

Verification of the seasonal forecast for winter 2024 in Bulgaria

Ilian Gospodinov

National institute of meteorology and hydrology, Bulgaria

ilian.gospodinov@meteo.bg

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1. Verification of the seasonal forecast for winter 2024

Tables 1 and 2 show the regular Bulgarian seasonal forecast for the winter season DJF 2024 issued in September (Month-3), October (Month-2), and November (Month-1) 2023 and for the individual months of the winter season issued back up to 3 months prior to the forecast one. The column “Category” gives the assessment of the month or the season based on real data.

Table 1. Scores of the seasonal forecast of mean seasonal temperature for winter 2024.

2023-2024	Month Season	Forecast			Index	Score		
		-1	-2	-3		-1	-2	-3
Temperature	December	0	1	1	1.96	0	3	3
	January	1	1	1	1.49	4	4	4
	February	1	1	1	1.98	3	3	3
	Winter	1	1	1	2.00	3	3	3

Table 2. Scores of the seasonal forecast of seasonal amount of precipitation for winter 2024.

2023-2024	Month Season	Forecast			Index	Score		
		-1	-2	-3		-1	-2	-3
Precipitation	December	1			0.02	3	1	1
	January	1	1		0.07	3	3	1
	February	1	1	1	-1.68	0	0	0
	Winter	1	1	1	-0.86	0	0	0

In average the forecast for temperature scores 3 which is very good. In average the seasonal precipitation amount forecast scores 1 which is not sufficient. And this time the reason is that the wet winter forecast contradicted the dry season that materialized. The indifferent monthly forecast for December and January resonated well with their normal precipitation outcome.

The MedCOF/SEECOF forecast for winter 2023 was stating warm and wet season (50% chance for above normal for both temperature and precipitation) for the region of Bulgaria. The national seasonal forecast was in the same direction. The MedCOF-SEECOF temperature forecast for winter 2023, for the region of Bulgaria, was for above normal temperature and it scored “excellent”. The precipitation forecast for wet season, however, failed.

In the national forecast it was said the the winter of 2024 would be less warm but wetter than the winter of 2023. The winter of 2024 was with temperatures above normal (+2.00) and with precipitation near or below normal (-0.86). The winter of 2024 therefore was as as warm (+2.00) but drier than the winter of 2023 (-0.07).

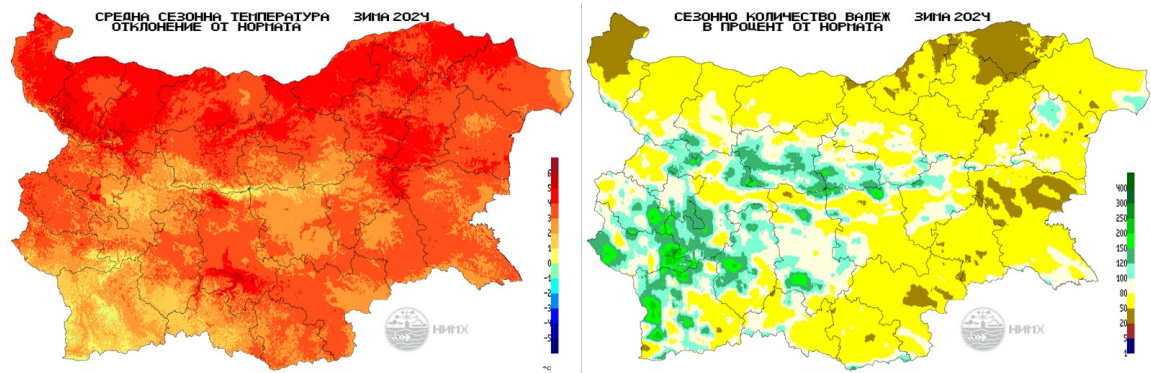


Figure 1. Departure of the seasonal mean temperature from normal (1991-2020) (left) and seasonal amount of precipitation in percent of normal (1961-1990) (right) for winter 2024 (December 2023 – January 2024 – February 2024) .

Figure 1, 2, 3, and 4 show maps of the departure from normal (1991-2020) of the seasonal/monthly mean temperature (left) and the seasonal/monthly amount of precipitation in percent of normal (1991-2020) (right) for the winter season of 2024 as a whole (Fig. 1) and the individual months of December 2023 (Fig.2), January 2024 (Fig.3), and February 2024 (Fig.4). The maps are regular operational products of the Bulgarian weather service and are given with reference to normal based on the latest period 1991-2020.

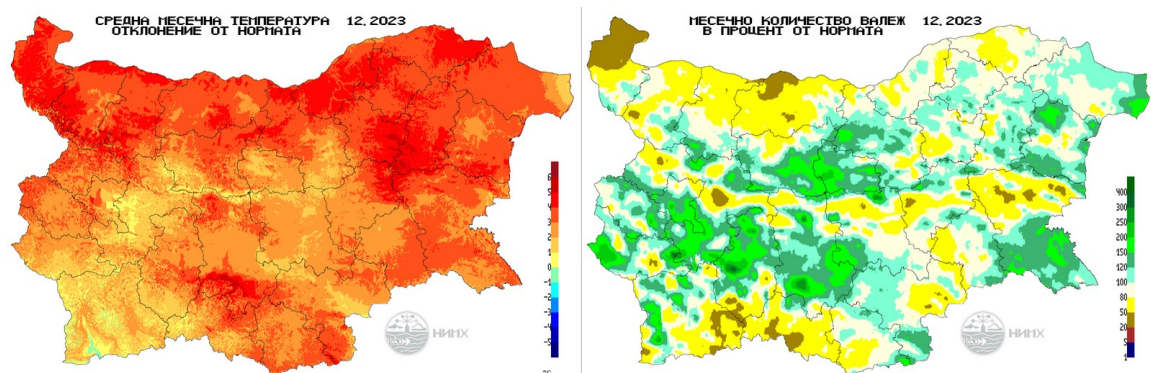


Figure 2. Departure of the monthly mean temperature from normal (1961-1990) (left) and monthly amount of precipitation in percent of normal (1961-1990) (right) for December 2023.

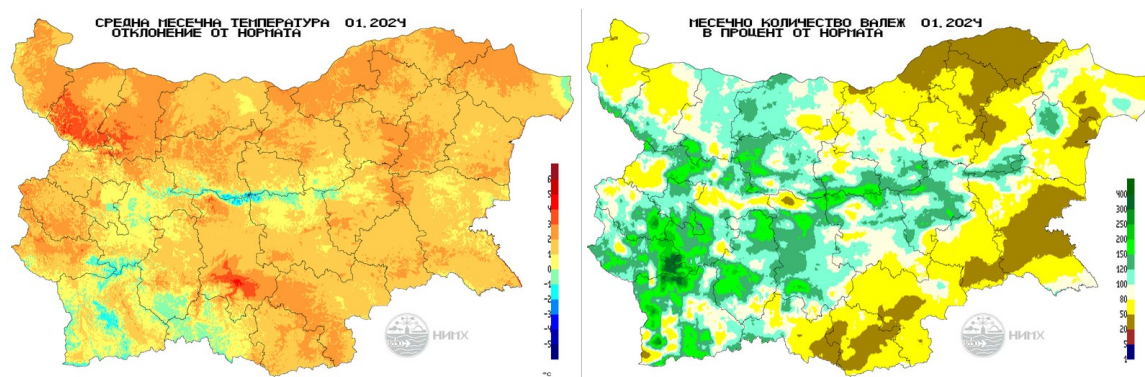


Figure 3. Departure of the monthly mean temperature from normal (1991-2020) (left) and monthly amount of precipitation in percent of normal (1991-2020) (right) for January 2024.

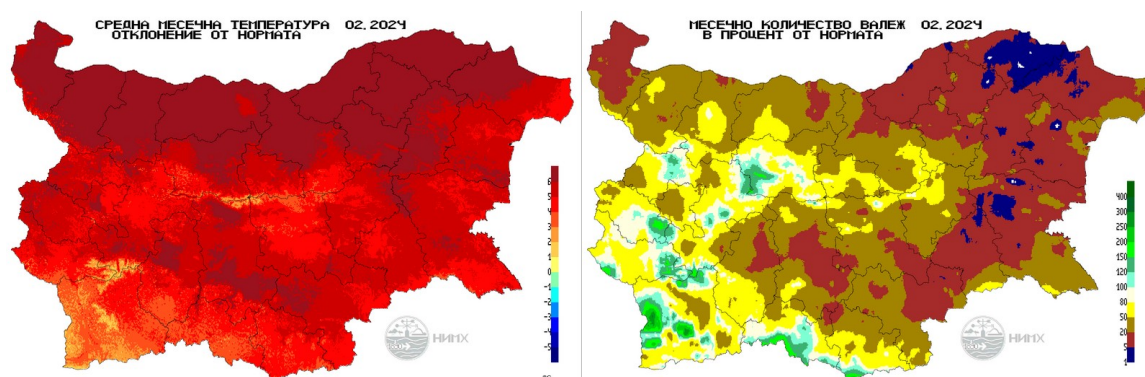


Figure 4. Departure of the monthly mean temperature from normal (1991-2020) (left) and monthly amount of precipitation in percent of normal (1991-2020) (right) for February 2024.

2. Extreme events

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. Bulgaria falls into the frontal zone and several atmospheric disturbances pass from west to east. 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 are 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.

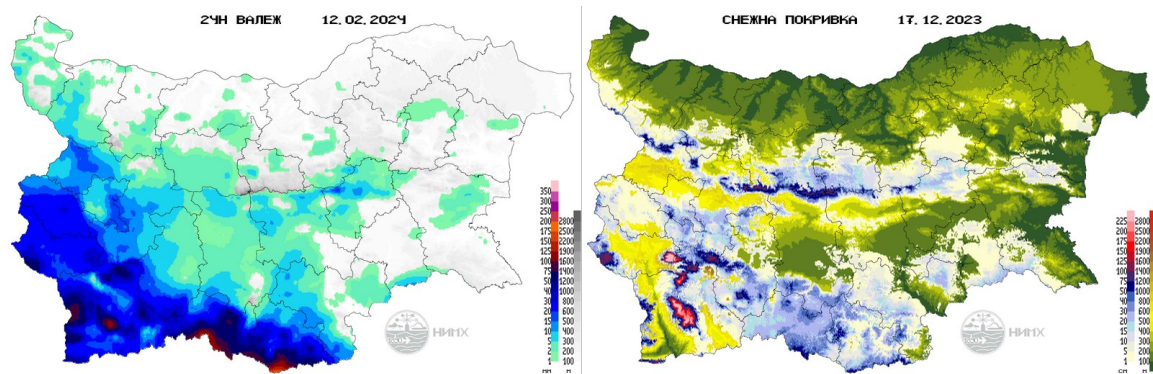


Figure 5. Daily precipitation amount on 12 February 2024 (left) and snow depth on 17 December 2023 (right)

3. Explanations

3.1 Regular seasonal forecasting in Bulgaria

The National institute of meteorology and hydrology (NIMH) is the national weather service of Bulgaria. We have been producing regular seasonal forecast for our country since 2005. It is updated once a month at the end of the month as soon as all forecast materials become available. It is based on subjective analysis of the map products from the numerical climate prediction models of the following centers or multi-model systems:





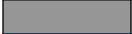
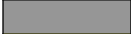

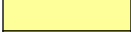






ECMWF, C3S, NMME, MetOffice, Meteo-France, NCEP

3.2 Notation rules

The categories “above normal”, “around normal”, and “below normal” by definition have an equal probability of occurrence of 33.3%. The aim of the seasonal forecast is to favor one or two of the three categories based on the analysis of all available forecast materials and assessment of the evolution of large climate structures for the upcoming months. We consider Bulgaria as a region that is relatively small compared to the spatial uncertainties of the modern seasonal forecasting materials. That is why we give a unique forecast valid for the entire country without detailing for different regions except occasionally and only for the first month based on analysis of the medium range weather forecast. The forecast is summarized in tables with the favored categories in color as follows:

We call “season” any three-month period which corresponds to the way the numerical seasonal forecast products are provided by the centers. However since 2011 the seasonal forecast is published only for the calendar season winter, spring, summer, and autumn.

The regular seasonal forecast is available to the public on the website of the institute though only in Bulgarian language.

	warm		wet
	warm to normal		wet to normal
	normal		normal
	cold to normal		dry to normal
	cold		dry
	not available		not available
	all categories are likely		all categories are likely

3.3 Verification rules

In order to quantify the seasonal forecast in terms of categories below, around, and above normal we do the following. Since we give a unique forecast for the expected category for the entire country we need to have a unique assessment of the category of a given month or season. The assessment of the category is based on data from 20 meteorological stations distributed evenly in the country. The data from each of those 20 stations are analyzed. These are records of mean monthly temperature and monthly amount of precipitation from 1950 to present. The percentiles for below, around, and above normal are found for each station based on the latest possible 30-year period 1980-2009. This period is chosen in order to match the base periods of some if not all of the climate centers producing probability map. This reference period is also more suitable to give monthly or seasonal category that would correspond better to the perception of the public. This should be especially true for the thermal category because of the recent overall warming trend. The months and seasons therefore can be attributed a certain category numbered from -2 (below normal) to +2 (above normal). These numbers for all 20 stations and for each individual month or season are then averaged in order to produce a unique category number for the entire country. The forecast itself is also attributed a number that reflects the forecast category. The numbers are -2 (below normal), -1 (below

or around normal), 0 (around normal), +1 (above or around normal), and +2 (above normal). In order to assess the skill of our forecast we find the difference between the forecast and the real category. If it is within ± 0.5 we consider that the forecast is excellent (4), within ± 1.0 – very good (3), within ± 1.5 – good (2), and above it is considered to be poor (0). If there is no given preference to any of the three categories we attribute score (1) reasonable, because at least the forecast is not misleading.

References:

Monthly bulletin of the National institute of meteorology and hydrology, Sofia, Bulgaria.

<https://bulletins.cfd.meteo.bg/>

Seasonal forecast for Bulgaria. Latest issue available online (<http://www.meteo.bg/en/forecasts/seasonal>).