MEDITERRANEAN CLIMATE OUTLOOK FORUM
MEDCOF-11 MEETING

ANALYSIS AND VERIFICATION
OF THE MEDCOF-10 CLIMATE OUTLOOK
FOR THE 2018 SUMMER SEASON
FOR THE MEDITERRANEAN REGION (MED)

First draft version

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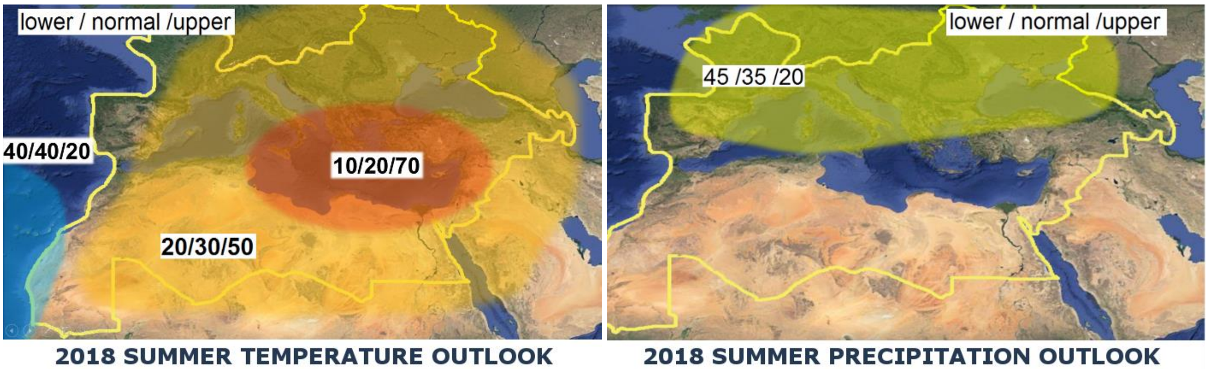
The following MedCOF verification report is based on

- the outcome of the consensus forecast of MedCOF 10,
- climate monitoring results of RA I NA RCC and RA VI RCC networks,
- the analysis and verification report of SEECOF-20 for 2018 summer season for southeast Europe (SEE)
- national verification reports received from NMHSs or posted in RCOF forums of MedCOF, SEECOF or PRESANORD.

1. MedCOF-10 Climate outlook for the 2018 summer season



(a) (b)

Figure 1: Graphical presentation of the climate outlook for the 2018 summer season for the Mediterranean region (a) Temperature Outlook; (b) Precipitation Outlook

General circulation

The tropical Pacific was returning to neutral conditions from la Niña Event. Above average temperatures appeared on the western and northern tropical Pacific, and below-average temperatures in the eastern and southern region. The trend of ENSO based on prediction models indicated a neutral state with some slightly above-average temperatures. Over the Atlantic Ocean, cold anomalies were developing over the northern tropical region and the western African Coast, trend confirmed by forecasts. Some models suggested that a warm tongue could develop over the equator. In the extratropics, warm anomalies persisted in the western North Atlantic and north of Europe. Over the Mediterranean sea SST was warmer than normal, particularly over the eastern part of the basin. Most drivers were in neutral or close to neutral state. TNA seemed to be developing a negative anomaly, but still close to neutral. TASI had below normal values, and was expected to continue like that for the summer.

There was no good agreement between models. Some of them showed a certain trend to a more frequent than normal NAO+ pattern, which was consistent with SST anomalies over the Atlantic, so their forecast was considered more likely than others.

Temperature

Temperatures were expected to be warmer than normal over most of Eastern MedCOF domain (see figure 1a) being the warm tercile more probable over Eastern Mediterranean and Southern/South-eastern Europe, with good agreement among most models. Models still showed a relatively high probability of the warm tercile over the rest of MedCOF area, with less agreement for the western end of it. On the other hand, some models forecasted below-normal temperatures over the Atlantic Ocean and western shores of Morocco and Mauritania, which was consistent with SST anomalies.

Within the RA VI part of the domain, the upper tercile was predicted with highest probability (70%) over the eastern Mediterranean region, including southern Italy, southern Balkans, Greece, western half of Turkey, Cyprus, and the Middle East (orange region in figure 1a). The warm scenario was also preferred for the rest of the domain, except the westernmost parts, but with 50% probability. For the northwestern half of France (mainland), Portugal and Spain (except the east); both the lower and middle tercile was predicted with 40% probability each.

Over North Africa, the warm tercile was assumed as the most probable scenario for the whole domain except for the western façade of Morocco, where either a cold or a neutral scenario was predicted with 40% probability each. For the rest of the domain, the warm scenario was preferred with 70% probability for the coasts of Tunisia, Libya and Egypt, and 50% elsewhere.

The outlook for temperature distinguished three regions with different tercile distributions. Two of them (orange and yellow region in figure 1a) had the highest probability for the upper tercile. This means for verification that a prediction of above-normal temperature (upper tercile) was assumed for these areas. The third region in the westernmost part of the MedCOF domain had a probability of 40% each for the lower and middle tercile. This means for verification that a prediction of either below-normal or around-normal temperature was assumed, which means the outlook is correct, when any of these two scenarios were predicted.

Precipitation

Precipitation forecasts were in less agreement than for temperature. Some models (like ECMWF S5, EUROSIP), showed a trend to a drier-than-normal summer over the northernmost part of the domain, while MF S6 showed a drier-than-normal summer for the Western Mediterranean, associated with NAO+ predominance. Drivers like TASI and TNA suggested a drier-than-normal summer over countries north of the Mediterranean and the Black Sea, and the north-eastern Iberian Peninsula. Combining all this factors, a drier-than-normal summer was forecasted over the northern part of the MedCOF area, with moderate uncertainty.
For the rest of the region no large-scale precipitation signal was present in the forecasts (see figure 1b). The climatological forecast (33, 33, 33) over the southern part of the domain also implied the fact that no meaningful forecast could be provided for these seasonally dry areas.

For the RA VI domain, the outlook distinguished two regions for precipitation. For the green region in Fig. 1b the lower tercile has the highest probability with 45% and covers most of the domain. For the remaining parts (Portugal, western and southern Spain, Greece, Turkey (except Black Sea coast), South Caucasus, Middle East and Cyprus) no privileged scenario was predicted. This means for verification that below-normal precipitation (lower tercile) was assumed for the green region and climatology (middle tercile) or dry season for the rest of the domain.

The North African domain was assumed to be on dry season, therefore climatology was assumed for verification.

2. Analysis of the 2017 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 summer 2018 (WMO RA I RCC Node on Climate Monitoring: http://www.meteo.tn/htmlen/donnees/climatemonitoring.php; WMO RA VI RCC Offenbach Node on Climate Monitoring: http://www.dwd.de/rcc-cm), contributions from Météo France (http://seasonal.meteo.fr/), Regional Climate Outlook Forums for Southeastern Europe (SEECOF-20, http://www.seevccc.rs) and North Africa (PRESANORD, http://acmad.net/rcc/presanord.php) and national verification reports from MedCOF participants.

2.1. General circulation

2.1.1. Ocean

The western tropical Pacific was more than 0.5 K warmer than normal (1981-2010 reference) in summer 2018, whereas anomalies in the eastern tropical Pacific were closer to normal on summer average (Fig. 2). Significant negative anomalies were still to be found close to the western coast of Peru. In June 2018, the Niño 1+2 region (close to South America) still had negative anomalies, while the Niño 3.4 region, which is located further in the open ocean already switched to positive values (Tab. 1). Later in the summer, anomalies in Niño 1+2 region dropped close to zero, whereas positive anomalies in Niño 3.4 increased slightly, but did not exceed +0.3 K (1971-2000 reference). This means that ENSO was in a neutral state in summer 2018 as predicted; the preceding La Niña ended definitively, and an El Niño event started to develop, but was still not in a mature stage.

In the Atlantic, a warm tongue can be identified over the equator. Further to the north, still in the northern tropical region, an area of cold anomalies extended between the Caribbean and the African west coast (Mauretania). The Tropical Northern Atlantic Index (TNA, anomaly of the average of the monthly SST from 5.5N to 23.5N and 15W to 57.5W) developed a negative anomaly until June 2018, which afterwards weakened to zero during July and August (Tab. 2). Similarly, the Tropical Atlantic SST index (TASI), calculated as the difference of the NAT (North Atlantic Tropical SST index, SSTs in the box 40°W - 20°W, 5°N - 20°N) and SAT (South Atlantic Tropical (SAT) SST index, SSTs in the box 15°W - 5°E, 20°S - 5°S) indices, had a peak of negative anomalies in June 2018 and decreased to zero in August (see https://stateoftheocean.osmc.noaa.gov/sur/atl/tasi.php).

In the subtropics, a warm anomaly can be found between North America and Western Europe, extending further to the Biscay and the North Sea up to the Arctic region. The cold blob over the North Atlantic still persisted south of Greenland. The Mediterranean was 1-2 K warmer than normal on summer average, and so was also the Black Sea.

In summary, all oceanic anomalies considered for the MedCOF-10 outlook were predicted correctly or occurred as expected.

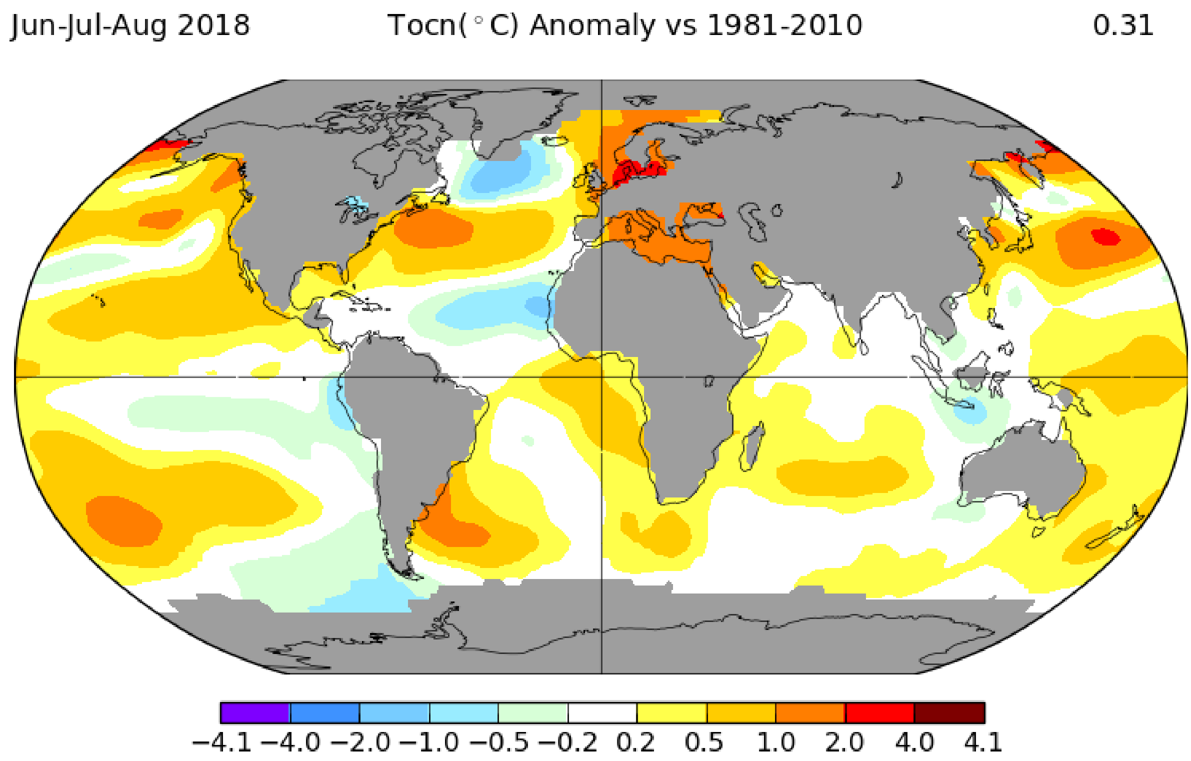


Figure 2: Sea surface temperature anomalies for boreal summer 2018 (June-August), 1981-2010 reference. Data from ERSSTv5 ocean model analysis with 250km smoothing, source: NASA GISS, https://data.giss.nasa.gov/gistemp/maps/

MONTH	NIÑO 1+2		NIÑO 3		NIÑO 4		NIÑO 3.4	
	TEMP	ANOM	TEMP	ANOM	TEMP	ANOM	TEMP	ANOM
June 2018	22.19°C	-0.69°C	26.72°C	0.29°C	29.16°C	0.32°C	27.85°C	0.20°C
July 2018	21.43°C	-0.19°C	26.05°C	0.43°C	29.10°C	0.30°C	27.52°C	0.30°C
August 2018	20.66°C	0.02°C	25.14°C	0.15°C	29.19°C	0.51°C	27.11°C	0.29°C

Table 1: Sea surface temperature and anomalies for various Niño regions in boreal summer months 2018 (June-August), 1971-2000 reference. Data from ERSST.v4 ocean model analysis, source: NOAA, https://www.ncdc.noaa.gov/teleconnections/enso/indicators/sst.php with definitions of Niño regions.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
2018	0.28	-0.09	0.02	-0.17	-0.40	-0.48	-0.21	0.01	0.33	0.16

Table 2: Monthly TNA index January – October 2018. Source: NOAA ESRL, https://www.esrl.noaa.gov/psd/data/climateindices/list/

2.1.2. Atmosphere

Seasonal averages of 500 hPa geopotential in summer 2018 show a strong zonal flow over the North Atlantic (Fig. 3). Over Europe, the flow was diffluent and a ridge-trough pattern was established on seasonal average especially over the Mediterranean region and extending to North Africa also. In particular, there was a trough close to the western coasts of Iberia and Morocco, a ridge over the Western Mediterranean and a trough over the Eastern Mediterranean. In terms of anomalies, it was more cyclonic than normal over the Mediterranean, clearly separated from anticyclonic anomalies north and south of it. This separation was most distinct in June (Fig.4). In July, cyclonic anomalies moved to the north, while high pressure anomalies developed over North Africa. In August this anomaly dipole moved to the south again. In summary, although there was some shifting of anomalies within the season, intraseasonal variability was relatively low, which means there was no principal change of large-scale circulation patterns during summer.

Sea level pressure distribution shows that the Azores High extended far into the European continent, but also to the western Mediterranean and western parts of North Africa. The eastern Mediterranean subregion and the Middle East were rather under cyclonic influence (Fig. 5). This was persistent during all summer months (Fig. 6). Seasonal SLP anomalies were around or slightly negative in the entire MedCOF domain. Highest cyclonic anomalies in June were recorded mainly in the eastern parts of the domain, from southern Italy to South Caucasus. During July, anomalies shifted further to the east, and in August, they became generally weaker.

The Icelandic Low was more intense than normal on seasonal average, and the Azores High was extended to the north. This implies a strong positive NAO phase, which persisted through all the summer months (Table 3). This was also expected in the MedCOF-10 outlook (see first chapter). In addition, a positive, but short EA phase occurred during July and August, implied by higher-than-normal high pressure further south (Iberia, western North Africa).

Weather types of the Météo France classification (Fig. 7) show a high frequency of the type “Atlantic Ridge” in all summer months, highest in June and decreasing to late summer. This type expresses the extension of the Azores High to the north but also high pressure influence over Central Europe, but more cyclonic conditions over the Mediterranean. In July, blocking types became very frequent, which imply cyclonic conditions over the western coasts of the MedCOF domain. In August Atlantic trough situations became more frequent, when high pressure was favored over the Western Mediterranean.

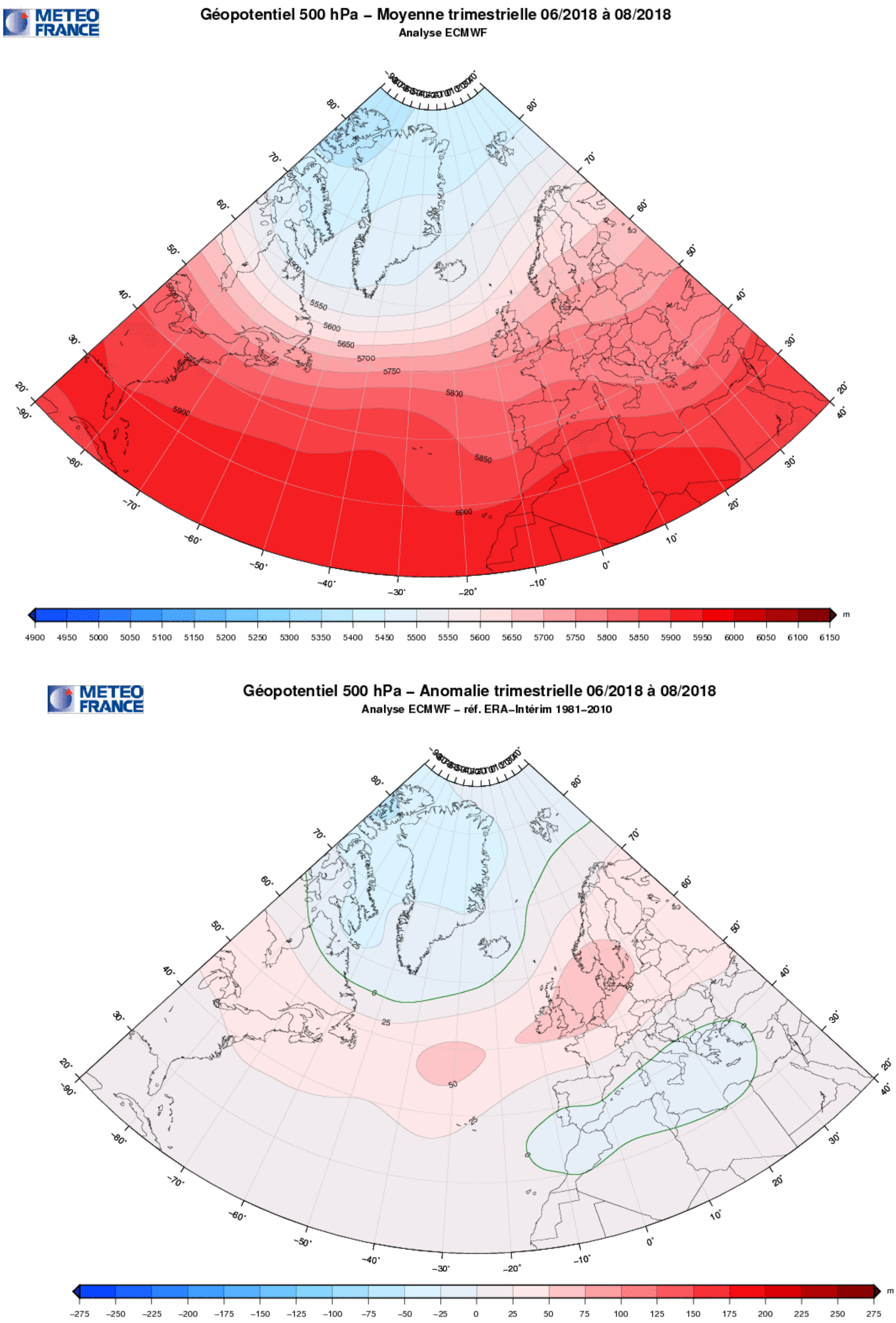


Figure 3: Seasonal mean and anomalies of 500 hPa geopotential for summer 2018 (1981-2010 reference). Source: Météo France, data source: ECMWF ERA Interim reanalysis, http://seasonal.meteo.fr/en/content/suivi-clim-cartes

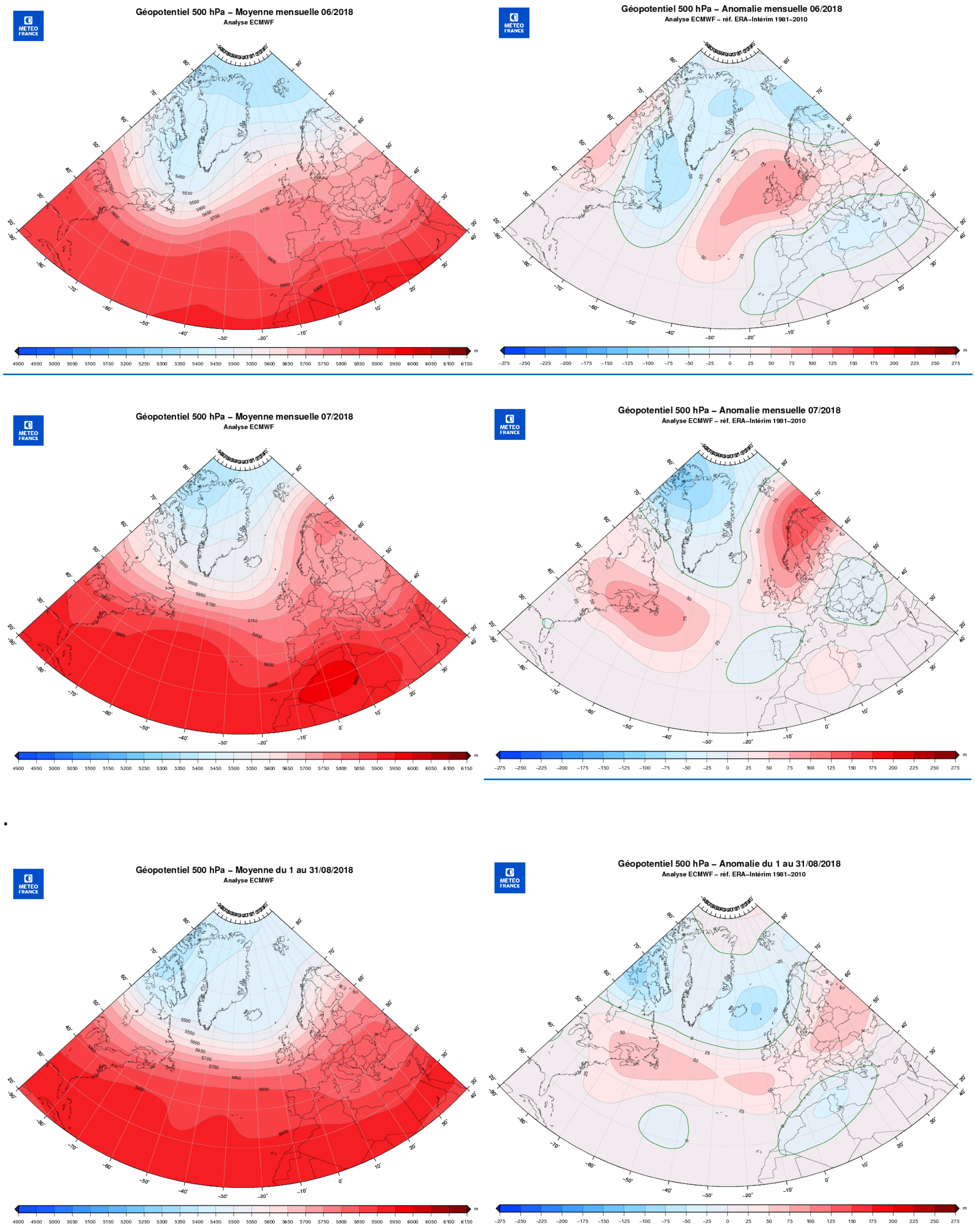
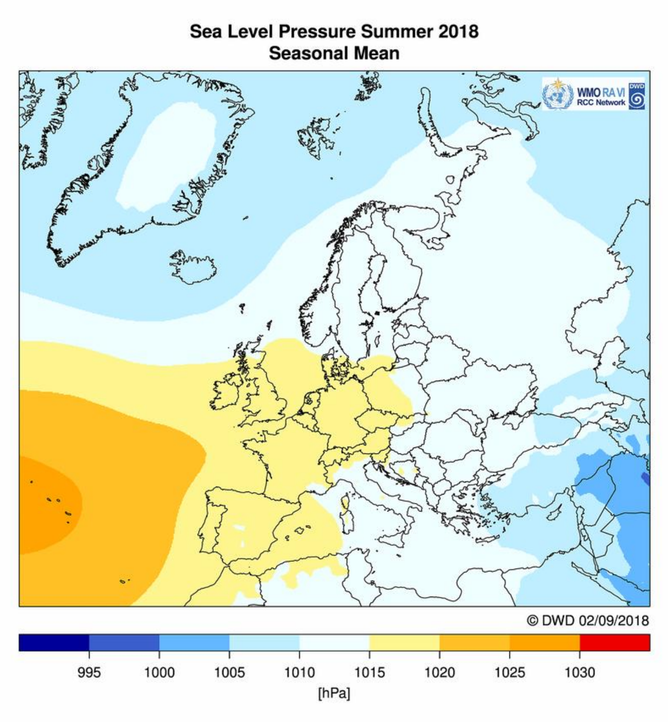


Figure 4: Same as Figure 3, but for the months June, July, August 2018.



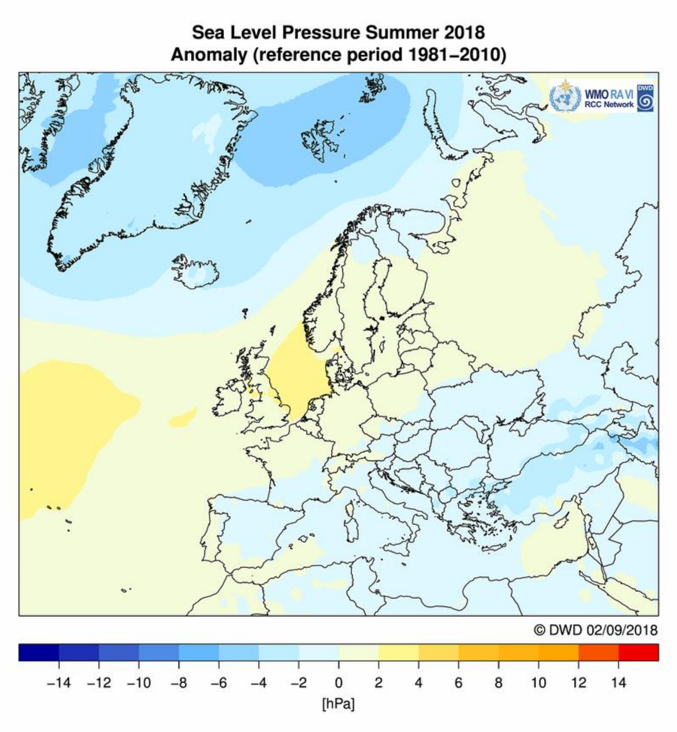


Figure 5: Seasonal mean sea level pressure (upper graph) and its seasonal anomalies (lower graph) for summer 2018 (1981-2010 reference). Source: Deutscher Wetterdienst (DWD), data source: DWD numerical ICON model analysis, http://www.dwd.de/EN/research/weatherforecasting/num_modelling/01_num_weather_prediction_modells/icon_description.html?nn=484268

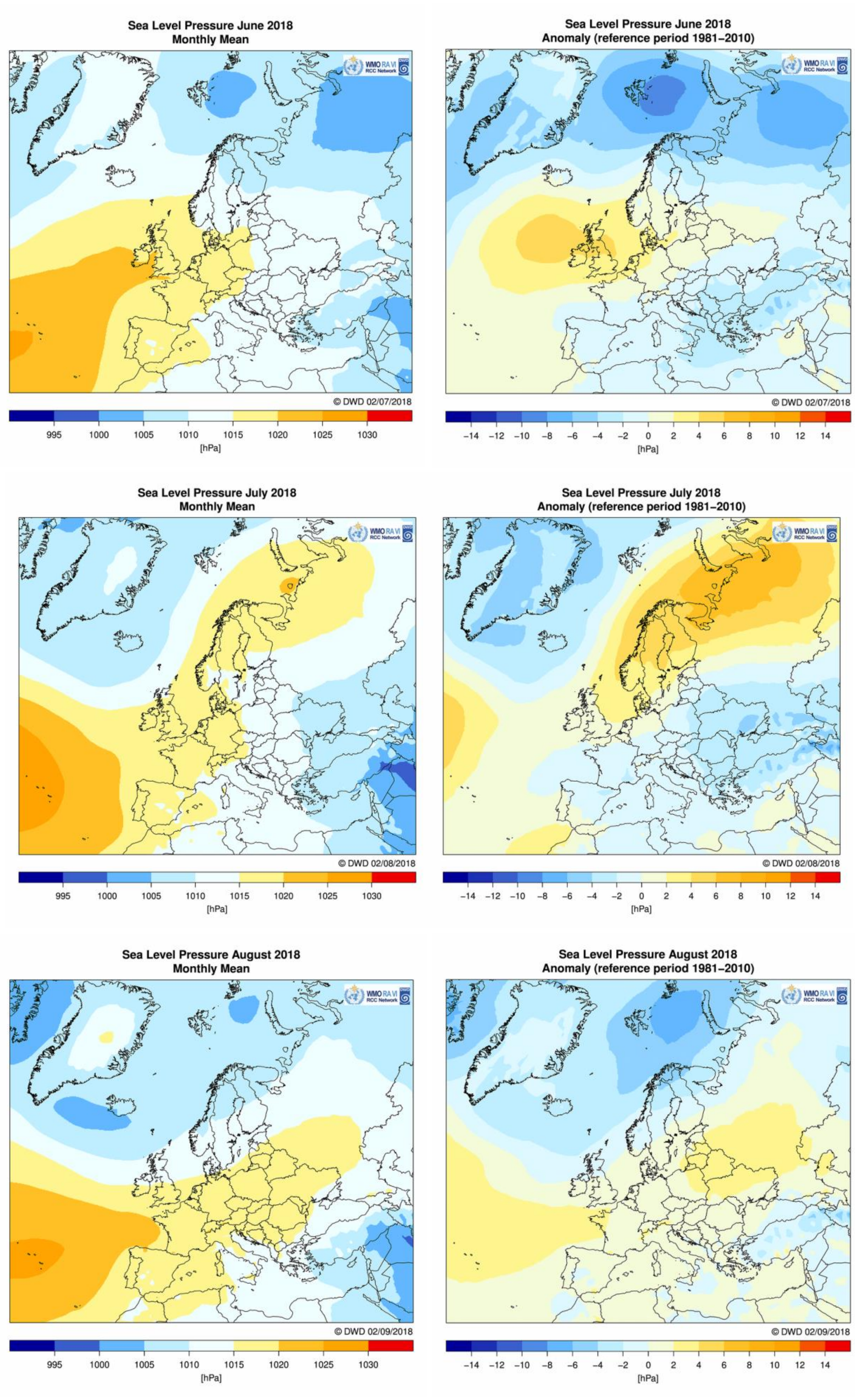


Figure 6: Same as Figure 5, but for the months June-August 2018.

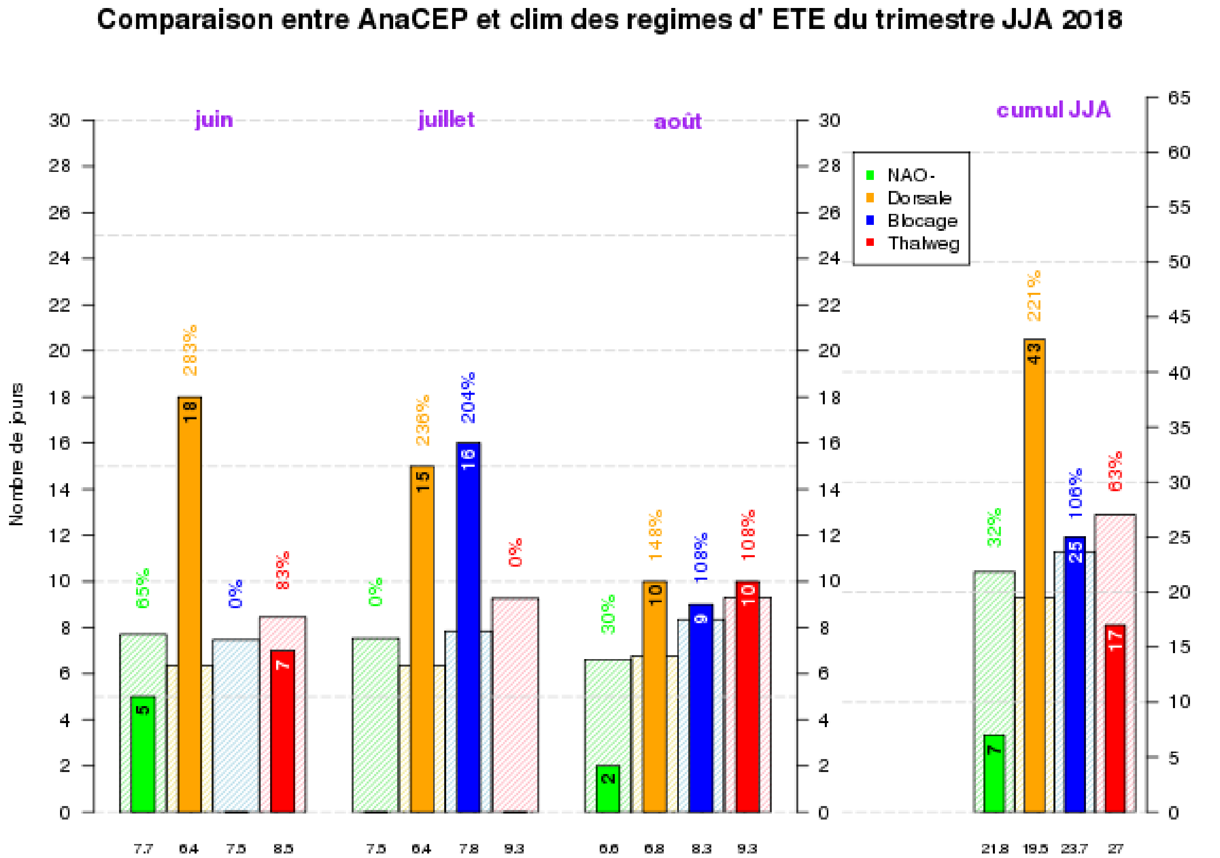


Figure 7: Number of days with circulation types of the Météo France classification for each month of the summer 2018 season and for the whole season (right), and in percent of the climatological frequency distribution 1981-2010. Circulation types are: negative North Atlantic Oscillation phase (NAO-), Atlantic ridge (Dorsale), Scandinavian Blocking (Blocage) and Atlantic trough (Thalweg). Source: Météo France,

http://seasonal.meteo.fr/en/content/suivi-clim-regimes-trim

yyyy	mm	NAO	EA	WP	EP/NP	PNA	EA/WR	SCA	TNH	POL	PT	Expl.Var
2018	6	1.41	-0.54	-0.44	0.05	0.66	-0.24	-0.77	-99.90	-0.93	-99.90	51.6
2018	7	1.42	2.36	-0.81	-0.16	-0.76	-2.16	2.27	-99.90	-0.15	-99.90	64.5
2018	8	2.40	1.82	-1.38	-0.78	1.24	-0.47	-1.05	-99.90	0.01	-0.92	58.8

Table 3: Circulation indices of NOAA CPC patterns for the summer months 2018.

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

2.2. Temperature

Europe and Middle East (RA VI)

Much of the domain was warmer than normal with seasonal temperatures in the upper tercile (Fig. 8ff). Especially the northern parts of the domain had a very warm summer; even the 90th percentile was exceeded like in much of Central Europe. In the southwestern half of Iberia, temperatures were in the middle or lower tercile, and also in places in Sicily, the southern Balkan Peninsula and Greece, southwestern Turkey and Middle East the middle tercile was reached. For E-OBS data, even in the latter areas the lower tercile was displayed.

Seasonal temperature anomalies in summer 2018 show a high spatial variability. In most of the domain, they ranged between 0 and +2°C (1981-2010 reference), locally higher. Negative anomalies were recorded in a few places in Iberia, southern Italy and over the central Mediterranean. Seasonal mean temperature for summer 2018 mostly ranged between 20 and 25°C in the lowlands, 15-20°C in most mountainous regions, 25-30°C in parts of Spain, at many Mediterranean coasts, over most of the sea and the islands and in the Middle East, above 30° in some eastern and southern parts of the Middle East.

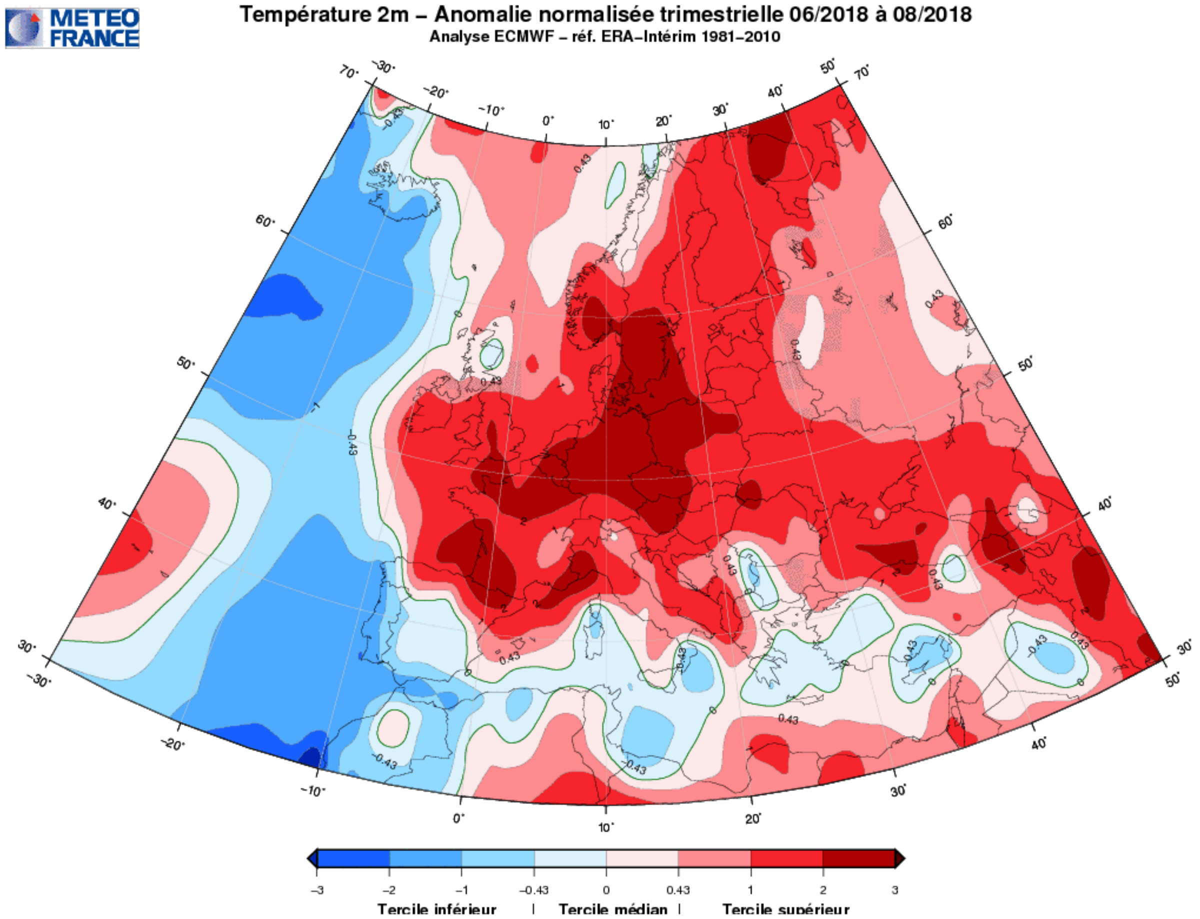


Figure 8: Seasonal normalized temperature anomalies of summer 2018 surface air temperature based on ECMWF / ERA-INTERIM grid data, 1981-2010 reference. The data range between -0.43 and +0.43 represents the middle tercile, below -0.43 the lower tercile and above +0.43 the upper tercile. Source: Météo France, data reference: http://www.ecmwf.int/en/research/climate-reanalysis/era-interim

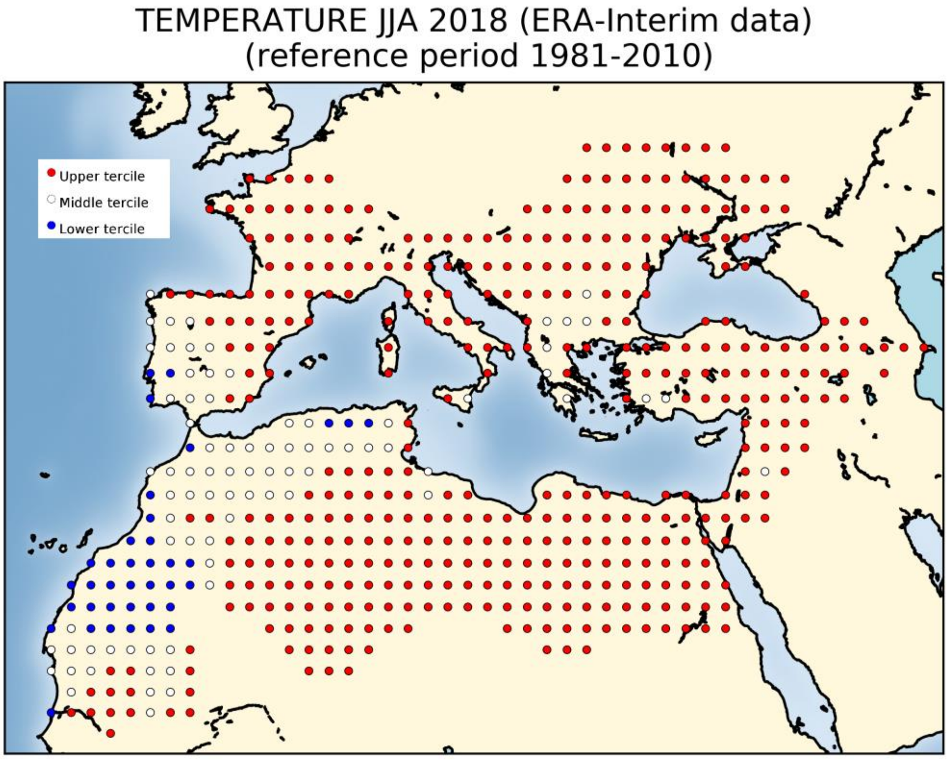
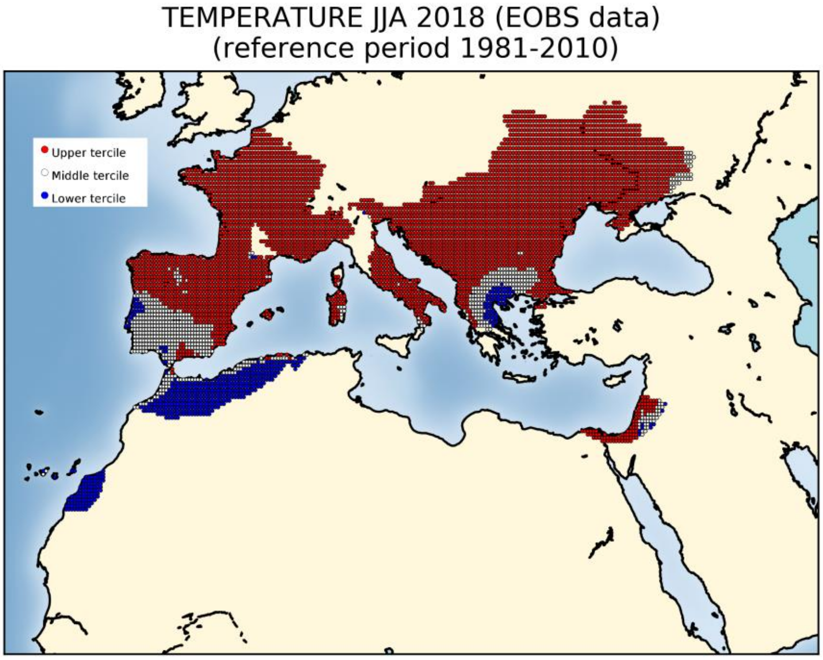


Figure 9: Terciles of summer 2018 surface air temperature based on ERA-Interim Reanalysis, 1981-2010 reference. Source: AEMET, data source http://www.ecmwf.int/en/research/climate-reanalysis/era-interim



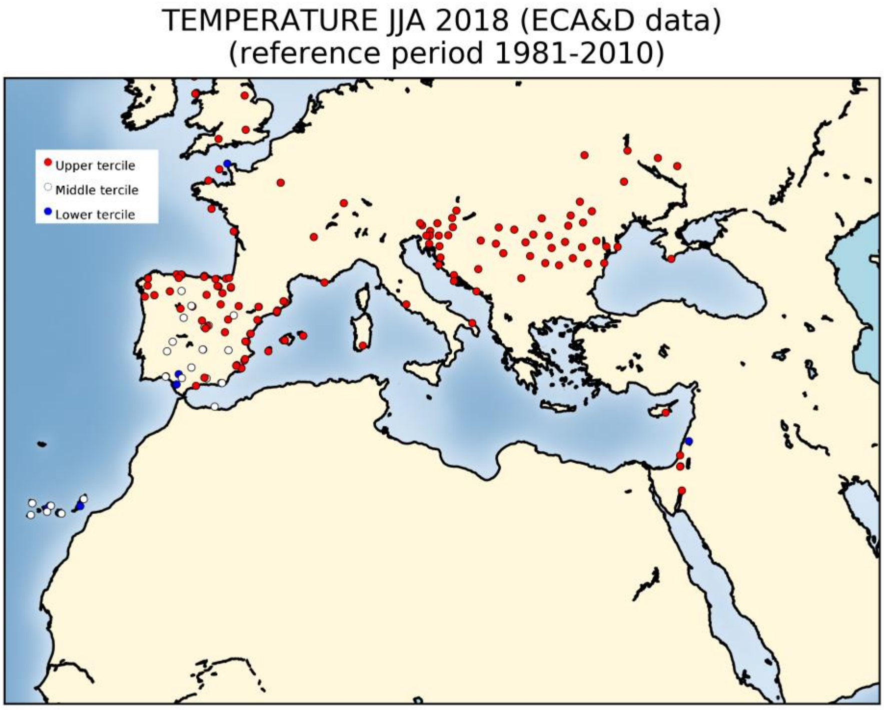


Figure 10: Terciles of summer 2018 surface air temperature based on interpolated E-OBS grid data (upper graph) and individual ECA&D station data (lower graph), 1981-2010 reference. Note: E-OBS uses a higher number of stations than those which are freely available at ECA&D. Source: AEMET, data source: http://www.ecad.eu/

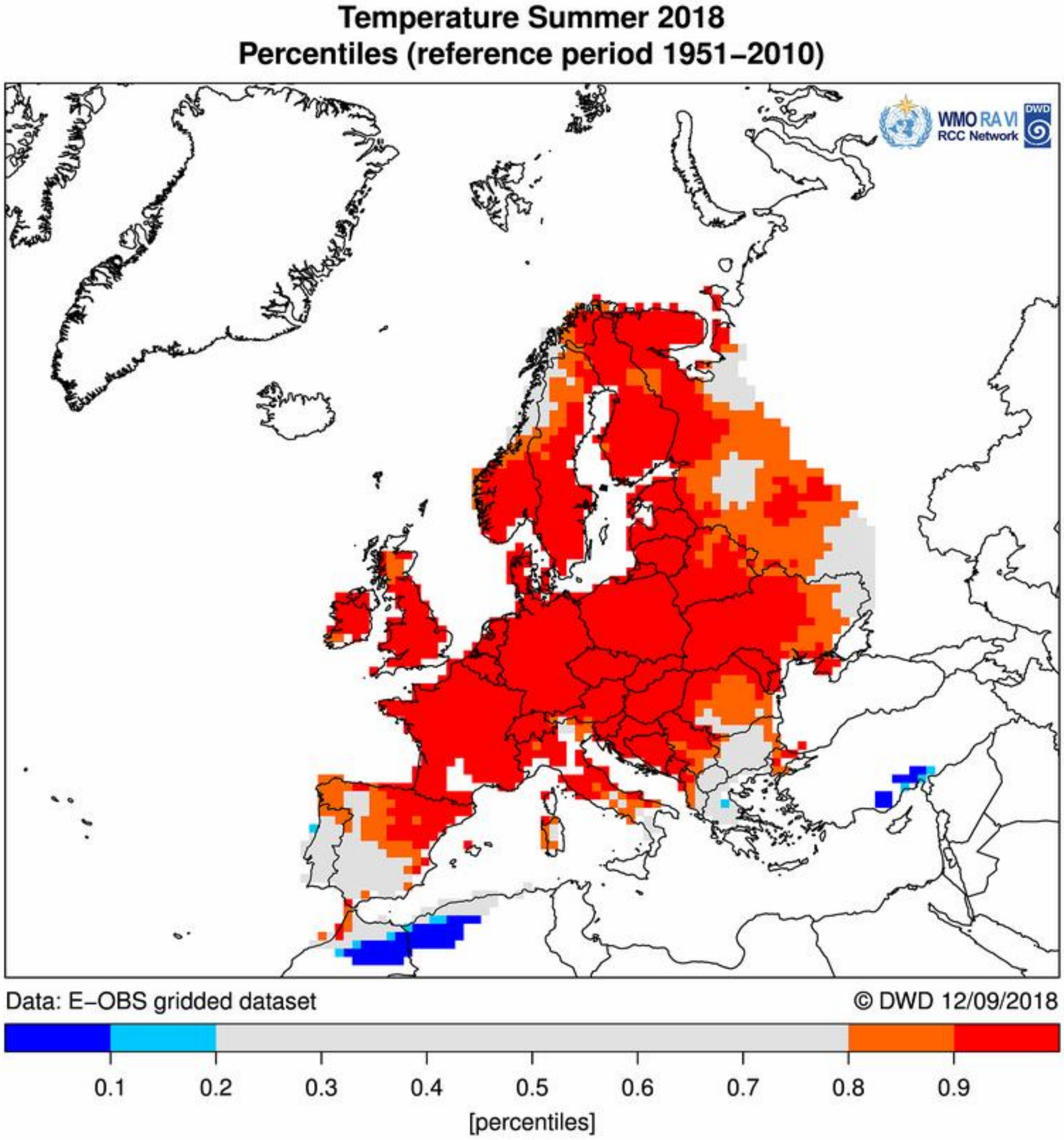


Figure 11: Percentiles of summer 2018 surface air temperature based on interpolated E-OBS gridded data, 1951-2010 reference. Source: DWD, data source: http://www.ecad.eu/

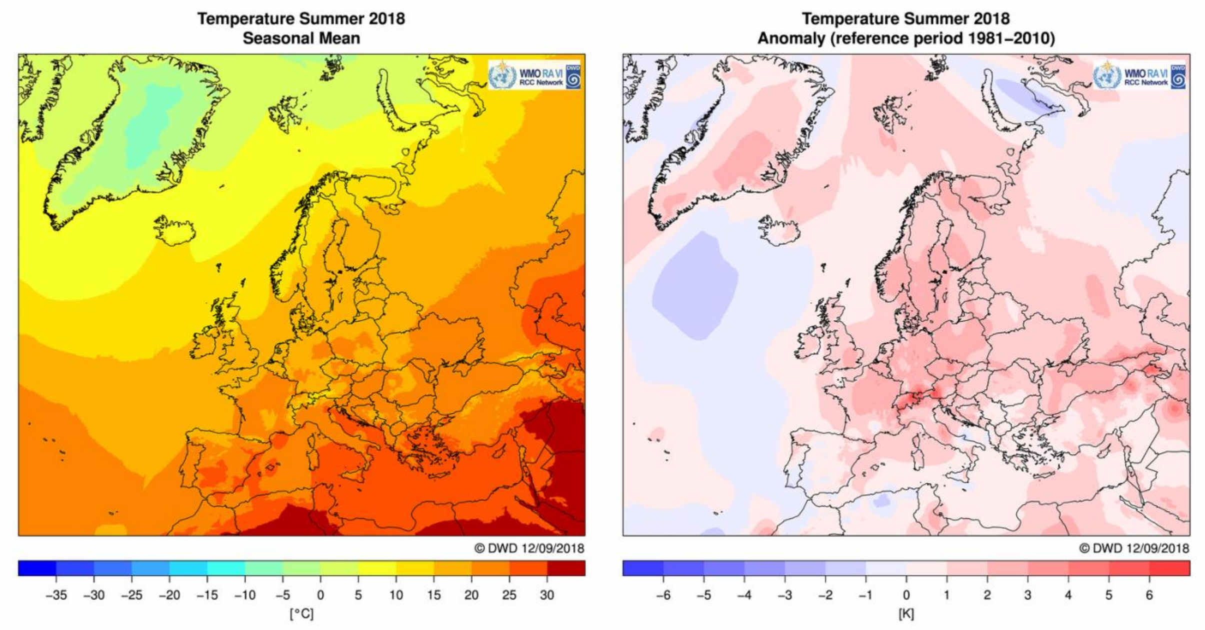


Figure 12: Surface air temperature for summer 2018. Left: seasonal mean, right: anomalies, 1981-2010 reference, source of both maps: WMO RAVI RCC, based on interpolated CLIMAT data, www.dwd.de/rcc-cm

North Africa (RA I)

Most of the domain had temperatures in the upper tercile. Only in western parts, mainly in Morocco, northern Algeria and Tunisia, temperatures were in the lower or middle tercile.

To be completed by RA I NA RCC

Figure 13: Mean temperature for summer season 2018 in North Africa (in °C). Source: INM, (Data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov)

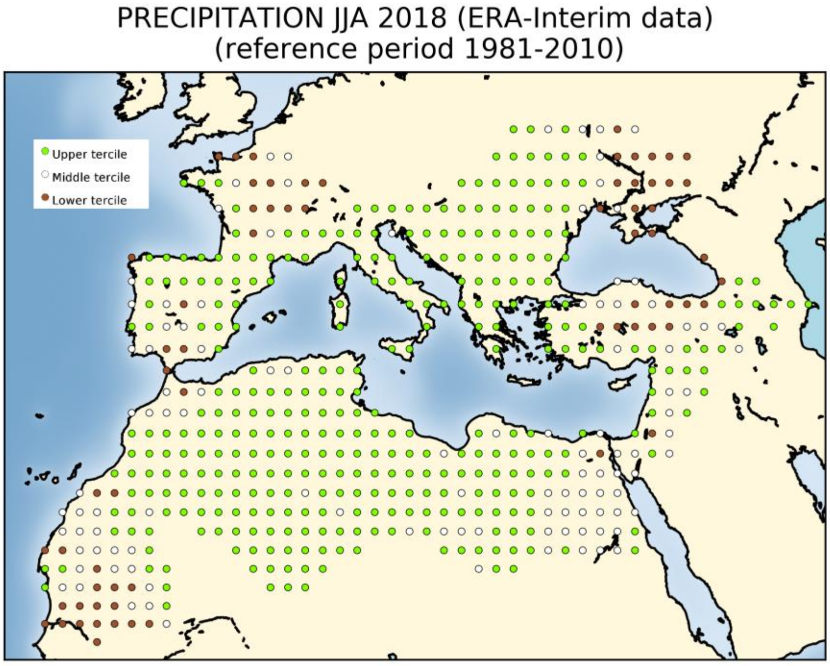
Figure 14: Temperature anomaly for summer season 2018 in North Africa (in °C), reference period 1981-2010. Source: INM, Data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov

2.3.Precipitation

Europe and Middle East (RA VI)

Correspondent to the cyclonic anomalies over the Mediterranean, much of the domain had a wetter-than-normal summer and most of the area had precipitation totals in the upper tercile (Fig. 15ff). However, there were also areas with around-normal or even below-normal in between, especially in western, central and southern Iberia, central and north-eastern France, eastern Ukraine, western Georgia, parts of Turkey and the Middle East. The wet areas came especially from frequent heavy precipitation over the warm water of the Mediterranean, while the dry areas from partly anticyclonic conditions in Western Europe (Atlantic Ridge) and Eastern Europe (Blocking High). E-OBS shows some additional dry areas, e.g. in Hungary, Slovenia and Croatia, which are not confirmed by ERA-Interim, maybe due to spatial resolution or missing stations. However, looking at anomalies, deviations from normal are relatively low there. GPCC also shows a dry area in eastern Azerbaijan, where data from the other data sets were not available or not complete, and in the western Ukraine.

Highest seasonal precipitation totals in the domain were recorded from areas of the northern and eastern Balkans, Romania, southwestern Ukraine and western Georgia with above 300mm. Much of southern Iberia, the Middle East, Cyprus, parts southern Turkey and eastern Azerbaijan received totals of less than 30mm or no precipitation at all.



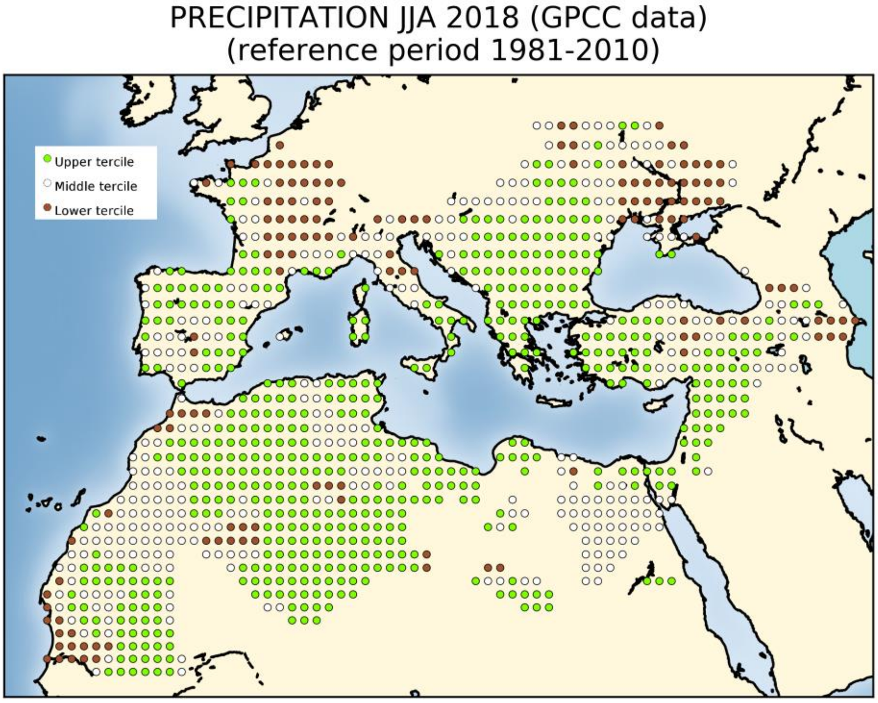
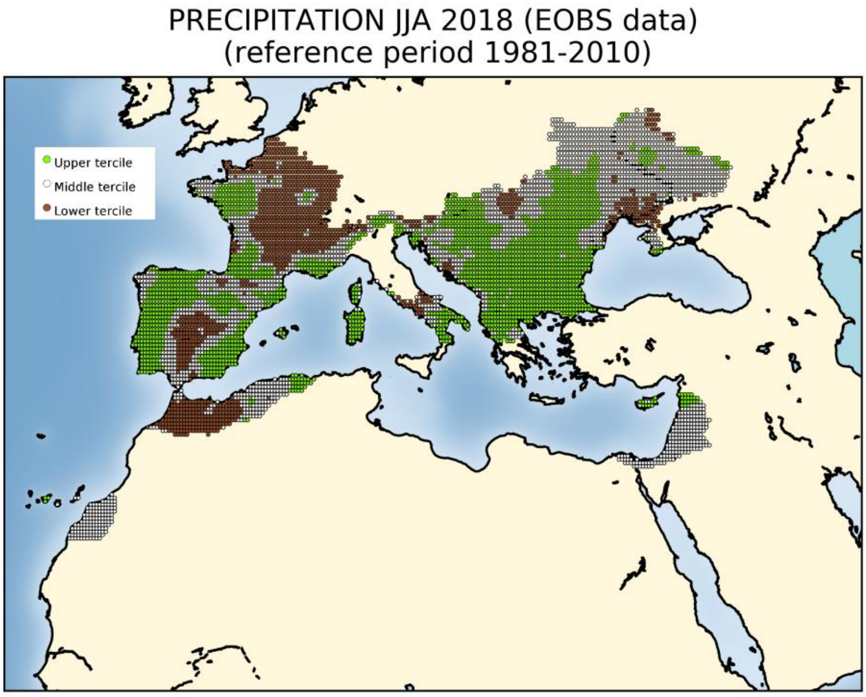


Figure 15: Terciles of summer 2018 precipitation based on ERA-INTERIM Reanalysis (upper graph) and GPCC (lower graph) grid data, 1981-2010 reference. Source: AEMET, data reference: ERA-INTERIM: http://www.ecmwf.int/en/research/climate-reanalysis/era-interim , GPCC: http://gpcc.dwd.de



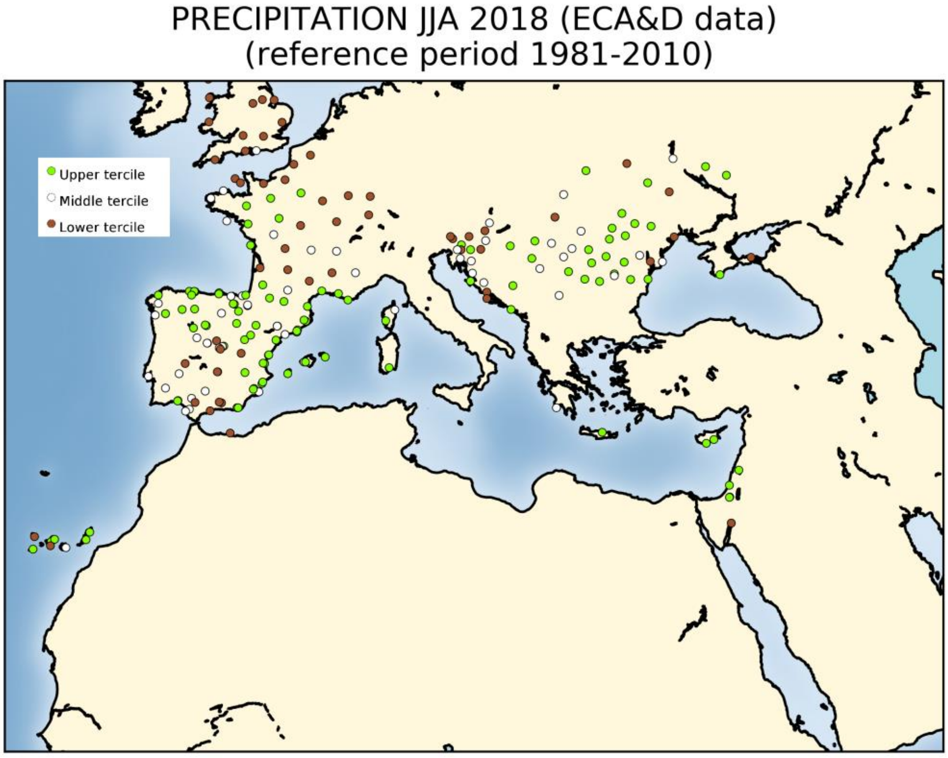
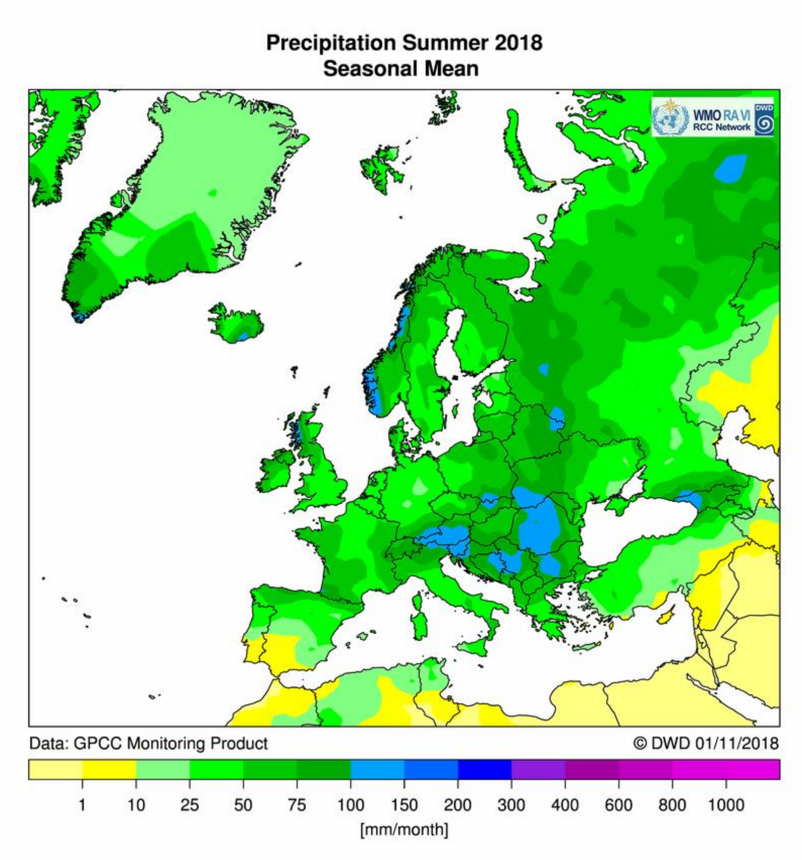


Figure 16: Terciles of summer 2018 precipitation based on interpolated E-OBS grid data (upper graph) and individual ECA&D station data (lower graph), 1981-2010 reference. Source: AEMET, data source: http://www.ecad.eu/



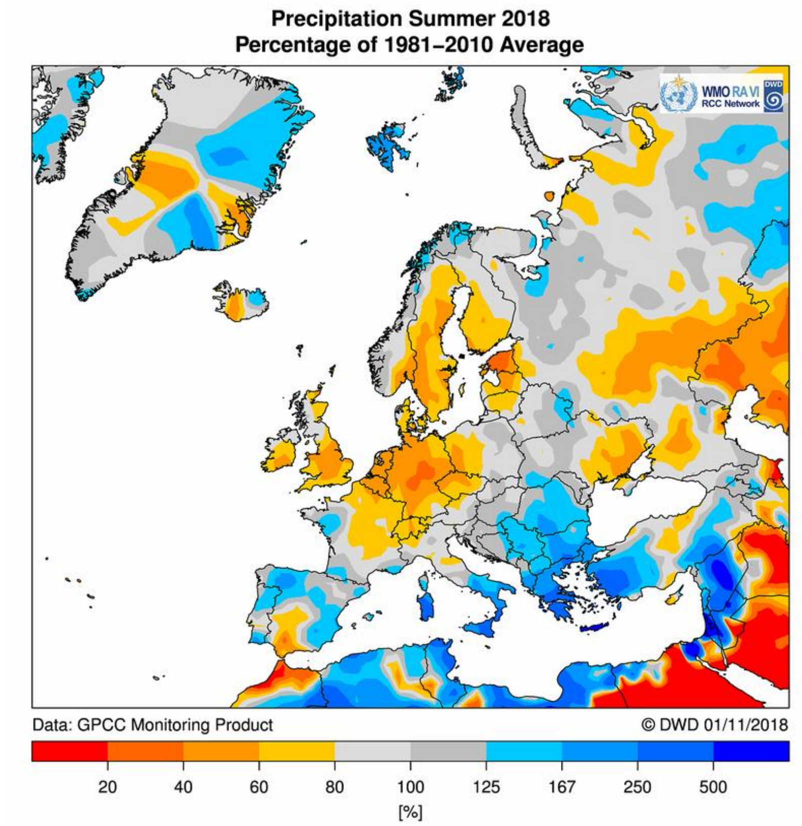


Figure 17: Precipitation for summer 2018 in Europe. Upper map: seasonal total in mm/month, lower map: percentage of 1981-2010 average, source: WMO RAVI RCC, www.dwd.de/rcc-cm , data source: GPCC, http://gpcc.dwd.de

A more detailed analysis for south-eastern Europe, including high impact events, is given in the analysis and verification report of the SEECOF-19 CLIMATE OUTLOOK for the 2018 summer season for southeast Europe (SEE), provided by SEECOF-20 (presently draft version):

http://www.seevccc.rs/SEECOF/SEECOF-20/Pre-COF/Draft-Version-Final-assessment-of-SEECOF-19-climate-outlook-for-summer-season.pdf

North Africa (RA I)

To be completed by RA I NA RCC

Figure 18: Total precipitation for summer season 2018 in North Africa (in mm). Source: INM, Data from GPCC (First Guess Product), http://gpcc.dwd.de

Figure 19: Precipitation anomaly for summer season 2018 in North Africa (in %) (Reference period 1981-2010). Source: INM, data from GPCC, http://gpcc.dwd.de

4. Verification of the MedCOF-10 climate outlook for the 2018 summer season

4.1. Temperature

Europe/RA VI

The MedCOF-10 outlook favored the upper tercile for the whole domain except westernmost parts (northwestern half of France and Iberia without the east). In the latter areas the lower or middle tercile was equally preferred.

The warm scenario was predicted correctly for most of the domain. Some areas close to the Mediterranean basin, however, had seasonal averages in the middle or lower tercile, which were not captured by the outlook. The reason might be frequent low pressure areas over the warm Mediterranean water, which produced cooling.

The cold or normal scenario for the westernmost parts of the domain was well predicted for Iberia except the north, whereas it was warm instead in western France. A reason might be subsidence warming due to an anomalous extension of the Azores High, which was underestimated in the outlook in its spatial extension.

North Africa (RAI)
to be added by RA I NA RCC.

4.2. Precipitation

Europe/RA VI

MedCOF-10 outlook favored a dry scenario (lower tercile) over most of the domain. For western and southern Iberia, Greece, most of Turkey (except Black Sea coast), South Caucasus, Middle East, Cyprus no signal was given, which means climatology was recommended.

The outlook failed in most of the domain. The dry scenario was correctly predicted only for some of the northern parts, particularly in France, northern Italy and the Ukraine. In contrast, much of the domain, especially the southern parts had above-normal precipitation, which was not predicted by the outlook. A reason might be that the dry area due to high pressure influence was shifted further to the north than expected and precipitation in Mediterranean cyclonic systems over warm water was more intense than expected. However, it has to be considered that the given probability was relatively low with 45% for the dry scenario, which implies uncertainty due to model disagreement. Also especially in some drier regions in the south, the deviations from normal were very small.

North Africa

To be added by RA I NA RCC.

4. Users' perceptions of the MedCOF-10 outlook

Some countries submitted seasonal forecasts to governmental authorities, public services, private companies for various sectors (e.g. energy, water management, civil fire protection), and the general public via mass media and the web. Also monthly briefings were organized. Others used the outlook only for internal purpose.

Feedback from users was reported by a few countries. Some negative feedback was related to the usability (when no privileged scenario was given) and reliability of forecasts.

In North Africa, no feedback was given by users.

Appendix A: Contributors to verification of MEDCOF-10

- World Meteorological Organization as initiator and supporter of this activity

Europe and Middle East (RA VI)

- Climate Centres:

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

- National Meteorological and Hydrological Services:

- Armenian State Hydrometeorological and Monitoring Service, Republic of Armenia
- Republic Hydrometeorological Service of the Republic of Srpska, 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
- Deutscher Wetterdienst, Federal Republic of Germany
- 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
- Republic Hydrometeorological Service of Serbia, Republic of Serbia
- Environmental Agency of the Republic of Slovenia, Republic of Slovenia
- AEMET, Spain
- Turkish State Meteorological Service, Republic of Turkey
- Ukrainian Hydrometeorological Center, Ukraine

- **Further National Meteorological and Hydrological Services via SEECOF-20**

APPENDIX B: **Analysis and verification of the MedCOF-10 climate outlook for the summer season 2018:**

Verification summary based on the national reports and contributions of the participants of the SEECOF-20 and MedCOF-11 meetings

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-10 climate outlook for temperature	Observed	MedCOF-10 climate outlook for precipitation	
Albania *	Normal to above normal	Above normal	Below normal	Normal to above normal	No events
Armenia (1)	Below normal (Ararat valley extremely low)	Above normal	Below Normal	No predictive signal	Winter 2016-17 was characterized by long lasting foggy weather: in Shirak Region, Ararat valley, low visibility less than 50 m was observed. Heavy snowfall (20mm/9h) on December 14 in Tavush region, on 28 of January in Gekharkuniq region 23mm/12 hours. Strong wind 25-29m/s on 3 of December in Lori and Gekharkuniq regions
Azerbaijan *	Below normal	Above normal	Normal	No signal	No events

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-10 climate outlook for temperature	Observed	MedCOF-10 climate outlook for precipitation	
Federation of Bosnia and Herzegovina (1)	Below normal in almost entire Bosnia and Herzegovina	Above-normal	Below normal in entire Bosnia and Herzegovina	Normal to above normal	The winter ranks as the fourth coldest in the central and northern regions and the seventh in the Southern region in the 21st century. December was extremely dry, driest on record on MS Bihac. January ranked as the coldest in the central and northern regions since 1963, and in the south and the west regions since 1985. The lowest temperature was measured on Bjelasnica amounting to -27.2°C (January, 7th).
Rep. Srpska, Bosnia and Herzegovina (5)	Below to near normal	Near normal	Below normal	No signal (means usual climate conditions would prevail)	--The month of January 2017 was extremely cold. There was a cold wave period in January with very low temperatures ranged from -29,6 (mountain station Sokolac) to extremely cold weather in the southerm places with modified Mediterranean climate as it is Trebinje station where is measured just -9,6 deg. of Celsius. --Winter 2017 was very cold or extremely cold over the most of Srpska (in between 2-4 percentiles).

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-10 climate outlook for temperature	Observed	MedCOF-10 climate outlook for precipitation	
Bulgaria (1)	Below normal	near normal	Near or below normal	Near or above normal	**December 2016** was very dry. **January 2017** was very cold. For some of the monitored stations it was the coldest January since 1960. There was a very significant snow event, lasting from 6th to 11th January 2017, resulting with a significant snow cover in the entire country. If compared to similar snow events from the last five years, it appears to be the most important recent snow event. The same period was also extremely cold. It ranks as the 4th among the coldest 5-day periods since 1991. However, in terms of apparent temperature it is the coldest period. The reason is that the low temperatures were accompanied by strong winds and cloudy conditions. The same winds and cloudiness however prevented minimum temperatures from exceeding the absolute minimums for January.

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-10 climate outlook for temperature	Observed	MedCOF-10 climate outlook for precipitation	
Croatia (1)	Normal	Above normal	**Normal** (part of the Northern Adriatic, the wider area of the town of Knin, part of the Southern Adriatic as well as Eastern Croatia) **Below normal** (in the remaining part of Croatia)	**Above normal** for the coastal part of Croatia and islands **no signal** in the remaining part of Croatia	December 2016 was extremely dry (very similar to December 2015 and 2014). In some parts of Croatia there were no precipitations at all. In January 2017, extreme weather conditions were connected to low temperature and strong wind. Two cold waves were recorded – from 3rd to 8th and from 15th to 19th. Some absolute minimum temperatures were measured in Dalmatia (Komiža (on island Vis), Makarska, Split airport and Dubrovnik airport). Together with gale force bora (NE wind) low temperature caused a lot of damages in the water supply system in Dalmatia and a lot of traffic interruptions. In February 2017, wider area of Rijeka (town at the North Adriatic) was extremely wet, but monthly precipitation was not exceeded maximum amounts for February.

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-10 climate outlook for temperature	Observed	MedCOF-10 climate outlook for precipitation	
Cyprus (5)	**December:** Below normal **January:** Colder than normal **February:** Normal and slightly colder than normal	above normal	**December:** Well above normal **January:** Inland and over the southern and eastern coasts below normal but above to well above normal over all other areas **February:** Well below normal	below normal	**December:** Extremes (deviating by 4°C or more from normal) were recorded mainly between 14th and 25th of December, at all the selected meteorological stations. Hail was recorded on the 5th, 12th, 13rd, 21st, 28th and 3 th of December. It is worth mentioning that there were 18 days with snow during December and on the 21thof December, 21cm of new snow on Troodos square. **January:** Extremely high temperatures were recorded, as an example Polis Chrysochous recorded a highest daily maximum of 20.9°C (with the normal being 16.3°C. Extremelly low temperatures (deviating by 4°C or more from normal) were also recorded mainly between 27th and 30th of January, at all the selected meteorological stations. Hail was recorded on the 1st, 2nd, 8th, 10th and 27th of January. It is worth mentioning that, there were 14 days with snow during January, on the 10th and on the 27th of January, 15 cm of new snow on Troodos mountains. **February:** Extremely high temperatures were recorded at all the selected meteorological stations, mainly on 28th of February, like Pafos airport that recorded a highest daily maximum of 26.6°C (with the normal being 17.1°C). Extremely low temperatures (deviating by 4°C or more from normal) were also recorded. Hail was recorded on the 9th, 11th, 12th, 13th and 22nd of February. It is worth mentioning that, there were 6 days with snow during February, on the 12th of February, 9 cm of new snow on Troodos square.

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-10 climate outlook for temperature	Observed	MedCOF-10 climate outlook for precipitation	
France (5)	Normal, in the Mediterranean area above normal	Normal, in the Mediterranean area above normal	Below normal, in the Mediterranean area normal	No signal except Mediterranean area (above normal)	Storms on 12-13 January (north) and 3-5 February (whole country) December exceptionally dry Heavy rains and snow accumulation in mountains, Corsica island, mainly 4 severe spells
Georgia *	Below normal	Above normal	Normal to above normal	No signal	No events

<table>
<tr><th rowspan="2">Country</th><th colspan="2">Seasonal temperature (JJA)</th><th colspan="2">Seasonal precipitation
(JJA)</th><th rowspan="2">High Impact Events</th></tr>
<tr><th>Observed</th><th>MedCOF-10 climate outlook for
temperature</th><th>Observed</th><th>MedCOF-10 climate outlook for precipitation</th></tr>
<tr><td>Greece
(2)</td><td>Below normal</td><td>Above normal</td><td>drier than normal,

wetter than normal in Crete</td><td>Above normal,
No signal for the northeast</td><td>December 2016 was a very dry month

In January 2017, an extreme weather/climate event, relative to total frost, was observed particularly in the first half of this month in Greek mainland (mainly north and central). A total frost event was recorded with its duration of five or more consecutive days. A representative case of this event is the meteorological station of Macedonia where the minimum and maximum temperature remained constantly below zero for five consecutive days during the period from 7-11th January 2017. Similarly, the station of Larisa observed a similar phenomenon with greater severity. It lasted longer, from 7th to 14th January 2017 (eight days) and larger magnitude of total frost was observed (highest minimum temperatures:

-18°C in Larisa as opposed to -9.6°C in Macedonia). Never before have the two phenomena been observed in these areas and generally in Greece.

Furthermore, in February 2017, high precipitation totals were locally recorded in western Crete, above the corresponding normal values. It is indicative that, the accumulated monthly precipitation for February 2017 was 148 mm from Met. Station Souda /HNMS (Hellenic National meteorological Service – HNMS, www.hnms.gr) and 133.0 mm from W.S Vryssai /NOA (W.S: weather station, National Observatory of Athens, www.noa.gr). The corresponding mean value for monthly precipitation for Souda (HNMS) in February is 112.8 mm. Thus, February 2017 was a wet month for western Crete, since the monthly precipitation of this particular month accounted for 131% of normal values.</td></tr>
</table>

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-10 climate outlook for temperature	Observed	MedCOF-10 climate outlook for precipitation	
Hungary*	Below normal	Normal to above normal	below normal	No signal	No events
Israel (5)	Below normal	above normal	Above normal	below normal	No high impact events in winter 2016/17.
Italy*	Above normal	Above normal	Below normal to normal, Sardinia, western Sicily above normal	Above normal	No events
Jordan*	Below normal	Above normal	Around normal	Below normal	No events
Lebanon *	Normal	Above normal	Below normal	Below normal	No events

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-10 climate outlook for temperature	Observed	MedCOF-10 climate outlook for precipitation	
Republic of Macedonia (5)	Below normal	Normal, Western part above normal	Below normal	No signal, west part above normal	**December 2016** Insignificant amounts of precipitation **January 2017** Extremely cold; Absolute minimal temperature of -23.3°C was measured in Kriva Palanka on 8th. Historical values exceeded for this month. Heavy snow fall. **February 2017** Unusually high air temperatures Insignificant amounts of precipitations and no snowfall.
Moldova (5)	Near normal	Near normal	Below or near normal	No predictive signal	On January 7th, an extreme meteorological phenomenon was observed in the form of a strong wind: the maximum speed of wind at MS Leova reached 26 m/s. Blizzard was observed in the first decade of January, resulting with snowdrifts on the roads, which created extremely unfavourable conditions for traffic. During the winter period, fogs, icy-frost deposits with a diameter of 1-12 mm, snowstorms, ice on the roads were observed.
Montenegro *	Normal to below normal	Above normal	Below normal	No signal	No events
Portugal *	Normal	Normal	Normal	Above normal	No events

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-10 climate outlook for temperature	Observed	MedCOF-10 climate outlook for precipitation	
Romania *	Below normal	Above normal	Below normal to normal	No signal	No events
Serbia (1)	Below normal in almost entire Serbia	**Above** normal	Below normal in entire Serbia	**No predictive signal** or above normal	**Winter of 2016/2017** was the 4th driest and 12th coldest for Serbia; 4 cold waves; the longest during first half of January in almost entire Serbia; The number of ice and frost days and days with severe frost was surpassed; **Cold and extremely dry December**; driest on record at two stations; rainfall was not registered on one station; fourth driest in Serbia; **January 2017 was the fourth coldest for Serbia and the coldest on record for two stations;** number of ice days was surpassed at three stations; number of frost days and days with snow cover was exceeded at most meteorological stations; Kopaonik mountain observed lowest daily minimum air temperature on record; Three cold waves; during the first cold wave, daily minimum air temperature difference from the mean daily minimum air temperature reached -20.4°C.

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-10 climate outlook for temperature	Observed	MedCOF-10 climate outlook for precipitation	
Slovenia (5)	Western and northern Slovenia: normal, above normal in some parts in the north-west eastern Slovenia: below-normal north-eastern Slovenia below normal to normal	Above normal, North-eastern Slovenia: near normal	below normal, small western part below normal to normal	no clear signal small western part wetter than normal	No high impact events in winter 2016/17.

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-10 climate outlook for temperature	Observed	MedCOF-10 climate outlook for precipitation	
Spain (5)	Above normal, in the west and some areas located in the NE fringe close to normal	normal	Above normal, Extremely wet in the southeast and Balearic Islands Dec and Jan dry, Febr wet	Above normal	Lower winter temperatures were recorded during the first days of a cold event, beginning the 18th January, with the outbreak of a very cold air mass from continental origin, which lasted till the 20th of January, affecting mainly Iberian Peninsula and Balearic Islands. The colder winter temperatures were recorded at principal stations, corresponded to El Puerto de Navacerrada, with -13.8 ºC (18th January), Molina de Aragón, with -13.4 ºC. The higher temperatures of winter were reached over Canary Islands, in the beginning of December and in mid- February as well. Noteworthy, 28.6ºC in Tenerife South Airport (17th February), 28.3ºC in Fuerteventura Airport (2nd December) and 27.6ºC in Gran Canaria Airport (3rd December).
Syria *	Below normal to normal	Above normal	Below normal in the north, Above normal in the south	Below normal	No events

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-10 climate outlook for temperature	Observed	MedCOF-10 climate outlook for precipitation	
Turkey (5)	Normal and below normal (Below normal in the east, west and northwestern part of the country.)	above normal	**Above normal (**mostly in the north coast**)** **Below normal (**in most of the country especially inland**)**	above normal (at the west coast) No signal (mostly in the northern half of the country except the west coast) below normal (in the southern half of the country except the southwest part)	In **December 2016**, strong storm caused financial damage on the houses and greenhouses in Anamur. Due to snow in Çanakkale, Çorum, Bilecik, Nevşehir, Ardahan, Artvin and Karaman, transportation was affected. In **January 2017**, snow caused difficulties in transportation in many cities. The prolonoged period of heavy rain caused flood in Mersin. In **February 2017**, agricultural areas were affected due to hail in Aydın. Heavy rain caused flood in Bodrum. In Aksaray, frost caused transportation difficulties. In Bingöl, one person lost his life due to storm.

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	MedCOF-10 climate outlook for temperature	Observed	MedCOF-10 climate outlook for precipitation	
Ukraine (1,5)	Normal (46%) and below normal (54%)	Near-normal in entire Ukraine	Normal (46%) Below normal (27%) above normal (27%)	No predictive signal in entire Ukraine	**In December** meteorological extraordinary phenomena in the form of **very heavy snow** (21-24 mm of precipitation fell in 12 hours; snow cover 10-40 cm) was observed on 2-3th of December in the north-east of the country (Kharkiv, Symy, Poltava regions). **In January** meteorological extraordinary phenomena in the form of **very heavy snow** (22-45 mm of precipitation fell in 8-12 hours) was observed on 6-7th of January in the south and the north-east parts of country (Odesa, Mykolayiv, Kherson, Kharkiv regions). Snowfall was accompanied by **strong blizzards** (wind speed 15-24 m/s during 14-24 hours, in Ust-Danaysk (Odessa region) wind speed was 25 m/s), snowdrifts were formed. Unfavorable weather conditions caused power outage, and disruptions in telecommunication, utilities and transport. **In February strong wind** was recorded in the west of the country (wind speed 25 m/s in Lviv, Ivano-Frankivsk regions on 24th of February and on 28th wind speed 40 m/s in the Carpathian highlands)

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: ERA-Interim 1981-2010 for temperature, GPCC 1981-2010 for precipitation

North Africa (RA I)

Appendix A: Contributors to the Pre-COF of MEDCOF-11

National Institute of Meteorology, Tunisia
National Meteorological Directorate, Morocco

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	MedCOF-10 climate outlook for temperature	Observed	MedCOF-10 climate outlook for precipitation	
Algeria *	Above normal in the north Normal to above normal elsewhere	Above normal tercile	Above normal in the south Below normal elsewhere	No clear signal	No comment
Egypt *	Normal to above normal	Above normal tercile	Below normal	No clear signal	No comment
Libya *	Normal to above normal	Above normal tercile	Normal to above normal in the south Below normal elsewhere	No clear signal	No comment

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High impacts events
	Observed	**MedCOF-10 climate outlook for temperature**	**Observed**	**MedCOF-10 climate outlook for precipitation**	
Morocco (1)	Above normal	Above normal tercile	Below normal except some areas in the Middle Atlas, the east Sahara	No clear signal	Increase of heat wave frequency, period, intensity The most severe heat wave lasted for 3 weeks. Increase of days with temperature exceeding 40°C Some absolute records of temperature were broken since 1968, 1985 and 1988
Tunisia (1)	Above normal in the north Normal to slightly above normal elsewhere	Above normal tercile	Above normal in the south-west and a small region in the north-east Normal to below normal elsewhere	No clear signal	06/06/2017: floods in the north of the country (Bizerte and Tunis) causing damage 26-28/06/2017: heat wave 10-12/07/2017: heat wave: rise in temperature with Sirocco shots. Maximum temperatures exceeded the normal of July and reached 42°C on the east coast and 46°C in the rest of the country.

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

References:

MedCOF 10 Outlook: http://medcof.aemet.es/images/doc_events/medcof10/step3/docStep3/Consensus_Statement_MedCOF-10_final.pdf

SEECOF 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

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

Météo France climate monitoring products: http://seasonal.meteo.fr/en/content/suivi-clim-cartes (password protected)

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

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