Météo-France Seasonal Forecast Bulletin

DECEMBER - JANUARY - FEBRUARY 2021/2022

Table of Content

General synthesis : DJF 2021/2022

The "La Nina" event should reach a "moderate" state this winter. The IOD decreases. On the equatorial Atlantic, the strong positive SST anomaly is weakening and coming back to neutral conditions. The impacts of these forcings in terms of large scale circulation (see VP/SF 200 hPa or MSLP) are visible in all the models in the tropics. In the Northern Hemisphere, models forecast nice teleconnections both in the Pacific and in the Atlantic. Anyway models are significantly different on Europe.

A) Oceanic forecast :

- ENSO : moderate La Niña

- IOD : neutral to positive

- Equatorial Atlantic : strong positive anomaly, decreasing

B) Drivers :

- Eastern phase of QBO

- some models suggest a temporary weakening of the polar vortex a the beginning of the winter, that could favour a SSW event and negative AO/NAO. This is not confirmed by the last monthly forecasts (GFS, ECMWF)

C) Atmospheric circulation :

the mean DJF circulation (in Z500) is quite well summarized by C3S multi-model forecast, with a stronger zonal gradient over west Atlantic (a mix of NAO+ and Atlantic Ridge, classical during La Niña events) and a positive anomaly centred over Central Europe (also visible in GPC multi-model chart). In between (west of Europe), the Z500 anomaly is weaker, representing the possibility of meridian circulation events (NAO- or blocking situations leading to cold events on Europe and precipitation events in the Western part of the Mediterrean basin).

D) Most likely conditions :

- over Europe and the Mediterranean Basin :

Warm tercile privileged over the Mediterranean Basin and Middle East and Scandinavia. Normal tercile over Western Europe.

Dry tercile is privileged over the Eastern part of the Mediterranean basin. And wet tercile around the Baltic Sea

Next bulletin : scheduled on December 22th

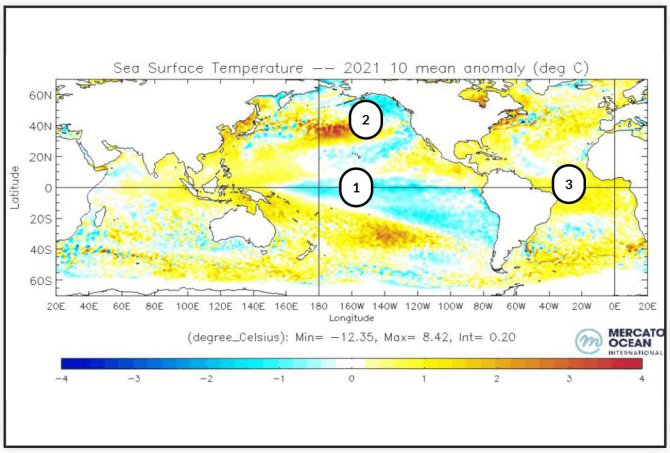
Oceanic analysis of October 2021 : SST anomalies

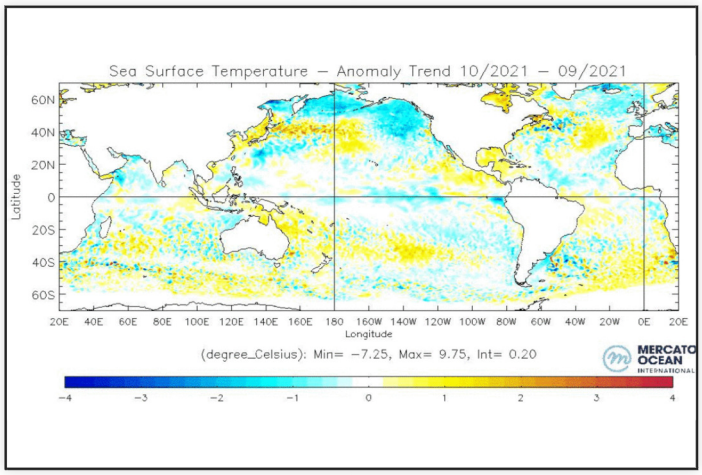
Current ENSO situation : weak La Niña

In the Pacific Ocean : the cold anomaly in the Central and East Pacific became stronger, the La Niña pattern is now well marked. Over the North Pacific, there has been a strong cooling over the highest latitudes, leading to a distinct PDO- pattern (see October SST anomaly map).

In the Indian Ocean : slight warm anomalies from India to the Maritime Continent, and near normal to the west.

In the Atlantic Ocean : the strong positive anomaly along the equator hasn't clearly evolved in October. The North Atlantic Ocean is globally warmer than normal, especially close to America and Europe.



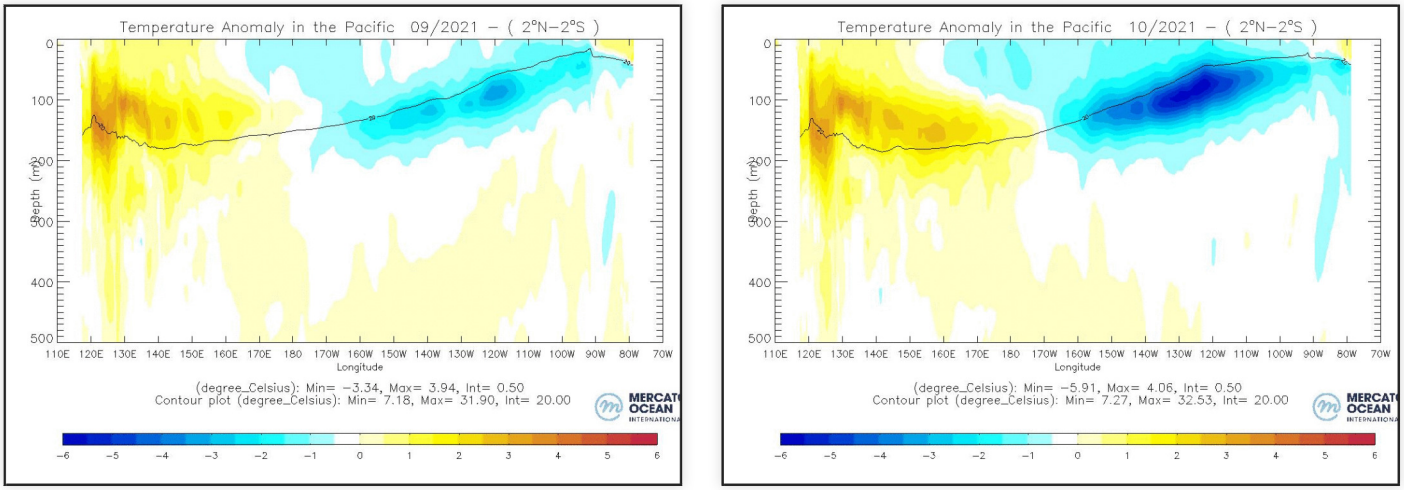


SST Anomalies and trend with the previous month (c) Mercator-Ocean

1 - La Niña pattern
2 - Negative PDO pattern
3 - Persistence of the strong warm anomaly

Oceanic analysis of October 2021 : Pacific vertical section

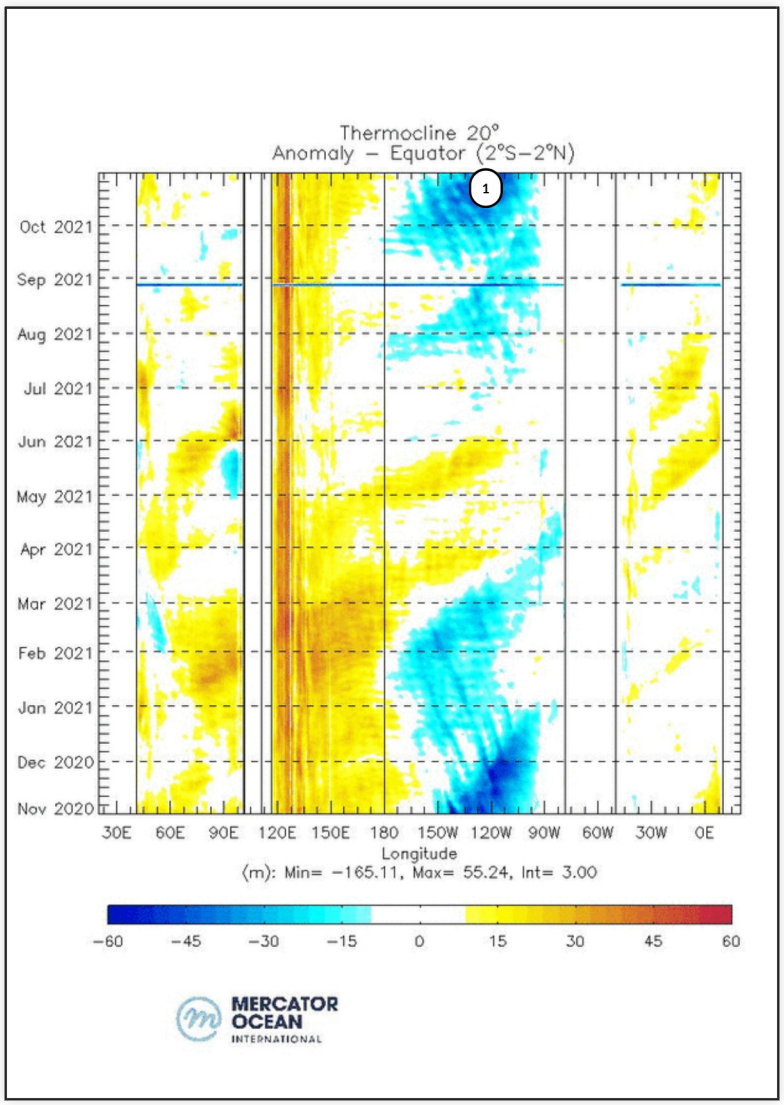
In subsurface, strong reinforcement of the cold anomaly in the Eastern part. The cooling is also visible in surface, though less intense.



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

Oceanic analysis of October 2021 : Hovmüller diagram of the 20°C isotherm

In the Pacific Ocean, the East-West contrast is now well settled, typical of La Niña.

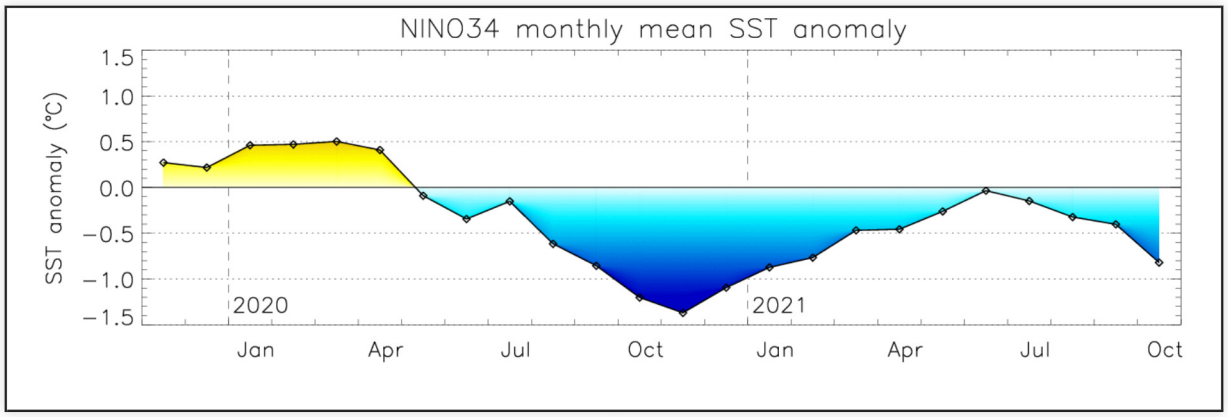


Evolution of the anomalies of depth of the thermocline (m) (materialized by the 20 ° C isotherm) (c) Mercator-Ocean

1 - Reemergence of the thermocline on the eastern Pacific

Oceanic analysis of October 2021 : Pacific Ocean - Nino3.4 index history

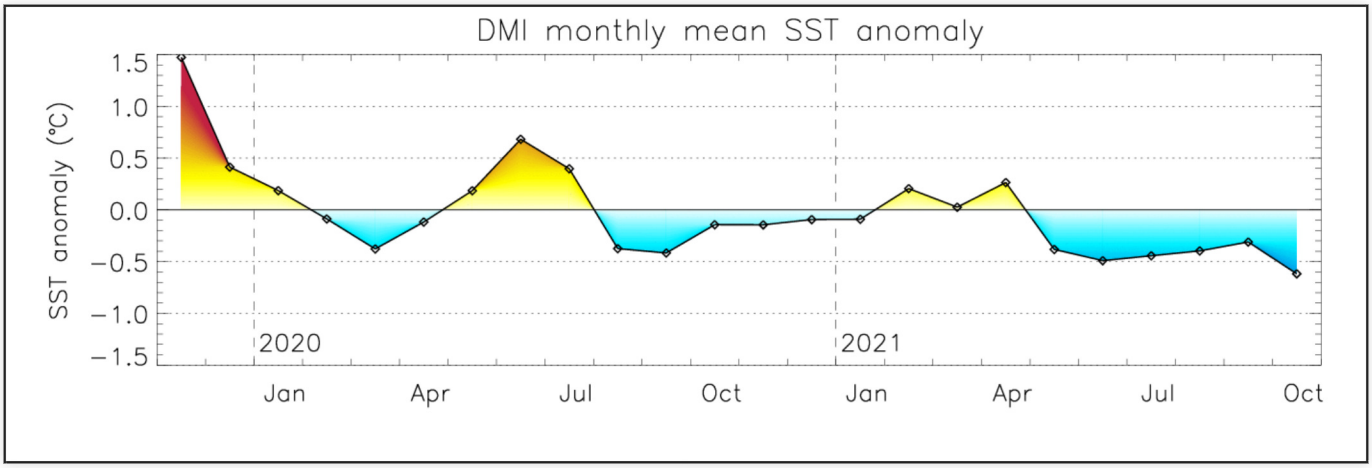
Nino3.4 index issued from Mercator Ocean PSYV4R2 analysis : near - 0.8°C
(see BOM site for weekly values : http://www.bom.gov.au/climate/enso/monitoring/nino3_4.png)



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

Oceanic analysis of October 2021 : Indien Ocean - DMI index history

DMI Index issued from Mercator Ocean PSYV4R2 analysis : -0.6 °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

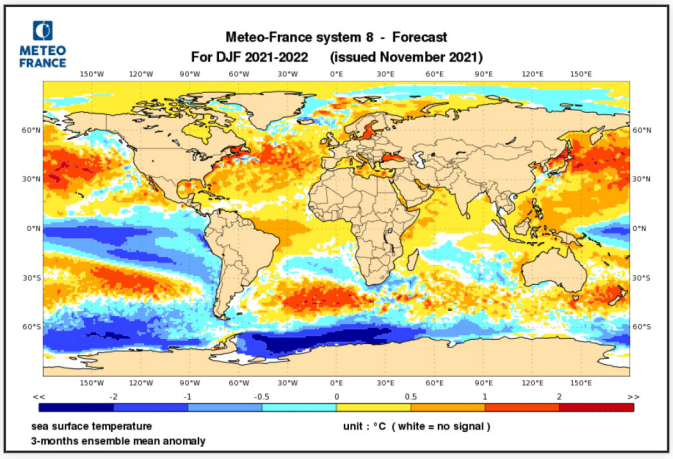
Oceanic forecast : SST anomaly

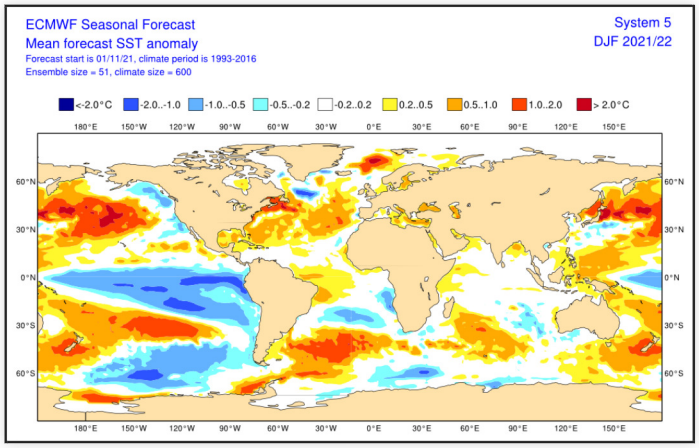
Good agreement between MF-S8 and ECMWF-SEAS5 in the main anomaly patterns.

In the Pacific Ocean : the spatial extension of the cold anomaly pattern is typical of a "la Niña" phenomenon. Good agreement on the anomaly patterns in mid-latitudes (Northern and Southern hemisphere), with a nice PDO- shape.

In the Indian Ocean : No more marked contrast between the east and west of the basin.

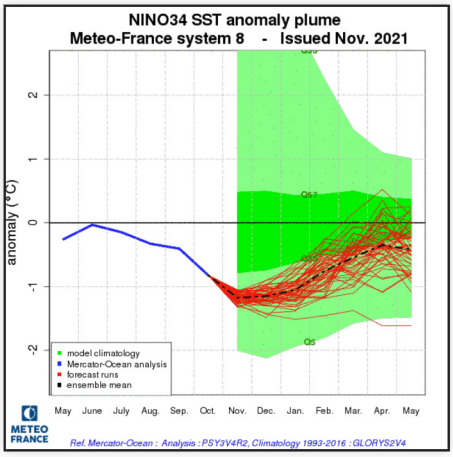
In the Atlantic Ocean : The large and strong warm anomaly along the equator is weakening and would mainly concern the western side (maybe due to more uncertainty in the East ?). In mid-latitudes in the Northern hemisphere, large area of warm anomaly from America to Europe, it seems that the intensity of the anomaly is stronger than in the analysis.

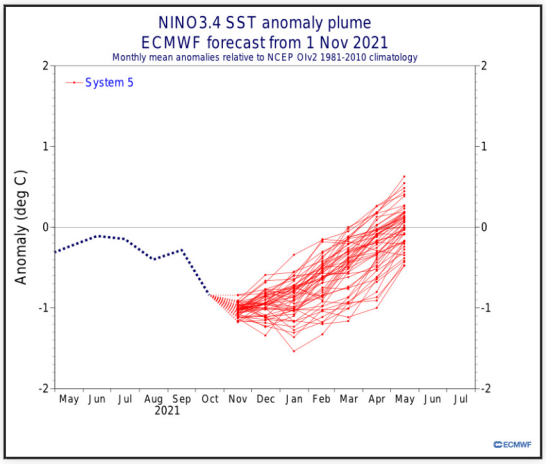




Oceanic forecast : NINO3.4 Plume diagrams

ECMWF-SEAS5 and MF-S8 : the two models are very close. They both forecast a maximum of "La Niña" in the coming months, reaching the state "moderate" (between -1 and -1.5°C)

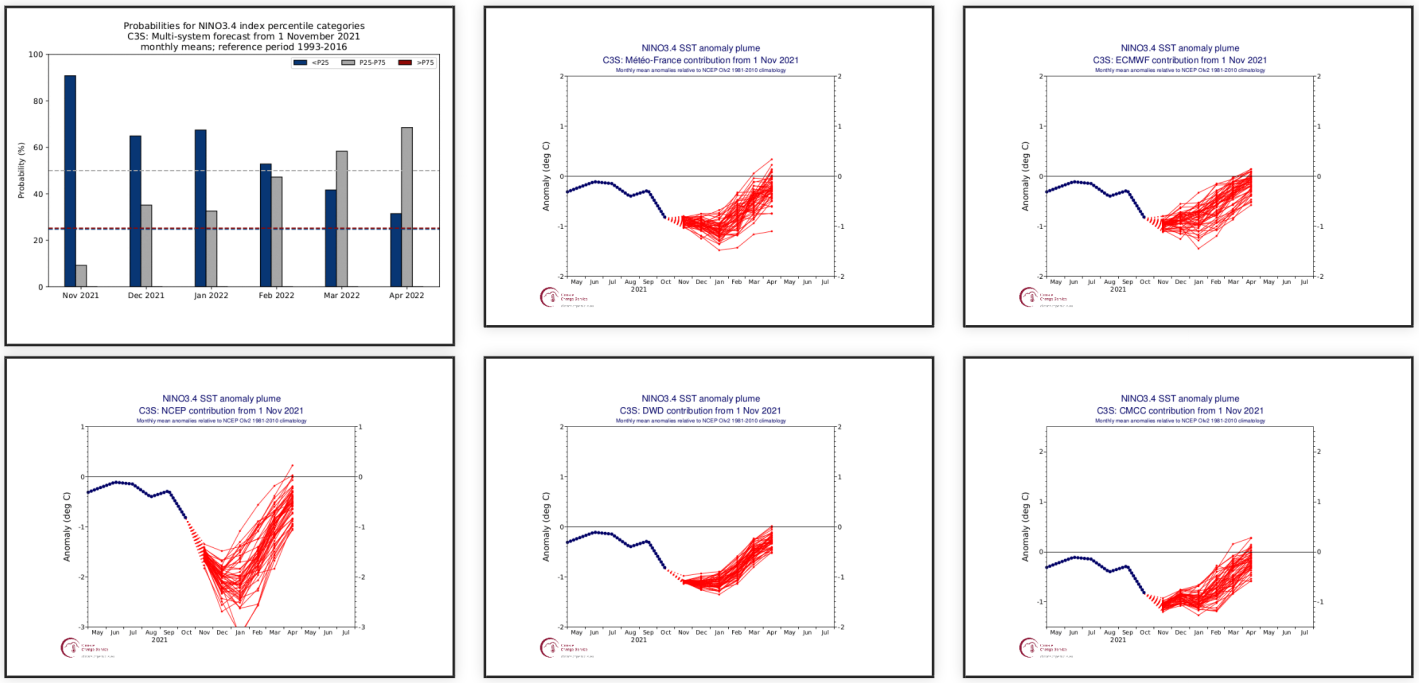




Oceanic forecast : C3S Nino3.4 re-scaled plume diagrams

Good agreement between models, the maximum of Nino3.4 is expected to slightly exceed -1°C, so we should have a "moderate" La Niña . Like last month, the NCEP model is very different from the others : its forecast last month was clearly wrong (to strong cooling in October), we decide not to taking it into account.

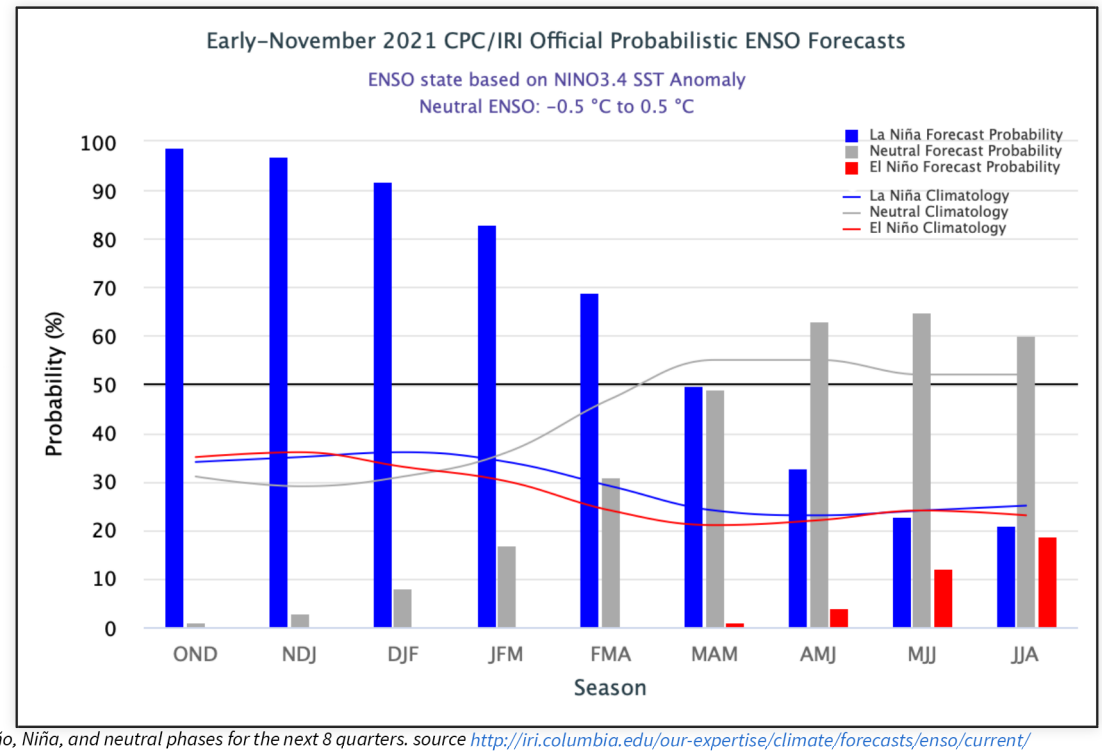
The most likely phase for the next three months : moderate La Niña.



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

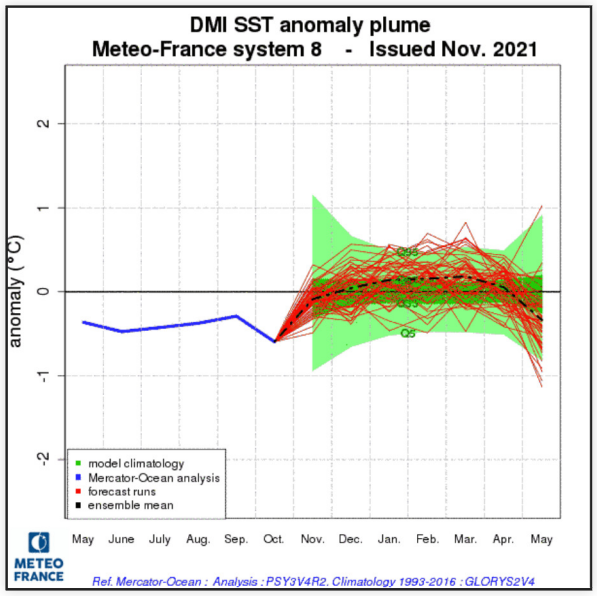
IRI forecast : above 90% chance of "La Nina"

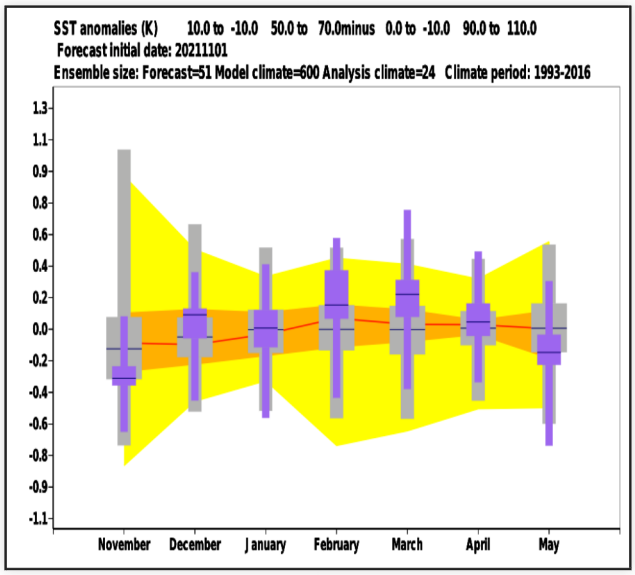


Probability of Niño, Niña, and neutral phases for the next 8 quarters. source http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/

Oceanic forecast : Indian ocean - DMI evolution

Good agreement for a rapid return to normal conditions, then positive values at the end of the quarter.



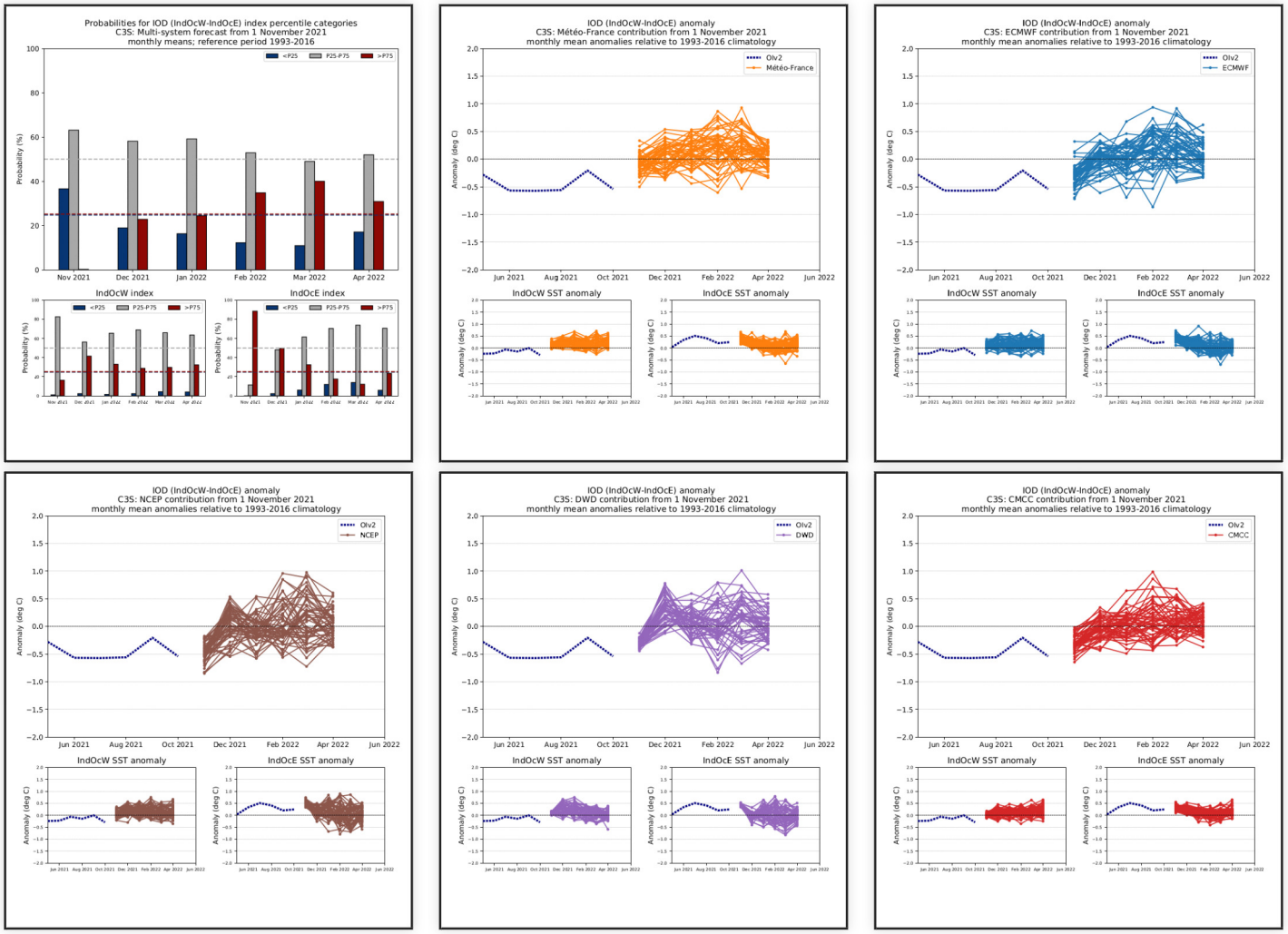


DMI index : analysis, forecasts and model climatology with MF-S7 on the left and ECM-SEAS5 on the right

Oceanic forecast : C3S IOD re-scaled plume diagrams

Good agreement between C3S models for a return to normal values, and possibly positive values.

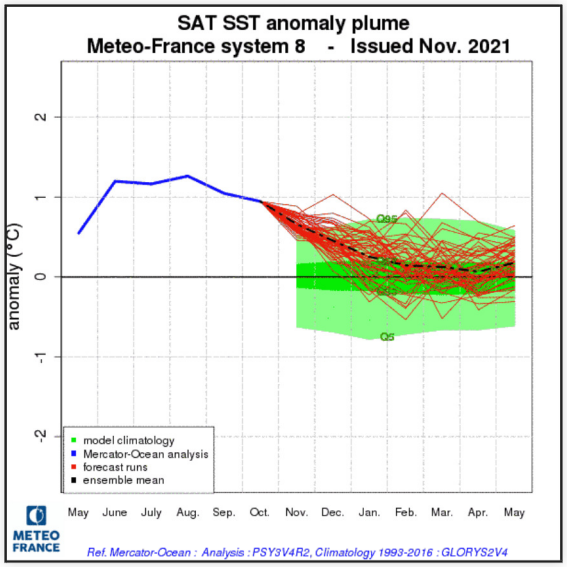
Expected Phase for the next three months : neutral.

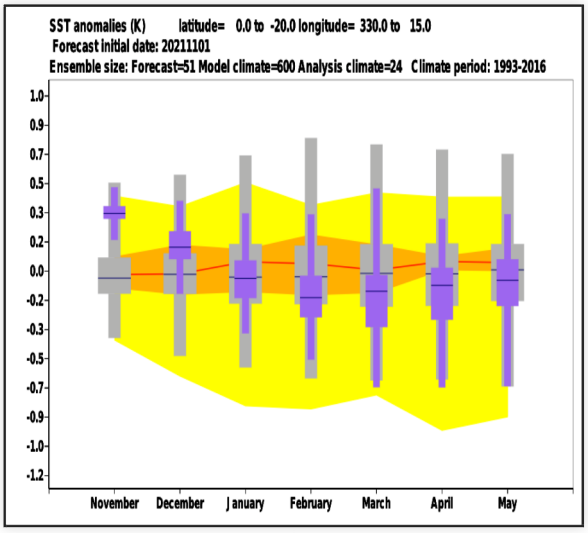


C3S multi-system probabilty forecast (top left figure) and C3S plume diagrams re-scaled from the variance of observations for the period 1981-2010.

Oceanic forecast : Atlantic ocean - SAT evolution

The index remains high for both models, but it drops sharply to approach neutral conditions at the end of the quarter.

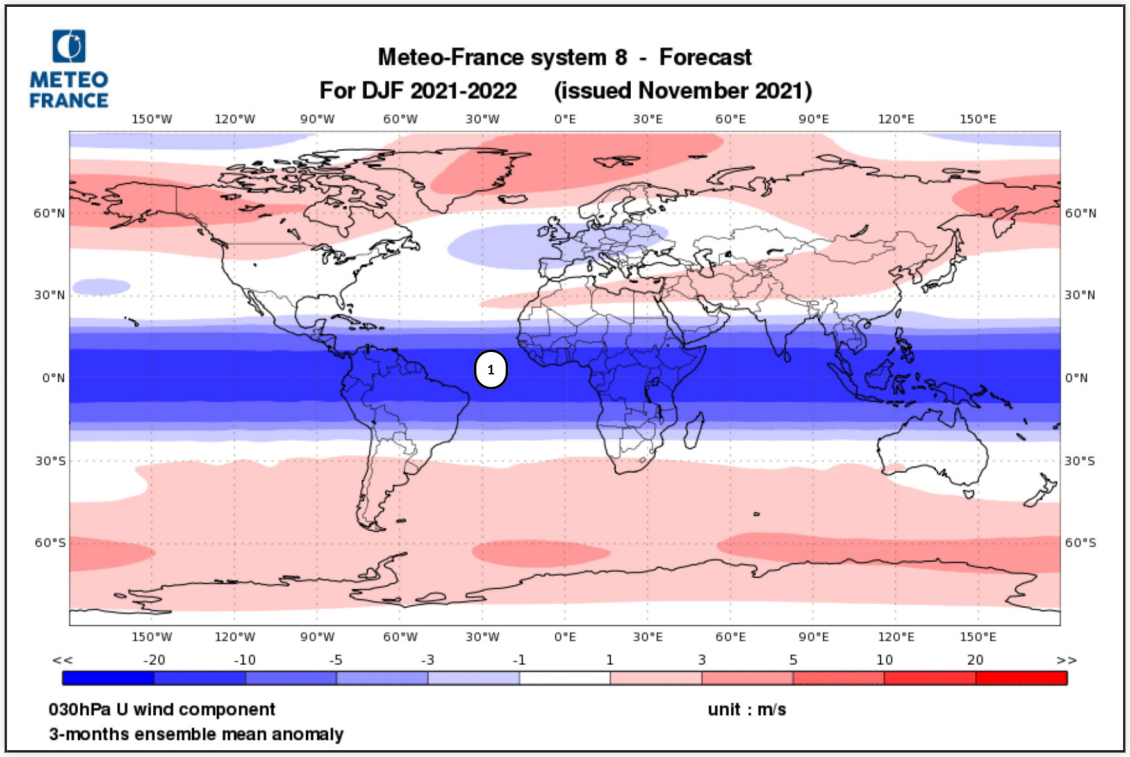




Anomaly on the SAT box : analysis, forecasts and model climatology with MF7 on the left and SEAS5 on the right

Drivers : QBO forecast

Easterly phase of the QBO.



MF-S8 forecast of the zonal component of the wind at 30hPa

1 - Negative values, corresponding to easterly winds

Drivers : polar vortex (U010 plumes)

There is a lot of uncertainty in the Polar Vortex forecast, looking at C3S models. Anyway, one can extract some similarities :

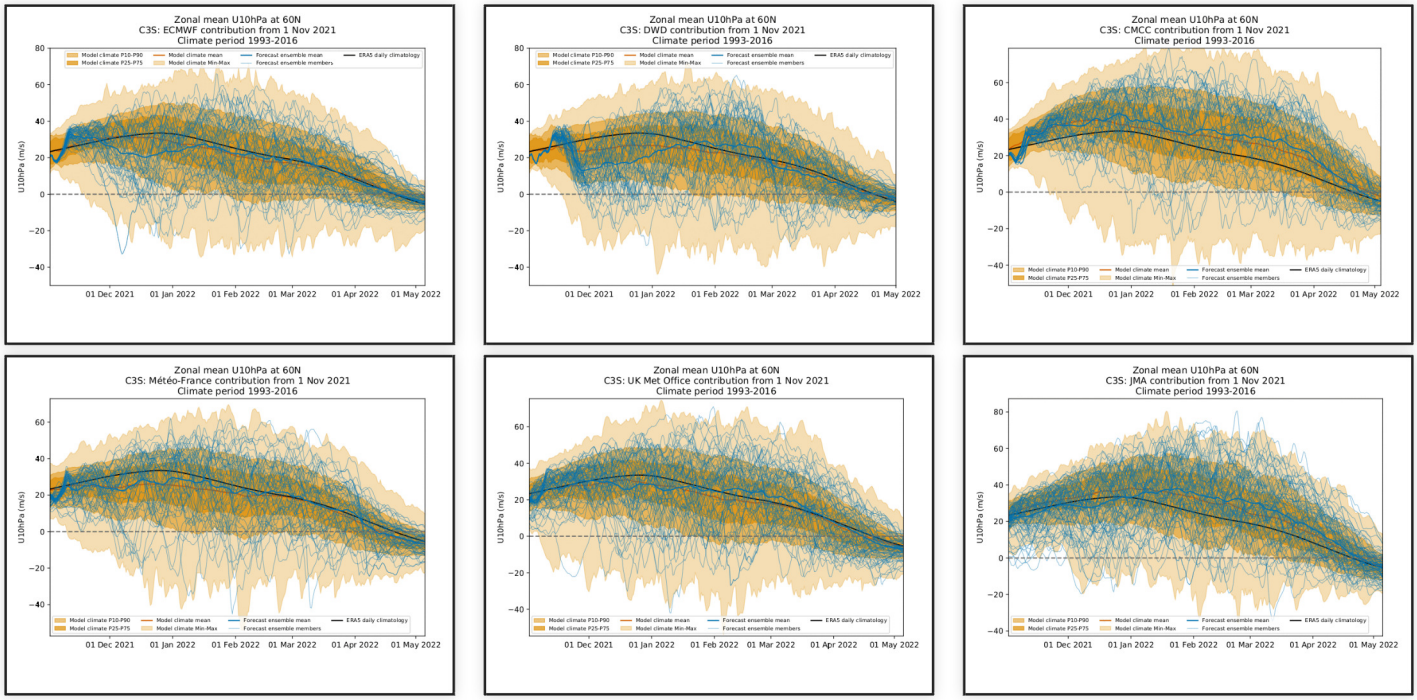
- reinforcement of the vortex in the 2nd half of November. This seems to be confirmed by NWP models (for instance GFS and ECMWF)

- possible weakening of the vortex (in comparison to their respective climatology) in January and February (ECMWF, DWD, JMA), no signal for the other models. The strengthening of the vortex seems to be the least probable scenario

- strengthening of the vortex in February (DWD, UKMO, JMA), no clear signal for the other models.

So there is a probablity that we observe a period of weak polar vortex in the first part of winter (visible in some models, and favoured by easterly QBO period) and so the probability of SSW would be enhanced, the probability of negative AO and NOA too.

The last ECMWF Extended forecasts (11th, 15th, 18th November) doesn't confirm the weakening of U10hpa of ECMWF-SEAS5 forecast.



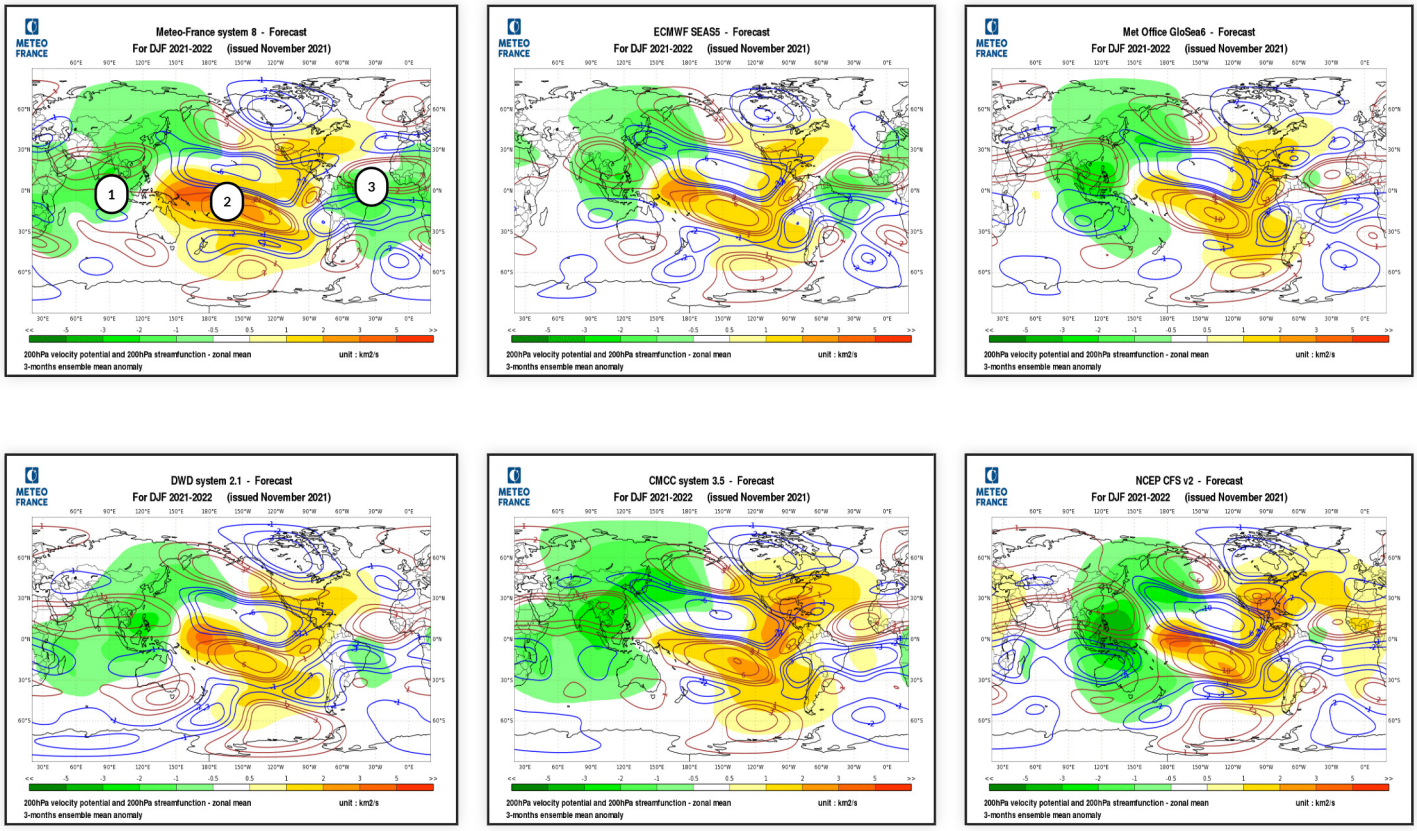
ECMWF-SEAS5, DWD, CMCC, MF-S7, UKMO, and JMA 010hPa zonal mean of u componant of wind at 60°N.

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

Good agreement between models. Anomalies are stronger and more consistent between models than last month.

Velocity Potential : strong dipole pattern corresponding to a classical "La Nina" response : a downward motion anomaly over the Central/East Pacific and an upward motion anomaly over the Maritime Continent extending to the east of the Indian basin. Over Africa and equatorial Atlantic, noticeable differences between models : the most probable scenario (consistent with the strong positive SST anomaly over the Equatorial wes Atlantic) is a negative anomaly (upward anomaly motion) over west Atlantic (MF, ECMWF, DWD). There is a good agreement for a positive anomaly centred on the Gulf of Mexico.

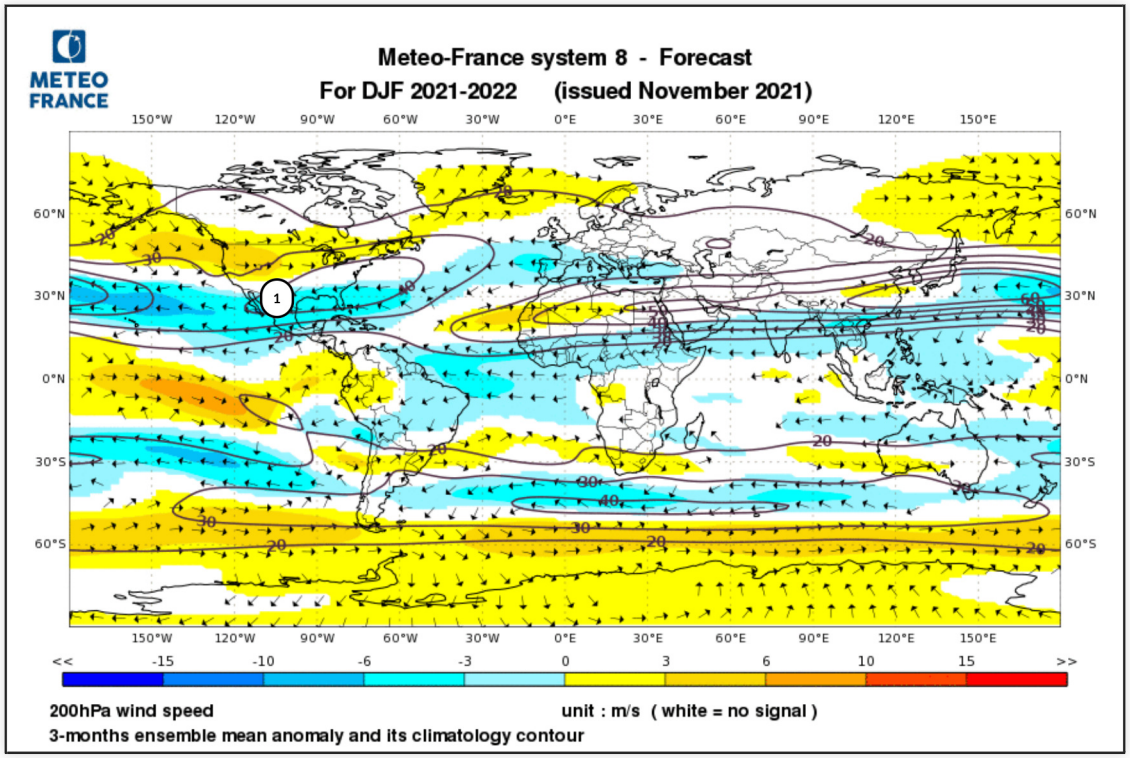
Streamfunction : clear dipoles on both sides of the equator over each basin. Teleconnexions toward mid-latitudes are predicted by all the models, both in the Pacific Ocean (negatice PNA) and in the Atlantic Ocean (up to the Iberic Peninsula).



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).

1 - VP : large area of upward motion anomaly
2 - VP : downward motion anomaly related to La Nina and negative IOD
3 - VP : upward motion anomaly in MF-S8 linked to warm SST anomalies

Atmospheric circulation forecasts : tropospheric jets



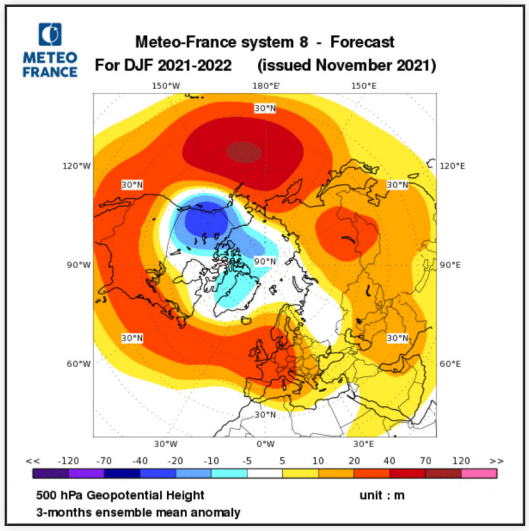
climatology of wind strength at 200 hPa (isolines) and wind force anomalies (color ranges)

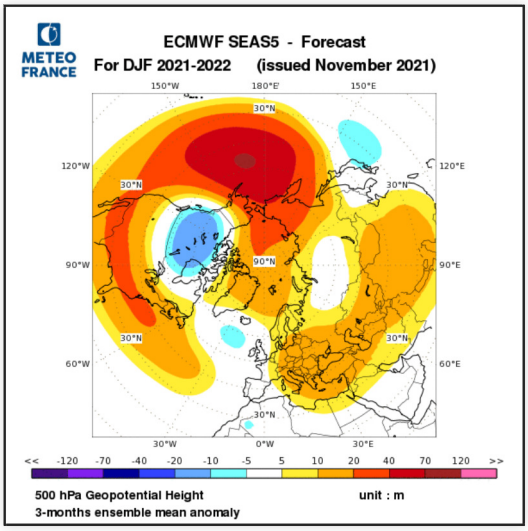
1 - Jet shifted to the north over North America and North Atlantic

Atmospheric circulation forecasts : 500 hPa Geopotential anomalies

Good agreement around the Pacific with a PNA- pattern, and good agreement for the "positive belt" anomaly extending from east Pacific to west Atlantic.

Over Europe and Asia and Arctic, the anomaly patterns are very different.





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

Atmospheric circulation forecasts : Z500 anomalies in C3S models

Comparing C3S models, there is a good agreement around the Pacific, in link with a negative PNA pattern induced by La Niña.

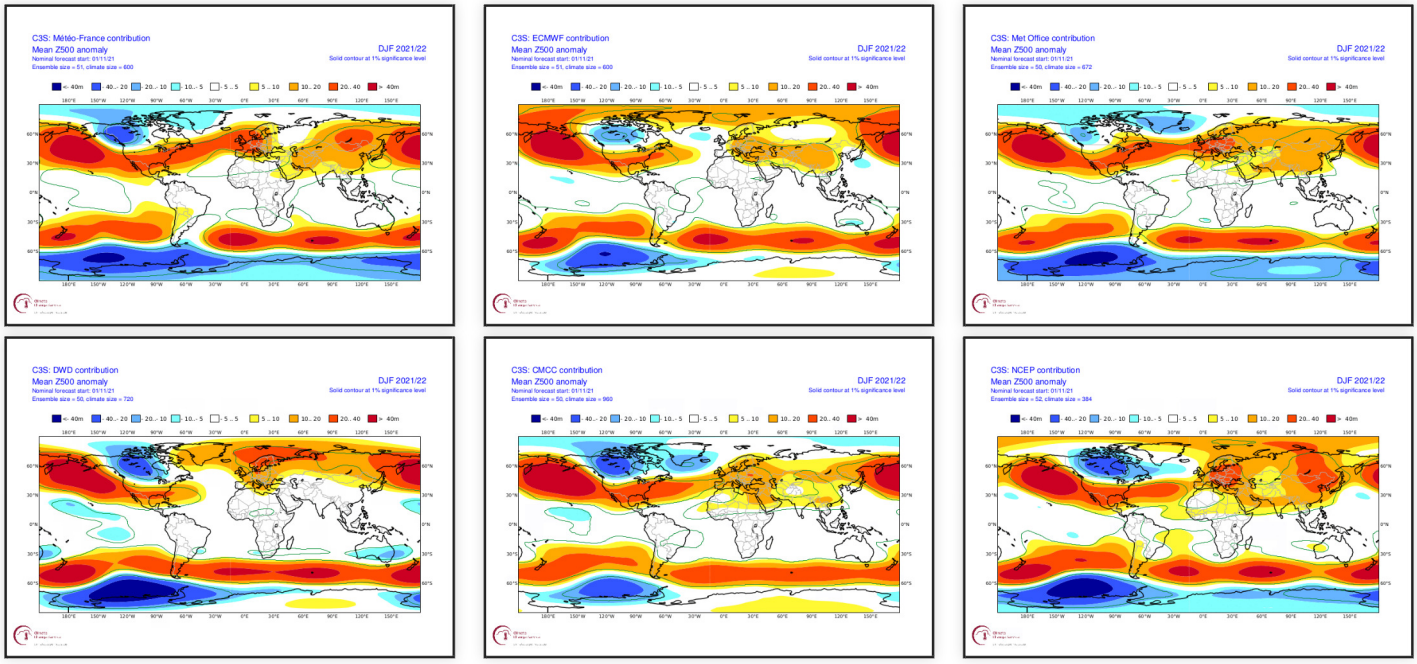
The agreement extends to the west part of North Atlantic.

Over the East part of North Atlantic and Europe, one can identify two clusters :

- the first one cluster (MF, UKMO, CMCC, ECC (not shown), and maybe NCEP) with a North-South gradient of Z500 anomaly in North Atlantic. So a pattern that looks like NAO+

- the second one (ECMWF, DWD, JMA (not shown)) with a meridian gradient between North Atlantic and Europe. This cluster corresponds to the models forecasting a temporary weak polar vortex (see "Drivers").

.



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

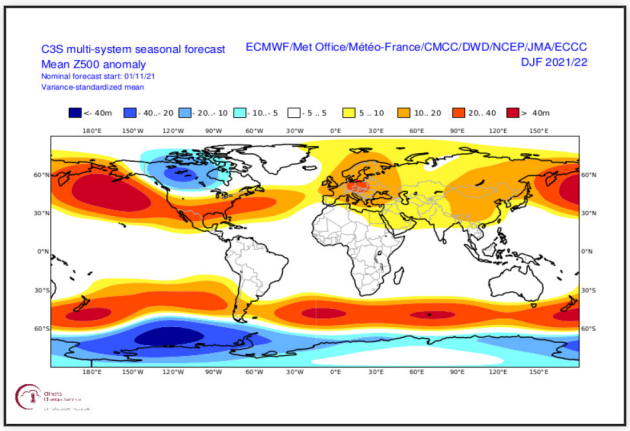
Atmospheric circulation forecasts : Z500 anomalies multi-systems

Good agreement over North America, a typical PNA- pattern is visible in both multi-model charts.

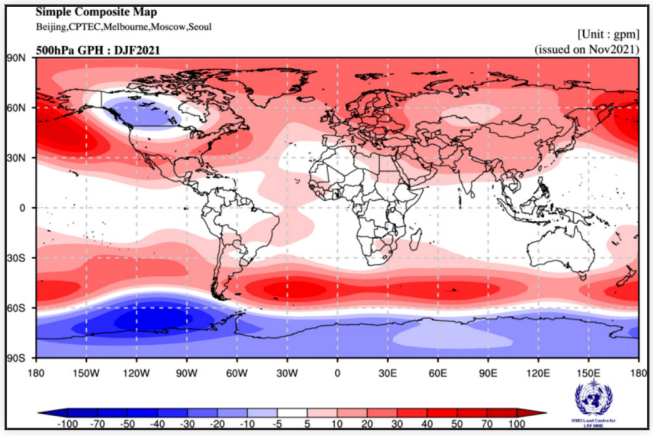
On the North Atlantic the C3S multi-model chart correspond to postive NAO on the Atlantic domain, the other chart (rest of GPCs) looks like a negative NAO.

Over Europe, they both forecast a positive anomaly centred over Central Europe.

Over Asia, the dominant pattern is a positive anomaly centred over China, no consensus over Russia.



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

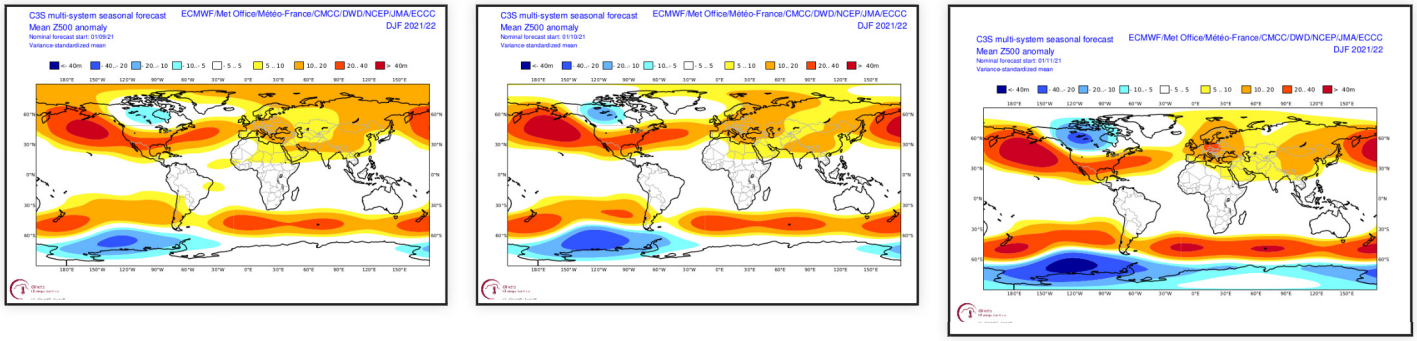


Others models of WMO multi-models 500hPa geopotential height anomalies.

Atmospheric circulation forecasts : Forecast stability

Good stability around the Pacific and North America.

Over North Atlantic, the Z500 anomaly pattern looks more and more to Atlantic Ridge, and the positive anomaly over centre Europe becomes stronger.

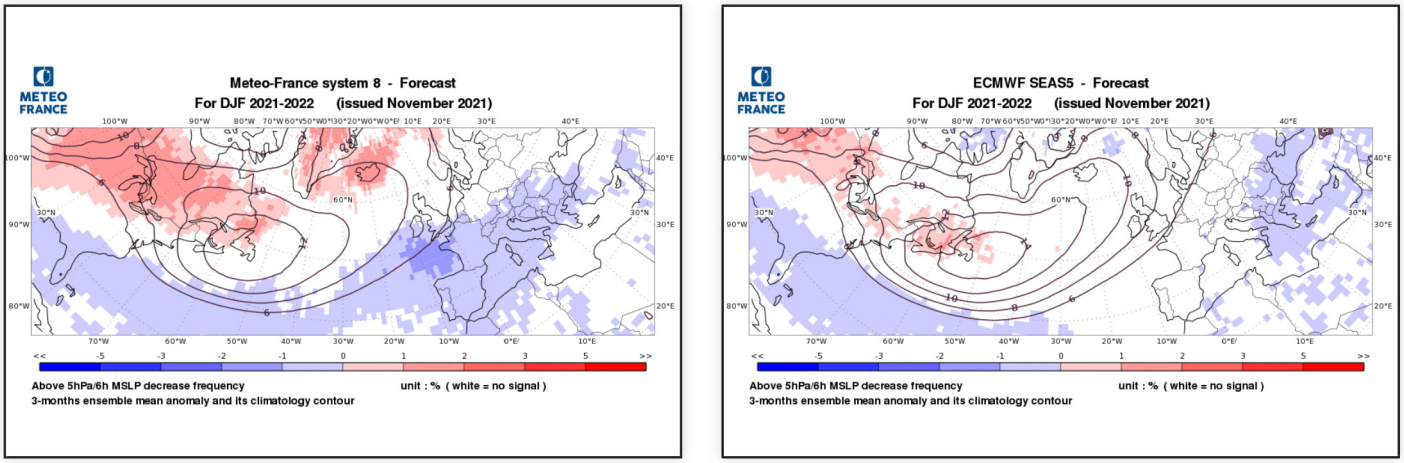


Successive forecasts of the C3S multi-model for the coming quarter

Atmospheric circulation forecasts : Strong MSLP decrease

Significant differences between models.

Reduction of frequencies with MF over Europe (consistent with NAO+), no signal with ECMWF (no significant departure from climatology).



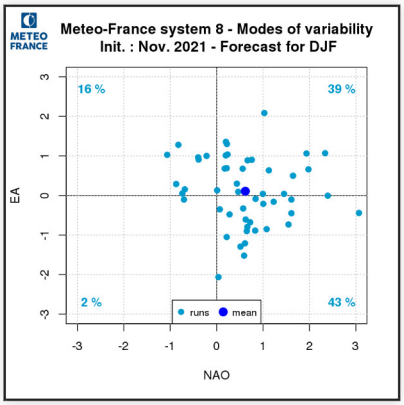
Frequency of more than 5hPa/6h MSLP decrease in MF-S7 (left) and ECMWF-SEAS5 (right)

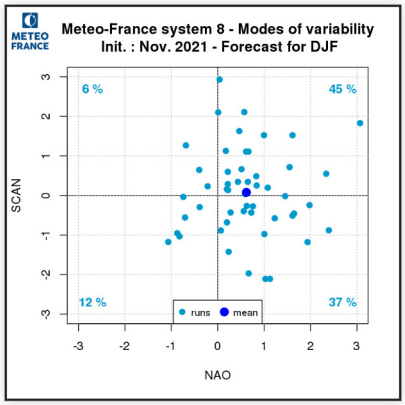
Modes of variability : forecast

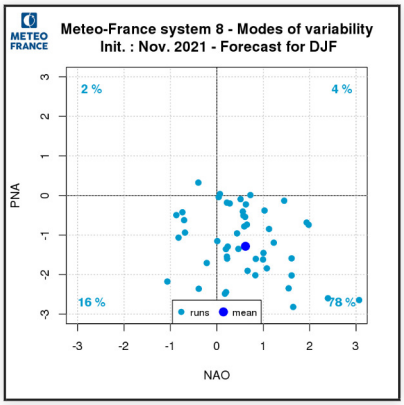
High confidence in a negative PNA.

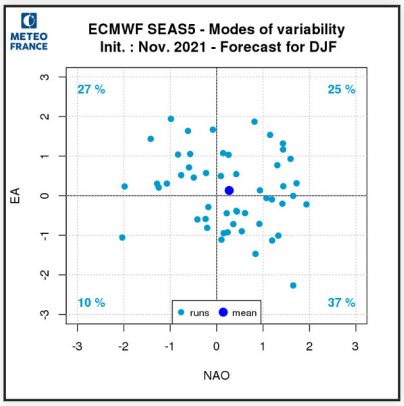
No signal for EA and SCAN

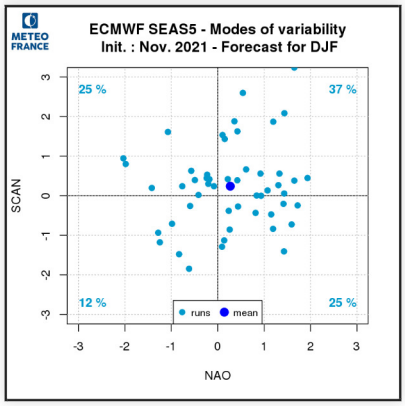
For NAO, there is a clear shift toward NAO+ in MF-S8, no signal in ECMWF-SEAS5.

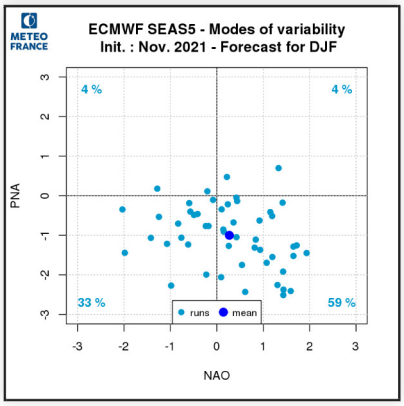










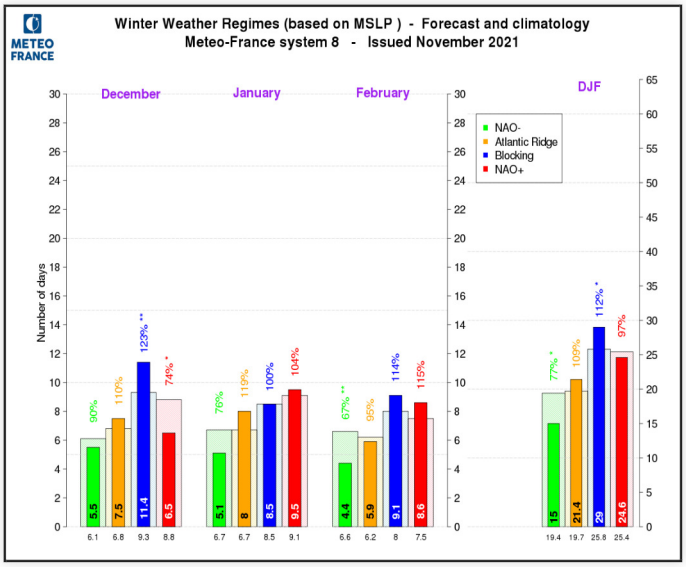


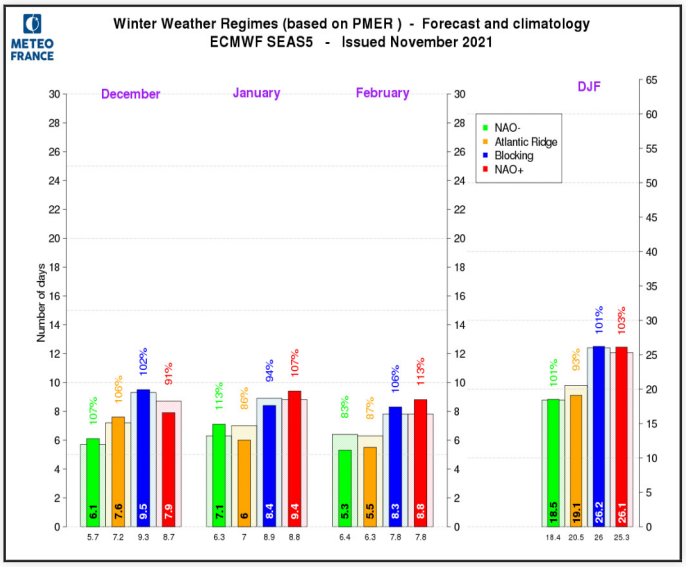
See the modes of variability patterns

Weather regimes : winter MSLP

A "normal" winter season with ECMWF-SEAS5, no significant departure from climatology.

With MF-S8, significant excess of Blocking and significantly less NAO- situations.



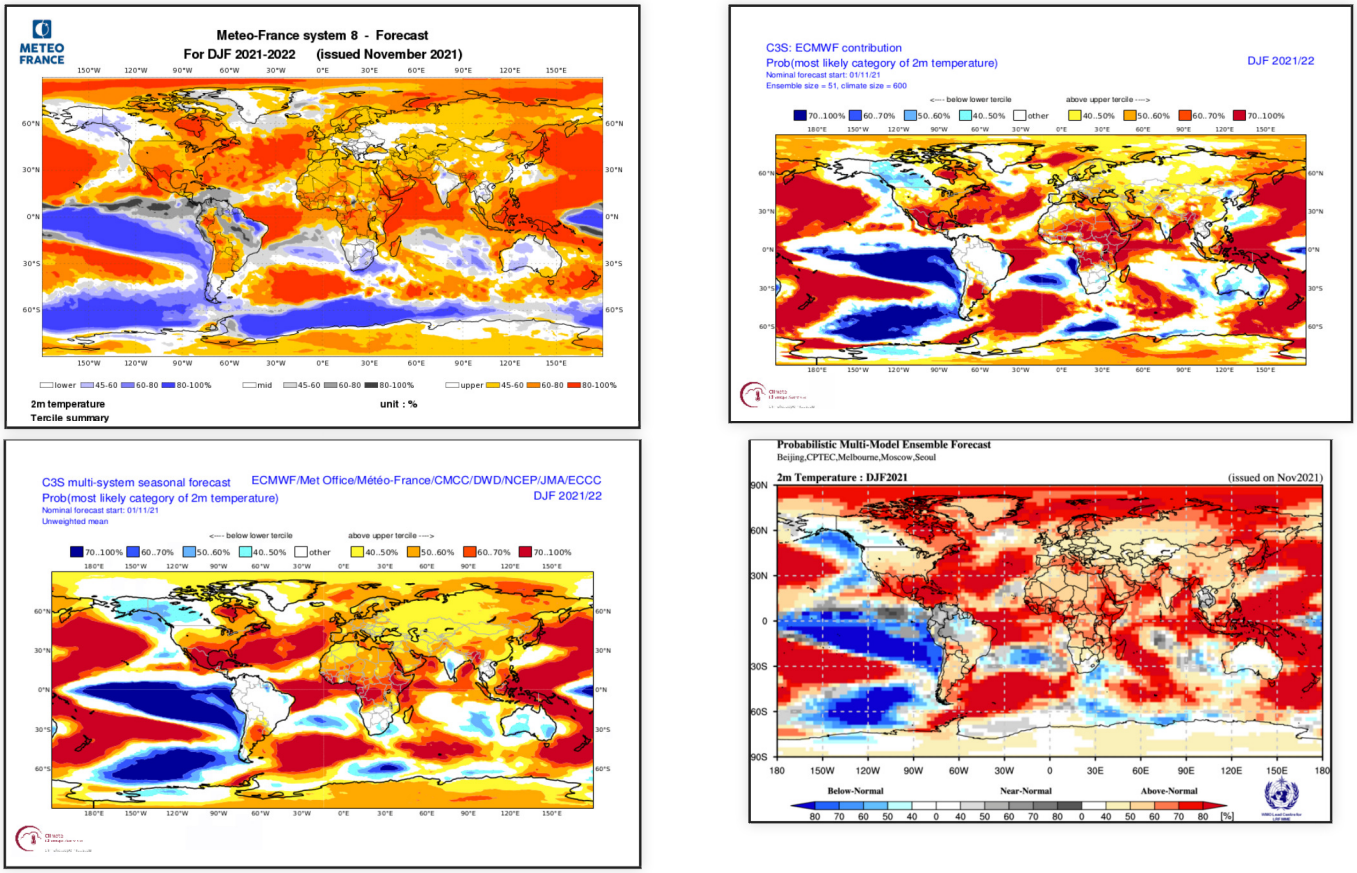


Frequency of SLP weather regimes, compared to model's own climatology, for the next three months and aggregation over the entire quarter, for MF-S8 (left) and SEAS5 (right).

Forecast of climatic parameters : Temperature probabilities

In the tropics, high probability of a warm signal over the Maritime Continent and Equatorial Africa. A normal or colder than normal signal is probable in Brazil, South Africa and Australia.

Over North America, good agreement for a colder than normal signal from Alaska to the Western Canada and a warm one from Quebec to Mexico.



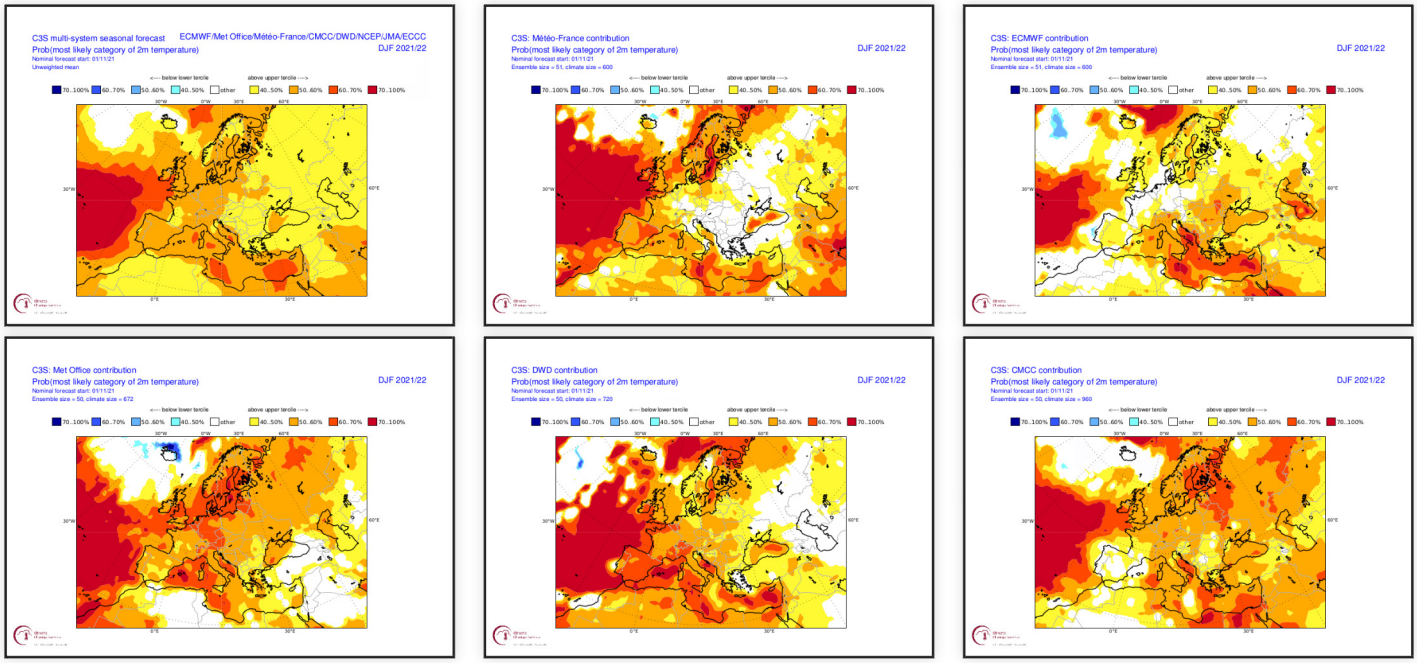
2m temperature probability map from MF-S8 (top left), ECMWF-SEAS5 (top right), C3S multi-models(bottom left) and others models of WMO multi-models (bottom right)

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

Over Europe, the cold tercile is nowhere the most probable, due partly to the positive climate trend (see for instance MF-S8 trend).

Important spread in C3S forecasts. For the models forecasting dominant NAO+ circulation (UKMO, CMCC for instance), the warm tercile is privileged over many European countries.

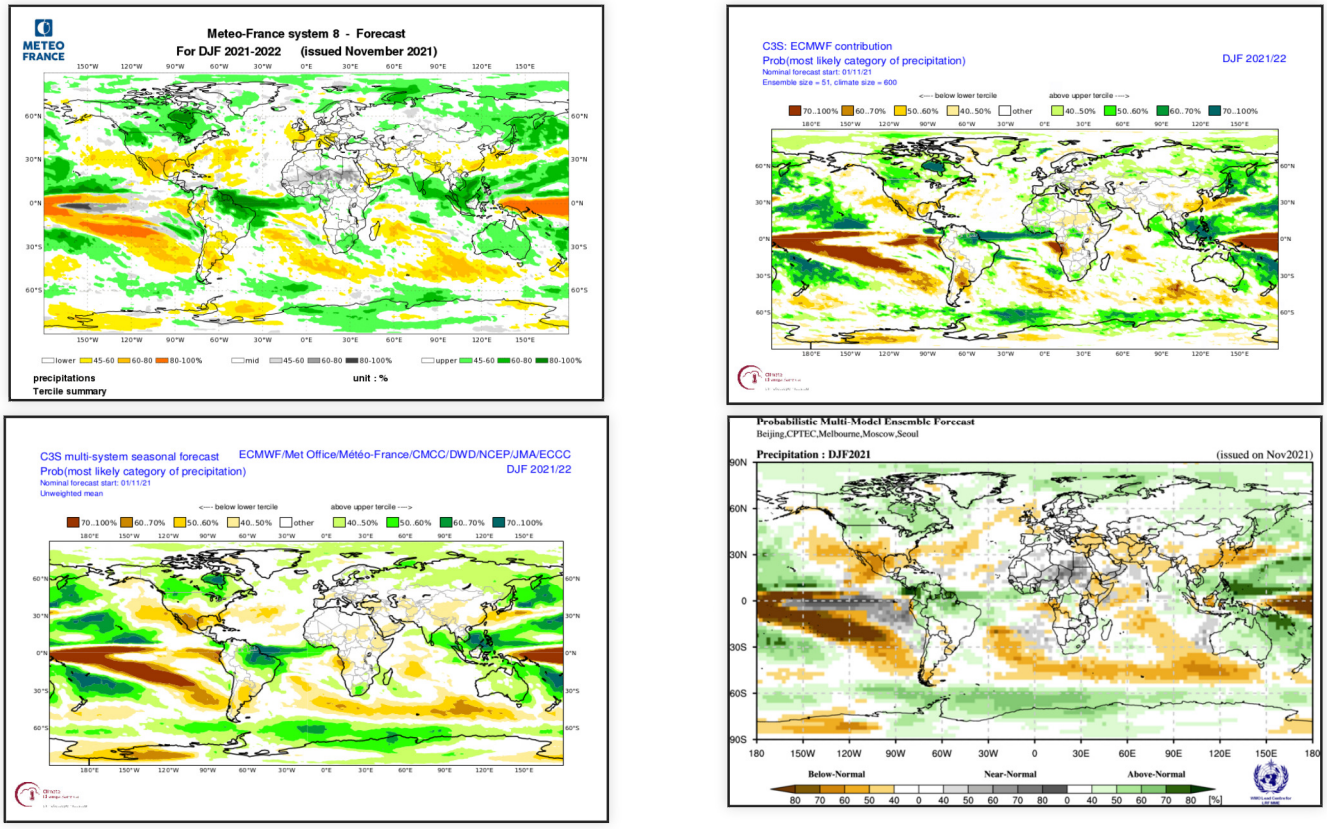
The warm Mediterranean Sea probably explains the high probabilities for the warm tercile in the basin.



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

Forecast of climatic parameters : Precipitation

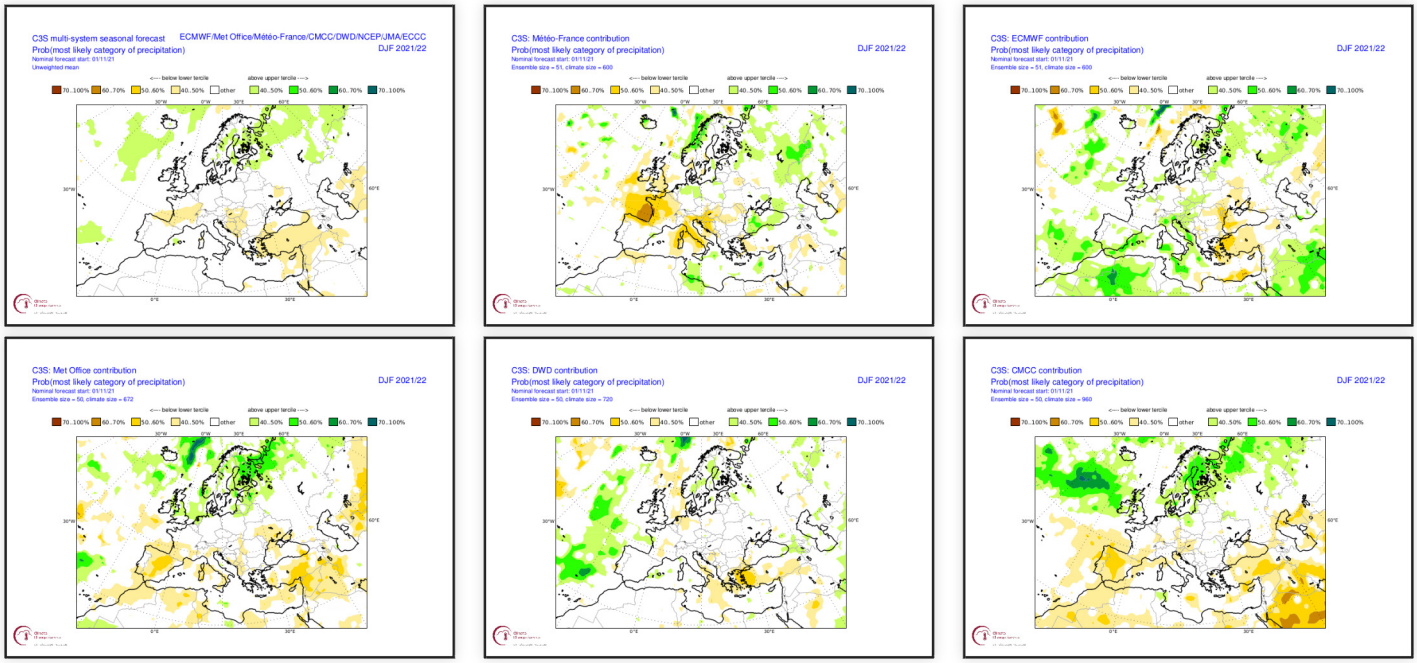
Classical effects of La Niña over the American continent, Africa, around the Maritime Continent.



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

Weak signal. The dominant pattern is "NAO+ like" (see C3S, with a North-South gradient of anomaly).

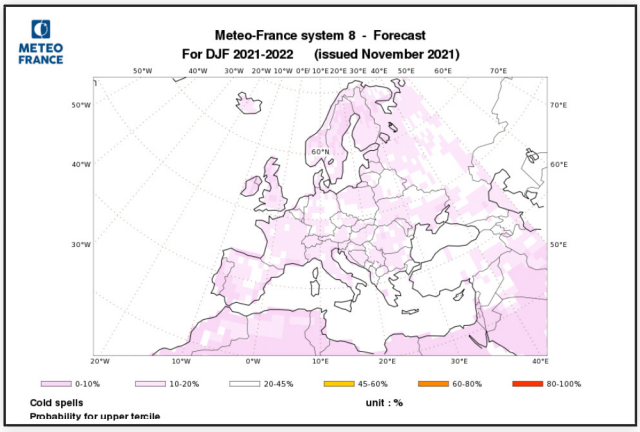


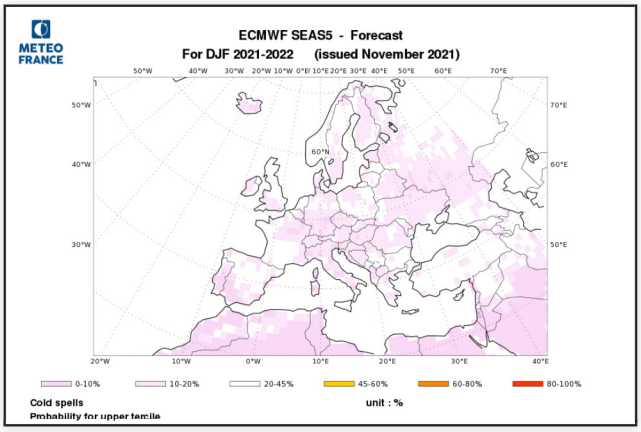
C3S multi-models probability map (top left) and MF-S8, SEAS5, UKMO, DWD, CMCC models.

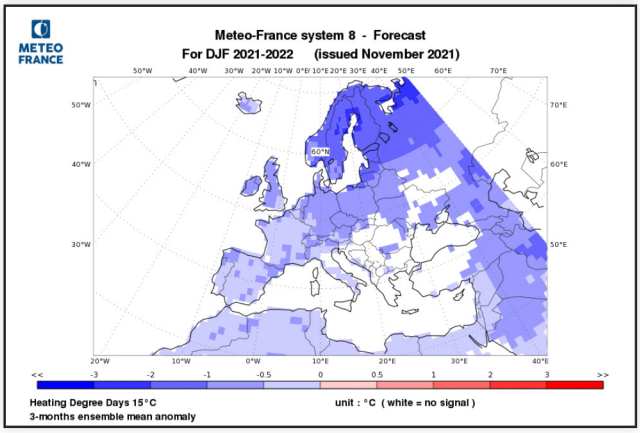
Forecast of climatic parameters : cold spell

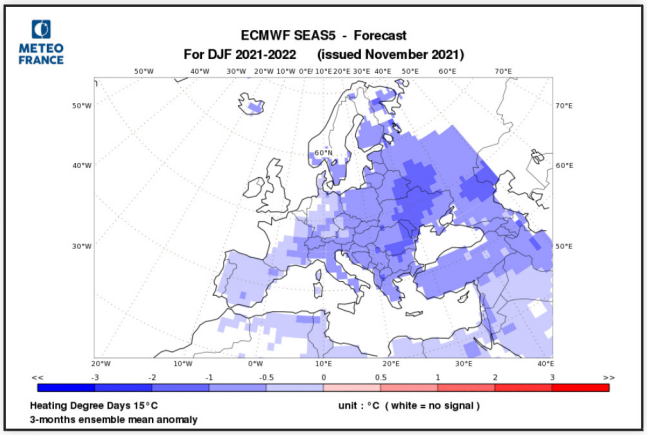
The probability of a cold spell is very low in both models (probably due to climate warming).

The need for heating is also reduced. But the 2 models show very different patterns, in link with their very different atmospheric circulation.









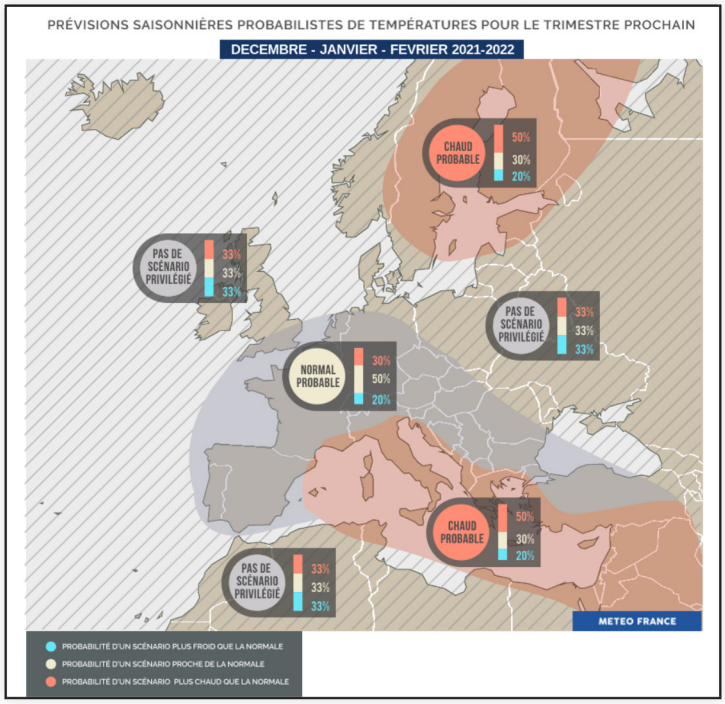
Above, cold wave probability and below, heating degree-days (base 15°C) for MF7 (right) and ECMWF (left)

Synthesis map for Europe : Temperature

Some models are forecasting a temporary weakening of the polar vortex in December and/or January. This seems realistic, especially with a negative QBO, but it is not confirmed by the last NWP forecasts (CFS, ECMWF dated of 18th November). So we don't exclude this possibility, but we can't considerer it as more probable than the non-occurrence of such event. We remind that in case of weak polar vortex vortex, meridian circulations are more likely.

So the mean DJF circulation (in Z500) is quite well summarized by C3S multi-model forecast, with a stronger zonal gradient over west Atlantic (a mix of NAO+ and Atlantic Ridge, classical during La Niña events) and a positive anomaly centred over Central Europe (also visible in GPC multi-model chart). In between (west of Europe), the Z500 anomaly is weaker, representing the possibility of meridian circulation events (NAO- or blocking situations leading to cold events on Europe and precipitation events in the Western part of the Mediterrean basin).

So in terms of temperature, we expect a "normal" winter on many European countries with quite important intra-seasonal variability (zonal conditions generally favoured by a strong jet over western Atlantic, with possibility of cold events). Due to the dominant high overCentral Europe and a warmer than normal Mediterrean sea, we could have milder conditions than normal around the basin. And finally, around the Baltic Sea, there is a good consensus between models to privilege a "warm" scenario.

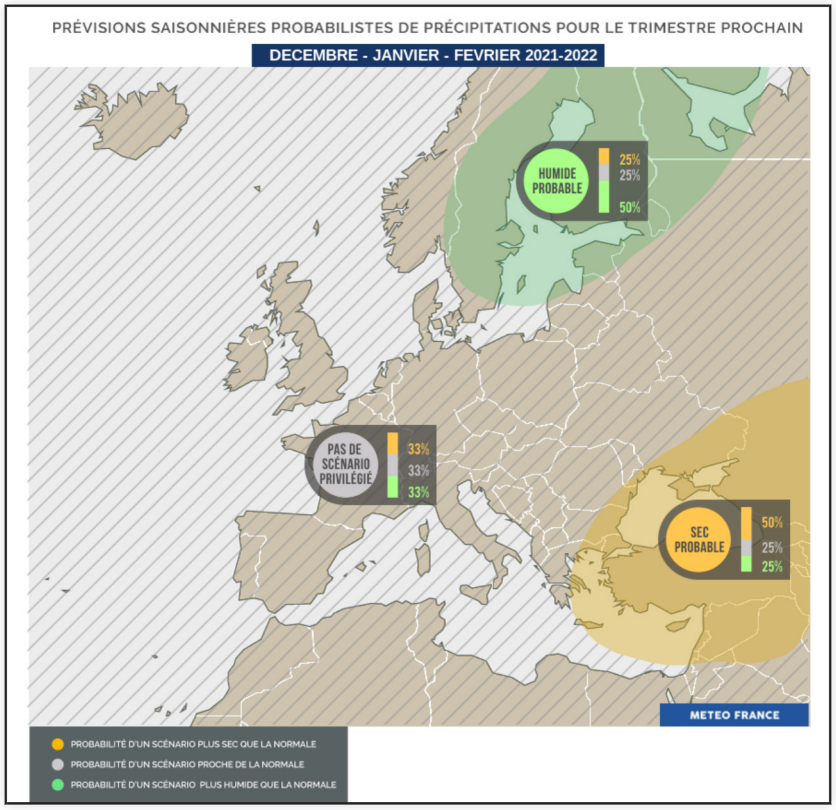


Synthesis map of probabilistic forecast for Europe. (c) Météo-France/DCSC/ACS

Synthesis map for Europe : Precipitation

The high intra-seasonal variability expected maybe explains the very low signal in the models for precipitation.

We finally keep only the main large scale signal visible in C3S multi-model chart (quite compatible with "other GPCs" chart) : an anhanced probability for the wet tercile aroud the Baltic Sea and a dry signal over the Middle East.



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