# Météo-France Seasonal Forecast Bulletin

MARCH - APRIL - MAY 2024

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# General synthesis : MAM 2024

The "El Nino" phase fully subsides during the quarter.

**A) Oceanic forecast** :

- ENSO : Return to neutral conditions at the end of the quarter.

- IOD : Continuation of neutral conditions.

- Equatorial and north tropical Atlantic, Northeastern Atlantic : Strong positive anomaly.

**B) Drivers :**

Positive ENSO phase fading, with gradual return to neutral conditions.

QBO easterly wind phase.

**C) Atmospheric circulation :**

In the intertropical zone, the atmospheric response differs from model to model: either an attenuated response to the El Niño and positive IOD phases; or a tripole of ascendances over the Indian and Atlantic Oceans and subsidences over the Pacific Ocean.
Current function patterns are similar from one model to another, with anticyclonic curvature over the Mediterranean Basin and cyclonic curvature over Northern Europe.
EA+ remains the preferred mode.

**D) Most likely conditions :**

Temperatures : Warmer-than-normal scenario over the southern two-thirds of Europe.

Precipitations : Scenario wetter than normal on eastern Europe.

**Next bulletin : scheduled on March 20th**

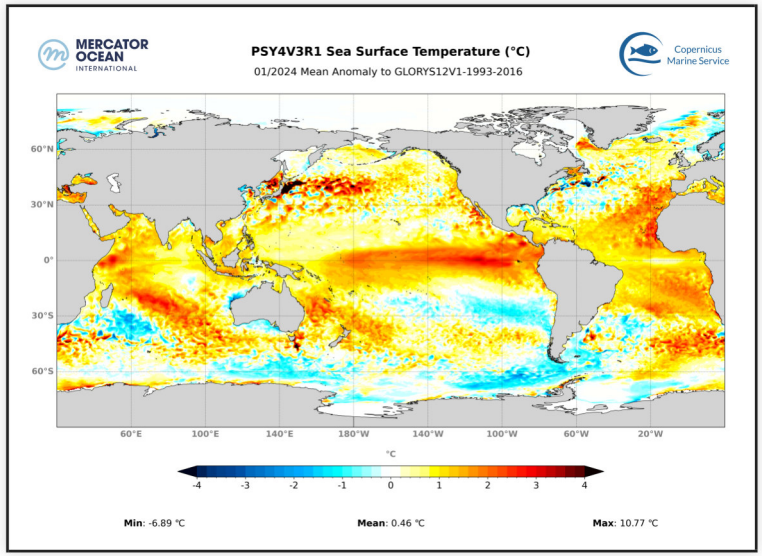
# Oceanic analysis of January 2024 : SST anomalies

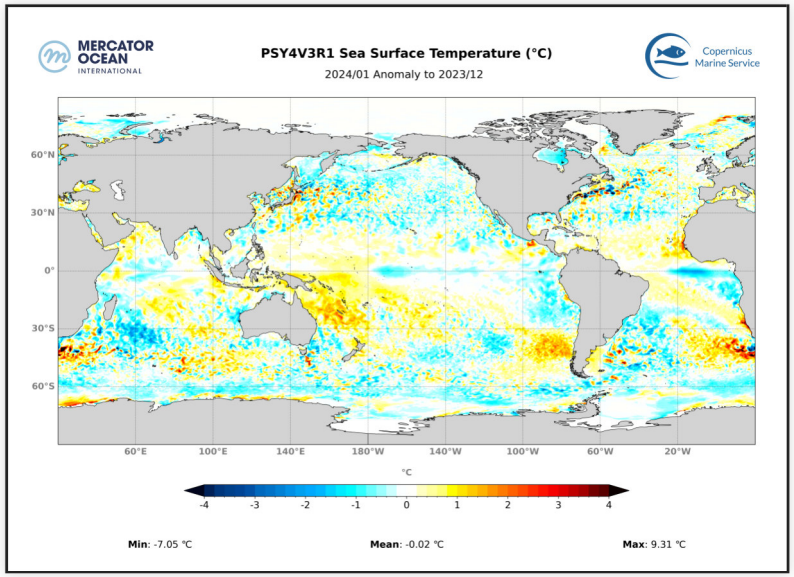
## Current ENSO situation : positive phase

In the Pacific Ocean : In the equatorial zone, the positive anomaly is still present, but is beginning to fade. Further north, the PDO-pattern is also fading.

In the Indian Ocean : The East/West contrast is still visible (warmer in the west than in the east), but is weakening.

In the Atlantic Ocean : Warm anomalies persist over almost the entire basin. However, there is a clear attenuation near the equator.

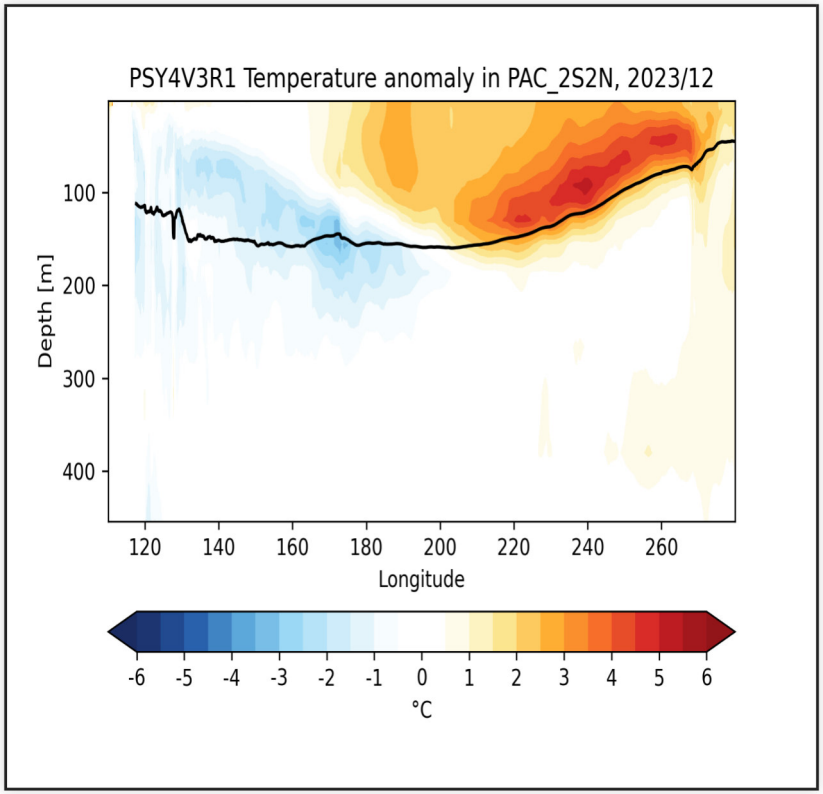


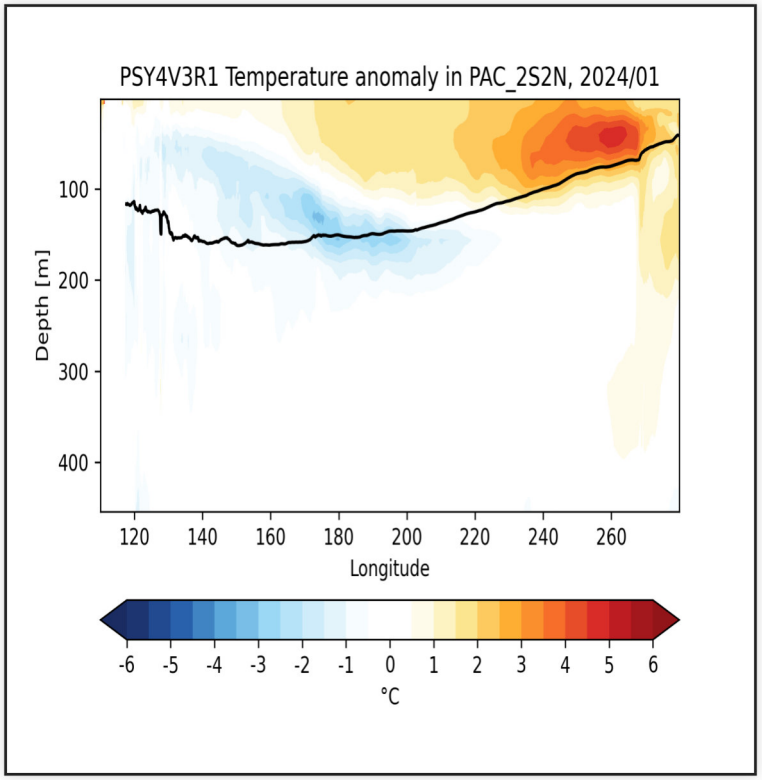




*SST Anomalies and trend with the previous month (c) Mercator-Ocean*

# Oceanic analysis of January 2024 : Pacific vertical section

In the subsurface, the warm anomaly is clearly receding, persisting only over the eastern part of the basin.

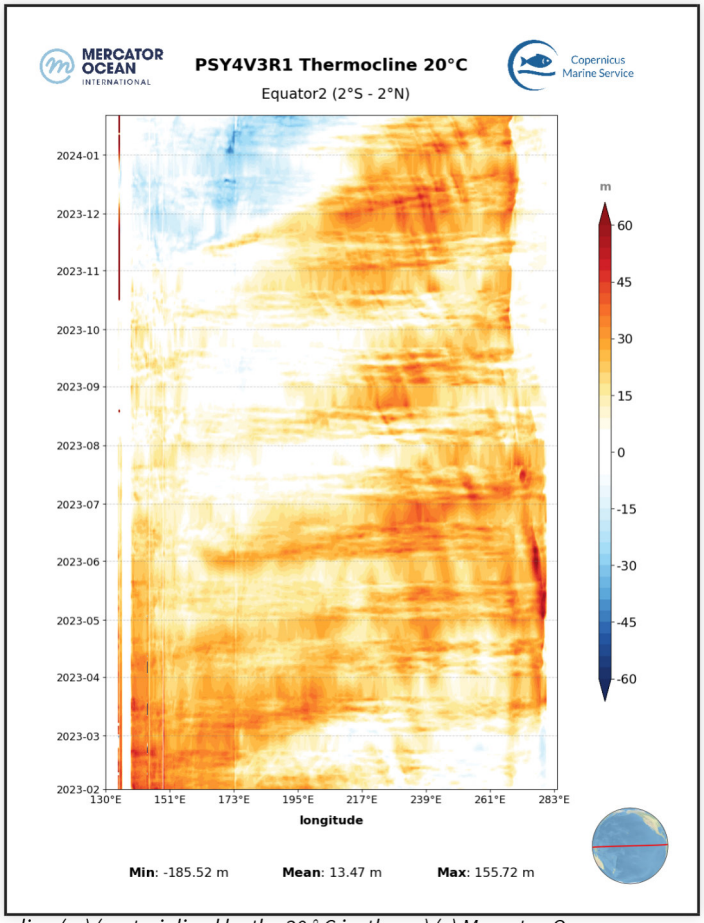



*Ocean temperature anomalies in the first 500 meters of the equatorial Pacific basin, monthly average. (c) Mercator-Ocean*

# Oceanic analysis of January 2024 : Hovmüller diagram of the 20°C isotherm

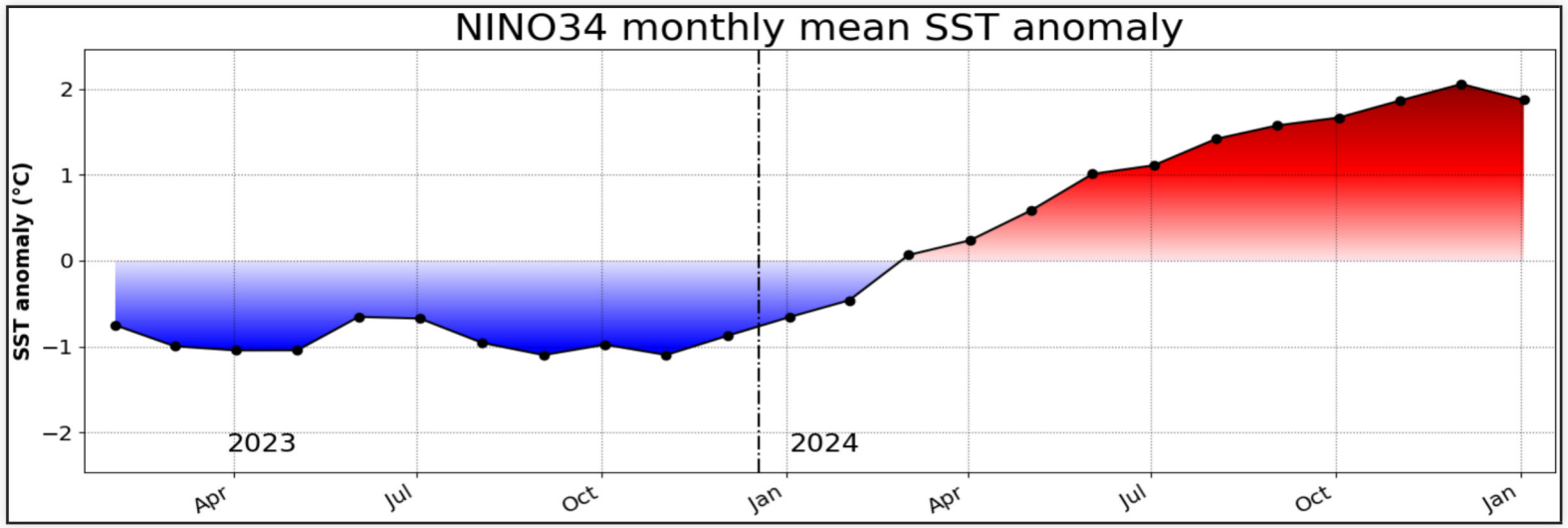
Same remark as before.




*Evolution of the anomalies of depth of the thermocline (m) (materialized by the 20 ° C isotherm) (c) Mercator-Ocean*

# Oceanic analysis of January 2024 : Pacific Ocean - Nino3.4 index history

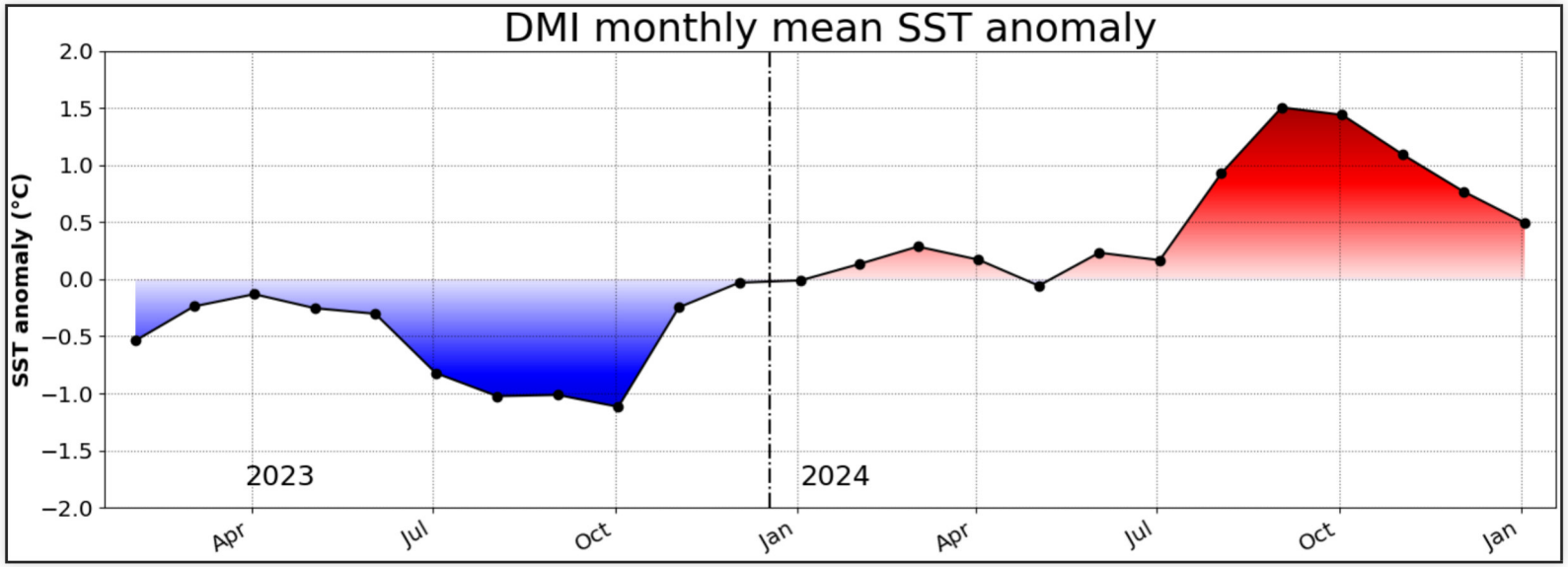
**Nino3.4 index issued from Mercator Ocean PSYV4R2 analysis : close to +1.9 °C**
(see BOM site for weekly values : http://www.bom.gov.au/climate/enso/monitoring/nino3_4.png )




*Evolution of SST in the NINO3.4 box (c) Mercator-Ocean*

# Oceanic analysis of January 2024 : Indien Ocean - DMI index history

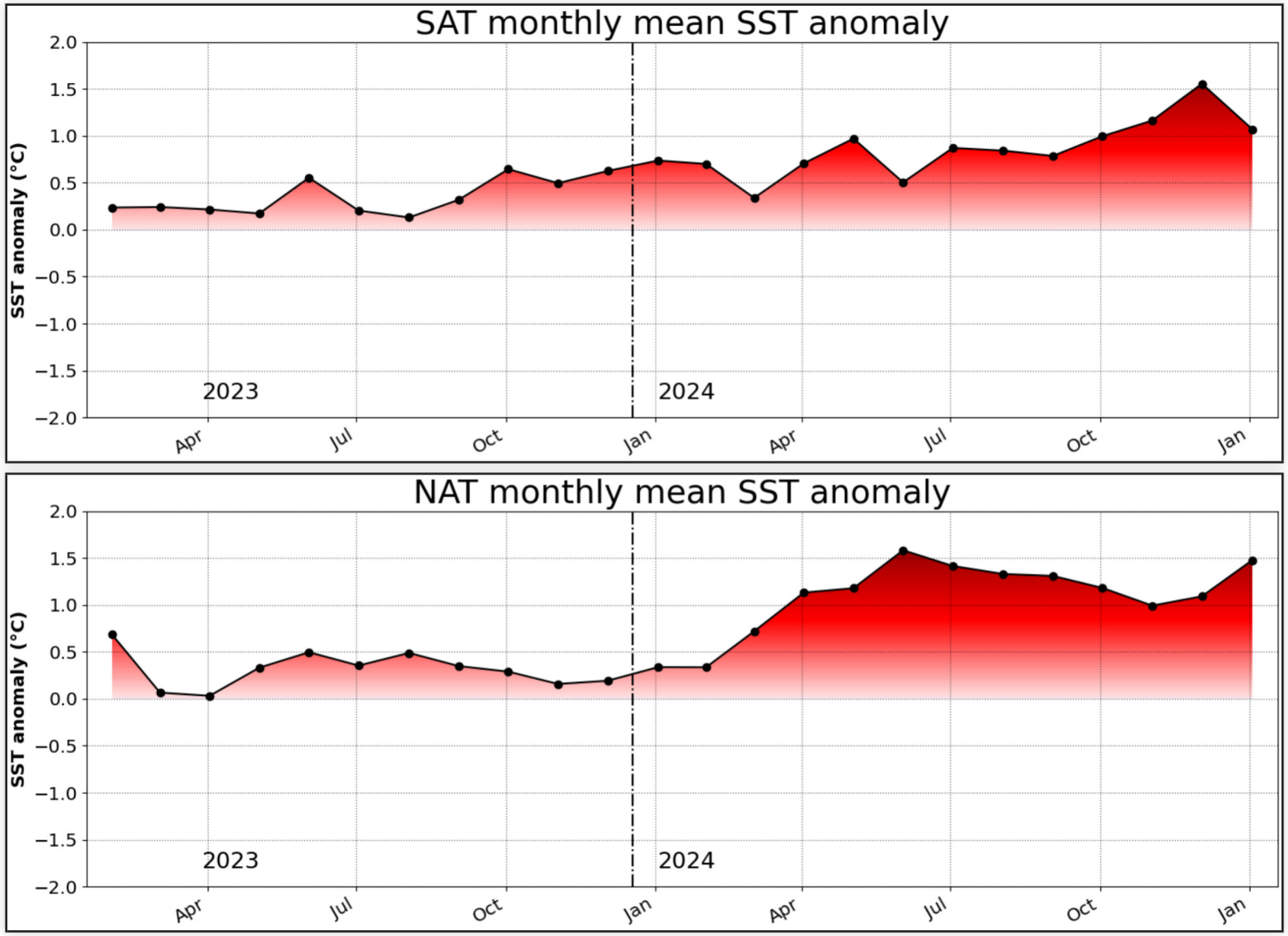
**DMI Index issued from Mercator Ocean PSYV4R2 analysis : close to +0.5°C**
(see BOM site for weekly values : http://www.bom.gov.au/climate/enso/monitoring/iod1.png )




*Evolution of SST in the DMI box (c) Mercator-Ocean*

# Oceanic analysis of January 2024 : Atlantic Ocean : SAT and NAT index

Warm anomalies remain marked, with an attenuation in the equatorial zone and an increase in the northern tropical zone.




*Evolution of SST in the SAT and NAT box (c) Mercator-Ocean*

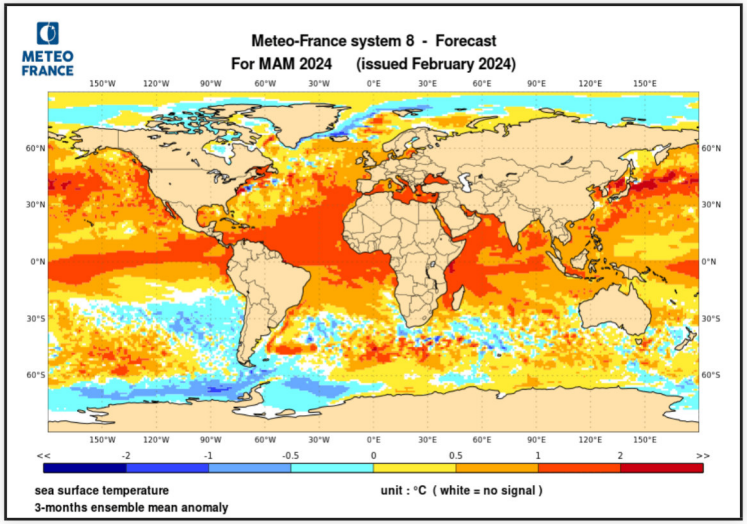
# Oceanic forecast : SST anomaly

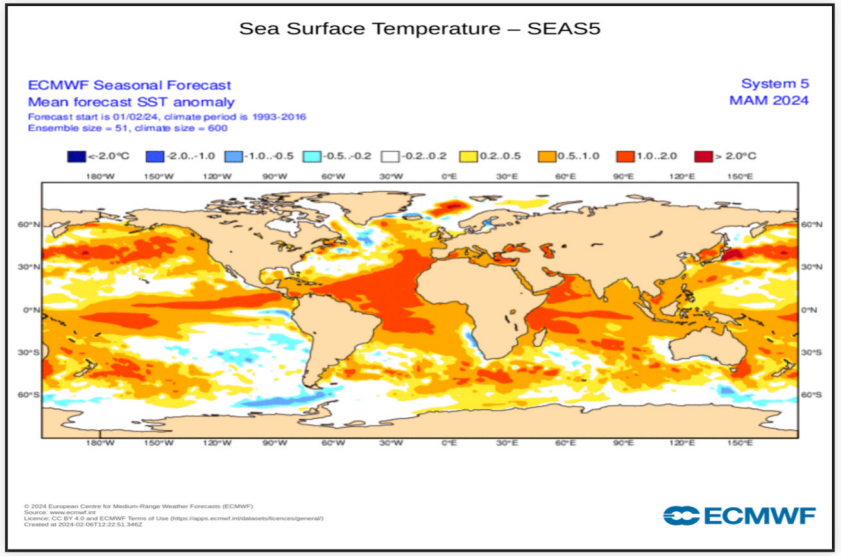
The patterns proposed by the two models are very close.

In the Pacific Ocean : In equatorial regions, the warm anomaly spreads westwards across the basin, attenuating as El Nino weakens. In the Northern Hemisphere, the PDO- pattern is barely visible.

In the Indian Ocean : The warm anomaly stretches eastwards across the basin.

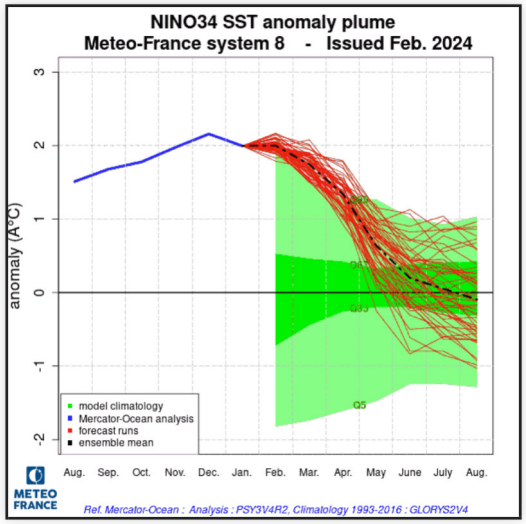
In the Atlantic Ocean : The warm anomaly remains widespread, from the equator to 30°N and Europe.

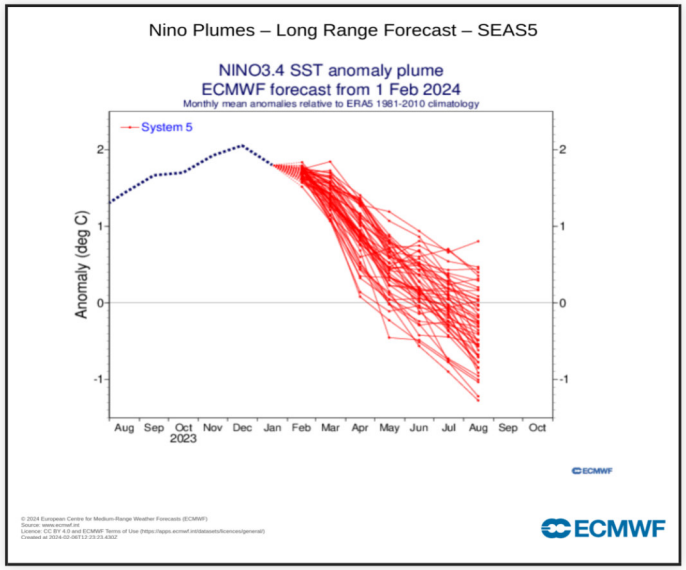


# Oceanic forecast : NINO3.4 Plume diagrams

Both models are in agreement on a rapid decline in the index and a return to neutral values at the end of the quarter.

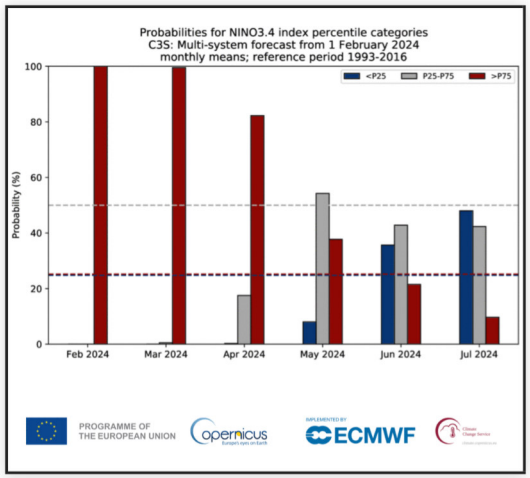


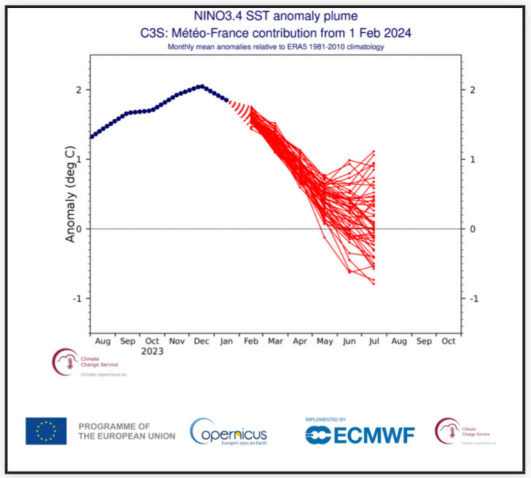



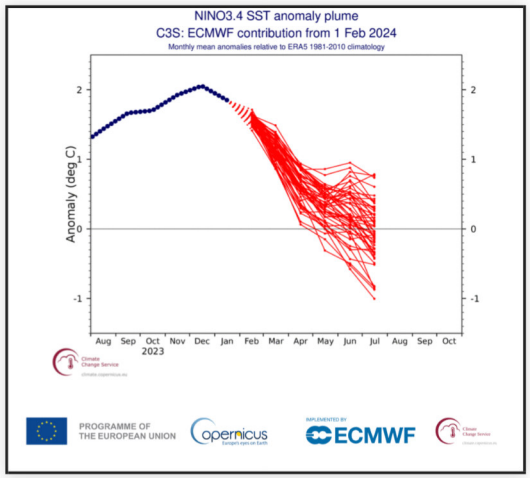
# Oceanic forecast : C3S Nino3.4 re-scaled plume diagrams

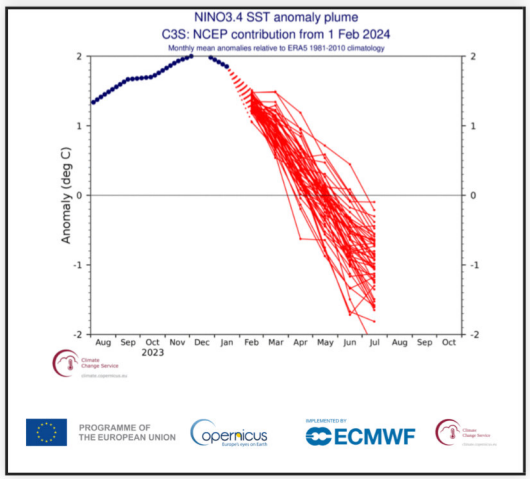
All models agree that the index will fade rapidly at the end of the quarter. Beyond that, divergences are clearly visible.

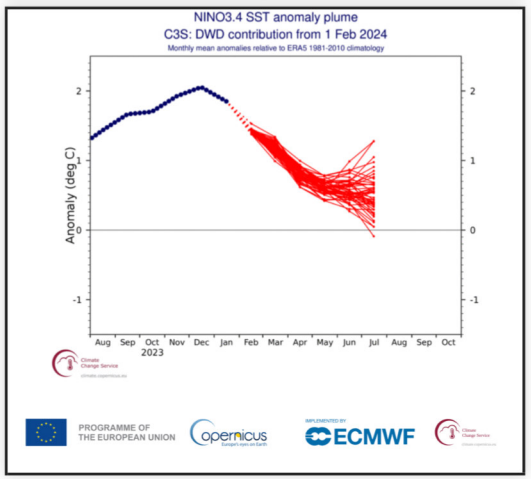
**The most likely phase for the next three months : Return to neutral phase**

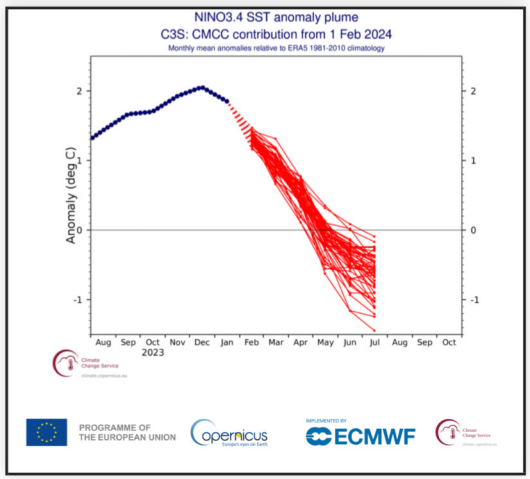


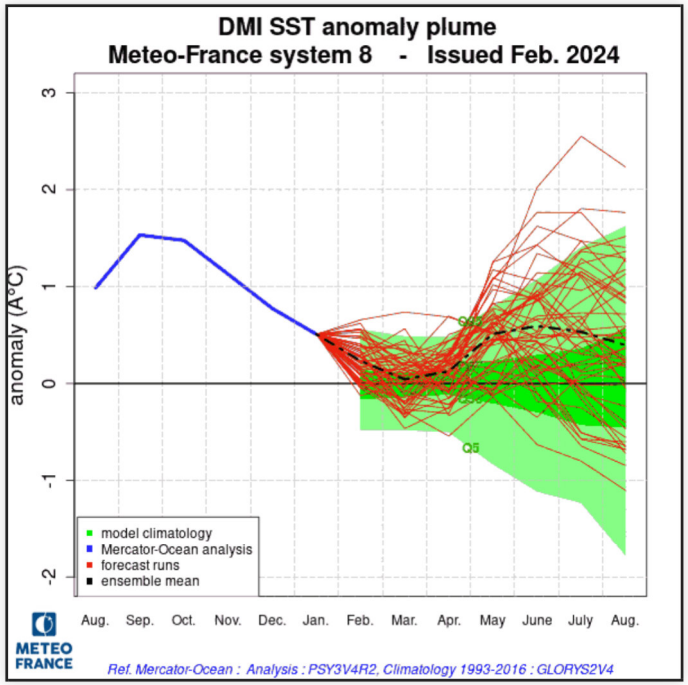



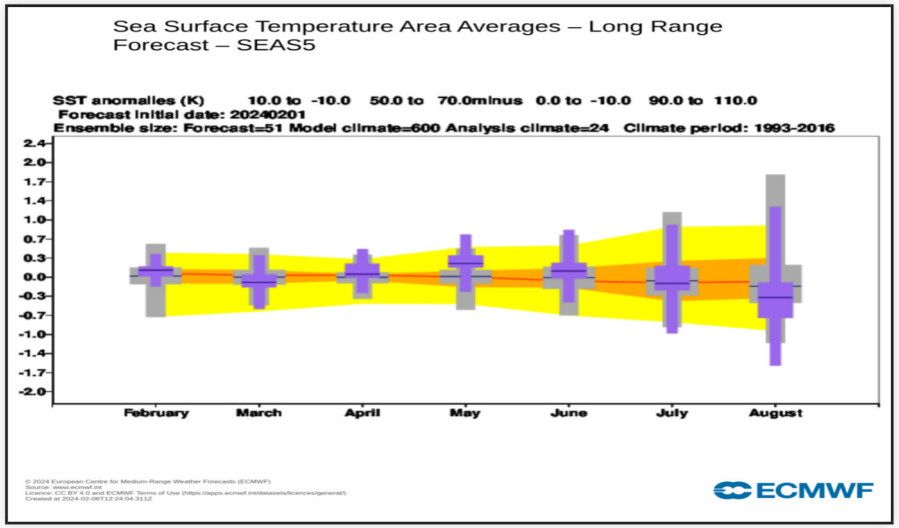




*C3S multi-system probabilty forecast (top left figure) and C3S plume diagrams re-scaled from the variance of observations for the period 1981-2010.*

# Oceanic forecast : Indian ocean - DMI evolution

The DMI index remained in neutral for the quarter.

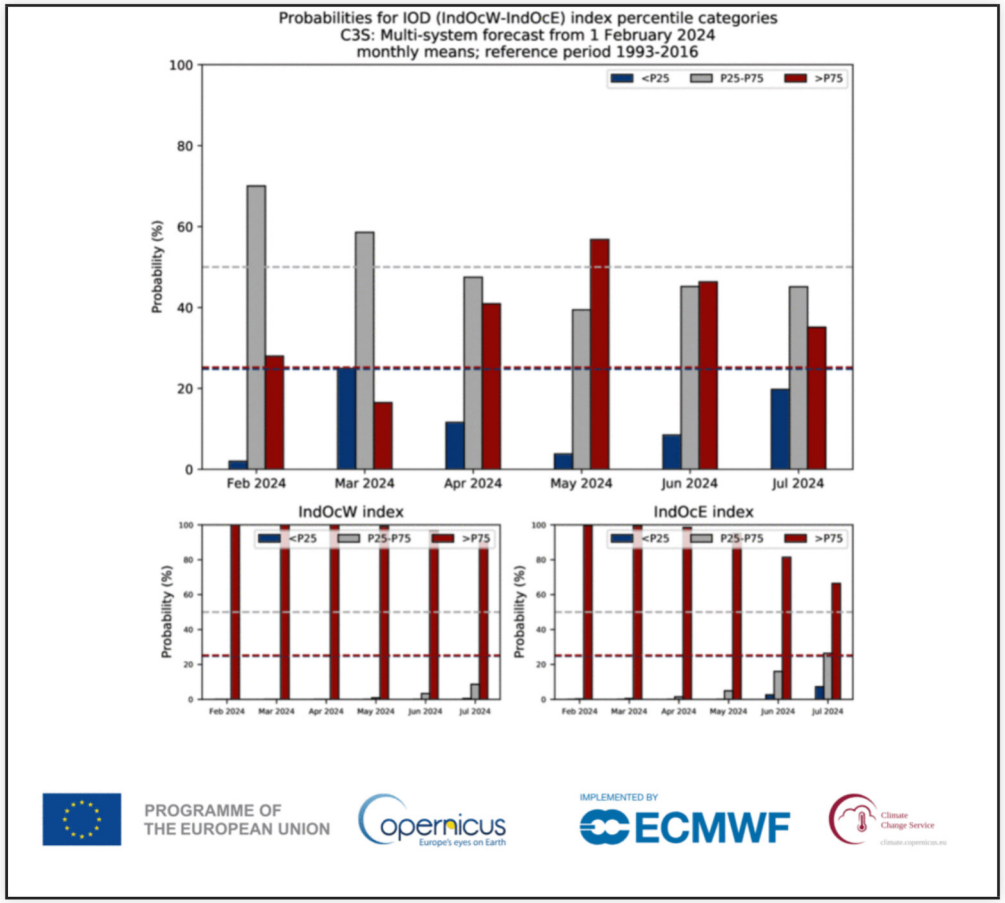



*DMI index : analysis, forecasts and model climatology with MF-S8 on the left and ECM-SEAS5 on the right*

# Oceanic forecast : C3S IOD re-scaled plume diagrams

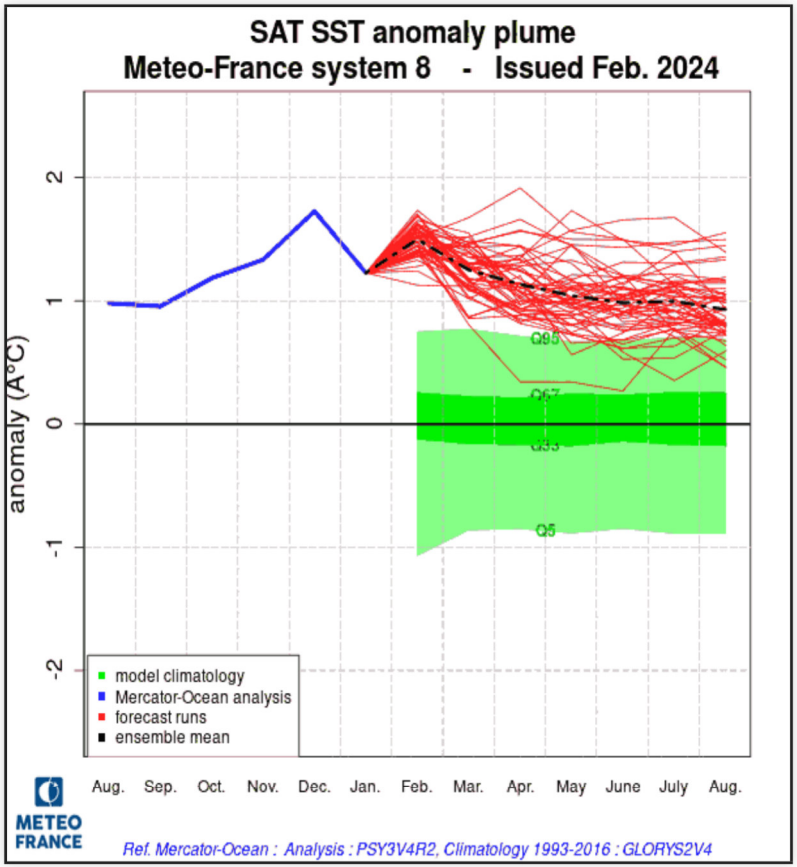
**Expected Phase for the next three months : neutral conditions**

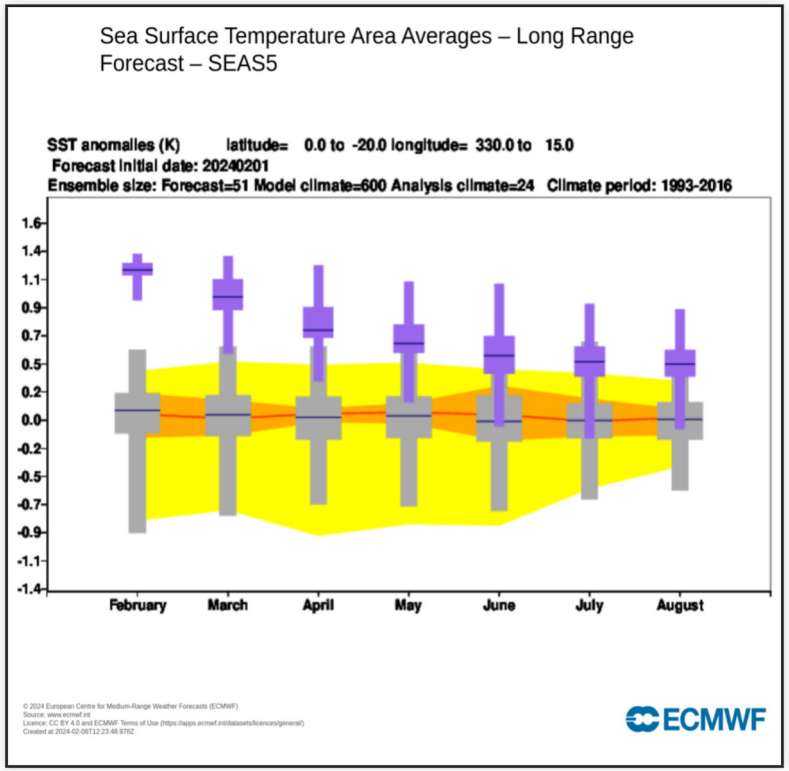



*C3S multi-system probabilty forecast for IOD , west box and east box Index*

# Oceanic forecast : Atlantic ocean - SAT evolution

Both models maintain a very marked warm anomaly for the quarter.

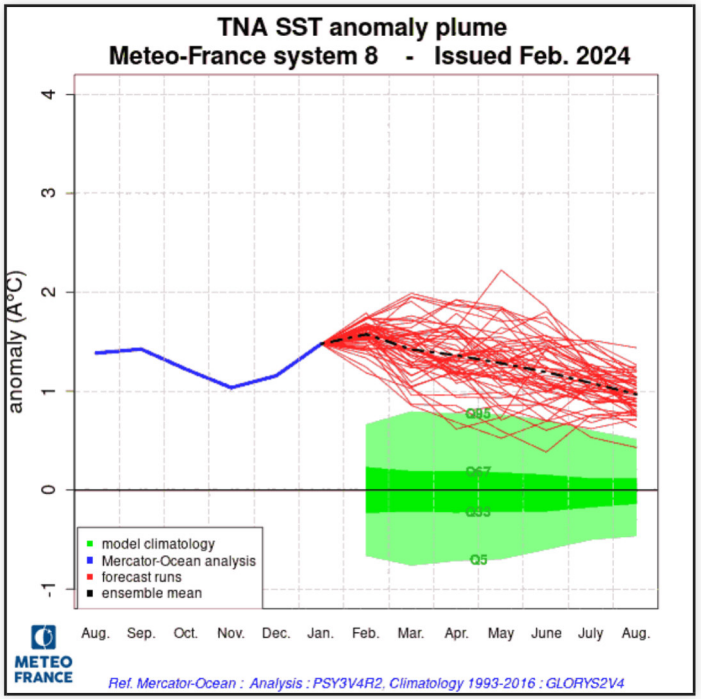


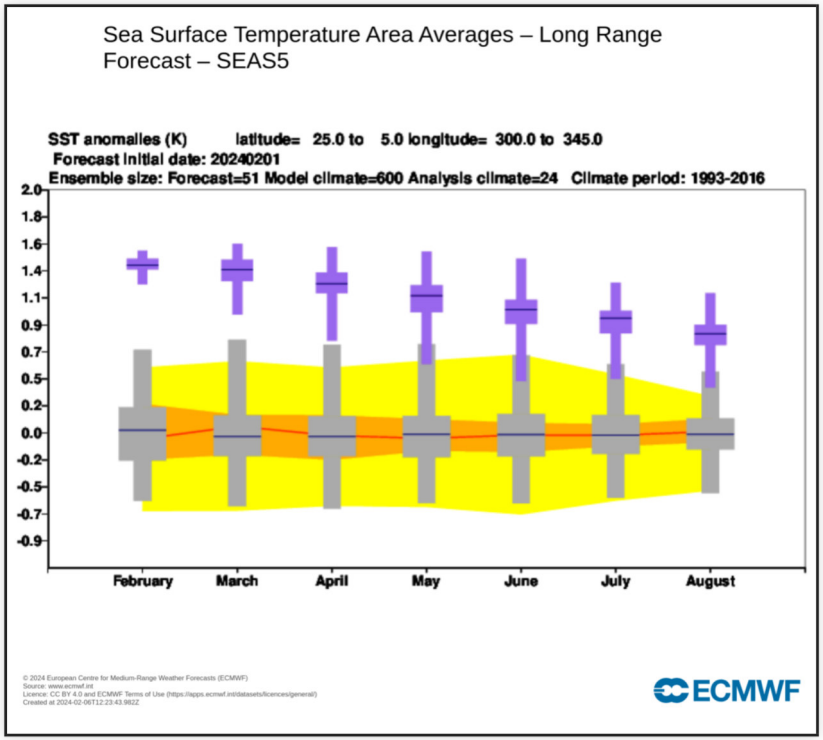




*Anomaly on the SAT box : analysis, forecasts and model climatology with MF-S8 on the left and SEAS5 on the right*

# Oceanic forecast : Atlantic ocean - TNA evolution

Both models maintain a very marked warm anomaly for the quarter.



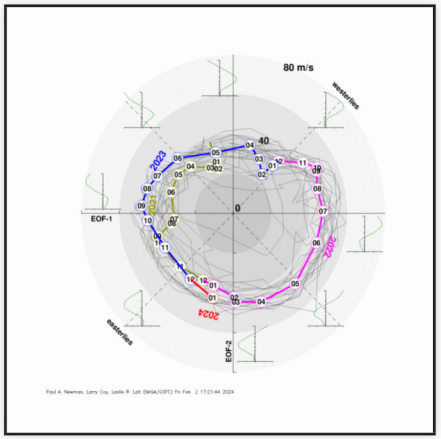



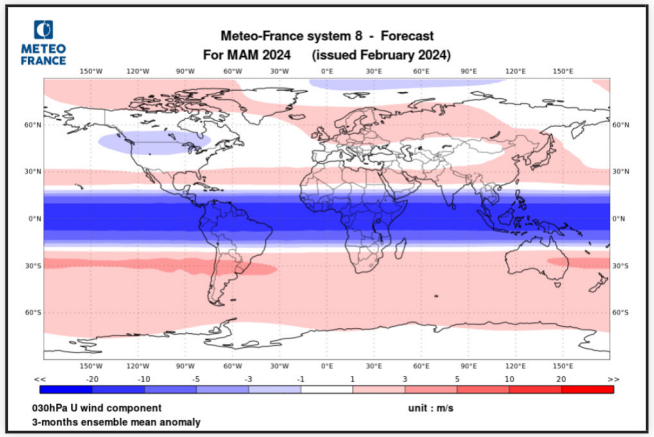

*TNA index : analysis, forecasts and model climatology with MF-S8 on the left and ECM-SEAS5 on the right*

# Drivers : QBO analysis

QBO is in an easterly wind phase, leading to a weakening of the polar vortex.

Ref : Marshall, A. G., & Scaife, A. A. (2009). Impact of the QBO on surface winter climate. *Journal of Geophysical Research: Atmospheres*, *114*(D18).

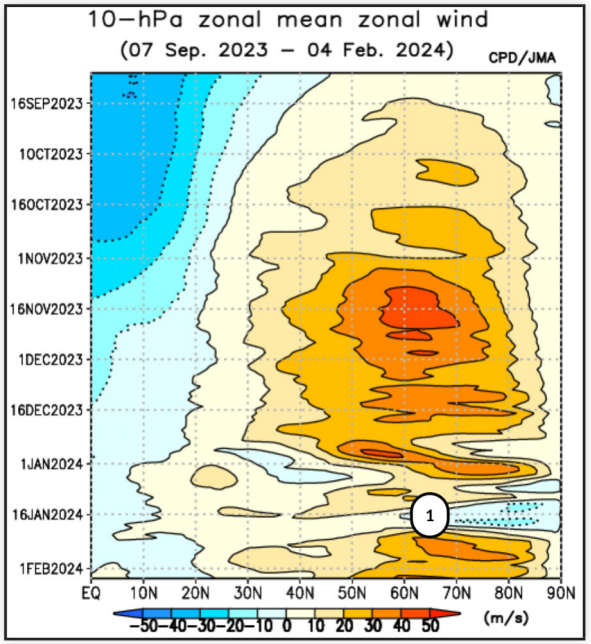


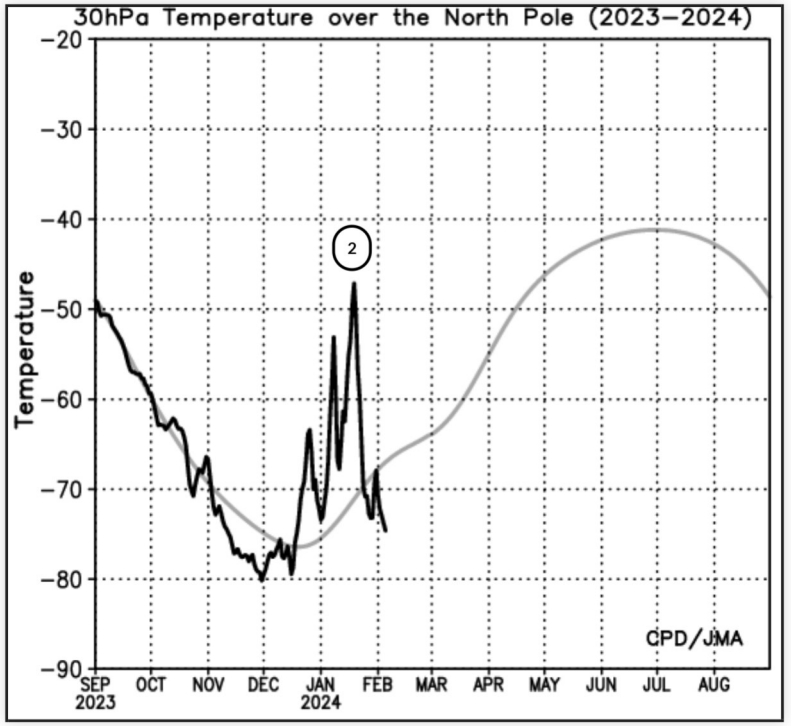




*The EOFs of the 1980-present QBO, NASA/ACD (left figure) and MF8 forecast of U30 (right figure)*

# Drivers : SSW

A limited SSW occurred in January, associated with a zonal wind inversion at 10 hPa, before a return to near-normal conditions in early February.



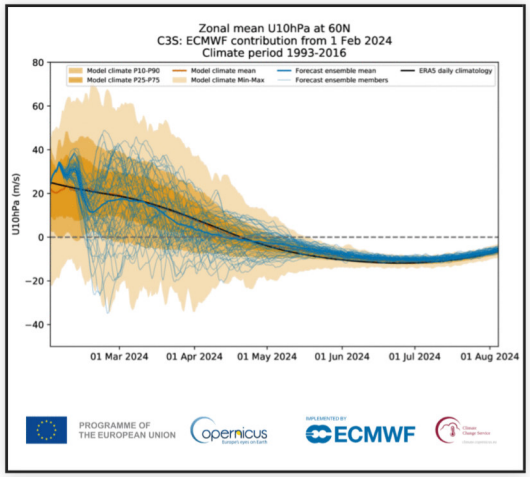



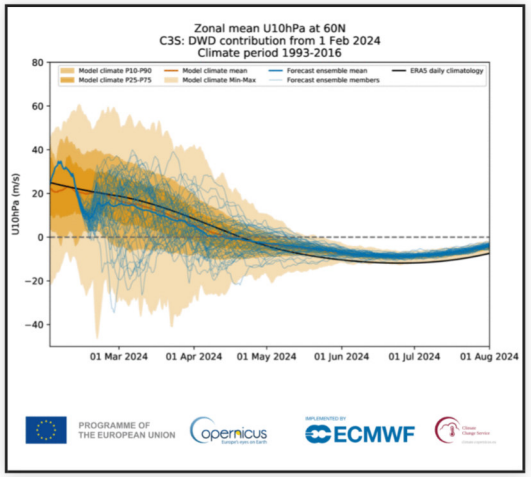

*10 hPa zonal wind Hovmuller diagram and 30 hPa temperature histogram. (c) Tokyo Climat Center JMA*

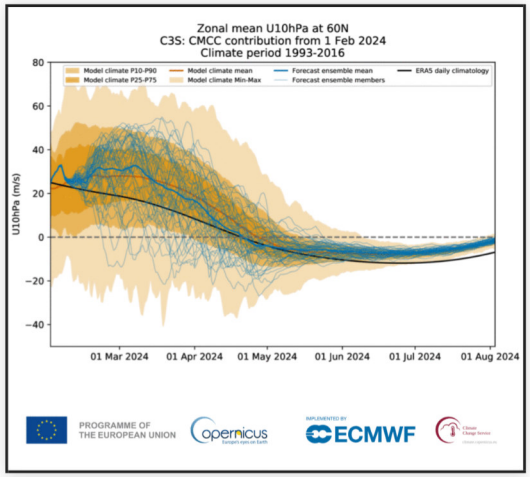
1 - 10 hPa wind reversal
2 - SSW in January

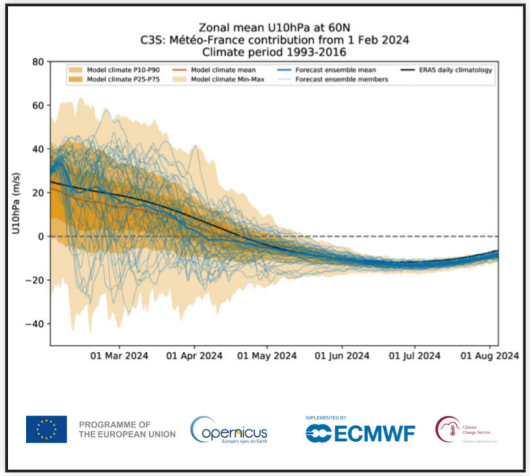
# Drivers : polar vortex (U010 plumes)

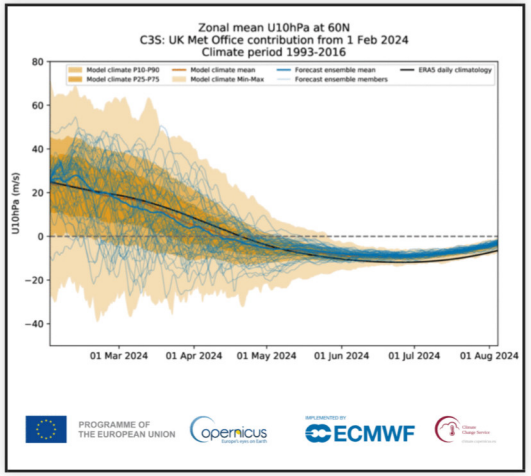
No particular signal.

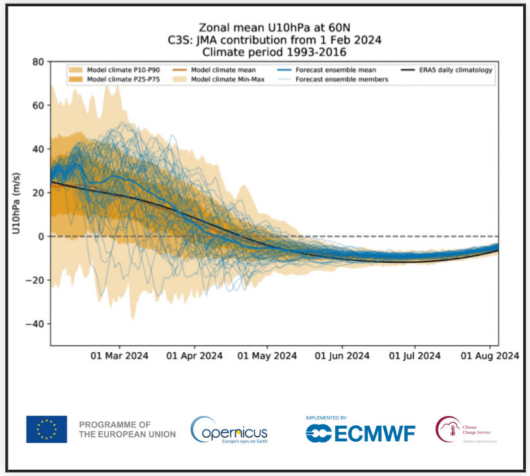


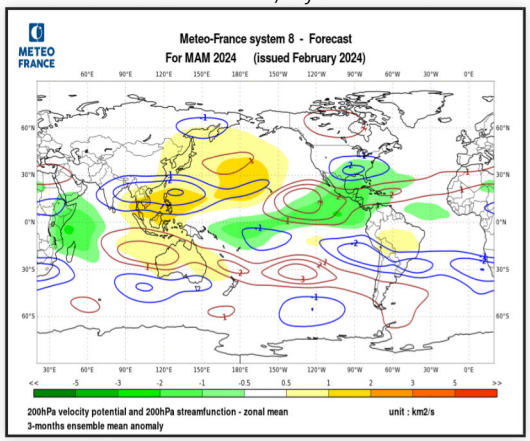



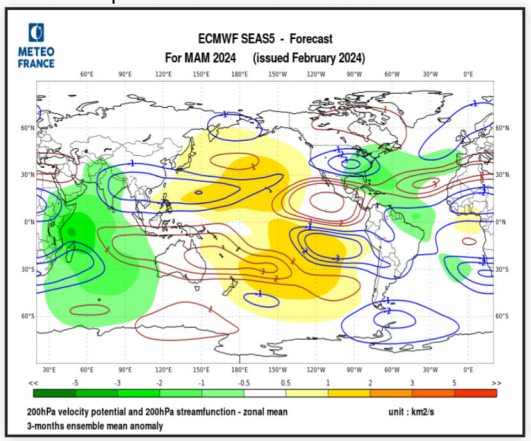

*ECMWF-SEAS5, DWD, CMCC, MF-S8, UKMO, and JMA 010hPa zonal mean of u componant of wind at 60°N.*

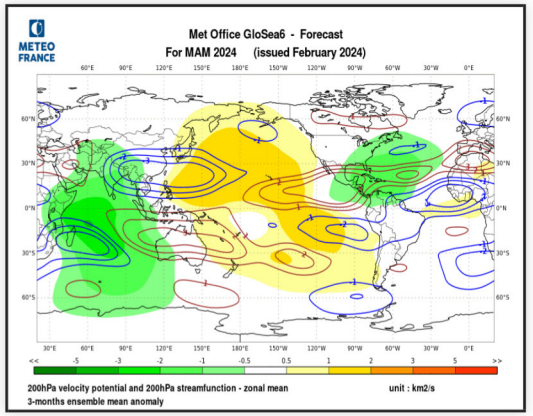
# Atmospheric circulation forecasts : velocity potentiel and stream function at 200hPa

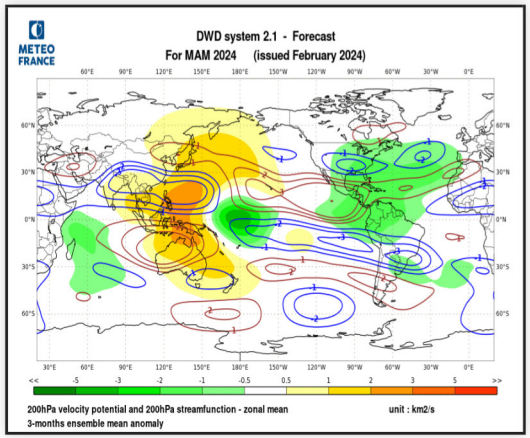
Velocity Potential : The models are divided into two patterns. MF8 and DWD retain a pattern still marked by the influence of El Nino and IOD+ (tripole of subsidences over the Maritime Continent and ascendances on either side over the Indian Ocean and Equatorial Pacific Basin). The other four models forecast an ascending dipole over the Indian Ocean (positive SST anomaly) and subsidences over the Pacific Ocean.

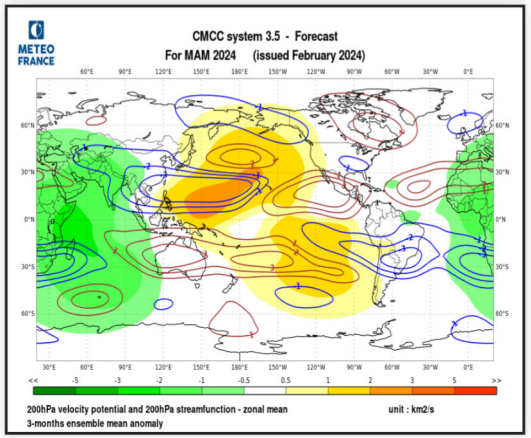
Streamfunctions : Fewer discrepancies between models around the equator (dipole over the Maritime Continent and dipole over the eastern Equatorial Pacific Basin). Some teleconnections to North America. Extension of the anticyclonic circulation from the eastern Pacific towards North Africa and the Mediterranean Basin, but less marked with MF8 and DWD). Cyclonic circulation over northern Europe for the other four models.

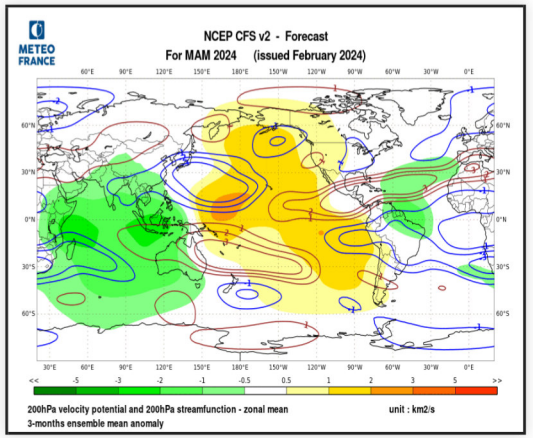


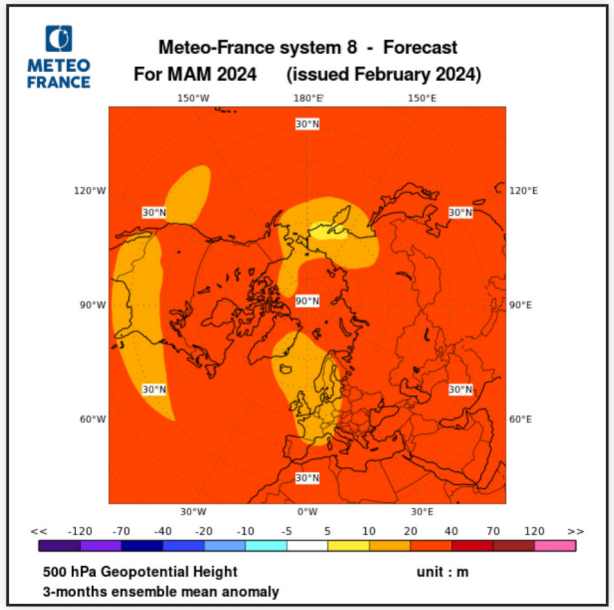



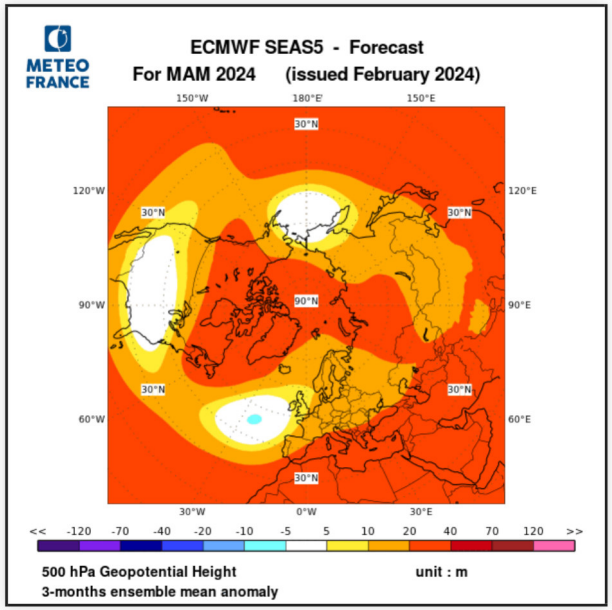




*MF8,SEAS5, UKMO, DWD, CMCC and NCEP 200hPa velocity potential anomalies (color range, green : ascending, orange: subsidence) and stream function anomalies (isolines, red: anticyclonic in the northern hemisphere, blue: cyclonic in the northern hemisphere).*

# Atmospheric circulation forecasts : 500 hPa Geopotential anomalies

Signals are weaker with MF8 than with ECMWF, but they all agree on a PNA+ pattern and a negative anomaly on the US. The divergences are stronger towards Europe, with a negative anomaly off Europe for ECMWF and a weak negative anomaly over Northern Europe for MF8.

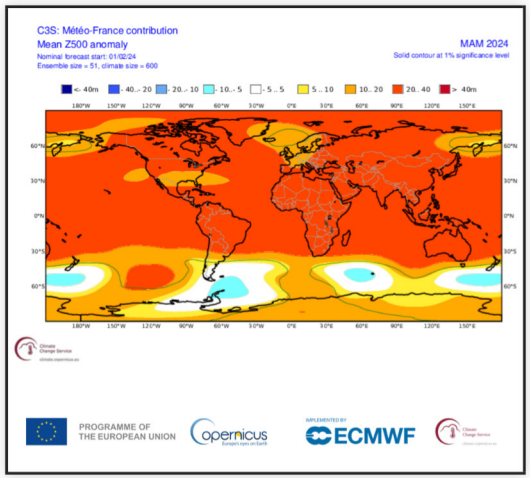


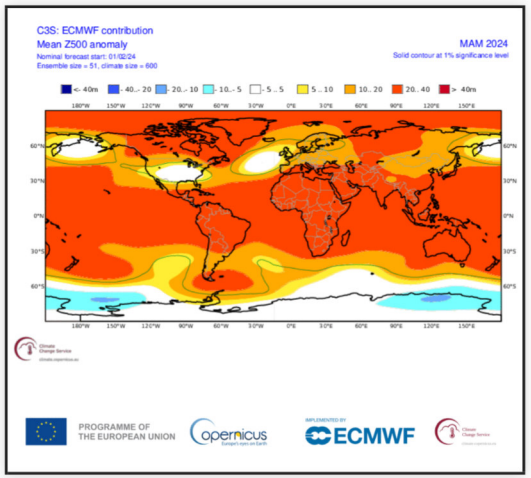



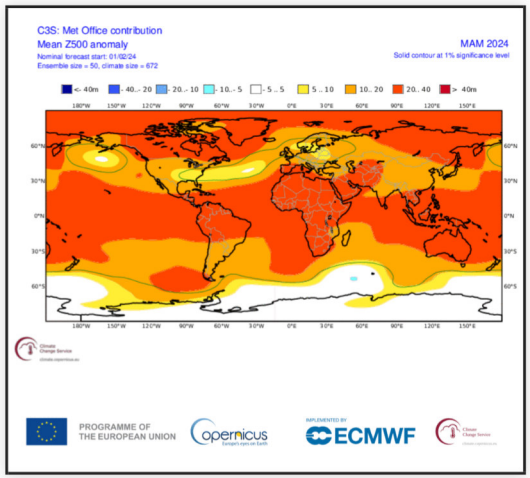

*polar projection of MF8 and SEAS5 500hPa geopotential height anomalies.*

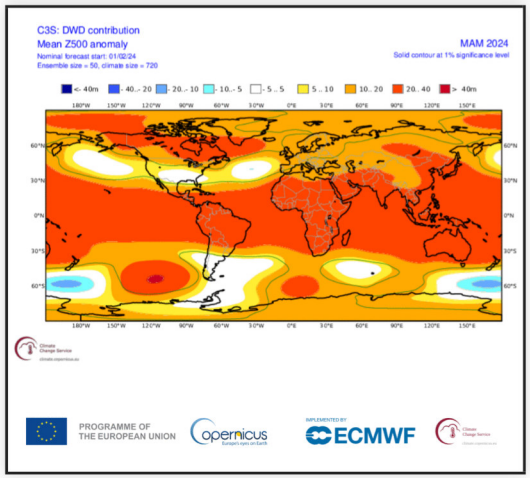
# Atmospheric circulation forecasts : Z500 anomalies in C3S models

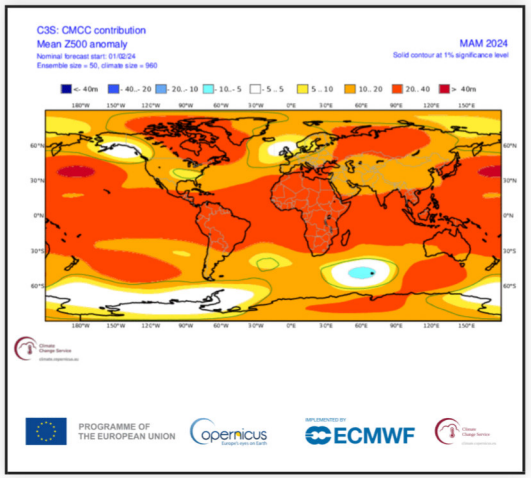
Most models show a PNA-type pattern over Alaska and an axis of more or less marked negative anomalies from the USA to Europe.
Only MF8 proposes much softer fields. The position of the minimum near Europe changes from model to model.

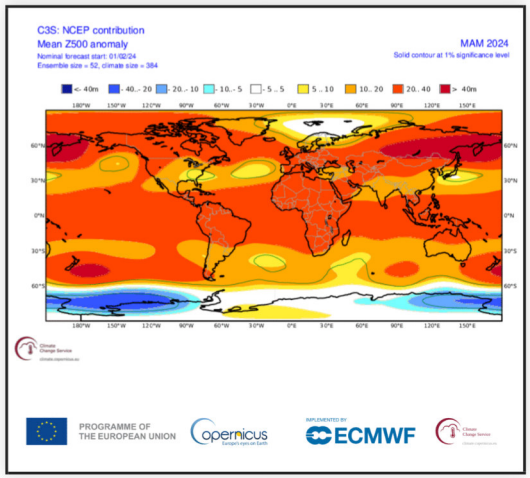


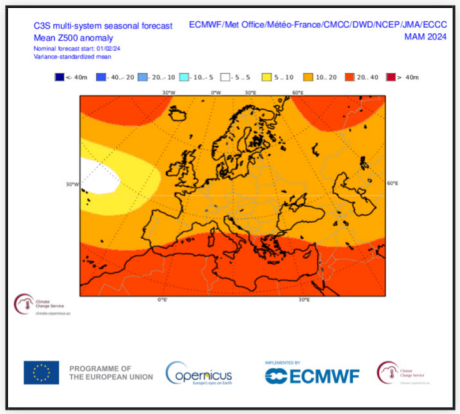



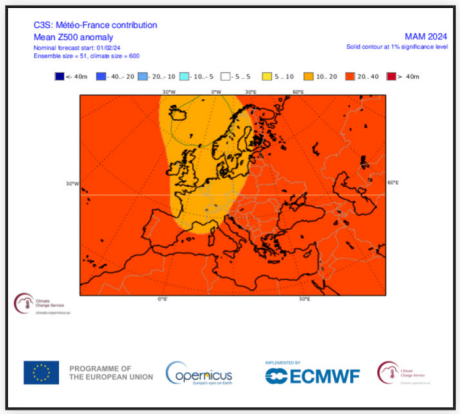



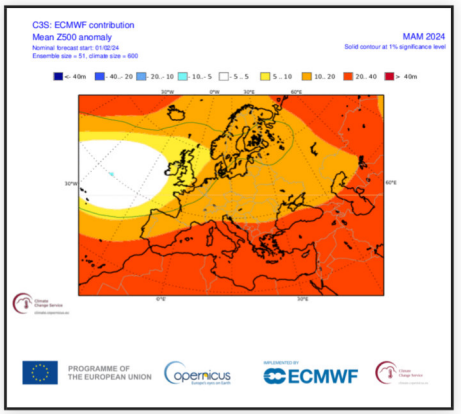

*MF-S8, SEAS5, UKMO, DWD, CMCC and NCEP 500hPa geopotential height anomalies.*

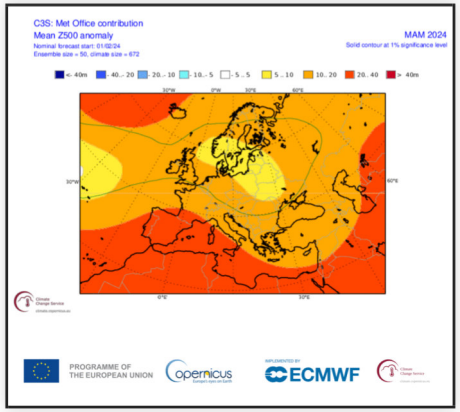
# Atmospheric circulation forecasts : Z500 anomalies in C3S models

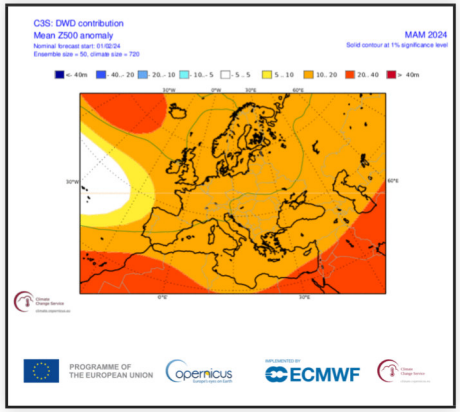
All models forecast one or even two minimums in the vicinity of Europe: the first in the Atlantic to the west of Europe and the second near Scandinavia, as well as a positive anomaly over the Mediterranean Basin.

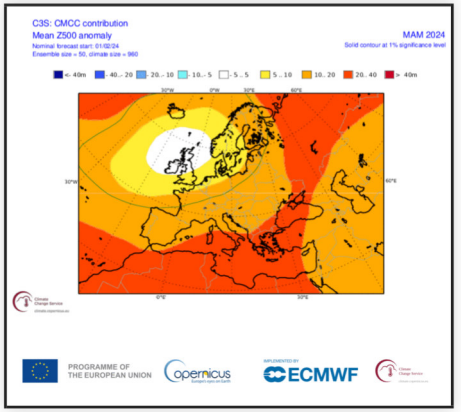


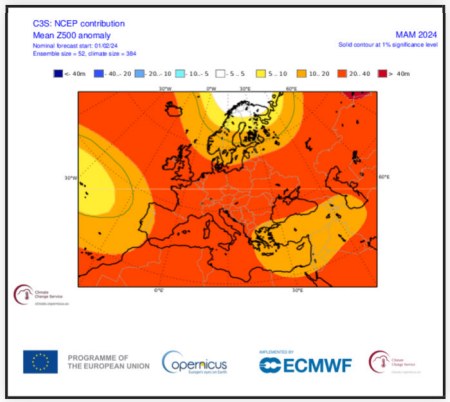



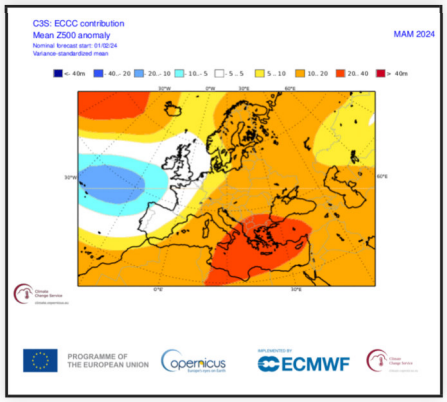



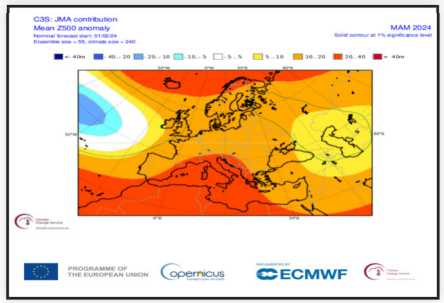



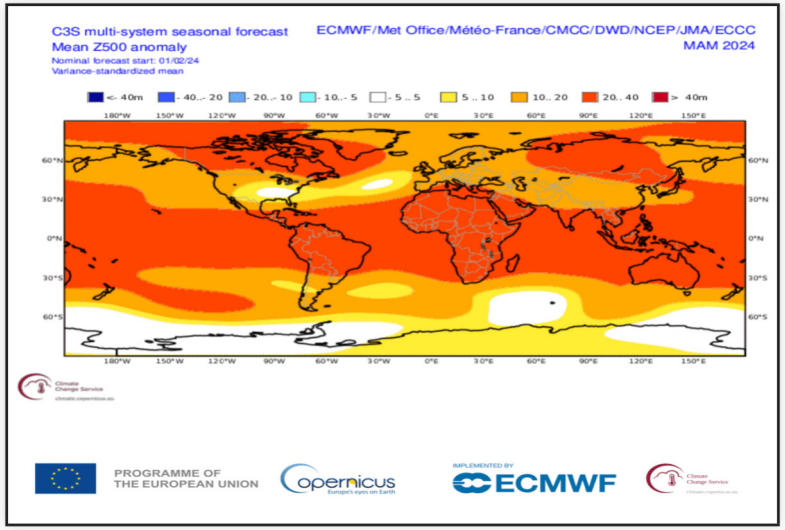



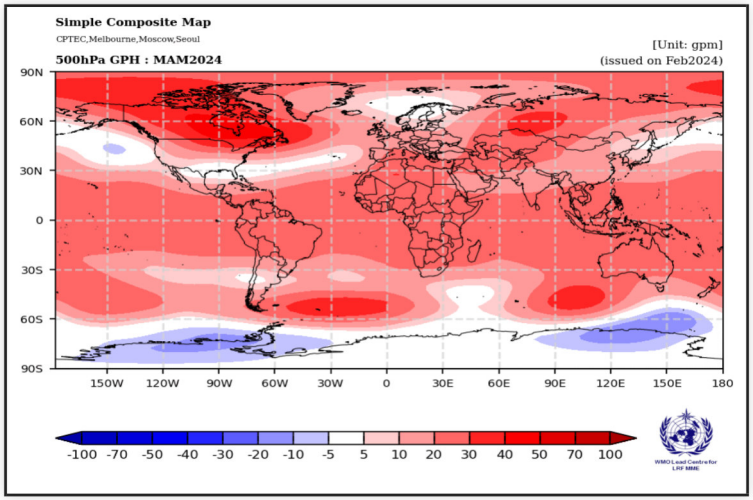

*multi-models 500hPa geopotential height anomalies*

# Atmospheric circulation forecasts : Z500 anomalies multi-systems

The two multi-models share many similarities. However, a relative minimum for Scandinavia is clearly visible in the WMO multi-model.



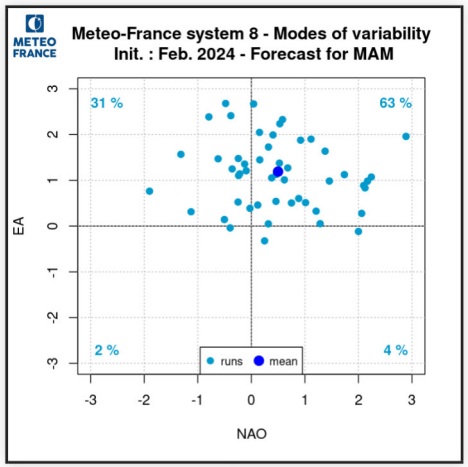

*C3S multi-models (MF-S8, ECMWF-SEAS5, UKMO, DWD, CMCC, NCEP, JMA, ECCC) 500hPa geopotential height anomalies.*

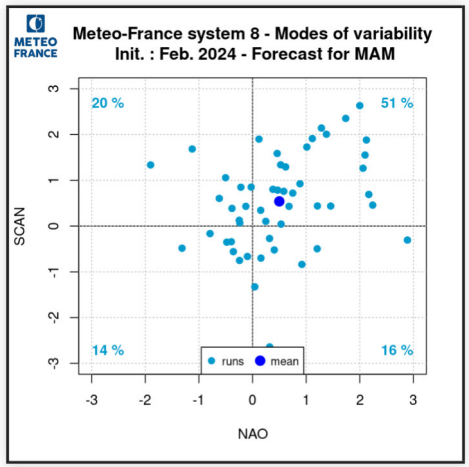


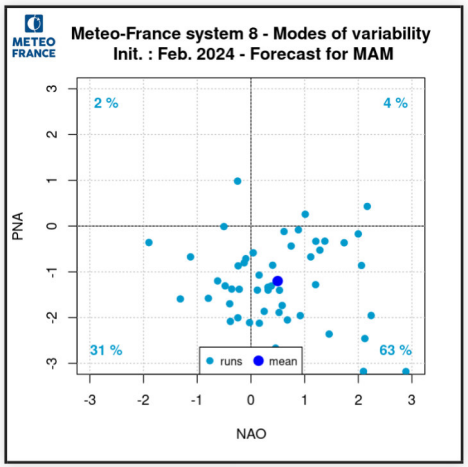

*Others models of WMO multi-models 500hPa geopotential height anomalies.*

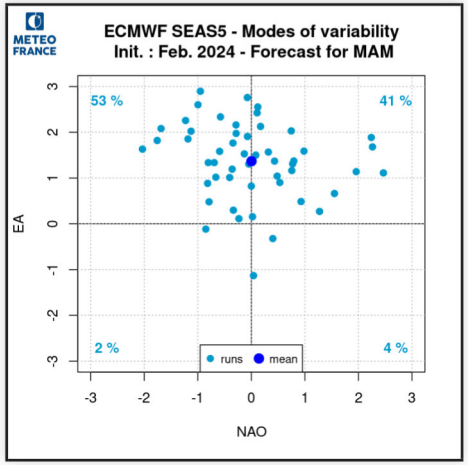
# Modes of variability : forecast

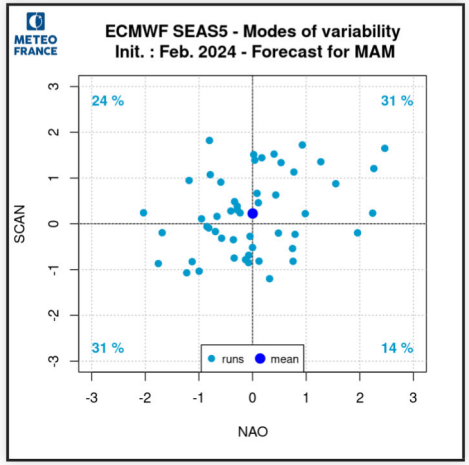
Both models foresee EA+ and PNA- modes.
Other signals are weak, close to neutral for ECMWF and slightly positive for MF8.

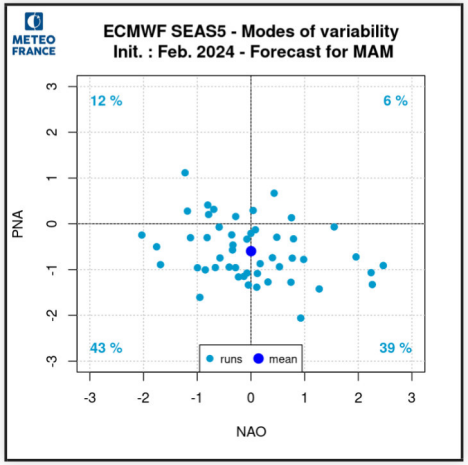


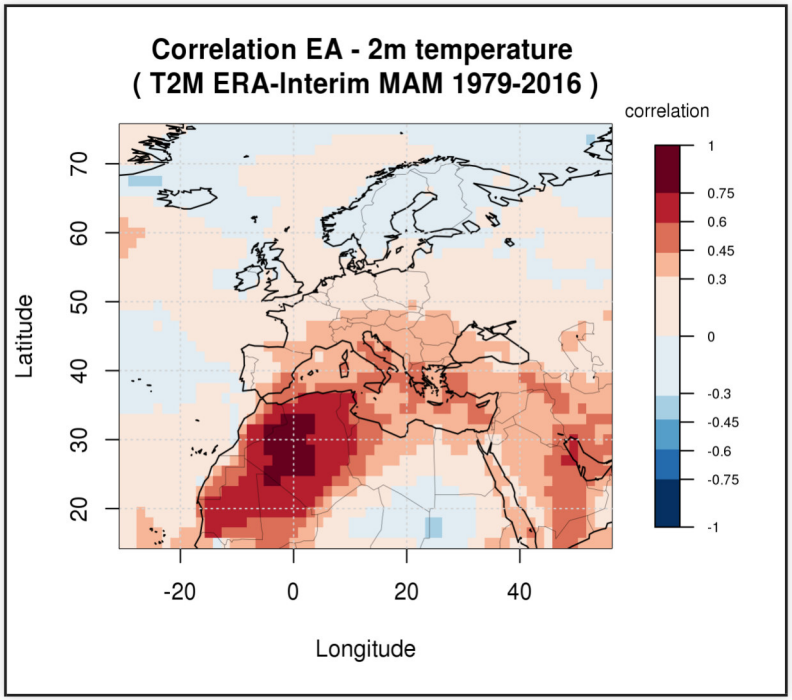



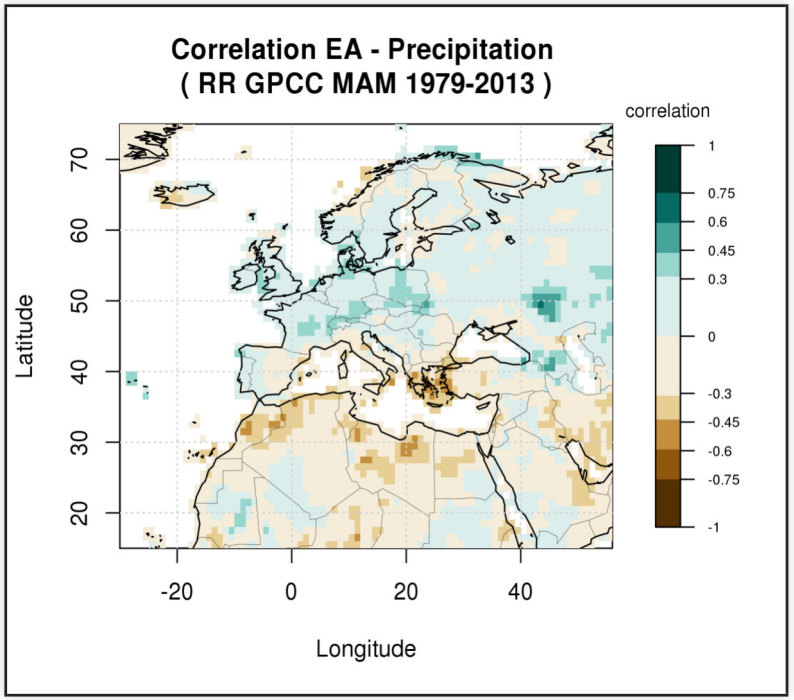




See the modes of variability patterns

# Modes of variability : EA impacts

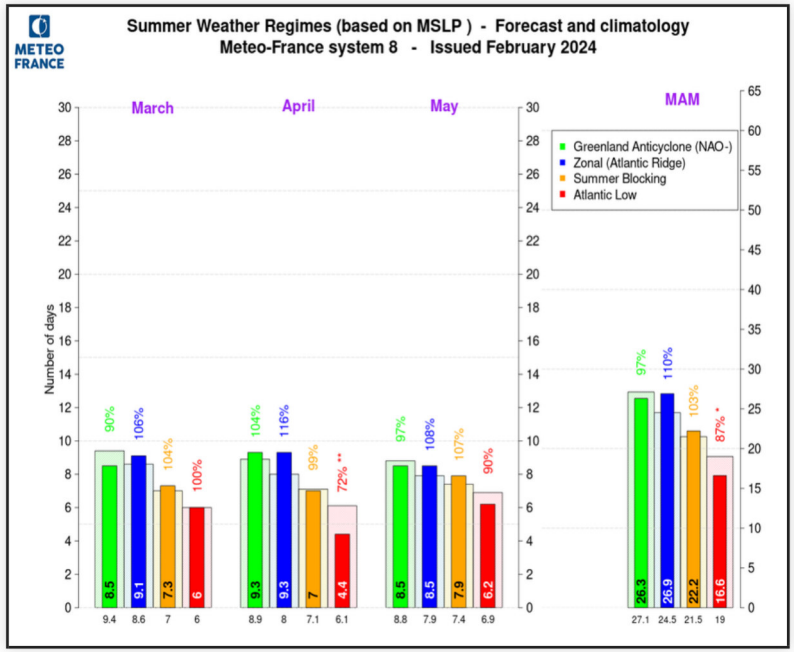
Positive EA is expected next quarter. This mode has a strong influence in particular on the temperature on southern Europe.

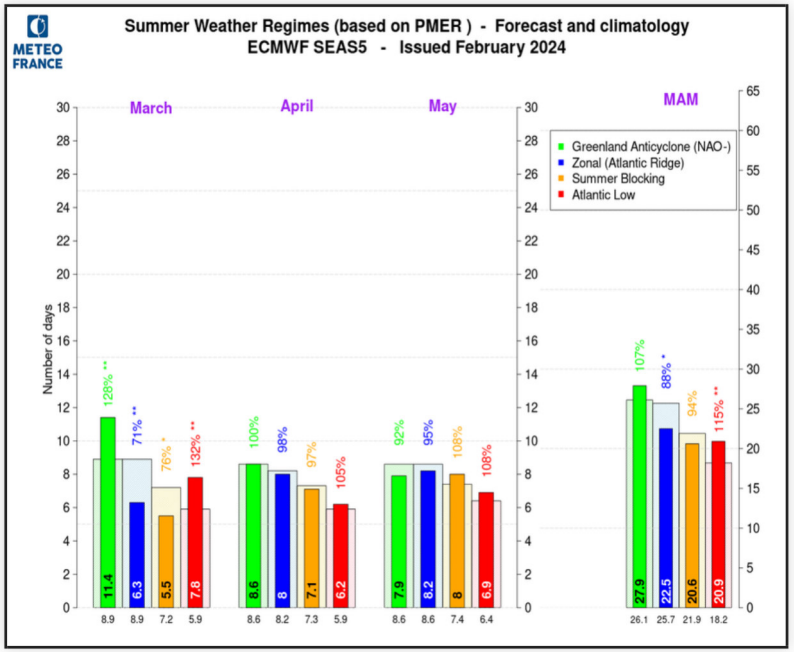


# Weather regimes : summer MSLP

MF8 and ECMWF are highly divergent for the first month (March). The Greenland Anticyclone NAO- regime clearly dominates for ECMWF, unlike MF8. The other difference concerns the zonal pattern, which is more present with MF8 than with ECMWF, in contrast to the Atlantic Low pattern, throughout the three months. Finally, over the quarter, climatological deviations are different between the two models for three of the four regimes, with significant differences for ECMWF.

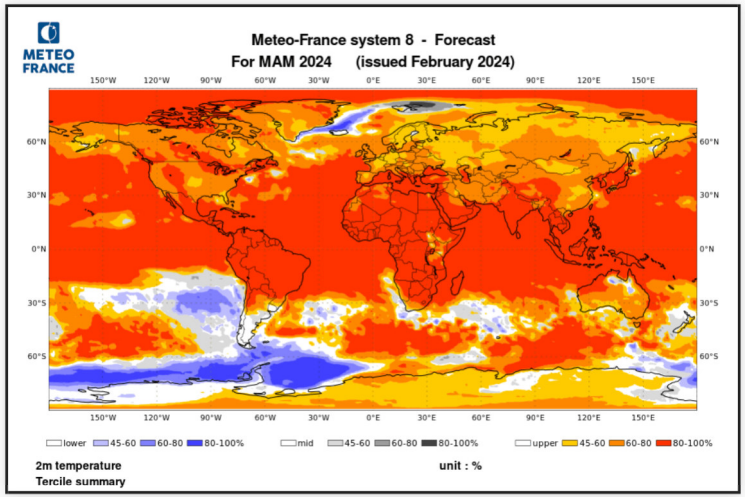


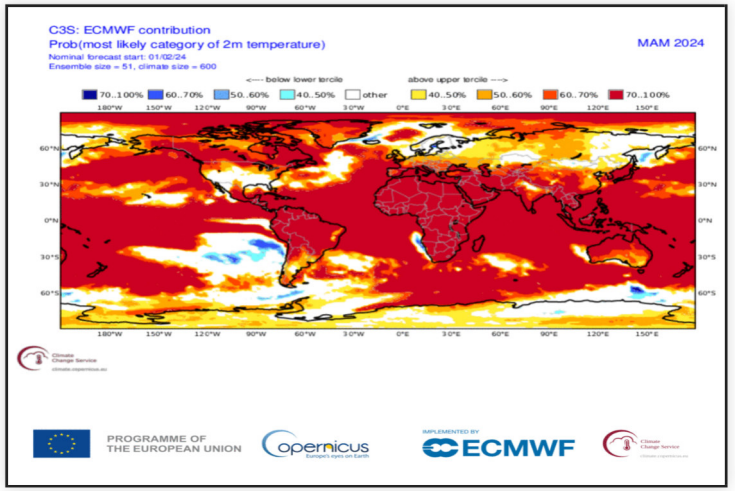



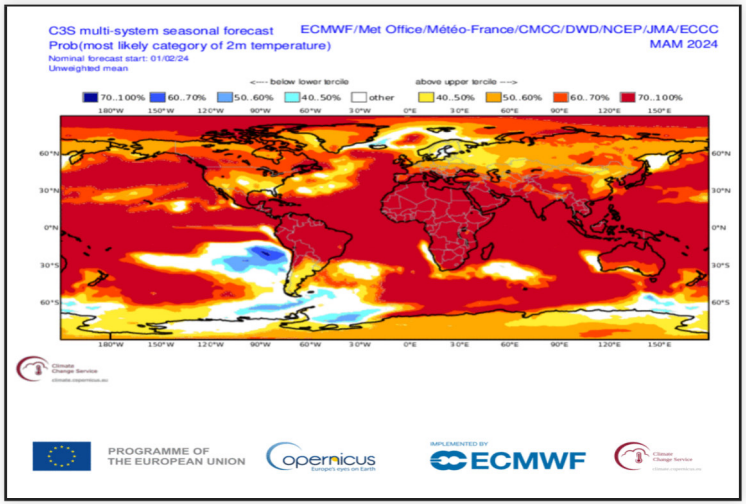

*Frequency of SLP weather regimes, compared to model's own climatology, for the next three months and aggregation over the entire quarter, for MF-S8 (left) and SEAS5 (right).*

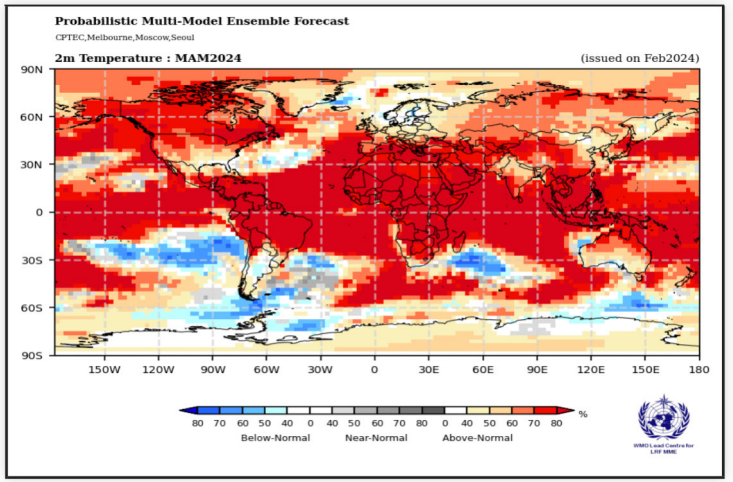
# Forecast of climatic parameters : Temperature probabilities

A warmer-than-normal signal is most likely over most of the globe, with the exception of southern South America.



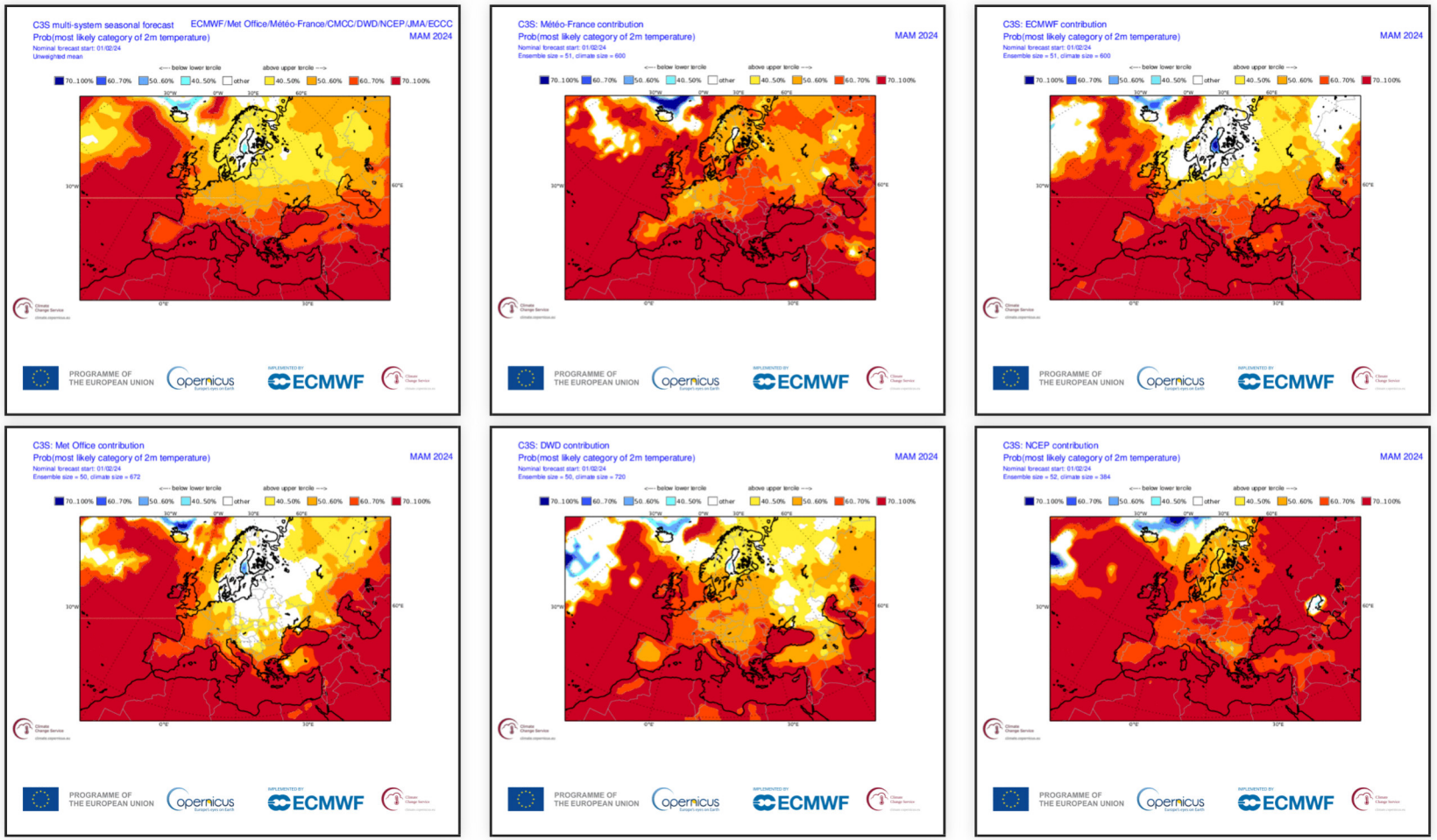




*2m temperature probability map from MF-S8 (top left), ECMWF-SLAS5 (top right), C3S multi-models(bottom left) and others models of WMO multi-models (bottom right)*

# Forecast of climatic parameters : T2M probabilities over Europe in C3S models

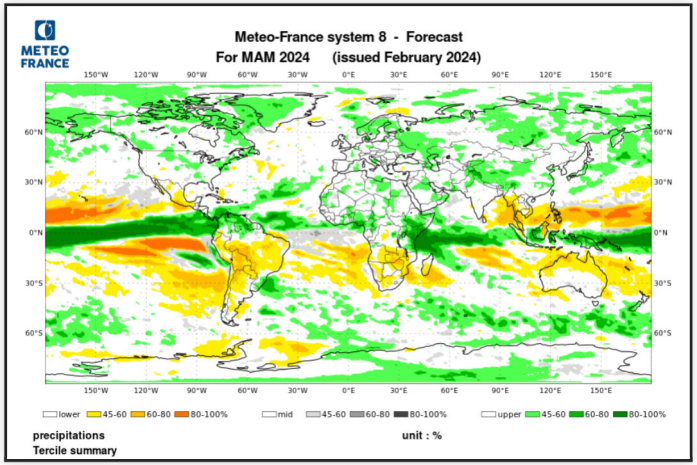
A warmer-than-normal scenario is likely over the Mediterranean Basin related to the anticyclonic curvature at 200 hPa.
Scenarios are more divergent as we move towards Northern Europe

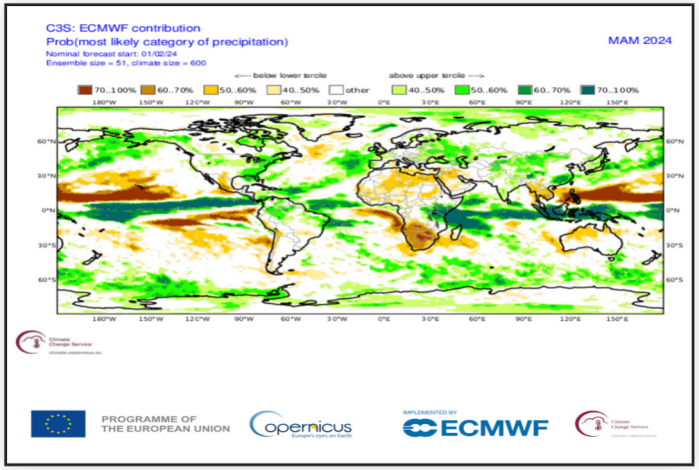


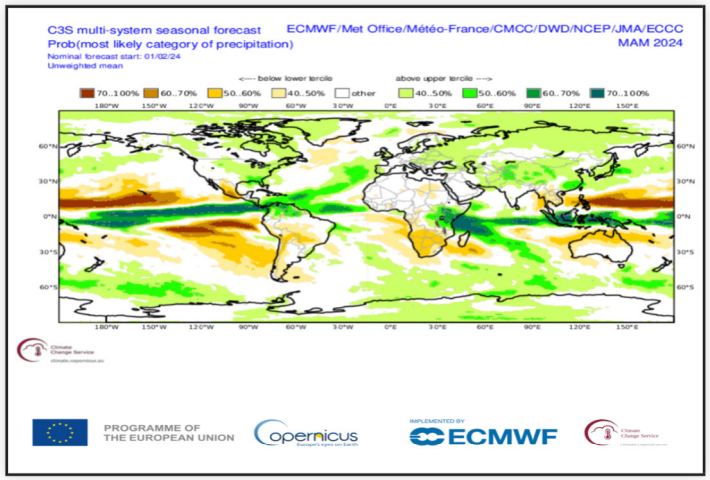

*C3S multi-models probability map (top left) and MF-S8, ECMWF-SEAS5, UKMO , DWD, CMCC models.*

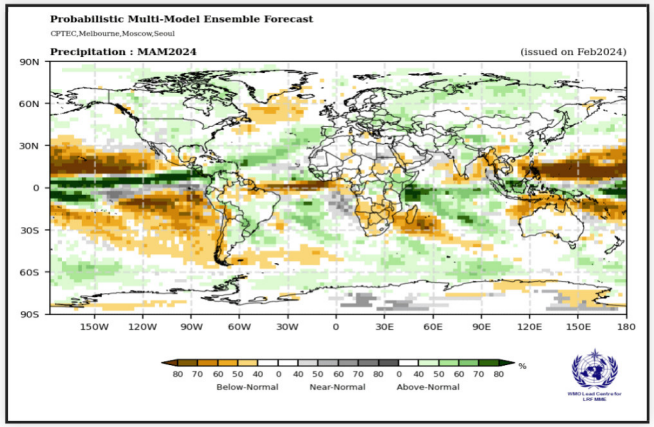
# Forecast of climatic parameters : Precipitation

The impacts of the El Nino phase are becoming less visible.
In the Northern Hemisphere, signals are fairly weak.



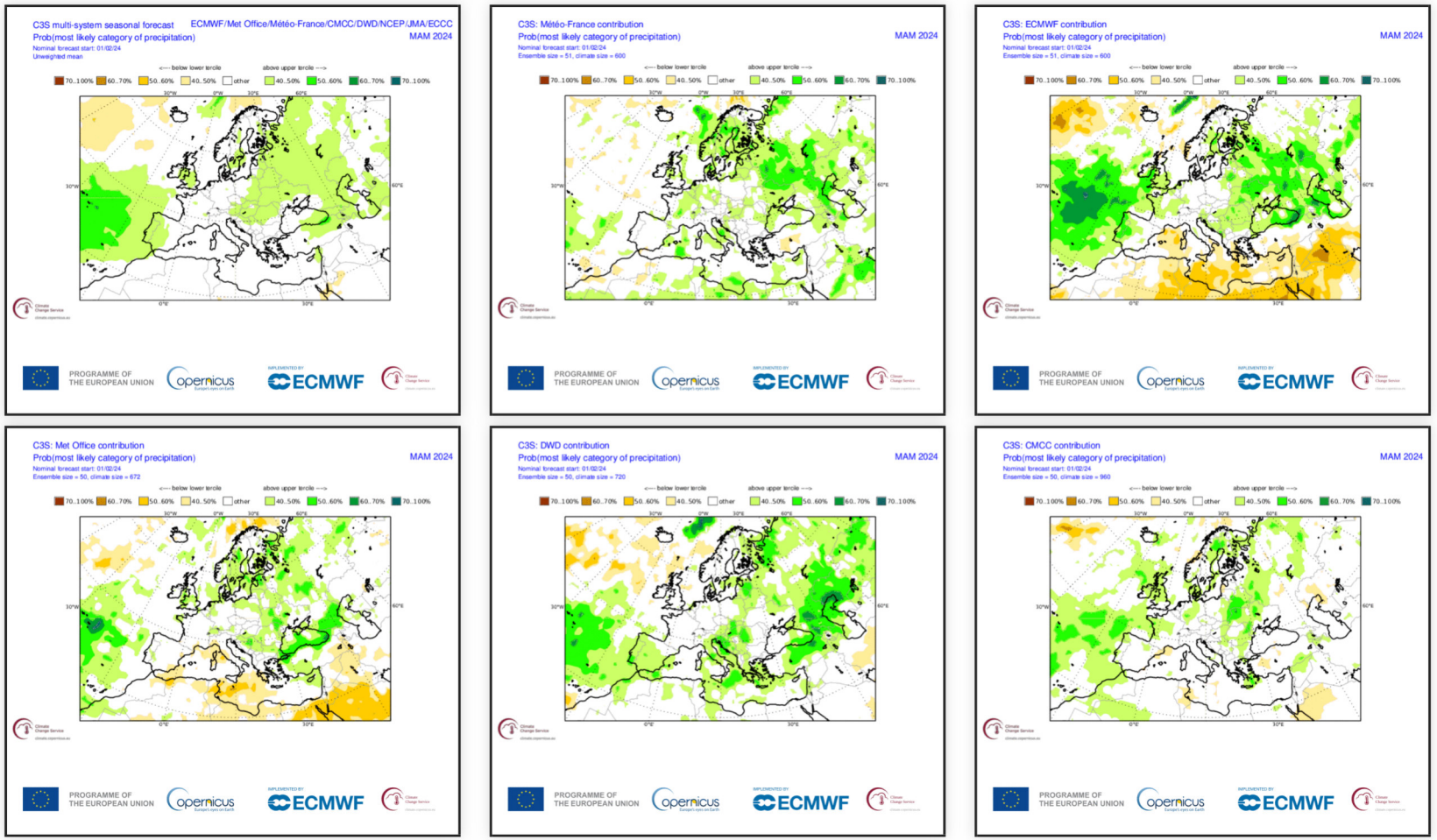




*precipitation probability map from MF-S8 (top left), ECMWF-SEAS5 (top right), C3S multi-models (bottom left) and others models of WMO multi-models (bottom right)*

# Forecast of climatic parameters : Precipitation probabilities over Europe in C3S models

Wetter-than-normal signals are predicted by each model, but depend on the atmospheric circulation adopted by each and thus on the position of the Z500 minima.

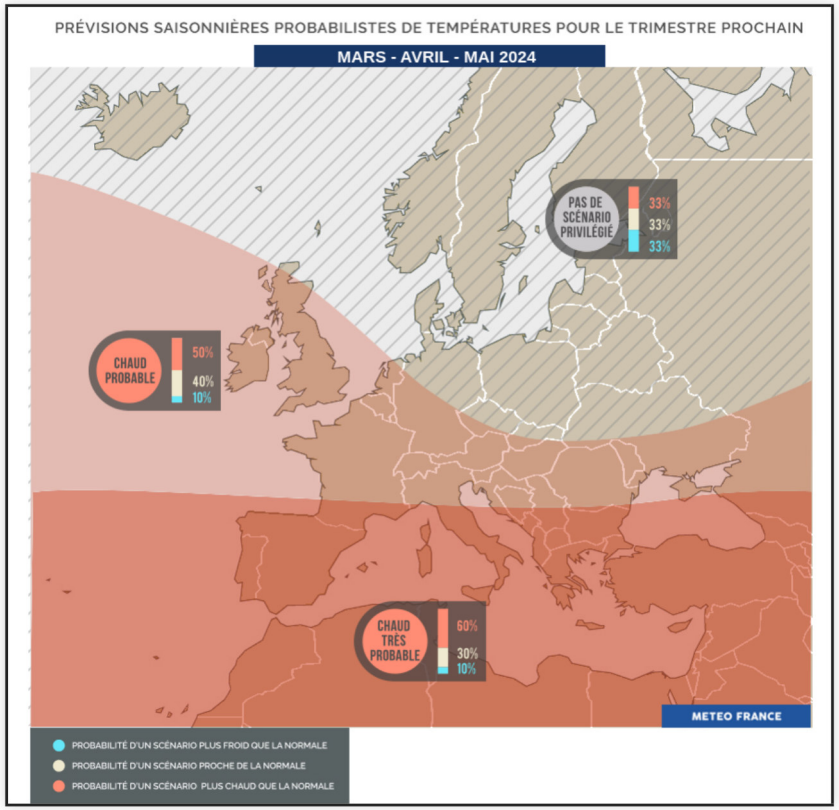



*C3S multi-models probability map (top left) and MF-S8, SEAS5, UKMO, DWD, CMCC models.*

# Synthesis map for Europe : Temperature

A warmer-than-normal scenario is favored from Western Europe (and France) to the Black Sea and Mediterranean Basin.

No scenario emerges elsewhere.

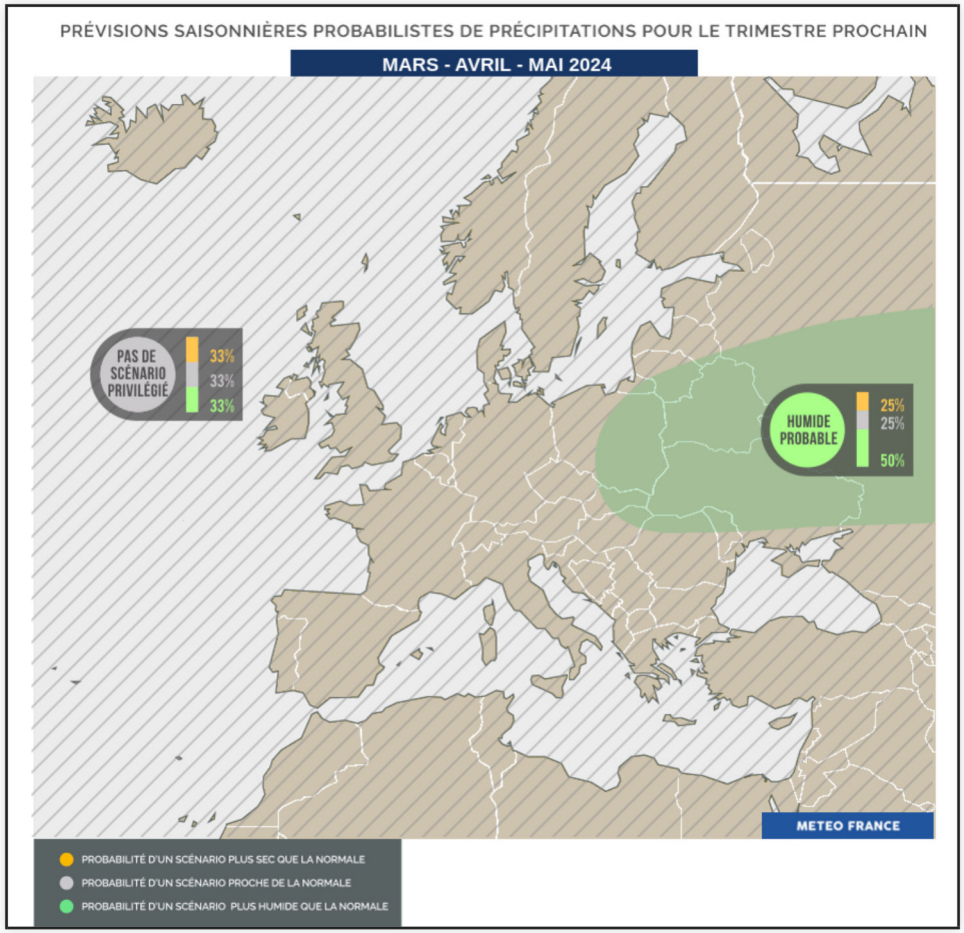



*Synthesis map of probabilistic forecast for Europe. (c) Météo-France/DCSC/ACS*

# Synthesis map for Europe : Precipitation

A wetter-than-normal scenario is favoured over Eastern Europe.

No scenario emerges elsewhere.




*Synthesis map of probabilistic forecast for Europe. (c) Météo-France/DCSC/ACS*