VERIFICATION BULLETIN

NOVEMBER - DECEMBER 2023 - JANUARY 2024

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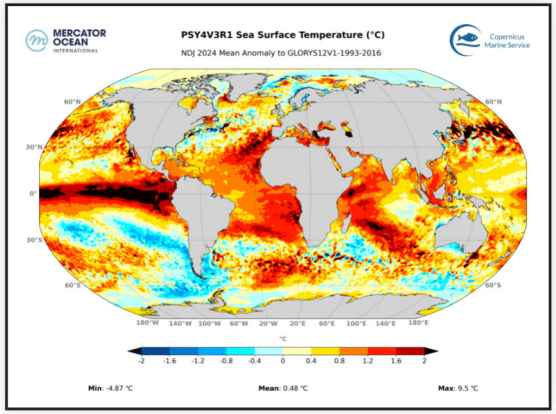
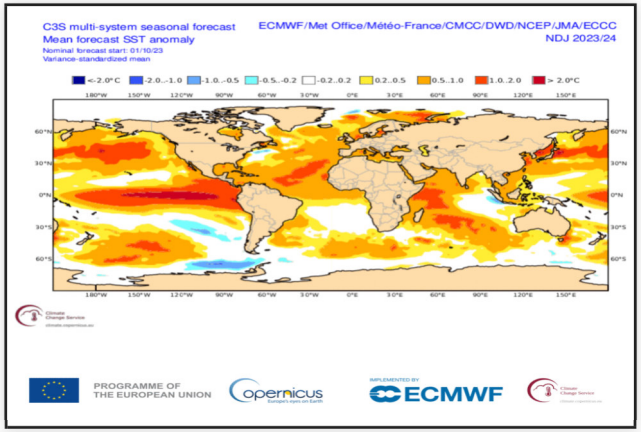
Introduction : Objective

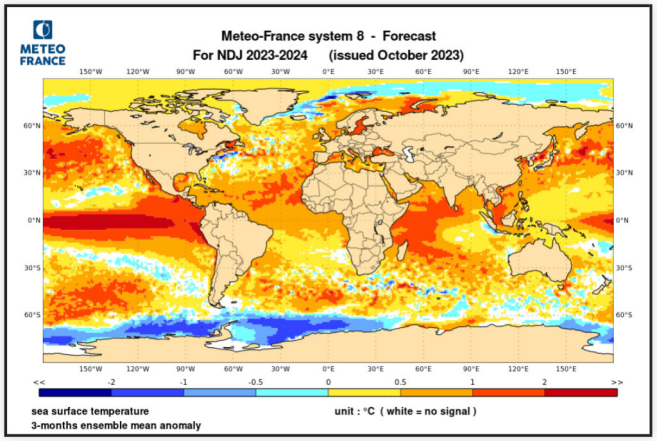
- **The objective of the Seasonal Verification Bulletin is to present an evaluation of the main elements highlighted in the Seasonal Forecast Bulletin : oceanic forcings, large scale circulation patterns, and a focus on temperature and precipitation forecast over Northern Atlantic, Europe and the Mediterranean 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.**

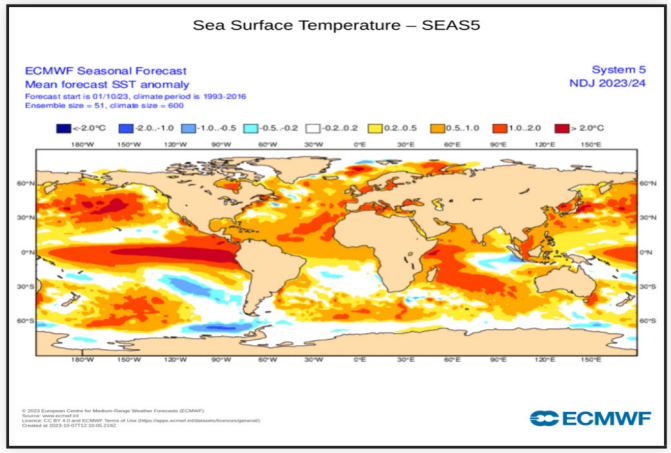
Oceans : surface temperature anomalies

In the Pacific Ocean, the various anomaly patterns predicted by the models are reflected in the analysis (El Niño phase in the equatorial basin, PDO- pattern in the northern hemisphere, cold anomaly in the southern hemisphere).
in the Indian Ocean, the reanalysis confirms the models' forecasts, i.e. a positive IOD phase (warm anomaly in the west vs. cold anomaly in the east).
In the Atlantic Ocean, on the other hand, the models failed to anticipate the strong positive anomaly stretching from Namibia to Spain, particularly from the Equator to the Southern Tropic.







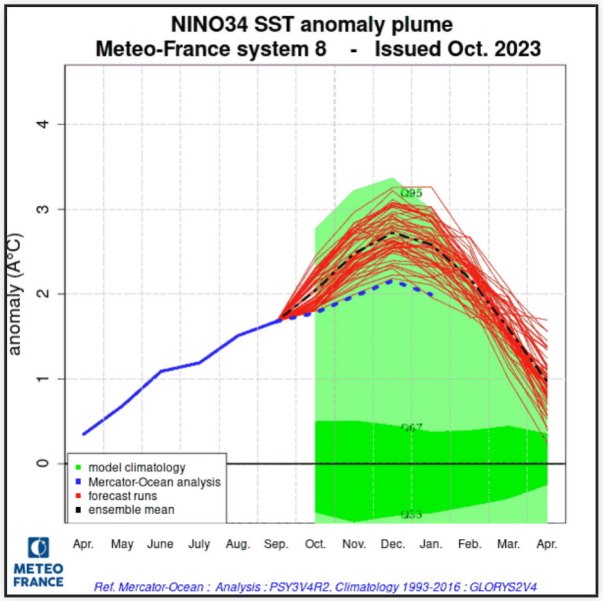


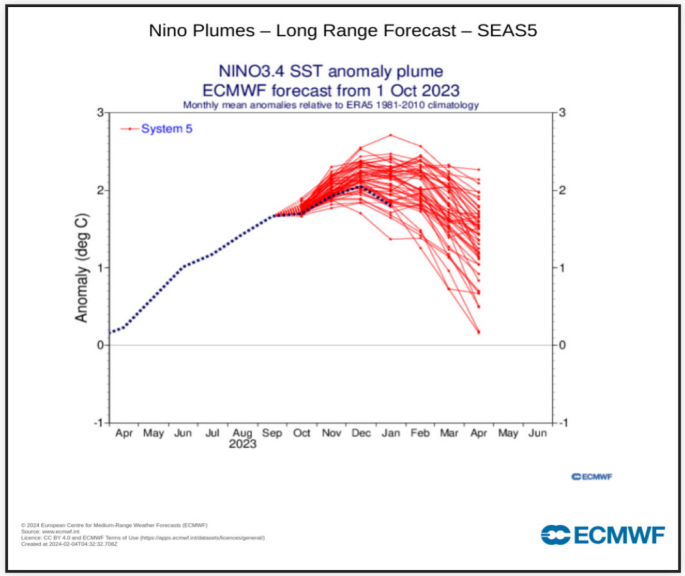
SST anomalies in the analysis from Mercator (top left), C3S multi-models (top right), MF-S8 (bottom left) and SEAS5 (bottom right)

Oceans : ENSO

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

the MF8 model is clearly too hot for the analysis. ECMWF, also too hot, is closer to analysis.

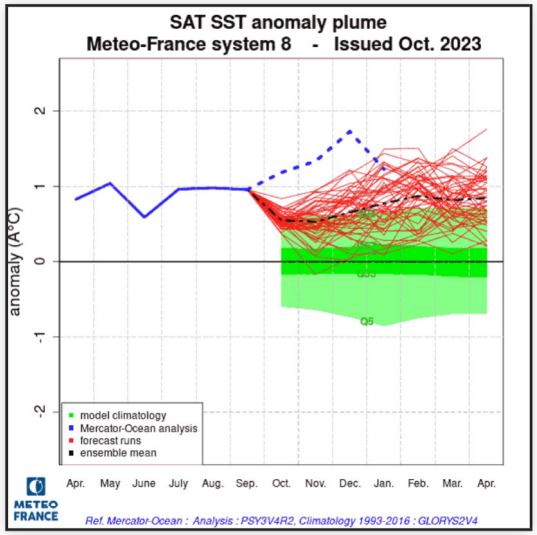


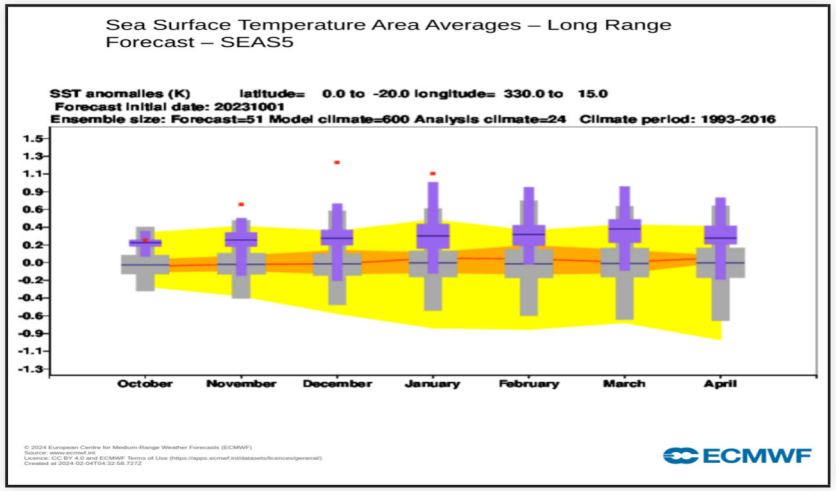


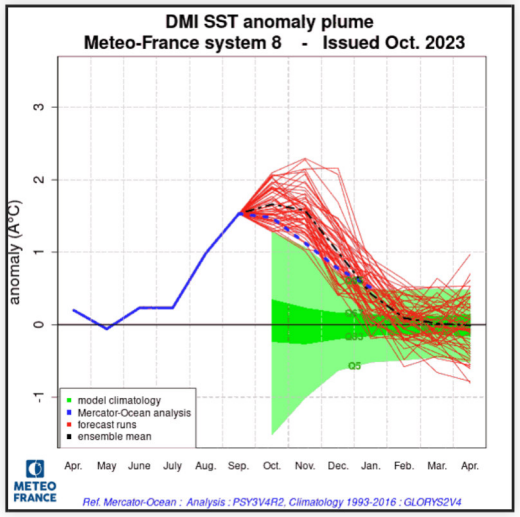
Oceans : tropical Atlantic and Indian Ocean index

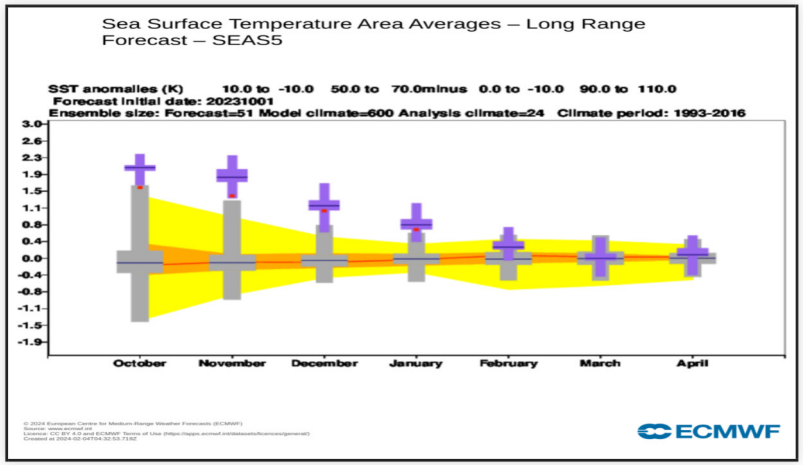
SAT : Both models underestimated the positive anomaly in the SAT index, which was particularly strong this quarter given its climatology.

DMI : MF8 and ECMWF were slow to attenuate the DMI index. However, reanalysis and models converged at the end of the period.



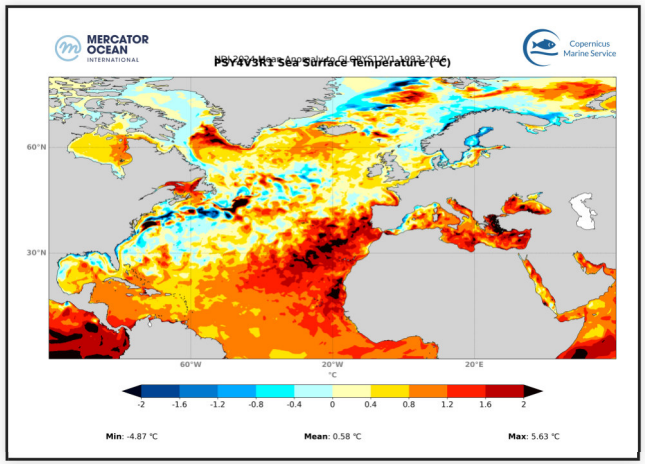


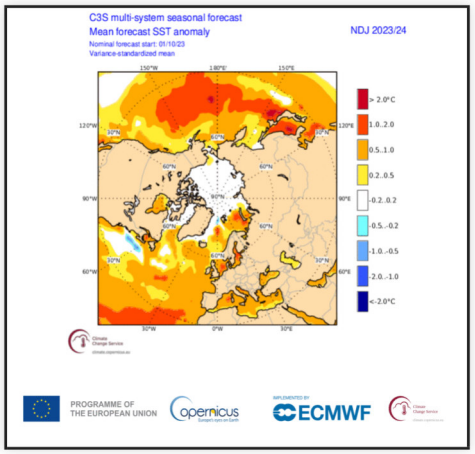


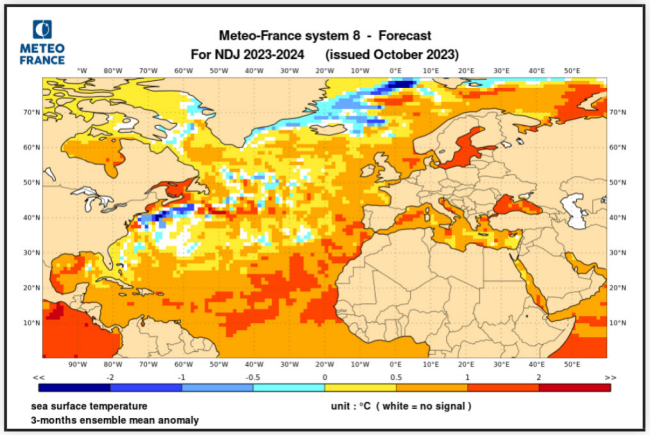


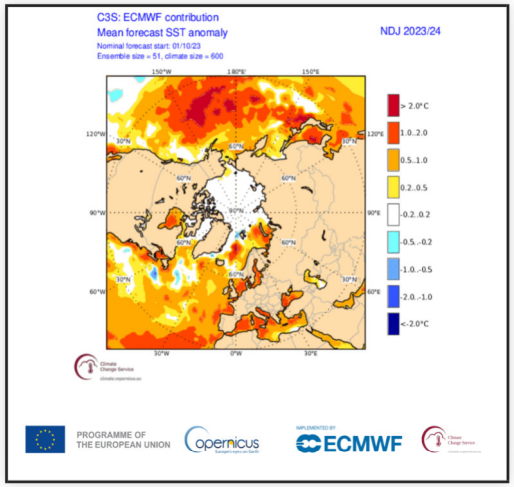
Oceans : North Atlantic SST

In the North Atlantic Basin, both models underestimated the strong warm anomaly from the West African coast to Spain. On the other hand, they did not see the cold anomaly around Scandinavia.
In the Mediterranean, the models did not predict the strong positive anomaly over the eastern two-thirds of the basin, nor the cold anomaly over the western side.







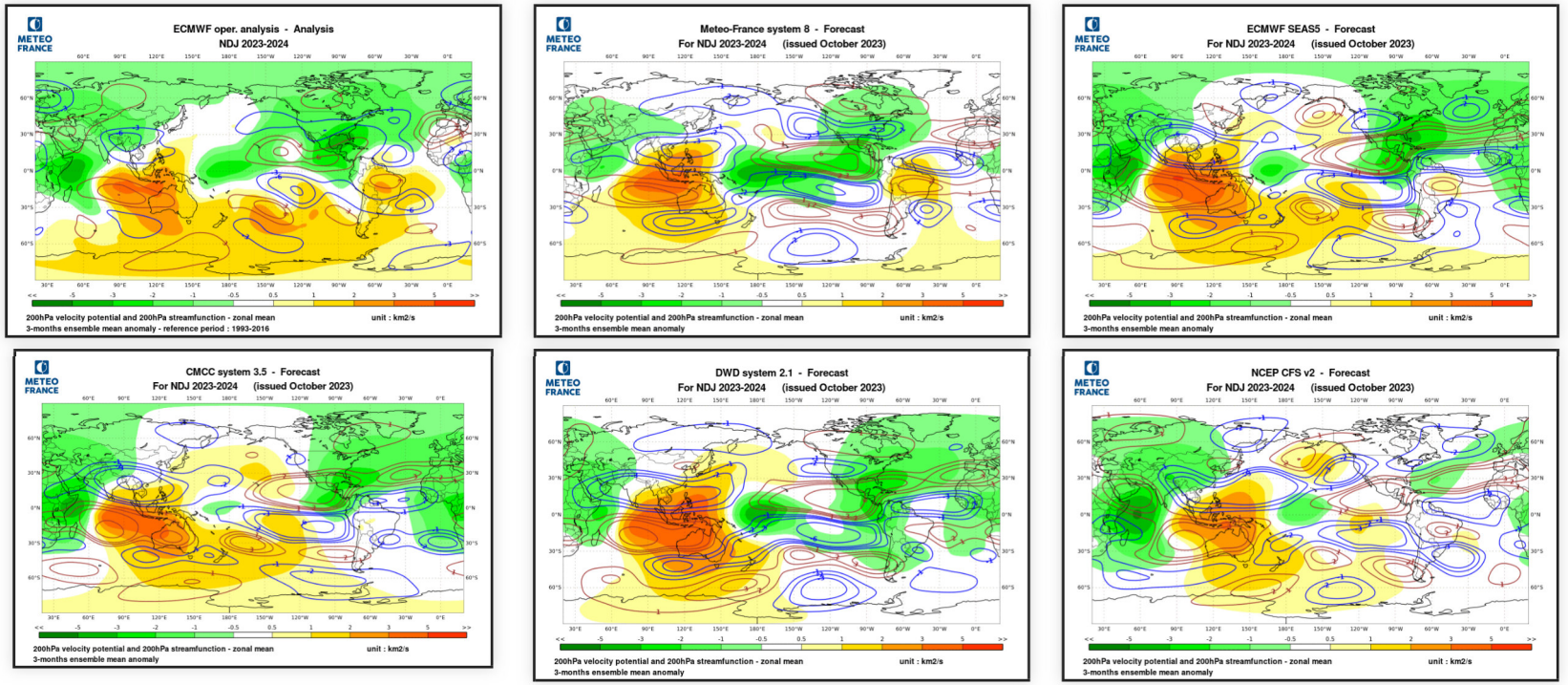


SST anomalies in the analysis from Mercator (top left), C3S multi-models (top right), MF-S8 (bottom left) and ECMWF SEAS5 (bottom right)

Atmospheric circulation : Global teleconnection

VP : The dipole over the Indian Ocean predicted by all the models is confirmed by analysis.
In the Pacific Ocean, the atmospheric response to the analysis does not really correspond to the classic El Niño phase pattern, in particular because of the subsidences over the southern part of the basin. Ecmwf is closer to the analysis. Analysis and models agree on the positive anomaly over Amazonia.

SF : Dipoles on the Indian and Pacific Oceans are confirmed by analysis, which is not the case on the Atlantic Ocean.
Teleconnections to North America are better predicted by MF8 and DWD than by ECMWF. Teleconnections from the Indian Ocean to Europe are visible in the analysis, but not in the models. This is why the dipole between anticyclonic curvature over Spain and cyclonic curvature over Scandinavia has not been anticipated.

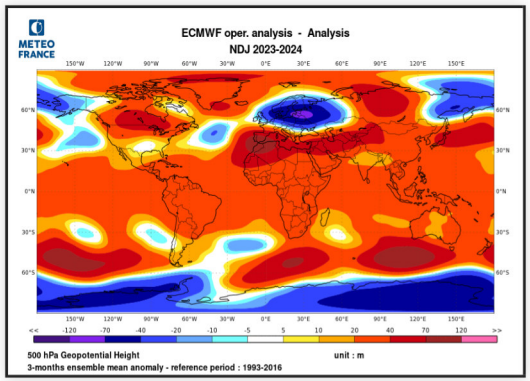


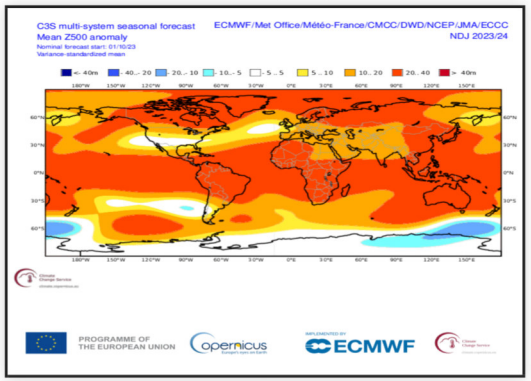
ECMWF analysis, MF-S8, ECMWF-SEAS5, CMCC, DWD and JMA 200hPa velocity potential anomalies (color range, green : ascending, orange: subsidence) and stream function anomalies (isolines, red: anticyclonic in the northern hemisphere, blue: cyclonic in the northern hemisphere).

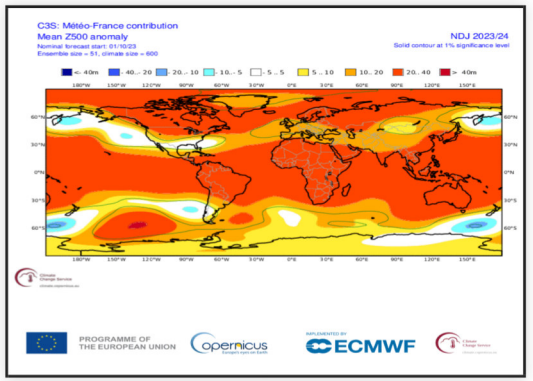
Atmospheric circulation : 500hPa Geopotential height

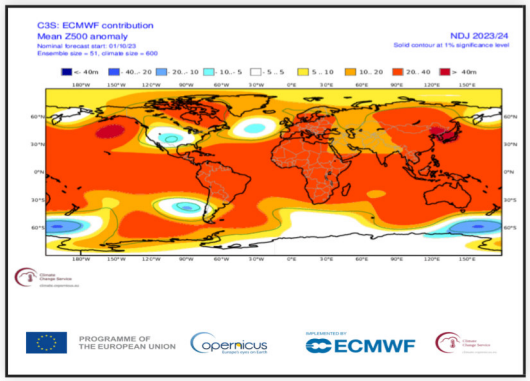
Southern Hemisphere : The various anomalies are more or less well seen by the models.

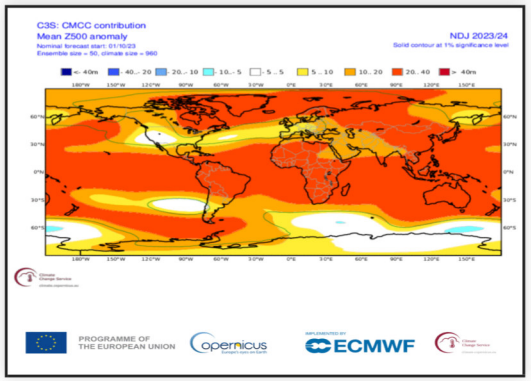
Northern Hemisphere : The positive anomaly over Canada is fairly well seen by the models, unlike the negative anomaly over Alaska. Over Europe, the pattern of positive anomalies over the Mediterranean Basin versus negative anomalies over Scandinavia and the central North Atlantic, linked to the 200 hPa circulation, is not seen by any model.

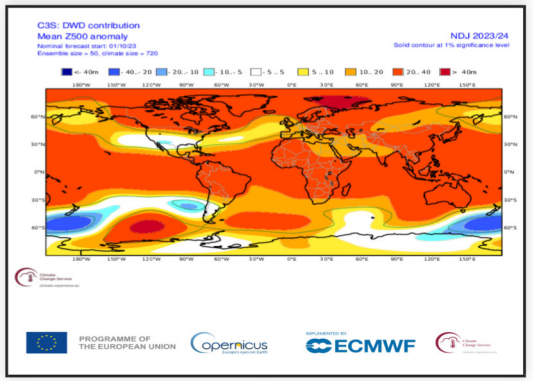










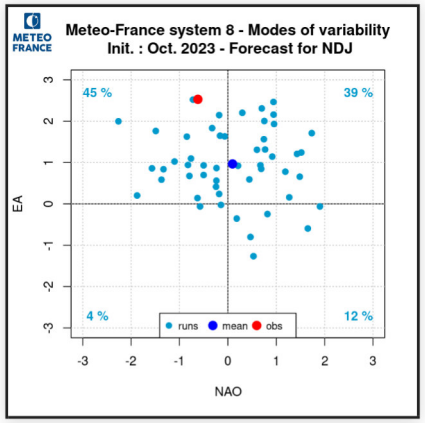


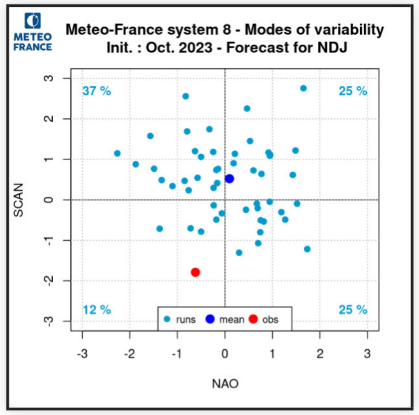
ECMWF analysis, C3S multi-system, MF-S8, ECMWF-SEAS5, CMCC and DWD 500hPa geopotential height anomalies.

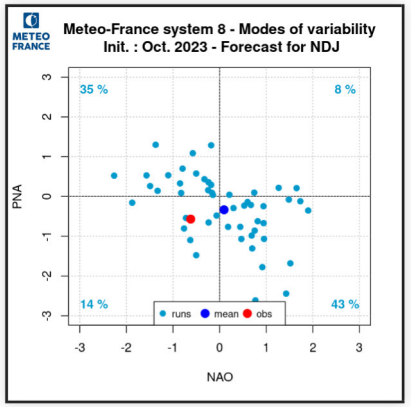
Atmospheric circulation : Modes of variability

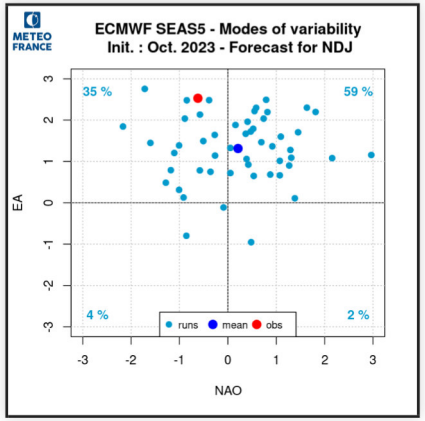
The EA+ mode was well planned but underestimated.
NAO- and especially SCAN- modes were not provided for in either model.

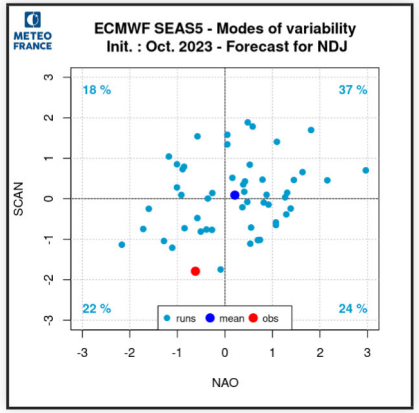
The PNA mode is well forecast.

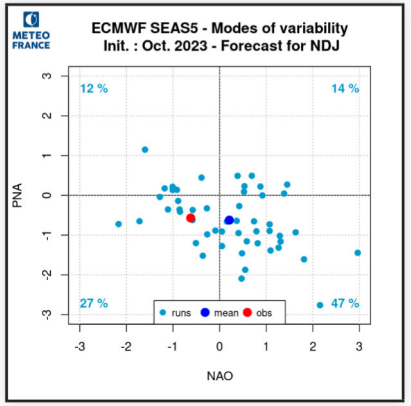






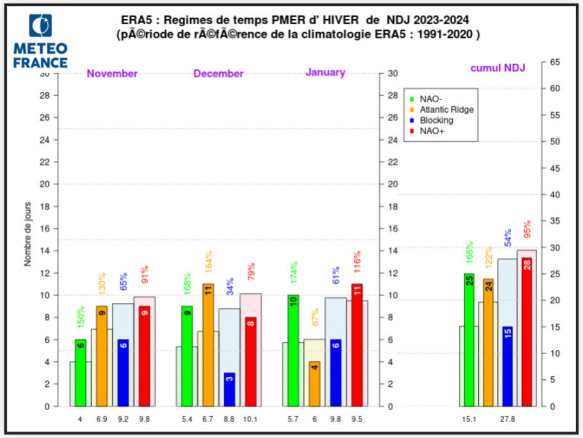


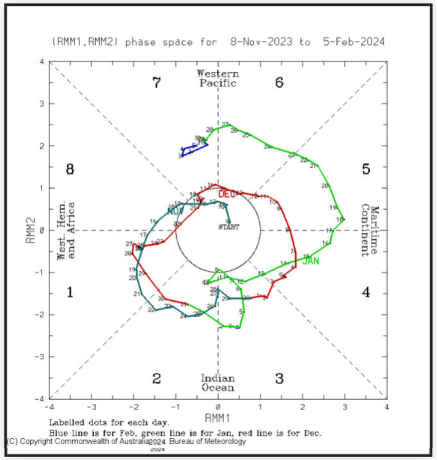


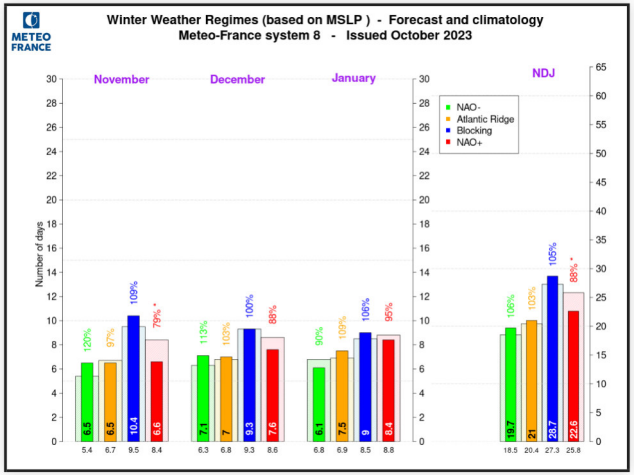


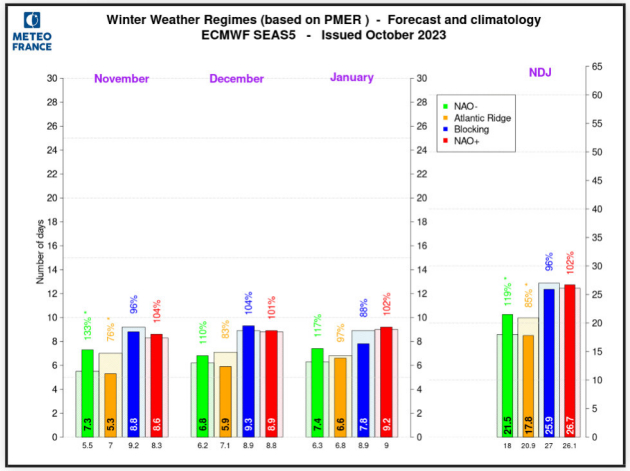
Atmospheric circulation : Winter SLP weather regimes

The NAO- and Atlantic Dorsal regimes clearly dominated over the quarter. Note the return of the NAO+ regime in January, perhaps linked to the MJO phases that month. Only the NAO- regime is significantly above its climatology for ECMWF.





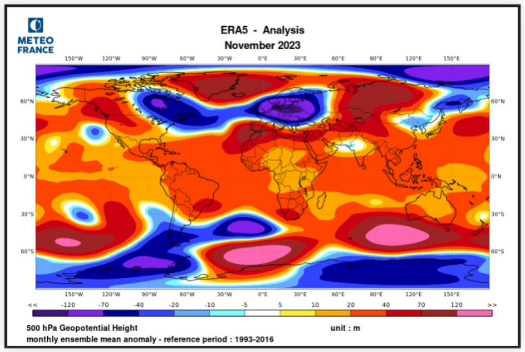


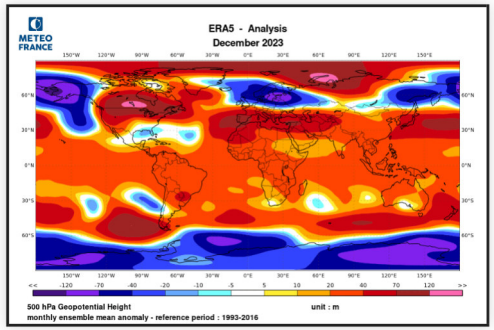


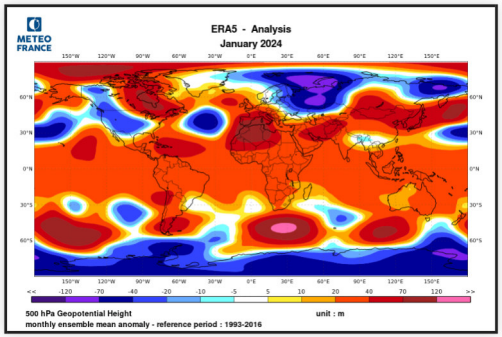
weather regime : ECMWF analysis top left, MF8 and ECMWF forecasts at the bottom. MJO phase top right

Atmospheric circulation : Variability within the quarter

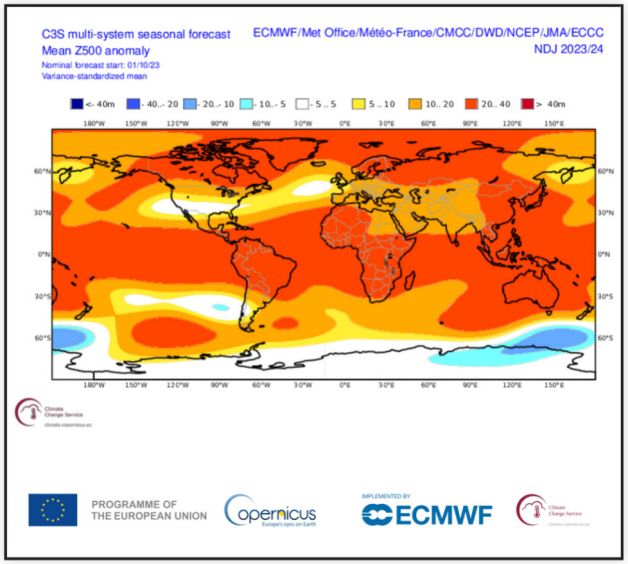
A month-by-month analysis shows a change in circulation for the month of January.

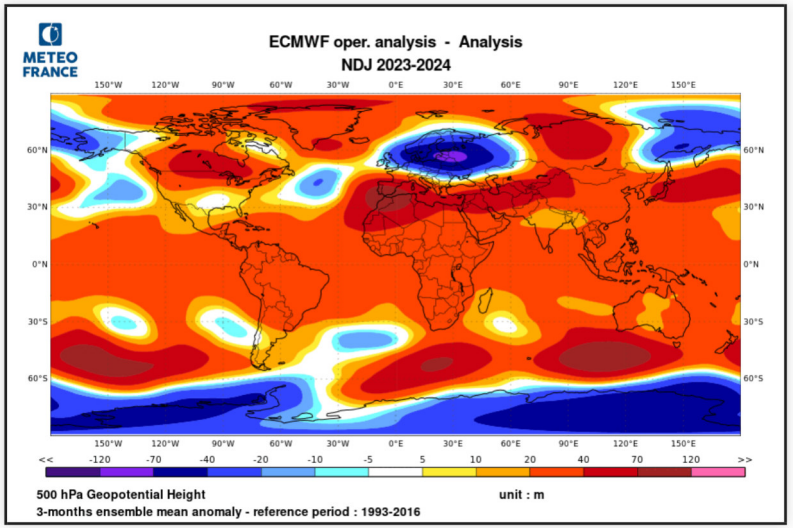






ECMWF analysis : September, octobre and novembre 500 geopotential height anomalies

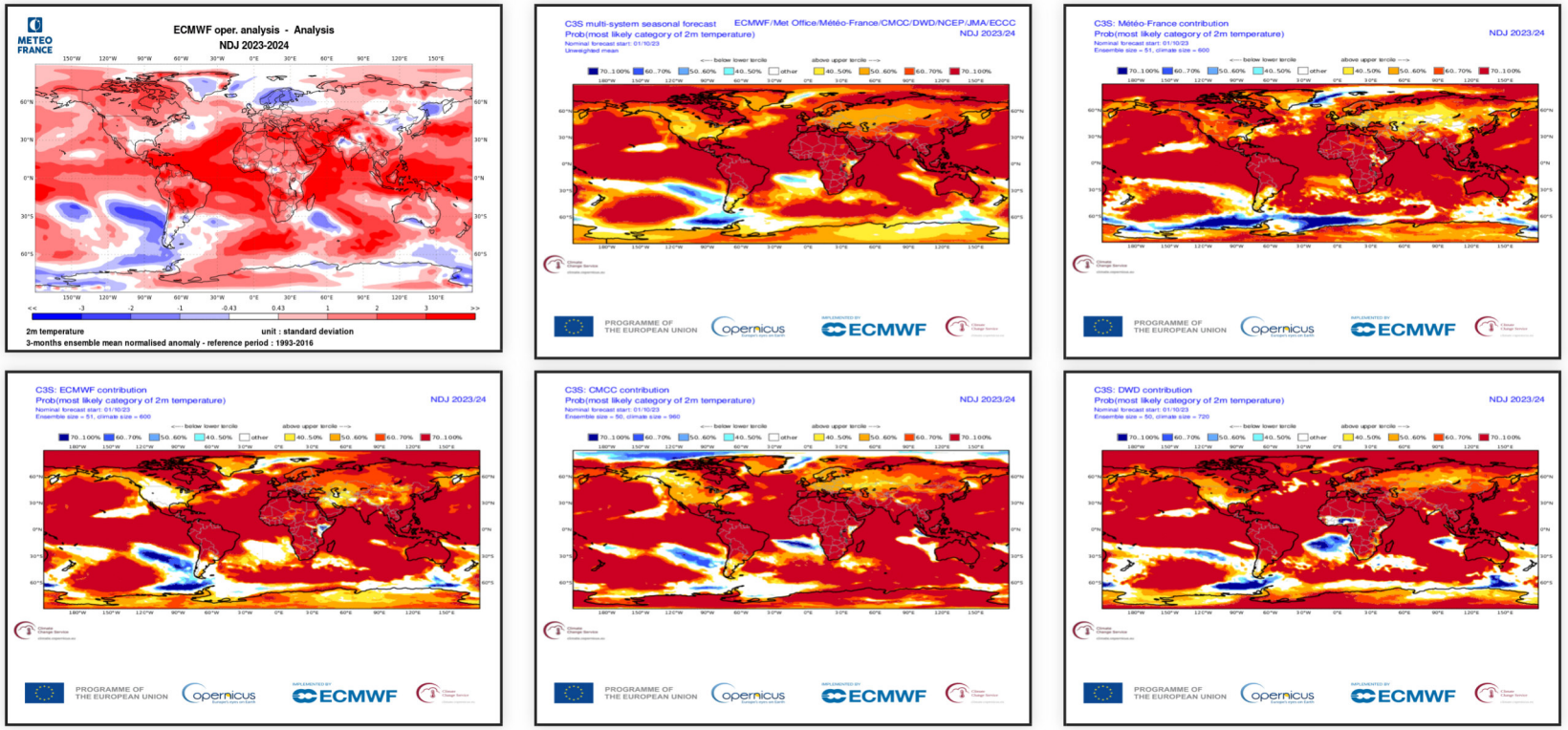




C3S multi-sytem forecast and ECMWF analysis 500 geopotential height anomalies for SON

Climatic parameters : temperature on the globe

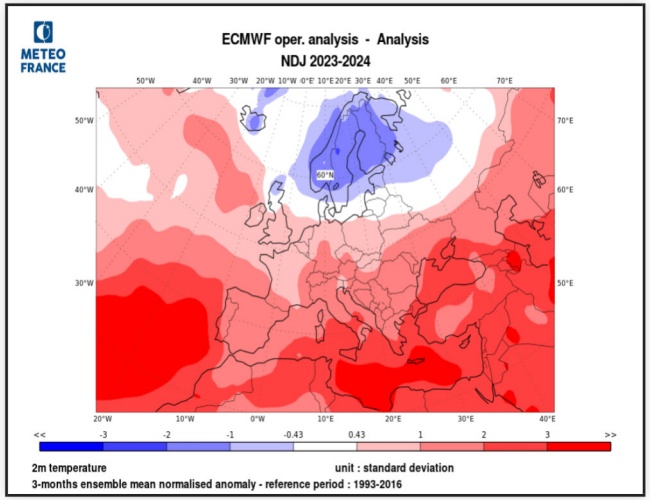
In the southern hemisphere, the main cold anomalies are well forecast (southern South America, Horn of Africa), with the exception of Australia.
In the Northern Hemisphere, less warm conditions over the USA are perceived by the models. In Europe, on the other hand, the cold anomaly over Scandinavia has not been forecast at all by the models.

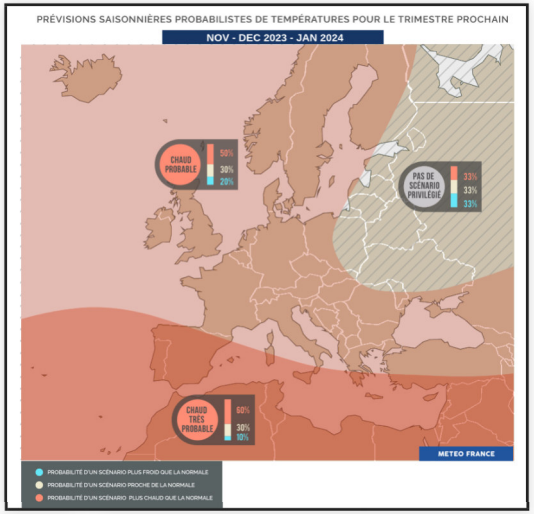


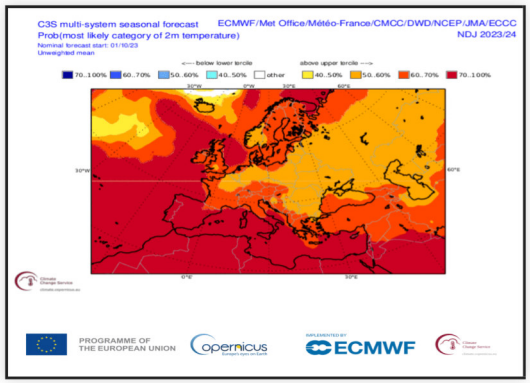
ECMWF analysis top left, forecast for multi-model top center and forecast for MF-S8 top right, ECMWF-SEAS5, CMCC, DWD on the bottom line.

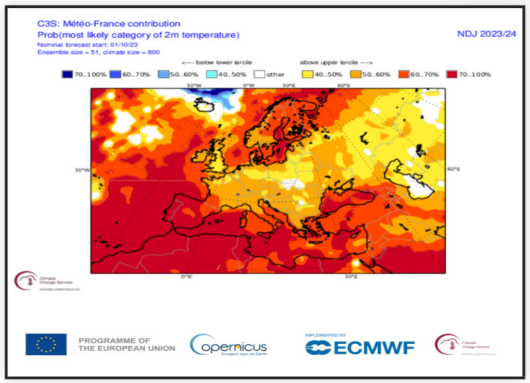
Climatic parameters : temperature over Europe

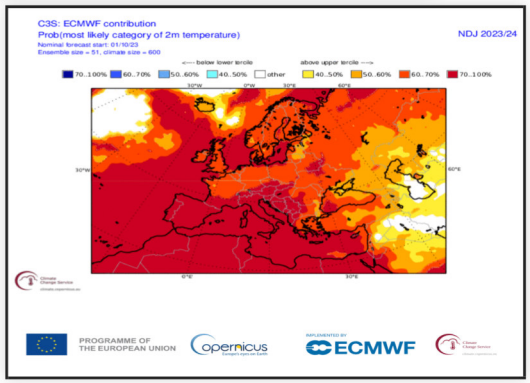
The warmer-than-normal scenario over the Mediterranean Basin, linked to the positive Z500 anomaly, was confirmed by the analysis, as well as over much of southern Europe. However, the cold anomaly over Scandinavia was not forecast.







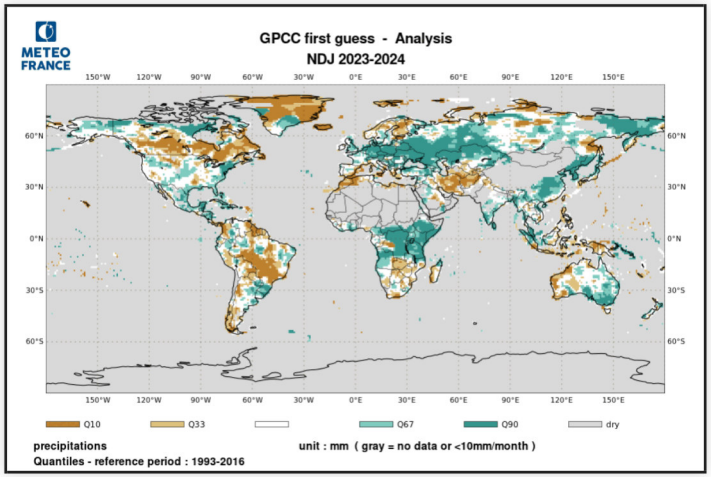


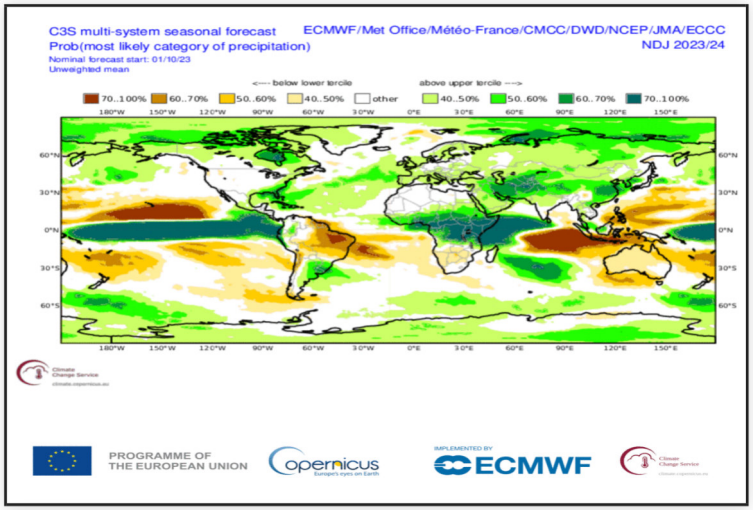


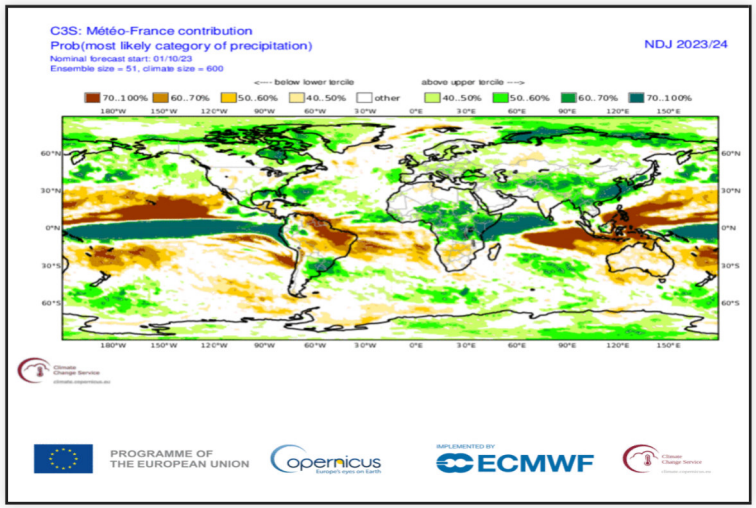
ECMWF analysis top left, synthetic forecast map top right. Forecast for multi-system , MF-S8 and SEAS5 on the bottom line.

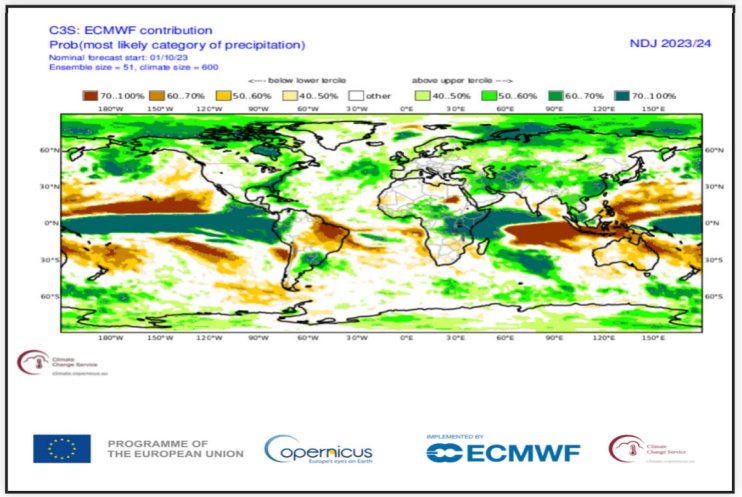
Climatic parameters : Precipitations over the globe

In the intertropics, the classic impacts of El Nino are less visible (Brazil, Maritime Continent), except over the Horn of Africa, where the wet anomaly is clearly present (also linked to the positive phase of the IOD).
At mid-latitudes in the Northern Hemisphere, differences between analyses and models are apparent (North America, Europe/Russia).





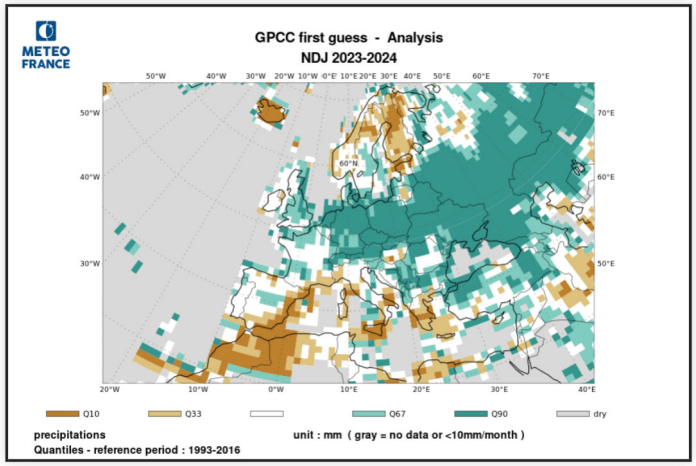


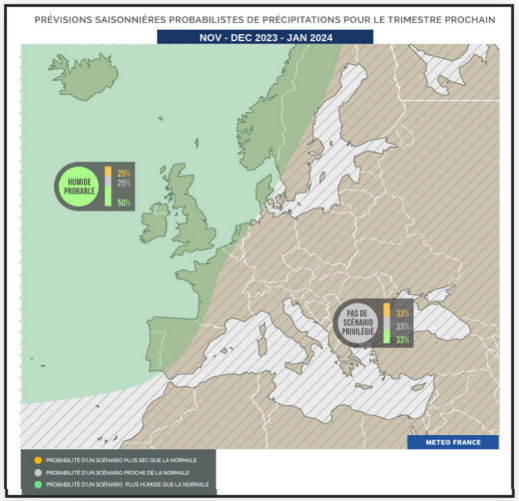


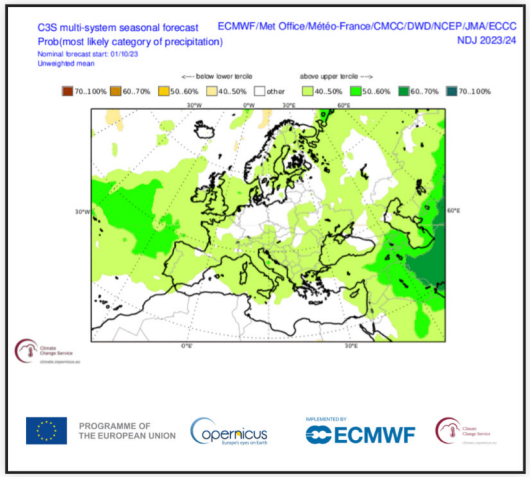
Standardized Precipitation Index analysed by IRI top left, forecast for multi-model top right and MF-S8 and SEAS5 on the bottom line.

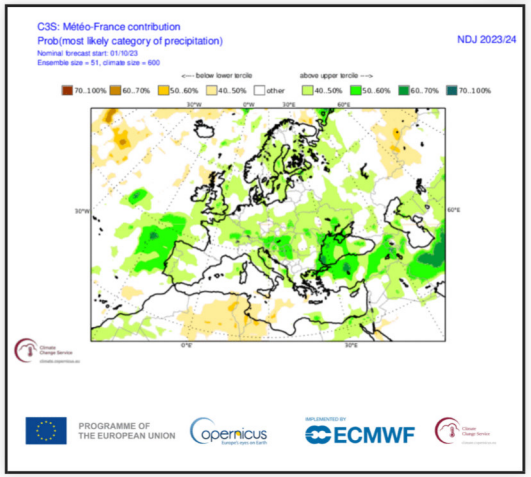
Climatic parameters : Precipitations over Europe

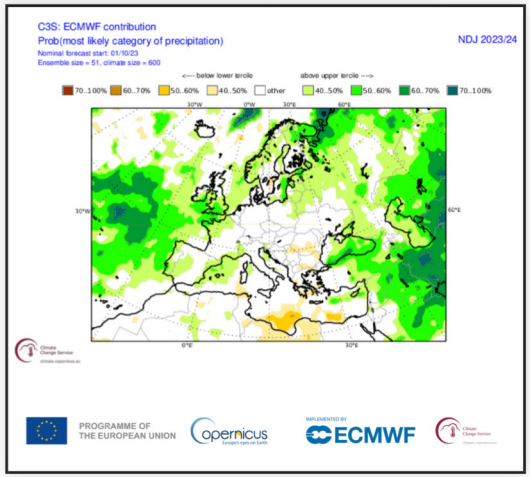
Discrepancies in atmospheric circulation over Europe between reanalysis and models strongly impact model forecasts. The wet scenario is not positioned in the right place. However, for the countries furthest west (Great Britain, France, Spain), the summary map and analysis are close.











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 ascent 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. Those from the Indian Ocean to Europe are less so. And the cyclonic curvature centered on Scandinavia was not seen by the models.

Z500 : Consequently, the strong Z500 anomaly over Scandinavia was not anticipated.

3) **Climatic parameters over Europe :**

Temperatures : The warm anomalies over the south-western two-thirds of Europe were correctly anticipated, unlike the cold anomaly over Scandinavia.

Precipitations : The problem of forecasting the negative Z500 anomaly over northern Europe has much greater repercussions for rainfall. The positive anomaly forecast over western Europe is positioned over central Europe on analysis, except from Great Britain to Spain.