



WMO RA I



WMO RA VI
RCC-Network



MEDITERRANEAN CLIMATE OUTLOOK FORUM MEDCOF-7 MEETING

ANALYSIS AND VERIFICATION OF THE MEDCOF-6 CLIMATE OUTLOOK FOR THE 2016 SUMMER SEASON FOR THE MEDITERRANEAN REGION (MED)

Draft version

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The following MedCOF verification report is based on

- the outcome of the consensus forecast of MedCOF 6,
- climate monitoring results of RA I NA RCC and RA VI RCC networks,
- the analysis and verification report of SEECOF-16 for 2016 summer season for southeast Europe (SEE)
- national verification reports received from NMHSs or posted in RCOF forums of MedCOF, SEECOF or PRESANORD.

1. MedCOF-6 Climate outlook for the 2016 summer season

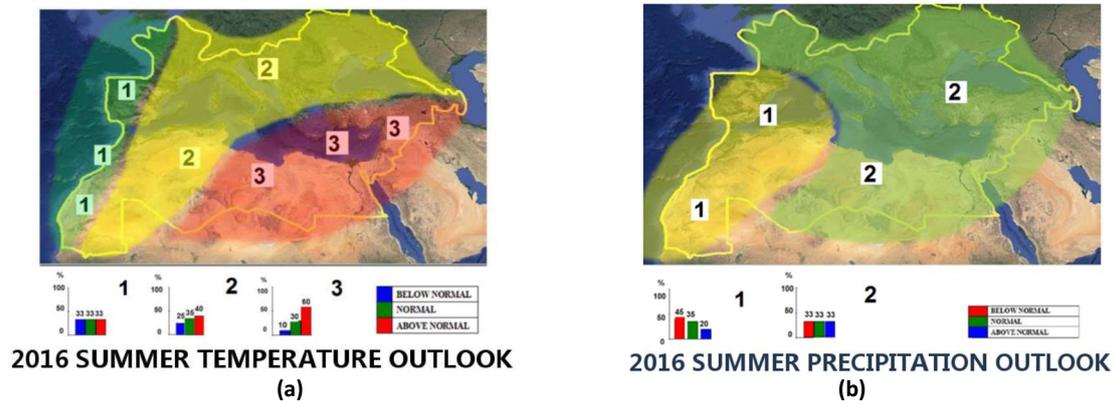


Figure 1: Graphical presentation of the climate outlook for the 2016 summer season for the Mediterranean region
(a) Temperature Outlook; (b) Precipitation Outlook

Temperature

Most models forecasted widespread warm global anomalies and prevailing warm air advection particularly over Europe and North Africa. On the other hand, models tended to maintain cold SST anomalies over the North-Atlantic for the summer season 2016. The cold oceanic influence was regarded as possibly important in the very western regions of the MedCOF area including the Iberian Peninsula and western North Africa.

However, due to the large uncertainty concerning the position of circulation, temperature forecast was correspondingly uncertain in the western regions, while the warm scenario appeared more probable in the east.

For the MedCOF-6 consensus statement, 3 regions were defined with increasing probabilities from the west to the east. Region 1 only covered the westernmost parts of the MedCOF area and had no privileged scenario, whereas the warm scenario was preferred both for Region 2 and 3 with 40% and 60% probability, respectively (Figure 1a). This means for verification that a prediction of close-to-normal temperature (middle tercile) was assumed for Region 1 and above-normal temperature (upper tercile) for Region 2 and 3.

Precipitation

For precipitation, uncertainties were larger than for temperature. Over the MedCOF region a drier-than-normal signal was forecasted by several models over Iberia and western North Africa, according with the main probable scenario in terms of circulation (advection of colder and drier air). Elsewhere, no clear signal emerged.

Two regions were defined for the MedCOF-6 outlook (Figure 1b). A dry scenario was privileged for Region 1 in the western MedCOF area with 45% probability, while for the remaining larger part (Region 2) no privileged scenario was found. This means for verification lower-than-normal precipitation (lower tercile) in Region 1 and close-to-normal precipitation (middle tercile) was assumed for Region 2. Dry-masking in arid regions was not considered for this season because the border and the threshold of dry-masking still needs to be defined and agreed upon.

2. Analysis of the 2016 summer season

Analysis of the summer season temperature and precipitation anomalies and general circulation are based on seasonal bulletins on the climate in the WMO region I – NA and VI for the summer 2016 (WMO RA I RCC Node on Climate Monitoring and watch: <http://www.meteo.tn/htmlen/donnees/climatemonitoring.php>; WMO RA VI RCC Node on Climate Monitoring: <http://www.dwd.de/rcc-cm>), contributions from Météo France (<http://elaboration.seasonal.meteo.fr/en/content/climate-monitoring>), Regional Climate Outlook Forums for Southeastern Europe (SEECOF-16, <http://www.seevccc.rs/?p=1514>) and North Africa (PRESANORD, <http://nwp.gov.eg/index.php/rcof/presanord>) and national verification reports from MedCOF participants.

2.1. General circulation

Subtropical air masses dominated this summer throughout almost the whole MedCOF region. The Azores High was slightly more intense than normal and extended clearly to the western parts of the MedCOF region (France, Iberia, western Mediterranean, northern parts of Morocco and Algeria, Figure 2 and 3), leading to subsidence and enhanced incoming solar radiation and sunshine, particularly over Iberia.

However, there was a change of large-scale circulation over the North Atlantic and Europe during summer 2016. In June, an NAO- situation dominated due to higher-than-normal geopotential and surface pressure over Greenland/Iceland and low pressure conditions over the middle latitudes and the western Mediterranean (Figure 4). In July, a strong positive phase of an East Atlantic (EA) pattern developed with low pressure over northern Europe, whereas the Azores High extended further north to the middle latitudes (Table 1). The NAO- phase was still active, but restricted to the western Atlantic with no more effect for Europe. In August, the Azores High intensified further, especially over Western Europe. This induced a development of a large-scale blocking situation. In fact, the number of blocking weather types increased considerably in August according to the Météo France weather type classification (Figure 5) and became the dominant feature for Western Europe. This circulation change affected particularly France with above-normal rain in June and advection of cooler air from the North Atlantic (due to the season: water cooler than land and the cold SST anomaly over the North Atlantic) and increasing dryness until August, to a lesser extent also Iberia and the middle latitudes over Eastern Europe.

The western and central Mediterranean including Italy, western Balkans, and western and central parts of North Africa had more or less mostly cyclonic conditions during summer. Several upper air low pressure systems prevailed over a relatively small area from Sicily to Greece and to Tunisia causing convective precipitation and cooling. In June, the most cyclonic area in this part extended from Italy over the western Mediterranean to Tunisia. In July, cyclonic influence became weaker, but regenerated again in August, now also affecting the central Mediterranean from southern Balkans to Libya. However, due to the dry season, convective precipitation occurred mostly only occasionally and was only locally heavy.

Nevertheless, this resulted in anomalous high precipitation in a subregion of southern Italy, Greece and northwestern Libya / southern Tunisia, although absolute totals in southern Europe were much higher than in North Africa. Some more local convective events also occurred at the southeastern flank of the Azores High in parts of Morocco, Algeria, Tunisia and Libya, at the eastern flank over the northern Balkans.

Much of the northeastern part of the MedCOF region was influenced by a strong negative phase of the East Atlantic – West Russia pattern. This corresponded with high pressure anomalies especially in the upper air from the Ukraine to the eastern Balkans and even western Turkey and Cyprus. This pattern was extremely intensified in August, when the Russian High increased considerably in intensity and extension. Subsidence due to high pressure and warm continental air advection at its south flank led to long warm and dry periods during summer in these parts, but nevertheless with some local thunderstorms and convective rain.

The South Caucasus, eastern Turkey and the Middle East and eastern North Africa were rather cyclonic this summer. This resulted in frequent rain particularly in the western South Caucasus and northeastern Turkey due to moisture uptake over the large lakes and orography. Over the Middle East and Egypt, there was hardly any rain due to the dry season.

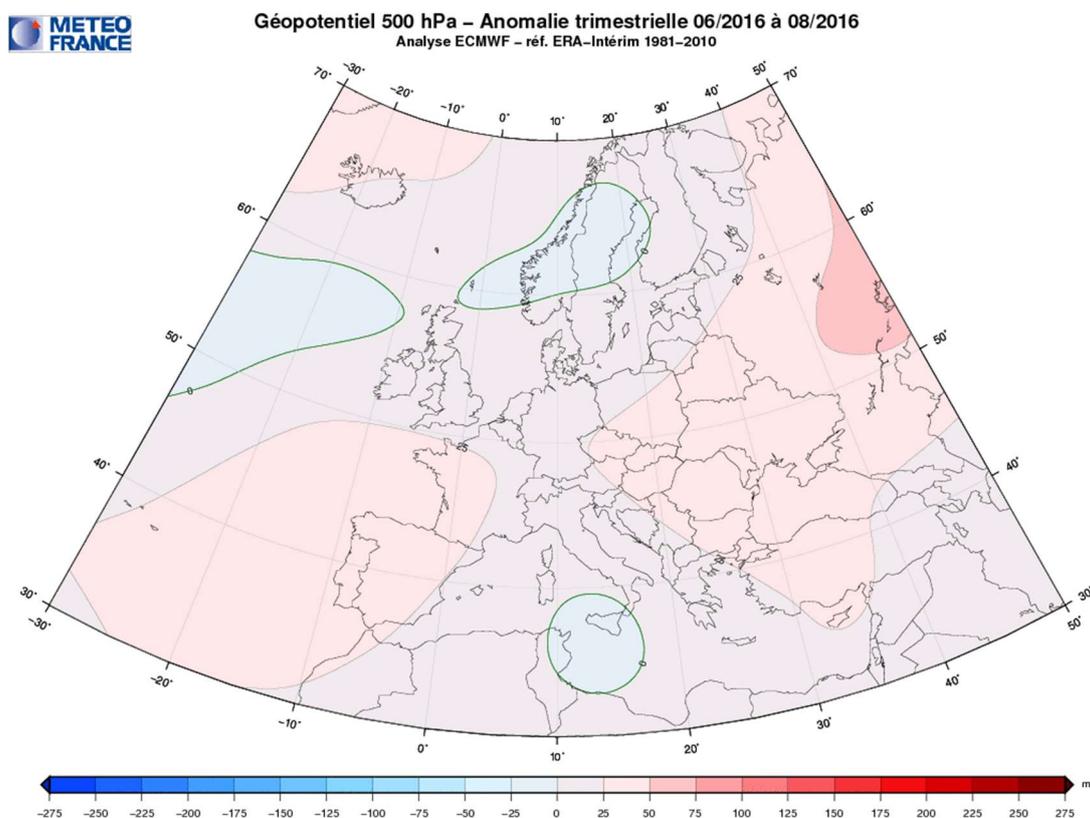


Figure 2: Mean seasonal anomalies of 500 hPa geopotential for summer 2016 (1981-2010 reference). Source: Météo France, data source: ECMWF ERA Interim reanalysis, <http://elaboration.seasonal.meteo.fr/en/content/era-interim-quarterly-means-or-default-operational-ecmwf>

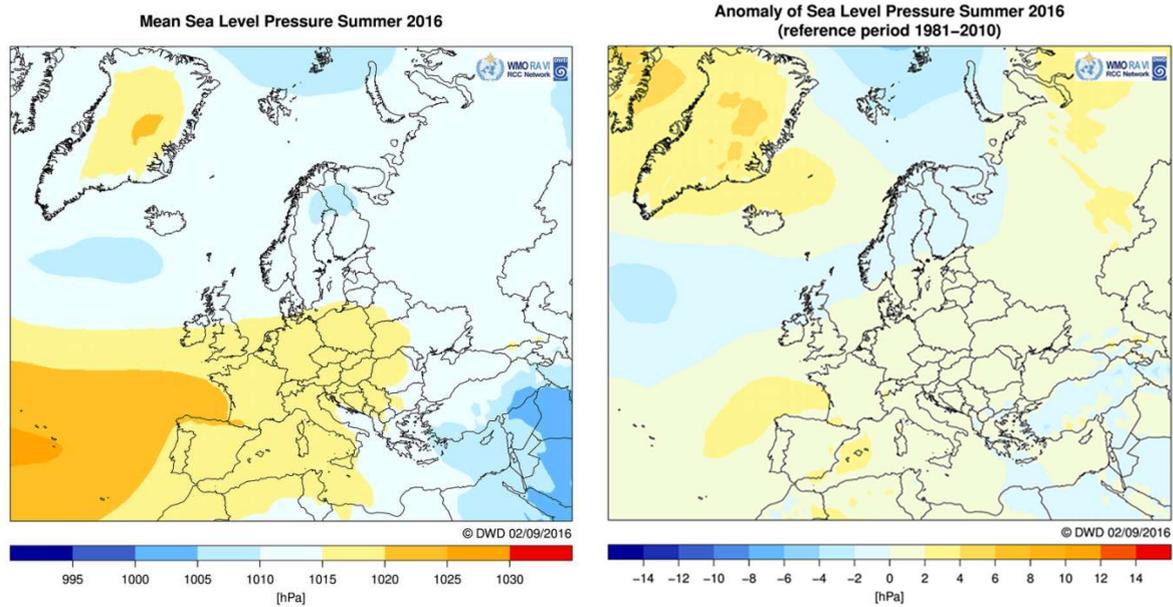


Figure 3: Seasonal mean sea level pressure (left) and its seasonal anomalies (right) for summer 2016 (1981-2010 reference). Source: Deutscher Wetterdienst (DWD), data source: DWD numerical ICON model analysis, http://www.dwd.de/EN/research/weatherforecasting/num_modelling/01_num_weather_prediction_modells/icon_description.html?nn=484268

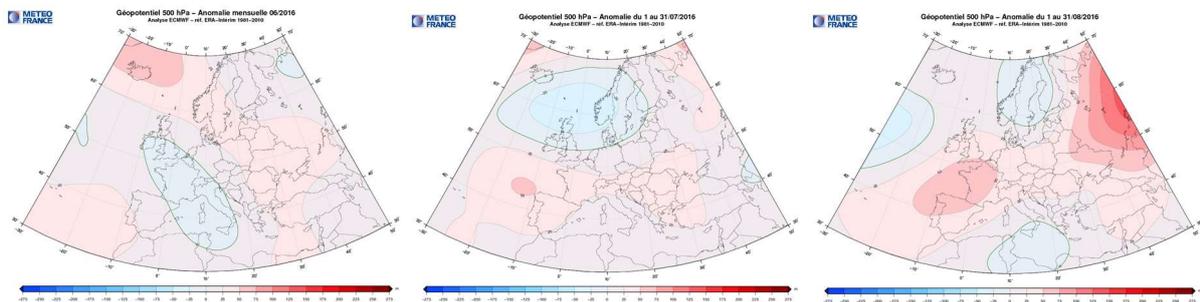


Figure 4: Same as Figure 2, but for the months June, July, August 2016.

Comparaison entre AnaCEP et clim des regimes d' ETE du trimestre JJA 2016

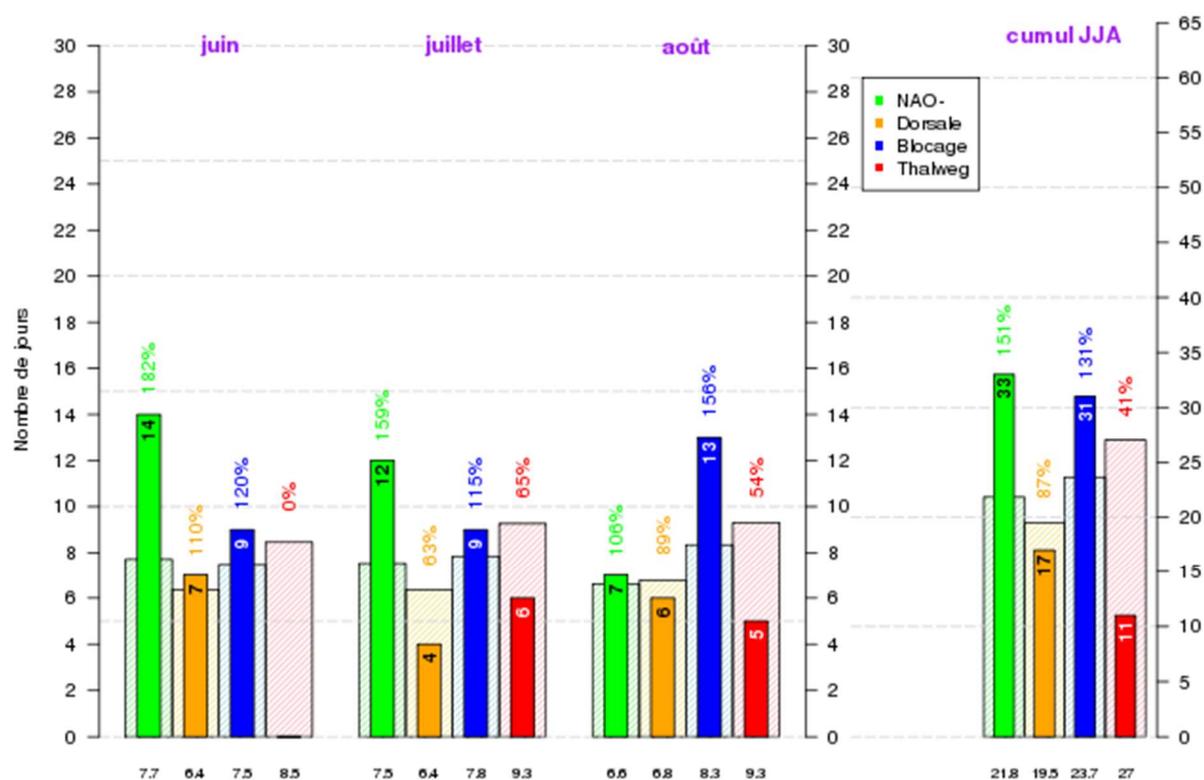


Figure 5: Number of days with circulation types of the Météo France classification for each month of the summer 2016 season and for the whole season (right), and in percent of the climatological frequency distribution 1981-2010. Circulation types are: negative North Atlantic Oscillation phase (NAO-), Atlantic ridge (Dorsale), Scandinavian Blocking (Blocage) and Atlantic trough (Thalweg). Source: Météo France,

<http://elaboration.seasonal.meteo.fr/en/content/observed-weather-patterns-0>

yyyy	mm	NAO	EA	WP	EP/NP	PNA	EA/WR	SCA	TNH	POL	PT	Expl.Var
2016	6	-0.13	0.41	-0.62	1.26	-0.64	-1.85	-0.95	-99.90	-1.07	-99.90	61.8
2016	7	-1.72	1.82	-1.42	-0.36	0.53	-1.01	-0.70	-99.90	-0.24	-99.90	62.4
2016	8	-2.24	2.08	-0.37	-0.42	-0.91	-3.30	-0.44	-99.90	2.43	-0.76	61.7

Table 1 : Circulation indices of NOAA CPC patterns for the summer months 2016.

ftp://ftp.cpc.ncep.noaa.gov/wd52dg/data/indices/tele_index.nh

2.2. Temperature

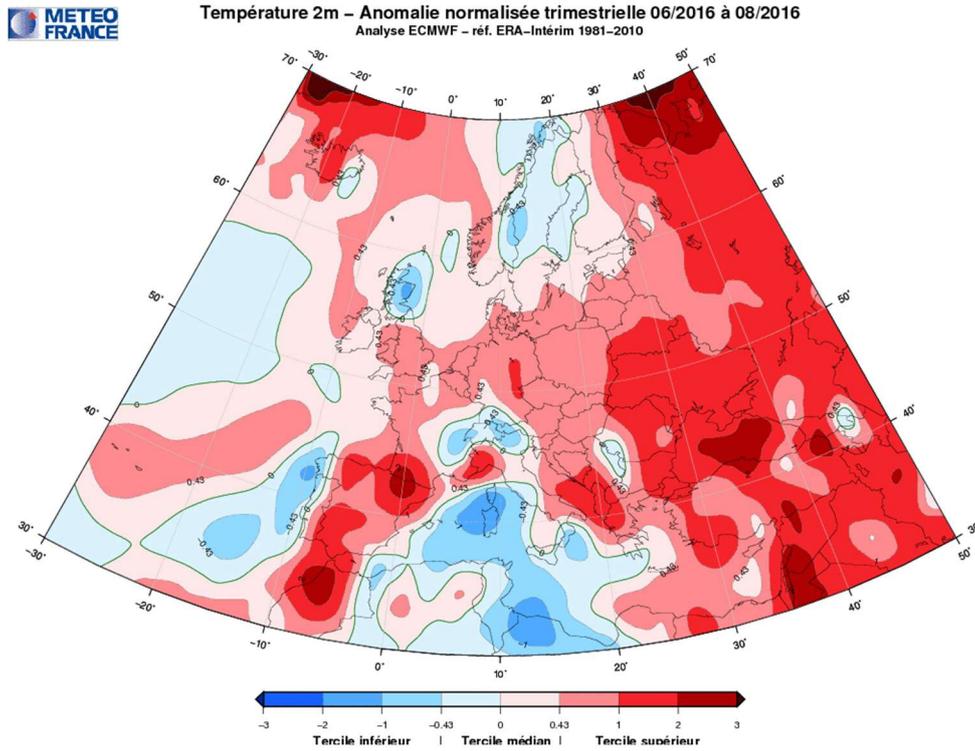


Figure 6: Seasonal normalized temperature anomalies of summer 2016 surface air temperature based on ECMWF / ERA-INTERIM grid data, 1981-2010 reference. The data range between -0.43 and +0.43 represents the middle tercile, below -0.43 the lower tercile and above +0.43 the upper tercile. Source: Météo France, data reference: <http://www.ecmwf.int/en/research/climate-reanalysis/era-interim>

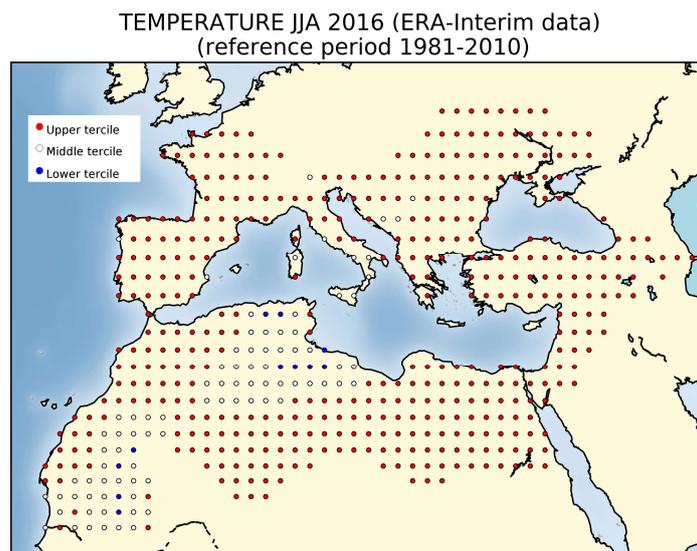


Figure 7: Terciles of summer 2016 surface air temperature based on ERA-Interim Reanalysis, 1981-2010 reference. Source: AEMET, data source <http://www.ecmwf.int/en/research/climate-reanalysis/era-interim>

Europe and Middle East (RA VI)

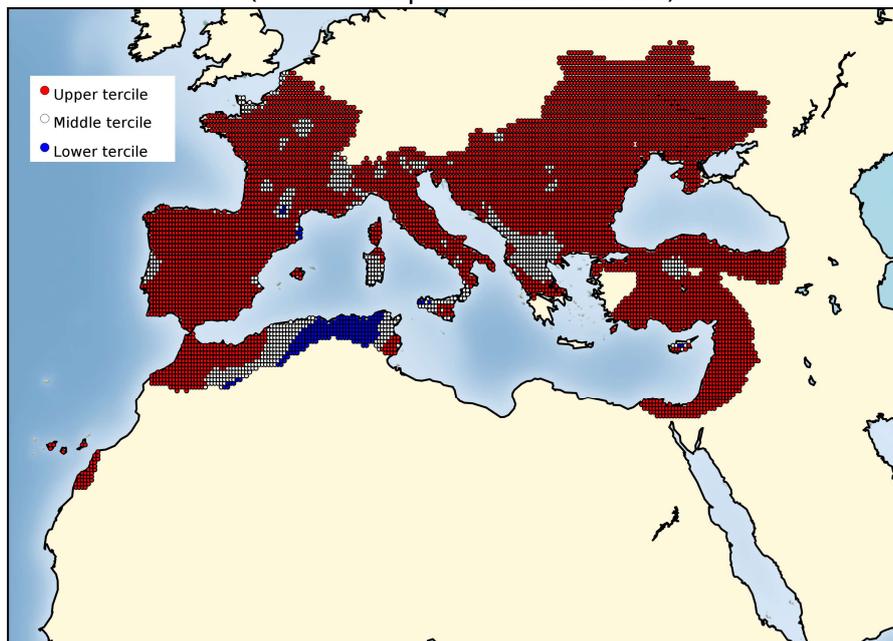
Analysis of both terciles and anomalies of all data for summer 2016 sets show a warm summer by finding almost the whole RA VI part of the MedCOF region in the upper tercile. Seasonal mean temperatures in the lowlands ranged from 17°C in northern France to more than 30°C in eastern Syria and Jordan. Daily maxima reached up to 37°C in Moldova, 38°C in Serbia, Georgia, 39°C in Macedonia, 40°C in the Ukraine and Cyprus, 41°C in France and Italy, 42°C in Spain, nearly 45°C in Portugal, 46°C in Israel. Anomalies (1981-2010 reference) ranged from below -1°C in the western Mediterranean to above +2°C locally in Spain, the Ukraine, Turkey and the Middle East. Compared to 1961-1990 reference, summer was warmer than normal in the whole area and anomalies peaked above +3°C in central Spain, Montenegro. The number of hot (tropical) days (daily maximum \geq 30°C) was well above normal in much of the region. It was the second warmest summer in Portugal since 1931 (behind 2005) and the third warmest summer in Spain since 1965 (behind 2003 and 2015). Heat waves were recorded in many countries, but not the same time, e.g. in Spain (July and August), France (late August), Croatia (late June, mid-July), Bulgaria (mid-June), Moldova (late June, late August), Ukraine (mid-July).

In western parts (France, Iberia), both E-OBS and ERA-Interim analyses suggest a few places in the middle or even the lowest tercile, which is supported by a few ECA&D station data. These stations were mostly located near the coasts and therefore have lower temperature variability. On the whole, these were exceptions. However, missing (free) data in Portugal in ECA&D and the relatively coarse resolution of ERA-Interim cannot exclude some more places in the middle tercile.

In the central Mediterranean area, there were also some places in the middle tercile in Italy (particularly in the south) and in the Balkans (particularly the west). This can be explained by the upper air low anomaly in that part of the region (see above).

For the eastern parts, only a small part of Turkey was in the middle tercile according to E-OBS, which was not supported by ERA-Interim, but confirmed by national data for the east of the country.

TEMPERATURE JJA 2016 (EOBS data)
(reference period 1981-2010)



TEMPERATURE JJA 2016 (ECA&D data)
(reference period 1981-2010)

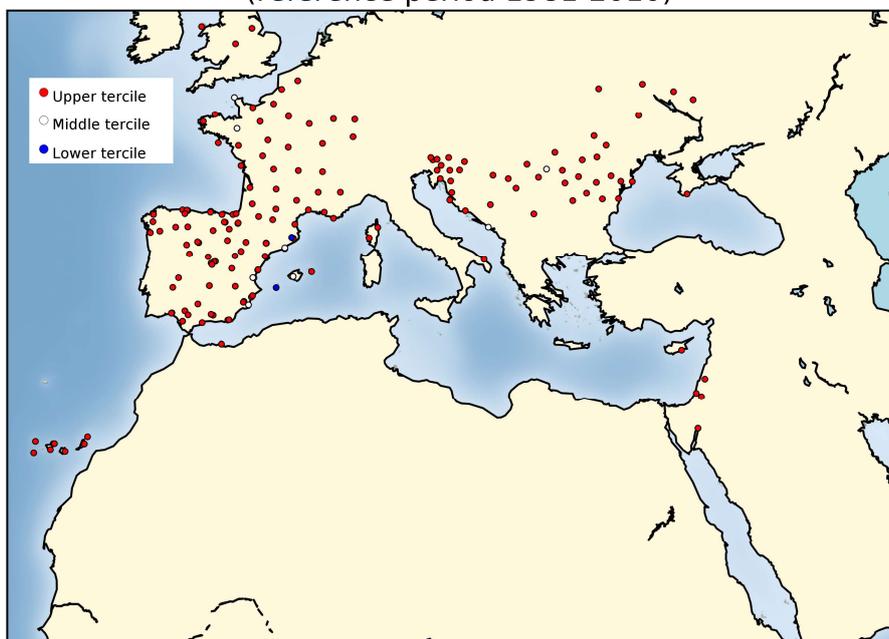


Figure 8: Terciles of summer 2016 surface air temperature based on interpolated E-OBS grid data (upper graph) and individual ECA&D station data (lower graph), 1981-2010 reference. Source: AEMET, data source: <http://www.ecad.eu/>

**Temperature Percentile E OBS Summer 2016
(reference period 1951–2010)**

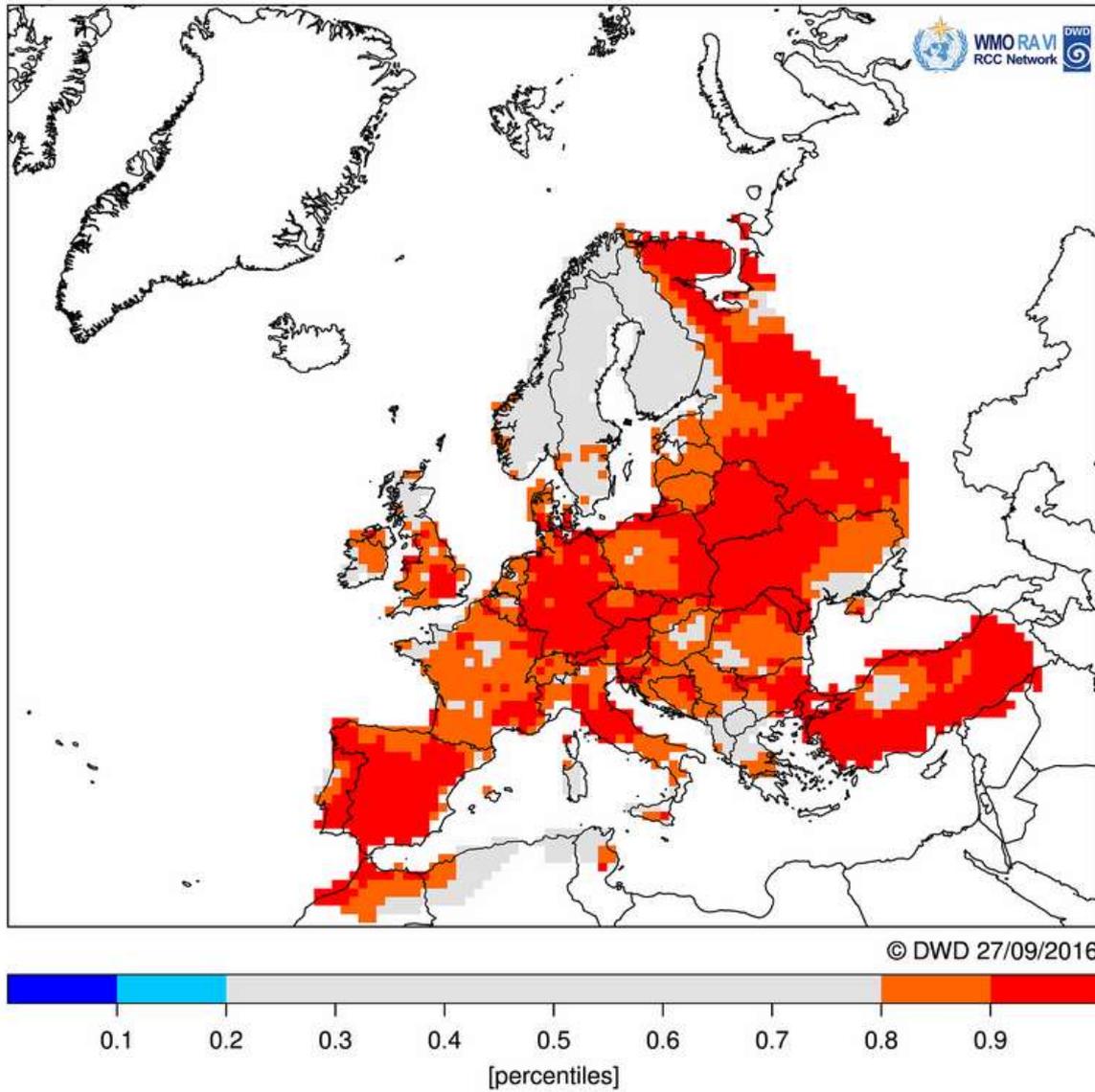


Figure 9: Percentiles of summer 2016 surface air temperature based on interpolated E-OBS gridded data, 1951-2010 reference. Source: DWD, data source: <http://www.ecad.eu/>

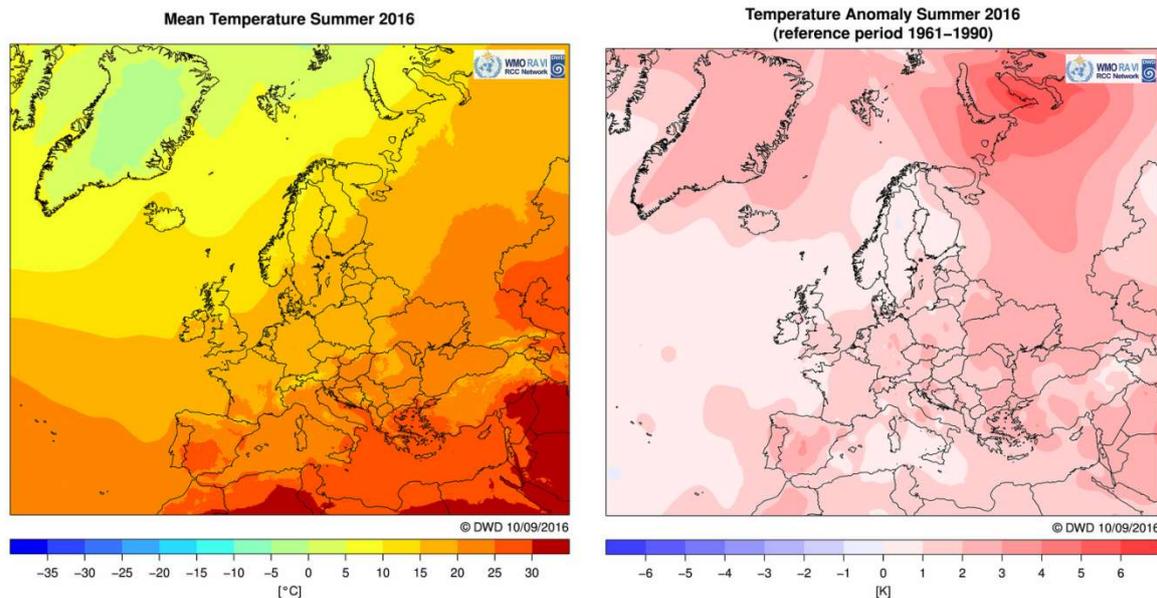


Figure 10: Surface air temperature for summer 2016. Upper left: Europe, seasonal mean, upper right: anomalies Europe, 1961-1990 reference, source of both maps: WMO RAVI RCC, based on interpolated CLIMAT data, www.dwd.de/rcc-cm, lower map: anomalies MedCOF region, 1981-2010 reference, source: WMO RA I NA RCC, data source: NCEP/NCAR Reanalysis, <http://www.esrl.noaa.gov/psd/data/composites/day/>

North Africa (RA I)

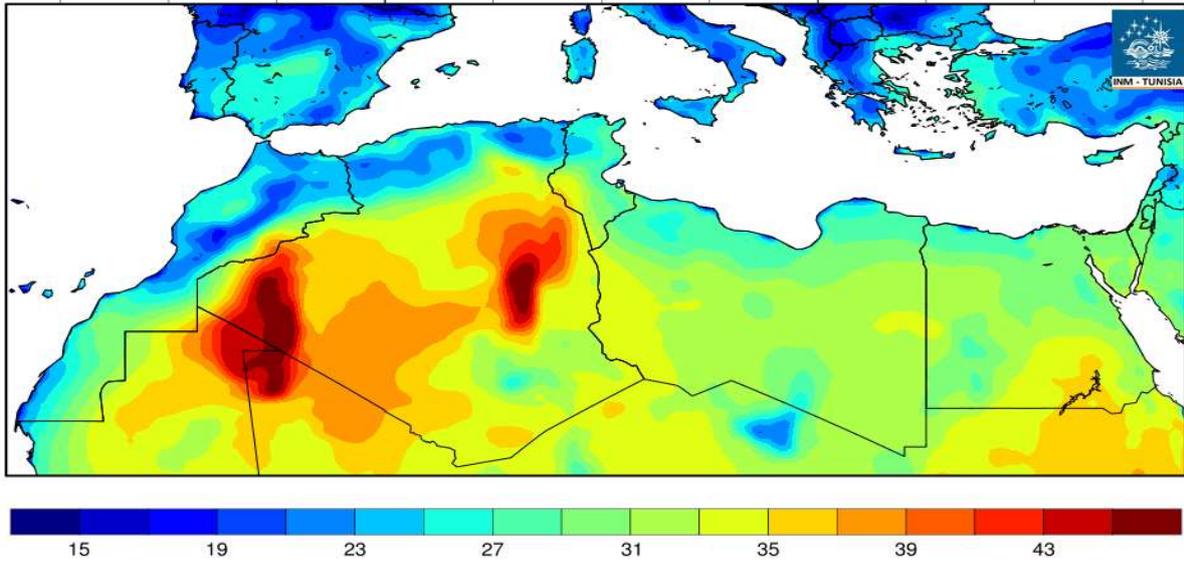
Summer 2016 was hotter than normal in almost all North Africa. Mean temperatures were ranging between 19°C and 47°C. Slightly negative anomalies were recorded over the extreme north of Tunisia.

The summer seasonal mean temperature had its minimum over north-western regions and the coastal areas of Tunisia. The lowest value of absolute minimum temperature in the country was 16.7°C measured in Thala in the center-west of Tunisia. The south of Tunisia was mainly the hottest region in 2016 summer season, with the highest value of absolute maximum temperature at 38.5°C registered in Nafta. Mean temperature was above normal in the eastern coastal areas, and the central west with anomalies up to +1.5°C. Elsewhere temperatures were normal to slightly above normal.

Summer season was also hotter than normal over all of Morocco.

Anomalies were also higher over Egypt. Elsewhere (over Algeria and Libya), temperatures were normal to above normal.

Average Temperature (°C)
Summer 2016

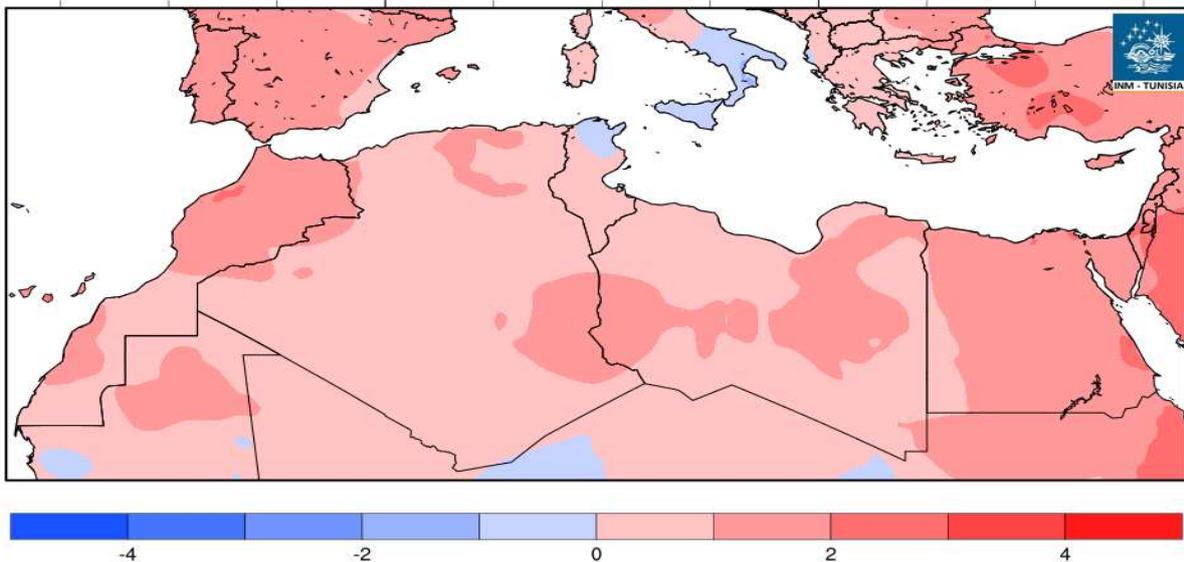


Data Source: NCEP/NCAR-Reanalysis

North African Regional Climate Center
National Institute of Meteorology Tunisia

Figure 11: Mean temperature for summer season 2016 in the North African MedCOF region (in °C). Source: INM, (Data from NCEP/NCAR reanalysis, <http://www.esrl.noaa.gov>)

Anomaly Temperature in °C (Base period: 1981-2010)
Summer 2016



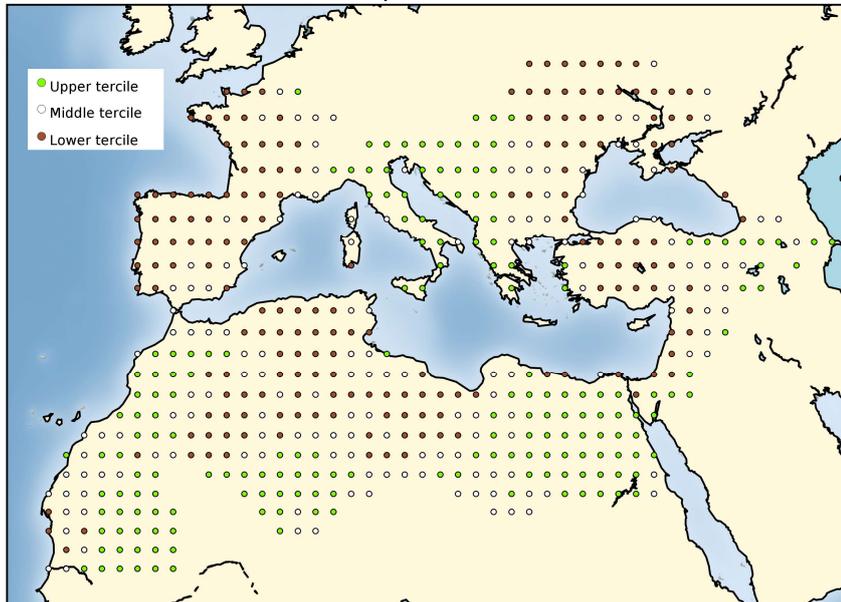
Data Source: NCEP/NCAR-Reanalysis

North African Regional Climate Center
National Institute of Meteorology Tunisia

Figure 12: Temperature anomaly for summer season 2016 in the North African MedCOF region (in K), reference period 1981-2010. Source: INM, Data from NCEP/NCAR reanalysis, <http://www.esrl.noaa.gov>

2.3.Precipitation

PRECIPITATION JJA 2016 (ERA-Interim data)
(reference period 1981-2010)



PRECIPITATION JJA 2016 (GPCC data)
(reference period 1981-2010)

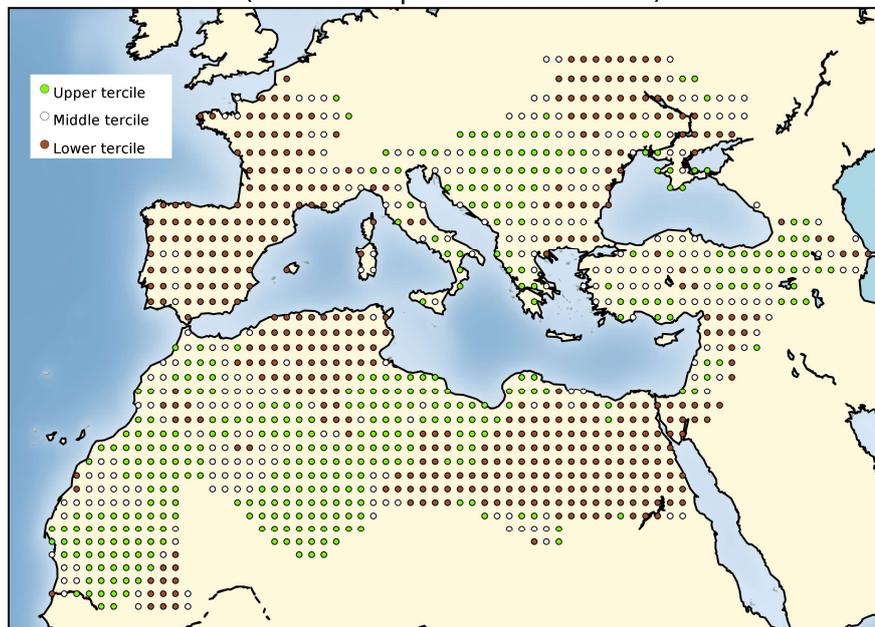


Figure 11: Terciles of summer 2016 precipitation based on interpolated ERA-INTERIM (upper graph) and GPCC (lower graph) grid data, 1981-2010 reference. Source: AEMET, data reference: ERA-INTERIM: <http://old.ecmwf.int/publications/library/do/references/show?id=90276> GPCC: <http://gpcc.dwd.de>

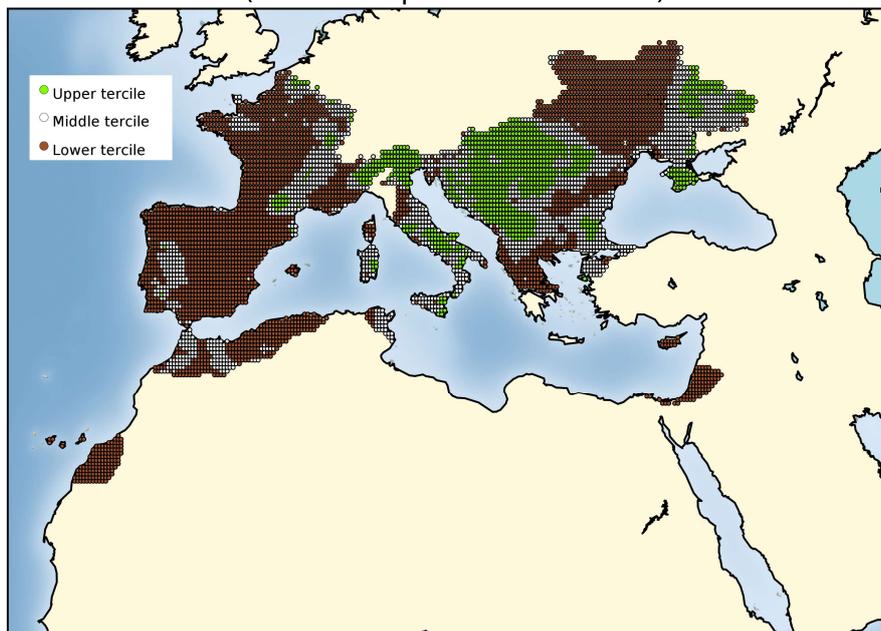
Europe and Middle East (RA VI)

Seasonal precipitation totals in the RA VI part of the MedCOF region varied between 0mm in places of southern Iberia and in the Middle East up to at least 150mm in the Alps, the Carpathian region, in northeastern Turkey and western Georgia; in some places even more than 400mm. Percentages of the 1981-2010 reference ranged from below 20% in places of Spain up to more than 150% locally e.g. in Italy, Serbia, Greece, eastern Turkey and South Caucasus. Monthly totals exceeded even 400% of the normal locally. Extreme events in form of local thunderstorms with heavy rain, partly also with stormy gusts and large hail occurred in all 3 months throughout the region except the arid areas. Daily totals exceeded partly 100mm, particularly in parts of the Balkans, causing flash floods, damage of roads, financial losses and human casualties.

In western parts of Europe (France and Iberia), precipitation was mainly normal to below normal (lower or middle tercile), only in places in southern and eastern France in the upper tercile due to some local heavy rain. Especially July and August were two very dry months in France, after heavy rain with severe flooding at the beginning of June. In Italy, most of the Balkan Peninsula, Hungary, Romania and eastern Ukraine, precipitation was mostly normal to above normal. Areas with below-normal precipitation in that part were to be found in Slovenia, Bulgaria. Some of these areas, however, experienced long dry periods, e.g. southeastern Bulgaria. Western and northern parts of the Ukraine, Turkey (except the east) and Georgia (except some stations in Georgia) had normal to below normal precipitation, whereas eastern Turkey and Armenia rather above normal. For western and northern regions of the Ukraine this dryness was extremely atypical, at least one station saw the driest summer since 1961. Cyprus, too, was relatively dry except some local thunderstorms. Especially in southern areas with below-normal precipitation, many wildfires were reported.

The drier-than-normal areas in the west and in the east can be explained by high pressure influence. While the above-normal precipitation was related to the upper air low pressure anomaly in Italy and the western Balkans and the rain in northern parts of the MedCOF region to heavy rains especially at the beginning of June, the remaining positive precipitation anomalies were due to local or subregional convective systems, partly enhanced by sea or lake effects.

PRECIPITATION JJA 2016 (EOBS data)
(reference period 1981-2010)



PRECIPITATION JJA 2016 (ECA&D data)
(reference period 1981-2010)

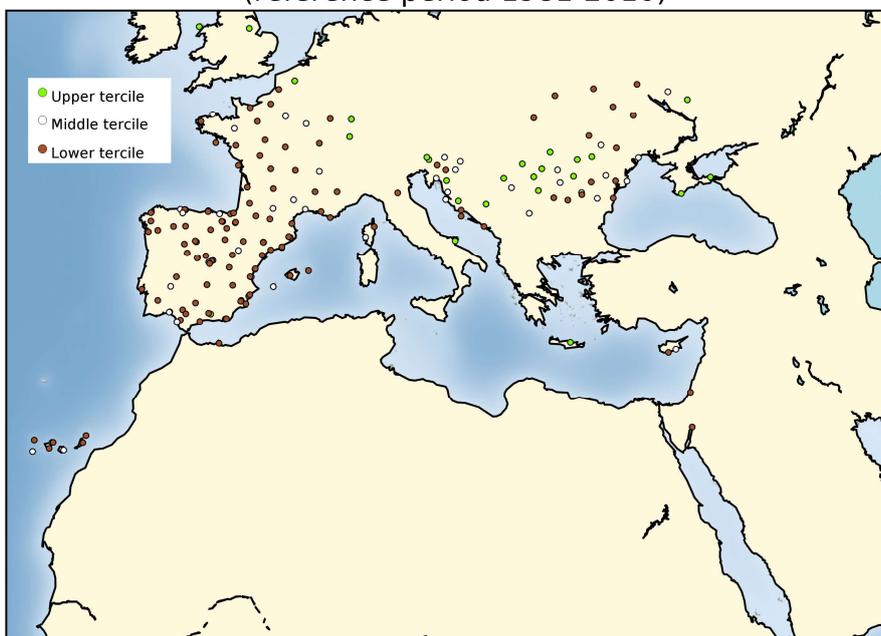


Figure 12: Terciles of summer 2016 precipitation based on interpolated E-OBS grid data (upper graph) and individual ECA&D station data (lower graph), 1981-2010 reference. Source: AEMET, data source: <http://www.ecad.eu/>

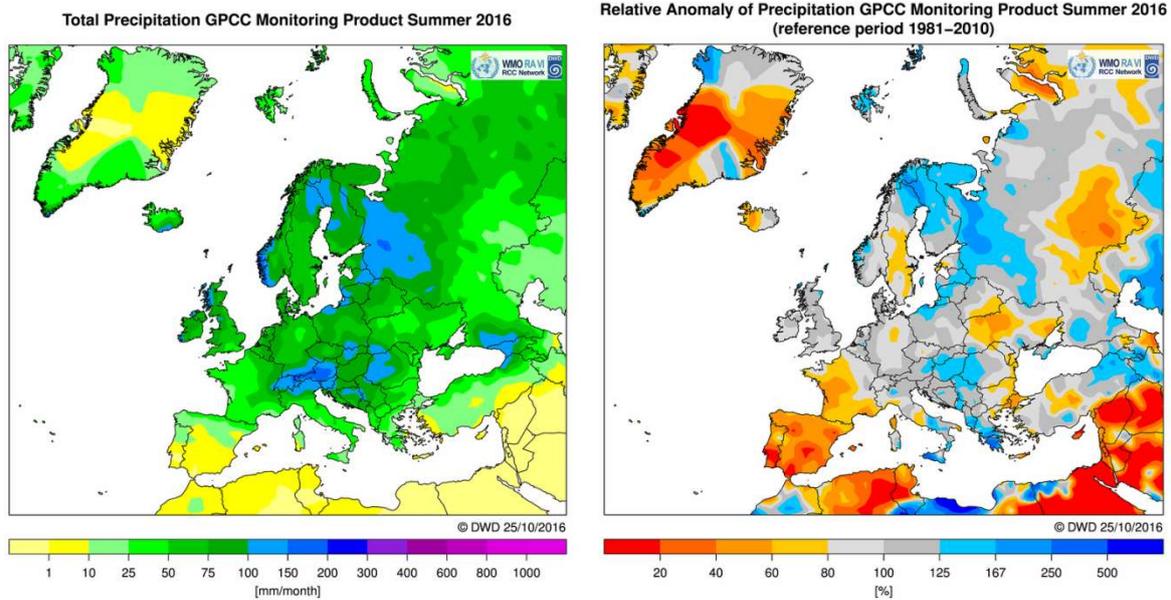


Figure 13: Precipitation for summer 2016 in Europe. Left: seasonal total in mm/month, right: relative anomalies, 1981-2010 reference, source: WMO RAVI RCC, www.dwd.de/rcc-cm, data source: GPCC, <http://gpcc.dwd.de>

A more detailed analysis for south-eastern Europe, including high impact events, is given in the analysis and verification report of the SEECOF-15 CLIMATE OUTLOOK for 2016 summer season for southeast Europe (SEE), provided by SEECOF-16 (presently draft version):

<http://www.seevccc.rs/SEECOF/SEECOF-16/Pre-COF/Draft-Version-Final-assessment-of-SEECOF-15-climate-outlook-for-summer-season.pdf>

North Africa (RA I)

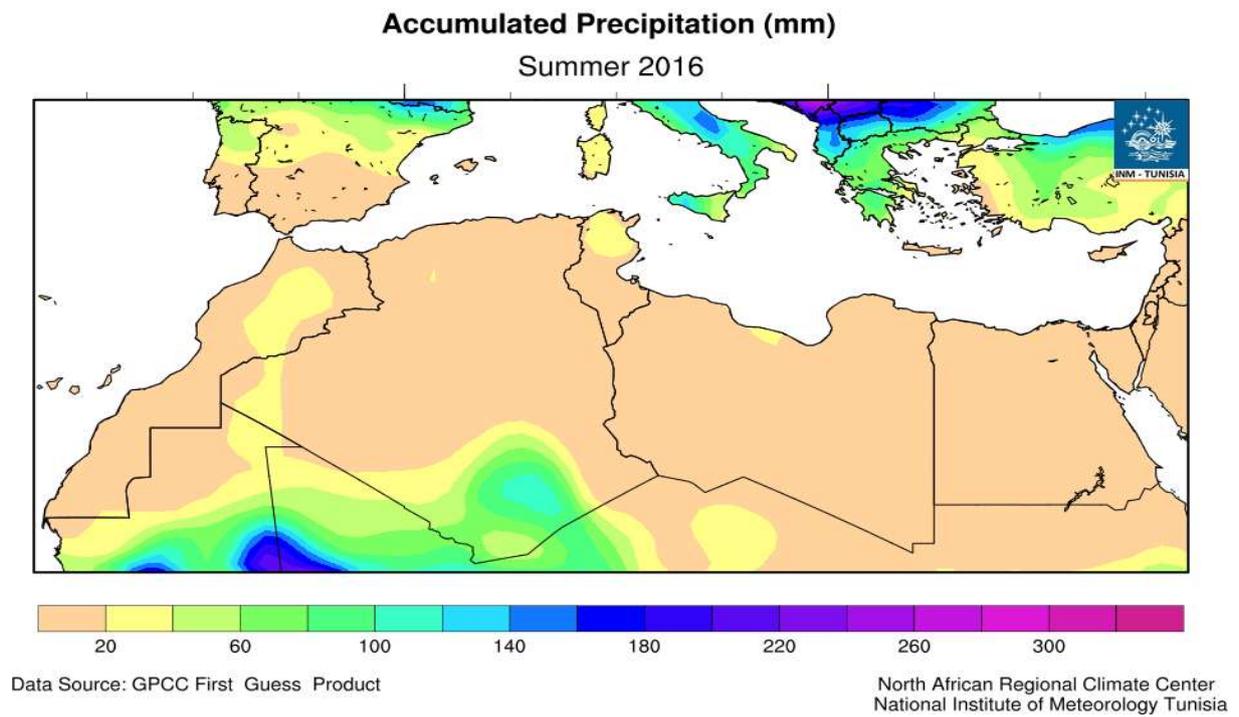


Figure 14: Total precipitation for summer season 2016 in the North African MedCOF region (in mm). Source: INM, data from GPCC, <http://gpcc.dwd.de>

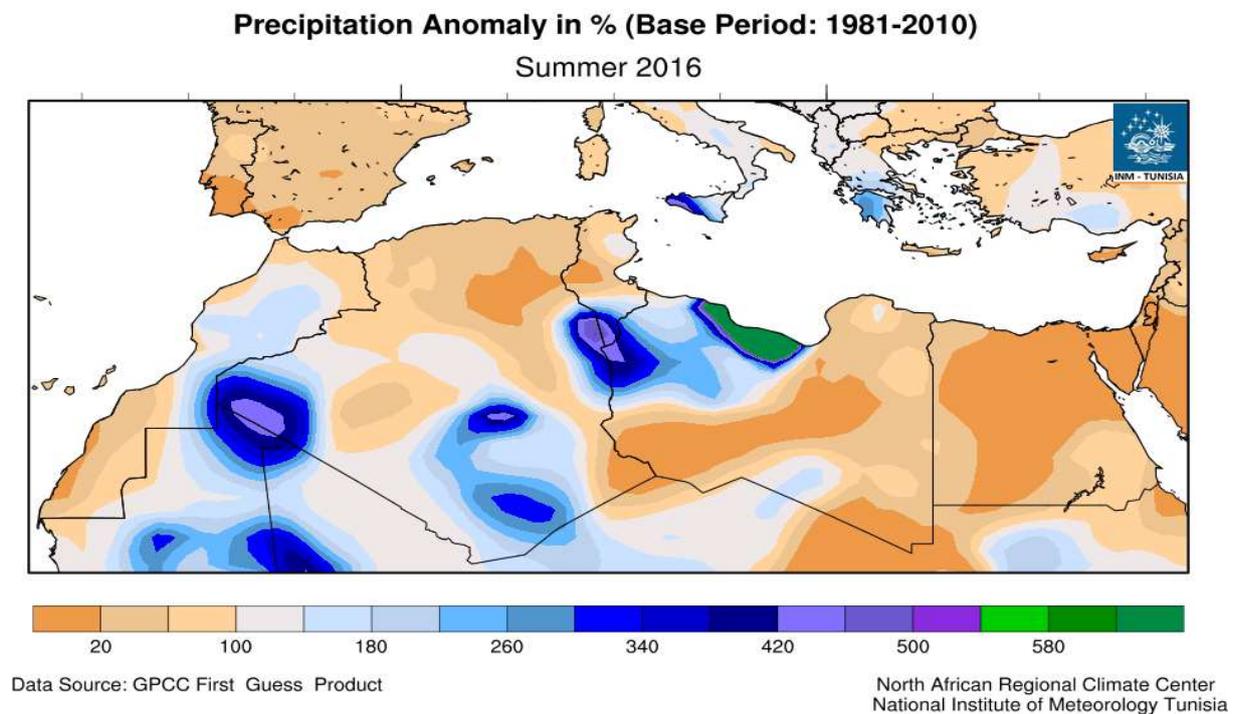


Figure 15: Precipitation anomaly for summer season 2016 in the North African MedCOF region (in %) (Reference period 1981-2010). Source: INM, data from GPCC, <http://gpcc.dwd.de>

Summer 2016 was wetter than normal over the south of Tunisia, north-western regions of Libya, the central east and the South of Algeria. In Morocco, precipitations were in the normal to above normal category. Elsewhere precipitations were below normal.

Precipitation in Tunisia was at its maximum in the north and mainly in the north-west. Extreme values were registered in Siliana such as the highest 24-hour precipitation total with 59 mm. With reference to 1981-2010 period, seasonal precipitation totals were below normal all over the country except some of the south-eastern regions where precipitation was near normal.

In Morocco, precipitations were above normal to normal over all of the country.

3. Verification of the MedCOF-5 climate outlook for the 2016 summer season

3.1. Temperature

Europe/RA VI

The MedCOF-6 outlook favored the warm scenario in Region 2 and 3, which cover almost the whole RA VI part. It was mainly correct for these two regions. A few places, which were in the middle or (very exceptional) in the lower tercile occurred either very locally or/and could not be supported by data.

For Region 1 (the westernmost part of the RA VI MedCOF region), no privileged scenario could be given by MedCOF-6. According to the analysis data, temperature in this region was normal to above normal (middle or upper tercile), the majority in the upper tercile. Since climatology was assumed for no privileged scenario, the result of the MedCOF-6 outlook was mostly not correct or not applicable. The main reason was a circulation change during the summer season, which could not be resolved on seasonal average and hence caused uncertainty.

North Africa (RAI)

The MedCOF-6 climate outlook for the 2016 summer season favored an above-normal temperature over the entire North African domain except the western region where no clear signal was detected. Probability for the upper tercile over eastern regions (including Egypt, Libya and the southeast of Algeria) was 60%. Over the remaining regions (including Tunisia and Algeria) the probability for the upper tercile was 40%.

In fact, in almost all regions of North Africa, temperature anomalies were normal to above normal except Morocco and Egypt where conditions were in the above-normal tercile.

This indicates that the MedCOF-6 climate outlook for the summer season temperature was able to predict temperature anomalies registered for most of North African regions except the western region where no scenario was specified.

3.2. Precipitation

Europe/RA VI

MedCOF-6 outlook favored a drier-than-normal summer (lowest tercile) in the southwest of the RA VI part of the MedCOF region (Iberia and western Mediterranean). This was mainly correct. In a few places, precipitation was only slightly below normal and therefore in the middle tercile.

For the rest of the RA VI part, no privileged scenario could be given by MedCOF-6. The above-normal precipitation systems over Italy / West Balkans, Hungary/Romania, eastern Ukraine and northeast Turkey / western Georgia and the drier areas in between could not be resolved by the outlook.

North Africa (RAI)

Over the North African region a drier-than-normal signal was favored over western regions with a probability of 45% for the below-normal tercile. Elsewhere, there was no preference for any climate defined categories.

Summer 2016 was wetter than normal over the south of Tunisia, north-western regions of Libya, the central east and the South of Algeria. In Morocco precipitations were in the normal to above normal category. Elsewhere precipitations were below normal. MedCOF-6 precipitation prediction didn't give any valuable information.

4. Users' perceptions of the MedCOF-6 outlook

Generally no official feedbacks were reported or given by users. In some countries, the MedCOF outlook is used for national seasonal forecasts provided to civil services, water management authorities, and the general public via the web. In other countries, the outlook is only used for internal purpose and not distributed to the public.

Appendix A: Contributors to the Pre-COF of MEDCOF-7

- World Meteorological Organization

Europe and Middle East (RA VI)

- National Meteorological and Hydrological Services:
 - Météo France, Republic of France
 - Deutscher Wetterdienst, Federal Republic of Germany
 - South East European Virtual Climate Change Center hosted by Republic Hydrometeorological Service of Serbia, Republic of Serbia
 - Armenian State Hydrometeorological and Monitoring Service, Republic of Armenia
 - National Institute of Meteorology and Hydrology, Republic of Bulgaria
 - Meteorological and Hydrological Service, Republic of Croatia
 - Meteorological Service, the Republic of Cyprus
 - The National Environmental Agency of Georgia, Georgia
 - Hellenic National Meteorological Service, Greece
 - Israel Meteorological Service, State of Israel
 - Republic Hydrometeorological Institute, Former Yugoslav Republic of Macedonia
 - State Hydrometeorological Service, Republic of Moldova
 - Federal Hydrometeorological Service of the Federation of Bosnia and Herzegovina, Federation of Bosnia and Herzegovina, Bosnia and Herzegovina
 - Republic Hydrometeorological Service of the Republic of Srpska, Republic of Srpska, Bosnia and Herzegovina
 - Republic Hydrometeorological Service of Serbia, Republic of Serbia
 - Environmental Agency of the Republic of Slovenia, Republic of Slovenia
 - Turkish State Meteorological Service, Republic of Turkey
 - Ukrainian Hydrometeorological Center, Ukraine
- WMO RA VI RCC Offenbach Node on Climate Monitoring, Deutscher Wetterdienst, Germany

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	MedCOF-6 climate outlook for temperature	Observed	MedCOF-6 climate outlook for precipitation	
Portugal (5) *	Normal to above normal	No privileged scenario	Normal to above normal	Above normal	No events reported
Spain (5)	Mainly above normal , over parts of Valencia, central Mallorca close to normal, Ibiza and Formentera Islands below normal	No privileged scenario in western Spain, above normal in eastern Spain incl. Balearic Islands	Mainly below normal, in Extremadura and some isolated areas of the northern fringe, Valencia, western Andalucía, Ibiza, Formentera Islands normal, Bay of Cadiz above normal	Below normal	3 heatwaves (July and August), several severe precipitation events, mainly associated with thunderstorms in all 3 summer months
France (5)	Above normal	NW half no signal, SE half above normal	Below normal	no signal	May 28 – June 4: Severe flooding in northern France and Seine basin Severe drought in July-August August 23-27: heat wave
Italy (5) *	Normal to above normal	Above normal	Mostly normal, locally above or below normal	No privileged Scenario	No events reported
Slovenia (5)	Above normal	Above normal to normal	Below normal at approximately one fifth of the stations Normal at approximately half of the stations	No clear signal	The highest daily air temperature in summer 2016 in Slovenia was measured on 12th July 2016 at two meteorological stations: Metlika and Črnomelj, both in south east of Slovenia. At both stations, daily maximum air temperature reached 35.0°C. Higher temperatures were not measures in Slovenia in summer 2016. There wasn't any distinctive heat wave during the season. There were four episodes of severe weather in summer 2016: 25–27 June: strong thunderstorms with locally heavy

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	MedCOF-6 climate outlook for temperature	Observed	MedCOF-6 climate outlook for precipitation	
			Above normal at approximately one third of the stations		precipitation (in northern, eastern and southern parts of country), wind (in eastern part of country) and hail (in south: Brkini, Snežnik and Javorniki). 13 July: strong local thunderstorms in northern, eastern and northeastern parts of Slovenia. 15 August: strong local thunderstorms over areas of Maribor, Mislinjska dolina, central parts of the country and in east of the country. 29 August: strong local thunderstorms over areas of Slovenj Gradec, Velenje, Celje, Maribor, Škofja Loka, Vrhnika, Postojna and Ribnica.
Hungary (5) *	Above normal	Above normal	Mainly above normal	No privileged scenario	No events reported
Ukraine (5)	Above normal	Above normal to normal	Extremely unequal distribution of terciles across the country Below normal in north and west parts of country Above normal in north-east parts of country	No clear signal in most of the country Below normal to normal in the southeast of the country	The highest daily temperature during summer 2016, measuring 40.0°C was observed on July 17th in Kup'yans of Kharkov region and it was very dangerous phenomena. On June 17th - the highest daily precipitation was recorded in Konop of Sumy region (north-east of country) – 99 mm.
Republic of Moldova (5)	Above normal	Above normal to normal	Near to below normal	No clear signal	During summer, thunderstorms, fog, hail and wind intensifications up to 25 m/s (Jun MS Camenca) were recorded. There extreme meteorological phenomena as shower rainfalls and hail: On June 1st MS Chisinau observed 63 mm of precipitations

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	MedCOF-6 climate outlook for temperature	Observed	MedCOF-6 climate outlook for precipitation	
					<p>in 4 hours and 30 minutes, at the MS Baltata in 4 hours - 53 mm, at the AMP Rezina and HP Rezina in 12 hours less than 51-66 mm;</p> <p>On June 3rd the MS Leova observed 65 mm of precipitation in 7 hours</p> <p>On June 13th the MS Ceadir-Lunga observed 69 mm of precipitations in 1 hour and 45 minutes, on June 14th at the AMS Soldanesti observed 55 mm of precipitation in 12 hours</p> <p>Overnight 18th to 19th the MS Bravicea received 73 mm in 10 hours, the AMP Singerei and Nisporeni received 52 mm and 56 mm in 12 hours, respectively. However, on June 18th hail was recorded; with the highest diameter up to 25 mm in MS Bravicea and up to 30 mm at the Cornesti.</p> <p>On June 24th at the HP Hincesti received 71 mm of precipitations in 40 minutes, the AMP Straseni received 52 mm in 1 hour;</p> <p>On June 28th the MS Cornesti received 30 mm in 1 hour and 101 mm in 7 hours - the MS Stefan-Voda received 81 mm in 5 hours, at the MS Camenca - received 70 mm in 8 hours;</p> <p>On July 3rd the Dumeni received 32 mm of precipitation in 50 minutes;</p> <p>On August 21st the AMP Singerei received 52 mm of precipitations in 12 hours;</p> <p>On August 24th the MS Bravicea received 99 mm in 5 hours.</p> <p>Isolated heavy rainfalls observed in June, accompanied by</p>

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	MedCOF-6 climate outlook for temperature	Observed	MedCOF-6 climate outlook for precipitation	
					<p>hail caused damages to crops and material damages to the national economy.</p> <p>Anomalous warm weather on the territory of the country was recorded in the 3rd decade of June, when decadal average of the temperature was 4.4-5.6°C higher than the norm and which was first time in the entire period of observations.</p>
Romania (5)*	Mainly above normal, in the southwest around normal	Above normal	In the west: above normal, other parts: below normal to normal	No privileged scenario	No events reported
Serbia (1,5)	Above normal	Above normal to normal	Above normal	No clear signal	<p>June 2016 was the fifth warmest on record in Serbia. Record-breaking number of tropical nights in June was registered at 8 main stations. Zrenjanin observed highest Jun precipitation total on record.</p> <p>July 2016 was the third wettest on record in Negotin, Leskovac and Vranje.</p> <p>August 2016 was the second wettest on record on Zlatibor and Pozega, and fourth wettest in Banatski Karlovac.</p> <p>During summer 2016, only one heat wave was registered in the period from 17 to 25 June in Vranje and Dimitrovgrad. It was the third wettest summer on record in Zrenjanin.</p>
Croatia (1, 5)	Above normal	Above normal to normal	<p>Above normal wider area of Osijek, Pazin and island Mali Lošinj</p> <p>Normal in the most of the country</p>	No clear signal	<p>Summer 2016 was extremely warm in most of the country.</p> <p>Two heat waves were observed during summer, the first one was lasting from June 23rd to 26th, and the second one from July 10th to 14th, but none of them was as long-lasting and intense as in summer 2015.</p> <p>In all 3 months severe weather phenomena caused by convective instabilities (thunderstorms, hail, heavy rains,</p>

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	MedCOF-6 climate outlook for temperature	Observed	MedCOF-6 climate outlook for precipitation	
			Below normal Wider area of Poreč, Šibenik, Split, and island of Hvar		flash floods and waterspouts) were observed across most of Croatia. They were more common in June and August. In June, record-breaking daily precipitation totals were observed in Ploče, south Adriatic (160 mm, measurements from 1978) and in Pazin, Istra (74 mm, measurements from 1961). In August, record-breaking daily precipitation totals were observed in Mali Lošinj, north Adriatic (96.2 mm, measurements from 1961)
Republic of Srpska, Bosnia and Herzegovina (5)	Above normal	Above normal to normal	Normal to above normal	No clear signal	August extremely hot and dry, less than 5mm in many places in the south, forest fires
Federation of Bosnia and Herzegovina, Bosnia and Herzegovina (1)	Above normal	Above normal to normal	Normal to above normal	No clear signal	No high impact events.
Montenegro (1,5)	Above normal	Above normal to normal	Normal in the large part of the country Above normal from central to southern part of the country	No clear signal	No high impact events.
Albania (5)*	Above normal	Above normal	Normal to above normal	No privileged Scenario	No events reported
The former Yugoslav Republic of Macedonia (5)	Slightly above normal	Above normal to normal	Very variable precipitation regime	No clear signal	June The highest minimum air temperature was exceeded in the following places:

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	MedCOF-6 climate outlook for temperature	Observed	MedCOF-6 climate outlook for precipitation	
					<p>21.0°C on 24th in Ohrid, 22.4°C on 24th in Prilep, 23.6°C on 23th in Skopje.</p> <p>August On August 6th Skopje valley was affected by a flash flood caused by heavy rain. The extreme precipitation of 96.5 mm that was registered in Skopje during 5 hours has 0.1% probability of occurring once in a thousand year. There were human victims and lot of damages on the local houses and fields.</p> <p>Berovo observed highest minimum air temperature of 17.6°C on 7th August.</p>
Bulgaria (1)	Above normal	<p>Above normal to normal in the most of the country</p> <p>Above normal along the coasts and in the hinterland of the Black Sea</p>	<p>Normal in most of the country</p> <p>Below normal Along the coasts and hinterland of the Black Sea</p>	<p>No clear signal In the most of the country</p> <p>Normal to below normal along the coasts and in the hinterland of the Black Sea</p>	<p>Warmer than normal conditions were observed during all summer months in 2016. Mostly dry conditions were observed during all months, out of which July was the driest. The southeast of the country experienced a relatively long dry period and consecutively dangerous fire weather conditions.</p> <p>Dangerously hot weather lasted couple of days in the middle of June which was announced by the weather service releasing the appropriate weather warnings.</p> <p>No temperature records have been broken.</p>
Greece (2, 5)	Above normal	Above normal	<p>Near to below normal in most of the country</p>	<p>No clear signal on the north of the country</p>	No high impact events.

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	MedCOF-6 climate outlook for temperature	Observed	MedCOF-6 climate outlook for precipitation	
				Normal to below normal in the most of the country	
Turkey (2)	Normal to Above normal (Near normal in the eastern and central part of the country)	Above normal	Above normal mostly in the northern areas Below normal in the south of the country	Normal to below normal in the south and southeast of the country No clear signal in most of the territory	In June 2016, strong wind caused material damage on the houses and some vehicles in Gumusane. Agriculture was affected by hail in Konya, Eregli, Kahramanmaras and Bilecik. In July 2016, heavy rain caused flood and landslide in Ordu. In Kayseri, heavy rain led to flooding and transportation disruption claiming one casualty due to flooding. In August 2016, agricultural areas were affected by hail in Aydin, Kastamonu and in Isparta. Transportation was disrupted due to heavy rain in Eksisehir, Ankara, Kars and Antakya.
Georgia (1)	Above normal	Above normal	Normal in most of the territory excluding several stations where it was	No clear signal	No high impact events.

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	MedCOF-6 climate outlook for temperature	Observed	MedCOF-6 climate outlook for precipitation	
			above or below than normal		
Armenia (1)	Above normal	Above normal to normal	Above normal to normal	Above normal to normal	<p>The summer 2016 was characterized by a strong wind, heavy precipitation and in particular intense hail accompanied by large hailstones.</p> <p>June: On June 4th and 6th in Yerevan Martuni (Gekharquinig region) and Ijevan (Tavush region) heavy hail storm was observed with hailstones of 2 mm in diameter. On June 12th heavy rainfall (44mm/12h) was observed in Ijevan (Tavush region).</p> <p>July: Torrential rainfall, was observed on July 2th and 6th in Talin (55mm/2h), Fantan (40 mm/3h), Aparan (37 mm/3h), (Argatsotn and Kotayk region) accompanied by strong wind with gusts reaching 25-28 m/s .On July 10th , Armavir and Yereva observed hailstones of 28 mm in diameter.</p> <p>The highest July air temperature reaching 41-42°C was measured in Ararat on July 21th</p> <p>August: Significant precipitations deficit was observed across most of the country. Strong wind gusts reaching 25 m/s were observed. Strong wind with gusts reaching 25-28 m/s was observed in different areas during the summer.</p>
Azerbaijan (5)*	Mostly above normal	Above normal	Normal to below normal	No privileged scenario	No events reported
Syria (5)*	Above normal	Above normal	Dry season	No privileged scenario	No events reported

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	MedCOF-6 climate outlook for temperature	Observed	MedCOF-6 climate outlook for precipitation	
Lebanon (5)*	Above normal	Above normal	Dry season	No privileged scenario	No events reported
Cyprus (5)	Above normal	Above normal	Generally Below normal	Dry season masking	<p>June</p> <p>Temperature extremes were recorded with highest positive departures between 8 and 10°C, like Polis Chrysochou station where the highest daily air temperature (40.2°C) was 9.9°C higher than normal (30.3°C) and Paphos airport where the highest daily air temperature (37.8°C) was 10.2°C higher than normal (27.6°C). During June 18-25, 8 EMMA warnings indicating yellow awareness level were issued in regard to the extremely high temperatures, referring to maximum and minimum temperatures.</p> <p>On June 19th outbreak of a huge fire was registered in Solia region destroying 18,57km² of forest area. Due to the high temperatures and the low percentages of relative humidity, it was difficult to bring fire under control.</p> <p>The lowest daily air temperatures were also observed, with negative departures between 5 and 6°C below normal, like the mountainous station of Prodromos where an extreme minimum of 9.1°C was by 5.9°C below station's normal (15.0°C).</p> <p>During June local showers or thunderstorms caused by thermal instability were recorded on 9th, 10th and 11th June resulting in accumulated precipitation of 29% of normal. In certain areas, like Kalavassos damn and Athalassa stations the accumulated precipitation sums was higher than normal, amounting to 489% and 173% of normal, respectively.</p> <p>July</p> <p>Extreme highs and lows (both maximum and minimum departing by 4°C of normal) were recorded. Note the 39.1°C highest maximum of Polis Chrysochous station departing by almost 6°C from normal and the 33.1°C highest maximum of Prodromos station departing around 5°C from normal. Two highest minimums with positive departures higher than 4°C</p>

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	MedCOF-6 climate outlook for temperature	Observed	MedCOF-6 climate outlook for precipitation	
					<p>of normal, the first at Athalassa station on 6th July and the second at Pafos airport on 24th July. At Prodromos station lowest maximum (23.5°C) and lowest minimum (12.8°C) temperatures were recorded with negative departures higher than 4°C from normal.</p> <p>On 5th, 23rd and 31st July episodes of thundery activity and isolated showers resulted in accumulated precipitation accounting for 21% of the normal. Extreme accumulated precipitation was recorded in several areas, like Saittas with 38.8 mm of precipitation which is 388% of normal.</p> <p>August</p> <p>During the period between 2nd and 5th August, the maximum temperatures of Polis Chrysochous station were diverted by 4°C higher than the normal maximum of the station. Generally, the highest monthly temperature maximum of 40.4°C was recorded on 8th August over the inland station of Athalassa (average 36.9°C). For a sequence of days EMMA warning for high temperature was issued.</p>
Israel (5)	Above normal	Above normal	No comment	Dry season masking	No high impact events.
Jordan (5)*	Above normal	Above normal	Dry season	No privileged scenario	No events reported

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 basic climatological period

* Data sources: E-OBS, NOAA NCDC, GPCC, ECA&D

North Africa (RA I)

Appendix A: Contributors to the Pre-COF of MEDCOF-7

National Institute of Meteorology, Tunisia

National Meteorological Directorate, Morocco

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	MedCOF-6 climate outlook for temperature	Observed	MedCOF-6 climate outlook for precipitation	
Algeria*	Normal to above normal	Above normal	Above normal in the south Below normal Elsewhere	Below normal	No comment
Egypt*	Above normal	Above normal	Below normal	No clear signal	No comment
Libya*	Normal to above normal	Above normal	Above normal in the north western region Below normal elsewhere	No clear signal	No comment
Morocco (1)	Above normal	No clear signal	Normal to above normal	Below normal	No comment
Tunisia (1)	Above normal in the east coastal areas Normal to slightly above normal elsewhere	Above normal	Near normal in the south-east regions Below normal elsewhere	Below normal	No comment

Note:

(1) Basic climatological period (1981-2010)

* Data source: The National Climatic Data Center (NCDC)

References:

MedCOF 6 Outlook: http://medcof.aemet.es/images/doc_events/medcof6/step3/docStep3/Consensus_Statement_MedCOF-6_final.pdf

SEECOF 16 Online Forum: <http://www.seevccc.rs/forum/>

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

WMO RA I RCC Node on Climate Monitoring Website with monitoring results: <http://www.meteo.tn/htmlen/donnees/climatemonitoring.php>

RA VI RCC-CM Website with monitoring results: <http://www.dwd.de/rcc-cm>

Météo France climate monitoring products: <http://elaboration.seasonal.meteo.fr/en/content/climate-monitoring>

ECMWF ERA Interim reanalysis: <http://www.ecmwf.int/en/research/climate-reanalysis/era-interim>

NOAA ESRL composite maps: <http://www.esrl.noaa.gov/psd/data/composites/day/>

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

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

GPCC: <http://gpcc.dwd.de>