VERIFICATION BULLETIN

DECEMBER 2023 - JANUARY - FEBRUARY 2024

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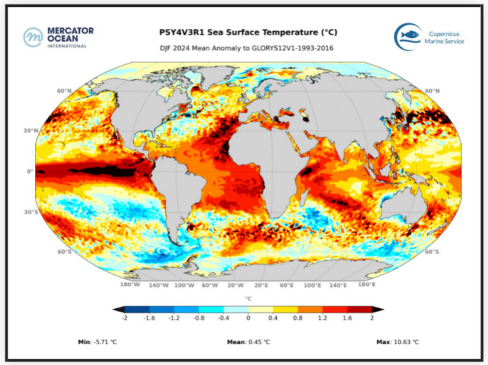
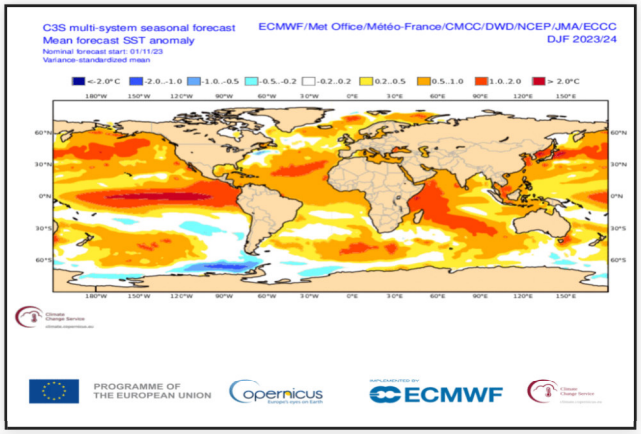
Introduction : Objective

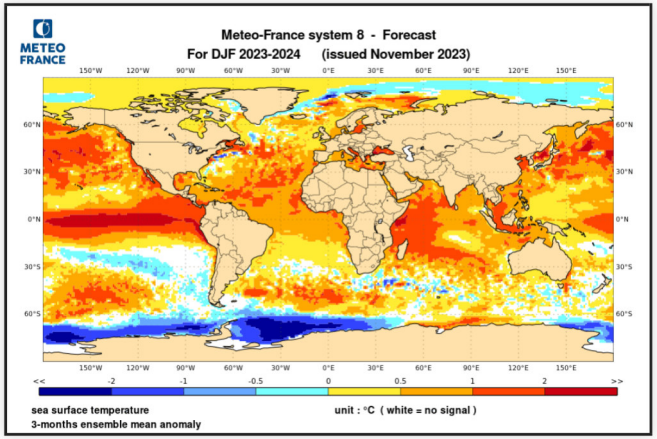
- **The objective of the Seasonal Verification Bulletin is to present an evaluation of the main elements highlighted in the Seasonal Forecast Bulletin : oceanic forcings, large scale circulation patterns, and a focus on temperature and precipitation forecast over Northern Atlantic, Europe and the Mediterranean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

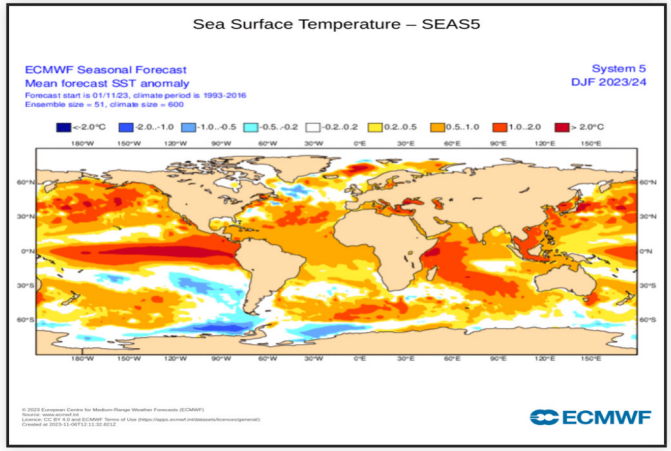
Oceans : surface temperature anomalies

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 (stronger warm anomaly over the west of the basin).
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.







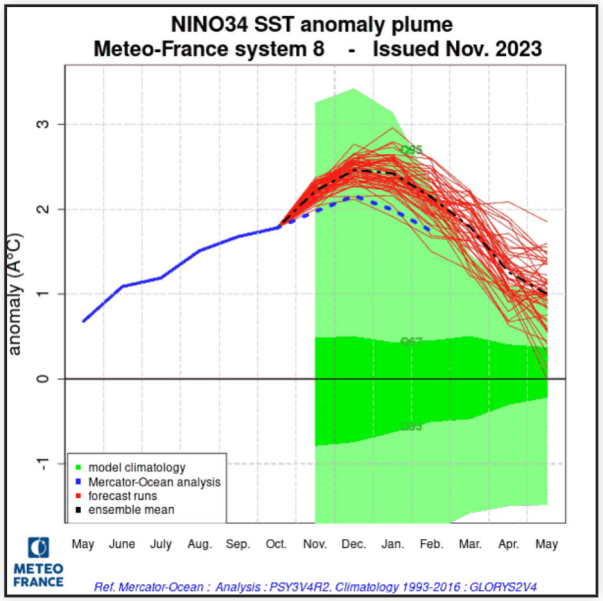


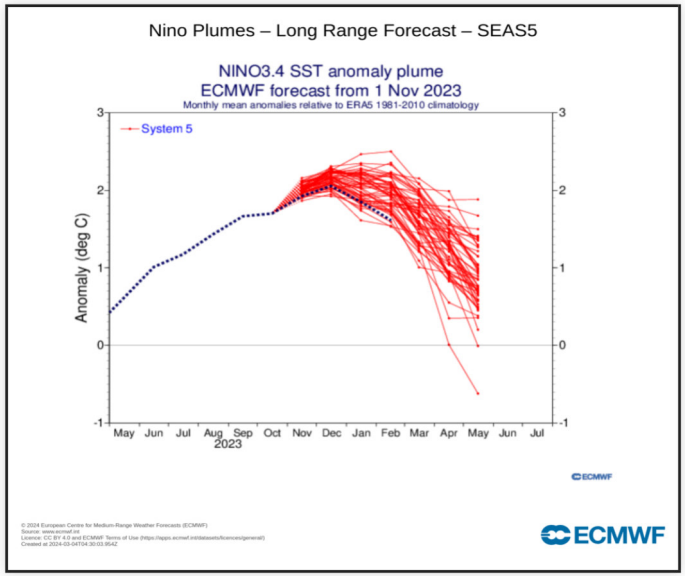
SST anomalies in the analysis from Mercator (top left), C3S multi-models (top right), MF-S8 (bottom left) and SEAS5 (bottom right)

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.

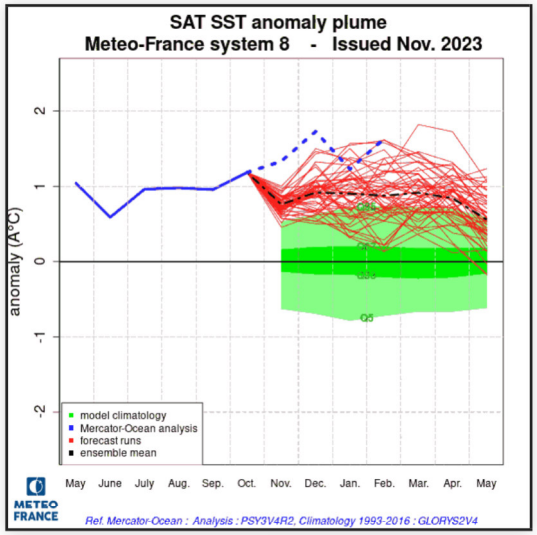


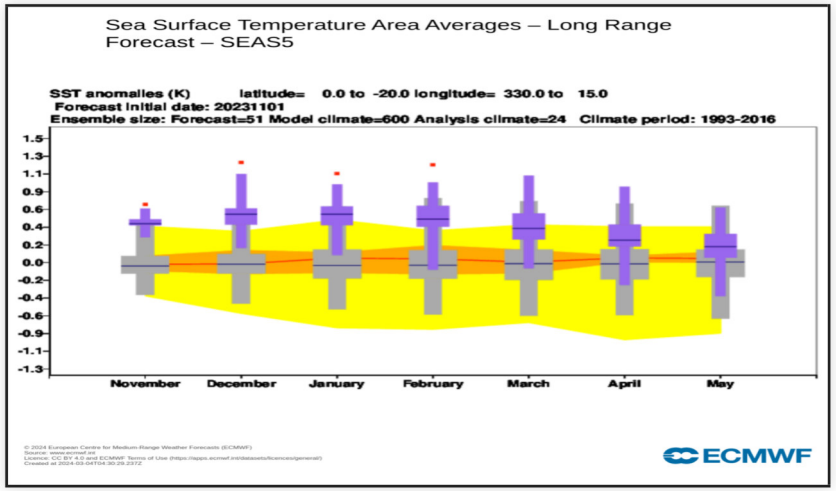


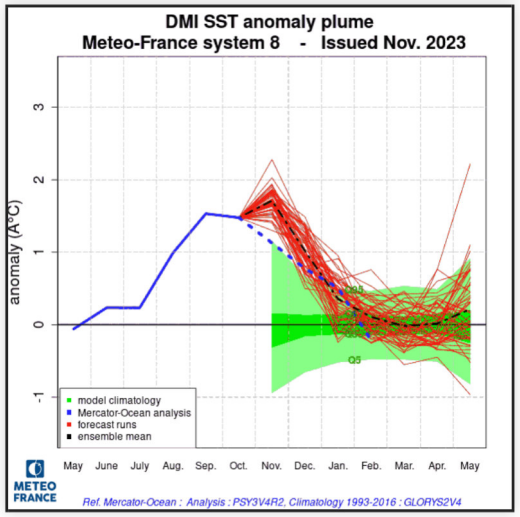
Oceans : tropical Atlantic and Indian Ocean index

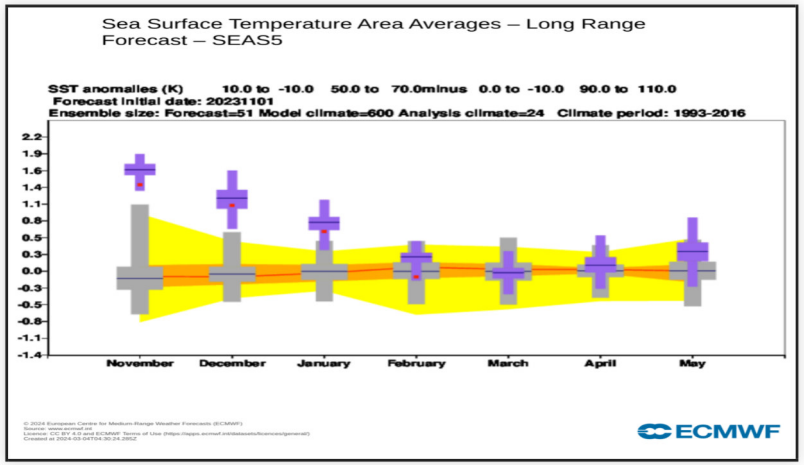
SAT : Both models underestimated the positive anomaly in the SAT index, which was particularly strong this quarter given its climatology.

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



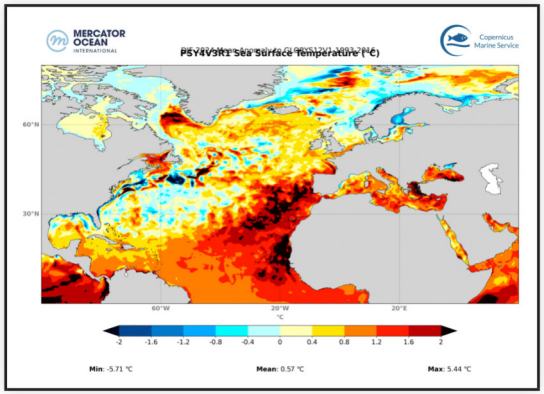


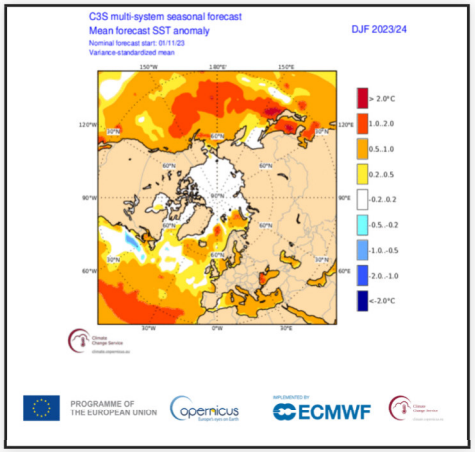


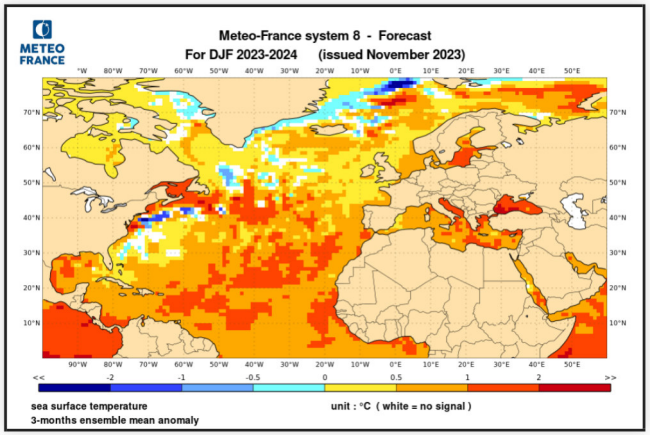


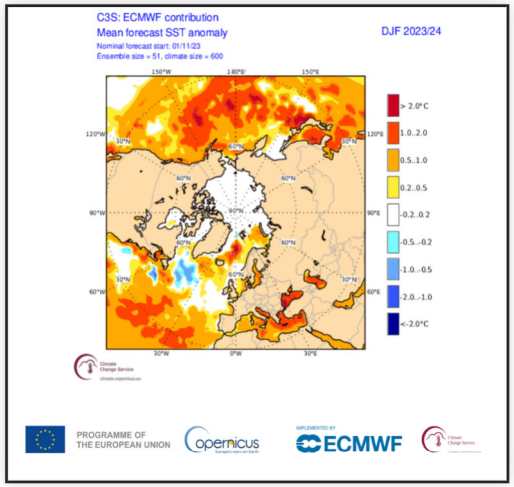
Oceans : North Atlantic SST

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.







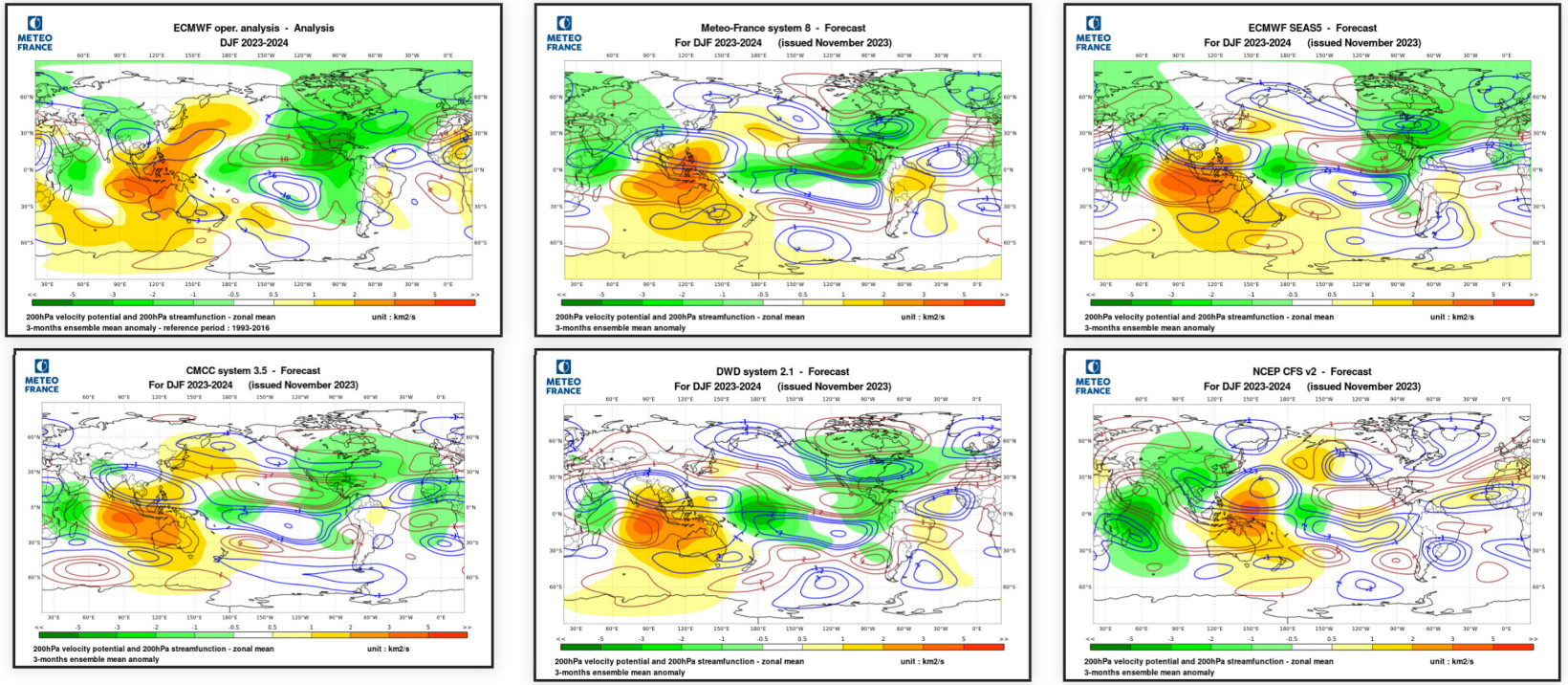


SST anomalies in the analysis from Mercator (top left), C3S multi-models (top right), MF-S8 (bottom left) and ECMWF SEAS5 (bottom right)

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 correspond to the classic El Niño phase pattern. Analysis and models suggest the positive anomaly over Amazonia. Over West Africa the subsidence observed was not predicted by the models.

SF : Dipoles on the Indian and Pacific Oceans are confirmed by analysis.Teleconnections to North America are rather well predicted by models. From South America to North Africa and to Europe thera are similarities between analysis and forecast, possibly linked to a teleconnection from Brazil.

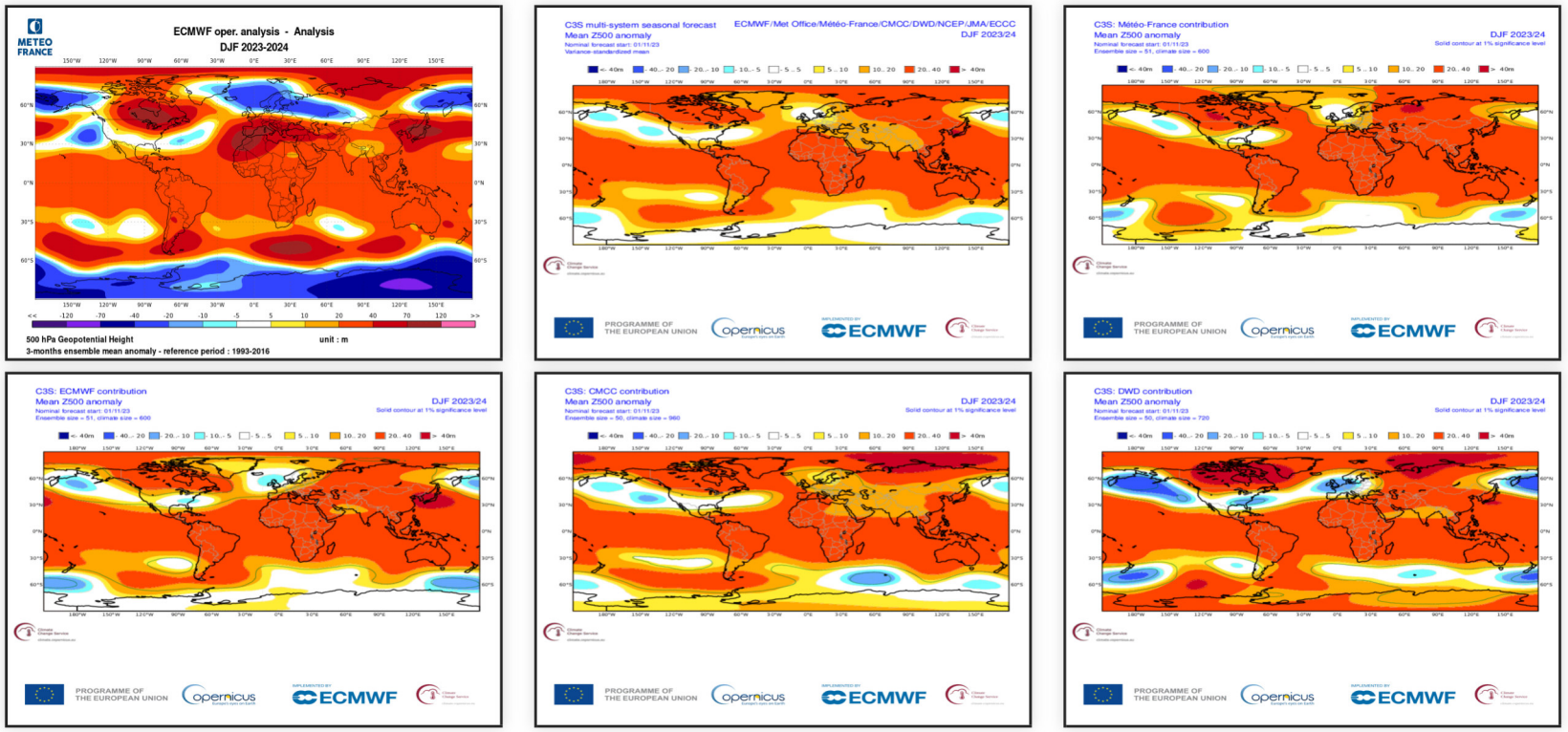


ECMWF analysis, MF-S8, ECMWF-SEAS5, CMCC, DWD and JMA 200hPa velocity potential anomalies (color range, green : ascending, orange: subsidence) and stream function anomalies (isolines, red: anticyclonic in the northern hemisphere, blue: cyclonic in the northern hemisphere).

Atmospheric circulation : 500hPa Geopotential height

Southern Hemisphere : The main anomalies are well forecasted around Pacific unlike others basins.

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 suggested by multi-models.

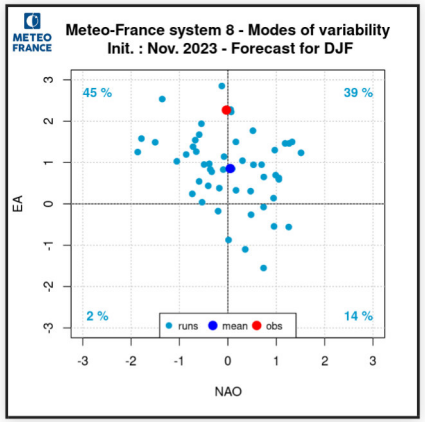


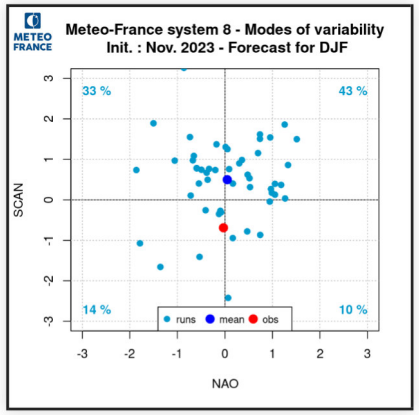
ECMWF analysis, C3S multi-system, MF-S8, ECMWF-SEAS5, CMCC and DWD 500hPa geopotential height anomalies.

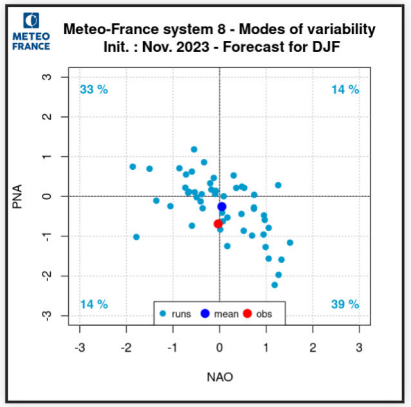
Atmospheric circulation : Modes of variability

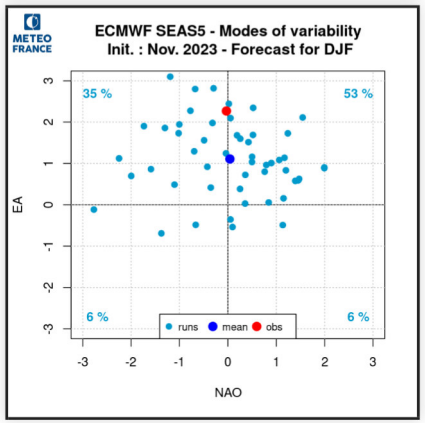
The EA+ mode was well planned but underestimated.
NAO close to zero both in the analysys and the forecasts.

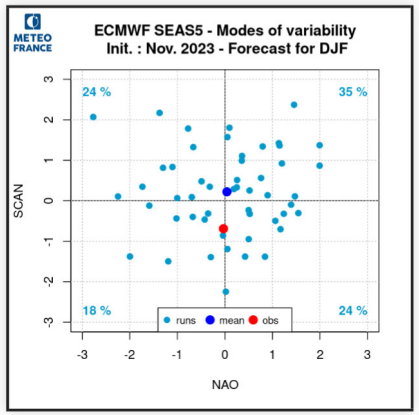
The PNA mode is well forecast. The forecast of SCAN *mode* favor the positive phase while it is the negative phase which was observed.

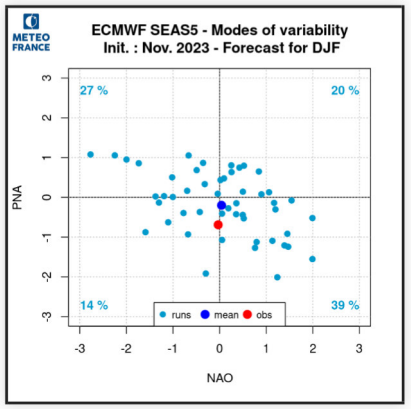








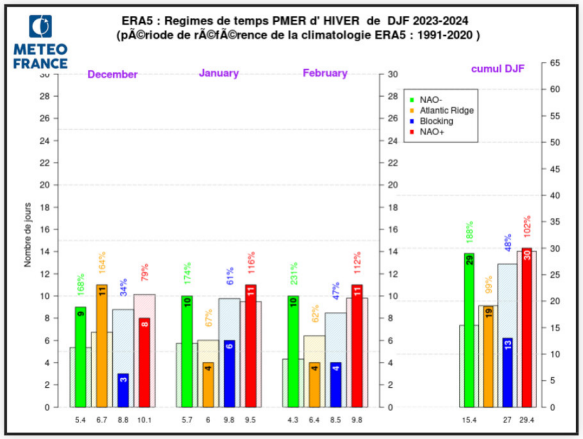


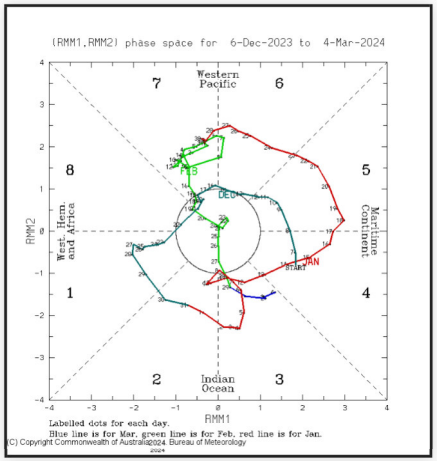


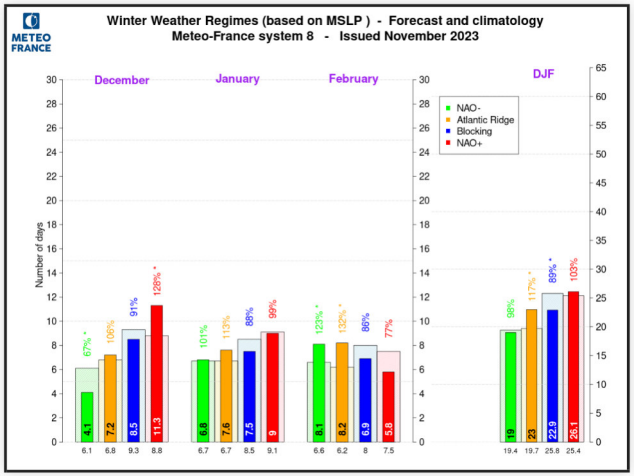
Atmospheric circulation : Winter SLP weather regimes

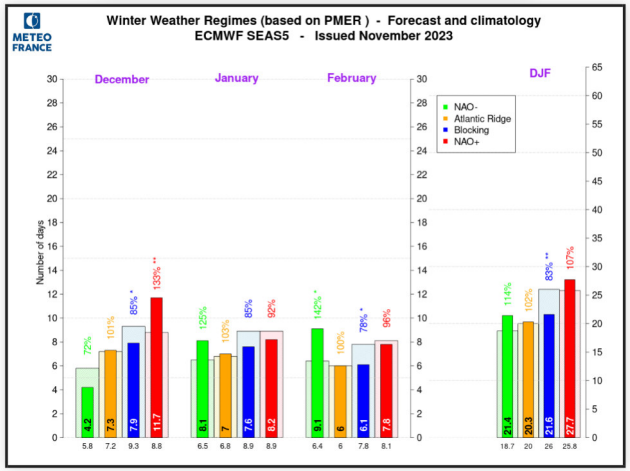
The NAO- regime was more frequent than normal over the quarter unlike blocking regime.

Models correctly predicted the deficit of the blocking regime but not the surplus of the NAO - régime





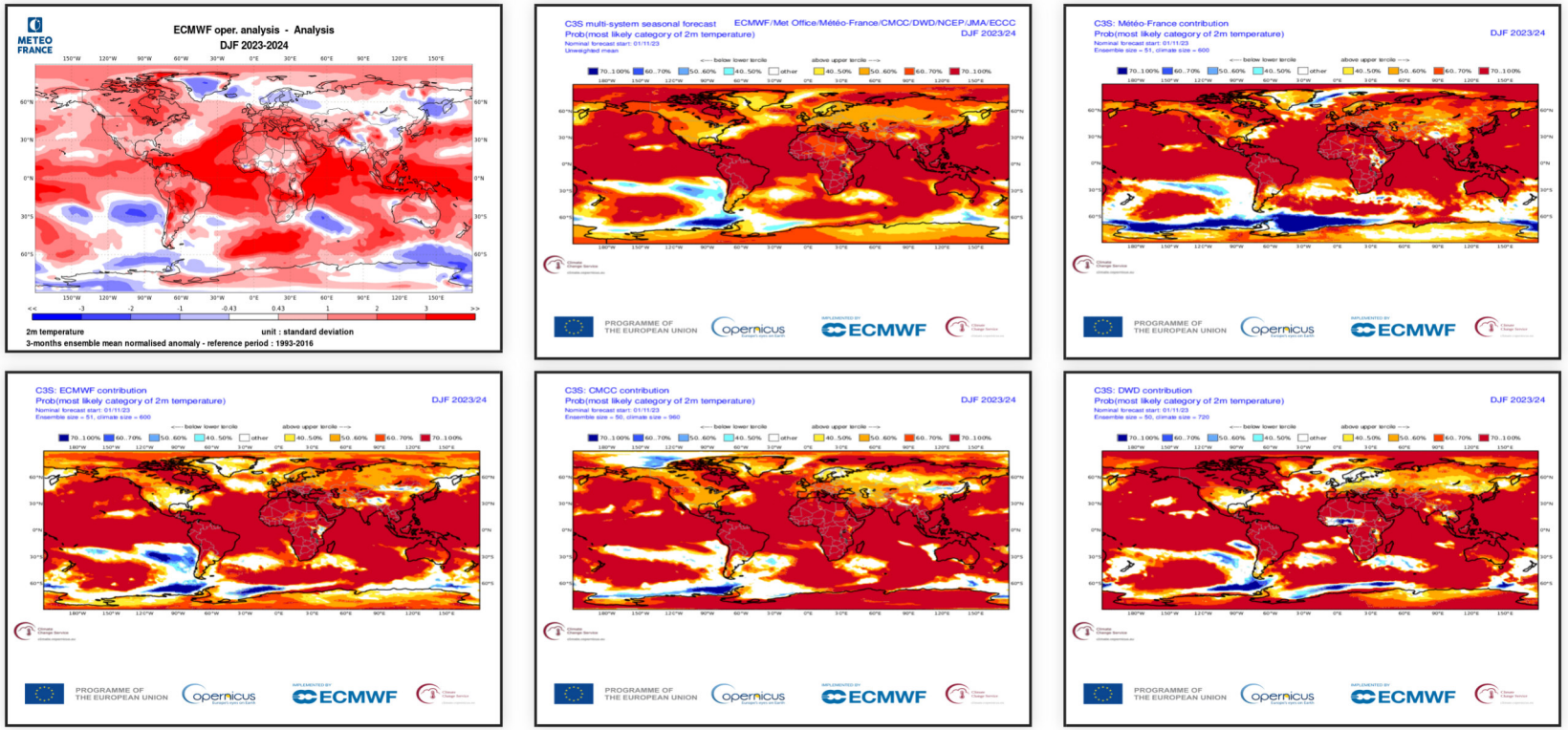




weather regime : ECMWF analysis top left, MF8 and ECMWF forecasts at the bottom. MJO phase top right

Climatic parameters : temperature on the globe

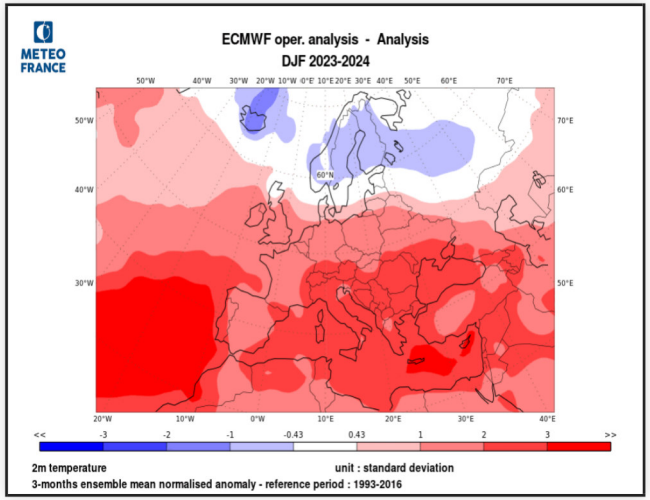
In the southern hemisphere, the main cold anomalies are well forecast and are linked to oceanic anomalies.
In the Northern Hemisphere the cold anomaly from Greenland to Scandinavia has not been forecast (the models suggested a lower probability of warm anomaly than elsewhere).

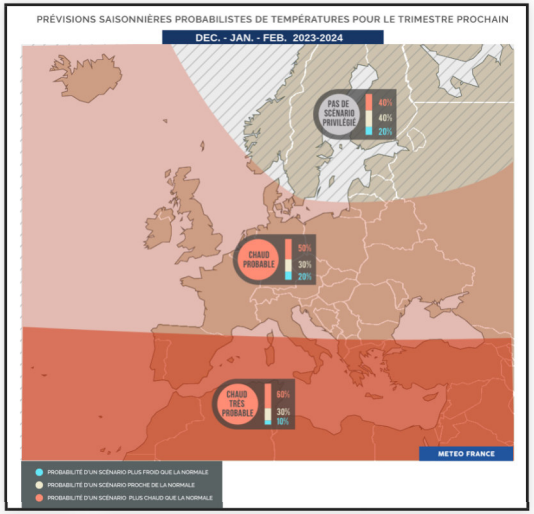


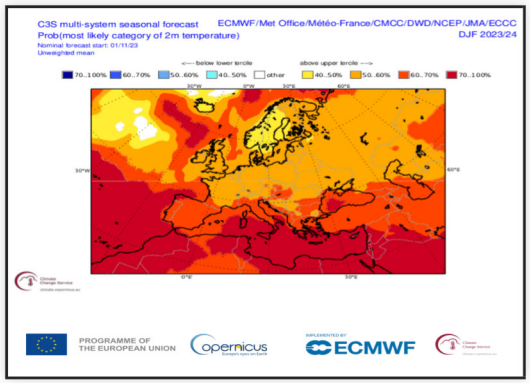
ECMWF analysis top left, forecast for multi-model top center and forecast for MF-S8 top right, ECMWF-SEAS5, CMCC, DWD on the bottom line.

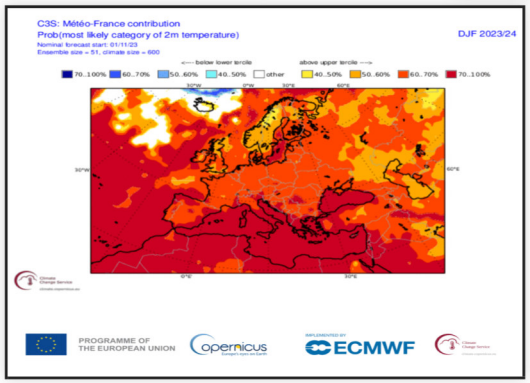
Climatic parameters : temperature over Europe

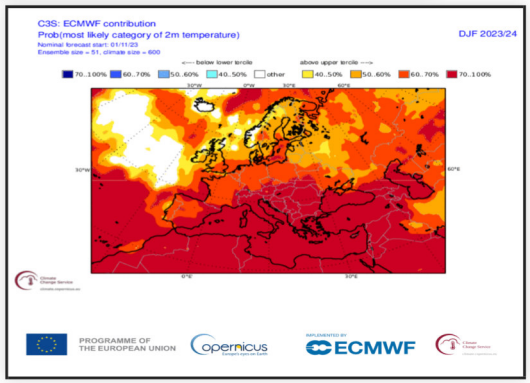
The warmer-than-normal scenario over the Mediterranean Basin, linked to the positive Z500 anomaly, was confirmed by the analysis, as well as over much of southern Europe. However, the cold anomaly over Scandinavia was not forecast.







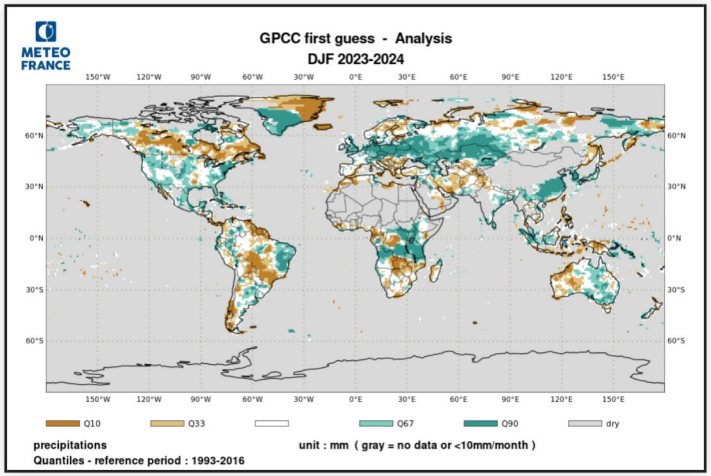


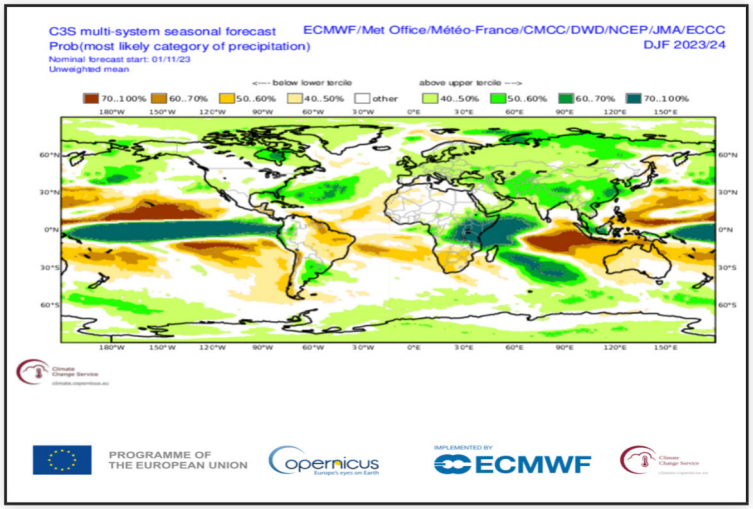


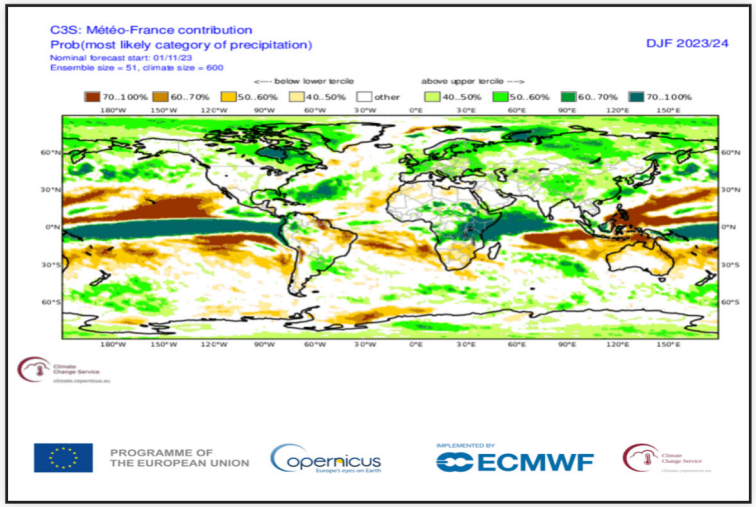
ECMWF analysis top left, synthetic forecast map top right. Forecast for multi-system , MF-S8 and SEAS5 on the bottom line.

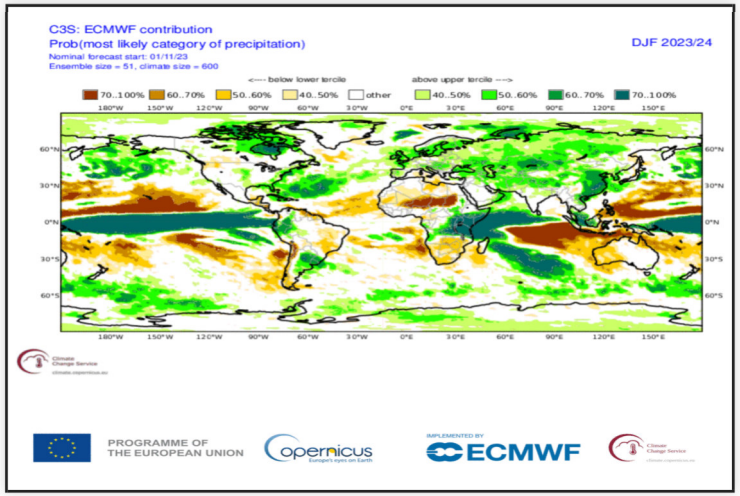
Climatic parameters : Precipitations over the globe

In the intertropics, the classic impacts of El Nino are less visible (Brazil, Maritime Continent), except over African Great lakes, 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 in North America while wet signal on Eurasia is well anticipated.





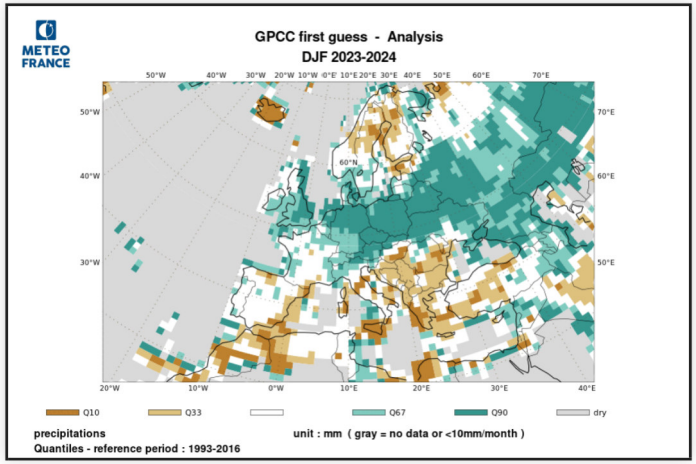


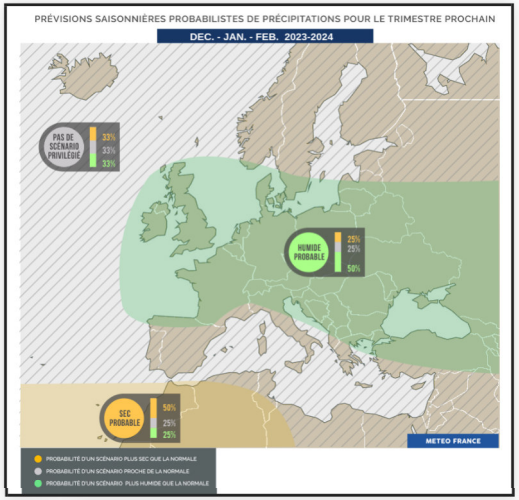


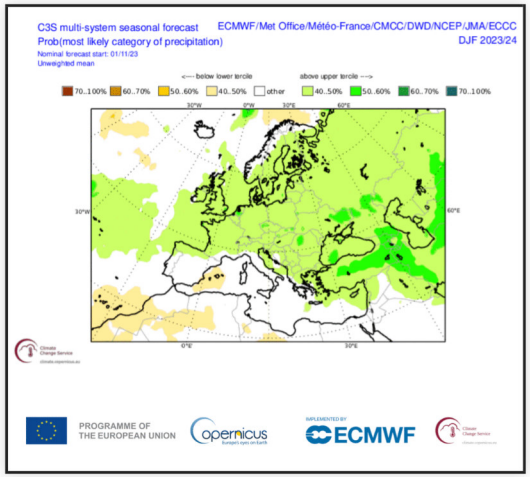
Standardized Precipitation Index analysed by IRI top left, forecast for multi-model top right and MF-S8 and SEAS5 on the bottom line.

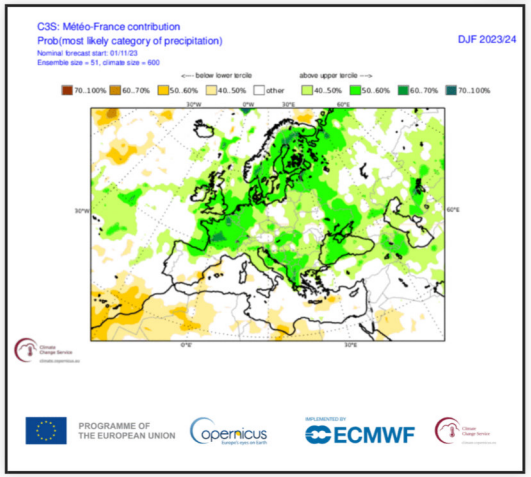
Climatic parameters : Precipitations over Europe

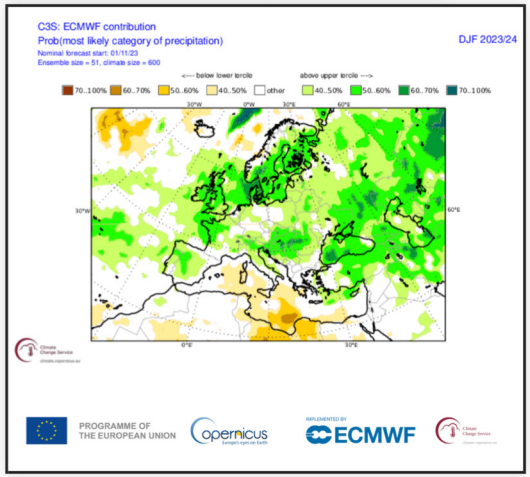
The wet sceanrio dominates both in forecasts and analysis over much of Europe. A dry scenario was indeed forecast for the north of the Maghreb but it also affected the south-east of Europe.











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. The anticyclonic curvature over North Africa was seen by the models but the cyclonic from greenland to Scandinavia are less so.

Z500 : Consequently, the strong Z500 anomaly over Scandinavia was underestimated

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 wet sceanrio dominates both in forecasts and analysis over much of Europe. A dry scenario was indeed forecast for the north of the Maghreb but it also affected the south-east of Europe.