Météo-France Seasonal Forecast Bulletin

JANUARY - FEBRUARY - MARCH 2024

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General synthesis : JFM 2024

The "El Nino" phenomenon peaks at the beginning of the quarter before diminishing as the months go by. The positive phase of the IOD rapidly fades, returning to neutral at the end of the period.

A) Oceanic forecast :

- ENSO : El Niño conditions. NINO3.4 index peaks in January (close to 2 degrees), then declines.

- IOD : DMi index declines rapidly towards neutrality

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

B) Drivers :

Positive phase of ENSO.

End of the positive phase of IOD, although still influencing atmospheric circulation.

QBO easterly wind phase.

C) Atmospheric circulation :

In the intertropics, atmospheric circulation remains under the influence of ENSO and IOD, with a dipole (lift/subsidence) over the Indian Ocean, lift over the Pacific Ocean and subsidences over Brazil.
Teleconnections are visible towards North America in particular.
In the Northern Hemisphere, the EA+ mode remains in favor, as does the NAO- regime, on a quarterly scale.

D) Most likely conditions :

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

Precipitations : Scenario wetter than normal on large central part of Europe.

Next bulletin : scheduled on January 18th

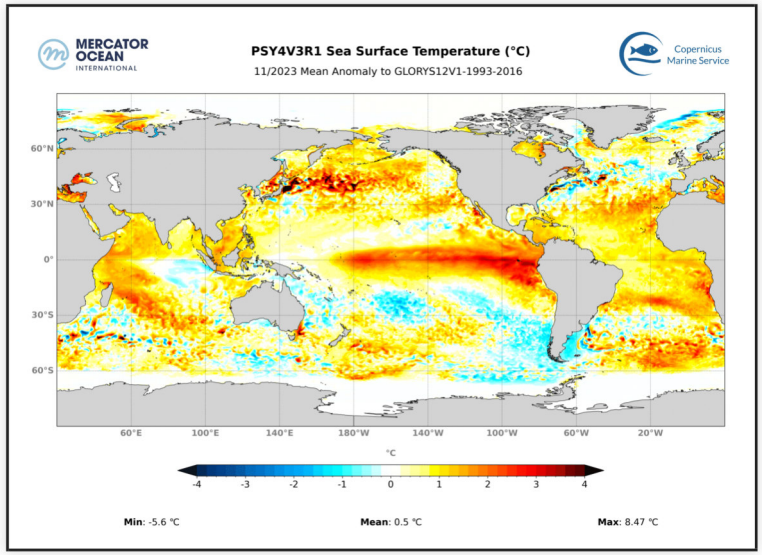
Oceanic analysis of November 2023 : SST anomalies

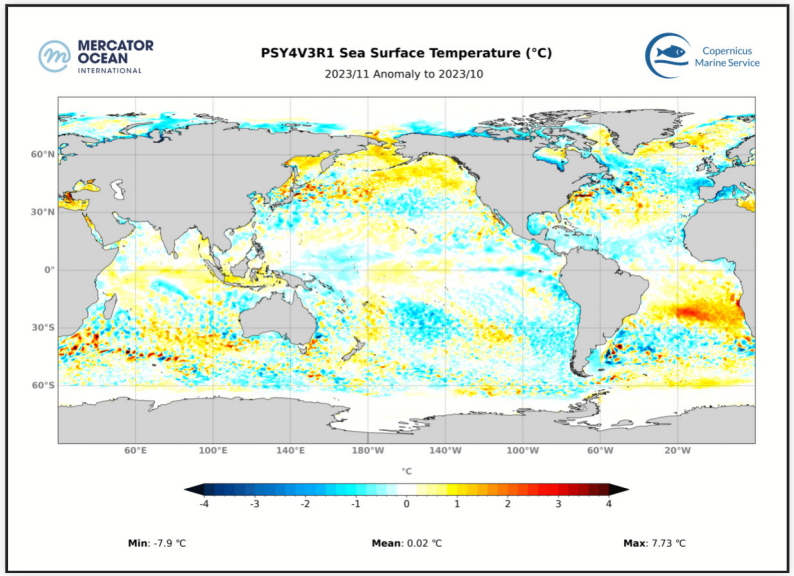
Current ENSO situation : positive phase

In the Pacific Ocean : In equatorial regions, the warm anomaly is moving slowly westwards (see trend map). In the Northern Hemisphere, the PDO- pattern is more attenuated.

In the Indian Ocean : The contrast between the west and east of the basin continues, with warmer conditions in the west and colder conditions in the east.

In the Atlantic Ocean : Overall, the basin remains warmer than normal. However, the warm anomaly is fading near Europe and remains stable at the equator.

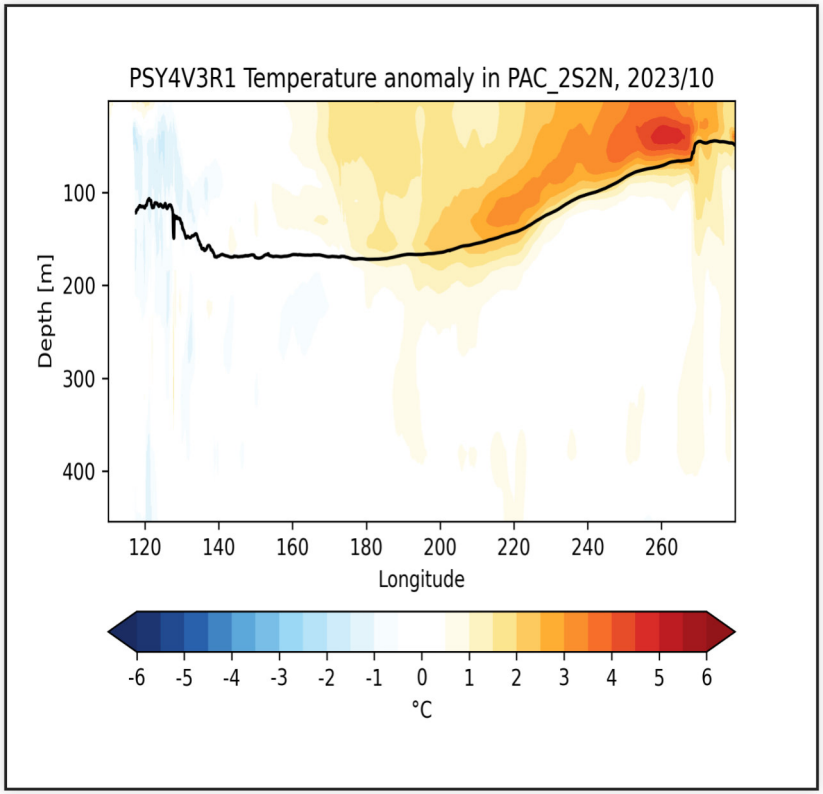


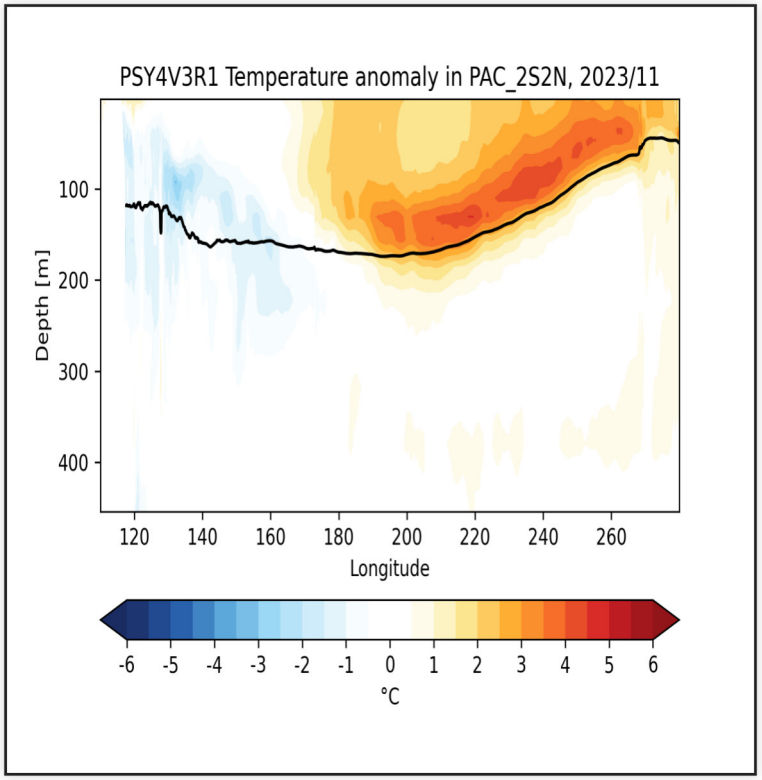


SST Anomalies and trend with the previous month (c) Mercator-Ocean

Oceanic analysis of November 2023 : Pacific vertical section

In the subsurface, the warm anomaly is gradually shifting westwards.

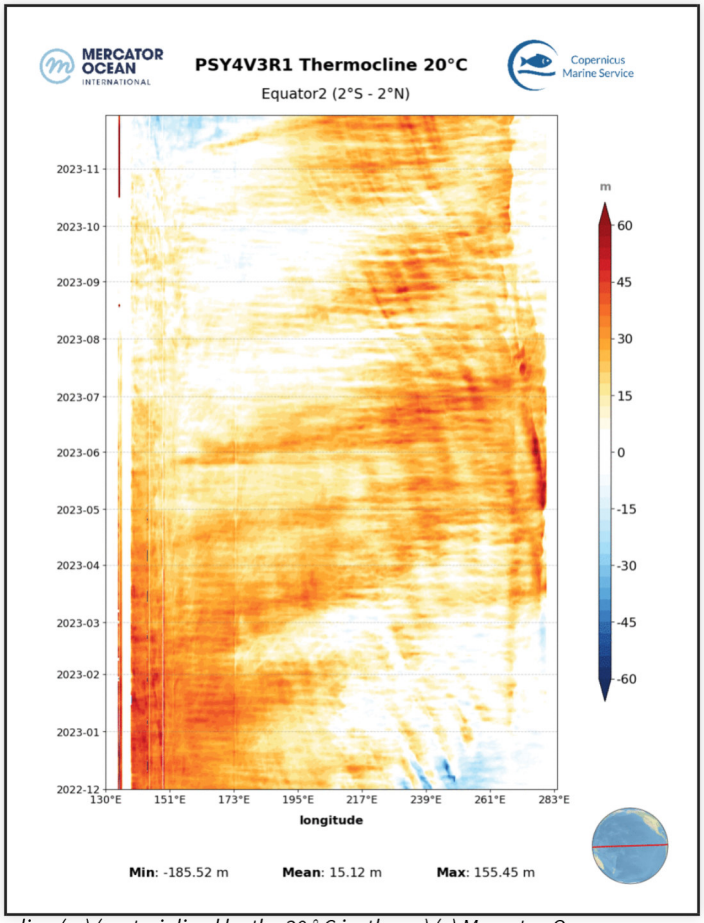




Ocean temperature anomalies in the first 500 meters of the equatorial Pacific basin, monthly average. (c) Mercator-Ocean

Oceanic analysis of November 2023 : Hovmüller diagram of the 20°C isotherm

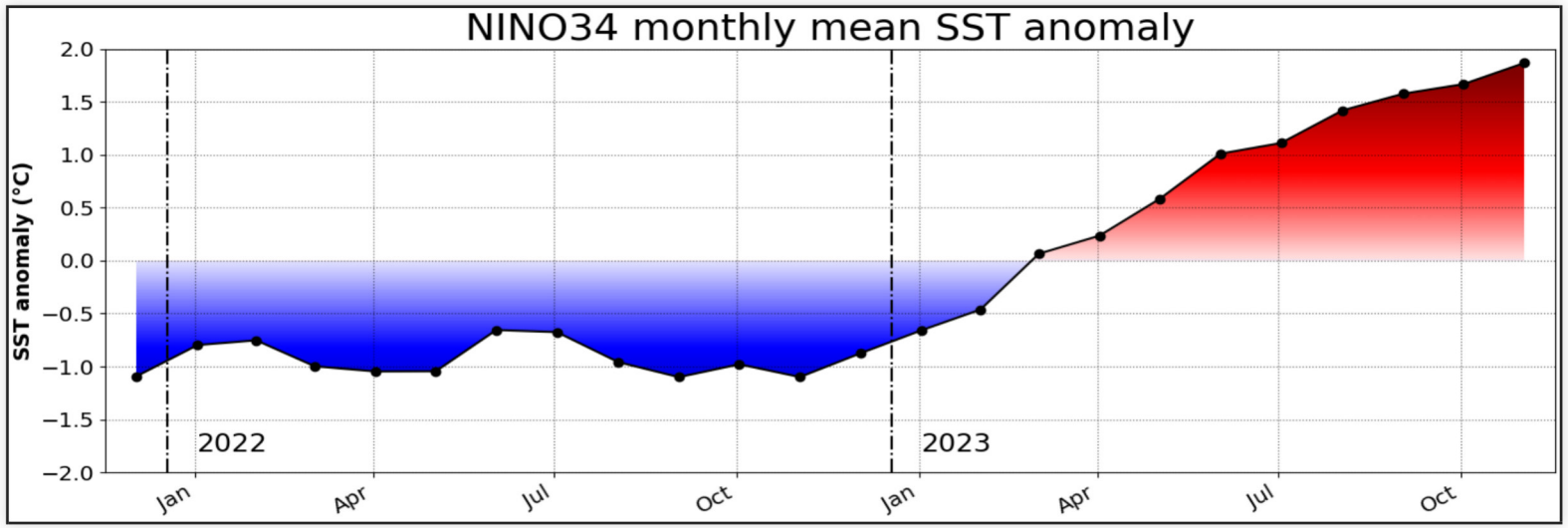
Little change in the thermocline.



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

Oceanic analysis of November 2023 : Pacific Ocean - Nino3.4 index history

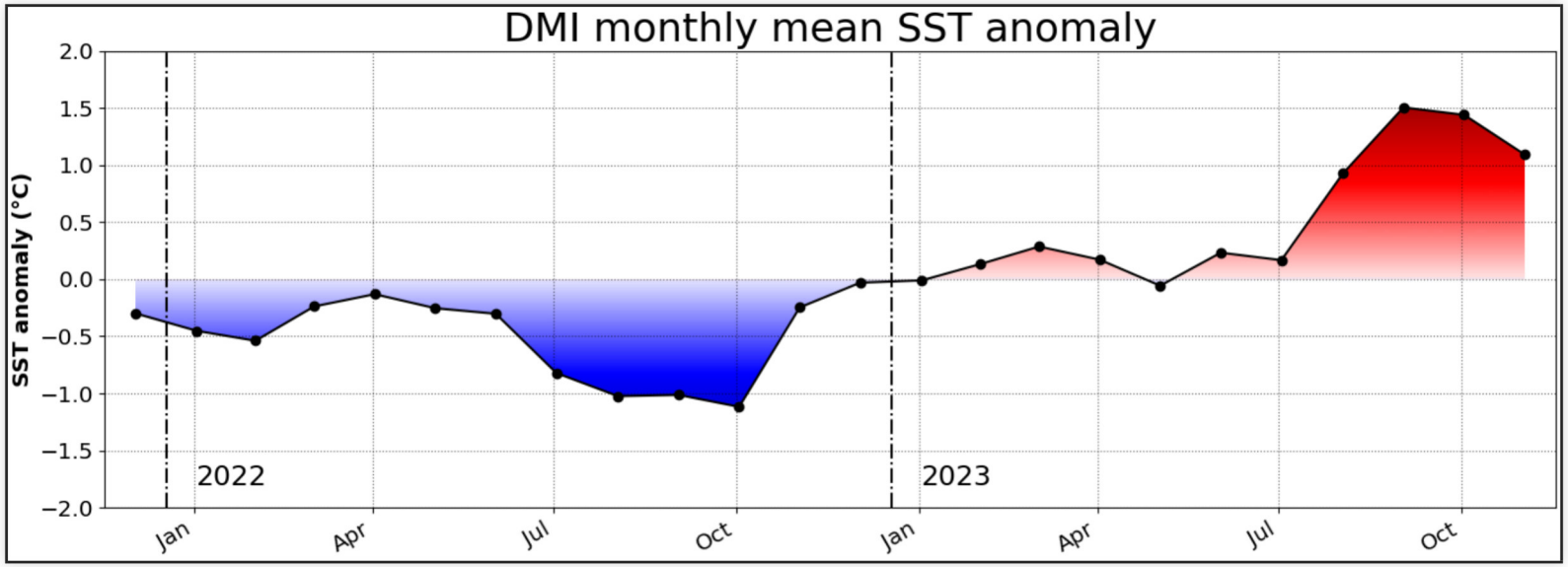
Nino3.4 index issued from Mercator Ocean PSYV4R2 analysis : above +1.9 °C
(see BOM site for weekly values : http://www.bom.gov.au/climate/enso/monitoring/nino3_4.png)



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

Oceanic analysis of November 2023 : Indien Ocean - DMI index history

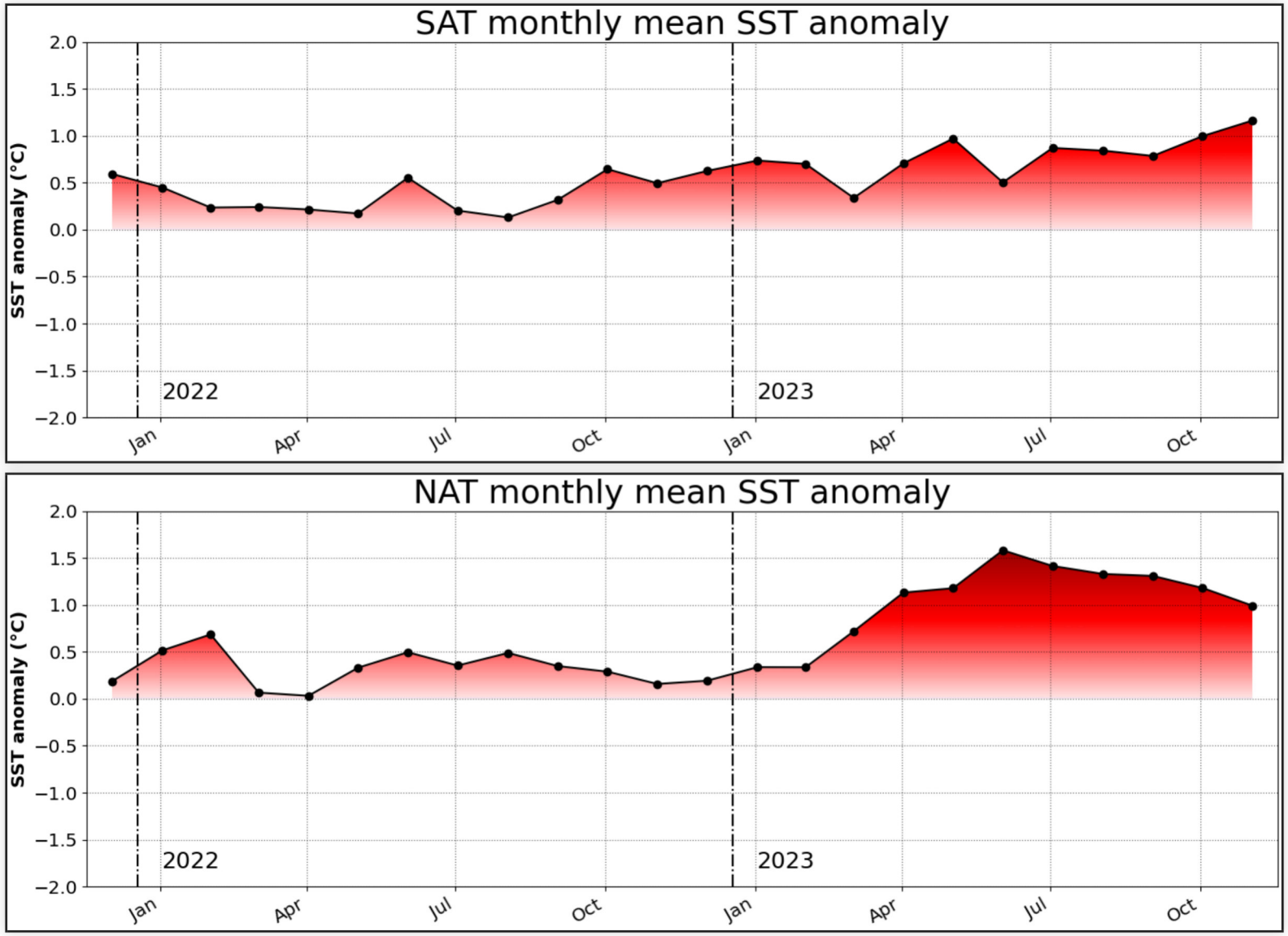
DMI Index issued from Mercator Ocean PSYV4R2 analysis : close to +1.1°C
(see BOM site for weekly values : http://www.bom.gov.au/climate/enso/monitoring/iod1.png)



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

Oceanic analysis of November 2023 : Atlantic Ocean : SAT and NAT index

The warm anomaly is slowly decreasing in the tropical zone, while remaining stable in the equatorial region.



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

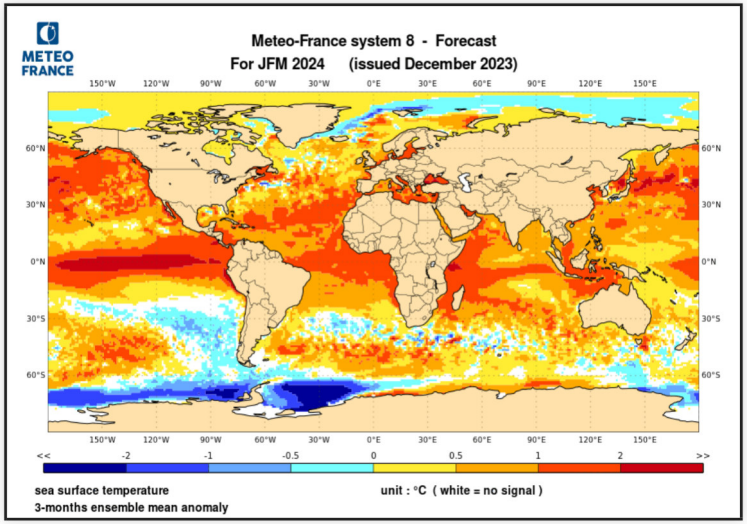
Oceanic forecast : SST anomaly

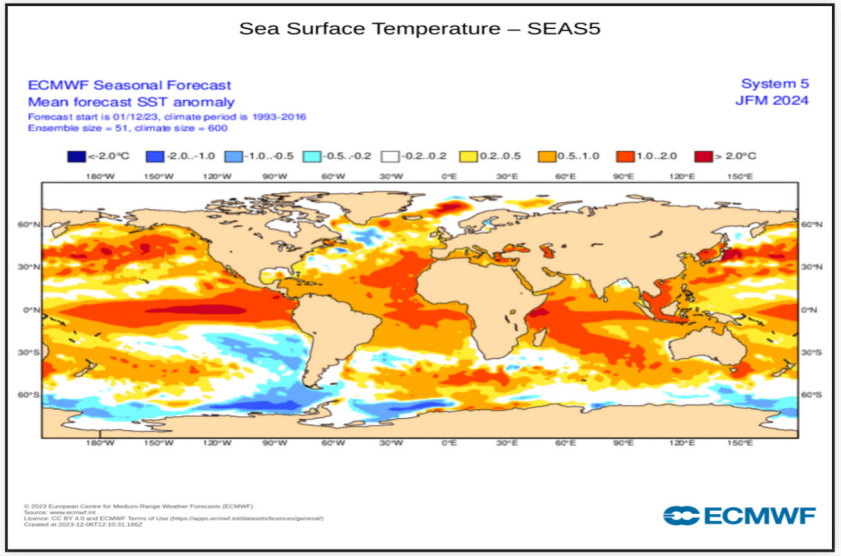
Both models agree on the main anomalies.

In the Pacific Ocean : In the equatorial zone, the warm anomaly continues its slow westward movement. In the Northern Hemisphere, the PDO- pattern is very attenuated with ECMWF and has even disappeared with MF-S8.

In the Indian Ocean : The cold anomaly in the east of the basin has disappeared, while the warm anomaly in the west persists.

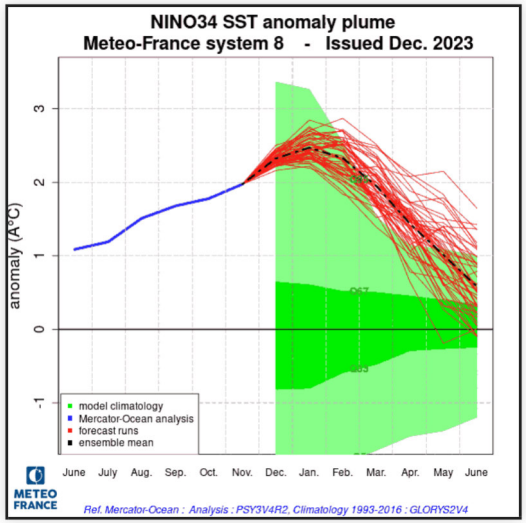
In the Atlantic Ocean : In equatorial and tropical zones, the two models are very close. This is less true in the northern hemisphere.

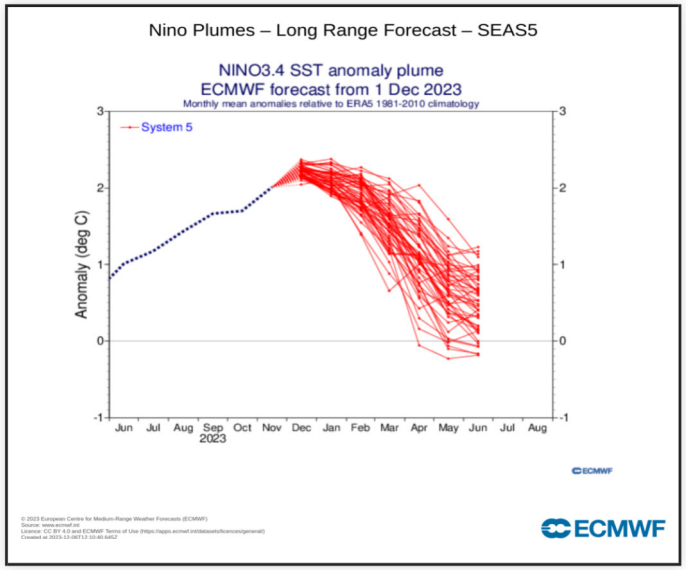




Oceanic forecast : NINO3.4 Plume diagrams

For both models, the index peaks at the very beginning of the period before decreasing rapidly.

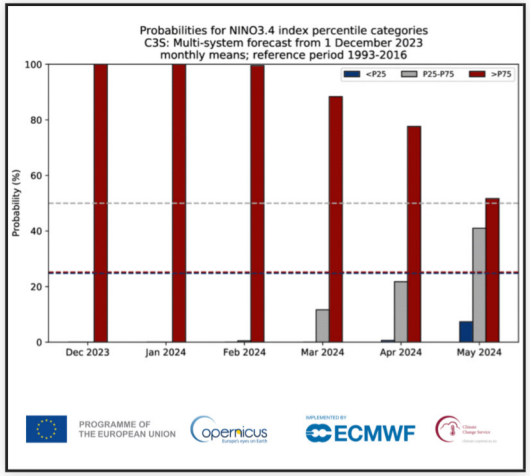


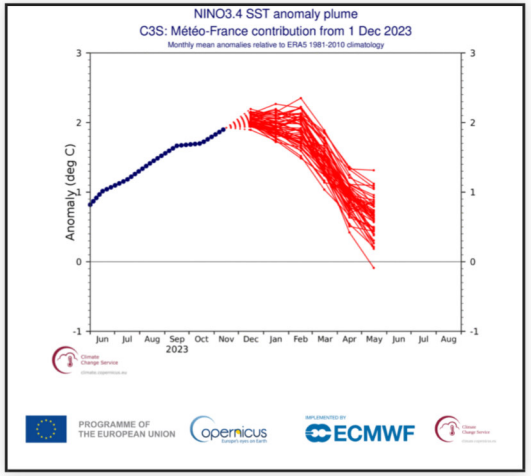


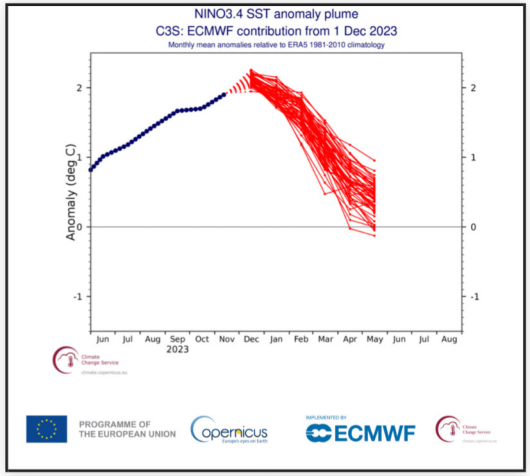
Oceanic forecast : C3S Nino3.4 re-scaled plume diagrams

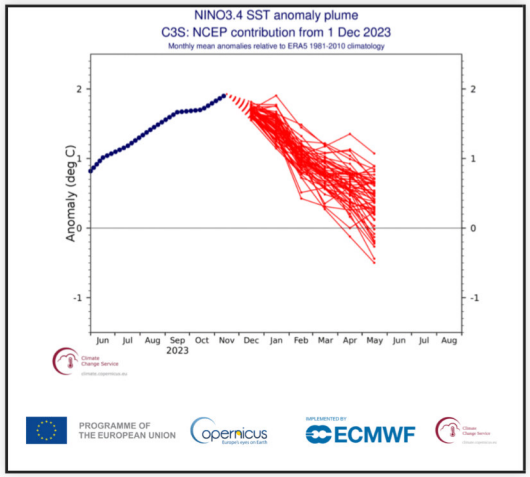
With the exception of the colder NCEP model, all the other models agree that the Nino3.4 index will peak in January, at around +2°C.

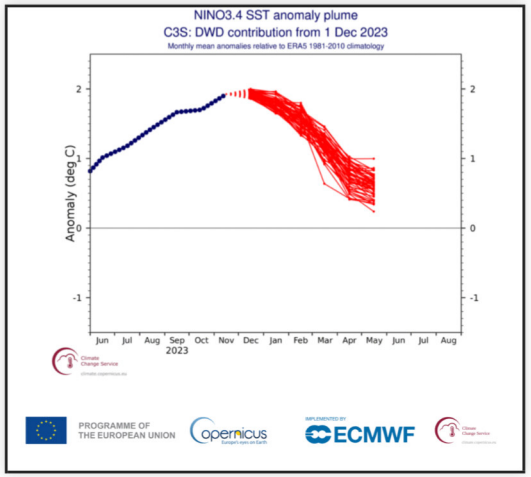
The most likely phase for the next three months : Positive phase

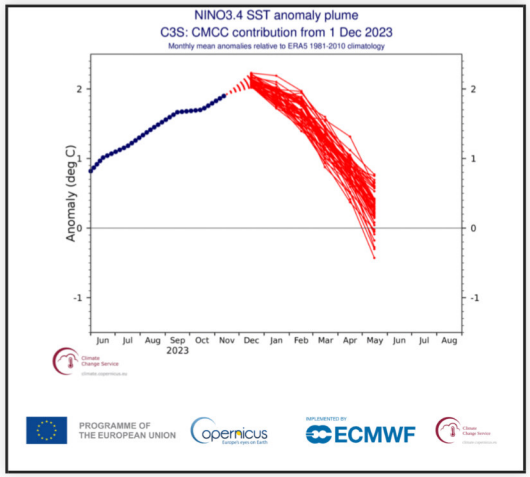








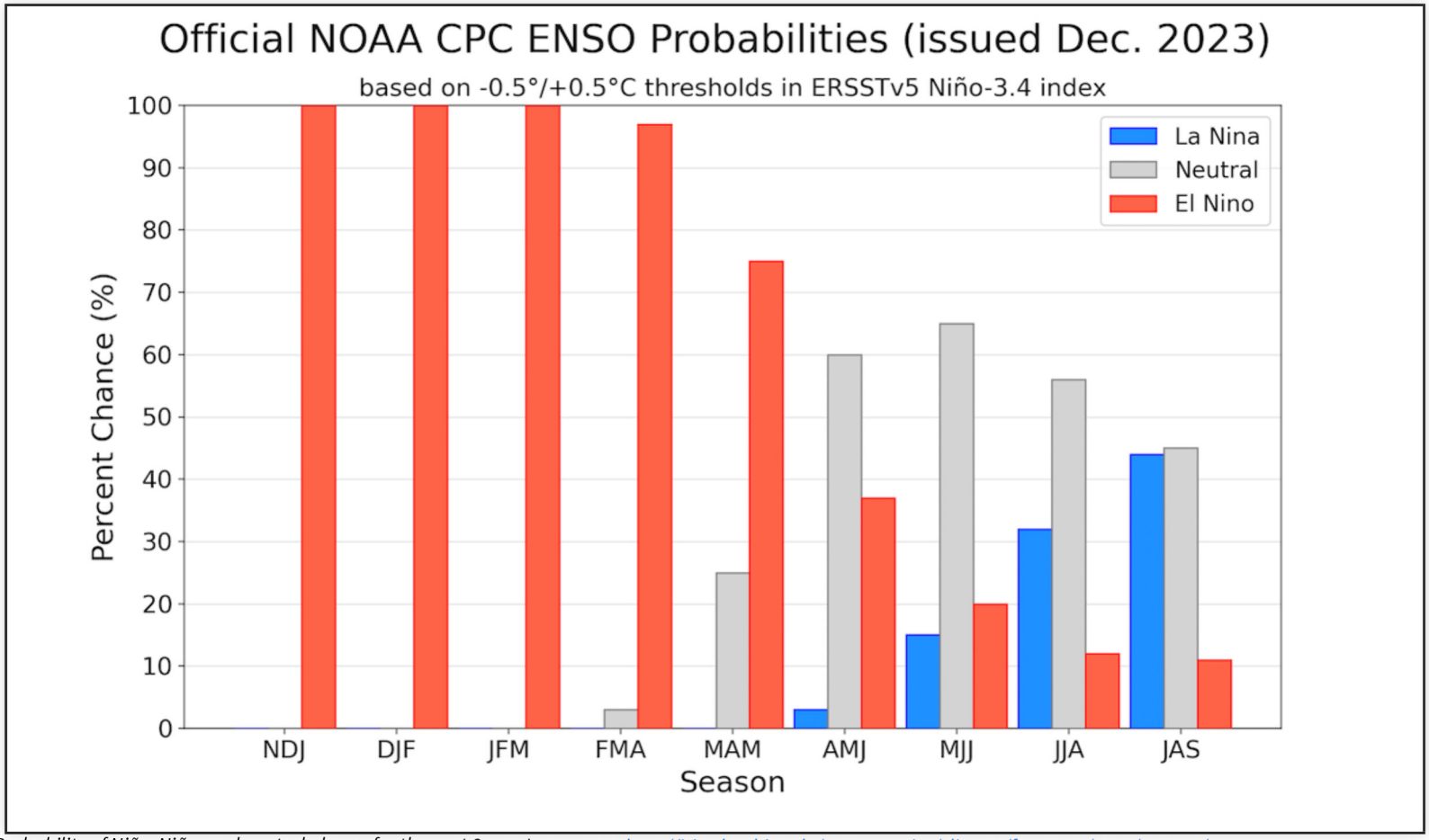




C3S multi-system probabilty forecast (top left figure) and C3S plume diagrams re-scaled from the variance of observations for the period 1981-2010.

Oceanic forecast : Synthesis from IRI

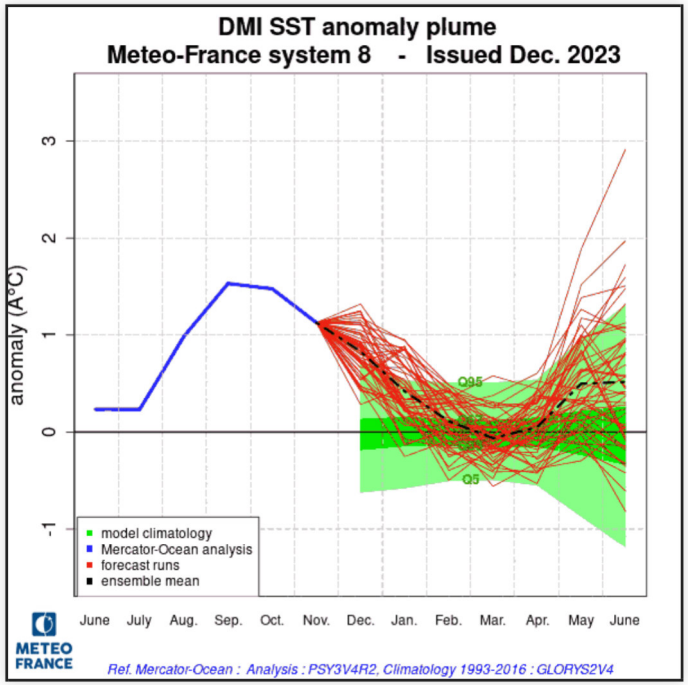
IRI forecast : 100% probability of El Niño conditions for JFM.

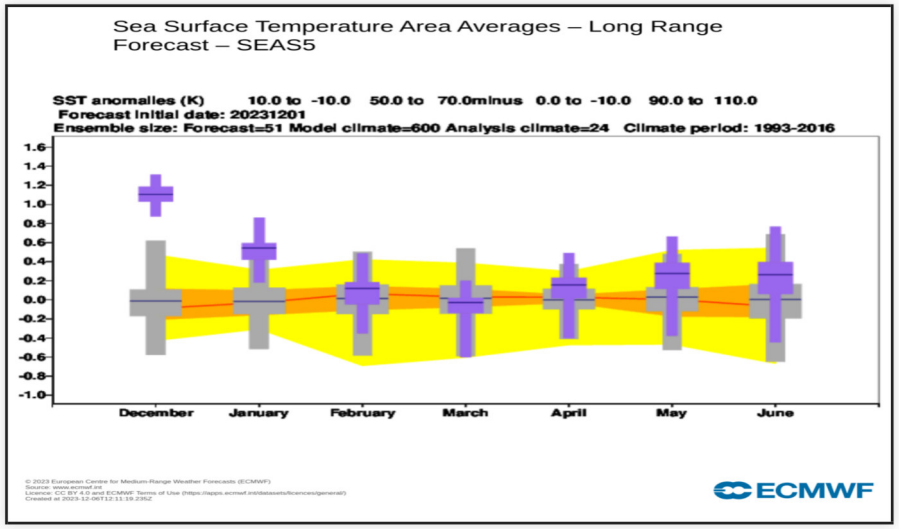


Probability of Niño, Niña, and neutral phases for the next 8 quarters. source http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/

Oceanic forecast : Indian ocean - DMI evolution

The DMI index fell rapidly, returning to normal values at the end of the quarter.

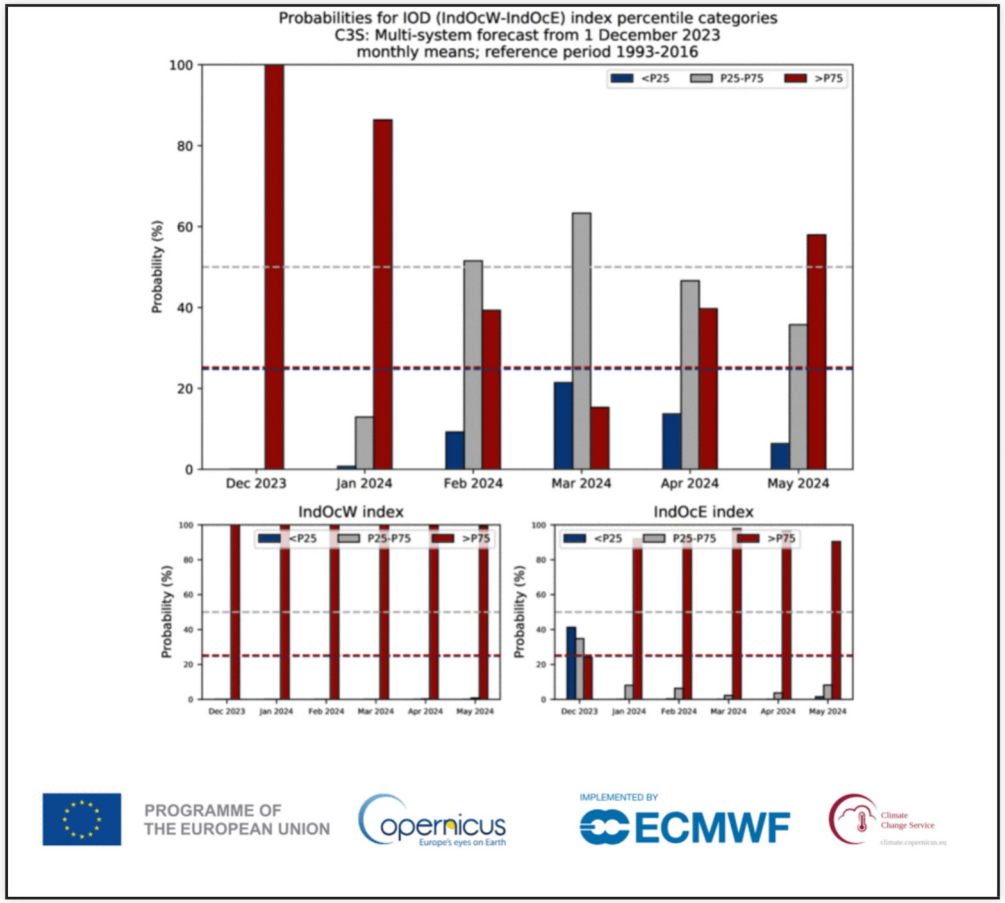




DMI index : analysis, forecasts and model climatology with MF-S8 on the left and ECM-SEAS5 on the right

Oceanic forecast : C3S IOD re-scaled plume diagrams

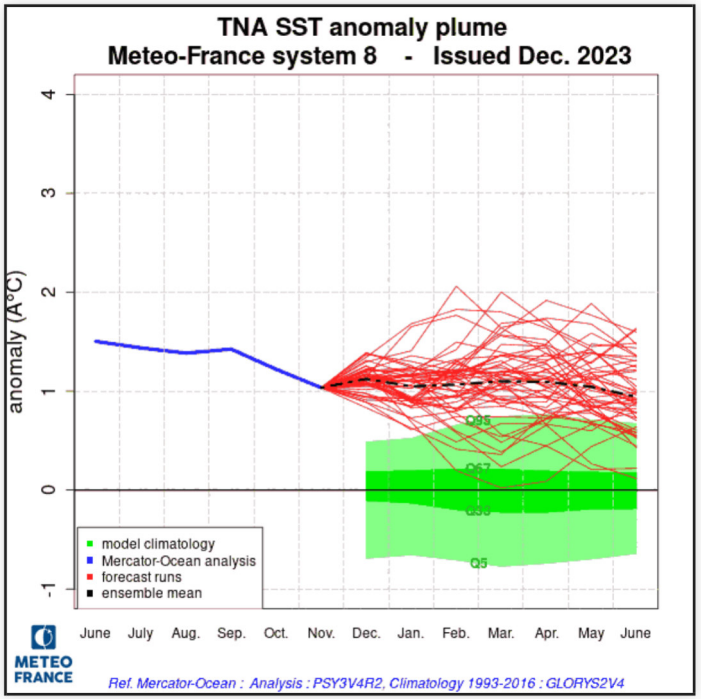
Expected Phase for the next three months : the positive phase is the most likely.

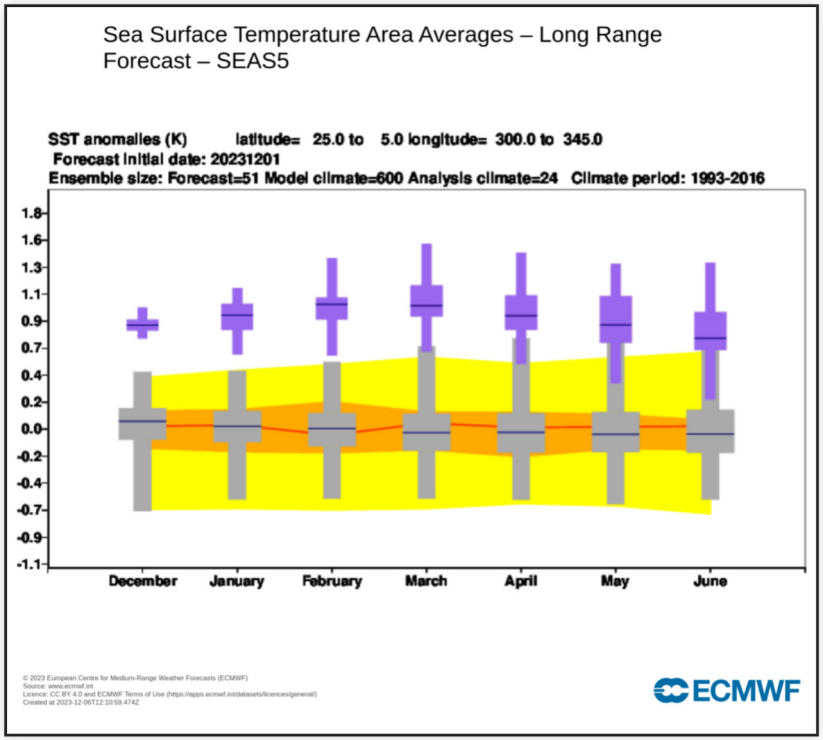


C3S multi-system probabilty forecast for IOD , west box and east box Index

Oceanic forecast : Atlantic ocean - TNA evolution

The warm anomaly in the TNA index remains particularly strong for the months ahead.



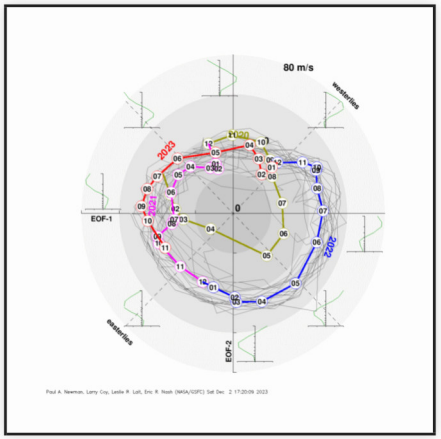


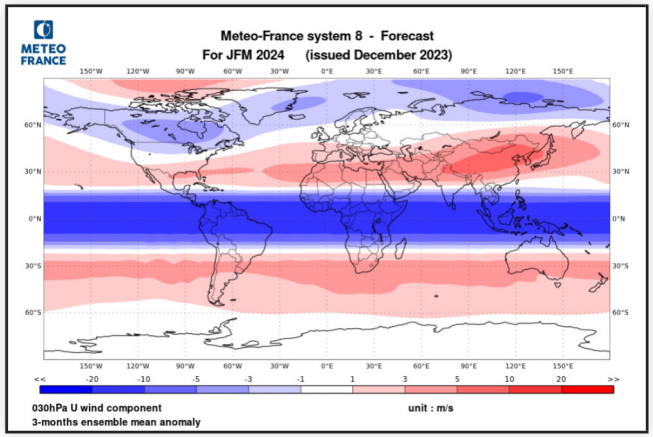
TNA index : analysis, forecasts and model climatology with MF-S8 on the left and ECM-SEAS5 on the right

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).

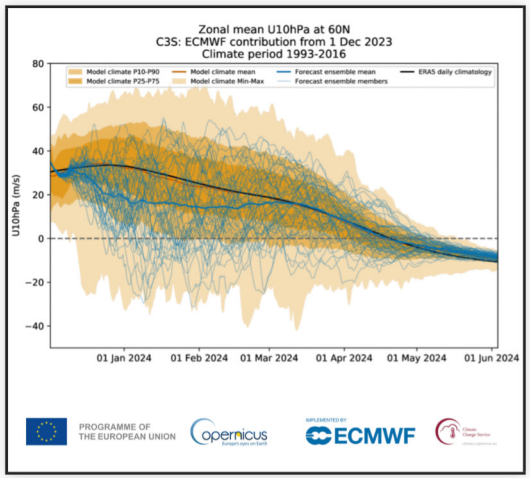


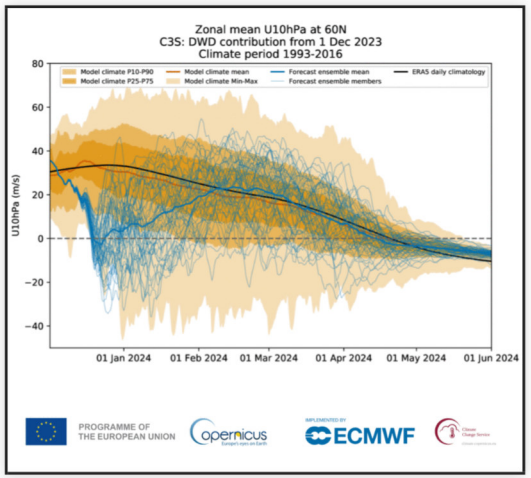


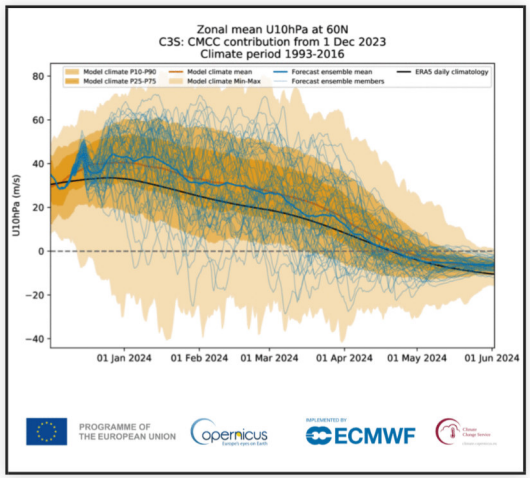
The EOFs of the 1980-present QBO, NASA/ACD (left figure) and MF8 forecast of U30 (right figure)

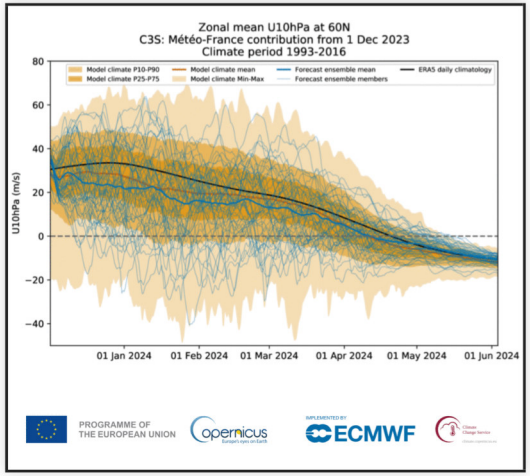
Drivers : polar vortex (U010 plumes)

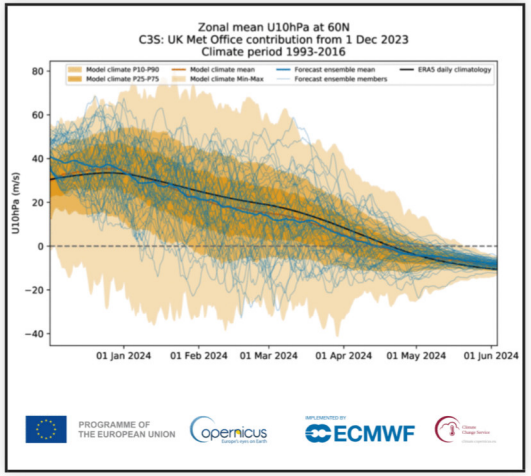
Four of the six models (including MF-S8) predict a vortex close to climatology.
But two models (ECMWF and DWD) predict a weakening of the polar vortex at the start of the period, increasing the probability of SSW.

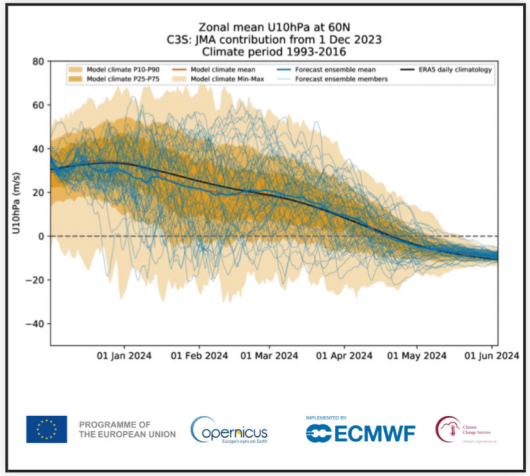










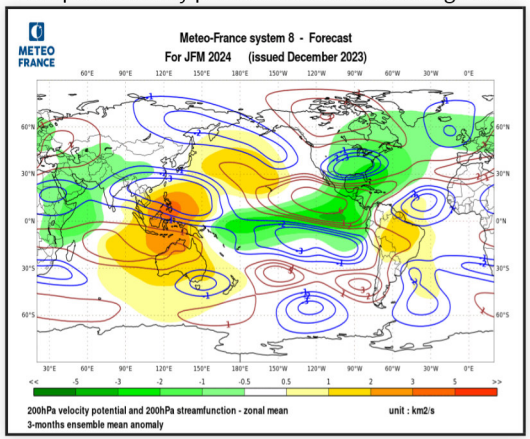


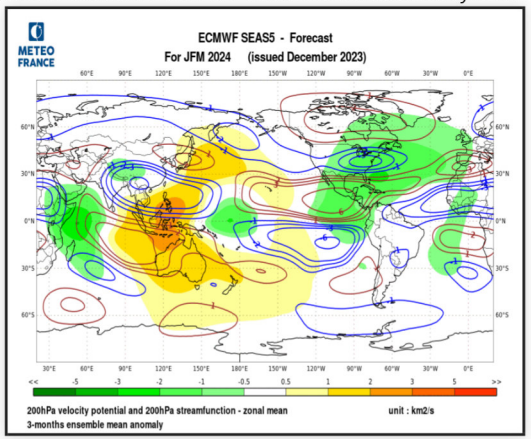
ECMWF-SEAS5, DWD, CMCC, MF-S8, UKMO, and JMA 010hPa zonal mean of u componant of wind at 60°N.

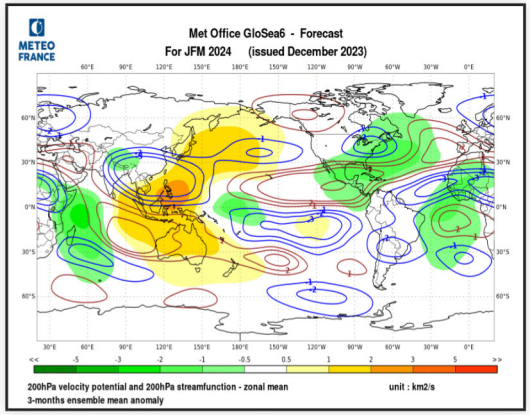
Atmospheric circulation forecasts : velocity potentiel and stream function at 200hPa

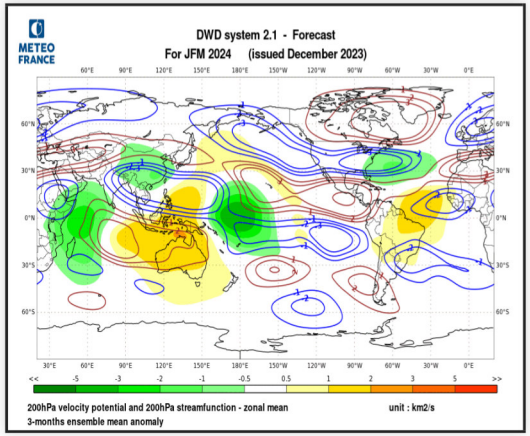
Velocity Potential : All models forecast a dipole over the Indian Ocean (lift anomaly over the Horn of Africa and strong subsidence anomaly over the Maritime Continent and Australia, extending northwards towards the Bering Strait), with more or less marked lift anomalies visible over the Pacific Ocean.

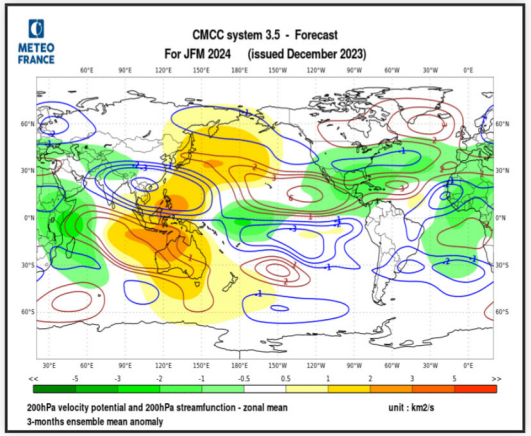
Streamfunctions : Dipoles in the Indian and Pacific basins are highly visible. The Atlantic dipole is not seen by some models. Teleconnections to North America and Europe are clearly present. All models envisage an anticyclonic curvature over the Mediterranean and a cyclonic curvature further north.

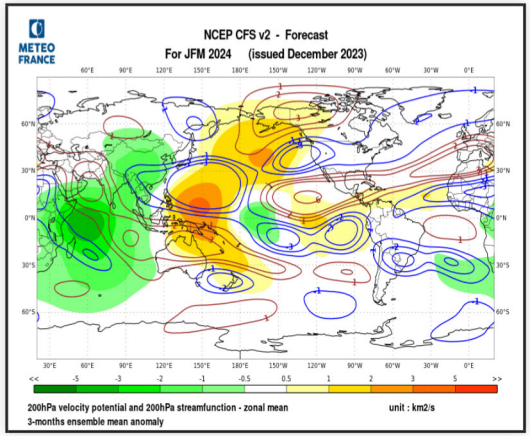








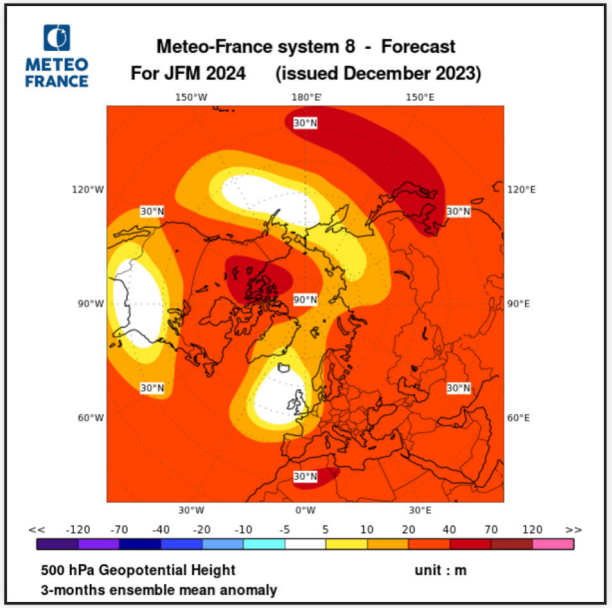


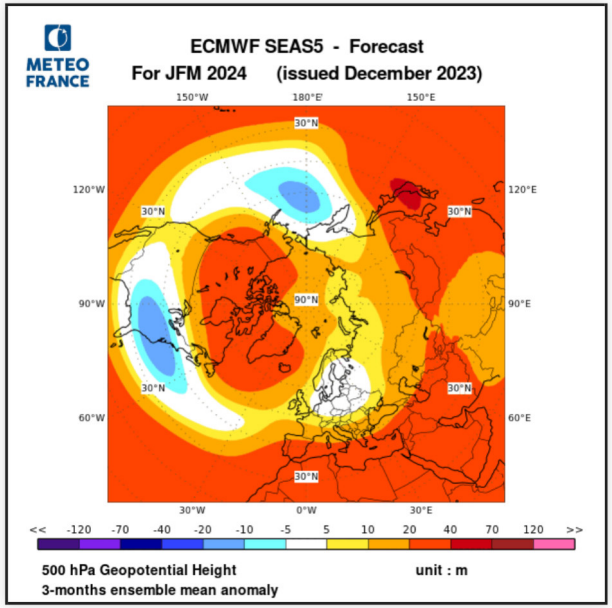


MF8,SEAS5, UKMO, DWD, CMCC and NCEP 200hPa velocity potential anomalies (color range, green : ascending, orange: subsidence) and stream function anomalies (isolines, red: anticyclonic in the northern hemisphere, blue: cyclonic in the northern hemisphere).

Atmospheric circulation forecasts : 500 hPa Geopotential anomalies

Over North America, the two models are fairly similar, with a PNA+ pattern and a negative anomaly over the southern United States.
Near Europe, both models forecast a negative anomaly, but with a different location.

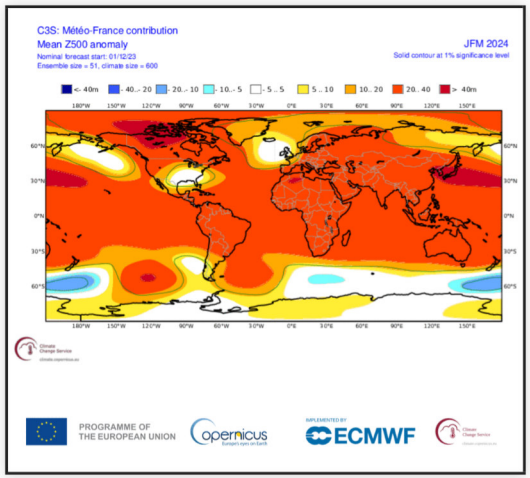


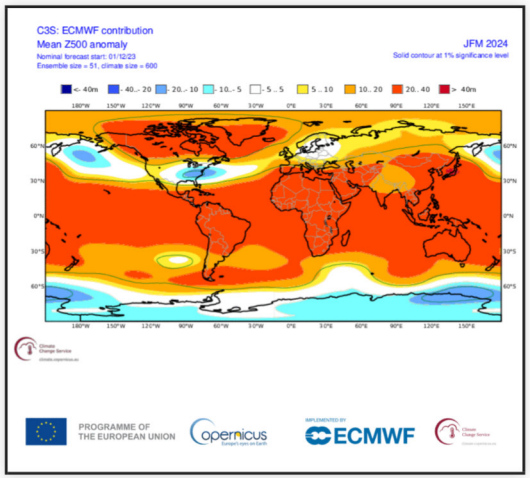


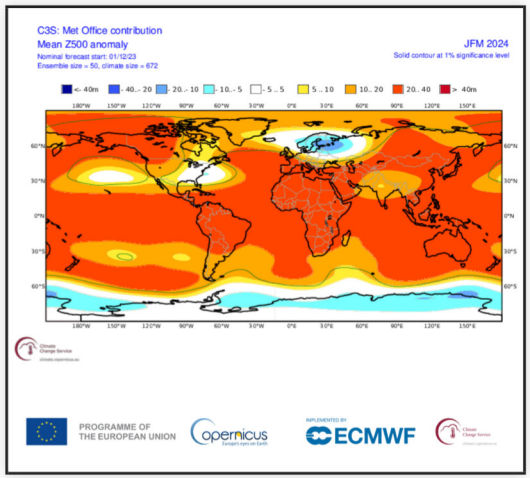
polar projection of MF8 and SEAS5 500hPa geopotential height anomalies.

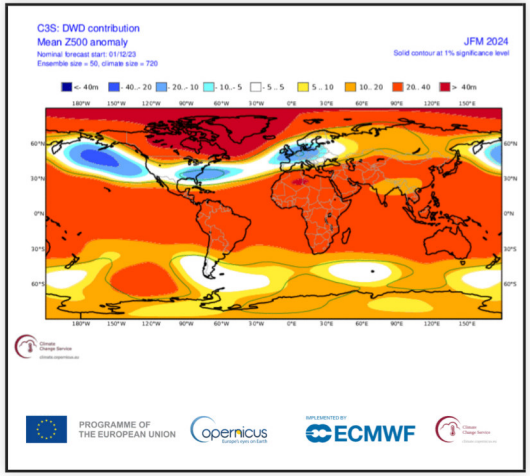
Atmospheric circulation forecasts : Z500 anomalies in C3S models

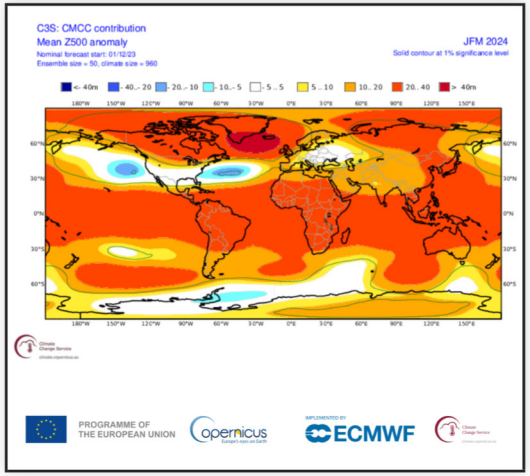
All models (except NCEP) forecast a positive Z500 anomaly from Canada to Greenland, and negative anomalies off Alaska (PNA+), over the southern USA and in the vicinity of Europe.

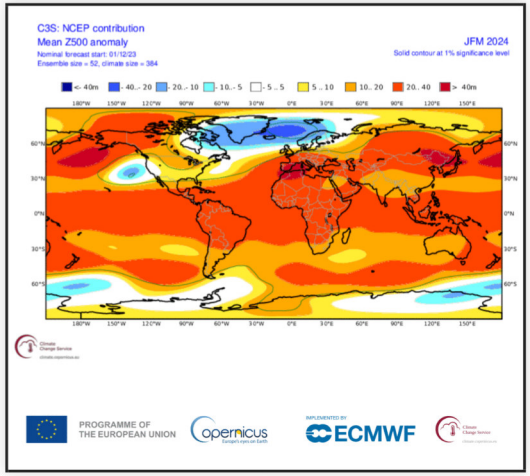








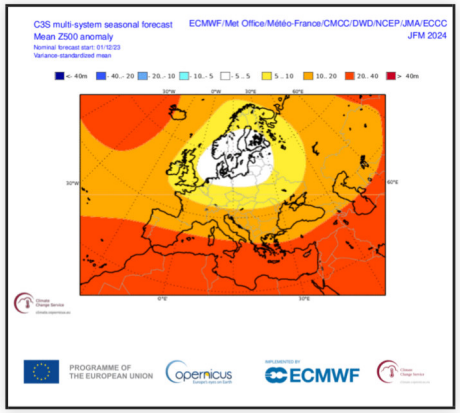


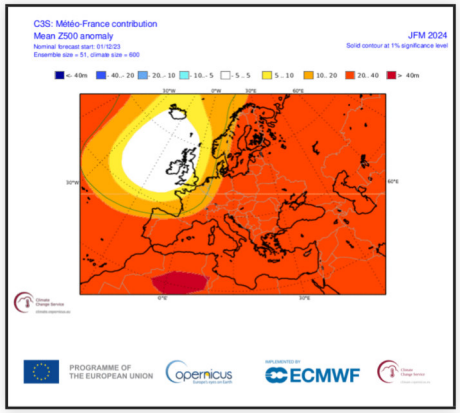


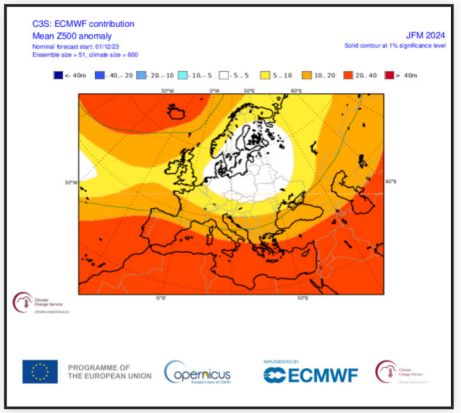
MF-S8, SEAS5, UKMO, DWD, CMCC and NCEP 500hPa geopotential height anomalies.

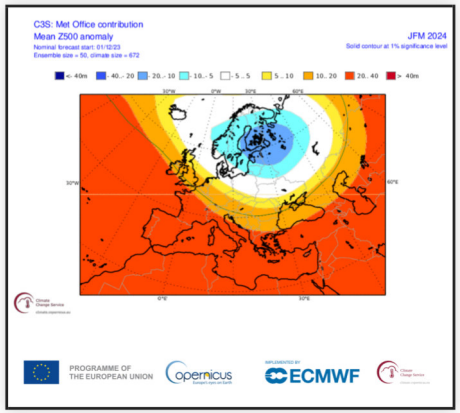
Atmospheric circulation forecasts : Z500 anomalies in C3S models

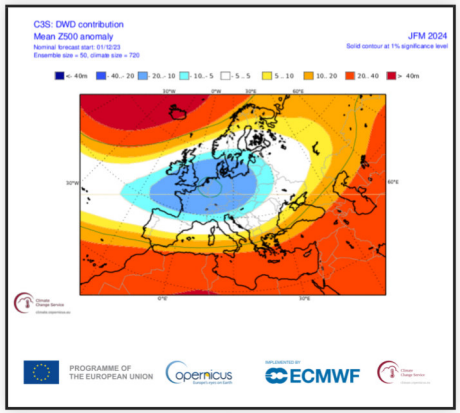
The negative anomaly in Z500 is predicted by all models, but its position varies from one model to another. For most of them, it is centered between the Benelux and Baltic countries (over Denmark for the multi-model). Only MF-S8 proposes an anomaly centered west of Ireland.

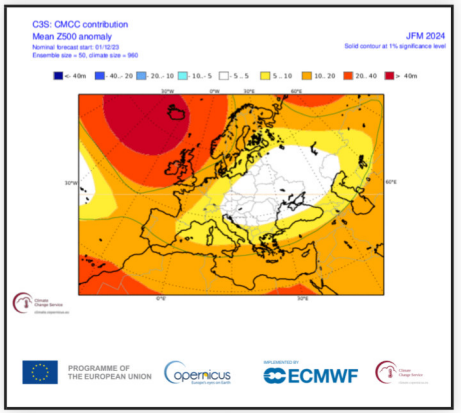


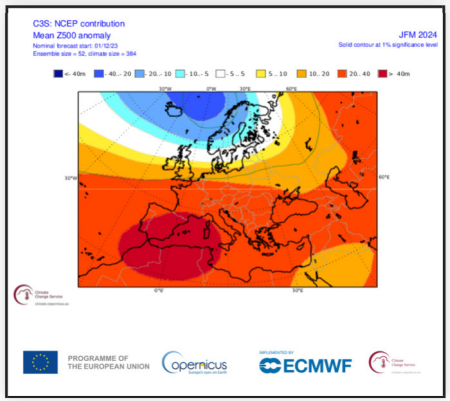


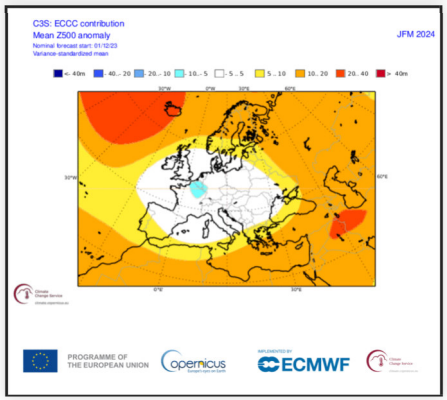


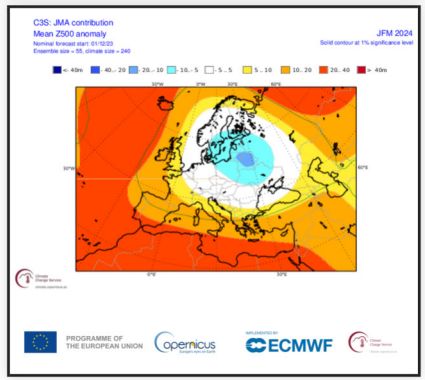








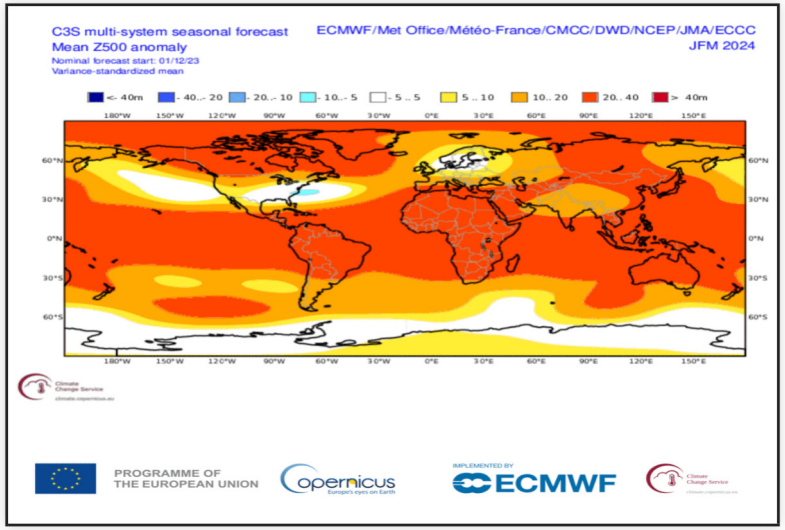




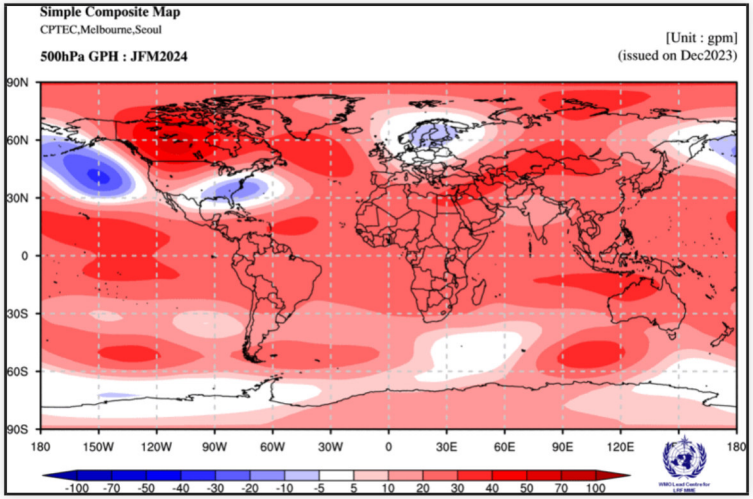
multi-models 500hPa geopotential height anomalies

Atmospheric circulation forecasts : Z500 anomalies multi-systems

The 500 hPa circulation proposed by the two multi-models follows the patterns of most of the individual models, with the exception of the NCEP and MF-S8 models.



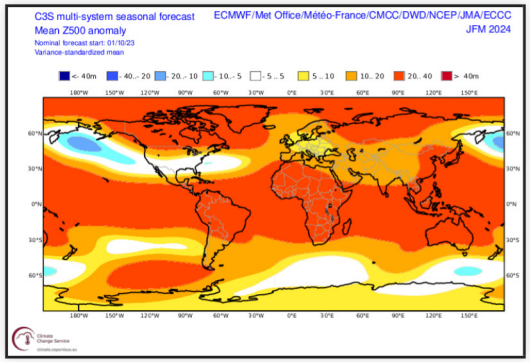
C3S multi-models (MF-S8, ECMWF-SEAS5, UKMO, DWD, CMCC, NCEP, JMA, ECCC) 500hPa geopotential height anomalies.

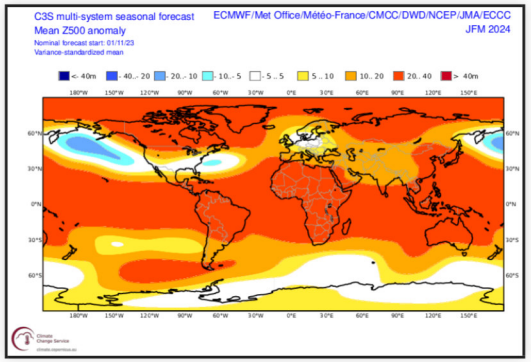


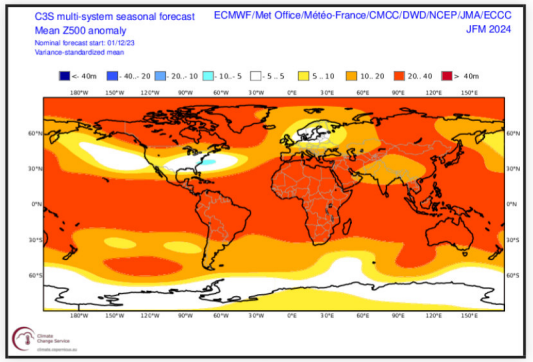
Others models of WMO multi-models 500hPa geopotential height anomalies.

Atmospheric circulation forecasts : Forecast stability

Good stability with the C3S multi-models, even over Europe.





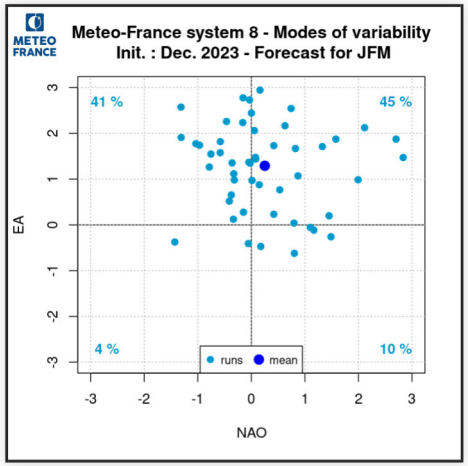


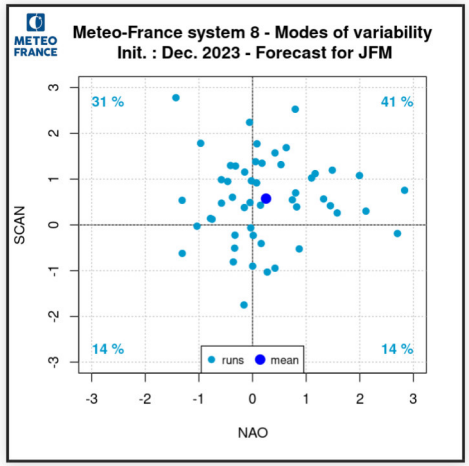
Successive forecasts of the C3S multi-model for the coming quarter

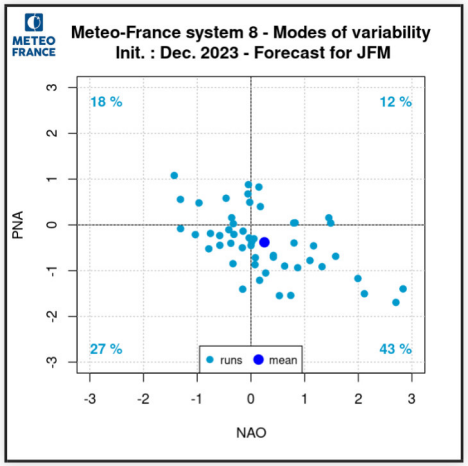
Modes of variability : forecast

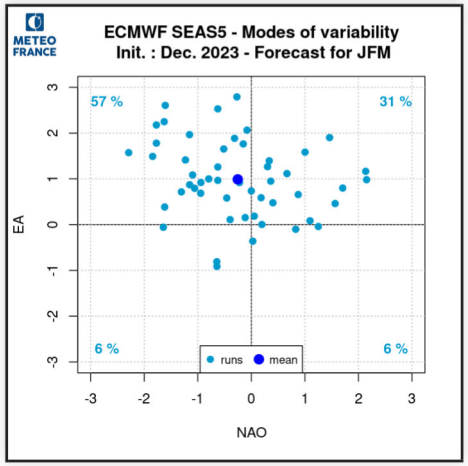
The EA+ mode is preferred by both models.

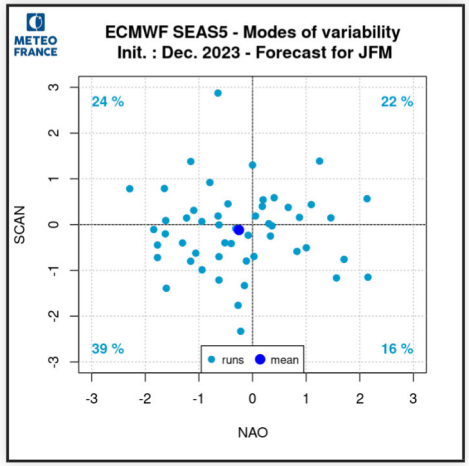
Signals are weak for all other modes. SCAN+ mode is favored by MF-8, while NAO+ and PNA- modes are close to neutrality.

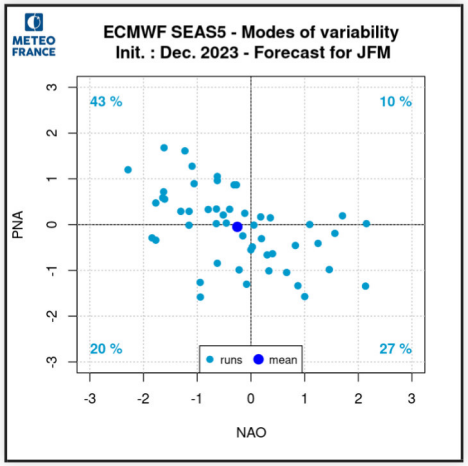








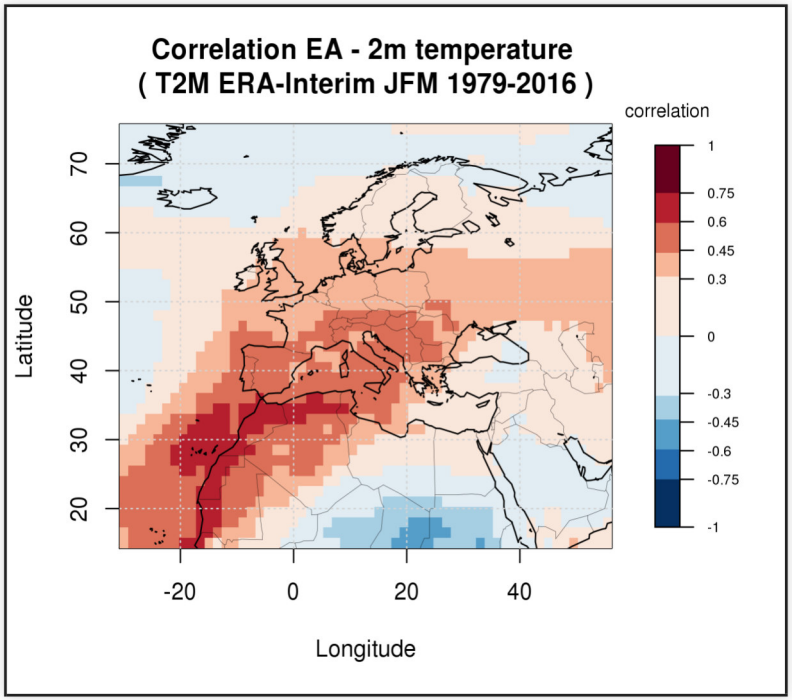


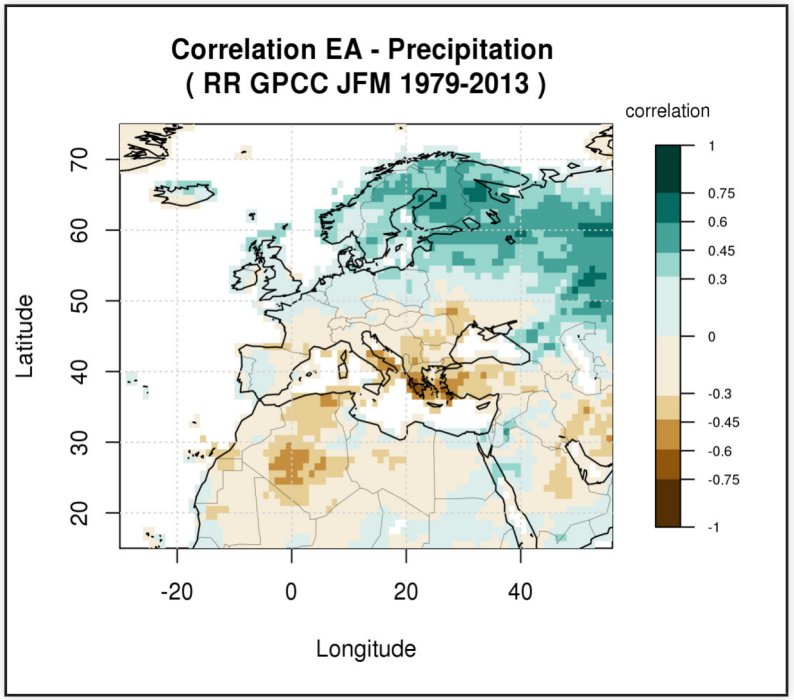


See the modes of variability patterns

Modes of variability : EA impacts

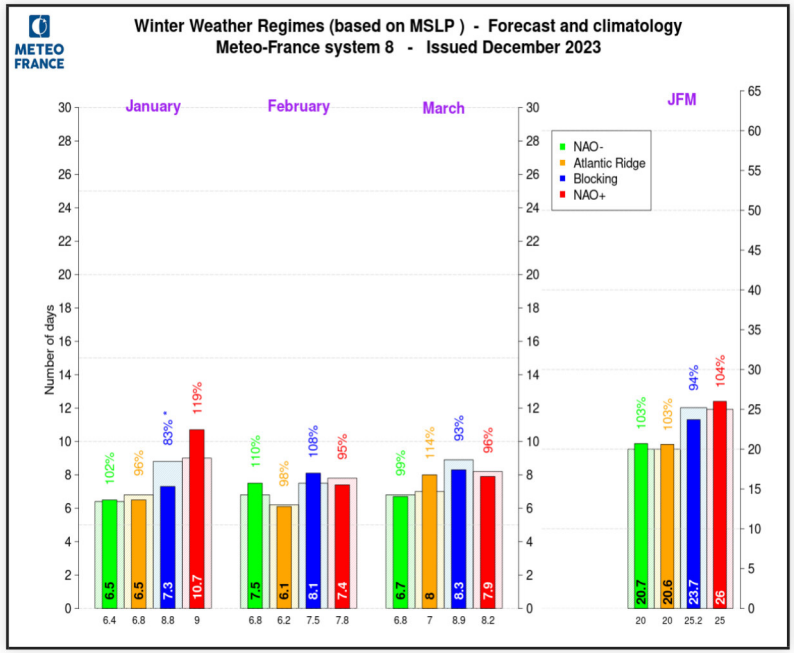
Positive EA is expected next quarter. This mode has a strong influence in particular on the temperature on the south-western Europe.

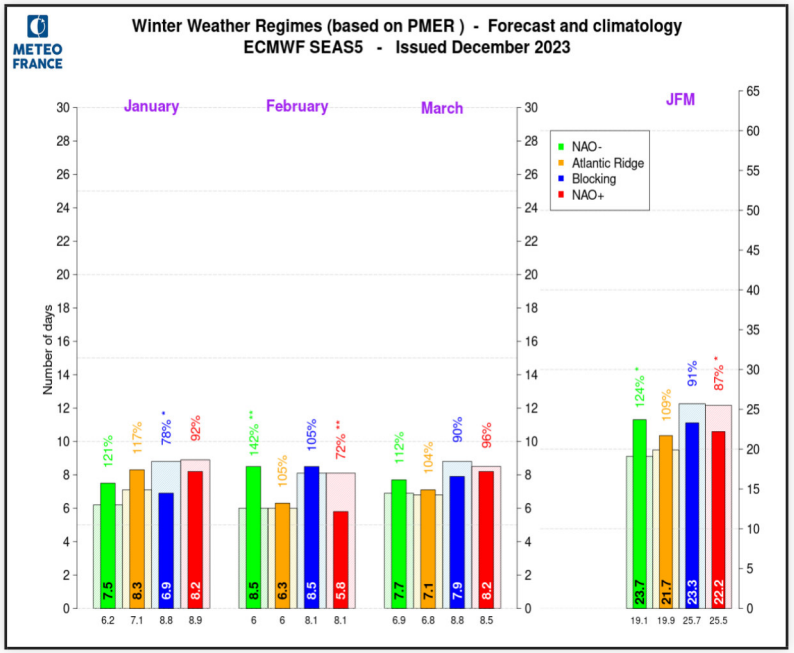




Weather regimes : winter MSLP

For MF-S8, the frequency of regimes over the quarter remains very close to its climatology, despite a January dominated by the NAO+ regime.
For ECMWF, the NAO- regime is significantly higher than its climatology, unlike the NAO+ regime.

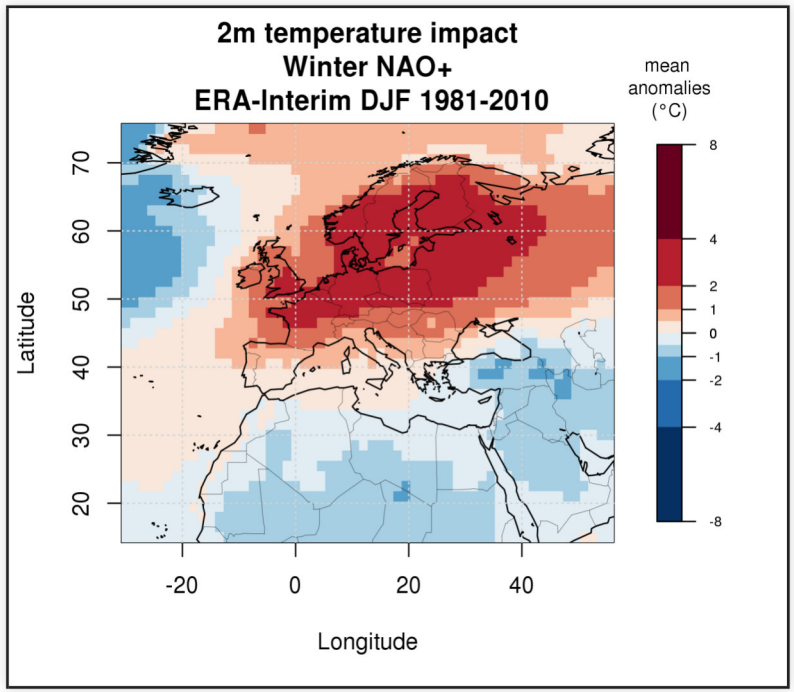


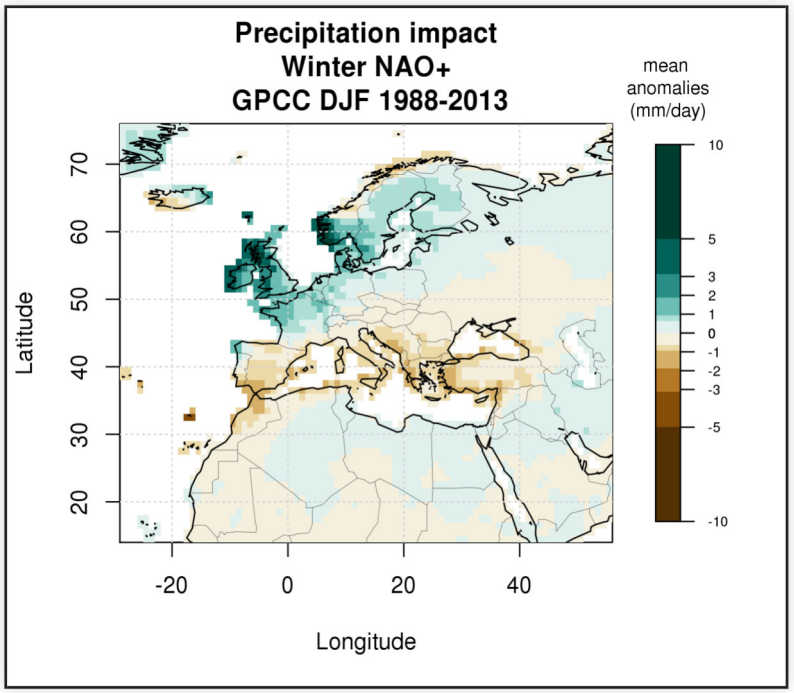


Frequency of SLP weather regimes, compared to model's own climatology, for the next three months and aggregation over the entire quarter, for MF-S8 (left) and SEAS5 (right).

Weather regimes : Impacts

The NAO+ weather regime is significantly lower than its climatology for MF-8, while the NAO- regime is more frequent than its climatology for ECMWF.

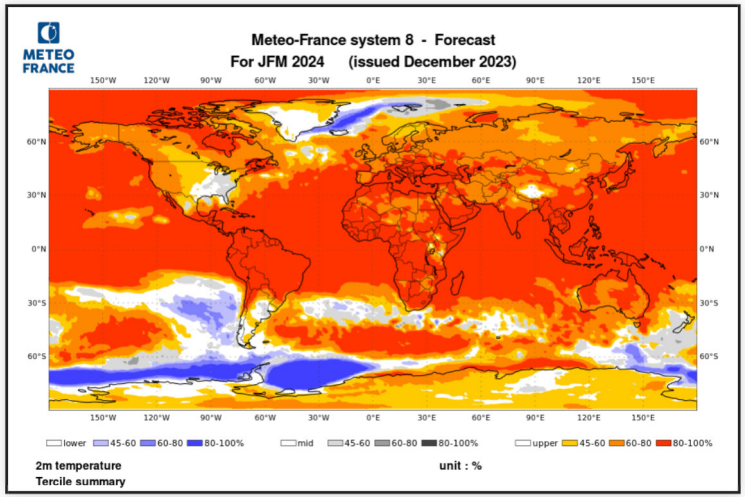


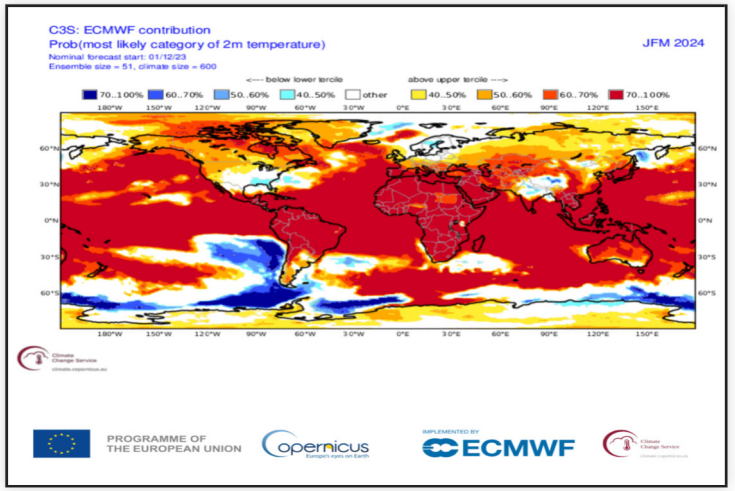


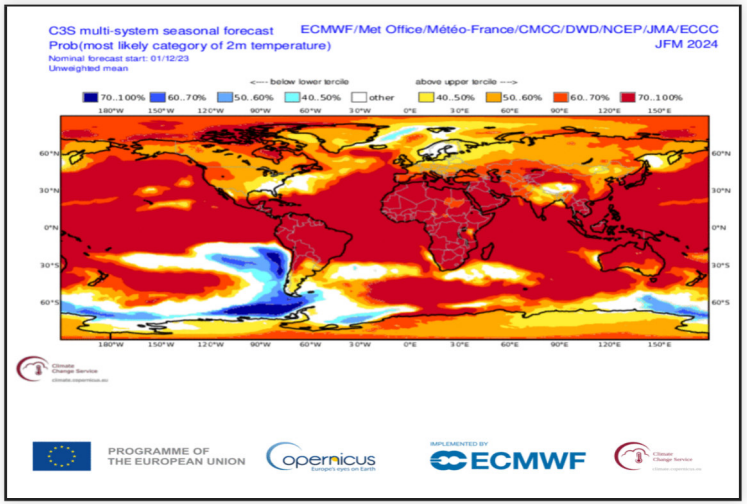
Impact of NAO weather regimes on temperature and precipitation. (ref ERA-interim 1981-2010)

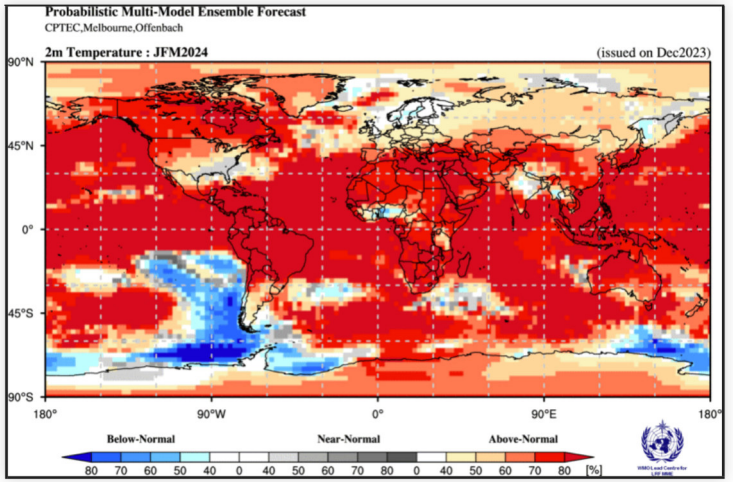
Forecast of climatic parameters : Temperature probabilities

Warmer-than-normal conditions are likely, even very likely, over most regions of the globe.





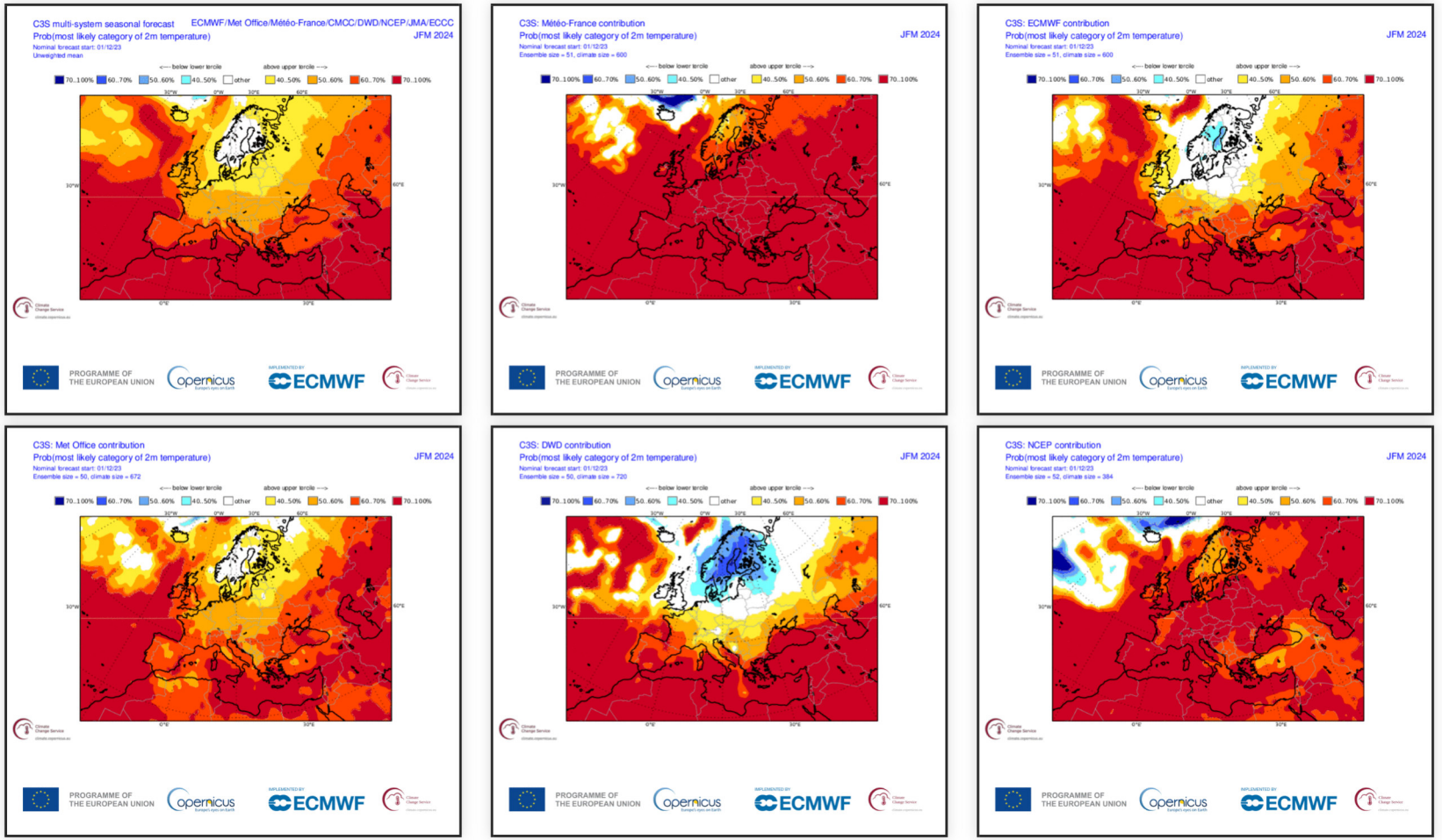




2m temperature probability map from MF-S8 (top left), ECMWF-SLAS5 (top right), C3S multi-models(bottom left) and others models of WMO multi-models (bottom right)

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

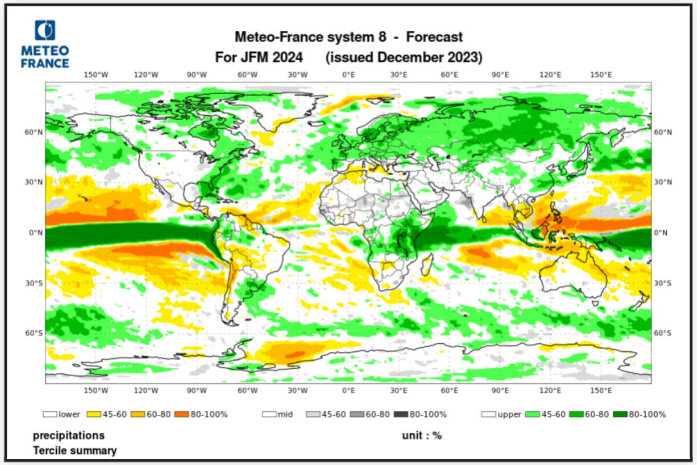
A warmer-than-normal scenario is likely over the Mediterranean Basin for all models.
However, as we move northwards, divergences between models become apparent, linked to the positioning of the negative anomaly at Z500.

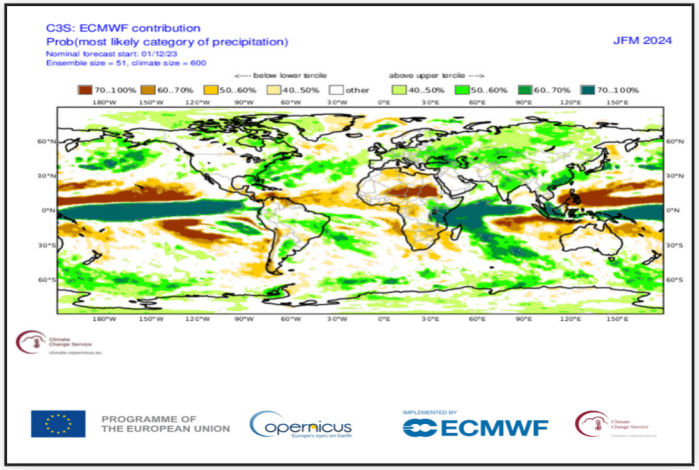


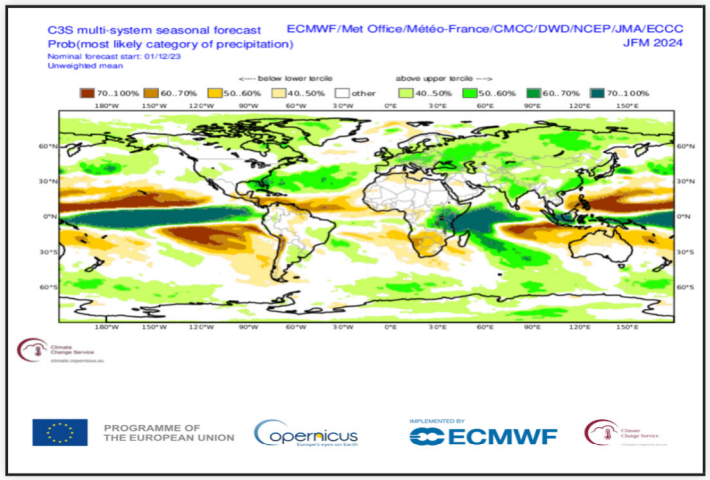
C3S multi-models probability map (top left) and MF-S8, ECMWF-SEAS5, UKMO , DWD, CMCC models.

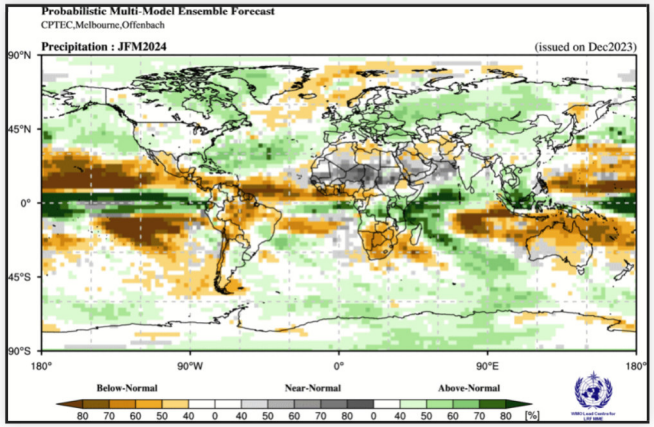
Forecast of climatic parameters : Precipitation

Good agreement between models. The impacts of El Nino in the intertropical zone is clearly visible.
In the Northern Hemisphere, the wetter-than-normal scenario dominates in most regions.





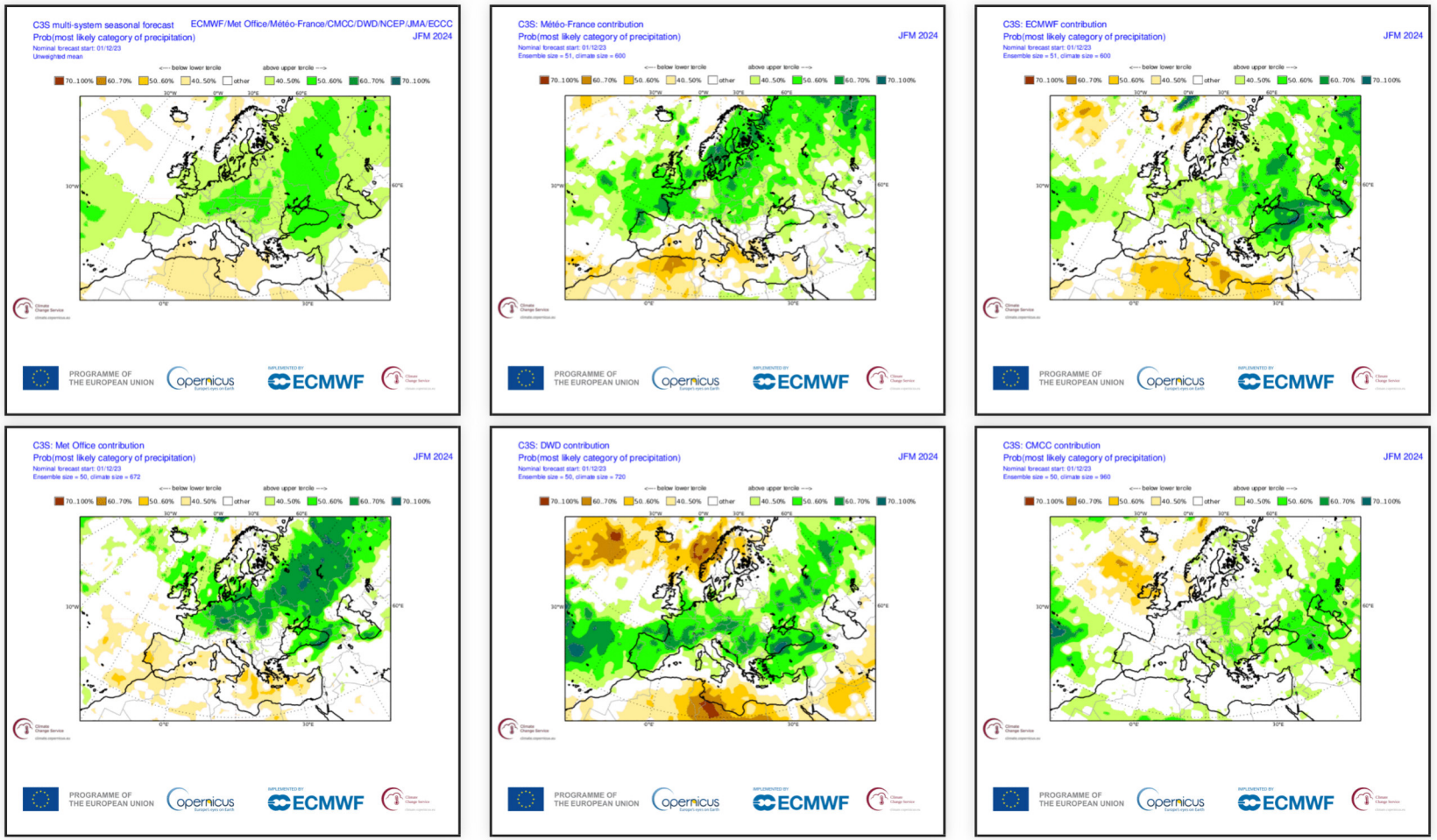




precipitation probability map from MF-S8 (top left), ECMWF-SEAS5 (top right), C3S multi-models (bottom left) and others models of WMO multi-models (bottom right)

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

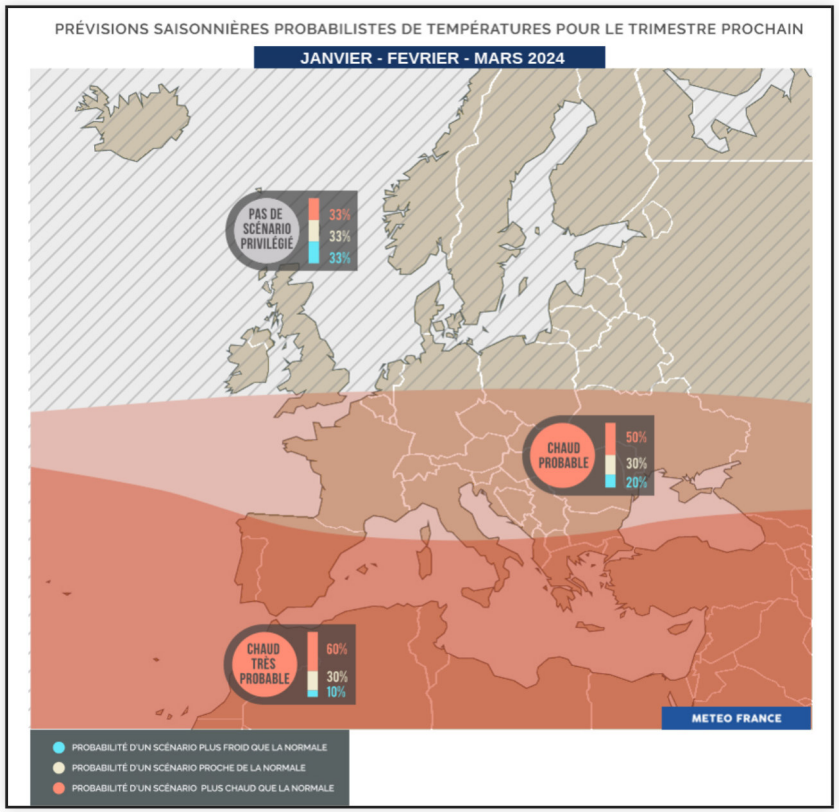
Due to the anticyclonic curvature at 200 hPa, a drier-than-normal scenario is likely over the southern Mediterranean. Over Europe, a wetter-than-normal signal dominates, with the location depending on the position of the Z500 minimum.



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

Synthesis map for Europe : Temperature

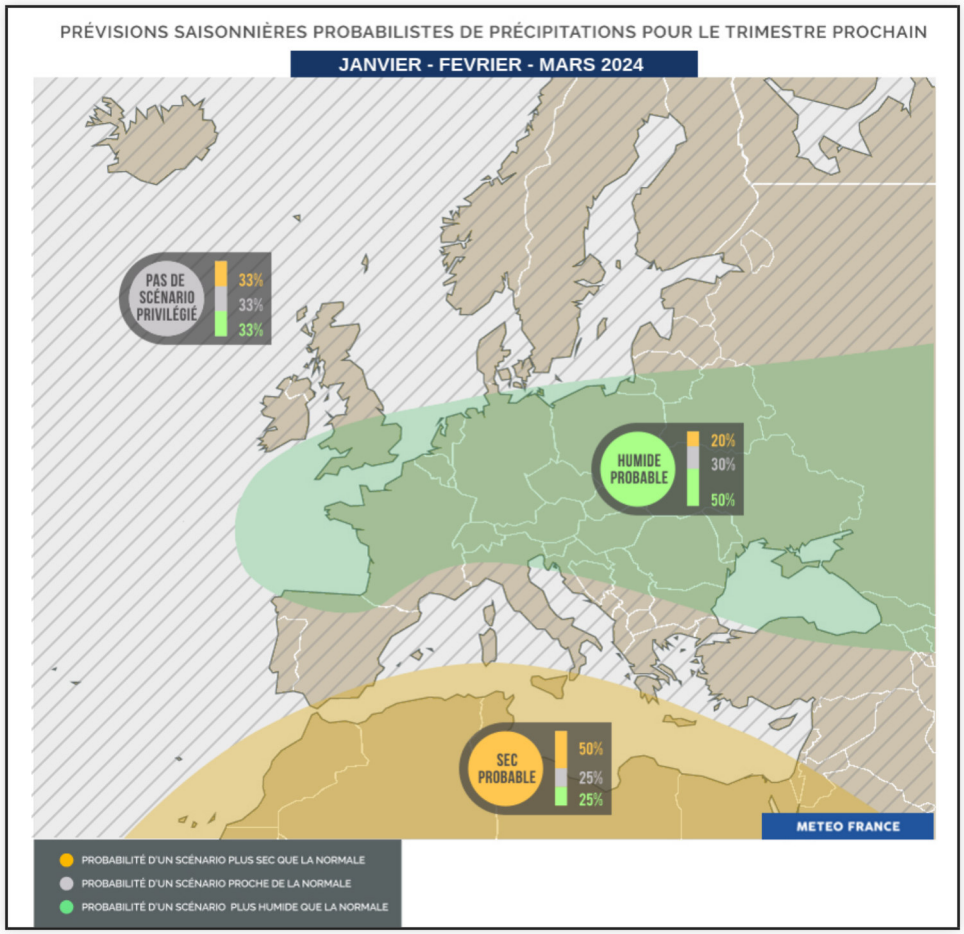
The warmer-than-normal scenario is very likely over most of the Mediterranean basin, and likely on an axis running from France to Ukraine.
No scenario is favored further north.



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

Synthesis map for Europe : Precipitation

A wetter-than-normal scenario is likely in central Europe from France to Eastern Europe.
a drier-than-normal scenario is most likely over the southern Mediterranean basin.
Elsewhere, no scenario emerges.



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