Verification of the seasonal forecast for winter 2023 in Bulgaria

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1. Verification of the seasonal forecast for winter 2023

Tables 1 and 2 show the regular Bulgarian seasonal forecast for the winter season DJF 2023 issued in September (Month-3), October (Month-2), and November (Month-1) 2022 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 2023.

2022-2023	Month	Forecast				Score		
	Season	-1	-2	-3	Index	-1	-2	-3
Temperature	December	0	1		2.00	0	3	1
	January	1	1		2.00	3	3	1
	February	0	1	1	1.56	0	3	3
	Winter	1	1		2,00	3	3	1

Table 2. Scores of the seasonal forecast of seasonal amount of precipitation for winter 2023.

2022-2023	Month	Forecast				Score		
	Season	-1	-2	-3	Index	-1	-2	-3
Precipitation	December	1			-0.52	0	1	1
	January	0			1.21	2	1	1
	February	-1		-1	-1.41	4	1	4
	Winter			1	-0.07	1	1	2

In average the forecast for temperature scores 2 which is good. In average the seasonal precipitation amount forecast scores 1.6 which is not sufficient. But the reason is that there was indifferent forecast for many of the lead times.

The MedCOF/SEECOF forecast for winter 2023 was stating warm or normal (40% chance for above and for near normal) season with no specific forecast for precipitation in 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 near or above normal temperature and it scored "very good". The precipitation forecast for no signal has not been graded.

In the national forecast it was said the the winter of 2023 would be similar to the winter of 2022 or colder and with less precipitation. The winter of 2022 was with temperatures above normal (+1.98) and with precipitation near or above normal (+0.79). The winter of 2023 therefore was as warm (+2.00) as winter 2022 and with less precipitation (-0.07).
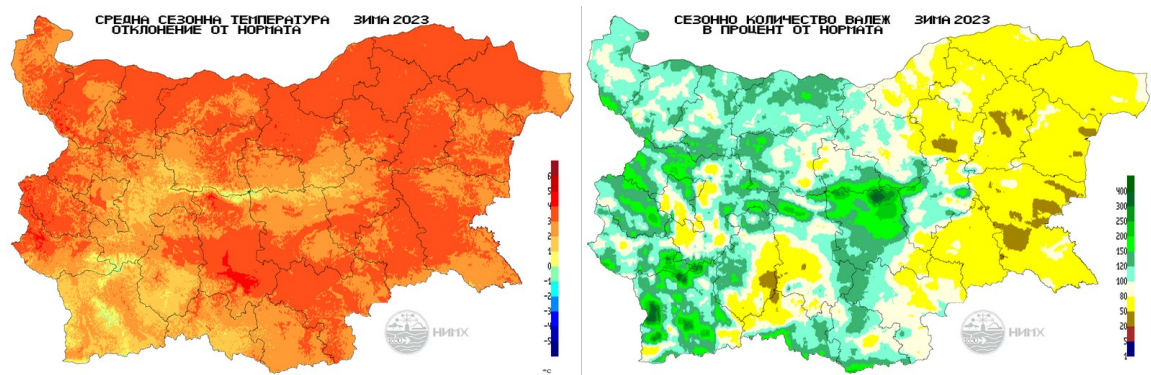

Figure 1. Departure of the seasonal mean temperature from normal (1991-2020) (left) and seasonal amount of precipitation in percent of normal (1961-1990) (right) for winter 2023 (December 2022 – January 2023 – February 2023) .

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 2023 as a whole (Fig. 1) and the individual months of December 2022 (Fig.2), January 2023 (Fig.3), and February 2023 (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.
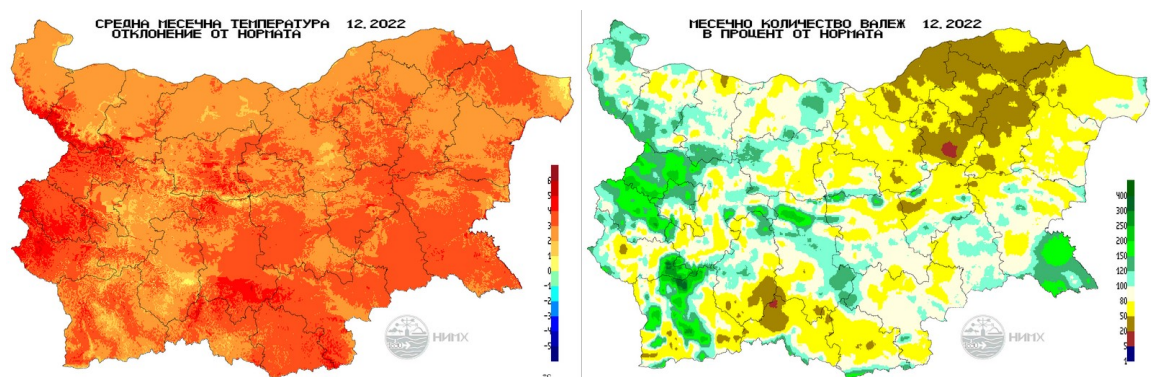

Figure 2. Departure of the monthly mean temperature from normal (1961-1990) (left) and monthly amount of precipitation in percent of normal (1961-1990) (right) for December 2022.
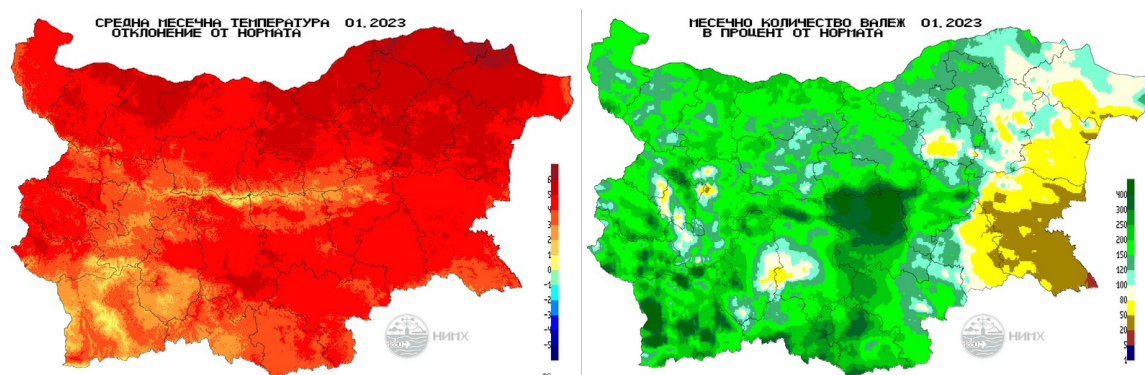
Figure 3. Departure of the monthly mean temperature from normal (1991-2020) (left) and monthly amount of precipitation in percent of normal (1991-2020) (right) for January 2023.
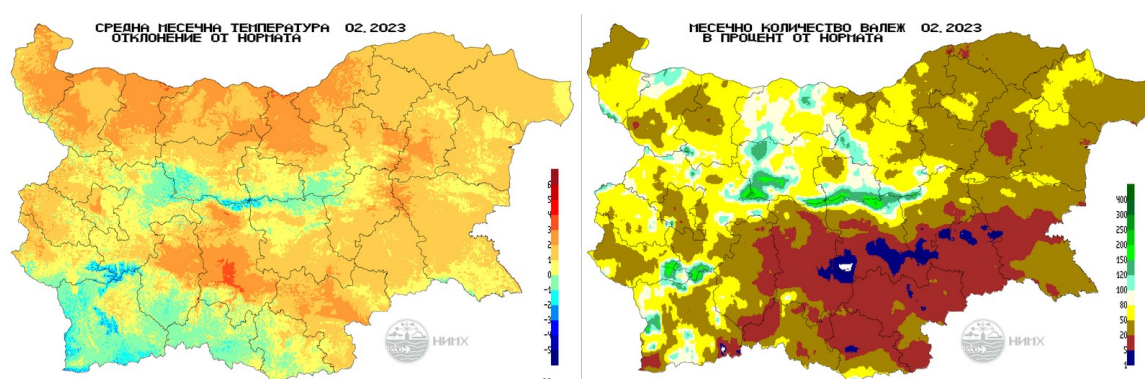

Figure 4. Departure of the monthly mean temperature from normal (1991-2020) (left) and monthly amount of precipitation in percent of normal (1991-2020) (right) for February 2023.

2. Extreme events

The winter of 2023 was very warm – among the warmest for the last 20 years. December 2022 (fig. 2 right)and February 2023 was even drier (Fig. 4 right). January 2023 was marked by heavy rain in part of Central Bulgaria which lead to local floods. There was a state of emergency declared in a number of municipalities in South central Bulgaria (Fig. 5 left). The zonality of the winter circulation favored strong wind events and there was a number of them in all three winter months. The biggest snow event was in February (fig 5 right) but it was not exceptional.
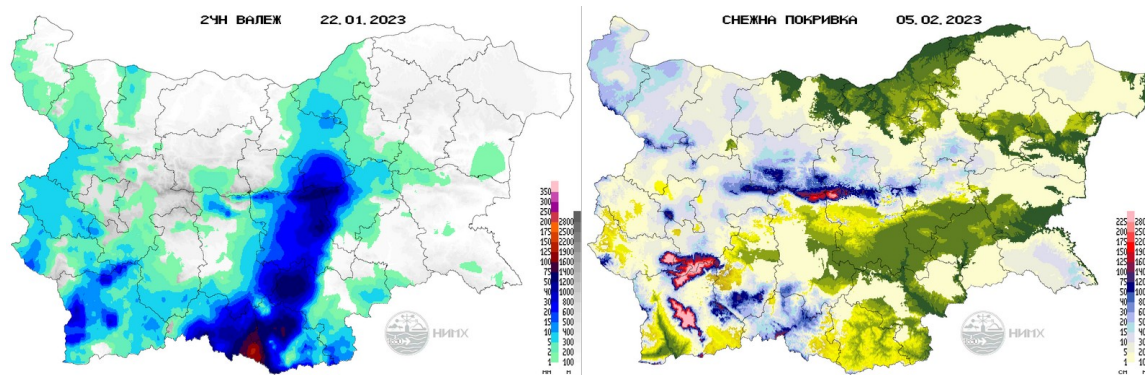
Figure 5. Daily precipitation amount on 21-22 January 2023 (left) and snow depth on 05 February 2023 (right)

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.

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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).