



# Météo-France Seasonal Forecast Bulletin

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### General synthesis : FMA 2022

In the Pacific, the La Nina phenomenon will reach its maximum, moderate, during this quarter. In the Equatorial Atlantic, the strong warm anomaly disappears for almost all models. Mid-latitude teleconnections are well established, particularly in the Northern Hemisphere. The forecasts of these models show good convergences, including towards Europe.

#### A) Oceanic forecast :

- ENSO : moderate La Niña
- IOD : neutral
- Equatorial Atlantic : back to neutral

#### **B) Drivers :**

- La Nina impacts

#### C) Atmospheric circulation :

The expected atmospheric circulation is well represented by the C3S multi-model : a NAO+ pattern with a negative anomaly over Greenland and a positive anomaly over the North Atlantic extending largely over Europe.

#### D) Most likely conditions :

#### - over Europe and the Mediterranean Basin:

Privileged warm tercile on a south-west-northeast axis including almost all of Europe and north-west Russia. No scenario elsewhere.

Privileged dry tercile from Iberian Peninsula and France to the Black Sea. Privileged wet tercile in northern Europe. No scenario elsewhere.

#### Next bulletin : scheduled on February 18th

### Oceanic analysis of December 2021 : SST anomalies

#### **Current ENSO situation : moderate La Niña**

In the Pacific Ocean : the cold anomaly in the Central East Pacific is getting stronger. The La Niña phenomenon est now moderate. Over the North Pacific, the warm anomalies strengthens a little. The anomalies structure looks like the PDO- pattern

In the Indian Ocean : slight warm anomalies close to neutrality.

In the Atlantic Ocean : the positive anomaly along the equator anomaly weakens noticeably. The North Atlantic Ocean cools but remains globally warmer than normal.



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

1 - La Niña pattern 2 - Negative PDO pattern 3 - Slight warm anomaly

### Oceanic analysis of December 2021 : Pacific vertical section

In subsurface, clear reinforcement of the warm anomaly in the western part. The cold anomaly extends eastwards.



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

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

In the Pacific Ocean, the East-West contrast remains, typical of La Niña.



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

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

Nino3.4 index issued from Mercator Ocean PSYV4R2 analysis : near - 1.0°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 December 2021 : Indien Ocean - DMI index history

DMI Index issued from Mercator Ocean PSYV4R2 analysis : near -0.2 °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 : On the Central East Pacific Ocean, the cold anomaly pattern is typical of a "la Niña" phenomenon. Good agreement on the anomaly patterns in mid-latitudes. Especially in the north hemisphere, the pattern looks like a negative PDO one.

In the Indian Ocean : Neutral conditions.

In the Atlantic Ocean : MF-S8 gives warmer conditions than ECMWF-SAE5 and the other models around the Equator (remains of "El Nino Atlantic") and in the northern hemisphere (no cold anomaly south of Greenland).





### 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 January and February, around -1°C. MF-S8 is a little colder.





### 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 . We can notice that the NCEP model has reset and is now closer to the others, even if too cold.

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



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

### Oceanic forecast : Indian ocean - DMI evolution

Neutal conditions (MF8) during the quarter.



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

#### Oceanic forecast : Atlantic ocean - SAT evolution

The two models are very different. if ECMWF remains neutral for the coming months, MF-S8 maintains warmer than normal conditions.



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

#### Drivers : polar vortex (U010 plumes)

Analysis of the 10 hPa winds shows that all models except MF-S8 forecast a well-marked polar vortex for the end of winter.



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 most models. Only MF-S8 stands out, especially in the Atlantic.

Velocity Potential : well marked dipole pattern corresponding to a classical "La Nina" response : a downward motion anomaly over the Central/East Pacific and an upward motion anomaly from the Maritime Continent extending to the Asian Pacific Coasts for most models. MF-S8 predicts an upward motion anomaly over the Equatorial Atlantic (consistent with warm SST anomaly) extending to the Indian Basin and South-East Asia.

There is a good agreement for a positive anomaly centred on the Gulf of Mexico.

Streamfunction : clear dipole on both sides of the equator over Pacific Ocean with teleconnexions toward mid-latitudes (negative PNA). A dipole is also visible in the Indian Ocean, except with MF-S8. In the Atlantic Ocean, the dipole over the equatorial zone is well marked. In the North Atlantic, all models, except MF-S8, offer the same pattern.





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).

- VP : differnet pattern of upward motion anomaly with the second se

### Atmospheric circulation forecasts : 500 hPa Geopotential anomalies

Good agreement around the Pacific with a PNA- pattern, and good agreement for the positive anomaly over the Gulf of Mexico.

On the other hand, from Western Canada to Greenland and Europe, there are great differences between the two models, ECMWF predicting a NAO+ pattern.



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



### Atmospheric circulation forecasts : Z500 anomalies in C3S models

All the C3S models are in agreement around the North Pacific for a PNA- pattern, in connection with the La Nina phenomenon.

From North-East America to North Altantic and Europe, all the C3S models except MF-S8 agree for a NAO+ pattern.



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

### Atmospheric circulation forecasts : Z500 anomalies multi-systems

Very good agreement between the two multi-models, both in North America with the classic PNA- pattern and in the North Atlantic with the NAO+ pattern



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

Very good stability with the C3S multi-models.

The positive anomaly over Europe becomes stronger.



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

### Modes of variability : forecast

High confidence in a negative PNA.

There is a clear signal for NAO+ with ECMWF-SAE5.



See the modes of variability patterns





### Modes of variability : NAO impacts

The NAO phase is the dominant mode





### Weather regimes : winter MSLP

MF-S8 is close to climatology.

ECMWF-SAE5 favors the NAO+ regime while the NAO- regime is clearly sidelined.



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).

### Weather regimes : Impacts

This regime is dominant in ECMWF-SEAS5 forecast.



Impact of Summer Blocking weather regimes on temperature and precipitation. (ref ERA-interim 1981-2010)

### 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 warme than normal signal from Mexico to the South of the United States.



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

According to the NAO+ regime impacts, a warmer than normal signal is the most probable frome Europe to Russia.



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

With the exception of MF-S8, all other models forecast conditions consistent with the impacts of the NAO+ regime :

- a drier than normal signal over Southern Europe and Central Europe.
- a wetter than normal signal from Ireland to Scandinavia.



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

### Synthesis map for Europe : Temperature

The NAO+ pattern is highlighted by the analysis of the modes of variability such as that of the regimes. Consistent with this analysis, the different models suggest a more or less strong probability of warm anomalies over most of Europe.



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

### Synthesis map for Europe : Precipitation

The NAO+ regime favors a north-south contrast over Europe: wetter than normal over northern Europe and drier than normal over southern Europe.

This pattern is found in the forecasts of the various models.



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