Thirtieth Session of the
SOUTH EAST EUROPEAN CLIMATE OUTLOOK FORUM

SEECOF-30 ONLINE MEETING

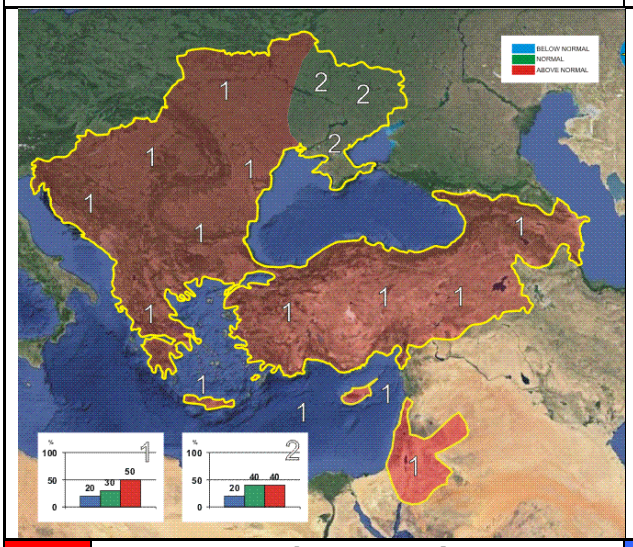
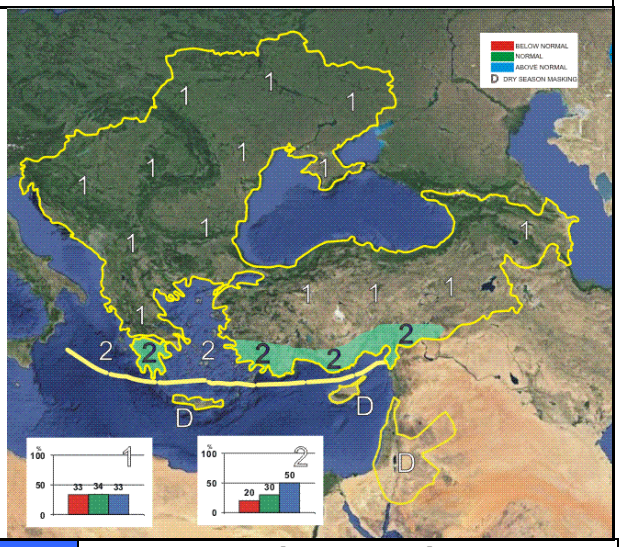
ANALYSIS AND VERIFICATION OF THE SEECOF-29 CLIMATE OUTLOOK FOR THE SUMMER OF 2023 FOR SOUTH-EAST EUROPE (SEE)

CLIMATE OUTLOOK FOR 2023 SUMMER SEASON FOR THE SEE REGION

As stated in the SEECOF-29 Consensus Statement on the Seasonal Climate Outlook for the 2023 Summer Season over South-East Europe (document:
http://www.seevccc.rs/SEECOF/SEECOF-29/STEP-3/Consensus%20Statement%20SEECOF-29.pdf

Observed sea surface temperatures and forecast for the summer three months showed above normal temperatures on the Tropical Pacific evolving towards a moderate El Niño event. Over the Indian Ocean, a positive phase of Indian Ocean dipole (IOD) was observed. However, models didn't agree on showing a teleconnection towards MedCOF domain. Above normal sea surface temperature anomalies over Tropical and Eastern North Atlantic were suggested to continue. In the atmosphere, models tended to show more frequency of high latitude blocking, with zonal regimes less favored. Below normal pressures were showed by most models, although there were spatial differences in the position of the main anomaly patterns. With this general context, above normal temperatures can were expected over most of the SEECOF domain (Zone 1 in Figure 1), with the exception of Northwestern Africa and Northeastern part of MedCOF domain, where normal to above temperatures were expected. The warm signal seemed more intense over the rest of Northern Africa, Mediterranean Sea and parts of the Middle East.

Southern parts of Greece as well as southern coasts of Turkey with its hinterland were likely to experience near- or above-normal conditions in terms of summer precipitation sums (Zone 2 in Figure 2) while in most of the SEECOF region there was equal probability for summer precipitation (Zone 1 in Figure 2). It is noteworthy that certain parts of the country, particularly mountainous regions, might observe near- or above-normal summer precipitation totals due to the episodes of enhanced convection accompanied by heavy precipitation.

2023 Summer Temperature Outlook	2023 Summer Precipitation Outlook
	

	Above Normal		Above Normal
	Normal		Normal
	Below Normal		Below Normal

Figure 1. Graphical presentation of the Climate Outlook for the 2023 Summer Season for the SEE Region

ANALYSIS OF THE SUMMER 2023 FOR THE SEE REGION

Analyses of the summer season 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
- Analysis and verification of the MedCOF-20 Climate Outlook for the 2023 Summer season for the Mediterranean region, http://www.seevccc.rs/SEECOF/SEECOF-30/STEP-1/MedCOF-20-Verification_JJA_2023_RA I+VI_draft1.pdf
- Seasonal bulletin on climate in the WMO Region VI for the summer of 2023 (WMO RA VI RCC Node-CM, DWD), http://www.seevccc.rs/SEECOF/SEECOF-30/STEP-1/Analyses-Verification-of-the-SEECOF-29-Climate-outlook-for-summer-season-2023-RA%20VI_RCC-on-CM.pdf.pdf
- Climate monitoring products of the South East European Virtual Climate Change Center – SEEVCCC (Member of the WMO RA VI RCC Node-CM), http://www.seevccc.rs/imgsrc/clim_mon/202308/
- National climate monitoring reports of the following SEECOF-30 participating countries: Bulgaria, Federation of Bosnia and Herzegovina / Bosnia and Herzegovina, Republic of Srpska / Bosnia and Herzegovina, Croatia, Cyprus, Georgia, Israel, Republic of North Macedonia, Republic of Moldova, Montenegro, Serbia, Slovenia, Turkey and Ukraine are available on:

  http://www.seevccc.rs/SEECOF/SEECOF-30/STEP-1/

The entire SEECOF region observed above-normal summer temperatures. Temperature anomalies reached up to +3ºC above normal, relative to the 1981-2010 base period, at some locations in southern Balkans, Moldova, Ukraine and Jordan. The summer temperature anomalies are shown in Figures 4 and 5 (left panel).

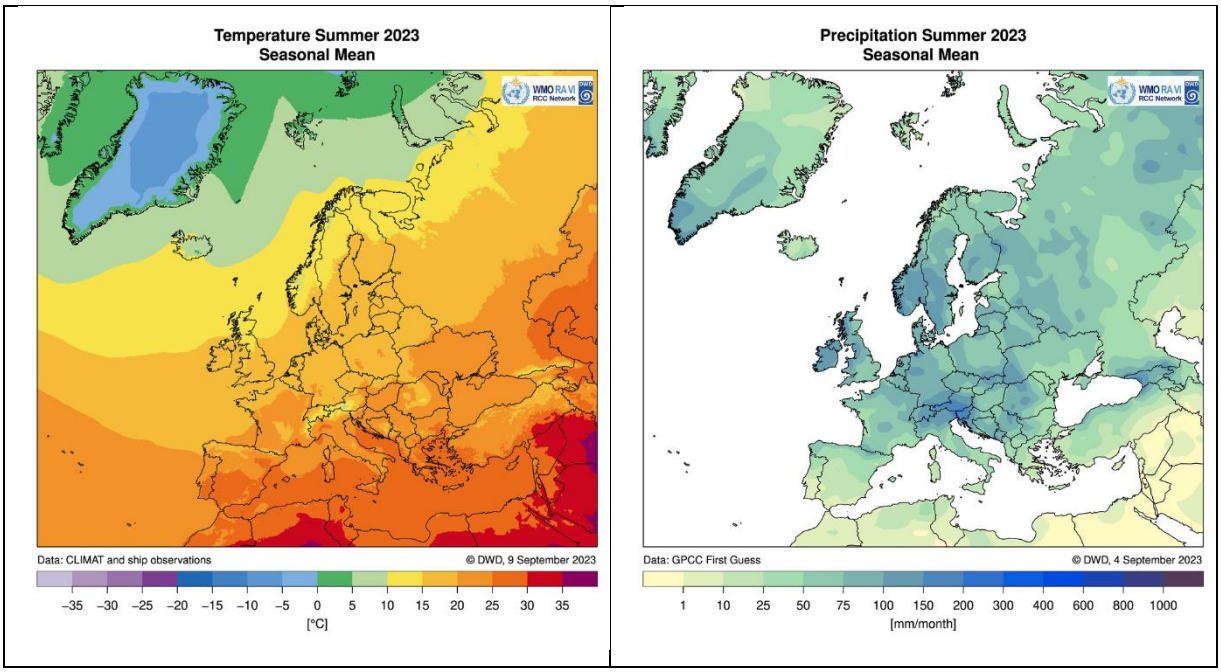


Figure 2. Summer season 2023, Europe – observed temperatures (left panel) and observed precipitation in mm per month (right panel). Source:
https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_month_ttt.html (left panel)
https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_month_rrr.html (right panel)

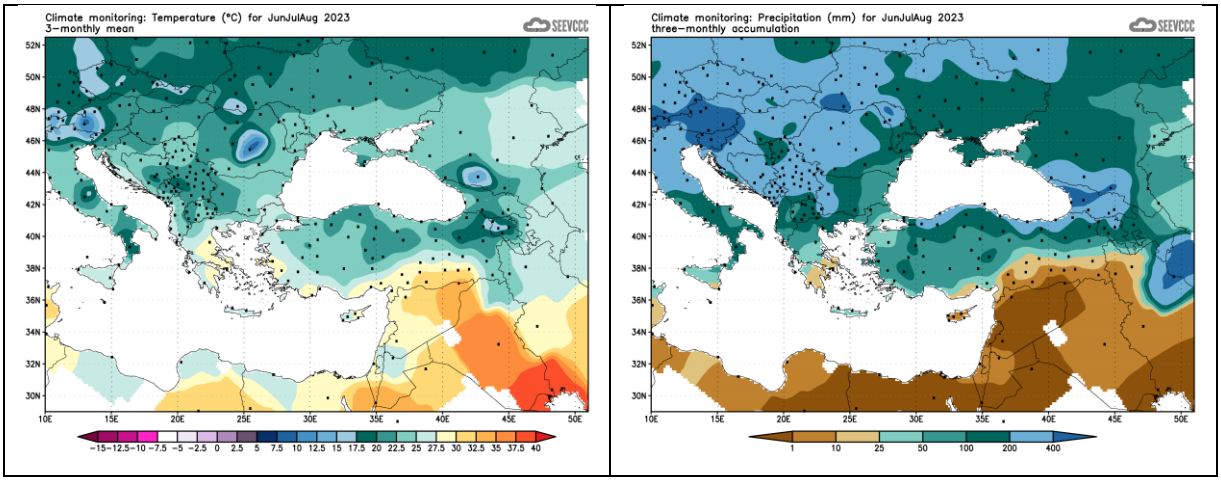


Figure 3. Summer season 2023, SEECOF region – observed temperature (left panel) and observed precipitation (right panel). Source:
http://www.seevccc.rs/imgsrc/clim_mon/202308/temp_av3m.gif (left panel)
http://www.seevccc.rs/imgsrc/clim_mon/202308/prec_tot3m.gif (right panel)

Seasonal precipitation was characterized by positive anomalies in northwestern, southern and some central parts of the Balkans, Turkey, South Caucasus and Middle East (more than 250% of the long-term average). It was drier than normal (less than 75% of the long-term average) in the eastern Balkans, southwestern Ukraine, Moldova, Cyprus and southeastern Turkey. The summer precipitation anomalies are presented in Figures 4 and 5 (right panel).

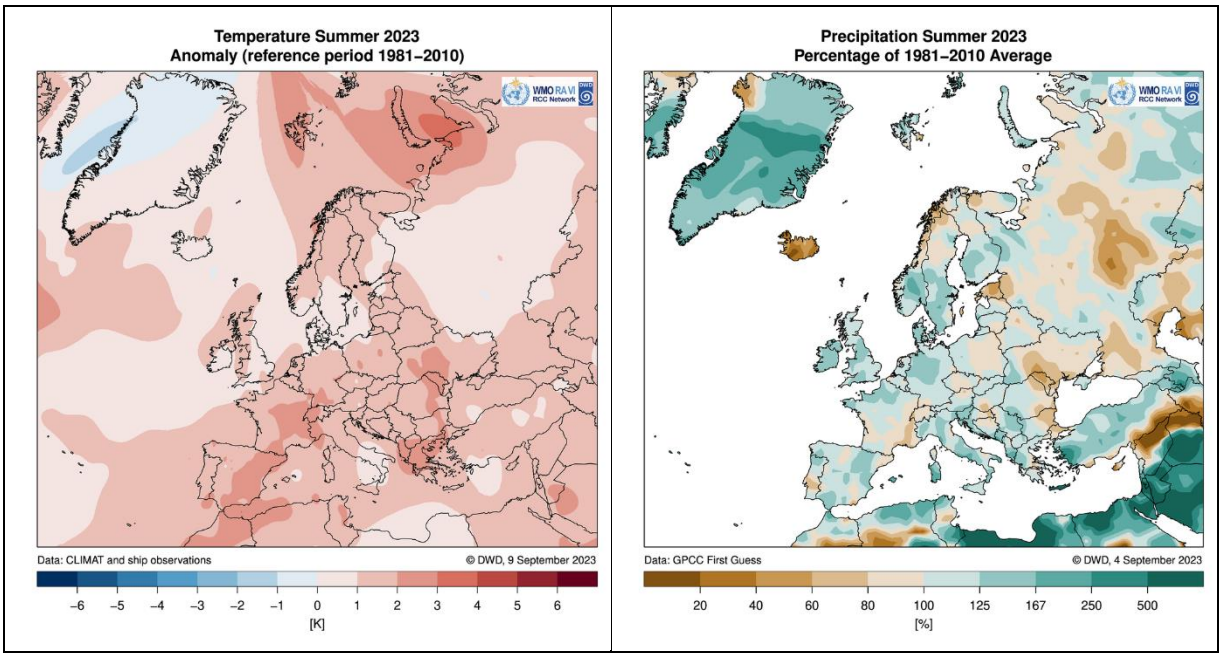


Figure 4. Summer season 2023, Europe – observed temperature anomalies (left panel) and observed precipitation anomalies in percent of 1981-2010 normal (right panel). Source: https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_month_ttt.html (left panel)
https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_month_rrr.html (right panel)

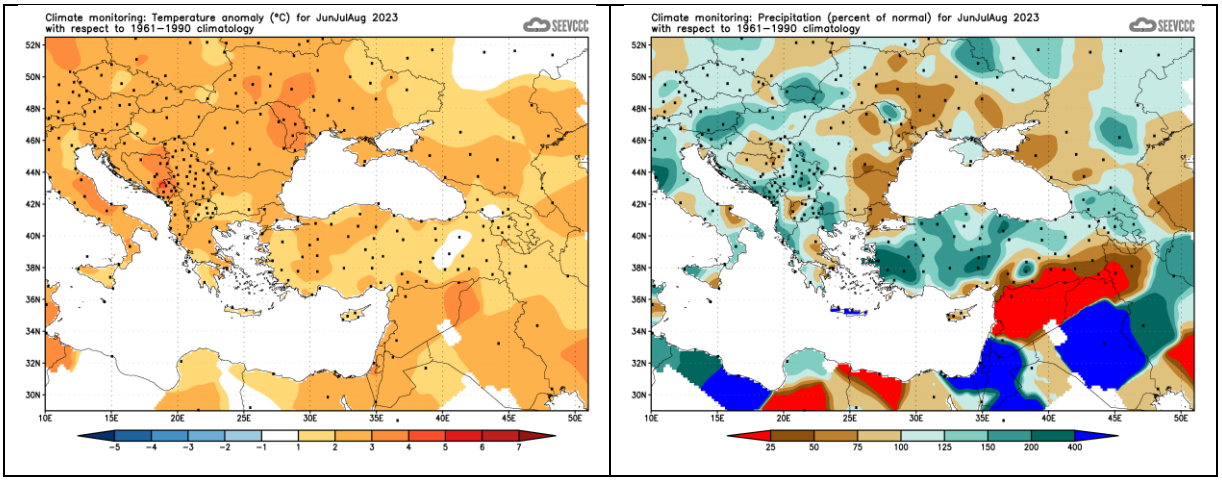


Figure 5. Summer season 2023, SEECOF region – observed temperature anomalies (left panel) and observed precipitation anomalies in percent of 1961-1990 normal (right panel). Source:
http://www.seevccc.rs/imgsrc/clim_mon/202308/temp_an3m.gif (left panel)
http://www.seevccc.rs/imgsrc/clim_mon/202308/prec_pn3m.gif (right panel)

VERIFICATION OF CLIMATE OUTLOOK FOR THE 2023 SUMMER

Summer 2023 temperature was in the above normal category in almost the entire SEECOF region, consequently, the outlook was correct except for some parts of Turkey and South Caucasus.

In most parts of the Balkans, Ukraine and South Caucasus, SEECOF-29 Climate outlook for summer precipitation was relatively correct, practically everywhere where near normal summer precipitation totals were registered. On the other hand, seasonal precipitation was characterized by positive anomalies in the southern Balkans, Aegean Sea and southern part of Turkey (more than 250% of the long-term average), consequently, the outlook for summer precipitation totals was correct for the Mediterranean part of the SEECOF region.

APPENDIX A: **Analysis and verification of the SEECOF-29 climate outlook for the 2023 summer season:**
Verification summary based on the national reports and contributions of the participants of Pre-COF of the SEECOF-30 meeting

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	SEECOF-29 climate outlook for temperature	Observed	SEECOF-29 climate outlook for precipitation	
Bosnia and Herzegovina (FBIH) (2)	**Above normal** in almost entire Bosnia and Herzegovina	**Above normal** (20, 30, 50)	**Normal in** central, north entire Bosnia and Herzegovina; **Above normal** - Mostar	**No predictive signal**	Summer June – AMS Snjeznica 50 mm (precipitation) for 30 min. Local showers (northeast Bosnia) caused flooding on smaller rivers. Flooded houses and destroyed roads. July – Flooding on smaller rivers. Local showers caused flooding on smaller rivers. Flooded houses and destroyed agricultural areas. The wind broke and felled trees. (north Bosnia and Herzegovina). 12.-19.07. very warm and extremely warm period
Croatia (2)	**Above normal**	**Above normal** (20,30,50)	**Above normal** (the largest part of the territory) **Normal** (the eastern part of Croatia)	**No predictive signal**	Summer 2023 was warm and very warm. In all three months heat waves were observed (one in June, July and August). In all three months convective related severe weather phenomena (thunderstorms, hail, heavy rains, flash floods, waterspouts) were observed mostly all over Croatia. In June, relatively often, severe thunderstorms accomanied with large amount of precipitation in short time, hail and flash floods hit mostly continental part of Croatia. Flood damage and crops damage due to hail were reported and traffic on many local road were interupted. In July convective activity was very frequent all over Croatia. Urban floods as a result of large amounts of precipitation in a short time were common. Flood damage and corps and infrastructual damage were also frequent due to very large hail. Severe thunderstorms hit large part of continental Croatia on 19th July.

					In Zagreb, due to very strong wind (wind gusts up to 115 km/h) and heavy precipitation, unfortunately three people died. In August, a few convective episodes hit mostly north Adriatic and continental part of Croatia and on 28th August whole country. Flash floods caused damage on houses and roads. From 4 to 8th August, due to heavy precipitation in Slovenia and Austria, high water levels were observed in north part of Croatia and the Mura, Drava and Sava rivers flooded relatively large area of northern Croatia. The total estimated damage amounts to 2.180.000,00 euros.
Cyprus (1)	June **Normal** July **Above normal** August **Above normal**	June **Normal** July **Normal** August **Normal**	June **Normal** July **Below normal** August **Above normal**	June **Below Normal** July SW part below normal, NE part **Above Normal** August South and East part **Below normal** and North and West part **Above normal**	**June** All of the maximum were around normal. Extreme daily maximum temperatures were also recorded with great positive deviations, such as at the station of Paphos and Achna with extreme maximum temperatures of 34.1°C and 37.5°C, respectively, which in both cases were 6.5°C above the normal maximum temperature of each station, which is 27.6°C and 31.0°C, respectively. Extremely daily minimum temperatures were also recorded with great positive deviations, like the Achna station were the minimum temperature (23.7°C) was 4.8°C higher than the normal one (18.9°C). Also, at the station of Larnaca the minimum temperature (24.1°C) was 4.7°C above normal (19.4°C). On the 13 th of June an EMMA yellow warning was issued, concerning rain and thunderstorms. **July** The mean maximum and minimum temperature was above normal in all of the selected stations. Daily maximum temperatures above normal (deviating by 4°C or more from normal) were recorded, like the highest daily maximum temperature of Achna that was 42.6°C (with a normal of 33.2°C) and the highest daily maximum temperature of Paphos Airport that was 38.1°C (with a normal of 29.9°C). Highest daily minimum temperatures were also recorded, with positive departures greater than 4°C, like the station of Larnaka where a minimum of 29.9°C was by 7.9°C above station's normal (22.0°C) and the station of Achna where a minimum of

					28.5°C was by 6.7°C above station's normal (21.8°C). During July, extremely high temperature warnings, EMMA warnings, have been issued at both the yellow risk level and the orange risk level for both the maximum and the minimum temperatures. Specifically, a total of 20 EMMA warnings for extremely high temperatures were issued; 15 of which were at the yellow risk level during the periods 13/7, 15-28/7 and 31/7, while 5 of them were at the orange risk level during the periods 13-16/7 and 23/7. **August** All average daily maximum and minimum temperatures were above normal, while the positive deviation from normal of both the average daily maximum and average daily minimum temperature is notable for the forest station at Prodromos, which is located at an altitude of 1736 meters. At all reference stations precipitation was close to normal, except from the station at Prodromos where it was below normal and the station at Athalassa where it as well above normal. At this point it is worth mentioning that the largest contribution to the total August 2023 rainfall amounts, particularly over the inland and the southeastern areas of the island, is not only due to isolated thunderstorms of thermal instability during noon and early afternoon, but also due to a disturbance which affected the island late in the evening of the 28th of August. Such disturbances, of dynamic causes, the result of which is rainfall accompanied by intense thundery activity during the evening hours, is something that does not happen often in Cyprus, especially during the month of August. Extreme maximum temperatures with positive deviations of more than 4°C were recorded, as at Prodromos station where the highest daily temperature 38.4°C was 10.4°C above the normal (28°C), that is the highest daily maximum temperature ever recorded at this station since its operation date. Also, at the station at Athalassa the extreme maximum (45.3°C) was 8.3°C above normal. Extreme minimum temperatures with positive departures of more than 4°C were also recorded. The extreme minimum (29.5°C) at Prodormos station was 11.4°C above normal which is also a record regarding the highest daily minimum

					temperature ever recorded at this station. At Larnaka airport the extreme minimum (27.2) was 4.9°C above normal. For the periods 1-4, 13-19 and 22-23 of August EMMA yellow warnings were issued, concerning high temperatures. At the same time, for the period 14-17 August EMMA orange warnings, once again concerning high temperatures, were also issued. For the periods 22 and 27-28 of August local showers accompanied sometimes with thunderstorms were recorded, resulting in accumulated precipitation of 4.9mm (or 245% of normal). On the 28th of August EMMA yellow warning was issued concerning thundery activity.
Republic of Moldova (2)	**Above normal**	**Above normal**	**Mostly below normal**	**Below, near or above normal** (33%,33%,33%)	On July 25-26, thunderstorms, hail, and squally winds with a maximum speed of 17-25 m/s were observed over most of the territory of the republic. On July 25, at the Soroca meteorological station, the wind speed reached 27 m/s, which is a extreme meteorological phenomenon. On July 26, a extreme meteorological phenomenon in the form of heavy downpour was observed at Baltata meteorological station: 53 mm of precipitation (80% of the monthly norm) fell in 2 hours. Heavy rains, in some places with hail and strong winds, caused damage to agricultural crops and economic objects.
Montenegro (2)	**Above normal**	50% **Above normal** 30% **Normal** 20% **Below normal**	**Normal** in the small part of Montenegro in the north mountainous region; **Above normal** in the largest part of the country	**No predictive signal** (33,34,33)	24.06.2023: Storm (heavy precipitation, thundering and wind gust) in whole country. In some hilly places it was followed by hail. Wind broke branches in Podgorica. 26.07.2023: Strong wind on the southern coast. 19.08.2023. Hail in Bijelo Polje and surrounding settlements (northern region). Many properties were flooded and basements. Sewage holes spilled over the gardens. The hail was falling 30 minutes affecting Plant production and several local roads. 29.08.2023. Storm impact on Podgorica (capital town). Due to strong wind one tree fell and one person was injured.

Serbia (2)	**Above normal** in most of Serbia	**Above-normal** (20, 30, 50) in entire Serbia	**Above normal** in most of Serbia, **average and below average** precipitation sums in some parts of northern and western Serbia	**No predictive signal** (33, 34, 33) in entire Serbia	11th warmest summer for Serbia since 1951. 3rd warmest summer for Serbia based on the minimum air temperature. Record-breaking number of tropical nights on Palic and Sombor. Rainy summer in the east, parts of southwestern, central and southeastern Serbia. 2nd wettest summer for Krusevac and Cuprija. Number of days with precipitation sums of 20 mm and above exceeded in Krusevac.
Slovenia (2)	**Warmer than normal** (1991–2020 reference period)	**Warmer than normal** (1981–2010 reference period)	**Wetter than normal** (1991–2020 reference period)	**No predictive signal** (1981–2010 reference period)	Temperature above average, the ninth warmest summer since at least 1950, precipitation above average, the wettest summer since at least 1950. Very unusual combination of high temperature and wet conditions. Precipitation above average in the north of Slovenia in all three summer months, very wet June and August at the national level. Very frequent thunderstorms in July, especially on 3, 12–13, 15–19, 20–22 and 24–26 July. Heavy rain, strong wind and hail caused damage over large part of Slovenia. On 1 August an isolated thunderstorm over Brkini (south west Slovenia), which later strengthened over the Ilirska Bistrica basin, hit Koseze near Ilirska Bistrica with a tornado. Several buildings were damaged. Severe storms with extreme rainfall from 3 to 6 August over the belt from Trnovski gozd to Gorenjska and the Kamnik-Savinja Alps and after that towards Koroška and north of Štajerska, causing multiple landslides, heavy floods and damage to transport infrastructure. There were reports of six casualties. The floods turned out to be the worst natural disaster since Slovenian independence in 1991, with multibillion-euro damage. Extreme extent of damage was caused by a combination of antedecedent high soil moisture and very heavy downpours during the event.

Ukraine (2)	**Above normal**	**Above normal** (western part) **Above and normal** (eastern part)	**Above normal** (28% stations) **Normal** (31% stations) **Below normal** (41% stations)	**Above normal** 33 **Normal** 34 **Below normal** 33	During summer meteorological extraordinary phenomenas were observed in many regions of the country. Heavy rains 30-80 mm precipitation with duration from 2 to 12 hours were recorded in the western, northern and north-eastern parts of the country and in Odesa region. Heavy showers 30-43 mm/hour. In Odesa was recoded 57 mm/hour 20/07/23. Storm winds and squalls (with speed 25-29 m/c) were fixed in Zakarpattia (Uzhhorod), Kyiv (Baryshivka) regions and Odesa. Localy caused loss power, telecommunications, utilities and transport.
Bulgaria (2)	**Above normal**	**Above normal**	Dry or **Near normal**	**No predictive signal**	The month of June was with normal temperatures but the month of July of 2023 is one of the three hottest for the last 25 years. There was a long heat wave in the middle and late July that compared to the longest ever in Bulgaria. But there are no beaten monthly absolute maximum temperatures. The heat wave repeated in August but with lower strength. The maximum summer temperature is 43.0 °C in Ruse on 25 July. The above normal rain in West Bulgaria in June was the cause of local floods mostly in the northwest. Then in July and August the summer turned dry. In late August there were dry conditions in southeast where fire danger increased to extreme levels. It was also associated with sustained northeasterly winds. The hot weather in late August was broke by a cold front. A thunder storm on 30 August brought lightning activity in Ruse where 2 children were killed by a flash lightning at a stadium.
The Republika Srpska, Bosnia and Herzegovina (1)	**Above normal** over entire RS entity	**Above normal** (20,30,50)	**Normal** over the most area of the RS entity	**No predictive signal**	Long lasting drought and very high temperatures caused wild fires in some parts of the Southern area, the most frequent affected region of the Republika Srpska.

Israel (1)	**Above normal**	**Above normal** (20, 30, 50)	-	-	No high impact events.
Georgia (1)	**Above normal**	**Above normal**	**Above and near normal**	**Above normal** 33 % **Near normal** 34 % **Below normal** 33 %	No high impact events.
Republic of North Macedonia (1)	**Above normal**	**Above Normal** (20, 30, 50)	**Normal to very wet on west mountainous part**	**No predictive signal** (33, 34, 33)	No high impact events.
Turkey (2)	**Above normal**	**Above normal**	**Below normal in Southeastern and Northwestern Anatolia region – Above normal at Western, northern and middle parts of the country**	**No clear signal for Turkey except southwest part – Near normal southwest region of Turkey**	Settlements were affected by forest fires in Damyeri area of Çanakkale on August 22, 2023. 11 villages were affected by the fire, which was brought under control on August 24, and 303 families were affected. Extraordinary heavy rainfall occurred at Düzce between July 8 and July 9. 122 houses flooded as a result of flooding. In addition, energy, water stations and farmlands were damaged. Turkey's maximum temperature record was broken with 49.5°C measured in Sarıcakaya - Eskişehir on August 15. August 2023, was the second hottest August in the 51 years long term period (1971-2023). Maximum temperature record was broken in 70 stations in the 2023 summer season.

Note:
1 – Basic climatological period (1981-2010)
2 – Basic climatological period (1991-2020)