MEDITERRANEAN CLIMATE OUTLOOK FORUM
MEDCOF-12 ONLINE MEETING

ANALYSIS AND VERIFICATION
OF THE MEDCOF-11 CLIMATE OUTLOOK
FOR THE 2018-19 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 11,
- climate monitoring results of RA I NA RCC and RA VI RCC networks,
- national verification reports received from NMHSs or posted in RCOF forums of MedCOF, SEECOF or PRESANORD,
- SEECOF-21 verification report

1 MedCOF-11 Climate outlook for the 2018-19 winter season

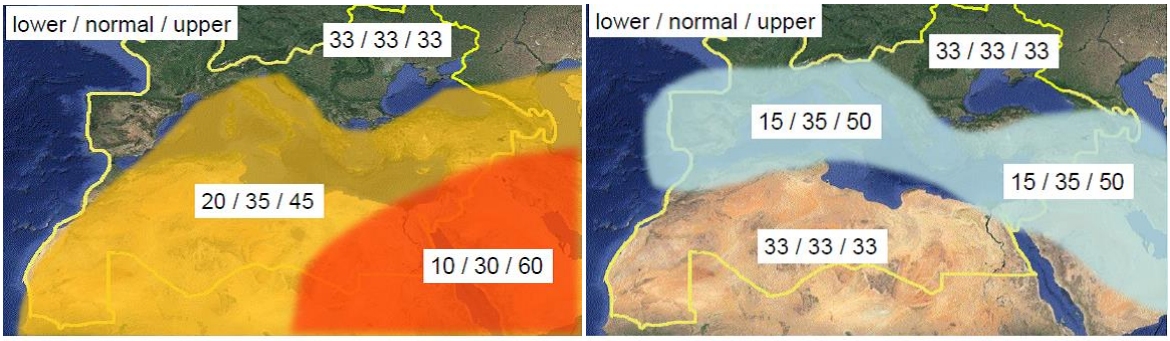


Figure 1: Graphical presentation of the climate outlook for the 2018-19 winter season for the Mediterranean region (a) Temperature Outlook; (b) Precipitation Outlook

1.1 General circulation

The tropical Pacific reflected weak El Niño conditions in terms of SST indices. The latest ENSO predictions indicated that a moderate El Niño event would continue throughout the winter. Some influence of El Niño on general circulation at mid-latitudes was expected by the canonical response of positive PNA and the potential teleconnection up to the Atlantic Ocean. Most dynamical models suggested that El Niño conditions would favor negative North Atlantic Oscillation (NAO). Additionally, this was supported by the analysis of different sources of predictability (solar activity, NH snow cover, sea ice extent) favoring a shift of the low pressure systems track southwards and the associated increase in precipitation over the Mediterranean basin.

1.2 Temperature

A tendency for above-average temperatures was the main feature over most of the southern part of the region, including northern Africa, Middle East and the Mediterranean Sea. The highest probability for above-average temperatures was expected over the southeastern part of the domain (see figure 1a). For the northern parts, no clear tendency could be found.

The following three regions with different tercile distributions were defined within the MedCOF domain (Fig. 1a):

- **Region 1 (no color):** coastal region of Morocco, Iberia, France, northern Italy, Balkans (without Adriatic coast), Bulgaria, Romania, Hungary, Moldova, Ukraine. No privileged scenario (33/33/33).
- **Region 2 (orange**): Morocco except coast, Algeria, Tunisia, Libya (except southeast), Mediterranean basin, Italy except north, Dalmatian coastal region, Greece, Turkey, Cyprus, South Caucasus, northwest Syria. Warm scenario favored (20/35/45), but with higher uncertainty than for Region 3.
- **Region 3 (red):** Middle East (except northwest Syria), southeast Libya, Egypt. Warm scenario favored (10/30/60).

This means for verification that a prediction of normal temperature (middle tercile range) was assumed for Region 1 and above-normal temperature (upper tercile range) for Region 2 and 3.

1.3 Precipitation

Although precipitation uncertainties are generally larger than for temperature, additionally the uncertainty related to the predominance of negative NAO was the main feature for the precipitation outlook. A shift of the precipitation distribution over the Mediterranean Sea was assumed. The negative NAO pattern would favor wetter-than-normal conditions over most of the Mediterranean Sea, including most of southern Europe, northern Morocco, Anatolia, Caucasus and Middle-East (see figure 1b). In addition, local factors (for example SSTs in the smaller basins of the region) might shape local variability at a regional level. However, no privileged scenario could be found for the north and the south of the domain due to uncertainty.

For precipitation, three regions were defined in the MedCOF-11 outlook (Fig. 1b):

- **Region 1 (northern region without color):** France (except south), Hungary, Romania, Bulgaria, Moldova, Ukraine, northwestern Turkey, Georgia. No privileged scenario (33/33/33).
- **Region 2 (light blue):** Iberia, southern France, Italy, Balkans, Greece, Turkey (except northwest), Armenia, Azerbaijan, northern coasts of Morocco, Algeria and Tunisia, Mediterranean basin, Middle East. Wet scenario favored (15/35/50)
- **Region 3 (southern region without color):** North Africa (except northern coasts of Morocco, Algeria and Tunisia).

This means for verification that normal precipitation (middle tercile) was assumed for Region 1 and 3, and above-normal precipitation (upper tercile) for Region 2.

2 Analysis of the 2018-19 winter season

Analysis of the winter season temperature and precipitation anomalies and general circulation are based on maps and seasonal bulletins on the climate in the WMO region I – NA and VI for the winter 2018/19 (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 Forum for Southeastern Europe (SEECOF, 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

Sea surface temperature (SST) anomalies in the eastern tropical Pacific in boreal winter 2018/19 were above normal with peak values above +1°C (Fig. 2), implying moderate El Niño conditions as predicted. Looking at individual months, SST anomalies decreased from December 2018 to weaker conditions in January 2019, but increased slightly in February again in Niño 3 and 4 regions, not falling below the 0.5°C threshold (Table 1).

In the Mediterranean, SST was above normal on DJF 2018/19 average, with anomalies in western parts even above +1°C. Also the other surrounding sea surfaces (eastern North Atlantic, Black Sea, western Indian Ocean) were all warmer than normal (mostly around +0.5°C).

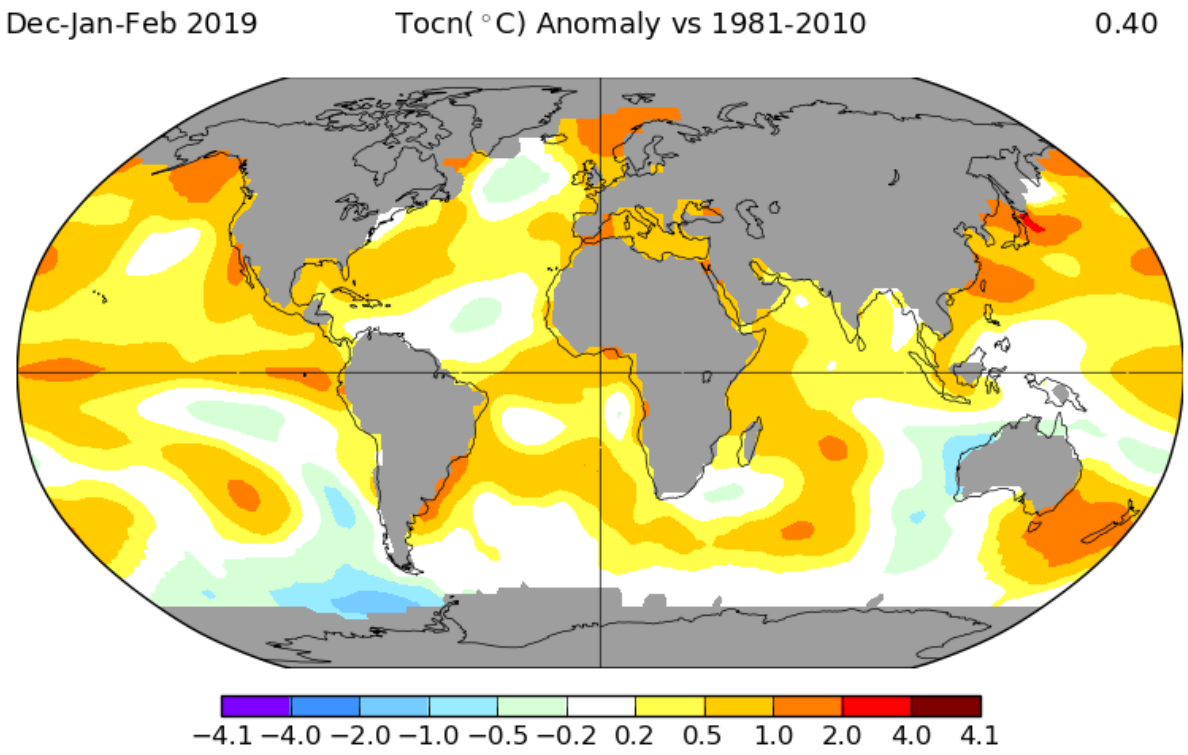


Figure 2: Sea surface temperature anomalies for boreal winter 2018-19 (December-February), 1981-2010 reference. Data from ERSSTv5 Ocean model analysis with 250km smoothing, source: NASA GISS, https://data.giss.nasa.gov/gistemp/maps/

MONTH	NIÑO 1+2		NIÑO 3		NIÑO 4		NIÑO 3.4	
	TEMP	ANOM	TEMP	ANOM	TEMP	ANOM	TEMP	ANOM
December 2018	23.60°C	+0.78°C	26.12°C	+0.98°C	29.52°C	+1.03°C	27.53°C	+0.96°C
January 2019	25.10°C	+0.58°C	26.17°C	+0.54°C	29.00°C	+0.70°C	27.08°C	+0.51°C
February 2019	26.45°C	+0.31°C	26.91°C	+0.55°C	29.06°C	+0.96°C	27.41°C	+0.68°C

Table 1: Sea surface temperature and anomalies for various Niño regions in boreal winter months 2018-19 (December-February), 1971-2000 reference. Data from ERSSTv5 ocean model analysis, source: NOAA, https://www.ncdc.noaa.gov/teleconnections/enso/indicators/sst.php with definitions of Niño regions.

2.1.2 Atmosphere

Seasonal averages of 500 hPa for DJF 2018/19 show a broad ridge over Western Europe and western North Africa and a trough over Eastern Europe reaching far to the south over the Balkan Peninsula to the central and eastern Mediterranean and North Africa (Fig. 3). This pattern was very intense for the season as reflected by high anomalies.

Sea level pressure shows a similar distribution (Fig. 4). Especially western North Africa, Iberia and France experienced anticyclonic conditions on average, while centers of low pressure can be seen over the eastern Mediterranean and near the Red Sea.

This pattern was more or less the same for all winter months, in January shifted to the west, in February to the east (Fig. 5). February, however, had high positive geopotential anomalies over much of Europe, while they were negative over North Africa. Near surface, high pressure influence extended from southwestern Europe far to the Balkan Peninsula and Eastern Europe in February (Fig. 6).

According to Météo France weather type classification, the prevailing types were Blocking and NAO+ in December and February, and Atlantic Ridge in January (due to shifting of the pattern to the west). In contrast, NAO- patterns, which were expected by the Outlook, occurred only rarely – just on 3 days during the whole winter (Fig. 7).

The NOAA CPC teleconnection patterns, too, did not show any NAO- signal; rather a weak NAO+ in December and an almost neutral NAO phase in January and February (Table 2). Most dominant was an EA+ pattern in December and an EA- pattern (corresponding to Atlantic Ridge) in January.

Verification analysis of Météo France has shown that model forecasts of 200hPa velocity potential and stream function were quite poor for Europe and North Africa (Fig. 8). Although El Niño was well predicted, the expected teleconnection, which should have resulted in a NAO- pattern, had not really occurred.

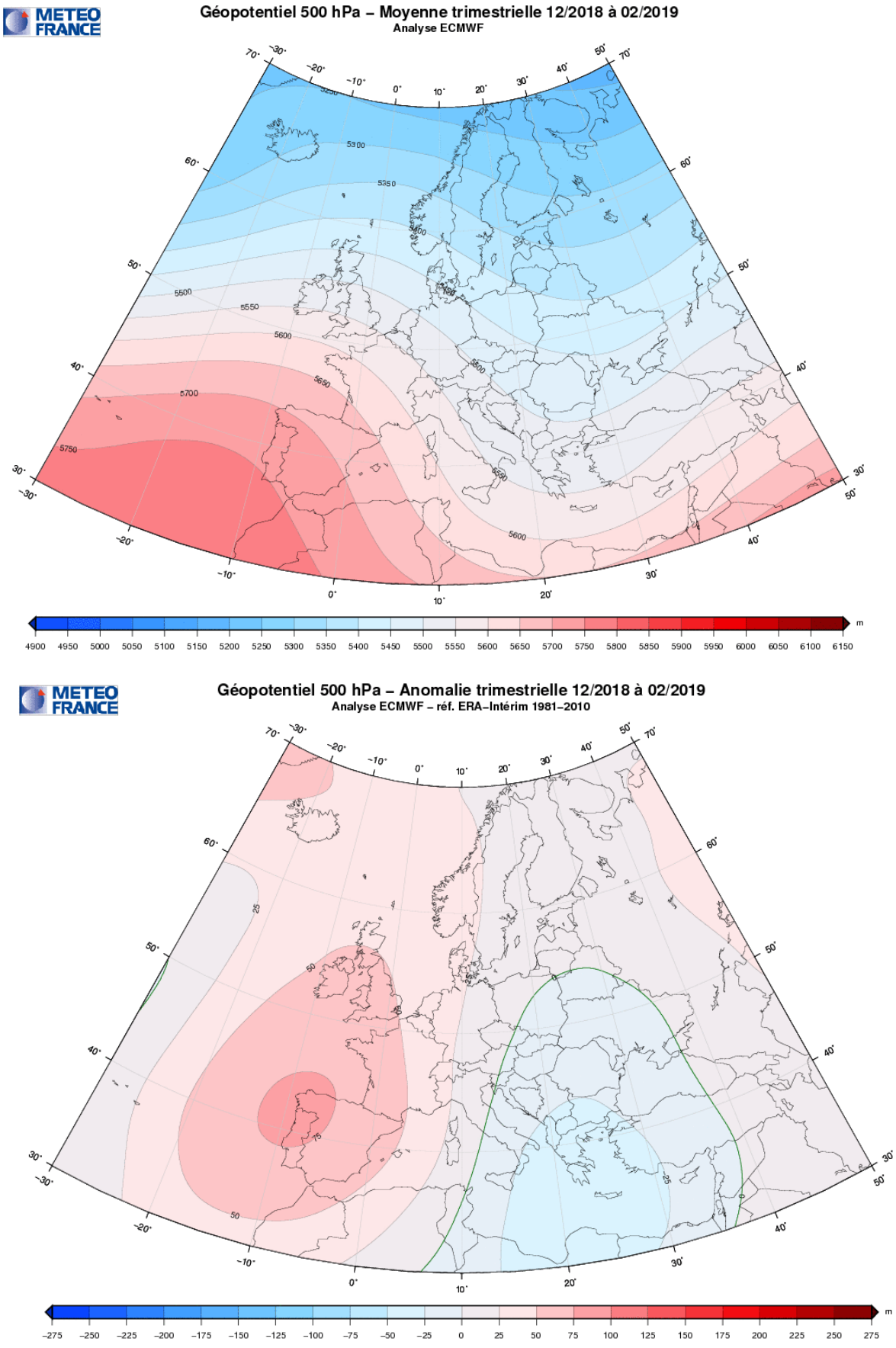


Figure 3: Seasonal mean and anomalies of 500 hPa geopotential for winter 2018-19 (1981-2010 reference). Source: Météo France, data source: ECMWF ERA Interim reanalysis, http://seasonal.meteo.fr/en/content/suivi-clim-cartes

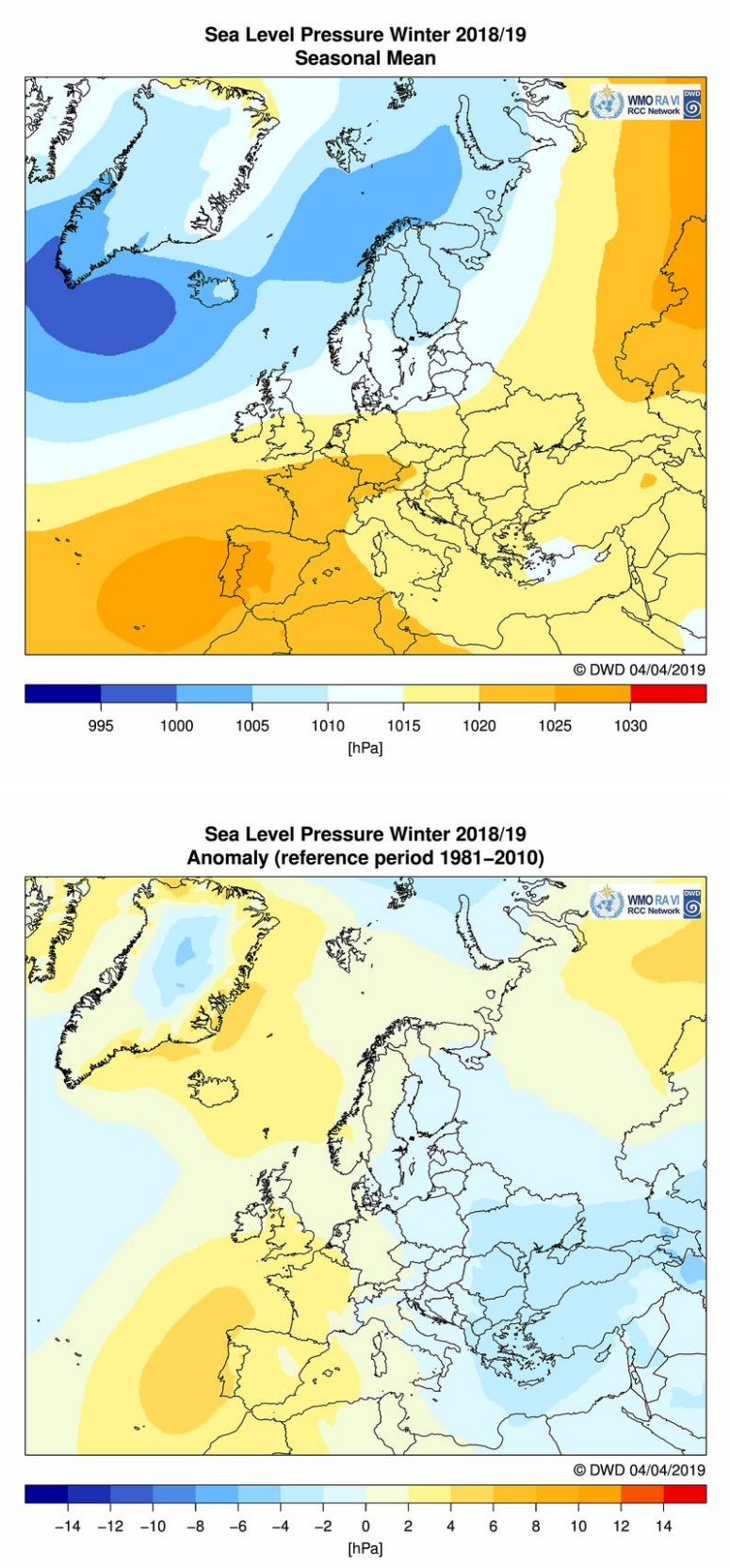


Figure 4: Seasonal mean sea level pressure (upper graph) and its seasonal anomalies (lower graph) for winter 2018-19 (1981-2010 reference). Source: Deutscher Wetterdienst (DWD), data source: DWD numerical ICON model analysis, http://www.dwd.de/EN/research/weatherforecasting/num_modelling/01_num_weather_prediction_modells/icon_description.html?nn=484268

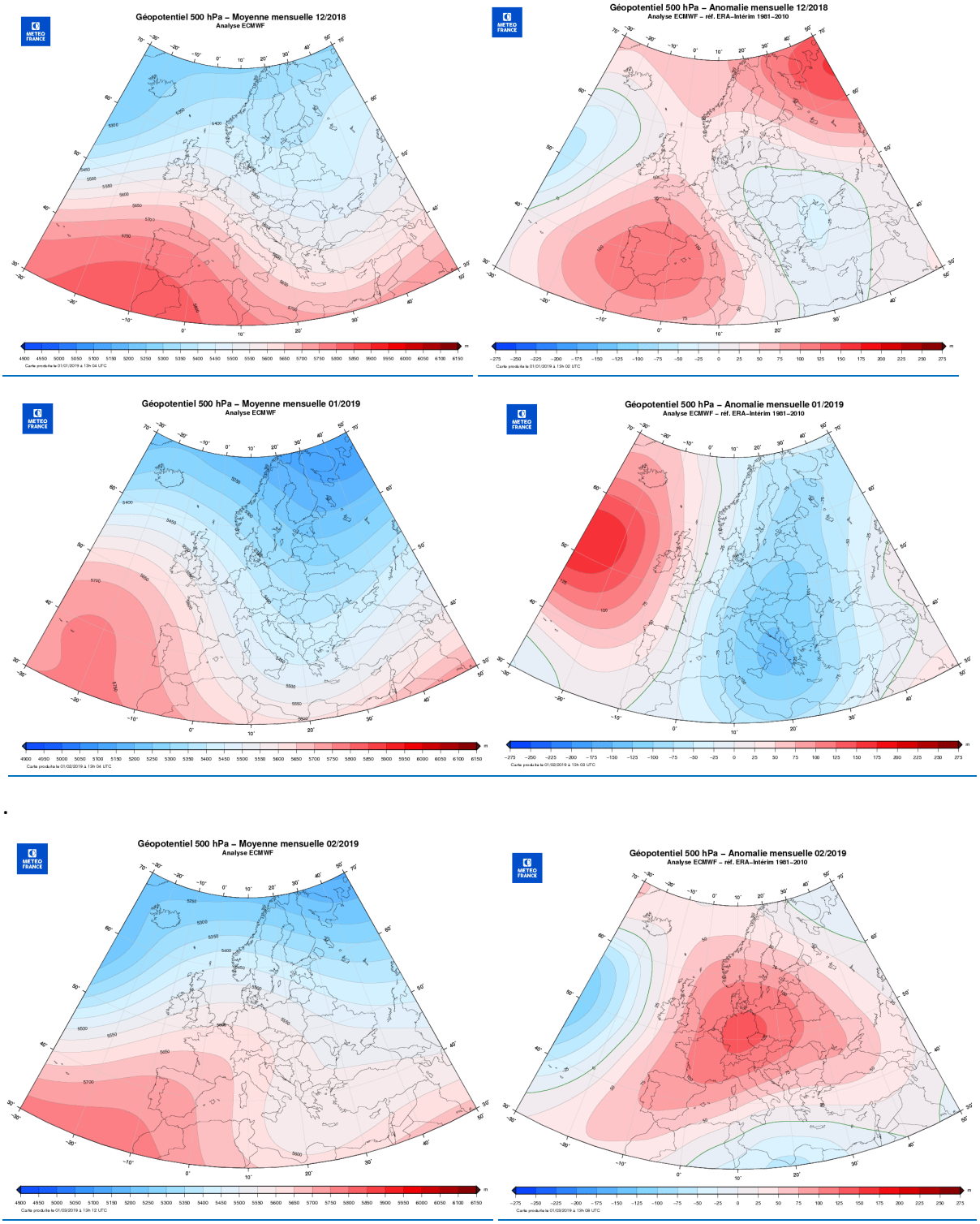


Figure 5: Same as Figure 3, but for the months December 2018, January 2019, February 2019

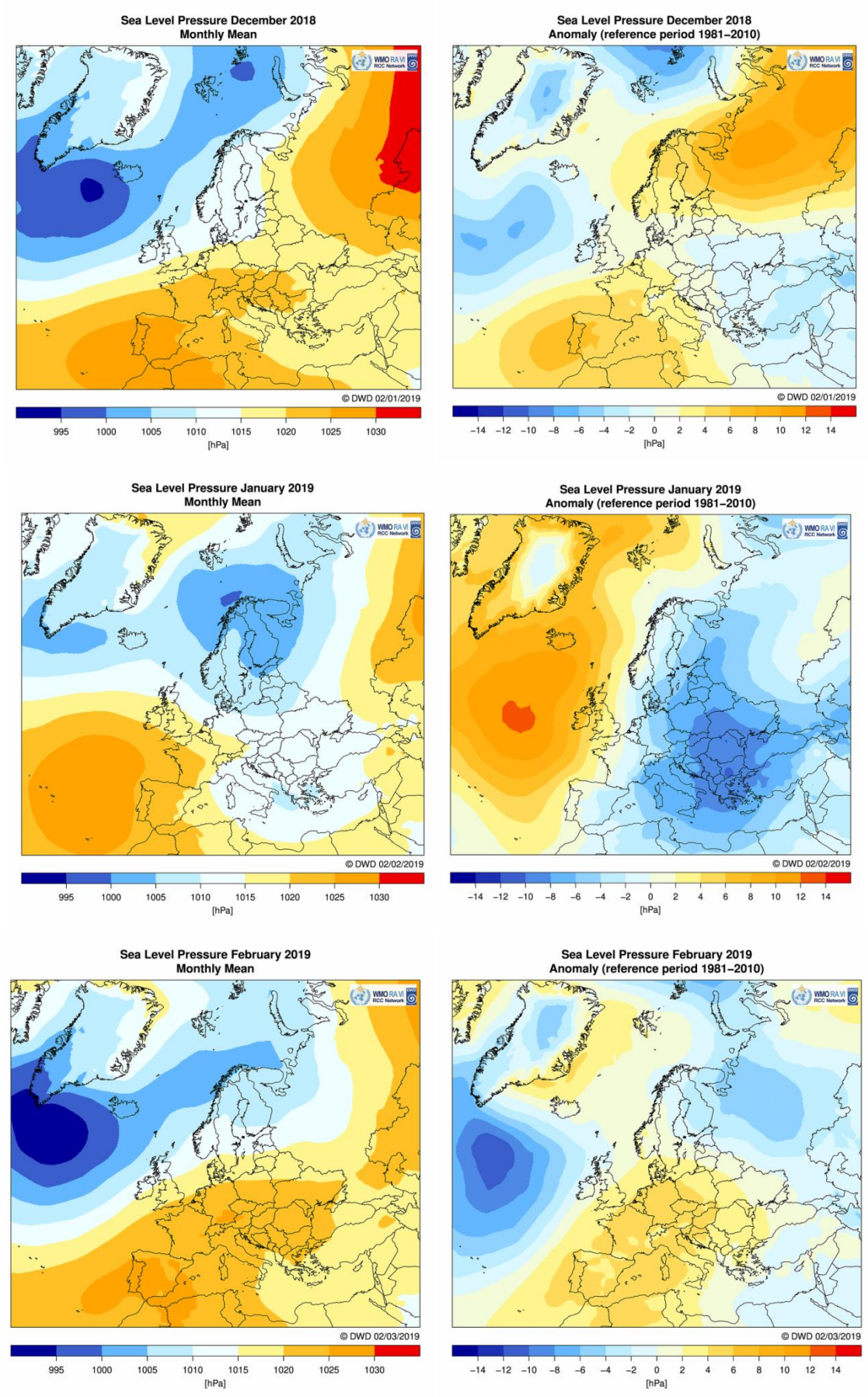


Figure 6: Same as Figure 4, but for the months December 2018 - February 2019

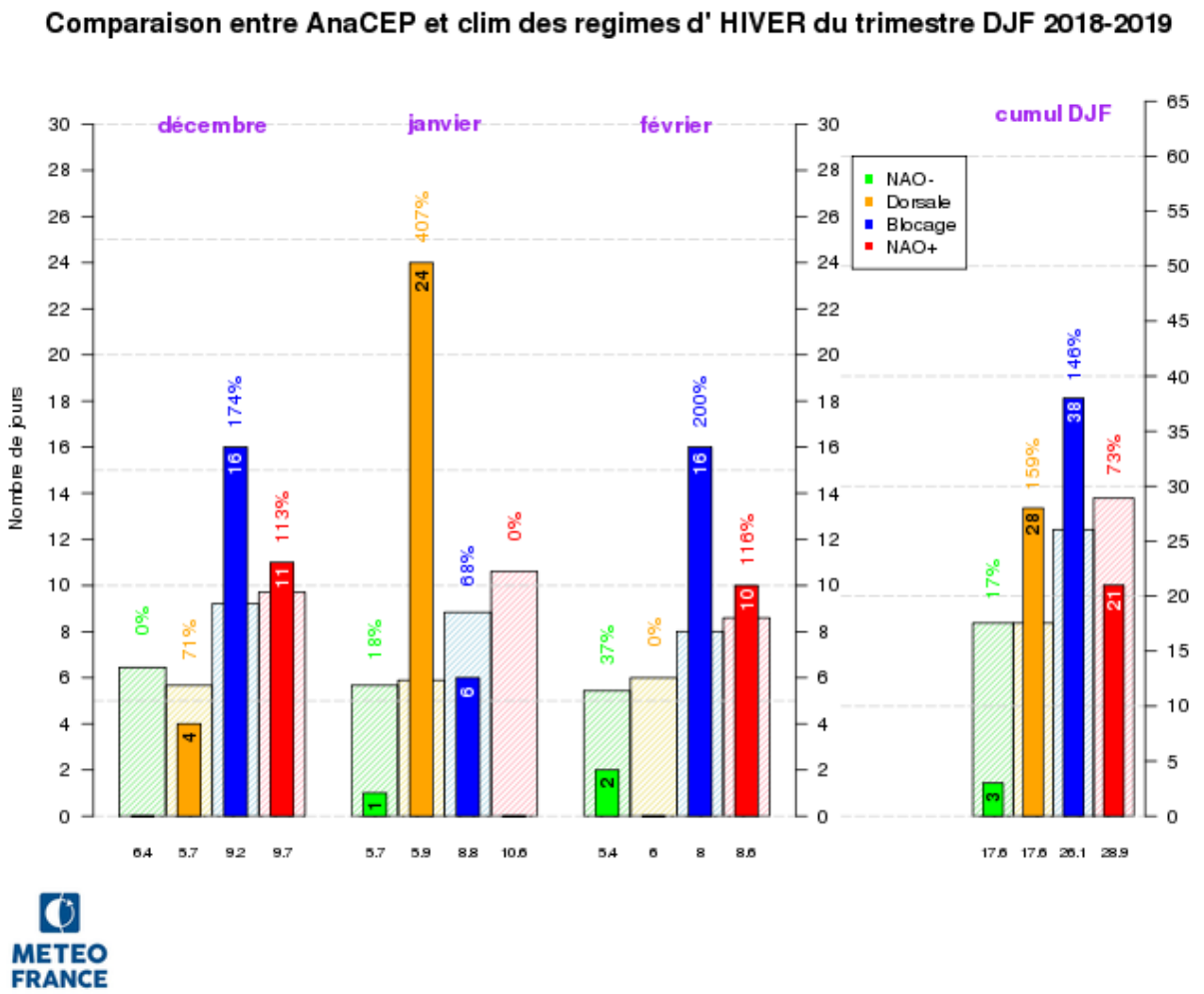


Figure 7: Number of days with circulation types of the Météo France classification for each month of the winter 2018-19 season and for the whole season (right), and in percent of the climatological frequency distribution 1981-2010. Circulation types are: negative North Atlantic Oscillation phase (NAO-), 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
2018	12	0.48	1.44	0.11	-99.90	0.56	-0.43	1.35	-0.62	1.54	-99.90	57.2
2019	1	0.18	-1.67	1.05	1.07	0.42	0.72	-0.09	0.34	0.08	-99.90	58.3
2019	2	-0.11	-0.12	2.09	1.20	-1.73	0.45	-0.40	1.64	0.69	-99.90	60.7

Table 2: Circulation indices of NOAA CPC patterns for the winter months 2018/19.

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

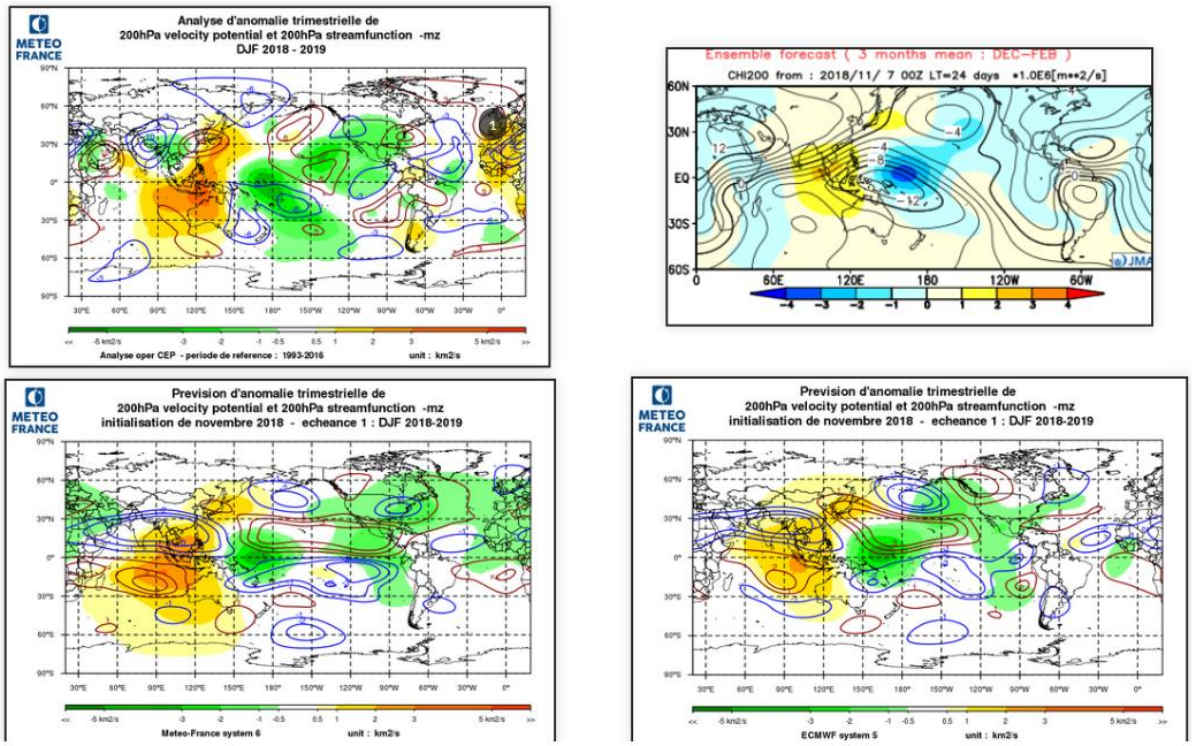


Figure 8: Velocity potential and stream function in 200 hPa for DJF 2018-19, analysis (upper graphs) and forecasts (lower graphs) from Météo France (left) and ECMWF (right) models.

Source: Météo France, http://seasonal.meteo.fr/Slides/Verification

2.2 Temperature

Europe and Middle East (RA VI)

According to ERA Interim Reanalysis, winter 2018/19 was mostly warmer than normal in the RA VI part of the domain, especially in northern parts, mostly above the upper tercile (Fig. 9, 10). In several areas throughout the domain, temperature was around normal, and in places in Italy and southern Balkans even below the lower tercile. For E-OBS and ECA&D data, the locations of below-normal temperature differ partly from ERA-Interim (probably due to data gaps), but are still in minority (Fig. 11). Several places, particularly in western parts, but also in the Middle East were even warmer than the 90th percentile (Fig. 12). In the lowlands of Armenia, no snow cover was formed due to high temperature.

Mean seasonal temperature in the lowlands ranged from -4°C in the eastern Ukraine to around 15°C in Jordan (Fig. 13). Some unusually high daily maxima were measured, e.g. above 24°C in Cyprus in December 2018. Seasonal anomalies (1981-2010 reference) were lowest in places in Sicily (-2°C) and highest locally in northeastern Turkey and South Caucasus (> +5°C). Greece had a very cold episode in early January, but February was mild. Also Moldova and Ukraine had a relatively cold January with heavy snowfalls, followed by a mild February with maxima up to 17°C in Moldova.

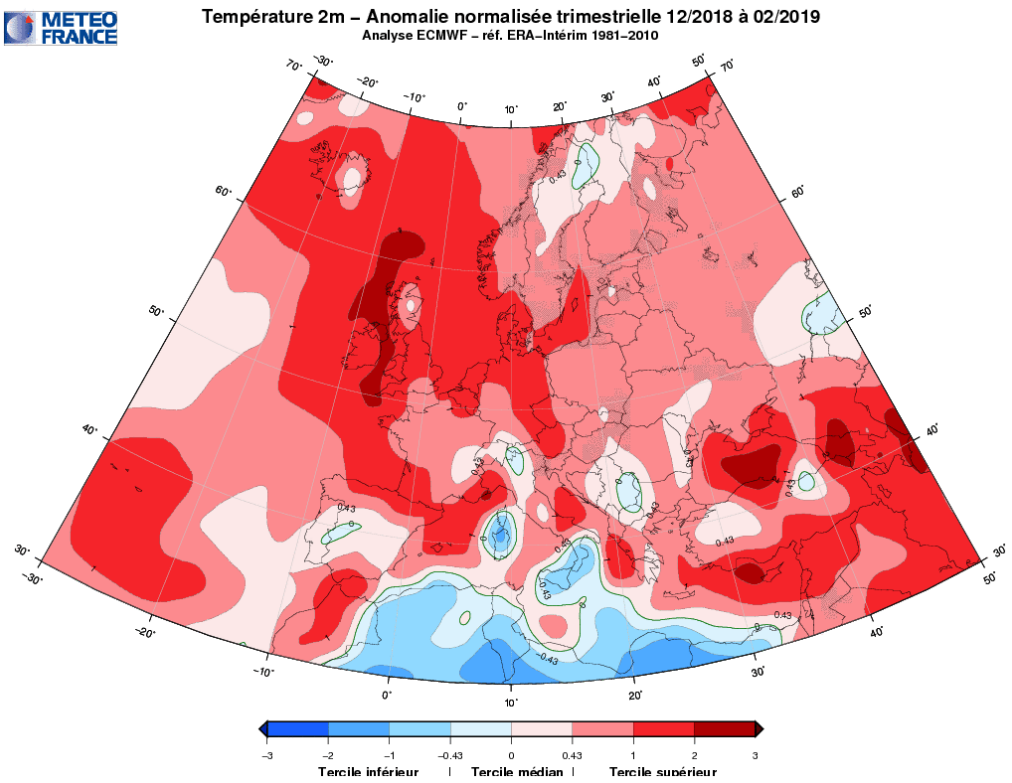


Figure 9: Seasonal normalized temperature anomalies of winter 2018/19 surface air temperature based on ECMWF / ERA-INTERIM grid data, 1981-2010 reference. The data range between -0.43 and +0.43 represents the middle tercile range, -0.43 the lower tercile and +0.43 the upper tercile. Source: Météo France, data reference: http://www.ecmwf.int/en/research/climate-reanalysis/era-interim

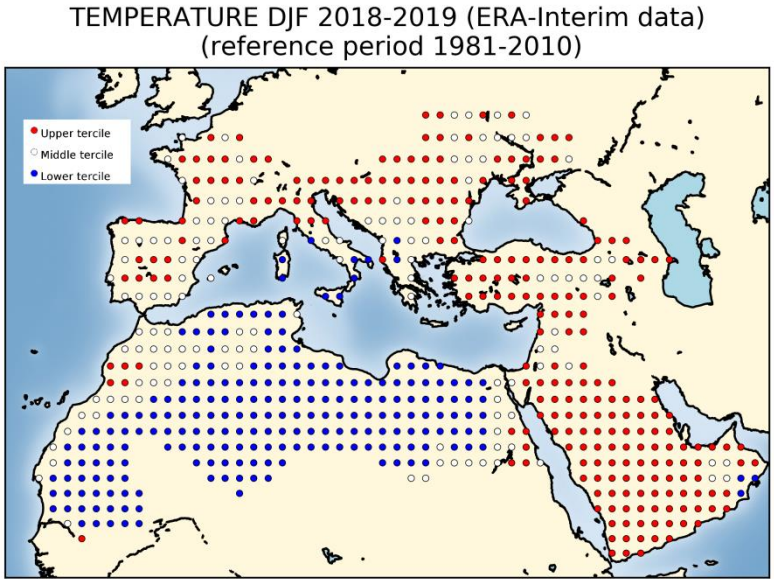
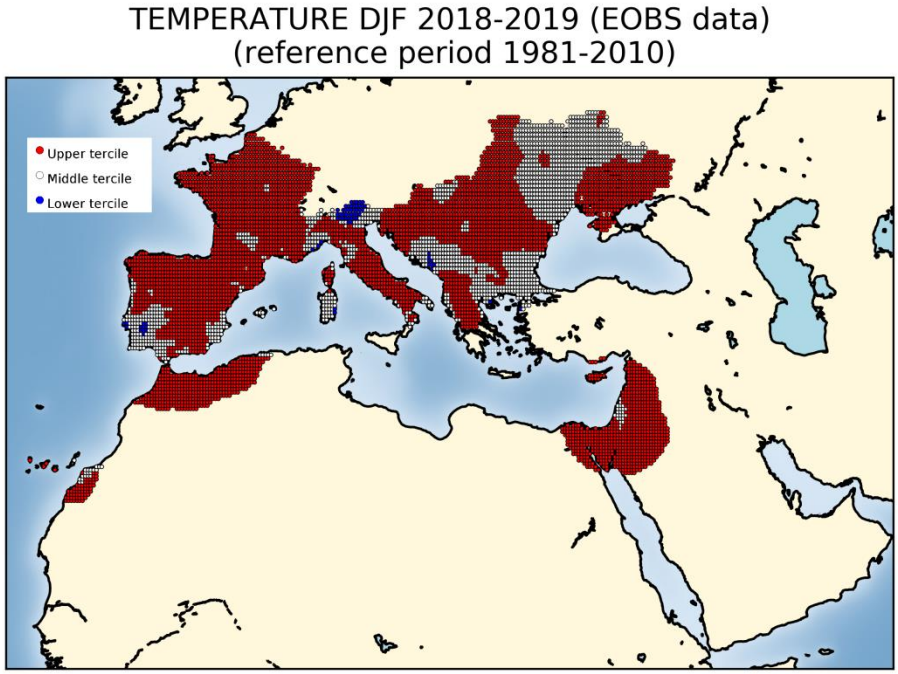


Figure 10: Terciles of winter 2018/19 surface air temperature based on ERA-Interim Reanalysis, 1981-2010 reference. Source: AEMET, data source http://www.ecmwf.int/en/research/climate-reanalysis/era-interim



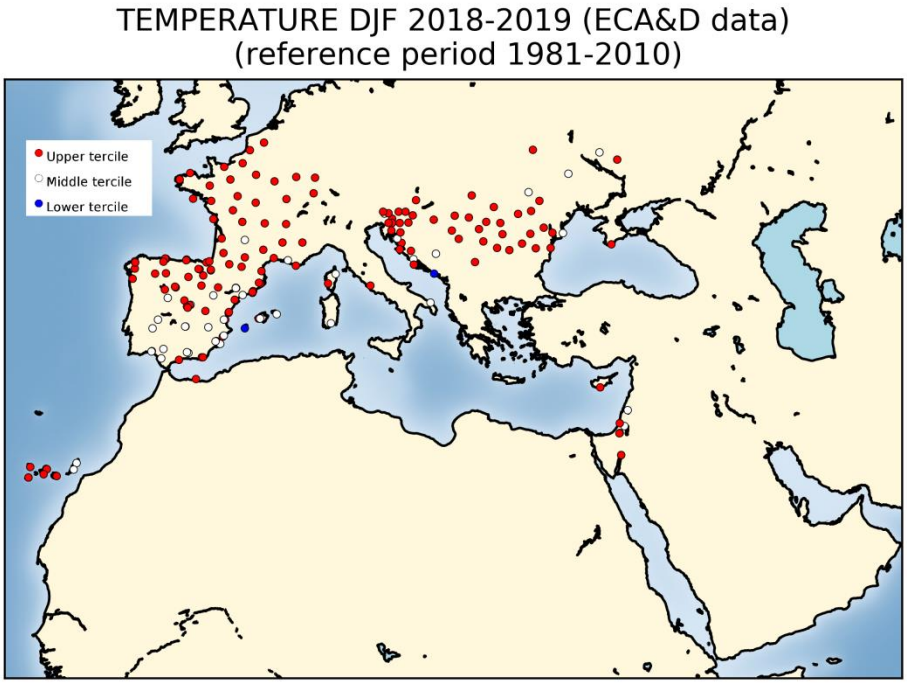


Figure 11: Terciles of winter 2018/19 surface air temperature based on interpolated E-OBS grid data (upper graph) and individual ECA&D station data (lower graph), 1981-2010 reference. Source: AEMET, data source: http://www.ecad.eu/

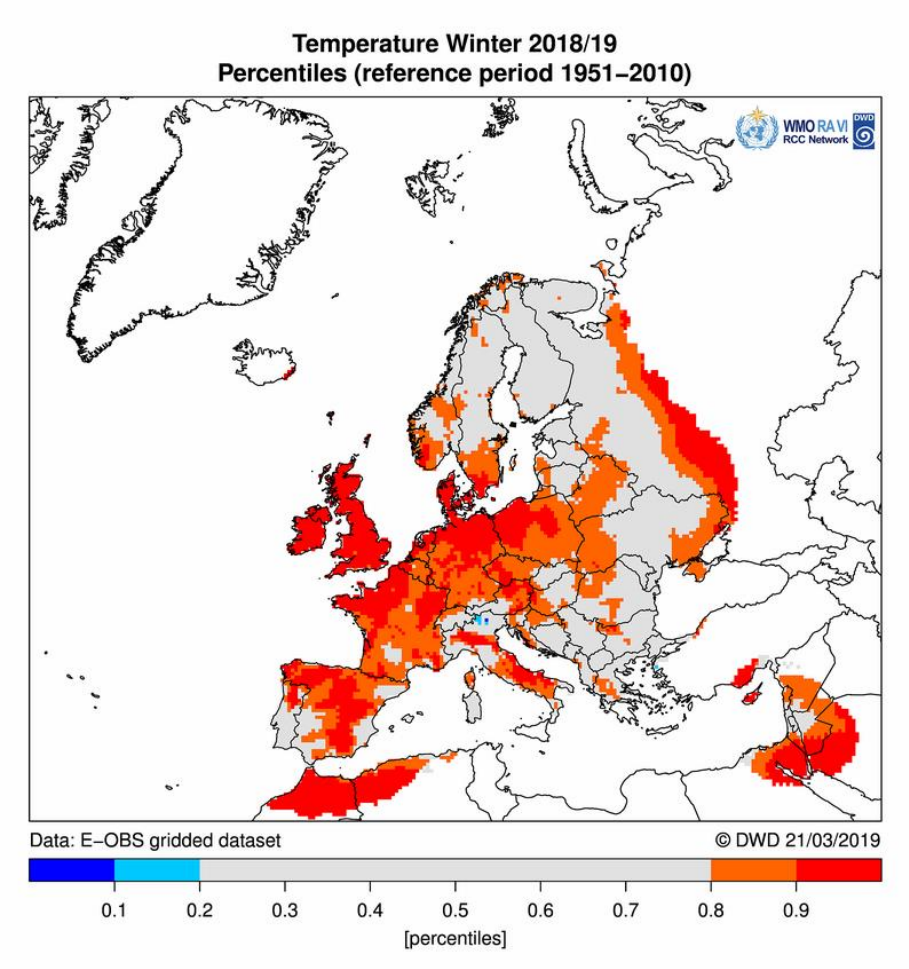


Figure 12: Percentiles of winter 2018/19 surface air temperature based on interpolated E-OBS gridded data, 1951-2010 reference. Source: DWD, data source: http://www.ecad.eu/

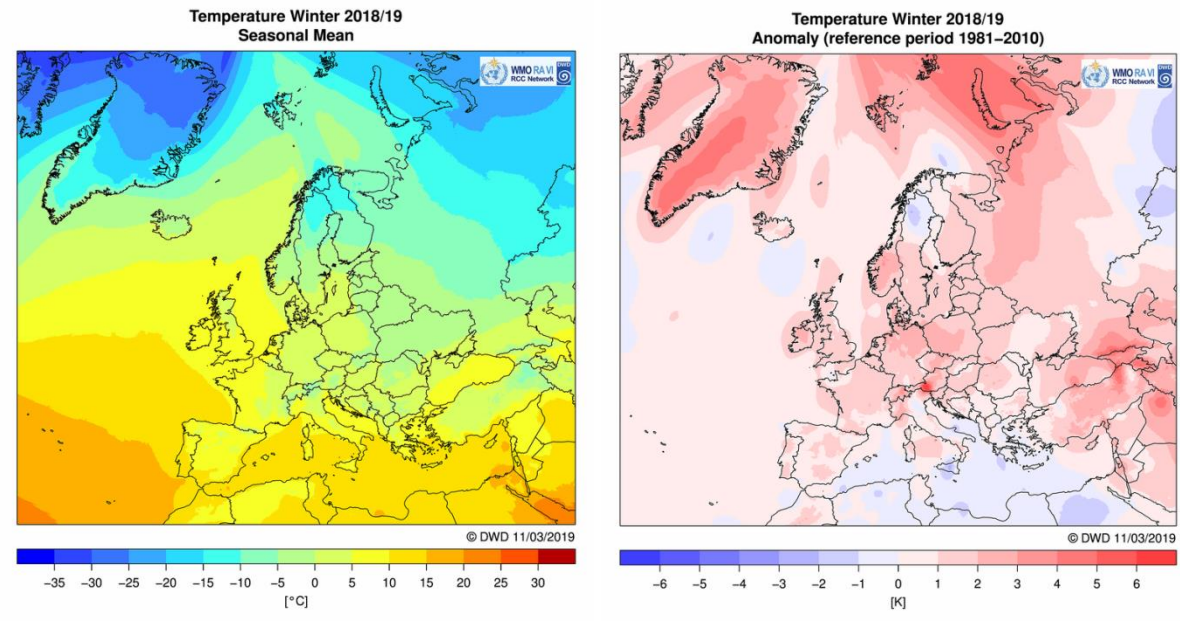


Figure 13: Surface air temperature for winter 2018/19. Left: seasonal mean, right: anomalies, 1981-2010 reference, source of both maps: WMO RAVI RCC, based on interpolated CLIMAT data, www.dwd.de/rcc-cm

North Africa (RA I)

Winter 2018-19 temperature was below normal throughout the North Africa region with the exception of the center of Algeria and the northern half of Morocco which was above normal. Mean temperatures ranged between -2°C and 22°C. Winter season mean temperature was at its minimum over the north of Tunisia, Algeria and Morocco.

In Tunisia, the seasonal mean temperature during the winter was at its minimum over north-western regions. The lowest value of seasonal mean temperature was 6.3°C measured in Thala in the Center-west of Tunisia. The eastern part of the country was mainly the warmest region this winter season. The highest value of absolute maximum temperature was registered during January 2019, it was 26.6°C measured in Kairouan, right in the center of Tunisia.

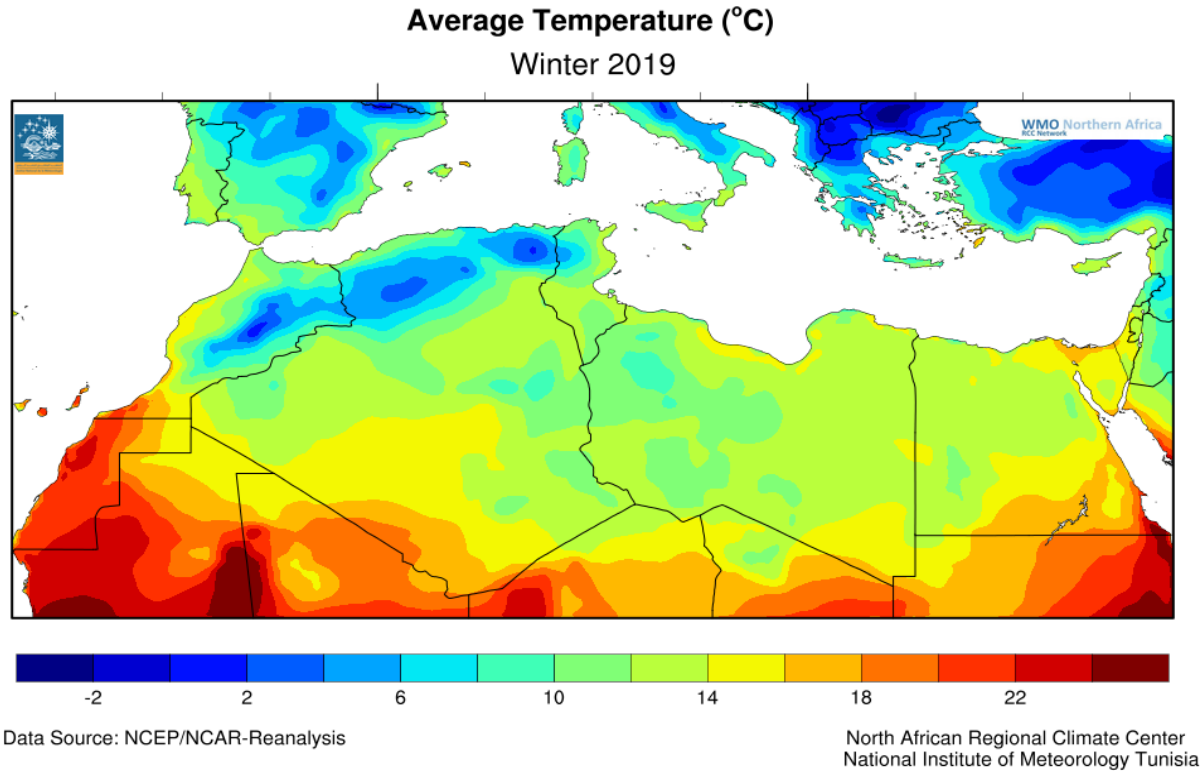


Figure 14: Mean temperature for winter season 2018/19 in North Africa (in °C). Source: INM Tunisia, Data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov

Over Morocco, for temperature, normal conditions were observed (1981-2010 reference period) over 12 out of 28 synoptic stations generally located at the north Atlantic coast. The remaining stations were characterized by above-normal temperatures except Rabat. This station has known below-normal conditions.

Over Algeria, comparing with the normal of the season, the mean temperatures of the winter season (DJF 2018-2019) were normal for all the stations with the exception of the southernmost regions which were below the lower tercile. The maximum anomaly recorded was around 0.8°C at the station of TENES in the northern part of Algeria.

Mean temperature in Tunisia registered was normal to above normal over the north and the center-east, the anomalies ranging from -0.77°C in the south-west to +0.77°C in the center east. Elsewhere the mean temperature was below normal.

Over Libya, temperatures were below normal over most of the country with the exception of the extreme northeast where the temperature was above normal.

In Egypt, the winter temperature was above normal over the eastern part, below normal over the western part and normal over the south of the country.

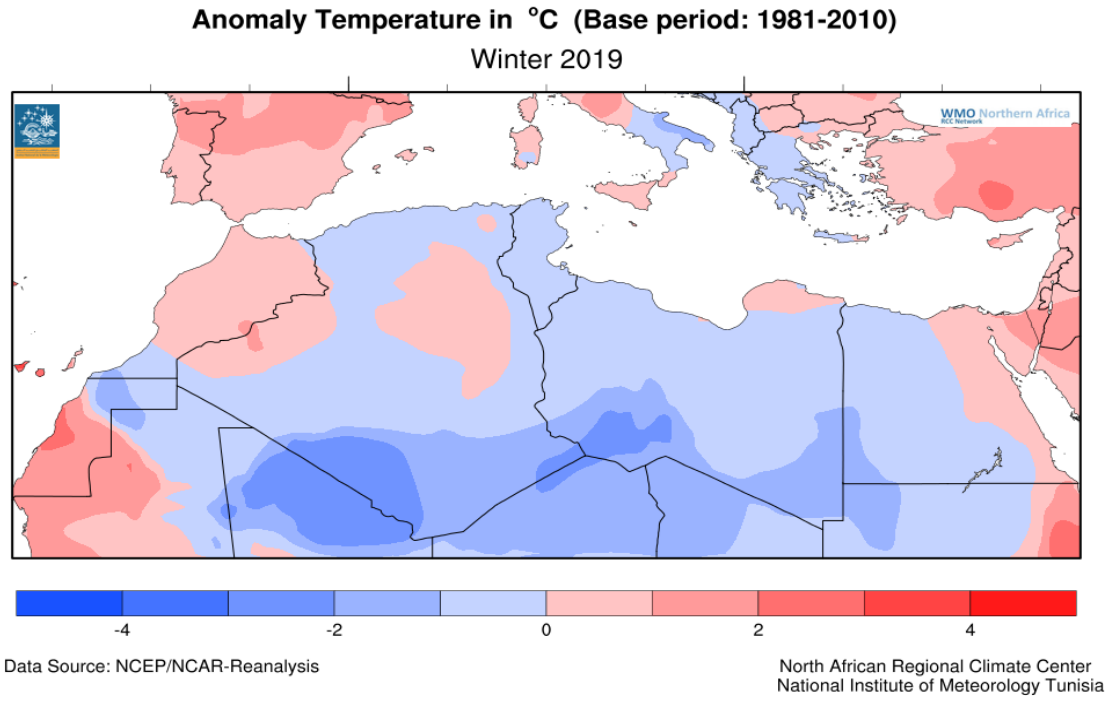


Figure 15: Temperature anomaly for winter season 2018/19 in North Africa (in °C), reference period 1981-2010. Source: INM Tunisia, Data from NCEP/NCAR reanalysis, http://www.esrl.noaa.gov

2.3 Precipitation

Europe and Middle East (RA VI)

Due to the circulation pattern (prevailing ridges in the west, troughs in the east), the highest precipitation totals were measured in the eastern Mediterranean region, especially at the coasts of western Balkans, Greece, Turkey, Middle East, but also the eastern Black Sea coast in Georgia with highest seasonal totals above 900mm locally (Fig. 16). The high precipitations totals in eastern parts mainly came from a number of extreme events due to some quasi-stationary Mediterranean cyclones. Western parts of the domain also saw some storms, e.g. storm Gabriel in late January, storm Helena in early February or storm Isaias on 10-11 February, but in general, winter storms with high impact were relatively rare in Western Europe that season. Lowest totals of less than 30mm were recorded in places of eastern Spain.

Especially countries of southwestern Europe / near the western Mediterranean had below-normal precipitation, lowest in places of southern Spain with less than 20% of normal. Towards the east, precipitation was mostly above normal, particularly in places of Turkey, Middle East and South Caucasus up to above 167% of normal.

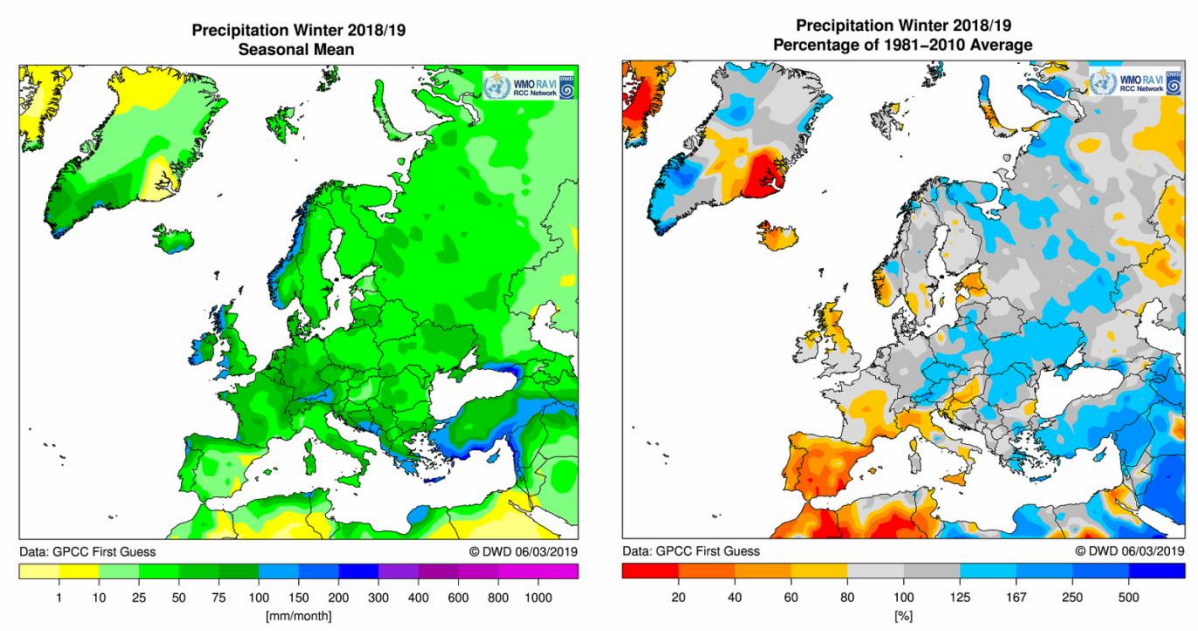
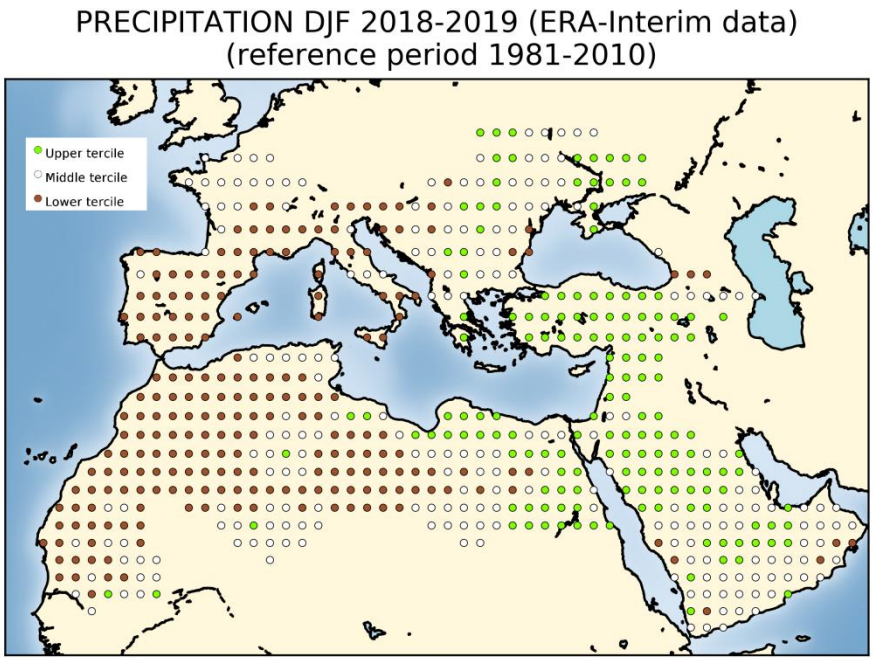


Figure 16: Precipitation for winter 2018/19 in Europe. Left: seasonal total in mm/month, right: percentage of 1981-2010 average, source: WMO RAVI RCC, www.dwd.de/rcc-cm, data source: GPCC, http://gpcc.dwd.de

According to ERA-Interim, precipitation in Iberia and France was mostly in the lower tercile range, only locally in the middle or upper tercile range (Fig. 17). Italy, Balkan Peninsula and Eastern Europe had totals in all three tercile ranges, reflecting the local variability. In Turkey and Middle East, the majority of grid points was in upper tercile range. GPCC data show a similar distribution with only local differences, and also EOBS and ECA&D data show the same tendency (Fig. 18).



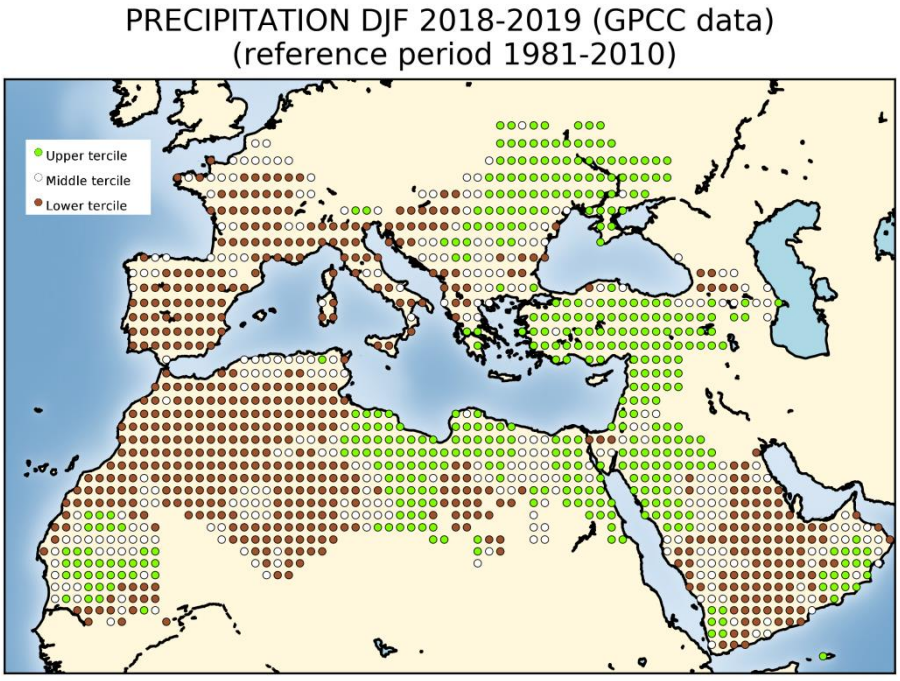
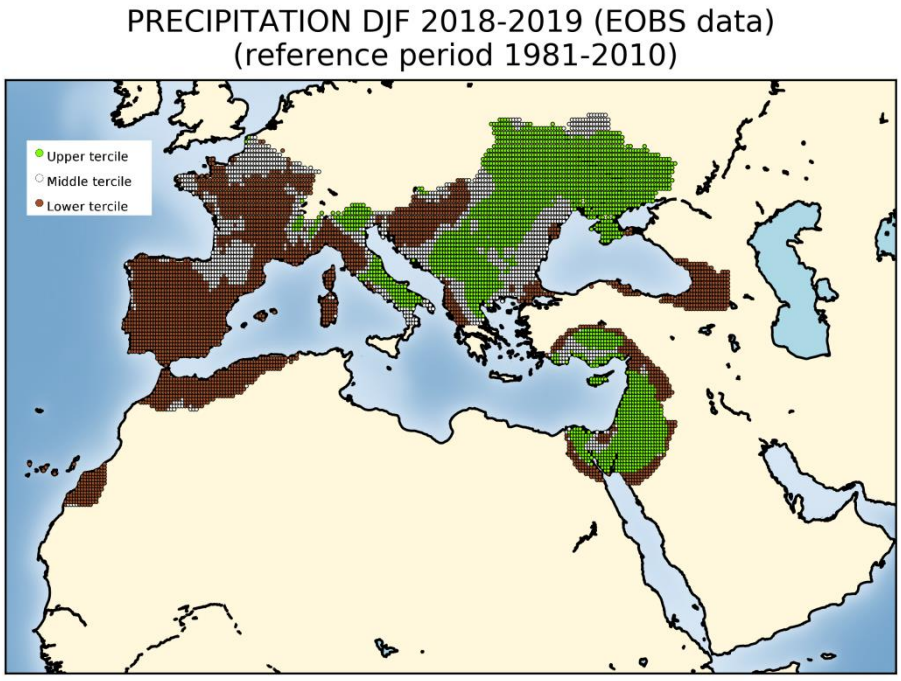


Figure 17: Terciles of winter 2018/19 precipitation based on ERA-INTERIM Reanalysis (upper graph) and GPCC (lower graph) grid data, 1981-2010 reference. Source: AEMET, data reference: ERA-INTERIM: http://www.ecmwf.int/en/research/climate-reanalysis/era-interim , GPCC: http://gpcc.dwd.de



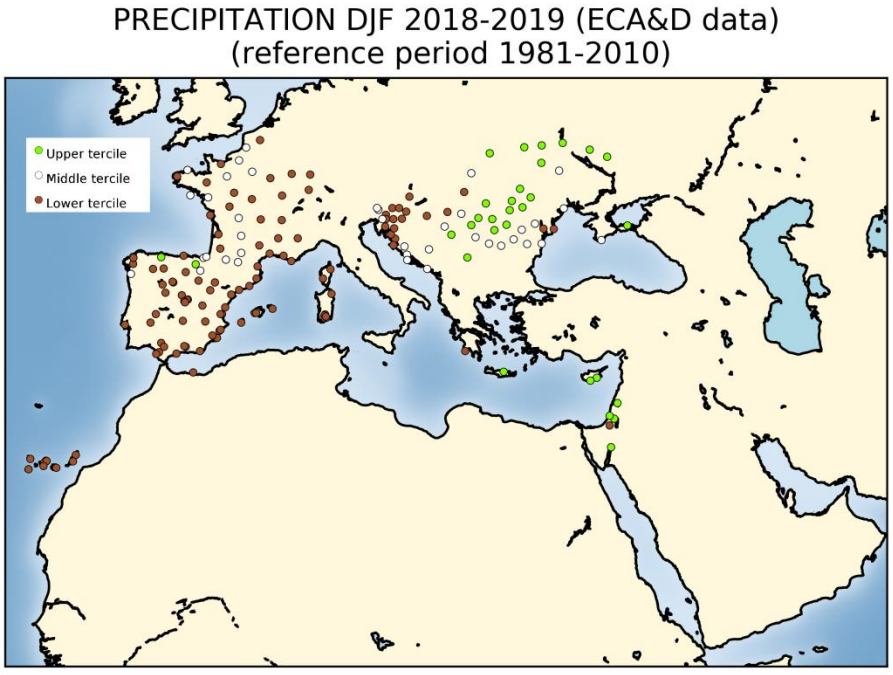


Figure 18: Terciles of winter 2018/19 precipitation based on interpolated E-OBS grid data (upper graph) and individual ECA&D station data (lower graph), 1981-2010 reference. Source: AEMET, data source: http://www.ecad.eu/

A more detailed analysis for south-eastern Europe, including high impact events, is given in the analysis and verification report of the SEECOF-20 CLIMATE OUTLOOK for 2018-19 winter season for southeast Europe (SEE), provided by SEECOF-21: http://www.seevccc.rs/?p=1663

Differences observed on Tercile maps for precipitation during DJF 2018-2019

In general, reasonable consistency is observed over the four maps in Fig. 17-18, but some marked differences (from one tercile to the opposite one) can be noted between GPCC and ERA-interim data over Southern Arabian Peninsula, Libya and Mauritania. These three regions are not covered by ECA&D and EOBS data, so it is not possible to include them in the comparison.

These three regions, especially Libya and Mauritania, have very low mean precipitation during winter (Figure 19), so very small amounts of precipitation can change the character of the season from dry to wet. GPCC monitoring product uses available gauges, but these regions are not well covered. To cover regions with no gauges, a climatology-based interpolation is made. To check if this can contribute to generate differences, we represent in Figure 20 GPCC data with only observations and the complete analysis. We can see that great areas with no data have been covered with negative precipitation anomalies based on values of a few grid-points surrounding them.

The fact that the areas that present differences are mostly filled with interpolation-based values, and the low values of climatological precipitation, together with the nature of ERA-interim precipitation values (which are forecasted precipitation), introduce an uncertainty factor that can explain the differences in the assignment of terciles.

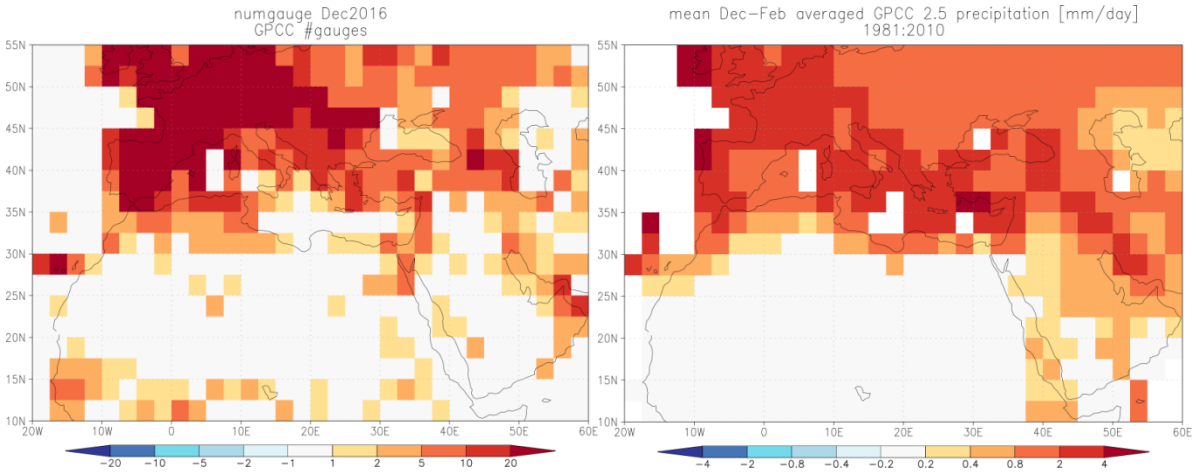


Figure 19: Number of gauges used per GRID-point by GPCC (left) and mean precipitation during DJF (1981-2010) (right). Source: AEMET

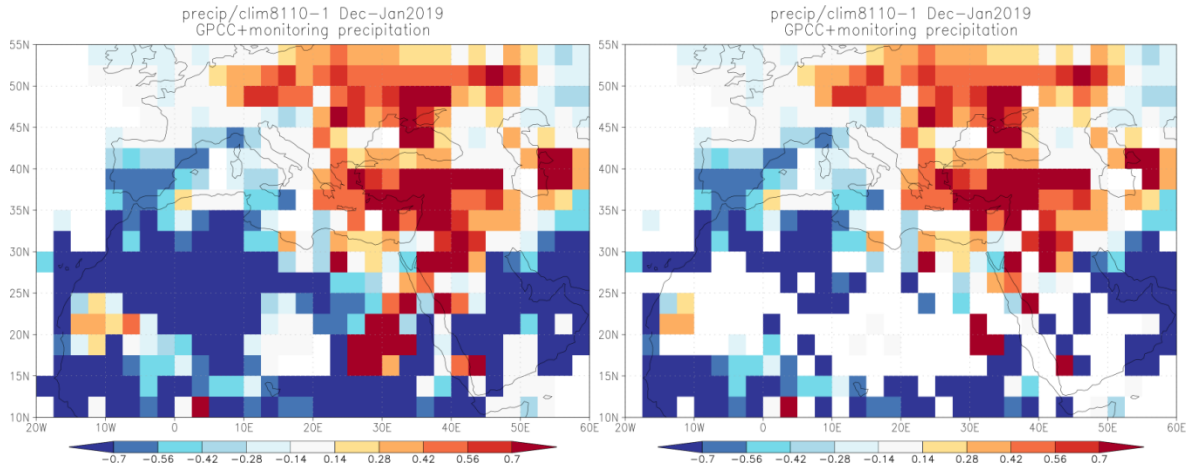


Figure 20: Relative precipitation anomalies for using only gauge observations (right) and from GPCC dataset (left) for December 2018 - January 2019. Source: AEMET

North Africa (RA I)

Winter precipitation was very low over North Africa. Precipitation registered over the Mediterranean coastline of the domain ranged between 20mm and 300 mm. Winter 2018-19 was near to below normal over most of the region.

Precipitation in Tunisia was at its maximum in the North and especially in the extreme North-West area where the seasonal total exceeded 800 mm. The maximum seasonal total (802 mm) was observed in Ain Drahem in the north-west and the minimum (1.8 mm) was registered in El-Borma in the extreme south. Extreme daily values were registered in Oued mallegue such as the highest 24-hour precipitation with a total of 52.5 mm. Compared to 1981-2010 period, total precipitation amount was above normal over the north western regions of the country; elsewhere precipitation was below to near normal.

Regarding precipitation over Morocco during the winter season, it was characterized by below-normal conditions for all synoptic stations. In general, December, January and February were in deficit for all stations. The relative anomaly for DJF2018-19 also was characterized by below-normal conditions over the country, the maximum of deficit exceeded 80% relatively to the seasonal normal. It should be noted that winter precipitations of this season in Morocco are globally very low.

Over Algeria, for the winter season (DJF2018-2019) precipitations were generally characterized by below-normal conditions in the western and southern part and normal in the extreme south and the eastern part of Algeria, using tercile method.

Over Libya, the precipitation was characterized by below to near-normal conditions over most of the country.

In general, in Egypt, winter season precipitation was marked by a strong regional disparity with rainfall deficits in the south and surpluses in the north. Precipitations during winter season 2018/2019 were normal over northern Egypt at synoptic stations, and above normal over Alexandria, Minya, and Luxor, except Cairo station, which was normal.

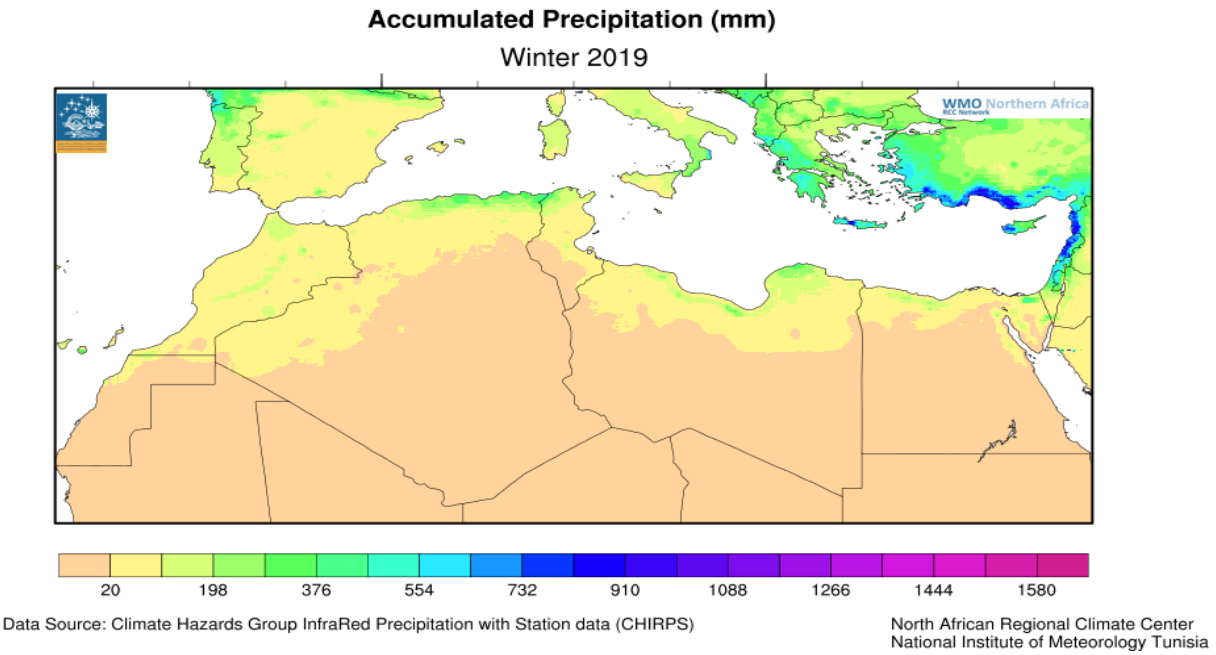


Figure 21: Total precipitation for winter season 2018/19 in North Africa (in mm). Source: INM Tunisia, Data from GPCC (First Guess Product), http://gpcc.dwd.de

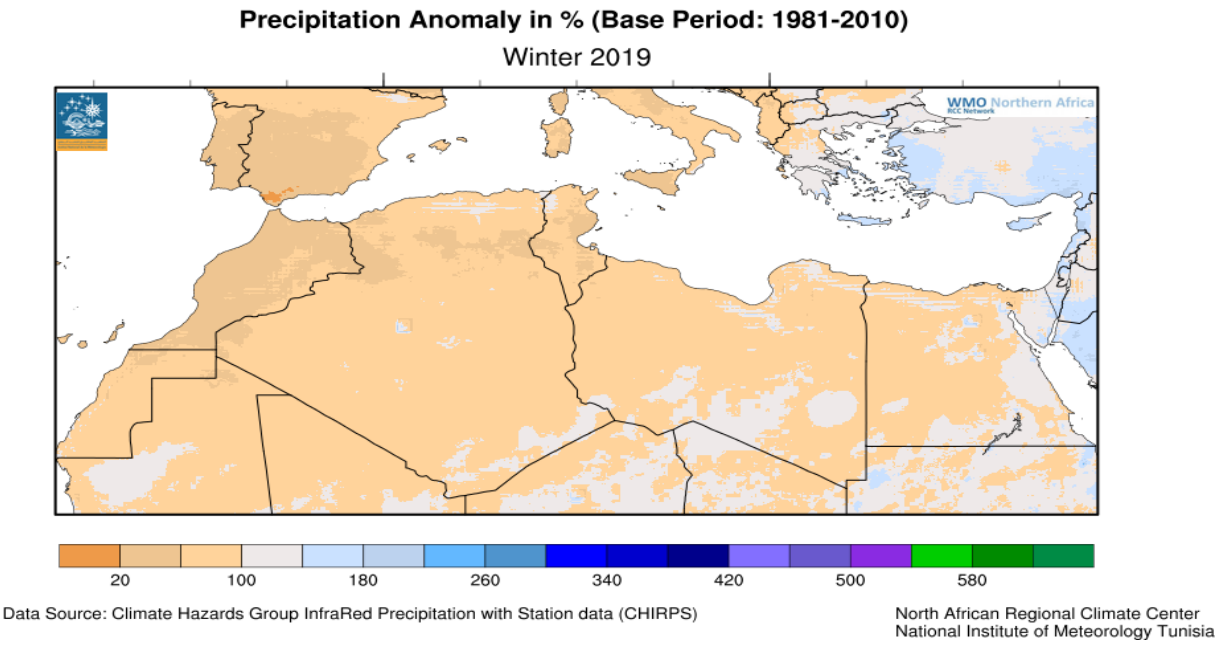


Figure 22: Precipitation anomaly for winter season 2018/19 in North Africa (in %) (reference period 1981-2010). Source: INM Tunisia, data from GPCC, http://gpcc.dwd.de

3 Verification of the MedCOF-11 climate outlook for the 2018-19 winter season

3.1 Temperature

Europe/RA VI

The MedCOF-11 outlook favored the upper tercile range over the Mediterranean basin and the southeast of RA VI, but no privileged scenario for Iberia and northern parts of the RA VI MedCOF domain.

The outlook was mostly correct for the southeast, especially Turkey, Middle East, South Caucasus, where much of the area had temperatures in the upper tercile range. It was not correct over much of Italy, which had below-normal temperature in many places. The areas without any privileged scenario mostly had temperatures in the middle or upper tercile range. Since climatology had to be assumed for those areas, the outlook can be regarded as partly correct for these countries in terms of verification.

North Africa (RAI)

The MedCOF-11 climate outlook for the 2018-19 winter season favored above-normal temperature over the eastern part of the domain with probability of 60% and 45% elsewhere.

In fact, in almost all regions of North Africa, temperature anomalies were below to near normal, above normal over the north of Morocco, the center of Algeria and the east of Egypt. Maximum anomalies were registered over the southwest of Algeria and Libya.

This indicates that the MedCOF-11 climate outlook for the winter season temperature was able to predict positive temperature anomalies registered over some regions.

3.2 Precipitation

Europe/RA VI

The MedCOF-11 outlook favored the wet scenario (upper tercile range) over an area from Iberia over the Mediterranean basin to the Middle East and no privileged scenario for areas north of it (most of France and northeastern parts of the domain).

The outlook was correct for parts of Greece and for most of Turkey and the Middle East, where precipitation totals were in the upper tercile range. Western parts from Iberia to Italy and western Balkans mostly had below-normal precipitation, which was not captured by the outlook. From those countries where no privileged scenario was favored, France was mostly in the lower tercile range and Ukraine and Moldova in the upper tercile range, so the outlook has not predicted these anomalies.

North Africa

Over the North African region, above-normal conditions in the extreme northeast of the domain were expected. Elsewhere, no preference for any climate defined categories.

Winter 2018-19 was wetter than normal over parts from northwest to southeast of Algeria, some stations in Egypt (Alexandria, Minya, and Luxor), the extreme northeast of Tunisia and the extreme north of Morocco. Elsewhere precipitations were below to near normal.

The MedCOF-11 climate outlook for the winter season precipitation was able to predict the positive precipitation anomalies in the extreme north-west of the North African domain.

4 Users' perceptions of the MedCOF-11 outlook

Europe/RA VI:

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

Croatian Meteorological Service provides seasonal forecasts to Croatian Civil Protection, to Croatian Water Management and in different form (adjusted format) to the general public on its web page.

In Armenia, the State Hydromet Service shares seasonal forecasts with governmental authorities, private companies and the public via mass media. Positive feedback was obtained from the users related to the reliability of forecasts.

In some other countries seasonal forecasts are not distributed to the public operationally.

In Israel, the seasonal forecast skill is still too low in order to provide it to decision makers in the government or to public services. As there are other professional and unprofessional seasonal forecasts in the air, the Israel Meteorological Service (IMS) provides only the wide public with the seasonal forecast to show its efforts to deal with this tough issue. The most important forecast is for precipitation. The IMS gave no signal for the DJF precipitation; therefore the end users were not satisfied as they could not use the forecast.

North Africa

In North Africa, no feedback was given by users.

Appendix A: Contributors to MEDCOF-12

- World Meteorological Organization

Europe and Middle East (RA VI)

- Climate Centres:

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

- National Meteorological and Hydrological Services:

- State Hydrometeorological Service, Republic of Armenia
- 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, Israel
- State Hydrometeorological Service, Republic of Moldova
- Agencia Estatal de Meteorología (AEMET), Spain

- others via SEECOF-21:

- Federal Hydrometeorological Institute, Bosnia and Herzegovina
- Republic Hydrometeorological Service of the Republic of Srpska, Bosnia and Herzegovina
- National Environmental Agency, Democratic Republic of Georgia
- Institute of Hydrometeorology and Seismology of Montenegro, Montenegro
- Hydrometeorological Service, Republic of North Macedonia
- Republic Hydrometeorological Service of Serbia, Republic of Serbia
- Slovenian Environment Agency, Republic of Slovenia
- Turkish State Meteorological Service, Republic of Turkey
- Ukrainian Hydrometeorological Centre, Ukraine

North Africa (RA VI)

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

- National Meteorological and Hydrological Services:

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

APPENDIX B: **Analysis and verification of the MedCOF-11 climate outlook for the winter season 2018/2019:**

Verification summary based on the national reports and contributions of the participants of the SEECOF-21 and MedCOF-12 online meetings

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

Europe (RA VI)

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	MedCOF-11 climate outlook for temperature	Observed	MedCOF-11 climate outlook for precipitation	
Albania *	Normal to above normal	Above normal (20/35/45)	Below normal to normal	Normal to above normal (15/35/50)	No events
Armenia (5)	Above normal	Above normal (20,35,45)	Above normal	Above normal (15,35,50)	Foggy weather was observed in December and January in Shirak Region, Ararat valley with very low visibility less than 50 m. Strong wind 26m/s at 12 of December in Aragacotn, 28m/s in January in Gekgarquniq was observed.
Azerbaijan *	Above normal	Near or above normal (20,35,45)	Normal to above normal	Above normal (15,35,50)	No events

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	**MedCOF-11 climate outlook for temperature**	**Observed**	**MedCOF-11 climate outlook for precipitation**	
Federation of Bosnia and Herzegovina (1)	Above normal and normal in almost entire Bosnia and Herzego-vina (except below normal in mountaino-us areas)	No predictive signal (33,33,33) in North and Central parts and above normal (20,35,45) in South Bosnia and Herzegovina	Below normal and normal in almost entire Bosnia and Herzegovina (except above normal in central Bosnia)	No predictive signal (33,33,33) in North and Central parts and above normal (15,35,50) in South Bosnia and Herzegovina	December: >20 cold days in Central and north Bosnia January: 1-15 day snowing and >25 cold days Central B&H February: South B&H – wind > 100 km/h
The Republika Srpska - Bosnia and Herzegovina (5)	Above normal (warmer) over the northern area, near normal over the rest of RS – except the south with colder pattern (below normal).	no signal (33,33,33) except the south: normal and above normal (20,35,45)	Below normal (dry) over the south, normal to above normal (slightly wetter) over the rest of RS	normal and above normal (15,35,50) except south: no signal (33, 33, 33)	According to 6 months SPI6-index, over most of RS occurred long lasting drought, slight to moderate, from sep2018 – feb2019
Bulgaria (1)	Near or above normal	No signal (33,33,33)	Near or below normal	Near or above normal (15,35,50)	In the period 23-27 January 2019 a Mediterranean cyclone brought a stationary precipitation event in the mountainous southern region of Bulgaria. The 24-hour precipitation amounts in the Rhodopes reached 70-80 mm on 26 January and the snow depth was above 150 cm.

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	**MedCOF-11 climate outlook for temperature**	**Observed**	**MedCOF-11 climate outlook for precipitation**	
Croatia (5)	Above normal most of Croatia	Above normal (20,35,45)	Mainly below normal Normal in Dalmatia and its hinterland and wider areas of towns Pazin, Senj, Slavonski Brod	Above normal (15,35,50)	Winter 2018/2019 – a few episodes with hurricane strong bura wind (NE wind along the Adriatic coast) was recorded. Sea and road traffic between continental part and Adriatic coast were completely interrupted. The measured wind gusts on the Pag bridge on January 6 was 220 km/h. In Dalmatia, on February 23 the wind gusts in Split was 176 km/h and in Makarska 191 km/h. February 2019 was warmer than normal in the whole country. The absolute maximum temperature was measured in north-west part of Croatia – in Sisak 23,5°C (measurement from 1949) and in Varaždin 22,5°C (measurement from 1949) on 28 February.
Cyprus (5)	**Above normal** **DEC** Above Normal **JAN** Slightly Above Normal **FEB** Above Normal	Above normal (20,35,45)	**Well above normal** **DEC** Well above Normal **JAN** Well above Normal **FEB** Well above Normal	Above normal (15,35,50)	December: high daily temperature maxima up to 24.8°C (Paphos), but low mean daily minima (-2.9°C in Prodomos). Second highest December precipitation for the last 15 years. Local showers on almost all days, most of the time with thunderstorms. Snowfall particularly on the last days of the month. January: again high precipitation (187% of normal). Local showers and thunderstorms on most days, hail and snowfall several times. February: once more high precipitation (208% of normal). Several periods of local showers, thunderstorms, partly with hail, periods of snowfall.

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	**MedCOF-11 climate outlook for temperature**	**Observed**	**MedCOF-11 climate outlook for precipitation**	
France (5)	Above normal all over the country, anomaly stronger in the central north than in the southeast	No signal (33,33,33) except Corsica (20,35,45)	Below normal on national average (-15%), in the southeast -30%.	Above normal (13/35/50) in the south, no signal elsewhere (33,33,33)	9 December: Storm in Corsica 29-30 January: Storm Gabriel in southwestern France, gusts >100km/h, perturbations on transport 10-11 February: Storm Isaias, first northern half of France, then southeast, gusts 110-130km/h 21-24 and 29-30 January: snow depth 3-13cm on plain
Georgia (1)	Above normal	Near or above normal (20,35,45)	Near and below the norm in most of the territory of Georgia, above the norm at several stations	Above normal (15,35,50)	No high impact events.

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	MedCOF-11 climate outlook for temperature	Observed	MedCOF-11 climate outlook for precipitation	
Greece (2)	Near normal in most of Greece	Above normal (20,35,50) except northeast (no signal, 33,33,33)	Wetter than normal in the southern areas of Greece, as well as in west Crete and drier than normal in the northwest mainland.	Above normal (15,35,50) except northeast with no signal (33,33,33)	8 January: minimum temperature at Florina was -23°C, second lowest recorded value. 3-17 January: the same station experienced fifteen consecutive days and nights with total frost (Tmax and Tmin ≤ 0). 6-18 January: minimum temperature at the same station was lower than -15°C (that is the limit for red alert in North Greece at the Meteoalarm system). 9 January: minimum temperature at Tatoi, Attica was -8.9°C, second lowest recorded at the specific station. 23-27 January: heavy rainfalls caused flooding in the area of Peloponnese (Ilia, Messinia, Lakonia), where rivers overflowed, crop areas were destroyed and people were trapped in buildings and cars. 12-17 and 23-26 February: heavy rainfalls caused extensive flooding and landslides at the area of Crete island. Infrastructures were destroyed, roads were closed, crops were damaged and people were trapped in their cars. Also the severe flood events caused 5 fatalities.
Hungary*	Above normal	No predictive signal (33,33,33)	Around normal	No predictive signal (33/33/33)	No events
Israel (5)	Above normal	Above normal (10,30,60)	Above normal	Above normal (15,35,50)	No events

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	MedCOF-11 climate outlook for temperature	Observed	MedCOF-11 climate outlook for precipitation	
Italy*	Above normal in the north, Below normal to normal in the south and in Sardinia	Above normal (20/35/45) In the north no predictive signal (33,33,33)	Below normal to normal	Above normal (15,35,50)	No events
Jordan*	Normal to above normal	Above normal (10,30,60)	Normal to above normal	Above normal (15,35,50)	No events
Lebanon *	Normal to above normal	Above normal (10,30,60)	Above normal	Above normal (15,35,50)	No events
Moldova (5)	Above normal	No predictive signal (33,33,33)	60% of the territory above normal, 30% near normal, 10% below normal	No predictive signal (33, 33, 33)	Heavy snowfalls with precipitation of 20-35 mm in 12 hours (January 11, MS Codrii, Chisinau, HP Chisinau Bic River, Leuseni). Fog, rime ice deposits, blizzard, an increase of wind speed up to 24 m/s (December, MS Leova), black ice.
Montenegro (1)	Normal to above normal	Normal to above normal (20,35,45)	Normal, dry for most of the country, very dry in the central part of the coastal region	Normal to above normal (15,35,50)	Strong bora had highest impact in the southern part of the central region and along the coastal region. The trees and facades were mostly affected. (stormy weather in Budvy, https://youtu.be/3nkHZ2omdEs , and in Podgorici, https://youtu.be/U0ilykLFi7g , https://www.youtube.com/watch?v=ipCw6JxO38s&feature=youtu.be)

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	MedCOF-11 climate outlook for temperature	Observed	MedCOF-11 climate outlook for precipitation	
North Macedonia (5)	Normal	Above normal (20,35,45)	Normal	Above normal (15,35,50)	January: Prolonged period with cold weather and low temperatures (almost twenty days with minimum temperatures below 0°C). New record values for January monthly sums were measured in Gevgelija-202mm and Strumica-127mm (southeastern part of the country). Also new record values were measured for maximum daily precipitation on Jan.26th for D.Kapija-89mm and Strumica-54mm (south-eastern part of the country).
Portugal *	Normal to above normal	No predictive signal (33,33,33)	Below normal	Above normal (15,35,50)	No events
Romania *	Normal to above normal	No predictive signal (33,33,33)	Normal to above normal, at the coast locally below normal	No predictive signal (33,33,33)	No events
Serbia (1,5)	Normal in most parts of Serbia	No predictive signal (33,33,33) in entire Serbia	Above normal and normal in most of Serbia	Above normal (15, 35, 50) in entire Serbia	Winter of 2018/2019 was the 2nd wettest at Mnt. Kopaonik * December: record-breaking snow depth in Zrenjanin (Dec 16) * January: record-breaking number of days with precipitation (Valjevo, Kragujevac and Pozega) and cloudy days (Cuprija and Dimitrovgrad) * February: record-breaking daily precipitation sum in Valjevo (Feb 12)

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	MedCOF-11 climate outlook for temperature	Observed	MedCOF-11 climate outlook for precipitation	
Slovenia (5)	Warmer than normal, normal in the Alps	No clear signal (33,33,33)	drier than normal in the east, central Slovenia and parts of the west, normal in other parts of the west, wetter than normal at some stations only	wetter than normal in the west, normal or wetter than normal in the east (15, 35, 50)	Temperature above average (among the 14 warmest since 1961), Precipitation below average (among the 10 driest since 1961), snow cover below average, Very warm February (among 8 to 10 warmest since 1961), with record-breaking temperature in the northeast on the last day of the month, Very dry December (among 5 driest since 1961).

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	**MedCOF-11 climate outlook for temperature**	**Observed**	**MedCOF-11 climate outlook for precipitation**	
Spain (5)	Warm in most of the main part of the northern half and center of Spain, warm or even very warm in some mountainous areas of these regions. Over the southern third of Spain it was very variable, alternating zones where winter was warm with others where it was cold. On Balearic Islands overall normal, as well as on Canary Islands.	No predictive signal (33/33/33)	Overall very dry, with an average precipitation over Spain of 98 mm, 51% below seasonal average. Fifth driest winter since 1965 and second driest of the 21st century behind 2011-2012, which is the driest of the series with 65 mm. The quarter started with a very dry December month, followed by a normal January and a very dry February.	Above normal (15, 35, 50)	Cold episodes very scarce, few of them intense: 1-8 January, 10-12 January, 1-4 February, low daily minima, e.g. Molina de Aragón -11.3°C on 11 January. Warm event in the last part of February, new records of daily highest maximum temperature for winter. On mainland Spain, up to 28.3°C in Murcia. Precipitation events: 2-3 December: Storm Etienne in Galicia 12-14 December: particularly intense between Basque country and Navarra, and north of Balearic islands 15-16 December: mainly affecting Galicia 19-20 January: in main part of Spain, more intense in Galicia 22-24 January: on the northern third of the peninsula, central parts, and Balearic islands, locally more in Cantabrian areas and north of Navarra 29-31 January: Storm Gabriel, wind, rain, snow and milder air, main part of mainland Spain affected, more intense in the southwest of Galicia 1-2 February: Storm Helena, hurricane winds, flooding, traffic accidents. Precipitation in most part of the territory, more intense in Cantabrian regions, north of Navarra and Sierra de Cádiz. 44 provinces under weather alert on 1 February for wind, coastal phenomena, rain or snow. Waves possibly reaching 9 meters. 9 February: intense precipitation to the west of Galicia Several records of maximum daily precipitation, up to 96mm in Vigo Airport on 30 January.

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	**MedCOF-11 climate outlook for temperature**	**Observed**	**MedCOF-11 climate outlook for precipitation**	
Syria *	Normal to above normal	Above normal (10,30,60)	Above normal	Above normal (15,35,50)	No events
Turkey (5)	Normal to above normal	Normal to above normal (20,35,45)	Normal to above normal	Normal to above normal (15,35,50)	No events
Ukraine (1,5)	Above normal (66% stations) Normal (34% stations)	No predictive signal (33,33,33)	Above normal (81% stations) Normal (18% stations) Below normal (1% stations)	No predictive signal (33, 33, 33)	On December 25th very heavy snowfalls (20-32 mm precipitation per 8-12 hours) and strong blizzard (for 12-15 hours with wind gusts 17-21 m/s) in Poltava, Kharkiv, Kropivnytsky, Dnipro regions, in Odessa 26 m/s. In January very heavy snowfalls (20-28 mm precipitation per 12 hours and strong wind 28 m/s) in Carpathian mountains, only locally at single stations. Unfavorable weather conditions caused losses of power, telecommunications, utilities and transport.

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)

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High impacts events
	Observed	MedCOF-11 climate outlook for temperature	Observed	MedCOF-11 climate outlook for precipitation	
Algeria (1)	normal for all the stations with the exception of the southernmost regions which were below the lower tercile	Above normal tercile (20,35,45)	Above normal over gradient north west /south east Normal to below normal elsewhere	Normal over all parts of northern Algeria (15,35,50), elsewhere no signal expected (33,33,33)	Strong winds recorded Snow fall accumulations were also recorded at: Miliana, Médéa, Ain Bessam Bordj Bou Arreridj, Souk Ahras and Tebessa. Intense rainfall event.
Egypt (1)	Above normal over the east , below normal over the west and normal over southern Egypt	Above normal tercile throughout of the country (10,30,60) with the exception of the western regions (20,35,45)	Normal over northern Egypt Above normal over Alexandria, Minya, and Luxor	No clear signal (33,33,33)	The station of Mersa Matruh recorded 22.1 mm on 26 December 2018, the highest 24-hour rainfall. The lowest value of minimum temperature over Egypt was about 0.3°C on 14 February 2019 at Minya station. The highest value of maximum temperature over Egypt was about 43.2°C on 25 February 2019 at Kharga station.
Libya *	Above normal over the extreme northeast, below normal elsewhere.	Above normal tercile (20,35,45)	Below to near normal over most of the country	No clear signal (33,33,33)	No comment

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High impacts events
	Observed	**MedCOF-11 climate outlook for temperature**	**Observed**	**MedCOF-11 climate outlook for precipitation**	
Morocco (1)	Normal to above normal over Morocco except Rabat	No signal over west (33,33,33) Above normal elsewhere (20,35,45)	Below normal for all synoptic stations.	Above normal tercile over the extreme north (15,35,50) No signal elsewhere (33,33,33)	December : New records of daily maximum temperature for 3 stations (FES, ESR and TAZ) February: New records of daily maximum temperature for ESR.
Tunisia (1)	Below normal in some parts of the North-East and the South of Tunisia Above normal in the center east, and near normal elsewhere	Above normal tercile (20,35,45)	Above normal over some regions of the northwest Below to near normal elsewhere.	Above normal over extreme north (15,35,50) No clear signal elsewhere (33,33,33)	Cold episodes records taking place in January (23-26, 11-12) and February (3-5). Strong wind speed recorded Snowfall accumulations were reported in: Kasserine, Beja, Jandouba, Siliana, Kef, Zaghouen with Hmax =100cm in Makther.

Note:

(1) Basic climatological period (1981-2010)

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

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

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

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

GPCC: http://gpcc.dwd.de