VERIFICATION BULLETIN

FEBRUARY - MARCH - APRIL 2022

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Introduction : Objective

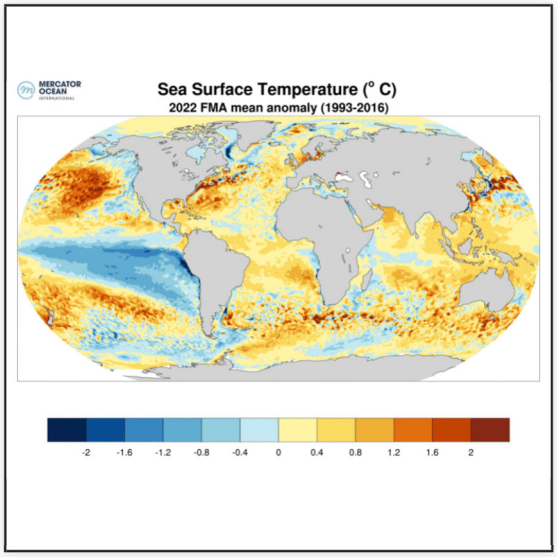
- **The objective of the Seasonal Verification Bulletin is to present an evaluation of the main elements highlighted in the Seasonal Forecast Bulletin : oceanic forcings, large scale circulation patterns, and a focus on temperature and precipitation forecast over Northern Atlantic, Europe and the Mediterranean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

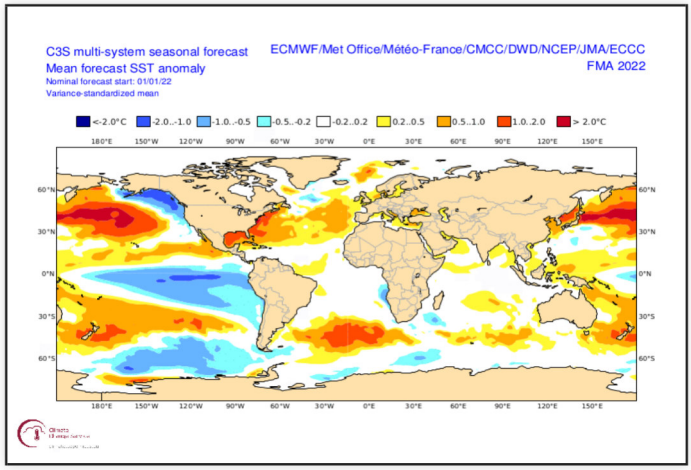
Oceans : surface temperature anomalies

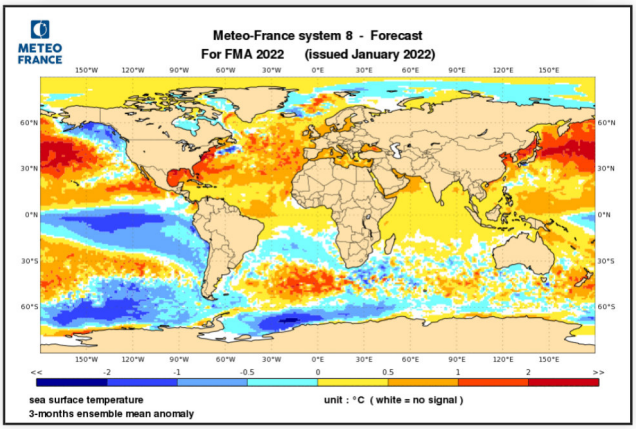
The main patterns were well predicted over the Pacific Ocean (La Nina and PDO-).

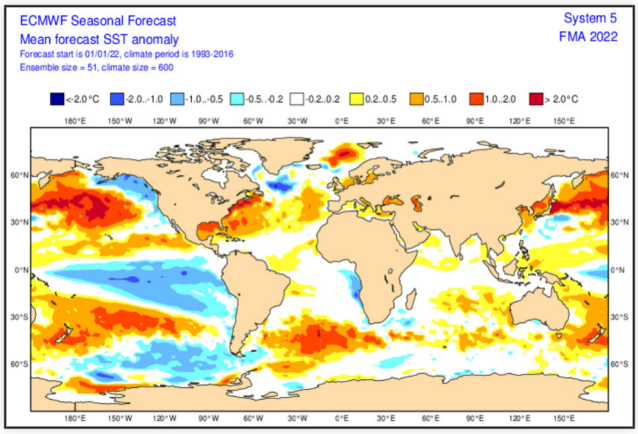
In the North Atalntic, the wide warm anomaly was correctly forecasted. Note that the cold blob (south of Greenland) was not visible in MF-S8 forecast. North and south of the equator, warm anomalies were underestimated by ECMWF-SEAS5 and C3S multi-model, MF-S8 forecast was better.

The east-west gradient in the tropical north Indian Ocean (tracer of IOD) was underestimated by models.







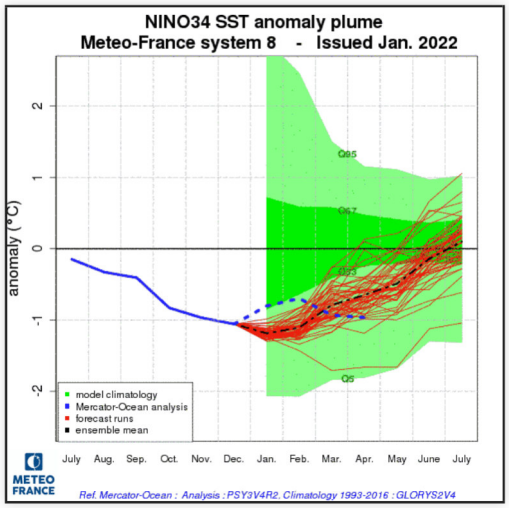


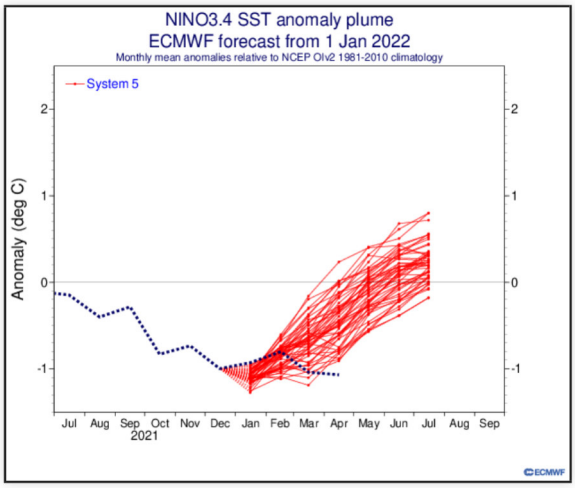
SST anomalies in the analysis from Mercator (top left), C3S multi-models (top right), MF-S8 (bottom left) and SEAS5 (bottom right)

Oceans : ENSO

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

At seasonal scale, models correstly forecasted NINO3.4 index. But the dynamic of its evolution (cooling in March the April) was not foreseen by the models. In April, the observed value is out of the spread of ECMWF-SEAS5 forecast.

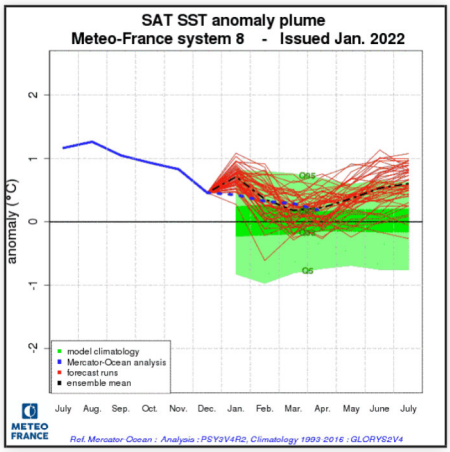


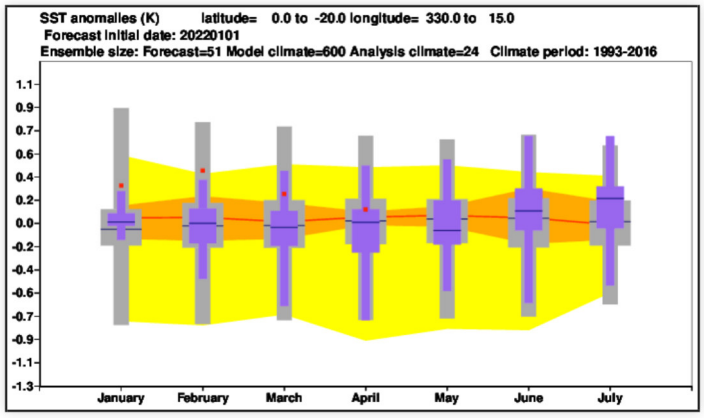


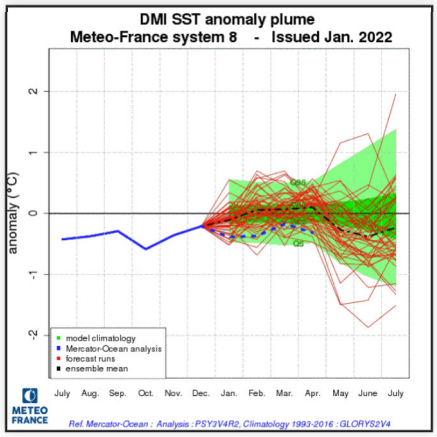
Oceans : tropical Atlantic and Indian Ocean index

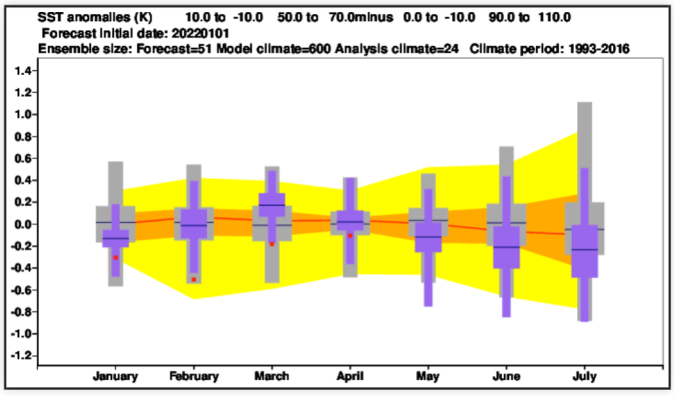
SAT : good forecast for MF-S8, ECMWF-SEAS5 wasn't warm enough (observation at the edge of the boxplots).

DMI : the negative DMI observed (in the cold tercile) was not forecasted by the models







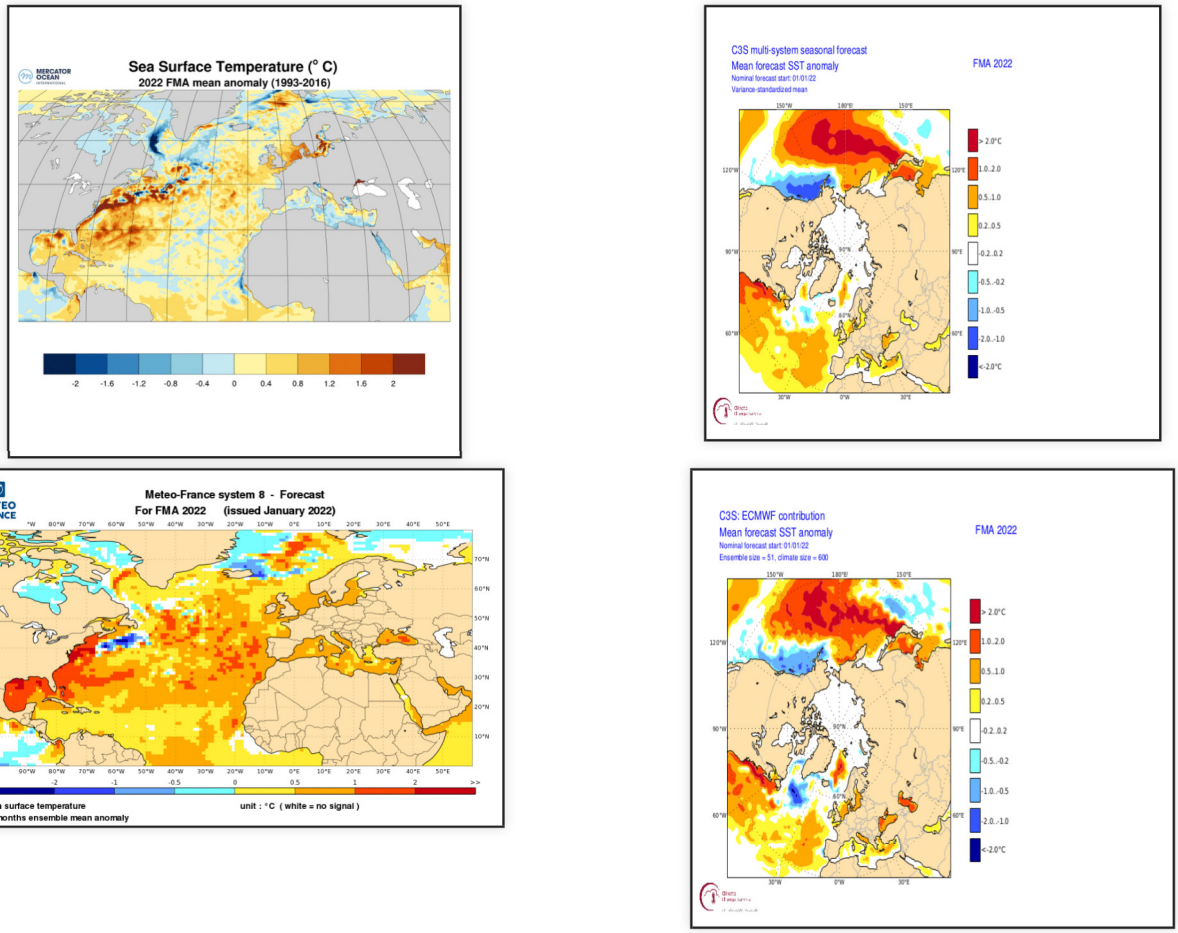


Oceans : North Atlantic SST

The global pattern is correct over North Atlantic (wide warm anomaly).

In details, MF-S8 was too warm on several regions : on French and Portugal coasts and it didn't forecast the cold anomaly south of Greenland.

The cold anomaly observed in the Mediterranean Sea was not correctly forecasted by the models.

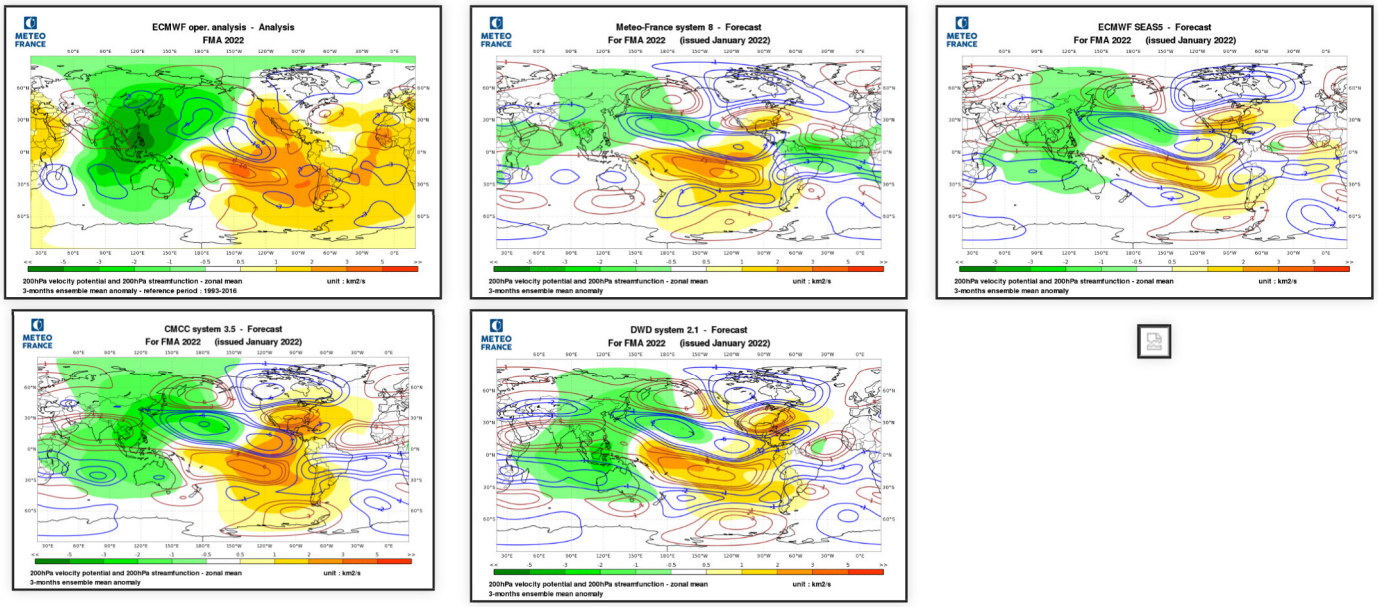


SST anomalies in the analysis from Mercator (top left), C3S multi-models (top right), MF-S8 (bottom left) and ECMWF SEAS5 (bottom right)

Atmospheric circulation : Global teleconnection

VP : The main effect of the "La Niña" phenomenon is clearly visible with a downward anomaly over the central and east Pacific Ocean, it was well forecasted by all the models. The dipole formed by the negative anomaly centred over the maritime continent, associated with the downward anomaly over East Africa, is linked to a negative IOD situation. This dipole was underestimated by the models, as was underestimated the negative IOD. Over equatorial Atlantic and West Africa, the pattern was not correctly forecasted, but the anomaly gradient (relatively weaker VP anomalies in the west compared to the east) was suggested by several models.

SF : PNA- pattern over north Pacific up to north-west Atlantic, with a shift to the east compared to the models. Over the east Atlantic, there are similarities between the teleconnections forecasted by models and the analysis (positive anomaly over west Africa and negative anomaly south of Iberian peninsula). The positive anomaly centred on India was quite well forecasted by the models.

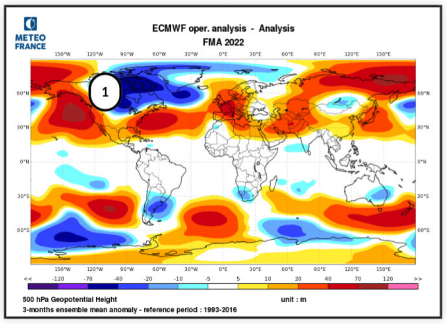


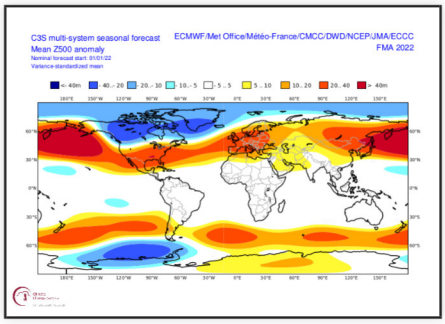
ECMWF analysis, MF-S8, ECMWF-SEAS5, CMCC, DWD and JMA 200hPa velocity potential anomalies (color range, green : ascending, orange: subsidence) and stream function anomalies (isolines, red: anticyclonic in the northern hemisphere, blue: cyclonic in the northern hemisphere).

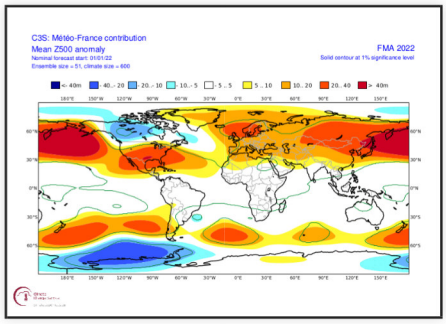
Atmospheric circulation : 500hPa Geopotential height

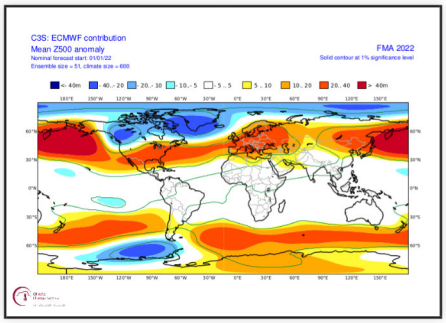
North America : The PNA- pattern linked to La Nina, slightly shifted to the east compared to forecast models.

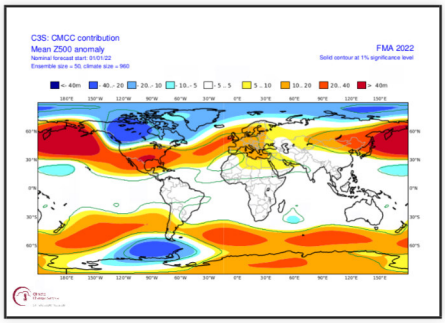
From the USA to Europe the postive anomaly was pretty well forecasted by models.

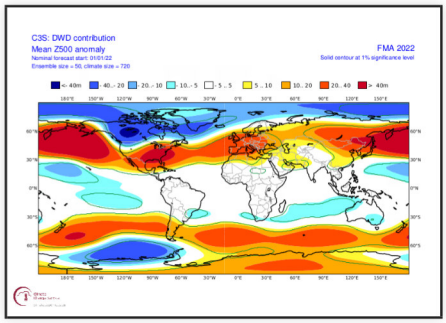












ECMWF analysis, C3S multi-system, MF-S8, ECMWF-SEAS5, CMCC and DWD 500hPa geopotential height anomalies.

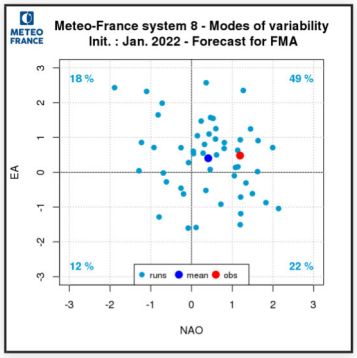
1 - Look like PNA -

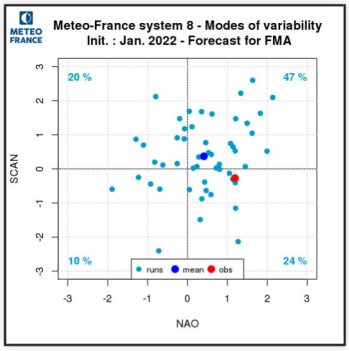
Atmospheric circulation : Modes of variability

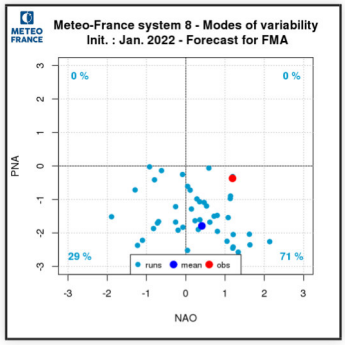
For both models, the most probable scenario was "positive NAO and positive EA" with a higher confidence for NAO than EA. This was a good forecast.

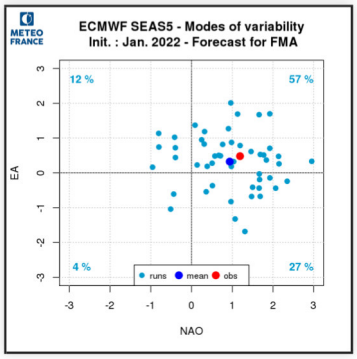
The negative SCAN was not predicted.

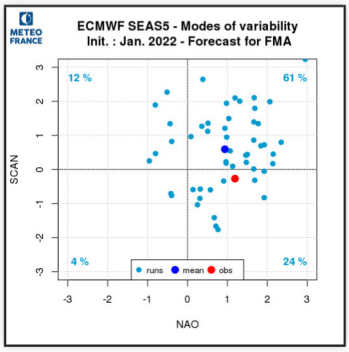
The PNA value is close to 0, it was predicted to be negative. Anyway, the pattern looks like negative PNA in the analysis, the shift toward the east probably explain the bad projection on the classical PNA pattern.

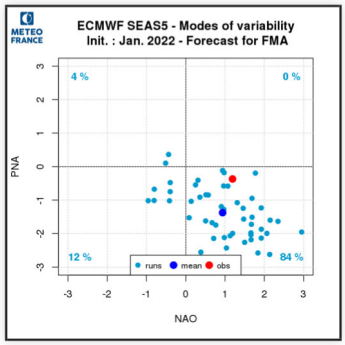






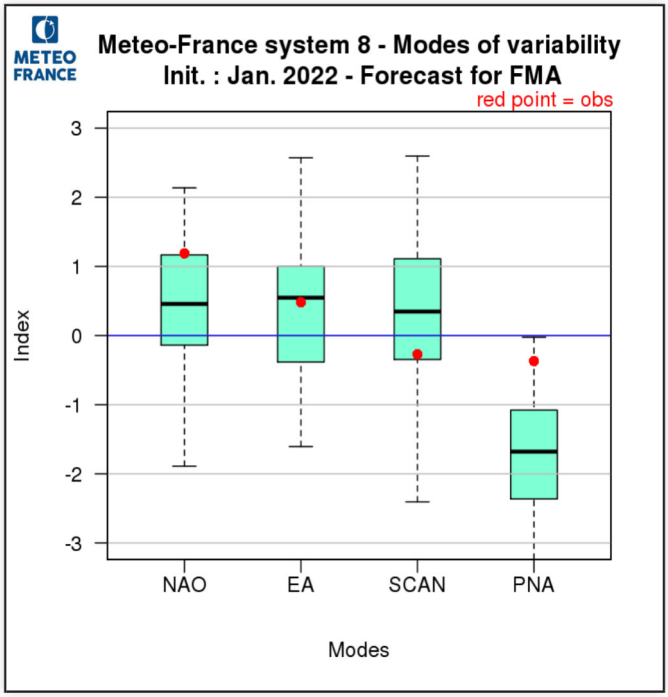


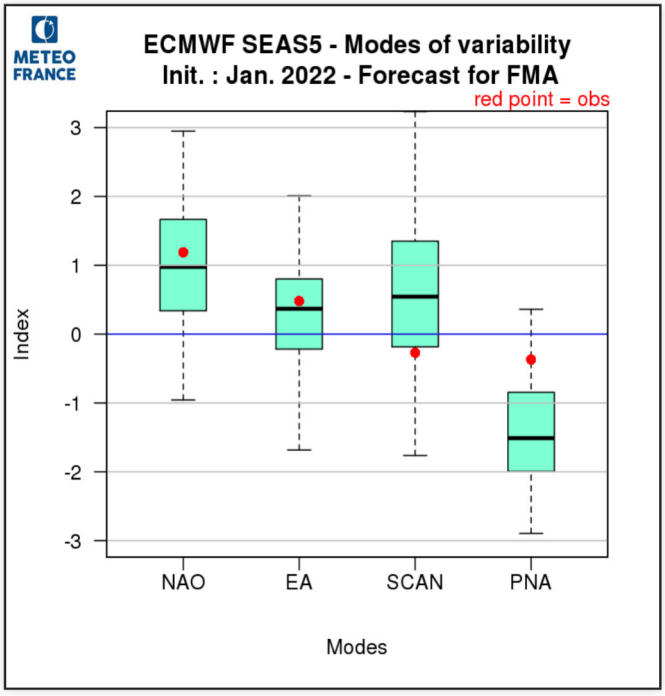




Atmospheric circulation : Modes verification

Same observation as for the previous slide

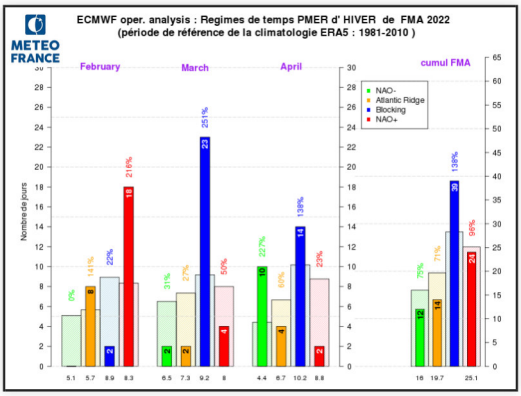


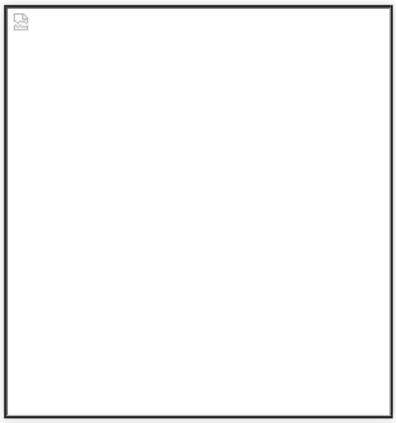


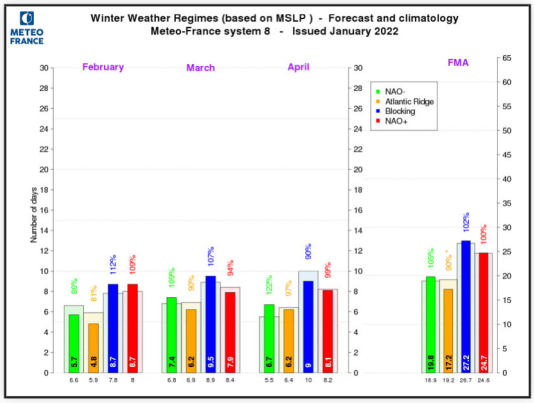
Atmospheric circulation : Winter SLP weather regimes

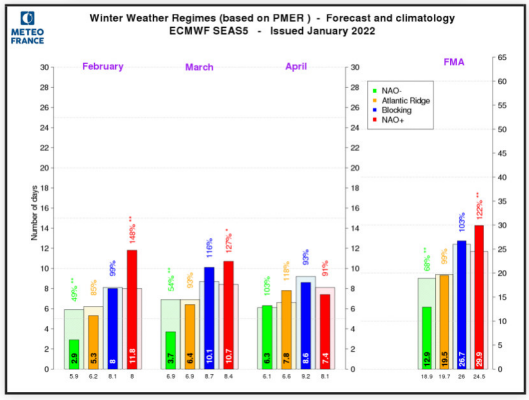
Strong interseasonal variability but, over the quarter, Blocking is dominant.

Models were not able to anticipate regime frequencies.





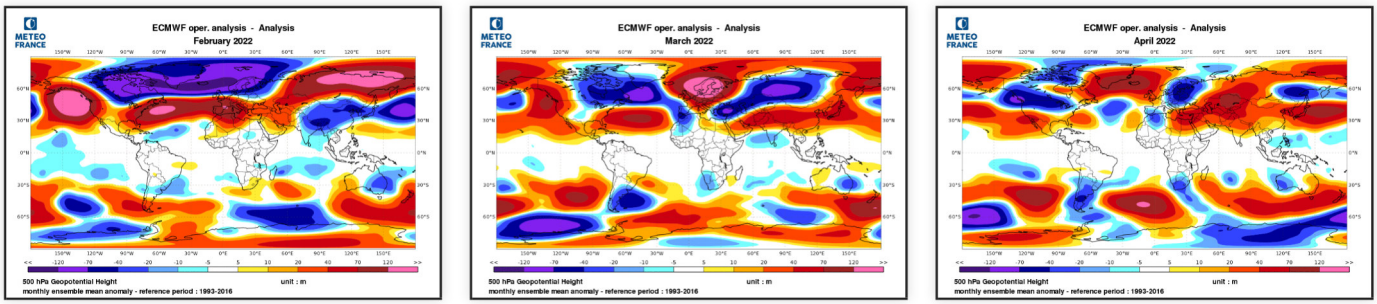




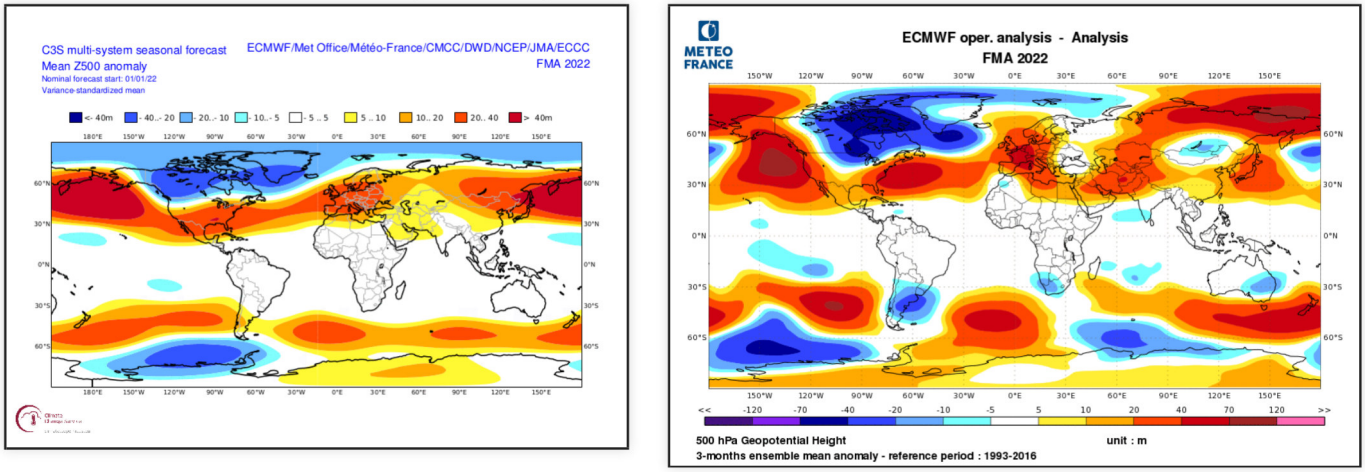
weather regime : ECMWF analysis top left, MF8 and ECMWF forecasts at the bottom. MJO phase top right

Atmospheric circulation : Variability within the quarter

Important intra-seasonal variaibility over north Atlantic and Eurasia. Nevertheless the averaged circulation over the quarter was well predicted by the multi-model.



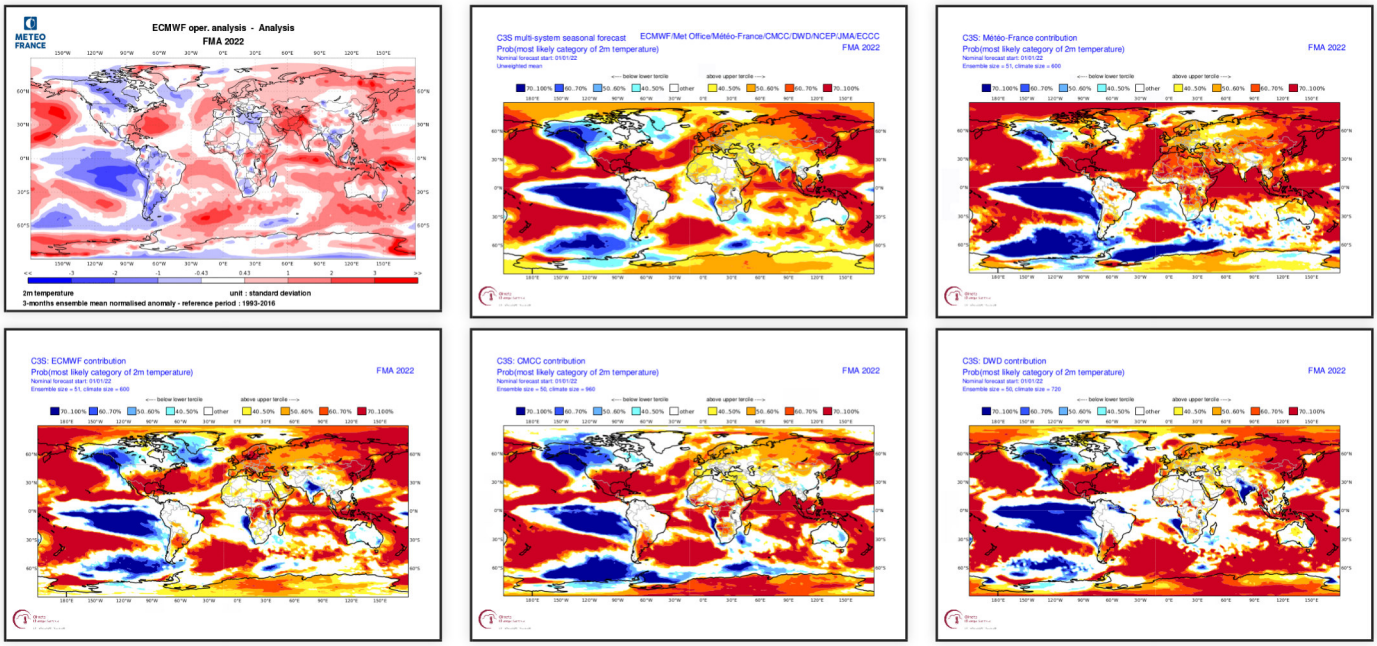
ECMWF analysis : January, February and March 500 geopotential height anomalies



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

Climatic parameters : temperature on the globe

Inland, looking at C3S multi-model in the north hemisphere, the areas with the strongest probabilities (Canada, USA, east Russia) were globally well forecasted.



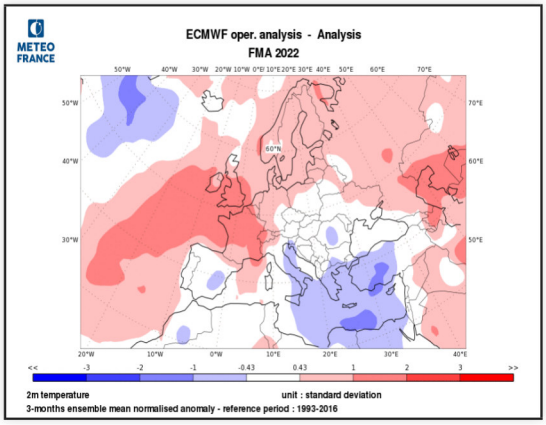
ECMWF analysis top left, forecast for multi-model top center and forecast for MF-S8 top right, ECMWF-SEAS5, CMCC, DWD on the bottom line.

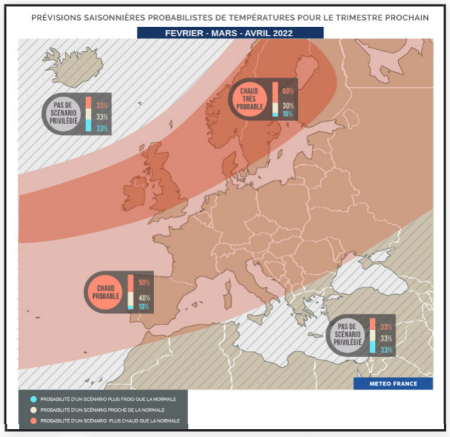
Climatic parameters : temperature over Europe

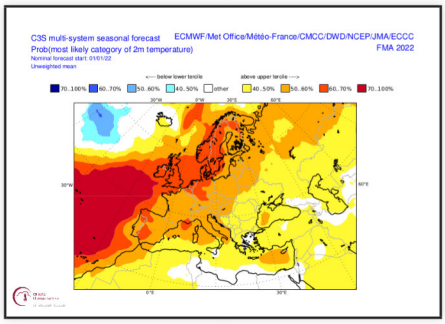
In the area with highest probabilities for the warm scenario (from the British Isles to Scandinavia), we observed warmer than normal conditions.

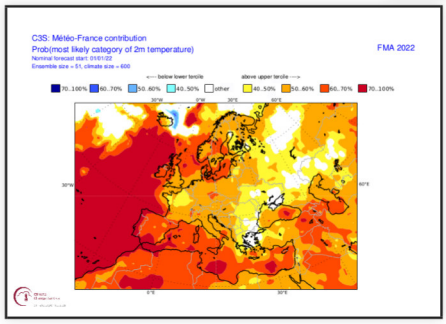
Over most of Europe up to Russia, the warm scenario was privileged. And globally it was correct.

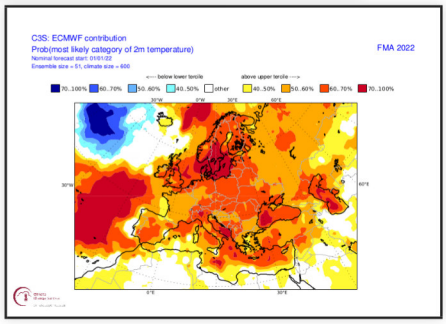
The cold pattern over the east of the Mediterranean Sea was not predicted.







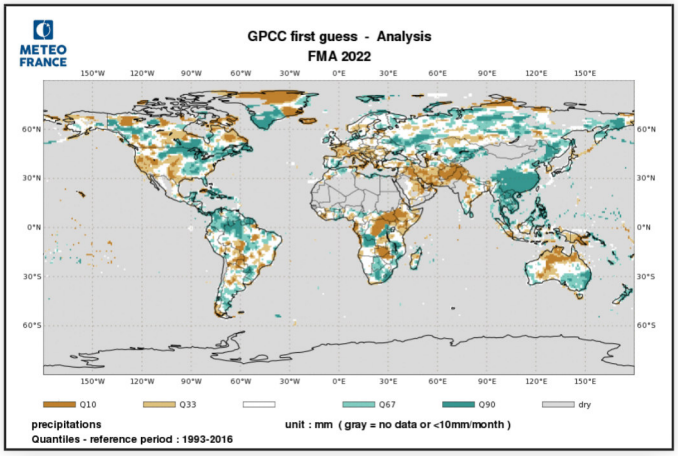


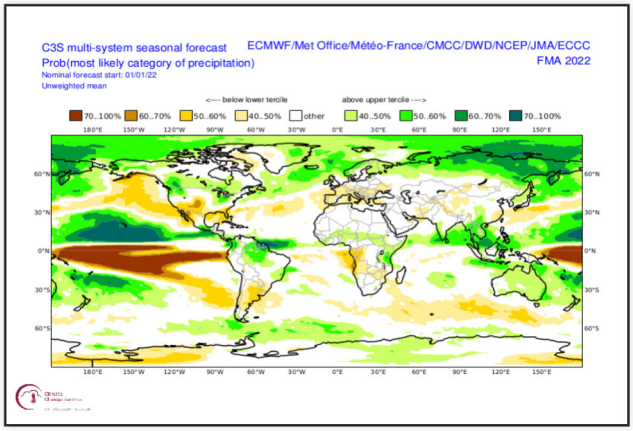


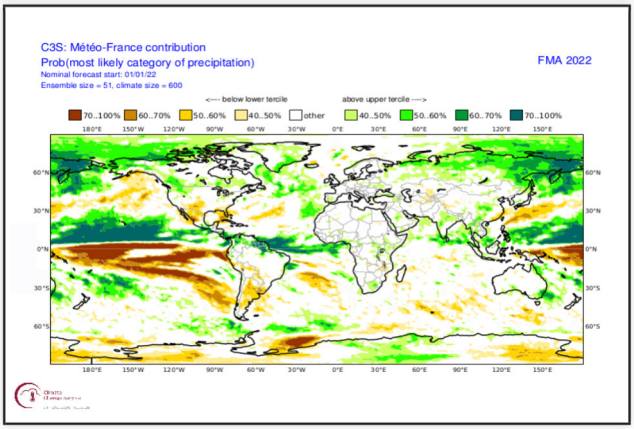
ECMWF analysis top left, synthetic forecast map top right. Forecast for multi-system , MF-S8 and SEAS5 on the bottom line.

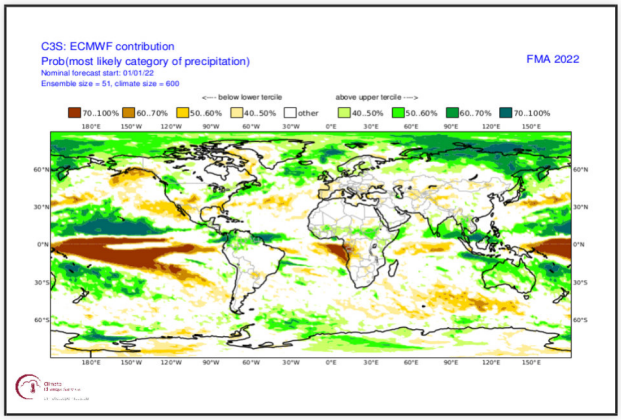
Climatic parameters : Precipitations over the globe

In the North hemisphere, probabilities were genarally low. Except over north-east Russia, and the forecast was globally correct.







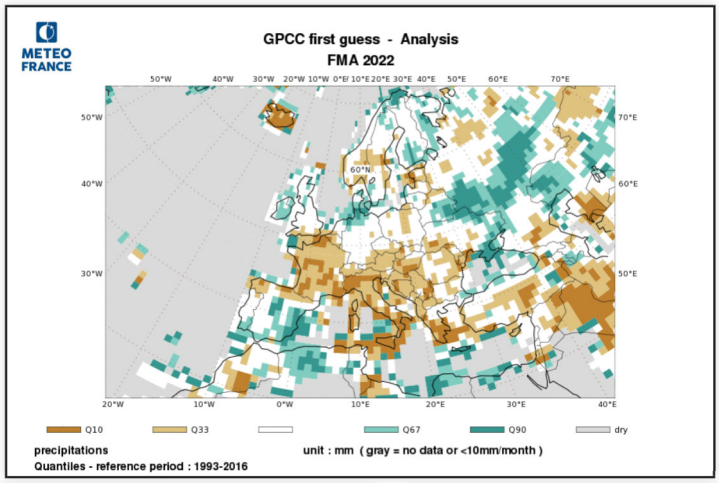


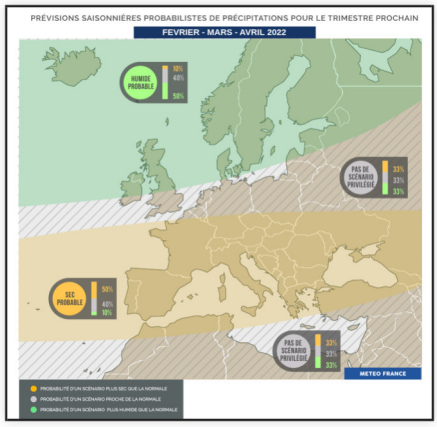
Standardized Precipitation Index analysed by IRI top left, forecast for multi-model top right and MF-S8 and SEAS5 on the bottom line.

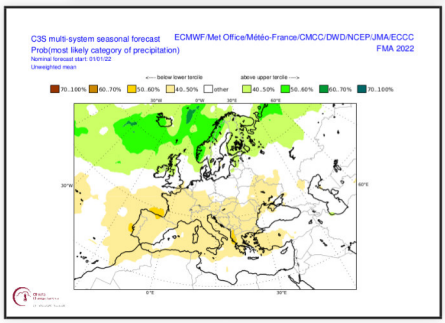
Climatic parameters : Precipitations over Europe

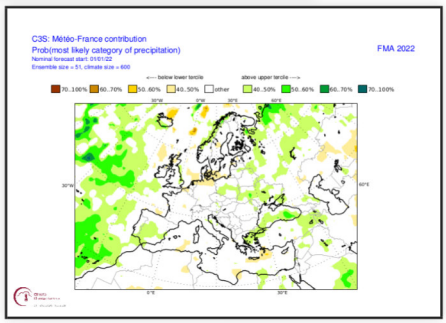
The dry conditions from west to central Europe were globally well predicted.

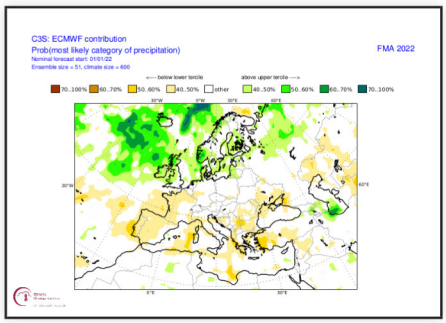
The wet conditions privileged by models over Scandinavia was not really observed.











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 FMA 2022

1) **Oceans :**

Good forecasts of the main patterns in the Pacific Ocean (La Niña and PDO-), but note that the dynamic of ENSO (reinforcement of la Niña) was not forecasted by the models .

In tropical north Atlantic and in tropical north Indian Ocean (for the IOD), some anomaly patterns were not correctly forecasted by models.

2) **Large scale atmospheric circulation :**

VP 200 hPa : over the Pacific and the Indian oceans the main patterns were quite well forecasted. Over the Atlantic and Africa, the anomaly patterns observed were complex, however models were able to forecast the gradients (especially the east-west gradient over the Atlantic).

SF 200 hPa : globally, a good forecast over the north hemisphere. The PNA teleconnexion is slightly shifted to the east compared to the forecasts. The teleconnexion from tropical Atlantic to the iberian peninsula was suggested by the models.

Z500 : good forecast over the north hemisphere, except the complex pattern over Russia.

3) **Climatic parameters over Europe :**

Temperatures : Good forecasts of warm anomalies over the most of the domain related to NAO+. Cold anomalies over the eastern Mediterranean basin were not forecasted.

Precipitations : The dry conditions from west to central Europe were well predicted.