MEDITERRANEAN CLIMATE OUTLOOK FORUM
MEDCOF-23 Online Forum

MONITORING SUMMARY MEDCOF-23

for October 2024

Final version

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The following MedCOF monitoring summary is based on

- climate monitoring results from RA VI RCC Node-CM at DWD,
- Seasonal forecast bulletins and verification bulletins from RA VI RCC Node-LRF at Météo France,
- SEECOF monitoring report
- Assessments from NOAA CPC and BOM Australia

1 Oceanic Analysis

1.1 Sea Surface Temperature (SST) anomalies

Significant change in the ocean state is found across all basins since last winter.

- **Pacific Ocean :**
  - **ENSO**: Niño3.4 index is slightly negative above the threshold of -0.5 °C. ENSO remains in a neutral state if we refer to this NOAA Oceanic Niño index: https://origin.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_v5.php However, RONI (Relative Oceanic Niño Index) has a value of -0.76 °C over the ASO quarter and MEI (multivariate ENSO index) reached -0.7 °C in recent months. Link RONI and link EMI . According to recent NOAA CPC diagnostic discussion (14 November 2024), ENSO is still neutral, but La Niña is most likely to emerge until December 2024 with 57% chance and is expected to persist through January-March 2025. http://www.seevccc.rs/SEECOF/SEECOF-32/STEP-2/CPC-NCEP-ENSO-diagnostic-discussion-14-November-2024.pdf The Australian BOM model suggests likely continuation of the neutral state through DJF 2024/25: http://www.bom.gov.au/climate/enso/#tabs=Pacific-Ocean
  - **PDO** remains in a strong negative phase, stronger than last year. https://stateoftheocean.osmc.noaa.gov/atm/pdo.php Strong east-west gradient in the northern Pacific.
- **IOD** : No significant East/West gradient over the Indian Ocean.
- **Atlantic** :
  - SST close to neutrality in the northwest part of basin
  - A strong warm SST anomaly is present from the coast of Quebec to the central North Atlantic and up to the Caribbean.
  - Neutral to negative anomalies from Greenland to Ireland/UK, and also close to Western Europe / North Africa.
- The **Mediterranean Sea** did not continue its high anomalies of the months before. According to Mercator Ocean (Fig. 1.1), the western Mediterranean had close to normal SST in October 2024, the eastern Mediterranean slightly above normal (1993-2016). ERSST_v5 data from NASA show positive anomalies for the entire Mediterranean between +0.5 °C and 1.0 °C (1991-2020 reference), but also less than in summer (JJA) 2024. https://data.giss.nasa.gov/gistemp/maps/
- The **Black Sea** was more than 1.0 °C warmer than normal according to NASA ERSST_v5, less than 1.0 °C, but still warmer than normal according to Mercator Ocean.

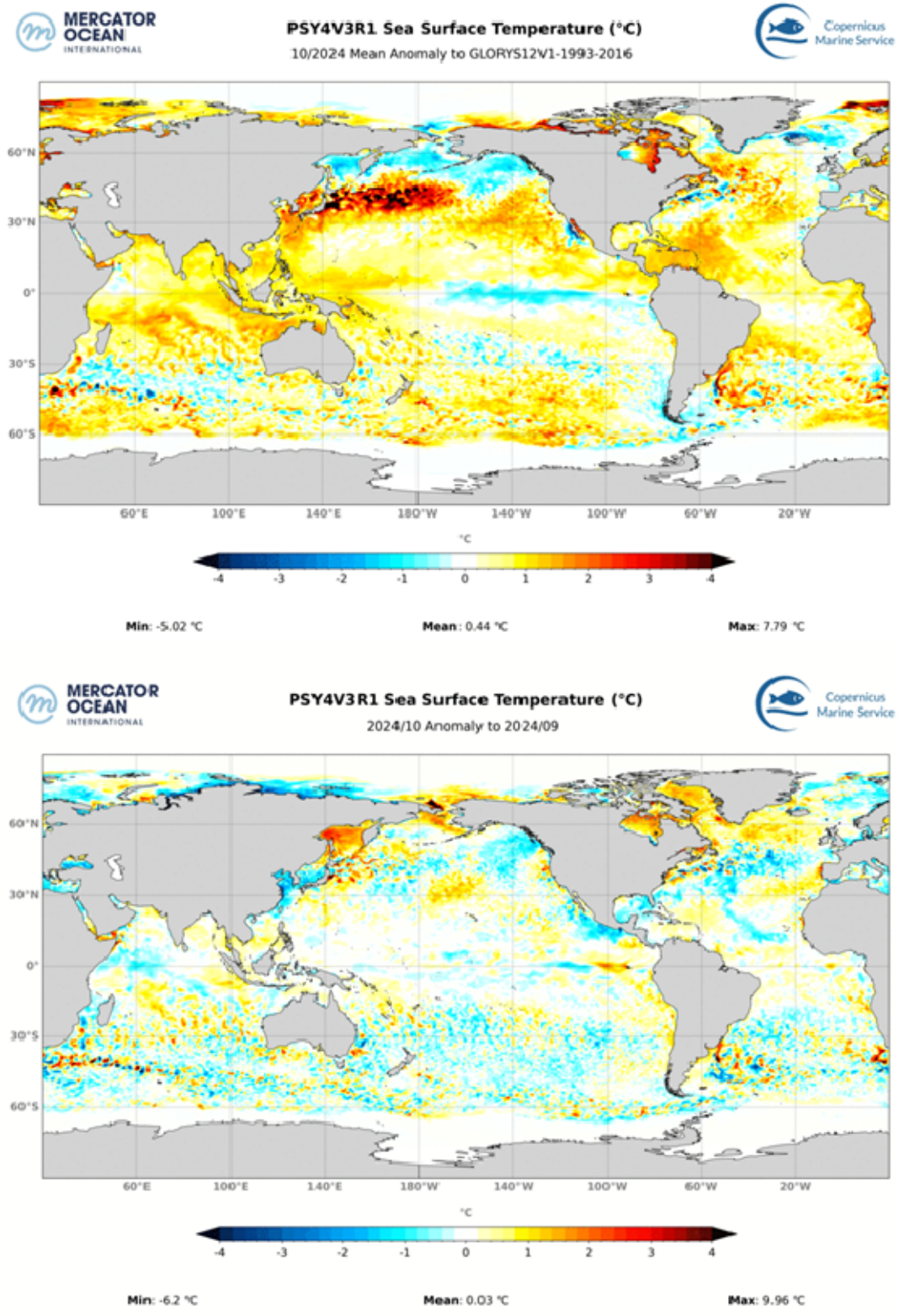

Figure 1.1: Upper map: sea surface temperature anomalies for October 2024. Lower map: anomaly differences October minus September 2024 (anomaly trend). Source: Météo France, Mercator Ocean data.

1.2 ENSO analysis of recent months and years:

Since last boreal winter (DJF 2023/24) the ENSO state changed from El Niño to neutral conditions in summer (JJA 2024) and is changing now into direction to La Niña, presently with still weak anomalies (Fig. 1.2). Most recent data of NOAA CPC even suggest a slight relative increase of SST in November 2024, with positive anomalies in the Niño 1+2 region. This could mean that the tendency to La Niña might stop, but this is not sure yet.

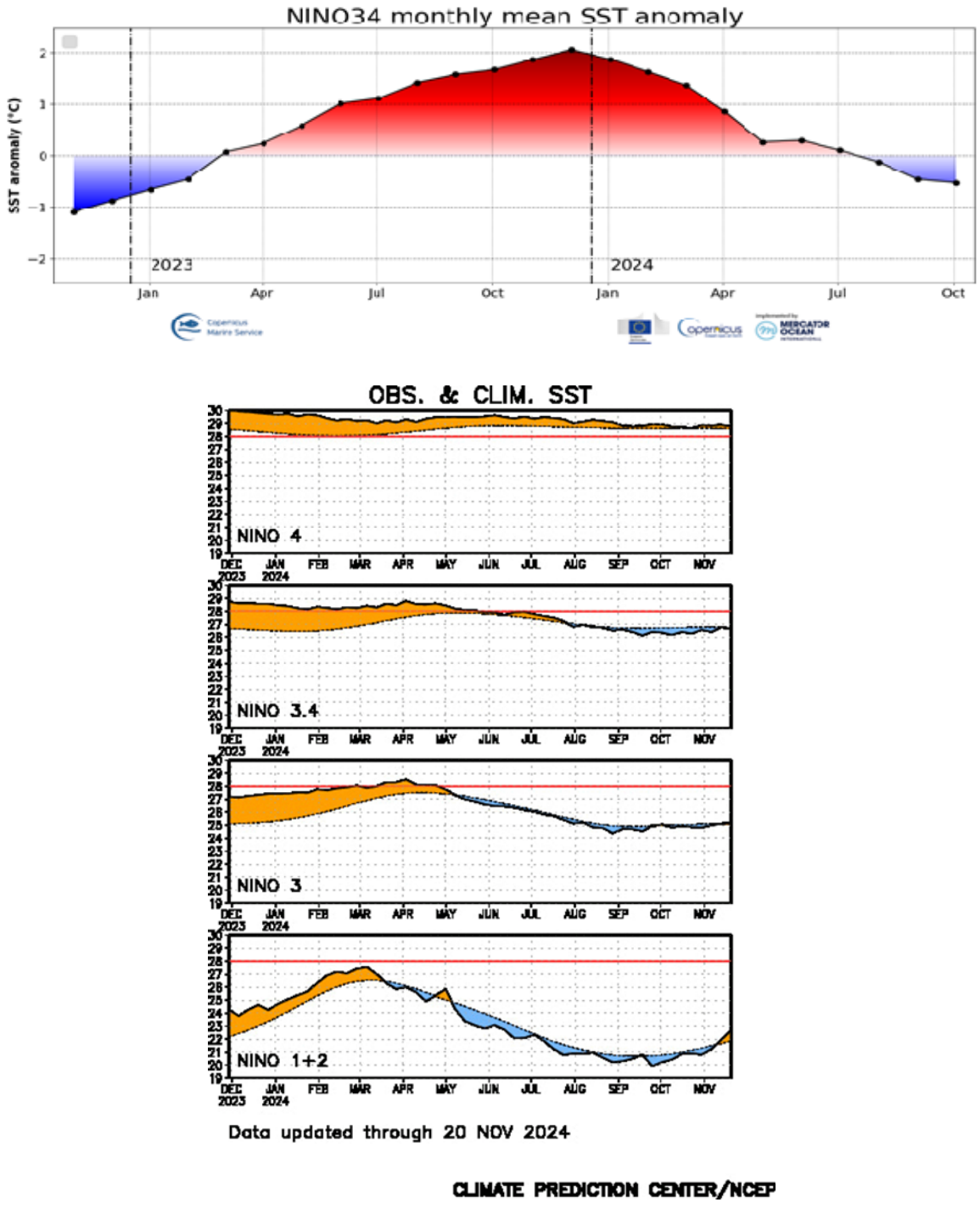

Figure 1.2: Evolution of sea surface temperature anomalies in several Niño boxes. Source: Upper map: Météo France, Mercator Ocean data. Lower map: NOAA CPC, https://origin.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/enso.shtml#history

1.3 ENSO Forecasts

According to Copernicus C3S and NMME multi-system forecasts, there is a wide range of forecasts for DJF 2024/25 from close to neutral to moderate La Niña. Therefore, there is still high uncertainty about ENSO.

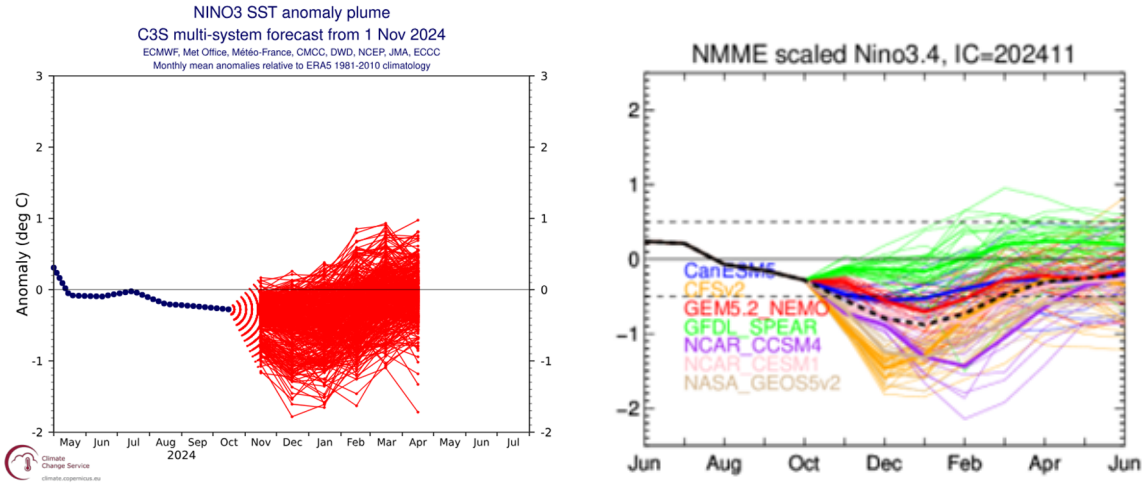

Figure 1.3: Evolution of El Niño3.4 expected temperature from C3S (left) and NMME (right) until April-June 2025. Source: C3S: https://climate.copernicus.eu/charts/c3s_seasonal/c3s_seasonal_plume_mm ; NMME: https://www.cpc.ncep.noaa.gov/products/NMME/current/plume.html

1.4 Pacific Decadal Oscillation (PDO) analysis:

Since January 2020, PDO was negative without interruption and became more intense especially since May 2024. October 2024 value of PDO Index after NOAA was -3.0, https://stateoftheocean.osmc.noaa.gov/atm/pdo.php

PDO- means warm SST anomalies in the interior North Pacific and cool SST anomalies along the North American coast or above average sea level pressures over the North Pacific, see https://www.ncei.noaa.gov/access/monitoring/pdo/ . A negative PDO has a tendency to intensify La Niña, but to weaken El Niño events.

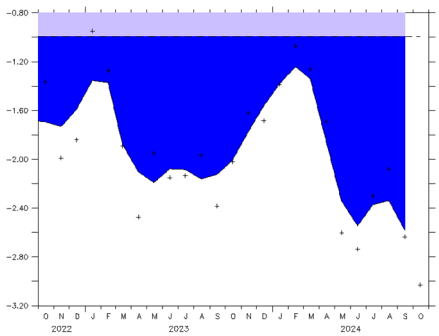

Figure 1.4: Evolution of PDO index, source: https://stateoftheocean.osmc.noaa.gov/atm/pdo.php . Crosses: monthly values, shaded areas: 3-month averages.

1.5 Indian Ocean Dipole (IOD):

The IOD according to BOM was slightly negative in October 2024 and so was also the DMI based on Mercator Ocean (Fig. 1.5). With the week ending 10 November 2024 (most recent data available), the IOD index was negative the fifth consecutive week, but it needs six weeks to be classified a negative IOD phase. So, the present IOD state is still neutral. According to forecasts, IOD will return to neutral levels in December 2024 and will remain so in the following four months.

IOD events typically break down in November or December with the arrival of the Asian monsoon.

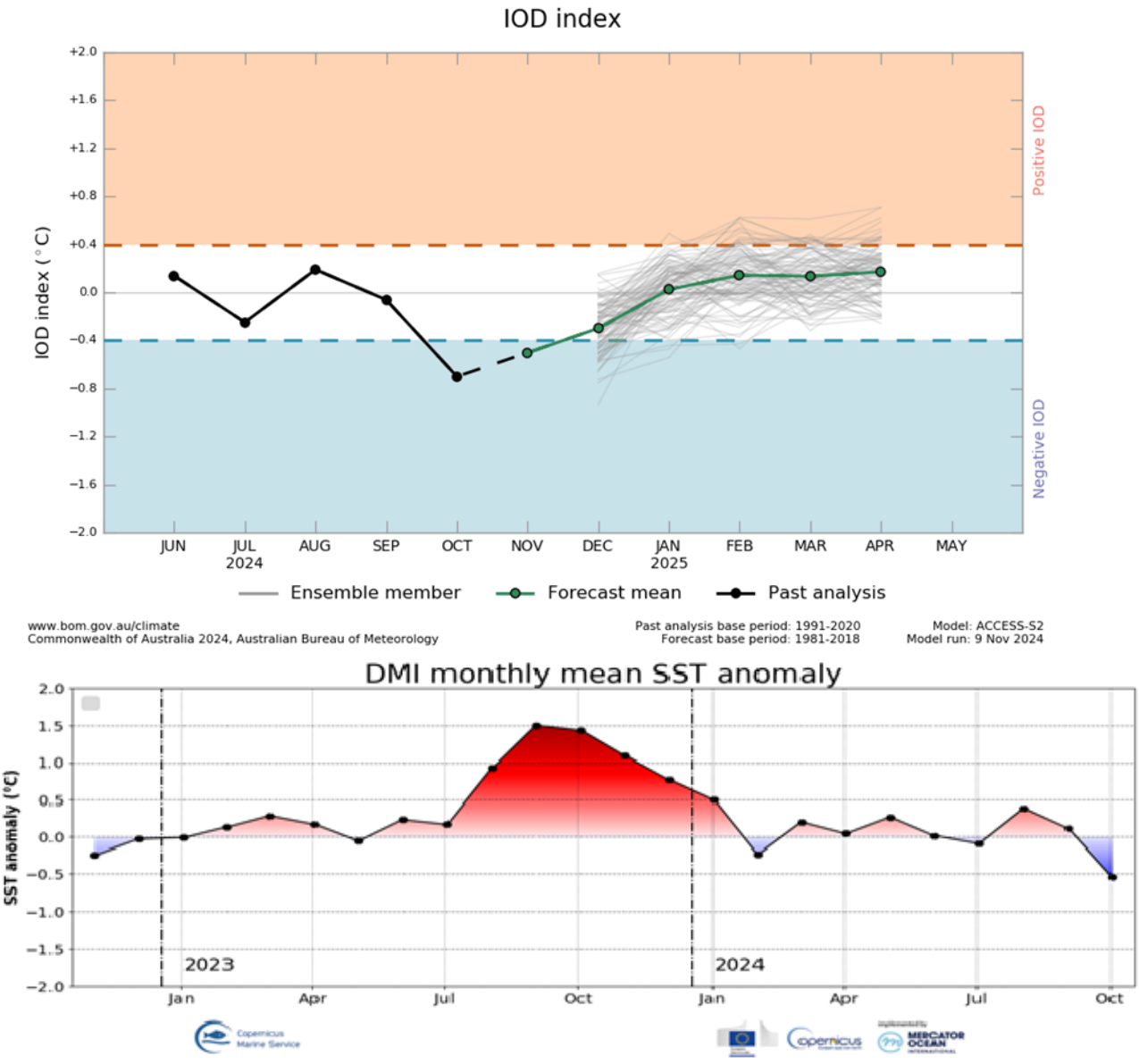

Figure 1.5 Observed and expected evolution of Indian Ocean Dipole. Source: upper map: BOM, http://www.bom.gov.au/climate/enso/index.shtml#tabs=Indian-Ocean), lower map: Météo France, Mercator Ocean data

2 Atmospheric Circulation Analysis

2.1 Velocity potential and stream function anomalies in the high troposphere

Velocity Potential 200 hPa: Downward anomaly from central Pacific to South America. Upward anomaly from the maritime continent to the Indian Ocean and Africa. This is rather typical for La Niña.

Stream function at 200 hPa: small dipole around the equator over the Central Pacific and another over Africa, no clear teleconnection visible.

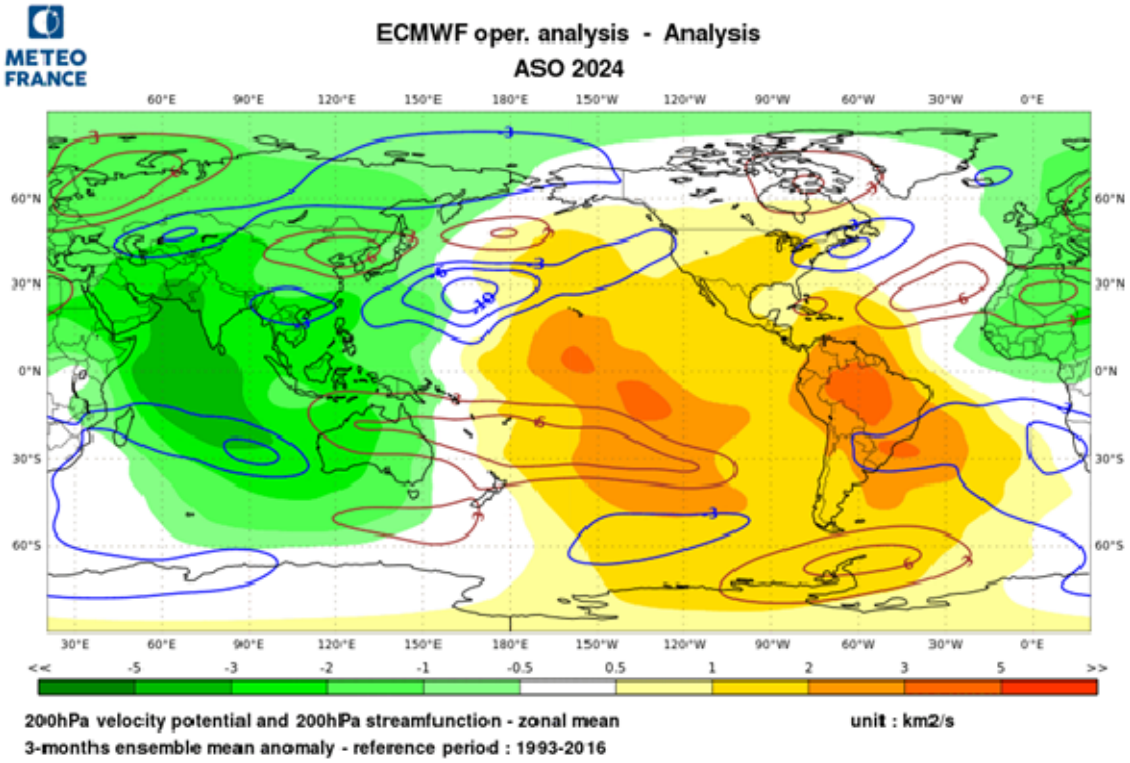

Figure 2.1: Averaged anomalies of stream function (contours) and velocity potential (shaded) average during August-October 2024. Positive shaded values (yellow/orange): convergence (downward motions). Negative ones (green): divergence (upward motions). Positive contours (red): anticyclonic circulation in the northern hemisphere, negative contours (blue): cyclonic circulation in the northern hemisphere.

Source: Météo France

2.2 SOI index:

SOI index was slightly positive (0.5, La Niña) in October 2024, in line with SST anomalies. However, since July 2024, the SOI index oscillated between negative and positive from -0.7 in July to +0.9 in August 2024, so there is still no stable trend into direction of La Niña. This means that also the atmospheric component of ENSO is still uncertain, like the oceanic component.

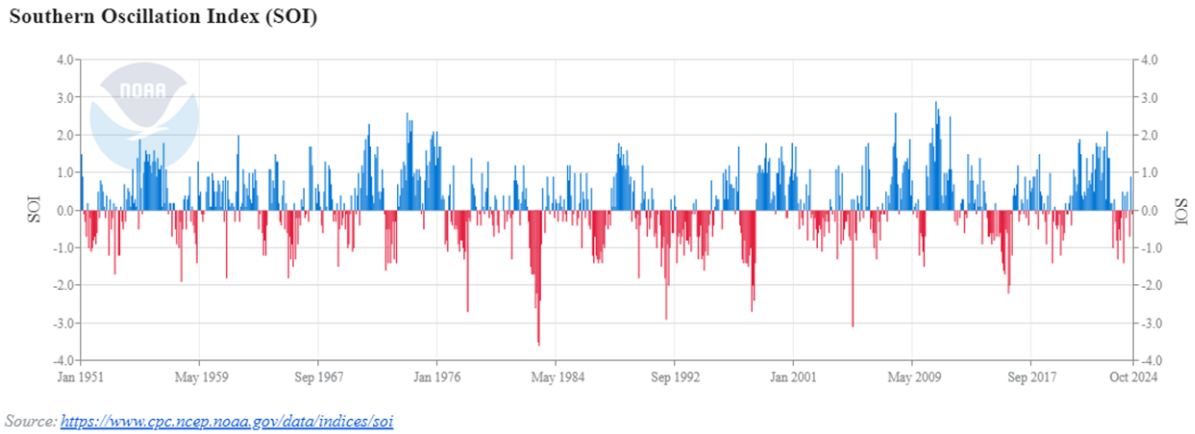

Figure 2.2: Southern Oscillation Index (SOI). Positive values mean La Niña response, negative values El Niño response. Source: https://www.ncdc.noaa.gov/teleconnections/enso/indicators/soi/

2.3 Geopotential height at 500 hPa:

In October 2024, the polar vortex in the stratosphere of the northern hemisphere was unusually weak (https://www.severe-weather.eu/global-weather/record-weak-polar-vortex-event-2024-winter-weather-pattern-united-states-canada-europe-fa/). Consequently, the Arctic Oscillation was more meridional than usual, and large anomaly patterns occurred even in the troposphere in the 500 hPa geopotential (Fig. 2.3). Wave-like patterns can be seen not only in polar latitudes, but also in subtropical latitudes over the entire northern hemisphere. Concerning the MedCOF domain, anticyclonic patterns were located over the eastern North Atlantic and the central Mediterranean, and cyclonic patterns over the Iberian Peninsula / Morocco and the South Caucasus.

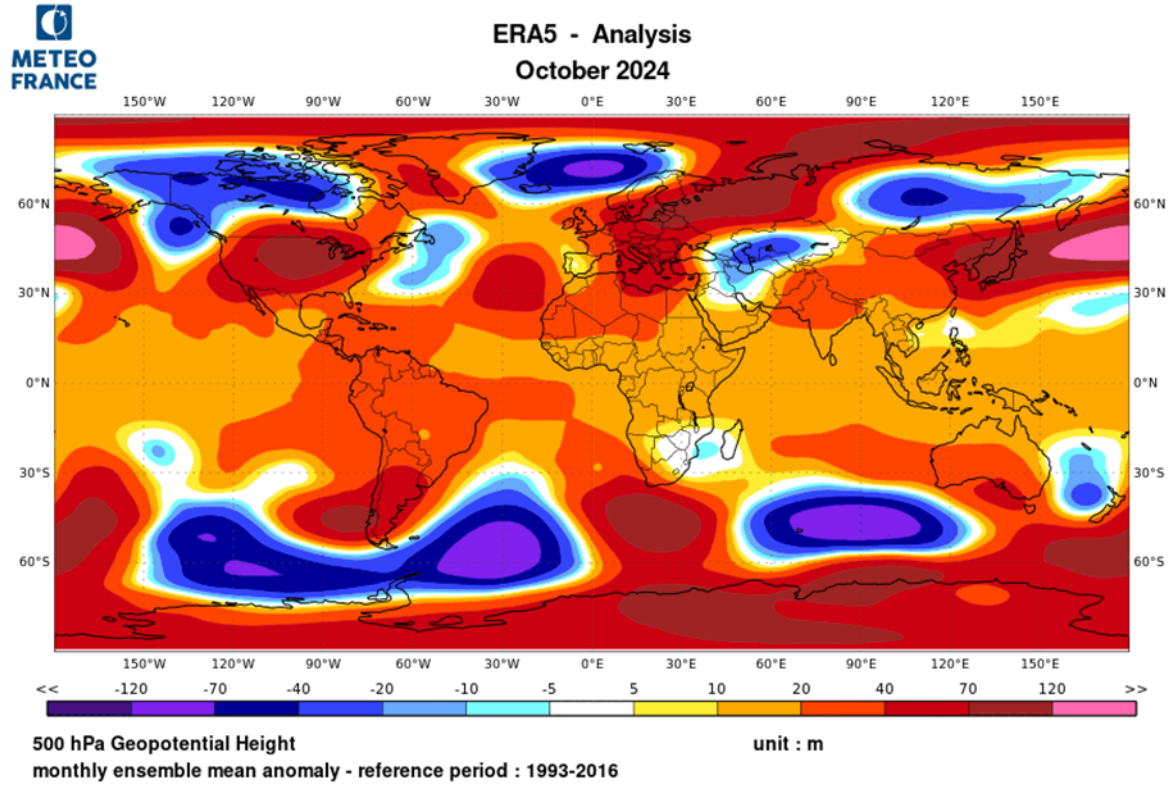

Figure 2.3: Anomalies of Geopotential height at 500hPa (Source: Météo-France, http://seasonal.meteo.fr/content/suivi-clim-cartes-ref93-16 , data from ERA5)

2.4 Sea level pressure (SLP)

Near surface, there were also patterns more intense than normal in October 2024, in the polar latitudes a low-pressure system south of Svalbard and the Greenland High, in the subtropical latitudes the Azores High and another high-pressure centre over the Balkan Peninsula. The Russian High over the European part was shifted more to the north compared to normal. South of the Russian High, cold air moved to the eastern parts of the domain, especially to the South Caucasus, and then further to eastern Türkiye, the Middle East, and Egypt. Cyclonic circulation on average occurred over the Iberian Peninsula, France, and the western Mediterranean, temporarily also in western parts of North Africa.

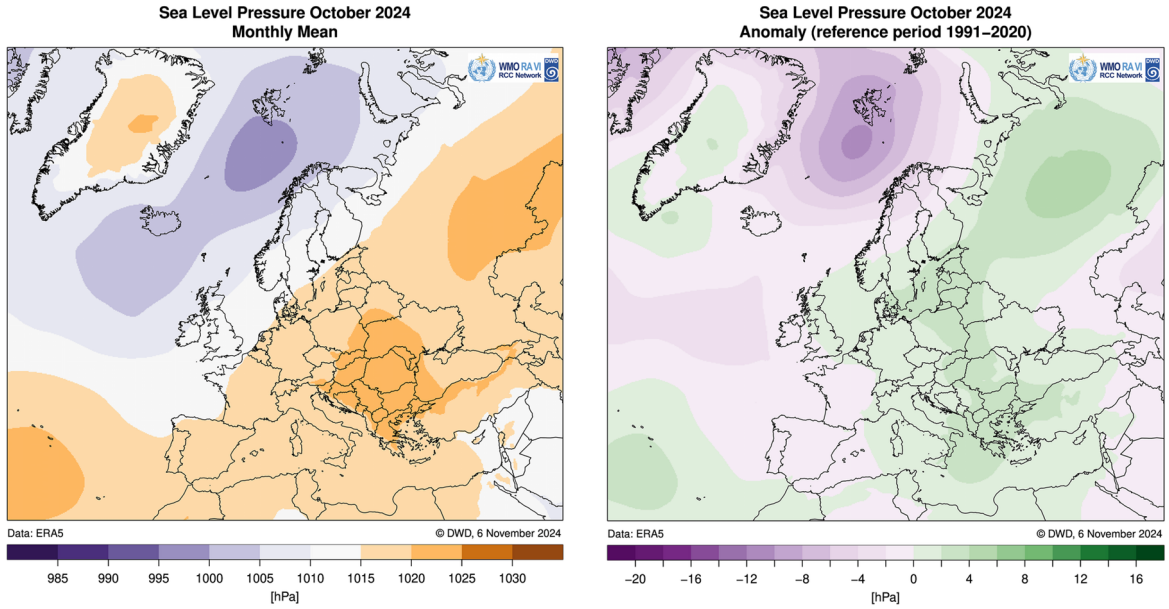

Figure 2.4: Mean sea level pressure and anomalies (1991-2020 reference) over the North Atlantic, Europe and North Africa for October 2024. Source: DWD, https://www.dwd.de/DE/leistungen/rcccm/int/rcccm_int_ppp.html?nn=490674

2.5 Circulation patterns

Due to the highly meridional structure of mid-tropospheric circulation, the zonal North Atlantic patterns NAO+ and EA+ became weaker in October 2024 compared to boreal summer 2024 (Tab. 2.1). Instead, a negative East Atlantic / West Russia pattern (EATL/WRUS-) developed in autumn with peak in September 2024. In October 2024, since anticyclonic conditions expanded far north to Scandinavia, a positive Scandinavian pattern (SCAND+) evolved. Last, but not least, a negative Polar/Eurasia pattern (POLEUR-) reflected the weak polar vortex.

Table of Teleconnection Indices

OCTOBER 2024

MONTH	NAO	EA	WP	EP-NP	PNA	TNH	EATL/WRUS	SCAND	POLEUR
OCT 24	0.1	1.0	0.9	-1.8	0.2	---	-1.4	1.1	-1.0
SEP 24	-1.2	1.3	1.4	-2.8	1.1	---	-3.4	0.4	0.3
AUG 24	0.7	3.7	1.1	-2.6	-1.0	---	-0.3	-1.2	-1.3
JUL 24	1.5	2.4	-0.8	-0.5	2.0	---	-0.4	-1.6	-0.1
JUN 24	0.2	1.3	-1.3	1.2	1.1	---	-2.3	-1.2	-1.0
MAY 24	-0.4	-0.2	-0.3	-0.9	-2.3	---	0.3	0.9	-0.6
APR 24	-1.0	3.0	0.7	-0.3	-0.9	---	-0.7	-0.7	0.4
MAR 24	-0.6	1.5	1.0	0.5	0.1	---	1.1	0.8	0.2
FEB 24	0.8	1.7	1.6	-0.5	-0.2	-0.3	-0.2	-0.5	-1.8
JAN 24	-0.3	2.6	0.7	0.1	-0.1	-0.3	0.5	-1.2	-0.9
DEC 23	1.7	1.5	1.2	---	0.9	-1.1	0.1	0.7	-0.5
NOV 23	-0.5	1.2	0.6	0.4	0.5	---	0.1	-0.1	0.3
OCT 23	-1.7	1.2	-0.8	0.3	1.5	---	0.6	-0.6	-0.1

Table 2.1: Evolution of the main atmospheric indices for the Northern Hemisphere for the last months:
http://www.cpc.ncep.noaa.gov/products/CDB/Extratropics/table3.shtml

2.6 North Atlantic Oscillation (NAO) and Arctic Oscillation (AO)

A NAO- phase persisted from mid-September to mid-October 2024, followed by NAO+ from mid-October to mid-November 2024. GEFS forecasts for NAO in December 2024 show a large variability with no clear tendency, neither to NAO+ nor to NAO-.

The AO showed a similar behavior like NAO in September and October 2024, but came closer to neutral in November 2024. Again, no clear tendency can be drawn for December 2024.

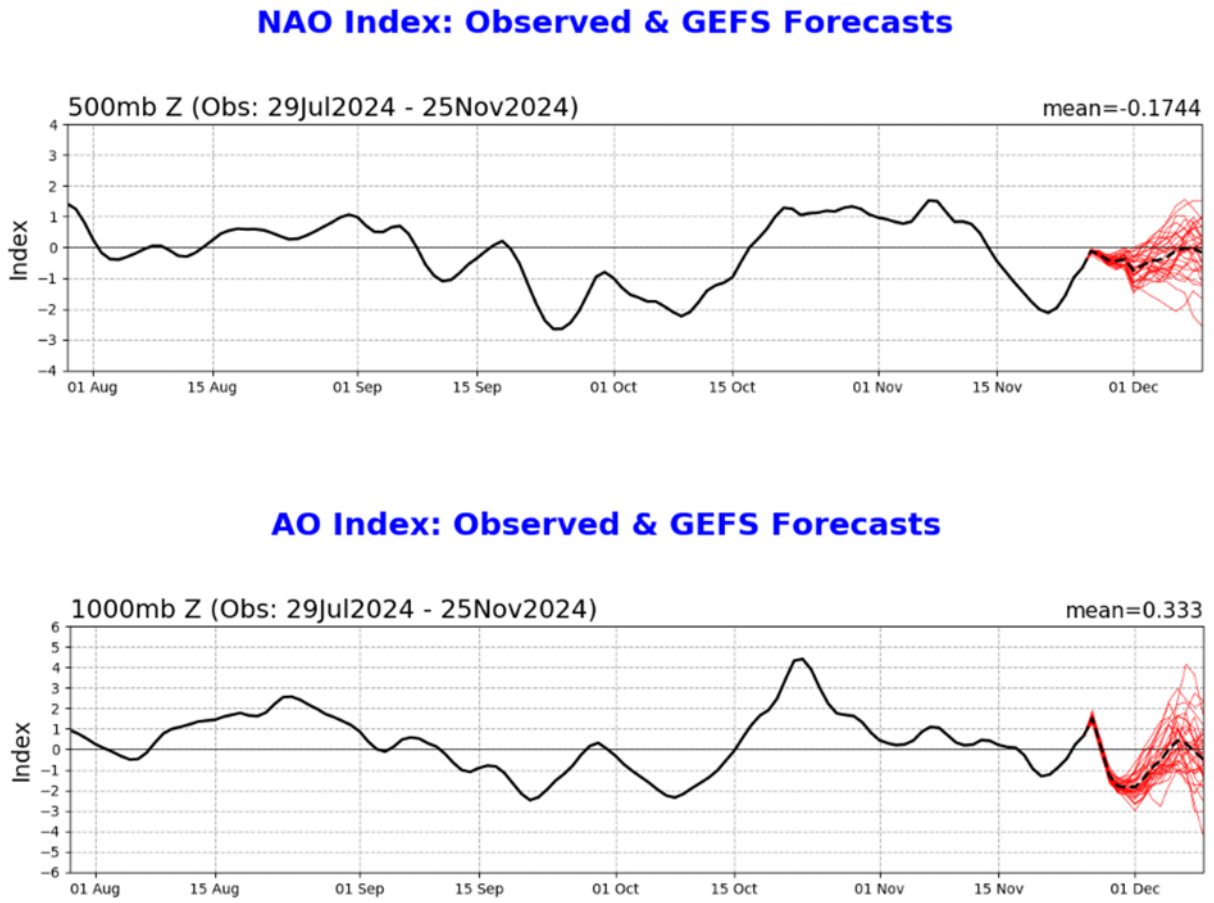

Figure 2.6: North Atlantic Oscillation (NAO) and Arctic Oscillation (AO) indices. Source: NOAA CPC, https://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_ao_index/ao.shtml

2.7 Weather regimes

Over the North Atlantic and Europe, weather regime frequencies show intra-seasonal variability during ASO season (Fig. 2.7). The predominance of the NAO- regime and zonal regime can't be explained by the MJO (Fig. 2.8), mainly active in phase 5/6 which favours the blocking regime.

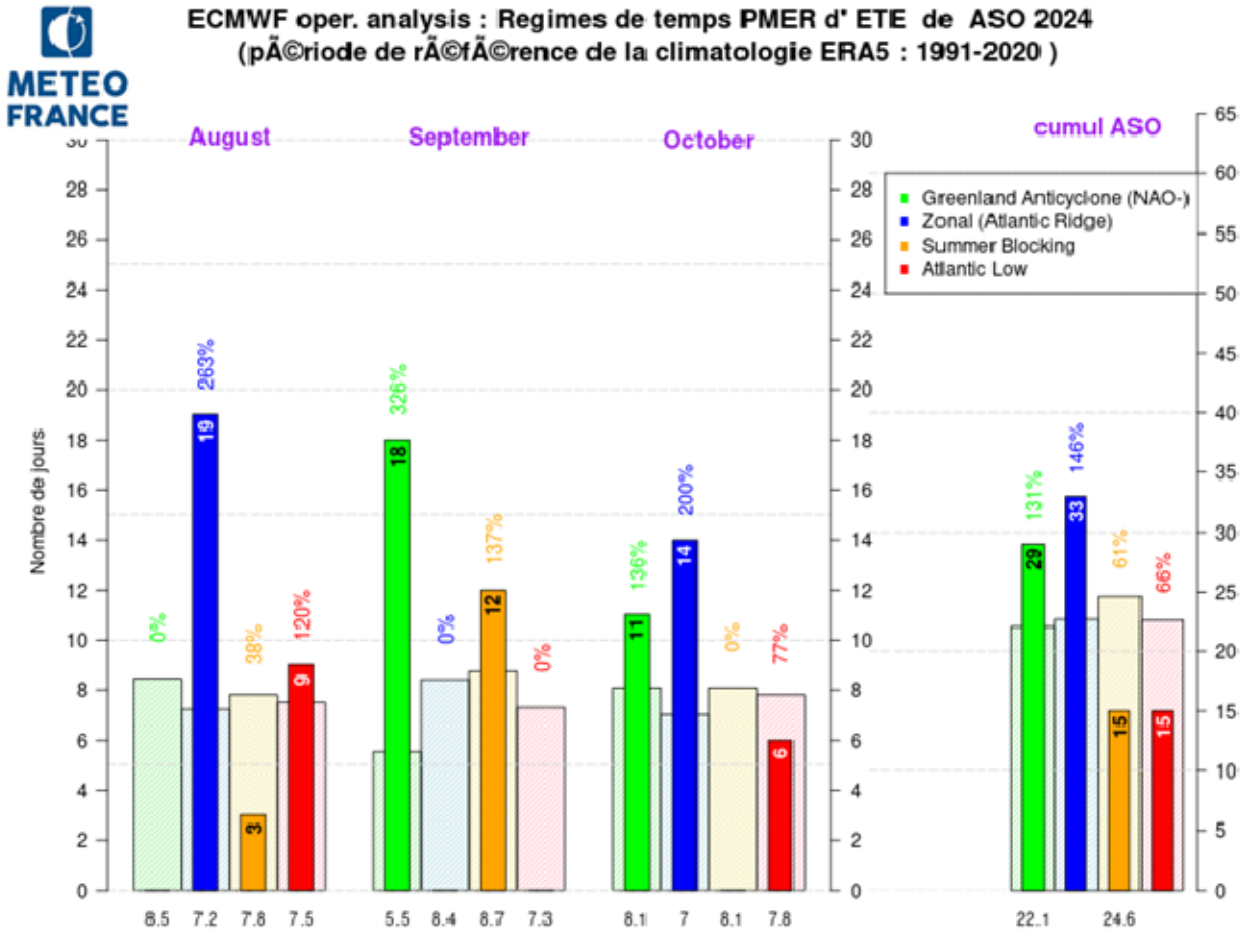

Figure 2.7: Weather regimes frequencies during ASO 2024 compared to 1991-2020 climatology and aggregation over the entire quarter, source: Météo France, data from ERA5.

2.8 Madden-Julian Oscillation (MJO)

MJO was particularly active over the Maritime Continent and the western Pacific in September and October 2024, but less over other parts. In November 2024, there was more activity over the eastern Pacific and Africa, and more recently, over the Indian Ocean. For December 2024, again higher activity is forecasted for the Maritime Continent. Up to now, no clear impact on the MedCOF domain can be seen for longer duration.

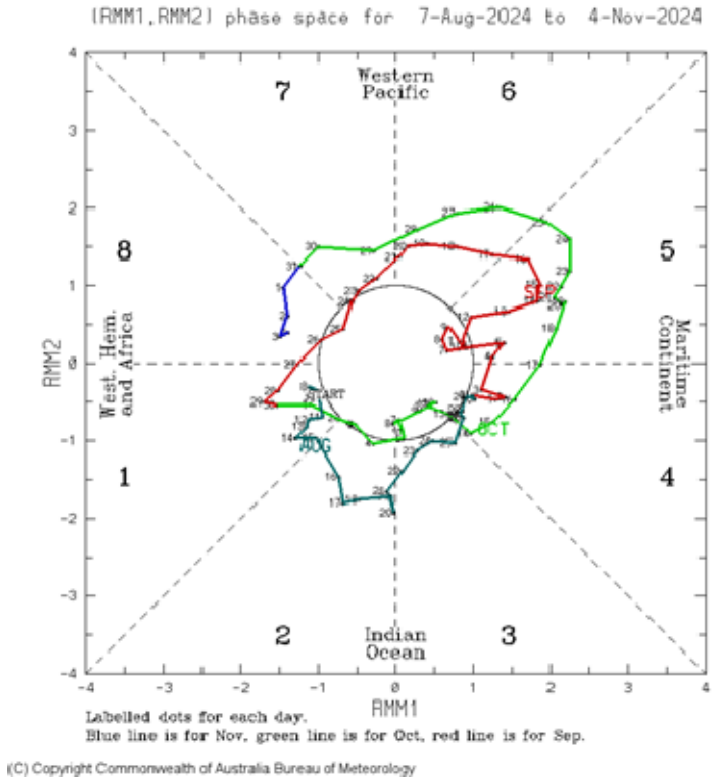

Fig. 2.8: MJO phase diagram August-November 2024. Source: http://www.bom.gov.au/climate/mjo/

3 Drivers

Summary

- IOD and ENSO probably neutral next months. However ,we can expect a la Niña type atmospheric perturbation (already present in the analysis - see RONI and EMI index and PV200hPa analysis)
- positive PDO : strengthens the la Niña type atmospheric perturbation
- Warm Tropical Atlantic

El Niño ==> Statistical effect on the Atlantic/Europe sector is different between the beginning and the end of winter

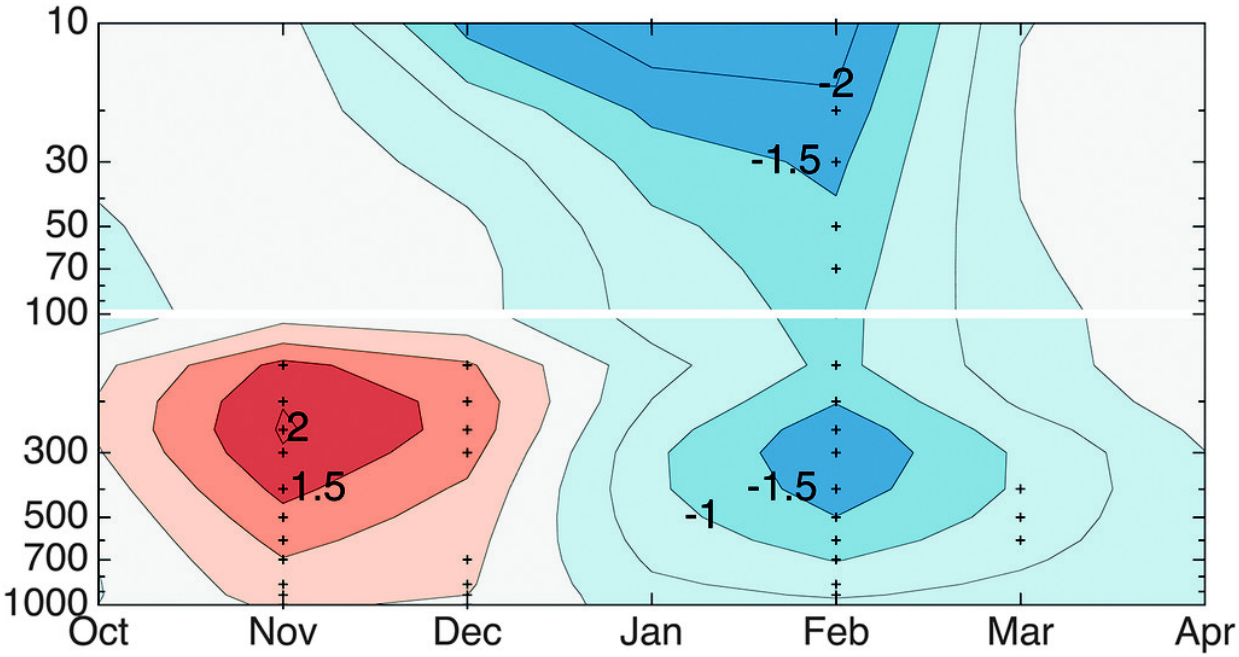

Fig 3.1: Regression of zonal wind (m s−1) on the Niño-3.4 index on a pressure level–month plane. The zonal wind time series is defined as the area average of the zonal wind in the area 40°–50°N, 90°W–0° for levels below 100 hPa, and the zonal mean is in the latitude band 50°–60°N for levels at and above 100 hPa (Citation: Martin P. King et all, Bulletin of the American Meteorological Society 99, 7; 10.1175/BAMS-D-17-0020.1)

At the end of autumn and beginning of winter, the westerly flow is reinforced, while at the end of winter and beginning of spring it is attenuated (following an increased frequency of SSW). For La Niña, it might be reversed.

IOD ==> In the case of a strong positive phase of the IOD, it is a NAO+ type circulation which is favored during winter

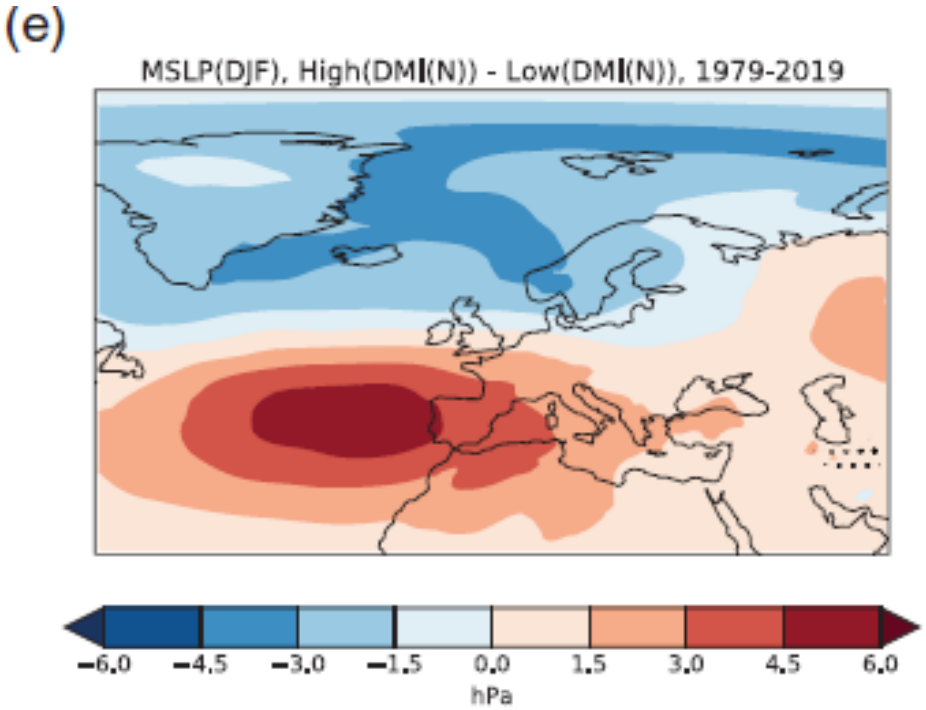

Fig 3.1: MSLP (hPa) with ENSO signal removed and stippling denoting statistical significance at the 90% level (source : Hardiman et al. Predictability of European winter 2019/20: Indian Ocean dipole impacts on the NAO. Atmospheric Science Letters, 21(12), e1005)

4 Temperature

Europe/RA VI domain

According to Copernicus data, October 2024 was 1.23 ºC warmer than the 1991-2020 average in Europe and the fifth warmest October on record. The warming trend rate in Europe since 1981 was about 0.38 °C per decade.

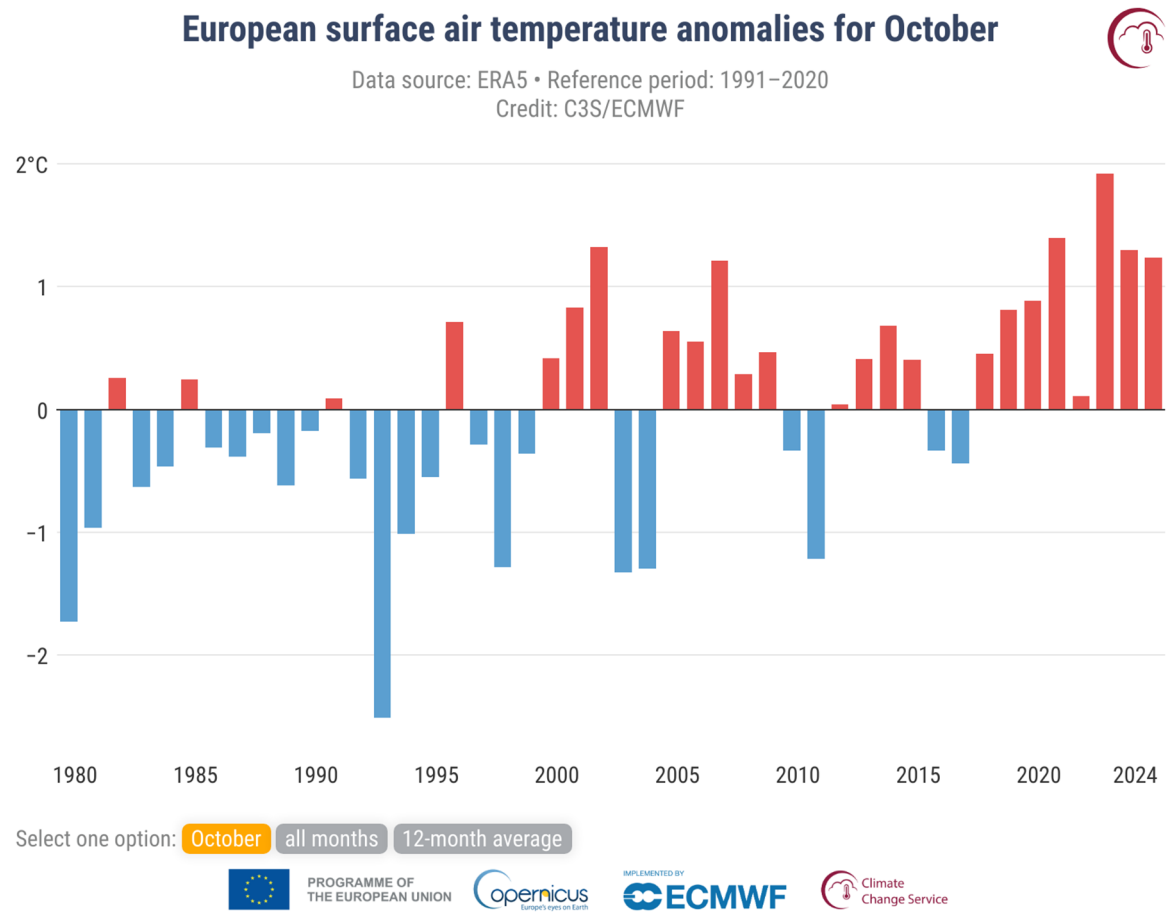

Fig. 4.1: Monthly European-mean surface air temperature anomalies relative to 1991-2020 for October months, from 1979 to 2024. Data source: ERA5. Credit: Copernicus Climate Change Service/ECMWF, https://climate.copernicus.eu/surface-air-temperature-maps

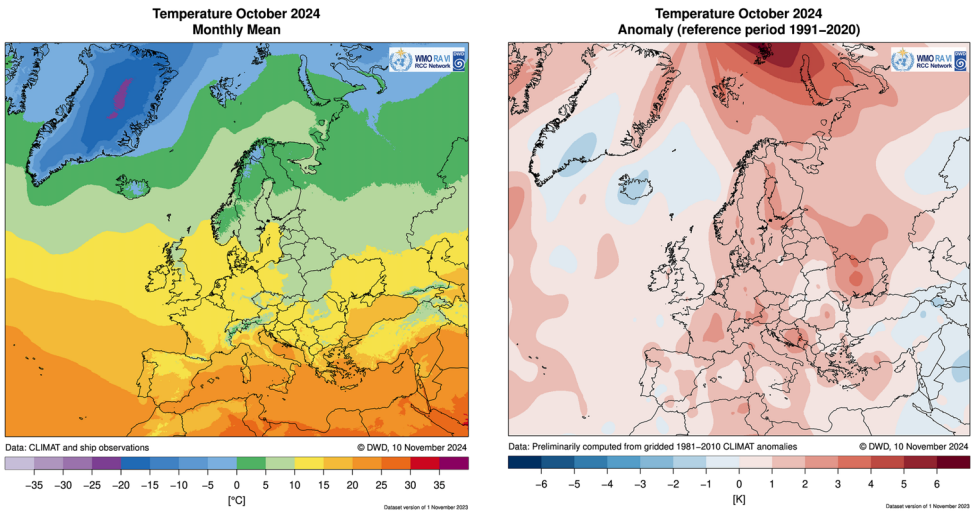

Fig. 4.2: Mean temperature (left) and anomalies (1991-2020 reference, right) in °C in the RA VI Region (Europe) interpolated from CLIMAT station data, for October 2024. Source: DWD, https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_month_ttt.html

Within the RAVI MedCOF domain, monthly mean temperatures in the lowlands in October 2024 ranged from around 8 °C in northwestern Ukraine to around 25 °C in southern Israel. The month was warmer than on 1991-2020 average in most parts. Anomalies were mostly between +1 °C and +2 °C, partly above, locally up to +3 °C in the eastern Ukraine and on the western Balkans. October 2024 was slightly colder than normal only in easternmost parts (South Caucasus, eastern Türkiye, Middle East) and locally in southwestern Spain. Anomalies in those areas were mostly weaker than −1 °C, in Armenia and locally in eastern Türkiye larger.

In terms of terciles, most of the domain had temperatures above the upper tercile (1993-2016 reference) that month. On parts of the Iberian Peninsula and in the easternmost parts mentioned above, October 2024 temperatures were in the middle percentile range, in the South Caucasus locally even below the lower tercile.

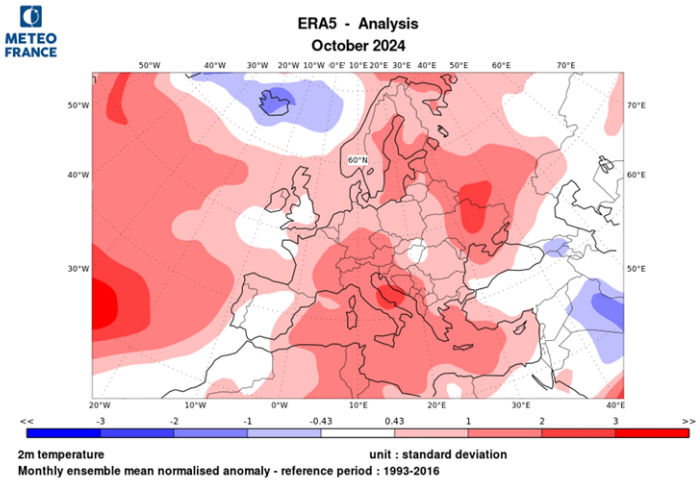

Fig. 4.3: Mean standardized temperature anomalies with terciles for October 2024. Source : Météo France, http://seasonal.meteo.fr/content/suivi-clim-cartes-ref93-16, data source : ERA5 reanalysis

Temperature in North Africa

The graph 4.4 shows the monthly trend in air temperature anomaly in degrees Celsius of October since 1979 through 2024. For each year, the positive anomaly is indicated by the red vertical bars and the negative anomaly is indicated by the blue vertical bars. The black line tracks the changes in the trend over time.

For October the land mean temperature of North Africa region was above the normal 1991-2020, has reached +0.8 °C. The warming rate was about 0.42 °C per decade.

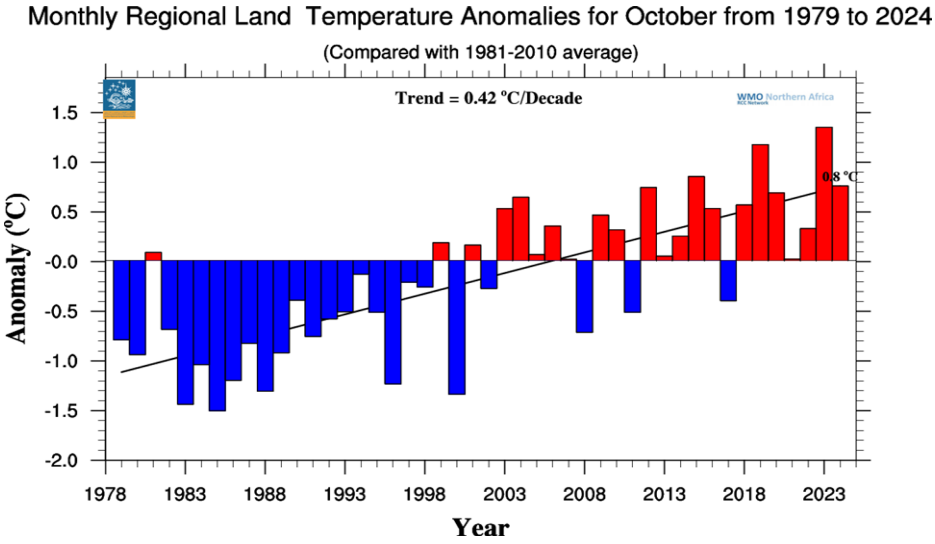

Figure 4.4: October mean temperature anomaly (until October 2024) time series plot with trend line

Monthly mean temperature in October 2024 mostly ranged from 20°C to 30°C, in small parts reaching 14 °C, especially in the center of Morocco. In some parts of the central and southern Algeria the mean temperature was above 32 °C.

Compared to the 1991-2020 reference, temperature anomalies were above normal over most of the domain, they were in a range between +1 and +2 °C in Tunisia, Morocco, and most parts of Algeria, with small parts experiencing temperature anomalies reaching +4 °C, especially in the center-west of Algeria. Temperature anomalies were below normal and mostly ranged between 0 and -2 °C over the east and the south of Egypt and the south of Morocco.

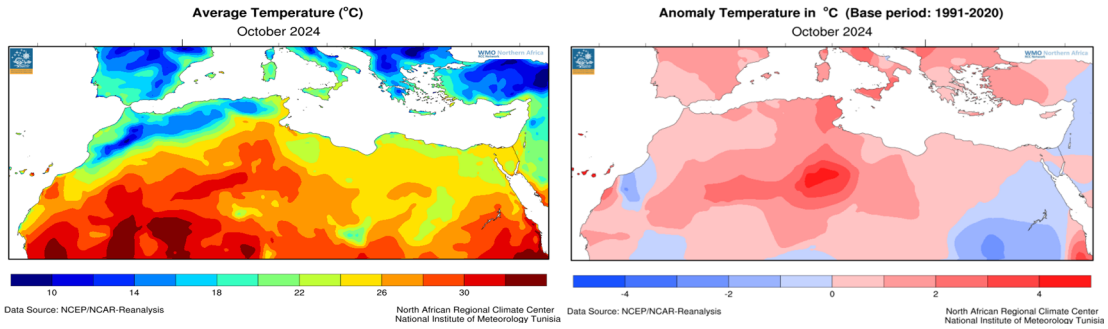

Figure 4.5: Left: Mean temperature; Right: Absolute anomalies of temperature in the RAI-NA Region (North Africa) Data from NCDC (National Climate Data Centre NOAA – reference 1991-2020),

https://www.meteo.tn/en/climate-monitoring-watch

5 Precipitation

Europe/RA VI domain

Especially western parts of the MedCOF RA VI received abundant precipitation in October 2024, with more than 100 mm in large parts of Portugal, Spain, France, northern Italy, and Slovenia. Several places had more than 200 mm, due to some extreme heavy rain events. Similar totals fell also in places on the eastern and southern Black Sea coastal areas. The areas further east were much drier, mostly with totals below 50 mm. Parts of southern Türkiye, Cyprus, and most of the Middle East were completely dry that month.

Correspondingly, anomalies were very high that month in western parts of the domain, exceeding +70 mm in several areas of Spain and Portugal, throughout northern Italy, and in places at the Black Sea and in the central Ukraine, +50 mm in northwestern France. In contrast, it was much drier than normal in southern Italy, over much of the Balkan Peninsula, in Türkiye and in the northern parts of the Middle East. Particularly high deficits of more than 50 mm were registered in southern Italy, Greece, and western Türkiye, where drought conditions were reported.

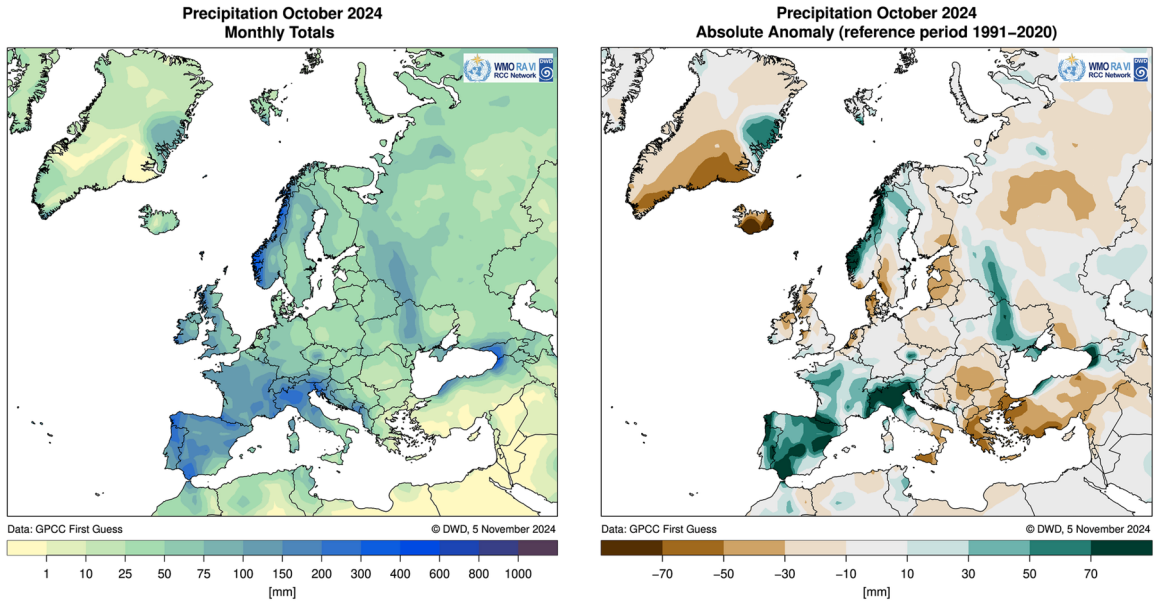

Fig. 5.1: Monthly precipitation totals (left) and percentage of 1991-2020 normal (right) for October 2024 in Europe/RAVI. Data from GPCC (First Guess version). Source: DWD, https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_month_rrr.html

In terms of terciles, the above-mentioned areas with above-normal precipitation mostly had totals above the upper tercile. The dry areas mentioned above had totals mostly in the lower percentile range.

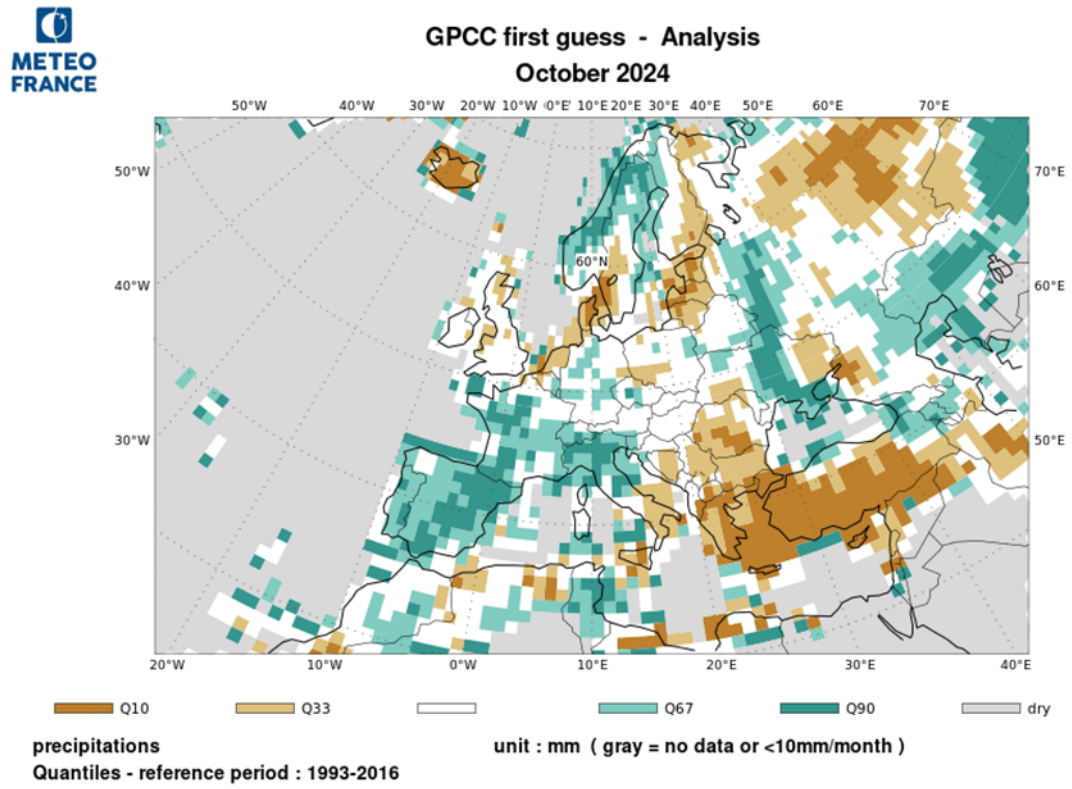

Fig. 5.2: Quantiles of monthly precipitation totals for October 2024. Source : Météo France, http://seasonal.meteo.fr/content/suivi-clim-cartes-ref93-16, data source : GPCC

Precipitation in North Africa

In October 2024 the North African domain was very dry. Overall, the precipitation totals were below 20 mm. The eastern regions of Tunisia, the north of both countries Algeria and Morocco received the highest rainfall amounts, exceeding 75 mm.

Anomalies (1991-2020 reference) were mostly negative during this month of 2024 with totals less than 60% of the normal. Locally in the south of Algeria, south of Libya, and over most of Egypt, precipitation was above normal. Elsewhere in Morocco, most parts of Algeria, most parts of Libya, and Tunisia, precipitation was below normal.

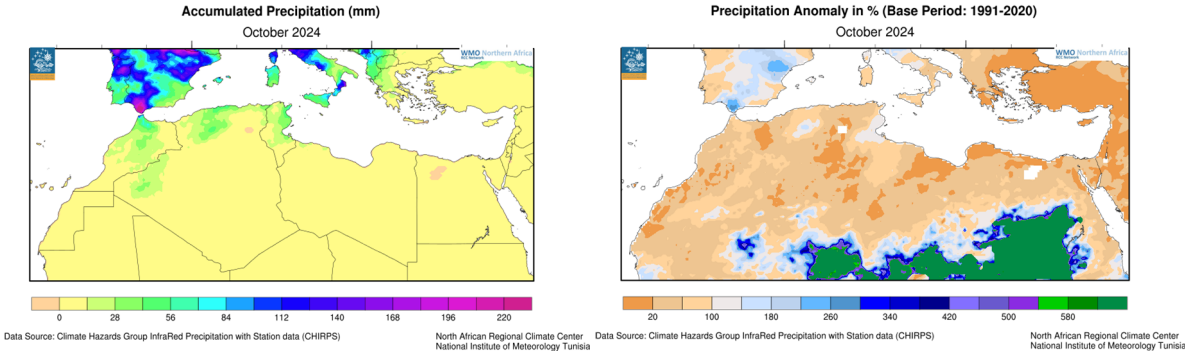

Figure 5.3: Left: Total precipitation; Right: Percentages of normal in the RAI-NA Region (North Africa) Data from NCDC (National Climate Data Centre NOAA – reference 1991-2020)
https://www.meteo.tn/en/climate-monitoring-watch

3. Soil moisture

Europe/RA VI domain

Soil moisture was well below normal in October 2024 especially in the eastern Ukraine, Armenia, Romania, Bulgaria, parts of Greece, small areas of Türkiye, Cyprus, and southeastern Spain. Soils were significantly wetter than normal in northern parts of Spain, France, and parts of northern and central Italy.

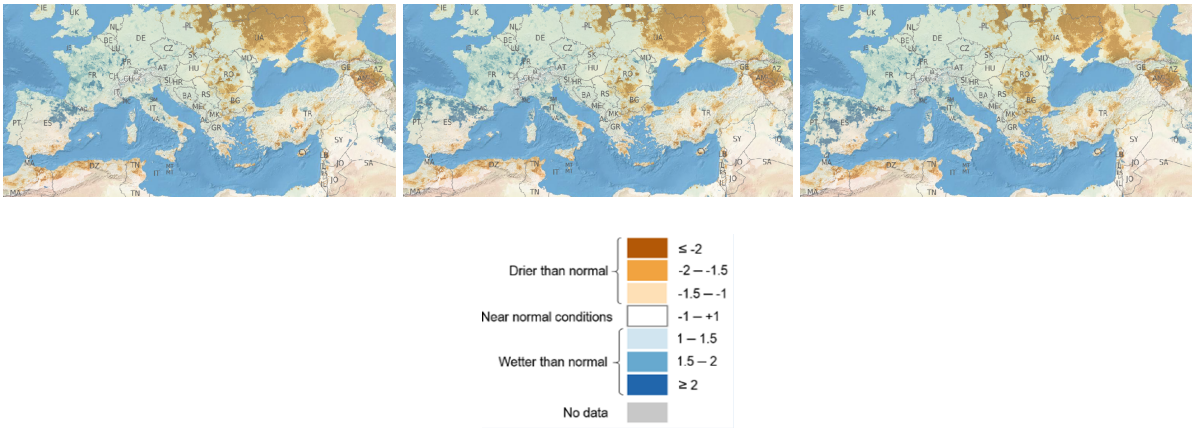

Figure 6.1: 10-day anomalies of soil moisture index (SMI) in October 2024, reference period: 1995-2023. Source: European Drought Observatory (EDO), https://edo.jrc.ec.europa.eu/edov2/php/index.php?id=1111

North Africa/RA I domain

In October 2024, soil moisture anomalies were slightly above normal over the northeastern coastal area of Libya and the north of Egypt. Elsewhere, over Algeria, Tunisia, Morocco and most parts of Libya the anomalies were below normal.

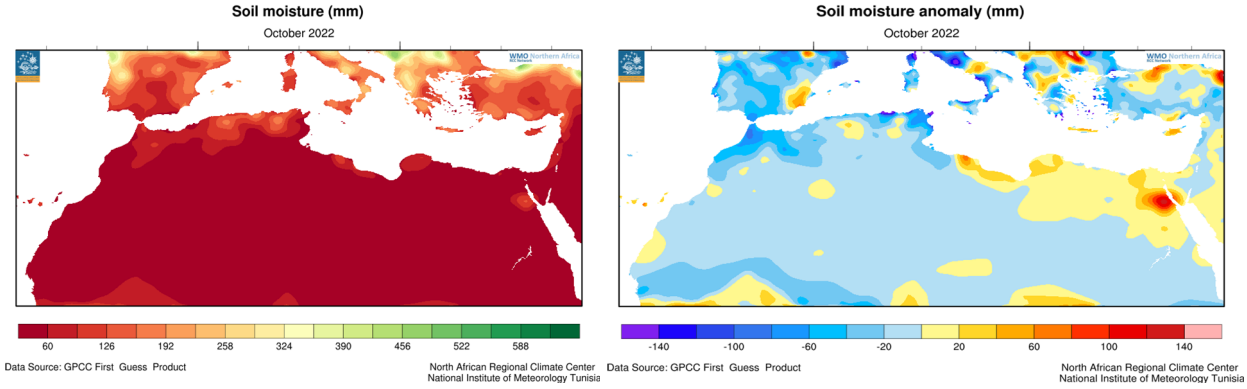

Figure 6.2: October 2024 soil moisture, left: monthly total, right: monthly anomalies with reference period 1991-2020.

References:

Météo France monthly and seasonal climate monitoring maps: http://seasonal.meteo.fr

WMO RA I RCC Node on Climate Monitoring Website with monitoring results: https://www.meteo.tn/en/climate-monitoring-watch

WMO RA VI RCC Node on Climate Monitoring Website with monitoring results: http://www.dwd.de/rcc-cm

GPCC: http://gpcc.dwd.de

Copernicus Climate Change Service: https://climate.copernicus.eu

NOAA National Centers of Environmental Information (NCEI): https://www.ncei.noaa.gov/

NOAA National Centers of Environmental Prediction (NCEP): https://www.ncep.noaa.gov/

Deutscher Wetterdienst (DWD), Germany: https://www.dwd.de

EU Joint Research Centre: http://edo.jrc.ec.europa.eu

Australian Government – Bureau of Meteorology: http://www.bom.gov.au