MEDITERRANEAN CLIMATE OUTLOOK FORUM
MEDCOF-19 Online Forum

ANALYSIS AND VERIFICATION
OF THE MEDCOF-18 CLIMATE OUTLOOK
FOR THE 2022 SUMMER SEASON
FOR THE MEDITERRANEAN REGION (MED)

First draft

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The following MedCOF verification report is based on

- the outcome of the consensus forecast of MedCOF 18,
- climate monitoring results of RA I NA RCC and RA VI RCC networks,
- the verification bulletin of Météo France,
- the analysis and verification report of SEECOF-28 for 2022 summer season for southeast Europe (SEE)
- national verification reports received from NMHSs or posted in RCOF forums of MedCOF, SEECOF or PRESANORD.

1 MedCOF-18 Climate outlook for the 2022 summer season

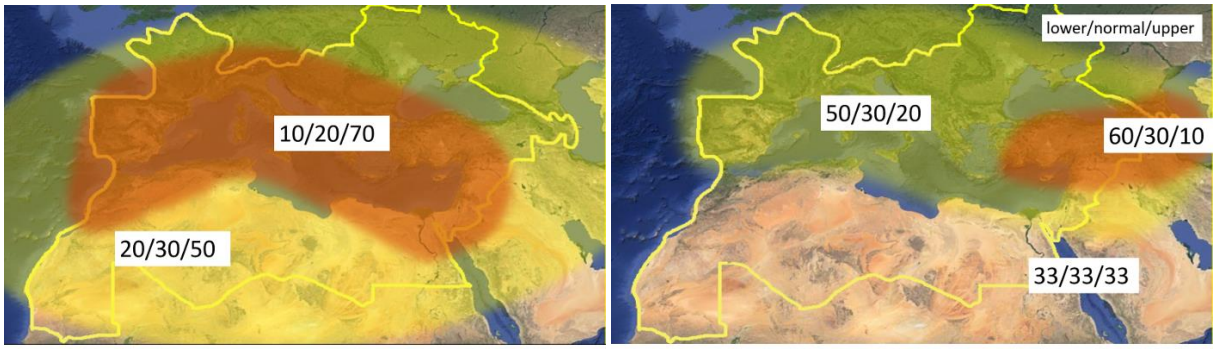


Figure 1: Graphical presentation of the climate outlook for the 2022 summer season for the Mediterranean region (a) Temperature Outlook, (b) Precipitation Outlook

Sea surface temperature, general circulation and soil moisture

As stated in the MedCOF18 consensus statement, sea surface temperatures forecasts for summer 2022 showed moderate La Niña conditions and a negative Indian Ocean Dipole, while positive anomalies were taking place in the equatorial Atlantic. Most models showed a typical atmospheric response to La Niña conditions, with good agreement for a negative PNA pattern. Over the Atlantic, a majority of models favoured NAO+ and EA+ scenarios, so zonal circulation was expected to predominate. Soil was dry over north-western parts of the domain, which was associated with an enhancement of heat waves.

Temperature

Within this general context, temperature should be warmer than normal for most of the domain. Even warmer probability was expected over an area closer to the Mediterranean Sea. The outlook favoured the warm scenario with 70% probability over and around the Mediterranean Sea, and 50% probability for the remaining areas in the northern parts of the domain and over North Africa (Fig. 1a).

Precipitation

Precipitation forecast showed a robust dry signal for the Mediterranean Sea, Southern Europe and Middle East. Probabilities for the dry tercile seemed to be higher over the eastern part of that area. The rest of the domain did not show any privileged scenario for precipitation. The outlook therefore preferred the dry scenario with 60% probability over Türkiye and the northern Middle East, and 50% for the rest of the RA VI part of the domain (Fig. 1b). The climatological forecast (33, 33, 33) over the southern part of the domain (North Africa) also implies the fact that no meaningful forecast can be provided for these seasonally dry areas.

2 Analysis of the 2022 summer season

Analysis of the summer season temperature and precipitation anomalies and general circulation are based on maps and monthly or seasonal bulletins on the climate in the WMO Region RA I – NA and RA VI for the summer 2022 (WMO RA I RCC Node on Climate Monitoring: https://www.meteo.tn/en/climate-monitoring-watch; WMO RA VI RCC Offenbach Node on Climate Monitoring: http://www.dwd.de/rcc-cm), contributions from Météo France (http://seasonal.meteo.fr/), Regional Climate Outlook Forums for Southeastern Europe (SEECOF-28, http://www.seevccc.rs) and North Africa (PRESANORD, http://acmad.net/rcc/presanord.php), and national verification reports from MedCOF participants.

2.1 General circulation

2.1.1 Ocean

Sea surface temperatures (SST) in the central and eastern tropical Pacific and near the west coasts of South America were below the 1991-2020 normal in boreal summer 2022 (Fig. 2). This implies that La Niña conditions were still in place as expected. In contrary, SST in the tropical Atlantic was mostly above normal, in line with the MedCOF outlook, with wave-like patterns propagating over the North and South Atlantic. SST around the European continent was mainly above normal. Particularly warm was the western Mediterranean basin with anomalies up to above +2 °C, while the eastern Mediterranean was only slightly warmer than normal (+ 0.2-0.5 °C). The Black Sea was even slightly colder than normal. Over the Indian Ocean, a west-east gradient can be seen for both hemispheres, indicating a negative Indian Ocean Dipole as forecasted by the outlook.

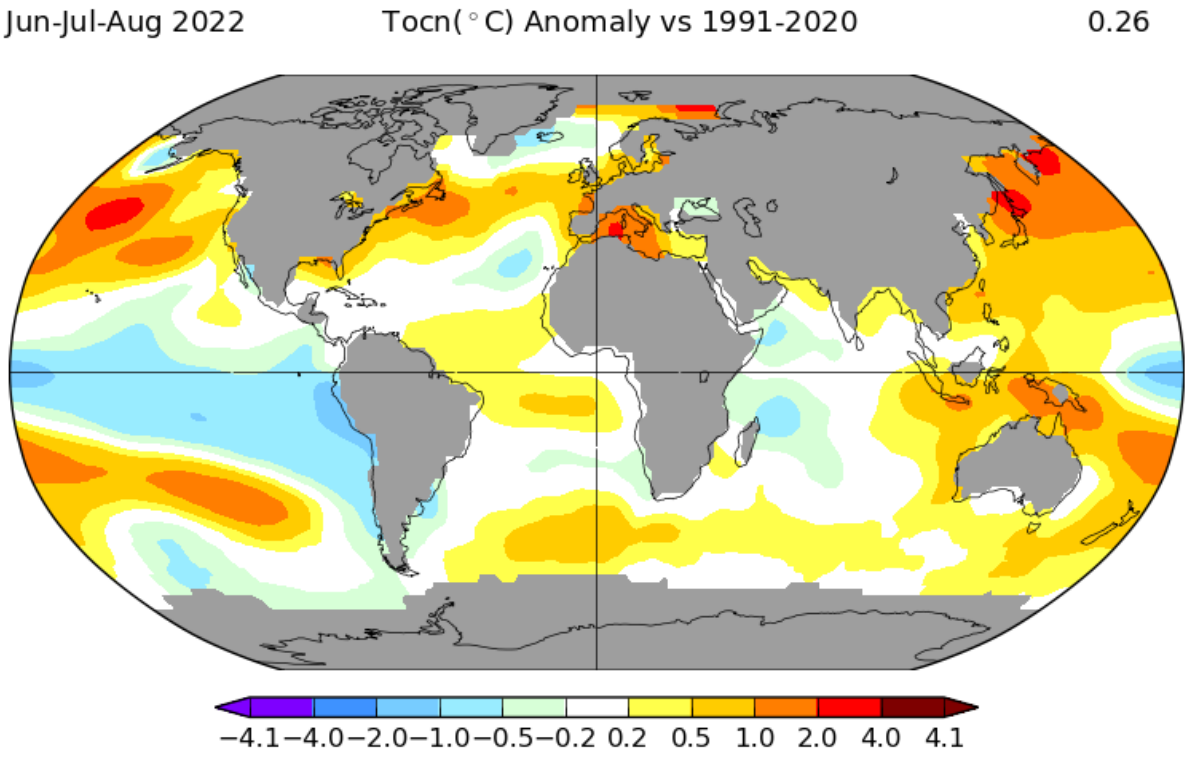


Figure 2: Sea surface temperature anomalies for boreal summer 2022 (June-August), 1991-2020 reference. Data from ERSSTv5 Ocean model analysis with 250km smoothing, source: NASA GISS, https://data.giss.nasa.gov/gistemp/maps/

When looking at the SST and subsurface temperature anomalies in the central and eastern equatorial Pacific (Fig. 3), first a warming can be seen in June 2022, but a cooling afterward until August 2022. This implies first a weakening, but later a regeneration of La Niña conditions.

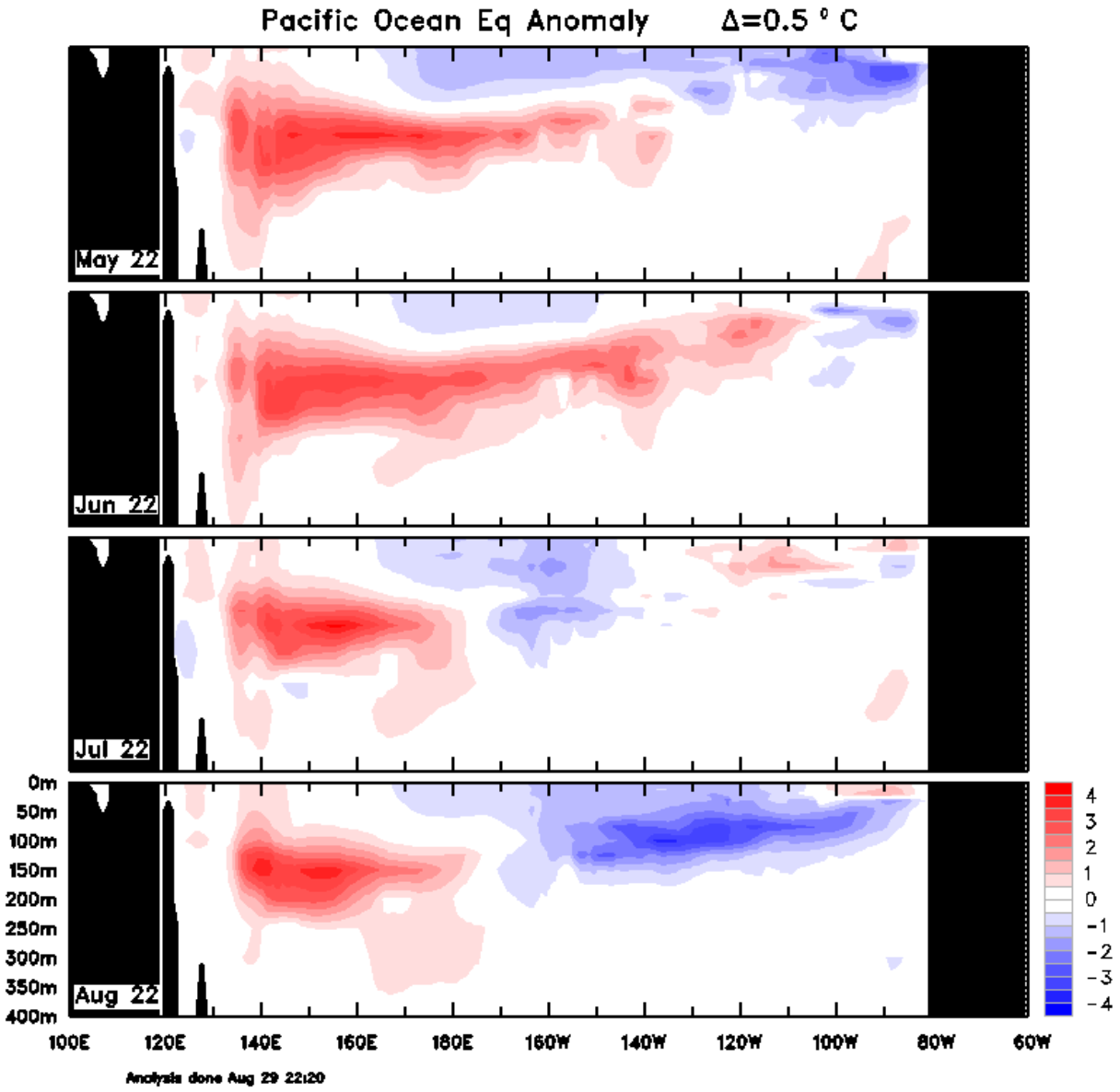


Figure 3: 4-month sequence of vertical temperature anomaly sections at the equatorial Pacific for May-August 2022. Source: Australian Government, Bureau of Meteorology (BOM), http://www.bom.gov.au/cgi-bin/oceanography/wrap_ocean_analysis.pl?id=IDYOC007&year=2022&month=08

Looking at the specific Niño regions (Tab. 1), SST was below normal (1971-2000 reference) during summer 2022 in all regions. In the eastern regions (1+2 and 3), the largest anomalies were in June, in the western regions (3.4 and 4) in August. SST values in region 3.4 fell below the La Niña threshold of −0.5°C in all three months, which means that La Niña weakened temporarily in summer 2022, but did never vanish.

YR	MON	NINO1+2	ANOM	NINO3	ANOM	NINO4	ANOM	NINO3.4	ANOM
2022	6	21.77	-1.41	26.02	-0.62	28.27	-0.57	27.03	-0.68
2022	7	20.67	-1.16	25.51	-0.36	27.90	-0.88	26.68	-0.62
2022	8	20.29	-0.57	24.69	-0.53	27.76	-0.93	25.92	-0.98

Table 1: Sea surface temperature and anomalies (in °C) for various Niño regions in boreal summer months 2022 (June-August), 1971-2000 reference. Data from ERSST.v5 ocean model analysis, source: NOAA, https://www.ncdc.noaa.gov/teleconnections/enso/sst with definitions of Niño regions, see also Fig. 4.

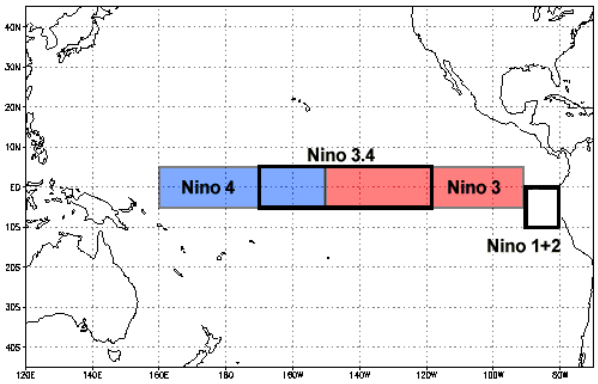


Figure 4: Niño regions. Source: NOAA NCEI, https://www.ncei.noaa.gov/access/monitoring/enso/sst

The Indian Ocean Dipole (IOD) index was negative during all the boreal summer months in 2022, largest in July (Fig. 5).

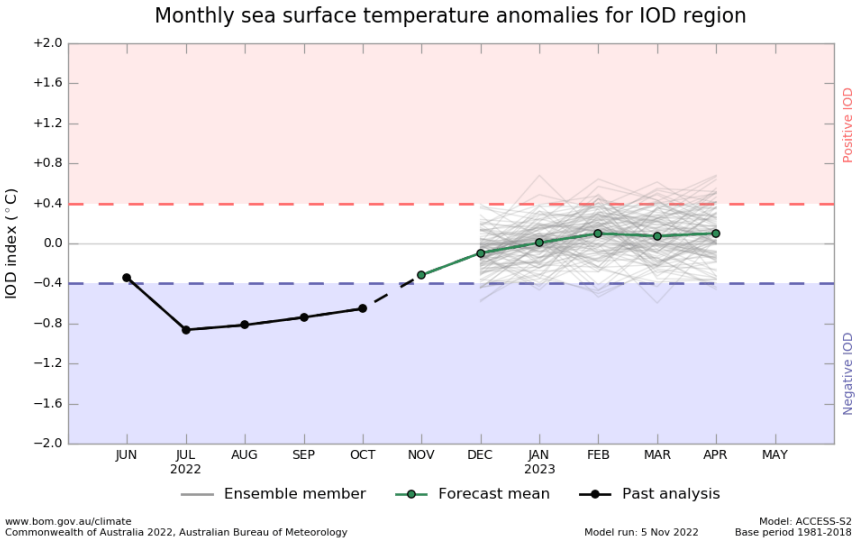


Figure 5: Monthly Indian Ocean Dipole (IOD) index. Source: Australian Government, Bureau of Meteorology (BOM), http://www.bom.gov.au/climate/enso/#tabs=Indian-Ocean

2.1.1. Atmosphere

Seasonal anomalies of 500-hPa geopotential in summer 2022 (Fig. 6) show positive anomalies over western parts of North America and negative anomalies over eastern parts. This points to a positive PNA pattern, which is not a typical response for La Niña (normally associated with a negative PNA). Over the North Atlantic, however, a strong zonal pattern can be identified, implying a NAO+/EA+ pattern as expressed in the MedCOF outlook. The positive anomalies extended also over much of the European continent, which is quite usual for NAO+/EA+ in summer.

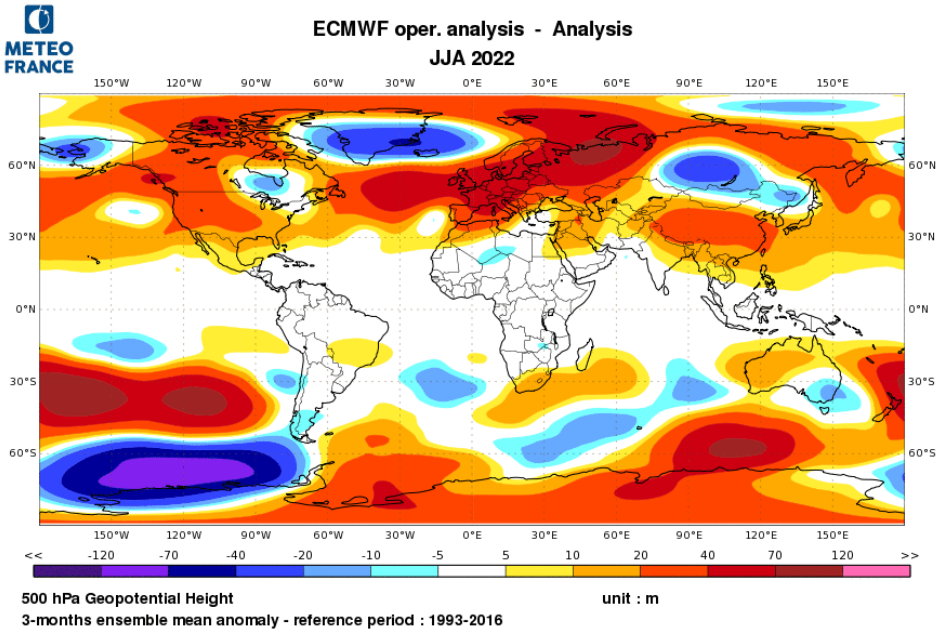


Figure 6: Seasonal anomalies of 500-hPa geopotential for summer 2022 (1993-2016 reference). Source: Météo France, data source: ECMWF, http://seasonal.meteo.fr/content/suivi-clim-cartes-ref93-16?language=en

Sea level pressure (SLP) anomalies (Fig. 7) show an Azores High more intense and more expanded to the north than usual. The Icelandic High, too, was more intense than normal. The resulting zonal airflow over the North Atlantic affected mainly northern parts of Scandinavia due to a large high-pressure zone expanding to the northern middle latitudes over Europe. Over the Mediterranean region, however, SLP was close to normal.

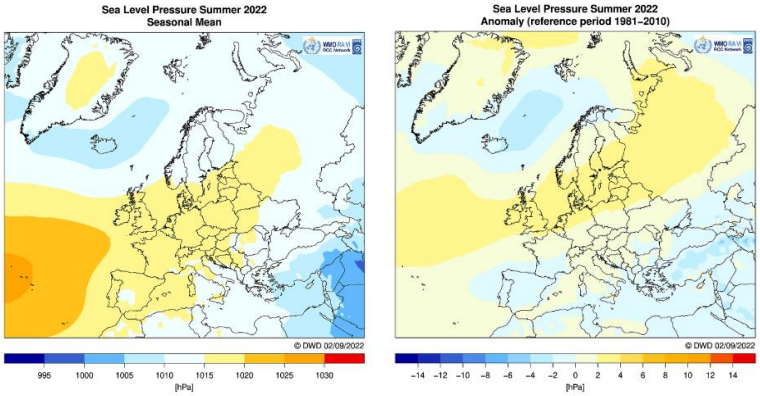


Figure 7: Seasonal mean sea level pressure and anomalies for summer 2021 (1981-2010 reference). Source: Deutscher Wetterdienst (DWD), data source: DWD numerical ICON model analysis.
https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_int_ppp.html

When looking at individual months (Fig. 8), it can be seen that an anticyclonic pattern over Europe dominated through all three summer months in 2022, but the position of anticyclonic influence varied from month to month. Western Mediterranean areas saw anticyclonic influence rather in June and July, eastern Mediterranean areas rather in August.

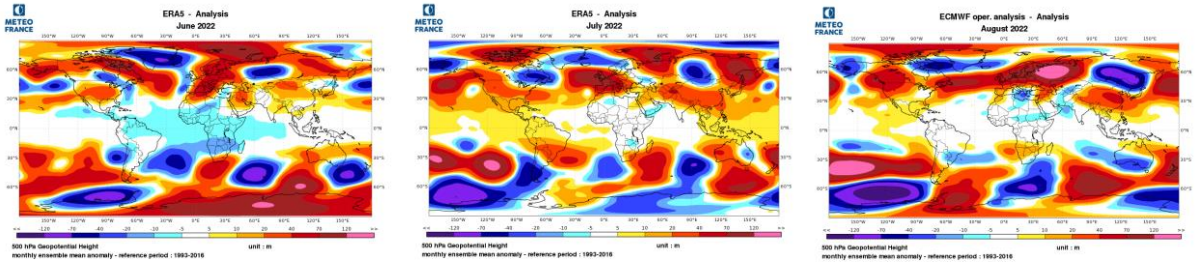


Figure 8: Same as Figure 6, but for the months June, July, and August 2022.

SLP, too, showed some variability from month to month (Fig. 9). A high-pressure bridge between the Azores High and the Russian High developed during summer 2022 until August. This prevented any cold air intrusions into Europe.

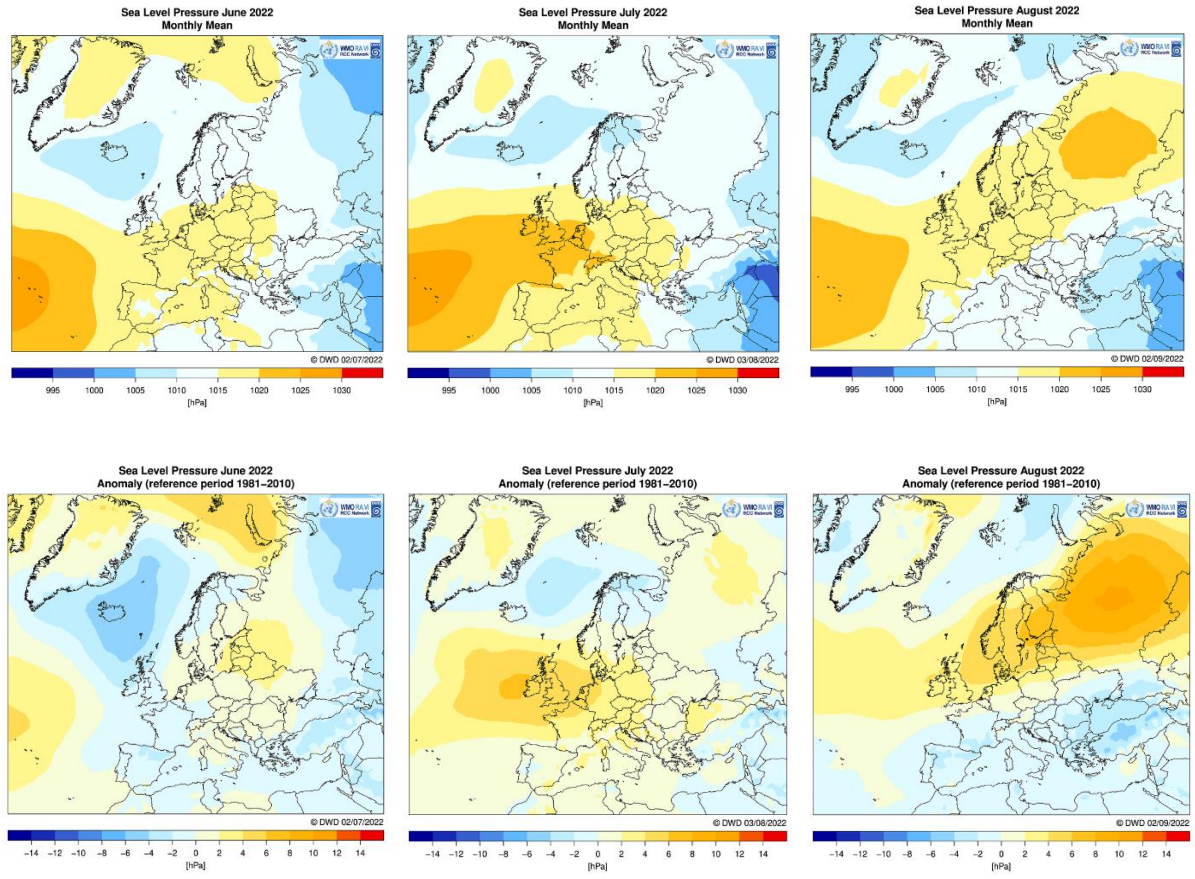


Figure 9: Same as Figure 7, but for the months June-August 2022.

The Météo France weather type classification, too, reveals some development in circulation during summer 2022, from the zonal type "Atlantic Ridge" in June to a summer blocking in August (Fig. 10).

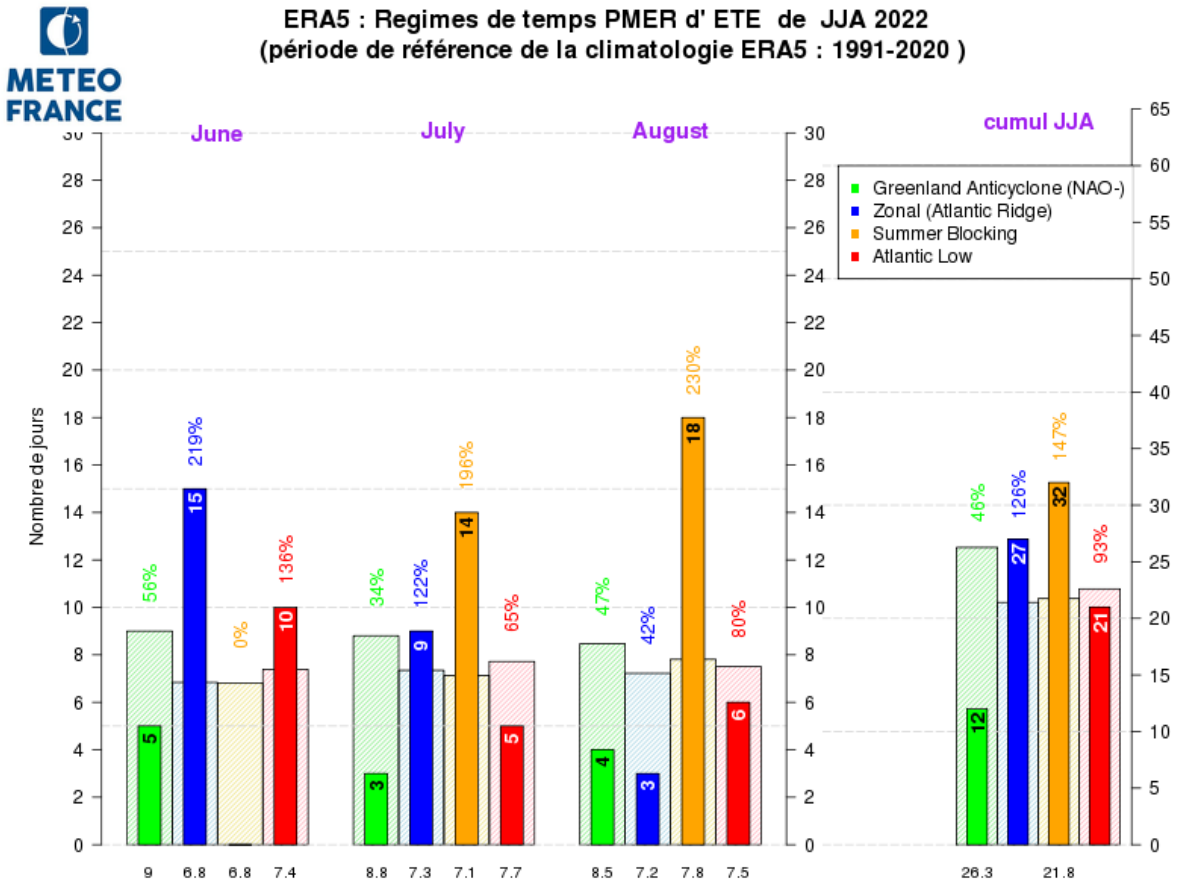


Figure 10: Number of days with circulation types of the Météo France classification for each month of the summer 2022 season and for the whole season (right), and in percent of the climatological frequency distribution 1991-2020. Source: Météo France, http://seasonal.meteo.fr/content/suivi-clim-regimes-trim?language=en

The NOAA CPC classification shows an EA+ pattern for all three summer months of 2022, but NAO+ only for August. PNA+ was most intense in July. Another outstanding feature was the development of a negative East Atlantic/West Russia (EA/WR-) pattern due to a strong Russian High in August.

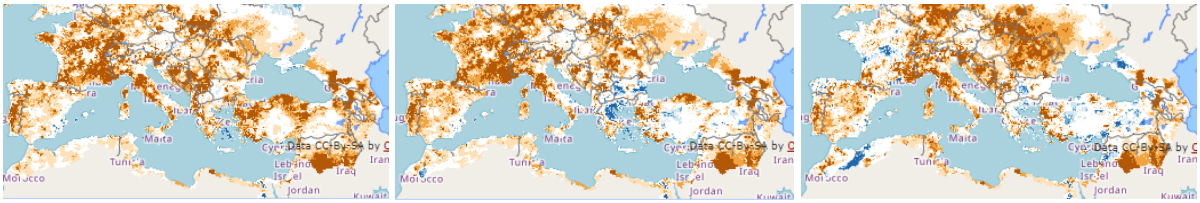
yyyy	mm	NAO	EA	WP	EP/NP	PNA	EA/WR	SCA	TNH	POL	PT	Ex.V
2022	6	0.19	0.51	-1.66	-0.04	-0.22	-0.51	0.04	-99.90	-1.28	-99.90	39.4
2022	7	-0.06	1.42	-0.52	-1.64	1.96	-1.17	-0.54	-99.90	0.03	-99.90	69.9
2022	8	1.76	1.37	-0.41	-1.11	0.76	-3.43	0.99	-99.90	-0.35	1.17	58.4

Table 2: Circulation indices of NOAA CPC patterns for the summer months 2022. ExV = explained variance in %. https://ftp.cpc.ncep.noaa.gov/wd52dg/data/indices/tele_index.nh

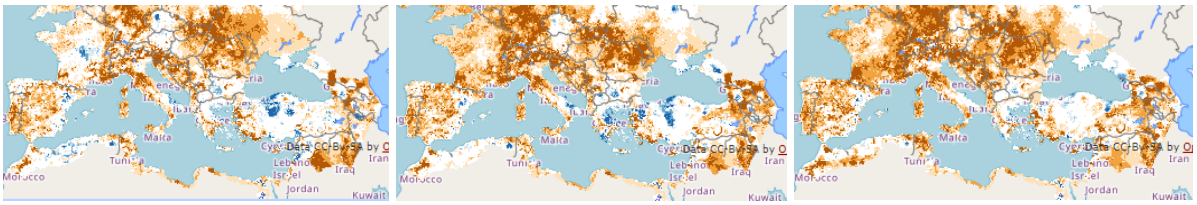
2.2 Soil moisture

Soil moisture was above normal during summer in most of the domain, particularly in northern parts (Fig. 11). Dry soils can enhance warming due to missing evaporation.

June 2022 first decade *second decade* *third decade*



July 2022 first decade *second decade* *third decade*



August 2021 first decade *second decade* *third decade*

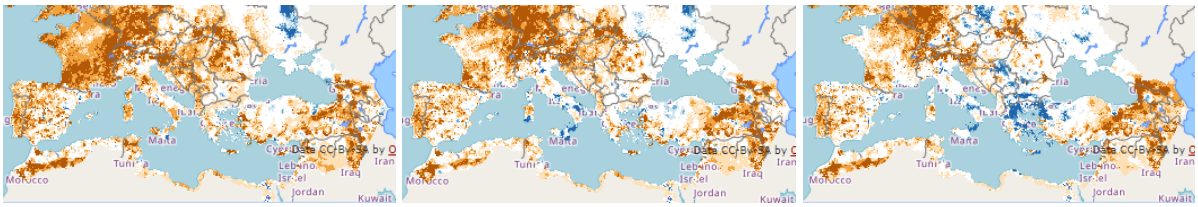


Figure 11: Soil moisture anomalies for 10-day periods in summer 2022 (brown: below normal, blue: above normal, 1995-2021 reference). Source: European Drought Observatory (EDO), https://edo.jrc.ec.europa.eu/edov2/php/index.php?id=1138

2.3 Temperature

Europe and Middle East (RA VI)

Temperature was higher than the 1991-2020 normal in almost the entire domain (Fig. 12). They were particularly high in western parts with anomalies between +1 °C and up to +3 °C in places in southern France and northwestern Italy. Anomalies in eastern parts of the domain were between 0 °C and +2 °C; places in northwestern Türkiye were even slightly colder than normal.

Seasonal mean temperatures in the lowlands ranged from around 19°C in northwestern France to around 30 °C in southeastern Türkiye, eastern Syria, and eastern Jordan, in higher elevations mostly between 10 and 15 °C.

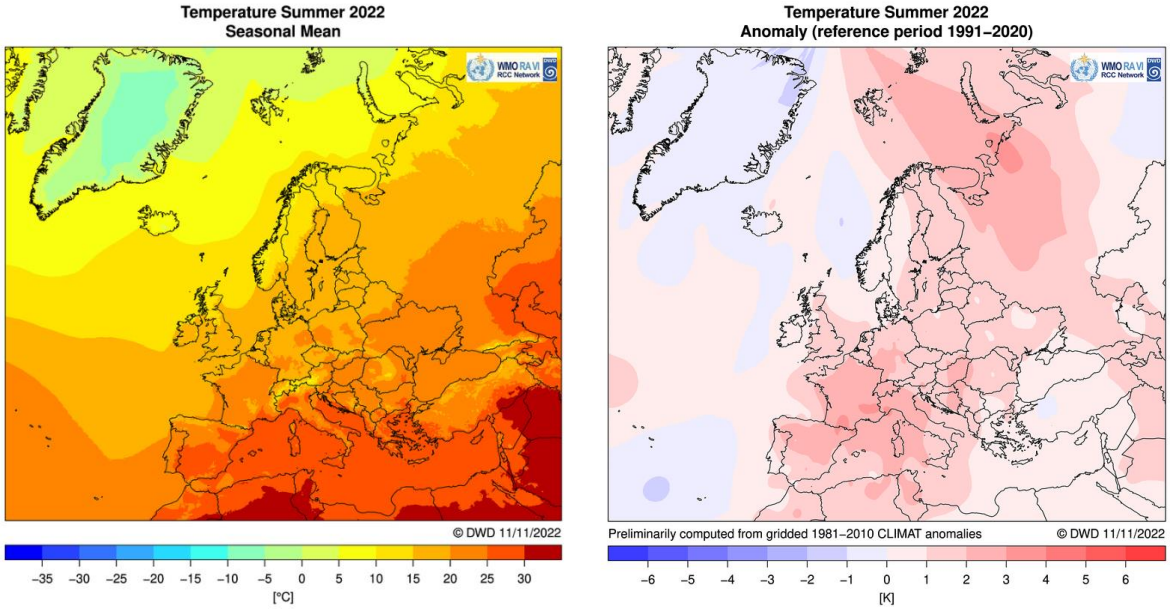


Figure 12: Surface air temperature for summer 2022. Left: seasonal mean, right: anomalies, 1991-2020 reference, source of both maps: WMO RAVI RCC, based on interpolated CLIMAT data, www.dwd.de/rcc-cm

In terms of terciles, temperatures were in the upper tercile in almost the entire domain (Fig. 13-15). Only in an area in western and central Türkiye, temperatures were in the lower or middle tercile, and also Cyprus had temperatures in the middle tercile.

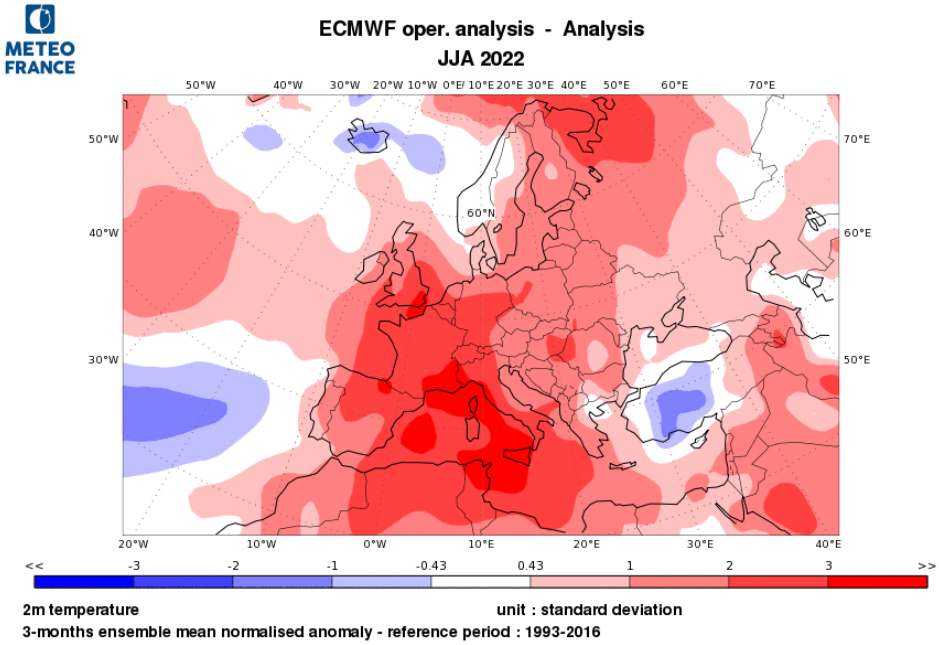


Figure 13: Seasonal normalized temperature anomalies of summer 2022 surface air temperature based on ECMWF operational analysis data, 1993-2016 reference. The data range between -0.43 and +0.43 represents the middle tercile, below -0.43 the lower tercile and above +0.43 the upper tercile. Source: Météo France

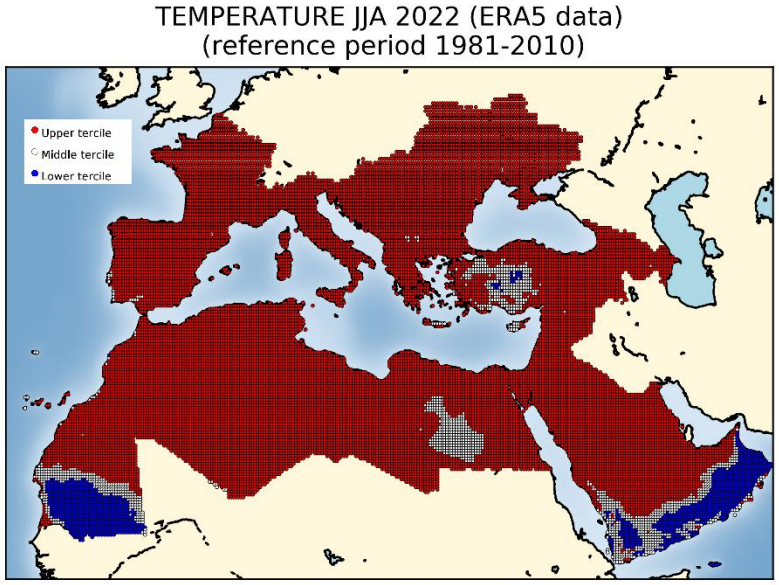
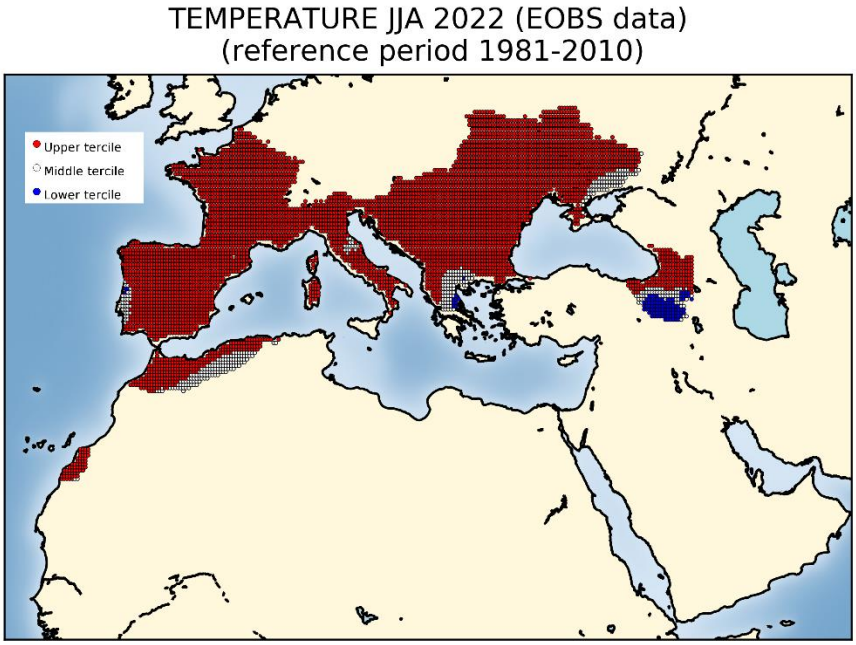


Figure 14: Terciles of summer 2022 surface air temperature based on ERA5 Reanalysis, 1981-2010 reference. Source: AEMET, data source https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5

E-OBS data shows some more areas in the lower and middle tercile, but this is not supported by other data sources, so it might be due to interpolation effects due to missing data.



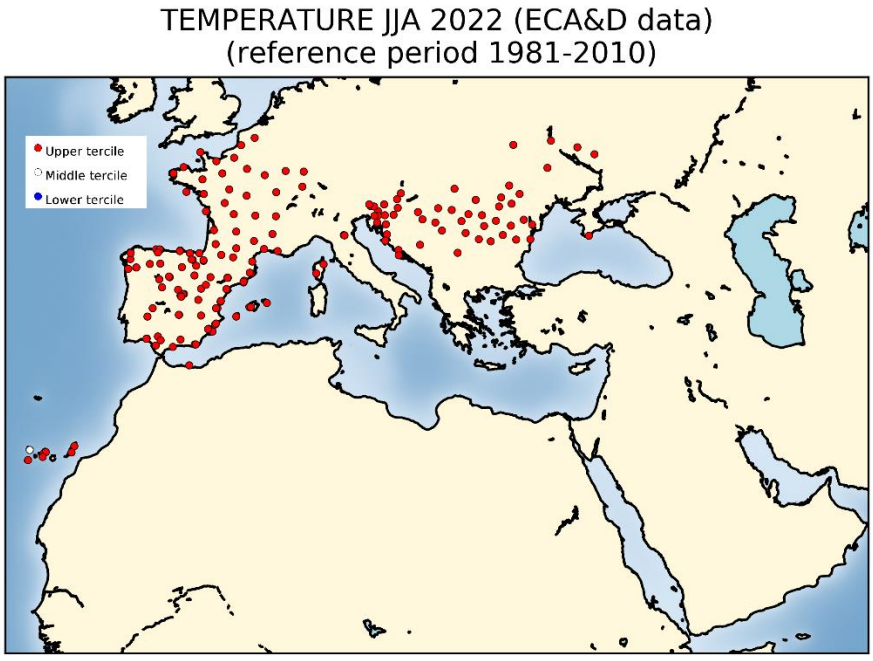


Figure 15: Terciles of summer 2022 surface air temperature based on interpolated E-OBS grid data (upper graph) and individual ECA&D station data (lower graph), 1981-2010 reference. Note: E-OBS uses a higher number of stations than those which are freely available at ECA&D. Source: AEMET, data source: http://www.ecad.eu/

North Africa (RA I)

Summer 2022 was hotter than normal in the most parts of North African countries: Morocco, Algeria, Tunisia, Libya and Egypt. Mean temperatures ranged between 16 °C and 46 °C, even 48 °C in some regions of Algeria. The seasonal mean temperature was at its minimum over the center of Morocco and the coastal areas of North Africa (Figure 17).

The anomalies (with respect to 1981-2010 normal) reached between -1 °C locally in a small region between the southeast of Algeria and southwest of Libya and +2 °C in most parts of the region, even +3 °C in the North of Algeria and most parts of Tunisia (Figure 18).

In Egypt, summer 2022 was warmer than normal in the most parts of the country. Mean temperatures were between 23.3 °C in the north (EL-ARISH) and 32.1 °C in the south of Egypt (ASSWAN). The anomalies (with respect to 1981-2010 normal) reached between 0.2 °C in DAKHLA and 1.1 °C in EL-HURGHADA.

In Tunisia, temperatures mostly remained above normal throughout the season. A very large part of the Tunisian country was affected by the high heat, and most regions experienced exceptionally high temperatures with several records. The average temperature ranged from 26.3 °C in Tabarka to 34.4 °C in Tozeur. The seasonal mean temperature was above the reference normal (1991-2020) with a significant anomaly ranging from +1 °C in Tabarka to +2.9°C in Le kef (station in the Northwest), ranking this summer 2022 the second hottest summer after summer 2021 (30 °C). Maximum temperatures during this summer were high in all regions and ranged from 31.1 °C in Mahdia to 40.9 °C in Tozeur; they were above the seasonal normal with anomalies ranging from +0,4 °C in Elborma to +3.3 °C in Nabeul.

Summer 2022 in Algeria was marked by very hot temperatures. The mean temperature ranged between 22 °C over the coastal regions and 44 °C, even 46 °C over the southwest and the center of the country. The anomalies (with respect to 1981-2010 normal) reached between -1 °C in the extreme southwest and +3 °C in the northern regions.

Overall in Morocco, the temperature was above normal throughout the 2022 summer season. The anomalies were above the reference normal (1981-2010), ranging between +1 °C and +2 °C, even +3 °C in the southwest.

Also, in Libya, the summer was much warmer than normal; the mean temperature was above normal over the most part except a small region in the eastern south where the temperature was near to below normal. The anomalies ranged between -1 °C in the southeast and +2 °C.

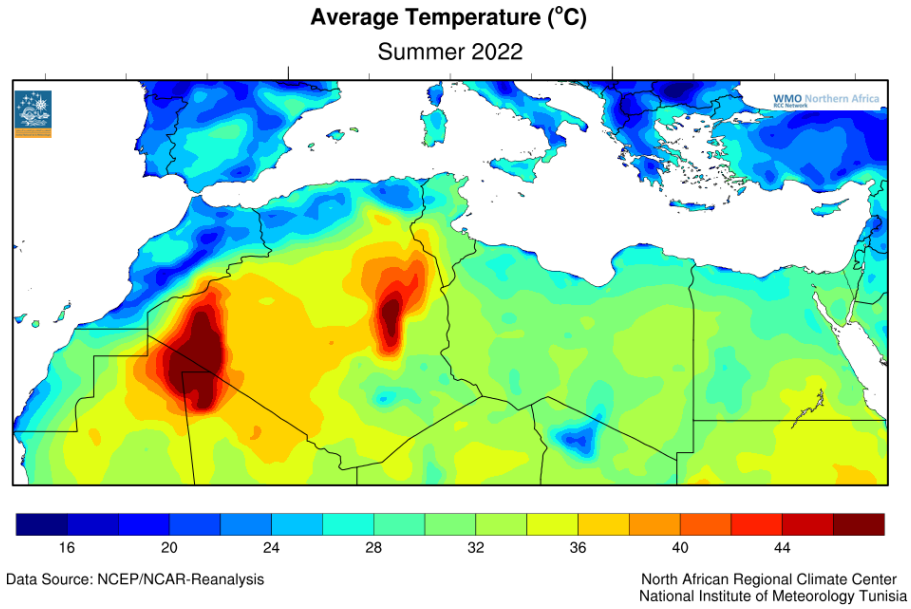


Figure 16: Mean temperature for summer season 2022 in North Africa (in °C). Source: INM, (Data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov)

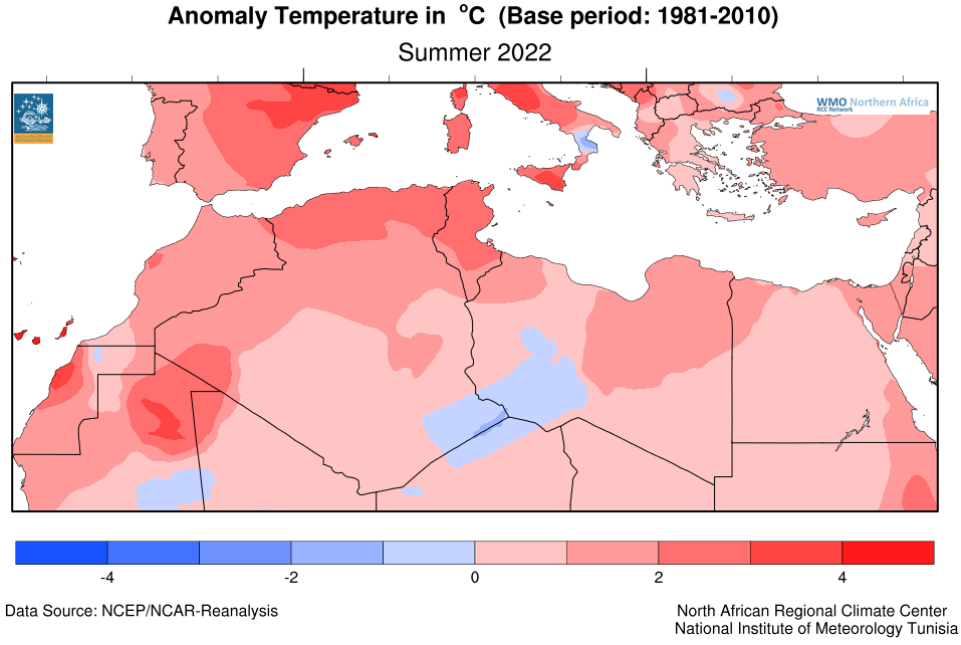


Figure 17: Temperature anomaly for summer season 2022 in North Africa (in °C), reference period 1981-2010. Source: INM, Data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov

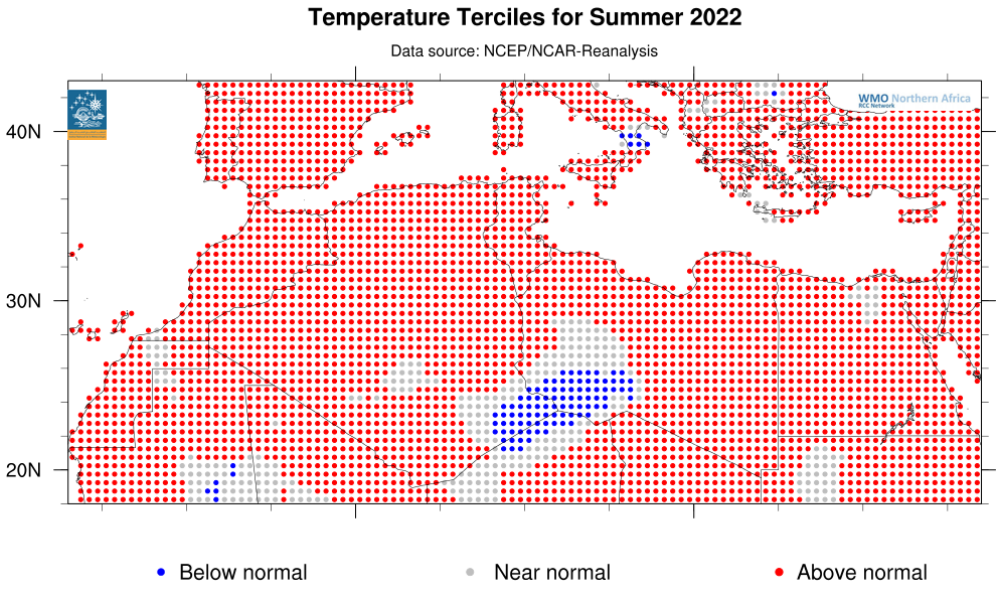


Figure 18: Tercile distribution for temperature of JJA 2022 in North Africa, reference period 1981-2010. Source: INM, Data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov

The temperature terciles map shows that the temperature was in the upper tercile over almost all of the regions except the southwest of Libya and locally in the southeast of Algeria, and the center of Morocco where the temperature was in the middle and the lower tercile.

2.4 Precipitation

Europe and Middle East (RA VI)

Precipitation was below normal in most of Iberia, France, the western Mediterranean region, northern Italy, the northern Balkan Peninsula and further northeast up to the Ukraine (Fig. 19). Particularly dry in relative terms was Iberia with large parts having received less than 40% of normal precipitation. Above-normal precipitation occurred only locally in that area due to convective events. In contrary, the southern Balkans, Greece, western and central Türkiye had above-normal precipitation in summer 2022 with anomalies mostly between +10 mm and +30 mm per month, while eastern Türkiye and Georgia were drier than normal.

Seasonal totals ranged from zero in Israel and Jordan to above 300 mm in the Alps and in western Georgia.

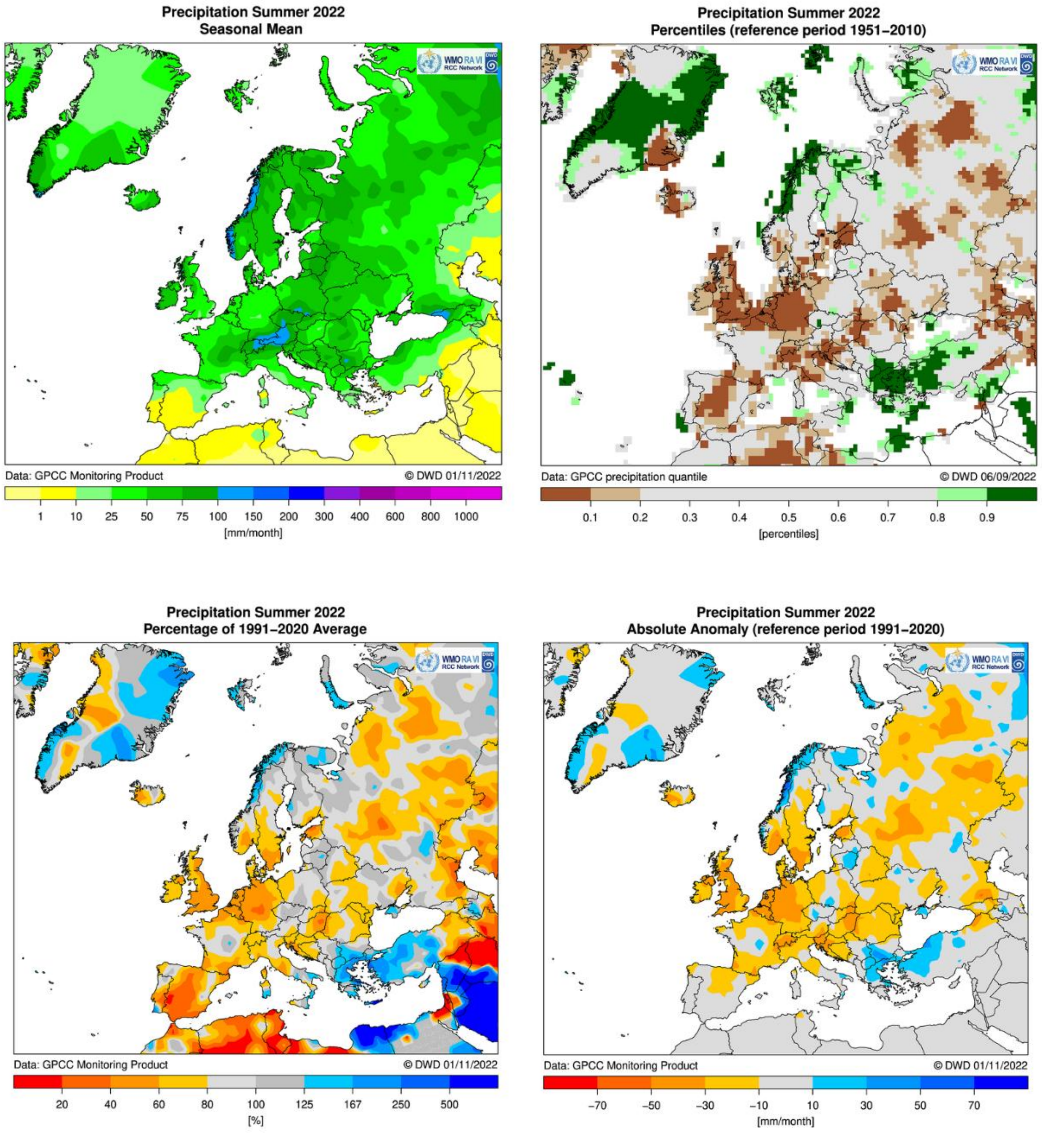


Figure 19: Precipitation for summer 2022 in Europe. Upper maps: seasonal total in mm/month and percentiles, lower maps: percentage of 1991-2020 average and absolute anomalies, source: WMO RAVI RCC, www.dwd.de/rcc-cm , data source: GPCC, http://gpcc.dwd.de

In terms of percentiles, precipitation was in the lower tercile particularly in most of Iberia, parts of France, central Italy, the northern Balkan Peninsula, most of the Ukraine, eastern Türkiye and South Caucasus (Fig. 20-21). The eastern Mediterranean part mainly has received above-normal precipitation in the upper tercile. Some local discrepancies between the datasets can be seen for some places, which might be due to different or poor data coverage.

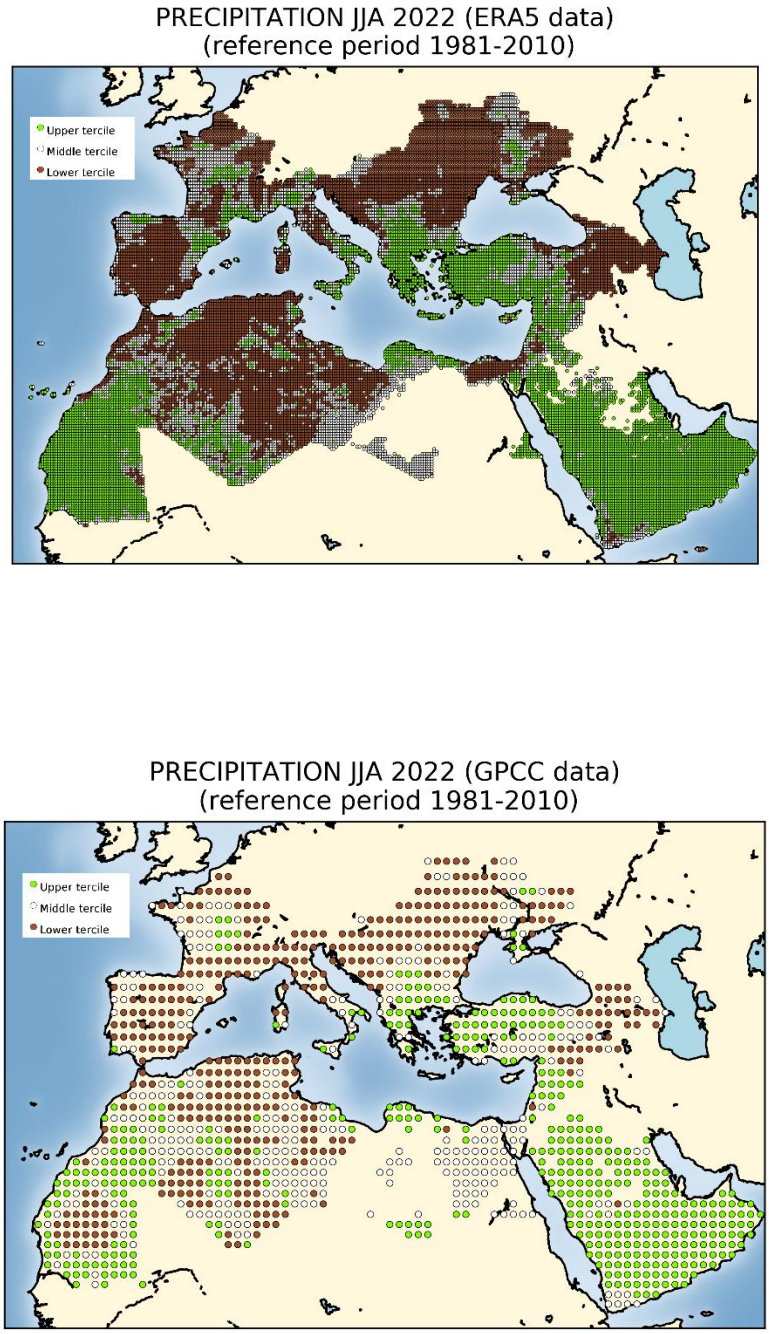
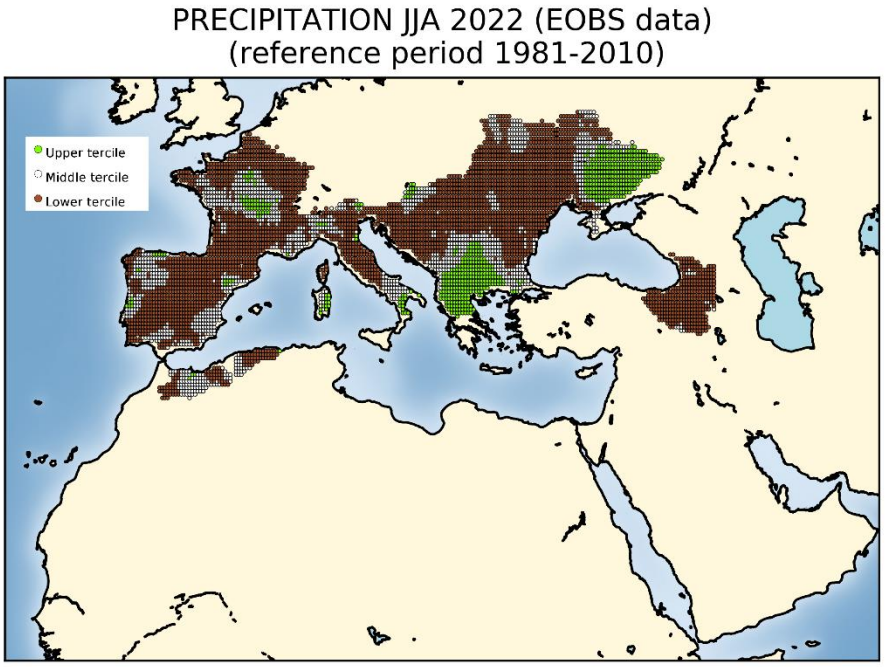


Figure 20: Terciles of summer 2022 precipitation based on ERA5 Reanalysis (upper graph) and GPCC (lower graph) grid data, 1981-2010 reference. Source: AEMET, data reference:

ERA5: https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5 , GPCC: http://gpcc.dwd.de



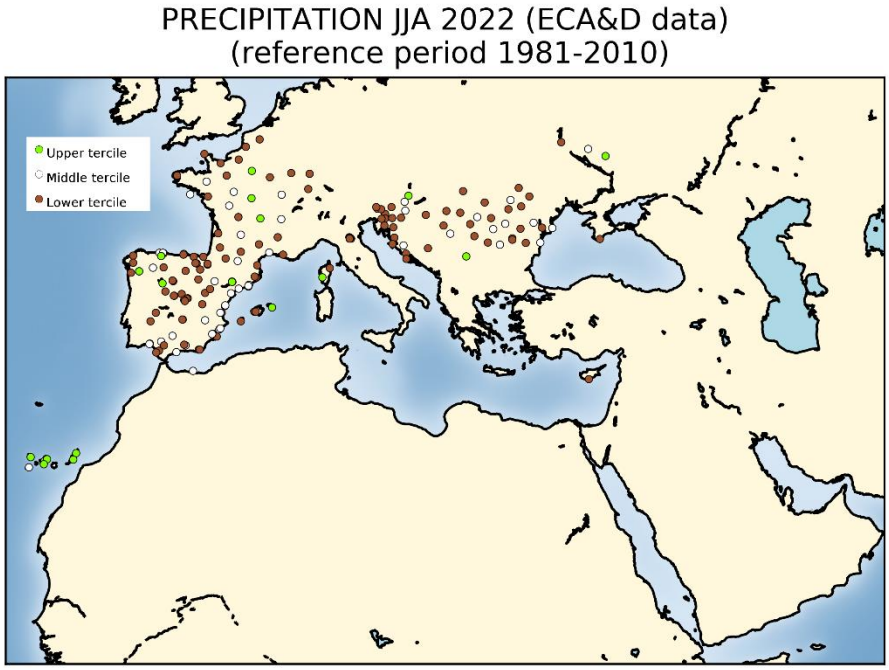


Figure 21: Terciles of summer 2022 precipitation based on interpolated E-OBS grid data (upper graph) and individual ECA&D station data (lower graph), 1981-2010 reference. Source: AEMET, data source: http://www.ecad.eu/

A more detailed analysis for south-eastern Europe, including high impact events, is given in the analysis and verification report of the SEECOF-27 CLIMATE OUTLOOK for the 2022 summer season for southeast Europe (SEE), provided by SEECOF-28:

http://www.seevccc.rs/SEECOF/SEECOF-28/STEP-1/Draft-Version-Final-assessment-of-SEECOF-27-climate-outlook-for-summer-season-2022.pdf

North Africa (RA I)

Overall, summer 2022 has been very dry in terms of rainfall, the accumulated precipitation didn't exceed 20 mm over the most parts of the North African countries, except locally the north and the south of Algeria and the northwest of Tunisia which reached between 60 mm and 80 mm.

In Tunisia, rains were rare or even absent during the summer 2022. The seasonal cumulative of all stations (27 main stations) reached 167.4 millimeters; it was below normal over all of the country with a deficit of 75%.

In Morocco, precipitation during summer 2022 was near to above normal over the southern part and near to below normal over the northern part.

In Algeria, generally the precipitation was below normal except some regions in the extreme south and locally in the western center where the precipitation was near to above normal.

In Libya, the summer 2022 was dry, the precipitation was near normal over the eastern regions and below normal elsewhere.

Overall, Egypt was marked by a dry summer season. During the 2022 summer season, the accumulated precipitation in Egypt was characterized by below normal conditions in the north.

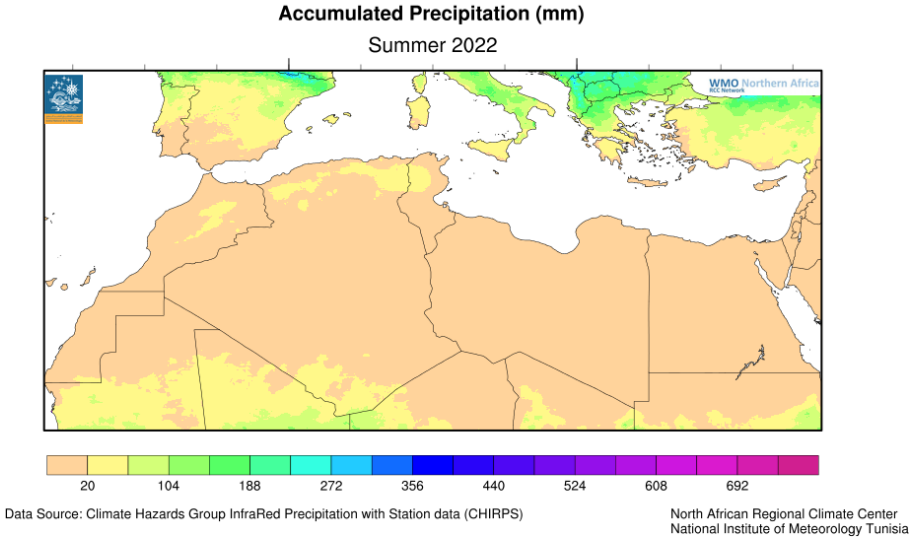


Figure 22: Total precipitation for summer season 2022 in North Africa (in mm). Source: INM, Data from CHIRPS: ftp://ftp.chc.ucsb.edu/

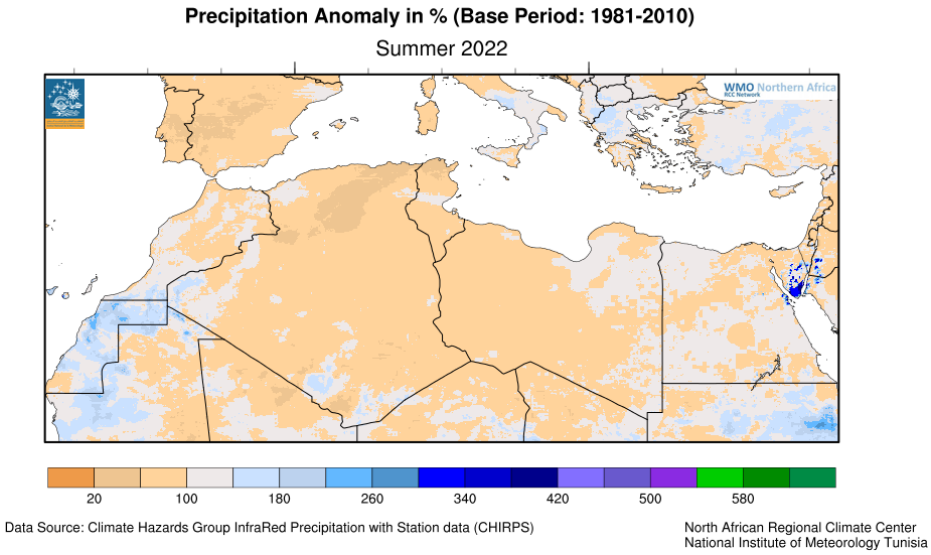


Figure 23: Precipitation anomaly for summer season 2022 in North Africa (in %) (Reference period 1981-2010). Source: INM, data from CHIRPS: ftp://ftp.chc.ucsb.edu/

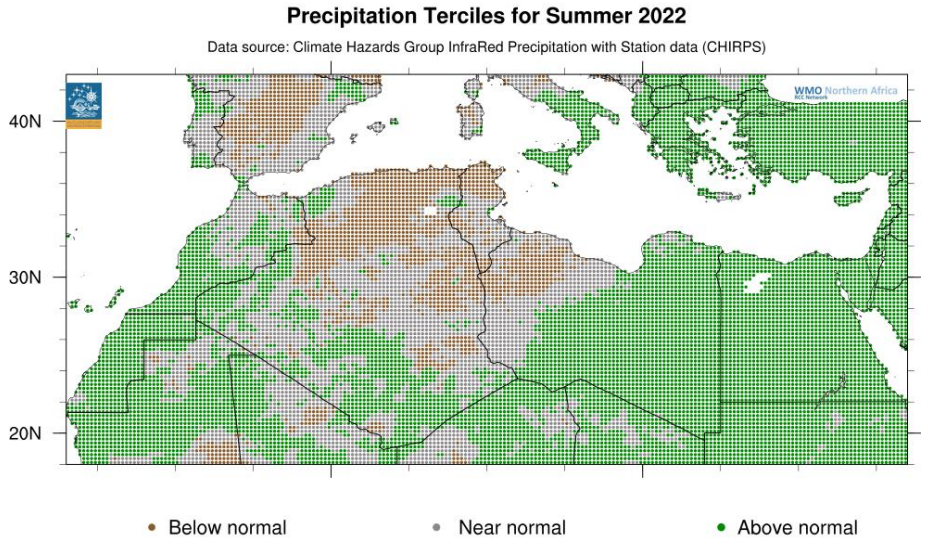


Figure 24: Tercile distribution for precipitation of JJA 2022 (Reference period 1981-2010). Source: INM, data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov

The precipitation terciles map shows that the precipitation was in the upper tercile over almost all of Egypt, the most part of Libya and Morocco and locally over the Algerian south. Elsewhere and in Tunisia, in western Libya, most parts of northern and southwestern Algeria, the precipitation was in the middle and the lower tercile.

3 Verification of the MedCOF-14 climate outlook for the 2020 summer season

3.1. Temperature

Europe/RA VI

The MedCOF-18 outlook favored the upper tercile for the whole domain with 70% probability for most of the area. For northern France and northeastern parts of the domain (Ukraine, Moldova, South Caucasus, northeastern Türkiye, the probability was 50%.

The outlook was correct for almost the entire domain. Only for western Türkiye and Cyprus, temperature was in the lower or middle tercile and therefore overestimated by the outlook.

North Africa (RAI)

The MedCOF-18 climate outlook for the summer 2022 season favored the upper tercile over the entire North African domain. The outlook of temperature was correct over all of the region.

3.2. Precipitation

Europe/RA VI

The MedCOF-18 outlook favored a dry scenario (lower tercile) over the whole domain with 50% probability over most parts, and 60% for the east (Türkiye, South Caucasus, northern Middle East).

The outlook was correct for most of the domain. However, some larger parts, especially in the eastern Mediterranean region had precipitation in the upper or middle tercile, which was not forecasted by the outlook.

North Africa

No scenario for the North Africa region was favored. In fact, the precipitation was near to below normal over most parts of North.

MedCOF-18 outlook could not provide a meaningful precipitation forecast for these seasonally dry region as mentioned in the MedCOF-18 outlook report.

4. Users' perceptions of the MedCOF-14 outlook

Europe/RA VI

For the SEECOF domain, Users' perceptions are reflected in the national verification summaries for SEECOF-27, which are available on the SEECOF website:

http://www.seevccc.rs/SEECOF/SEECOF-28/STEP-1/

From the other countries, the following information was given:

Spain: AEMET provides seasonal forecasts to the general public on the AEMET webpage and on the MedCOF webpage.

North Africa

Morocco: The seasonal forecast outlook is monthly disseminated to 15 departments and ministries.

Tunisia: The permanent national commission responsible for drawing up the national plan to fight against disasters and their prevention and the Ministry of Agriculture.

Appendix A: Contributors to verification of MEDCOF-18

- World Meteorological Organization as initiator and supporter of this activity

Europe and Middle East (RA VI)

- **Climate Centres:**

- WMO RA VI RCC Offenbach Node on Climate Monitoring, Deutscher Wetterdienst, Germany
- South East European Virtual Climate Change Center hosted by Republic Hydrometeorological Service of Serbia, Republic of Serbia

- **National Meteorological and Hydrological Services:**

- Republic Hydrometeorological Service, Republika Srpska, Bosnia and Herzegovina
- Deutscher Wetterdienst, Federal Republic of Germany
- Météo France, Republic of France
- AEMET, Spain

- **Further National Meteorological and Hydrological Services via SEECOF-28:**

- Centre of Operational Hydrometeorology, Armenia
- Federal Hydrometeorological Institute, Federation of Bosnia and Herzegovina
- National Institute of Meteorology and Hydrology, Bulgaria
- Meteorological and Hydrological Service of Croatia, Republic of Croatia
- Meteorological Service of Cyprus
- National Environmental Agency (NEA), Georgia
- Hellenic National Meteorological Service, Greece
- Israeli Meteorological Service
- State Hydrometeorological Service, Republic of Moldova
- Hydrometeorological Institute of Montenegro
- Hydrometeorological Service of Republic of North Macedonia
- Republic Hydrometeorological Service of Serbia, Republic of Serbia
- Slovenian Environment Agency, Slovenia
- Turkish State Meteorological Service, Republic of Türkiye
- Ukrainian Hydrometeorological Center, Ukraine

North Africa (RA I)

- Egyptian Meteorological Authority (EMA)
- National Institute of Meteorology, Tunisia

APPENDIX B: **Analysis and verification of the MedCOF-18 climate outlook for the summer season 2022:**

Europe/RA VI

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	**MedCOF-18 climate outlook for temperature**	**Observed**	**MedCOF-18 climate outlook for precipitation**	
Albania *	Above normal	Above normal (10, 20,70)	North: around normal South: above normal	Below normal (50,30,20)	
Armenia *	Above normal	Above normal (20, 30,50)	Below normal	Below normal (60,30,10)	
Azerbaijan *	Above normal	Above normal (20, 30,50)	Below normal to normal	Below normal (60,30,10)	
Federation of Bosnia and Herzegovina (6)	Above normal in almost entire Bosnia and Herzegovina (very warm and extremely warm	Above normal (10, 20,70)	Below normal in almost entire Bosnia and Herzegovina; Extremely dry - Mostar	Below normal (50,30,20)	Summer - At several stations during the summer, precipitation totals were below 90 mm • Sarajevo - the second hottest summer • June. Temperature records were observed at the following Meteorological stations: Zenica. Floods (smaller rivers) in the cities od Tešanj, Maglaj Srebrenik etc. • July. Temperature record was observed at Meteorological station Zenica. Wildfires in Hercegovina • August. Wildfires in Hercegovina • Extremely warm west and central part

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-18 climate outlook for temperature	Observed	MedCOF-18 climate outlook for precipitation	
Rep. Srpska, Bosnia and Herzegovina (5)	Above normal	Above normal (10, 20,70)	Mostly below normal	Below normal (50,30,20)	long lasting drought and high temperatures caused wild fires in the Southern area of the Republika Srpska. Long lasting drought from January to July, with 3rd lowest 7-month amount of precipitation over the historical period 1950-2022 with very bad influence to agriculture production and hydro plant potential
Bulgaria (6)	Above normal	Above normal (10, 20,70)	Near normal in average	Below normal (50,30,20)	July 2022 was characterized by even drier conditions compared to the July 2021 and 2020. The drought recorded in the mid-summer aggravated the fire weather conditions. Extreme levels of the fire weather index were recorded at the end of July and the beginning of August similarly to summer 2021. Fire fighters experienced a hectic fire season again. Extreme fire risk on 23 August 2022. • June was marked by wet conditions accompanied by thunderstorms and hail resulting with the flood in Ruse at the Danube on 6 June and other hail storms later in the month. Lightning in Bulgaria on 26 June – the day with most thunders in the summer.

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-18 climate outlook for temperature	Observed	MedCOF-18 climate outlook for precipitation	
Croatia (5)	Above normal	Above normal (10, 20,70)	Below normal (the largest part of the territory) Normal (wider area of town Varaždin, part of hinterland of Dalmatia and south Croatia)	Below normal (50,30,20)	Summer 2022 was extremely warm. • During all three months heat waves were observed (one in June, two in July and August). • During all three months absolute maximum temperatures were recorded. During all three months convective related severe weather phenomena (thunderstorms, hail, heavy rains, flash floods, waterspouts) were observed mostly across entire Croatia. • Despite high amount of precipitation sums (locally) in short time, the consequences of the long-term drought were visible in agriculture and at the record low water levels of the Drava river. • In June, northern part of Croatia was hit by severe thunderstorms and hail (hail diameter was around 7 cm at places.) Hail caused flood damage and crops damage as well as traffic disruption. • In June, severe thunderstorms were more common in continental part of Croatia. • In July, convective activity was very frequent all over Croatia. Urban floods as a result of large amounts of precipitation sums in a short time were common. Flood damage and crops along with infrastructural damage were also frequent. Severe thunderstorms were recorded in large parts of Croatia on 26th July. • In August, a few convective episodes hit mostly Dalmatia. Flash floods caused damage on houses and 10 roads

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	**MedCOF-18 climate outlook for temperature**	**Observed**	**MedCOF-18 climate outlook for precipitation**	
Cyprus (5)	Around normal	Above normal (10, 20,70)	June: Above normal July: below normal August: normal	Below normal (60,30,10)	On the 14th of June an EMMA yellow warning was issued, concerning rain and thunderstorms. • During July EMMA warnings with yellow awareness level were issued, concerning extreme high temperatures on for the periods 13-14, 17-21 and 24-31 of July. • During July no precipitation was recorded. • For the period 1-5 of August EMMA yellow warnings were issued, concerned high temperatures. On the 20th, 21st and 25th of August episodes of local showers resulted in accumulated precipitation of 2.7mm (135% of normal)
France *	Above normal	Above normal: North (20, 30,50) South: (10,20,70)	North and south: below normal Centre: normal to above normal	Below normal (50,30,20)	-
Georgia (5)	Above normal	Above normal (20, 30,50)	Below to near normal	Below normal (60,30,10)	The summer 2022 in Georgia was below the normal almost across the entire country. • During the summer season, June was the wettest in Georgia, precipitation was near- and above the normal. • July and August were marked by dry conditions in the country and precipitation sums were below the normal. • Summer was dry almost across entire Georgia

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-18 climate outlook for temperature	Observed	MedCOF-18 climate outlook for precipitation	
Greece (5)	Above normal	Above normal (10, 20,70)	Wetter than normal conditions prevailed in most of Greece	Below normal (50,30,20)	On 8 and 9 July 2022 a barometric low-pressure system brought severe thunderstorms to the north and central parts of Greece. Skyros island declared state of emergency after significant damage was recorded, including the collapse of two bridges in the north of the island and flooding in areas on the west and south. • In the period from 21 to 25 August 2022 a cut-off low that remained above Greece for almost a week, coupled with thermal instability and caused thunderstorms accompanied by a high frequency of lightning, heavy rainfall and hail. Intense weather phenomena affected most of the country, mainly the continental Greece and 11 the Aegean islands. Tatoi station, in the northern suburbs of Athens, recorded a 5-day precipitation total of 94.8 mm while its monthly total precipitation of a 30-year (1981-2010) historical average amounts to 7.4 mm. Flooded roads and homes were reported in Macedonia, Attica and East Sterea. Hailstorm hit thousands of acres with crops; landslides and damages to the road network were reported in Kalavryta, Trikala and Santorini island.
Hungary*	Above normal	Above normal (10, 20,70)	Below normal	Below normal (50,30,20)	
Israel (5)	Above normal	Above normal (10, 20,70)	No precipitation	No signal (33,33,33)	

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-18 climate outlook for temperature	Observed	MedCOF-18 climate outlook for precipitation	
Italy*	Above normal	Above normal (10, 20,70)	North and centre: below normal South: normal to above normal	Below normal (50,30,20)	
Jordan*	Above normal	Above normal (10, 20,70)	No precipitation	No signal (33,33,33)	
Lebanon *	Above normal	Above normal (10, 20,70)	Above normal	No signal (33,33,33)	

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-18 climate outlook for temperature	Observed	MedCOF-18 climate outlook for precipitation	
Moldova (5)	Above normal	Above normal (20, 30,50)	Below normal	Below normal (50,30,20)	The high thermal regime and the lack of precipitation, reported in the period of May-July, caused atmospheric and pedological drought. Due to the dry climate, unfavorable conditions contributed to the formation of fruit in autumn and spring cereal crops, in corn, sunflower, sugar beet, as well as for the growth and development of vegetable crops and other agricultural crops. The Selianinov Hydrothermal Coefficient (CHT), which characterizes the level of wetting of the territory, for May was on average 0.4, for June and July it was on average 0.3, which corresponds to very strong drought. • On some days during the season (July 6, 8 and 27, August 9, 16 and 30), extreme weather phenomena were reported in the form of extreme heavy rains and hail causing damage to agricultural crops and damage to objects of the national economy. Thus, according to the data of the automatic weather stations, installed in the municipality of Chisinau, on August 9, within one hour, 80 mm of precipitation (160% of the monthly norm), on August 9 – within one hour, 52 mm of precipitation (105% from the monthly norm)
Montenegro (5)	Above normal	Above normal (10, 20,70)	Normal in the large part of Montenegro; Dry in the belt from Podgorica – Cetinje – Herceg Novi	Below normal (50,30,20)	On the 23rd June: storm weather in central and northern region – in Podgorica, heavy precipitation and hail affected – the largest fruit plantation and vineyards of AD "Plantaže" enterprise with estimated damage cost to over millions of euros; – crops in the suburbs, – crashed trees.
North Macedonia (5)	Above normal	Above normal (10, 20,70)	Normal to very wet on west mountainous part	Below normal (50,30,20)	• June - Exceeded maximum daily precipitation amount of 90.3mm on 11th in Mavrovo

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-18 climate outlook for temperature	Observed	MedCOF-18 climate outlook for precipitation	
Portugal *	Above normal	Above normal (10, 20,70)	North: around normal Centre: below normal South: above normal	Below normal (50,30,20)	
Romania *	Above normal	Above normal (10, 20,70)	Below normal	Below normal (50,30,20)	
Serbia (5)	Above normal	Above normal (10, 20,70)	Below normal in northern and part of western Serbia Above normal in central, southeastern and part of western Serbia	Below normal (50,30,20)	3rd warmest summer for Serbia since 1951 • Warmest summer for Palic, Novi Sad, Kikinda and Banatski Karlovac • 2nd warmest summer for Zrenjanin, Veliko Gradiste and Pozega • 3rd warmest summer for Belgrade, Sombor, Cuprija and Crni Vrh • 2nd warmest summer for Serbia based on the minimum air temperature • Record-breaking number of summer and tropical days for Kikinda, Banatski Karlovac and Veliko Gradiste, in Zrenjanin and Sombor, tropical days and nights, respectively. • Dry summer in parts of northern and western Serbia, rainy in parts of central and southeastern Serbia, within the average elsewhere • 5th wettest summer for Dimitrovgrad and 7th driest for Sombor 2 days with precipitation of 50 mm and more are recorded in Loznica, 1 day in Novi Sad, Kragujevac, Smederevska Palanka and Zlatibor.

Slovenia (5)	Above normal	Above normal (10, 20,70)	Below normal	Below normal (50,30,20)	Temperature above average, the second warmest summer since at least 1950. • Very hot June, the third warmest since at least 1950, very hot July, the second warmest since at least 1950, hot August, among the seven warmest since at least 1950. • Precipitation below average, the third driest summer since 1961, the driest at some weather stations in central and west Slovenia. • Very dry June, the eighth driest since 1961, very dry July, the fifth driest since 1961, dry August. • Drought/Dry spell from approx. 28 April to 7 September in the entire country, especially in central and western Slovenia. There were significant regional differences as May was wet in some parts of eastern Slovenia. In some regions, especially in the western Slovenia, this drought was actually a part of a drought starting in June 2021. Huge losses in agriculture were reported, probably around 100 million euro. Ongoing damage in spruce forests due to massive bark beetle attack (due to water stress and high temperature). • Thunderstorm/Squall lines on 2 June at several places in eastern part of Slovenia. Severe supercell thunderstorms, raging from Austrian Carinthia through Koroška, Štajerska and Dolenjska regions in Slovenia to northwestern Croatia. One severe thunderstorm also in extreme northwestern Slovenia. Supercell storms brought heavy downpours, severe wind gusts and devastating hail at some places. Damaged cars and infrastructure by hail. Heavy damage by hail, downpours and severe wind gusts in agriculture. Many trees were down and roofs damaged due to wind. Many buildings flooded, some landslides. • Heatwave from 15 June to 25 August. Intense heatwave, especially in the littoral region (Bilje recorded seven consecutive days with daily maximum temperature over 35 °C, station record). Peak of heatwave on 22 and 23 July. Some stations recorded highest July temperature ever: Dobliče 39.4 °C, Tolmin 38.9 °C and Ljubljana 37.9 °C. Heat stress and drought heavily affected agriculture.

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-18 climate outlook for temperature	Observed	MedCOF-18 climate outlook for precipitation	
Spain (5)	Above normal	Above normal (10, 20,70)	Mostly below normal	Below normal (50,30,20)	Summer had three heat episodes: a) 12-18 June b) 9-26 July c) 30 July - 15 August Summer was marked by a heat wave of exceptional duration and intensity that affected mainland Spain and the Balearic Islands between 9 and 26 July. The highest summer temperatures were: 46°C (Morón de la Frontera, 24 July), 45 °C (Murcia and Alcantarilla, 25 July), 44.8 °C (Sevilla/airport, 22 January) The highest values of daily summer precipitation were: 39.2 mm (Castellón, 24 June), 30.3 mm (Santiago, 27 June), 29.6 mm (Lugo, 2 June), 28.7 mm (Igueldo, 25 June), 21 mm (Lleida, 6, July), 125 mm (Hondarribia, 17 August), 46 mm (Barcelona, 17 August), 40 mm (Girona, 18 August), 40 mm (Donostia, 18 August), 28 mm (Tortosa, 16 August) and 27 mm (Menorca, 31 August)
Syria *	Above normal	Above normal (10, 20,70)	No precipitation	Below normal (60,30,10)	
Türkiye (6)	Near normal at western and inner parts Above normal at eastern parts	Above normal West/Centre: (10, 20,70) East: (20,30,50)	Above normal at the western and inner parts - Below normal at eastern parts	Below normal (60,30,10)	The summer season of 2022 was the 8th hottest summer season in the last 52 years (1971-2022). • The August 2022 was the 3th hottest month in the last 52 years (1971-2022). • Maximum temperature record was broken at 6 stations in the 2022 summer season. • Extreme drought conditions recorded in the southeaster part of the Türkiye

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-18 climate outlook for temperature	Observed	MedCOF-18 climate outlook for precipitation	
Ukraine (5)	Above normal	Above normal (20, 30,50)	Above normal (18% stations) normal	Below normal (50,30,20)	During summer, meteorological extraordinary phenomena were observed in many regions across the country. • Heavy rains 30-77 mm of precipitation per 2-12 hours were recorded in Heavy showers (30-35 mm/hour), Botievo (Zaporizhian region) recoded 88 mm/hour 04/08/22. • Storm winds and squalls (with speed 25-26 m/c) were recorded in Ivano-Frankivsk, Khmelnitsky Odesa regions, locally causing disruption in power, telecommunications, utilities and transport. Summer was dry across most regions in Ukraine, with the driest conditions at some places in the western and southern parts. Yavoriv and Rava-Ruska (Lviv region), Play (Zakarpattia region), Uman (Cherkasy region), Izmail (Odesa region) recorded minimum precipitation sums since 1961.

Note:

1 – Basic climatological period (1961-1990)

2 – Basic climatological period (1971-2000)

3 – Basic climatological period (1951-2000)

4 – Basic climatological period (1980-2009)

5 – Basic climatological period (1981-2010)

6 – Basic climatological period (1991-2020)

7 – No information about the basic climatological period

*Data base: ERA5 1981-2010 for temperature, GPCC 1981-2010 for precipitation

North Africa (RA I)

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	**MedCOF-14 climate outlook for temperature**	**Observed**	**MedCOF-14 climate outlook for precipitation**	
Algeria *	Above normal conditions Over the Northern (10%,20%,70%) Over the south (20%,30%,50%)	Near t below normal over the south west Above normal elsewhere	Above normal in NW Near normal to below normal elsewhere	No clear signal (33/ 33/33).	No comment
Egypt (1)	Above Normal	Above normal conditions Over the Northern (10%,20%,70%) Over the south (20%,30%,50%)	Near to below normal	Normal to below normal conditions (50%, 30%, 20) Over the extreme north No clear signal elsewhere (33/ 33/33).	No comment
Libya *	Above normal, locally below normal in the extreme NE	Above normal	Near normal in the eastern parts and locally in the NW below normal elsewhere	No clear signal (33/ 33/33).	No comment

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	**MedCOF-14 climate outlook for temperature**	**Observed**	**MedCOF-14 climate outlook for precipitation**	
Morocco	Above normal conditions over almost all the country	Above normal	Near to below normal	No clear signal (33/ 33/33).	No comments
Tunisia (2)	Above normal	Above normal	Below normal Over all of the country	No clear signal (33/ 33/33).	new records for maximum daily temperature: **June** BEJA: 47.8 °C at 06/27/2022 LE-KEF: 44.3 °C at 06/27/2022 MEDENINE :47.8°C at 06 /27/2022 TOZEUR: 48.7°C at 06/28/2022 KEBILI :48.1°C at 06/28/2022 **July** GAFSA :46.5°C at 07/02/2022 **August** MONASTIR :47.1 °C at 08/18/2022 JERBA: 46.7 °C at 08/18/2022 MEDENINE :48.3 °C at 08/18/2022

Note:
(1) Basic climatological period (1981-2010)
(2) Basic climatological period (1991-2020)

* Data source: Temperature: NCEP/NCAR reanalysis data, precipitation: CHIRPS

References:

MedCOF 18 Outlook: http://medcof.aemet.es/images/doc_events/medcof18/step3/docStep3/Consensus%20Statement%20MedCOF18_v3.pdf

SEECOF Online Forum: http://www.seevccc.rs/forum/

PRESANORD http://acmad.net/rcc/presanord.php

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

Météo France climate monitoring products: http://seasonal.meteo.fr

ECMWF ERA5 reanalysis: https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5

NOAA-NCEP-CPC northern hemisphere teleconnection patterns: http://www.cpc.ncep.noaa.gov/data/teledoc/telecontents.shtml

ECA&D, E-OBS: http://www.ecad.eu

GPCC: http://gpcc.dwd.de