MEDITERRANEAN CLIMATE OUTLOOK FORUM
MEDCOF-17 ONLINE MEETING

ANALYSIS AND VERIFICATION
OF THE MEDCOF-16 CLIMATE OUTLOOK
FOR THE 2021 SUMMER SEASON
FOR THE MEDITERRANEAN REGION (MED)

Draft version

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Compiled by

Agencia Estatal de la Meteorología (AEMET)

Madrid, Spain

WMO RA I North Africa RCC Tunisian Node

Institut National de la Météorologie (INM)

Tunis, Tunisia

WMO RA VI RCC Offenbach Node on Climate Monitoring

Deutscher Wetterdienst (DWD)

Offenbach, Germany

The following MedCOF verification report is based on

- the outcome of the consensus forecast of MedCOF 16,
- climate monitoring results of RA I NA RCC and RA VI RCC networks,
- national verification reports received from NMHSs or posted in RCOF forums of MedCOF, SEECOF or PRESANORD,
- SEECOF-25 verification report

1 MedCOF-16 Climate outlook for the 2021 summer season

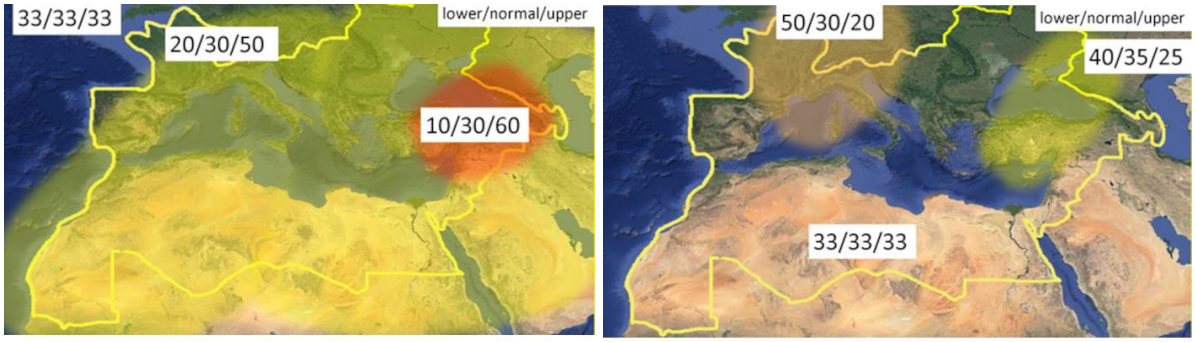


Figure 1: Graphical presentation of the climate outlook for the 2019-20 summer season for the Mediterranean region (a) Temperature Outlook, (b) Precipitation Outlook

1.1 General circulation

Winter La Niña event had weakened during previous months, evolving towards neutral conditions, situation that was expected to continue during summer season. Positive sea surface temperature anomalies appeared over Atlantic Ocean, south of Greenland, and negative ones over North Sea. Within this general context, higher than normal pressures were expected over large parts of central Europe, and lower than normal over parts of Northern Africa and Middle East.

1.2 Temperature

As stated in the MedCOF-16 consensus statement for the seasonal climate outlook for the 2021 summer season, warmer than normal conditions over most of the domain (Fig. 1a). The highest probability for above-average temperatures was expected over Eastern Mediterranean, Turkey and the Caucasus.

1.3 Precipitation

Regarding precipitation, the consensual forecast had shown drier than normal conditions over France and North Western Mediterranean Sea. A less robust dry signal appeared over Turkey, Southeastern Ukraine and Western Caucasus. For the rest of the region no large-scale precipitation signal was present in the forecasts (see figure 2). The climatological forecast (33, 33, 33) over the Southern part of the domain also implies the fact that no meaningful forecast could be provided for these seasonally dry areas.

2 Analysis of the 2021 summer season

Analysis of the summer season temperature and precipitation anomalies and general circulation are based on

- maps and seasonal bulletins on the climate in the WMO region I – NA and VI for the winter 2019/20:
    - 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/),
- the Regional Climate Outlook Forum
    - for Southeastern Europe (SEECOF, http://www.seevccc.rs),
    - for North Africa (PRESANORD, http://acmad.net/rcc/presanord.php),
- national verification reports from MedCOF participants.

2.1 General circulation

2.1.1 Ocean

Tropical Pacific temperatures were mostly close to normal, slightly cold over Eastern Tropical Pacific (Fig. 2), although most of Northern Pacific Ocean showed positive anomalies (with large areas with more than +1K). Eastern tropical Indian Ocean was warmer than normal. The Mediterranean, too, was warmer than normal with anomalies of +1 K. The Black Sea also was above +0.5 K warmer than normal. Southern Tropical Atlantic showed positive anomalies, surpassing +1 K over large areas, and even reaching +2K close to African Shores.

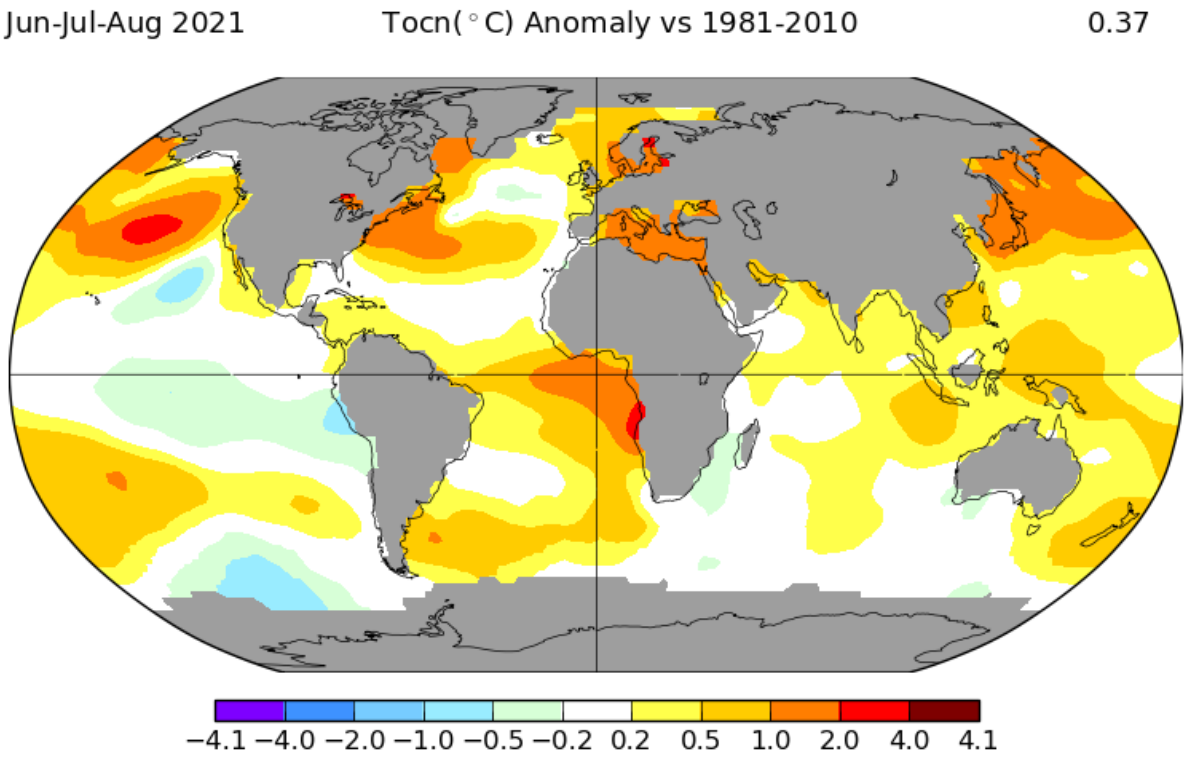


Figure 2: Sea surface temperature anomalies for boreal summer 2021 (June-August), 1981-2010 reference. Data from ERSSTv5 Ocean model analysis with 250km smoothing, source: NASA GISS, https://data.giss.nasa.gov/gistemp/maps/

ENSO

Looking at Figure 2, anomalies were close to normal or slightly cold for most of the Tropical Pacific. Figure 3 shows neutral ENSO conditions during June-August on el Niño3.4 region, with a tendency to evolve towards negative anomalies.

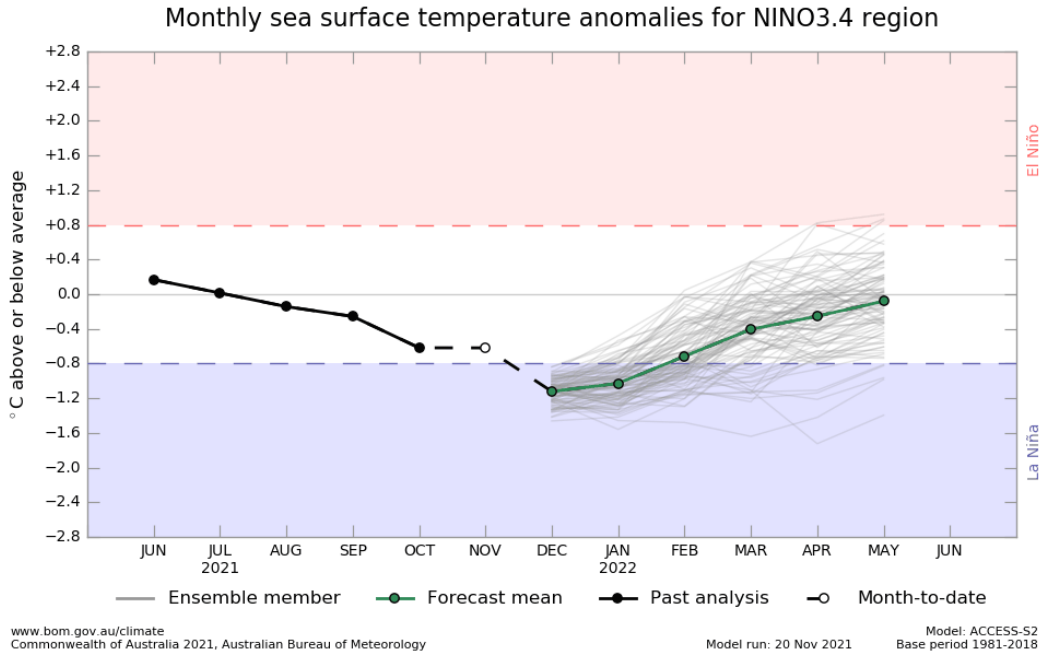


Figure 3: Observed and forecasted evolution of el Niño 3.4 (ref. 1981-2010)

Indian Ocean Dipole (IOD)

The IOD remained between neutral and negative phase boundaries during summer 2021, coming from high positive values in Spring.

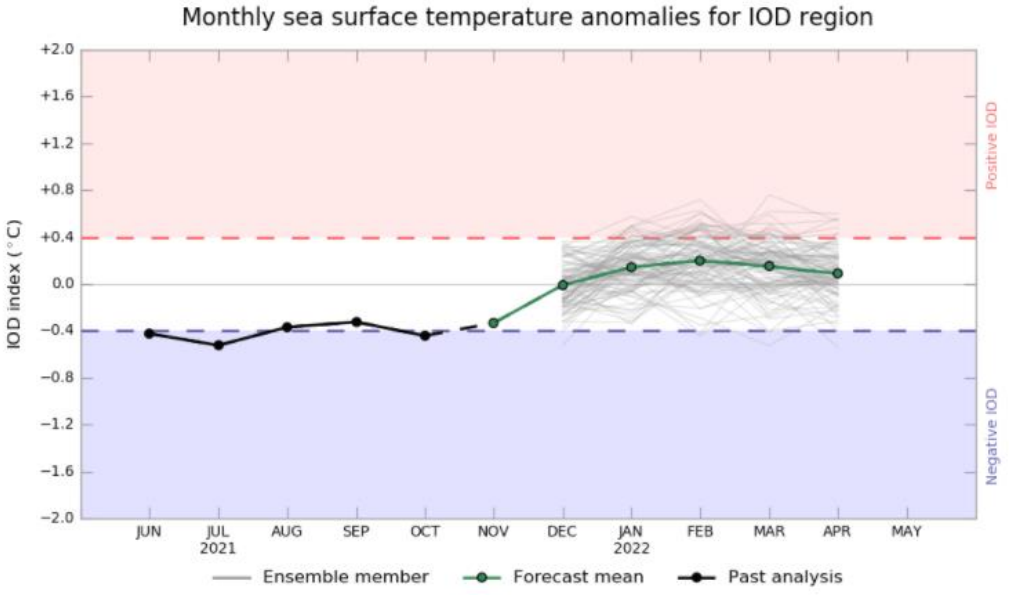


Figure 4: Indian Ocean Dipole (IOD) index (monthly values). Source: Australian Bureau of Meteorology (BOM), http://www.bom.gov.au/climate/enso/#tabs=Indian-Ocean

2.1.2 Atmosphere

Seasonal averages of 500-hPa geopotential in summer 2021 show positive geopotential anomalies over Northern Atlantic Ocean and NorthWest Europe. Negative anomalies were observed over Eastern Europe, Eastern Mediterranean and SouthWestern Europe. Positive (anticyclonic) anomalies extended over the western and central Mediterranean up to the Balkans and Ukraine, while South Caucasus, Turkey, Cyprus and Middle East had negative anomalies (Fig. 5).

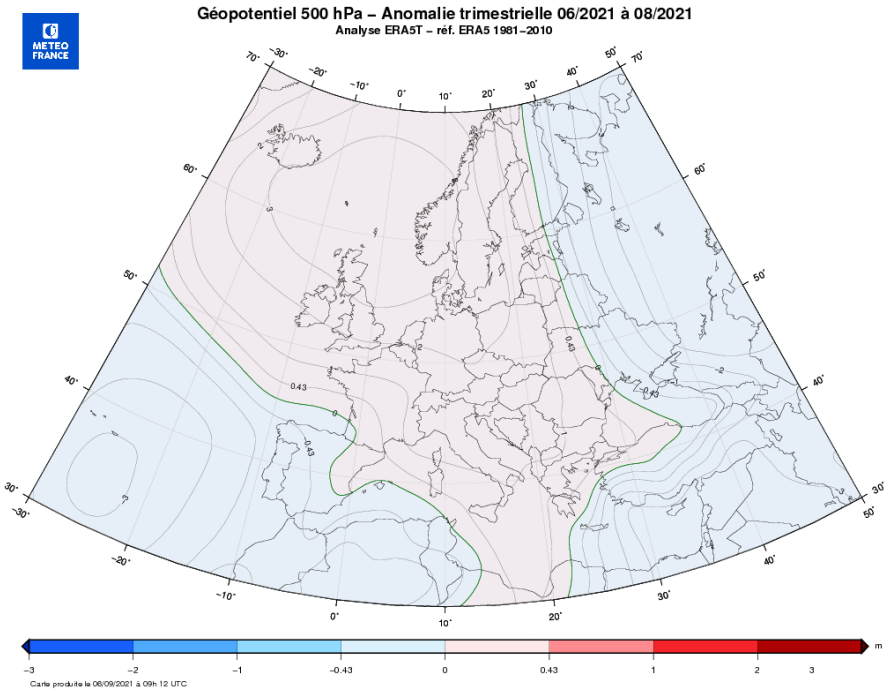
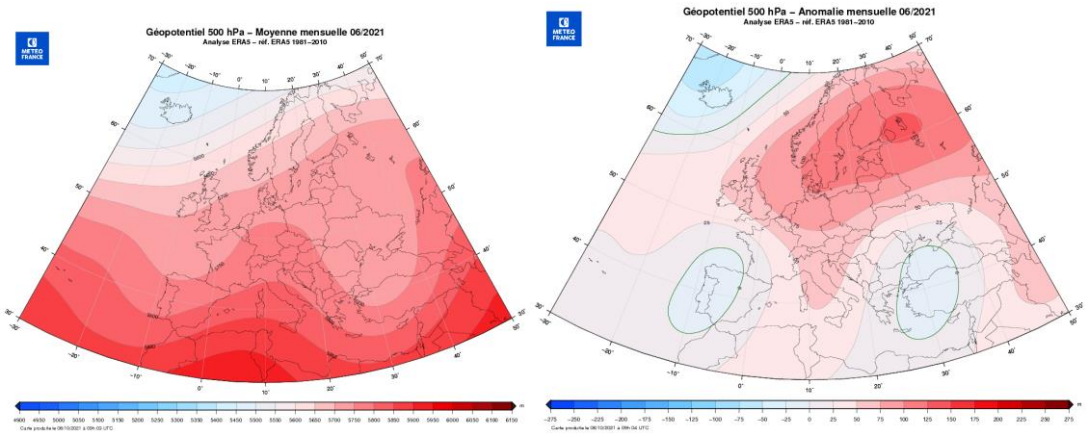


Figure 5: Seasonal standarized anomalies of 500-hPa geopotential for summer 2021 (1981-2010 reference). Source: Météo France, data source: ECMWF ERA5 reanalysis, http://seasonal.meteo.fr/content/suivi-clim-cartes-ERA5 (login required)

However, anomaly patterns changed significantly over the course of the summer, with positive anomalies moving from the Baltic Sea in June towards Scandinavia and Iceland along July and August, with a clear meridional pattern in August. (Fig. 6).



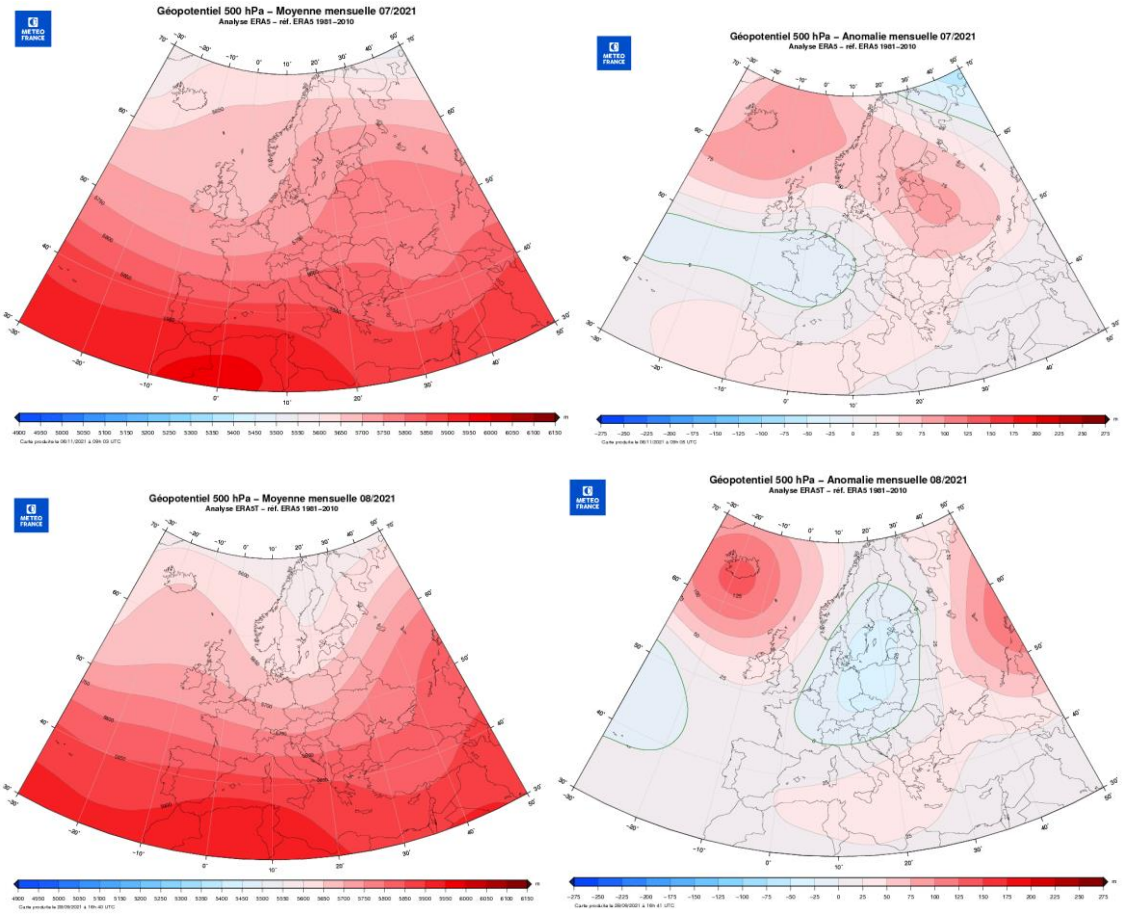
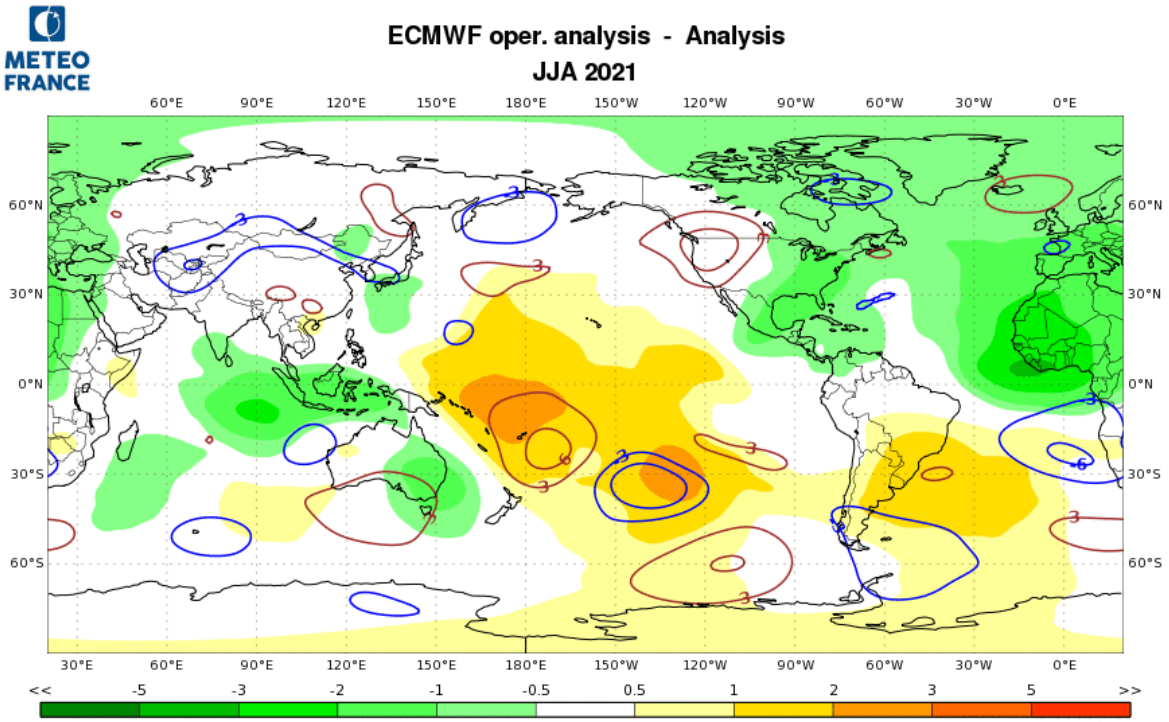


Figure 6: 500hPA mean and anomaliest for he months of June, July, and August 2021.


METEO FRANCE
ECMWF oper. analysis - Analysis
JJA 2021
60°E 90°E 120°E 150°E 180°E 150°W 120°W 90°W 60°W 30°W 0°E
60°N
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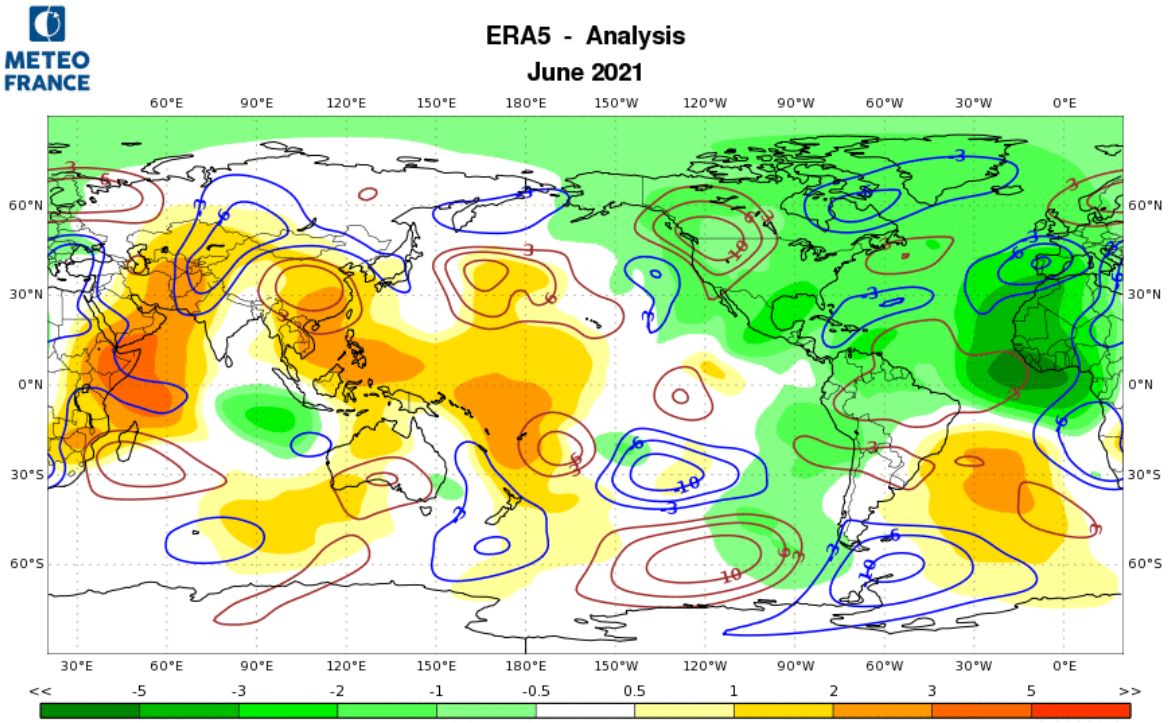
200hPa velocity potential and 200hPa streamfunction - zonal mean
unit : km2/s
3-months ensemble mean anomaly - reference period : 1993-2016


METEO FRANCE
ERA5 - Analysis
June 2021
60°E 90°E 120°E 150°E 180°E 150°W 120°W 90°W 60°W 30°W 0°E
60°N
30°N
0°N
30°S
60°S
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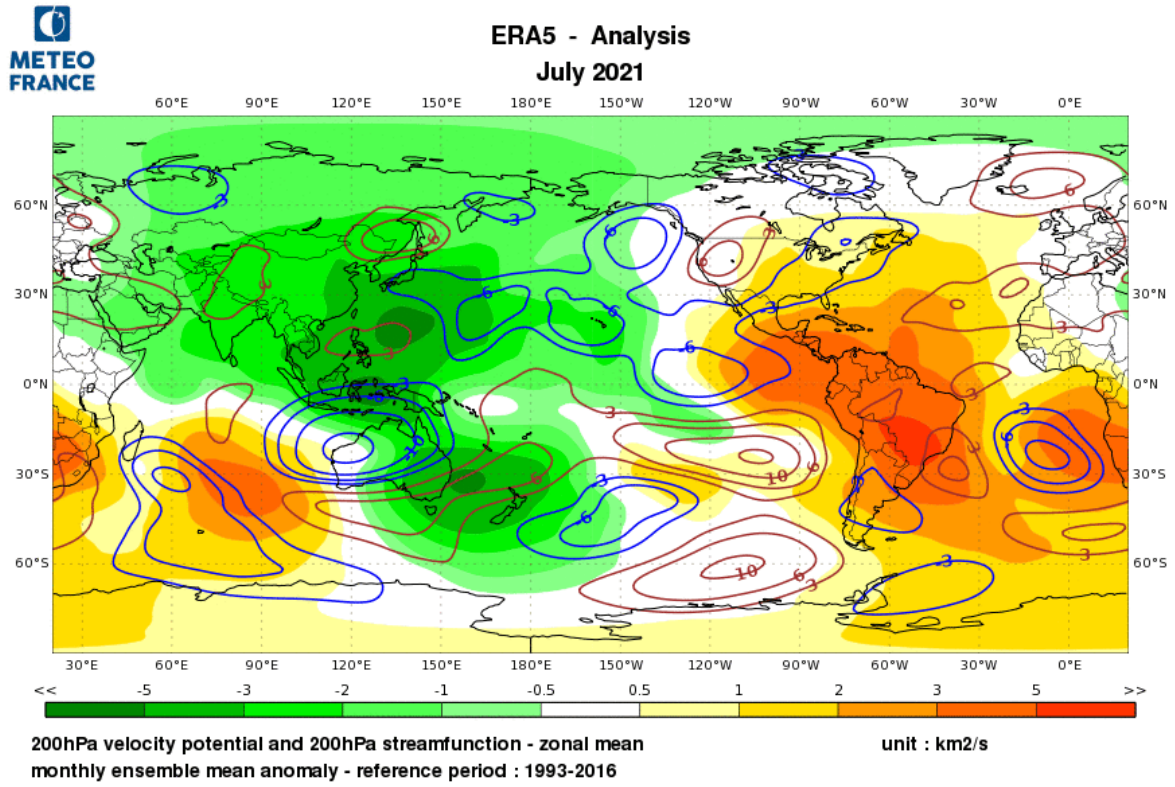
200hPa velocity potential and 200hPa streamfunction - zonal mean
unit : km2/s
monthly ensemble mean anomaly - reference period : 1993-2016



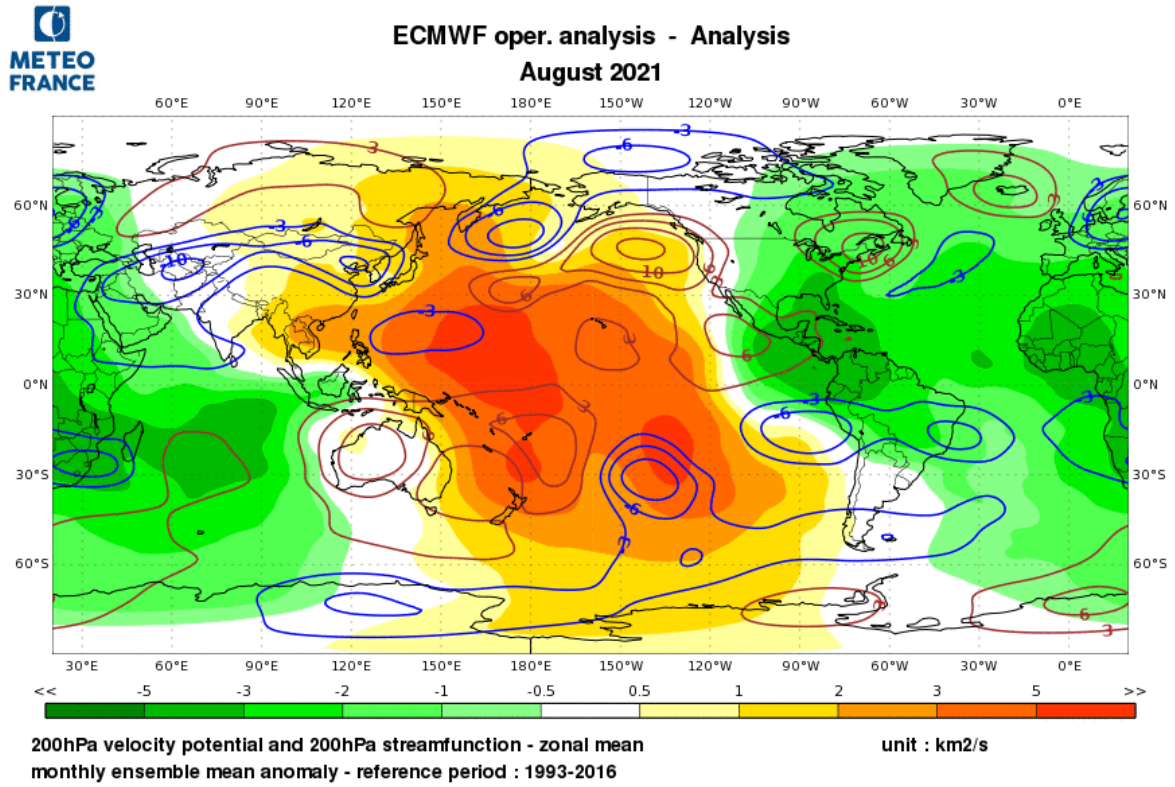


Figure 7: Velocity potential anomalies (color shading: green: upward motion, orange: downward motion) and stream function anomalies (isolines, red: anticyclonic in the northern hemisphere, blue: cyclonic in the northern hemisphere, vice versa in the southern hemisphere). Data basis: ECMWF analysis. Source: Météo France, http://seasonal.meteo.fr/sites/data/Bulletins/Verification/VERIFICATION_202003_DJF2019-2020.pdf , login required.

Downward motion was observed over Tropical Pacific and upward motion over Western Africa in average for summer 2021. However, low amplitude anomalies observed in June-August average maps can be the result of the very different anomaly patterns observed along the summer months, partly due to a very active MJO oscillation during summer. This can be one cause for the changing geopotential anomaly patterns observed over Europe.

Monthly NOAA CPC teleconnection patterns showed differences among summer months, with a positive phase for both the North Atlantic Oscillation (NAO) in June and negative one in August, and positive Scandinavian pattern in July shifting to the opposite phase in August. Positive phase of East Atlantic pattern (EA) in all three summer months, most intense in July (Tab. 1).

yyyy	mm	NAO	EA	WP	EP/NP	PNA	EA/WR	SCA	TNH	POL	PT	Expl. Var.
2021	6	1.08	1.02	-0.82	-0.26	0.82	-1.77	-0.11	-99.90	0.86	-99.90	65.5
2021	7	0.06	2.16	-0.44	-1.28	0.11	-0.49	1.48	-99.90	0.84	-99.90	71.6
2021	8	-0.49	1.08	-1.94	-1.82	0.93	-2.37	-1.40	-99.90	-0.51	-1.17	48.8

Table 1: Circulation indices of NOAA CPC patterns for the winter months 2019/20. Source: ftp://ftp.cpc.ncep.noaa.gov/wd52dg/data/indices/tele_index.nh

The circulation type classification of Météo France showed a clear dominance of blocking pattern in average, although zonal regime was most frequent in August.

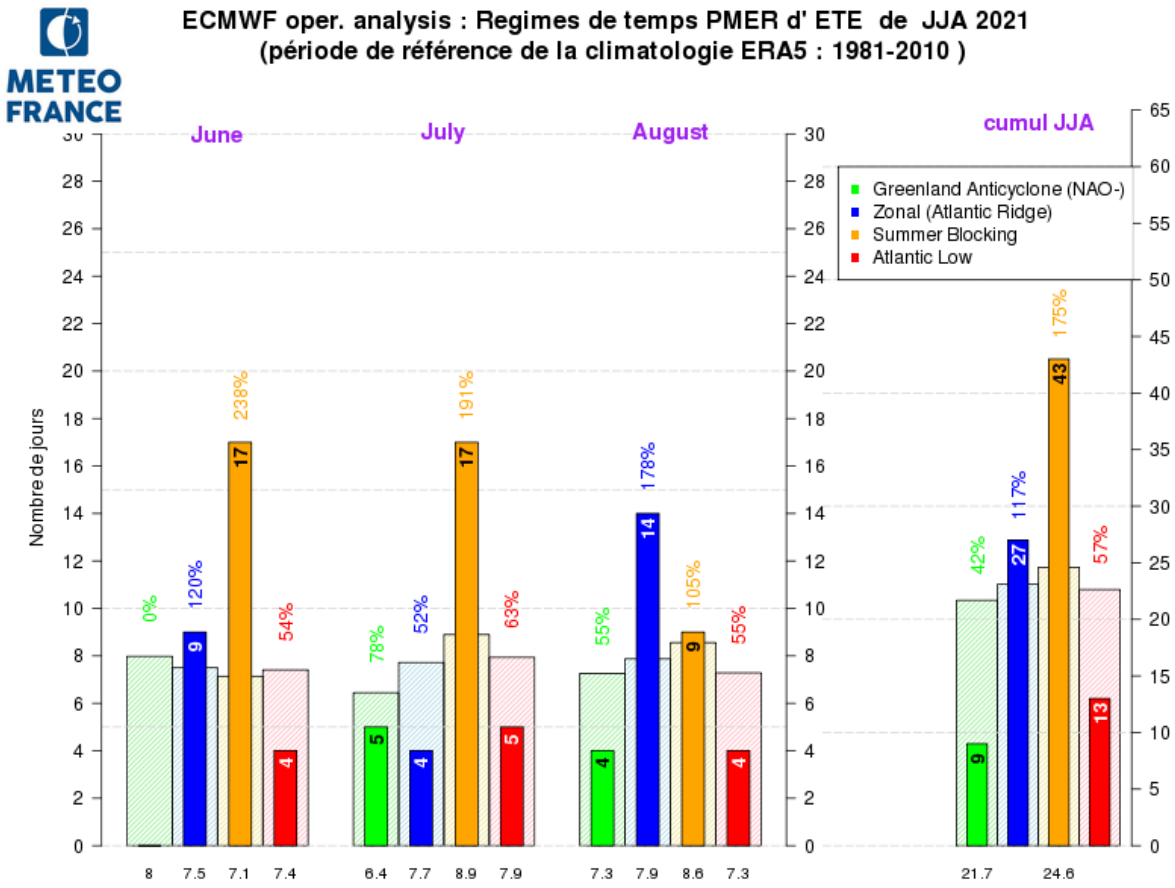


Figure 8: Number of days with circulation types of the Météo France classification for each month of the summer 2021 season and for the whole season (right), and in percent of the climatological frequency distribution 1981-2010. Source: Météo France, http://seasonal.meteo.fr/en/content/suivi-clim-regimes-trim

Seasonal mean sea level pressure in summer 2021 was characterized by almost neutral anomalies, with low pressures appearing over Western Mediterranean and the Black Sea and high pressures over the rest of the domain.

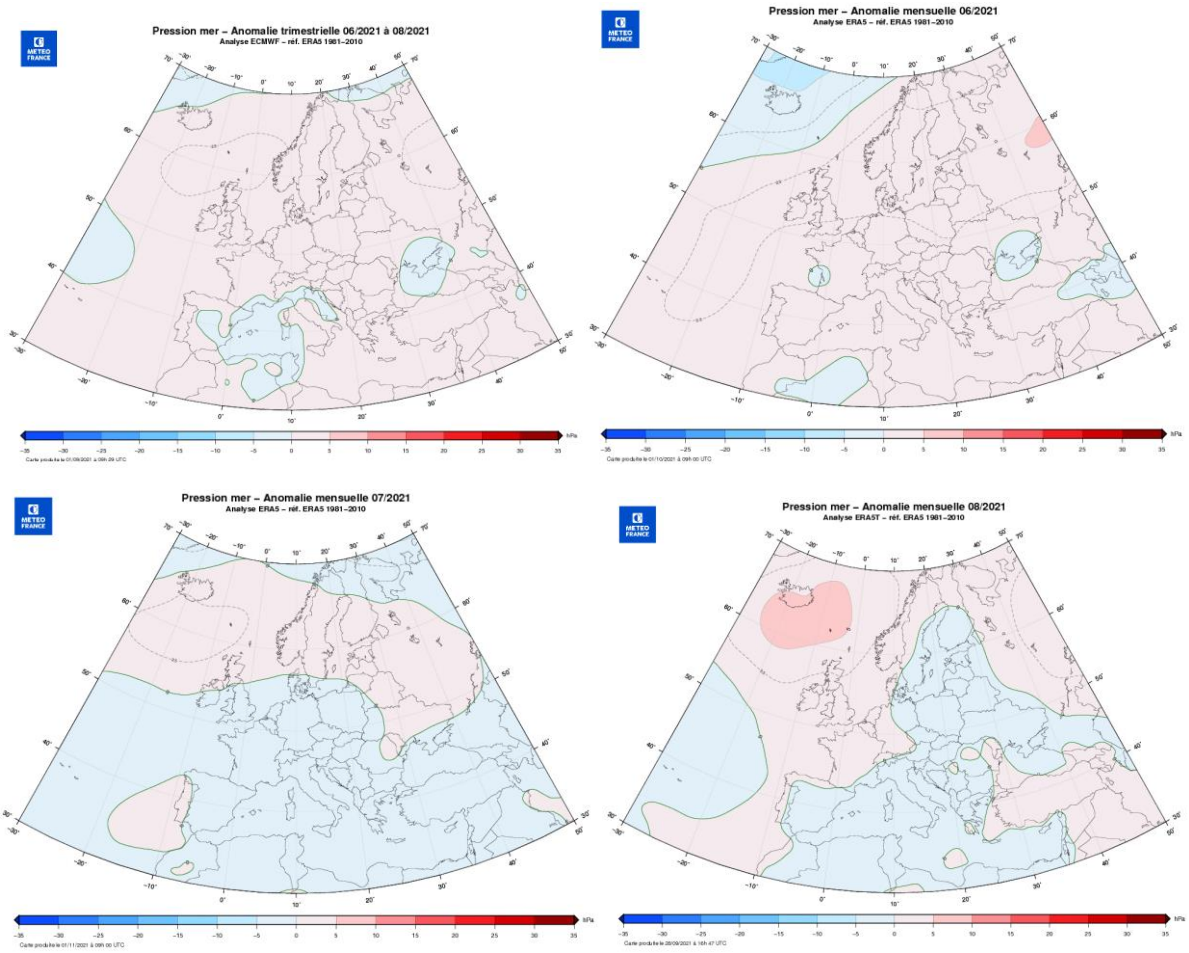


Figure 9: Seasonal mean sea level pressurev anomalies for summer 2021 (1981-2010 reference). Source: http://seasonal.meteo.fr/content/suivi-clim-cartes-ERA5

For single months, again significant differences are found.

2.2 Temperature

Europe and Middle East (RA VI)

Seasonal means and anomalies

Seasonal mean temperature in summer 2021 ranged from below 10°C in high mountain areas to over 30ºC over extense Areas of the Middle East and Northern Africa. Temperatures between 10 and 15ºC were registered over northern Scandinavia, Scotland and Alpine regions, between 15 and 20 ºC over most of Europe, and over 20ºC in most of Iberia, Italy, The Blakans, Ukraine, Southwestern Russia, and Turkey, surpassing 25º over Southern Iberia, Italy, Greece, Southern Turkey, Middle East and Azerbaijan.

Temperature was above the 1981-2010 normal in the whole RA VI MedCOF region, with the exception of Portugal and small areas over Western France. Anomalies ranged from around -0.5ºC over Portugal and Western France to +3.5ºC over parts of Western Russia.

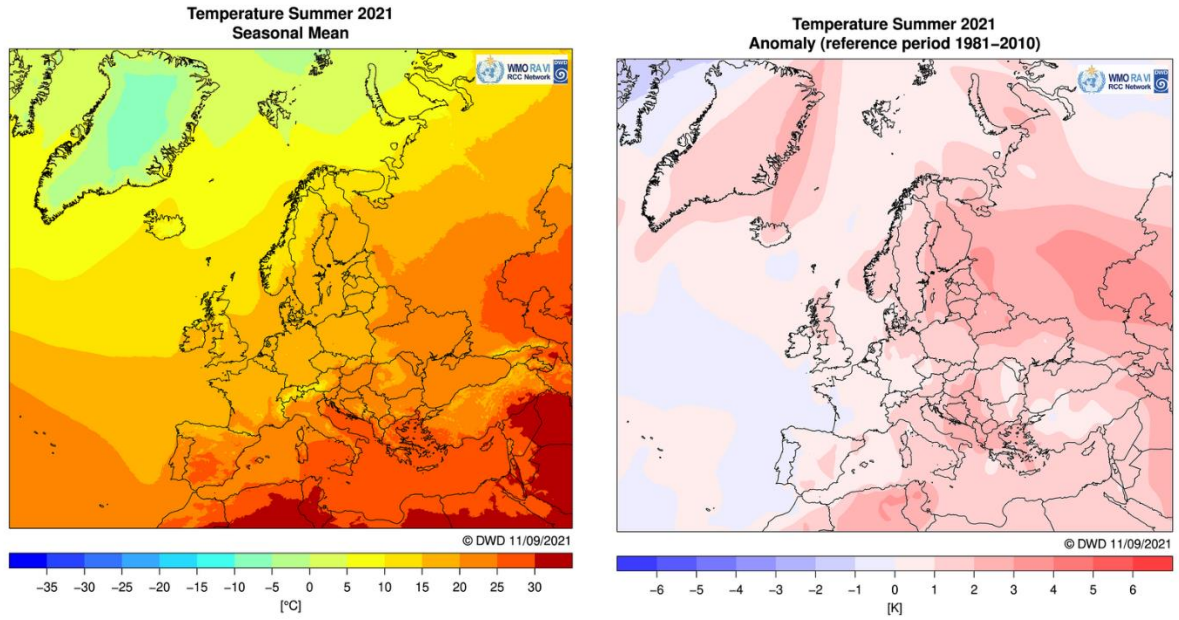


Figure 10: Surface air temperature for winter 2019/20. Left: seasonal mean, right: anomalies, 1981-2010 reference, source of both maps: WMO RAVI RCC, based on interpolated CLIMAT data, www.dwd.de/rcc-cm

Terciles

In terms of terciles, cold tercile were observed over Western Iberia and Central Turkey, normal conditions over the rest of Iberia, France, Switzerland, Southern Germany and Southwestern Ukraine. Warm tercile was observed over the rest of the domain (Figures 11 and 12 – note that there are slight differences among both maps due to the different reference period). ECAD stations data show warm tercile observed over Eastern half of Iberian Peninsula, in agreement with Figure 12 (both have the same reference period).

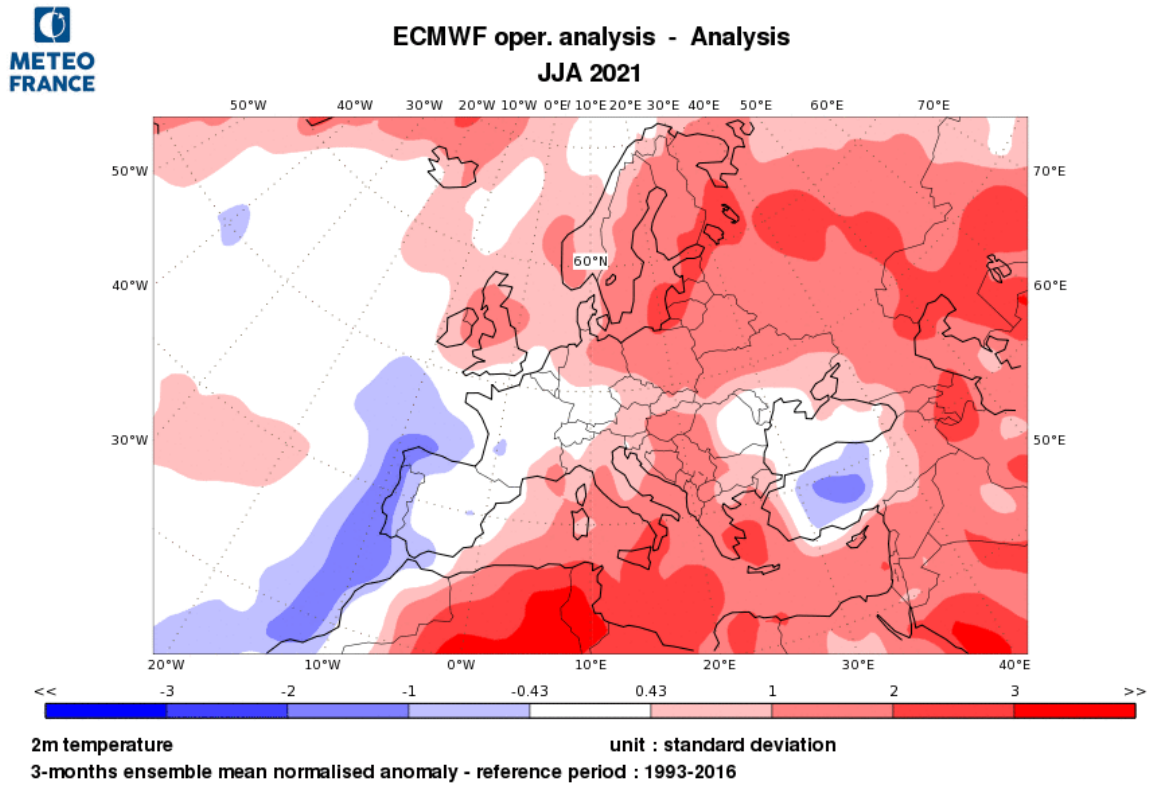


Figure 11: Seasonal normalized anomalies of summer 2021 surface air temperature based on ECMWF-ERA5 grid data, 1993-2016 reference. The data range between -0.43 and +0.43 represents the middle tercile, below -0.43 the lower tercile and above +0.43 the upper tercile. Source: Météo France, http://seasonal.meteo.fr/content/suivi-clim-cartes-ERA5

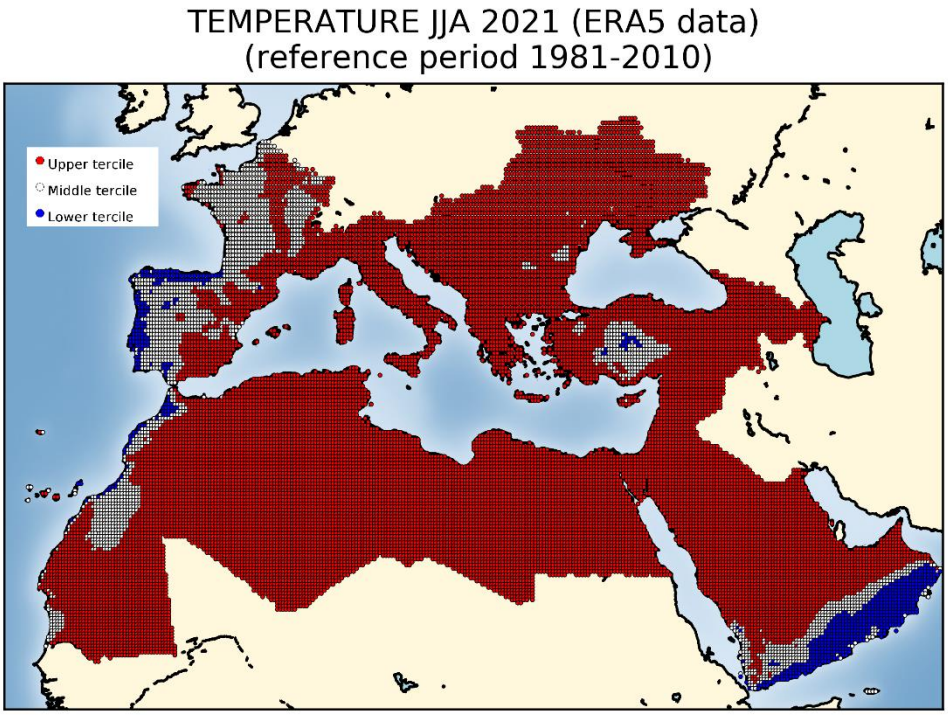


Figure 12: Terciles of winter 2019/20 surface air temperature based on ERA5 Reanalysis, 1981-2010 reference. Source: AEMET, data source https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5

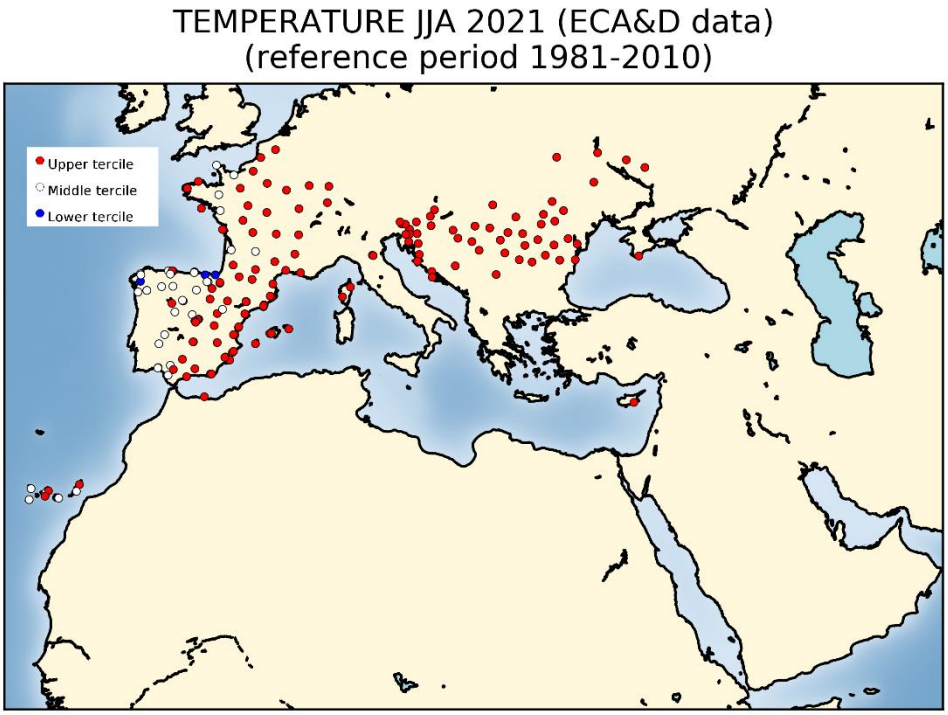


Figure 13: Terciles of summer 2021 surface air temperature based on individual ECA&D station data (lower graph), 1981-2010 reference. Source: AEMET, data source: http://www.ecad.eu/

North Africa (RA I)

Summer 2021 was hatter than normal in the most parts of North African countries: Morocco, Algeria, Tunisia, Libya and Egypt. Mean temperatures were ranging between 16°C and 46°C even 48 °C in some region of Algeria. The seasonal mean temperature was at its minimum over the center of Morocco and the coastal areas of North Africa.

The anomalies (with respect to 1981-2010 normal) reached between -1°C over the extreme south of Egypt and aver the north east of Libya and +2°C in the almost part of the regions even +3°C in the south west of Algeria.

In Tunisia temperatures mostly remained above normal throughout the season. A very large part of Tunisian country was affected by the high heat, and most regions experienced exceptionally high temperatures with several records. the average temperature reached 29.95 °C and was above the reference normal (1981-2010) with a significant difference of (+2.65 °C).

Maximum temperatures during the summer of 2021 were high in all regions and ranging from 30° C in Mahdia to 42.7° C in El Borma, they were above the seasonal reference normal with a variation ranging from (+0 , 3° C) in Mahdia to (+ 4.2 C) in Thala. This summer is the hottest summer since 1950.

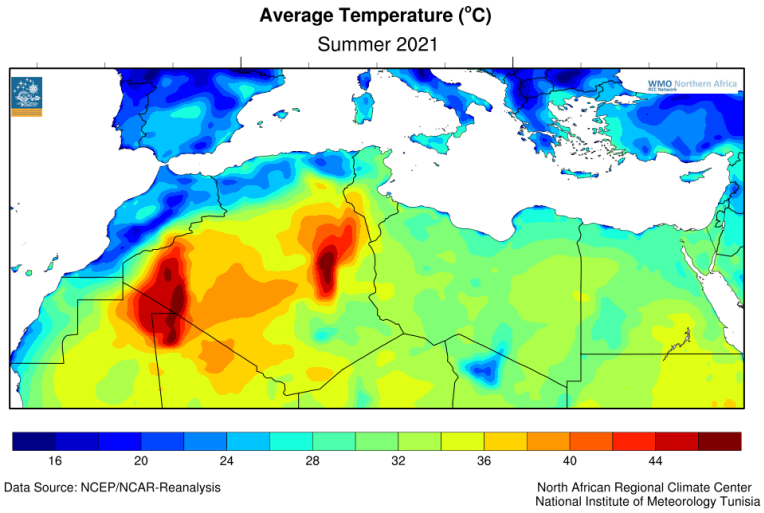


Figure 14: Mean temperature for summer season 2021 in North Africa (in °C). Source: INM, (Data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov)

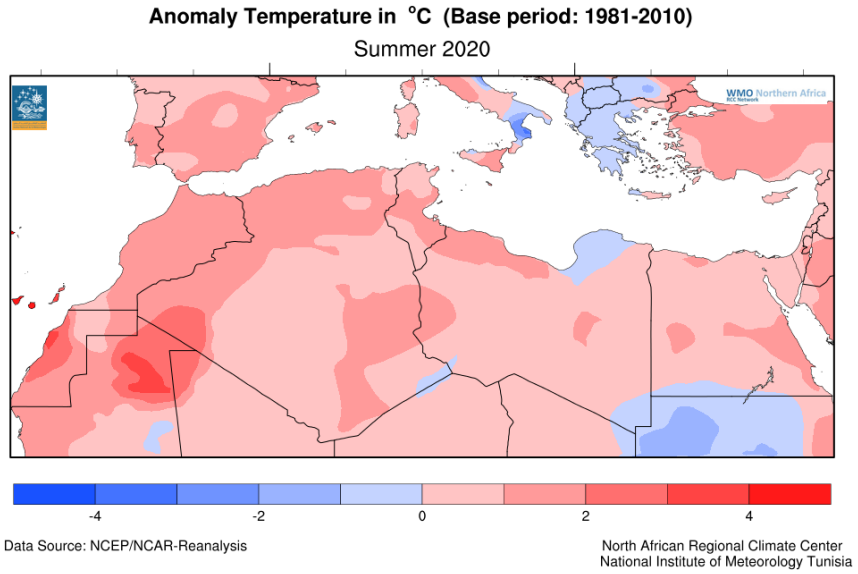


Figure 15: Temperature anomaly for summer season 2021 in North Africa (in °C),reference period 1981-2010. Source: INM, Data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov

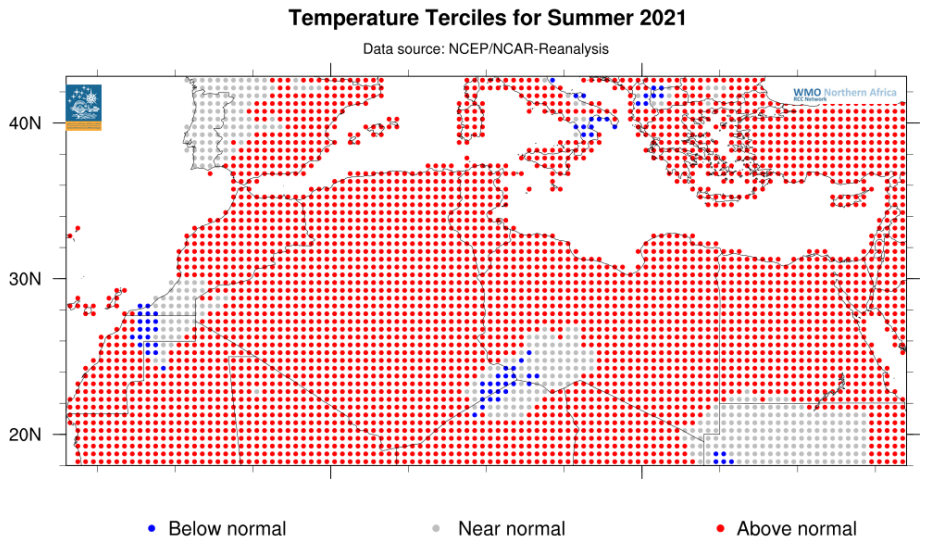


Figure 16: Tercile distribution for temperature of JJA 2021, 1981-2010 reference.

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 south east of Libya and south of Morocco where the temperature was in the middle tercile.

2.3 Precipitation

Europe and Middle East (RA VI)

Seasonal means and anomalies

Seasonal precipitation totals in summer 2021 in the European MedCOF domain ranged from less than 10mm in Southern Iberia and to above 150 mm locally at Alpine Region (Fig. 17). Precipitation was around normal or below normal in much of Iberia, Southern France, Italy, on the Balkan Peninsula, Georgia, Armenia, Azerbaijan,and Eastern Turkey and extense areas of the Middle East. Precipitation was mostly above normal in eastern Spain, northern France, Southern Ukraine and most of Turkey, Armenia, Azerbaijan, and the Middle East.

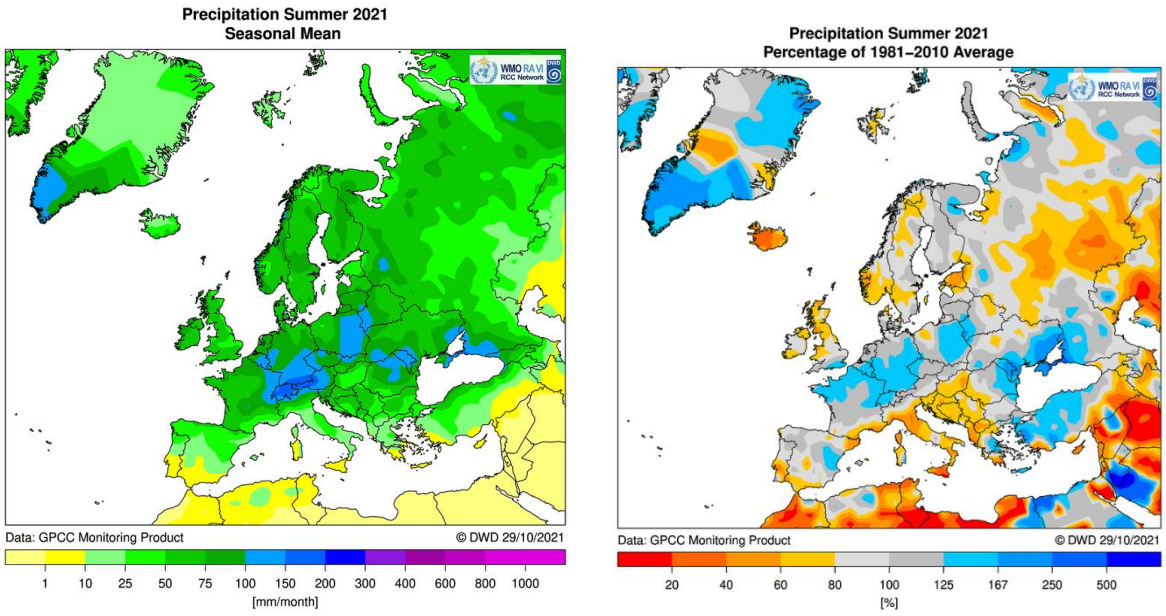
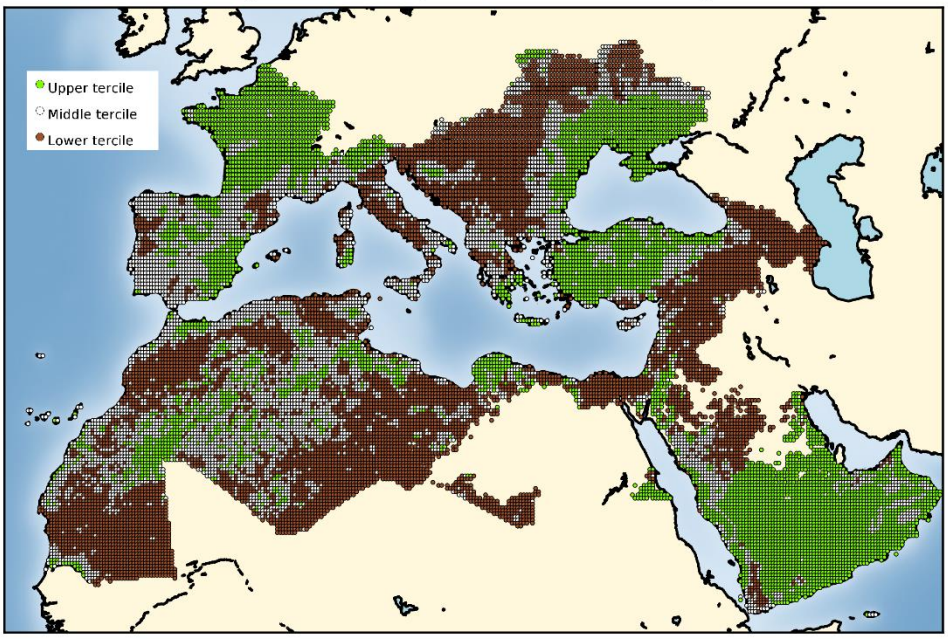


Figure 17: Precipitation for summer 2021 in Europe. Left: seasonal total in mm/month, right: percentage of 1981-2010 average, source: WMO RAVI RCC, www.dwd.de/rcc-cm, data source: GPCC, http://gpcc.dwd.de

Terciles

In terms of terciles, precipitation in Italy, on the Balkan Peninsula, the Caucasus and the Middle Eastwas mostly in the lower tercile, locally in the middle or rarely in the upper tercile, according to ERA5 reanalysis (Fig. 18). Iberia, parts of Italy and Southern part of France had precipitation mostly in the middle tercile, partly in the upper or lower tercile. Northern half of France, most of Turkey, Cyprus, and Southern Ukraine had precipitation mainly in the upper tercile. GPCC analysis is very similar.

PRECIPITATION JJA 2021 (ERA5 data)
(reference period 1981-2010)



PRECIPITATION JJA 2021 (GPCC data)
(reference period 1981-2010)

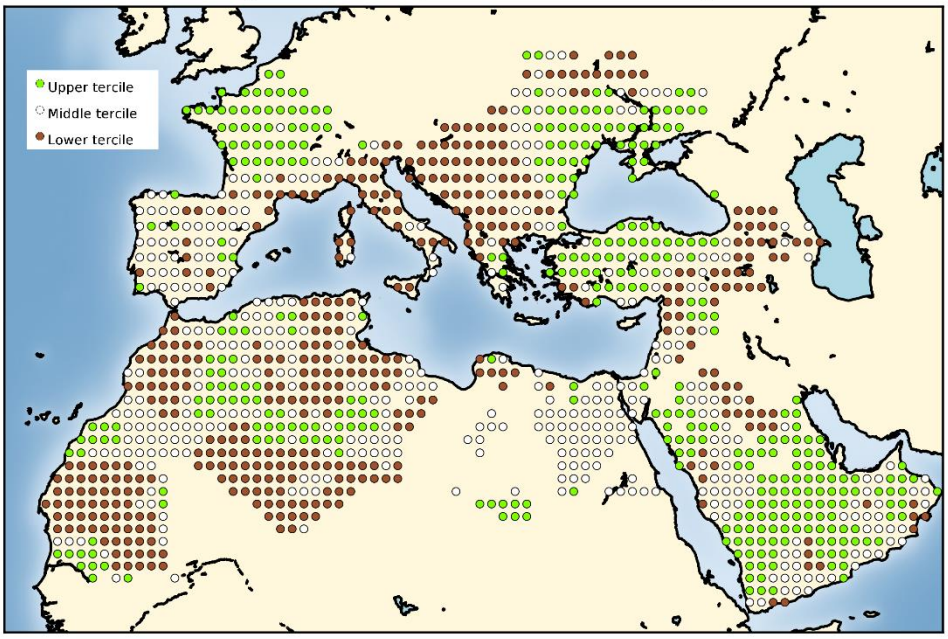


Figure 18: Terciles of summer 2021 precipitation based on ERA5 reanalysis (upper graph) and GPCC (lower graph) grid data, 1981-2010 reference. Source: AEMET, data reference: ERA5: https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5 , GPCC: http://gpcc.dwd.de

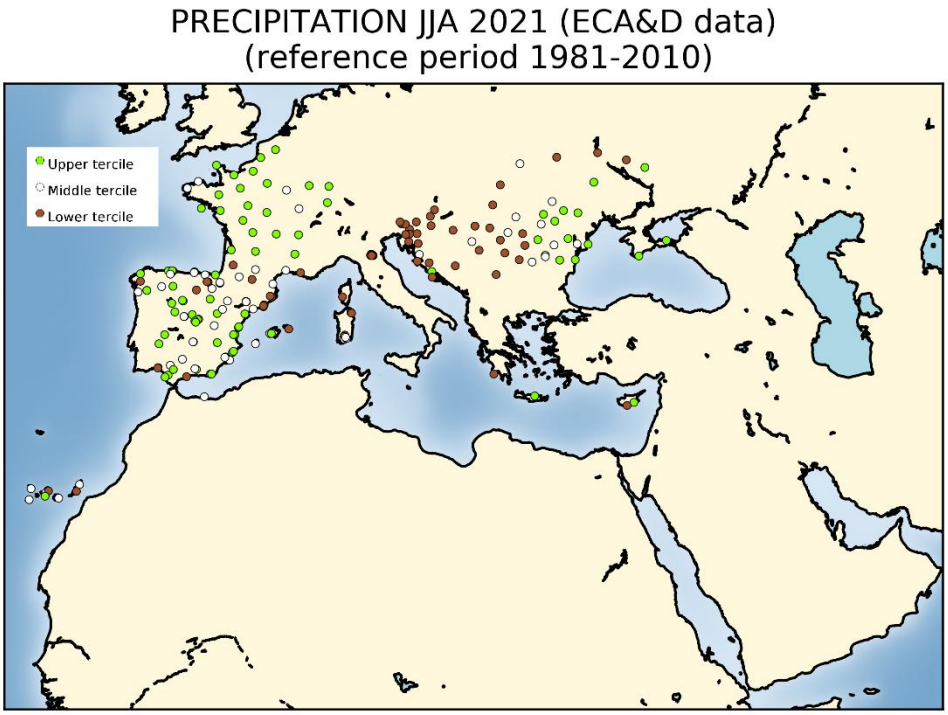


Figure 19: Terciles of summer 2021 precipitation based on individual ECA&D station data (lower graph), 1981-2010 reference. Source: AEMET, data source: http://www.ecad.eu/

North Africa (RA I)

During the 2021 summer season, the accumulated precipitation didn't exceed 20 mm over the most parts of the North African countries, except the north of Algeria which reached 80mm.

In Tunisia, rains were rare or even absent during the summer 2021. The seasonal cumulative of all stations (24 main stations) reached 268 millimeters, it was below normal over the 24 main stations with a deficit of 51%.

In Morocco, precipitation during summer 2021 was near to below normal.

In Algeria the precipitation was above normal in the north western regions, near normal over the remain regions of the north and below normal elsewhere.

In Libya, the precipitation was near normal over the eastern parts and locally in the northwest elsewhere precipitation was below normal.

In Egypt, the precipitation was characterized by a combination of near normal to below normal conditions over all of the country.

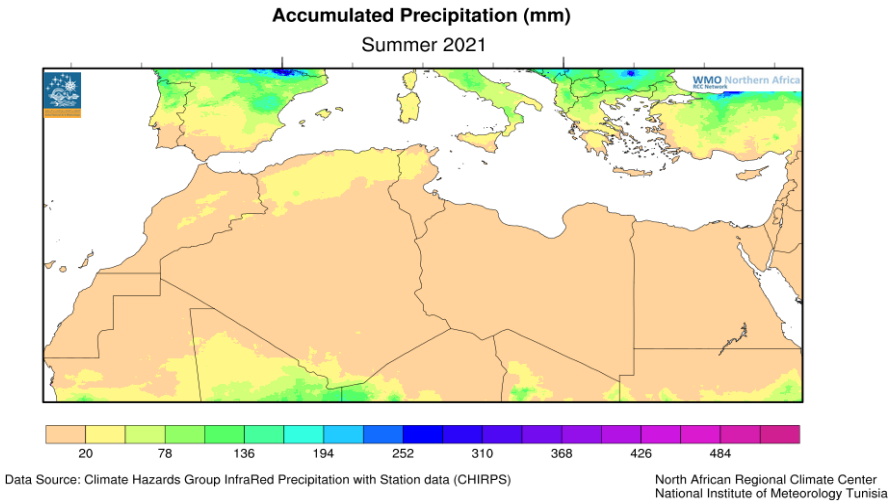


Figure 20: Total precipitation for summer season 2020 in North Africa (in mm).

Source: INM, Data from CHIRPS: ftp://ftp.chc.ucsb.edu/

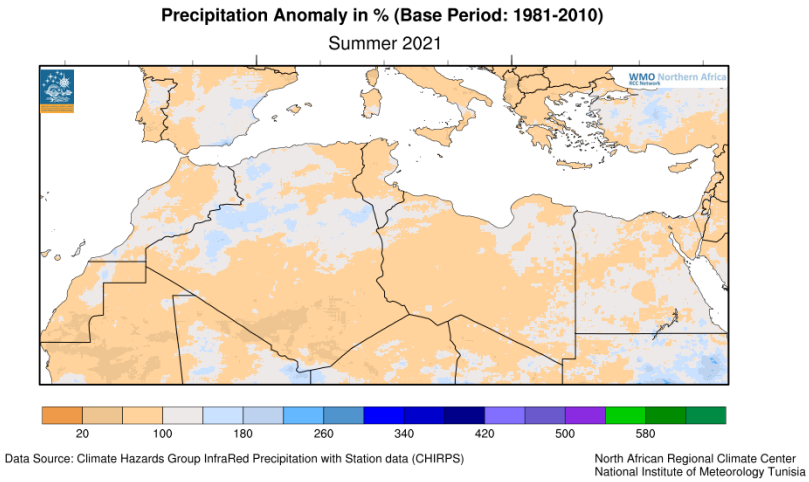


Figure 21: Precipitation anomaly for summer season 2021 in North Africa (in %) (Reference period 1981-2010).

Source: INM, Data from CHIRPS: ftp://ftp.chc.ucsb.edu/

3 Verification of the MedCOF-16 climate outlook (2021 summer season)

3.1 Temperature

Europe/RA VI

The MedCOF-16 outlook favored the upper tercile range for the whole domain with 50-60% probability.

The outlook was correct for almost the whole domain with the exception of Western Iberia and Western France, and an area over Central Turkey, were normal or even below normal temperatures were observed.

North Africa (RAI)

The MedCOF-16 climate outlook for the summer 2021 season favored the upper tercile over the entire North African domain. The outlook of temperature was correct over most of the region.

3.2 Precipitation

Europe/RA VI

The MedCOF-16 outlook favored the dry scenario (lower tercile range) over most France, Northern Italy and North Eastern Spain (50% probability), and for Turkey and South Eastern Ukraine (40% probability). For the rest of the domain, no privileged scenario was given.

The outlook was correct for North Eastern Spain, Northern Italy, Eslovenia and Hungary. However, in France, Turkey and South of Ukraine, wet tercile was observed, opposite of what was expected in the outlook. Dry tercile was observed over The Balkans, where no privileged scenario was expected in 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-16 outlook can't provided meaningful precipitation forecast for these seasonally dry region as mentioned in the MedCOF-16 outlook report.

4 Users' perceptions of the MedCOF-16 outlook

Europe/RA VI:

In Spain, AEMET provides seasonal forecasts to the general public on AEMET and MedCOF webpages.

Other countries do not provide a seasonal outlook to users operationally or no feedback was given.

North Africa

National Institute of Meteorology of Tunisia "NIM" provides seasonal forecast to general public in the NIM website.

Appendix A: Contributors to MEDCOF-16

- World Meteorological Organization

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:

- State Hydrometeorological Service, Republic of Armenia
- Federal Hydrometeorological Institute, Bosnia and Herzegovina
- National Institute of Meteorology and Hydrology, Republic of Bulgaria
- Meteorological and Hydrological Service, Republic of Croatia
- Meteorological Service, Republic of Cyprus
- Météo France, Republic of France
- National Environmental Agency, Democratic Republic of Georgia
- Deutscher Wetterdienst, Federal Republic of Germany
- Hellenic National Meteorological Service, Greece
- Israel Meteorological Service, Israel
- State Hydrometeorological Service, Republic of Moldova
- Republic Hydrometeorological Service of Serbia, Republic of Serbia
- Agencia Estatal de Meteorología (AEMET), Spain
- Turkish State Meteorological Service, Republic of Turkey

- others via SEECOF-25:

- Hydrometeorological Service, Republic of North Macedonia
- Slovenian Environment Agency, Republic of Slovenia
- Ukrainian Hydrometeorological Centre, Ukraine

North Africa (RA VI)

- Climate Centres:
- WMO RA I North Africa RCC Tunisian Node, Institut National de la Météorologie (INM), Tunis, Tunisia

- National Meteorological and Hydrological Services:
- National Meteorological Office, Algeria
- National Meteorological Directorate, Morocco
- National Institute of Meteorology, Tunisia

APPENDIX B: **Analysis and verification of the MedCOF-16 climate outlook for the summer season 2021:**

Verification summary based on the national reports and contributions of the participants of the SEECOF-25 and MedCOF-16 online meetings

In brackets: probabilities in % (lower, middle, upper tercile range) for the country concerned, as stated by the MedCOF outlook.

Europe (RA VI)

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-16 climate outlook for temperature	Observed	MedCOF-16 climate outlook for precipitation	
Albania	Above normal	Above normal (20/30/50)	Normal to Below normal	No predictive signal (33/33/33)	No events
Armenia (1)	Above normal	Above normal (60/20/10)	Below normal	Below normal (45/35/20)	• The maximum temperature exceeded the maximum value ever observed in Areni 41.3◦C (June 25), Yerevan 41.1◦C (June 24), Ararat 41.3◦C (July 21) Heat wave and Drought: There has been a sharp increase in the number of hit days and drought in the considering period. • Heat wave observed on June 15-30, July 1-6, July 19-21, August 5-10, 27-31. The duration of the wave observed in June was quite long 15 days. The maximum deviation of the maximum temperature from the norm was 14.9◦C the maximum deviation of the average temperature from the norm was 19.1 ◦C. • Heavy rainfall In Fantan 30 mm /12 hoursin July 2 and July14, In Yerevan 33mm/3 hours (July 14), in Aparan 30mm/12 hours (8.08), in Masrik (August14) during the period 14:00-14:45, heavy rain, thunderstorm and large hail ware observed. Strong wind: 20 m / s with the gust 25 m / s, in Armavir, in Jun 5 and 20 m / s with the gust 30 m / s in June 27were observed. In the Ijevan 8-10 m / s with the gusts 25- 27 m / s in July 2, 13 and19 were observed. • Dust storm: in Ararat Valley was recorded with the wind speed of 16m/sec.

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-16 climate outlook for temperature	Observed	MedCOF-16 climate outlook for precipitation	
Azerbaijan	Above normal	Above normal (20/30/50)	Below normal	No predictive signal (33/33/33)	No events
Federation of Bosnia and Herzegovina (1)	Above normal in almost entire Bosnia and Herzegovina (very warm and extremely warm)	Above normal (10, 30, 60) In Bosnia and Herzegovina)	Below normal Below normal in almost entire Bosnia and Herzegovina;	No predictive signal (33/33/33)	• At several stations during the summer, precipitation fell below 90 mm - June Temperature record on meteorological stations: Sarajevo, Bugojno, Zenica, Gradacac, Jajce I Bjelasnica - July Temperature record on meteorological station Sarajevo Extremely warm west and central part.
Bulgaria (1)	Above normal	Above normal (10/40/50)	Near or below normal	No predictive signal (33/33/33)	• The drought conditions in the height of the summer worsened the fire weather conditions. The fire weather index was at extreme levels at the end of July and the beginning of August. Fire fighters were dealing simultaneously with several major fires. Figure 5 shows the extreme fire risk for 3 August 2021. • Cooler and moist air came at the end of August to ease the drought but also brought thunderstorms and hailstorms. Lightnings stroke two people and hails devastated crop fields in South Bulgaria. Figure 6 shows the lightnings in Bulgaria on 25 August.
Croatia (1,5)	Above normal	Above normal (30/30/50)	Below normal (most of central and eastern Croatia, part of mountaino us Croatia – Gorski kotar, part of North	Below normal (50,30,20) part of north Adriatic, part of mountainous Croatia (Gorski kotar) and part of northwestern Croatia No predictive signal (33,34,33)	Summer 2021 was very warm and extremely warm. In all three months heat waves were observed (two in June and August and one in July). In June, in Daruvar and Slavonski Brod, (continental part of Croatia) there were observed maximum air temperatures which exceeded the absolute maximum on record. In all three months convective related severe weather phenomena (thunderstorms, hail, heavy rains)

Cyprus **(5)**	Normal to above normal	Above normal (10/30/60)	Dec-Jan: Well above normal Feb: slightly below normal	Below normal (40/35/25)	• June All of the maximum temperatures were around normal. Extreme daily maximum temperatures were recorded with great positive departures, like Prodromos station where the maximum for the station was 33.1°C departing 8.1°C from the normal (25°C), and at Polis Chrysochous, where the maximum temperature of the station was 38°C was 7.7°C greater than normal of 30.3°C. Extreme daily minimum temperatures were also recorded with great positive departures, like Polis Chrysochous station where the minimum for the station was 25.9°C departing 7.4°C from the normal 18.5°C), and at Athalassa, where the minimum temperature of the station was 27.3°C was 8.2°C greater than normal of 19.1°C For the period 21 -22 of June EMMA yellow warnings were issued, concerning rain and thunderstorms, whereas 27 -29 of June EMMA yellow warnings were issued, concerning high temperature. • July All the mean maximum and minimum, were above normal. Daily maximum temperatures above normal (deviating by 4°C or more from normal) were recorded, like the highest daily maximum temperature of Pafos that was 37.3°C (with a normal of 29.9°C) and the highest daily maximum temperature of Prodromos that was 34.6°C (with a normal of 27.9°C). Highest daily minimum temperatures were also recorded, with positive departures greater than 4°C, like the station of Larnaka where a minimum of 29°C was by 7°C above station's normal (22°C) and the station of Polis Chrysochous where a minimum of 26.8°C was by 5.7°C above station's normal (21.1°C). It is especially useful to be added that in Athalassa station it was recorded on July 2021, the second highest mean maximum temperature (39.5°C) since 1983. During July EMMA warnings with yellow awareness level were issued, concerning extreme high temperatures on for the periods 9-18 and 26-31 of July and with orange awareness level on 1 st and 2nd of July. Also, EMMA warnings with yellow awareness level were issued, concerning thunderstorms on 24th and 25th of July. On the 10th, 23rd, 24th and 25th of July local showers and thunderstorms resulted in accumulated precipitation of 38% of normal. • August Extremes were recorded with positive departures greater than 4°C, like Polis Chrysochous station where the highest daily maximum temperature (40.9°C) was 7.6°C greater than normal (33.3°C) and Prodromos station, where the highest daily maximum temperature (36.6°C) was 8.6°C greater than normal (28°C). Extremes were also recorded with positive departures greater than 4°C, like Athalassa station where the highest daily minimum temperature (28.1°C) was 6.2°C greater than normal (21.9°C) and Larnakas station, where the highest daily minimum temperature (28.5°C) was 6.2°C greater than normal (22.3°C). For the period 2-5 of August EMMA orange warnings were issued, while for

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	**MedCOF-16 climate outlook for temperature**	**Observed**	**MedCOF-16 climate outlook for precipitation**	
					the 6th of August and the periods 11- 13, 15-16, 20-22 and 24-28 of August yellow warnings were issued. All the above warnings concerned high temperatures, except the warning on the 6 th of August that concerned thunderstorms. On the 6th , 12th, 13th and 20th of August episodes of local showers and isolated thunderstorms resulted in accumulated precipitation of 2mm (100% of normal). Hail was reported on 6th of August at Troodos. Evaluation of June's seasonal forecast for the area of Cyprus The seasonal forecast suggested that June's temperature would be generally normal while the Balkans and Middle East would be warmer than normal.
France (5)	Normal (North West) to above normal (South East)	Above normal South East(20/30/50) North West no predictive signal (33/33/33)	Above normal	Below normal (50/30/20)	
Georgia (1)	Above normal for the whole area of the country	Above normal (10/30/60)	On the most territory of the country was below and near the norm, only several location in the eastern part of the country was above normal	Below normal (40/35/25)	• During the summer season, extreme weather events were observed in the form of heavy rains and hail (JuneJulyAugust). The hail was mainly observed in eastern Georgia, causing damage to agriculture. Heavy rains have raised water levels on some rivers and flooded homes and farmlands.

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	**MedCOF-16 climate outlook for temperature**	**Observed**	**MedCOF-16 climate outlook for precipitation**	
Greece (2)	Above normal	Above normal (10/30/60) Northeast: (10/40/50)	Wetter than normal values in the areas of Thrace, Thessaly, east Peloponnese and areas in the central and eastern Crete. Dryer than normal values in the rest of the country	No predictive signal (33/33/33)	• During the period 22 June to 2 July 2021 heat wave conditions prevailed on the Greek mainland. High temperatures for the season were observed during that period, with the maximum in some places exceeding 42°C. • During 28 July to 11 August 2021 Greece experienced prolonged heat wave conditions. The main feature was the long duration of the heat wave episode, as well as the very high temperatures. During that heat wave episode, several stations had daily maximum temperature above 39 oC for 8-11 consecutive days (e.g Argos and Serres station 11 and 10 consecutive days respectively; Larisa, Hellinikon, Astros and Tithorea stations 8 consecutive days). The highest daily maximum temperature were observed mainly during the period 1-5/8/2021, where several stations of Greek mainland recorded daily maximum temperature ≥ 45 oC (e.g on 03.08.2021 Argos station located in east Peloponnese recorded maximum temperature 46.3oC). Also the minimum temperature values in many stations reached and exceeded 29oC. Moreover the automatic weather station Kythira recorded the highest daily minimum temperature 34.7 oC on 04.08.2021. • Due to the heat wave conditions, a number of wildfires spread across the country that had to battle devastating blazes for nearly two weeks. The largest and most destructive fires were raged in the island of Evia (50887,6 ha burnt area according to Copernicus - https://emergency.copernicus.eu/mapping/list-ofcomponents/EMSR527), in Attiki (north of Athens) and the southern Peloponnese region, causing thousands of evacuations, destroying hundreds of thousands of hectares of land and forest along with a number of houses and businesses, while there were two casualties. According to EFFIS (European Forest Fire Information System - https://effis.jrc.ec.europa.eu) 128300 ha were burnt in year 2021 up today, i.e 613 % above the average bunt area of 2008-2020.

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-16 climate outlook for temperature	Observed	MedCOF-16 climate outlook for precipitation	
Hungary*	Above normal	Above normal (20/30/50)	Below normal	Below normal (50/30/20) over the west, no predictive signal in the east (33/33/33)	No events
Israel (5)	Above normal	Above normal (10/30/60)	-	-	No events
Italy*	Above normal	Above normal (20/30/50)	Normal to below normal	South: no predictive signal (33/33/33) North: below normal (50/30/20)	No events
Jordan*	Above normal	Above normal (10/40/50)	Mainly above normal	No predictive signal (33/33/33)	No events
Lebanon *	Above normal	Above normal (10/30/60)	Normal	Below normal (40/35/25)	No events
Republic of Moldova (5)	Above normal	Above normal 20/30/50)	Mostly above normal	No predictive signal (33/33/33)	During the summer season, extreme weather events were observed in the form of heavy rains and hail (JuneAugust), which caused damage to crops and damage to the objects of the national economy.me and glazed ice, blizzard and black ice on roads were observed.
Montenegro	Above normal	Above normal (20/30/50)	Normal to below normal	No predictive signal (33/33/33)	No events

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	**MedCOF-16 climate outlook for temperature**	**Observed**	**MedCOF-16 climate outlook for precipitation**	
Republic of North Macedonia (5)	Above normal	Above normal (20/30/50)	Below normal - variable precipitation	No predictive signal (33/33/33)	August - Exceeded absolute maximum temperature 39.4°C on 2nd in Bitola 41.4°C on 2nd in Strumica 44.1°C on 2nd in Gevgelija.
The Republika Srpska, Bosnia and Herzegovina	Above normal	Above normal (10, 30, 60)	Below normal	No predictive signal (33/33/33)	• Long lasting drought and high temperatures caused wild fires in the Southernarea of the Republika Srpska. June 2021 was driest on record over 130 years; the fifth warmest June in 130 years. • The lack of JJA rainfall total, averaged over the Srpska teriitory, was -35%; the real drought was worse, due to the heat and wind, which additionally dried up the soil. • Suthern of the RS was hit by an extreme drought; dry period lasted over 100 days. This affected forest fires. • JJA Tmean anomaly counted from 1.6 to 2.8℃; JJA Tmax= 40.2℃ (Banja Luka/July 8th); JJA Tmin = 3℃ (Drinić, Sokolac/August 30th). • According to poor amount of precipitation, very high air temperatures and increased evaporation, summer 2021 is among 5 driest in the past 70 years.
Portugal *	Normal to below normal	Above normal (20/30/50) (South) No predictive signal (33/33/33) (North)	Normal to below normal	No predictive signal (33,33,33) South: below normal (50/30/20)	No events
Romania *	Above normal	Above normal (20/30/50)	Normal to above normal	No predictive signal (33/33/33)	No events

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	**MedCOF-16 climate outlook for temperature**	**Observed**	**MedCOF-16 climate outlook for precipitation**	
Serbia (1,5)	Above normal	Above normal (20/30/50)	Normal and below normal and normal in most of Serbia	No predictive signal (33,33,33)	• Fifth warmest summer for Serbia since 1951, and 3rd warmest for Belgrade since 1888 and at Kopaonik since 1950 • 4th warmest for Valjevo since 1926 and at Zlatibor since 1950 • Up to 22 summer days, 28 tropical days and 28 tropical nights more than normal • 4th driest summer at Zlatibor since 1950.
Slovenia (5)	Above normal	Above normal (20/30/50)	Below normal	Below normal (40/35/25)	Thunderstorms with downpour hail and also severe wind gusts between 31 July and 1 August from north-west through central and central-east of Slovenia. Flooded objects, trees down, hail damage. • Supercell thunderstorms with medium to large hail on 8 August from central to central-east of the country. Extensive damage in agriculture (especially hops), many vehicles and objects damaged. • Severe thunderstorms with downpour, hail and severe wind gusts on 15 August in eastern Slovenia. Mostly flooded objects and wind damage on roofs, trees down. Station record wind gust of 33 m/s measured in Krško.

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	**MedCOF-16 climate outlook for temperature**	**Observed**	**MedCOF-16 climate outlook for precipitation**	
Spain (5)	Normal (West), above normal (East	Most of Spain: above normal (20/30/50) North West: No predictive signal (33/33/33)	Summer has been wet or very wet in wide areas of the IP and the Balearic Islands, and dry or very dry in Pyrenees, Catalonia and points dispersed in Andalusia, Galicia and Castilla y León, mainly. On the other hand, summer has been normal in large part of western Andalusia, Galicia, Castilla y León, the Basque Country and Murcia.	North East (Catalonia): below normal (50/30/20) No predictive signal (33,33,33)	• A intense heat wave was in mid-August in Spain on 11- 16. During this episode both the maximum and minimum temperatures reached high values, exceeding 40 ^{o}C in most of the peninsular territory and the Balearic Islands,even reaching over 45 ^{o}C in wide areas of Andalusia and Murcia and in points of the Valencian Community and Castilla-La Mancha. • The highest summer temperatures were observed during the heat wave of mid-August: 47.0 ^{o}C (Alcantarilla), 46.9 ^{o}C (airport Cordoba airport), 46.2 ^{o}C (Murcia) and 46.0 ^{o}C (Granada). In seventeen main stations, the maximum temperature recorded during this heat wave constituted a new absolute temperature record. • The lowest summer temperatures were 2.6 ^{o}C (Lugo/airport) , 2.7 ^{o}C (Puerto de Navacerrada) and ..4 ºC (Burgos airport). • The highest values of daily summer precipitation in the main observatories were: Gijon (64.5 mm on June 17), Madrid-Retiro (40.4 mm on June 16), Madrid-Torrejón (46.9 mm on June 16) , Teruel (33 mm on Juky 25); Alicante (26.4 mm on July 26t) , Donostia-Igueldo (36,5 mm on July 7), Tortosa / Roquetes (68.2 mm on August 24), Valencia (28.2 mm on August 24) Salamanca/ Airport (31.2 mm on August 25), Madrid/Retiro (32.5 mm on August 31) and Puerto de Navacerrada (65.8 mm, on August 31). • Teruel station recorded 222.0 mm accumulated in the quarter, which is the highest value in the series. In this station and 26 days of storm (record number in summer).
Syria	Above normal	Above normal (10/30/60)	Normal to below normal	No predictive signal (33,33,33)	No events

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-16 climate outlook for temperature	Observed	MedCOF-16 climate outlook for precipitation	
Turkey (5)	Above normal Near normal at inner parts	Above normal (20/30/50), higher probabilities in Eastern Turkey (10/30/60)	Above normal at the western and northern coast of Turkey - Below normal at southeastern part of the Turkey	No predictive signal at the western and northern coast of Turkey – Below normal (40/35/25) at southeastern part of the Turkey	• Settlements were affected by forest fires in 49 provinces, mainly Manavgat/Antalya, Marmaris/Muğla, between July 28 and August 12. Many houses and workplaces were burned and a total of 8 people lost their lives. • Extraordinary heavy rainfall occurred at Kastamonu and Sinop provinces between • August 9 and August 12. As a result of the flood, a total of 77 people lost their lives. In addition, settlements, energy, and communication transmission lines and highways were damaged. • Turkey's maximum temperature record was broken with 49.1°C measured in Cizre on July 20. • July 2021, was the second hottest July in the 51 years long term period (1971-2021). • Maximum temperature record was broken in 42 stations in the 2021 summer season.
Ukraine (1,5)	Above normal	Above normal (10/40/50)	Above normal (48% stations) Normal (32% stations) Below normal (20% stations)	No predictive signal (33, 33, 33) Below normal (40/35/25) (South East)	• During summer meteorological extraordinary phenomenas were observed in many regions of the country. Were recorded heavy rains (30-91 mm precipitation per 3-12 hours) and record rains 22/07 in Odesa 101 mm/7 hours and 126 mm/5 hours in Berdiansk (Zaporizhzhia region). • Heavy showers (30-37 mm/hour), in Teteriv (Kyiv region) was 51 mm/hour 04/07. Storm winds and squalls (with speed 25-27 m/c) were fixed in Lviv, Ivano-Frankivsk, Ternopil, Kyiv, Kropivnytsk, Odesa, Doneck, Luhansk regions. • Hail (diameter 25-30 mm) was fixed in Zakarpattia, Kyiv and Kropivnytsk regions. Unfavorable weather conditions localy caused loss power, telecommunications, utilities and transport. Summer was wet in the most of regions of Ukraine, with the exception some places of the western and nothern parts. In Svitiaz (Volyn region), Volnovaha (Doneck region), Strilcove (Kherson region), in Ai-Petri, Kerch (Crimea) were recorded maximum presipitation from 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 – 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-16 climate outlook for temperature**	**Observed**	**MedCOF-16 climate outlook for precipitation**	
Algeria *	Above Normal	Above Normal	Above normal in NW Near normal to below normal elsewhere	No clear signal (33/ 33/33).	No comment
Egypt*	Above normal	Above normal	Near to below normal	No clear signal (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-16 climate outlook for temperature**	**Observed**	**MedCOF-16 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 (1)	Above normal	Above normal	Near normal in the South Below normal elsewhere	No clear signal (33/ 33/33).	A new records for maximum daily temperature : **June:** Tozeur: 48.7°C 06/30/2021 Kébili: 48.1°C 06/30/2021 **July:** Kasserine 43.9 07/04/2021 Remada 48.1 07/04/2021 **August:** Thala: 41.3°C 08/08/2021 Kasserine: 43.5°C 08/08/2021 Gafsa: 46.1°C 08/08/2021 Kebili :48.5°C 08/08/2021 Jendouba: 49°C 08/09/2021 Siliana: 46.2°C 08/10/2021 Zaghouan: 47.5°C 08/10/2021 Bizerte: 48. 9 °C 08/10/2021 Tunis: 48. 9 °C 08/10/2021 Beja: 48.9 °C 08/10/2021 Kelibia: 43.5°C 08/11/2021 Nabeul: 46.3 °C 08/11/2021 Kairouan: 50.3 °C 08/11/2021

					Sidi Bouzid: 47.4 °C 08/11/2021

Note:
(1) Basic climatological period (1981-2010)
* Data source: Temperature: NCEP/NCAR reanalysis , precipitation: CHIRPS

Note:
(1) Basic climatological period (1981-2010)
* Data source: Temperature: The National Climatic Data Center (NCDC)

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MedCOF-16 Outlook: http://medcof.aemet.es/images/doc_events/medcof13/step3/docStep3/Consensus_Statement_MedCOF-16_final.pdf

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-CM Website with monitoring results: http://www.dwd.de/rcc-cm

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

PRESANORD: http://nwp.gov.eg/index.php/rcof/presanord

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