SOUTH EAST EUROPEAN CLIMATE OUTLOOK FORUM

SEECOF-22 MEETING

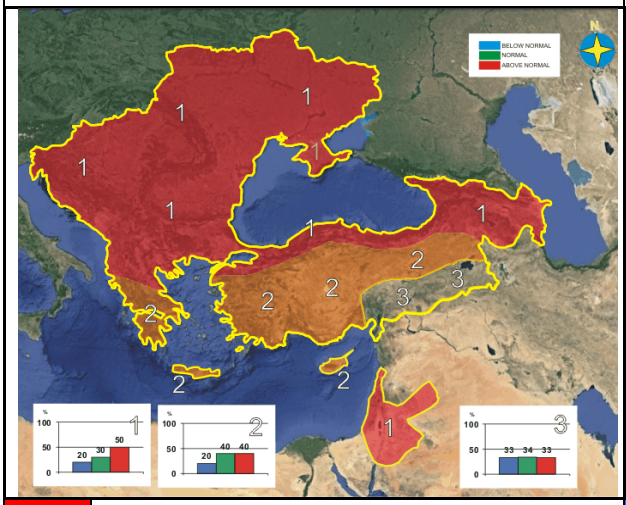
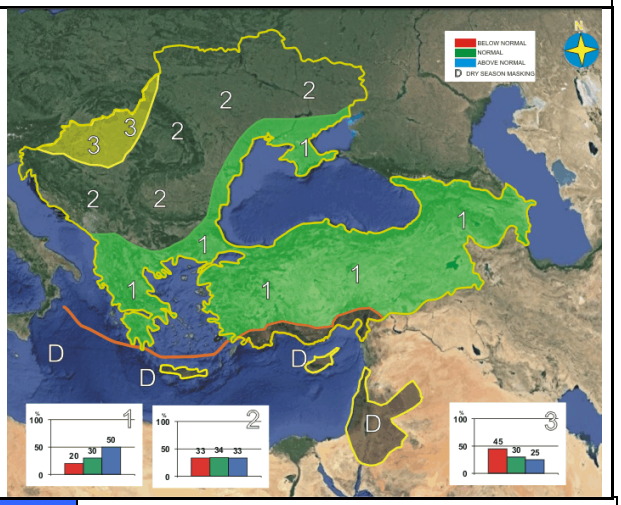
DRAFT VERSION

ANALYSIS AND VERIFICATION OF THE SEECOF-21 CLIMATE OUTLOOK FOR THE 2019 SUMMER FOR SOUTH-EAST EUROPE (SEE)

CLIMATE OUTLOOK FOR 2019 SUMMER SEASON FOR THE SEE REGION

As stated in the SEECOF-21 Consensus Statement on the Seasonal Climate Outlook for the 2019 Summer Season over South-East Europe (document: http://www.seevccc.rs/SEECOF/SEECOF-21/STEP-/Consensus%20Statement%20SEECOF-21.pdf, probability for he above-average summer temperature was decreasing across the SEECOF region spreading from northern-northeastern toward southeastern parts. The most of the SEECOF region was likely to experience above-average summer temperature (zone 1 in Figure 1, left panel), while central and southern Greece, Ionian Sea, Aegean Sea, Eastern Mediterranean, as well as western, southern and central parts of Turkey were likely to have near-or above normal conditions. On the other hand, in southeastern part of Turkey (zone 3 in Figure 1, left panel) there were approximately equal probabilities for below-, near-or above normal-averages of the summer temperature. 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. The coasts of the Aegean and Black Sea, as well as the Southern Balkans, South Caucasus region and most of Turkey were expected to receive above normal summer precipitation sums (zone 1 on Figure 1, right panel). On the other hand, Pannonia Plain and the north-western slopes of the Carpathian region (zone 3 on Figure 1, right panel) were likely to experience a precipitation deficit. In most of the SEECOF region (zone 2 in Figure 1, right panel), there were approximately equal probabilities for below-, near-or above normal-averages. It was noted that certain parts of the country, particularly mountain regions might observe near-or above-normal summer precipitation due to the episodes of enhanced convection accompanied by heavy precipitation. Due to dry season masking, it was not possible to forecast summer precipitation totals for the Eastern Mediterranean with belonging coasts and hinterland, Crete as well as Israel and Jordan.

2019 Summer Temperature Outlook	2019 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 2019 Summer Season for the SEE Region

SHORT ANALYSIS OF SUMMER 2019 FOR THE SEE REGION

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

- operational products of the RCC Node-CM (Regional Climate Centre on Climate Monitoring) provides maps for the World Meteorological Organization (WMO) Region VI (Europe and Middle East), http://rcccm.dwd.de/DWD-RCCCM/EN/products/europe/europe_node.html;
- seasonal bulletin on climate in the WMO Region VI for the summer of 2019 (WMO RA VI RCC Node-CM, DWD), http://www.seevccc.rs/SEECOF/SEECOF-22/Pre-COF/RA%20VI_RCC-contribution-SEECOF-21-Verification_JJA_2019.pdf;
- Global Climate Bulletin (Meteo France), http://www.seevccc.rs/SEECOF/SEECOF-22/Pre-COF/RCC-LRF-Meteo-Frnace-VERIFICATION-BULLETIN-JJA-2019.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/201908/;
- 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, Montenegro, the Republic of Moldova, Serbia, Slovenia, Turkey and Ukraine (documents available on: http://www.seevccc.rs/SEECOF/SEECOF-22/Pre-COF/).

Almost the entire SEECOF region, apart from central Turkey observed above-normal summer temperatures.

Summer temperatures across the lowlands in most of the SEECOF region were mainly in a 20ºC-25ºC range; 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. On the other hand, at some high-lying areas in the Carpathian region, Turkey and South Caucasus, summer temperatures were in a 15ºC - 20°C range. The presentation of summer temperatures is presented in Figures 2 and 3 (left panel).

In the whole SEECOF region above-normal anomalies were observed. Up to +2ºC in most of the region, in parts of the central and western Balkans up to +4ºC and up to +1ºC in central Turkey. The summer temperature anomalies are presented in Figures 4 and 5 (left panel).

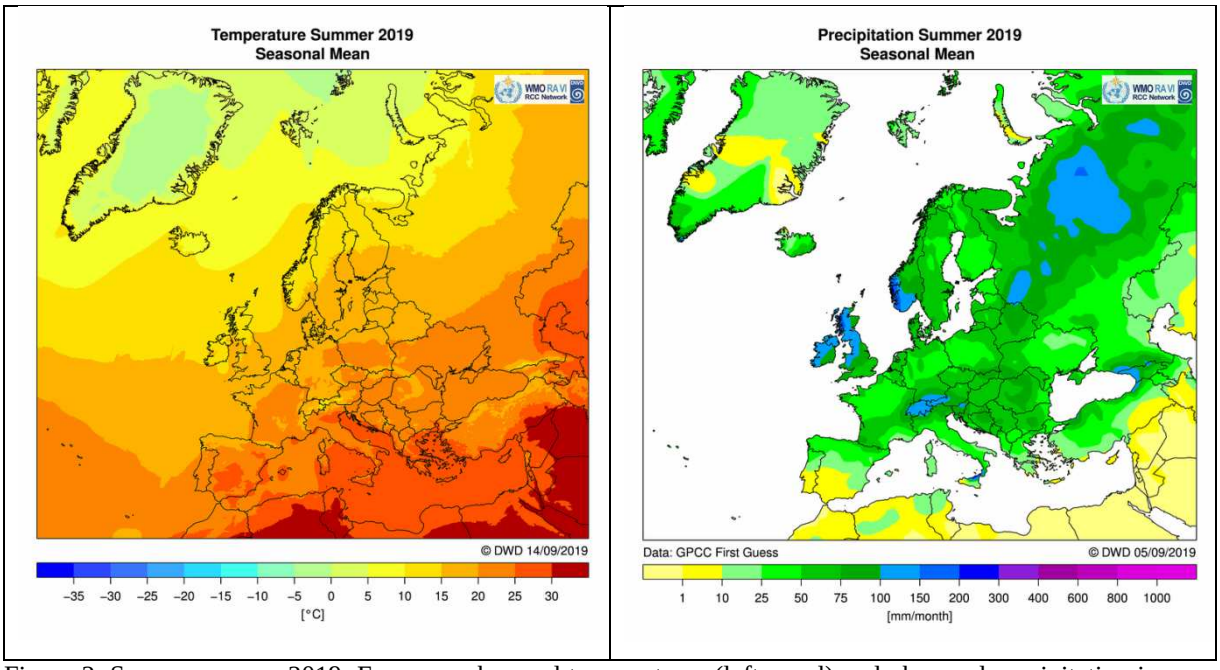


Figure 2. Summer season 2019, Europe – observed temperatures (left panel) and observed precipitation in mm per month (right panel). Source:
https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_int_ttt.html (left panel)
https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_int_rrr.html (right panel)

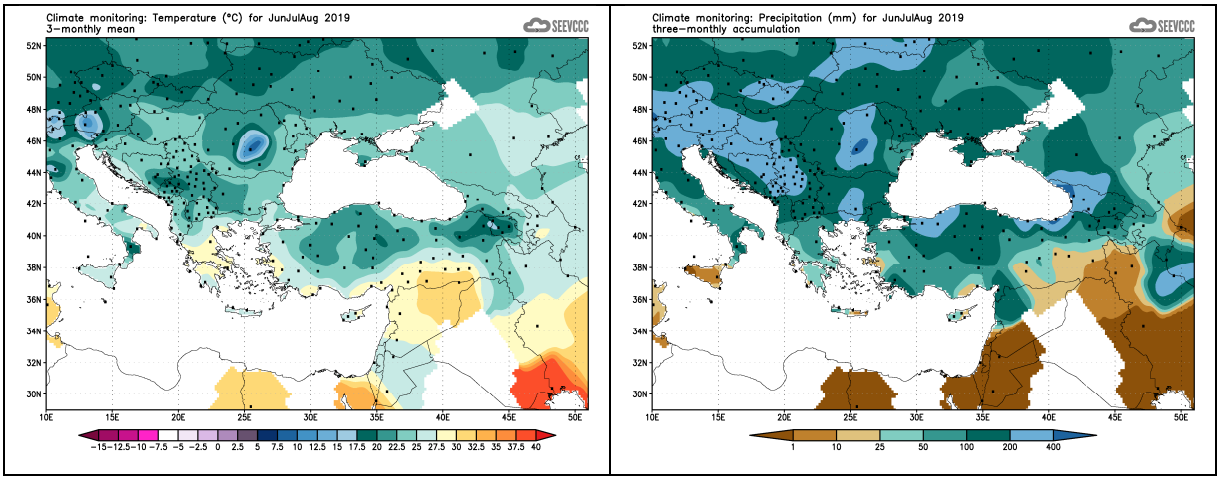


Figure 3. Summer season 2019, SEECOF region – observed temperatures (left panel) and observed precipitation in mm per month (right panel). Source: http://www.seevccc.rs/?p=6

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

Precipitation was characterized by positive anomalies along the coasts of the Adriatic, Ionian and Aegean Sea, in most of Turkey, Azerbaijan and Middle East. It was drier than normal in parts of the eastern Balkans, Moldova and Ukraine. The summer precipitation anomalies are presented in Figures 4 and 5 (right panel).

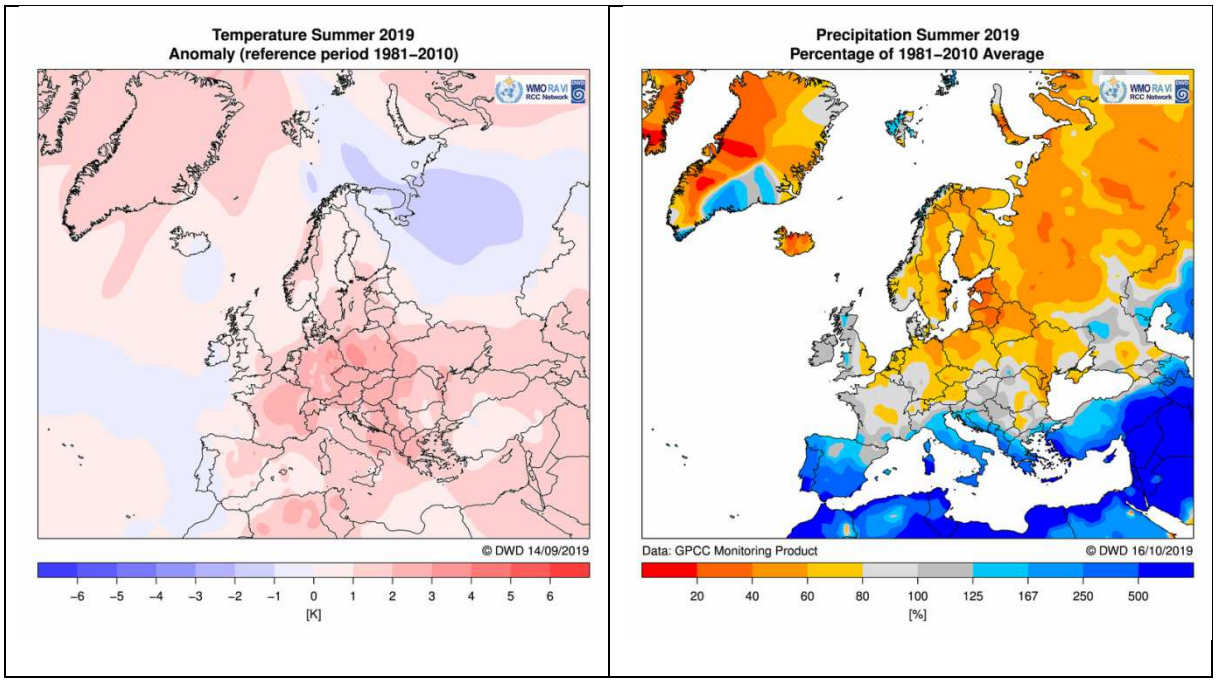


Figure 4. Summer season 2019, Europe – observed temperature anomalies (left panel) and observed precipitation anomalies in percent of 1981-2010 normal (right panel). Source: https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_int_ttt.html (left panel)
https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_int_rrr.html (right panel)

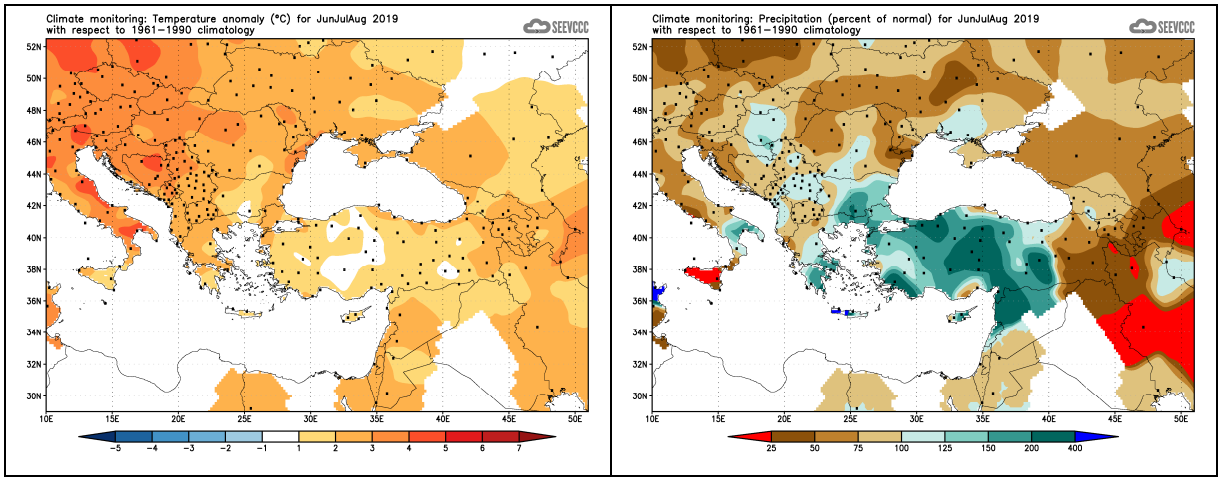


Figure 5. Summer season 2019, SEECOF region – observed temperature anomalies (left panel) and observed precipitation anomalies in percent of 1961-1990 normal (right panel). Source: http://www.seevccc.rs/?p=6

VERIFICATION OF CLIMATE OUTLOOK FOR 2019 SUMMER

The SEECOF-21 Climate Outlook for the 2019 summer concluded that most of the SEECOF region (zone 1 in Figure 1, left panel) had higher likelihood for above-average temperature. Probability for exceeding average summer temperature was lower in southern part of the Balkan Peninsula and most of Turkey (zone 2 in Figure 1, left panel). Based on the aforementioned regional, sub-regional and national climate monitoring products, the anomalies of the mean summer air temperatures were above normal in most of the SEECOF region, implying that the climate outlook for the summer air temperature was accurate for most of the SEECOF region, except for some parts of Turkey.

Summer precipitation sums were expected to be above-normal along the coasts of the Aegean and Black Sea, as well as the Southern Balkans, South Caucasus region and most of Turkey (zone 1 on Figure 1, right panel). For the Pannonia Plain and the north-western slopes of the Carpathian region (zone 3 on Figure 1, right panel) precipitation deficit was expected. 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. Based on the aforementioned regional, sub-regional and national climate monitoring products, the climate outlook for the summer precipitation was accurate for most of the zone 1, except for southern parts of Ukraine and Moldova, as well as Georgia.

APPENDIX A: Contributors to the pre Pre-COF of SEECOF-22

- World Meteorological Organization
- Deutscher Wetterdienst, the Federal Republic of Germany
- Meteo France, Republic of France
- Royal Netherlands Meteorological Institute, the Netherlands
- South East European Virtual Climate Change Center hosted by the Republic Hydrometeorological Service of Serbia, the Republic of Serbia
- 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
- Hydrometeorological Service, Republic of North 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-21 climate outlook for the 2019 summer season:**
Verification summary based on the national reports and contributions of the participants of Pre-COF of the SEECOF-22 meeting

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	SEECOF-21 climate outlook for temperature	Observed	SEECOF-21 climate outlook for precipitation	
Armenia (1)	**Above normal**	**Above normal**	**Below normal**	**Below normal**	Heat Wave was observed from 22 of July until 20 of August in lowland areas. The maximum air temperature reached 43.0°C in Meghri on July 30, (the highest recorded was 43.7°C in Meghri on July 31, 2011 and in Yerevan on July 12, 2018). Drought was recorded from May up to the end of August in Ararat valley and Syuniq lowlands. Extreme precipitation sums (65mm/25 min) were recorded in Tashir(lori) on 8 Jun and 69mm/12hour in Aparan (Aragatcotn) regions on 6th of July. Severe hailstorms were observed with diameters of hail exceeding 20 mm. Forest fires: Forest fires were recorded in Vayots Dzor and Sjuniq region (July, August). Forest fires were characterized by higher frequency during the summer season of 2019.
Federation of Bosnia and Herzegovina, Bosnia and Herzegovina (1)	**Above normal** in almost entire Bosnia and Herzegovina (extremely warm)	**Above Normal** (20, 30, 50)	**Below normal** west Bosnia; **Normal** central Bosnia and Herzegovina, Exceptive – Bugojno (extremely wet)	**No predictive signal** (33, 34, 33)	- **June** 1 st warmest (Bihac and Drvar); 2 nd warmest (Bjelasnica, Gradacac, Livno, Sanski Most, Sarajevo, Stolac and Tuzla. 1 st wettest (Bugojno) - **Summer** 5 th and 6 th warmest summer for Bosnia and Herzegovina; MS Mostar 75 days with T max ≥30°C, 52 days withT min ≥20°C. Extremely wet for MS Neum (coastline) and Bihac (west Bosnia)

Republic of Srpska, Bosnia and Herzegovina (5)	**Above normal**	**Above normal** (20, 30, 50)	**Normal**	**No predictive signal** (33, 33, 33)	Extremely warm weather pattern over the RS caused intense convective Cb instability (hail, thunder, storm wind gust, showers, temperature drop) on 3-June, 5-June, 16-June, 23-June; 4-July,7-July,13-July,18-July;27-July; 13-August, 17-August
Bulgaria (1)	**Above normal**	**Above normal**	**Near or above normal**	**Near or above normal**	Summer 2019 started with wet weather in June and finished with dry weather in August. It was warm throughout the season except for part of July. The dry weather in August brought risky fire weather illustrated. There were strong convection days with 24-hour precipitation amounts above 100 mm at few stations.
Croatia (1, 5)	**Above normal**	**Above normal** (20,30,50)	**Below normal** (wider area of Parg, wider areas of city of Zagreb, Bjelovar and Sisak, and part of the Northern and Middle Adriatic) **Above normal** (wider area of city of Varaždin)	**Below normal** (45,30,25) The northernmost part of Croatia **No predictive signal** (33,34,33) The rest of Croatia	**Summer 2019** was very warm and extremely warm. Heat waves were observed during all three months (two in June and July and three in August) – and only in June there were several maximum air temperatures which exceeded the absolute maximum (Dubrovnik, Hvar, Pazin, Poreč, Zadar, Parg, Puntijarka and Zavižan). In all three months convective related severe weather phenomena (thunderstorms, hail, heavy rains, flash floods, waterspouts) were observed mostly all over Croatia.

Cyprus (5)	**June** Normal to Above Normal **July** Normal to Above Normal **August** Normal to Above Normal	**June** Normal **July** Normal **August** Normal, except SE part that it would be 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** West and North part above Normal and South and East part below normal	**June** Both maximum and minimum temperatures 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 of 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 higher than normal of 34.0°C. June ranks as the 6th in terms of highly accumulated precipitation was a month ranked 6 th 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). The accumulated precipitation was a result of local thunderstorms in the period from the 1 st to the 5 th and from the 11 th to the 19 th of June which in some cases were accompanied by hail. **July** Both maximum and minimum temperatures 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 recorded at 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 that was by 5.3°C above station's normal (22°C). During July, 13 EMMA warnings with yellow awareness level were issued, concerning extremely high temperatures, not only

					maximum but also minimum temperatures. On 16 th , 20 th and 24 th of July isolated showers resulted in accumulated precipitation of 29% of normal. **August** Extremes were recorded with positive departures greater than 4°C, like Achna station where the highest daily maximum temperature (38.6°C) was 5.1°C greater than normal (33.5°C) and Prodromos station, where the highest daily maximum temperature (32.7°C) was 4.7°C greater than normal (28°C). Generally, the highest maximum of the month was recorded on 1st of August over the inland station of Athalassa and it was 41.1°C with the normal being 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 2 nd , 4 th , 5 th , 7 th , 8 th and 21 st of August episodes of local showers and isolated thunderstorms resulted in accumulated precipitation of 55% of normal.
Georgia (1)	**Above normal**	**Above normal**	**Near and below Normal**	**Above normal**	No high impact events
Greece (2, **5**)	**Above normal** (relative to the period 1971-2000) for most of the country	**Above normal** for north Greece	**Above or near to normal values** (1971-2000) for the most of the country and especially for west Crete, except the north	**Above normal** for most of Greece	On June 11 th, 2019: Heavy rain caused flooding in Varkiza (suburb of southern Attica) and traffic problems. On June 18 th and 19 th, 2019: Summer thunderstorms with intense electrical activity accompanied by hail caused flooding in Attica. On July 10-11, 2019: Storm affected cenrtal and east Macedonia, mainly the Perfecture of Halkidiki. Seven people died and 120 were injured, roofs collapsed, trees and electrical posts fell, caravans and boats were swept away in the storm that broke out at night. Also

			Ionian and east Aegean islands and northwest Peloponnese		the violent storm led to power outages in most of the Halkidiki region. On July 14-17, 2019: Heavy thunderstorms affected mainly south Ionio, west Greece, west Crete, and Sporades islands and caused flooding and destructions.
Israel (5)	**Above normal**	**Above normal** (20, 30, 50)	**No precipitation**	**Dry season masking**	No high impact events
Republic of North Macedonia (5)	**Above normal**	**Above normal** (20, 30, 50)	**Below normal** -variable precipitation regime	**No predictive signal** (33, 34, 33) and **above normal** (20, 30, 50)	No high impact events
Republic of Moldova (5)	**Above normal**	**Above normal**	**Near normal** 70% of the territory **Below normal** 25% of the territory **Above normal** 5% of the territory	**Below, near or above normal** (33%,34%,33%)	During the summer season, meteorological phenomena in form of torrential rains and hail (June, July), as well as strong winds with a maximum speed of up to 27 m/s (July 3rd, MS Ceadâr-Lunga) were reported, which caused the damage of agricultural crops, the deterioration of the objects of the national economy and the disconnection from the sources of electricity.
Montenegro (1,5)	**Above normal** very warm to extremely warm	**Above normal** 50% above normal 30% normal 20%	**Normal** for the most of the country	**No predictive signal** (33, 34, 33)	The 4 th July: Heavy hail impact in the northern mountainous region;

		below normal			 https://www.vijesti.me/vijesti/drustvo/pogledajte-video-kad-grad-uhvati-na-putu-jasenovo-polje-savnik The 28 th July: The storm surges hit Montenegrinian coast as meteorologist forecasted.  Sveti Stefan (Foto: Danijela Lasica) Combination of the storm and surge consequences: https://www.vijesti.me/vijesti/drustvo/video-pogledajte-kako-izgleda-kad-talasi-i-vjetar-udruze-snage

Serbia (1,**5**)	**Above normal** in entire Serbia	**Above normal** (20, 30, 50)	**Normal** in most of Serbia	**Below-normal** (45, 35 20) in northern Serbia **No predictive signal normal** (33, 34, 33)	*** Summer 2019** The 5th warmest summer for Serbia, the 3rd warmest for Palic (northern Serbia). The 2nd warmest summer for Serbia based on the minimum air temperature. There were 73 days with the "feels like" temperature (THI) above 30 degrees, which is 6 days above the summer of 2017 that ranks as the 2nd warmest in the period from 1951 up to now. A heat wave was registered in the period from August 23rd to September 2nd in most of Serbia. *** June** The warmest June for Serbia based on the minimum air temperature. The 3rd warmest June for Serbia based on the mean air temperature. The 6th wettest June for Sombor (northern Serbia). Record-breaking precipitation sums for Pozega (southwestern Serbia). A heat wave was registered on Zlatibor (southwestern Serbia), lasting for 5 days.
Slovenia (5)	**Warmer than normal**	**Warmer than normal**	**Drier than normal** in the west and north-east **Normal to wetter than normal** in the south-east	**Drier than normal** in the north-east **No clear signal** elsewhere	• Second warmest summer since 1961, second only to summer 2003, • Second warmest June since 1961, second only to June 2003. Two to three heatwaves. June temperature records for Slovenia: Ljubljana 36.5 °C (former record 35,6 °C in 2003), Rateče (35.5 °C), Kredarica (20,8 °C) and many more. • August among 6 warmest since 1961. • Summer was dry, among 15 driest since 1961, • This summer, there were large number of thunderstorms with hail, heavy precipitation and strong wind gusts. Some featured episodes: − 11 June in south-east Slovenia thunderstorms with hail with diameter between 5 and 10 cm (Stari trg ob Kolpi near border with Croatia). Some damage. − 19–23 June thunderstorms with heavy precipitation and hail (20 June Trzin near Ljubljana 120 mm precipitation in one hour). − 7 July, thunderstorms with strong wind gusts over central and north-east Slovenia. Ptuj region wind gusts over 28 m/s, precipitation 49 mm in 25 minutes. Damage: floods, ruined trees, damage on roofs and crops.

					− 8 July, Supercell storm from south foothills of Julian Alps over Ljubljana region to Kočevje region (south east Slovenia): strong wind gusts, heavy precipitation and hail. Some damage.
Turkey (2)	**Near and above normal**	**Near and above normal**	**Above normal** at inner and western part of Turkey **Below normal** at eastern part of Turkey	**Above normal** Dry for Mediterranean Sea costal	• June 2019, was the hottest June in the long term period (1971-2019). Turkey June Mean temperature is 21.3°C, June 2019 mean temperature was 23.4°C. • June and August 2019 mean temperatures were above normal, July 2019 mean temperature was around normal (RF: 1981-2010). • 8 stations reached new maximum temperature record in June 2019. • 15 stations reached new maximum temperature record in August 2019. • In June 2019, 7 casualties due to heavy rain and flood in Trabzon (in Black Seas Region). • In June 2019, 3 casualties due to heavy rain and flood and 1 casualty due to lightning in Agri (Eastern Anatolian Region) province. • In June 2019, heavy hail caused damage in agricultural areas in Ankara. • In June 2019, heavy rain and flood damaged infrastructure. 3 casualties in Ankara. • In July 2019, flood and landslide caused transportation difficulties, damaged livestock and 2 casualties in Duzce. • In August 2018, flood and landslide caused damage in agricultural areas, livestock, transportation and 2 casualties in Samsun (Black Sea Region).
Ukraine (5)	**Above normal**	**Above normal**	**Below normal** (67% stations)	**Below normal 33%**	During the summer season, extraordinary meteorological phenomena were observed in many regions of the country.

			Normal (21% stations) **Above normal** (12% stations)	**Normal** **34%** **Above normal** **33%** **southern part** **Above** 50% **Normal** 30% **Below** 20%	In June - heavy rains (30-60 mm precipitation per 2-9 hours, 05/06 in Hivoron 104 mm/7h and in Nova Kahovka 93/5h, 19/06 in Rava-Ruska 83/3h), showers (32-46 mm per hour), squalls (speed 25 m/s), big hail (diameter 23-30 mm). In July - heavy rains (30-70 mm precipitation per 2-9 hours), squalls (speed 26-30 m/s). In August - heavy rains (30-76 mm precipitation per 2-12 hours, 04/08 in Hourly 105 mm/8h and in Bilgorod-Dnistrovsky 121 mm/6h, 14/08 in Drohobych 90 mm/10h), big hail (diameter 27 mm), 13/08 in Chernivtsy region was big hail with diameter 60 mm. Unfavorable weather conditions locally caused power outage, and disturbances in telecommunications, utilities and transport. Summer was hottest at some places in the western part of Ukraine in the last 58 years. June was the warmest in the entire period of meteorological observations (ever since the record-keeping began), maximum temperatures were 30…37 °C. Summer was arid in most of Ukraine, driest conditions since 1961 were recorded in the north and in the center.

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