VERIFICATION BULLETIN

SEASONAL FORECAST FOR THE SUMMER 2018

May 2018 Initialisation

C3S multi-system seasonal forecast
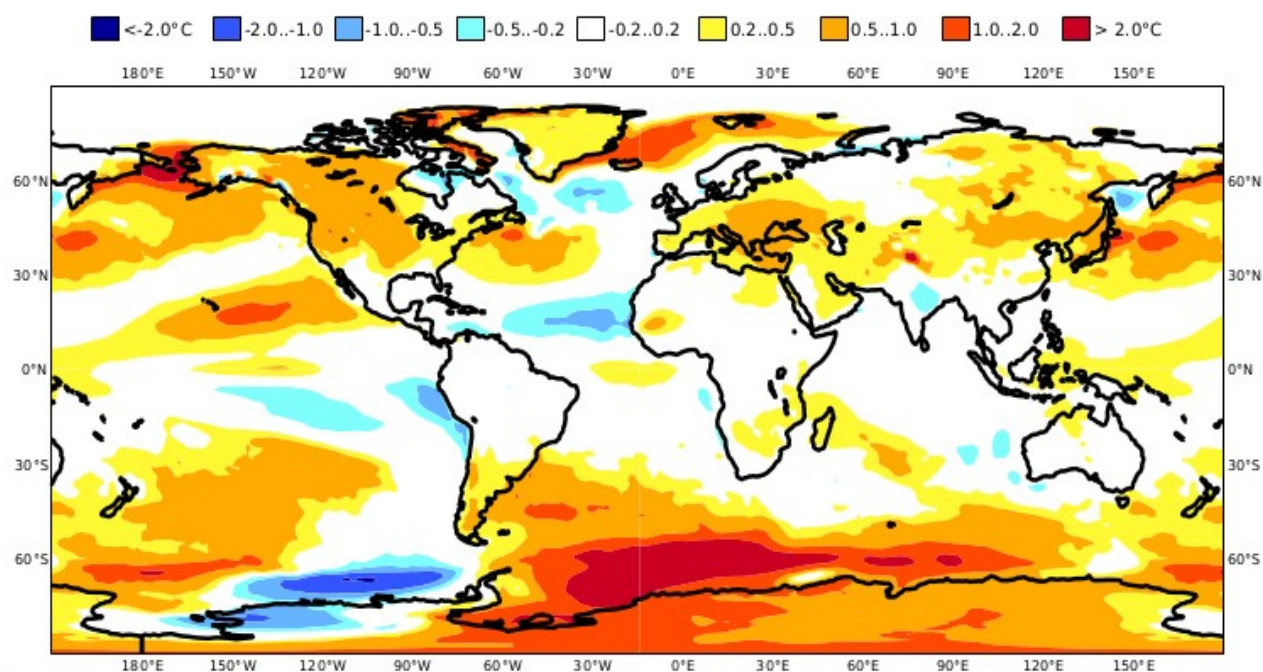Mean 2m temperature anomaly
Nominal forecast start: 01/05/18
Variance-standardized mean

ECMWF/Met Office/Météo-France
JJA 2018

Issued by: Météo-France

Date: December 2018

Objectives

- *This seasonal forecast (SF) verification bulletin has been elaborated in the frame of the RCC-LRF RA6 activities and aims to identify and to analyze the performance of the individual SF models (and Multi-Models as C3S one) used in our RCC bulletin 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 prepared in the frame of the C3S_433 contract on the period from Jan 2016 to Mar 2018. Thus, this bulletin uses mainly products available on the C3S website in October 2018 or in the individual Global Producing Centre (GPC) websites and especially the Meteo-France one.*

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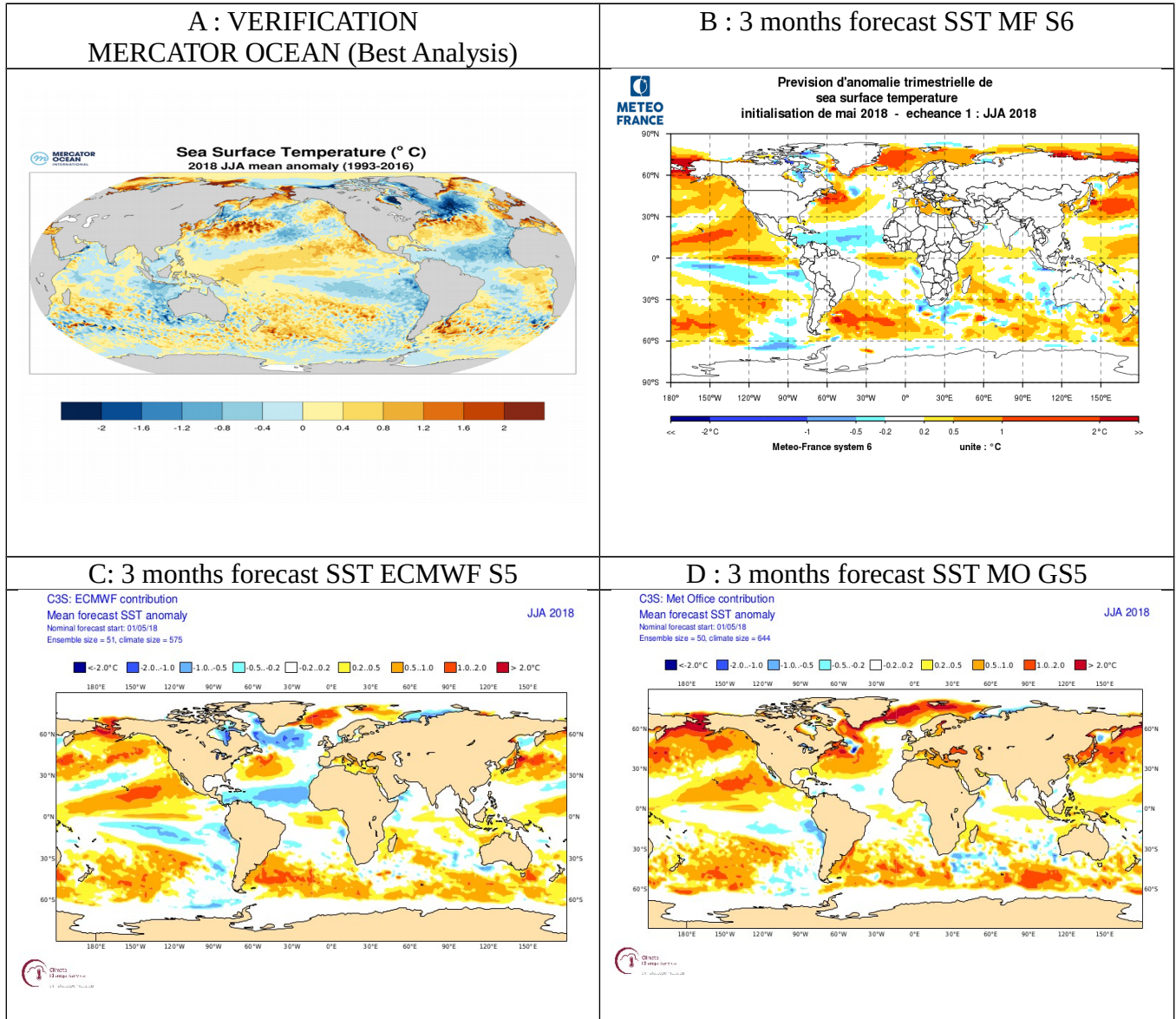
Content

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 S6

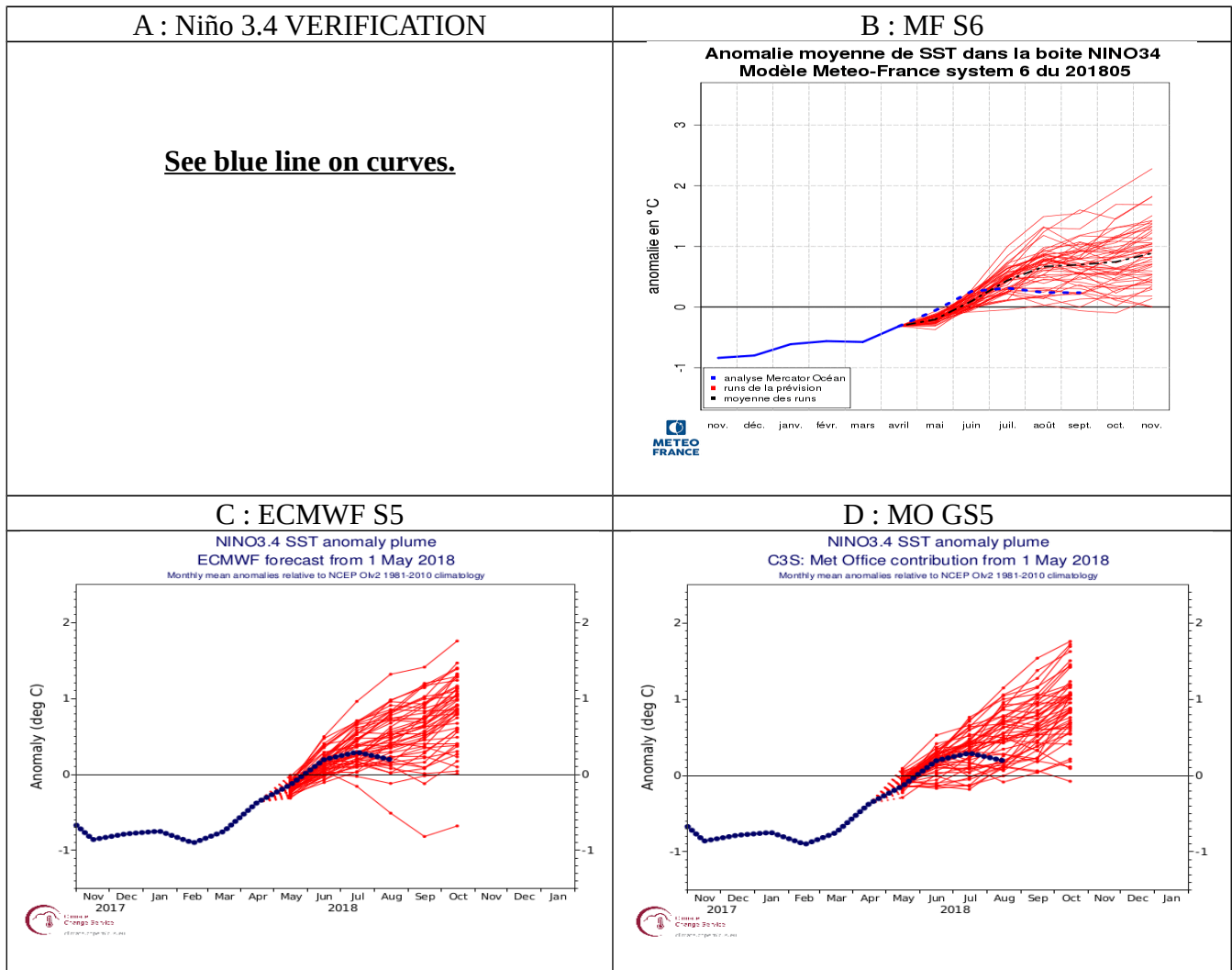| C: 3 months forecast SST ECMWF S5	D : 3 months forecast SST MO GS5

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 1993-2016.

- B: MF S6 : The forecasts is quite good over the North Pacific except underestimation ofit doesn't detect the cold water anomaly in central part and it overestimatesion overEl Niño box. Over the north Atlantic the cold area south of Greenland is underestimatesnot detected. Over the Indian Ocean, forecast anomalies are consistent with the analysis.

- C : ECMWF S5 : The forecasts are correct on all the basins.

- D : MO GS5 : Cold anomalies are too weak from African coasts in the Caribbean as well as in the center of North Pacific and south of Greenland.

I-2) Ocean Indices

Selection of the parameters : 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.

Niño 3.4 Index

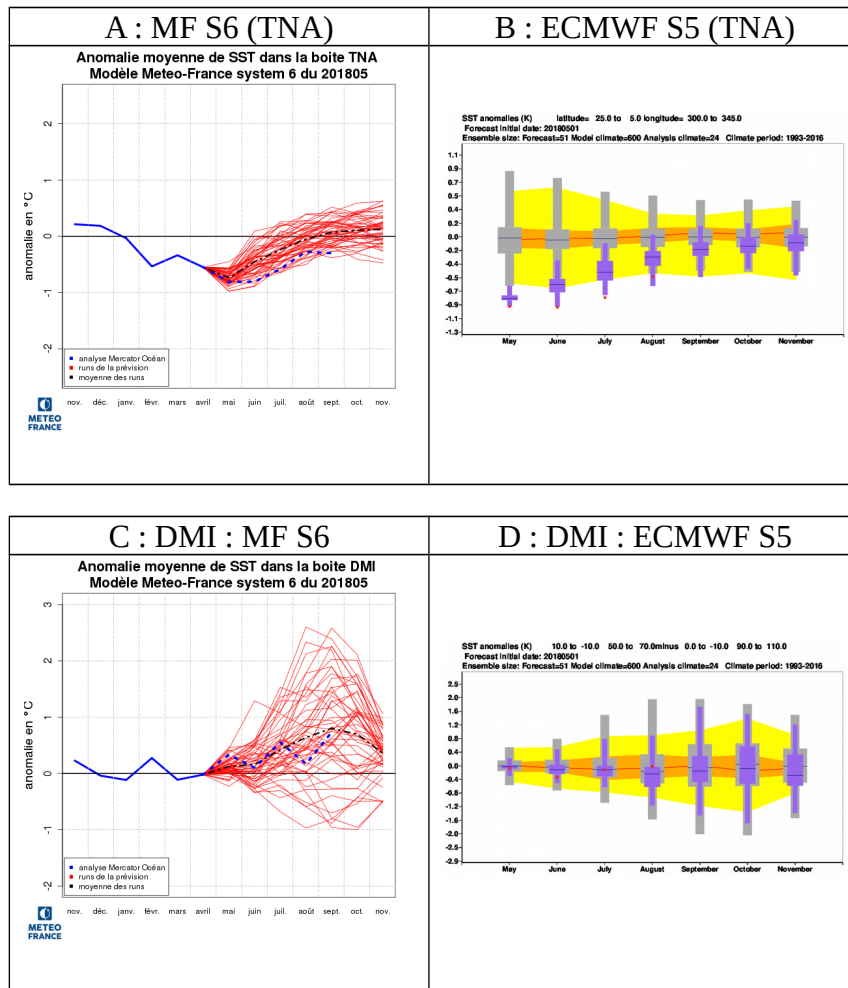| A : Niño 3.4 VERIFICATION	B : MF S6
See blue line on curves.	
C : ECMWF S5	D : MO GS5

COMMENTS :
- B, C and D : warming is slower than forecasted by models.

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 S6 (TNA)	B : ECMWF S5 (TNA)

C : DMI : MF S6	D : DMI : ECMWF S5

COMMENTS :

- A and B (TNA) : The strong negative anomaly at the beginning of the period decreases a little too quickly with the models.
- C and D (DMI) : Forecast and analysis remains close to normal . Notice that analyses are significantly different between MF and ECMWF
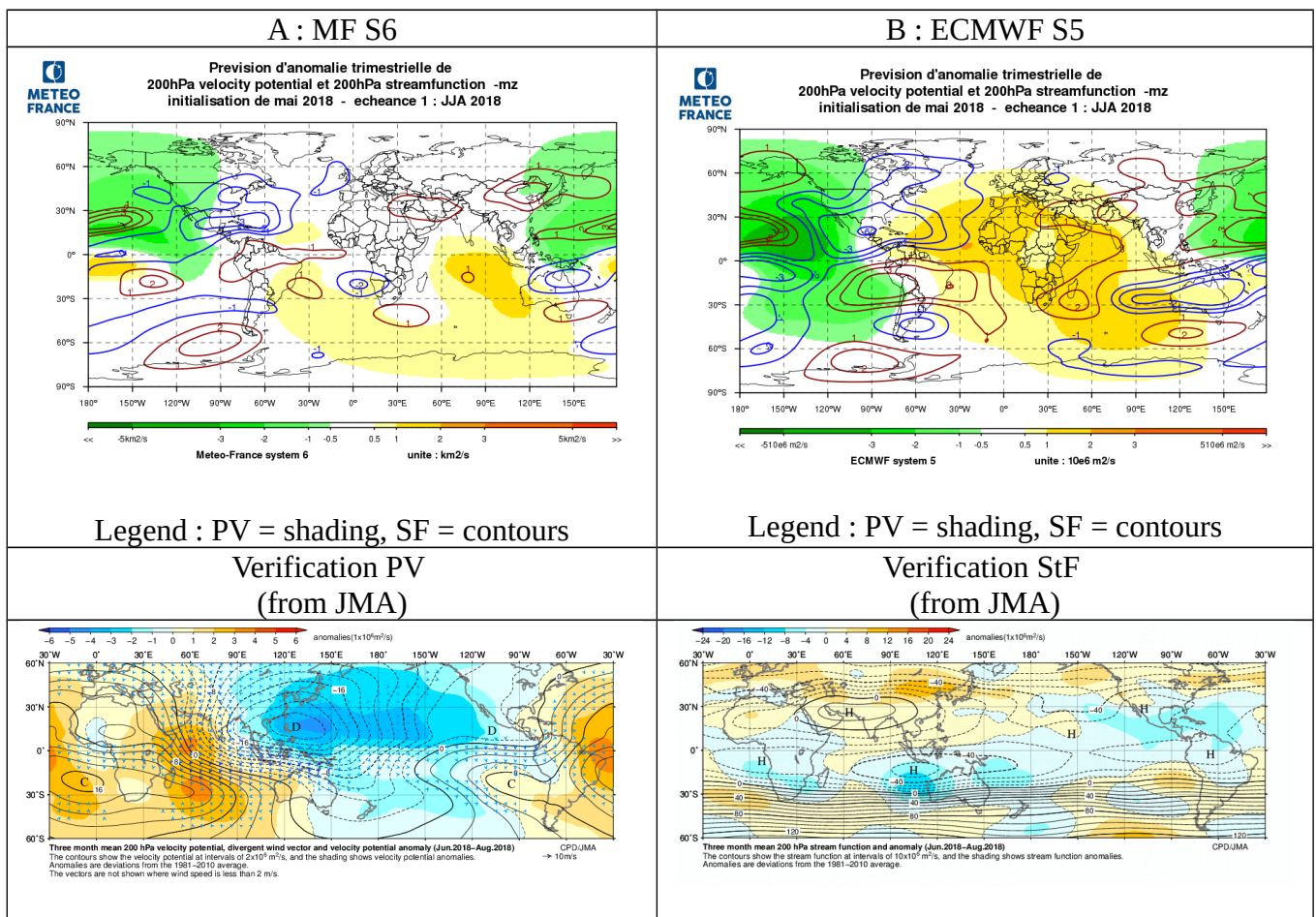
II) Atmospheric circulation forecast

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 MF S6 and ECMWF S5.

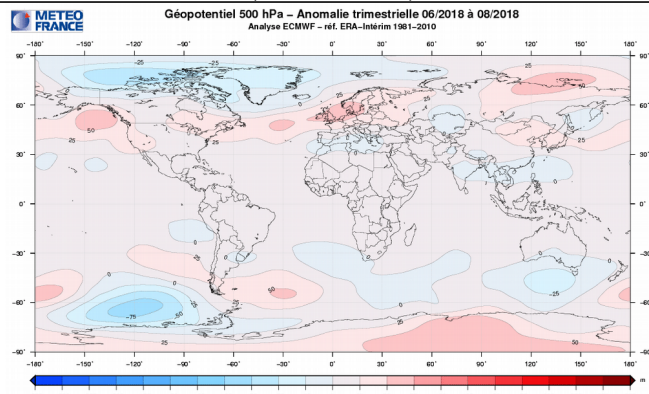| A : MF S6	B : ECMWF S5
Legend : PV = shading, SF = contours	Legend : PV = shading, SF = contours
Verification PV (from JMA)	Verification StF (from JMA)

COMMENTS :

- A : MF S6 :
  PV : forecast is rather correct over the Maritime Continent and Pacific. The strong positive anomalies of velocity potential is not forecasted in the western of Indian Ocean and the Atlantic
- StF : Forecasts are pretty good over Pacific. Elsewhere anomalies are predominantly poorly (or not) forecasted.
- B: ECMWF S5 :
  PV : the forecasts are pretty good over Pacific like MF-S6. Elsewhere, positive anomalies are fairly well forecasted except in West Africa, where negative anomalies are observed.
  StF : Good forecast over Pacific, South America and east of the Indian Ocean
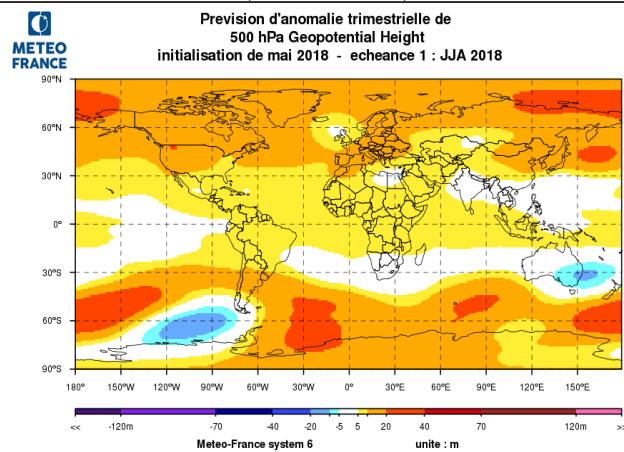
II-2) Geopotential height 500 hPa anomalies

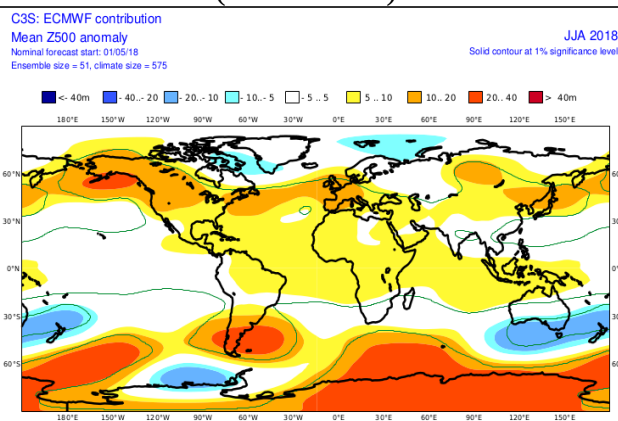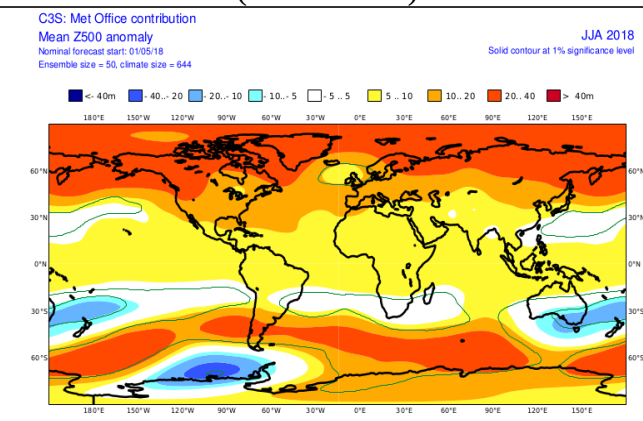| A : Verification from CEP analysis (MF website)	B : MF-S6 (MF website)
Géopotentiel 500 hPa – Anomalie trimestrielle 06/2018 à 08/2018 Analyse ECMWF – réf. ERA–Intérim 1981–2010 http://seasonal.meteo.fr/fr/content/suivi-clim-cartes	Prevision d'anomalie trimestrielle de 500 hPa Geopotential Height initialisation de mai 2018 - echeance 1 : JJA 2018 Meteo-France system 6 · unite : m

| C: ECMWF S5 (C3S website)	D : GloSea5 (C3S website)
C3S: ECMWF contribution Mean Z500 anomaly Nominal forecast start: 01/05/18 Ensemble size = 51, climate size = 575 JJA 2018 Solid contour at 1% significance level	C3S: Met Office contribution Mean Z500 anomaly Nominal forecast start: 01/05/18 Ensemble size = 50, climate size = 644 JJA 2018 Solid contour at 1% significance level

COMMENTS :

- A : Observation : Positive anomaly from Gulf of Alaska to Florida, negative over the North of Canada and Labrador sea extending from Greenland to the extreme north of Europe
  Positive anomaly over Atlantic Ocean near 45°N including Northwest Europe
  Negative anomaly over Mediterraneanmediterranean and positive north-east of Russia
- B : MF S6 : On the northern hemisphere forecast anomalies aren't correlated with analysis.
  On the southern hemisphere forecasts are rather good despite of some shifts of the structures especially to Australia.
- C : ECMWF S5 : Remarkable forecast from America to West Europe. Shift of anomalies over Asia and south hemisphere
- D: MO GS5 : Similarities with MF S6 on the northern hemisphere.

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).

| A : MF S6 (NAO)	B: MF S6 (EA)
C : ECMWF S5 (NAO)	**D : ECMWF S5 (EA)**
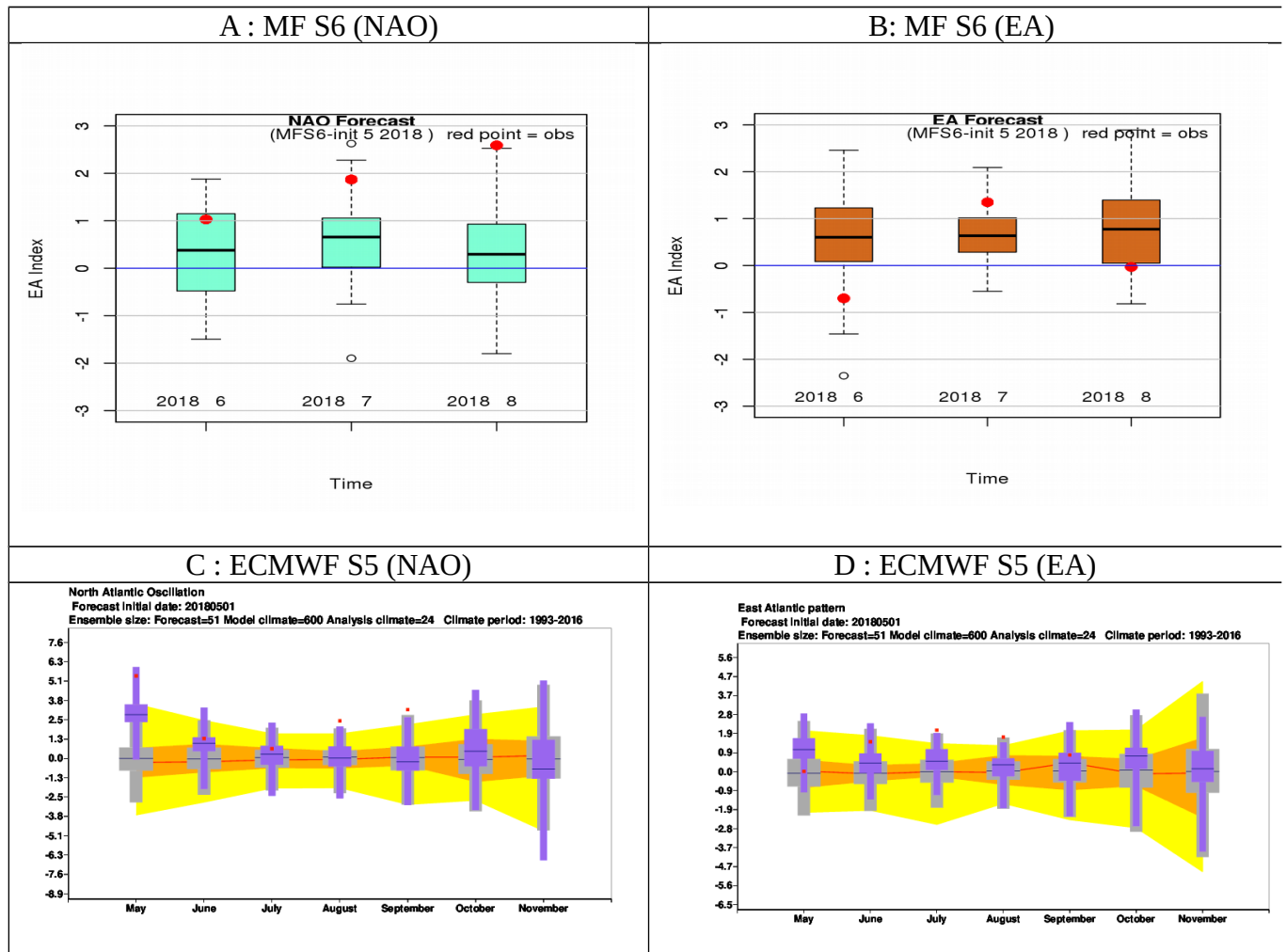
COMMENTS :

- A and C : The NAO mode still positive during the summer 2018 with extreme value in August. These positive values were rather well forecasted both for MF S6 and ECMWF S5.
- B and D : The EA mode was different between models during the summer 2018 : The signal was not correctly identified by MF S6 which forecasted a positive anomaly every month. ECMWF S5 has well forecasted the sign of the anomaly.
  (Pay attention that the EA patterns are inconsistent 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

A : Verification	B: MF S6
C: ECMWF S5	D: MO GS5
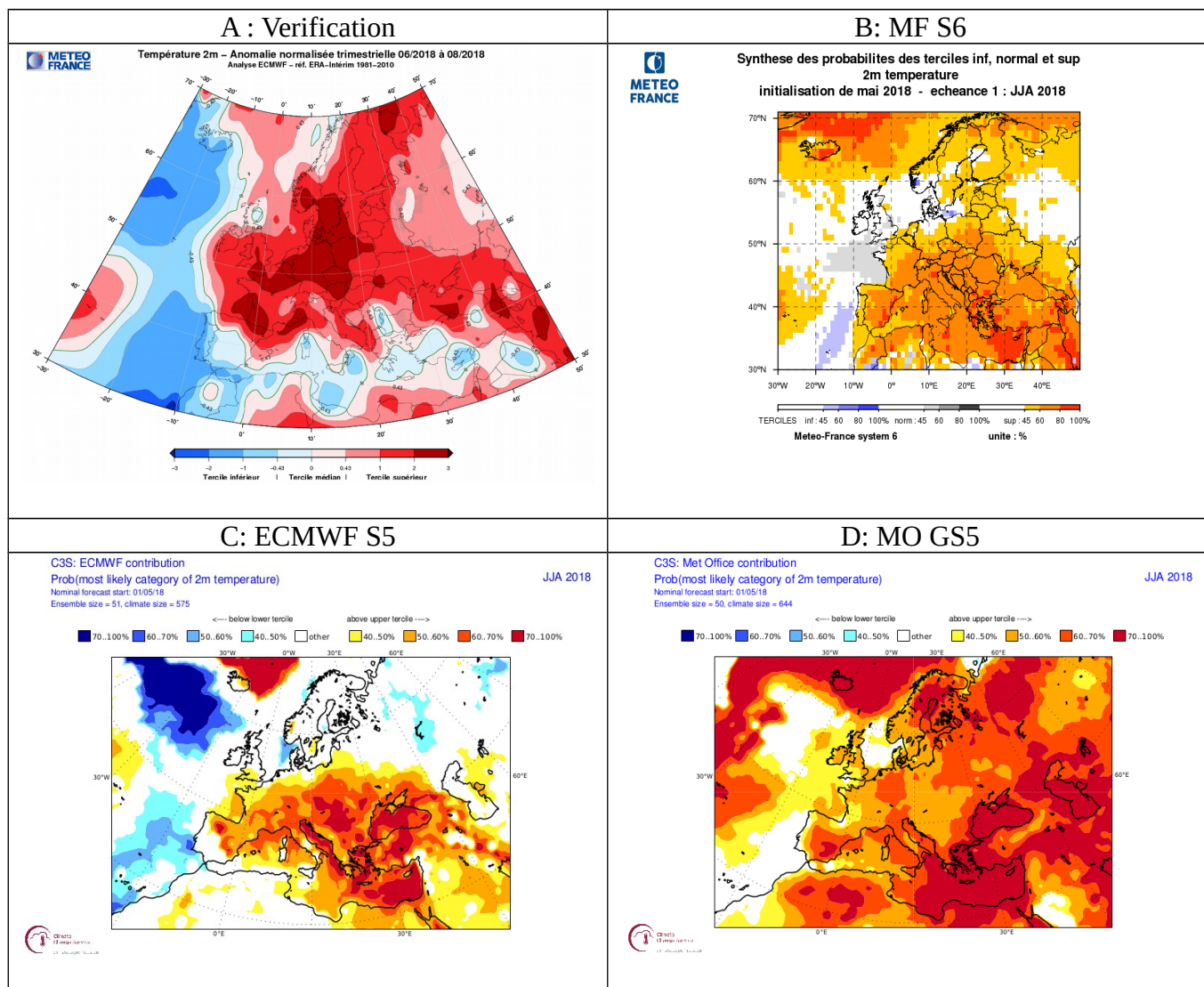
COMMENTS :
- A : Observation : From ERA-I analysis (MF product), strong positive normalized temperature anomaly in most countries except for the Iberian Peninsula, near Mediterranean and Russian regions
- B : MF S6 : The warm forecasted doesn't extend north enough and is excessive on the Mediterranean and the Iberian peninsula
- C : ECMWF S5 : Same conclusions as MF S6 except in Iberian Peninsula and on the west of the Mediterranean where forecast is better.
- D : MO GS5 : Around the North Sea and the Baltic warm signal better than others models. On the other hand its forecast of strongest anomaly is shifted to the east.

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.

This skill has been performed for the MFS6 model over three domains : Europe, Northern Europe and Southern Europe

Temperature	Europe	Northern Europe	Southern Europe
MF S6 (lower tercile)	0,52	No value*	0,74
MF S6 (upper tercile)	0,33	0,45	0,37

* = ROC impossible to calculate because there is no event observed.

COMMENT **:** Lower tercile are rather well forecasted especially off the coast of Portugal. On the other hand forecast of upper tercile are poorly forecasted.

III-2) Precipitation

A : Verification	B : MF S6

C : ECMWF S5	D : MO GS5
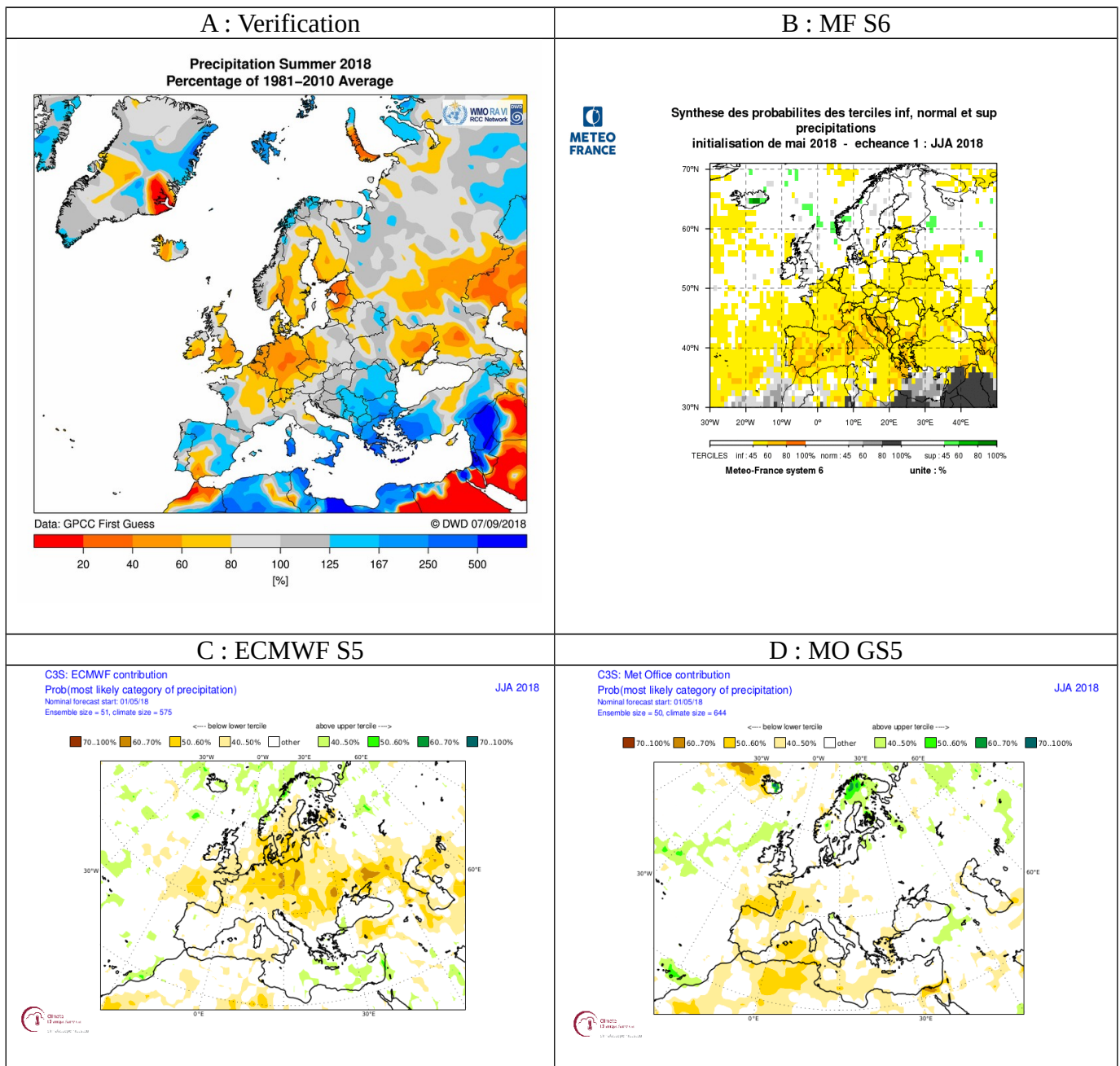
COMMENTS :

- A : Observation :   According to the GPCC analysis, above normal precipitation around the Mediterranean especially to the Balkans, whereas around Baltic Sea and the North Sea and north of the Black Sea and the Caspian sea received below normal precipitation.
- B : MF S6 : It wrongly forecasts dry conditions on southern Europe and it doesn't forecast dry conditions on northern Europe.
- C: ECMWF S5 : This model captured lack of precipitation over the North of Europe. It suggests wet conditions on the eastern Mediterranean.
- D : MO GS5 : Anomalies are weak or not forecast

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.

This skill has been performed for the MFS6 model over three domains : Europe, Northern Europe and Southern Europe

Precipitation	Europe	Northern Europe	Southern Europe
MF S6 (lower tercile)	0,23	0,48	0,36
MF S6 (upper tercile)	0,17	0,53	0,33

COMMENT **:** Results close to 0 in Northern Europe and very bad south where the model is shifted to dry classes.

VERIFICATION OF THE SEASONAL FORECAST
FOR THE SUMMER 2018

(From the individual SF models : MF Syst 6, ECMWF Syst 5 et Met Office GloSea 5, initialisation of May 2018)

GENERAL SUMMARY

1) Oceanic Forecast :

In the Pacific ocean, warming east of equatorial rail has been slower than forecasted by models. On the Atlantic basin, attenuation of the strong cold anomaly in TNA box was too fast with models . Over the Indian Ocean forecast anomalies are consistent with the analysis. ECMWF-S5 was better than the other models for cold anomaly especially in the centre of the Central Pacific, south of Greenland and tropical north Atlantic.

2) Large scale atmospheric circulation :

Global anomaly of circulation are remarkable well forecasted by ECMWF-S5 from America to West Europe. MF-S6 and MO-GS5 are similar and have their anomalies not well correlated with analysis.

The positive NAO mode were rather well predicted by MF-S6 and ECMWF-S5.

3) Regional temperature and precipitation :

temperature :
Forecasted positives anomalies are shifted to the southward (MF-S6 and ECMWF-S5) or eastward (MO-GS5) compared to the analysis.
precipitation :
Poor or reverse forecasts with MF-S6 and MO-GS5.
ECMWF-S5 has captured the lack of precipitation over large part of the European continent and it suggests wet conditions on the eastern Mediterranean.