Thirty-second Session of the
SOUTH EAST EUROPEAN CLIMATE OUTLOOK FORUM

SEECOF-32 ONLINE MEETING

ANALYSIS AND VERIFICATION OF THE SEECOF-31 CLIMATE OUTLOOK FOR THE SUMMER OF 2024 FOR SOUTH-EAST EUROPE (SEE)

CLIMATE OUTLOOK FOR 2024 SUMMER SEASON FOR THE SEE REGION

As stated in the SEECOF-31 Consensus Statement on the Seasonal Climate Outlook for the 2024 Summer Season over South-East Europe (document:
http://www.seevccc.rs/SEECOF/SEECOF-31/STEP-3/Consensus%20Statement%20SEECOF-31.pdf

Observed sea surface temperatures showed that the moderate El Niño event present in winter has rapidly faded away, and forecast for the summer three months showed a transition to a moderate La Niña conditions. Indian Ocean Dipole (IOD) was in neutral phase, but some models showed agreement in a transition to a positive phase. Most of the Atlantic basin was experiencing above normal temperatures, and was expected to continue doing so. In the atmosphere, models showed trend to favour positive summer NAO and East Atlantic patterns, but there were divergences among models on the geopotential anomaly patterns proposed.

With this general context, above normal temperatures were expected over the entire SEECOF domain, with the probability increasing from the north (Zone 2 in Figure 1) towards the rest of the region (Zone 1 in Figure 1),

Southern, eastern and parts of central Balkans and western, central and northern Turkey were likely to experience below-normal conditions in terms of summer precipitation sums (Zone 1 in Figure 2) while in rest of the SEECOF region there were equal probability for below-, near- or above-normal summer precipitation (Zone 2 in Figure 2).

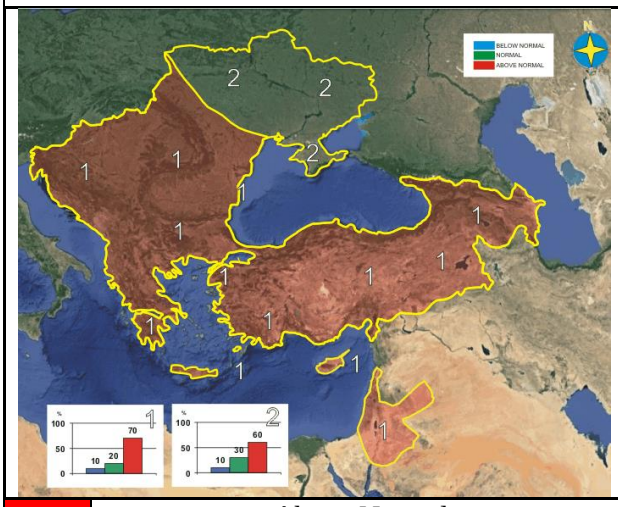
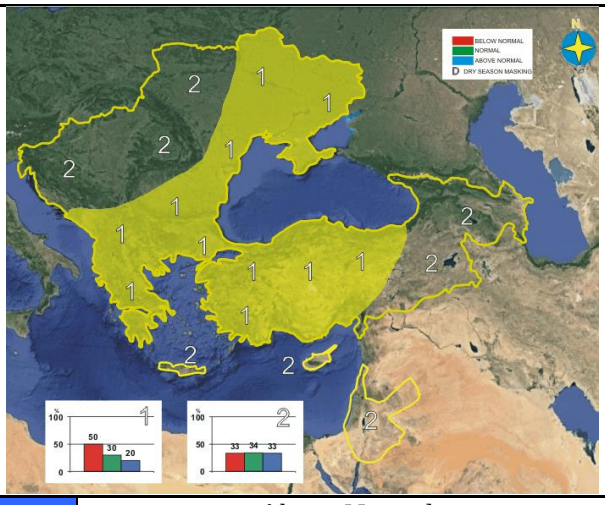
2024 Summer Temperature Outlook		2024 Summer Precipitation Outlook	
			
	Above Normal		Above Normal
	Normal		Normal
	Below Normal		Below Normal

Figure 1. Graphical presentation of the Climate Outlook for the 2024 Summer Season for the SEECOF Region

ANALYSIS OF THE SUMMER 2024 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
- 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/202408/
- National climate monitoring reports of the following SEECOF-32 participating countries: Bulgaria, Federation of Bosnia and Herzegovina / Bosnia and Herzegovina, Republic of Srpska / Bosnia and Herzegovina, Croatia, Georgia, Greece, Israel, Republic of North Macedonia, Republic of Moldova, Montenegro, Serbia, Slovenia, Turkey and Ukraine are available on:

  http://www.seevccc.rs/SEECOF/SEECOF-32/STEP-1/

Almost the entire SEECOF region observed above-normal summer temperatures, beside some parts of eastern Turkey and South Caucasus. Temperature anomalies reached up to +6ºC above normal, relative to the 1991-2020 base period, at some locations in central Balkans and southeastern Turkey. The summer temperature anomalies are shown in Figures 4 and 5 (left panel).

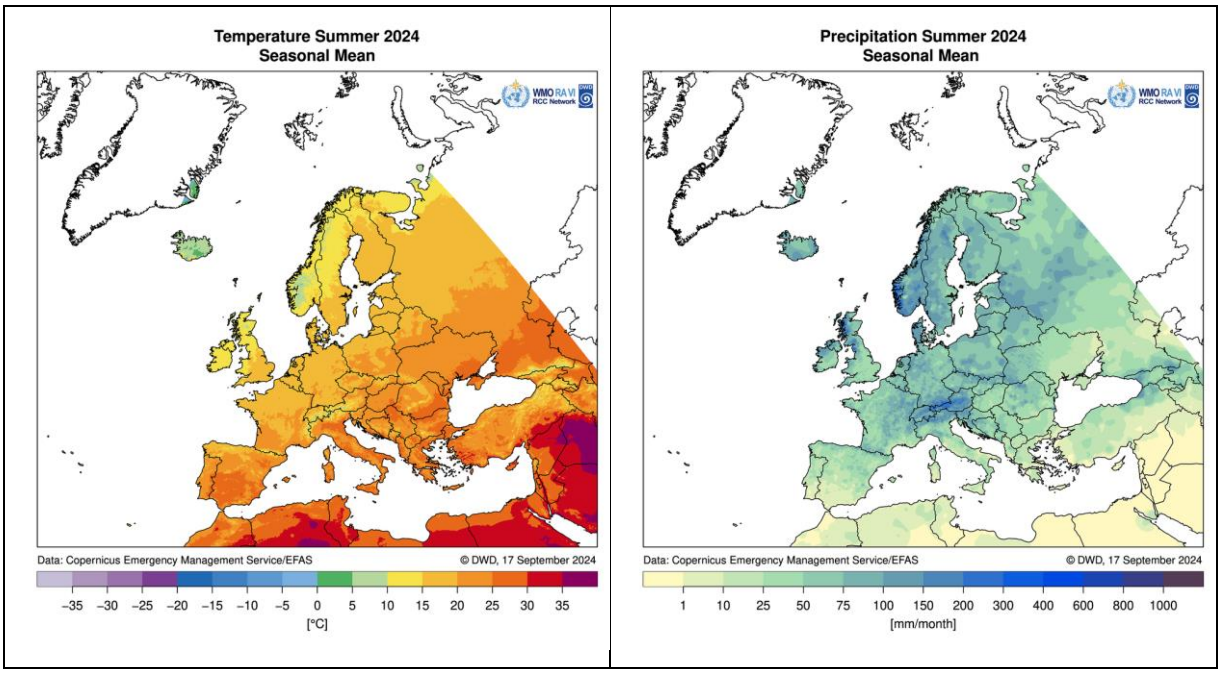


Figure 2. Summer season 2024, Europe – observed temperatures (left panel) and observed precipitation in mm per month (right panel). Source:
https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_month_ttt.html (left panel)
https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_month_rrr.html (right panel)

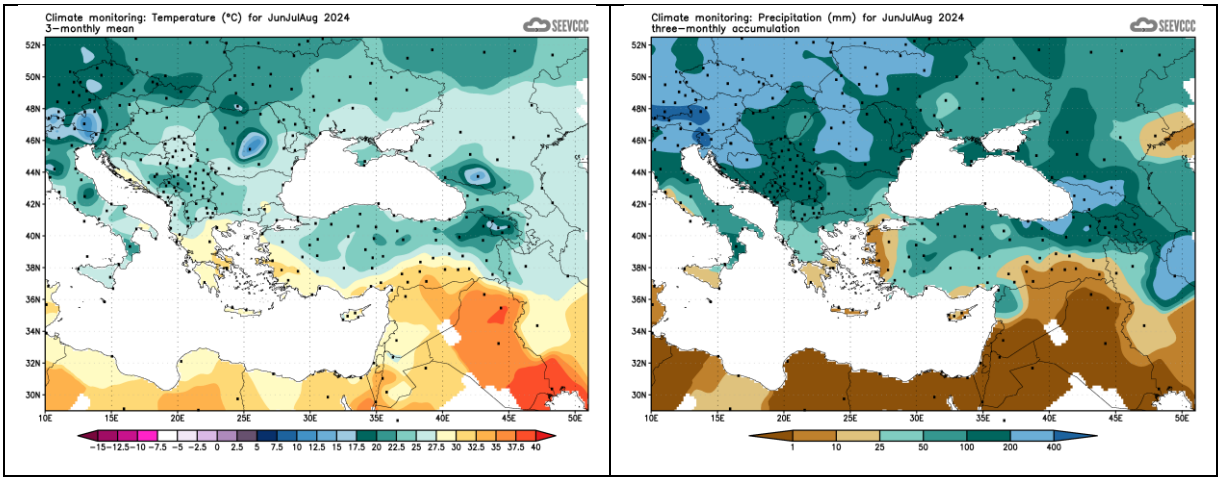


Figure 3. Summer season 2024, SEECOF region – observed temperature (left panel) and observed precipitation (right panel). Source:
http://www.seevccc.rs/imgsrc/clim_mon/202408/temp_av3m.gif (left panel)
http://www.seevccc.rs/imgsrc/clim_mon/202408/prec_tot3m.gif (right panel)

Seasonal precipitation was characterized by negative anomalies in most of the Balkans, western and southeastern Turkey and most of Ukraine, less than 40% of the long-term average in northwestern Turkey and central Ukraine. It was wetter than normal in central and northeastern Turkey, Armenia and Azerbaijan, more than 250% of the long-term average in central Azerbaijan. The summer precipitation anomalies are presented in Figures 4 and 5 (right panel).

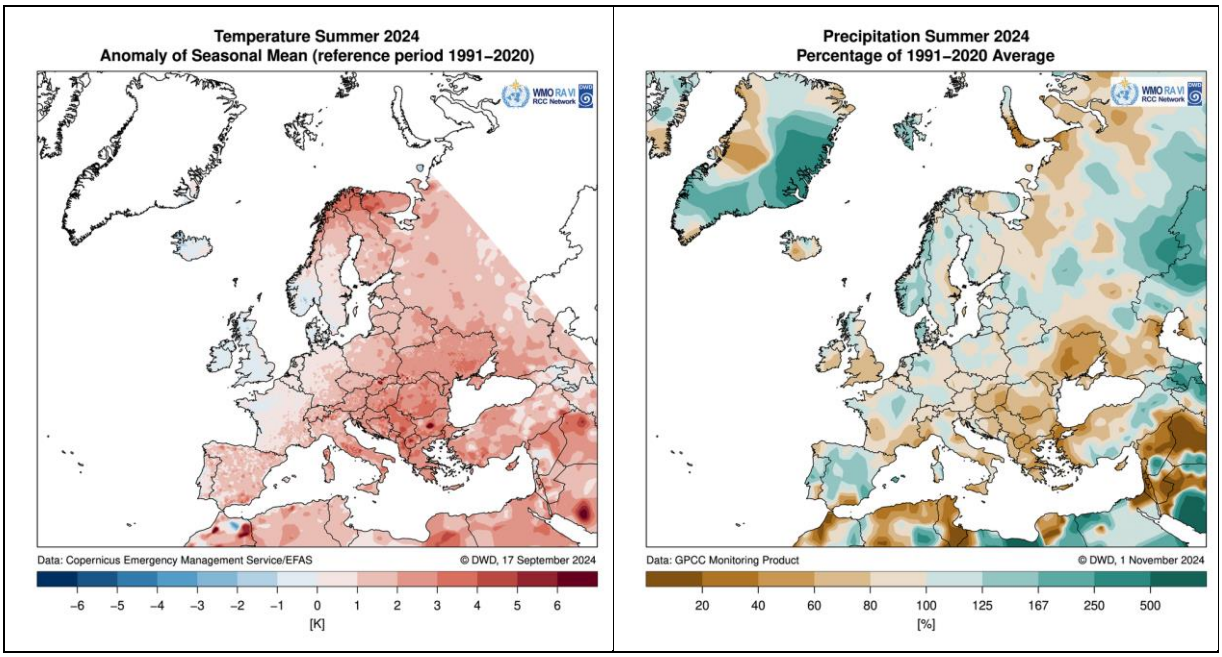


Figure 4. Summer season 2024, Europe – observed temperature anomalies (left panel) and observed precipitation anomalies in percent of 1991-2020 normal (right panel). Source: https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_month_ttt.html (left panel)
https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_month_rrr.html (right panel)

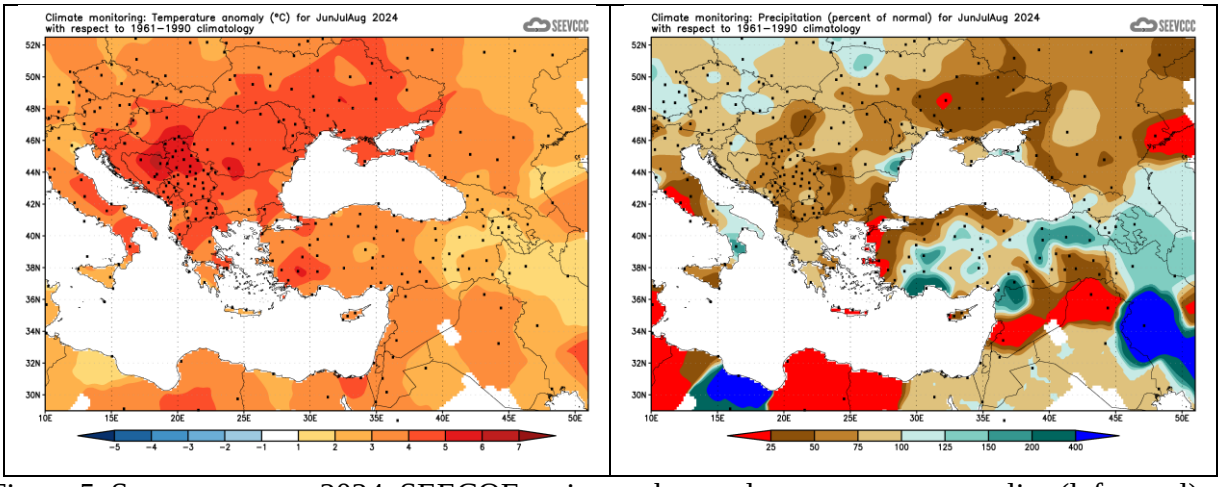


Figure 5. Summer season 2024, SEECOF region – observed temperature anomalies (left panel) and observed precipitation anomalies in percent of 1961-1990 normal (right panel). Source:
http://www.seevccc.rs/imgsrc/clim_mon/202408/temp_an3m.gif (left panel)
http://www.seevccc.rs/imgsrc/clim_mon/202408/prec_pn3m.gif (right panel)

VERIFICATION OF CLIMATE OUTLOOK FOR THE 2024 SUMMER

Positive NAO and EA for the summer 2024 were correctly forecasted. Observed values are shown in Table 1.

Table 1. NOAA-CPC modes of variability

yyyy	mm	NAO	EA	PNA	EA/WR	SCA
2024	June	0.22	1.32	1.14	-2.32	-1.24
2024	July	1.48	2.39	2.01	-0.41	-1.61
2024	August	0.69	3.67	-1.04	-0.25	-1.18

Summer 2024 temperature was in the above normal category in almost the entire SEECOF region, consequently, the outlook was correct except for some parts of eastern Turkey and South Caucasus.

SEECOF-31 Climate outlook for summer 2024 precipitation was correct for the Balkans, Cyprus, most of Turkey, Ukraine and Georgia. On the other hand, seasonal precipitation was characterized by positive anomalies in northeastern Turkey, Armenia and Azerbaijan (more than 250% of the long-term average) consequently the outlook for summer precipitation totals was not correct for this parts of the SEECOF region.

APENDIX A: **Analysis and verification of the SEECOF-31 climate outlook for the 2024 summer season:**
Verification summary based on the national reports and contributions of the participants of Pre-COF of the SEECOF-32 meeting

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	SEECOF-31 climate outlook for temperature	Observed	SEECOF-31 climate outlook for precipitation	
Federation of Bosnia and Herzegovina, Bosnia and Herzegovina ref. (1991-2020)	**Above normal** in almost entire Bosnia and Herzegovina	**Above normal** (10, 20, 70)	**Below average** in most of Bosnia and Herzegovina. **Above average** - west and southwest	**Below normal** (50,30,20)	• The warmest in July and August in entire Bosnia and Herzegovina. • The absolute maximum temperature in August was exceeded two days in a row. • The warmest summer since official measurements began.
Republic of Srpska, Bosnia and Herzegovina ref. (1981-2010)	**Above normal**	**Above normal**	**Normal or below;** locally **Above normal**	**No predictive signal** or **drier**	• No high impact events.

Bulgaria ref. (1991-2020)	**Above normal**	**Above normal** (50, 30, 20)	**Dry or near normal**	**Above normal (**50, 30, 20**)**	• The month of June 2024 is the warmest month of June in Bulgaria since 1930 and the driest for the last 30 years. • The month of July 2024 is almost as warm as the warmest month of July since 1930 – July 2012. In terms of precipitation it is as dry as July 2023. • August 2024 is among the warmest months of August since 1930 and among the driest for the last 10 years. As a result, the summer of 2024 is among the warmest if not the warmest since 1930 and among the driest since the beginning of the 21 century. • There was again a long heat wave in July and August but there are no registered record maximum temperatures. Due to the heat and the drought, the fire season was busy in July and August. The crops also experienced heat and drought stress, which reflected in the yields.
Croatia ref. (1991-2020)	**Above normal**	**Above normal** (10,20,70)	**Normal** (most of Croatia)	**No predictive signal** **Below normal** (part of Dalmatia) (50,30,20)	• Summer 2024 was extremely warm. At most stations, it is the warmest summer since measurements have been made. • In all three months heat waves were observed (3 in continental part and 4 at Adriatic coast) and they were long lasting. • 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 accompanied with large amount of precipitation in short time (Parg 154 mm, June 11) hail and flash floods hit mostly continental part of Croatia. Flood damage and corps damage due to hail were reported and traffic

					on many local road were interrupted. • 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 (Ogulin, July 28, 70 mm in 1 hour). Flood damage and crops and infrastructural damage were also frequent due to large hail (July 13, Međimurje – north Croatia). • August - a few convective episodes hit almost whole Croatia from August 17 till August 20. In Zagreb on August 20, 89,9 mm of rain was measured. Flash floods and fallen trees caused damage on houses and roads.
Georgia ref. (1981-2010)	**Above Normal**	**Above Normal**	**Near Normal,** also **Above** and **Below Normal**	**No predictive signal**	• No high impact events
Greece ref. (1981-2010)	**Above normal** for the whole area of the country**.**	**Above normal** with 70% probability.	**Drier than normal conditions** prevailed over most of Greece.	**Below normal** (zone 1, 50% below normal, 30% around normal, 20% above normal).	• The heat wave of July 2024 was the longest heat wave on record. Lasted 11 days on average and affected mainland and Ionian islands.
Israel ref. (1991-2020)	**Above Normal**	**Above normal** (70, 20, 10)	**No precipitation**	**No precipitation**	• No high impact events

Montenegro ref. (1991-2020)	**Above normal**	**Above normal** (70, 20, 10)	**Normal** in the largest part of the country **Dry** in the north-eastern part of northern region and southern coastal region **Very dry** in eastern part of northern region	**Below normal** (50, 30, 20)	• 02.07.2024: strong wind and precipitation – 2 person died (when a crane collapsed during a heavy storm, while one person died from lightning strike on the Luštica peninsula in the Bay of Kotor); • Strong wind in Nikšić caused material damage. On the coast, beach furniture was demolished, and several cars were destroyed by fallen trees; • In Podgorica and its surroundings, a large number of streets were under water, trees and electric poles were downed. • The wind in Bar uprooted parts of trees, damaged cars, as well as several vessels in the marina. • The Port of Bar suffered a lot of material damage due to the strong storm that hit Montenegro today, said the Minister of Transport and Maritime Affairs, Filip Radulović, and announced financial assistance from the Government. • Due to the strong storm, there was a problem with the electrical network in several municipalities. • -the wind was up to 200 km/h (reported by IHMS). • 05.08.2024: lightning strike: -caused Kotor forest fires, while in the village near Pljevlja house was burnt.
Republic of Moldova ref. (1991-2020)	**Above normal**	**Above normal**	**Mostly below normal**	**No predictive signal**	• On some days during the season, extreme meteorological phenomena in the form of heavy downpours and hail were observed in places across the territory: • On June 4, hail with a maximum diameter of 26 mm was observed in the area of the Nisporeni agrometeorological post;

					• On June 12, in the area of the Soldanesti agrometeorological post, 58.5 mm of precipitation fell in 3 hours, at the Bravici meteorological station, 55.5 mm fell in 4 hours; • On June 14, in the area of the Brinza hydrological post (Cahul district), 90.2 mm of precipitation fell in 12 hours; • On July 24, in the area of the Telenesti agrometeorological post, 59 mm of precipitation fell in 2 hours. Heavy rains, in places with hail and squalls, caused significant damage to national economic facilities and agricultural lands. • The increased temperature regime and significant precipitation deficit observed in the territory of the Republic of Moldova for most of the summer (July/August) contributed to the occurrence of atmospheric and soil droughts. • Due to the dry weather observed in July and August in most of the country, unfavorable conditions were created for the formation of corn, sunflower, sugar beet crops, as well as for the growth and development of vegetable and other agricultural crops.
Serbia ref. (1991-2020)	**Above normal**	**Above-normal** (10, 20, 70) in entire Serbia	**Below normal** in most of Serbia. **Average precipitation sums** in some parts	**Below normal** (50, 30, 20) in entire Serbia	• Warmest summer for Serbia since 1951. • The warmest June, July and August. • The maximum seasonal air temperature exceeded in Sombor. • In most of Serbia, the highest minimum seasonal air temperature since the record-keeping began.

			of central and southern Serbia		• Since the record-keeping began in Serbia, record-breaking minimum daily air temperature of 30,6°C was measured in Vrsac on July 13. • The maximum number of summer and tropical days, as well as tropical nights has been exceeded in most of Serbia. • Temperature humidity index – THI (feels like temperature) was above 40°C for 23 days and above 30°C for 83 days. • Five heat waves, in the middle of July and middle of August very intensive. • 4th driest summer for Novi Sad and Kopaonik, 5th driest for Cuprija, and 6th driest for Crni Vrh. • Extreme drought during July and August in most of Serbia
Slovenia ref. (1991-2020)	**Above normal**	**Above normal**	**Drier than normal** in northeastern, western, and southeastern Slovenia; **Wetter than normal** in central and eastern Slovenia	**No predictive signal**	• Thunderstorms/Squall lines on June 3, 2024: An extremely severe downpour from a slow-moving thunderstorm occurred between 17:45 and 19:15 CET, with peak rainfall intensity around 18:00 CET (15-minute interval). Although no official stations recorded the event (as they were all outside the rainfall core), radar and damage assessment suggest that approximately 100 mm of rain fell in less than an hour. Around 100 housed were flooded, some very severely. • Hail on July 1, 2024: a supercell thunderstorm developed near Grosuplje and travelled eastwards. Large hail, with a maximum size of around 4 cm (according to ESWD reports), fell particularly in a belt from Ivančna Gorica to Trebnje. Crops and cars were

					severely damaged. The event lasted less than an hour, from approximately 12:40 to 13:30 CET. • Hail on July 13, 2024: Two supercell thunderstorms developed around 15:00 CET near Celje and travelled in an ENE direction towards Lendava. Both storms produced large hail, with many places experiencing hail up to 5 cm in diameter (according to ESWD reports), and up to 10 cm in the Slovenska Bistrica region. More than 200 roofs were damaged by hail in the municipalities of Slovenska Bistrica and Oplotnica alone. Many vehicles and photovoltaic systems were also severely damaged. Later, both supercells merged near Slovenian-Croatian border and continued towards Lendava. The event ended by 18:00 CET. Rain and wind gusts also caused some damage, although the highest officially measured wind speed was only 21 m/s. • Thunderstorms/Squall lines from July 19 to 20, 2024: A chain of thunderstorms developed over northern Slovenia on the evening of July 19 and travelled southeast towards Croatian border. Many stations reported severe downpours, reaching or exceeding the 100-year return period in some places: for example, Krvavec recorded 66 mm in 60 minutes, and Gačnik near Maribor recorded 66 mm in 90 minutes (some unofficial stations reported even stronger downpours, according to ESWD database). There was flooding in many areas and some landslides, including in Logarska Dolina and near Dravograd. The village of Kokra was severely hit by a landslide, which damaged 10 houses.

Turkey ref. (1991-2010)	**Above normal** **Near normal** in eastern parts	**Above normal**	**Below normal** in western, and Southeastern parts **Above normal** in inner and northeastern parts	**Below normal** in the western and inner parts **No predictive signal** in eastern parts	• Summer 2024 was the hottest summer season on record. • June 2024 and July 2024 were the hottest months, while August 2024 ranked as the fourth hottest. • Maximum temperature records were broken at 65 stations in June 2024, 3 stations in July 2024, and 3 stations in August 2024. • Between 15 and 18 August 2024, a fire in Izmir damaged many houses and workplaces across an area of 2,159 hectares.
Ukraine ref. (1991-2010)	**Above normal**	**Above normal**	**Below normal** (55,35,10)	**Below normal** (50, 30, 20)	• During summer meteorological extraordinary phenomenas were observed in many regions of the country. • In June Heavy rains 30-98mm/4-9h were recorded in Zakarpattia, IvanoFrankivsk, Lviv, Vinnytsa, Kyiv regions. In Vylkovo (Odesa region) was recoded heavy shower 82 mm/1h. 14/06/24. • In July Storm squalls (with speed 25-28 m/c) were fixed in Kherson and Odesa regions. Heavy rains 30-65mm/2-9h were recorded in Lviv, Zakarpattia, Ivano-Frankivsk regions, heavy showers 30-38 mm/1h were in Chernihiv and Kyiv regions. • In August heavy rains 30-71mm/6- 12h were recorded in western part of the country, also in Chernihiv and Odesa regions. Locally caused loss power, telecommunications, utilities and transport. • The summer 2024 was one of the hottest since 1961, and in many regions it was the warmest on record. • The summer was dry in most regions, except for the west of the country.

					• In the eastern, central and southern parts of the country, August was the driest month, when the amount of precipitation was from 2 to 19% of the norm
Republic of North Macedonia ref. (1981 -2010)	**Above normal**	**Above normal** (70, 20, 10)	**Extremly dry to normal**	**Below normal** (50, 30, 20)	• Highest number of summer days (Tmax>25.0C). • **June** Highest value of daily Tmin 23.6°C on 23rd in Skopje. Highest value of daily Tavg 31.4°C on 21st in Strumica.