Sixteenth Session of
SOUTH EAST EUROPEAN CLIMATE OUTLOOK FORUM

SEECOF-20 MEETING

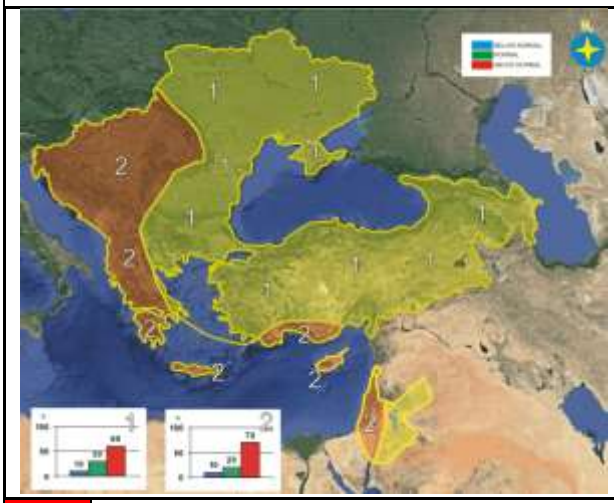
DRAFT VERSION

ANALYSIS AND VERIFICATION OF THE SEECOF-19 CLIMATE OUTLOOK FOR THE 2018 SUMMER FOR SOUTH-EAST EUROPE (SEE)

CLIMATE OUTLOOK FOR 2018 SUMMER SEASON FOR THE SEE REGION

As stated in the SEECOF-19 Consensus Statement on the Seasonal Climate Outlook for the 2018 Summer Season over South-East Europe (document: http://www.seevccc.rs/SEECOF/SEECOF-19/STEP-3/Consensus%20Statement%20SEECOF-19.pdf, the entire SEECOF region is likely to experience above-average summer temperature. Probability for the above-average summer temperature increases across the areas spreading from northern-northeastern toward western and southern parts of the SEECOF region. Probability for exceeding average summer temperature is lower in eastern part of the Balkan Peninsula, Ukraine, along the coasts of the Aegean and Black Sea, most of Turkey, South Caucasus region as well as in Jordan (zone 1 in Figure 1), while probability for above-average conditions is highest for the Pannonia Plain, Central and Western Balkans, most of the Greece, along the coasts of Adriatic, Ionian and Eastern Mediterranean Sea with belonging coasts, as well as in Israel (zone 2 in Figure 1). The generalized relatively high warm signal is probably partly due to the background climatic warming trend.

Uncertainties in regional predictions are higher for precipitation than for temperature. Drivers like TASI and TNA suggest drier than normal summer in northern part of SEECOF domain, along the coasts of Black Sea as well as in the South Caucasus region. Summer precipitation sums are likely to be below-average in most of the SEECOF region (zone 1 in Figure 2), with the exception of the coasts of the Adriatic, Ionian and Aegean Sea with the belonging hinterland, south of the Balkan Peninsula, as well as in continental part of Turkey (zone 2 in Figure 2) with approximately equal probabilities for below-, near- or above normal-averages. It should be noted that certain parts of the country, particularly mountain regions may observe near- or above- normal summer precipitation due to the episodes of enhanced convection accompanied by heavy precipitation. Due to dry season masking, it is not possible to forecast summer precipitation totals for the Eastern Mediterranean with belonging coasts and hinterland, Crete as well as in Israel and Jordan.

2018 Summer Temperature Outlook	2018 Summer Precipitation Outlook
	

	Above Normal		Above Normal
	Normal		Normal
	Below Normal		Below Normal
		D	Dry season masking

Figure 1. Graphical presentation of the Climate Outlook for the 2018 Summer Season for the SEE Region

SHORT ANALYSIS OF SUMMER 2018 FOR THE SEE REGION

Analyses of the summer temperature and precipitation anomalies are based on:

- operational products of the European Climate System Monitoring – ECSM (the ECSM system is a technical platform of the DWD, WMO RA VI RCC Node on Climate Monitoring), http://www.dwd.de/rcc-cm;
- seasonal bulletin on climate in the WMO Region VI for the summer of 2018 (ECSM, DWD, WMO RA VI RCC Node on Climate Monitoring), http://www.seevccc.rs/SEECOF/SEECOF-20/Pre-COF/Climate-Monitoring-Report-Summer-Season-2018-exp-RCC-CM.pdf;
- climate monitoring products of the South East European Virtual Climate Change Center – SEEVCCC (Member of the WMO RA VI Pilot RCC Node on Climate Monitoring), http://www.seevccc.rs/imgsrc/clim_mon/201808/, and
- national climate monitoring reports of the following SEECOF-20 participating countries: Armenia, Bulgaria, Bosnia and Herzegovina (the Federation of Bosnia and Herzegovina, Republic Srpska), Croatia, Cyprus, Georgia, Greece, Israel, Montenegro, the former Yugoslav Republic of Macedonia, the Republic of Moldova, Serbia, Slovenia, Turkey and Ukraine (documents available on: http://www.seevccc.rs/SEECOF/SEECOF-20/Pre-COF/).

The entire SEECOF region observed above-normal summer temperatures.

Summer temperatures across the lowlands in most of the SEECOF region were mainly in a range from 20ºC to 25ºC; along the coasts of the eastern Mediterranean, Ionian, Aegean, and Adriatic Sea, as well as Azerbaijan, Israel and Jordan summer temperatures reached up to 30ºC, while in south-eastern Turkey, the average temperature was even higher. Conversely, at some high-lying areas in the Carpathian region, northeastern Turkey and South Caucasus summer temperatures were in a range from 15ºC to 20°C. The summer temperatures are presented in Figures 2 and 3 (left panel). During summer, maximum daily air temperature in the SEECOF region was registered on July 12 in Yerevan, Armenia.

In most of the SEECOF region anomalies were up to 2ºC above normal; in south-eastern Ukraine, southeastern Turkey and South Caucasus they were up to 5ºC above normal. The summer temperature anomalies are presented in Figures 4, 5 and 6 (left panel).

In most of the SEECOF region, June conditions were above normal, with the highest positive anomalies reaching 4ºC in the northeastern Turkey and South Caucasus. In the central and southern Balkans, western and southeastern Turkey anomalies reached up to 1ºC. Negative anomalies, of -1ºC were recorded in eastern fYR Macedonia.

July was characterized by below normal conditions in parts of central and eastern Balkans, across the south Adriatic Sea and south-eastern Turkey. Warmer than normal, up to 2ºC, was in rest of the SEECOF region, with the highest positive anomalies reaching 5ºC in northeastern Turkey, south Caucasus, and Middle East.

In August, above normal mean air temperature was registered in most of the SEECOF region, with anomalies reaching up to 3ºC. High positive anomalies, of around 4ºC, were registered in eastern Turkey and Armenia. Heat waves were observed in Croatia and Armenia.

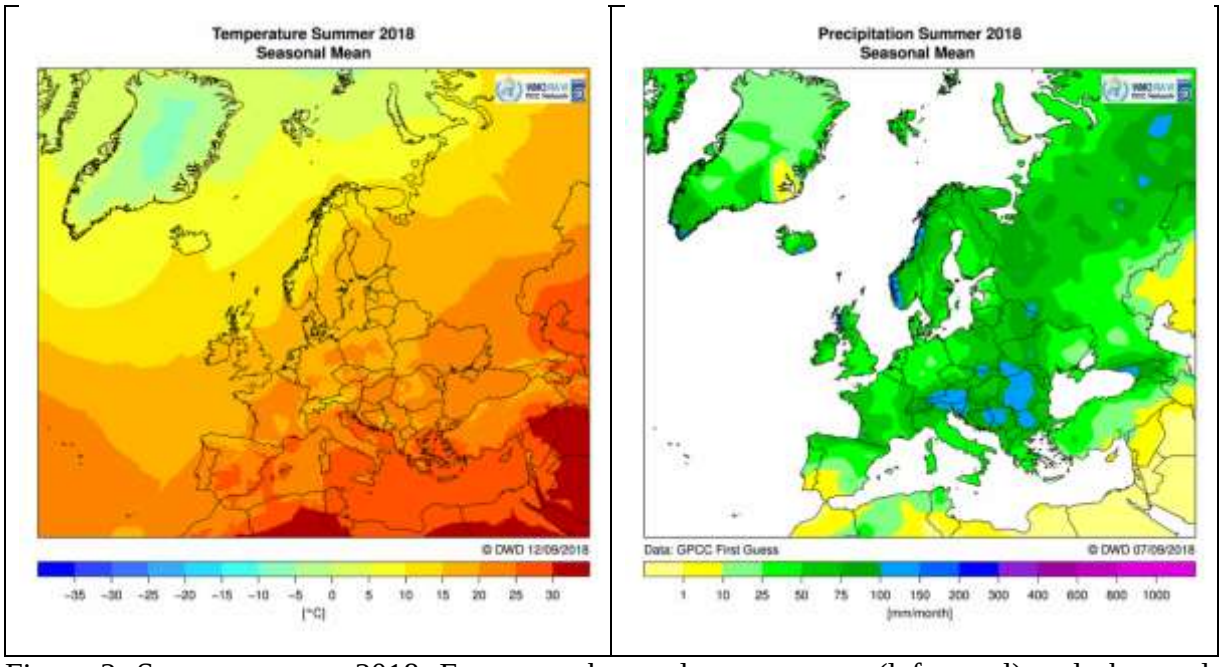


Figure 2. Summer season 2018, Europe – observed temperatures (left panel) and observed precipitation in mm per month (right panel). Source: http://www.dwd.de/rcc-cm

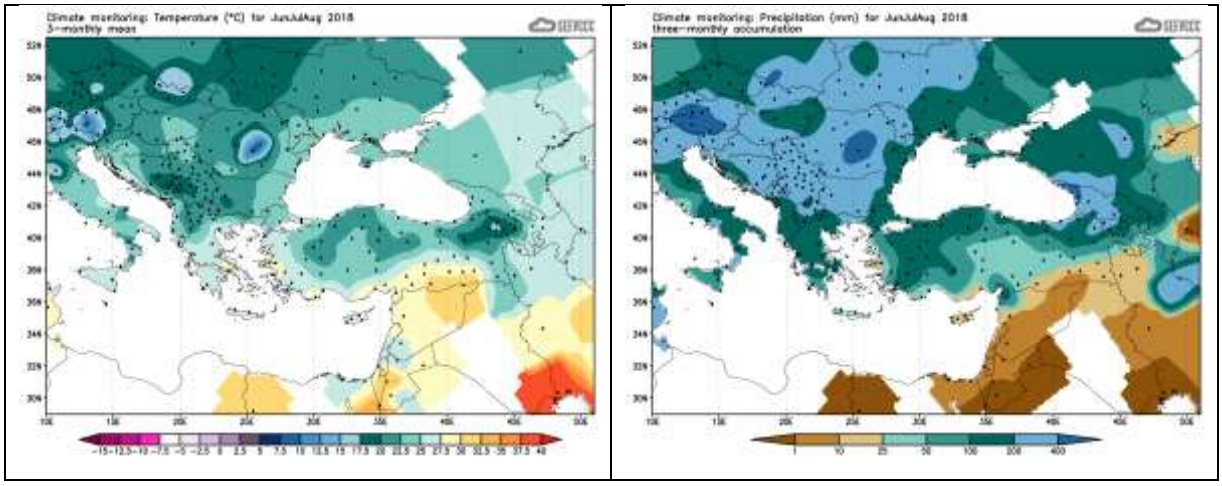


Figure 3. Summer season 2018, SEECOF region – observed temperatures (left panel) and observed precipitation in mm per month (right panel). Source: http://www.seevccc.rs/?p=6

The summer precipitation totals were between 200 mm and 400 mm in most of the Balkans, Ukraine and Georgia, with more than 400 mm in the Carpathian Mountains and western Georgia. Dry conditions, with below 25 mm of precipitation, were observed in Cyprus, southern Turkey and Middle East. In rest of the SEECOF region precipitation sums were in a range from 25 mm to 100 mm. The summer precipitation totals are presented in Figures 2 and 3 (right panel).

Precipitation anomalies were characterized by great diversity within the SEECOF area. Wetter than normal was in most of the Balkans, Moldova, Turkey, Armenia and Middle East, even more than 500% of normal in south of Greece and Middle East. Drier than normal was in eastern Ukraine, western Cyprus, parts of central Turkey and eastern Azerbaijan. The summer precipitation anomalies are presented in Figures 4, 5 and 6 (right panel).

During June, it was wetter than normal in most of the SEECOF region. Drier than normal conditions were registered in eastern Ukraine, northern Turkey, western Georgia and eastern Azerbaijan. Thunderstorm accompanied by very large hail (up to 10 cm) observed on June 8th in Bela Krajina, Slovenia, damaged more than 1000 buildings and great number of vehicles. Extremely heavy rain, of 105 mm in approximately one hour accompanied by hailstorm was registered in Niksic, Montenegro, on June 13. In the period from June 25 to 29, heavy rainfall affected several areas of Northern and Central Greece, flash flooding occurred in the area of Mandra in Attica region that caused destructions.

July was wetter than normal, in most of the SEECOF region. Monthly precipitation sums were below average in central and southern Turkey, most of Azerbaijan and Middle East. Extremely heavy rain (41mm/hour) was recorded in Shirak region, Armenia, on July 6.

August was drier than normal in most of the SEECOF region. Wetter than normal conditions were observed in the southern Balkans, south Caucasus, southwestern and northeastern Turkey. Three days marked by heavy rain caused landslide with one human casualty in Ordui, Turkey. Agricultural areas in Aydın and Aksaray, Turkey, were affected by heavy rain. Record-breaking daily precipitation was observed in Rahiv (82 mm) on August 17 of and in Selyatyn (98 mm) on August 26, in Ukraine.

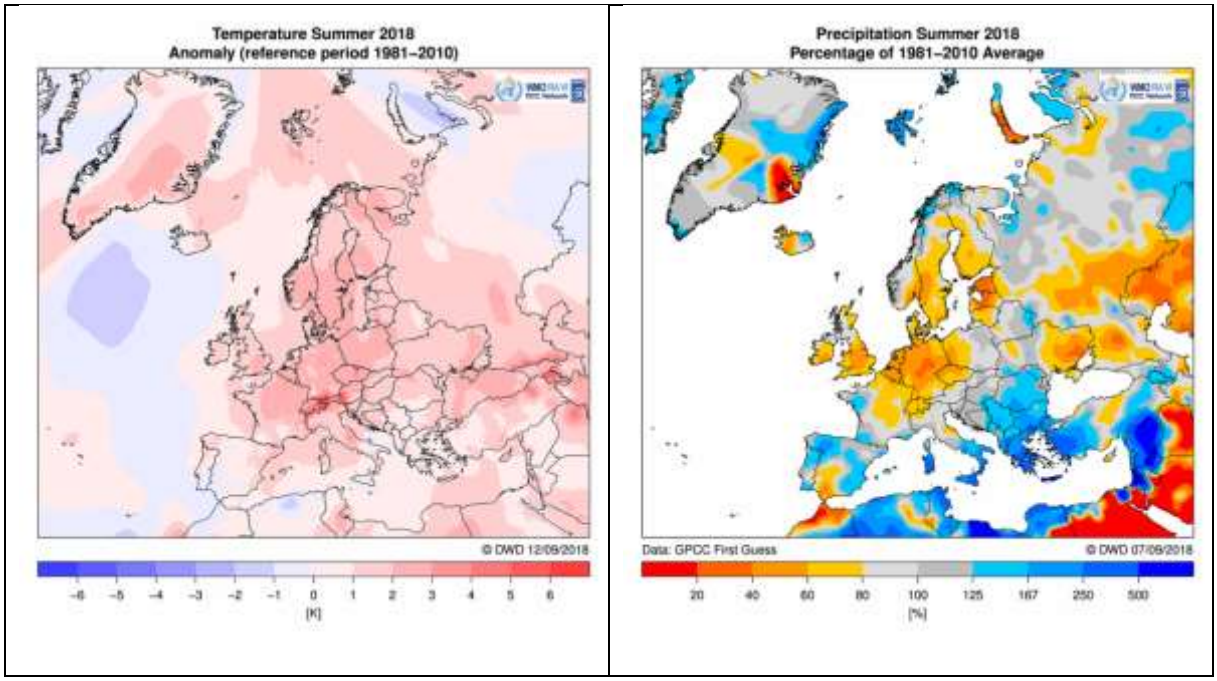


Figure 4. Summer season 2018, Europe – observed temperature anomalies (left panel) and observed precipitation anomalies in percent of 1981-2010 normal (right panel). Source: http://www.dwd.de/rcc-cm

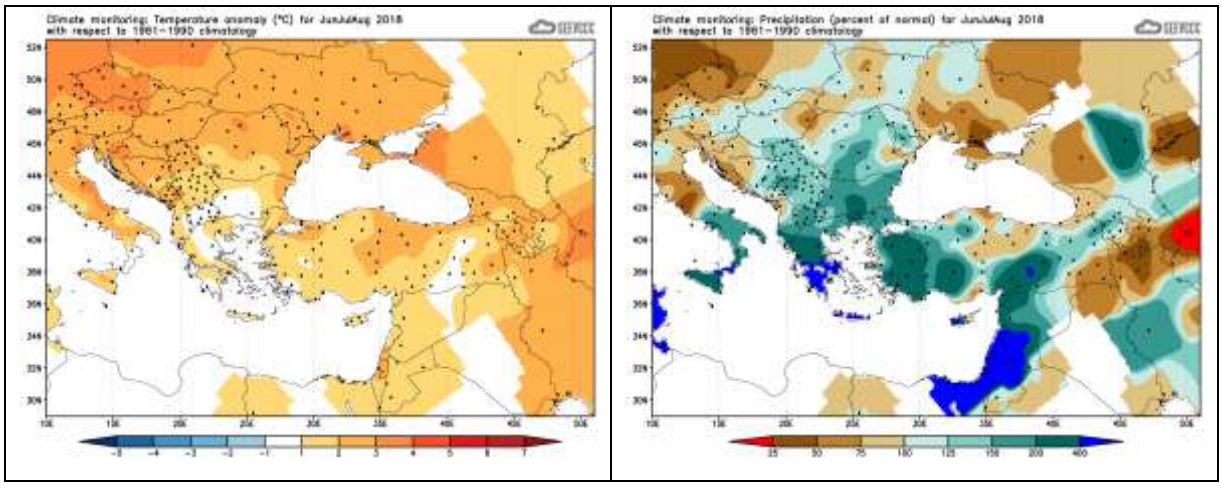


Figure 5. Summer season 2018, SEECOF region – observed temperature anomalies (left panel) and observed precipitation anomalies in percent of 1961-1990 normal (right panel). Source: http://www.seevccc.rs/?p=6

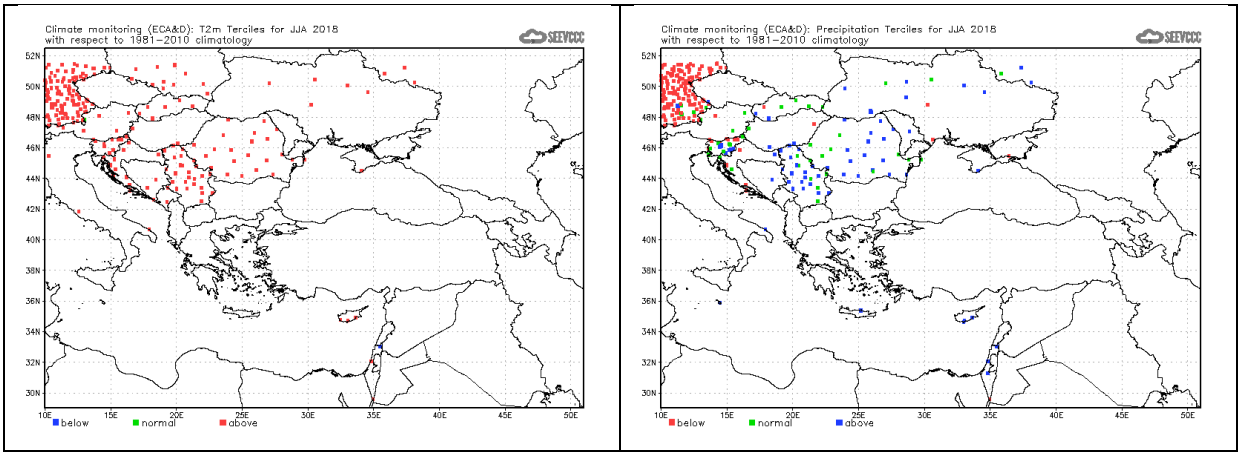


Figure 6. Summer season 2018, SEECOF region – observed temperature (left panel) and precipitation (right panel) terciles in reference to 1981-2010 normal. Source: http://www.seevccc.rs/IDX/SEECOF-MONIT/2018/season/

VERIFICATION OF CLIMATE OUTLOOK FOR 2018 SUMMER

The SEECOF-19 Climate Outlook for the 2018 summer concluded that the entire SEECOF region had higher likelihood for above-average temperature relative to the average and below-average temperature. Probability for the above-average summer temperature was expected to increase across the areas spreading from northern-northeastern toward western and southern parts of the SEECOF region. Probability for exceeding average summer temperature was lower in eastern part of the Balkan Peninsula, Ukraine, along the coasts of the Aegean and Black Sea, most of Turkey, South Caucasus region as well as in Jordan, while probability for above-average conditions was highest for the Pannonia Plain, Central and Western Balkans, most of the Greece, along the coasts of Adriatic, Ionian and Eastern Mediterranean Sea with belonging coasts, as well as in Israel. Based on the aforementioned regional, sub-regional and national climate monitoring products, it turned out that the monitored anomalies of the mean summer air temperatures were above normal in most of the SEECOF region, which means that the climate outlook for the summer air temperature was accurate.

Summer precipitation sums in most of the SEECOF region (zone 1 in Figure 2) were expected to be below-average. Based on the aforementioned regional and sub-regional climate monitoring products, it turned out that the monitored summer precipitation anomalies were above normal in most of the SEECOF region, which means that the climate outlook for the summer precipitation was not accurate for most of the zone 1, except for northernmost part of Turkey and eastern Ukraine. Additionally, it was emphasized that in rest of the SEECOF region, it was not possible to predict summer precipitation totals due to equal chances for below-, near-, or above-normal conditions, or due to the dry season masking effect. Consequently, those regions were not taken into consideration for the verification of the summer precipitation.

APPENDIX A: Contributors to the pre Pre-COF of SEECOF-19

- World Meteorological Organization
- Deutscher Wetterdienst, the Federal Republic of Germany
- South East European Virtual Climate Change Center hosted by the Republic Hydrometeorological Service of Serbia, the Republic of Serbia
- Royal Netherlands Meteorological Institute, the Netherlands
- Armenian State Hydrometeorological and Monitoring Service, the Republic of Armenia
- National Institute of Meteorology and Hydrology, the Republic of Bulgaria
- Meteorological and Hydrological Service, the Republic of Croatia
- Meteorological Service, the Republic of Cyprus
- Department of Hydrometeorology, the Republic of Georgia
- Hellenic National Meteorological Service, the Republic of Greece
- Israel Meteorological Service, the State of Israel
- Republic Hydrometeorological Institute, the former Yugoslav Republic of Macedonia
- State Hydrometeorological Service, the Republic of Moldova
- Hydrological and Meteorological Service of Montenegro, the Republic of Montenegro
- Federal Hydrometeorological Service of the Federation of Bosnia and Herzegovina, the Federation of Bosnia and Herzegovina, Bosnia and Herzegovina
- Republic Hydrometeorological Service of Republic of Srpska, Republic Srpska, Bosnia and Herzegovina
- Republic Hydrometeorological Service of Serbia, the Republic of Serbia
- Slovenian Environment Agency, Slovenia
- Turkish State Meteorological Service, the Republic of Turkey
- Ukrainian Hidrometeorological center, Ukraine

APPENDIX B: **Analysis and verification of the SEECOF-19 climate outlook for the 2018 summer season:**
Verification summary based on the national reports and contributions of the participants of Pre-COF of the SEECOF-20 meeting

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	SEECOF-19 climate outlook for temperature	Observed	SEECOF-19 climate outlook for precipitation	
Armenia (1)	**Above normal**	**Above normal**	**Below normal**	**Below normal** (extremely dry)	**Heat Wave** was observed in the period from the end of June until the end of August. The maximum temperature of 43.7 C was observed on July 12 in Yerevan. **Drought** was registered from 21st June up to the 24th October **Wind storm**: On 17thAugust, strong wind (25m/sec) was observed in Gumry. **Extreme precipitation** (41mm/hour) was recorded on 6th July in Shirak region. **Forest fires**: Vayots Dzor region (July, August)
Federation of Bosnia and Herzegovina, Bosnia and Herzegovina (1)	**Above normal** in whole country (Bosnia and Herzegovina)	**Above Normal** (20, 30, 50)	**Above normal** center of Bosnia and Herzegovina **Below normal** south west of Bosnia and Herzegovina	**No predictive signal** (45, 35, 20)	June – Extremely warm (Bugojno, Drvar, Gradacac, Livno, Neum and Zenica July – Extremely wet (Zenica). 1st wettest July for Zenica. August – Extremely warm (Bihac, Bugojno, Gradacac, Neum, Sanski Most, Tuzla and Zenica) 7th warmest for Gradacac

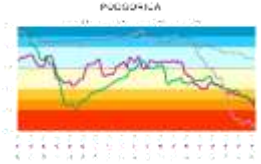
Republic of Srpska, Bosnia and Herzegovina (5)		**Above normal** (20, 30, 50)		**No predictive signal** (45, 35, 20)	
Bulgaria (1)	**Near or above normal**	**Near or above normal**	**Above normal**	**Near or below normal**	June and July 2018 were very wet.
Croatia (1, 5)	**Above normal**	**Above normal** (10,20,70)	**Below normal** the wider areas of the city of Zagreb, part of the Northern, Middle and Southern Adriatic and their hinterland **Above normal** the wider areas of the towns of Osijek and	**Below normal** (45,35,25) the Northern part of Croatia **No predictive signal** (33,34,33) Along the Adriatic coast and in the area close to it	Summer 2018 was extremely warm in the whole country. Two heat waves were observed during summer – both in August, but there weren't any temperature records. In all three months, convective related severe weather phenomena (thunderstorms, hail, heavy rains, flash floods, waterspouts) were observed mostly all over Croatia.

			Šibenik		
Cyprus (5)	**June** Normal **July** Above Normal **August** Above Normal	**June** Normal **July** Normal **August** Normal, except southeast coast (1 to 2°C below normal)	**June** Above Normal **July** Below normal **August** Below Normal	**June** Below Normal **July** West part below Normal, East part above Normal **August** Normal, except NW part above normal and SE part below normal	**June** June ranked as 6th from all Junes available in high accumulated precipitation, (mean area average accumulated precipitation) a record of 27.1mm of accumulated precipitation resulting to 411% of the climatological precipitation (6.6mm). This is evidenced mainly from the chart of the distribution of the mean area average precipitation of June instead from the records available from the table below. The accumulated precipitation was a result of local thunderstorms the period from the 1st to the 5th and from the 11th to the 19th of June which in some cases were accompanied by hail. These thunderstorms caused serious damages in agriculture. About the evaluation of the recorded temperatures both maximum and minimum (table below) were around normal, suggesting that June was almost a normal month. Extremes were also recorded with great positive departures of 4 to 6°C, like Paphos airport where the absolute maximum if the station was 31.7°C departing 4.1°C from the normal (27.6°C), or over Athalassa station, where the highest daily maximum temperature of 40.8°C was 6.8°C greater than normal of 34.0°C. **July** Both maximum and minimum, were above normal. The recorded maximum temperature was around 0.5-1.5°C above normal over the most areas of Cyprus. Daily maximum temperatures that were above normal (deviating by 4°C or more from normal) were also recorded in many stations. Except the highest daily maximum temperature of Prodromos that was 33.7°C (with a normal of 27.9°C), note the highest daily maximum of Larnaka and Achna that was 37.8°C and 38.5°C respectively (with normal of 32.5°C and 33.2°C). Highest daily minimum temperatures were also recorded, with positive departures greater than 4°C, like Polis Chrysochous, where a minimum of 27°C was by 5.9°C above station's normal (21.1°C)

					and the station of Larnaka, where a minimum of 27.3°C was by 5.3°C above station's normal (22°C). During July 13 EMMA warnings with yellow awareness level were issued, concerning extreme high temperatures, not only maximum but also minimum temperatures. On 16th, 20th and 24th of July isolated showers resulted in accumulated precipitation of 29% of normal. **August** Extremes were recorded with positive departures higher than 4°C, like Achna station where the highest daily maximum temperature (38.6°C) was 5.1°C higher than normal (33.5°C) and Prodromos station, where the highest daily maximum temperature (32.7°C) was 4.7°C higher than normal (28°C). Generally, the highest monthly maximum of 41.1°C was recorded on 1st of August over the inland station of Athalassa breaking the previous record of 36.9°C. For the dates 2, 3, 8, 9, 10, 12, 14, 15, 17 and 23 of August, EMMA warnings for high temperature were issued. Daily minimum temperatures were also recorded, like Prodromos, where a minimum of 12.9°C was 5.2°C below station's normal (18.1°C), a negative departure greater than 4°C. On the 2nd, 4th, 5th, 7th, 8th and 21st of August episodes of local showers and isolated thunderstorms resulted in accumulated precipitation of 55% of normal.
Georgia (1)	**Above normal**	**Above normal**	**Near the norm** In the most territory of Georgia **Above the norm and below the norm** on the several	**Above normal**	No high impact events

			stations		
Greece (2, **5**)	**Above normal** relative to the period 1971-2000, especially in the areas of Aegean and Ionian Sea **closer to normal values** in central mainland	**Above normal**	**Above normal** especially in the central and southern areas of Greece as well as in the Ionian Sea islands	**Below normal**	During 2-3/6 two people lost their lives due to thunderstorm in the areas of Kozani and Thessaloniki. On 23 of July strong westerly winds caused destructive wildfires in the eastern parts of Attica and Peloponnese region. The worst incident took place in the area of Mati in the region of Attica, where a major destructive wildfire due to very strong westerly winds caused the death of 99 people while 164 people were injured. During 25-29/6, heavy rainfall affected several areas of Northern and Central Greece. Flash flooding occurred in the area of Mandra in Attica region that caused destructions.
Israel (5)	**Above normal**	**Above normal** (10, 20, 70)	**No precipitation**	**Dry season masking**	No high impact events
The former Yugoslav Republic of Macedonia (5)	**Normal**	**Above normal** (10, 20, 70)	**Above normal** variable precipitation regime	**No predictive signal** (33, 34, 33)	**June** - Exceeded daily precipitation 39.6mm on 15th in Skopje

Republic of Moldova (5)	**Above normal**	**Normal and lower normal**	**Near normal** 65% of the territory **Above normal** 25% of the territory **Below normal** 10% of the territory	**Lower normal and normal**	During the summer season, extreme meteorological phenomena have been reported in the form of torrential rain and hail (June, July), affecting crops and the national economy. During the summer season, thunderstorms, fog, hail and wind gusts up to 18 m/s (July, August).have been reported. High heat and shortage of precipitations, which occurred in the first half of June and during August led to the drying of the upper soil layer, which created not very favourable conditions for the formation of the crops, as well as for the land preparation works for the sowing of autumn crops.
Montenegro (1,5)	**Above normal** very warm in NW parts to extremely warm from N-NE to coastal region	**Above normal** (10, 20, 70)	**Below normal** dry in the belt from the central to coastal area **Normal** in the most of the country **Above normal** wet in the N and E mountainous region	**No predictive signal** (33, 34, 33)	1. HEAVY PRECIPITATION followed by wind and hail 13.06.2018: Rozaje: a lot of water on the streets – difficulties with the traffic; Niksic: - around 105 mm or rainfall accompanied by hail in approximately one hour affected: agriculture, moreover streets were flooded, traffic was disrupted in the city and its surroundings, problems with energy supply, basements were under the water, rooves were damaged.  Source: Svetlana Mandić, daily newspaper „Vijesti“ http://www.vijesti.me/vijesti/pogledajte-u-niksicu-grad-padao-gotovo-sat-nevrijeme-unistilo-baste-ulice-pop-992563

					2. Slow onset of hydrological DROUGHT: -from central to southern parts of the country (Podgorica, Bar, Ulcinj) consecutive decrease of water level in the rivers (e.g.SPI monitoring for Podgorica, figure below)  http://www.meteo.co.me/misc.php?text=135&sektor=1
Serbia (1,**5**)	**Above normal** in almost entire Serbia	**Above normal** (10, 20, 70)	**Above normal** in most of Serbia, except in north-eastern part	**Below-normal** (45, 35 20)	**Summer 2018** The 10th warmest summer for Belgrade. The 6th wettest summer for Serbia. The warmest summer for Serbia based on the minimum air temperature. There were 74 days with apparent temperature above 30 degrees, which is 7 days more compared to the previous summer, which ranked as the second warmest since 1951 up to date. **June** The second wettest June for Zlatibor, third wettest for Veliko Gradiste. On June 30, Novi Sad observed record-breaking daily precipitation sum for June. Sjenica registered 27 rainy days, thereby breaking the previous record **July** 7th wettest July for Serbia, wettest on record for Kraljevo, 2nd wettest for Pozega, Sjenica and Kopaonik. Record-breaking number of days with precipitation above 0.1 mm registered at 6 MMS. **August** August 2018 was the 3rd warmest for Palic and 4th warmest for Banatski Karlovac. The wettest August on record for Crni Vrh.

					Record-breaking daily precipitation sums in Zrenjanin and Crni Vrh. The number of tropical nights was surpassed in Sombor, Palic and Belgrade.
Slovenia (5)	**Warmer than normal**	**Warmer than normal**	**Drier than normal** in the north **wetter than normal** in the south-east and central Slovenia	**Drier than normal** in the east **No clear signal** in the west	Ranks in the 5 warmest summer seasons since 1961. August among 5 warmest since 1961. Precipitation normal for the whole country but wetter than normal in the south-east and central Slovenia and drier than normal in the north of the country. On 8 June, thunderstorm with very large hail (up to 10 cm) damaged more than 1000 buildings and great number of vehicles in Bela Krajina (south-east of Slovenia).
Turkey (2)	**Above normal**	60% above normal, 30% normal, 10% below normal 50% above normal, 30% normal, 20% below normal (in the whole country except northeastern part)	40% higher than normal	45% below normal, 35% around normal and 20% above normal (in the northern coast) 33% below normal, 34% normal and 33% above normal (in the whole	In **June** 2018, hail caused damage in agricultural areas in Bursa, Aydın and Afyonkarahisar. Lightning damaged livestock in Bilecik during thunderstorm. In **July** 2018, frost caused agricultural damage in Burdur. Heavy rain caused difficulties in transportation in İstanbul. In **August** 2018, in Isparta lightning damaged livestock. In Ordui, 3 days of heavy rain caused landslide claiming one life.

				country except the northern coast)	
Ukraine (5)	**Above normal**	**Above normal**	**Below normal** (38% stations) **Normal** (35% stations) **Above normal** (27% stations)	**Below normal** 45% **Normal** 35% **Above normal** 20%	During the summer season, extreme climatological phenomena were observed in many regions of the country. Very heavy rains were recorded (30-98 mm precipitation per 2-10 hours), in Novodnistrovsk 116 mm per 13 hours), showers (30-42 mm per hour), squalls (speed 25-38 m/s), big hail (diameter 22-35 mm), tornado 29/06/2018 in Zaporizzya region. Unfavourable weather conditions locally caused power outage, disruptions in telecommunications, utilities and transport. August was arid in most regions of Ukraine and in the southern and the eastern parts, certain areas didn't observe any precipitations at all. The highest daily precipitation on record was observed in Rahiv (Zakarpattya region) – 82 mm on 17th of August and in Selyatyn (Chernivtsi region – 98 mm) on 26th of August.

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