Météo-France Seasonal Forecast Bulletin

DECEMBER 2023 - JANUARY - FEBRUARY 2024

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General synthesis : D 2023 - JF 2024

The El Nino phenomenon will peak at the coming months, while the positive phase of IOD decreases rapidly. Atmospheric circulation is largely conditioned by these two phenomena.

A) Oceanic forecast :

- ENSO : El Niño conditions (moderate to strong with Nino3.4 index close to 2)

- IOD : Positive phase (moderate to strong at the beginning with DMI index close to 1.5)

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

B) Drivers :

Positive phase of ENSO and IOD

QBO easterly wind phase.

C) Atmospheric circulation :

Between the tropics, atmospheric circulation is largely influenced by the positive phases of ENSO and IOD, with subsidies over the eastern Indian Ocean and ascents over the Pacific Ocean. Teleconnections are expected from the Pacific Ocean to North America and from the Indian Ocean to the Middle East.
Overall, positive EA mode is favored. NAO+ regime more frequent than climatology in December becomes less likely the followings months to benefit from NAO- regime more likely in January and February. This being excpected in conditions El Niño

D) Most likely conditions :

Temperatures : Warmer-than-normal scenario over Western and Southern Europe.

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

Next bulletin : scheduled on December 20th

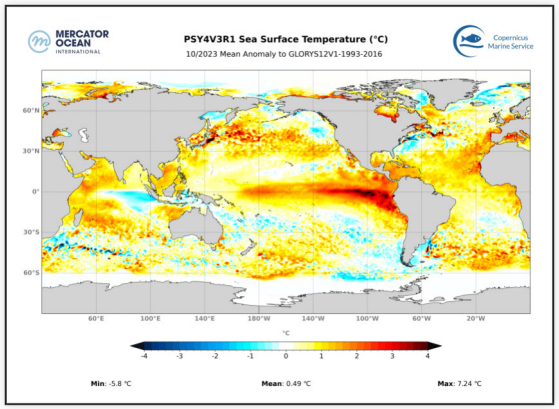
Oceanic analysis of October 2023 : SST anomalies

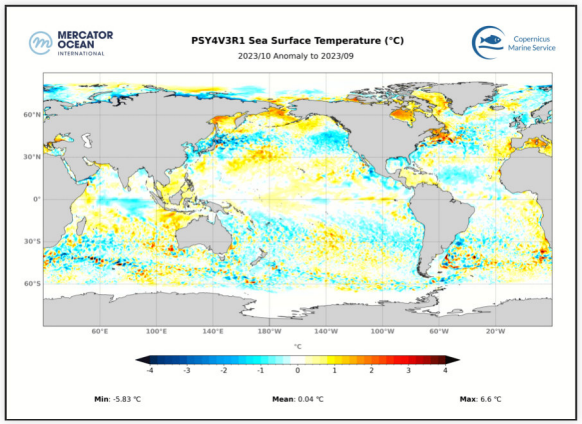
Current ENSO situation : positive phase

In the Pacific Ocean : In the equatorial zone, little change compared to the previous month : the positive SST anomaly is still marked near the South American coast and extends beyond the date change line. In the Northern Hemisphere, the PDO- pattern persists despite a cooling in the west part.

In the Indian Ocean : Little change, with a continuing contrast between warmer conditions in the west and colder conditions in the east of the basin.

In the Atlantic Ocean : From the equatorial zone to the Northern Hemisphere, the positive SST anomaly persists, even if it is tending to weaken.

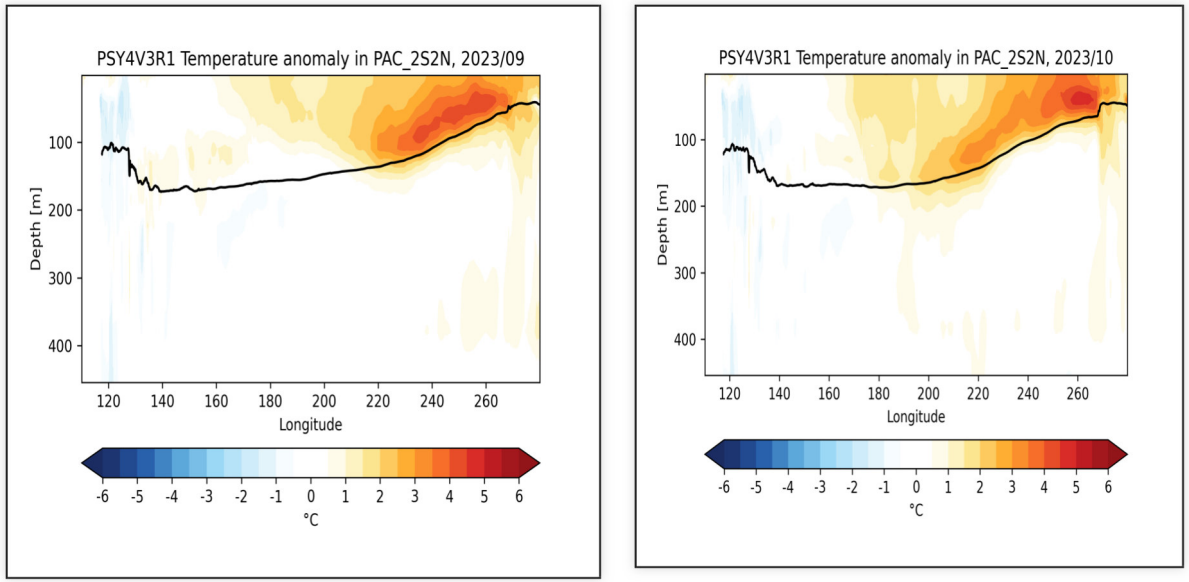




SST Anomalies and trend with the previous month (c) Mercator-Ocean

Oceanic analysis of October 2023 : Pacific vertical section

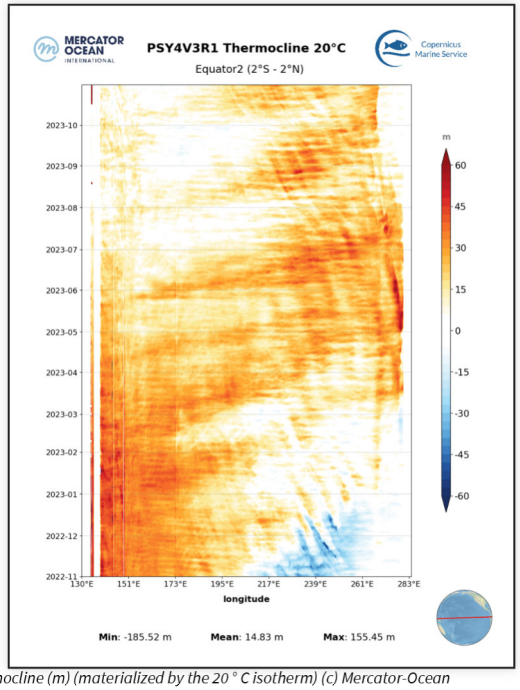
In the subsurface, the warm anomaly is spreading slowly westwards.



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

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

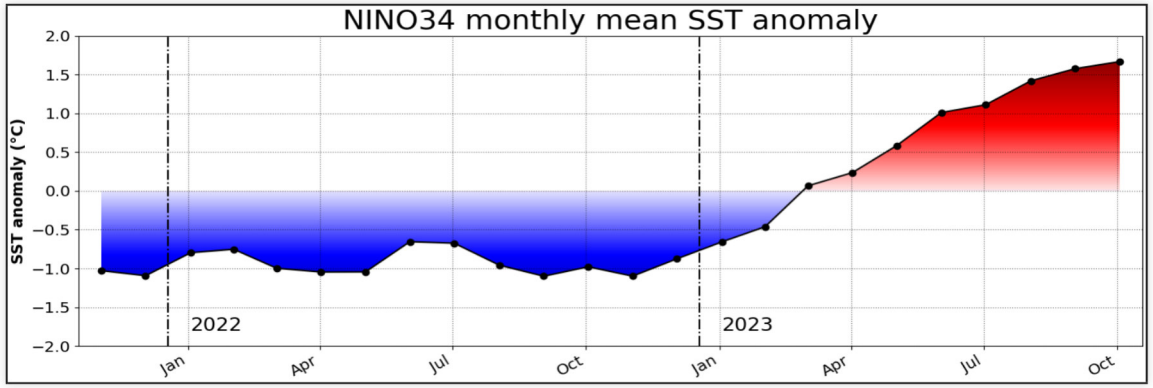
Little change in the thermocline.



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

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

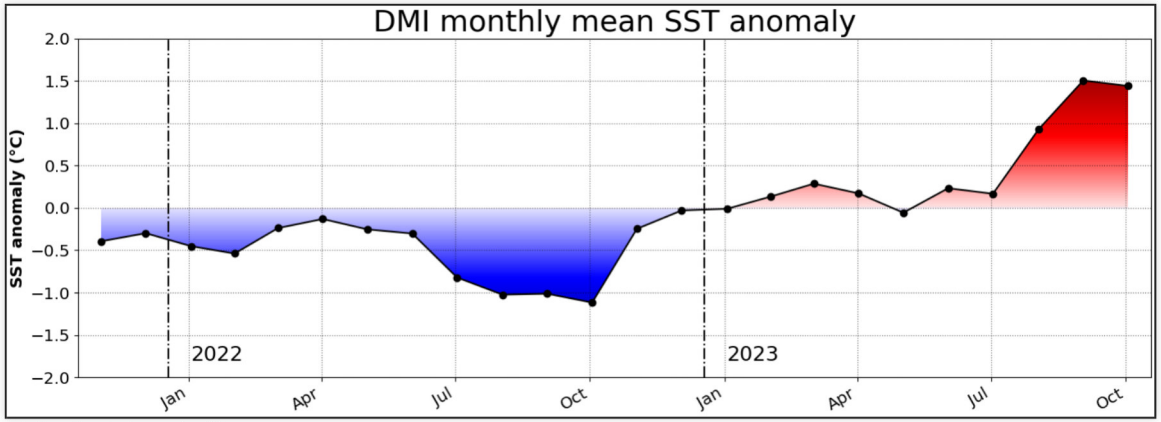
Nino3.4 index issued from Mercator Ocean PSYV4R2 analysis : above +1.6 °C
(see BOM site for weekly values : http://www.bom.gov.au/climate/enso/monitoring/nino3_4.png)



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

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

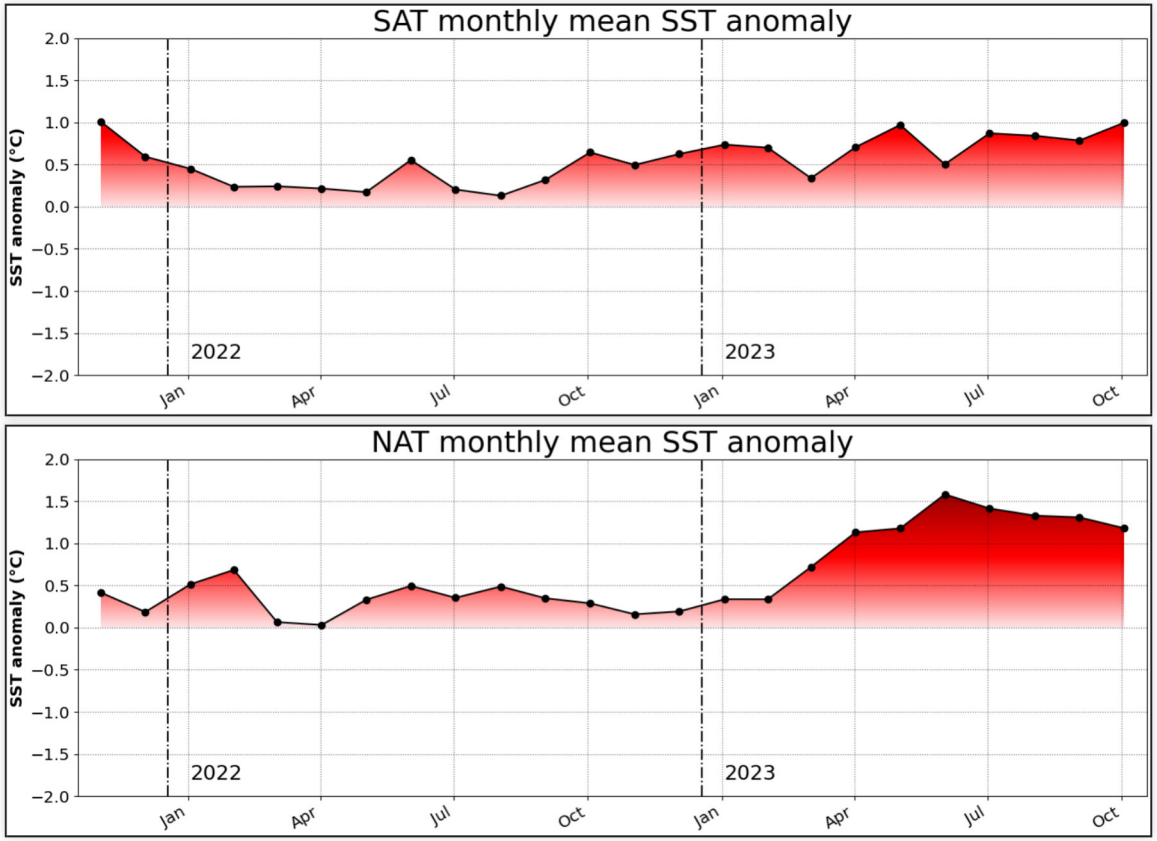
DMI Index issued from Mercator Ocean PSYV4R2 analysis : close to +1.5°C
(see BOM site for weekly values : http://www.bom.gov.au/climate/enso/monitoring/iod1.png)



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

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

The warm anomaly remains strong in the northern Atlantic tropical zone, and more moderate in the equatorial zone.



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

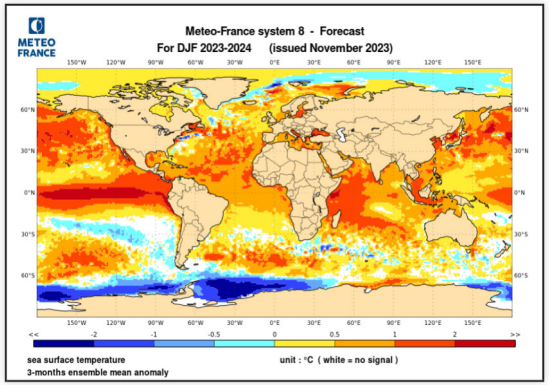
Oceanic forecast : SST anomaly

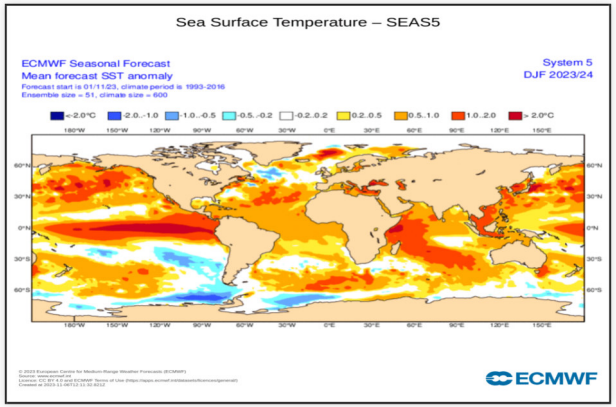
Very good agreement between the two models on the main anomalies.

In the Pacific Ocean : In the equatorial zone, the warm anomaly continues to move westwards, reaching the Solomon Islands. In the Northern Hemisphere, the PDO- pattern is still present.

In the Indian Ocean : The east-west gradient in SST, and in particular the warm anomaly near Africa, are predicted by both models.

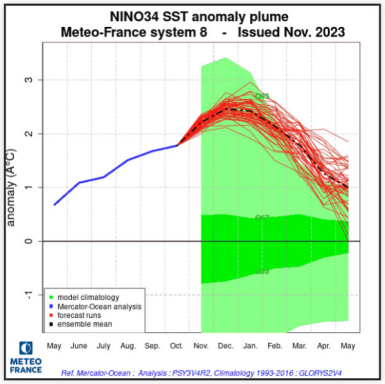
In the Atlantic Ocean : MF8 and ECMWF are now well in phase on positive anomalies over the North and Equatorial Atlantic.

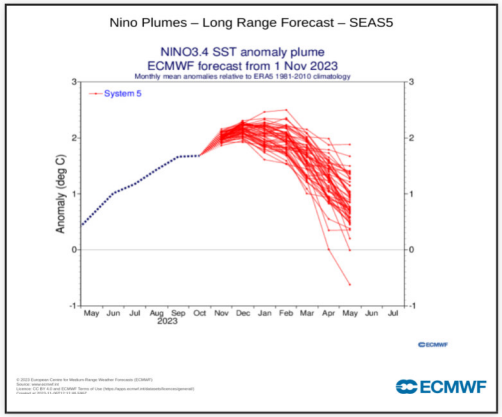




Oceanic forecast : NINO3.4 Plume diagrams

MF8 and ECMWF forecast the peak of the Nino3.4 index in next quarter. MF8 is forecasting higher values than ECMWF.

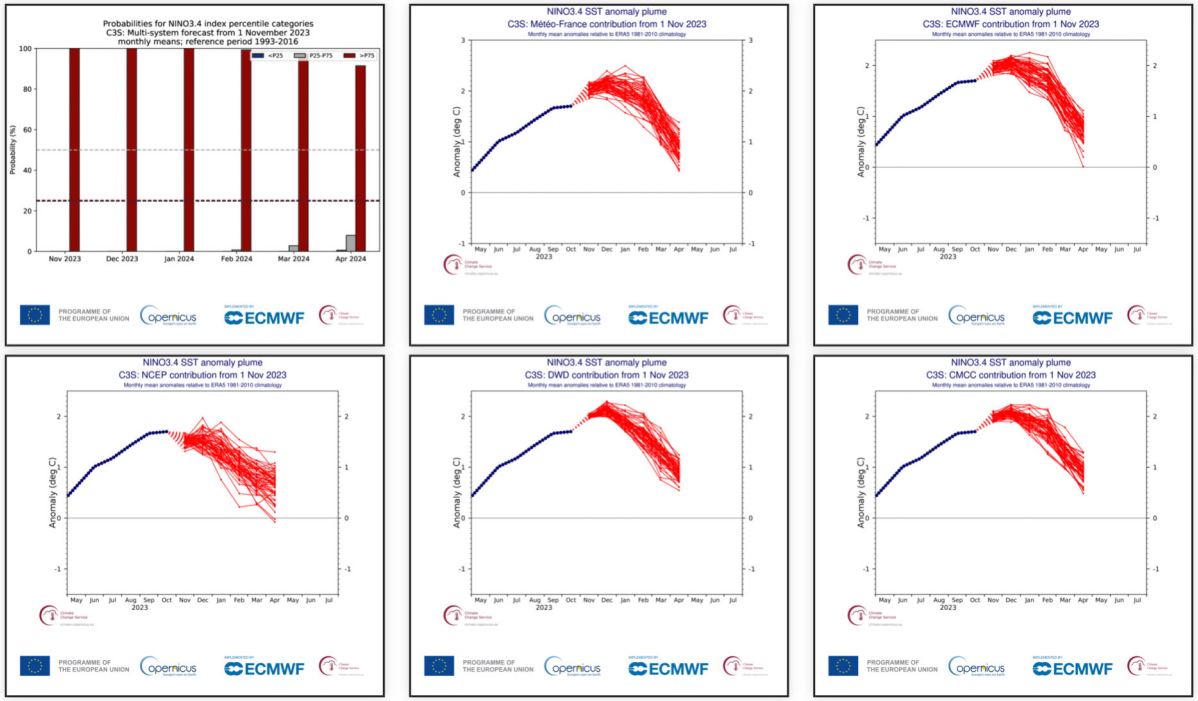




Oceanic forecast : C3S Nino3.4 re-scaled plume diagrams

Most models forecast an increase in the index until December/January, to peak around +2°C.

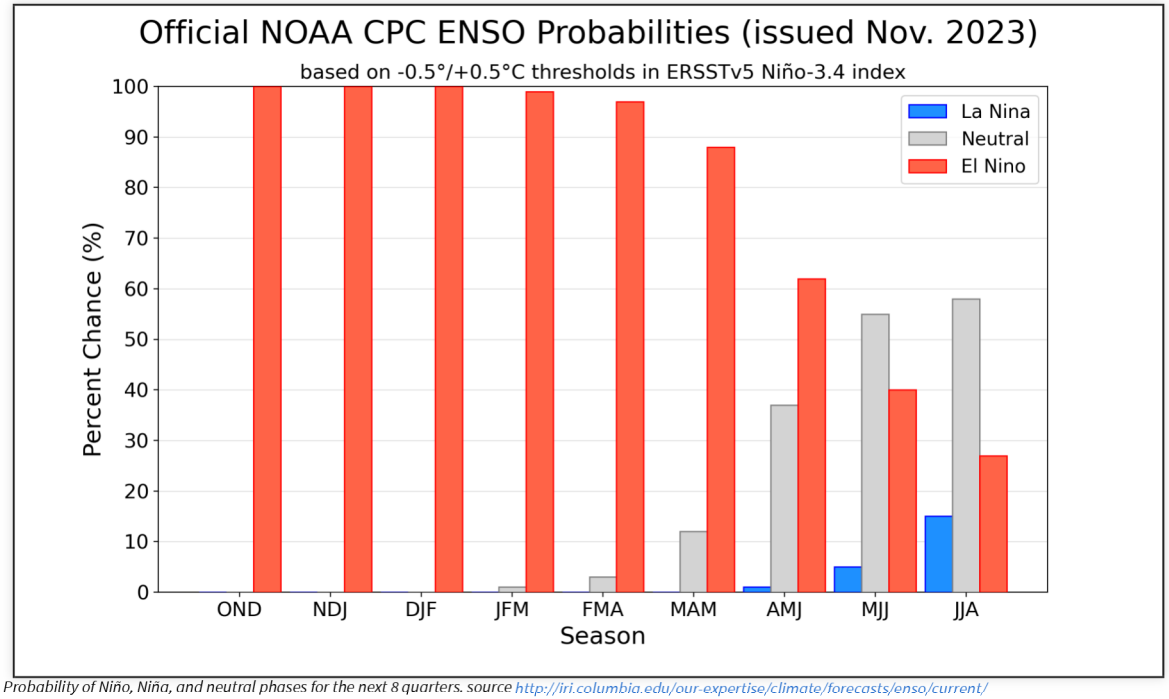
The most likely phase for the next three months : Positive phase



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

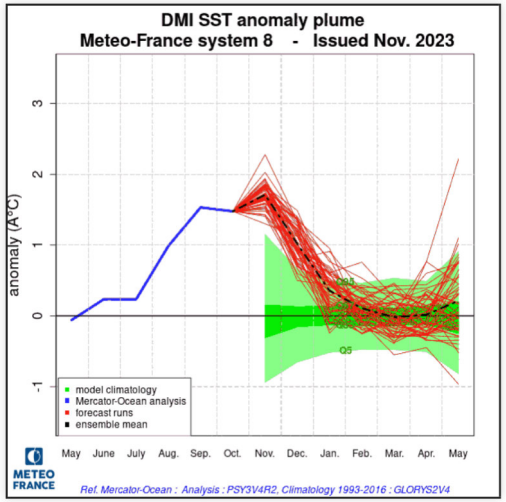
IRI forecast : 100% probability of El Niño conditions for DJF.

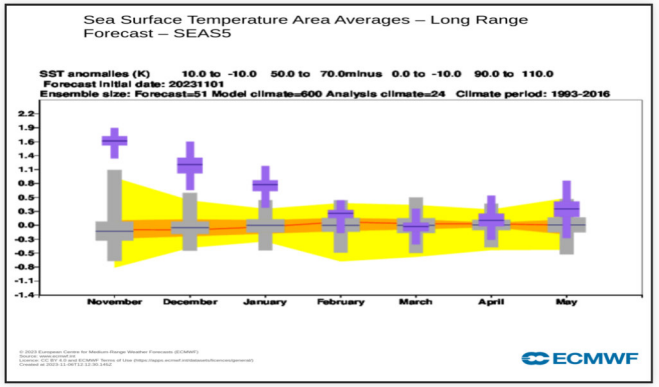


Probability of Niño, Niña, and neutral phases for the next 8 quarters. source http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/

Oceanic forecast : Indian ocean - DMI evolution

The DMI index peaked in November and declined significantly during the next quarter.

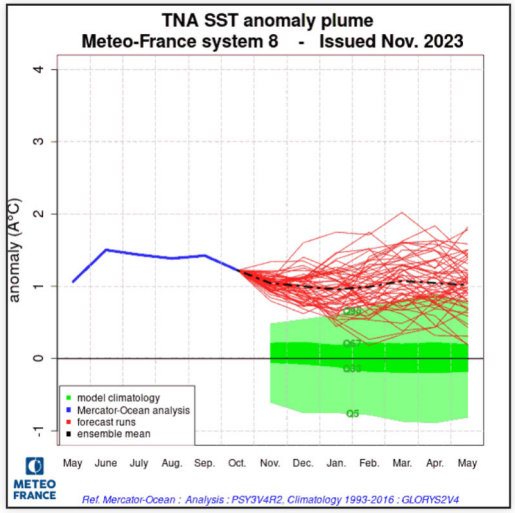


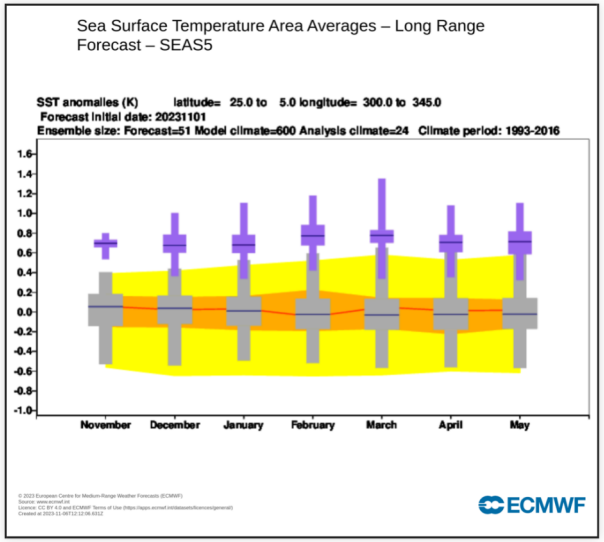


DMI index : analysis, forecasts and model climatology with MF-S8 on the left and ECM-SEAS5 on the right

Oceanic forecast : Atlantic ocean - TNA evolution

The warm anomaly in the TNA zone predicted by both models is particularly high.



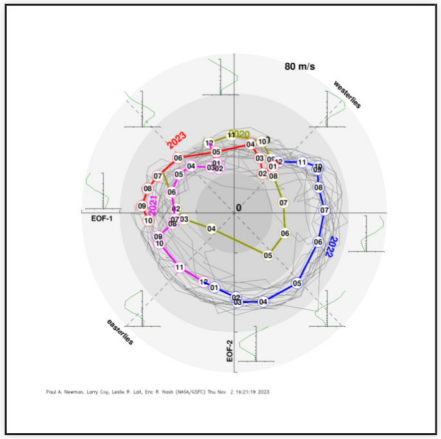


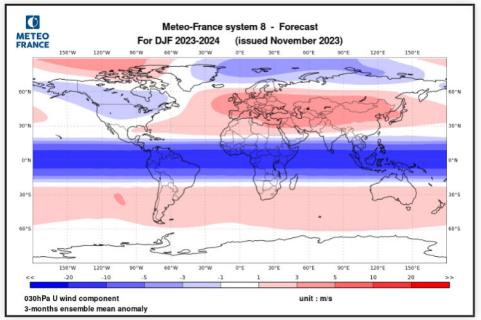
TNA index : analysis, forecasts and model climatology with MF-S8 on the left and ECM-SEAS5 on the right

Drivers : QBO analysis

QBO enters 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).

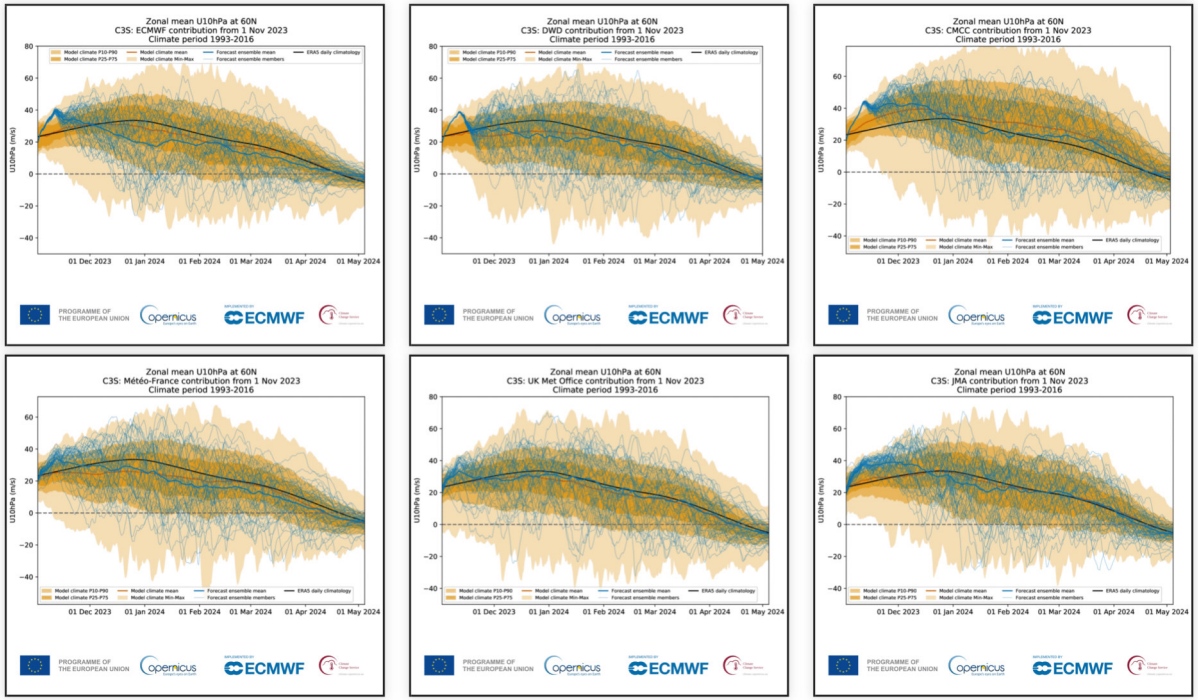




The EOFs of the 1980-present QBO, NASA/ACD (left figure) and MF8 forecast of U30 (right figure)

Drivers : polar vortex (U010 plumes)

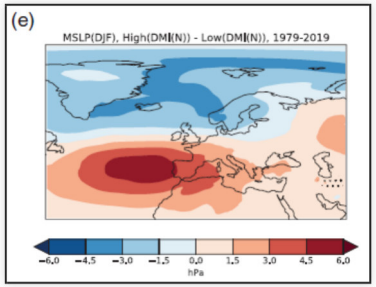
The polar vortex accentuated in relation to its climatology in December weakens significantly in January-February, a sign of a higher than normal probability of SSW.



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

Drivers : Indian SST _ positive IOD

In case of strong positive phase of the IOD, it is an NAO+ type circulation which is favored during winter.

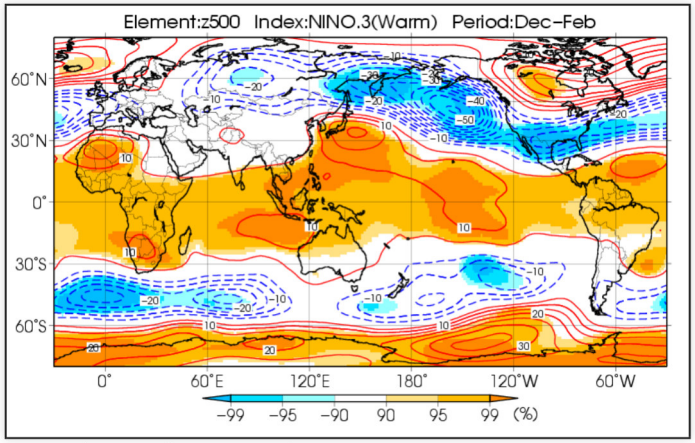


MSLP (hPa) with ENSO signal removed and stippling denoting statistical significance at the 90% level (source : Hardiman and all Predictability of European winter 2019/20: Indian Ocean dipole impacts on the NAO. Atmospheric Science Letters, 21(12), e1005)

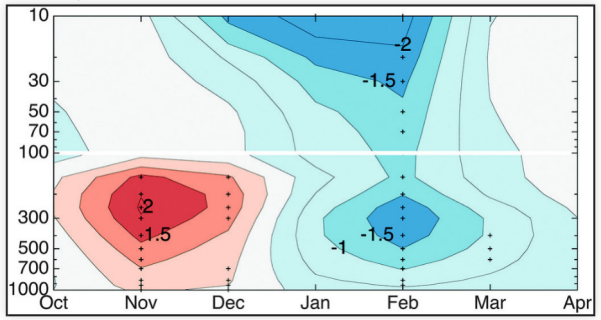
Drivers : Pacific SST _ Statistical effect of El Niño

The composite map of the December-February quarter for the el Niño episode, is associated with a positive phase of PNA and a negative phase of the NAO.

Nevertheless this averge hides an evolution over the quarter : the westerly flow is renforced in November and December while in January and February it is attenuated (following an increased frequency of SSW).



Composite field of Geopotential at 500Hpa for El Nino years between 1959 and 2013



Regression of zonal wind (m s−1) on the Niño-3.4 index on a pressure level–month plane. The zonal wind time series is defined as the area average of the zonal wind in the area 40°–50°N, 90°W–0° for levels below 100 hPa, and the zonal mean is in the latitude band 50°–60°N for levels at and above 100 hPa (Citation: Bulletin of the American Meteorological Society 99, 7; 10.1175/BAMS-D-17-0020.1)

Drivers : Summary

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

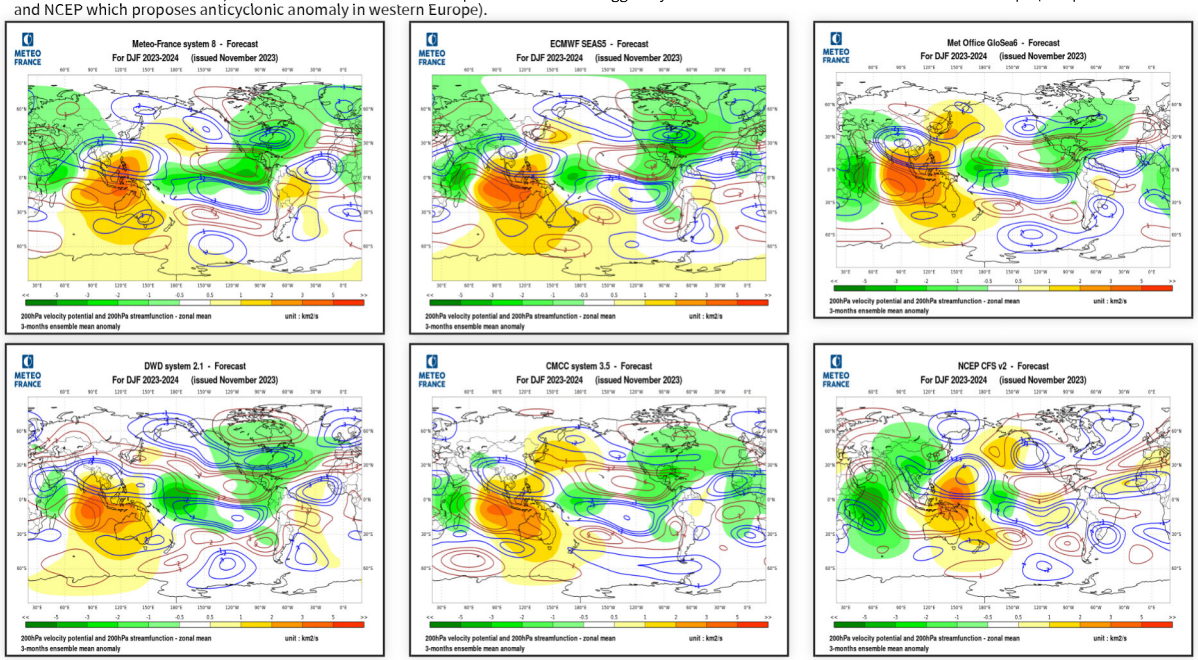
El Niño favors a transition from the positive phase of NAO to a negative phase of NAO during the quarter (linked to a weakening of the polar vortex and higher probabilities of SSW).This weakening is visible in the wind forecast at 10Hpa.

The positive phase of IOD favors the positive phase of NAO.

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

Velocity Potential : The models all agree on the strong anomaly of subsidences over the eastern Indian Ocean (linked to El Nino and IOD+). On the other hand, lift anomalies over the Pacific are more marked with MF8 and DWD than with Met Office and NCEP. Finally, most models predict subsidences over the Amazon and lifts over East Africa.

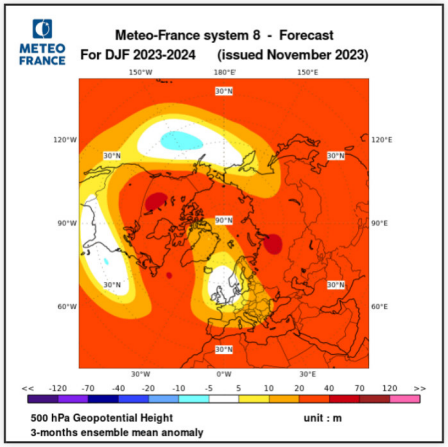
Streamfunction : Dipoles over the Indian, Pacific and Atlantic oceans are clearly visible. In the northern hemisphere, teleconnections have been set up, particularly on the Pacific towards North America (less marked with Met Office and NCEP). All models also show teleconnections from the Indian and Atlantic basins (anticyclonic curvature over northern Africa). Over the North Atlantic and Europe most of models suggest cyclonic circulation over north or north-west of Europe (except Met Office and NCEP which proposes anticyclonic anomaly in western Europe).

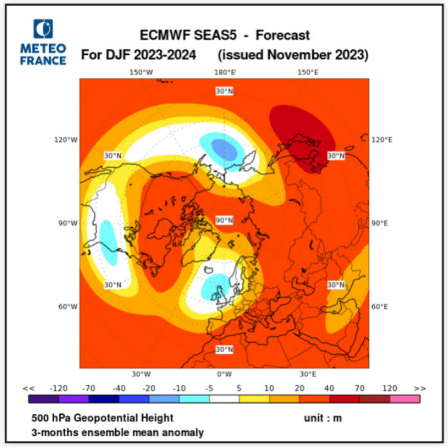


MF8,SEAS5, UKMO, DWD, CMCC and NCEP 200hPa velocity potential anomalies (color range, green : ascending, orange: subsidence) and stream function anomalies (isolines, red: anticyclonic in the northern hemisphere, blue: cyclonic in the northern hemisphere).

Atmospheric circulation forecasts : 500 hPa Geopotential anomalies

Similarities on large structures (positive PNA on North America and relative weakness on Northern Europe)

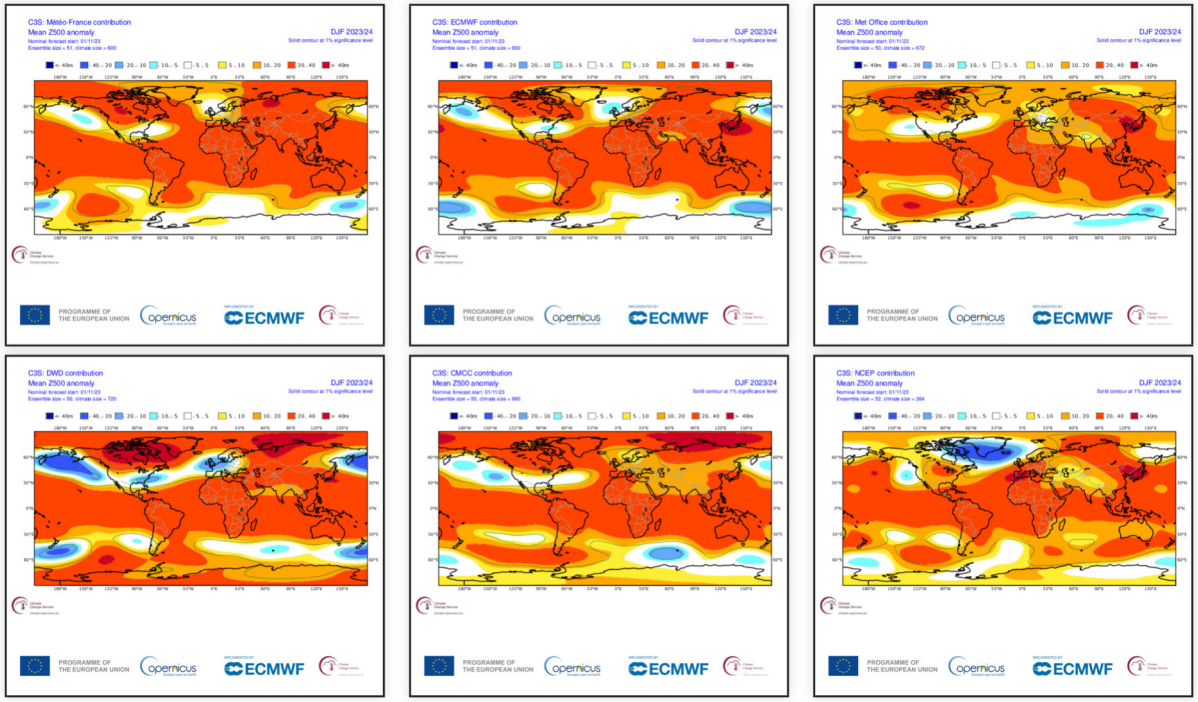




polar projection of MF8 and SEAS5 500hPa geopotential height anomalies.

Atmospheric circulation forecasts : Z500 anomalies in C3S models

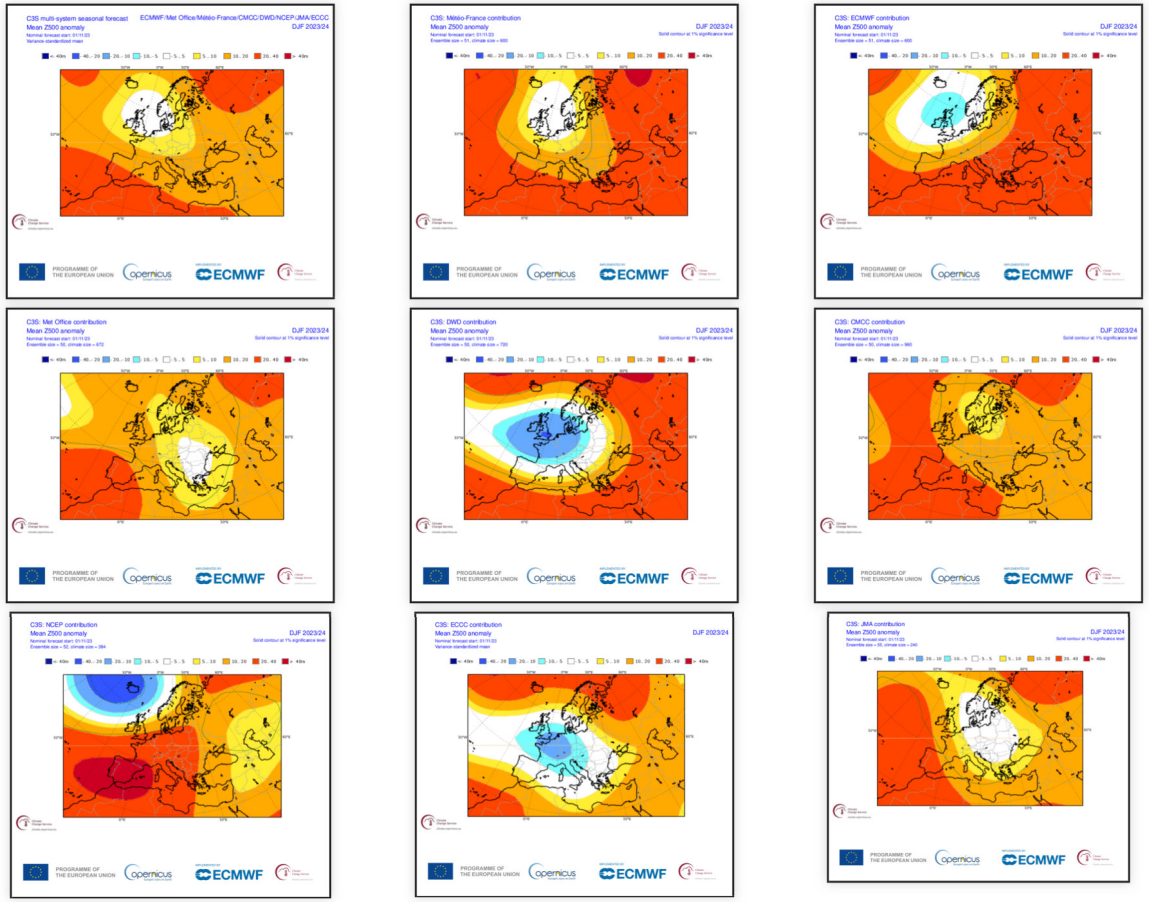
NCEP is the only model to isolate a minimum around Greenland and propose a positive anomaly from Caribbean to western Europe. The other models (including MF-8) forecast a positive anomaly from Canada to Greenland and northern Russia, and relative weakness from the Gulf of Mexico to Europe.



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

Atmospheric circulation forecasts : Z500 anomalies in C3S models

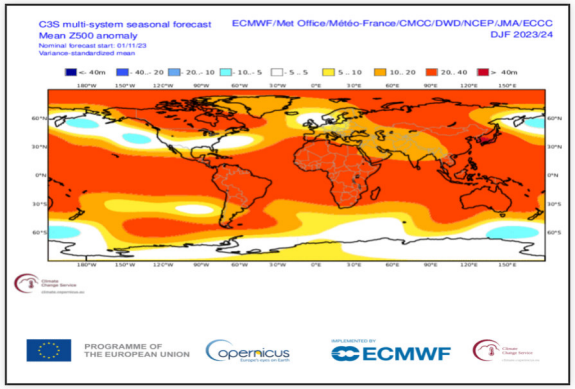
Uncertainty about the precise position of the negative geopotential anomaly which on avergage is positionned around the North Sea.



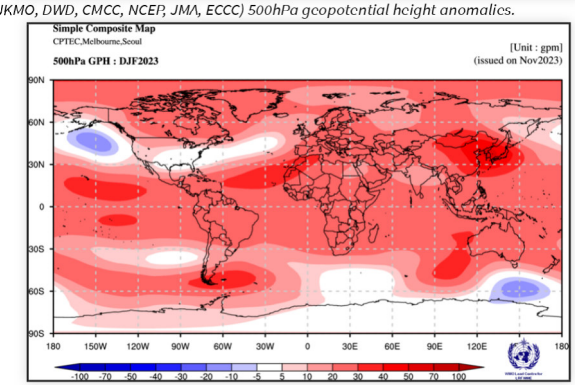
multi-models 500hPa geopotential height anomalies

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 model.



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

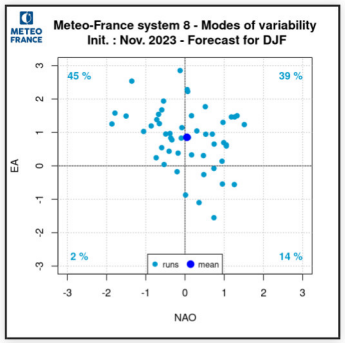


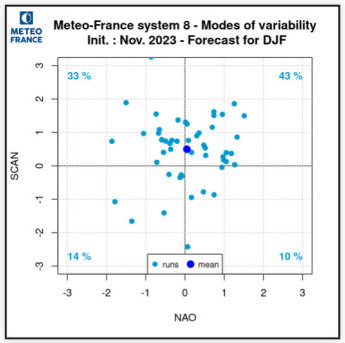
Others models of WMO multi-models 500hPa geopotential height anomalies.

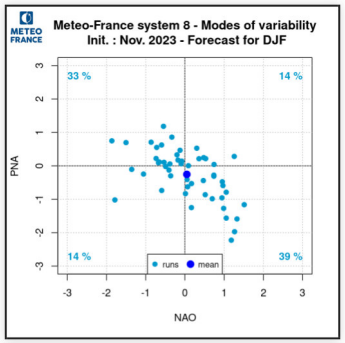
Modes of variability : forecast

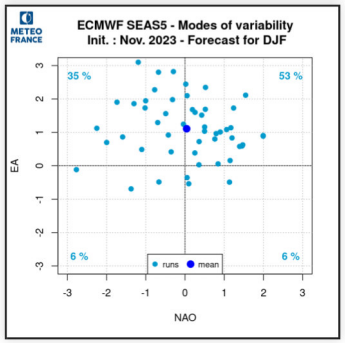
The EA+ mode is preferred by both models.

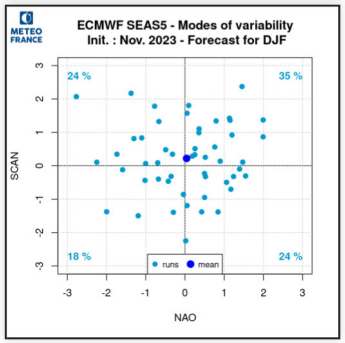
Signals are weak for all other modes. SCAN+ mode is favored by MF-8, while NAO+ and PNA- modes are close to neutrality.

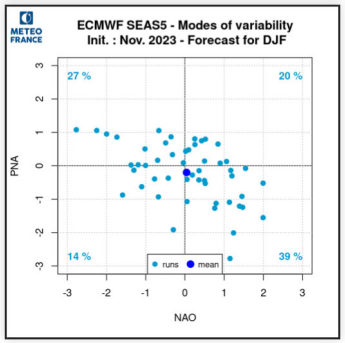








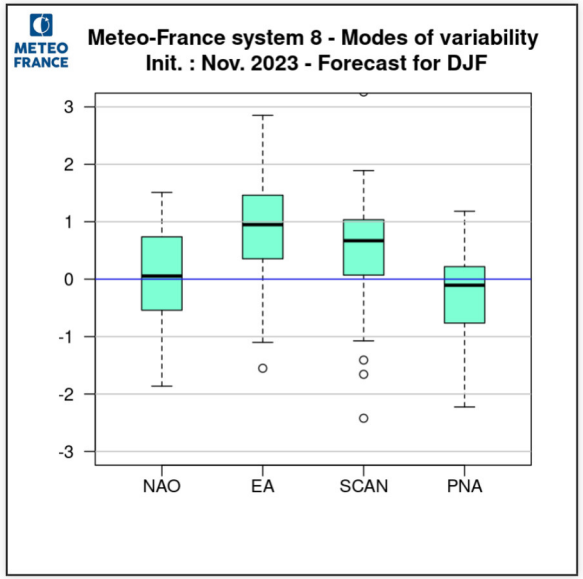


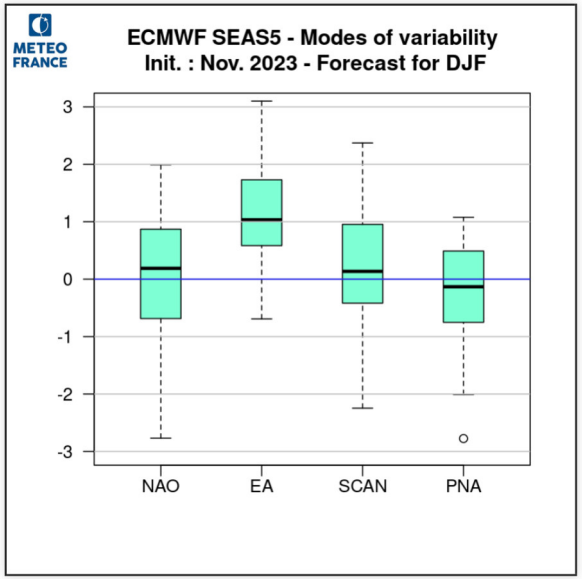


See the modes of variability patterns

Modes of variability : forecast

On the Atlantic and Europe the atmospheric circulation is strongly influenced by the positive phase of EA mode.

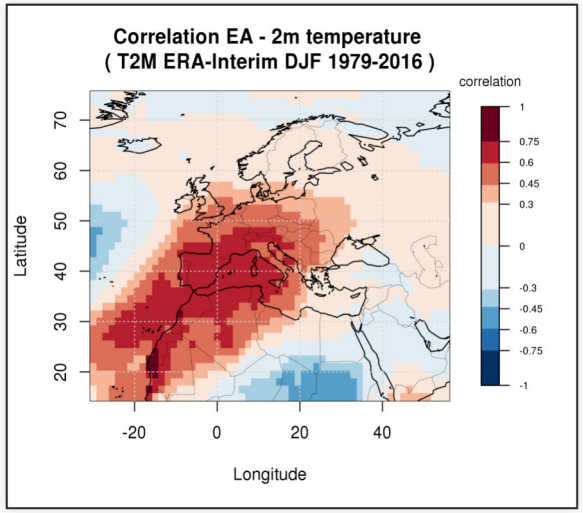


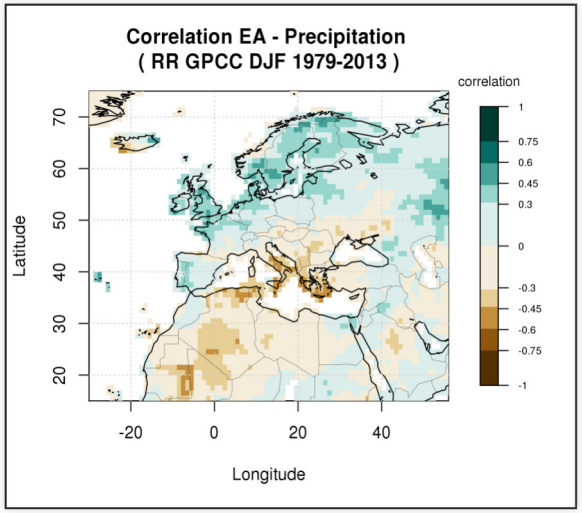


MF-S8 and ECMWF-SAES-S5 boxplot of modes of variability

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.



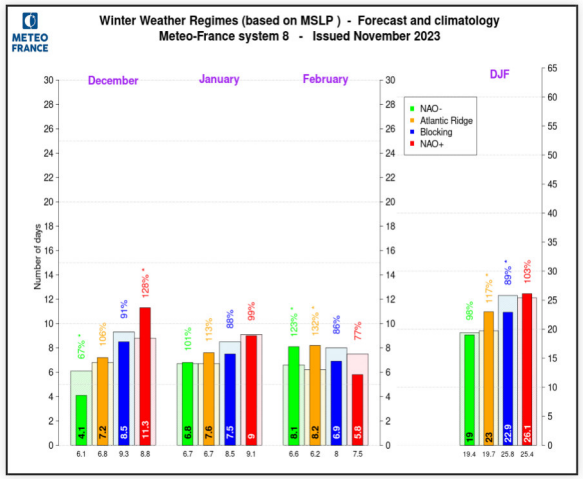


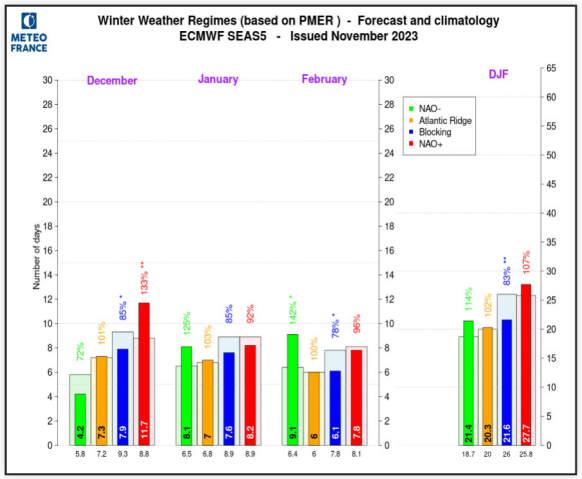
Weather regimes : winter MSLP

The blocking regime is significantly lower than its climatology for both models.

For MF8 the Atlantic Ridge regime is significantly above its climatology.

.We note that with both models the frequency of the NAO+ regime decreases during the quarter unlike the NAO- regime whose frequency increases.

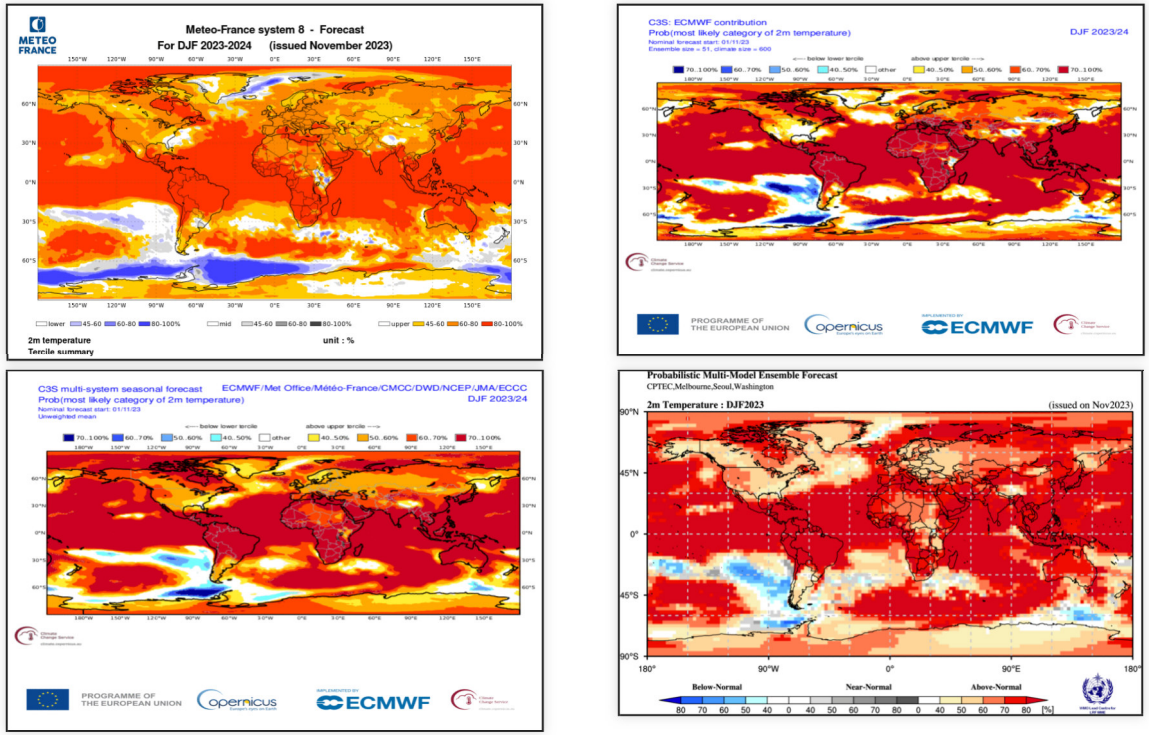




Frequency of SLP weather regimes, compared to model's own climatology, for the next three months and aggregation over the entire quarter, for MF-S8 (left) and SEAS5 (right).

Forecast of climatic parameters : Temperature probabilities

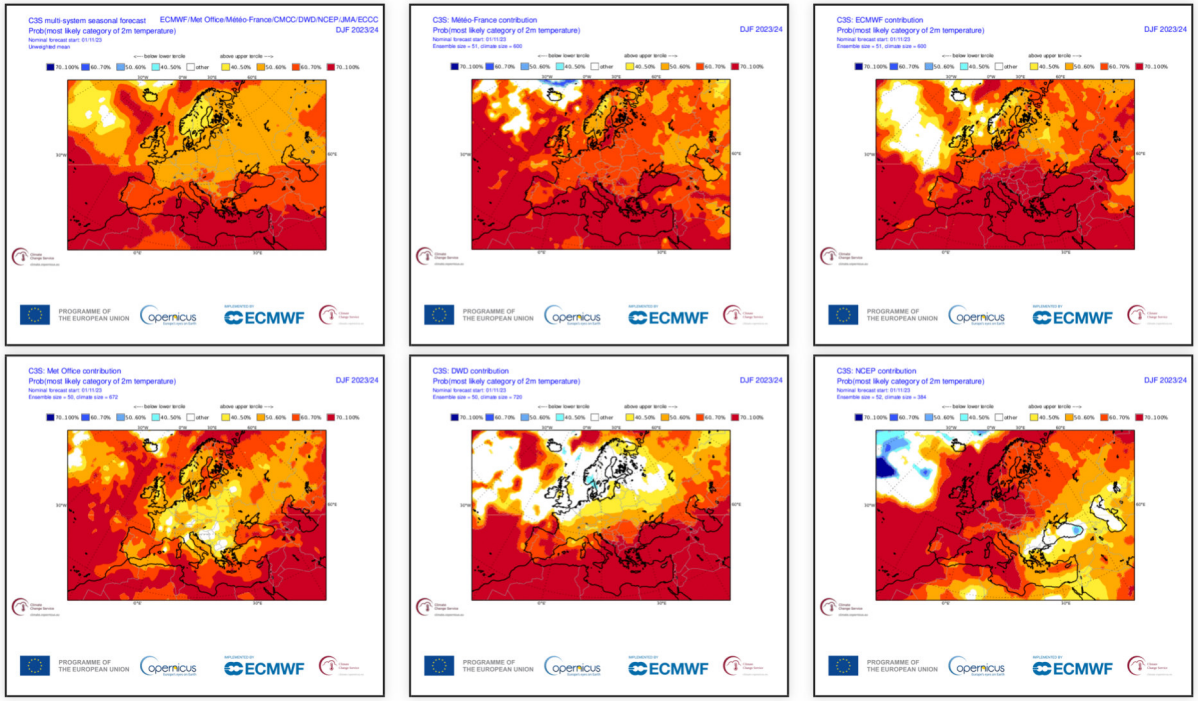
Warmer-than-normal conditions are likely, even very likely, over most regions of the globe.



2m temperature probability map from MF-S8 (top left), ECMWF-SEAS5 (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

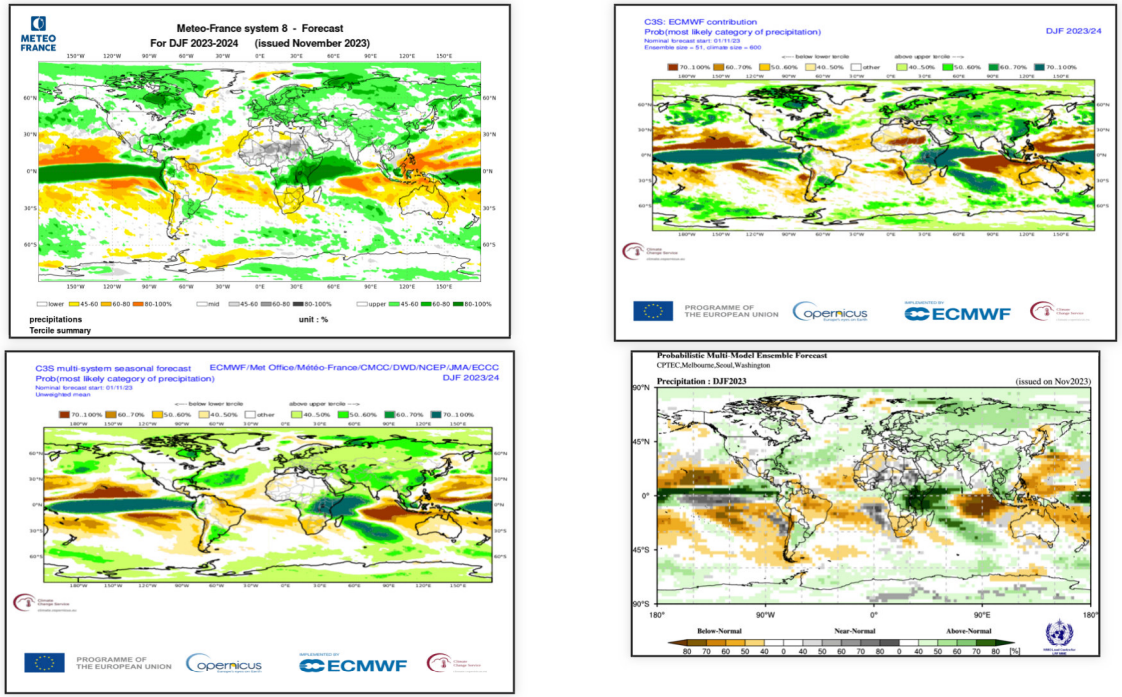
The probability of a warmer-than-normal scenario remains high over the Mediterranean Basin.



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

Forecast of climatic parameters : Precipitation

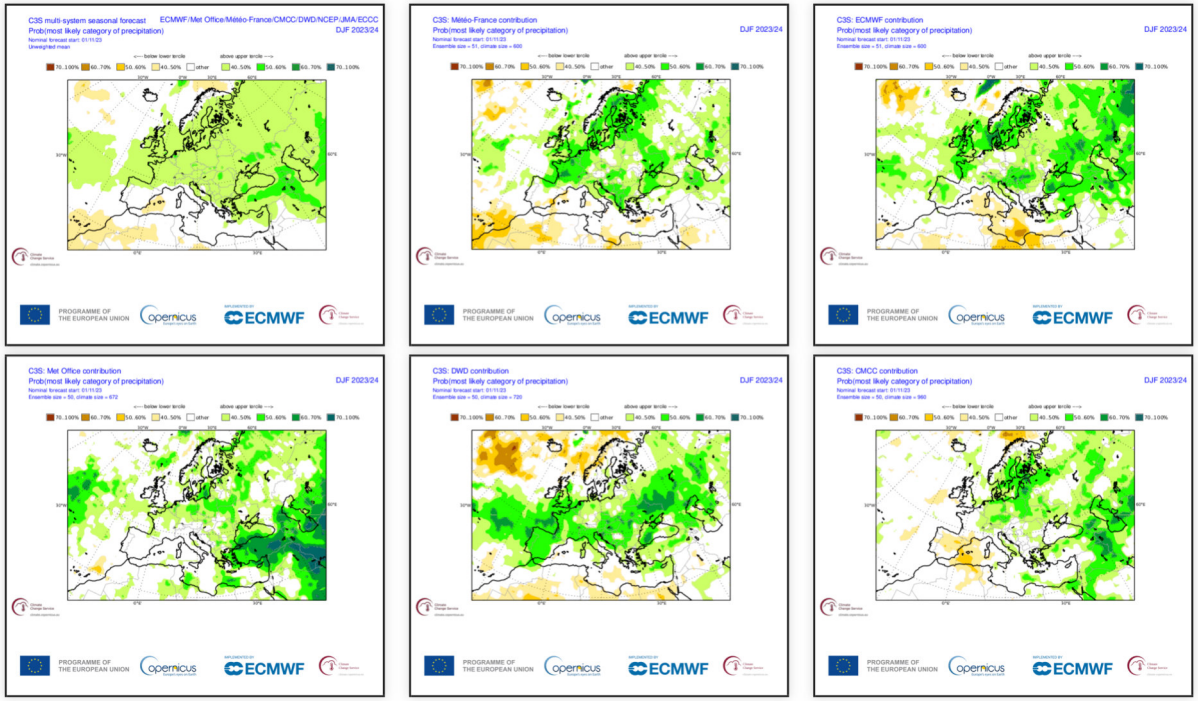
Very good agreement between models across the tropics, with patterns consistent with the impact of a strong El Niño and positive IOD (dry over the Maritime Continent and Amazon, wet over the Horn of Africa). In mid-latitudes, large-scale patterns are close between models.



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

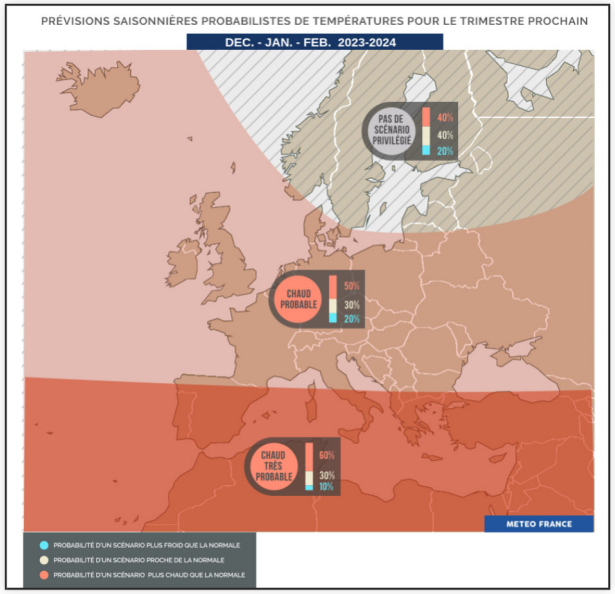
A wetter-than-normal signal probabilities concerned a large part of europe in connection with the weakness of geopotential.



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 likely, if not very likely, over much of Europe and Mediterranean regions.



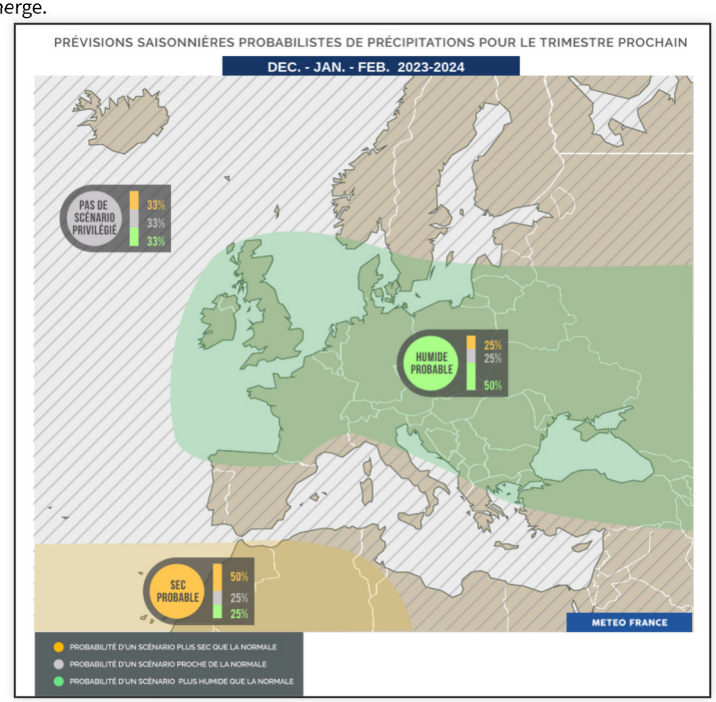
Synthesis map of probabilistic forecast for Europe. (c) Météo-France/DCSC/ACS

Synthesis map for Europe : Precipitation

Most models converge on a wetter than normal scenario in most European countries.

A dry scenario is more probable from Canaries to Algeria.

Elsewhere no scenario emerge.



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