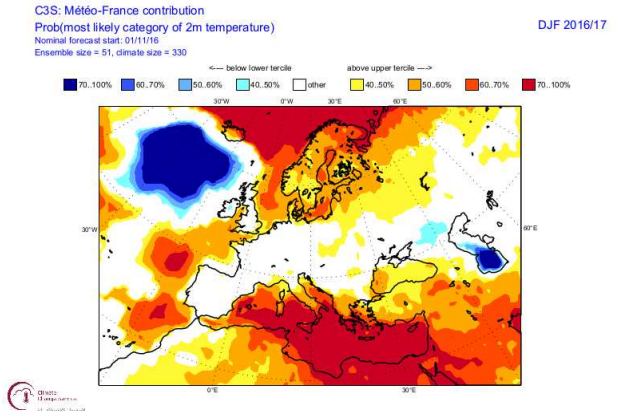
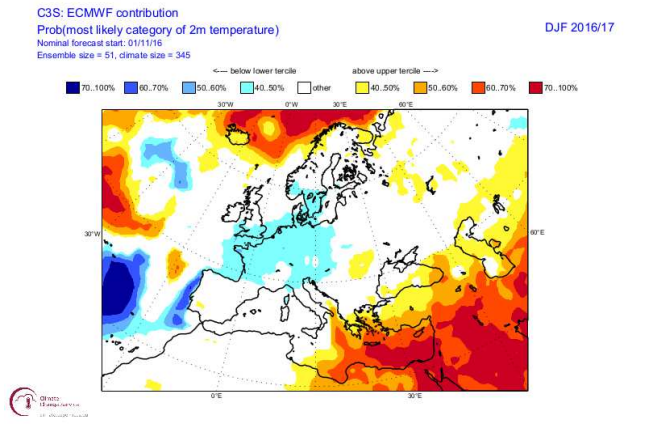
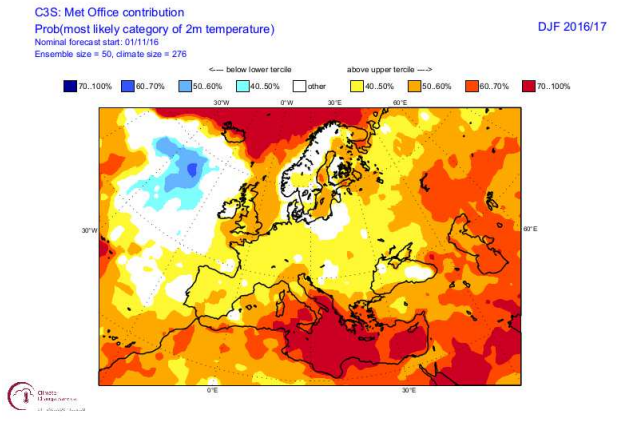
- Observation (grey bars) : The winter has been characterized by a strong excess of BL regime and a deficit of NAO- and NAO+ regimes
- Arp S5 (blue bars) : Little anticipation for an excess of BL and a deficit of NAO- but no really signals for the two other regimes
- ECMWF S4 (orange bars): No really anticipation for the excess of BL, good forecast for a little excess of AR but bad forecast for an excess of NAO-

-

# III) Regional temperature and precipitation forecast

Selection of the parameter : For temperature and precipitation, the verification concerns the synthesis of the tercile (most likely category) and not an anomaly.

## III-1) Temperature

| A : Verification | B: Arp S5 |
|---|---|
|   |   |
| C: ECMWF S4 | D: GloSea5 |
|   |   |

COMMENTS :

- A : Observation : From ERA-I analysis (MF product), above normal temperatures have been observed in the Western Mediterranean area and the Northern Europe while normal temperatures have concerned a large part of the Western Europe and below normal temperatures the South-Eastern Europe.

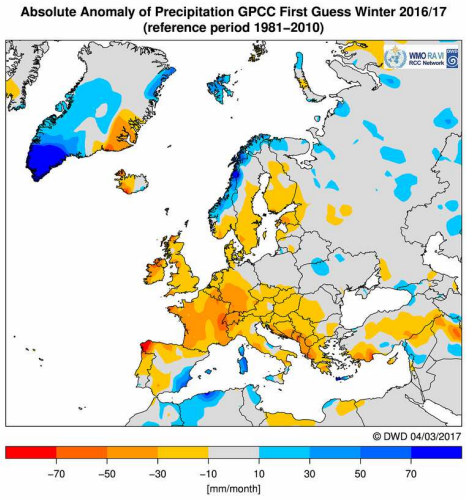
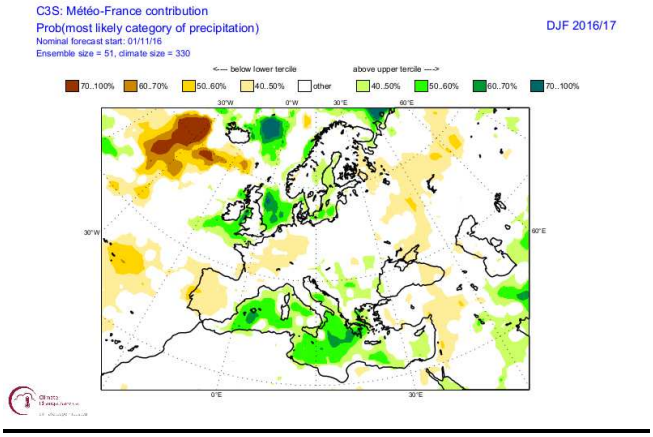
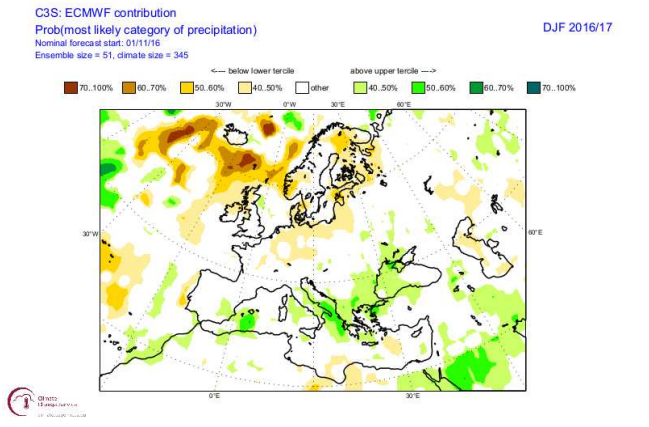
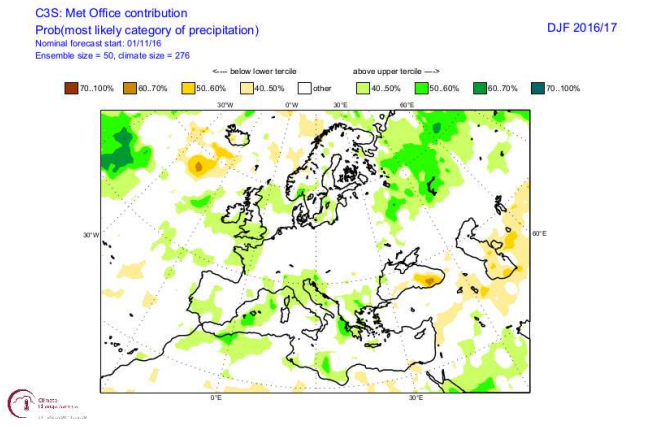
- B : Arp S5 : Correct signal for Northern Europe, western part of Mediterranean sea and western Europe. The cold area over South Eastern Europe (especially Turkey) has not been identified
- C : ECMWF S4 : Too cold signal for the main part of western Europe and too warm on Eastern Mediterranean part.
- D : GloSea5 : The global warm signal over Europe was too extended even the forecast on North western Europe and Western Mediterranean was good. Bad forecast for the southern and eastern Europe

Index about the performance of the forecast : The performance of a specific forecast can be globally estimated over the domain of interest by a spatial calculation of the area under a ROC Curve for lower/higher tercile.

| Temperature | Europe | Northern Europe | Southern Europe |
|---|---|---|---|
| Arp S5 (lower tercile) | xx (in progress) | xx | xx |
| Arp S5 (upper tercile) | xx | xx | xx |

COMMENT **:** Calculation of the scores in progress, comments soon available

## III-2) Precipitation

| A : Verification | B : Arp S5 |
|---|---|
|  |  |
| **C : ECMWF S4** | **D : GloSea 5** |
|  |  |









COMMENTS :

- A : Observation : From GPCC analysis, global below normal precipitation over Europe except the North Eastern part (normal) and locally Norway and Western Mediterranean area (above normal).
- B : Arp S5 : Below normal precipitation expected on Southern Europe but with an under-estimated signal in term of extension; above normal precipitation

signal well anticipated for western Mediterranean area; No good signal for Northern Europe (except Norway) and South Eastern Europe.

- C: ECMWF S4 : Below precipitation signal not anticipated for Western Europe, Above precipitation signal expected on Balkans while below precipitation has been observed.
- D : GloSea 5 : Global above precipitation signal expected over Europe while below precipitation has been observed. Correct signal on the Western Mediterranean area and Algeria.

Index about the performance of the forecast : The performance of a specific forecast can be globally estimated over the domain of interest by a spatial calculation of the area under a ROC Curve for lower/higher tercile.

| Precipitation | Europe | Northern Europe | Southern Europe |
|---|---|---|---|
| Arp S5 (lower tercile) | xx (in progress) | xx | xx |
| Arp S5 (upper tercile) | xx | xx | xx |

COMMENT **:** Calculation of the scores in progress, comments soon available

***VERFICATION OF THE SEASONAL FORECAST***
***FOR THE WINTER 2016-2017***

*(From the individual SF models : Arpege Syst 5, ECMWF Syst 4 et Met Office GloSea 5, initialisation of November 2016)*

## *GENERAL SUMMARY*

*1) Oceanic Forecast :*
*The end of the Niña event on the Equatorial Pacific with the come back to a neutral situation at the end of the winter ("Nada" situation), has been correctly anticipated by the three SF models (in spite of a too long duration for Arp S5). Smaller scale anomalies on the Pacific Ocean as the warm anomaly on the South American Coasts or at the South of Alaska are not been so well identified. Quite good forecasts on the Atlantic and Indian basins, as shown by the anticipation of the evolution of the TNA and DMI indices.*

*2) Large scale atmospheric circulation :*
*On the North Hemisphere, the models have generally badly located the centres of high and low values with spatial gaps causing locally inverse forecasts to the observations. The negative phase of the Pacific North American mode has been more and less well forecasted by the SF models (more with Arp S5 and less by ECMWF S4) but none of the models had correctly anticipated the anomalies observed this winter on the Europe-Atlantic domain with high values on the North Sea, corresponding to a strong excess of Scandinavian blocking regime.*

*3) Regional temperature and precipitation :*
*Over Europe, the performance of the SF differs significantly according to the models and the domains taken into account :*

- *the warm and wet signal for the Western Mediterranean has been well anticipated*
- *the warm signal for the Northern Europe was well forecasted but not the dry one*
- *The normal signal for the temperature of the Southern Europe was also quite well forecasted but not the dry one*
- *The cold and dry signal for the South Eastern Europe was not really anticipated by the models.*