MEDITERRANEAN CLIMATE OUTLOOK FORUM
MEDCOF-18 Online Forum

MONITORING SUMMARY MEDCOF-18

for April 2022

Final version

Last update: 27 May 2022

Compiled by

WMO RA VI RCC Toulouse Node on Long Range Forecasting

Météo France

Toulouse, France

WMO RA I North Africa RCC Tunisian Node

Institut National de la Météorologie (INM)

Tunis, Tunisia

WMO RA VI RCC Offenbach Node on Climate Monitoring

Deutscher Wetterdienst (DWD)

Offenbach, Germany

The following MedCOF monitoring summary is based on

- Monitoring information from RA I NA RCC and RA VI RCC Node-CM
- Contribution from Météo France (draft of LRF bulletin)
- Further information from various sources (BOM, NOAA-CPC)
- SEECOF-27 Monitoring document

1. Oceanic Analysis

Over the Pacific Ocean: La Niña:

- Below-average sea surface temperatures (SST) persisted during April 2022 across most of the central and eastern Pacific Ocean (Fig. 1.1), showing that La Niña is still present, even strengthening in the eastern part of the basin.
- La Niña in winter 2021/22 had a weaker peak than in winter 2020/21, but the development in the following spring was very different in these two years. In spring 2021, there was a clear tendency to a decay of La Niña, but in spring 2022 an intensification took place, suggesting that La Niña is rather continuing than decaying. Negative SST anomalies are quite strong for this time of year (Fig. 1.2).
- In the subsurface, anomalies in April were weaker than in March in the central Pacific, but spread over a larger area (Fig. 1.3).
- In the North Pacific, a PDO- (negative Pacific decadal oscillation) pattern still exists.
- For more details see:
    - http://seasonal.meteo.fr/slides/BulTech (password protected)
    - https://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.shtml
    - http://www.bom.gov.au/climate/enso/index.shtml#tabs=Pacific-Ocean
    - PDO: https://www.ncdc.noaa.gov/teleconnections/pdo/

Over the Maritime Continent and the Indian Ocean:

- Anomalies over the tropical Indian Ocean are quite weak.
- Indian Ocean Dipole (IOD) presently neutral, very weak gradient could be a beginning of a development to a negative IOD.
- Very high warm anomalies close to India and the Arabic Peninsula (in April stronger than in March), and also warm anomalies around Australia and the maritime continent (little change compared to March).

Over the North Atlantic:

- Mostly weak anomalies in the tropics, warm over the equator except for the Gulf of Guinea (neutral). Neutral to cold anomalies in the tropical North Atlantic.
- Positive anomalies close to France and the North Sea, negative anomalies near the west coast of Iberia and West Africa.

Over the Mediterranean and Black Sea:

- Western and central Mediterranean colder than normal.
- Eastern Mediterranean and Black Sea close to normal SST.

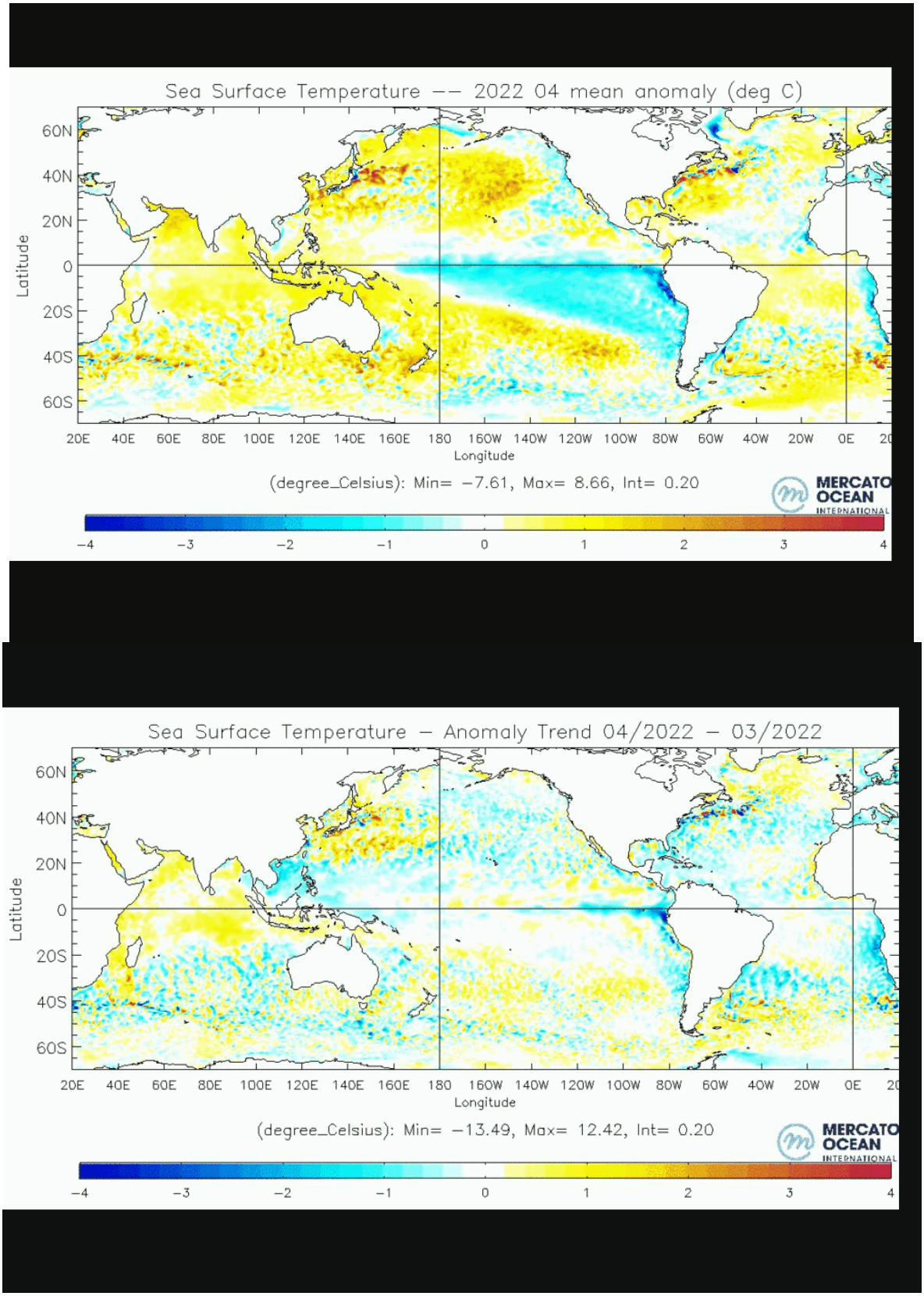

Figure 1.1: Sea surface temperature anomalies for April 2022, 1992-2013 reference (upper map) and anomaly differences April minus March 2022 (anomaly trend). Source: Météo France

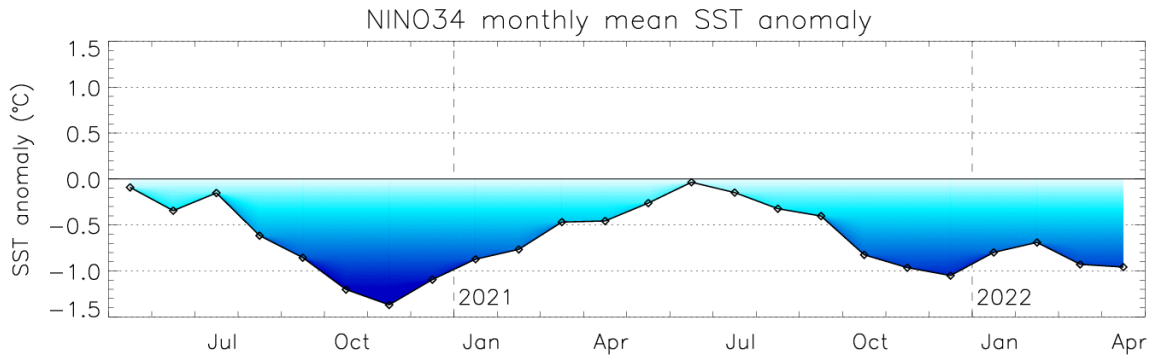

Figure 1.2: Evolution of sea surface temperature anomalies in the Niño3.4 box, 1992-2013 reference. Data from Mercator Ocean, source: Météo France.

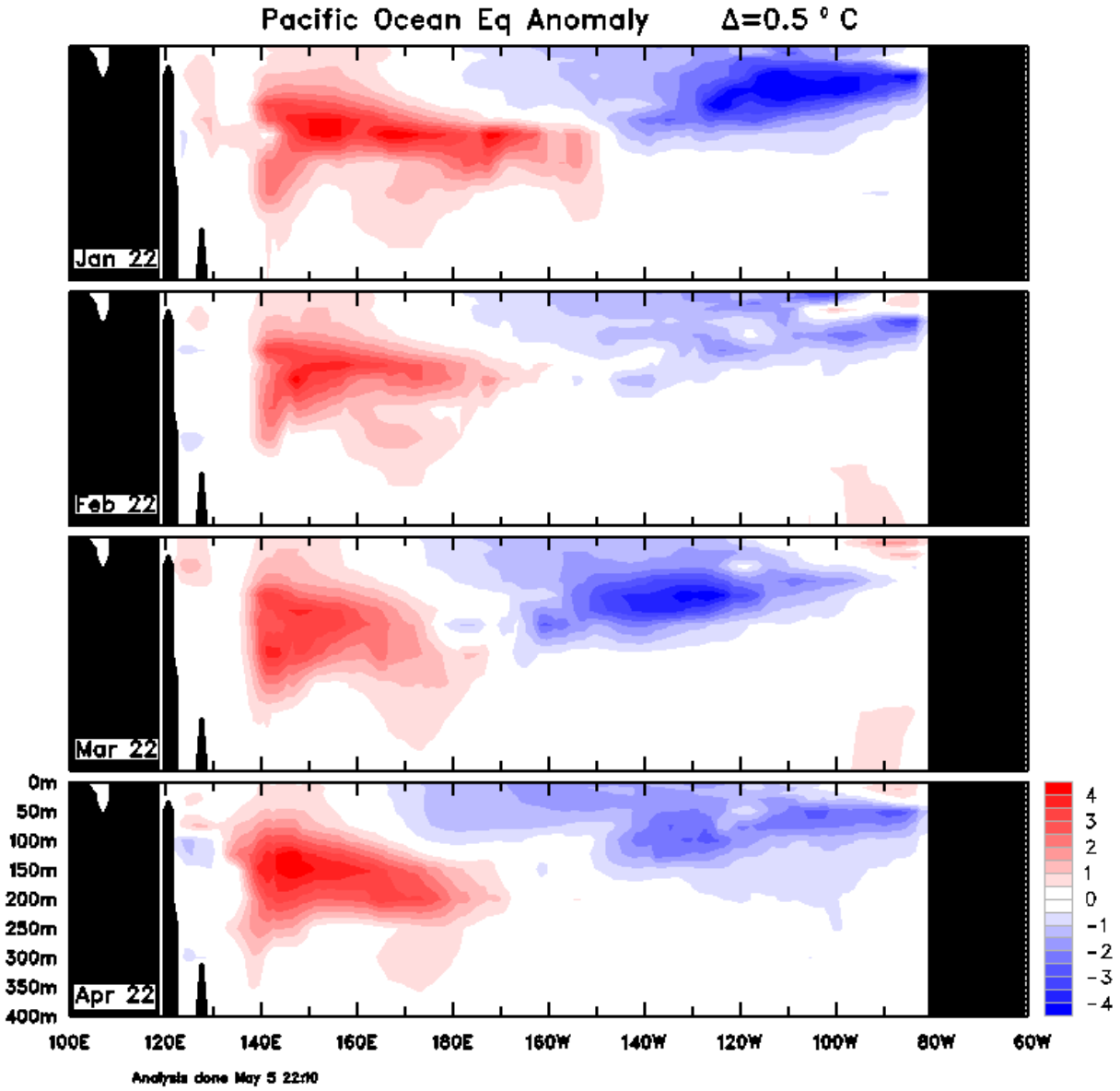

Figure 1.3: Monthly Pacific Ocean temperature anomalies in the sub-surface January-April 2022, 1900-1992 reference (Climatology after Levitus World Ocean Atlas). Source: BOM, http://www.bom.gov.au/climate/enso/index.shtml#tabs=Sea-sub%E2%80%93surface

2. Atmospheric Circulation Analysis

Velocity Potential Anomaly field in the high troposphere (fig. 2.1a – insight into Hadley-Walker circulation anomalies), Southern Oscillation Index (SOI) and Madden-Julian Oscillation (MJO) (fig. 2.1.b)

- Upward motion anomaly over the western tropical Pacific and close to Australia and the maritime continent, downward over the eastern tropical Pacific. Typical La Niña response and closely related to ocean anomalies.
- Still high positive SOI values (March +1.8, April +1.7 according to NOAA CPC, even stronger than during previous winter 2021/22)
  - https://www.ncdc.noaa.gov/teleconnections/enso/soi
  - http://www.bom.gov.au/climate/enso/index.shtml#tabs=Pacific-Ocean&pacific=SOI
- Another downward anomaly over the southern hemispheric part of the western Indian Ocean can be related to a beginning development of IOD induced circulation (together with the upward anomaly over the maritime continent).

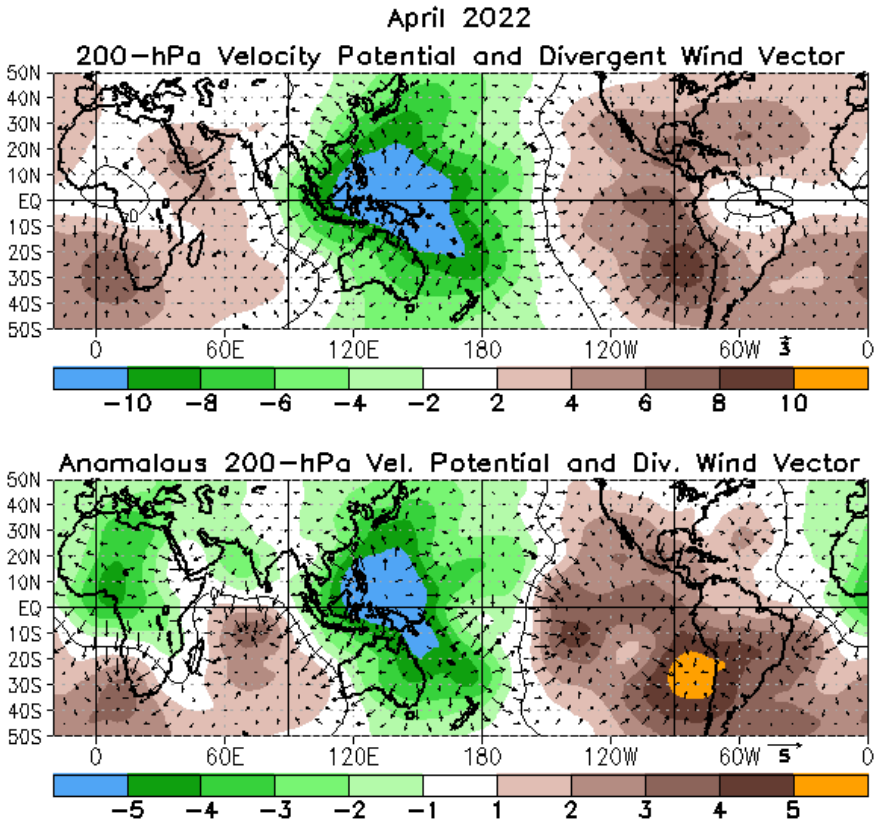

Figure 2.1.a: Velocity Potential monthly mean (upper map) and anomalies (lower map) at 200 hPa and associated divergent circulation mean and anomaly for April 2022. Green (brown) indicates a divergence-upward motion (anomaly) (convergence-downward motion anomaly). http://www.cpc.ncep.noaa.gov/products/CDB/Tropics/figt24.shtml

- MJO was weak during April 2022. In May 2022 there was a development first over the Indian Ocean and then further passing the maritime continent and the western Pacific, enhancing the Southern Oscillation upward motion, but at the end of May, MJO weakened again.

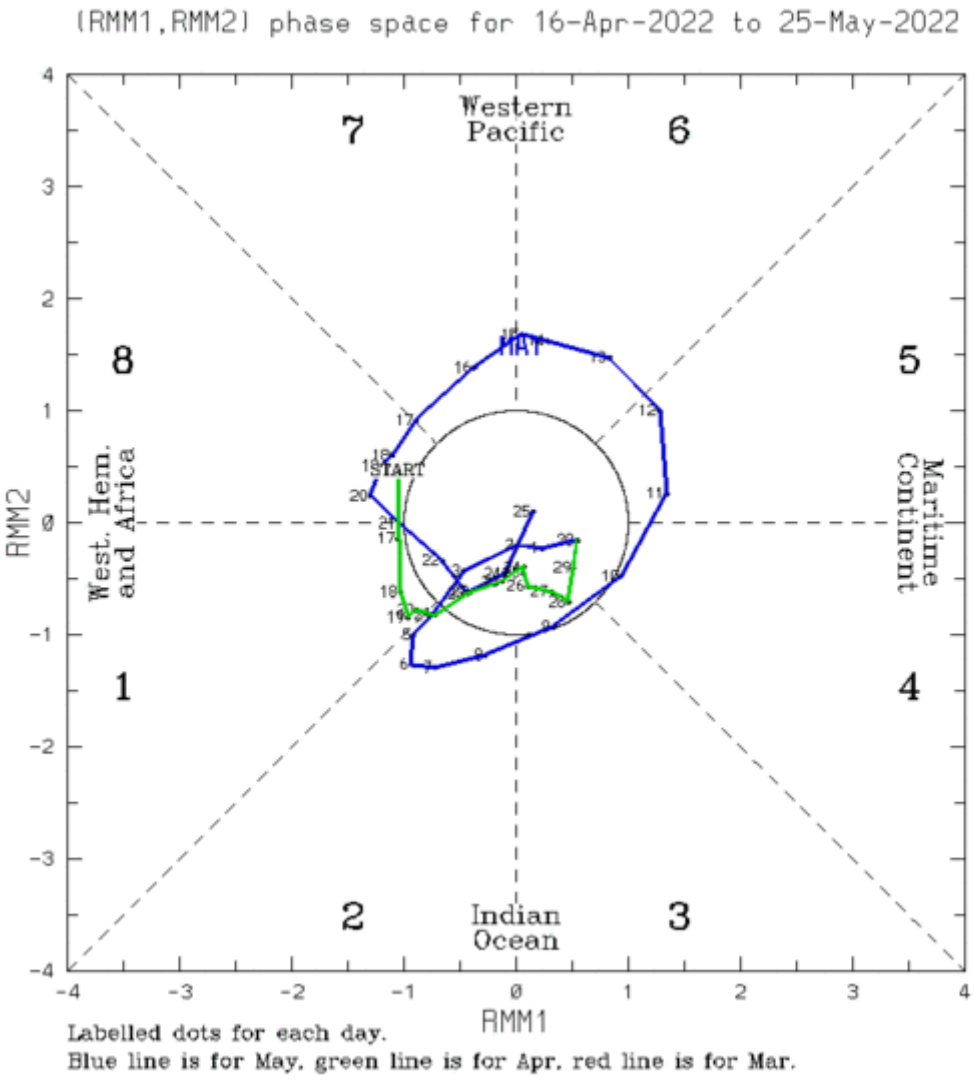

Figure 2.1.b: indices MJO

http://www.bom.gov.au/climate/mjo/

Stream Function anomalies in the high troposphere (fig. 2.2 – insight into teleconnection patterns tropically forced):

Over the eastern Pacific, a teleconnection pattern is visible reaching the middle latitudes in the northern hemisphere.

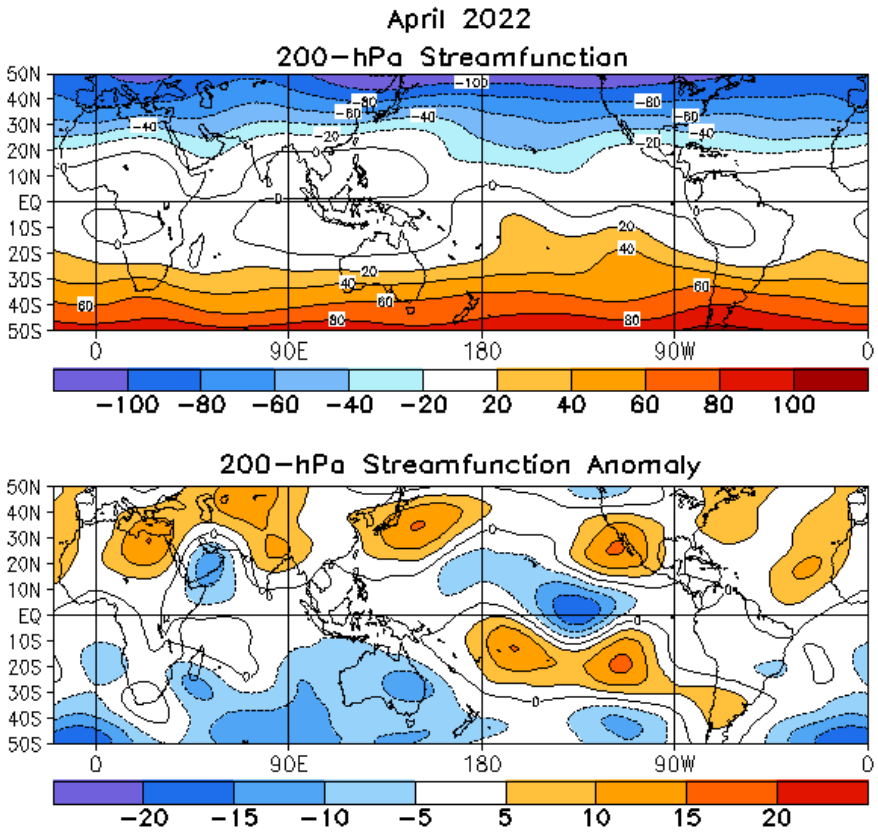

Figure 2.2: Stream Function and anomalies at 200 hPa in April 2022.

http://www.cpc.ncep.noaa.gov/products/CDB/Tropics/figt22.shtml

Geopotential height at 500 hPa (fig. 2.3 – insight into mid-latitude general circulation):

- Negative PNA pattern in April 2022 (PNA index -0.74 according to NOAA, https://www.ncdc.noaa.gov/teleconnections/pna/). The shift of the jetstream over the North Pacific can be identified (Fig. 2.3), typical La Niña response.
- Over the North Atlantic and Europe, similar quadrupole structures can be seen, suggesting a propagation of PNA anomaly wave to Europe including the Mediterranean. The pattern is very similar to that of April of last year (2021), also with La Niña and negative PNA.
- Especially over the MedCOF region negative geopotential anomalies from the northern Balkans to the Ukraine, positive anomalies over the eastern Mediterranean and negative anomalies over the western Mediterranean including Iberia and western parts of North Africa, but positive anomalies over France.

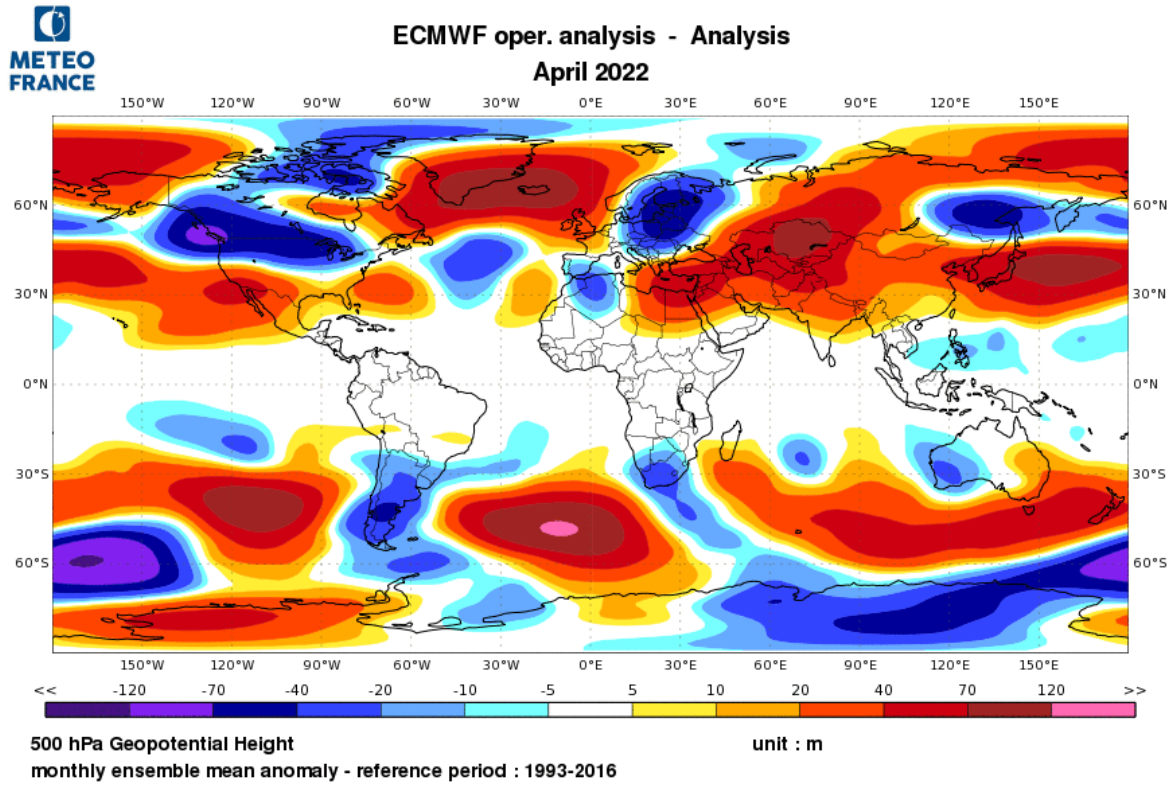

Figure 2.3: Anomalies of Geopotential height at 500hPa (Source: Météo-France, http://seasonal.meteo.fr/content/suivi-clim-cartes-ref93-16)

Sea level pressure and circulation types relevant for the domain

- Rather meridional over the North Atlantic, NAO- and EA-.
- Over Europe and the Mediterranean only weak pressure differences.
- Russian High quite weak in Europe.
- SCAND- pattern brought some cold air advection to Europe
- NAO- and AO- on most days during April 2022, however, change to a positive phase in May.
- Météo France weather type classification shows NAO- and summer blocking as the most frequent types in April. Until late May there was a more frequent occurrence of zonal types then, pointing to a change of circulation from May 2022.

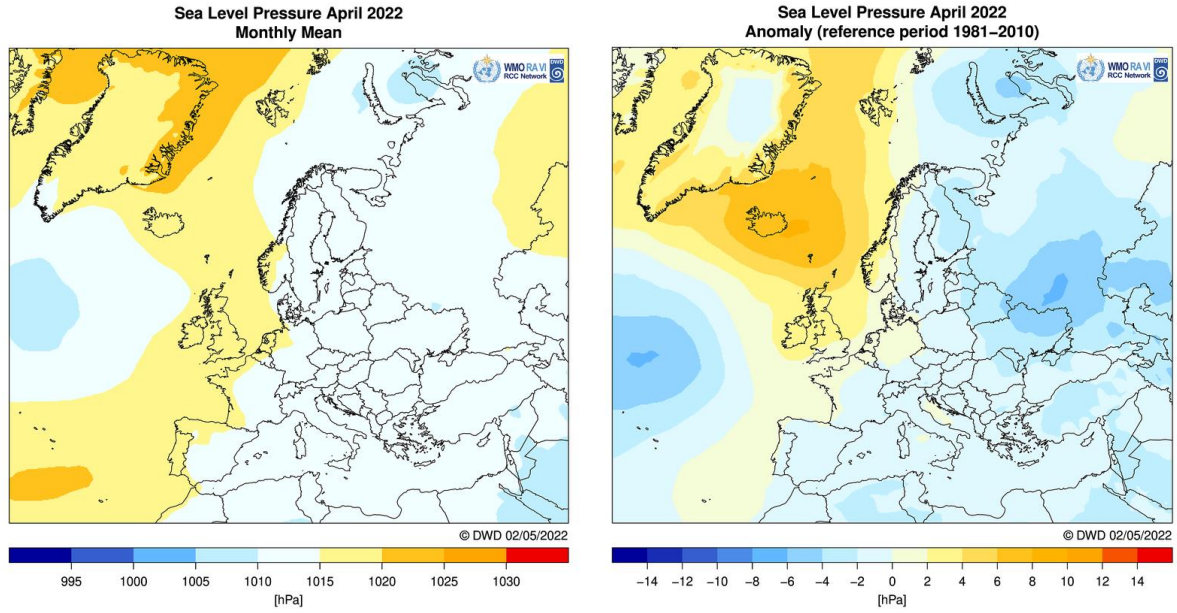

Figure 2.4: Mean sea level pressure over the North Atlantic, Europe and North Africa and 1981-2010 anomalies for April 2022. Source: DWD, https://www.dwd.de/DE/leistungen/rcccm/int/rcccm_int_ppp.html?nn=490674

MONTH	NAO	EA	WP	EP-NP	PNA	TNH	EATL/WRUS	SCAND	POLEUR
APR 22	-0.5	-0.9	0.3	-0.7	-1.0	---	-0.1	-0.7	-1.2
MAR 22	0.4	1.5	0.6	0.3	-0.2	---	1.4	1.0	-0.5
FEB 22	1.5	0.2	-0.4	-0.9	0.6	1.8	-0.9	-2.1	-1.6
JAN 22	0.7	-1.4	-1.4	0.5	0.6	0.7	1.1	-0.9	-0.3
DEC 21	0.2	-0.1	0.5	---	-2.9	-0.3	0.0	0.3	-0.5
NOV 21	-0.3	-0.9	-0.1	0.3	0.7	---	0.0	-0.8	0.5
OCT 21	-2.0	0.9	1.7	-2.4	1.4	---	-0.6	-0.2	-0.5
SEP 21	-0.1	1.7	-0.7	-1.9	0.3	---	0.5	-0.1	-1.0
AUG 21	-0.5	1.1	-1.9	-1.8	0.9	---	-2.4	-1.4	-0.5
JUL 21	0.1	2.2	-0.4	-1.3	0.1	---	-0.5	1.5	0.8
JUN 21	1.1	1.0	-0.8	-0.3	0.8	---	-1.8	-0.1	0.9
MAY 21	-1.1	0.8	0.2	0.0	-1.1	---	-1.2	-1.1	-0.5
APR 21	-1.7	0.3	-0.1	0.8	-1.3	---	-0.4	-1.2	-0.2

Table 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

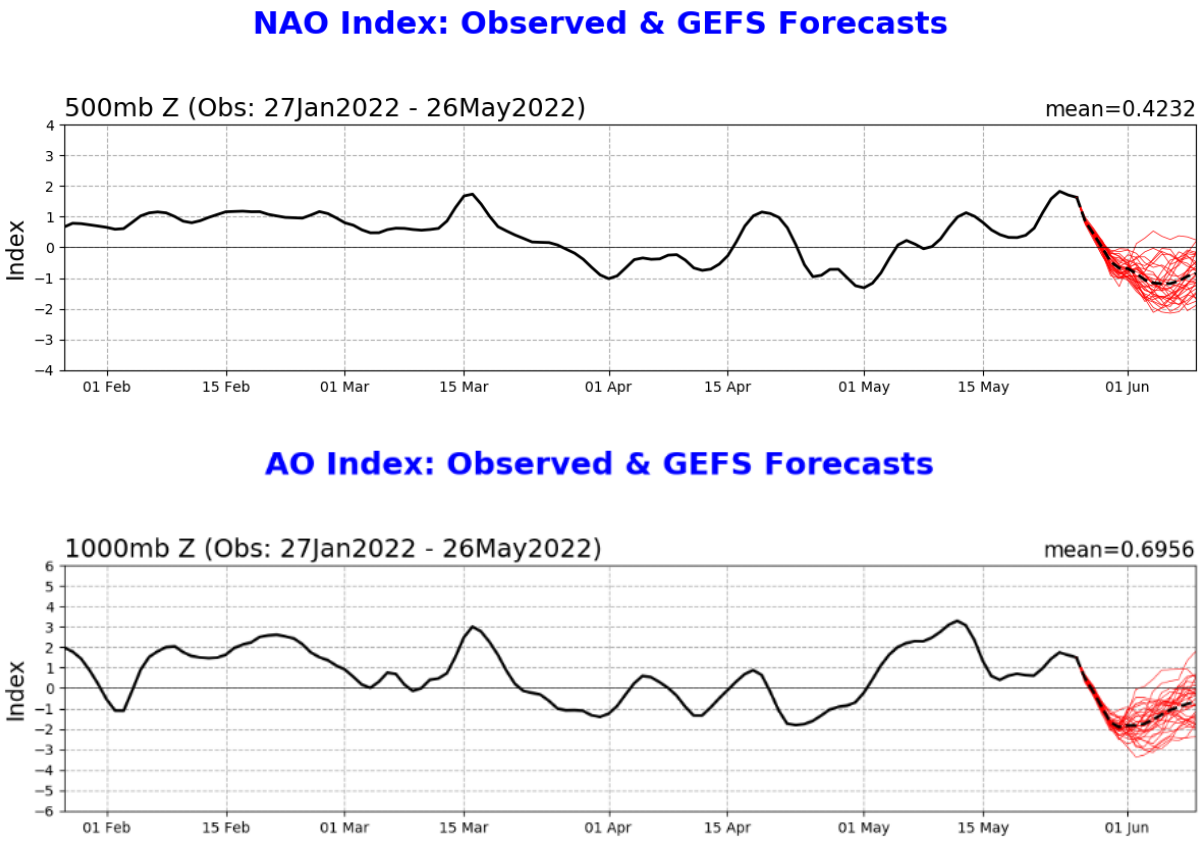

Figure 2.5: North Atlantic Oscillation (NAO) and Arctic Oscillation (AO) indices. Source: NOAA CPC, https://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_ao_index/teleconnections.shtml

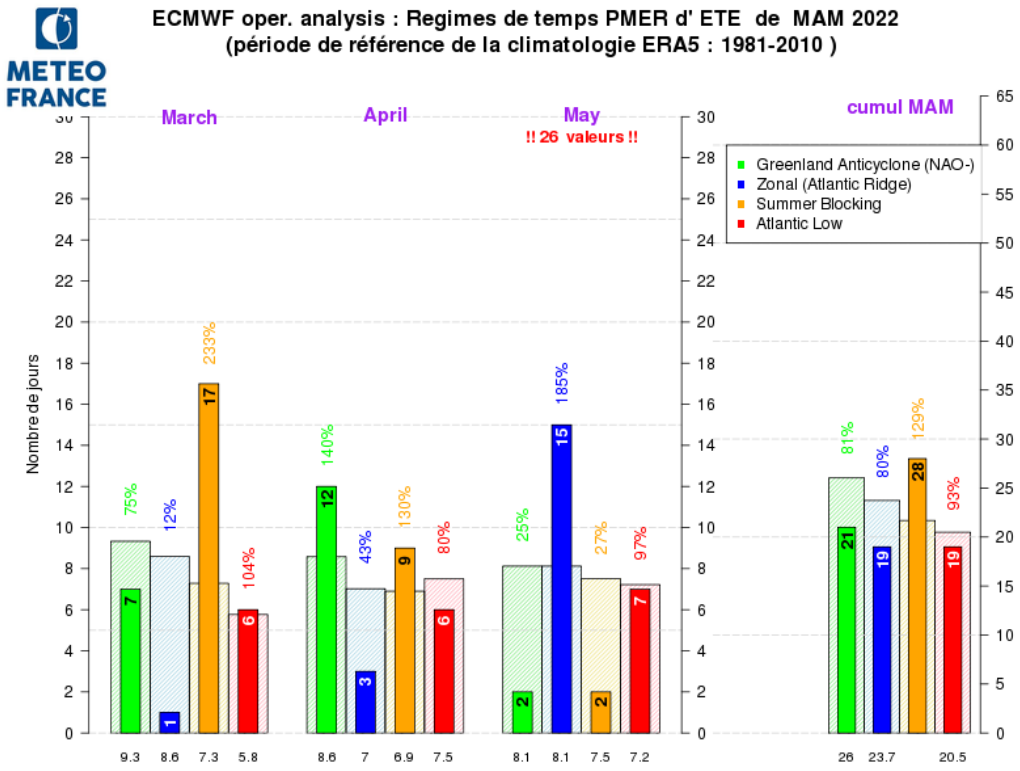

Figure 2.6: Distribution of weather types of Météo France classification (summer regime) for March-May 2022. Source: Météo France, http://seasonal.meteo.fr/content/suivi-clim-regimes-trim

3. Precipitation

Europe/RA VI domain

Monthly precipitation in April 2022 was mostly between 50 and 75 mm in most of Iberia, southwestern and eastern France, northern Italy, the Balkans, Romania, Moldova, the Ukraine and Georgia, partly higher. Totals of 25-50 mm were recorded in northwestern and southeastern France, central and southern Italy, Hungary, North Macedonia, western and northern Greece, northern and eastern Turkey and Armenia. Eastern and southern Greece, southwestern and central Turkey and Azerbaijan had totals of 10-25 mm. Driest areas of the domain were the Middle East countries and the islands in the eastern Mediterranean (Crete, Cyprus) with less than 10 mm of monthly precipitation.

Compared to the 1991-2020 normal, precipitation was mostly below or around normal in the domain. Some areas with significant above-normal precipitation (above 125% of normal) were eastern Spain and areas north and west of the Black Sea.

In terms of percentiles, especially large areas in the eastern Ukraine had precipitation above the 90^{th} percentile, while large areas particularly in the eastern Mediterranean recorded totals below the 20^{th} or 10^{th} percentile.

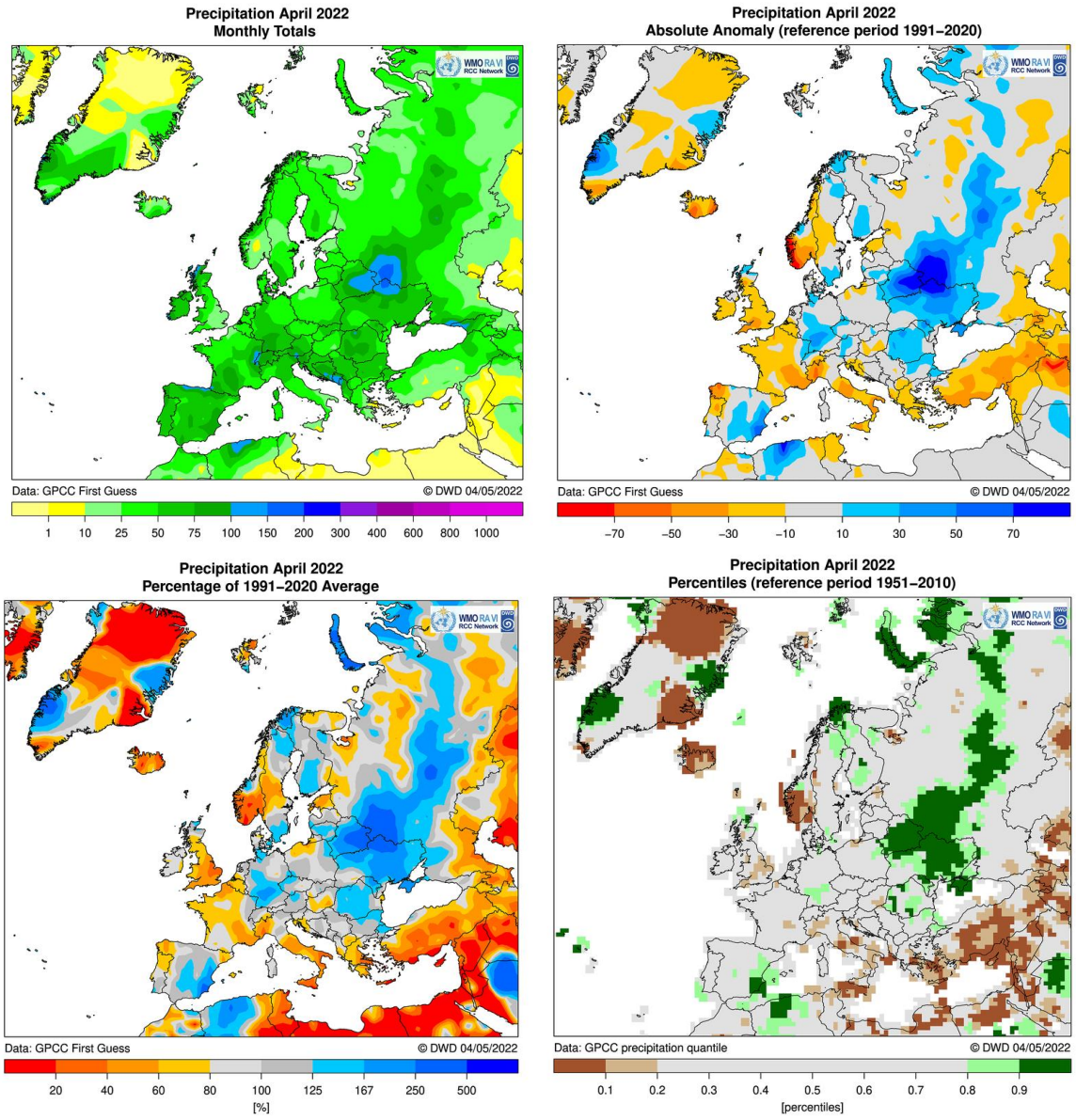

Figure 3.1: Monthly precipitation sum (upper left), absolute anomalies (upper right), percentage of normal (bottom left), and percentiles (bottom right) for April 2022 (1991-2020 reference for percentages and anomalies, 1951-2010 for percentiles) in Europe/RAVI. Data from GPCC (First Guess version). Source: DWD, http://www.dwd.de/DE/leistungen/rcccm/int/rcccm_int_rrr.html?nn=16102

Precipitation in North Africa

The majority of the North African domain was very dry in April 2022; the precipitations were less than 20 mm, except some parts of the northern regions of Tunisia, Algeria and of Morocco, which received nearly between 40 mm and 100 mm (Fig.3.2, left map).

Comparing to the 1981-2010 reference period (Fig.3.2, right map), precipitation during April 2022 was above normal over the north of Algeria, some parts of Egypt and locally over the south of Libya, elsewhere precipitation was below normal.

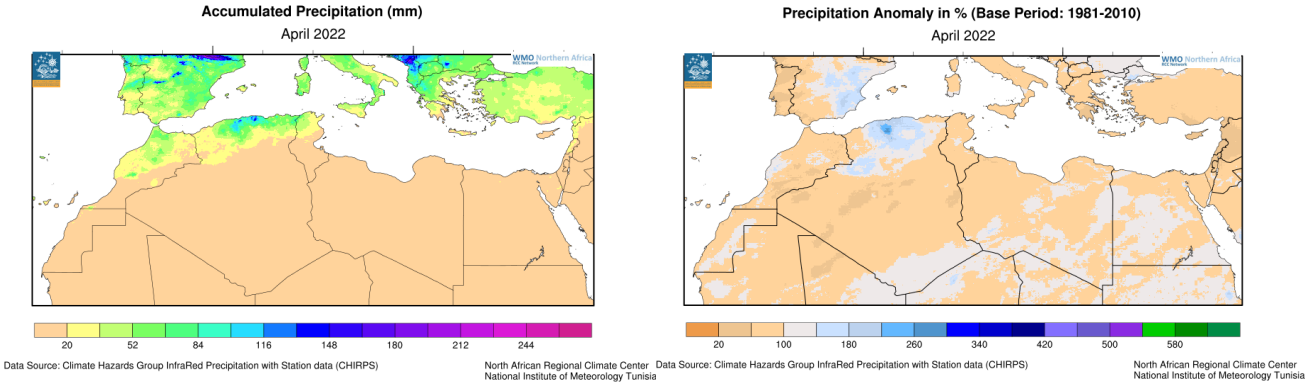

Fig.3.2: Left: Total precipitation; Right: Relative anomalies of precipitation (percentage of normal) in the RAI-NA Region (North Africa). Data from NCDC (National Climate Data Centre NOAA – reference 1981-2010)
https://www.meteo.tn/en/climate-monitoring-watch

Regarding to the tercile map (Fig.3.3), precipitation was above normal over the north of Algeria, the south of Egypt and some parts of the extreme south of Libya; elsewhere precipitation was below or near normal.

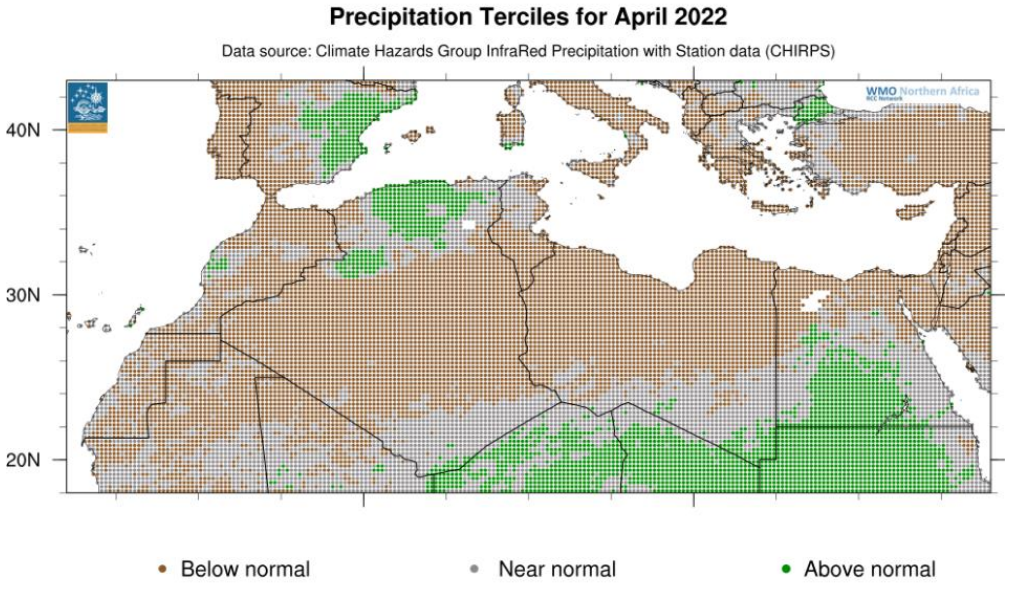

Fig.3.3: Precipitation terciles for April 2022 in the RAI-NA Region (North Africa). Source: INM Tunisia

4. Temperature

Europe/RA VI domain

Averaged over all RA VI land areas, the temperature anomaly in April 2022 was +0.5 °C (1981-2010 reference, Fig. 4.1). Although this was above normal, most April months of the recent years were warmer than this year. The last April month before 2022, which was colder was in 2017. The warming rate was +2.0 °C over the period 1981-2022 (42 years); this is equivalent to +0.48 °C per decade.

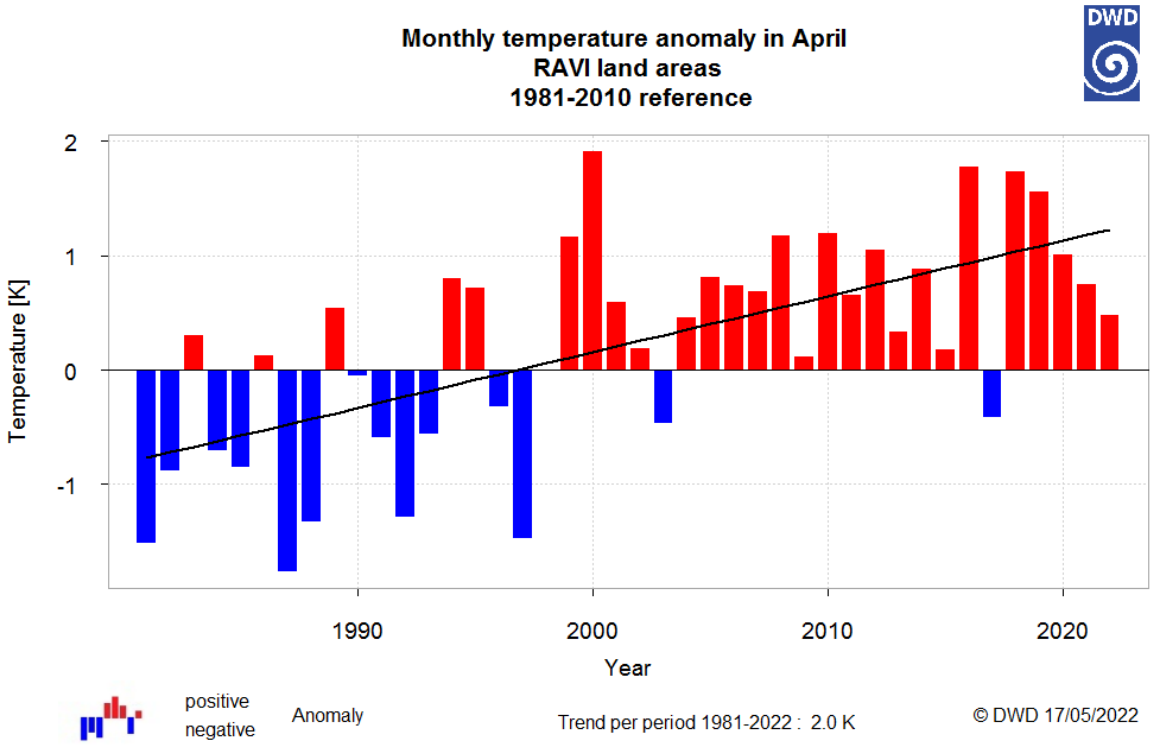

Fig. 4.1: Monthly mean temperature anomaly time series for the years 1981-2022 with trend line, averaged over all RA VI land areas. Source: DWD

Monthly mean temperatures in the MedCOF RA VI domain in April 2022 ranged from below 0 °C in the Alps to 25 °C in southern Jordan (Fig. 4.2). Most lowland areas had monthly averages of 10-15 °C, only some parts in the north and in higher altitudes had lower values. Over most of the Mediterranean sea surface, the air was warmer (15-20 °C) and much of the southern and eastern parts of the Middle East recorded even 20-25 °C.

Compared to the 1991-2020 normal, much of the domain was colder, particularly Iberia, the western Mediterranean, Italy, most of the Balkans, Hungary, Romania, Moldova and the Ukraine. Warmer than normal was the eastern Mediterranean region including Greece, Turkey, Cyprus, the Middle East and the South Caucasus. Temperatures in France were around normal.

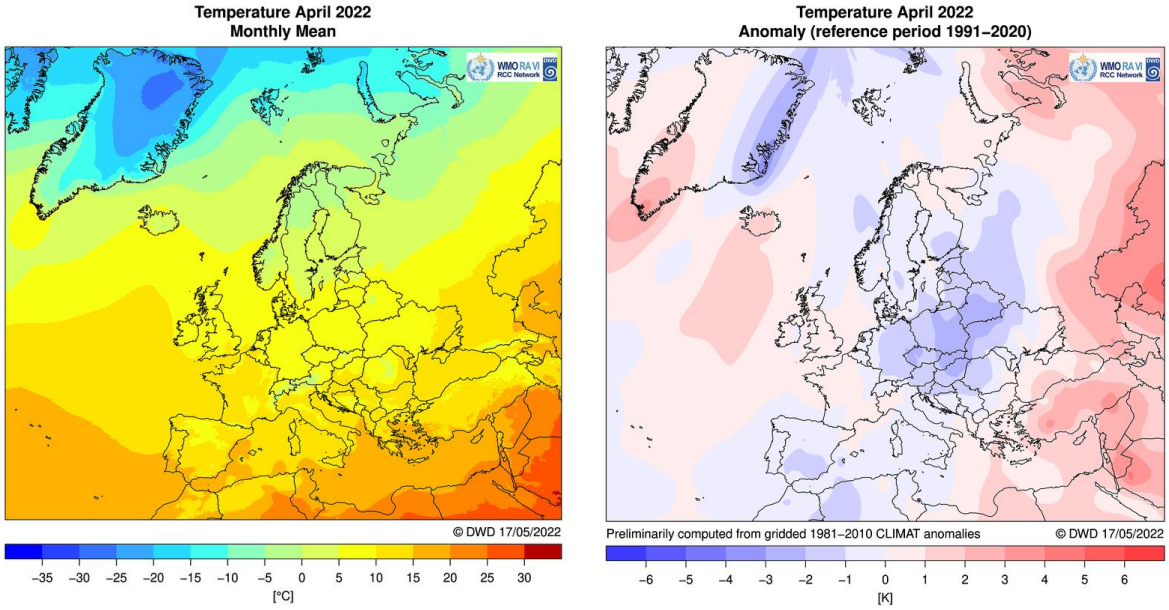

Figure 4.2: Mean temperature (left) and anomalies (1991-2020 reference, right) in °C in the RA VI Region (Europe) interpolated from CLIMAT station data, for April 2022. Source: DWD, http://www.dwd.de/DE/leistungen/rcccm/int/rcccm_int_ttt.html?nn=490674.

Temperature in North Africa

The graph in Fig. 4.3 shows the monthly trend of air temperature anomalies in °C in April since 1979 through 2022. 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.

With an excess of +0.9 °C of the land mean temperature over the North African domain, April 2022 was the seventh warmest April since 1979. The warming rate was about 0.37 °C per decade.

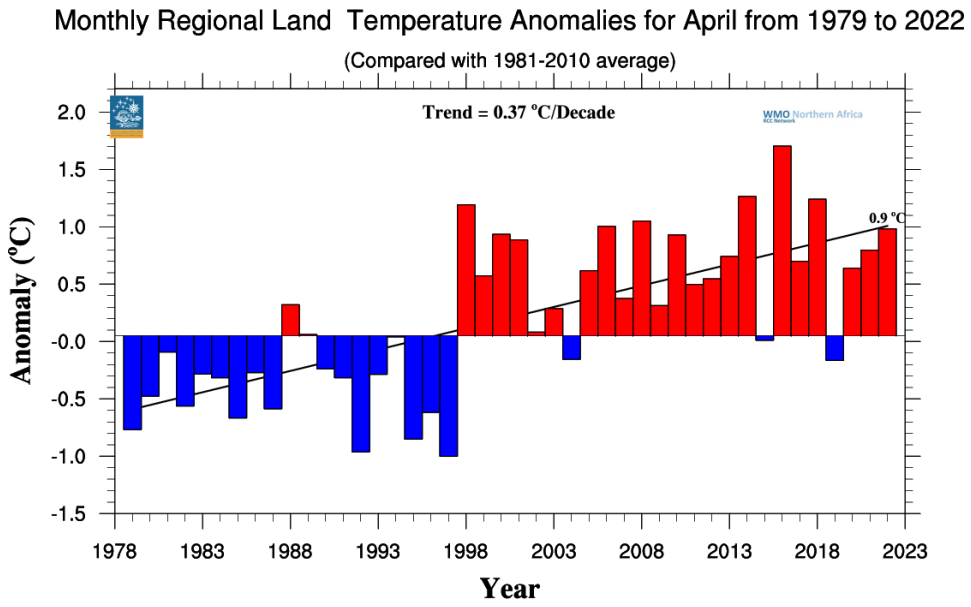

Figure 4.3: Monthly mean temperature anomaly time series 1979-2022 with trend line for land areas over the North African domain. Source: INM

The monthly mean temperature in April 2022 mostly ranged from 10 °C to 26 °C, in small parts reaching 6 °C, especially in the centre of Morocco and the north of Algeria. In some parts of southern Algeria, the eastern region of Libya, the mean temperature was above 28 °C and locally in southern Egypt even 30 °C.

Compared to 1981-2010 reference, temperature anomalies were above normal over the eastern half of the North African domain including Tunisia, the east of Algeria, Libya and Egypt. They were mostly in a range between +1 and +3 °C, highest in the east of Libya. Over the rest of the domain, temperature anomalies were below normal or near-normal, they mostly ranged between 0 and -2 °C and even -3 °C in the south of Algeria.

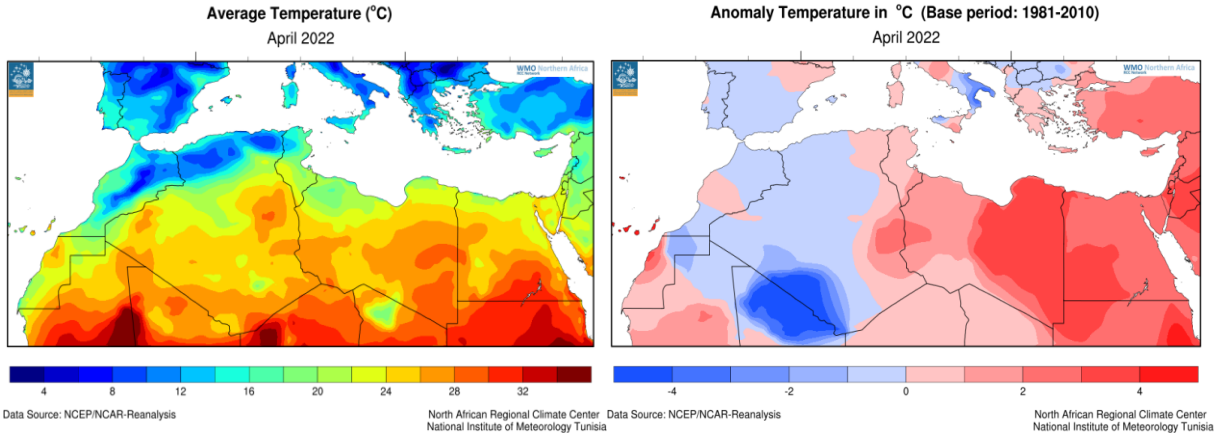

Fig. 4.4: Left: Mean temperature; Right: Absolute anomalies of temperature in the RAI-NA Region (North Africa). Data from NCDC (National Climate Data Centre NOAA – reference 1981-2010),

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

Regarding to the tercile map, the temperature anomalies were above normal over Egypt, Libya, Tunisia and the central east of Algeria, below normal over the south of Morocco and over some parts of the south and the north of Algeria. Elsewhere the temperatures were normal.

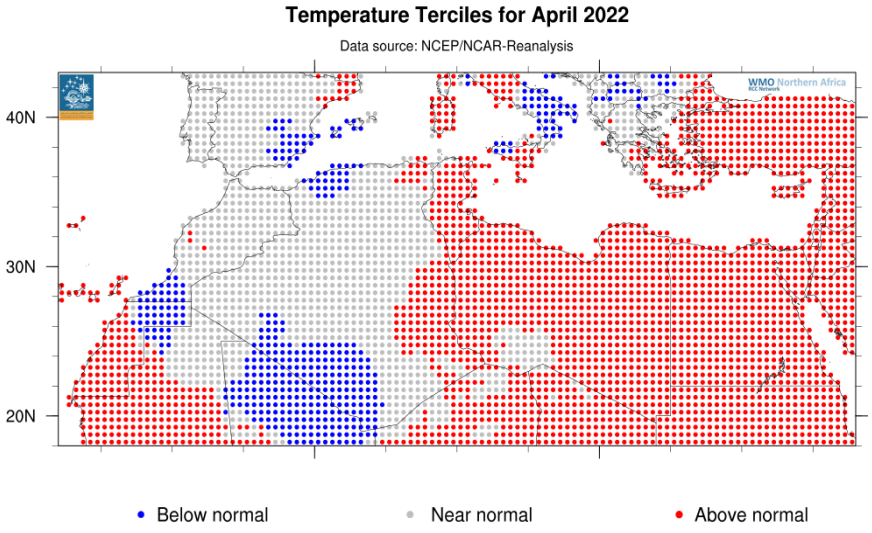

Fig. 4.5: Temperature terciles for April 2022 in the RAI-NA Region (North Africa). Data from NCDC (National Climate Data Centre NOAA – reference 1981-2010). Source: INM

5. Soil moisture

Soil moisture is not only important for agrometeorology, but also for climate diagnostics. In case of long-lasting anticyclonic periods, a dry soil may amplify positive temperature anomalies (and the risk of heat waves) due to missing cooling by less evaporation. It has also impact on precipitation because less evaporation causes a lower water vapour content in the atmosphere and hence less precipitation (which dries out the soils further).

Europe/RA VI domain

In April 2022, soils (near surface) were particularly drier than normal in the eastern Mediterranean region, especially in Turkey, and west of the Black Sea. Furthermore, some limited areas in Greece, Italy and southern and northwestern France had drier-than-normal soils. Iberia on the other hand, particularly in the east, had much wetter-than-normal soils due to frequent and partly heavy rain that month and lower evaporation due to lower temperatures than normal. Northern parts of the Ukraine, too, had wetter-than-normal soils.

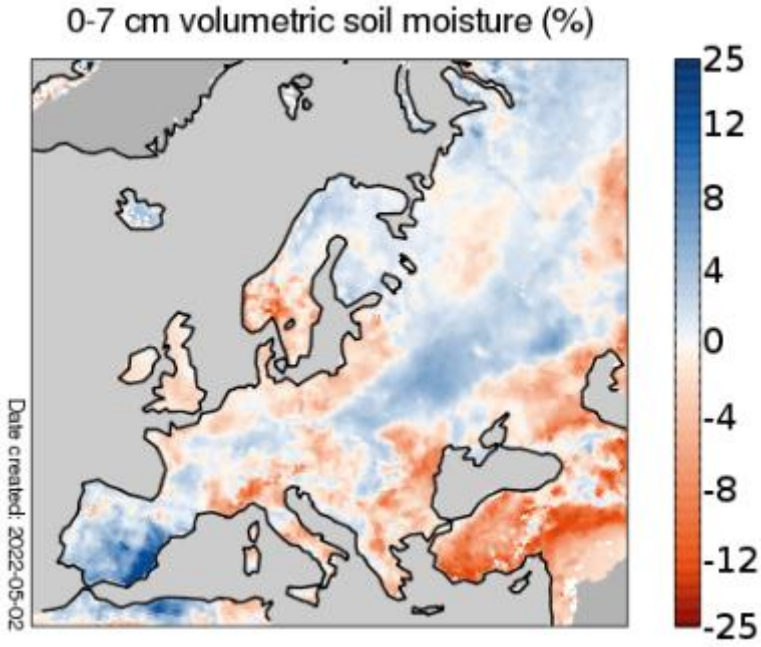

Fig. 5.1: Anomalies of soil moisture in Europe in % of the 1991-2020 normal in a depth layer of 0-7 cm for April 2022. Data from ERA5 reanalysis. Source: Copernicus, https://climate.copernicus.eu/precipitation-relative-humidity-and-soil-moisture-april-2022

In May, especially western parts of the domain were short of precipitation and soils became drier. Particularly large parts of France and Portugal were dry. In other areas, which had formerly wet soils, moisture decreased to near normal values like in central Spain or in the northern Ukraine. In the eastern Mediterranean, on the other hand, deficits of soil moisture became smaller due to some precipitation.

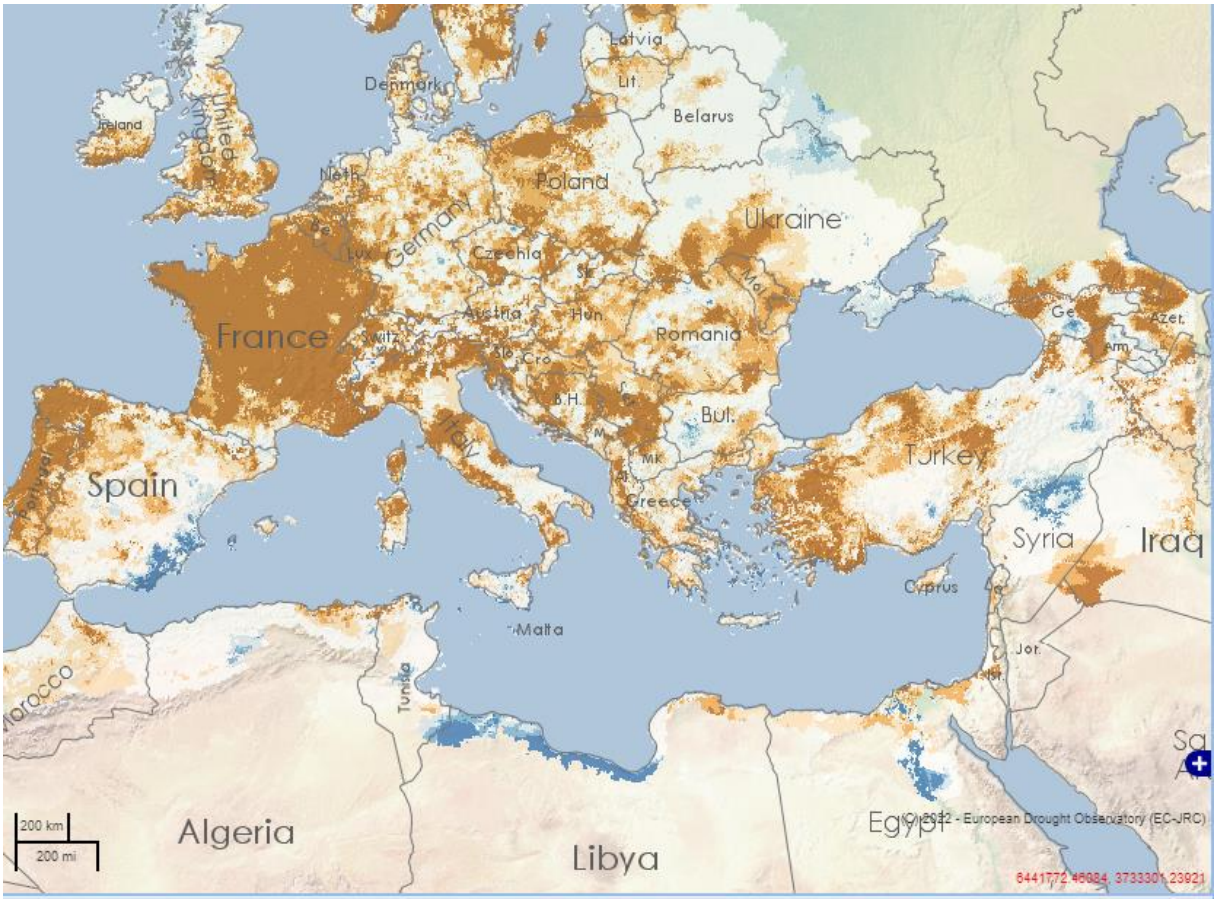

Fig. 5.2: Soil Moisture Index (SMI) anomaly for the second ten-day period of May 2022, 1995-2021 reference. Source: https://edo.jrc.ec.europa.eu/edov2/php/index.php?id=1111

North Africa

In April 2022, soil moisture (fig.5.3, left map) was strongly below normal over the most parts of the region, especially over the north of Morocco, the southeast of Algeria and the extreme north of Tunisia. Over the northeast of Libya and the north of Egypt soil moisture was above normal.

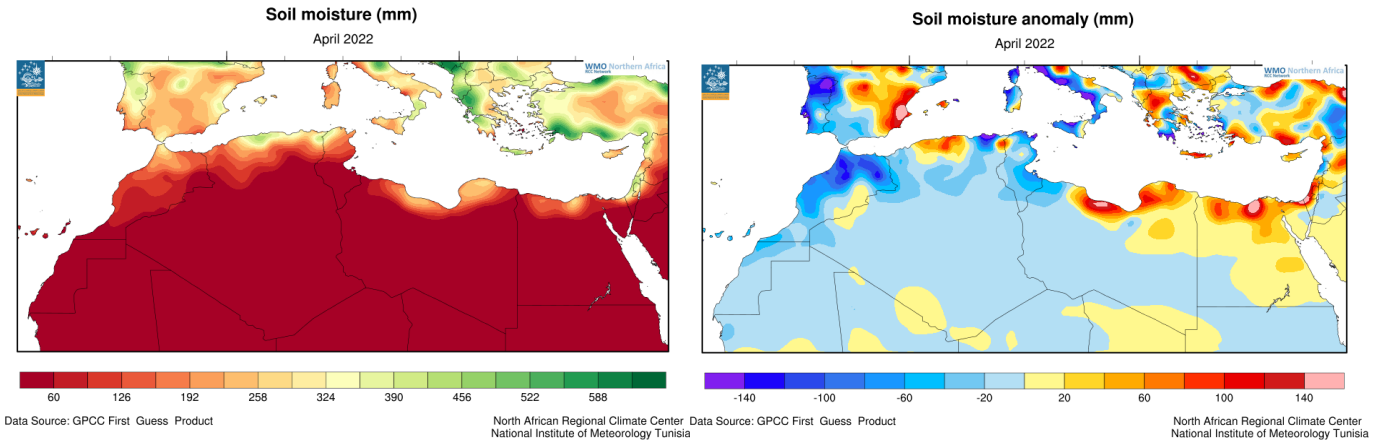

Fig. 5.3: April 2022 soil moisture, Left: monthly total, Right: monthly anomalies with reference period 1981-2010. Source: INM

6. Significant Events in April 2022 in the MedCOF region

2-4 April 2022: Unseasonably **cold weather** with frost hit parts of Europe on the weekend of 2-3 April 2022, following warmer-than-normal temperatures in previous weeks that caused rapid greening of flora. Damage to agriculture was widespread but apparently not as bad as it was the year before when a similar cold episode happened. The worst affected countries were **France** and **Spain**. Especially orchards and vineyards had been impacted. Growers across the affected regions burned candles, sprayed water and used wind turbines in efforts to protect their crops from freezing temperatures.

The nationally averaged minimum temperature in France (based on a selection of representative stations) dropped to -1.5 °C on early Monday, 4 April 2022, marking the country's coldest April morning since 1947, according to data provided by Meteo France. While Mourmelon in the Marne department east of Paris saw a daily minimum temperature of -9.3 °C, French mountainous regions recorded -21.5 °C, setting new April records. For France, 1-3 April were the coldest first three days of April since at least 1930. Very cold was it also on the islands of Corsica and Sardinia (Italy) where records were broken at Capes Caccia, Bellavista and Carbonara on 3 April.

Spain, too, noted new local April cold records at Segovia with -5.6 °C and Noáin Airport (-3.7°C, data since 1975). Some new records of lowest daily April maxima were also reported from Spain.

6 April 2022: Several **heat waves** occurred over large areas in northern Africa and the Arabian Peninsula that month, and this affected also the Middle East countries **Israel** and **Jordan**. Daily maxima of 42.0 °C were recorded in both countries on 6 April 2022, record heat for that time of year.

8 April 2022: A **storm** moved from the North Atlantic over **France** and southern Central Europe. It was named "DIEGO" by Instituto Português do Mar e da Atmosfera (IPMA), while the corresponding name in Central Europe was "ORTRUD". Wind gusts above 100 km/h were recorded even in lowlands. Storms with such intensities are not rare in Western and Central Europe, but quite unusual for the month of April, when normally the circulation is getting weaker after the winter half year.

17 April 2022: On Easter Sunday (17 April 2022), it was Western Europe and especially **Spain**, which saw a significant **warming** with 33.1 °C at Malaga Airport, exceeding its previous April record.

20 April 2022: The mountain observatory of Navacerrada in **Spain** (northwest of Madrid), at 1900 m altitude, recorded a **fresh snow cover** of 36 cm on 20 April 2022 after a significant cooling following heat only three days earlier. This accumulation of new snow in a single day is a remarkable amount for the month of April. Snowflakes fell in areas of Avila, Burgos and Soria even below 1000 m a.s.l.
Serbia, too, was under unusual wintry conditions with **frost and snow** on the mountains. Fresh snow on mountains in Serbia led to significant snow depths: Kopaonik 35 cm, Karajukica Bunari 22 cm, Kukavica 20 cm.

23-26 April 2022: Another **heat wave** came up late in the month from 23 April 2022, affecting particularly **Turkey** and **Cyprus** with daily maxima up to above 35 °C. Adana in Turkey measured 37.8 °C that day, Lefkoniko in Cyprus 34.8 °C on 24 April.

The heat wave extended even further north up to the Caucasus region. Temperatures around or above 30 °C in these days were measured in several places in **Georgia, Azerbaijan, Armenia**.

25 April 2022: Several **dust storms** (Saharan dust) had been observed in the Mediterranean region in late April. In particular, severe dust storms were affecting parts of the Middle East. On Monday, 25 April 2022, authorities in **Jordan** ordered schools in the south of the kingdom to close due to the heavy spread of dust. Especially schools in the governorates of Karak, Tafila, Aqaba and Maan were closed.

(taken from the event calendar of RA VI RCC, https://www.dwd.de/DE/leistungen/rcccm/int/rcccm_int_sse.html?nn=490674)

References:

Météo France Monthly Seasonal Forecast Bulletin and climate monitoring maps: http://seasonal.meteo.fr (password protected)

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

EDO (EU European Drought Observatory): https://edo.jrc.ec.europa.eu

SEECOF: http://www.seevccc.rs/?p=22