VERIFICATION BULLETIN

JANUARY - FEBRUARY - MARCH 2024

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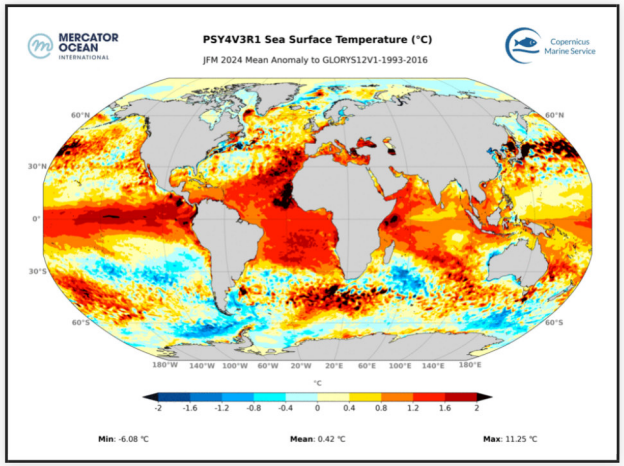
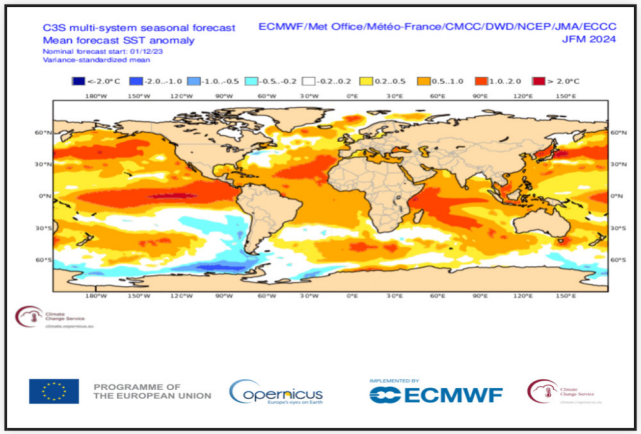
Introduction : Objective

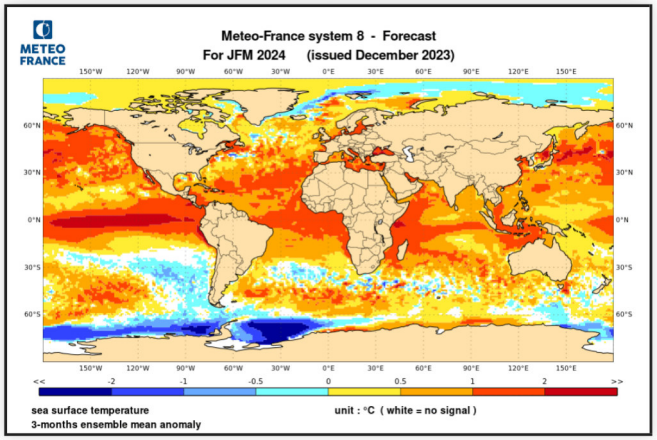
- **The objective of the Seasonal Verification Bulletin is to present an evaluation of the main elements highlighted in the Seasonal Forecast Bulletin : oceanic forcings, large scale circulation patterns, and a focus on temperature and precipitation forecast over Northern Atlantic, Europe and the Mediterranean Basin.**
- **The aim is not to evaluate the mean skill of Seasonal Forecast models, for which scores are calculated over the whole hindcast period, but to enhance the knowledge of the behavior of models for advanced users (as National Meteorological Services), in parallel with an assessment of expertised forecast. This approach meets the need of many users, who want to know the recent real-time performances of forecasts, for specific events.**
- **Thanks to Mercator-Ocean and DWD (RCC-Climate Monitoring node for Europe) for providing products and analysis on the monitoring part.**

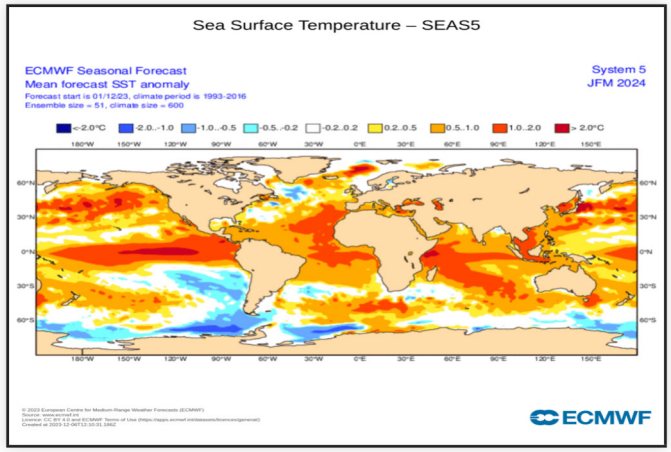
Oceans : surface temperature anomalies

In the Pacific Ocean, the main anomalies were well predicted by both models: warm anomaly in the equatorial zone (El Niño), PDO-pattern in the Northern Hemisphere and cold anomaly in the Southern Hemisphere.
In the Indian Ocean, the predicted patterns and the reanalysis are very close.
In the Atlantic Ocean, while the extent of the warm anomaly forecast by the models is validated by the reanalysis, the intensity of this anomaly has been largely underestimated by both MF and ECMWF.







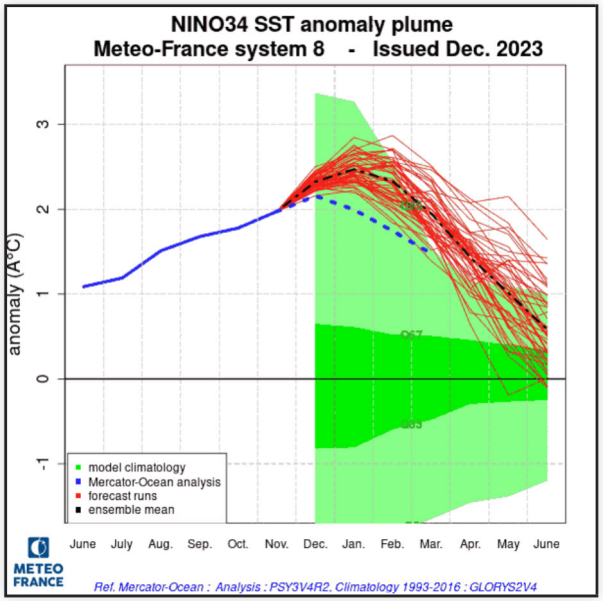


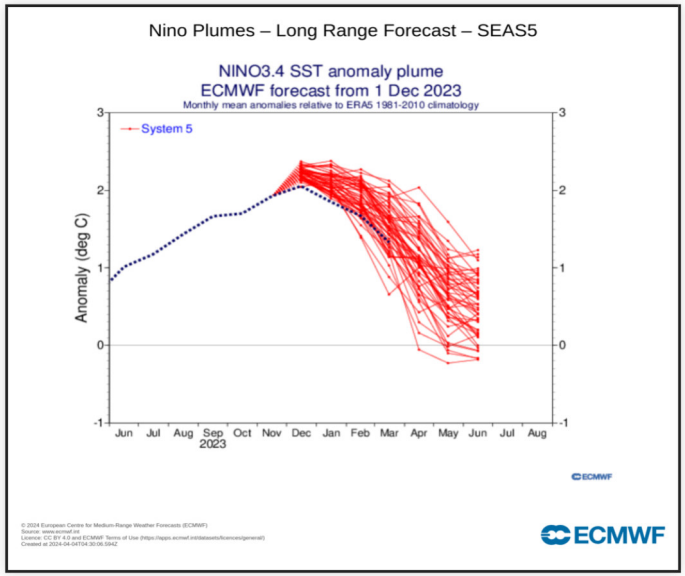
SST anomalies in the analysis from Mercator (top left), C3S multi-models (top right), MF-S8 (bottom left) and SEAS5 (bottom right)

Oceans : ENSO

CAUTION : reference analyses differ between MF-S8 (Mercator-Ocean 1993-2016) and ECMWF-SEAS5 (NCEP 1981-2010).

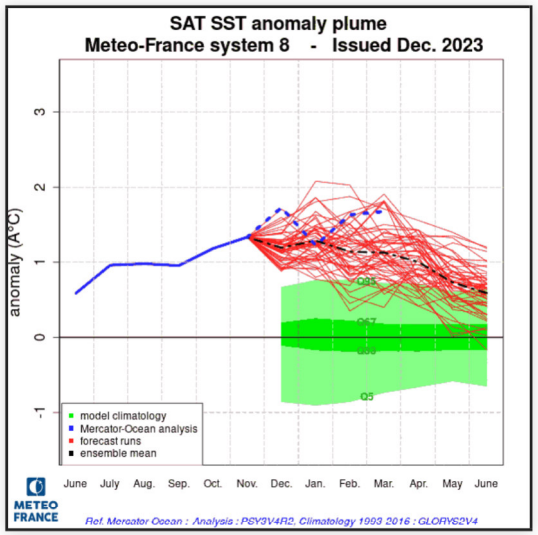
Both models are too hot, but ECMWF is closer to analysis than MF8.

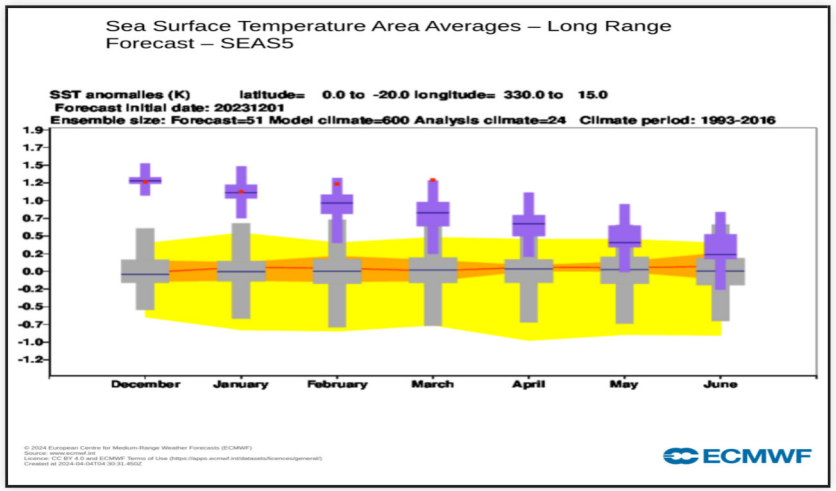


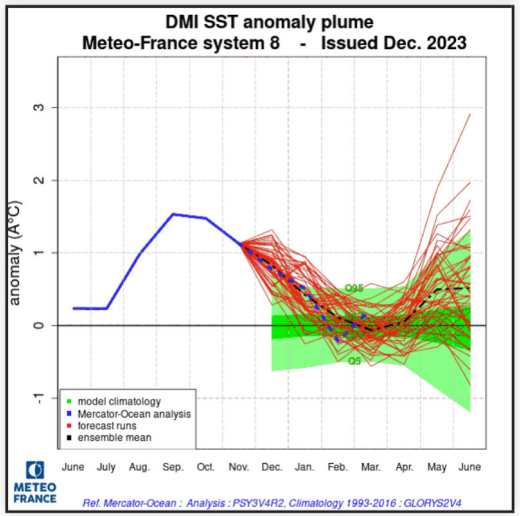


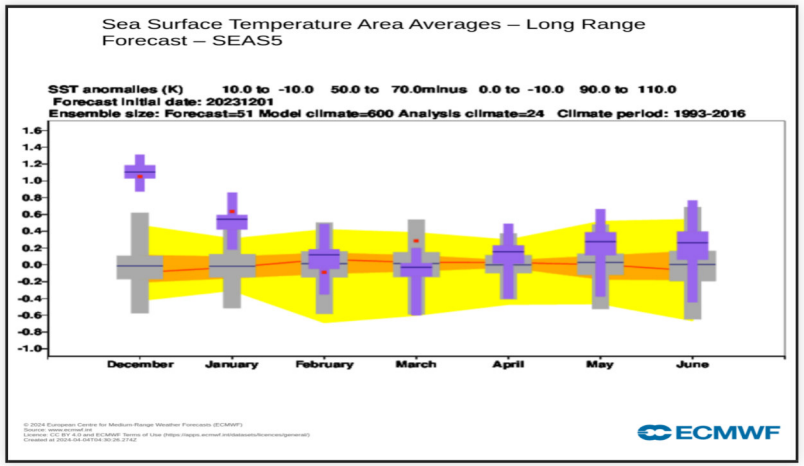
Oceans : tropical Atlantic and Indian Ocean index

SAT : Both models predicted a very high anomaly. Yet the reanalysis reveals an even stronger one.
DMI : The attenuation of the DMI index is well anticipated by the models.



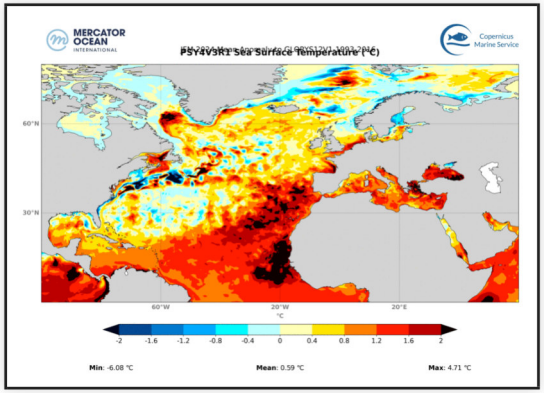


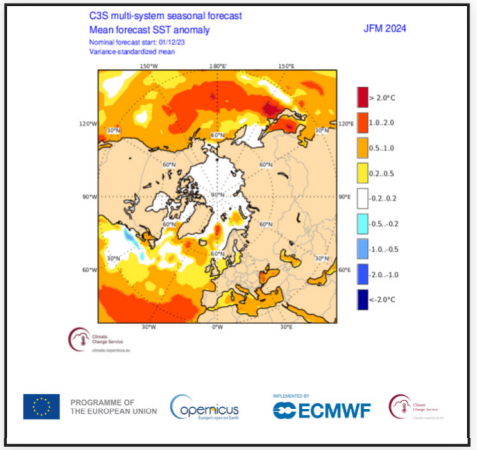


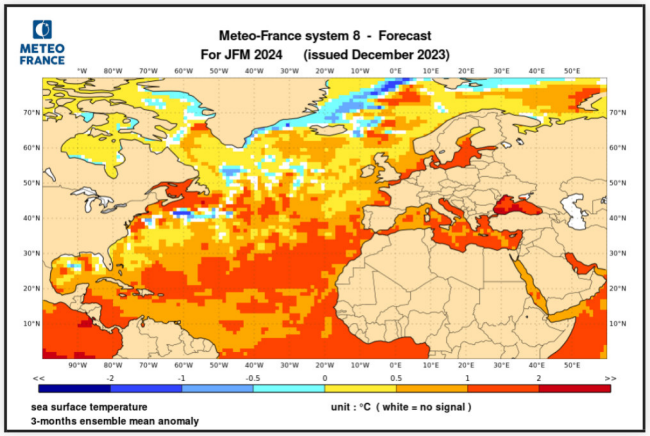


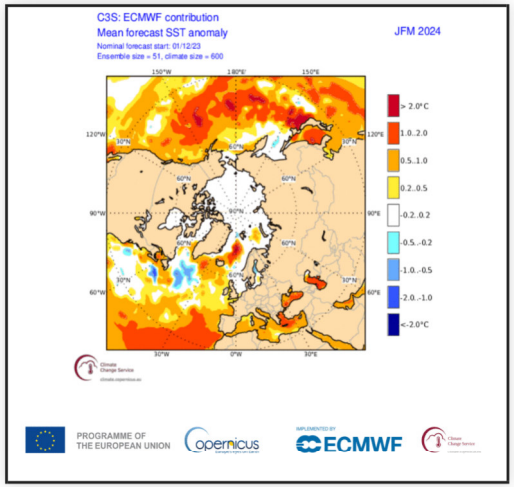
Oceans : North Atlantic SST

In the northern intertropical zone and all the way to Europe, the warm anomaly is anticipated by the models but clearly underestimated. Around Scandinavia, ECMWF is closer to the reanalysis (which shows a cold anomaly) than MF8.







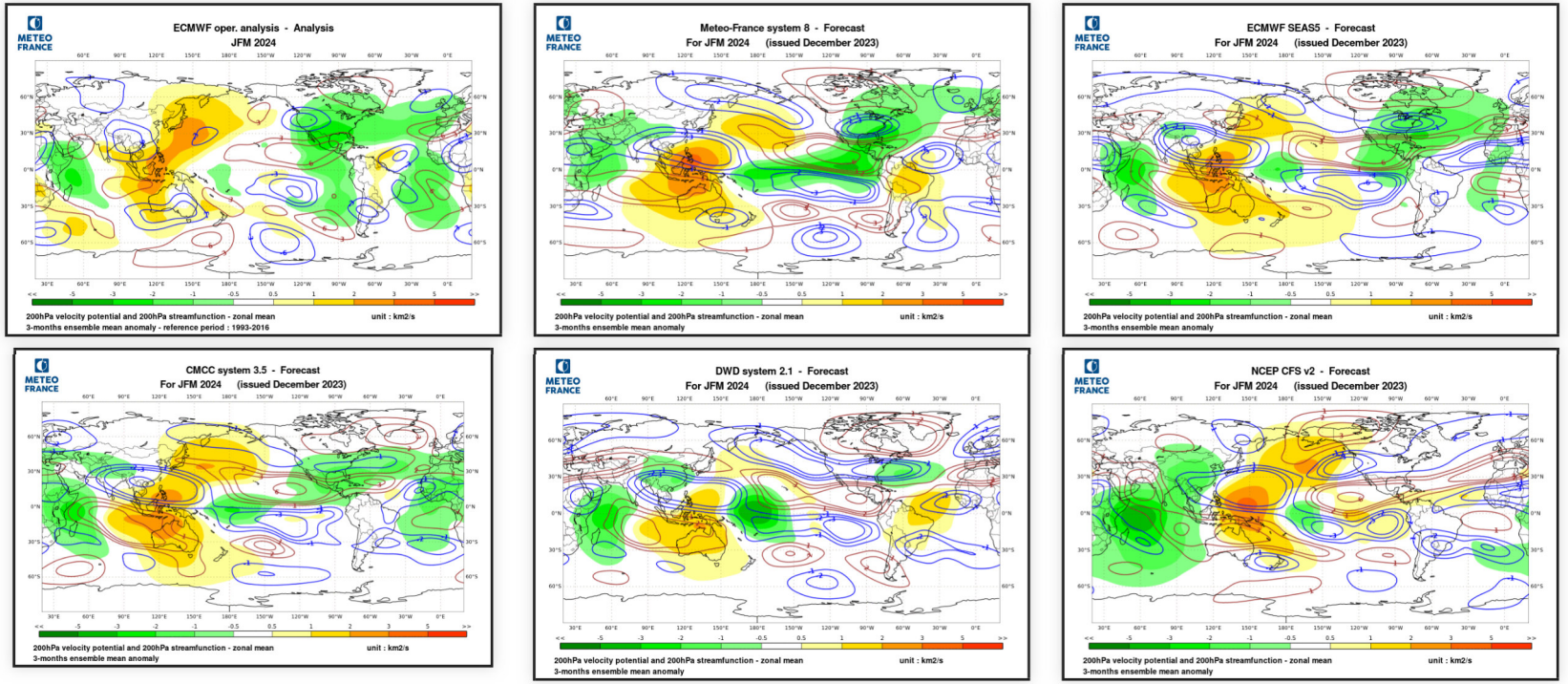


SST anomalies in the analysis from Mercator (top left), C3S multi-models (top right), MF-S8 (bottom left) and ECMWF SEAS5 (bottom right)

Atmospheric circulation : Global teleconnection

VP : The Indian Ocean dipole, linked to IOD+, was well forecast by all models. Similarly, the dipole of subsidences over the Pacific and ascendances over Brazil was generally well anticipated. The reanalysis shows ascendances over the Atlantic Ocean, which were more or less well forecast.

SF : The two dipoles, one on the maritime continent and the other on the Pacific, are well seen by the models. They are associated with teleconnections to the northern and southern hemispheres, again generally well seen by the models. The reanalysis also shows a dipole over Africa. The circulation over Europe may be linked to this dipole (teleconnections?) or to ascendances over Brazil.

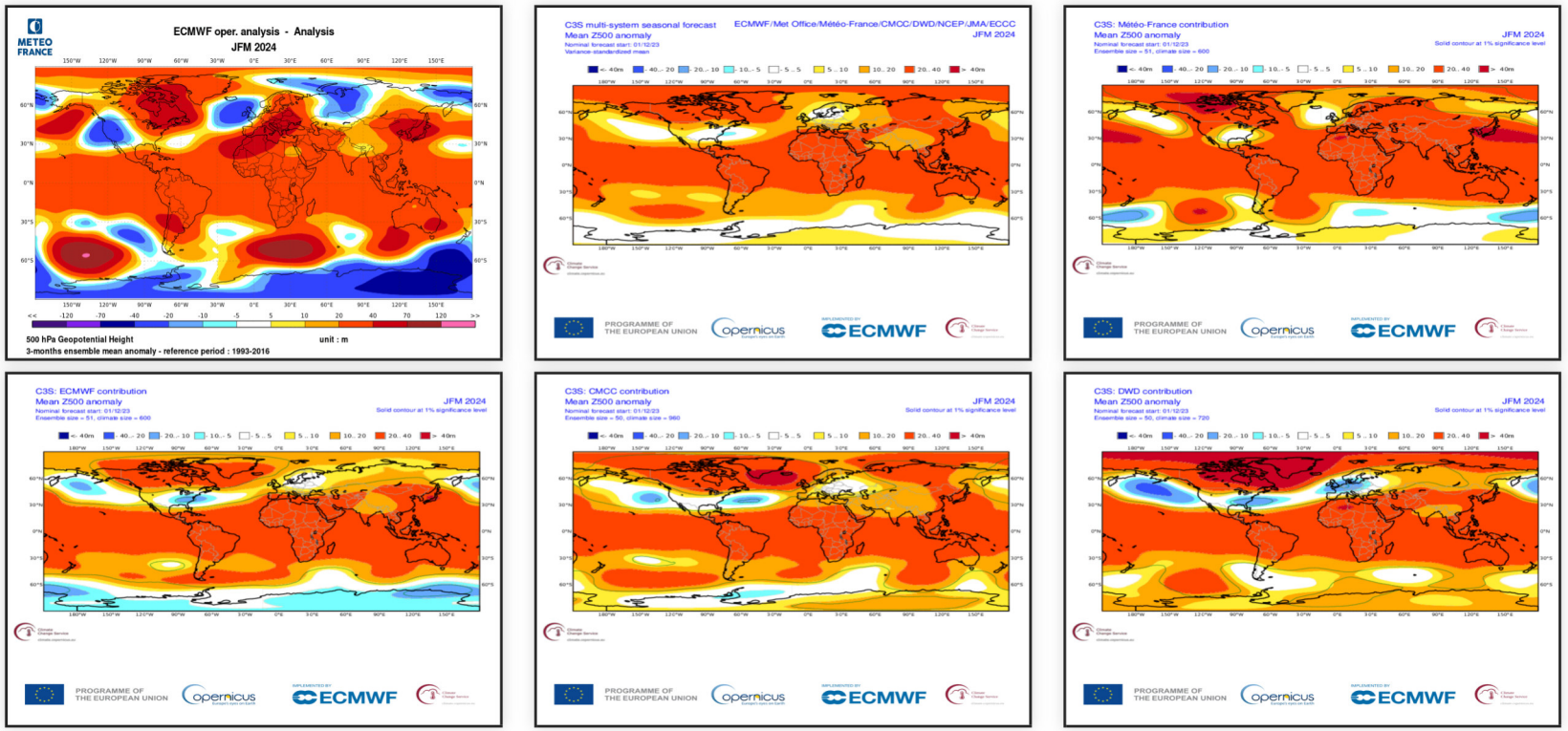


ECMWF analysis, MF-S8, ECMWF-SEAS5, CMCC, DWD and JMA 200hPa velocity potential anomalies (color range, green : ascending, orange: subsidence) and stream function anomalies (isolines, red: anticyclonic in the northern hemisphere, blue: cyclonic in the northern hemisphere).

Atmospheric circulation : 500hPa Geopotential height

Southern Hemisphere : Anomalies in the South Pacific and southwest of Australia are seen by all models.

Northern Hemisphere : Positive anomalies over Canada and the Mediterranean were forecast by all models. All models predicted a band of negative anomalies from Alaska to the USA and Europe. However, there were discrepancies between models and reanalysis regarding their location.

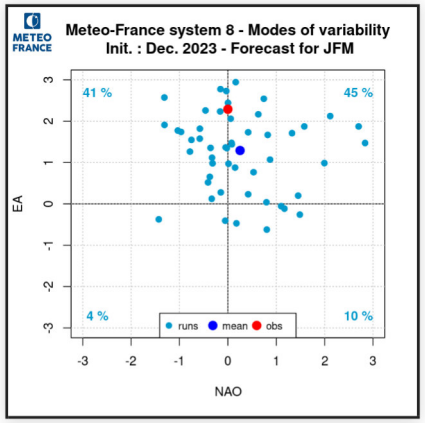


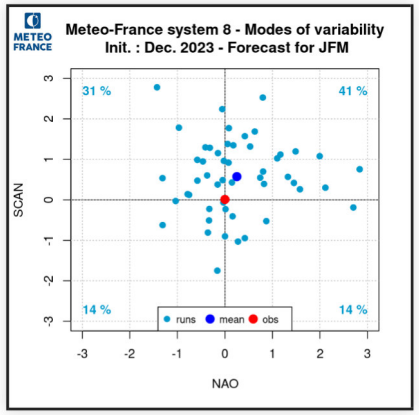
ECMWF analysis, C3S multi-system, MF-S8, ECMWF-SEAS5, CMCC and DWD 500hPa geopotential height anomalies.

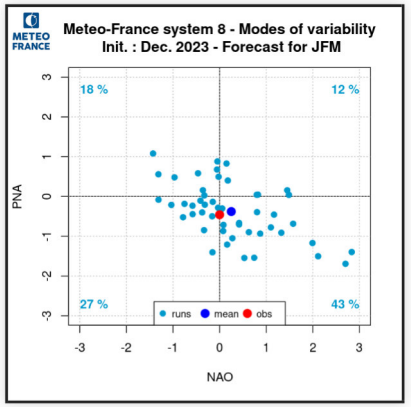
Atmospheric circulation : Modes of variability

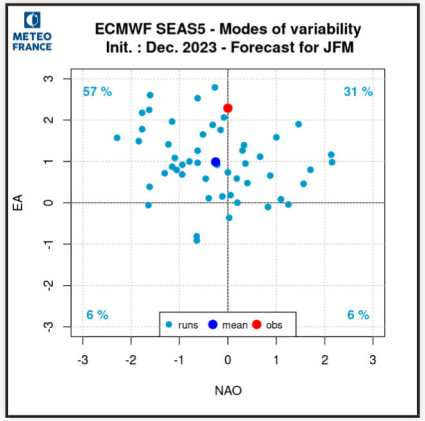
The domination of EA+ mode was well anticipated, but underestimated.

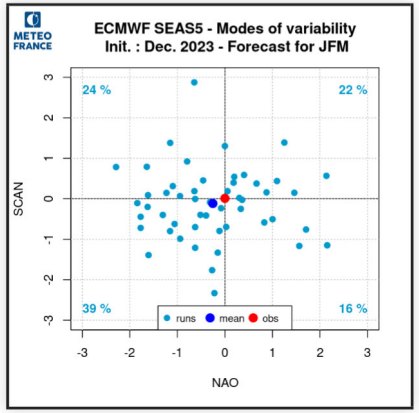
The other modes are very close to zero on analysis, which is in line with forecasts, except perhaps for the SCAN mode, which MF8 predicted to be in a positive phase.

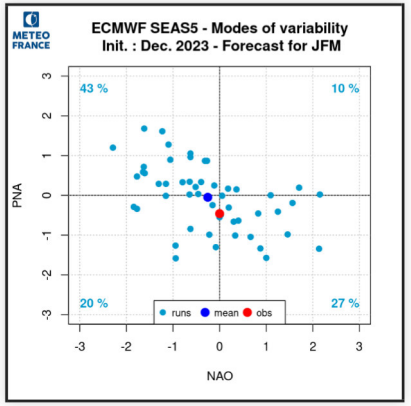






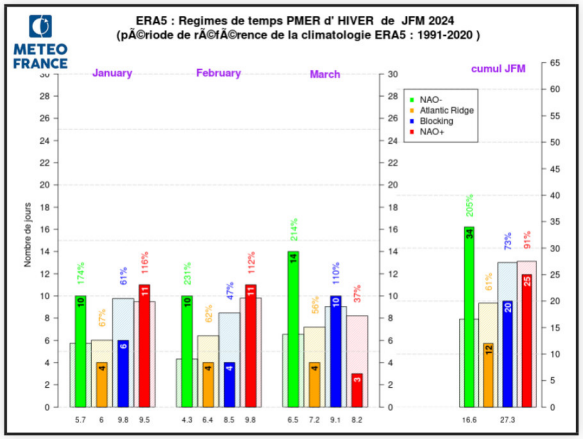


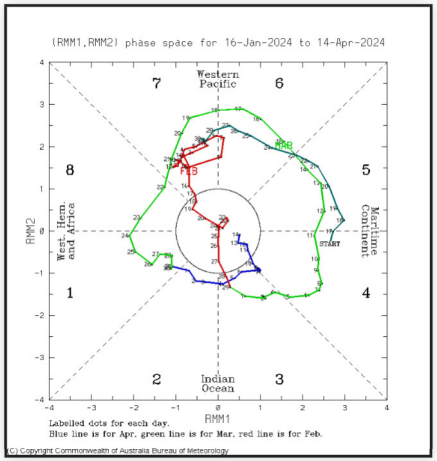


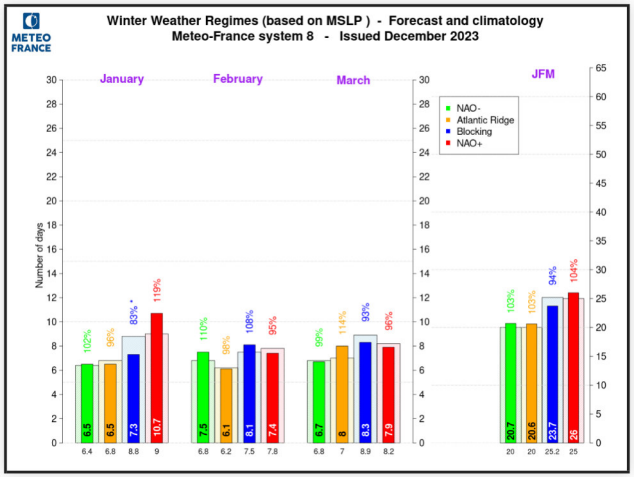


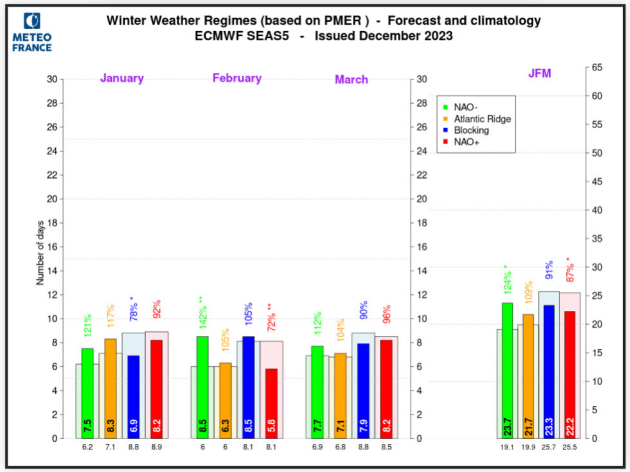
Atmospheric circulation : Winter SLP weather regimes

For each of the three months, and therefore also over the quarter, the NAO- regime is favored, while the frequency of the Atlantic Ridge regime is much lower than in climatology.
Only the ECMWF model had predicted a significant predominance of the NAO- regime.





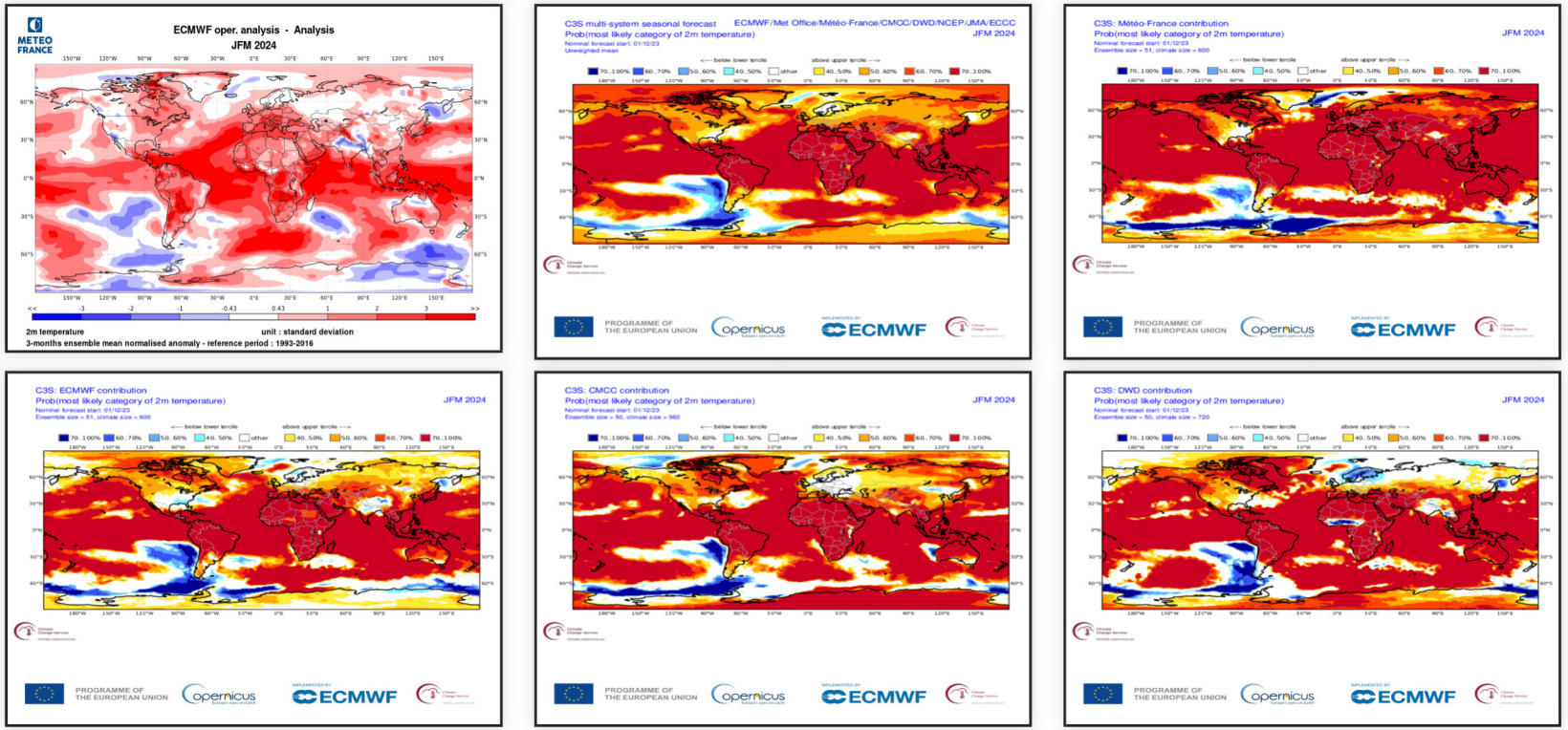




weather regime : ECMWF analysis top left, MF8 and ECMWF forecasts at the bottom. MJO phase top right

Climatic parameters : temperature on the globe

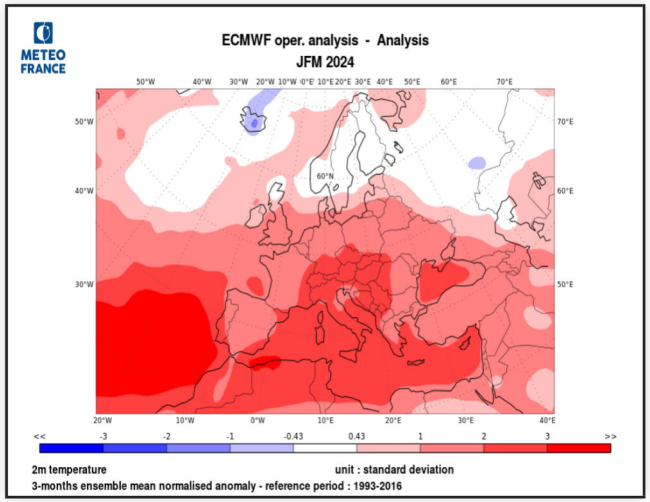
In the southern hemisphere, the main cold anomalies are well forecast and are linked to oceanic anomalies.
In the Northern Hemisphere, the warm anomaly over eastern Canada was generally well seen by the models, while the pattern over the USA was not validated by the analysis. The warm anomaly over the Atlantic is linked to the strong SST anomaly

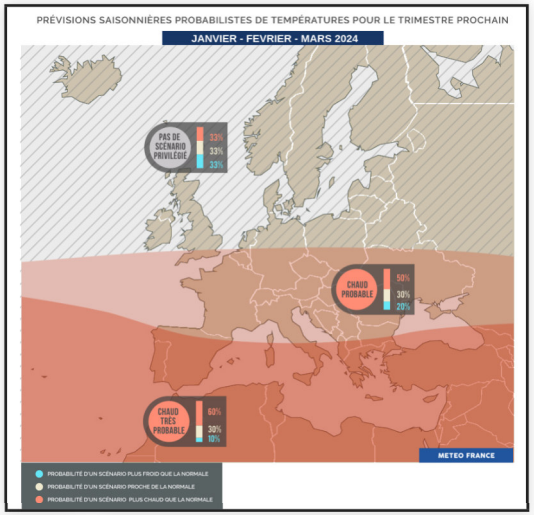


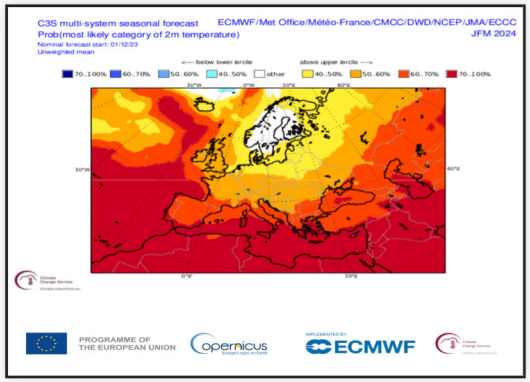
ECMWF analysis top left, forecast for multi-model top center and forecast for MF-S8 top right, ECMWF-SEAS5, CMCC, DWD on the bottom line.

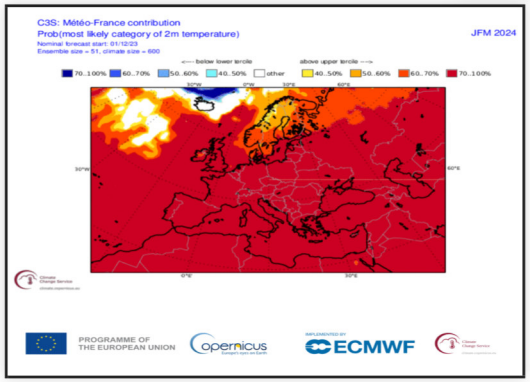
Climatic parameters : temperature over Europe

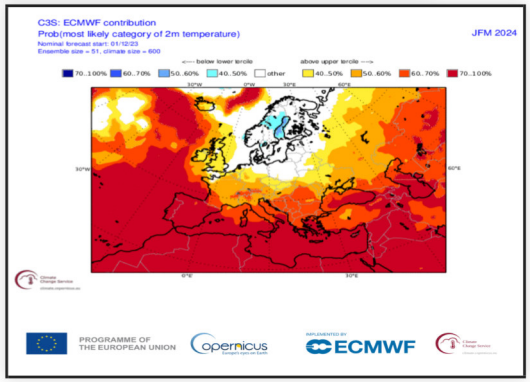
The warmer-than-normal scenario over a large southern half of Europe and the Mediterranean Basin is validated by the analysis, in conjunction with the positive Z500 anomaly. Further north, the models diverged, but the multi-model and ECMWF are close to the analysis.







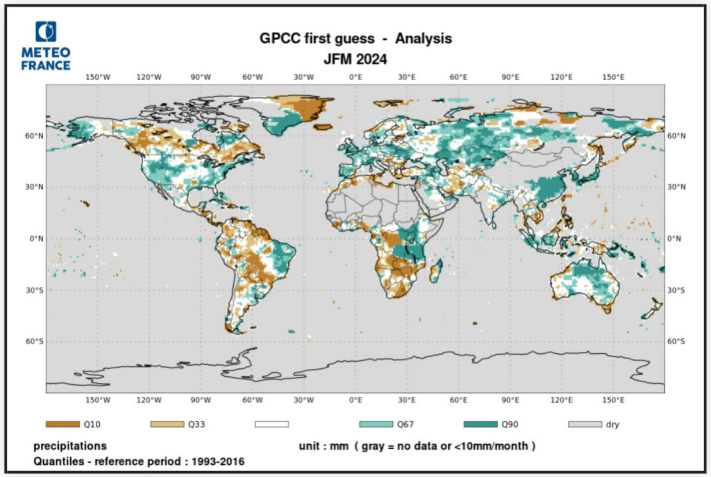


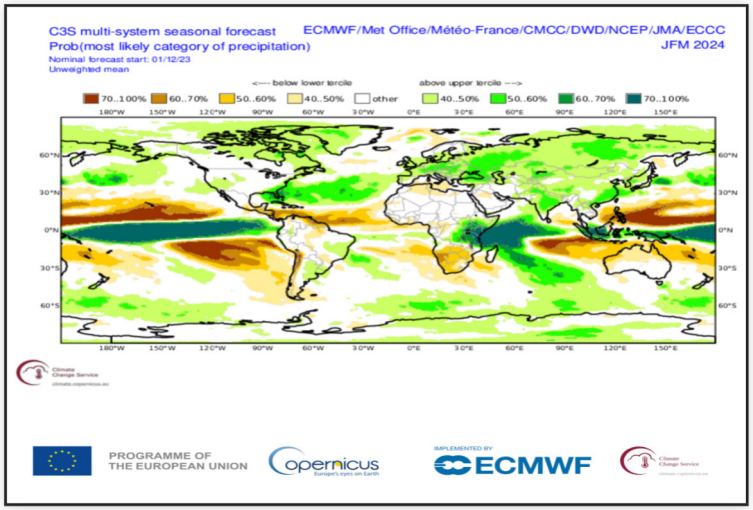


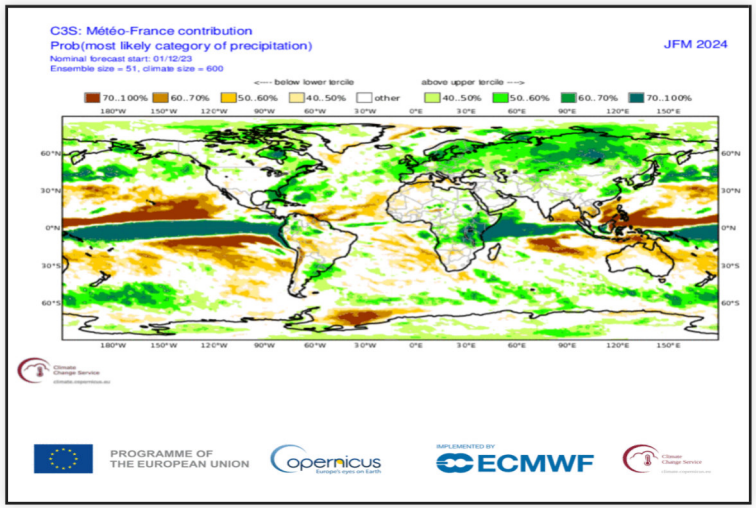
ECMWF analysis top left, synthetic forecast map top right. Forecast for multi-system , MF-S8 and SEAS5 on the bottom line.

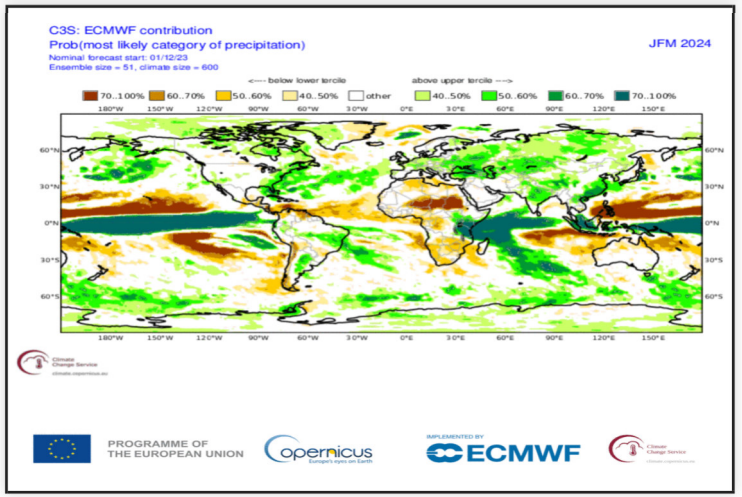
Climatic parameters : Precipitations over the globe

In the inter-tropical zone, the impacts predicted by the models are confirmed by analysis in Africa (also linked to IOD+) and South America. In North America, discrepancies are visible. On the other hand, from Europe to Russia, the predicted wet signal is confirmed by analysis.





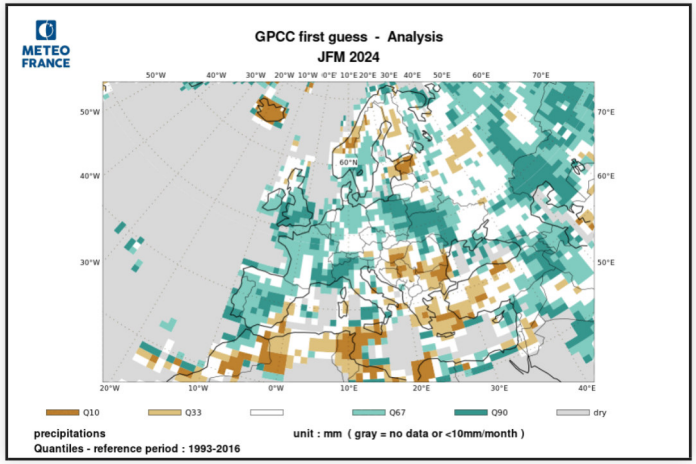


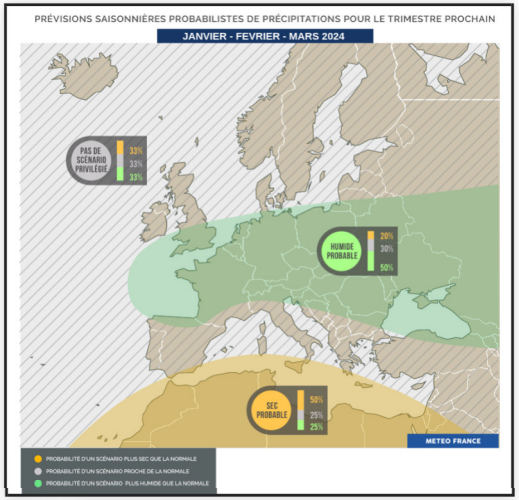


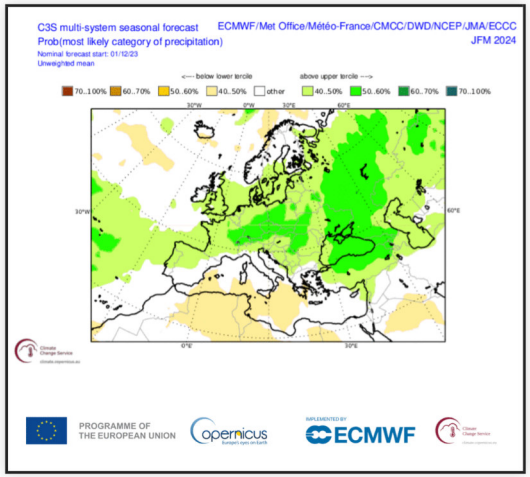
Standardized Precipitation Index analysed by IRI top left, forecast for multi-model top right and MF-S8 and SEAS5 on the bottom line.

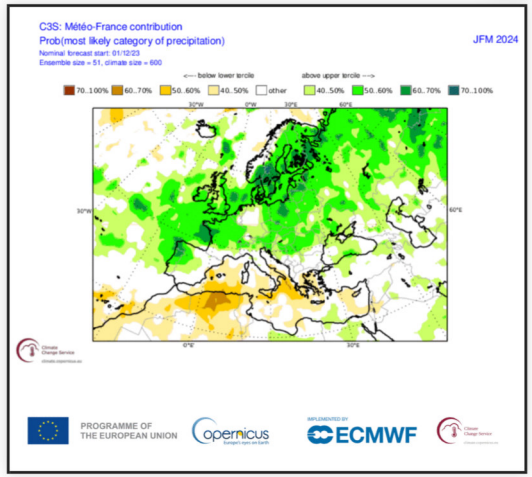
Climatic parameters : Precipitations over Europe

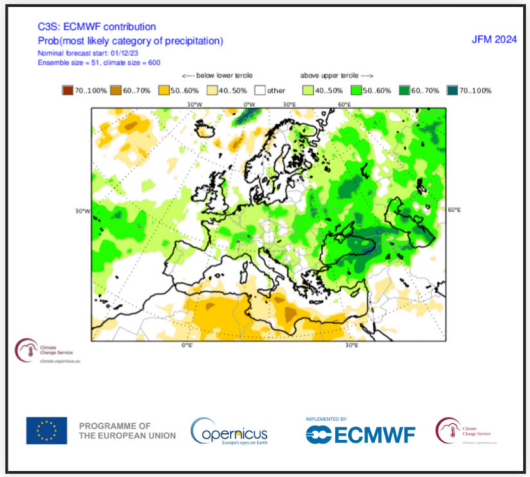
The wetter-than-normal scenario over a wide area of central Europe is validated by the reanalysis. Over the southern Mediterranean Basin, despite the scarcity of data available for analysis, the drier-than-normal scenario is consistent.











Precipitation anomalies analysed by IRI (top left). Synthetic forecast map for precipitation (top right) and forecast for multi-model,MF-S8 and SEAS5 (on the bottom line).

General summary : for the period ND 2023 - J 2024

1) **Oceans :**

The main SST anomalies predicted by the two models are well represented in the analysis.

2) **Large scale atmospheric circulation :**

VP 200 hPa : Areas of lifts and subsidence (Indian Ocean dipole, Pacific Ocean ascent, Amazonian subsidence) were generally well anticipated by the models.

SF 200 hPa : Teleconnections from the Pacific to North America are well seen by the models. The anticyclonic curvature over North Africa was seen by the models but the cyclonic one was well located only by MF8.

Z500 : MF8 is therefore closer to the analysis than the other models for the position of the negative anomaly near Europe.

3) **Climatic parameters over Europe :**

Temperatures : The warm anomalies were well anticipated.

Precipitations : The wet anomaly is well positioned over Central Europe. It could have been considered more extensive, as suggested by the models, which are very close to the analysis.