

Météo-France Seasonal Forecast Bulletin

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General synthesis : MAM 2021

Very good agreement between models in the tropics and globally in mid latitudes, in regions with strong signal. This is mainly linked to the impact of La Niña on global climate. On the North Atlantic, weak signal in PV and FC, but a NAO+ scenario seems to emerge in geopotential.

A) Oceanic forecast :

- ENSO : weakening La Niña, evolution toward neutral phase.
- IOD : close to normal, with a temporary positive phase (but weak)

B) Drivers :

- La Niña impacts still present
- SSW at the beginning of simulations, with impacts limited to February.

C) Atmospheric circulation :

- classical response to "La Niña" in the tropics (upward motion anomaly over the Eastern Indian Ocean and Maritime Continent, downward motion anomaly over Central Pacific). Very marked negative PNA teleconnection to North America.
- over the North Atlantic and Europe : NAO+ seems the most probable circulation (largely dominant in C3S models + consistent with U10hPa forecast in March, see drivers section), plus an Atlantic Ridge pattern (see ECMWF-SEAS5).

D) Most likely conditions :

- In the tropics, increased rainfall over the Maritime Continent, Southeast Asia and Australia as well as over northern South America. Precipitation in deficit over Mexico, the southern United States and the rest of South America as well as the East of Middle East. Excess precipitation over Canada and Siberia.
- **over Europe** : warm scenario on the East of the domain, normal on Western Europe. Wet scenario over Scandinavia, no scenario elsewhere.

Next bulletin : scheduled on March 19th
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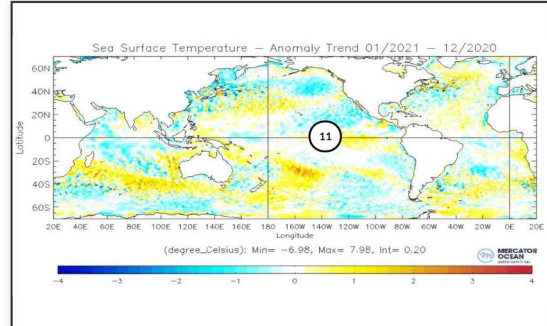
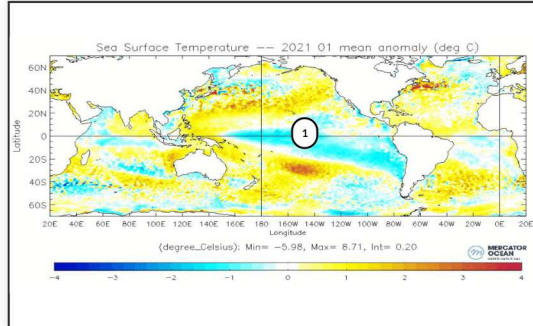
Oceanic analysis of January 2021 : SST anomalies

Current ENSO situation : La Niña

In the Pacific Ocean : The cold anomaly in Central Pacific is still very marked, despite a slight warming during the month of January. Strong persistent contrast between this cold anomaly and the warm anomalies in Northern and Southern Pacific.

In the Indian Ocean : cooling in the North part of the basin, the equator and up to the Southern tropic; and warming in mid-latitude in the South. As a result, complex pattern in the basin. The Indian Ocean Dipole looks neutral (see DMI in next slides).

In the Atlantic Ocean : in the Northern hemisphere, east/west contrast in SST anomalies, with cold anomalies close to Europe. In the Northern tropics, warm SST anomalies.

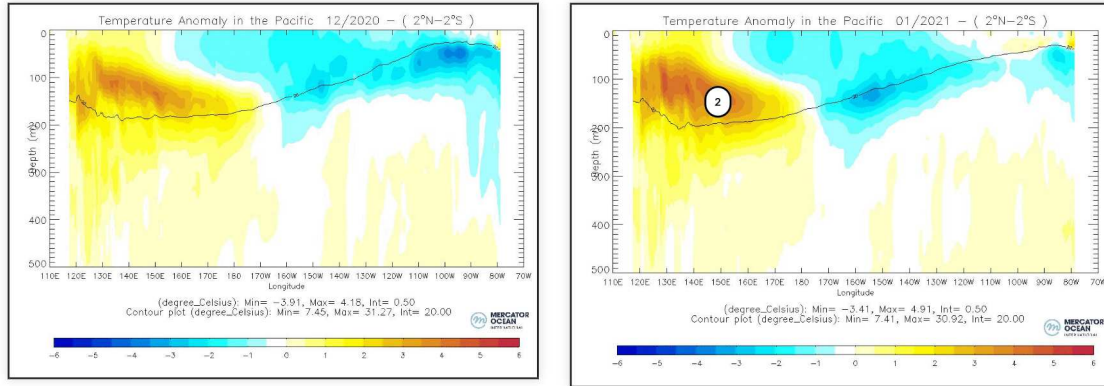


SST Anomalies and trend with the previous month (c) Mercator-Ocean

- 1 - La Nina cold anomaly
- 11 - weak warming in Nino3.4 box

Oceanic analysis of January 2021 : Pacific vertical section

In subsurface, almost stationary situation. On the western part of the basin, the hot reservoir continued to strengthen. On the eastern part close to surface, conditions has become neutral.

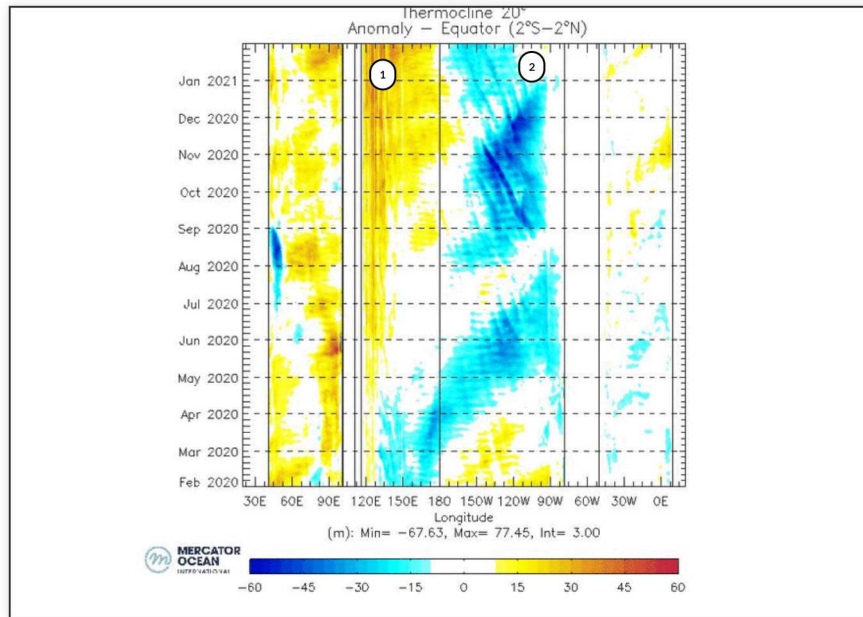


Ocean temperature anomalies in the first 500 meters of the equatorial Pacific basin, monthly average. (c) Mercator-Ocean

2 - strengthened warm anomaly

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

Persistent strong subsurface contrast in the Pacific, the positive anomaly in the West is stronger than in December.



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

1 - Warm anomalie in the west part

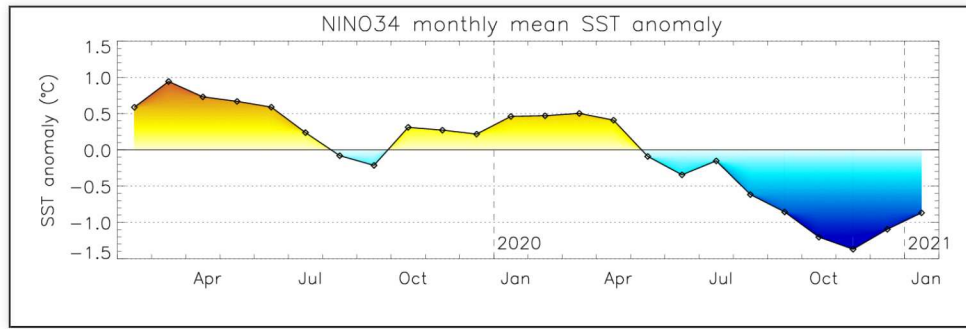
2 - Cold anomalies in the east part of the Pacific started to decrease

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

Nino3.4 index issued from Mercator Ocean PSYV4R2 analysis : -0.9 °C

(see BOM site for weekly values : http://www.bom.gov.au/climate/enso/monitoring/nino3_4.png)

Continued reduction of the negative anomaly, as foreseen last month.

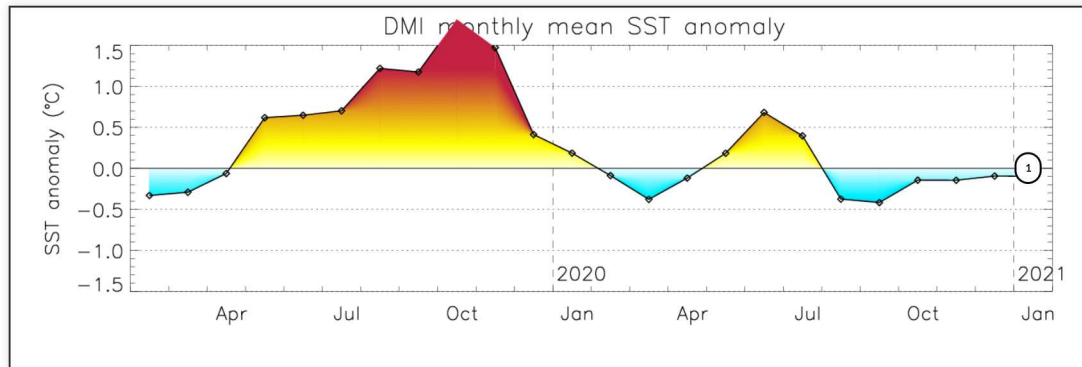


Evolution of SST in the NINO3.4 box (c) Mercator-Ocean

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

DMI Index issued from Mercator Ocean PSYV4R2 analysis : -0.1°C
(see BOM site for weekly values : <http://www.bom.gov.au/climate/enso/monitoring/iod1.png>)

Near neutral conditions



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

1 - Near neutral conditions

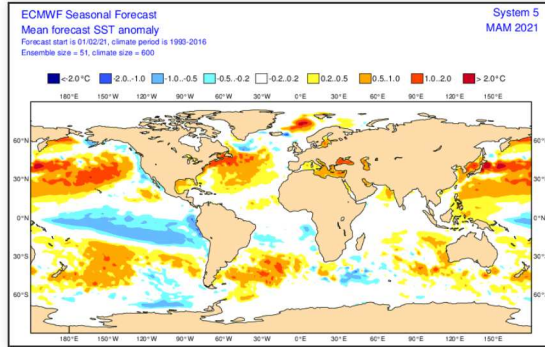
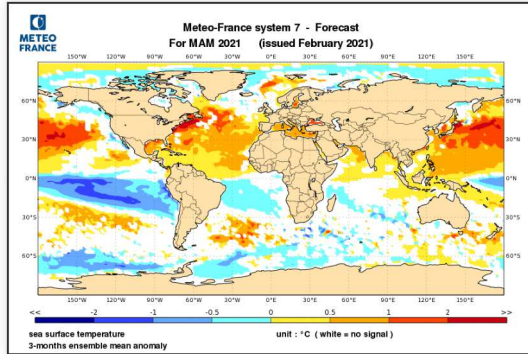
Oceanic forecast : SST anomaly

In the Pacific, good agreement between MF-S7 and ECMWF-SEAS5. But some differences in the other basins.

In the Pacific Ocean : the cold anomaly pattern associated to La Niña is still present in the forecasts. Its intensity is a little bit stronger in MF-S7 than in ECMWF-SEAS5, but its extension to the South-East (up to South America) is similar in both models. Good agreement on the warm anomaly patterns in mid-latitudes (Northern and Southern hemisphere)

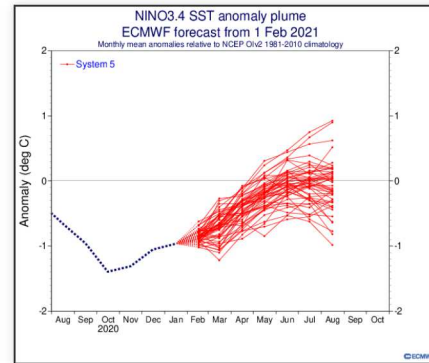
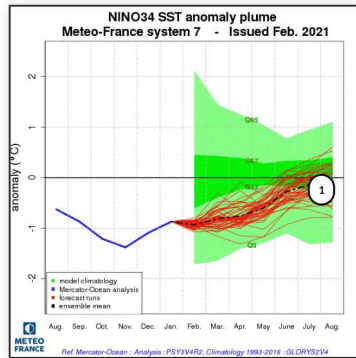
In the Indian Ocean : some differences between the two models, in both hemispheres. Looking at the other C3S models (see [C3S website](#)), the forecast is quite uncertain. The most probable scenario is closer to ECMWF-SEAS5 (warm anomalies in the North and in the South) than MF-S7.

In the Atlantic Ocean : the anomaly pattern foreseen by ECMWF-SEAS5 is shared by all C3S models, except MF-S7 (which seems to warm in Northern tropics).



Oceanic forecast : NINO3.4 Plume diagrams

ECMWF-SEAS5 and MF-S7 : both models predict a gradual attenuation of the cold anomaly over the next months. The ascent is a little more straightforward with ECMWF-SEAS5 than with MF-S7.

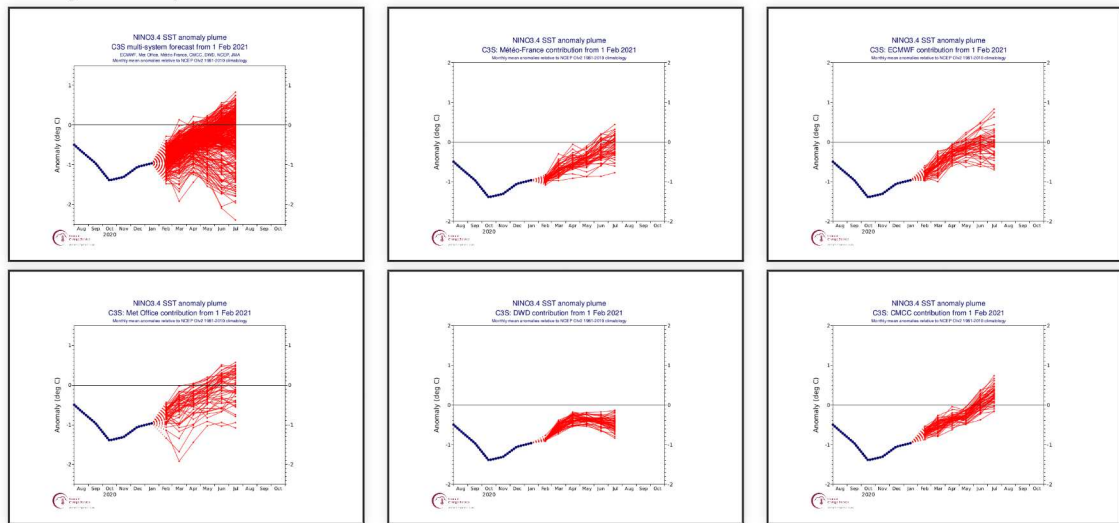


1 - Return to neutrality expected in the summer.

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

C3S models : most models agree on the gradual warming scenario, except NCEP and in a lesser degree DWD. It explains the very large spread of C3S multi-system chart.

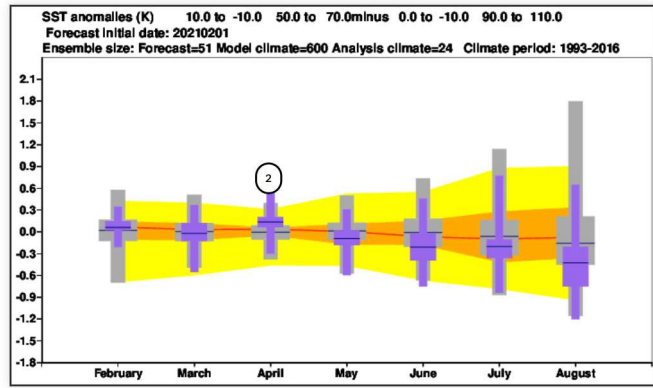
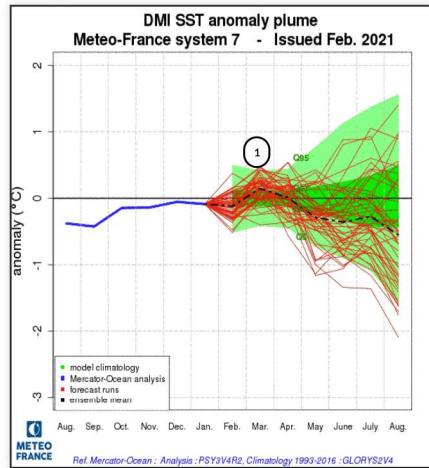
Expected Phase for the next three months : mitigation of the La Nina phenomenon and probable return to neutral during the MAM quarter.



C3S plume diagrams re-scaled from the variance of observations for the period 1981-2010.

Oceanic forecast : Indian ocean - DMI evolution

Both models predict a small hot surge during the next quarter, in a period of year with low variability (see the green zone in MF-S7 or orange zone in ECMWF-SEAS5).

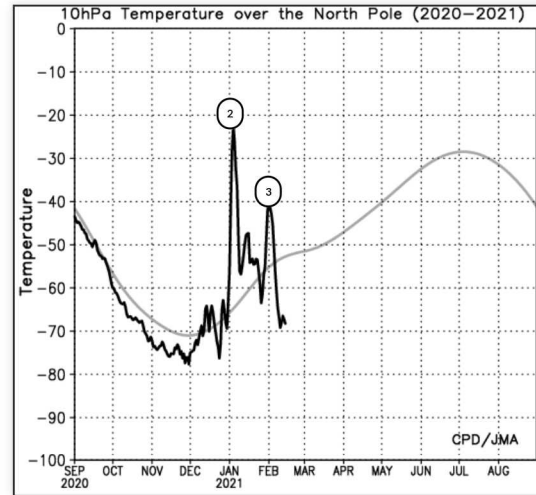
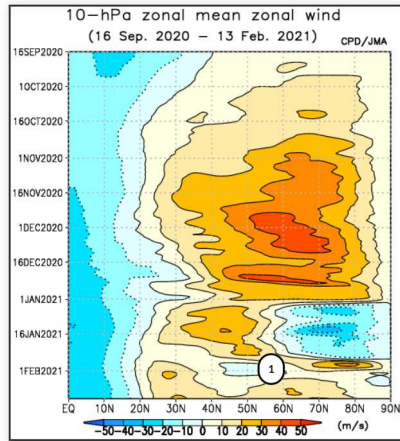


DMI index : analysis, forecasts and model climatology with MFT on the right and SEAS5 on the left

- 1 - MF-S7 : small surge in March
- 2 - ECMWF-SEAS5 : small surge in April

Drivers : SSW

After the spectacular SSW observed in early January, a second one occurred at the beginning of February with a rise in temperature to 30hPa of about 25 °C in a very few days. This should promote the NAO- weather regime in the coming weeks, maybe until early March. But this sub-seasonal effect does not generally last beyond that.



10 hPa zonal wind Hovmuller diagram and 30 hPa temperature histogram. (c) Tokyo Climat Center JMA

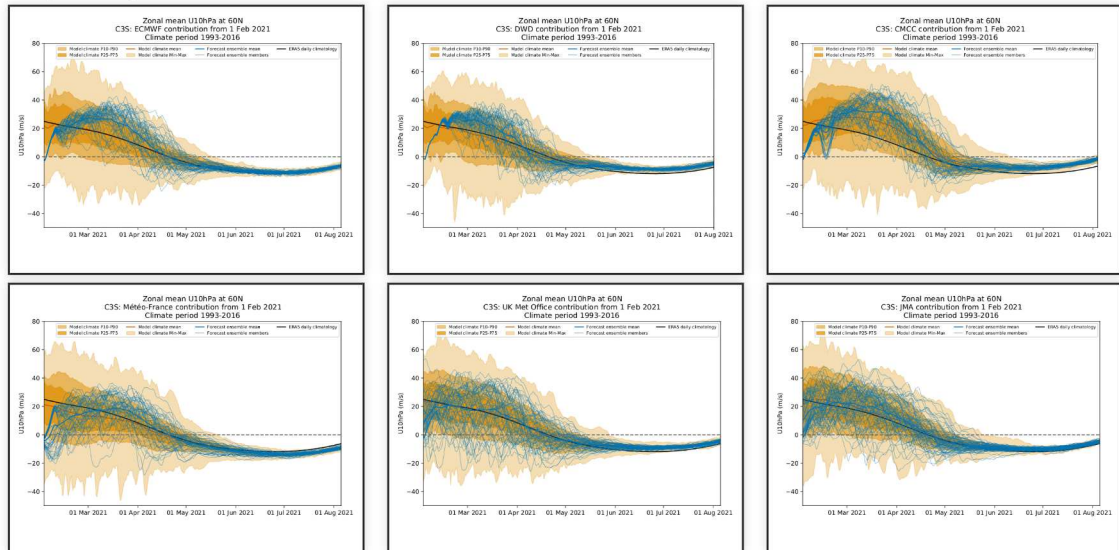
- 1 - zonal wind reversal in the first days of February
- 2 - Major SSW at the beginning of January
- 3 - spectacular rise in temperatures of around 25 °C

Drivers : U010 plumes

Depending on the initialization date of the model runs, the inversion of the wind in the stratosphere in the first days of February followed by a quick return to positive values (as described on the Hovmuller on the previous slide) is correctly foreseen or not.

For ECMWF, DWD and CMCC, the late initialization enabled a very good prediction by all the runs for these first days of February. For MF-S7 only part of the runs predicted the observed evolution. For UKMO and JMA, a large majority of the runs launched early did not correctly anticipate it.

Interestingly, most of the runs of C3S models predict a strong polar vortex in March (stronger than climatology) : this should enhanced the probability of NAO+ circulation.



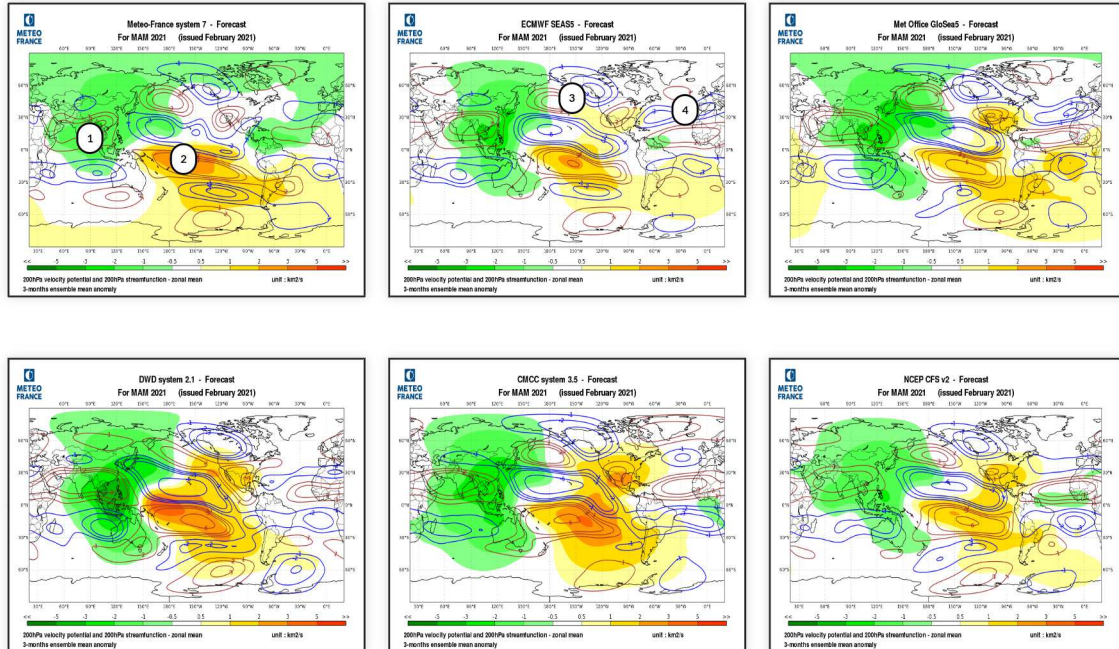
ECMWF-SEAS5, DWD, CMCC, MF-S7, UKMO, and JMA 010hPa zonal mean of u component of wind at 60°N.

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

Very good agreement between models in the tropics and globally in mid latitudes, in regions with strong signal. On the North Atlantic, week signal in PV and FC, but a scenario seems to emerge.

Velocity Potential : In connection with the La Nina situation, the models foreseen a strong dipole in the Pacific-Indian zone, with upward motion anomaly over the Maritime Continent extending to the Eastern Indian Ocean and large downward motion anomalies over the Pacific. Secondary anomalies are visible in a majority of models : a dipole +/- over Mexico/The Caribbean, a neagative anomaly over Asia in mid-latitudes.

Streamfunction : quadripole over Indian and Pacific oceans, in relation to La Niña. Magnificent teleconnection of negative PNA. Over the Atlantic, zonal patterns in the tropics (in all models), with a negative anomaly (cyclonic anomaly) covering south-western Europe (see ECMWF-SEASS or UKMO for instance).



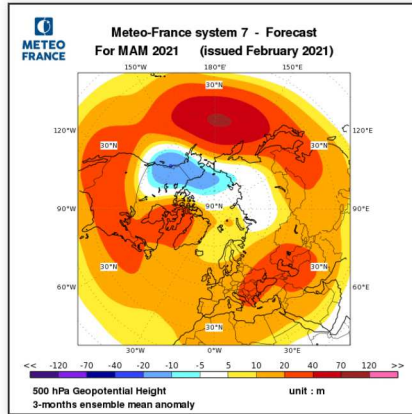
MF7, SEASS, UKMO, DWD, CMCC and NCEP 200hPa velocity potential anomalies (color range, green : ascending, orange : subsidence) and stream function anomalies (isolines, red: anticyclonic in the northern hemisphere, blue: cyclonic in the northern hemisphere).

- 1 - VP : large area of upward motion anomaly
- 2 - VP : large downward motion anomaly
- 3 - SF : pattern of negative PNA
- 4 - SF : cyclonic circulation anomalies at 200hPa

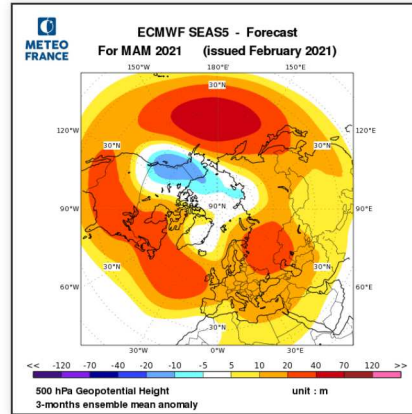
Atmospheric circulation forecasts : 500 hPa Geopotential anomalies

Good agreement for the negative PNA.

Over Eurasia, the two models have a similar scenario of positive Z500 anomaly, despite differences in the anomaly pattern. Over Northern Atlantic, the positive anomaly is much stronger in ECMWF-SEAS5.

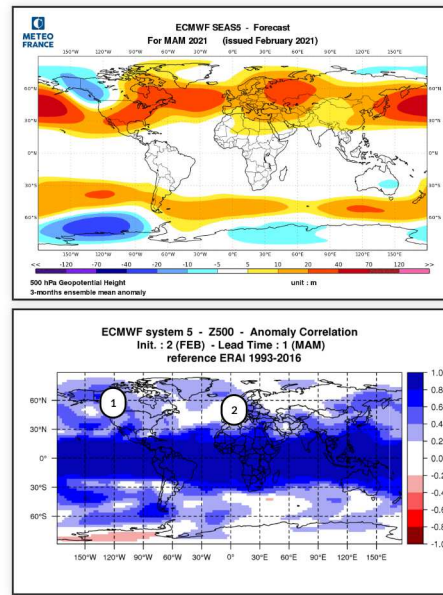
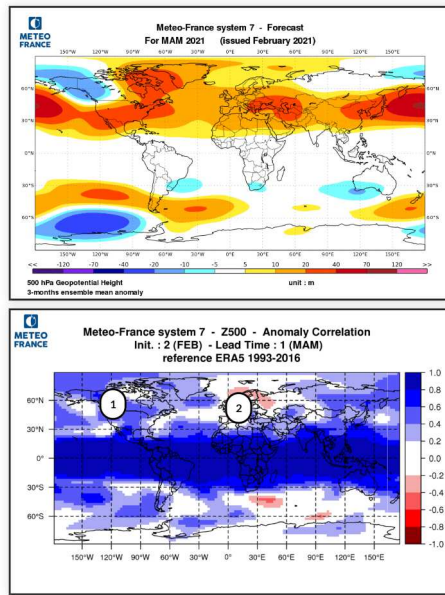


polar projection of MF7 and SEAS5 500hPa geopotential height anomalies.



Atmospheric circulation forecasts : Z500 scores

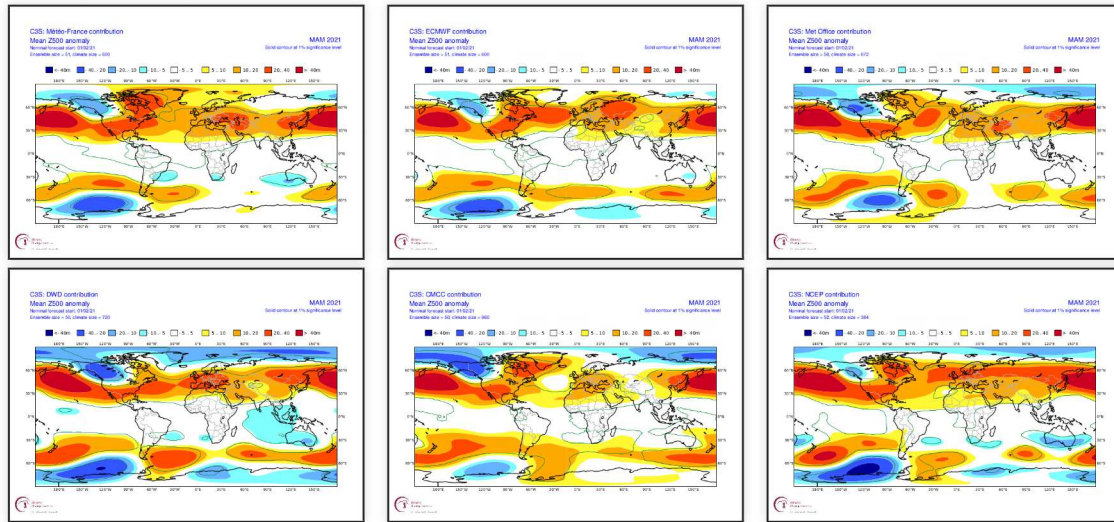
Over the hindcast period, scores are good over North America (in link with the PNA), but low over the Atlantic and Europe.



Atmospheric circulation forecasts : Z500 anomalies in C3S models

All C3S models agree on a marked negative PNA, as already seen on PV-FC200.

Over North Atlantic and Europe, there are noticeable differences between models. They tend to agree on a positive anomaly stretching for USA to Europe, and Eastwardly to Asia. Over Europe the anomaly pattern differs from one model to another but the positive anomaly is the most probable.

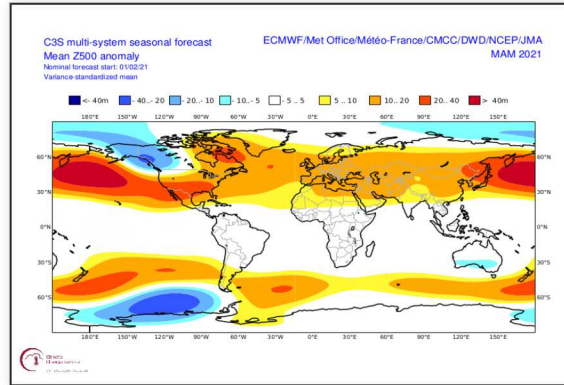


MF-S7, SEAS5, UKMO, DWD, CMCC and NCEP 500hPa geopotential height anomalies.

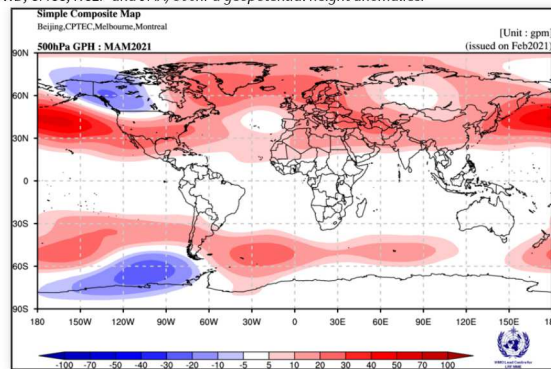
Atmospheric circulation forecasts : Z500 anomalies multi-systems

The two multi-models charts look similar but for North Atlantic and Eurasia.,

Looking at individual models, all the models that foreseen a NAO- scenario belong to the "non-C3S" group. Whereas almost all C3S models agree on a "NAO+" scenario. So it explains why the two multi-system are so different.



C3S multi-models (MF-S7, SEAS5, UKMO, DWD, CMCC, NCEP and JMA) 500hPa geopotential height anomalies.

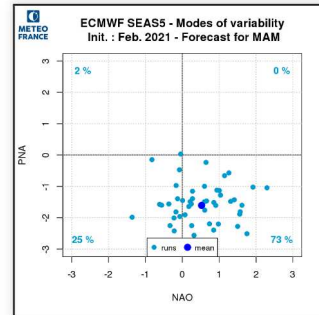
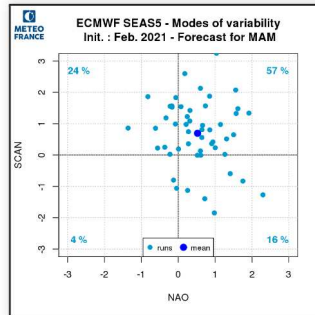
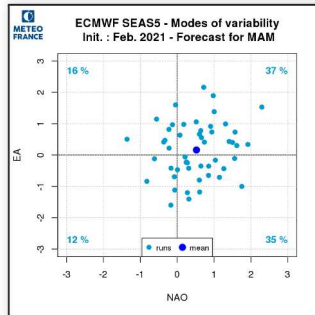
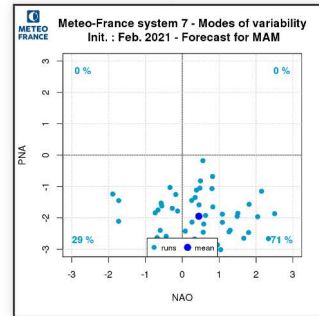
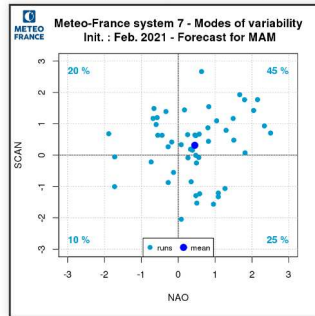
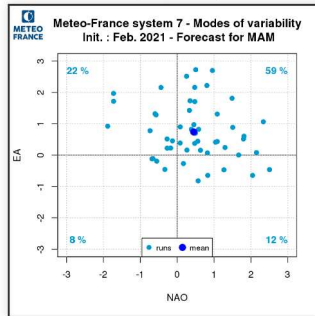


Others models of WMO multi-models 500hPa geopotential height anomalies.

Modes of variability : forecast

Unsurprisingly, all the individual members of each ensemble forecast negative PNA.

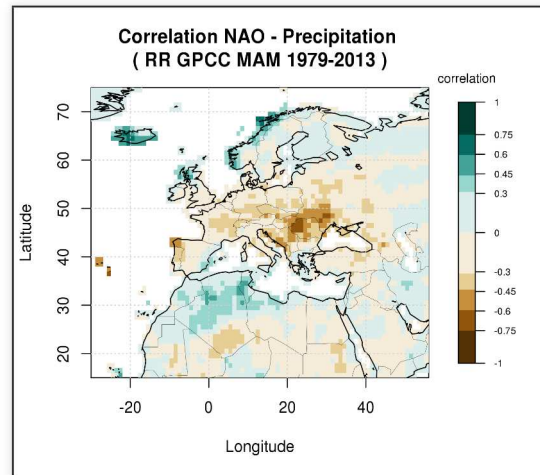
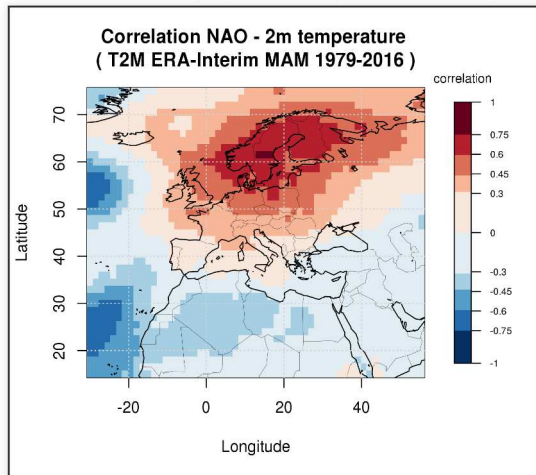
A positive NAO is probable (more than 70% of the ensemble, for the two models).



[See the modes of variability patterns](#)

Modes of variability : NAO impacts

NAO mode has a strong impact on Europe for this 3-month period

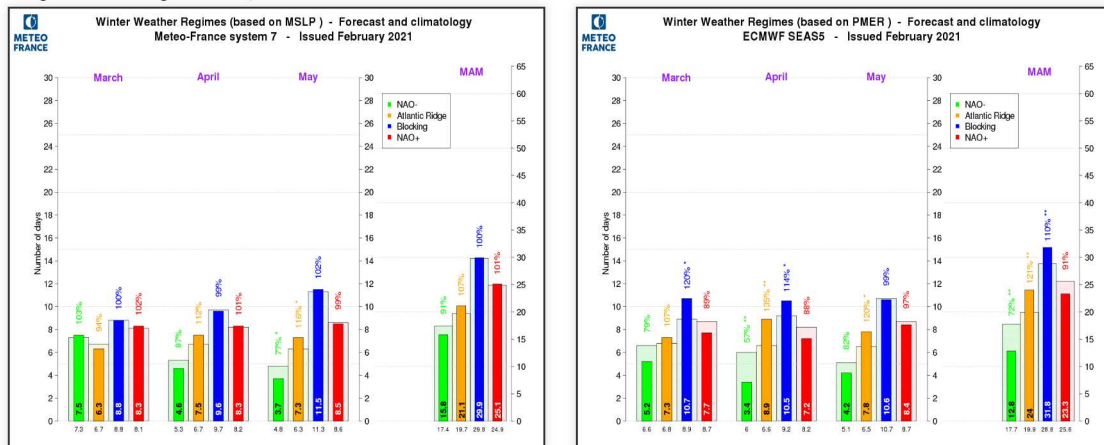


Weather regimes : winter MSLP

No clear consensus between the two models.

MF-S7's regime forecast is close to climatological values.

ECMWF-SEAS5's forecast is significantly different from climatology for 3 regimes : NAO- would be less frequent than normal, Atlantic Ridge and Blocking more frequent.

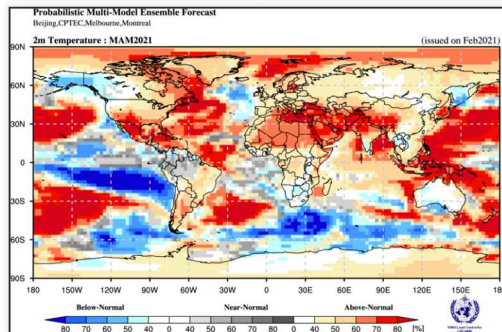
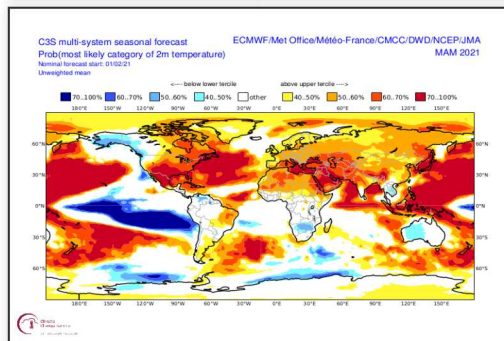
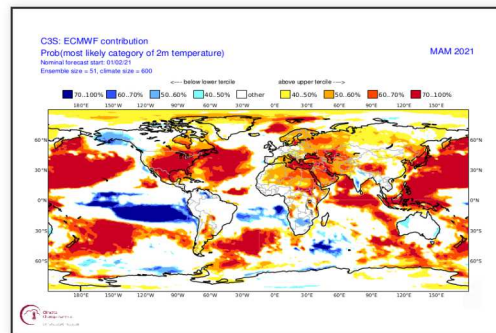
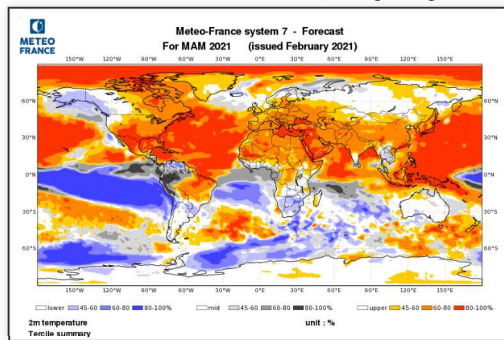


Frequency of SLP weather regimes, compared to model's own climatology, for the next three months and aggregation over the entire quarter, for MF-S7 (left) and SEAS5 (right).

Forecast of climatic parameters : Temperature probabilities

In a situation constrained by the La Niña in the Pacific and around.

- North America : strong signal in link with La Niña.
- South America : close to normal in the North-West, warmer than normal in the North-East
- North of Africa and Middle East : consistent signal of warmer than normal
- Asia : warmer than normal in the South, divergent signal in the North.

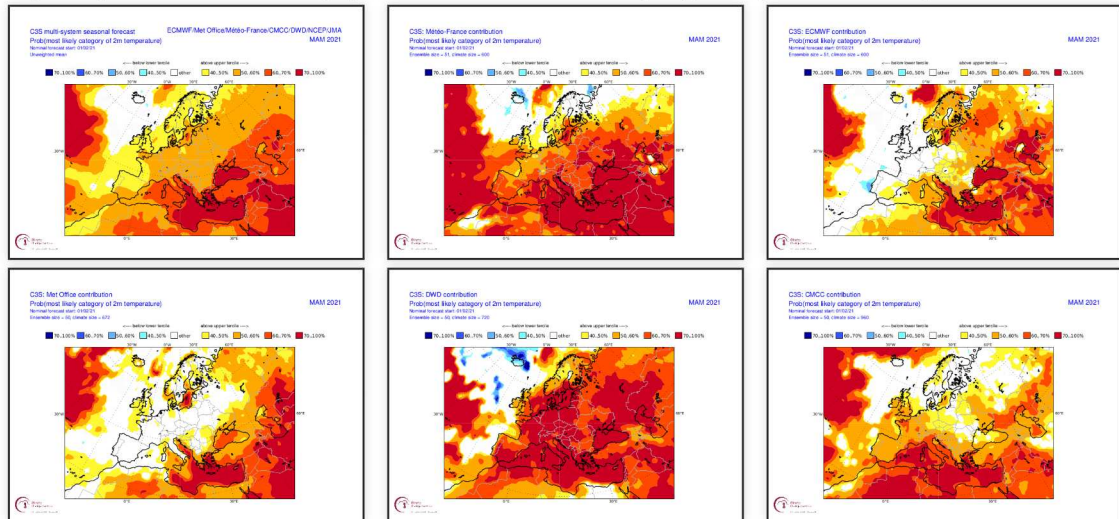


2m temperature probability map from MF-S7 (top left), ECMWF-SFAS5 (top right), C3S multi-models (bottom left) and others models of WMO multi-models (bottom right)

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

The "warmer than normal" scenario seems the most probable in the Eastern part of Europe.

Whereas in Western Europe, models are more divergent : two of them (ECMWF-SEAS5 and UKMO) privileged a "normal" scenario. This is probably linked to the "Atlantic Ridge" pattern visible in their Z500 anomaly map, that negates the "NAO+" impact.

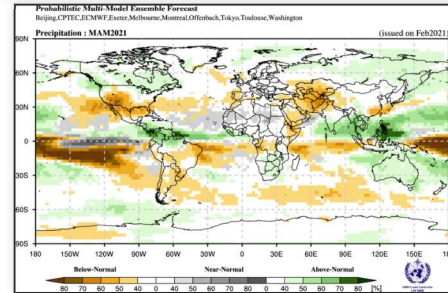
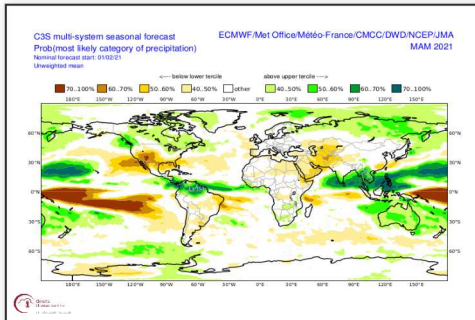
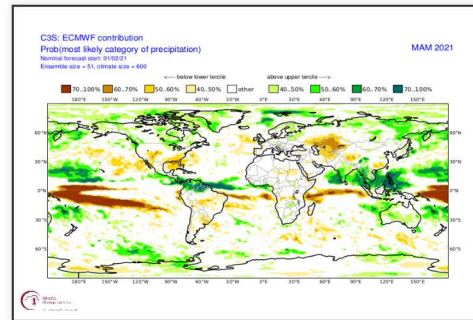
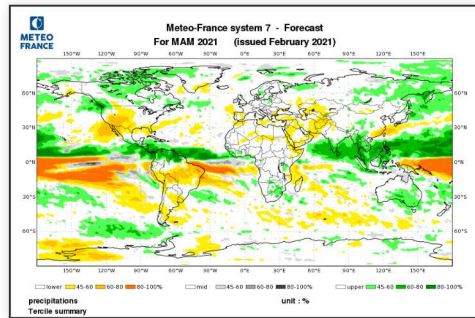


C3S multi-models probability map (top left) and MF-ST, ECMWF-SEAS5, UKMO, DWD, CMCC models.

Forecast of climatic parameters : Precipitation

Thanks to La Niña, models are remarkably consistent in the tropics and up to mid-latitudes over North and South America, but also over South of Africa (wet pattern).

Over Middle East, a "drier than normal" pattern is clearly foreseen by the models, consistent with Z500 anomaly charts.

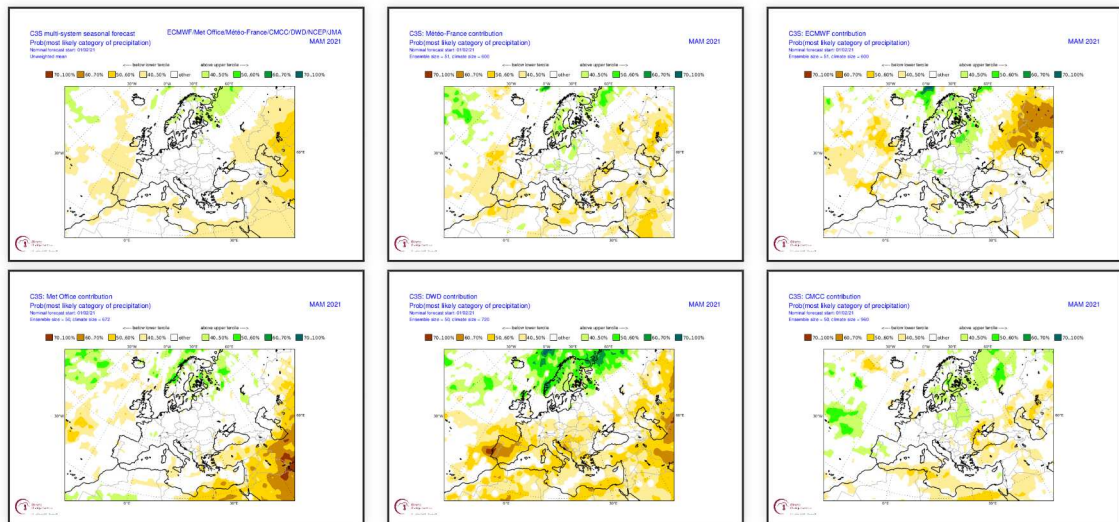


precipitation probability map from MF-S7 (top left), ECMWF-SEAS5 (top right), C3S multi-models (bottom left) and others models of WMO multi-models (bottom right)

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

Over Scandinavian countries, "wetter than normal" signal shared by C3S models : this is consistent with a dominant NAO+ circulation.

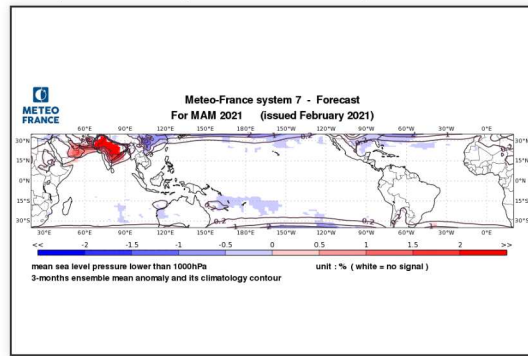
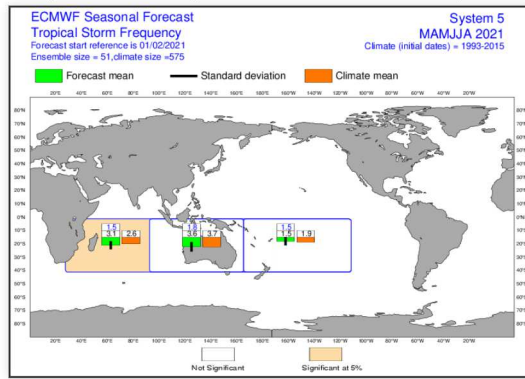
And traces of "dry" signal on Western Europe, along Southern Europe and the Mediterranean sea. The "dry" signal is much stronger in the Middle East.



C3S multi-models probability map (top left) and MF-S7, SEAS5, UKMO, DWD, CMCC models.

Forecast of climatic parameters : Tropical Storm Frequency

The cyclone risk is likely to increase in the Indian Ocean, but SST forecast is quite uncertain (see SST forecast slide).

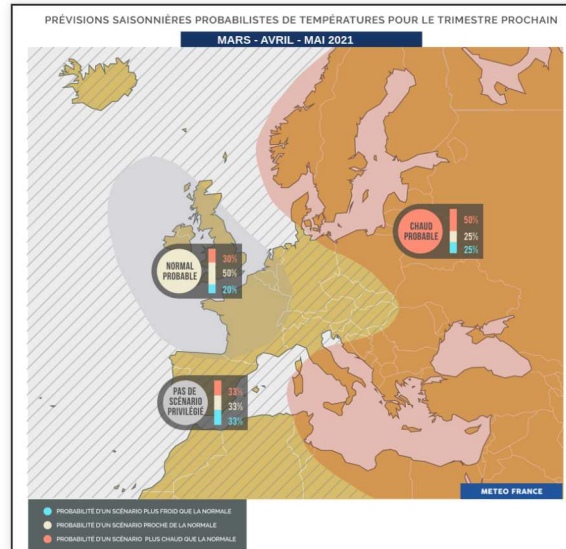


Synthesis map for Europe : Temperature

We take into account the C3S 's scenario of a dominant positive NAO, combined with a positive geopotential anomaly on the North Atlantic (Atlantic Ridge). This is more or less the scenario described by ECMWF-SEAS5.

As a result :

- the Eastern part of the domain should experience warmer than normal temperature : consequence of NAO+ on Scandinavia, and of positive geopotential anomalies on Middle East (almost all models).
- "normal" scenario over Western Europe, with mixed contribution of NAO+ and Atlantic Ridge.
- no scenario elsewhere

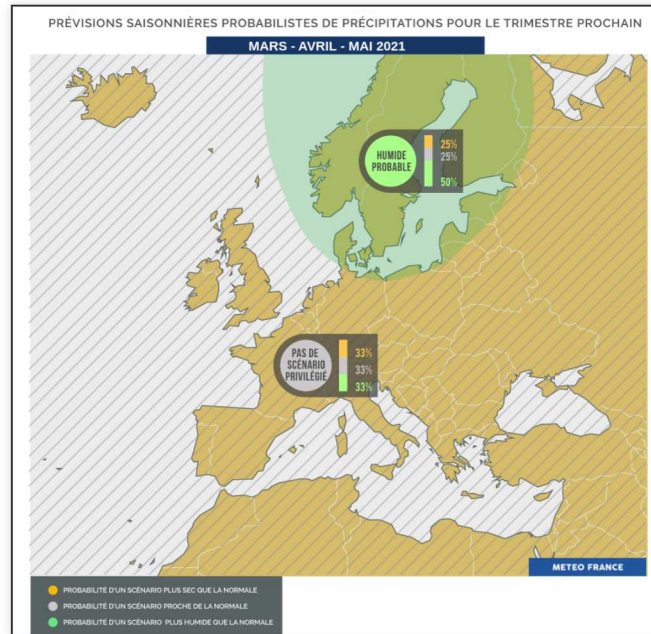


Synthesis map of probabilistic forecast for Europe. (c) Météo-France/DCSC/AVH

Synthesis map for Europe : Precipitation

No scenario, except a "wetter than normal" zone on Scandinavian countries in link with NAO+.

Possibly an enhanced probability of dryness on the Middle East, in link with postive Z500 anomalies : but models tend to shift this area Estward of our domain.



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