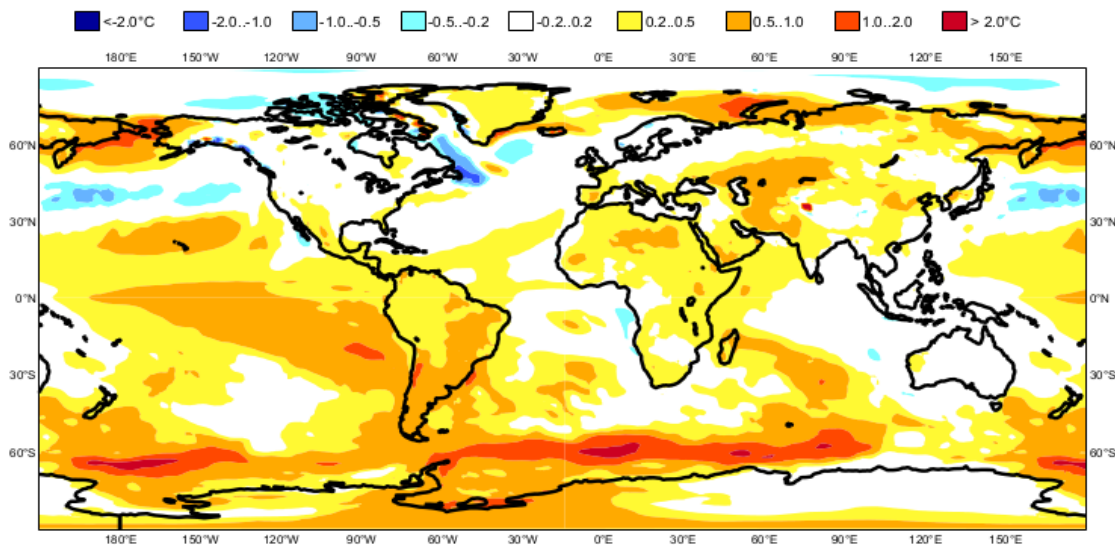# Copernicus
Europe's eyes on Earth

VERIFICATION BULLETIN

SEASONAL FORECAST FOR THE SUMMER 2017

May 2017 Initialisation

C3S multi-system seasonal forecast
Mean 2m temperature anomaly
Nominal forecast start: 01/05/17
Variance-standardized mean

ECMWF/Met Office/Météo-France
JJA 2017

Issued by: Météo-France

Date: 10th November 2017

Ref: C3S_433_Lot1_Seasonal Forecasts-Core Provider, 2015/SC1-METEO-FRANCE

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 Pre-Operational Phase of C3S , is only an experimental one and aims to assess the feasibility and the interest of such an 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 (ECMWF S4) , Meteo-France System 5 (MF S5) and Met Office GloSea5 (MO GS5). Later, the verification will be extended to all the individual SF models contributing to the C3S MM and to the MM itself.*

- *This preliminary version uses mainly first products available on the C3S website in September 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 goals 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 skill 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 seasonal forecast (SF) verification bulletin 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 of interest for most applications).*

- *The objective is not to evaluate the mean skill of the SF models or C3S Multi-Model, for which scores are calculated on the whole hindcast 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 be of interest to 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 Q4SEAS project partners to verify the consistency of the referential datasets, methods and diagnosis applied to the SF evaluation.*
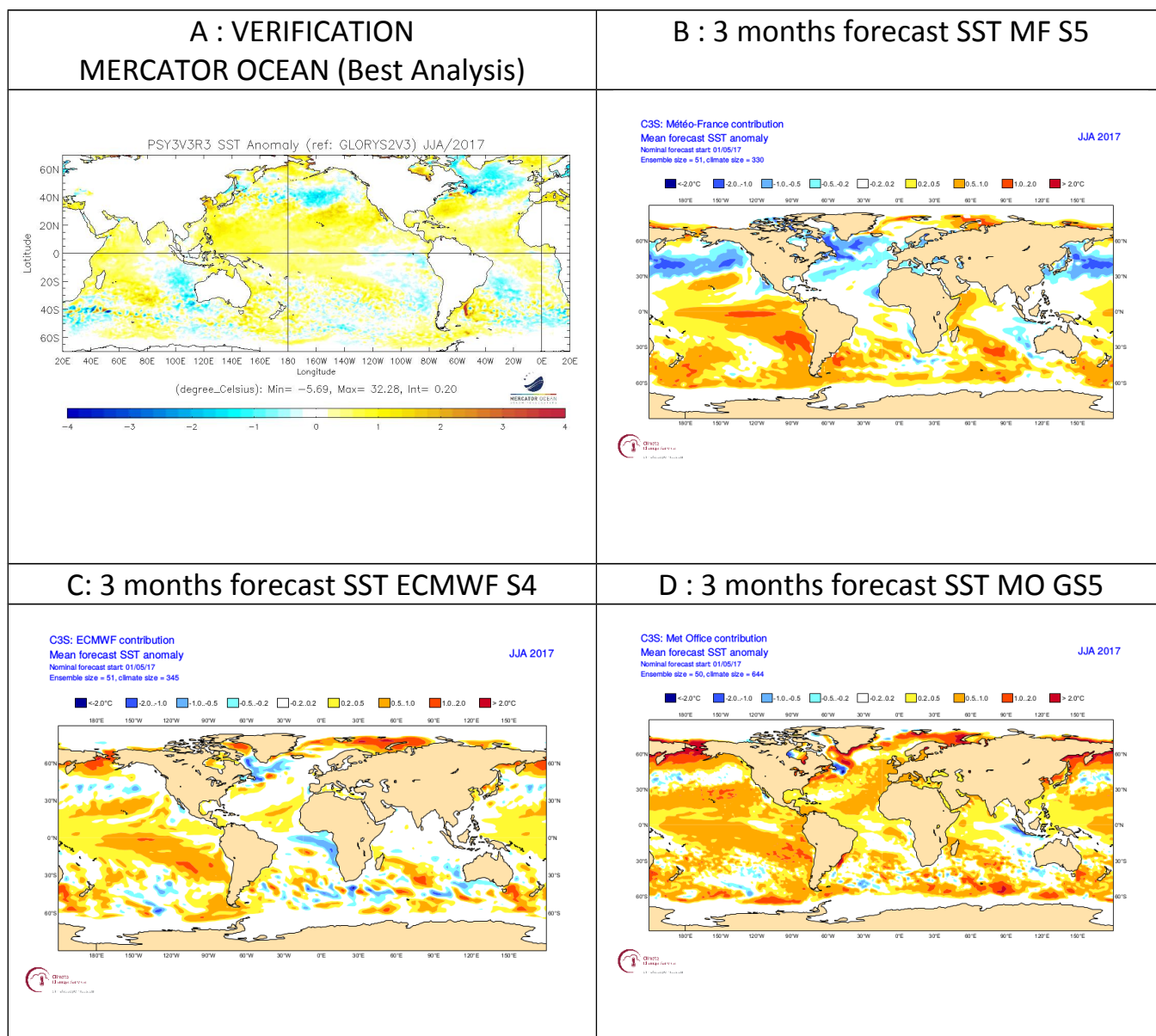
Content

I) Oceanic forecast :

I-1) Global SST forecast:

The verification concerns here the mean SST anomaly, forecast by the three individual C3S models.

A : VERIFICATION MERCATOR OCEAN (Best Analysis)	B : 3 months forecast SST MF S5

C: 3 months forecast SST ECMWF S4	D : 3 months forecast SST MO GS5

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.
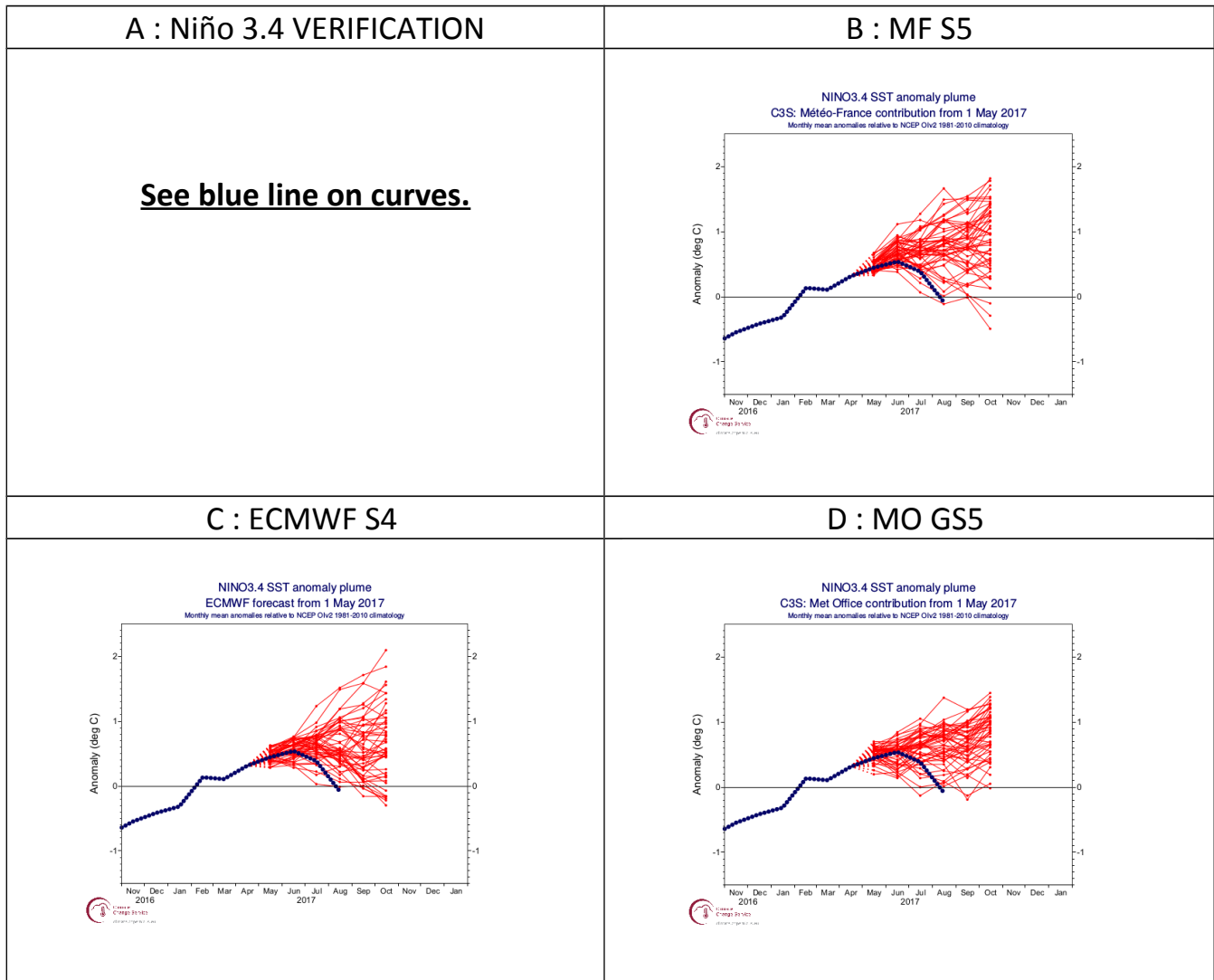
- B: MF S5 did not forecast well the anomalies on the Equatorial Pacific (too warm on the east part, too cold on the western part). A too warm signal was also expected on the South-East Tropical Pacific while the forecast was better on the North Pacific, except off the Baja California peninsula / Mexico. On the Atlantic basin, the forecast was globally too cold, as for example the cold anomaly not observed from Florida to Europe. However, the negative anomaly situated farther north (from Newfoundland to Iceland) was well forecast. Quite correct forecast over the Indian Ocean.

- C : ECMWF S4 : Over the Pacific ocean, same conclusions as for MF S5. However, on the equatorial rail, ECMWF S4 is closer to the analysis, with a small cooling trend over the extreme east of the rail and the positive anomalies pushed back further west. The negative anomaly present over the South of the Aleutians and the Gulf of Alaska is too weakly forecast. Over the Atlantic, ECMWF S4 forecast the development of the cold water tongue along the equator that did not occur. Further north in the Atlantic basin, the forecast is quite correct except for the southern part off Greenland where the negative anomalies are not strong enough and not extensive enough in the forecast. Over the Indian ocean, forecast anomalies are consistent with analysis, but they are too weak.

- D : MO GS5 : As the other two models, the MO GS5 SST forecast was too warm over the extreme east of the Pacific rail and over the southeastern part of the Tropical Pacific (off the Chilean coast). Over the North Pacific, the forecast was correct even if the negative anomalies were too weak. Over the Atlantic, negative anomalies observed off South-East Brazil, were not forecast by MO GS5. On the rest of the tropical part of the Atlantic, the forecast was better. Over the North Atlantic, the forecast was not correct at the southwest of the Iberian peninsula (too warm), and the negative anomalies present from southern Greenland to Iceland are not forecast. On the Indian basin, the forecast is quite good, except in the south of Sumatra and Java where the forecast anomalies are too strong and / or with bad sign.

I-2) Ocean Indices

<u>Selection of the parameters</u> : The chosen indices to represent the oceanic dynamics 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.

.1   Niño 3.4 Index

| A : Niño 3.4 VERIFICATION	B : MF S5
See blue line on curves.	
C : ECMWF S4	D : MO GS5

COMMENTS :

- B, C and D : Very few ensemble members were able to forecast the drop in SST over the Niño 3.4 area, leading to an incorrect ensemble mean index. This decrease began in July and intensified in August. The observed anomaly in August is on the lower limit of the forecast plume.

.2   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 the C3S website)

A : MF S5 (TNA)	B : ECMWF S4 (TNA)

C : DMI : MF S5	D : DMI : ECMWF S4
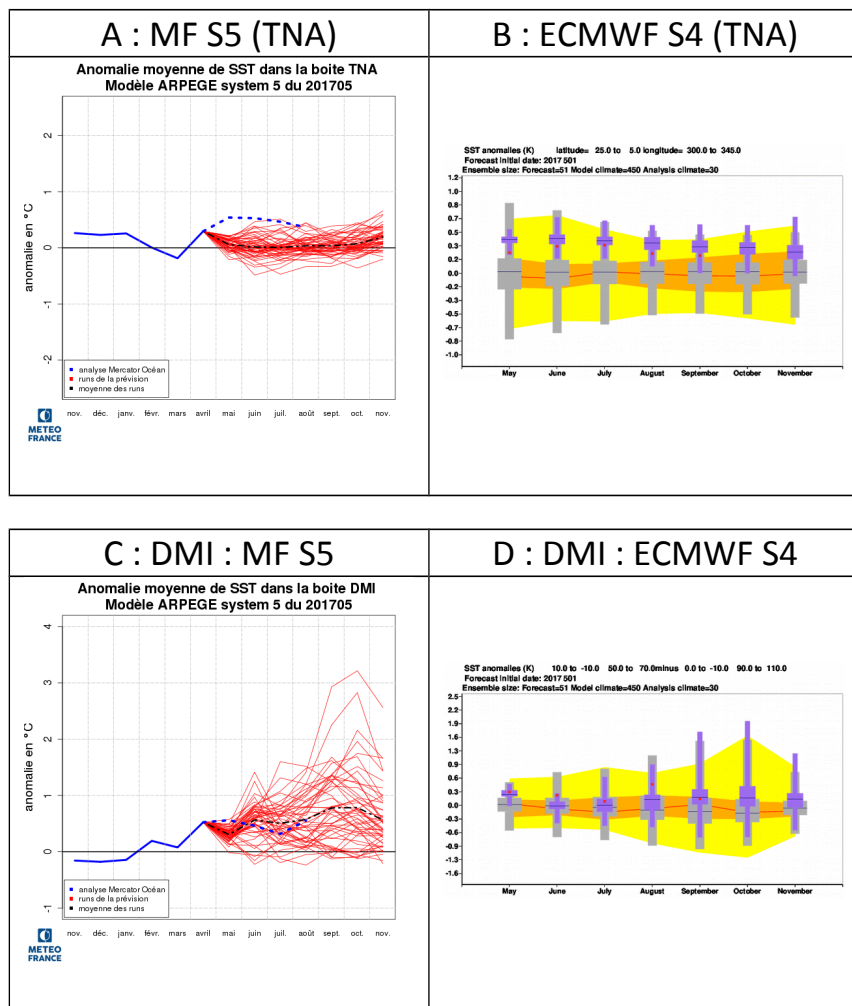
COMMENTS :

- A and B (TNA) : MF S5 underestimated the SST anomaly over the whole period (consistent with the analysis made in §I-1). ECMWF S4 slightly overestimated the SST anomaly over the entire period, but the forecast is quite correct.

- C and D (DMI) : MF S5 and ECMWF S4 : Good forecast of the evolution of the DMI index for the summer ; slight overestimation of the intensity of the DMI by ECMWF S4 but the trend was correct.

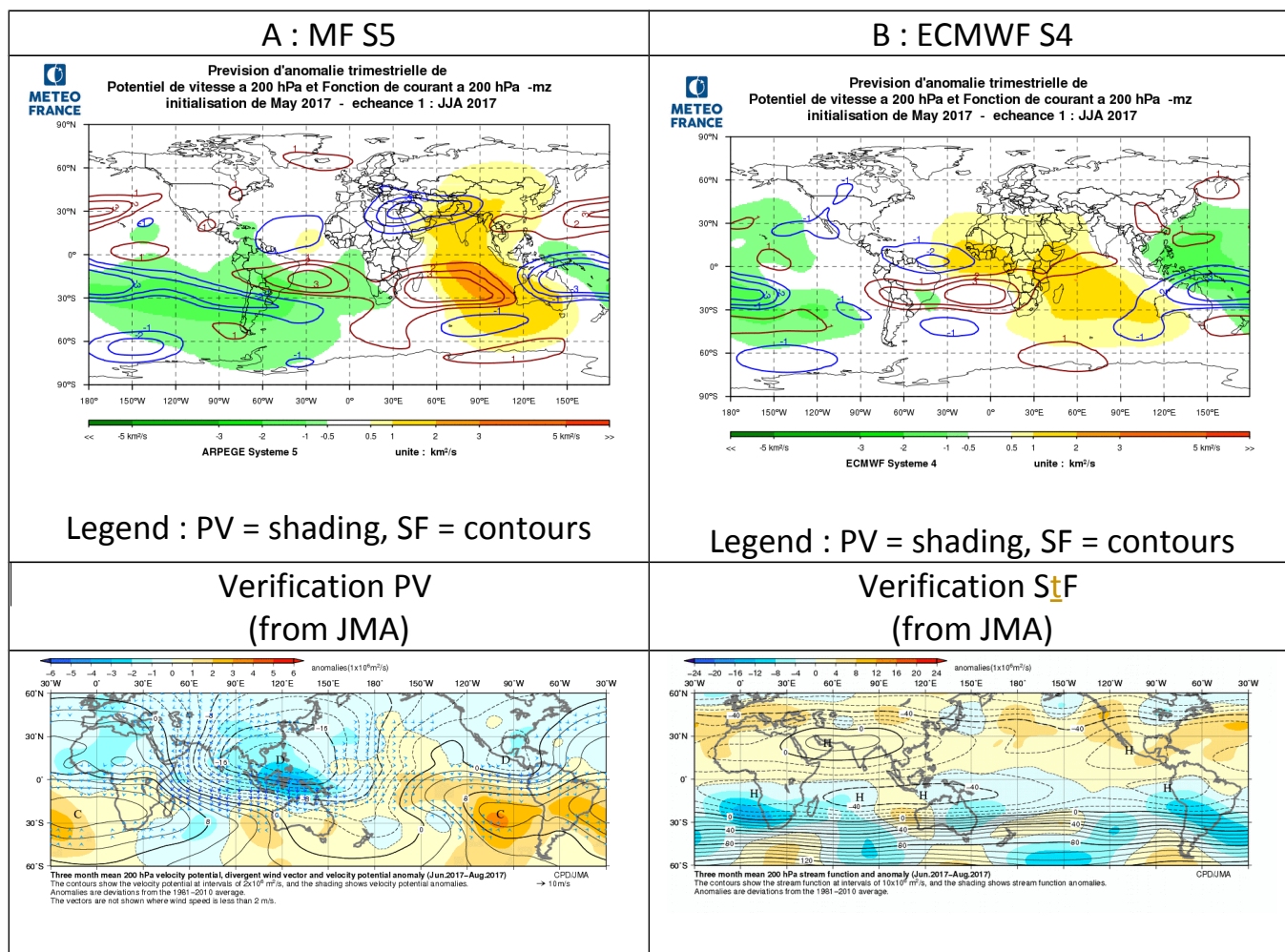# II) Atmospheric circulation forecast

II-1) Global Teleconnection

Selection of the parameter: Two parameters have been selected to represent the atmospheric teleconnection between tropical and mid-latitude areas: Potential Velocity (PV) and Stream Function (StF) .

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 : MF S5	B : ECMWF S4
Legend : PV = shading, SF = contours	Legend : PV = shading, SF = contours
Verification PV (from JMA)	Verification StF (from JMA)

COMMENTS :

- A : MF S5 : PV : the signal on the PV forecast was particularly weak: area of divergence anomaly over the maritime continent not forecast (except very slightly over New Guinea / Papua), area of convergence anomaly extending from Easter Island to Brazil and South Atlantic forecast as an area of divergence anomaly (reverse forecast), an area of
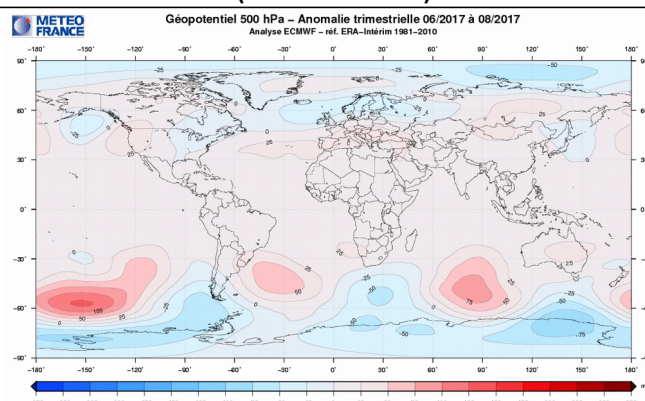
convergence anomaly forecast over the Indian ocean and overflowing India to Mongolia while it's an anomaly of divergence that has been observed (reverse forecast also). Only the convergence anomaly observed just west of Australia has been well forecast. StF : StF anomalies were also predominantly poorly (or not) forecast : only the positive anomaly over the North Pacific (from eastern Japan to California) seems well forecasted, as well as south of the 45°S over Pacific (around 60°S ; +/- pair of anomalies) and also just west of Australia (small positive anomaly). The observed positive anomaly from Florida to the Black Sea was not forecast. Forecast positive anomaly over Iceland when a negative StF anomaly was observed.

- B: ECMWF S4 : PV : a rather correct forecast over the maritime continent and the Pacific (negative anomaly, therefore divergence), except for the positive anomaly (convergence, therefore) observed and not forecast over Easter Island. Reverse forecast over South Brazil (forecast divergence as observed convergence) as well as over West Africa. Over the Indian basin the forecasts were bad, except off the coast of Australia. StF: Reverse forecast over South America, Baja California and Southern Africa. The observed positive anomaly from Florida to the Black Sea was not forecast. The tripole East of Australia (negative) / New Zealand-French Polynesia (positive) / North Sea Ross (negative) was rather well forecast. The small positive pole over China has also been well forecast.
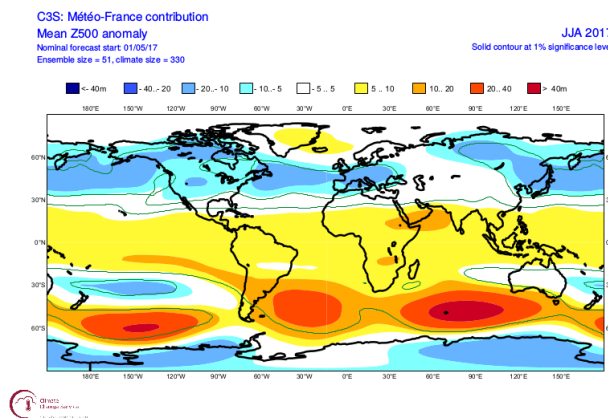
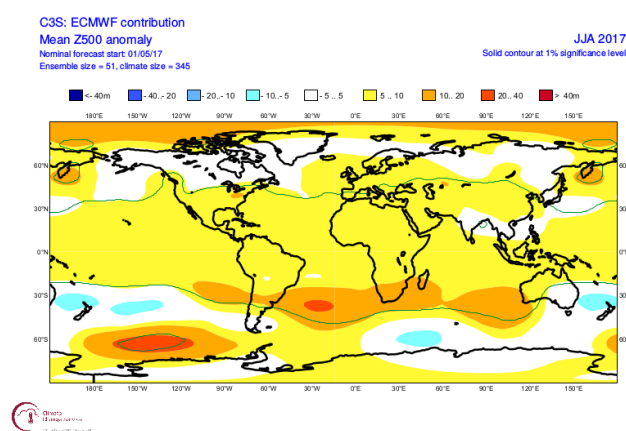## II-2) Geopotential height 500 hPa anomalies

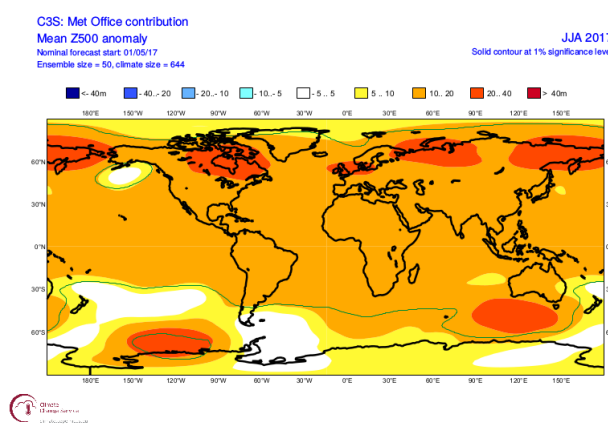| A : Verification from ERA I analysis (MF website)	B : MF-S5 (C3S website)

C: ECMWF S4 (C3S website)	D : GloSea5 (C3S website)

COMMENTS :

- A : Observation : Negative anomaly over the Gulf of Alaska, positive over California and Canada. Negative anomaly over the North-East of North America, extending from the North Atlantic to the North-West of Russia. Long positive anomaly extending from Florida to the north of the Mediterranean basin : this zonal structure of anomalies is projected on the mode of variability EA (very positive over the whole quarter).

- B : MF S5 : This model develops a too strong belt of negative anomalies in the northern hemisphere (between 30 ° N and 60 ° N). The forecast is poor over the North Atlantic and Europe, as the negative anomalies observed are further north (approximately 1000 to 1500 km) and Europe has experienced positive anomalies (approximately south of 50 ° N).

- C : ECMWF S4 : The forecast anomalies were weak in the northern hemisphere. Over the southern half of Europe, the model forecast the correct sign of the anomaly
- D: MO GS5 : This model forecast a positive anomaly belt in the northern hemisphere (between 45 ° N and 75 ° N approximately), with a weakness over the south of the Aleutian Islands. This last anomaly was relatively well anticipated (taking into account the overall context more anticyclonic than climatology). For the rest, the forecast was poor, with even reverse forecast over the North-Eastern part of the USA and also from the British Isles to the Northwest of Russia.

II-3) Modes of Variability

Selection of the parameter: Two monthly modes of variability have been selected to represent the large scale circulation over North Atlantic and Europe: North Atlantic Oscillation (NAO) and East Atlantic Mode (EA).

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 : MF S5 (NAO)

B: MF S5 (EA)

C : ECMWF S4 (NAO)

D : ECMWF S4 (EA)
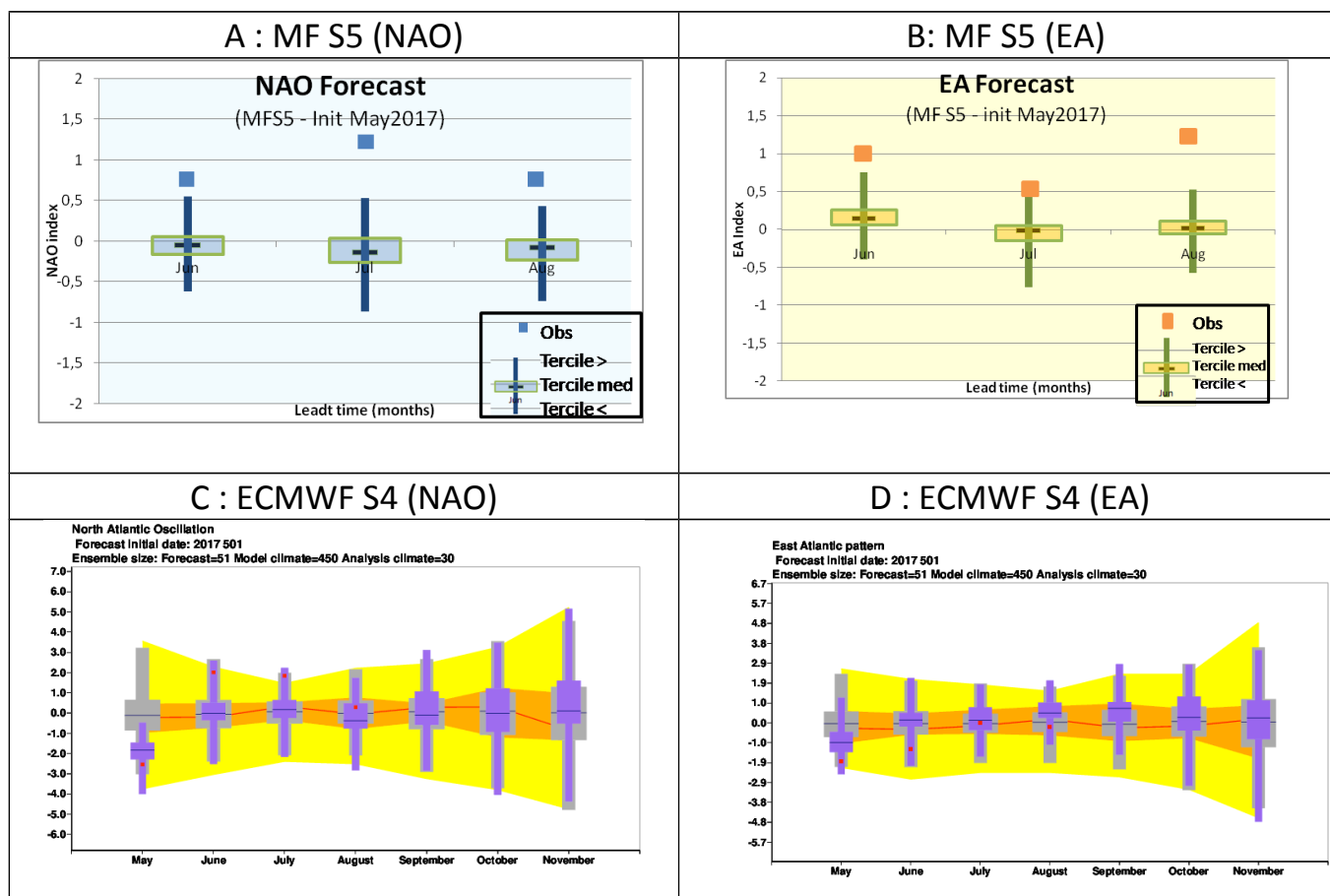
COMMENTS :

- A and C : The NAO mode has been strongly positive during the summer 2017 with monthly index values respectively of +0,69/+1,31/+0,78. The ECMWF forecast emphasizing the positive mode was good while the MF S5 (negative mode) was wrong.
- B and D : The EA mode has been strongly positive during the summer 2017 with monthly index values respectively of +0,97/+0,52/+1,21: The signal was not correctly identified both for MF S5 and ECMWF S4 (Pay attention that the EA patterns are opposite between MF and ECMWF)

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
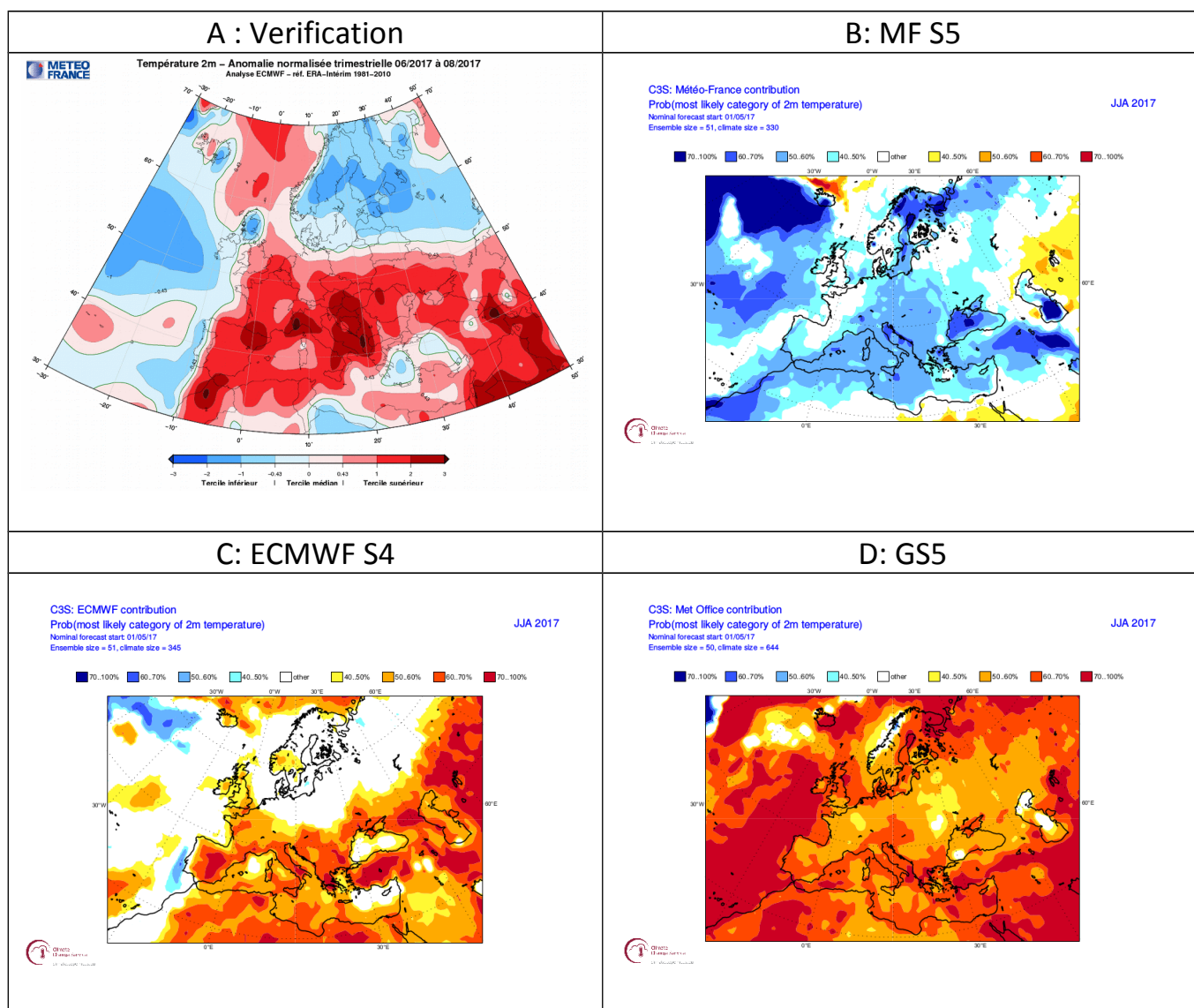
COMMENTS :
- A : Observation : From ERA-I analysis (MF product), strong positive normalized temperature anomaly over Europe, except over the western coastal strip of the Iberian peninsula, over the northwest of the British Isles, Fennoscandia and northwest Russia where the anomalies are negative.
- B : MF S5 : Poor forecast (reverse forecast), except for northern Sweden and Northeast Atlantic (likely cold scenario forecast and cold anomaly observed).
- C : ECMWF S4 : Good forecast (including for the small cold anomaly observed along Portugal), except over Turkey and the North West of the British Isles.
- D : MO GS5 : Rather good forecast over the European continent, but poor forecast over Fennoscandia, northwestern part of Russia, the Northwest of the British Isles and the Northeast Atlantic.

Forecast Performance Index : The performance of a specific forecast can be globally estimated over a domain of interest by a spatial calculation of the area under a ROC Curve for lower/higher tercile. As an example, this skill has been performed for the MFS5 model over three domains : Europe, Northern Europe and Southern Europe

Temperature	Europe	Northern Europe	Southern Europe
MF S5 (lower tercile)	0,53	0,33	0,31
MF S5 (upper tercile)	0,57	0,35	0,33

COMMENT : Very low spatial skill over Europe, worse than climatology both for Northern and Southern Europe

III-2) Precipitation

A : Verification	B : MF S5

C : ECMWF S4	D : MO GS 5
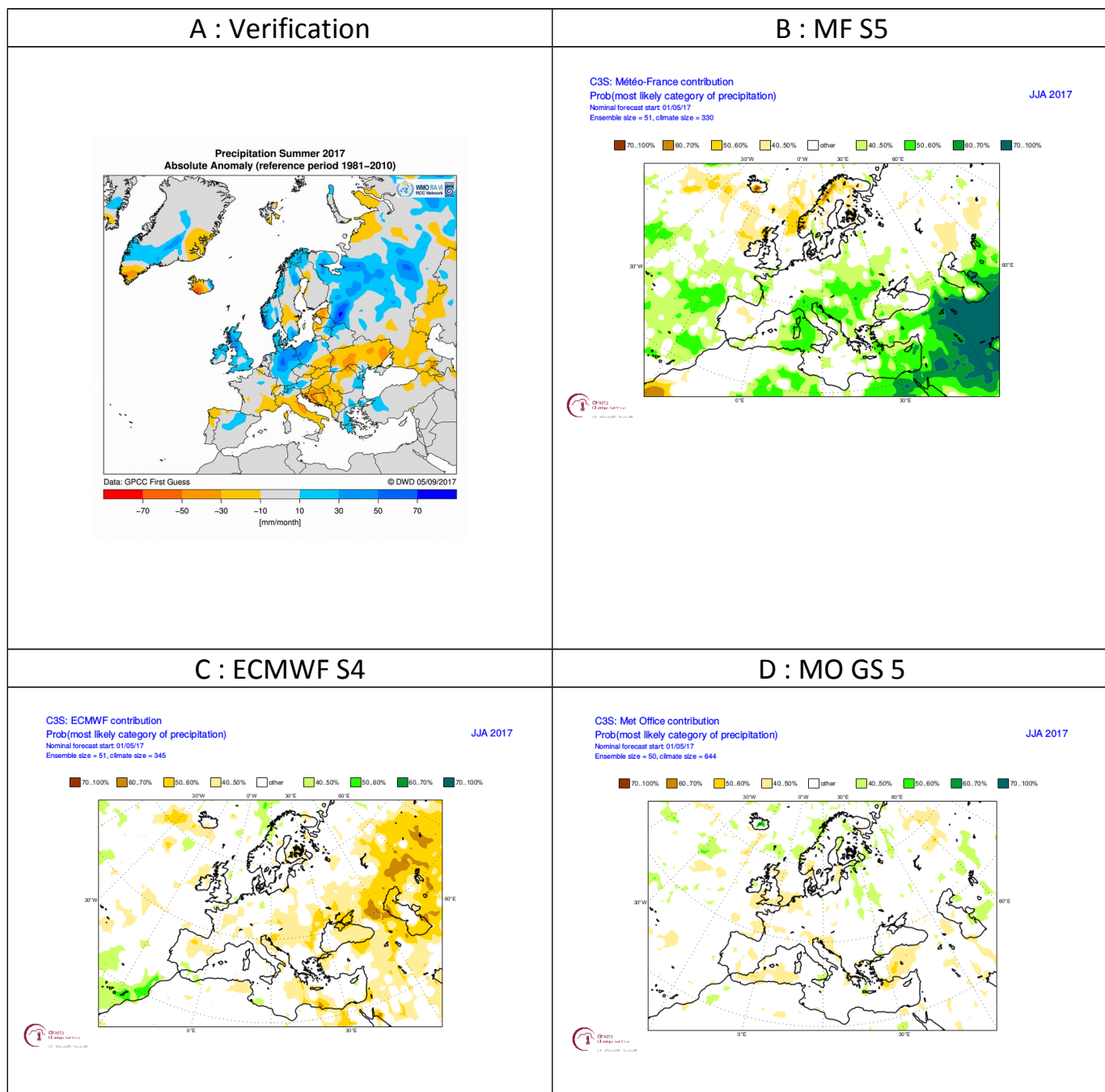
COMMENTS :

- A : Observation : According to the GPCC analysis, northern Europe experienced above normal precipitation, whereas Central Europe and Northern part of the Mediterranean basin received below normal precipitation.

- B : MF S5 : This model made a reverse forecast (except marginally over northern Poland).
- C: ECMWF S4 : This model did a rather good forecast over Central Europe. On the other hand, it had not forecast the excess of precipitation over northern Europe (nor over Spain, more marginally).
- D : MO GS 5 : Not much signal in the forecast. It appears that this model captured the north-south contrast over Europe (wetter than normal in the North , drier than normal in the South)

Forecast Performance Index : 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. As an example, this skill has been performed for the MFS5 model over three domains : Europe, Northern Europe and Southern Europe

Precipitation	Europe	Northern Europe	Southern Europe
MF S5 (lower tercile)	0,48	0,4	0,31
MF S5 (upper tercile)	0,43	0,44	0,28

COMMENT : Very low spatial skill over Europe, worst than the climatology both for three domains

**VERIFICATION OF THE SEASONAL FORECAST
FOR THE SUMMER 2017**

*(From the individual SF models : MF Syst 5, ECMWF Syst 4 et Met Office GloSea 5,
initialisation of May 2017)*

GENERAL SUMMARY

1) Oceanic Forecast :

In the Pacific ocean, the drop in SST over the Niño 3.4 area, beginning in July and intensifying in August, was not really forecast as a possible scenario by the three models (or very close to the edge of the forecast plume). The models missed also the negative anomalies of SST observed over the southeastern part of the tropical Pacific. More and less good forecast over the north Pacific. On the Atlantic basin, forecasts were most of the time not consensual between the models. Over the Indian basin, forecasts were more consensual and correct.

2) Large scale atmospheric circulation :

On the northern Hemisphere, the models have generally badly located the anomaly centres with often reverse signal. The positive NAO mode has been anticipated by ECMWF S4 but not the EA positive one. Very little signal from MF S5 in the anticipation of the large scale atmospheric circulation.

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 dry signal observed over Italy, the north of Balkans and Central Europe has been more or less well anticipated by ECMWF S4 (MO GS 5 was correct only for the temperature while MF S5 has fully missed the warm signal, partially due the climate change)
-   the cold signal for the NorthEastern Europe was not forecast (only marginally by MF S5 over Fennoscandia).
-   The warm signal over the Iberian Peninsula and France was quite well forecast by ECMWF S4 (and MOGS5 but this model forecast a warm scenario for the whole area)
-   The excess of precipitation for the Northern Europe was not anticipated by the models.