Twenty-sixth Session of the
SOUTH EAST EUROPEAN CLIMATE OUTLOOK FORUM

SEECOF-26 ONLINE MEETING

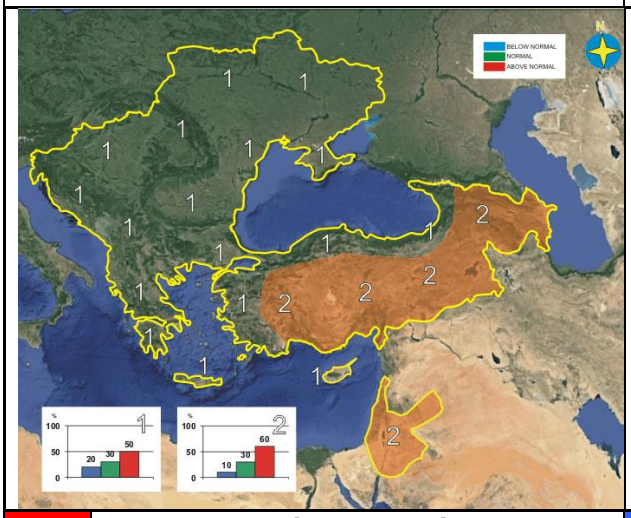
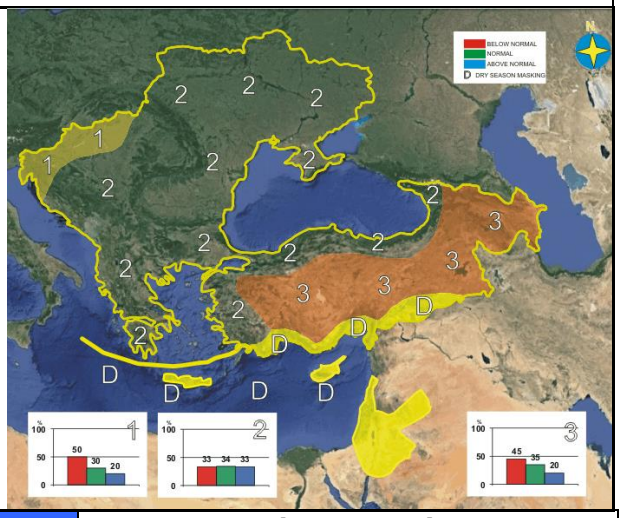
ANALYSIS AND VERIFICATION OF THE SEECOF-25 CLIMATE OUTLOOK FOR THE SUMMER OF 2021 FOR SOUTH-EAST EUROPE (SEE)

CLIMATE OUTLOOK FOR 2021 SUMMER SEASON FOR THE SEE REGION

As stated in the SEECOF-25 Consensus Statement on the Seasonal Climate Outlook for the 2021 Summer Season over South-East Europe (document: http://www.seevccc.rs/SEECOF/SEECOF-25/Step-3/Consensus%20Statement%20SEECOF-25.pdf
Winter La Nina event has weakened during the last months prior to summer, evolving toward neutral conditions, situation that was expected to continue during summer season. Positive SST anomalies appear over Atlantic Ocean, south of Greenland, and negative ones over North Sea. Within this general context, higher than normal pressures were expected over large parts of Central Europe, and lower than normal over parts of Northern Africa and Middle East.

In almost all SEECOF region (Zone 1 and 2 in Figure 1, left panel), summer temperature was likely to be above-normal with the probability increasing from the north-western to the south-eastern and eastern parts of the region. Regarding the precipitation sums, the uncertainty was high for the most of the SEECOF region where probabilities for below-, near- or above-average conditions were approximately equal (Zone 2 in Figure 1, right panel). Below-normal summer precipitation sums were predicted for the Pannonia Plain and western parts of Balkan Peninsula (Zones 1 in Figure 1, right panel), as well as for South Caucasus region and continental parts of Turkey (Zone 3 in Figure 1, right panel).

It was noted that certain parts of the country, particularly mountain regions might receive near- or above-normal summer precipitation totals 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 along the eastern coasts of Eastern Mediterranean, Crete, Israel and Jordan.

2021 Summer Temperature Outlook	2021 Summer Precipitation Outlook
	

	Above Normal		Above Normal
	Normal		Normal
	Below Normal		Below Normal

Figure 1. Graphical presentation of the Climate Outlook for the 2021 Summer Season for the SEE Region

ANALYSIS OF THE SUMMER 2021 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
- El Nino/Southern Oscillation (ENSO) Diagnostic Discussion (CPC/NCEP/NWS/IRI), http://www.seevccc.rs/SEECOF/SEECOF-26/STEP-2/CPC-NCEP-ENSO-diagnostic-discussion-14-October-2021.pdf
- Seasonal bulletin on climate in the WMO Region VI for the summer of 2021 (WMO RA VI RCC Node-CM, DWD), http://www.seevccc.rs/SEECOF/SEECOF-26/STEP-1/Analyses-Verification-of-the-SEECOF-25-Climate-outlook-for-summer-season-2021-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/202108/
- National climate monitoring reports of the following SEECOF-26 participating countries: Armenia, Bulgaria, Federation of Bosnia and Herzegovina / Bosnia and Herzegovina, Republic of Srpska / Bosnia and Herzegovina, Croatia, Cyprus, Greece, Georgia, Israel, Republic of North Macedonia, Republic of Moldova, Montenegro, Serbia, Slovenia, Turkey and Ukraine are available on:

  http://www.seevccc.rs/SEECOF/SEECOF-26/STEP-1/

The entire SEECOF region observed above-normal summer temperatures. Temperature anomalies reached up to +4ºC above normal relative to the 1981-2010 base period in the south-western Balkans. The summer temperature anomalies are shown in Figures 4 and 5 (left panel).

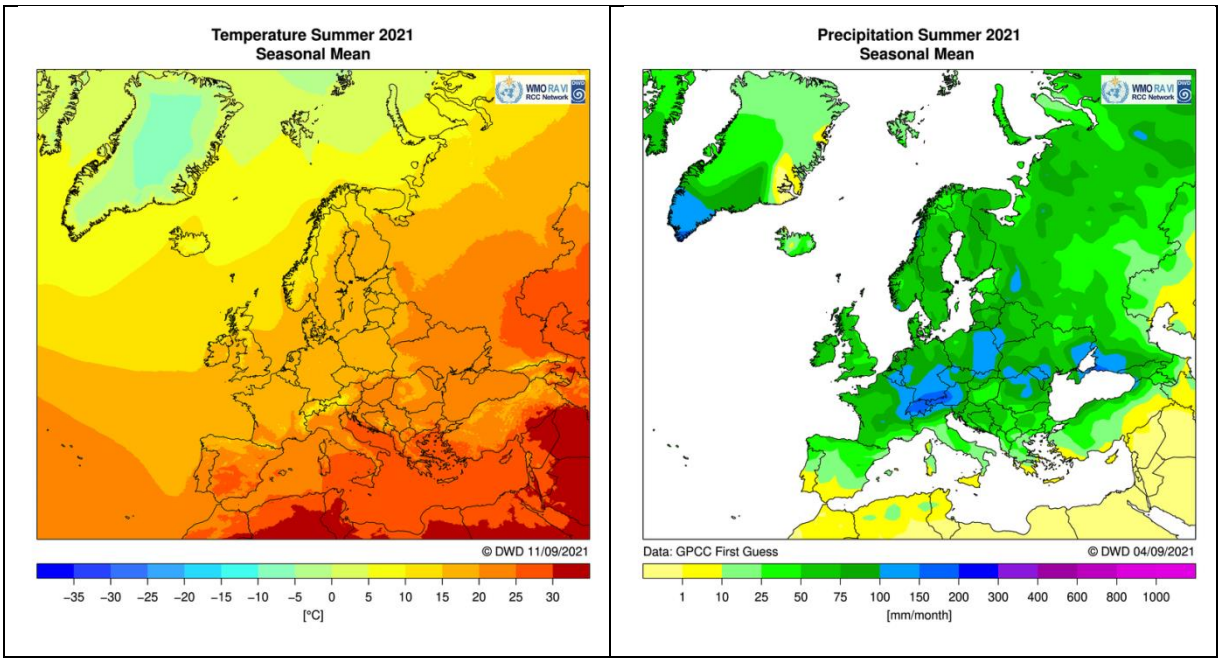


Figure 2. Summer season 2021, Europe – observed temperatures (left panel) and observed precipitation in mm per month (right panel). Source:
https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_int_ttt.html (left panel)
https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_int_rrr.html (right panel)

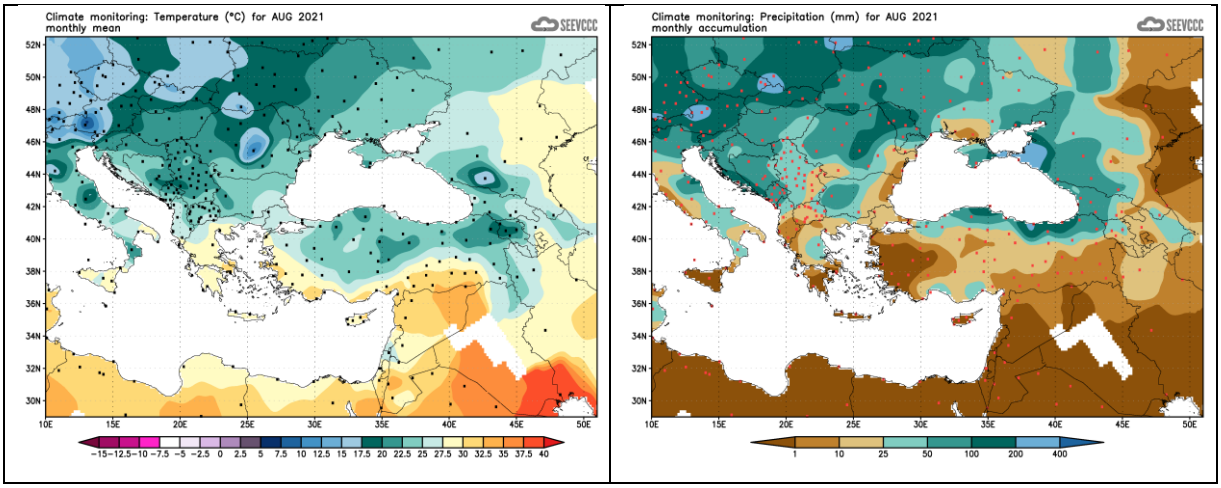


Figure 3. Summer season 2021, SEECOF region – observed temperature (left panel) and observed precipitation (right panel). Source:
http://www.seevccc.rs/imgsrc/clim_mon/202108/temp_av1m.gif (left panel)
http://www.seevccc.rs/imgsrc/clim_mon/202108/prec_tot1m.gif (right panel)

Seasonal precipitation was characterized by positive anomalies in the north-eastern Balkans, Aegean Sea, Moldova, southern Armenia and most of Turkey, as well as southern Ukraine (more than 250% of the long-term average). It was drier than normal (less than 75% of the long-term average) in the central and western Balkans, Pannonian Plain, northern Ukraine, Cyprus, southern Turkey and most part of Middle East. The summer precipitation anomalies are presented in Figures 4 and 5 (right panel).

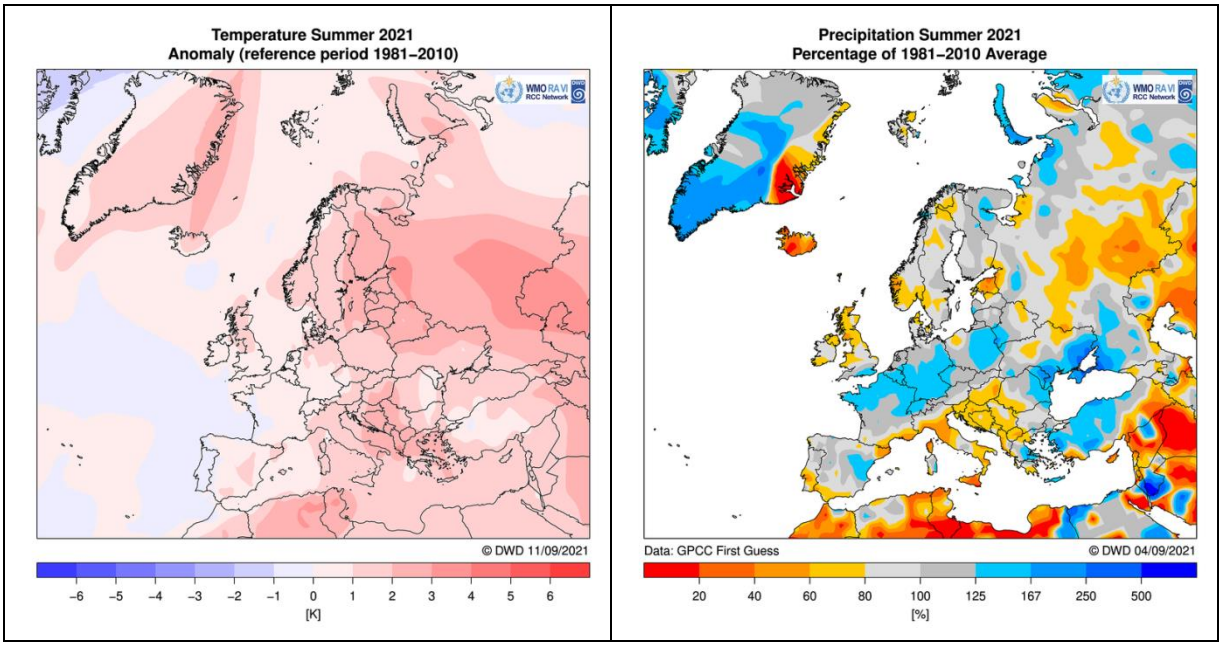


Figure 4. Summer season 2021, Europe – observed temperature anomalies (left panel) and observed precipitation anomalies in percent of 1981-2010 normal (right panel). Source: https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_int_ttt.html (left panel)
https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_int_rrr.html (right panel)

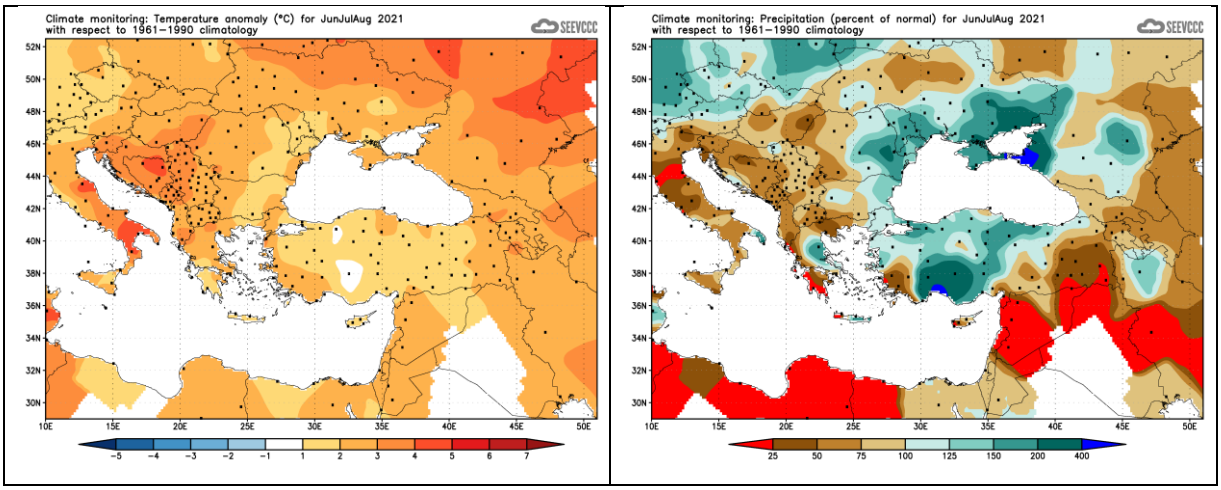


Figure 5. Summer season 2021, SEECOF region – observed temperature anomalies (left panel) and observed precipitation anomalies in percent of 1961-1990 normal (right panel). Source:
http://www.seevccc.rs/imgsrc/clim_mon/202108/temp_an3m.gif (left panel)
http://www.seevccc.rs/imgsrc/clim_mon/202108/prec_pn3m.gif (right panel)

VERIFICATION OF CLIMATE OUTLOOK FOR THE 2021 SUMMER

Summer 2021 temperature was in the above normal category in the entire SEECOF region, consequently, the outlook was correct for the whole region.

In most of the SEECOF region, SEECOF-25 Climate outlook for summer precipitation was relatively correct. On the other hand, in Turkey, Ukraine, Moldova, as well as some western and central parts of Balkans outlook for summer precipitation totals was incorrect.

APPENDIX A: **Analysis and verification of the SEECOF-25 climate outlook for the 2021 summer season:**
Verification summary based on the national reports and contributions of the participants of Pre-COF of the SEECOF-26 meeting

Country	Seasonal temperature (JJA)		Seasonal precipitation (JJA)		High Impact Events
	Observed	SEECOF-25 climate outlook for temperature	Observed	SEECOF-25 climate outlook for precipitation	
Armenia (1)	**Above normal**	**Above normal** (60,10,20)	**Below normal**	**Below normal** (45, 35, 20)	• The maximum temperature exceeded the maximum value ever observed in Areni 41.3◦C (June 25), Yerevan 41.1◦C (June 24), Ararat 41.3◦C (July 21) Heat wave and Drought: There has been a sharp increase in the number of hit days and drought in the considering period. • Heat wave observed on June 15-30, July 1-6, July 19-21, August 5-10, 27-31. The duration of the wave observed in June was quite long 15 days. The maximum deviation of the maximum temperature from the norm was 14.9◦C the maximum deviation of the average temperature from the norm was 19.1 ◦C. • Heavy rainfall In Fantan 30 mm /12 hoursin July 2 and July14, In Yerevan 33mm/3 hours (July 14), in Aparan 30mm/12 hours (8.08), in Masrik (August14) during the period 14:00-14:45, heavy rain, thunderstorm and large hail ware observed. Strong wind: 20 m / s with the gust 25 m / s, in Armavir, in Jun 5 and 20 m / s with the gust 30 m / s in June 27were observed. In the Ijevan 8-10 m / s with the gusts 25- 27 m / s in July 2, 13 and19 were observed. • Dust storm: in Ararat Valley was recorded with the wind speed of 16m/sec.

Federation of Bosnia and Herzegovina, Bosnia and Herzegovina (1)	**Above normal** in almost entire Bosnia and Herzegovina (very warm and extremely warm)	**Above normal** (10, 30, 60) In Bosnia and Herzegovina)	**Below normal** Below normal in almost entire Bosnia and Herzegovina;	**Below normal** **(**33,33,33)	• At several stations during the summer, precipitation fell below 90 mm - June Temperature record on meteorological stations: Sarajevo, Bugojno, Zenica, Gradacac, Jajce I Bjelasnica - July Temperature record on meteorological station Sarajevo Extremely warm west and central part.
Bulgaria (1)	**Above normal**	**Above normal**	**Near normal in average**	**No signal**	• The drought conditions in the height of the summer worsened the fire weather conditions. The fire weather index was at extreme levels at the end of July and the beginning of August. Fire fighters were dealing simultaneously with several major fires. Figure 5 shows the extreme fire risk for 3 August 2021. • Cooler and moist air came at the end of August to ease the drought but also brought thunderstorms and hailstorms. Lightnings stroke two people and hails devastated crop fields in South Bulgaria. Figure 6 shows the lightnings in Bulgaria on 25 August.
Croatia (1, 5)	**Above normal**	**Above normal** (20,30,50)	**Below normal** (most of central and eastern Croatia, part of mountaino us Croatia – Gorski kotar, part of North	**Below normal** (50,30,20) part of north Adriatic, part of mountainous Croatia (Gorski kotar) and part of northwestern Croatia **No predictive signal** (33,34,33)	• Summer 2021 was very warm and extremely warm. In all three months heat waves were observed (two in June and August and one in July). In June, in Daruvar and Slavonski Brod, (continental part of Croatia) there were observed maximum air temperatures which exceeded the absolute maximum on record. In all three months convective related severe weather phenomena (thunderstorms, hail, heavy rains)

Cyprus (5)	June **Normal** July **Normal to Above Normal** August **Normal to Above Normal**	June **Normal** July **Normal** August **Normal**	June **Below Normal** July **Below normal** August **Normal**	June **Below Normal** July **SWest part below Normal, NEast part above Normal** August **South and East below normal and North and West above normal**	• **June** All of the maximum temperatures were around normal. Extreme daily maximum temperatures were recorded with great positive departures, like Prodromos station where the maximum for the station was 33.1°C departing 8.1°C from the normal (25°C), and at Polis Chrysochous, where the maximum temperature of the station was 38°C was 7.7°C greater than normal of 30.3°C. Extreme daily minimum temperatures were also recorded with great positive departures, like Polis Chrysochous station where the minimum for the station was 25.9°C departing 7.4°C from the normal 18.5°C), and at Athalassa, where the minimum temperature of the station was 27.3°C was 8.2°C greater than normal of 19.1°C For the period 21-22 of June EMMA yellow warnings were issued, concerning rain and thunderstorms, whereas 27-29 of June EMMA yellow warnings were issued, concerning high temperature. • **July** All the mean maximum and minimum, were above normal. Daily maximum temperatures above normal (deviating by 4°C or more from normal) were recorded, like the highest daily maximum temperature of Pafos that was 37.3°C (with a normal of 29.9°C) and the highest daily maximum temperature of Prodromos that was 34.6°C (with a normal of 27.9°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°C was by 7°C above station's normal (22°C) and the station of Polis Chrysochous where a minimum of 26.8°C was by 5.7°C above station's normal (21.1°C). It is especially useful to be added that in Athalassa station it was recorded on July 2021, the second highest mean maximum temperature

					(39.5°C) since 1983. During July EMMA warnings with yellow awareness level were issued, concerning extreme high temperatures on for the periods 9-18 and 26-31 of July and with orange awareness level on 1 st and 2nd of July. Also, EMMA warnings with yellow awareness level were issued, concerning thunderstorms on 24th and 25th of July. On the 10th, 23rd, 24th and 25th of July local showers and thunderstorms resulted in accumulated precipitation of 38% of normal. • **August** Extremes were recorded with positive departures greater than 4°C, like Polis Chrysochous station where the highest daily maximum temperature (40.9°C) was 7.6°C greater than normal (33.3°C) and Prodromos station, where the highest daily maximum temperature (36.6°C) was 8.6°C greater than normal (28°C). Extremes were also recorded with positive departures greater than 4°C, like Athalassa station where the highest daily minimum temperature (28.1°C) was 6.2°C greater than normal (21.9°C) and Larnakas station, where the highest daily minimum temperature (28.5°C) was 6.2°C greater than normal (22.3°C). For the period 2-5 of August EMMA orange warnings were issued, while for the 6th of August and the periods 11-13, 15-16, 20-22 and 24-28 of August yellow warnings were issued. All the above warnings concerned high temperatures, except the warning on the 6 th of August that concerned thunderstorms. On the 6th , 12th, 13th and 20th of August episodes of local showers and isolated thunderstorms resulted in accumulated precipitation of 2mm (100% of normal). Hail was reported on 6th of August at Troodos. Evaluation of June's seasonal forecast for the area of Cyprus The

					seasonal forecast suggested that June's temperature would be generally normal while the Balkans and Middle East would be warmer than normal.
Georgia (1)	**Above normal**	**Above normal**	On the most territory of the country **was below and near the norm,** only several location in the eastern part of the country **was above the norm**	**Near or below normal** over all Georgia	• During the summer season, extreme weather events were observed in the form of heavy rains and hail (June-JulyAugust). The hail was mainly observed in eastern Georgia, causing damage to agriculture. Heavy rains have raised water levels on some rivers and flooded homes and farmlands.
Greece (2)	**Above normal** for the whole area of the country	**Above normal** for the whole area of Greece	Wetter than normal values in the areas of Thrace, Thessaly, east Peloponnese and areas in the central and eastern Crete. Dryer than normal values in the rest of the country	**No predictive signal** **(**33, 34, 33)	• During the period 22 June to 2 July 2021 heat wave conditions prevailed on the Greek mainland. High temperatures for the season were observed during that period, with the maximum in some places exceeding 42°C. • During 28 July to 11 August 2021 Greece experienced prolonged heat wave conditions. The main feature was the long duration of the heat wave episode, as well as the very high temperatures. During that heat wave episode, several stations had daily maximum temperature above 39 oC for 8-11 consecutive days (e.g Argos and Serres station 11 and 10 consecutive days • 10 • respectively; Larisa, Hellinikon, Astros and Tithorea stations 8 consecutive days). The highest daily maximum temperature were observed mainly during the period 1-5/8/2021, where several stations of Greek mainland recorded daily maximum temperature ≥ 45 oC (e.g on 03.08.2021 Argos station located in east

					Peloponnese recorded maximum temperature 46.3oC). Also the minimum temperature values in many stations reached and exceeded 29oC. Moreover the automatic weather station Kythira recorded the highest daily minimum temperature 34.7 oC on 04.08.2021. • Due to the heat wave conditions, a number of wildfires spread across the country that had to battle devastating blazes for nearly two weeks. The largest and most destructive fires were raged in the island of Evia (50887,6 ha burnt area according to Copernicus - https://emergency.copernicus.eu/mapping/list-of-components/EMSR527), in Attiki (north of Athens) and the southern Peloponnese region, causing thousands of evacuations, destroying hundreds of thousands of hectares of land and forest along with a number of houses and businesses, while there were two casualties. According to EFFIS (European Forest Fire Information System - https://effis.jrc.ec.europa.eu) 128300 ha were burnt in year 2021 up today, i.e 613 % above the average bunt area of 2008-2020.
Israel (5)	**Above normal**	**Above normal** (10, 30, 60)	——	——	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)	• August - Exceeded absolute maximum temperature 39.4°C on 2nd in Bitola 41.4°C on 2nd in Strumica 44.1°C on 2nd in Gevgelija.
Republic of Moldova (5)	**Above normal**	**Above normal**	Mostly **above normal**	**Below, near or above normal** (33, 34, 33)	• During the summer season, extreme weather events were observed in the form of heavy rains and hail (JuneAugust), which caused damage to crops and damage to the objects of the national economy.me and glazed ice, blizzard and black ice on roads were observed.

The Republika Srpska, Bosnia and Herzegovina	**Above normal**	**Above normal**	**Below normal**	**No signal**	• Long lasting drought and high temperatures caused wild fires in the Southernarea of the Republika Srpska. June 2021 was driest on record over 130 years; the fifth warmest June in 130 years. • The lack of JJA rainfall total, averaged over the Srpska teriitory, was -35%; the real drought was worse, due to the heat and wind, which additionally dried up the soil. • Suthern of the RS was hit by an extreme drought; dry period lasted over 100 days. This affected forest fires. • JJA Tmean anomaly counted from 1.6 to 2.8℃; JJA Tmax= 40.2℃ (Banja Luka/July 8th); JJA Tmin = 3℃ (Drinić, Sokolac/August 30th). • According to poor amount of precipitation, very high air temperatures and increased evaporation, summer 2021 is among 5 driest in the past 70 years.
Serbia (1,**5**)	**Above normal** in entire Serbia	**Above normal** (20, 30, 50) in entire Serbia	**Normal and below normal** in most of Serbia	**No predictive signal** (33, 34, 33) in entire Serbia	• Fifth warmest summer for Serbia since 1951, and 3rd warmest for Belgrade since 1888 and at Kopaonik since 1950 • 4th warmest for Valjevo since 1926 and at Zlatibor since 1950 • Up to 22 summer days, 28 tropical days and 28 tropical nights more than normal • 4th driest summer at Zlatibor since 1950.

Slovenia (5)	**Warmer than normal**	**Warmer than normal**	**Drier than normal**	**Drier than normal**	• Thunderstorms with downpour hail and also severe wind gusts between 31 July and 1 August from north-west through central and central-east of Slovenia. Flooded objects, trees down, hail damage. • Supercell thunderstorms with medium to large hail on 8 August from central to central-east of the country. Extensive damage in agriculture (especially hops), many vehicles and objects damaged. • Severe thunderstorms with downpour, hail and severe wind gusts on 15 August in eastern Slovenia. Mostly flooded objects and wind damage on roofs, trees down. Station record wind gust of 33 m/s measured in Krško.
Turkey (2)	**Above normal** **Near normal** at inner parts	**Above normal**	**Above normal** at the western and northern coast of Turkey - **Below normal** at southeastern part of the Turkey	**No clear signal** at the western and northern coast of Turkey – **Below normal** at southeastern part of the Turkey	• Settlements were affected by forest fires in 49 provinces, mainly Manavgat/Antalya, Marmaris/Muğla, between July 28 and August 12. Many houses and workplaces were burned and a total of 8 people lost their lives. • Extraordinary heavy rainfall occurred at Kastamonu and Sinop provinces between • August 9 and August 12. As a result of the flood, a total of 77 people lost their lives. In addition, settlements, energy, and communication transmission lines and highways were damaged. • Turkey's maximum temperature record was broken with 49.1°C measured in Cizre on July 20. • July 2021, was the second hottest July in the 51 years long term period (1971-2021). • Maximum temperature record was broken in 42 stations in the 2021 summer season.
Ukraine (5)	**Above normal**	**Above normal**	**Above normal (**48% stations) **normal (**32%	**Above normal (20%)** **Normal** and **below**	• During summer meteorological extraordinary phenomenas were observed in many regions of the country. Were recorded heavy rains (30-91 mm precipitation per 3-12 hours) and record rains 22/07 in Odesa 101 mm/7 hours and 126 mm/5 hours in

			stations) **below normal** (20% stations)	**(40%)**	Berdiansk (Zaporizhzhia region). • Heavy showers (30-37 mm/hour), in Teteriv (Kyiv region) was 51 mm/hour 04/07. Storm winds and squalls (with speed 25-27 m/c) were fixed in Lviv, Ivano-Frankivsk, Ternopil, Kyiv, Kropivnytsk, Odesa, Doneck, Luhansk regions. • Hail (diameter 25-30 mm) was fixed in Zakarpattia, Kyiv and Kropivnytsk regions. Unfavorable weather conditions localy caused loss power, telecommunications, utilities and transport. Summer was wet in the most of regions of Ukraine, with the exception some places of the western and nothern parts. In Svitiaz (Volyn region), Volnovaha (Doneck region), Strilcove (Kherson region), in Ai-Petri, Kerch (Crimea) were recorded maximum presipitation from 1961.

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