



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

SEECOF-31 ONLINE MEETING

ANALYSIS AND VERIFICATION OF THE SEECOF-30 CLIMATE OUTLOOK FOR THE 2023/24 WINTER FOR SOUTH-EAST EUROPE

CLIMATE OUTLOOK FOR 2023/24 WINTER SEASON FOR THE SEE REGION

As stated in the SEECOF-30 Consensus Statement on the Seasonal Climate Outlook for the 2023/24 Winter Season over South-East Europe (SEE) document:

http://www.seevccc.rs/SEECOF/SEECOF-30/STEP-3/Consensus_Statement-SEECOF-30.pdf

Ocean climate outlook for winter season suggested sea surface temperatures moderate to intense El Niño conditions, positive Indian Ocean Dipole and positive anomalies over most of the Atlantic Ocean. In the atmosphere, models showed cyclonic anomalies over northwestern Europe, and anticyclonic anomalies over northwestern Africa and parts of Mediterranean. Upper levels forecasted tendency to a weaker than normal Stratospheric Polar Vortex, favouring negative NAO phase for late winter, in agreement with El Niño impacts.

Analysis shows slightly overestimated El Niño and Indian Ocean Dipole forecast. Negative NAO phase was well forecasted for late winter. In addition, very warm sea surface temperature in South tropical Atlantic and near West Africa and Spain were underestimated. Cyclonic anomalies and anticyclonic anomalies over Mediterranean and Southeast Europe were underestimated.

Winter temperature was likely to be near or above-normal in most of the SEECOF region (zone 1 in Figure 1, left panel) and above-normal in Jordan, Israel, southern parts of Turkey, along the coasts of the Ionian, Aegean, Central and Eastern Mediterranean Seas with belonging hinterland (zone 2 in Figure 1, left panel). In most of the SEECOF region (zone 1 in Figure 2, right panel) winter precipitation totals were likely to be above-normal, while in the south of Greece, Turkey, Israel, Jordan, along the coasts of Ionian, southern coasts of the Aegean, southern and eastern coasts of the Black Sea (zone 2 in Figure 2, right panel), the uncertainty was high: probabilities for below, near- or above-average conditions were approximately equal.

It was noted that seasonal averages cannot provide details about short spells of weather during the season. It is possible that even in an average season spells of severe wintry weather (for

example: winter storms, very cold episodes, very wet spells) could occur and lead to significant local socio-economic impacts.

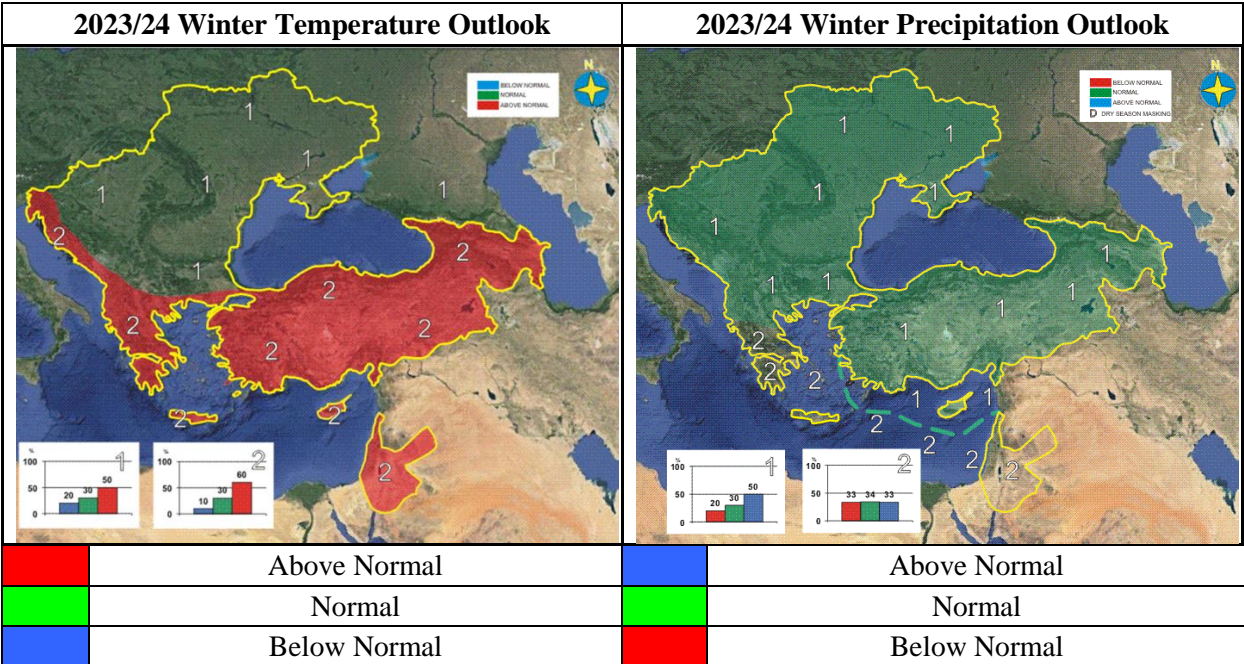


Figure 1. Graphical presentation of the Climate Outlook for the 2023/24 Winter Season for the SEE Region

ANALYSIS OF THE WINTER 2023/24 FOR THE SEE REGION

Analyses of the winter 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/202402/
- National climate monitoring reports of the following SEECOF-29 participating countries: Bulgaria, Federation of Bosnia and Herzegovina / Bosnia and Herzegovina, Croatia, Cyprus, Greece, Georgia, Republic of North Macedonia, Republic of Moldova, Montenegro, Republika Srpska / Bosnia and Herzegovina, Serbia, Slovenia, Turkey and Ukraine are available on:

<http://www.seevccc.rs/SEECOF/SEECOF-31/STEP-1/>

Winter 2023/24 seasonal mean temperature was in a range from $-5\text{ }^{\circ}\text{C}$ in the mountainous areas of the SEECOF region, to more than $15\text{ }^{\circ}\text{C}$ in the Middle East and southern part of the Ionian Sea area. In most of the low-lying regions it was between $0\text{ }^{\circ}\text{C}$ and $10\text{ }^{\circ}\text{C}$, except in northeastern Ukraine where it was lower than $0\text{ }^{\circ}\text{C}$ and eastern Mediterranean where it was up to $20\text{ }^{\circ}\text{C}$ (Figures 2 and 3, left panel). The entire region observed above-normal winter temperatures (Figures 4 and 5, left panel). Temperature anomalies reached up to $+5\text{ }^{\circ}\text{C}$ above normal, relative to the 1981-2010 base period, in most of the Balkans, Hungary, Romania, Moldova, southern Ukraine and most of Turkey.

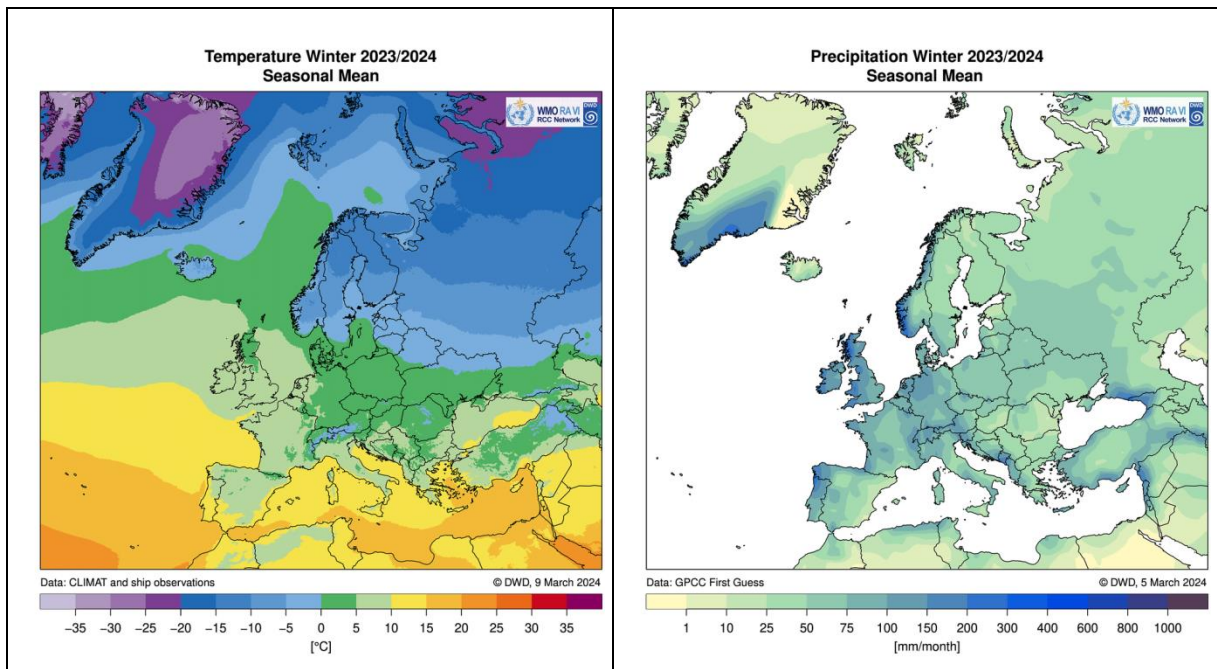


Figure 2. Winter season 2023/24, Europe – observed temperatures (left panel) and observed precipitation in mm per month (right panel). Source:

https://www.dwd.de/EN/ourservices/rccm/int/rccm_month_ttt.html?nn=790954#buehneTop (left panel)
https://www.dwd.de/EN/ourservices/rccm/int/rccm_month_rrr.html?nn=796932 (right panel)

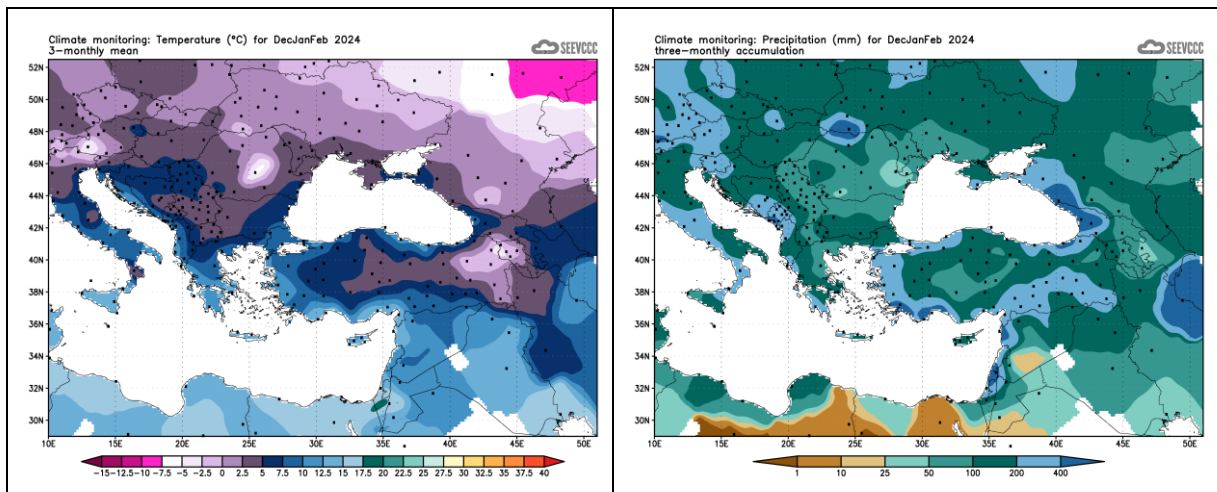


Figure 3. Winter season 2023/24, SEECOF region – observed temperature (left panel) and observed precipitation (right panel). Source:

http://www.seevccc.rs/imgsrc/clim_mon/202402/temp_av3m.gif (left panel)
http://www.seevccc.rs/imgsrc/clim_mon/202402/prec_tot3m.gif (right panel)

Seasonal precipitation totals (Figures 2 and 3, right panel) were between 200 mm and 400 mm in parts of the southwestern Balkans and western, southern and part of northern Turkey, with more than 400 mm in western Georgia, and some locations in Montenegro, southwestern Ukraine and southwestern Turkey. In rest of the SEECOF region, precipitation totals were below 200 mm. They were characterized by positive anomalies in Ukraine, most of South Caucasus region, part of eastern Turkey and part of northern Romania, up to 200% of the long-term average in northwestern Ukraine, eastern Armenia and most of Azerbaijan. It was drier than normal in almost the entire Balkans, southern Moldova, southern Romania, western Cyprus, southwestern and central part of Turkey, with less than 80% of the long-term average (Figures 4 and 5, right panel).

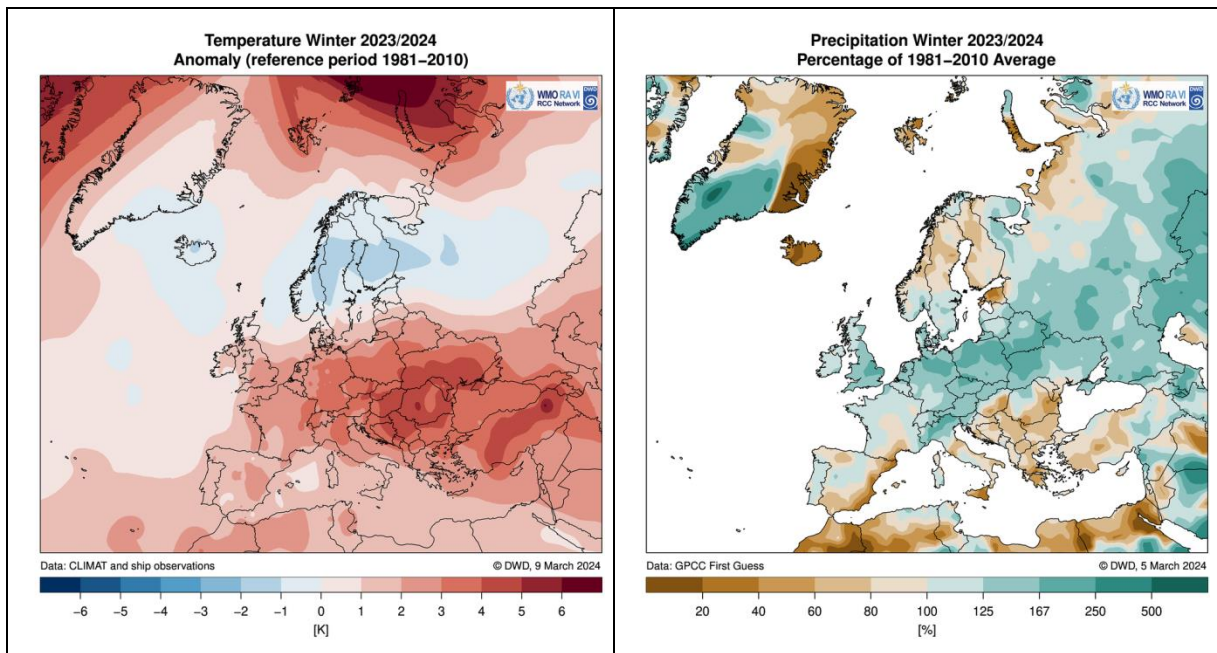


Figure 4. Winter season 2023/24, Europe – observed temperature anomalies (left panel) and observed precipitation anomalies in percent of 1981-2010 normal (right panel). Source: https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_month_ttt.html?nn=790954#buehneTop (left panel) https://www.dwd.de/EN/ourservices/rcccm/int/rcccm_month_rrr.html?nn=796932 (right panel)

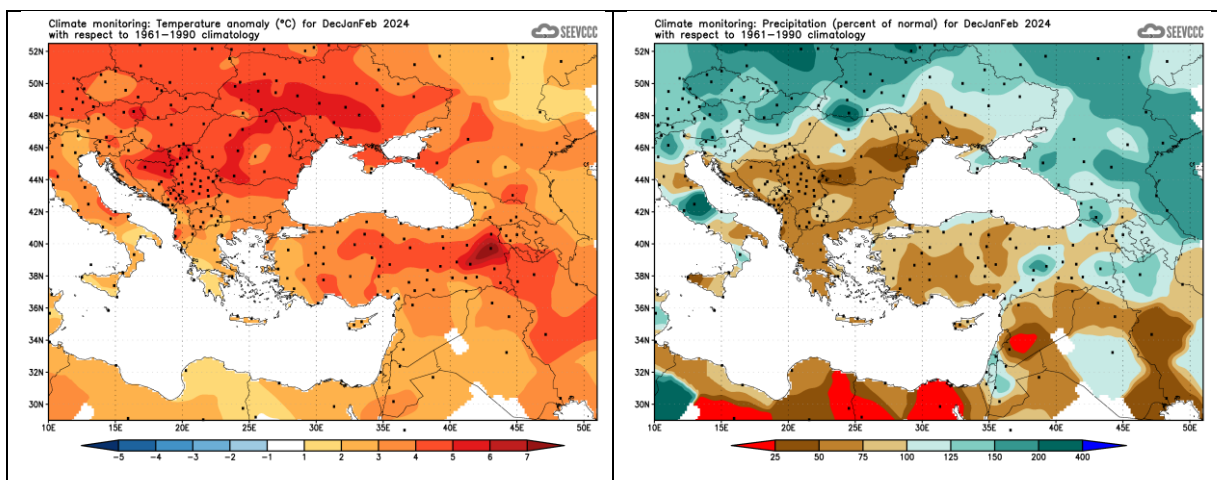


Figure 5. Winter season 2023/24, SEECOF region – observed temperature anomalies (left panel) and observed precipitation anomalies in percent of 1961-1990 normal (right panel). Source: http://www.seevcc.rs/imgsrc/clim_mon/202402/temp_an3m.gif (left panel) http://www.seevcc.rs/imgsrc/clim_mon/202402/prec_pn3m.gif (right panel)

VERIFICATION OF CLIMATE OUTLOOK FOR THE 2023/24 WINTER

Winter 2023/24 temperature was in the above normal category in the entire SEECOF region. Consequently, the outlook was correct for the SEECOF region.

In most of the SEECOF region, SEECOF-30 Climate outlook for winter precipitation was not correct. The outlook was relatively correct, forecasting above-normal precipitation sums, for most of Ukraine and most of South Caucasus. On the other hand, the outlook did not anticipate below-normal winter precipitation totals in most of the Balkans, Pannonian Plain, Carpathian Mountains and western and central Turkey.

APPENDIX A: Analysis and verification of the SEECOF-30 climate outlook for the 2023/24 winter season:

Verification summary based on the national reports and contributions of the participants of Pre-COF of the SEECOF-31 meeting

Country	Seasonal temperature (DJF)		Seasonal precipitation (DJF)		High Impact Events
	Observed	SEECOF-30 climate outlook for temperature	Observed	SEECOF-30 climate outlook for precipitation	
Republic of Srpska, Bosnia and Herzegovina ref. (1981-2010)	Above normal	Above normal	Normal to Below normal	Normal to Above normal	<ul style="list-style-type: none"> Storm winds, sometimes orcan wind gust forces, caused some material damage to buildings in the days 10-11 and 23-24 of February. 10th february: Čemerno 94km/h; Bileća 92.9 km/h; Ribnik 74 km/h; Han Pijesak 71.6 km/h 23rd february: Banja Luka 70.6 km/h; Višegrad 71.3 km/h; Čemerno 79.9 km/h; Ribnik 96.8km/h
Bulgaria ref. (1991-2020)	Above normal	Above normal	Near or Below normal	Above normal	<ul style="list-style-type: none"> All three winter months are relatively warm, with the warmest being February, which is also one of the warmest February months since 1930. With the least amount of precipitation is again February, when the monthly amounts of precipitation are below 50% of the climatic norm in most of the country. To a large extent, this also defines the whole winter as relatively dry. During the period 15–16 December, a Mediterranean cyclone moved across Greece to the east. Temperatures are quickly dropping and in many areas the rain is turning to snow. As a result of the heavy snowfall on December 16, the electricity supply was interrupted in some parts of the country. In South-West Bulgaria there are recorded freezing rain and glaze. During the period 21–23 December, two powerful cyclones developed in an area of low pressure in Northern Europe.

					<p>Bulgaria falls into the frontal zone and several atmospheric disturbances pass from west to east.</p> <ul style="list-style-type: none"> • On December 23, strong wind was recorded in many regions of the country. Hurricane wind with gusts over 40 m/s blows for 5 hours in Ruse. There were reports of broken shop windows and broken trees in the park by the Danube River. • During the period 25–27 January, the Balkans is under the combined influence of a cyclone centered over the Scandinavian Peninsula and an anticyclone centered over Western Europe. The pressure gradient in the country is increasing. As a result the wind from the northwest is increasing. On January 27, hurricane-force winds caused damage in Pazardzhik. According to data from the meteorological station in the city, the wind speed was 32 m/s. • During the period 11–13 February a Mediterranean cyclone and its associated frontal system pass. Heavy rainfall on February 11 and 12 caused landslides and an increase in the level of rivers and dams in a mountainous region in the south. On February 12, the largest 24-hour amount of precipitation for the winter season was measured - 112 mm (l/sq. m) of rain and hail at a station in the Rhodopes, where there was damage from heavy rains and strong winds.
<p>Bosnia and Herzegovina (FBIH) ref. (1981-2010)</p>	<p>Above normal in almost entire Bosnia and Herzegovina</p>	<p>Above normal (20, 30, 50) in entire Bosnia and Herzegovina</p>	<p>Below normal in almost entire Bosnia and Herzegovina</p>	<p>Above normal (20,30,50)</p>	<ul style="list-style-type: none"> • At meteorological stations Sarajevo, Bihac, Zenica and Mostar, the absolute temperature maximums for December were surpassed. • In February, snow cover was recorded only in mountainous areas. • February 2024 was the warmest February since official measurements began at many stations. • Climatological winter 2023/2024 is the warmest or second warmest winter since official measurements began.

<p>Croatia ref. (1991-2020)</p>	<p>Above normal (in whole Croatia)</p>	<p>Above normal Along the coast (10,30,60) Inland (20,30,50)</p>	<p>Below normal (part of Dalmatia)</p> <p>Normal (most of Croatia)</p> <p>Above normal (small part of Croatia)</p>	<p>Above normal (20,30,50)</p>	<ul style="list-style-type: none"> • Wind – a few episodes with gale and hurricane force gusts of bura wind (NE wind) was recorded along the Adriatic coast (December, January). Traffic between continental part and Adriatic coast were partly or completely interrupted. Maritime traffic was also partially interrupted and there were disruptions in air traffic. There was damage on roads. (One girl was injured.) • On 9th February very strong N wind with gale force gusts hit the continental part of Croatia. A construction scaffolding collapsed in Zagreb, luckily no one was injured. In February stormy jugo (SE wind) hit the Northern Adriatic – parts of the coast and beach were damaged. • Precipitation and floods – Episodes with heavy precipitation, thunderstorms and flash floods were rather frequent. • In February heavy rain, thunderstorms, often with hail, hit south part of Croatia (Metković, Neretva river valley) caused floods and flash floods. Many houses, fields and roads were flooded. Great damage was caused to greenhouses and agricultural areas. • During the winter there were several episodes with snow that caused traffic problems, mainly in mountainous Croatia.
<p>Cyprus ref. (1991-2020)</p>	<p>DEC Well Above</p>	<p>DEC Above normal</p>	<p>DEC Well Below</p>	<p>DEC Below normal</p>	<p>DEC:</p> <ul style="list-style-type: none"> • Extremes (deviating by 4°C or more from normal) were also recorded in all of the selected meteorological stations. As an example, note the

	<p>normal</p> <p>JAN Well Above normal</p> <p>FEB Well Above normal</p>	<p>JAN Above normal</p> <p>FEB Above normal</p>	<p>normal</p> <p>JAN Above normal</p> <p>FEB Well Below normal</p>	<p>JAN Below normal</p> <p>FEB Below normal</p>	<p>recorded maximum of Prodromos that was 17.1°C (with a normal of 8.3°C) and the maximum of Polis Chrysochous and Athalassa that was 26°C (with a normal of 18°C) and 25.3°C (with a normal of 17.3°C). Concerning the mean daily minimum temperatures note the recorded minimum of Larnaca airport that was 16.8°C (with a normal of 9.2°C) and the minimum of Prodromos that was 9.3°C (with a normal of 2.6°C).</p> <ul style="list-style-type: none"> • From the distribution (provisional accumulated precipitation chart) of the accumulated precipitation of December is evident that the surface distribution was well below normal reaching 50.9mm or 54% of normal. During the periods 6-12, 16 and 21-23 of December local showers and isolated thunderstorms were recorded. • For the 8th, 11th and 21st of December, yellow EMMA warning was issued concerning showers and thunderstorms. Based on the provisional data, hail was recorded on the 6th, 11th, 12th and in the 20th of the month, while there was no report for snow over Troodos. <p>JAN:</p> <ul style="list-style-type: none"> • Extreme high temperatures were also recorded, with positive departures greater than 4°C, as at Polis Chrysochou station where the highest maximum daily temperature of 23.8°C was by 7.5°C higher than normal. Also, the highest maximum daily temperature at Achna station (23.6°C) was by 7.3°C higher than normal. Extreme minimum temperatures with positive departure greater than 4°C were also
--	--	---	---	---	--

					<p>recorded. For example, at Paphos airport station the highest daily minimum temperature (17.1°C) was by 8.8°C higher than normal, while at Athalassa's and Larnaka's airport stations this was by 7°C higher than the corresponding normal one. From the provisional data recorded by the Department of Meteorology the model did not perform well over the amount of the accumulated precipitation, as the actual accumulated precipitation was more than the expected over the entire island.</p> <ul style="list-style-type: none"> • During the periods 1-5, 8-19 and 21-31 of January local showers and thunderstorms resulted in accumulated precipitation of 115.4mm or 139% of normal. It is worth mentioning that on the 10th, the 26th and the 28th of January hail was reported. Also, for the 10th and the 22nd of January, EMMA yellow level warnings for thunderstorms were issued, while on the 12th of January EMMA yellow level warning was issued for rainfall. On the 29th of January, EMMA orange level warning for thunderstorms was issued, as well. • It is worth mentioning that based on the provisional snowfall was reported for the periods 10, 12-15, 25-26 and 28-31 of January. <p>FEB:</p> <ul style="list-style-type: none"> • Extreme high temperatures were also recorded at the selected meteorological stations. Prodromos, for example, recorded a highest daily maximum of 15.2°C (with the normal being 6.7°C) and Athalassa that recorded a highest daily maximum of 22.9°C (with the normal being 16°C). Extreme low temperatures
--	--	--	--	--	--

					<p>(deviating by 4°C or more from normal) were also recorded. As an example, note the highest daily minimum temperatures of Pafos airport and Athalassa that were 17°C (with a normal of 8.1°C) and 13.2°C (with a normal of 5.3°C), respectively.</p> <ul style="list-style-type: none"> • Regarding the cumulative rain, it seems that February recorded a disappointing rainfall as it was only 55% of the month's normal. As can be seen from the distribution map of the provisional accumulated precipitation for February below, the average surface distribution reached only 38.2mm or 55% of the normal of the month. • During the periods 1-5, 9-10, 13-18, 20-21 and 25-26 of February local showers and thunderstorms were recorded. • Based on the provisional data, hail was recorded on the 9th, the 13th and the 14th of the month, while snow was recorded during the 1st of the month, during the period between 2-4, the 15th and the 18th of the month. During the periods 13-16 and 18-19 of February, yellow EMMA warnings were issued concerning showers and thunderstorms.
Greece ref. (1981-2010)	Above normal	Above normal	<p>Below normal mainly in west, central and north parts</p> <p>Near-to-normal in Attica region and eastern Aegean islands</p>	<p>Above normal in the central and south parts of Greece</p>	<ul style="list-style-type: none"> • No high impact events

Georgia ref. (1981-2010)	Above normal	Above normal	Above and near normal	Above normal	<ul style="list-style-type: none"> • No high impact events
Montenegro ref. (1991-2020)	Above normal	60% above normal 30% normal 10% below normal	Normal (central and northern mountainous region) Dry (northeastern mountainous region and southern region)	50% above normal 30% normal 20% below normal	<ul style="list-style-type: none"> • Storm: on the 27th February due to the storm, railway traffic from Belgrade to Bar was interrupted in some of its parts. Contact network and railway infrastructure was damaged.
Republic of Moldova ref. (1991-2020)	Above normal	Above normal	Near normal (65% of the territory) Below normal (35% of the territory)	Above normal	<ul style="list-style-type: none"> • During the period January 7-10, complicated weather conditions were observed in most parts of the country in the form of wet snow and snow, increased wind up to 12-17 m/s and a decrease in the average daily air temperature (January 9-10) to -9..-13°C. • The amount of precipitation during these days on 60% of the territory reached 30-58 mm (100- 170% of the monthly norm). In the 0 5 10 15 20 25 1 2 3 1 2 3 1 2 3 XII I II 2023-24 norma rest of the territory, in some places in the northern and southern regions, 15- 25 mm fell. • On January 8, extreme meteorological phenomena in the form of heavy snowfall with a precipitation amount of 23-26 mm in 12 hours were registered at

					<p>the Cornesti and Chisinau stations. The maximum height of snow cover at meteorological sites was recorded at the Balti, Cornesti, Bravica, Codrii, Chisinau and Leova stations – 18-26 cm. Also, during this period, ice deposits with a diameter of 1-6 mm were observed almost everywhere.</p> <ul style="list-style-type: none"> • Difficult weather conditions led to snow drifts and icy roads, traffic difficulties, and power outages.
<p>Serbia ref. (1991-2020)</p>	<p>Above normal in entire Serbia</p>	<p>Above-normal (20, 30, 50) in entire Serbia</p>	<p>Below normal in almost entire Serbia</p>	<p>Above-normal (20, 30, 50) in entire Serbia</p>	<ul style="list-style-type: none"> • THE WARMEST winter since 1951 and dry in most of Serbia. • Record breaking mean, mean maximum and mean minimum winter air temperature in most of Serbia. • The absolute winter maximum air temperature record was exceeded in Valjevo on December 2nd, reaching 25.6 °C. • One summer day was recorded in Valjevo, Kragujevac and Kraljevo. • Two heat waves were registered in most of Serbia. • Record low number of ice days at Crni Vrh, Zlatibor and Sjenica • Record low number of frost days at Crni Vrh and Kopaonik. • Record low number of days with snow cover in Kursumlija. • 3rd driest winter for Zajecar, 4th driest for Negotin, 5th driest for Kraljevo and Crni Vrh. • Record breaking winter sunshine duration in Kikinda, Krusevac and Kraljevo
<p>Slovenia ref. (1981-2010)</p>	<p>Warmer than normal</p>	<p>Warmer than normal</p>	<p>Wetter than normal</p>	<p>Wetter than normal</p>	<ul style="list-style-type: none"> • The warmest winter since at least the season 1950/51, • The warmest December and February since at least 1950, 15th warmest January since 1950,

			in major part of Slovenia, especially in the west and central north, normal in the south-east, parts of the north-east and at the coast		<ul style="list-style-type: none"> • Precipitation above average, the 15th wettest since 1950/51 season, • Wet December, the 19th wettest since 1950/51, and January, the 11th wettest since 1950/51, February normal at the national level but wet in the west and dry to very dry at the east.
Turkey ref. (1991-2020)	Above normal	Above normal	<p>Below normal at Western, southern, northern and middle parts of the country.</p> <p>Above normal Eastern Anatolia region and coast of the Eastern Blacksea (more than 20%).</p>	Above normal	<ul style="list-style-type: none"> • Extraordinary heavy rainfall occurred at Antalya between 12-13 February 66 houses and farmlands areas were damaged because of flood. • December 2023, was the most hottest December in the 53 years long term period (1971-2023). • January 2024, was the most hottest January in the 53 years long term period (1971-2023). • February 2024, was the second hottest February in the 53 years long term period (1971-2023). • Winter 2024, was the most hottest Winter Season in the 53 years long term period (1971-2023). • Maximum temperature record was broken in 18 stations in the 2024 winter season.
Republic of N. Macedonia ref. (1981-2010)	Above normal	Above normal	Dry to normal	Above normal (20, 30, 50)	<ul style="list-style-type: none"> • No high impact events

<p>Ukraine ref. (1991-2020)</p>	<p>Above normal</p>	<p>Above normal</p>	<p>Above normal (76%)</p> <p>Normal (17%)</p> <p>Below normal (7%)</p>	<p>Above normal</p>	<p>IN DECEMBER</p> <ul style="list-style-type: none"> • 01-02th, 13th, 21-22th heavy rain and snowfall (25-80 mm precipitation per day) in Carpathian mountains in Ivano-Frankivsk and Zakarpattia regions. • 24-25th - heavy ice (diameter 60 mm) in mountains in Zakarpattia region. <p>IN JANUARY were recorded</p> <ul style="list-style-type: none"> • 8-9th heavy snowfalls and blizzard (30 mm and wind gusts of 15 m/c for 14 hours) in Odesa region, • 7-12th heavy ice (20-30 mm) in Kropyvnytskyi and Dnipro region • 24th strong wind (gusts 25 m/c) in Ivano-Frankivsk region. <p>IN FABRUARY were recorded</p> <ul style="list-style-type: none"> • 5 th - strong wind (gusts 25 m/c) in Rivne region and • 9 th - strong wind 40 m/c in mountains in Zakarpattia region. • Unfavorable weather conditions caused loss power, telecommunications, utilities and transport. • February was the warmest in the western, southern, central parts and one of the warmest in the northern and eastern parts of Ukraine for the entire observation period. The average monthly temperature was +1..+7°C, that is 4-7°C higher than the 1991-2020 norm.
-------------------------------------	----------------------------	----------------------------	---	----------------------------	---