MEDITERRANEAN CLIMATE OUTLOOK FORUM
MEDCOF-23 Online Forum

ANALYSIS AND VERIFICATION
OF THE MEDCOF-22 CLIMATE OUTLOOK
FOR THE 2024 SUMMER SEASON
FOR THE MEDITERRANEAN REGION (MED)

First draft version

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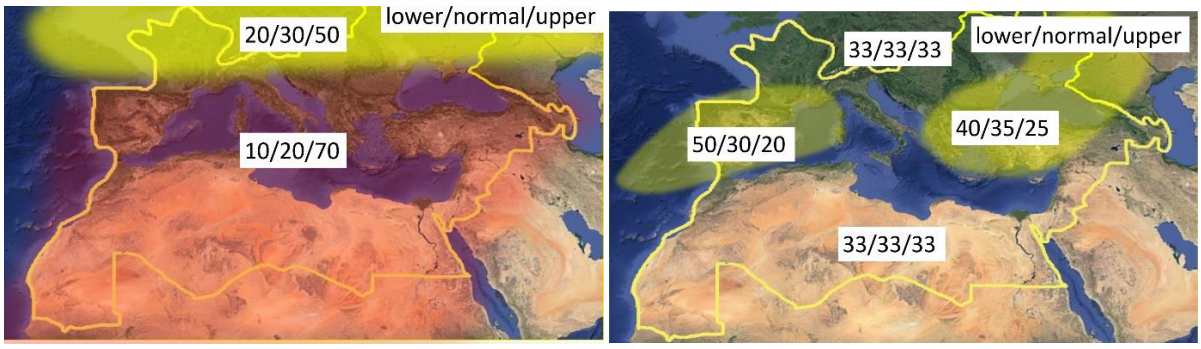
The following MedCOF verification report is based on

- the outcome of the consensus forecast of MedCOF-22,
- 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-32 for 2024 summer season for southeast Europe (SEE)
- national verification reports received from NMHSs or posted in RCOF forums of MedCOF, SEECOF or PRESANORD.

1 MedCOF-22 Climate outlook for the 2024 summer season



(a) (b)

Figure 1: Graphical presentation of the climate outlook for the 2024 summer season for the Mediterranean region (a) Temperature Outlook, (b) Precipitation Outlook

Sea surface temperature and general circulation

As stated in the MedCOF-22 consensus statement, observed sea surface temperatures showed that the moderate El Niño event of the previous winter 2023/24 had rapidly faded away, and forecasts for the three summer months 2024 showed a transition to moderate La Niña conditions. Indian Ocean Dipole was in neutral phase, but some models showed agreement in a transition to a positive phase. Most of the Atlantic basin experienced above-normal temperatures, and was expected to continue doing so. In the atmosphere, models showed a trend to favour positive summer NAO and East Atlantic patterns, but there were divergences among models on the geopotential anomaly patterns proposed.

Temperature

With this general context, above-normal temperatures were expected over most of the domain, with a more robust signal over southern and eastern parts of the domain (Fig. 1a).

Precipitation

Precipitation forecasts showed a dry signal over the western Mediterranean, and, with less probability, over parts of the Balkans, Türkiye and the Ukraine, with no clear signal over the rest of the domain (Fig. 1b). However, a significant wet signal was present in the models over wide parts of Middle East and easternmost Africa, so there was some uncertainty on precipitation over southeastern Egypt. Over the rest of North African domain, the area without signal also means that is a climatologically dry area.

2 Analysis of the 2024 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 2024 (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-32, http://www.seevccc.rs) and North Africa (PRESANORD, https://rcc.acmad.org/presanord.php), and national verification reports from MedCOF participants.

2.1 General circulation

2.1.1. Ocean

Sea surface temperatures (SST) in the eastern equatorial tropical Pacific and near the west coasts of South America were below the 1991-2020 normal in boreal summer 2024 and above normal in the western and central tropical Pacific (Fig. 2). This implies that SST anomalies in that region were shifting to La Niña conditions as expected. Most of the entire Atlantic basin had above-normal temperatures in this period as forecasted, with exception of the north. Particularly central parts of the North Atlantic were more than 2 °C warmer than normal. The entire Mediterranean Sea and the Black Sea were more than 1 °C warmer than normal on summer average. Over the Indian Ocean, no significant east-west gradient can be seen in Fig. 2, implying a neutral IOD phase.

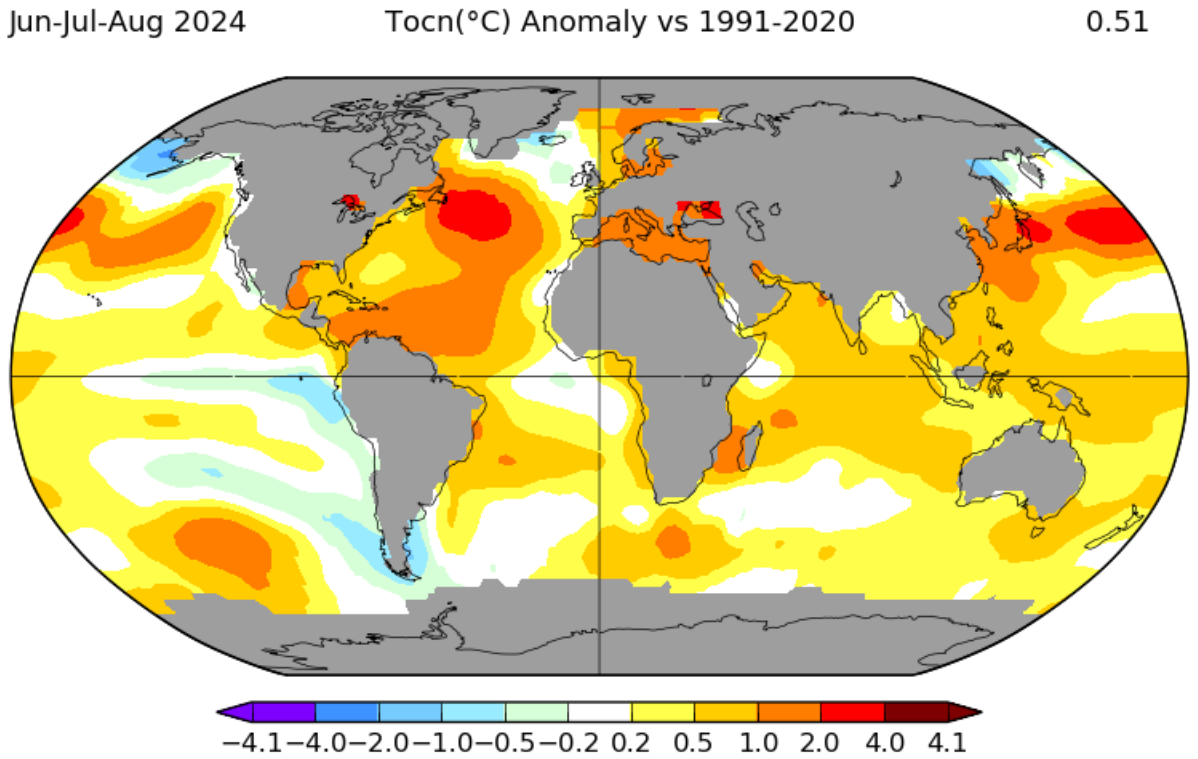


Figure 2: Sea surface temperature anomalies for boreal summer 2024 (June-August), 1991-2020 reference. Data from ERSSTv5 Ocean model analysis with 250km smoothing, source: NASA GISS, https://data.giss.nasa.gov/gistemp/maps/

When looking at the subsurface temperature anomalies in the central and eastern equatorial Pacific (Fig. 3), below-normal temperatures can also be seen in the central Pacific at around 150 m depth in all three boreal summer months.

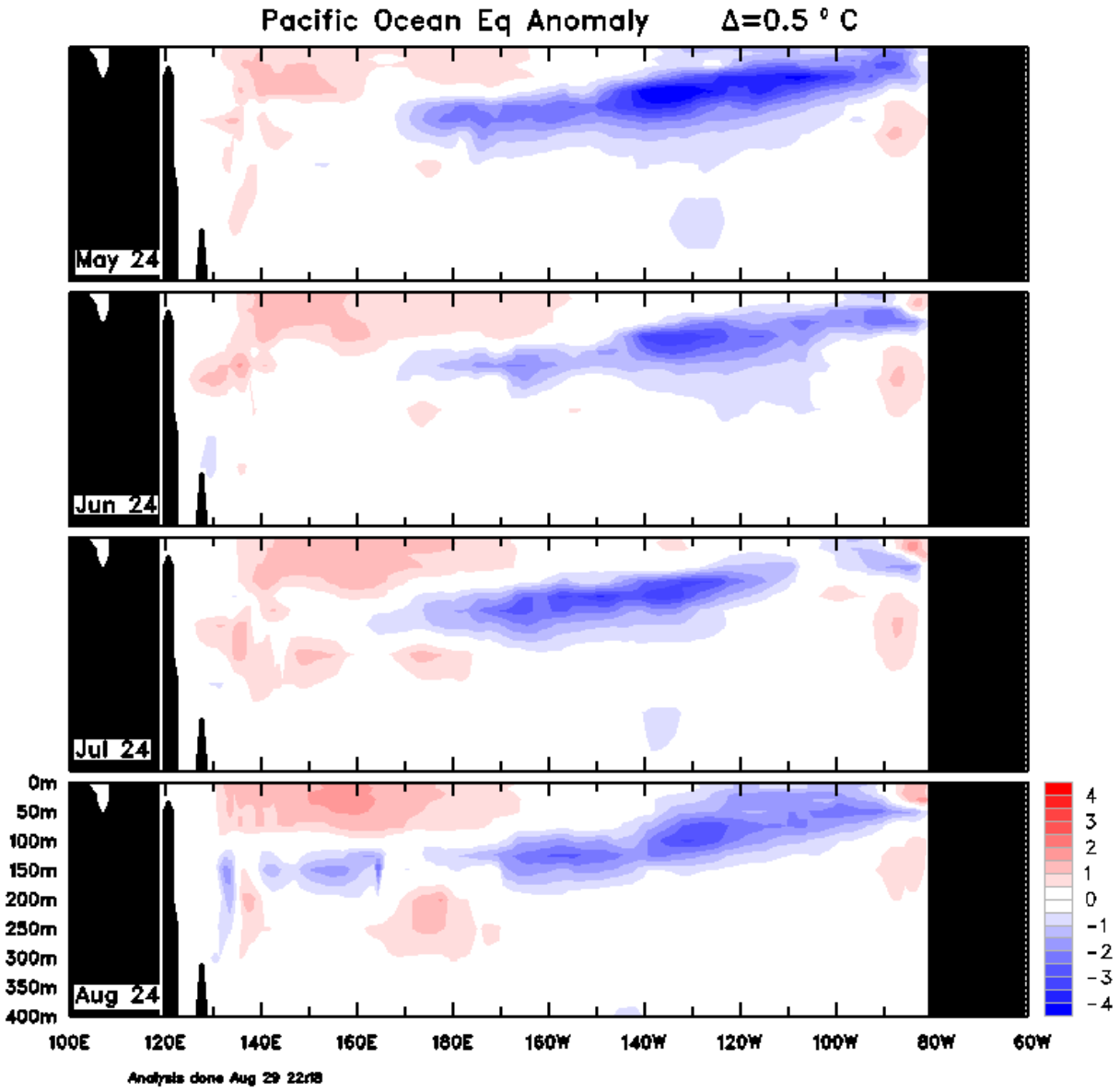


Figure 3: 4-month sequence of vertical temperature anomaly sections at the equatorial Pacific for May-August 2024. Source: Australian Government, Bureau of Meteorology (BOM), http://www.bom.gov.au/cgi-bin/oceanography/wrap_ocean_analysis.pl?id=IDYOC007&year=2024&month=08

Looking at the specific Niño regions (Tab. 1), SST was below normal (1971-2000 reference) throughout boreal summer 2024 in regions Niño1+2 and Niño3, but still positive in the westernmost region Niño4 (though with decreasing tendency from June to August 2024). In the combined region Niño3.4, which is often used as reference for El Niño / La Niña definition, the sign of anomalies changed from positive to negative in August 2024. The Oceanic Niño Index (ONI) used by NOAA had a value of exactly 0.0 °C for the JJA 2024 season, implying neutral conditions that time. ONI values before were positive, values after JJA 2024 were negative. This means that in JJA 2024 there was a transitional state from the former El Niño, which persisted until boreal spring 2024, to a tendency in direction of La Niña.

YR	MON	NINO1+2	ANOM	NINO3	ANOM	NINO4	ANOM	NINO3.4	ANOM
2024	6	22.52	-0.65	26.51	-0.14	29.49	0.65	27.95	0.24
2024	7	21.42	-0.41	25.79	-0.08	29.39	0.60	27.51	0.21
2024	8	20.52	-0.34	24.97	-0.25	29.17	0.48	26.83	-0.07

Table 1: Sea surface temperature and anomalies (in °C) for various Niño regions in boreal summer months 2024 (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.

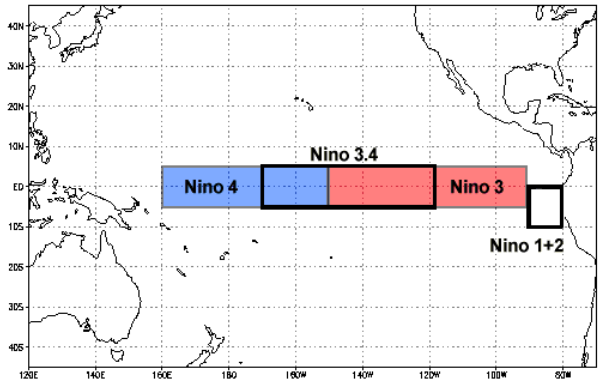


Figure 4: Niño regions. Source: NOAA NCEI, https://www.ncei.noaa.gov/access/monitoring/enso/sst

The Indian Ocean Dipole (IOD) index was neutral during all months in JJA 2024 as it was before in May 2024 (Fig. 5). The transition to a positive phase, which some models predicted, did not happen during this time.

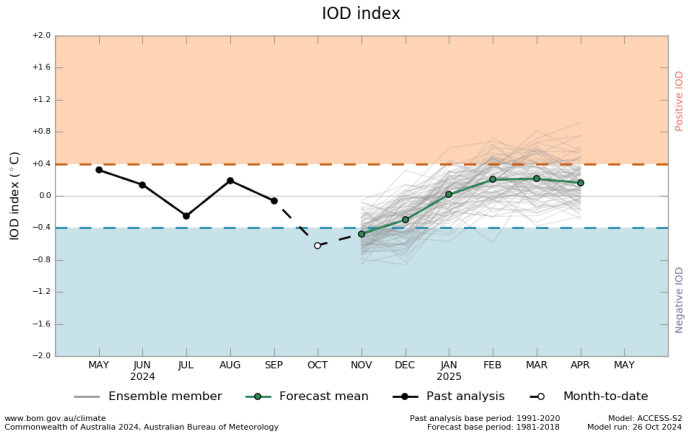


Figure 5: Monthly Indian Ocean Dipole (IOD) index. Source: Australian Government, Bureau of Meteorology (BOM), http://www.bom.gov.au/climate/enso/#tabs=Indian-Ocean

2.1.2. Atmosphere

Seasonal anomalies of 500-hPa geopotential in summer 2024 (Fig. 6) represent a mixture of several weather types, especially for the North Atlantic and Europe. Over the North Atlantic, an enhanced zonal circulation pattern (positive North Atlantic Oscillation (NAO+) and East Atlantic (EA+) patterns as proposed by the MedCOF outlook) is visible, particularly due to a strong Icelandic Low. Over Europe, this zonal flow was not continued, since there was a ridge instead.

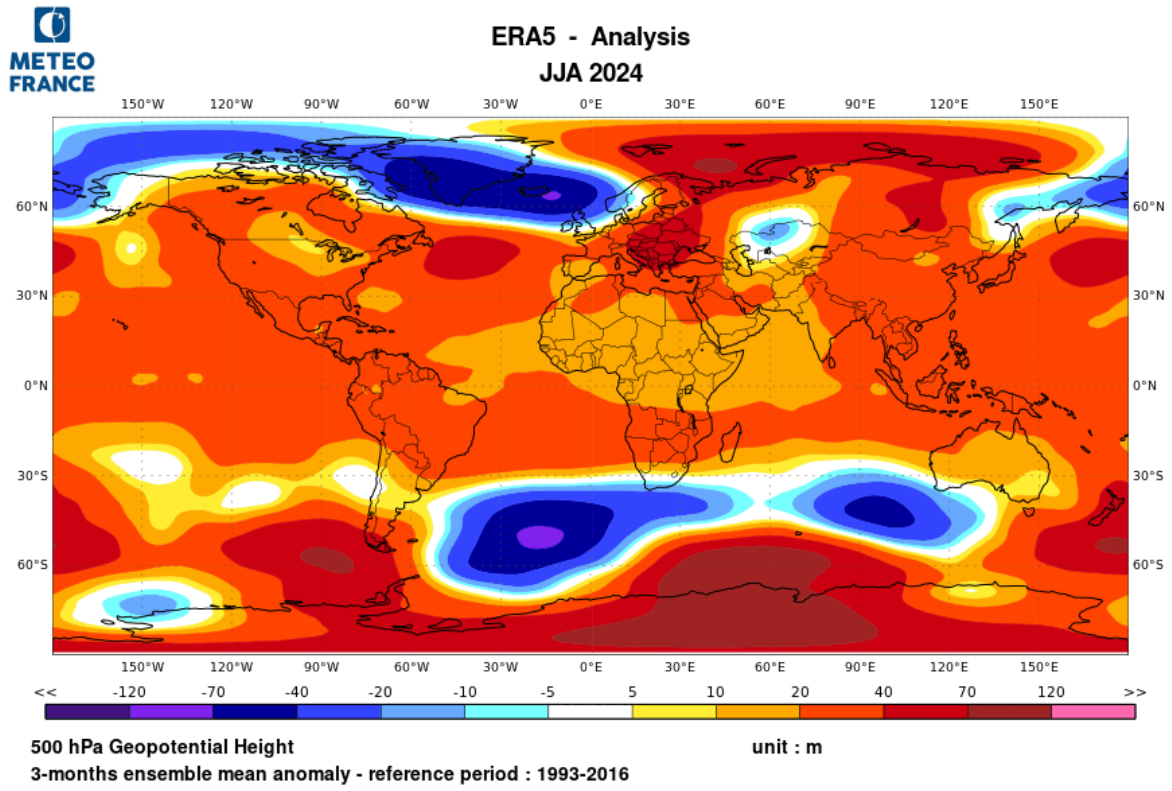


Figure 6: Seasonal anomalies of 500-hPa geopotential for boreal summer 2024 (1993-2016 reference). Source: Météo France, data source: ERA5, http://seasonal.meteo.fr/content/suivi-clim-cartes-ref93-16?language=en

Sea level pressure (SLP) anomalies (Fig. 7) show a westerly flow over the North Atlantic on summer 2023 average, due to an exceptionally intense Icelandic Low, quite unusual for summer. Increased cyclonic conditions from this pattern affected mainly parts of North-western and Northern Europe, but not the Mediterranean area.

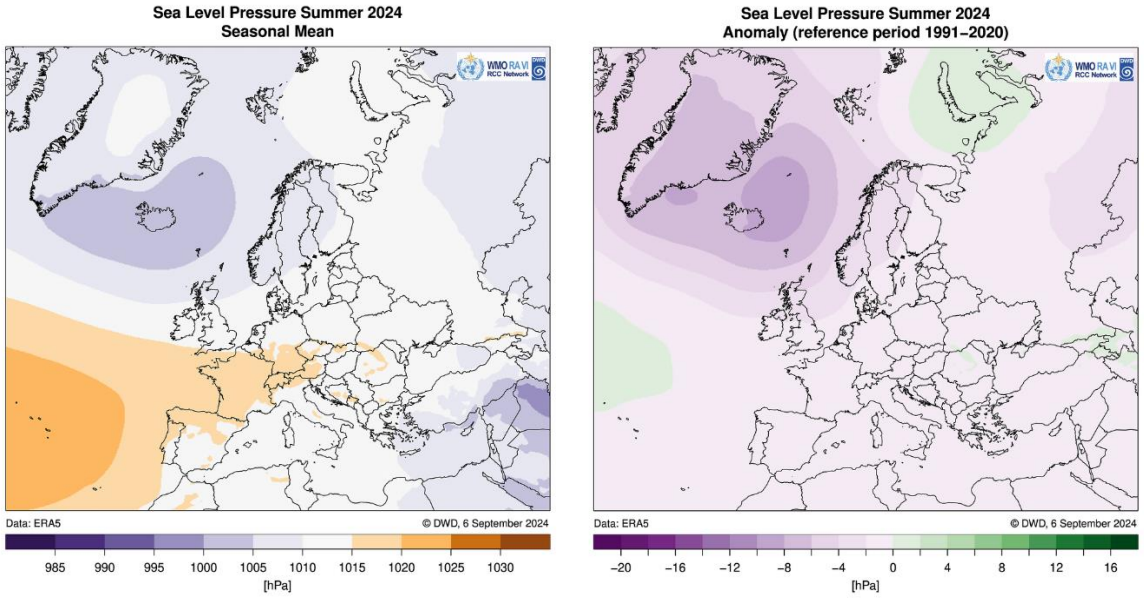


Figure 7: Seasonal mean sea level pressure and anomalies for summer 2024 (1991-2020 reference). Source: Deutscher Wetterdienst (DWD), data source: ERA5. https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_int_ppp.html

When looking at the 500-hPa geopotential maps for individual months (Fig. 8), it can be seen that the enhanced zonal flow over the North Atlantic and the anticyclonic area over Europe were present during all three months from June to August 2024. This is visible also for sea level pressure (Fig. 9). The anomaly of the Icelandic Low was strongest in August.

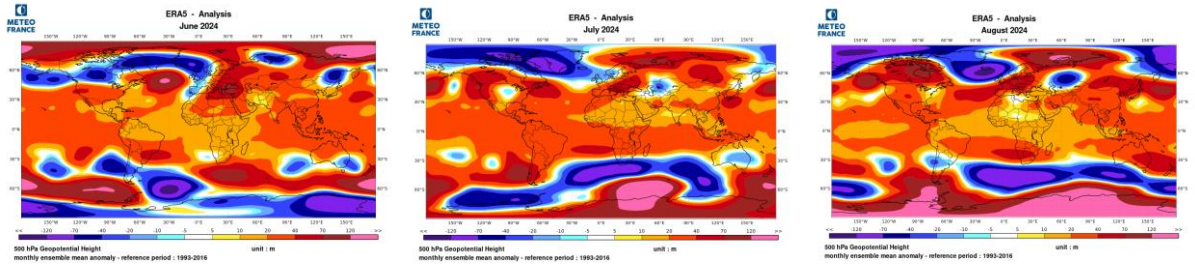


Figure 8: Same as Figure 6, but for the months June, July, and August 2024.

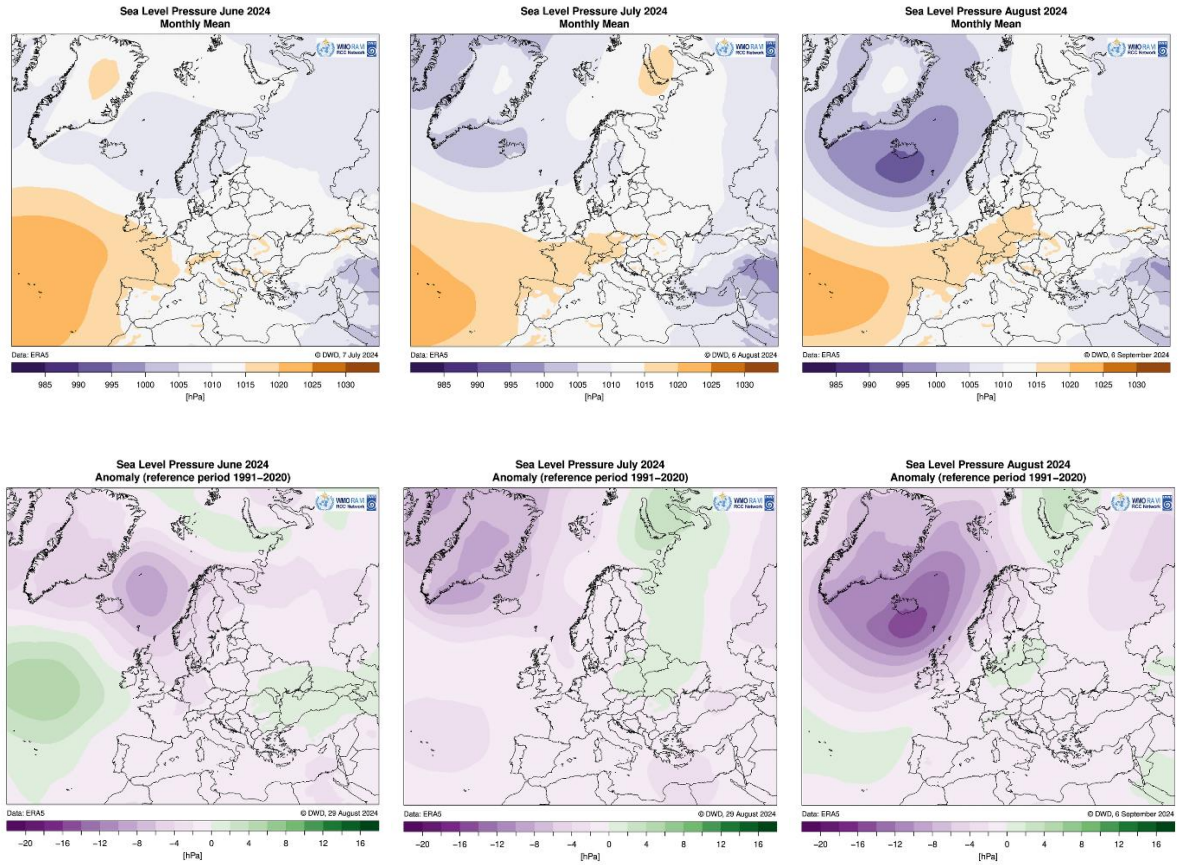


Figure 9: Same as Figure 7, but for the months June-August 2024.

According to the Météo France weather type classification, the zonal Atlantic Ridge type was by far the most frequent one in summer 2024 with more than twice the normal number of days (Fig. 10). This reflects mainly the summer NAO+ type. Also, more frequent than normal was the Atlantic Low type (resembling rather EA+), while NAO- and Summer Blocking types were quite rare this summer. Whereas the zonal Atlantic Ridge type occurred very frequently in all three summer months, the Atlantic Low type came frequently especially in late summer.

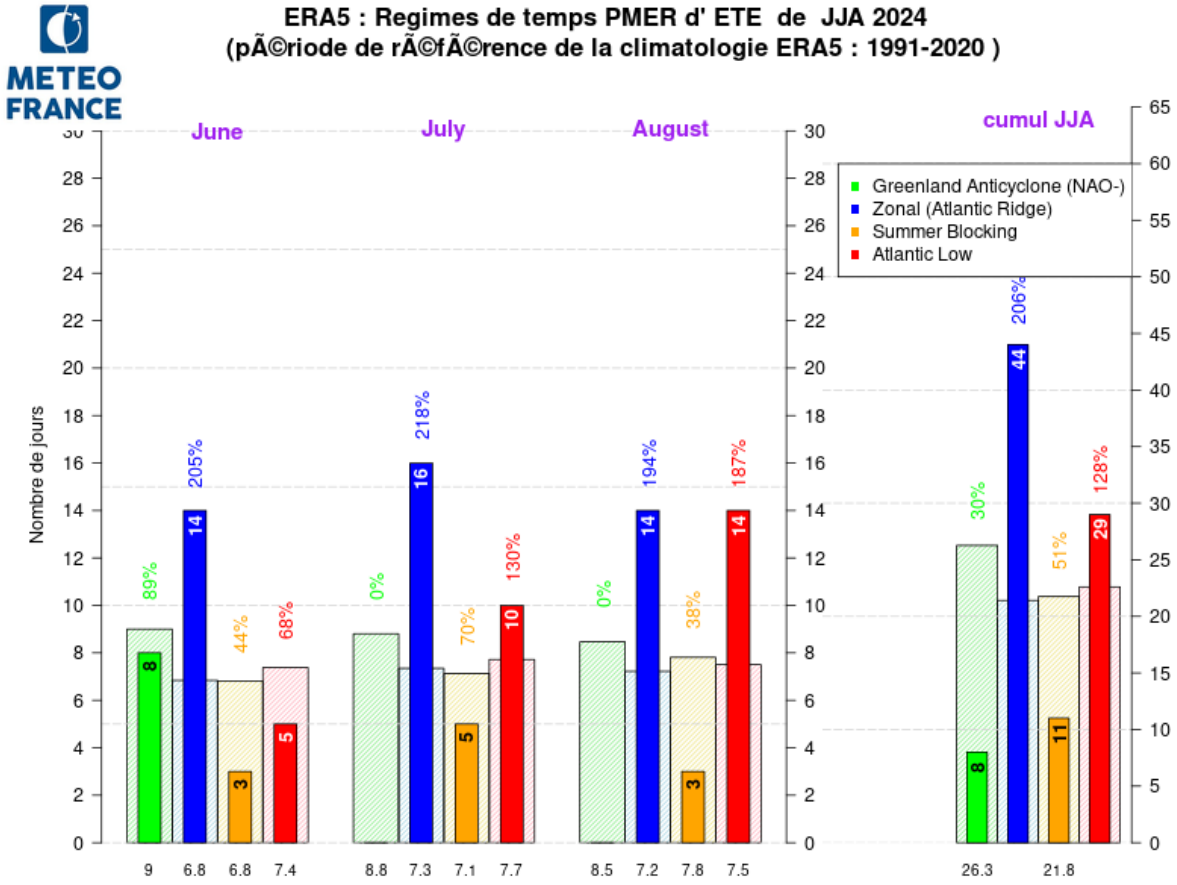


Figure 10: Number of days with circulation types of the Météo France classification for each month of the summer 2024 season and for the whole season (right), and in percent of the climatological frequency distribution 1991-2020. Source: Météo France, http://seasonal.meteo.fr/content/suivi-clim-regimes-trim?language=en

The NOAA CPC classification shows that there were contributions of various circulation patterns during the season. An outstandingly strong contribution came from EA+, again mostly in August. NAO+ was weaker than EA+ according to this analysis. Otherwise, there were also contributions from a negative East Atlantic/West Russia pattern (EA/WR-, mainly in June, when anticyclonic circulation occurred over Russia) and a negative Scandinavia pattern (SCA-) in all months (because the area of the Icelandic Low was expanded to Scandinavia).

yyyy	mm	NAO	EA	WP	EP/NP	PNA	EA/WR	SCA	TNH	POL	PT	Ex.V
2024	6	0.22	1.32	-1.29	1.25	1.14	-2.32	-1.24	-99.90	-1.00	-99.90	72.3
2024	7	1.48	2.39	-0.77	-0.49	2.01	-0.41	-1.61	-99.90	-0.13	-99.90	82.4
2024	8	0.69	3.67	1.06	-2.62	-1.04	-0.25	-1.18	-99.90	-1.34	-0.81	87.9

Table 2: Circulation indices of NOAA CPC patterns for the boreal summer months 2024. ExV = explained variance in %. https://ftp.cpc.ncep.noaa.gov/wd52dg/data/indices/tele_index.nh

2.2 Soil moisture

In some parts of the domain, soil moisture was below normal during the entire summer season (Fig. 11). This concerns especially areas in eastern Spain, southern Italy including Sardinia, parts of the Balkan Peninsula, Türkiye, South Caucasus, and eastern Ukraine. Otherwise, soils in other parts of the Iberian Peninsula and particularly in France were rather wet.

Dry soils can enhance warming due to missing evaporation, wet soils produce cooling as long as the air is not saturated.

01-10 June 2024 *11-20 June2024* *21-30 June 2024*

01-10 July 2024 *11-20 July2024* *21-31 July 2024*

01-10 August 2024 *11-20 August 2024* *21-31 August 2024*

Figure 11: Soil moisture decadal anomalies for the three summer months in 2024 (brown: below normal, blue: above normal, 1995-2023 reference). Source: European Drought Observatory (EDO), https://edo.jrc.ec.europa.eu/edov2/php/index.php?id=1111

2.3 Temperature

Europe and Middle East (RA VI)

Summer 2024 was once more very warm in almost the entire domain compared to the 1991-2020 normal. Especially in eastern parts, anomalies exceeded mostly +2 °C; in parts of the Balkan Peninsula, in the eastern Ukraine, and in western Türkiye, they reached even between +3 °C and +4 °C. Anomalies were lower than +2 °C in western parts of the domain (Portugal, Spain, France) and also in easternmost and southeasternmost parts (South Caucasus, eastern Türkiye, Jordan, Israel). Nevertheless, it was the sixth warmest summer since 1961 in Spain. In westernmost France, summer 2024 was even slightly cooler than normal.

Seasonal mean temperatures in the lowlands ranged from around 17 °C in north-western France to around 35 °C in eastern Syria, in higher elevations mostly between 10 and 15 °C, partly higher.

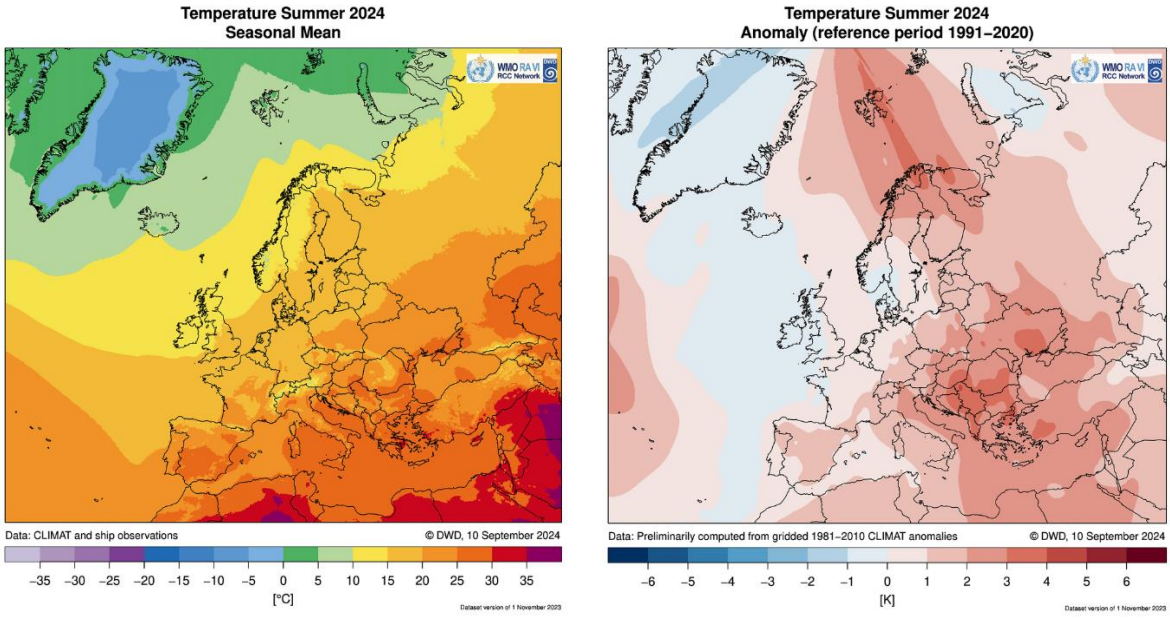


Figure 12: Surface air temperature for summer 2024. Left: seasonal mean, right: anomalies, 1991-2020 reference, source of both maps: WMO RAVI RCC, based on interpolated CLIMAT data, www.dwd.de/rcc-cm

In terms of terciles, when referring to the ERA5 reanalysis and the 1991-2020 reference, temperatures were in the upper tercile range in much of the domain (Fig. 13-14). In large parts of France and western Portugal, however, temperatures were in the middle tercile range.

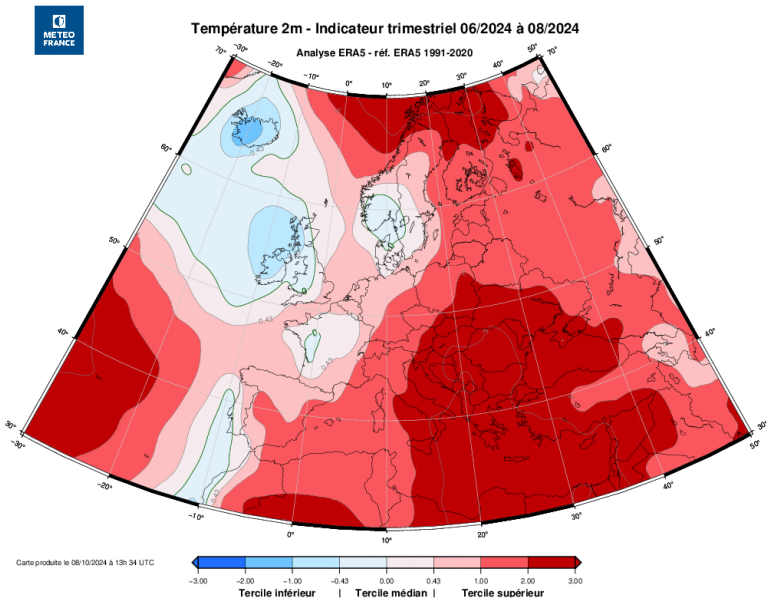


Figure 13: Seasonal normalized temperature anomalies of summer 2024 surface air temperature based on ERA5 reanalysis data, 1991-2020 reference. The data range between -0.43 and +0.43 represents the middle tercile range, below -0.43 the lower tercile range and above +0.43 the upper tercile range. Source: Météo France, http://seasonal.meteo.fr/content/suivi-clim-cartes-ERA5

Figure not available yet, might be provided for the second draft version.

Figure 14: Terciles of summer 2024 surface air temperature based on ERA5 Reanalysis, 1991-2020 reference. Source: AEMET, data source: https://www.ecmwf.int/en/forecasts/dataset/ecmwf-reanalysis-v5

E-OBS data, too show temperatures in the upper tercile range as expected from the outlook. However, there were more areas with temperatures in the middle tercile range, though these are smaller areas. Among them are, beside western France (Brittany) and the southwestern Iberian Peninsula, also southern Italy (Sicily) and southeastern Türkiye. Some parts of Sicily and places in southeastern Türkiye even had temperatures in the lower tercile range, but this is not reflected by individual ECA&D station data, so it might be an interpolation effect. Otherwise, places with temperatures in the middle tercile range are confirmed by station data.

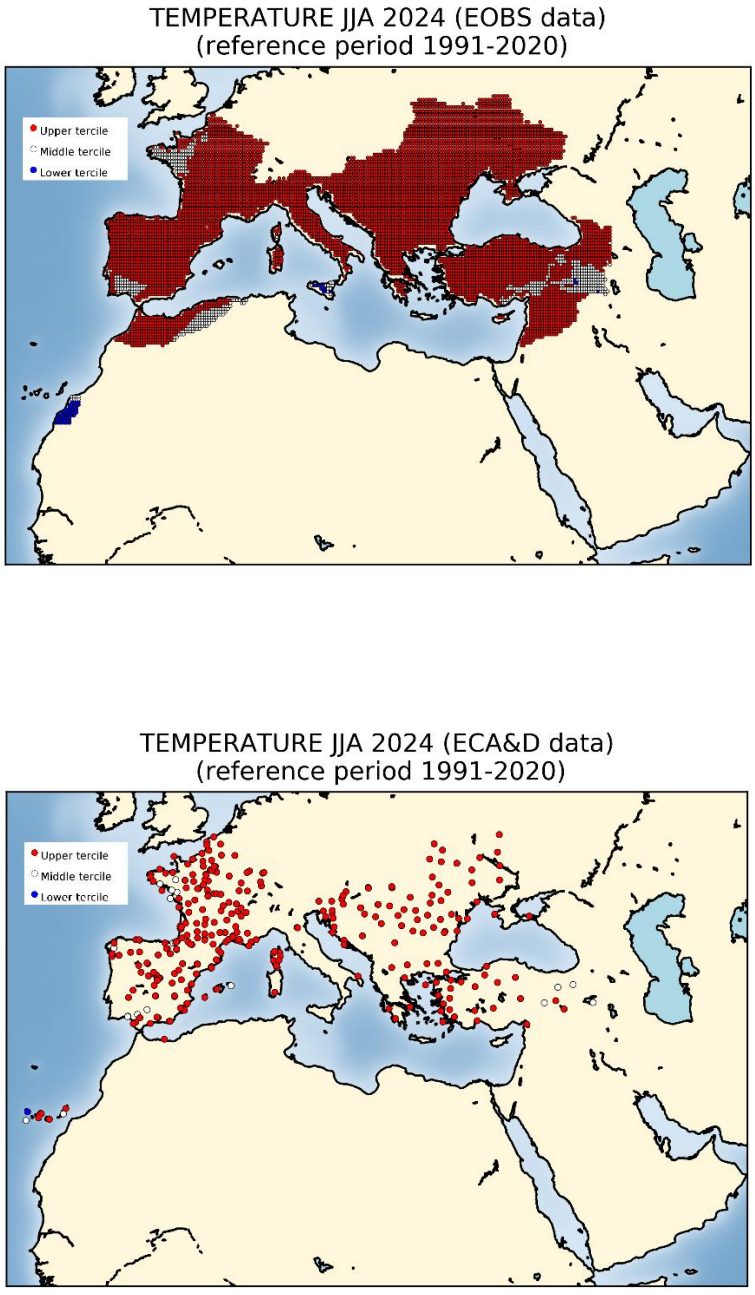


Figure 15: Terciles of summer 2024 surface air temperature based on interpolated E-OBS grid data (upper graph) and individual ECA&D station data (lower graph), 1991-2020 reference. Note: E-OBS uses a higher number of stations than those which are freely available at ECA&D. Source: AEMET, data source: http://www.ecad.eu/

North Africa (RA I)

Seasonal mean temperatures ranged from 16 °C to 30 °C in the domain's northern regions, particularly at higher elevations. Temperatures in the middle of the domain ranged between 30 °C and 46 °C over Algeria's center-west, Tunisia's south, and Algeria's center-east (Fig. 16).

Almost the whole domain had temperatures greater than the 1991-2020 normal (Fig. 17). They were especially high in the domain's eastern regions, with anomalies ranging from +2 °C to +3 °C across Libya and Egypt. Anomalies in the rest of the domain ranged from +1 °C to +2 °C. The southwest of Algeria and the south of Morocco were slightly colder than normal, with temperature anomalies reaching -1 °C.

In Tunisia, temperatures mostly remained above normal throughout the season. A very large part of the Tunisian country was affected by the high heat. The average temperature reached 28.97 °C and was above the reference normal (1991-2020) with a significant difference of (+1.19°C).
Maximum temperatures during the summer of 2024 were high in all regions and ranged from 29.63 °C in Mahdia to 40.6 °C in Tozeur.

In Egypt, summer 2024 was warmer than normal in most parts. Mean temperatures were between 26.1 °C in EL-ARISH and 34.4 °C in the south of Egypt (LUXOR and ASSWAN). The anomalies (with respect to 1991-2020 normal) reached between 0.4 °C in RAS-BENAS and 2.3 °C in the north of Egypt (ASSWAN).

In terms of terciles, temperatures were in the upper tercile range in almost the entire domain (Fig. 4). Only in an area in the south of the two countries Algeria and Morocco, temperatures were mainly in the lower or middle tercile range.

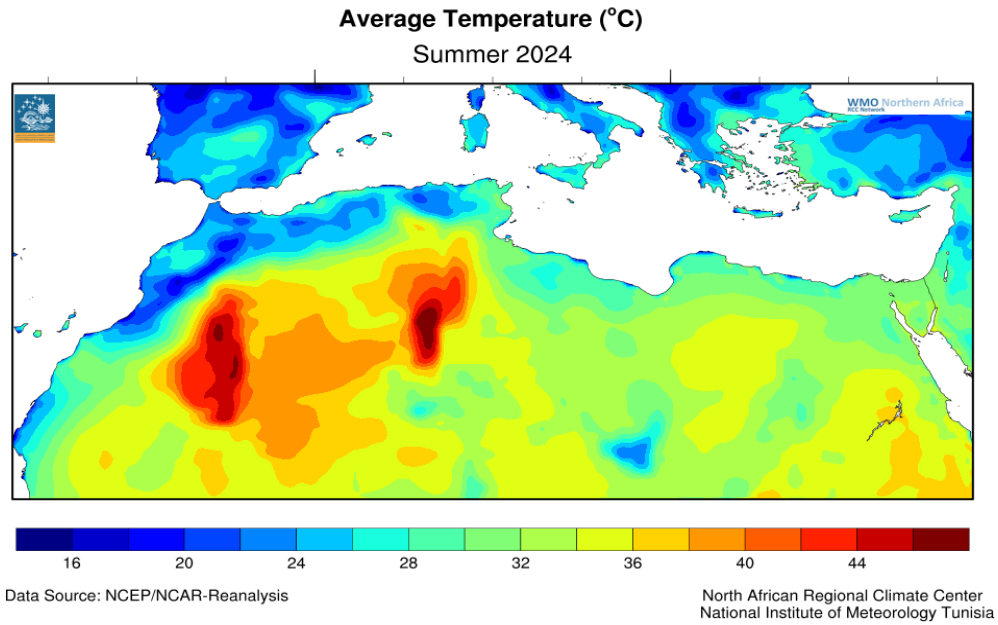


Figure 16: Mean temperature for summer season 2024 in North Africa (in °C). Source: INM, (Data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov)

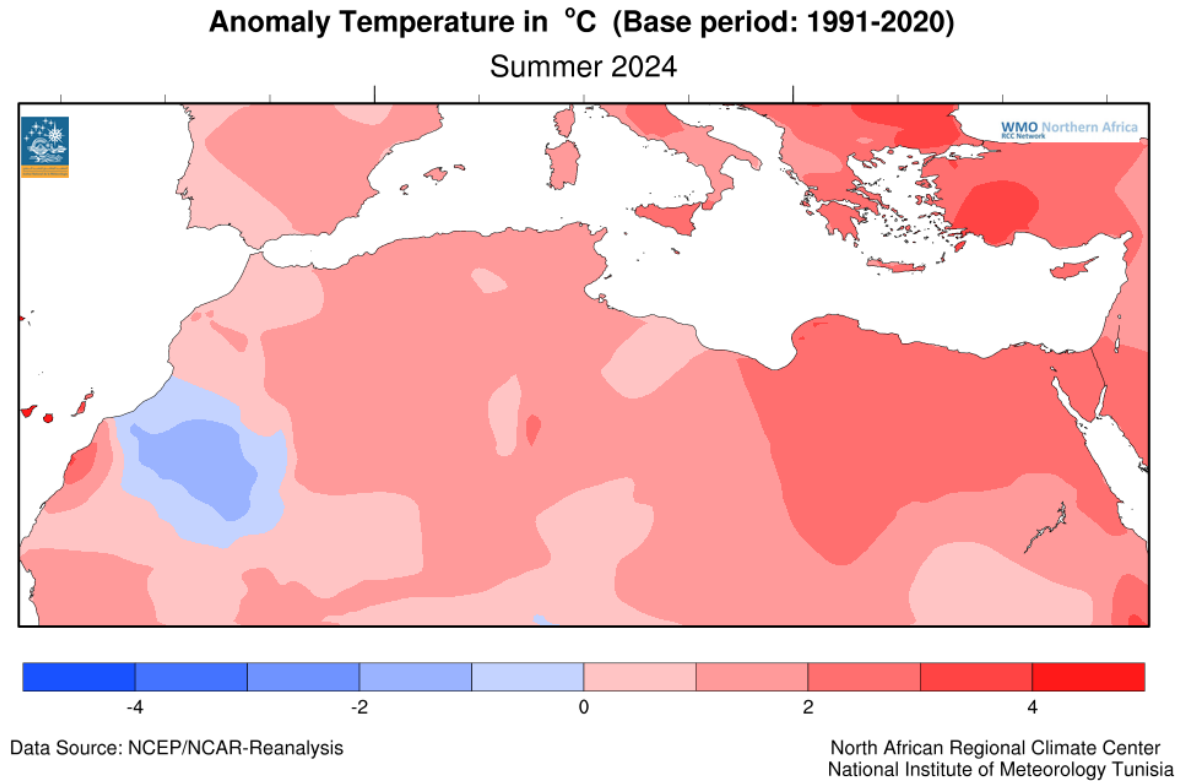


Figure 17: Temperature anomaly for summer season 2024 in North Africa (in °C), reference period 1991-2020. Source: INM, Data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov

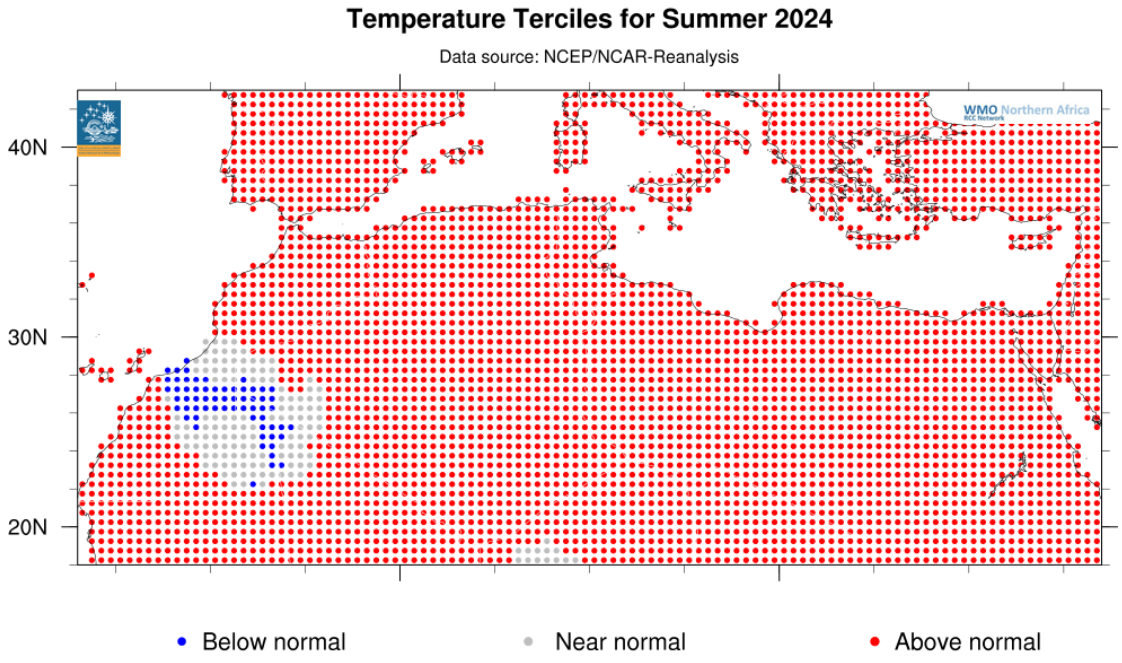


Figure 18: Tercile distribution for temperature of JJA 2024, reference period 1991-2020. Source: INM, Data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov

2.4 Precipitation

Europe and Middle East (RA VI)

Seasonal precipitation had much spatial variability in summer 2024 (Fig. 19). It was above normal over most of the Iberian Peninsula including the Baleares, in parts of western and eastern France, some northern parts of Italy, but also in several eastern parts like western Ukraine, southern and eastern Türkiye, and the South Caucasus. Drier-than-normal areas can be found particularly in southeastern Spain, southern France, north-western and southern Italy, on almost the entire Balkan Peninsula, Moldova, the eastern Ukraine, western and northern Türkiye, and most of the Middle East.

Seasonal anomalies exceeded +30 mm (+10 mm per month) in some of the above-mentioned wetter-than-normal areas, but were locally much higher. In the drier-than-normal areas, anomalies larger than −30 mm occurred very frequently, in some parts of Bosnia and Herzegovina, Romania, eastern Ukraine, and north-western Türkiye, they were even larger than −90 mm.

Seasonal totals ranged from zero in most of the Middle East to above 300 mm in Slovenia and at the coasts of western Georgia. Percentages were between below 20% of normal in parts of the Middle East and above 250% in western Azerbaijan.

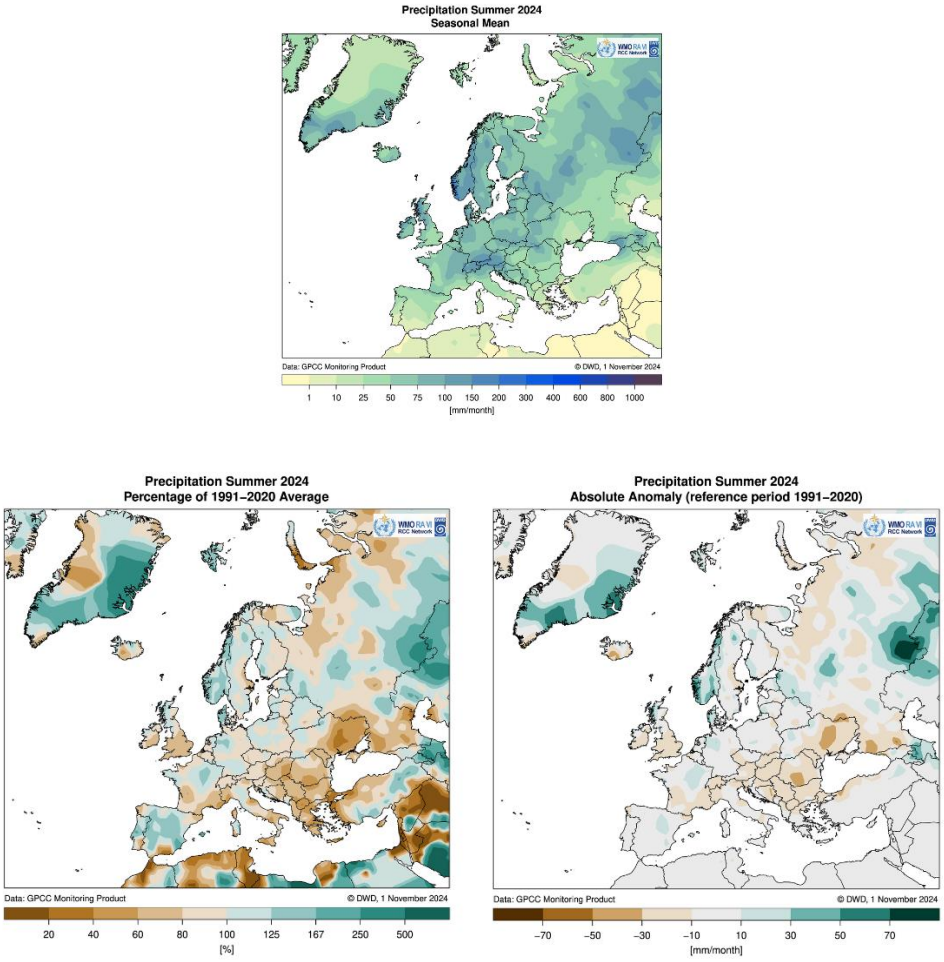


Figure 19: Precipitation for summer 2024 in Europe. Upper map: seasonal total in mm/month, lower maps: percentage of 1991-2020 average and absolute anomalies, source: WMO RAVI RCC, www.dwd.de/rcc-cm , data source: GPCC, http://gpcc.dwd.de

In terms of percentiles, the dry signals (lower percentile range) mentioned in the outlook can be seen over most of these areas, namely on the southern Iberian Peninsula, southern France, the Balkans, parts of Türkiye, and the Ukraine (Fig. 20-21). The rest of the Iberian Peninsula, however, had precipitation in the middle or upper tercile range, same for Türkiye, but it has to be considered that these areas are climatologically drier in summer than most other areas of the RA VI part of the domain. Additionally, precipitation was also partly in the lower (partly middle) tercile range in Italy, which was not covered by the dry signal of the outlook.

The results of the different datasets GPCC, E-OBS and ECA&D are quite similar to each other, except for local discrepancies due to different station coverage.

Figure for ERA5 not available yet, might be provided for the second draft version.

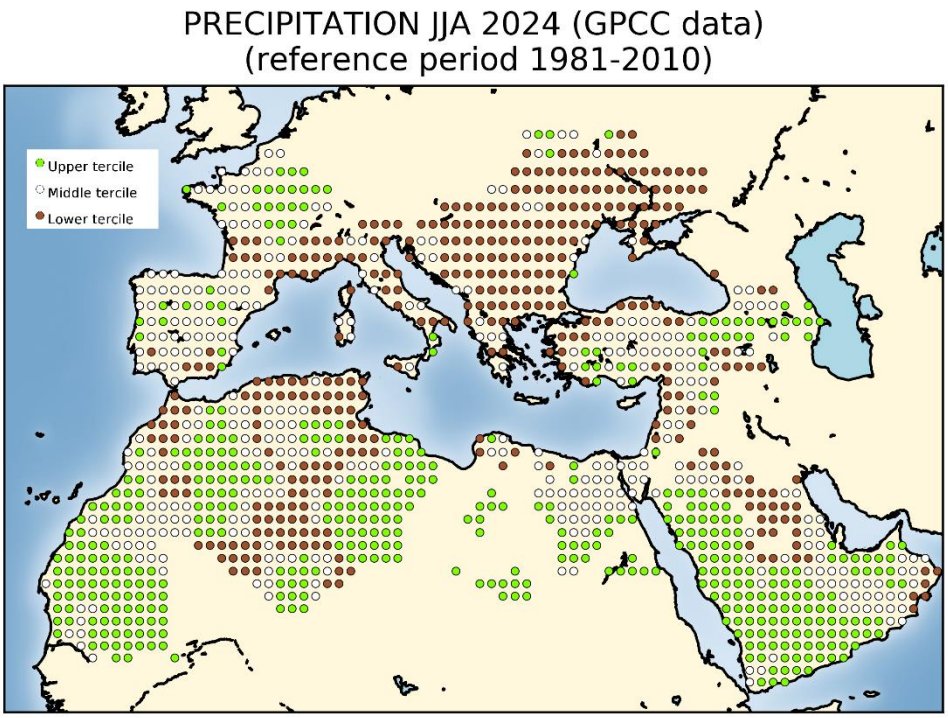
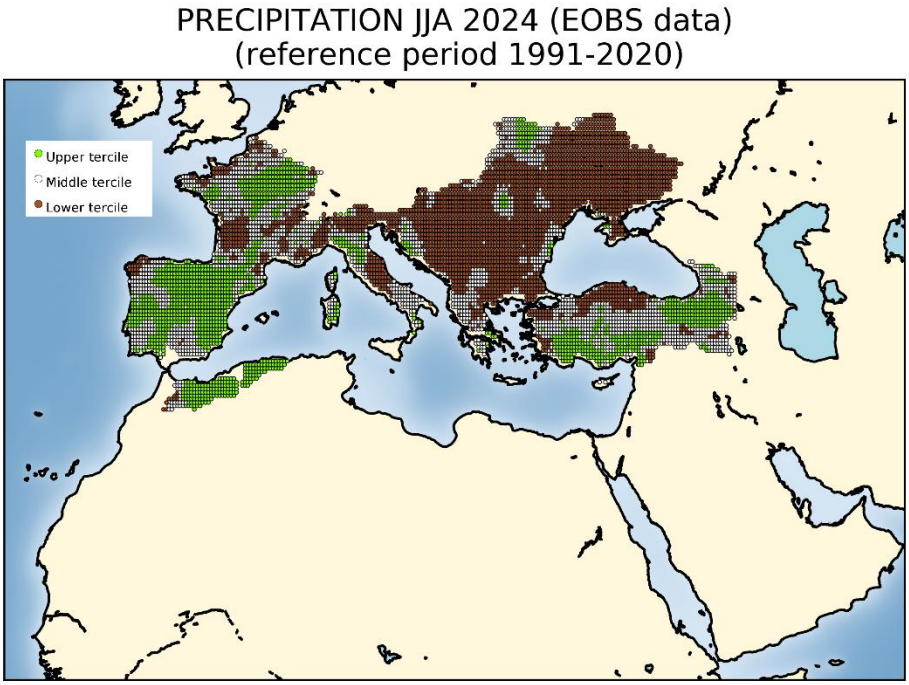


Figure 20: Tercile ranges of summer 2024 precipitation based on ERA5 Reanalysis (upper graph) and GPCC (lower graph) grid data, 1981-2010 reference. Source: AEMET, data reference:

ERA5: https://www.ecmwf.int/en/forecasts/dataset/ecmwf-reanalysis-v5, GPCC: http://gpcc.dwd.de



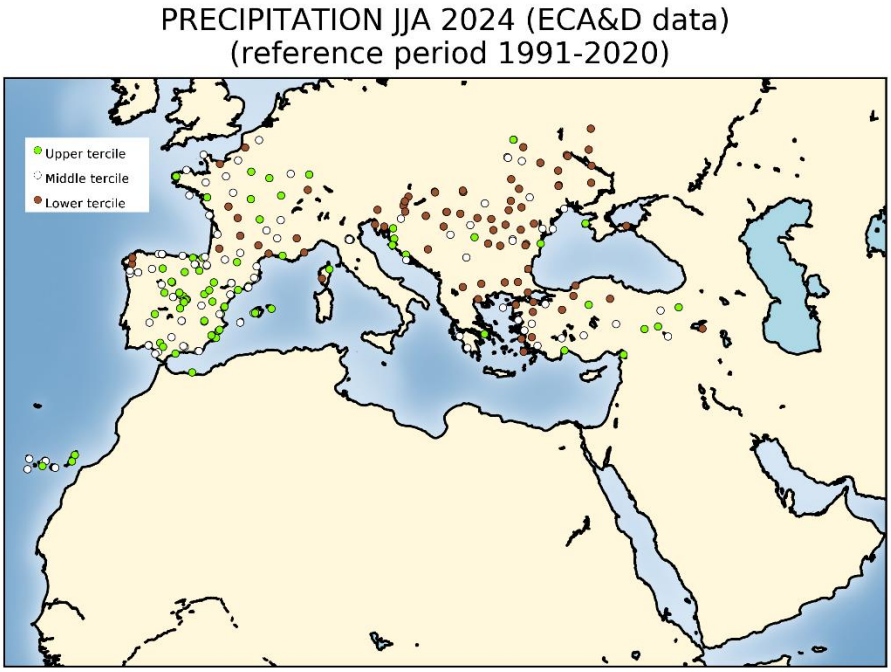


Figure 21: Tercile ranges of summer 2024 precipitation based on interpolated E-OBS grid data (upper graph) and individual ECA&D station data (lower graph), 1991-2020 reference. Source: AEMET, data source: http://www.ecad.eu/

A more detailed analysis for south-eastern Europe, including high impact events, is given in the analysis and verification report of the SEECOF-31 CLIMATE OUTLOOK for the 2024 summer season for southeast Europe (SEE), provided by SEECOF-32:

http://www.seevccc.rs/SEECOF/SEECOF-32/STEP-1/Draft-Version-Final-assessment-of-SEECOF-31-climate-outlook-for-summer2024-season.pdf

North Africa (RA I)

Overall, the summer of 2024 was exceptionally dry in terms of rainfall, with accumulated precipitation of less than 20 mm in most North African countries, with the exception of the extreme south of Algeria, where precipitation ranged between 20mm and 70mm (Fig. 22).

In terms of percentiles, precipitation was in the upper tercile range across the domain. Only for the north of the western part of the domain (north of Tunisia, Algeria, and Morocco), precipitation was below normal (Fig. 23).

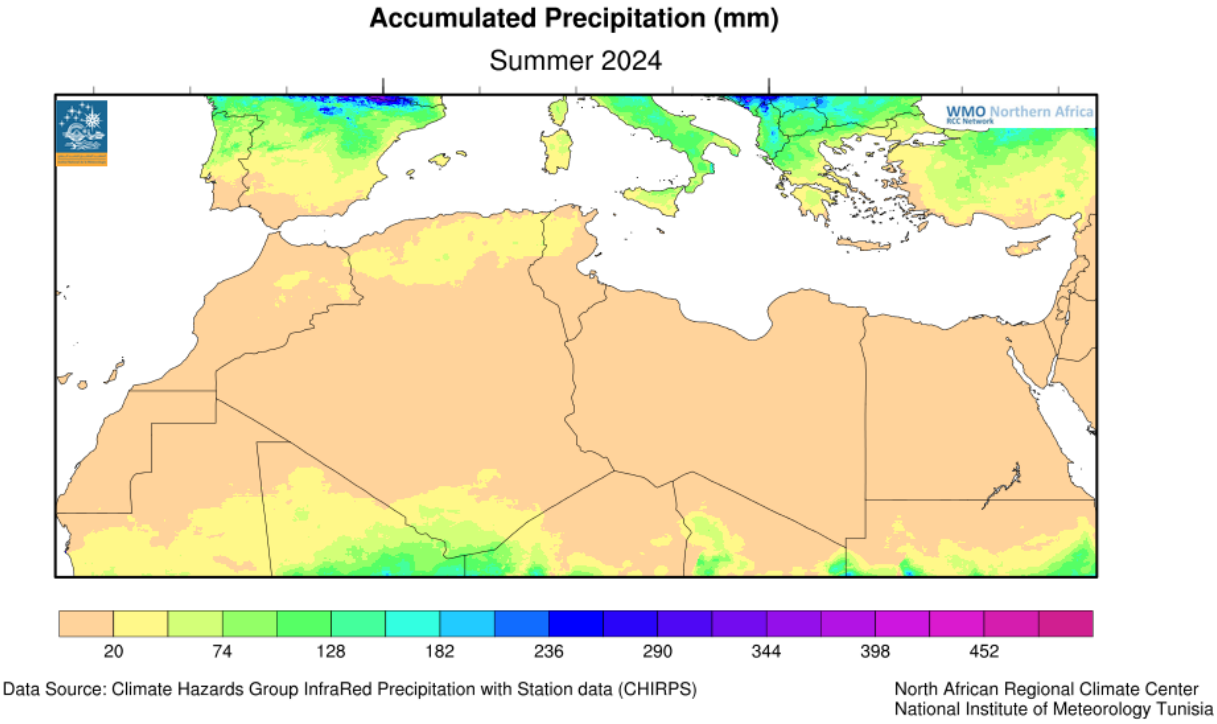


Figure 22: Total precipitation for summer season 2024 in North Africa (in mm). Source: INM, Data from CHIRPS: ftp://ftp.chc.ucsb.edu/

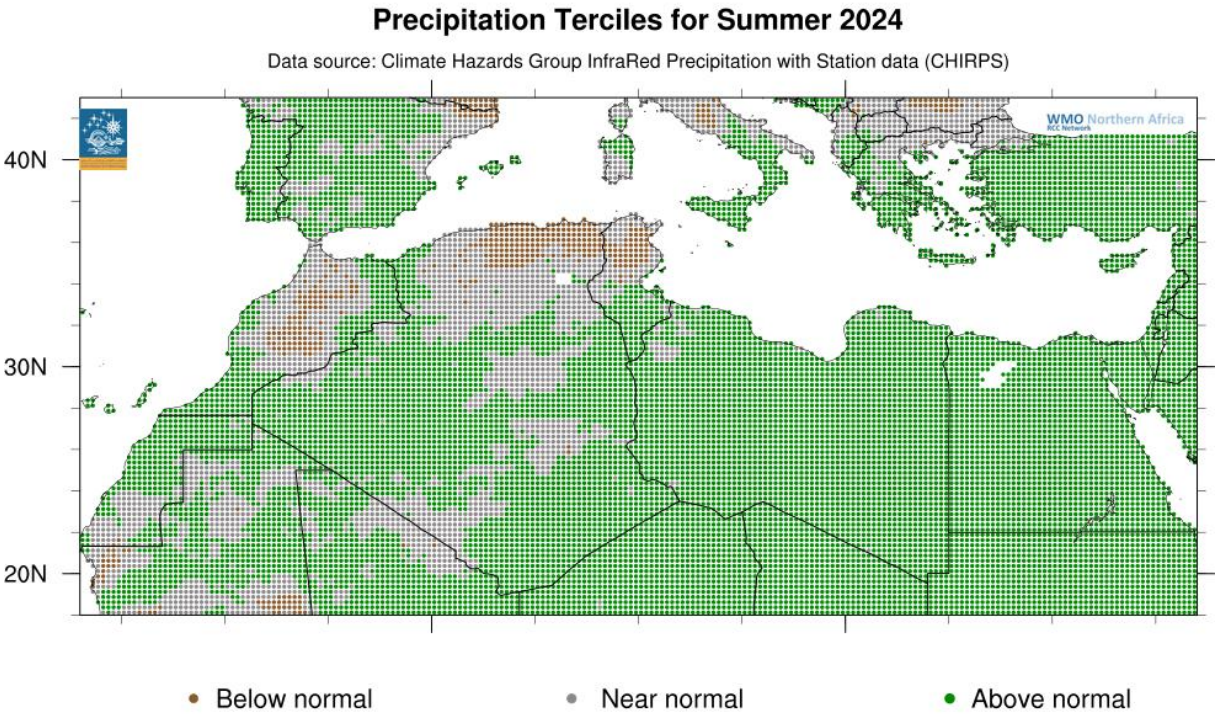


Figure 23: Tercile distribution for precipitation of JJA 2024 (Reference period 1991-2020). Source: INM, data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov

3 Verification of the MedCOF-22 climate outlook for the 2024 summer season

3.1 Temperature

Europe/RA VI

The MedCOF-22 outlook favoured the upper tercile range for the entire domain, with 50% probability for northern parts and 70% probability for southern parts.

The outlook was correct for almost the entire domain, except for some small areas of north-western France, the southwestern Iberian Peninsula, Sicily, and southeastern Türkiye, where temperatures were in the middle tercile range.

North Africa (RAI)

The MedCOF-22 climate outlook for the summer 2024 season favoured the upper tercile over the entire North African domain (10%, 20%, 70%).

With the exception of the south of Algeria and Morocco, where the temperature was in the normal to below normal tercile ranges, the temperature outlook was accurate over nearly the whole area.

3.2 Precipitation

Europe/RA VI

The MedCOF-22 outlook favoured a dry scenario (below lower tercile) over the Iberian Peninsula and the western Mediterranean with 50% probability and over parts of the Balkans, Türkiye and the Ukraine with 40%. Elsewhere in the domain, no privileged scenario was given.

The outlook was correct for the dry area over most of the Balkan Peninsula, northern Türkiye and most of the Ukraine. For the western dry area, the outlook was correct for southern France, whereas most of the Iberian Peninsula was wetter than normal with precipitation in the middle and upper tercile range.

North Africa

No scenario for the North Africa region was favoured. In fact, the precipitation was below normal over Tunisia, Egypt, north of Algeria, and north of Morocco and near to above normal over the remaining of North Africa.

MedCOF-22 outlook has not provided a meaningful precipitation forecast for this seasonally dry region.

4. Users' perceptions of the MedCOF-18 outlook

Europe/RA VI

From some countries, the following information was given:

- Israel: The NMHS has provided a summer outlook.
- Slovenia: The meteorological Service at the Slovenian Environment Agency currently doesn't provide a seasonal outlook for the country.

North Africa

No feedback known.

Appendix A: Contributors to verification of MEDCOF-22

- 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:**

- Météo France, Republic of France
- Deutscher Wetterdienst, Federal Republic of Germany
- AEMET, Spain

- **Further National Meteorological and Hydrological Services via SEECOF-32:**

- Federal Hydrometeorological Institute, Federation of Bosnia and Herzegovina
- Republic Hydrometeorological Service, Republika Srpska, Bosnia and Herzegovina
- National Institute of Meteorology and Hydrology, Bulgaria
- Meteorological and Hydrological Service of Croatia, Republic of Croatia
- National Environmental Agency (NEA), Georgia
- Hellenic National Meteorological Service, Greece
- Israel 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)

- WMO RA I North African RCC Tunisia Node on Climate Monitoring, National Institute on Meteorology, Tunisia
- Egyptian Meteorological Authority (EMA).

APPENDIX B: **Analysis and verification of the MedCOF-22 climate outlook for the summer season 2024:**

Europe/RA VI

Country (reference period)	**Seasonal temperature (JJA)**		**Seasonal precipitation (JJA)**		**High Impact Events**
	Observed	**MedCOF-22 climate outlook for temperature**	**Observed**	**MedCOF-22 climate outlook for precipitation**	
Albania *	Above normal	Above normal (10,20,70)	Below normal	Below normal (40,35,25)	
Armenia *	Above normal	Above normal (10,20,70)	Above normal	No privileged scenario (33,33,33)	
Azerbaijan *	Above normal	Above normal (10,20,70)	Above normal	No privileged scenario (33,33,33)	
Federation of Bosnia and Herzegovina (1991-2020)	Above normal in almost the entire country	Above normal (10,20,70)	Below average in most of Bosnia and Herzegovina. Above average - west and southwest	No privileged scenario (33,33,33)	• The warmest in July and August in entire Bosnia and Herzegovina. • The absolute maximum temperature in August was exceeded two days in a row. • The warmest summer since official measurements began.
Rep. Srpska, Bosnia and Herzegovina (1981-2010)	Above normal	Above normal (10,20,70)	Normal or below; locally above normal	No privileged scenario (33,33,33)	No high impact events.

Country (reference period)	**Seasonal temperature (JJA)**		**Seasonal precipitation (JJA)**		**High Impact Events**
	Observed	**MedCOF-22 climate outlook for temperature**	**Observed**	**MedCOF-22 climate outlook for precipitation**	
Bulgaria (1991-2020)	Above normal	Above normal (10,20,70)	Dry or near normal	Below normal (40,35,25)	The month of June 2024 is the warmest month of June in Bulgaria since 1930 and the driest for the last 30 years. • The month of July 2024 is almost as warm as the warmest month of July since 1930 – July 2012. In terms of precipitation it is as dry as July 2023. • August 2024 is among the warmest months of August since 1930 and among the driest for the last 10 years. As a result, the summer of 2024 is among the warmest if not the warmest since 1930 and among the driest since the beginning of the 21th century. • There was again a long heat wave in July and August but there are no registered record maximum temperatures. Due to the heat and the drought, the fire season was busy in July and August. The crops also experienced heat and drought stress, which reflected in the yields.

Country (reference period)	**Seasonal temperature (JJA)**		**Seasonal precipitation (JJA)**		**High Impact Events**
	Observed	**MedCOF-22 climate outlook for temperature**	**Observed**	**MedCOF-22 climate outlook for precipitation**	
Croatia (1991-2020)	Above normal	Above normal (10,20,70)	Normal (most of Croatia)	No privileged scenario (33,33,33)	• Summer 2024 was extremely warm. At most stations, it is the warmest summer since measurements have been made. • In all three months heat waves were observed (3 in continental part and 4 at Adriatic coast) and they were long lasting. • In all three months convective related severe weather phenomena (thunderstorms, hail, heavy rains, flash floods, waterspouts) were observed mostly all over Croatia. • In June, relatively often, severe thunderstorms accompanied with large amount of precipitation in short time (Parg 154 mm, June 11) hail and flash floods hit mostly continental part of Croatia. Flood damage and corps damage due to hail were reported and traffic 10 on many local roads were interrupted. • In July convective activity was very frequent all over Croatia. Urban floods as a result of large amounts of precipitation in a short time were common (Ogulin, July 28, 70 mm in 1 hour). Flood damage and crops and infrastructural damage were also frequent due to large hail (July 13, Međimurje – north Croatia). • August - a few convective episodes hit almost whole Croatia from August 17 till August 20. In Zagreb on August 20, 89,9 mm of rain was measured. Flash floods and fallen trees caused damage on houses and roads.

Country (reference period)	**Seasonal temperature (JJA)**		**Seasonal precipitation (JJA)**		**High Impact Events**
	Observed	**MedCOF-22 climate outlook for temperature**	**Observed**	**MedCOF-22 climate outlook for precipitation**	
Cyprus *	Above normal	Above normal (10,20,70)	Seasonally dry	Below normal (40,35,25)	
France (1991-2020)	Above normal	Above normal: (20,30,50) South: (10,20,70)	normal	South: below normal (50,30,20) Elsewhere: No privileged scenario (33,33,33)	France was impacted at the national scale by two heatwaves during summer 2024. The first heatwave occurred between 29 July and 2 August, with intense heat registered at its' peak on 30 and 31st July. Temperatures locally exceeded 40 °C over the Mediterranean coast. The night between 30 and 31 July was the 4th warmest on record at the national level, with minimum temperatures not falling below 21.1 °C on average. A second heatwave, less intense, impacted the country from 6th to 13th August. Temperatures locally exceeded 40 °C over the Aquitaine region. Warm conditions, including tropical nights, prevailed over southeast France and Corsica during most of end of July and August. During summer 2024, several severe thunderstorms with intense rainfall, wind gusts, and sometimes large hailstones, impacted the country. From 17th to 24th June, these storms impacted several regions. On the 21st, torrential rain led to landslides and destruction of the Berarde village in Isère. In July, hail and rain storms caused local damage in the Southwest to the Northeast part of the country, during three major episodes across the month. After a short period of heatwave conditions (see above), another sequence of stormy weather caused local damages to crops and landslides in mid- to end-August.
Georgia (1981-2010)	Above normal	Above normal (10,20,70)	Near normal, also above and below Normal	No privileged scenario (33,33,33)	No high impact events

Country (reference period)	**Seasonal temperature (JJA)**		**Seasonal precipitation (JJA)**		**High Impact Events**
	Observed	**MedCOF-22 climate outlook for temperature**	**Observed**	**MedCOF-22 climate outlook for precipitation**	
Greece (1981-2010)	Above normal	Above normal (10,20,70)	Drier than normal conditions prevailed over most of Greece.	Below normal (40,35,25)	The heat wave of July 2024 was the longest heat wave on record. Lasted 11 days on average and affected mainland and Ionian islands.
Hungary*	Above normal	Above normal (20,30,50)	Below normal	No privileged scenario (33,33,33)	
Israel (1991-2020)	Above normal	Above normal (10,20,70)	No precipitation	No privileged scenario (33,33,33)	No high impact events
Italy*	Above normal	Above normal (10,20,70) North: (20,30,50)	Normal or below normal	No privileged scenario (33,33,33)	
Jordan*	Above normal	Above normal (10,20,70)	Seasonally dry	No privileged scenario (33,33,33)	
Lebanon *	Above normal	Above normal (10,20,70)	Seasonally dry	No privileged scenario (33,33,33)	

Country (reference period)	**Seasonal temperature (JJA)**		**Seasonal precipitation (JJA)**		**High Impact Events**
	Observed	**MedCOF-22 climate outlook for temperature**	**Observed**	**MedCOF-22 climate outlook for precipitation**	
Moldova (1991-2020)	Above normal	Above normal (20,30,50)	Mostly below normal	No privileged scenario (33,33,33)	• On some days during the season, extreme meteorological phenomena in the form of heavy downpours and hail were observed in places across the territory; • On June 4, hail with a maximum diameter of 26 mm was observed in the area of the Nisporeni agrometeorological post; 12 • On June 12, in the area of the Soldanesti agrometeorological post, 58.5 mm of precipitation fell in 3 hours, at the Bravici meteorological station, 55.5 mm fell in 4 hours; • On June 14, in the area of the Brinza hydrological post (Cahul district), 90.2 mm of precipitation fell in 12 hours; • On July 24, in the area of the Telenesti agrometeorological post, 59 mm of precipitation fell in 2 hours. Heavy rains, in places with hail and squalls, caused significant damage to national economic facilities and agricultural lands. • The increased temperature regime and significant precipitation deficit observed in the territory of the Republic of Moldova for most of the summer (July/August) contributed to the occurrence of atmospheric and soil droughts. • Due to the dry weather observed in July and August in most of the country, unfavourable conditions were created for the formation of corn, sunflower, sugar beet crops, as well as for the growth and development of vegetable and other agricultural crops.

Country (reference period)	**Seasonal temperature (JJA)**		**Seasonal precipitation (JJA)**		**High Impact Events**
	Observed	**MedCOF-22 climate outlook for temperature**	**Observed**	**MedCOF-22 climate outlook for precipitation**	
Montenegro (1991-2020)	Above normal	Above normal (10,20,70)	Normal in the largest part of the country Dry in the north - eastern part of northern region and southern coastal region Very dry in eastern part of northern region	Below normal (40,35,25)	• 02.07.2024: strong wind and precipitation – 2 persons died (when a crane collapsed during a heavy storm, while one person died from lightning strike on the Luštica peninsula in the Bay of Kotor); • Strong wind in Nikšić caused material damage. On the coast, beach furniture was demolished, and several cars were destroyed by fallen trees; • In Podgorica and its surroundings, a large number of streets were under water, trees and electric poles were downed. • The wind in Bar uprooted parts of trees, damaged cars, as well as several vessels in the marina. • The Port of Bar suffered a lot of material damage due to the strong storm that hit Montenegro today, said the Minister of Transport and Maritime Affairs, Filip Radulović, and announced financial assistance from the Government. • Due to the strong storm, there was a problem with the electrical network in several municipalities. • -the wind was up to 200 km/h (reported by IHMS). • 05.08.2024: lightning strike: -caused Kotor forest fires, while in the village near Pljevlja house was burnt.
North Macedonia (1981-2010)	Above normal	Above normal (10,20,70)	Extremely dry to normal	Below normal (40,35,25)	• Highest number of summer days (Tmax>25.0C). • June Highest value of daily Tmin 23.6°C on 23rd in Skopje. Highest value of daily Tavg 31.4°C on 21st in Strumica

Country (reference period)	**Seasonal temperature (JJA)**		**Seasonal precipitation (JJA)**		**High Impact Events**
	Observed	**MedCOF-22 climate outlook for temperature**	**Observed**	**MedCOF-22 climate outlook for precipitation**	
Portugal *	Around normal in the west, above normal in the east	Above normal (10,20,70)	North: above normal South: seasonally dry	Below normal (50,30,20)	
Romania *	Above normal	Above normal (10,20,70)	Below normal	Below normal (40,35,25)	
Serbia (1991-2020)	Above normal	Above normal (10,20,70)	Below normal in most of Serbia. Average precipitation sums in some parts of central and southern Serbia	Below normal (40, 35, 25)	• Warmest summer for Serbia since 1951. • The warmest June, July and August. • The maximum seasonal air temperature exceeded in Sombor. • In most of Serbia, the highest minimum seasonal air temperature since the record-keeping began. • Since the record-keeping began in Serbia, record breaking minimum daily air temperature of 30,6°C was measured in Vrsac on July 13. • The maximum number of summer and tropical days, as well as tropical nights has been exceeded in most of Serbia. • Temperature humidity index – THI (feels like temperature) was above 40°C for 23 days and above 30°C for 83 days. • Five heat waves, in the middle of July and middle of August very intensive. • 4th driest summer for Novi Sad and Kopaonik, 5th driest for Cuprija, and 6th driest for Crni Vrh. • Extreme drought during July and August in most of Serbia

Country (reference period)	**Seasonal temperature (JJA)**		**Seasonal precipitation (JJA)**		**High Impact Events**
	Observed	**MedCOF-22 climate outlook for temperature**	**Observed**	**MedCOF-22 climate outlook for precipitation**	
Slovenia (1991-2020)	Above normal	Above normal (20,30,50)	Drier than normal in north-eastern, western, and southeastern Slovenia; Wetter than normal in central and eastern Slovenia	No privileged scenario (33,33,33)	• Thunderstorms/Squall lines on June 3, 2024: An extremely severe downpour from a slow-moving thunderstorm occurred between 17:45 and 19:15 CET. Radar and damage assessment suggest that approximately 100 mm of rain fell in less than an hour. Around 100 housed were flooded, some very severely. • Hail on July 1, 2024: a supercell thunderstorm developed near Grosuplje and travelled eastwards. Large hail, with a maximum size of around 4 cm (according to ESWD reports), fell particularly in a belt from Ivančna Gorica to Trebnje. Crops and cars were severely damaged. • Hail on July 13, 2024: Two supercell thunderstorms developed around 15:00 CET near Celje and travelled in an ENE direction towards Lendava. Both storms produced large hail, with many places experiencing hail up to 5 cm in diameter (according to ESWD reports), and up to 10 cm in the Slovenska Bistrica region. More than 200 roofs were damaged by hail in the municipalities of Slovenska Bistrica and Oplotnica alone. Many vehicles and photovoltaic systems were also severely damaged. • Thunderstorms/Squall lines from July 19 to 20, 2024: A chain of thunderstorms developed over northern Slovenia in the evening of July 19 and travelled southeast towards Croatian border. Many stations reported severe downpours, reaching or exceeding the 100-year return period in some places. There was flooding in many areas and some landslides, including in Logarska Dolina and near Dravograd. The village of Kokra was severely hit by a landslide, which damaged 10 houses.

Country (reference period)	**Seasonal temperature (JJA)**		**Seasonal precipitation (JJA)**		**High Impact Events**
	Observed	**MedCOF-22 climate outlook for temperature**	**Observed**	**MedCOF-22 climate outlook for precipitation**	
Spain (1991-2020)	Above normal (extremely warm)	Above normal (10,20,70)	Mostly normal or above normal, only parts of the north and southeast below normal	Below normal (50,30,20)	Summer had two heat episodes considered as heat waves were: a) 23 July – 1 August b) 4 August - 12 August Other notable warm episodes, but which cannot be classified as heat waves, were observed between 3-8 June, 24-27 June, 4-5 July, 10-11 July, 18-20 July, 17-24 August and 27-28 August. The highest summer temperatures were: 42.9°C (Bilbao, 11 August), 43.5°C (Morón de la Frontera, 24 July), 43.3 °C (Badajoz,24 July), and 43.2 °C (Granada/airport, 31 July). The lowest summer temperatures were: 1.9 °C (Burgos/airport, 13 June), 3.1 °C (Soria, 13 June), 2.7°C (Molina de Aragón, 2 June) and 3.7 °C (León, 2 June). The highest values of daily summer precipitation were: 80.2 mm (Palma de Mallorca, 11 June), 65.6 mm (Reus, 11 June), 51.2 mm (Murcia, 12 June), 40.3 mm (Donostia, 20 June), 38.6 mm (Valladolid, 25 June), 33.4 mm (Teruel, 6 July), 27.2 mm (Lleida, 29 July), 24.3 mm (Hondarribia, 6 July), 93.2 mm (Menorca/airport, 3 August), 57.2 mm (Guadalajara, 30 August) and 48.2 mm (Teruel, 27 August).
Syria *	Above normal	Above normal (10,20,70)	Seasonally dry	No privileged scenario (33,33,33)	

Country (reference period)	**Seasonal temperature (JJA)**		**Seasonal precipitation (JJA)**		**High Impact Events**
	Observed	**MedCOF-22 climate outlook for temperature**	**Observed**	**MedCOF-22 climate outlook for precipitation**	
Türkiye (1991-2020)	Above normal Near normal in eastern parts	Above normal (10, 20,70)	Below normal in western, and southeastern parts Above normal in inner and north-eastern parts	Below normal (40,35,25) in western and inner parts East: No privileged scenario (33,33,33)	• Summer 2024 was the hottest summer season on record. • June 2024 and July 2024 were the hottest months, while August 2024 ranked as the fourth hottest. • Maximum temperature records were broken at 65 stations in June 2024, 3 stations in July 2024, and 3 stations in August 2024. • Between 15 and 18 August 2024, a fire in Izmir damaged many houses and workplaces across an area of 2,159 hectares.
Ukraine (1991-2020)	Above normal	Above normal (20,30,50)	Below normal	Below normal (40,35,25)	• In June heavy rains 30-98mm/4-9h were recorded in Zakarpattia, Ivano-Frankivsk, Lviv, Vinnytsa, Kyiv regions. In Vylkovo (Odesa region) was recorded heavy shower 82 mm/1h. 14/06/24. • In July storm squalls (with speed 25-28 m/s) were fixed in Kherson and Odesa regions. Heavy rains 30-65mm/2-9h were recorded in Lviv, Zakarpattia, Ivano-Frankivsk regions, heavy showers 30-38 mm/1h were in Chernihiv and Kyiv regions. • In August heavy rains 30-71mm/6-12h were recorded in the western part of the country, also in Chernihiv and Odesa regions. Locally caused loss of power, telecommunications, utilities and transport. • The summer 2024 was one of the hottest since 1961, and in many regions, it was the warmest on record. • The summer was dry in most regions, except for the west of the country.

Note:

*no national reports. Data base: ERA5 1991-2020 for temperature, GPCC 1991-2020 for precipitation

North Africa (RA I)

Country (reference period)	**Seasonal temperature (JJA)**		**Seasonal precipitation (JJA)**		**High impacts events**
	Observed	**MedCOF-22 climate outlook for temperature**	**Observed**	**MedCOF-22 climate outlook for precipitation**	
Algeria*	Below normal to normal in the south Above normal elsewhere	Above normal (10,20,70)	Below normal in the North Near to above normal elsewhere	No clear signal (33/ 33/33)	No comment
Egypt (1991-2020)	Above normal	Above normal (10,20,70)	Below normal	No clear signal (33/33/33)	No comment
Libya*	Above normal	Above normal (10,20,70)	Normal to above normal	No clear signal (33/33/33)	No comment
Morocco*	Above normal over the north Normal to below normal over the south	Above normal (10,20,70)	Below normal over the north Normal to above normal elsewhere	No clear signal (33/33/33)	No comment

Country (reference period)	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	**MedCOF-22 climate outlook for temperature**	**Observed**	**MedCOF-22 climate outlook for precipitation**	
Tunisia (1991-2020)	Above normal	Above normal (10,20,70)	Below normal	No clear signal (33/33/33)	Precipitation: July 2024 is the second driest July on record since 1950. The total cumulative rainfall for the 27 main stations for the month was 1.8 mm . Temperature: July 2024 was ranked the 3rd hottest July since 1950.The average temperature (27 main stations) recorded was higher than the reference average (1991-2020) with a significant difference of +1.7°C. Several new records were registered for maximum temperature: On 01/07/2024: Siliana, 46.9°C; Kairouan,49.2°C.

Note:

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

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

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