MEDITERRANEAN CLIMATE OUTLOOK FORUM
MEDCOF-8 MEETING

ANALYSIS AND VERIFICATION
OF THE MEDCOF-7 CLIMATE OUTLOOK
FOR THE 2016-17 WINTER SEASON
FOR THE MEDITERRANEAN REGION (MED)

Final version

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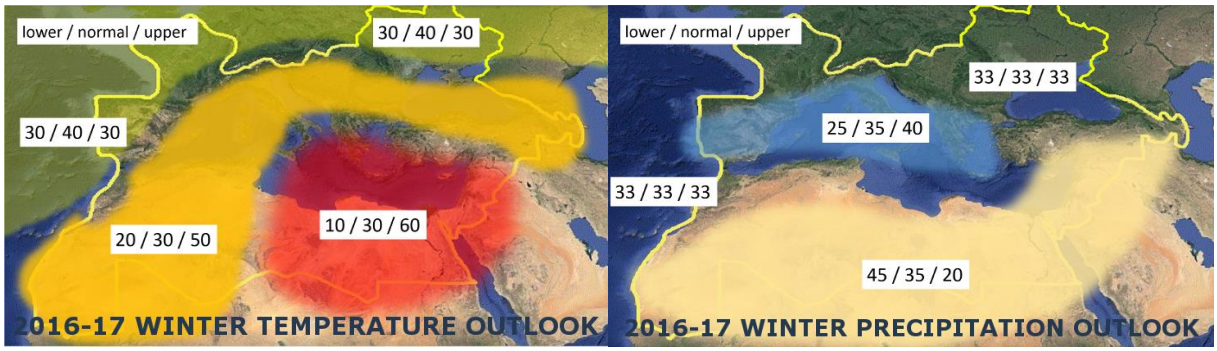
The following MedCOF verification report is based on

- the outcome of the consensus forecast of MedCOF 7,
- climate monitoring results of RA I NA RCC and RA VI RCC networks,
- the analysis and verification report of SEECOF-17 for 2016-17 winter season for southeast Europe (SEE)
- national verification reports received from NMHSs or posted in RCOF forums of MedCOF, SEECOF or PRESANORD.

1. MedCOF-7 Climate outlook for the 2016-17 winter season



(a) (b)

Figure 1: Graphical presentation of the climate outlook for the 2016-17 winter season for the Mediterranean region (a) Temperature Outlook; (b) Precipitation Outlook

General circulation

Due to a contradictory forcing over the North Atlantic/European sector with mean circulation dominated by a positive EA pattern with potentially cold episodes during negative NAO periods, there was uncertainty in the prediction of large-scale atmospheric circulation during the winter. The most probable scenario over the Mediterranean basin was assumed to be a cyclonic signal in the western part and a high geopotential anomaly over the Middle East.

Temperature

As stated in MedCOF-07 consensus statement for the seasonal climate outlook for 2016-17 winter season for the Mediterranean region, despite uncertainty in the large scale atmospheric circulation in the forecasting system there is a consensus for a positive gradient of temperature anomalies pointing from the NW to the SE of the domain. There is a tendency for the upper tercile over almost the whole region. Probabilities for the middle tercile over western coasts and the extreme north of Europe are of 40% (green region in figure 1 (a)). Probabilities for the above-normal scenario are of 60% over the Middle East and the southeast of the domain (red region in figure 1 (a)). Elsewhere probabilities are of 50% for the above- normal scenario (orange region in figure 1 (a)).
This means for verification that a prediction of close-to-normal temperature (middle tercile) was assumed for the green region and above-normal temperature (upper tercile) for the orange and red regions.

Precipitation

Uncertainty in precipitation predictions is very large. Over the central part of the MedCOF region a wetter-than-normal winter is favored with a probability of 40% for the upper tercile (blue region figure 1 (b)). For southern areas (North Africa and Middle East region) a drier-than-average season is favored with probability of 45% for the lower tercile (yellow region in figure 1 (b)). For the rest of the region (green region in figure 1 (b)) there is no preference for any climate defined categories.
For verification, the middle tercile was assumed for the green region, the upper tercile for the blue region and the lower tercile for the yellow region.

2. Analysis of the 2016-17 winter season

Analysis of the winter 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 winter 2016-17 (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-17, 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

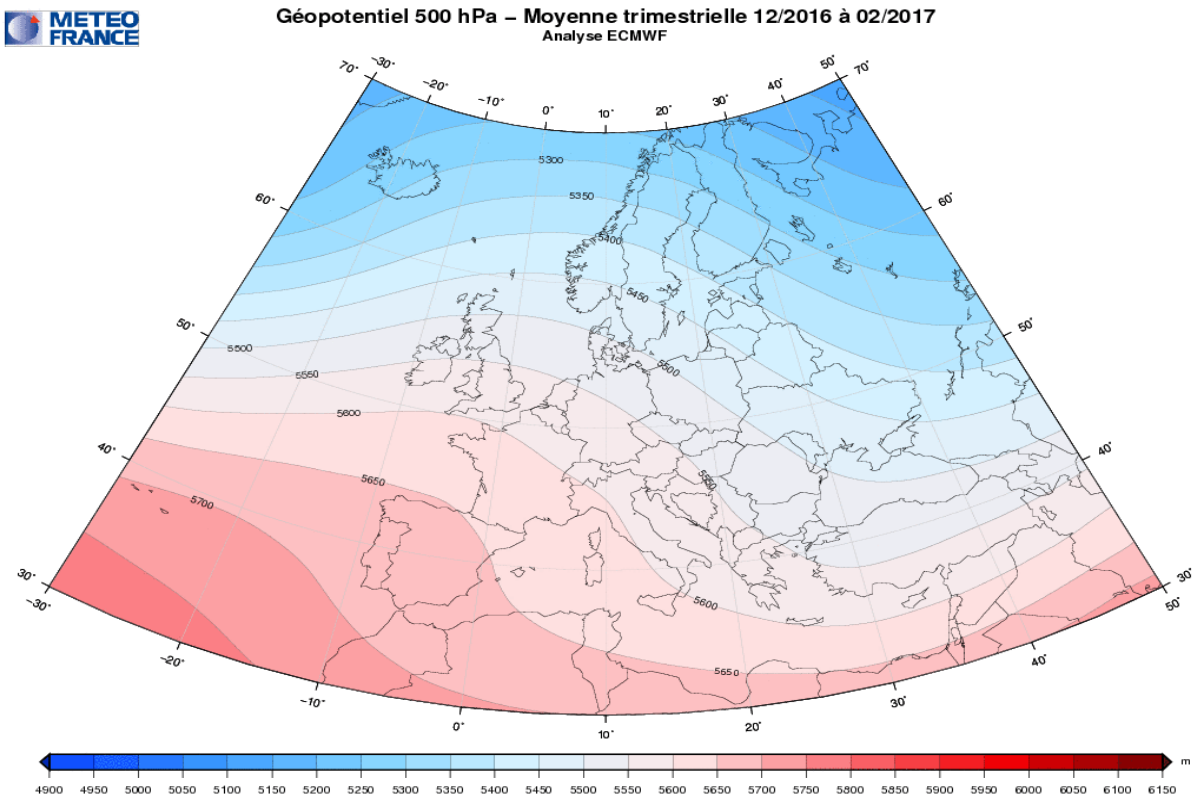
The mean atmospheric state for winter 2016/17 in the MedCOF region was characterized by a broad ridge over southwestern/western/central Europe and a trough from eastern Europe over the Mediterranean down to North Africa (fig. 2). Geopotential anomalies show a negative gradient from the northwest to the southeast of the MedCOF region. This was just the opposite of the MedCOF-7 prediction.

Near surface level, there were more or less anticyclonic conditions and positive anomalies over the MedCOF region that winter, except in the Middle East (fig. 3). Highest surface pressure, indicating the region of most subsidence was to be found over the northwestern Balkans.

During the season, however, a notable change of circulation took place. The ridge over southwestern/western Europe was most intense in December 2016, while cyclonic conditions were mainly restricted to eastern parts of the MedCOF region (fig. 4). Western parts of the MedCOF domain received a warming mainly through high pressure subsidence and warm and dry air advection from the southwest, whereas cold and relatively moist air from Russia affected the eastern parts far to the south to eastern North Africa. In January 2017, cyclonic circulation favorable for rain and snow extended also to the western Mediterranean, while the western ridge was weakening. Cold air spread more or less over the whole domain with some extreme cold waves. In February 2017, western and southwestern Europe became more cyclonic and were under the influence of a westerly flow near surface level (fig. 5), whereas the geopotential increased over the Mediterranean and the blocking High moved to eastern parts of the domain. This resulted in a warm airflow to most of the domain in the last winter month, either with mild and moist air from the Atlantic over relatively high SST or from the south, but partly with much precipitation, particularly close to the southern slopes of the Alps. Only the easternmost parts of the domain (South Caucasus, eastern Turkey, Middle East, eastern North Africa) located east of the blocking High were still affected by cold, but mostly dry air in February.

All three winter months had a higher-than-normal number of blocking weather types according to the weather type classification of Météo France (Fig. 6). The highest number and percentage of blocking situations occurred in December 2016; then the number decreased towards the later winter. The mean position of the blocking High moved from the west to the east, but existed in all the months. In January 2017 there were also quite a high number of Atlantic ridge patterns, while in February 2017 the westerly patterns came up with an above-normal number of NAO+ patterns.

The variability of circulation can also be seen by looking at the CPC teleconnection patterns (table 1). Over the North Atlantic, a positive NAO pattern dominated, which was weakest in January and strongest in February 2017. A positive EA pattern was also there in December and February, but interrupted by a negative phase in January. Although this interruption was not performed by a NAO-pattern as discussed in the MedCOF-7 outlook, there was nevertheless a blocking by an East Atlantic ridge. Regardless from this interruption, all three winter months were characterized more or less by a ridge-trough dipole expressed by a positive EA/WR pattern favorable for blocking.



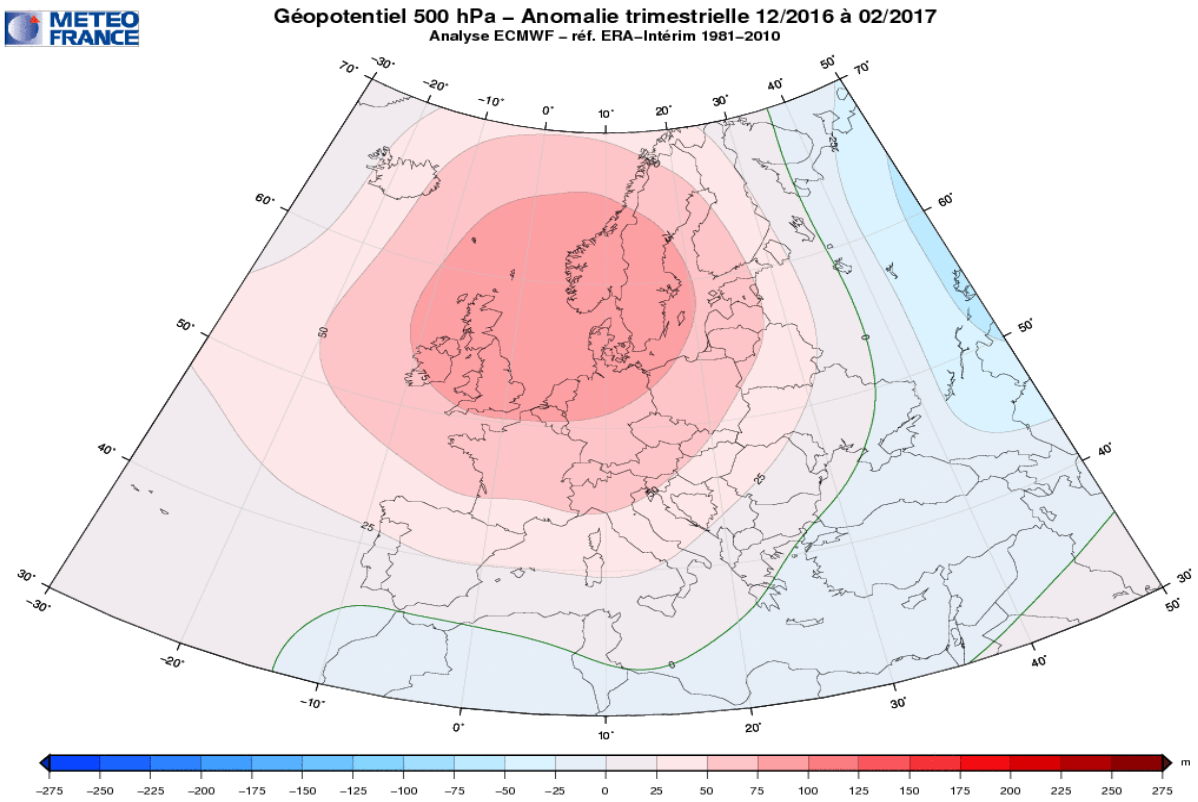


Figure 2: Seasonal mean and anomalies of 500 hPa geopotential for winter 2016-17 (1981-2010 reference). Source: Météo France, data source: ECMWF ERA Interim reanalysis, http://seasonal.meteo.fr/en/content/suivi-clim-cartes

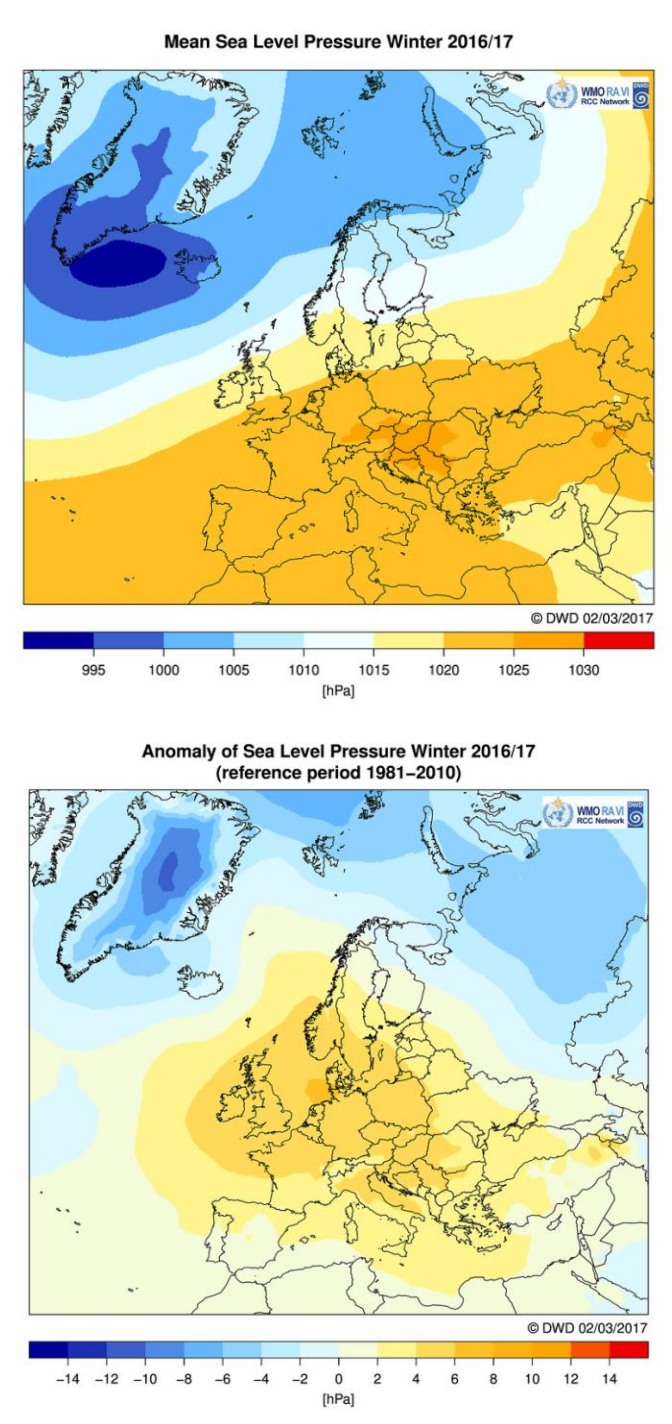


Figure 3: Seasonal mean sea level pressure (upper graph) and its seasonal anomalies (lower graph) for winter 2016-17 (1981-2010 reference). Source: Deutscher Wetterdienst (DWD), data source: DWD numerical ICON model analysis, http://www.dwd.de/EN/research/weatherforecasting/num_modelling/01_num_weather_prediction_modells/icon_description.html?nn=484268

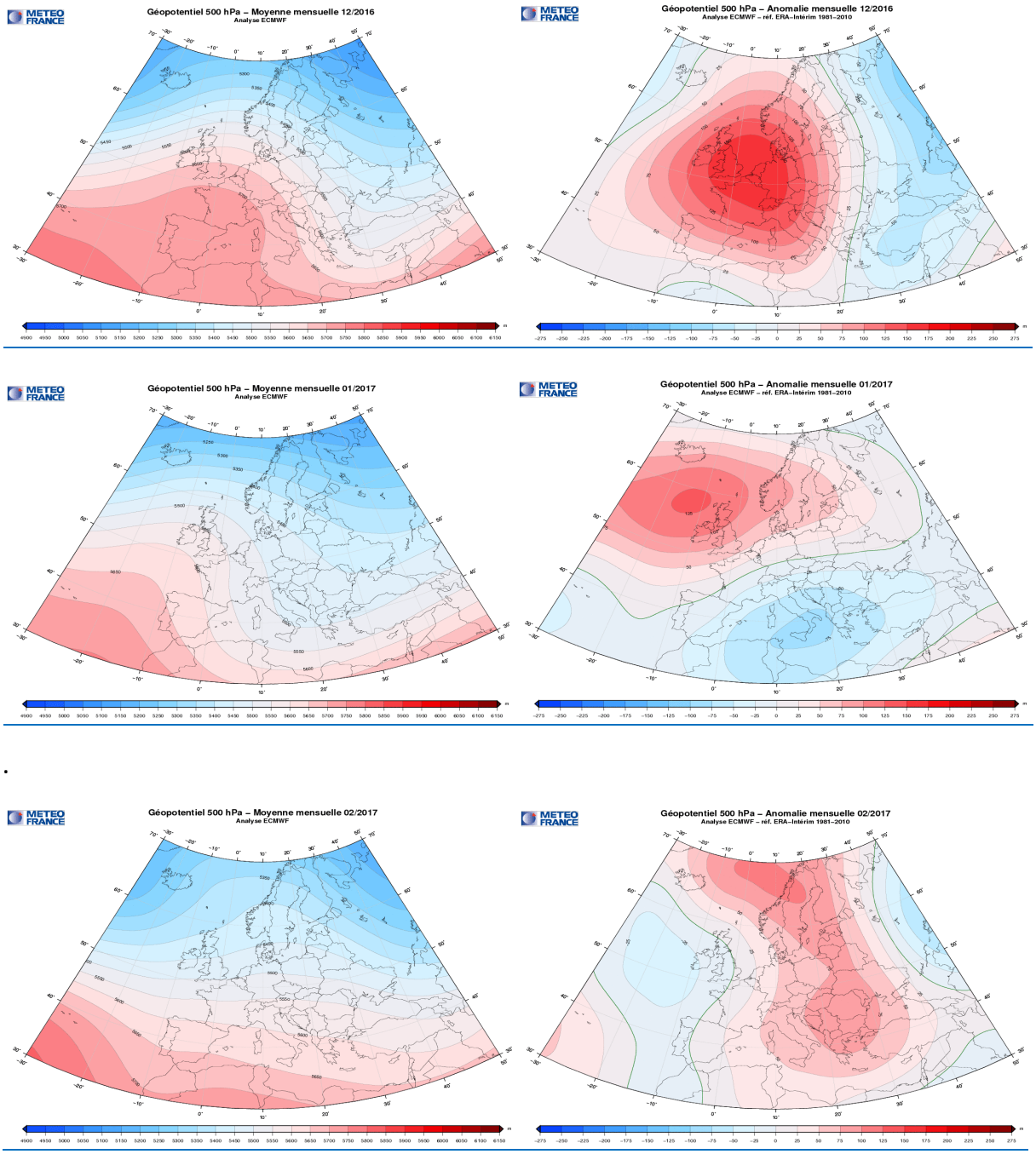


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Figure 4: Same as Figure 2, but for the months December 2016, January 2017, February 2017

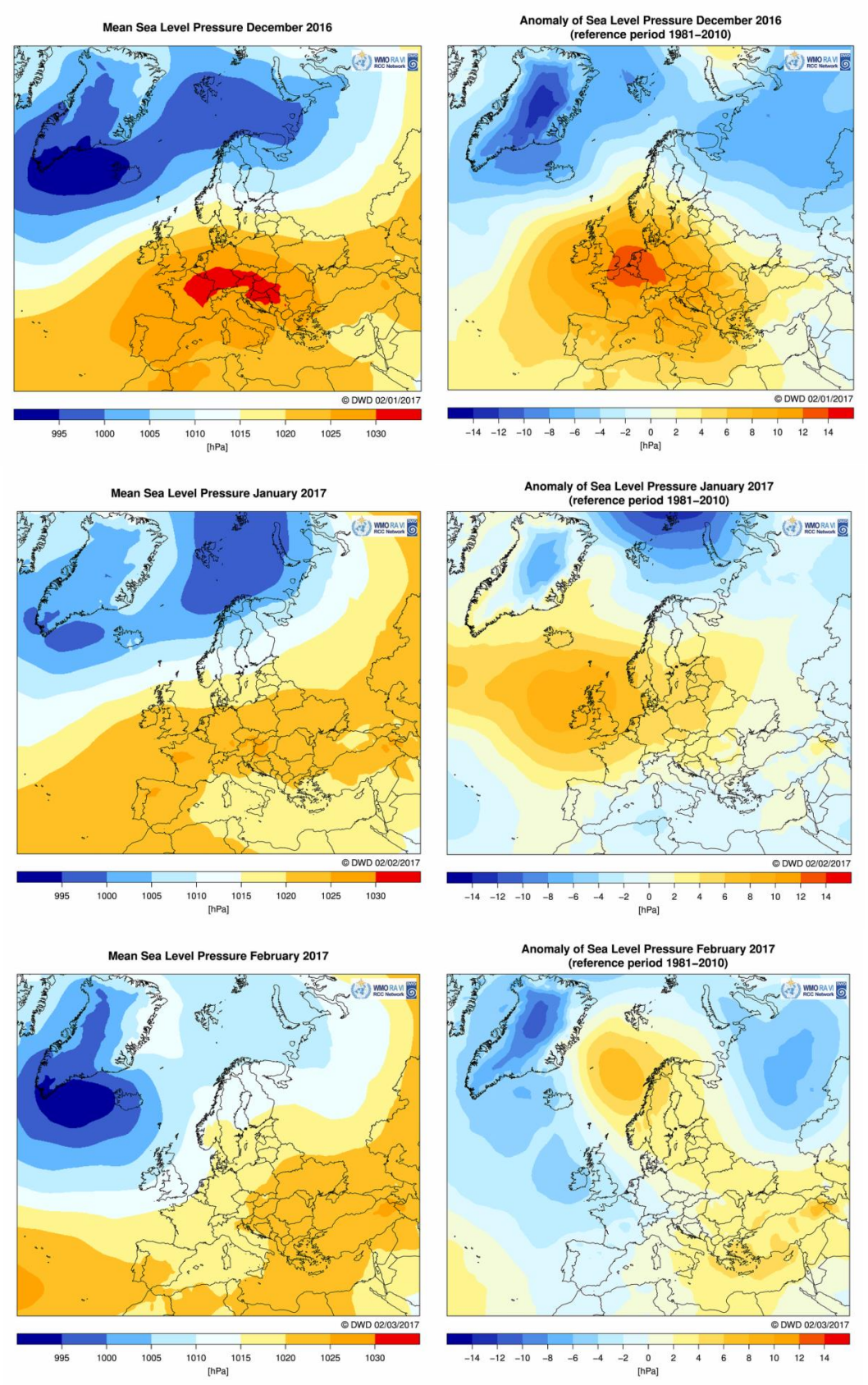


Figure 5: Same as Figure 3, but for the months December 2016, January 2017, February 2017

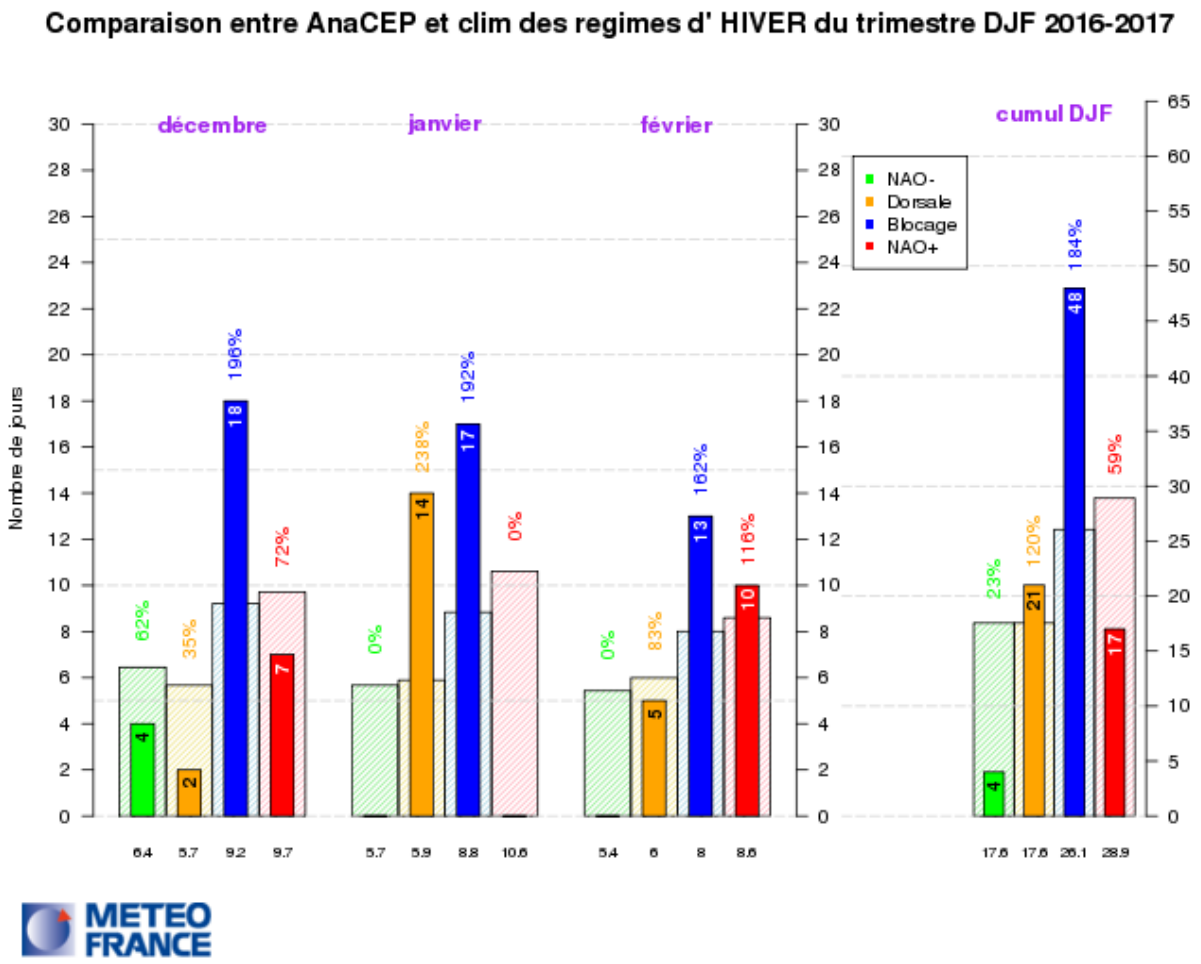


Figure 6: Number of days with circulation types of the Météo France classification for each month of the winter 2016-17 season and for the whole season (right), and in percent of the climatological frequency distribution 1981-2010. Circulation types are: negative North Atlantic Oscillation phase (NAO-), Atlantic ridge (Dorsale), Scandinavian Blocking (Blocage) and positive North Atlantic Oscillation phase (NAO+). 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
2016	12	0.35	0.87	0.97	-99.90	-0.65	1.52	-1.18	0.95	-1.10	-99.90	86.0
2017	1	0.05	-1.15	0.55	0.39	-0.29	0.63	0.17	-0.34	0.96	-99.90	58.1
2017	2	0.69	0.58	-0.15	0.21	-0.05	1.14	0.67	-0.11	-0.38	-99.90	62.4

Table 1 : Circulation indices of NOAA CPC patterns for the winter months 2016-17.

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

2.2. Temperature

Europe and Middle East (RA VI)

Winter 2016/17 was characterized by different temperature anomalies within the MedCOF region (fig. 7-9). Much of the Mediterranean Sea area, parts of Spain, southern France, Italy and the east Adriatic coast (shown by ECA&D data) were warmer than normal with temperatures in the upper tercile. Partly these areas were extremely mild with temperatures above the 90th percentile (fig. 10). On the other hand, it was relatively cold in Hungary, much of the Balkans, parts of the Ukraine, Turkey, parts of the Middle East and South Caucasus with temperatures in the lower tercile. Especially eastern Bulgaria saw an extremely cold winter with temperatures below the 10th percentile. The remaining areas were mostly in the middle tercile, mainly other parts of Spain, Portugal, most of France, most of Ukraine and Moldova, Albania and parts of Greece.

December 2016 was warmer than normal over the western Mediterranean, but colder in the eastern parts of the MedCOF region. January 2017 was mostly colder than normal, especially over the Balkans, where several extreme cold spells occurred. Some places in the Balkans saw the coldest January on record, for some Balkan countries it was at least one of the coldest January months for many years. February 2017 was a warm month except easternmost parts (South Caucasus, Turkey, central and eastern Turkey, Middle East).

Winter mean temperatures (fig. 11) mostly ranged from -5 to 5°C in the lowlands; higher averages were recorded in most of Spain and Portugal, western and southern France, parts of Italy, Greece and the Middle East from 5 to 10°C, in southern Iberia and over the Mediterranean Sea from 10 to 15°C. In the highlands, mean temperatures were mostly less than -5°C, in high elevations even below -10°C.

Seasonal anomalies (1961-1990 reference, fig. 11) were mostly positive over the western Mediterranean, Iberia, France and Italy in a range of 0 to +2°C, only some places of the land surfaces of these parts were slightly colder than normal. The eastern RA VI part of the MedCOF region (Balkans, Turkey, eastern Mediterranean, Middle East, South Caucasus) was, with only few exceptions (northwestern Balkans, Ukraine, Moldova, eastern South Caucasus), all colder than normal with anomalies from 0 to -5°C with lowest values in Armenia.

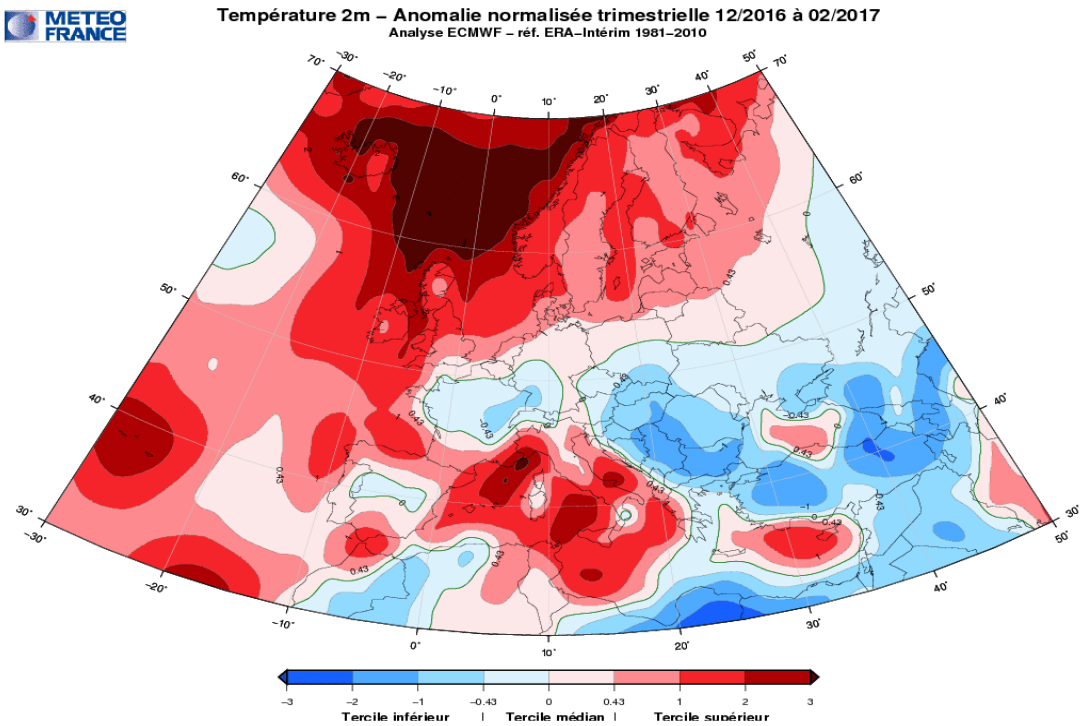


Figure 7: Seasonal normalized temperature anomalies of winter 2016-17 surface air temperature based on ECMWF / ERA-INTERIM grid data, 1981-2010 reference. The data range between -0.43 and +0.43 represents the middle tercile, below -0.43 the lower tercile and above +0.43 the upper tercile. Source: Météo France, data reference: http://www.ecmwf.int/en/research/climate-reanalysis/era-interim

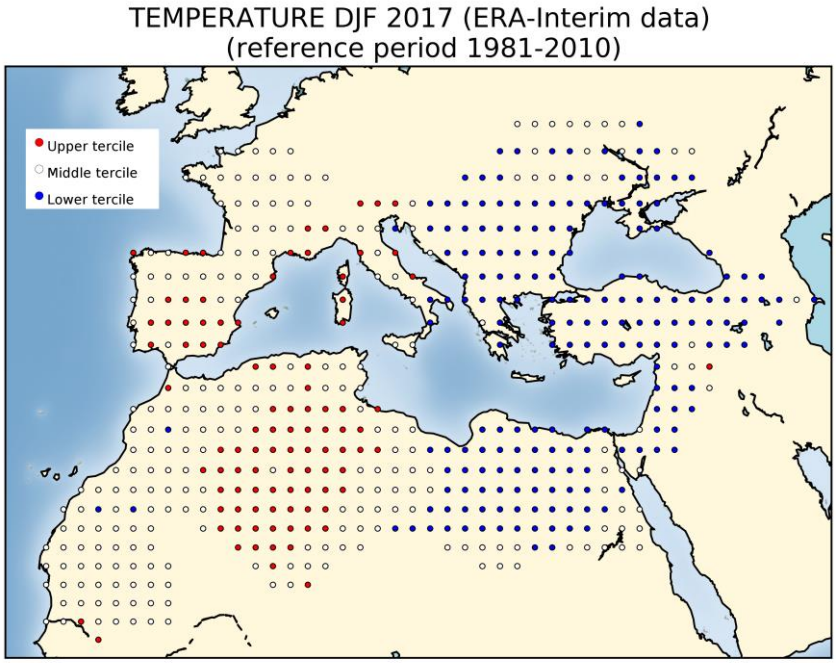
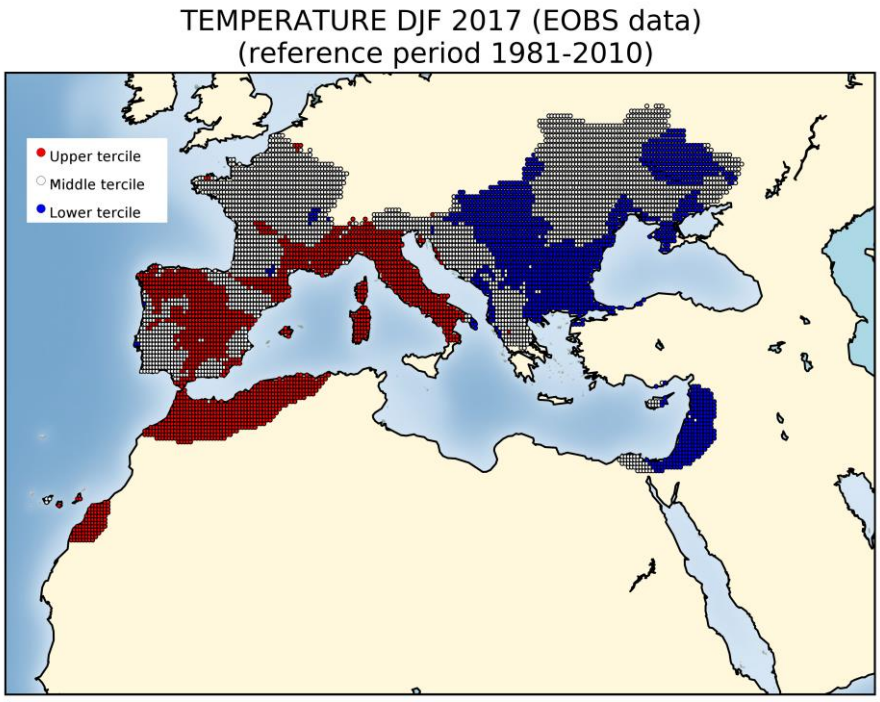


Figure 8: Terciles of winter 2016-17 surface air temperature based on ERA-Interim Reanalysis, 1981-2010 reference. Source: AEMET, data source http://www.ecmwf.int/en/research/climate-reanalysis/era-interim



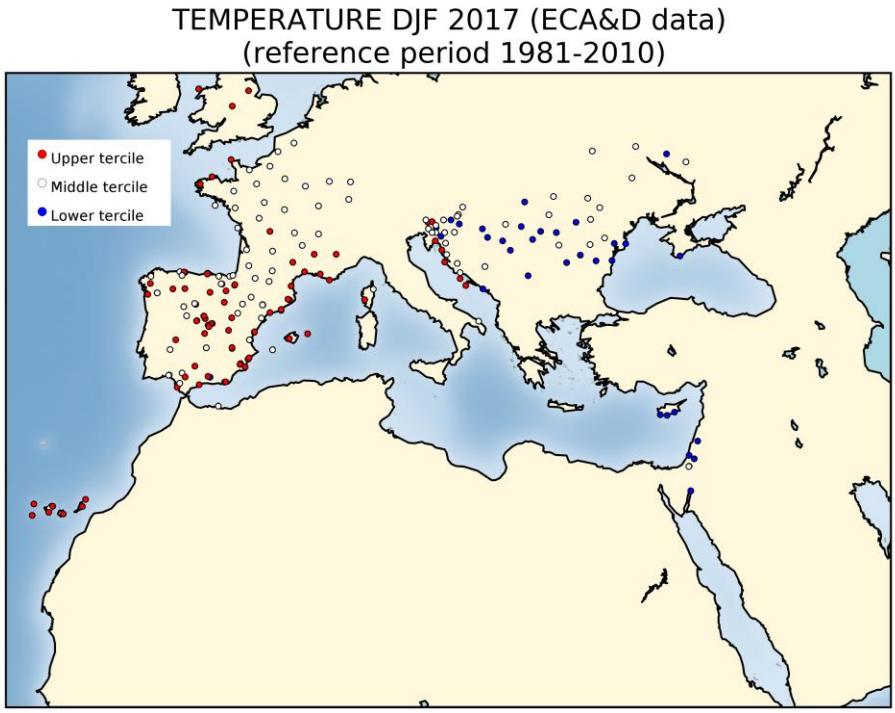


Figure 9: Terciles of winter 2016-17 surface air temperature based on interpolated E-OBS grid data (upper graph) and individual ECA&D station data (lower graph), 1981-2010 reference. Source: AEMET, data source: http://www.ecad.eu/

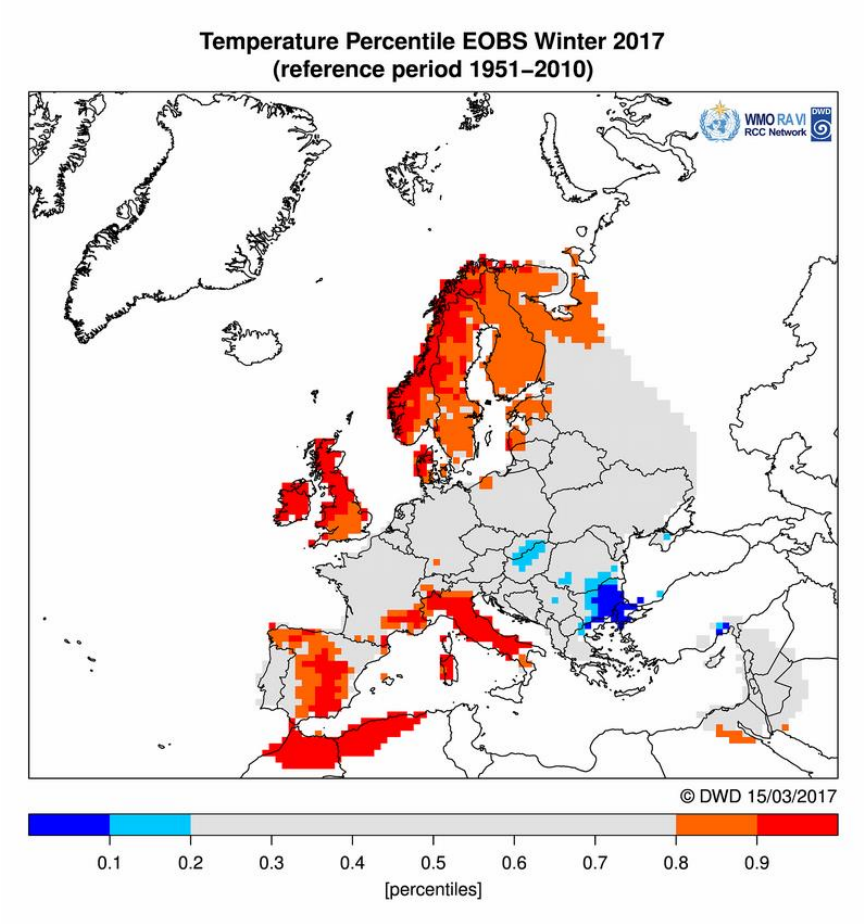


Figure 10: Percentiles of winter 2016-17 surface air temperature based on interpolated E-OBS gridded data, 1951-2010 reference. Source: DWD, data source: http://www.ecad.eu/

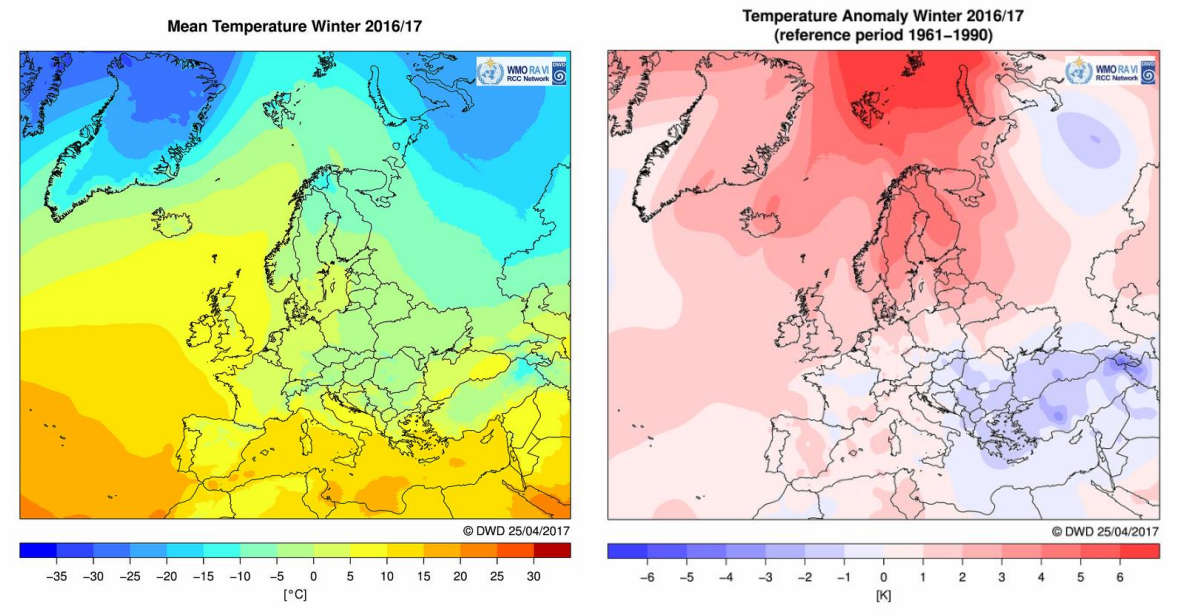


Figure 11: Surface air temperature for winter 2016-17. Left: seasonal mean, right: anomalies, 1961-1990 reference, source of both maps: WMO RAVI RCC, based on interpolated CLIMAT data, www.dwd.de/rcc-cm

North Africa (RA I)

Winter 2016-2017 has known a large variability over all North Africa. Mean temperatures ranged between 1°C and 25°C. Negative anomalies were recorded over Egypt, east of Libya, south-west of Algeria and central Morocco. Positive anomalies were registered in the center of the North Africa domain and in the south of Morocco. Elsewhere temperatures were near normal.

In Morocco, for temperature, near normal conditions were observed (1981-2010 reference period) over 17 out of 27 synoptic stations during winter season (DJF 2016-17). Above-normal conditions were registered in the extreme north and extreme south such as Tangier, Al ouceima, Casablanca, Fez, Taza, Sidi-Ifni and Dakhla. In the central east, below-normal temperatures were recorded at Sidi-Slimane, Midelt and Ouarzazate stations.

In Algeria, the mean temperature of the winter season (DJF 2016-17) was in the upper tercile over almost the whole country. When comparing with the normal of the season, mean temperatures were above normal also for all the stations with a maximum anomaly around +2.1°C at the station of Djelfa in the northern part of Algeria.

In Tunisia, the winter seasonal mean temperature was at its minimum in the western regions especially in the north-west of Tunisia. The lowest value of mean minimum temperature was -0.7°C measured in Thala in the north-west of Tunisia. The south-east of Tunisia was the hottest part in the 2016-2017 winter season. The highest value of mean maximum temperature was 20.7°C registered in El-Borma. Mean anomaly observed over Tunisia is of +0.7°C. Temperature of DJF 2016-17 was in the middle tercile. Anomalies vary from +0.1°C in the north-west (Tabarka station) up to +1.4°C in the south-west (El-Borma station). January was the coolest month in this season with an anomaly of -1.3°C compared to December with +1.5°C and February with +1.8°C.

In Egypt, winter season temperature was below normal. It was characterized by a succession of cold waves. Temperature of January was marked by below-normal conditions especially over the north and by above-normal conditions over the southern region. The lowest value of minimum temperature over Egypt was about 0.2°C on the 10th of January in El Arish in the north.

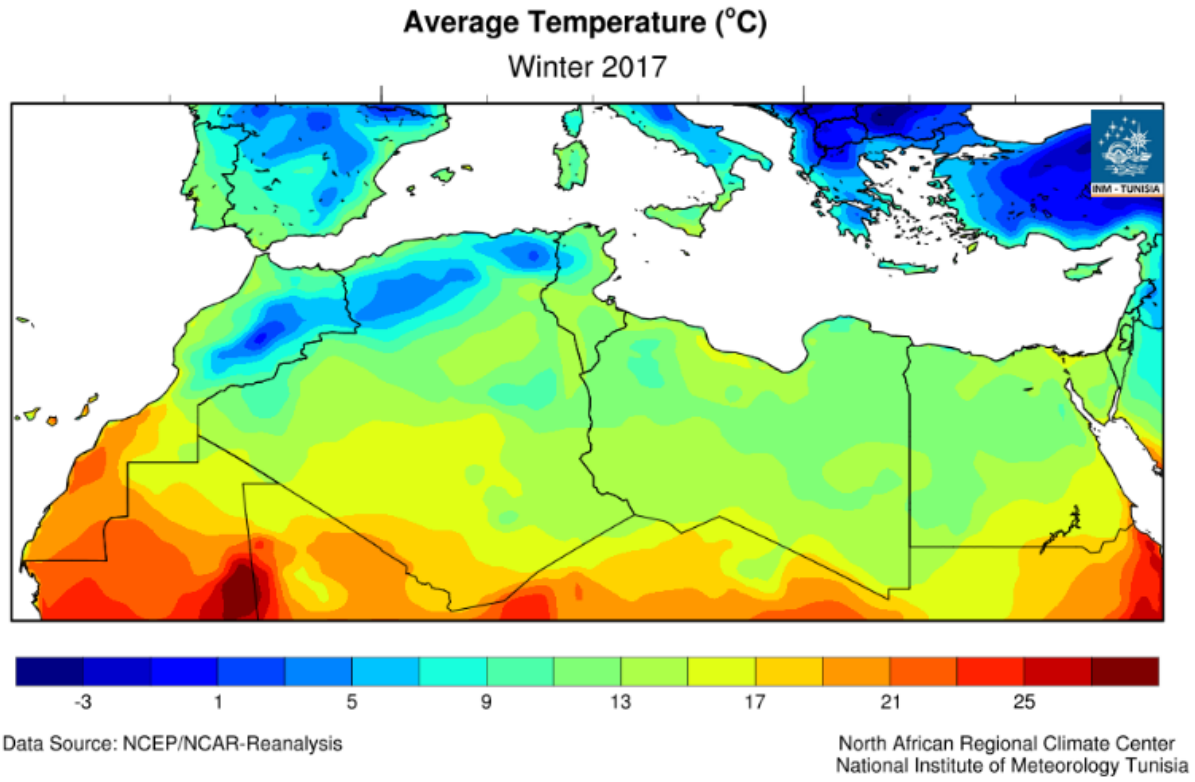


Figure 12: Mean temperature for winter season 2016-17 in North Africa (in °C). Source: INM, (Data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov)

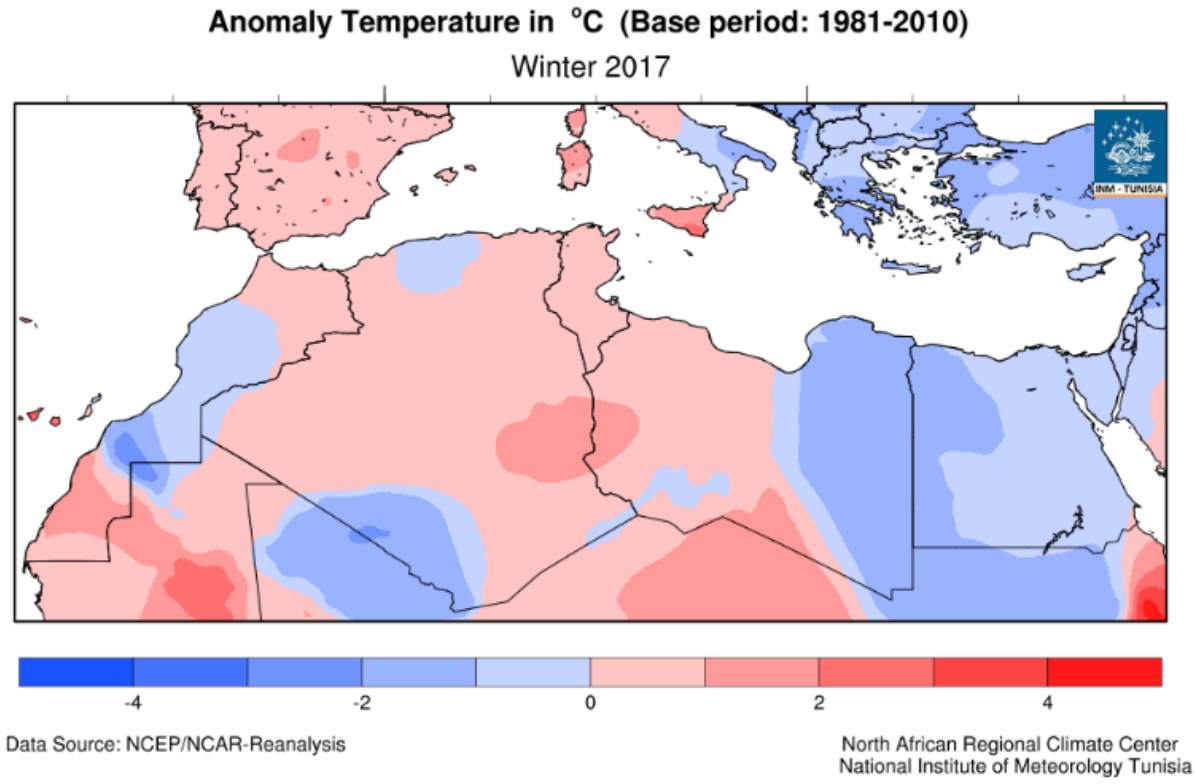


Figure 13: Temperature anomaly for winter season 2016-17 in North Africa (in °C), reference period 1981-2010. Source: INM, Data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov

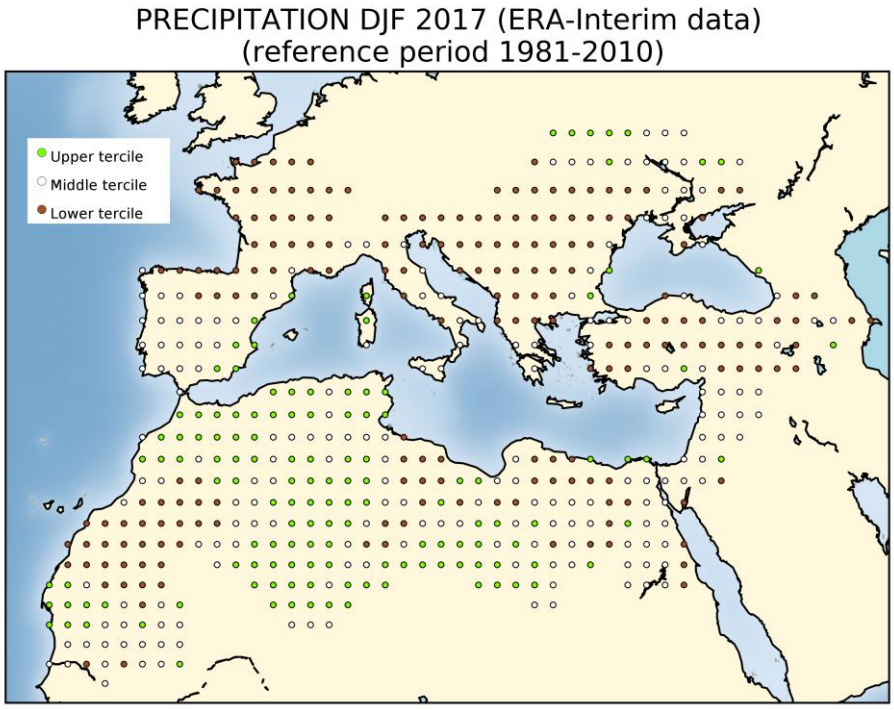
2.3.Precipitation

Europe and Middle East (RA VI)

Winter precipitation totals in the RA VI domain were mostly between 75 and 150mm. In some exposed areas especially at coasts, over sea areas and on mountains, they were higher, locally above 300mm. Parts of Georgia, north-eastern Turkey and western Crete received more than 400 mm of precipitation. In some parts of the interior land areas, especially on the Balkans, totals ranged between 30 and 75mm, in parts of eastern Syria and Jordan they were below 30mm.

Nearly the entire domain had a relatively dry winter, mostly with below 80% of the normal total, particularly over the land areas from France to the Balkans, but also in the southern Ukraine, central parts of Turkey and South Caucasus, and parts of the Middle East. Less than 40% was recorded locally. Most of the area received totals in the lowest tercile, mainly much of northern Spain, France, parts of Italy, much of the Balkans, Turkey and locally in the Middle East. Precipitation in the upper tercile was recorded particularly over the western Mediterranean basin from eastern Spain to Italy with totals of up to more than 250% of the normal, in parts of the Ukraine, places in Turkey, South Caucasus and the Middle East.

Corresponding to the surface pressure and geopotential distribution, there were differences from month to month. December 2016 was very dry especially over the land areas from northern Spain to western Turkey with totals below 20% of the normal over large areas, whereas the Mediterranean Sea was mostly wet and so were also easternmost parts from Southern Caucasus to the Middle East. Precipitation fell also often as snow, very heavily especially in the northeast Ukraine, and also as hail, e.g. in Cyprus. January 2017 had a similar spatial distribution, but with lower anomalies and very dry conditions in the Middle East. Again, there was heavy snow, particularly over the Ukraine and Turkey, but also heavy rain with flooding, especially in Turkey. February 2017 again was very dry in the Middle East (except some places, e.g. southernmost Israel) but also in Turkey, whereas Atlantic rain systems reached Iberia, and also the northern Adriatic Sea had much rain, even southern Greece and Turkey recorded some local heavy rain, hail and flooding.



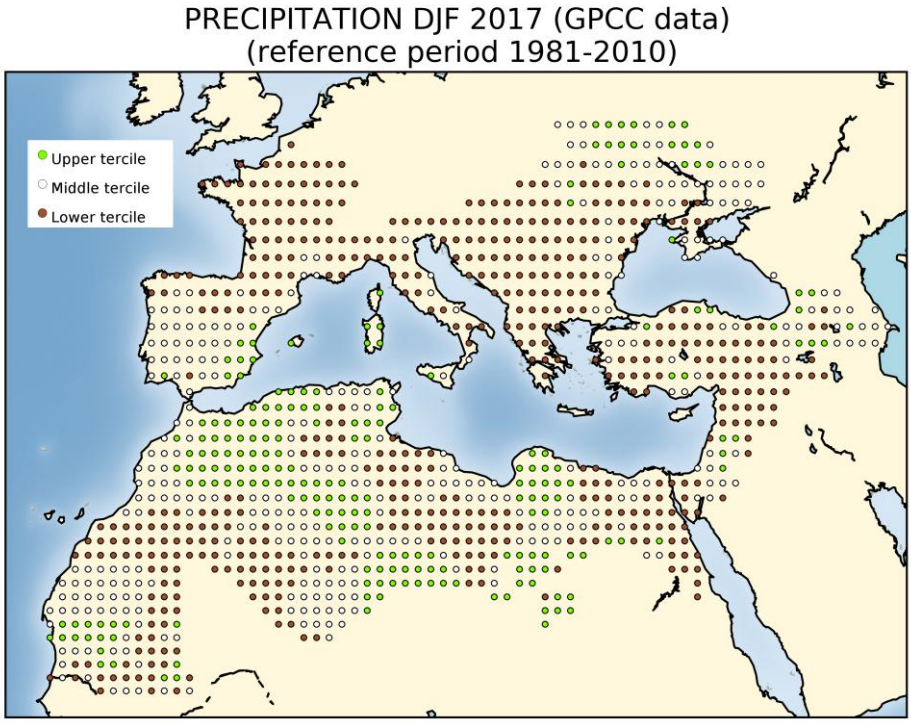
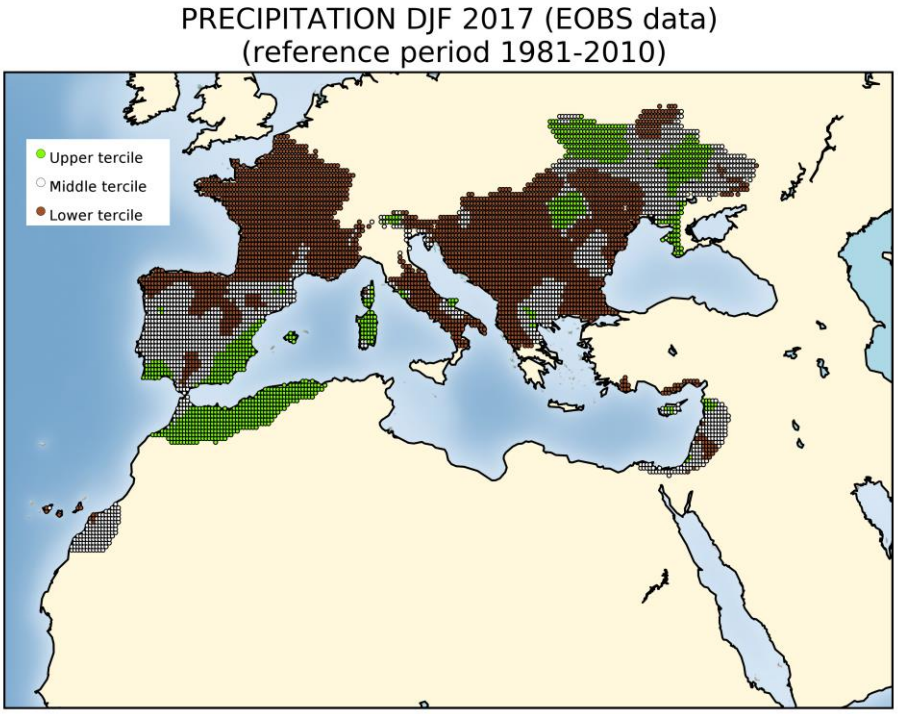


Figure 14: Terciles of winter 2016-17 precipitation based on ERA-INTERIM Reanalysis (upper graph) and GPCC (lower graph) grid data, 1981-2010 reference. Source: AEMET, data reference: ERA-INTERIM: http://www.ecmwf.int/en/research/climate-reanalysis/era-interim , GPCC: http://gpcc.dwd.de



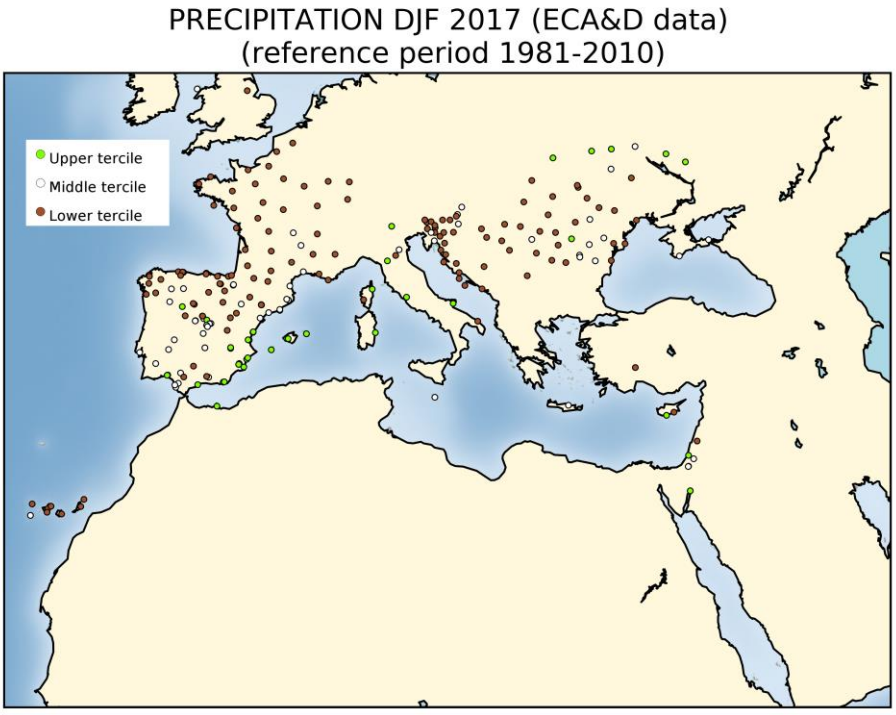


Figure 15: Terciles of winter 2016-17 precipitation based on interpolated E-OBS grid data (upper graph) and individual ECA&D station data (lower graph), 1981-2010 reference. Source: AEMET, data source: http://www.ecad.eu/

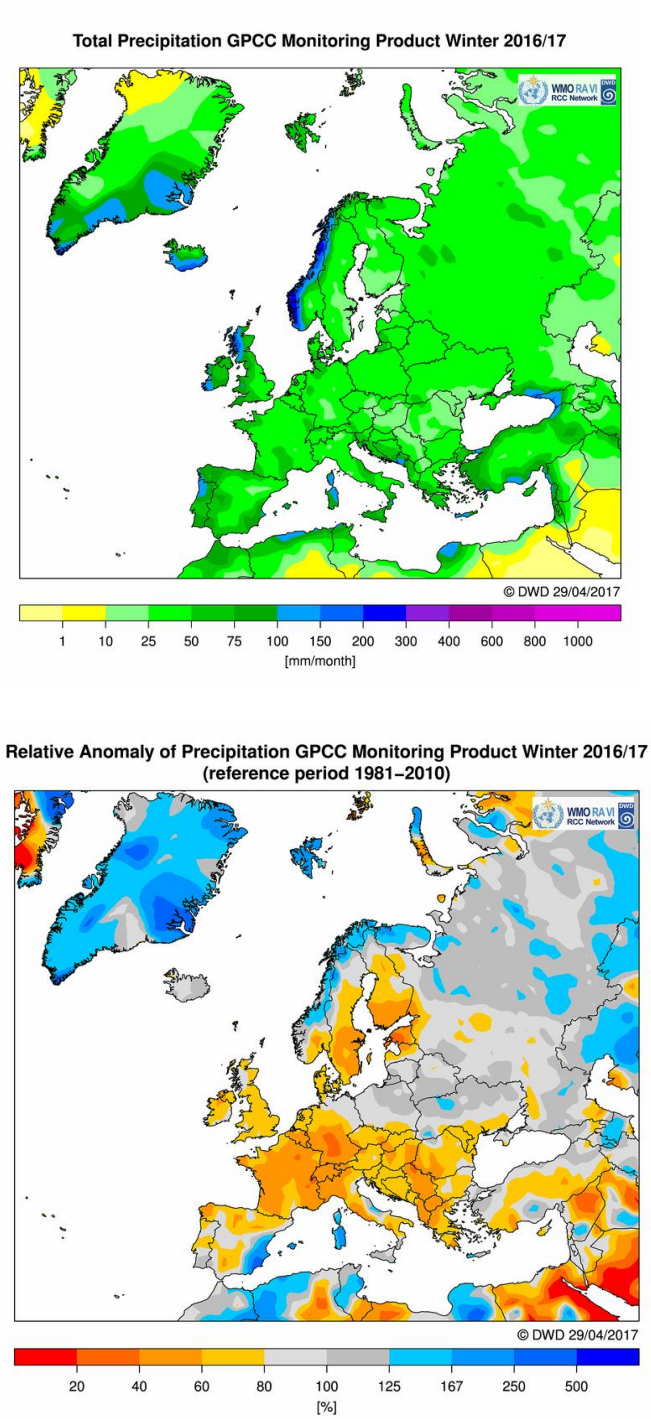


Figure 16: Precipitation for winter 2016-17 in Europe. Upper map: seasonal total in mm/month, lower map: relative anomalies, 1981-2010 reference, source: WMO RAVI RCC, www.dwd.de/rcc-cm , data source: GPCC, http://gpcc.dwd.de

A more detailed analysis for south-eastern Europe, including high impact events, is given in the analysis and verification report of the SEECOF-16 CLIMATE OUTLOOK for 2016-17 winter season for southeast Europe (SEE), provided by SEECOF-17 (presently draft version):

http://www.seevccc.rs/SEECOF/SEECOF-17/STEP-1/Draft-Version-Final-assessment-of-SEECOF-16-climate-outlook-for-winter-season-2016-2017.pdf

North Africa (RA I)

Winter 2016-2017 was wetter than normal over the northwest of the North Africa domain, the central east of Algeria and the center of Tunisia. A wet cell was also noticed over the southwest of Libya and the extreme south east of Algeria. Over the remaining southern region of the North Africa domain, precipitations were below normal. Elsewhere near normal conditions were registered.

In Morocco, winter season was characterized generally by normal to above-normal conditions with exception of Tangier, Bouarfa, Marrakech and southern stations (Tan-Tan, Laayoune et Dakhla) where below-normal precipitation was observed.

In Algeria, winter season was generally characterized by an above-normal condition in the west and central part and normal in the eastern and southern part of Algeria.

In Tunisia, precipitation was at its maximum total in the north-west. Anomalies vary from the north and center-east to the south. This anomaly varies from +136% in the center-east (Mahdia station) up to -98% in the south-west (El-Borma station). December was the wettest month with an anomaly of +101%. Wet anomalies reached +300% in the center-east (in Mahdia) and the center-west (in Tozeur). Maximum daily precipitations reached 188mm in Mahdia Boumerdes and 200mm in Zaghouan Jradou. In January, heavy snow in the mountainous region of the north-west and west of Tunisia took place.

In Egypt, winter season precipitation was marked by a strong regional variability with rainfall deficit in the south and surpluses in the north. 13.7% above-normal precipitation occurred over the north. Several extremely heavy rainfall events occurred in January in the north such as in Alexandria, which received 90.3% above normal rainfall amount. Port Said station recorded 28 mm on the 19th of December 2016 which was the highest 24-hour rainfall total in Egypt for the year.

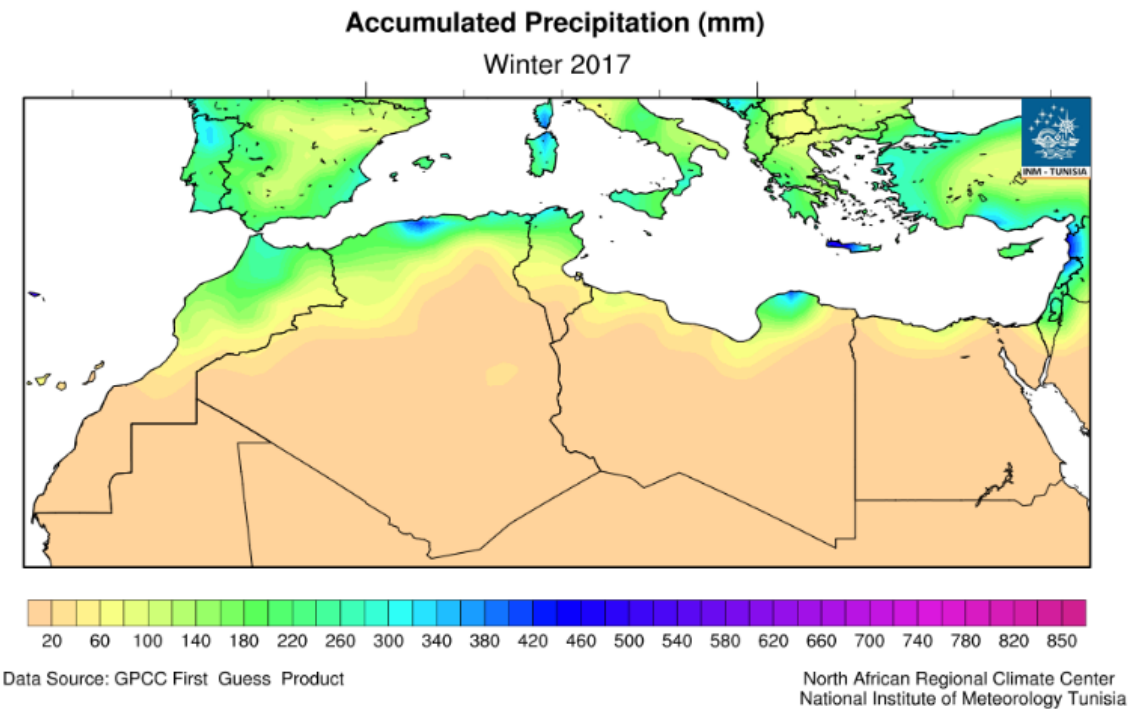


Figure 17: Total precipitation for winter season 2016-17 in North Africa (in mm). Source: INM, Data from GPCC (First Guess Product), http://gpcc.dwd.de

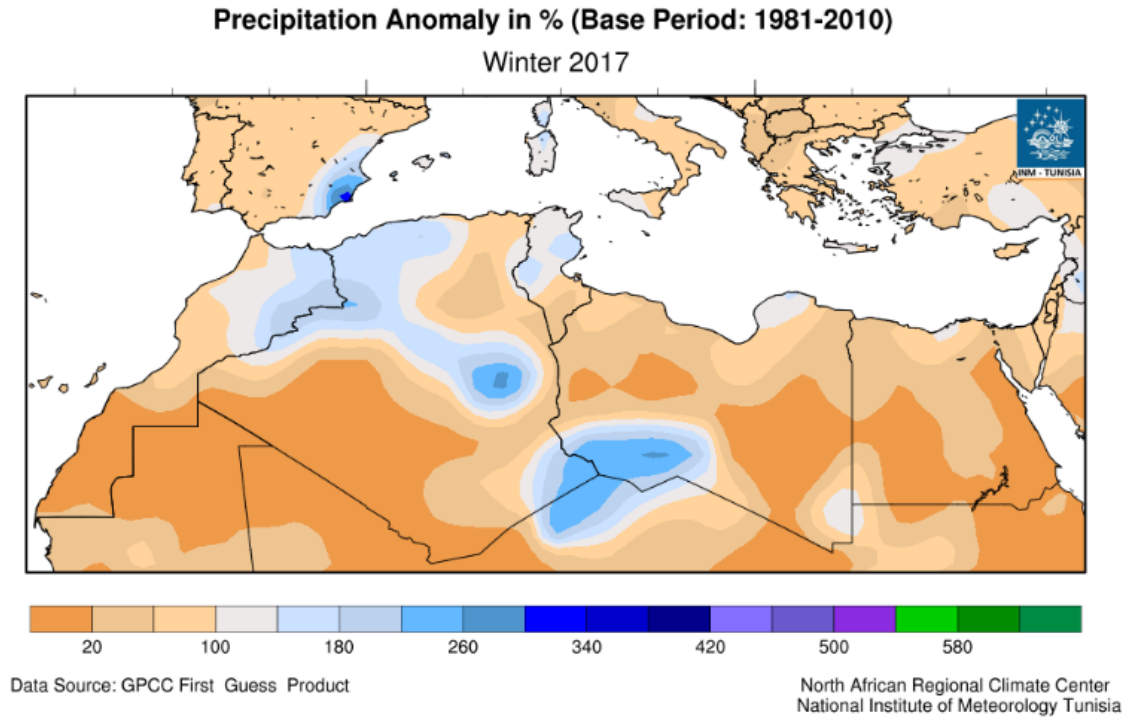


Figure 18: Precipitation anomaly for winter season 2016-17 in North Africa (in %) (Reference period 1981-2010). Source: INM, data from GPCC, http://gpcc.dwd.de

3. Verification of the MedCOF-7 climate outlook for the 2016-17 winter season

3.1. Temperature

Europe/RA VI

The MedCOF-7 outlook favored the upper tercile for the domain except for Iberia, France and the Ukraine, where the middle tercile was predicted.

The warm scenario was correctly predicted for the Mediterranean Sea area, but the outlook had not considered the cold anomalies over eastern land areas from the Balkans to the Middle East, so the eastern continental cold waves, which were extreme especially in January, were not detected. The middle tercile for Iberia, France and the Ukraine was predicted correctly for large parts of these countries.

North Africa (RAI)

The MedCOF-7 climate outlook for the 2016-17 winter season favored a tendency for the upper tercile over almost the whole region. Probabilities for the above-normal scenario are of 60% over Middle East and the southeast of the domain (Red region in figure 1 (b)). Elsewhere probabilities are of 50% for the above-normal case (Orange region in figure 1 (b)).

In fact, negative anomalies were recorded over Egypt, east of Libya and center-east of Morocco. Positive anomalies were registered in the center of North Africa domain and in the south of Morocco. Elsewhere temperatures were near normal.

This indicates that the MedCOF-7 climate outlook for the winter season temperature was not able to predict temperature anomalies registered for most of North African regions especially negative anomalies over eastern parts.

3.2. Precipitation

Europe/RA VI

MedCOF-7 outlook favored wetter-than-normal conditions (upper tercile) over Iberia, the western and central Mediterranean, and rather a dry scenario (lower tercile) over the eastern Mediterranean, Turkey and the Middle East. For the northern parts (France and the northeast of the domain from Hungary to South Caucasus) no privileged scenario was given.

The wet area was well predicted for the western Mediterranean and also the dry area for Turkey and much of the Middle East, but the wet area was smaller than predicted – Italy and the central Mediterranean were mostly dry, despite some heavy precipitation in February in the northern Adriatic Sea region. Iberia was only wet in the east and locally in the south, but close to normal or dry elsewhere.

In the northern areas, France was mainly dry and in the lower tercile, and also the area from Hungary to Moldova. In contrast, the Ukraine and South Caucasus received precipitation in the middle or upper tercile, which is partly correct when climatology and therefore the middle tercile are assumed for the non-privileged scenario prediction.

North Africa

MedCOF-7 outlook favored over the central part of the MedCOF region a wetter-than-normal winter with probability of 40% for the upper tercile (Blue region figure 1 (a)). For southern areas of North Africa and Middle East region a drier-than average season is favored with probability of 45% for the below-normal tercile (Yellow region in figure 1 (a)). For the rest of the region there is no preference for any climate defined categories.

Winter 2016-2017 was wetter than normal over the north west of North Africa domain, the north-west and center of Algeria, the center of Tunisia and the north of Egypt. A wet cell was noticed over the southwest of Libya and the extreme southeast of Algeria. Over the remaining southern region of the North Africa domain, precipitations were below normal. Elsewhere near normal conditions were registered.

This means the outlook was correct especially over much of southern parts of North Africa, but some wet spells were not captured by the outlook.

4. Users' perceptions of the MedCOF-6 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.

Appendix A: Contributors to MEDCOF-8

- World Meteorological Organization

Europe and Middle East (RA VI)

- Climate Centres:

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

- National Meteorological and Hydrological Services:

- 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-17**

APPENDIX B: **Analysis and verification of the MedCOF-7 climate outlook for the winter season 2016/2017:**

Verification summary based on the national reports and contributions of the participants of the SEECOF-17 and MedCOF-8 online meetings

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	MedCOF-7 climate outlook for temperature	Observed	MedCOF-7 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 (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	**MedCOF-7 climate outlook for temperature**	**Observed**	**MedCOF-7 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 (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	MedCOF-7 climate outlook for temperature	Observed	MedCOF-7 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 (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	**MedCOF-7 climate outlook for temperature**	**Observed**	**MedCOF-7 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 (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	**MedCOF-7 climate outlook for temperature**	**Observed**	**MedCOF-7 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 (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	**MedCOF-7 climate outlook for temperature**	**Observed**	**MedCOF-7 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

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	MedCOF-7 climate outlook for temperature	Observed	MedCOF-7 climate outlook for precipitation	
Greece (2)	Below normal	Above normal	drier than normal, wetter than normal in Crete	Above normal, No signal for the northeast	**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.

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	MedCOF-7 climate outlook for temperature	Observed	MedCOF-7 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 (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	MedCOF-7 climate outlook for temperature	Observed	MedCOF-7 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 (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	**MedCOF-7 climate outlook for temperature**	**Observed**	**MedCOF-7 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 (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	**MedCOF-7 climate outlook for temperature**	**Observed**	**MedCOF-7 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 (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	**MedCOF-7 climate outlook for temperature**	**Observed**	**MedCOF-7 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 (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	**MedCOF-7 climate outlook for temperature**	**Observed**	**MedCOF-7 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 (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	MedCOF-7 climate outlook for temperature	Observed	MedCOF-7 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 2-3 th 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-8

National Institute of Meteorology, Tunisia
National Meteorology Office, Algeria
National Meteorological Directorate, Morocco
Egyptian Meteorological Authority, Egypt

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High impacts events
	Observed	**MedCOF-7 climate outlook for temperature**	**Observed**	**MedCOF-7 climate outlook for precipitation**	
Algeria (1)*	Mean anomaly of +0.7º C. Warm tercile	Above normal	Above normal on a western and center of Northern part Normal to below normal in eastern and southern part	No clear signal in the north Below normal elsewhere	Strong winds recorded Heavy Snow falls accumulation were also recorded intense rainfall event
Egypt (1)*	Below normal	Above normal	Above normal to normal in the north Below normal elsewhere	Below normal	24-25/12/2016 in Alexandria and kafr El-Sheikh, a convective storm occurred causing flood causing casualties and damages. (11000$)

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High impacts events
	Observed	**MedCOF-7 climate outlook for temperature**	**Observed**	**MedCOF-7 climate outlook for precipitation**	
Libya *	Below normal in the east Near normal elsewhere	Above normal	Above normal in the south-east Normal to below normal elsewhere	Below normal in the center and the south No clear signal elsewhere	
Morocco (1)	Above normal in the extreme north and extreme south Below normal in the center east Normal elsewhere	Above normal	Below normal in the south Normal to above normal elsewhere	Below normal in the south No clear signal elsewhere	January 2017: Cold wave over most part of Morocco and heavy snowfall on the high and middle Atlas Mountains. Heavy hail over Rabat. February 2017: Continuous precipitation over Rabat (119mm in less than 24h)

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High impacts events
	Observed	**MedCOF-7 climate outlook for temperature**	**Observed**	**MedCOF-7 climate outlook for precipitation**	
Tunisia (1)	Normal conditions	Above normal	Above normal in the center Below normal in the south Normal elsewhere	Slightly above normal in the extreme north No clear signal elsewhere	15-18 December: Heavy rains over the eastern coastal regions. Maximum daily precipitations were registered on the 16th of December: in Mahdia Boumerdes 188mm, in Gabes ezzarat: 111mm, in Kairouan 130mm, in Monastir 116mm and in Sousse 113mm. 5-9 December: heavy rains over center-eastern regions. Maximum daily precipitations were registered on the 7th of December in Mahdia Port with 104mm and on the 8th of December in Zaghouan: Jradou 200mm and Zriba 140mm. January: Heavy snow in mountainous region of the north-west and west of Tunisia.

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

References:

MedCOF 7 Outlook: http://medcof.aemet.es/images/doc_events/medcof7/docMedcof7/Consensus_Statement_MedCOF-7.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

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

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

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/

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

GPCC: http://gpcc.dwd.de