

# Verification of the seasonal forecast for winter 2021 in Bulgaria

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22 April 2021, Sofia

## 1. Verification of the seasonal forecast for winter 2021

Tables 1 and 2 show the regular Bulgarian seasonal forecast for the winter season DJF 2021 issued in September (Month-3), October (Month-2), and November (Month-1) 2020 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 2021.

Temperature	Forecast			Category	Score		
	Month-1	Month-2	Month-3		Month-1	Month-2	Month-3
December	1	1	1	1.89	3	3	3
January	1	1	1	1.98	3	3	3
February	1	1	1	1.80	3	3	3
Winter	1	1	1	2.00	3	3	3

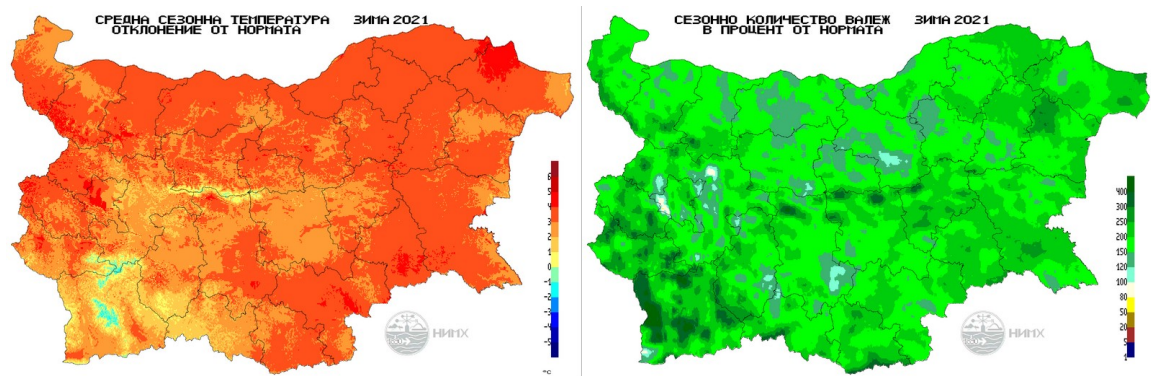
**Table 2.** Scores of the seasonal forecast of seasonal amount of precipitation for winter 2021.

Precipitation	Forecast			Category	Score		
	Month-1	Month-2	Month-3		Month-1	Month-2	Month-3
December	0		-1	1.41	2	1	0
January	0	-1		2.00	0	0	1
February	0	-1	-1	-0.47	4	3	3
Winter	-1		-1	1.95	0	1	0

In average the forecast for temperature scores 3.0 which is very good. In average the seasonal precipitation amount forecast scores 1.25 which is not sufficient.

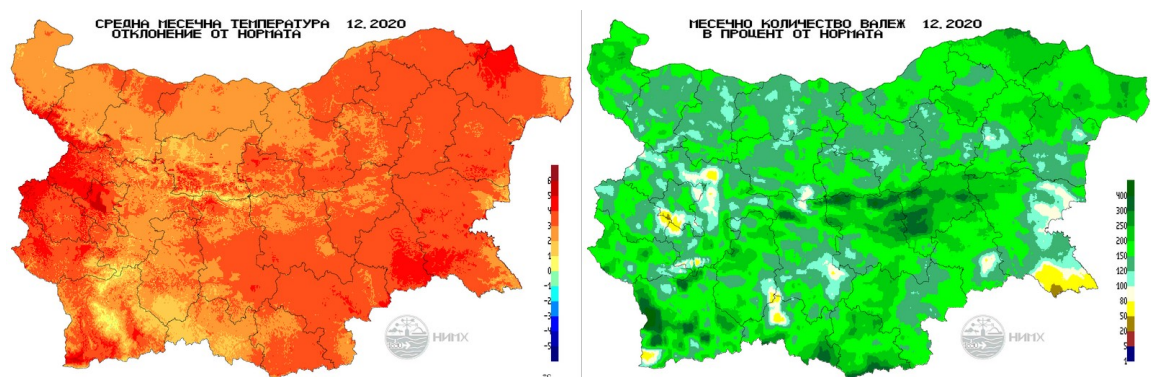
The MedCOF/SEECOF forecast for winter 2021 was stating warm (50% chance for above normal) and dry (50% chance for below normal) season or no signal for precipitation in the region of Bulgaria. The national seasonal forecast was in the same direction but with weaker probabilities. The MedCOF-SEECOF temperature forecast for winter 2021, for the region of Bulgaria, was for near or above normal temperature and it scored “very good”. The precipitation forecast was for near or below normal or no signal and it is not sufficiently good. Nevertheless the fact the no preference was given in the forecast in October shows the uncertainty was partially captured.

In the forecast it was said the the winter of 2021 would be similar to the winter of 2020 or less warm and with more precipitation. The biggest reason was that the winter of 2020 was very warm and dry. The winter of 2020 was with temperatures above normal (1.98) and with precipitation near or below normal (-1.06). The winter of 2021 therefore was indeed as warm (2.00) as winter 2020 but a lot wetter (1.95).

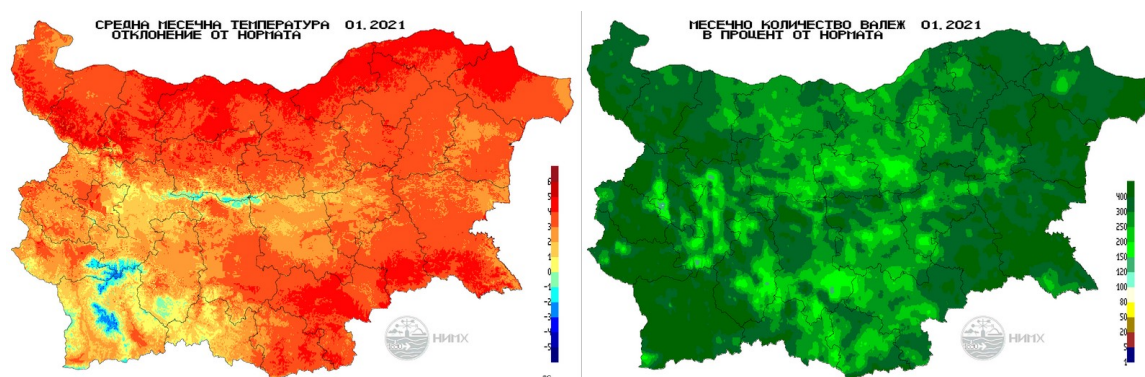


**Figure 1.** Departure of the seasonal mean temperature from normal (1961-1990) (left) and seasonal amount of precipitation in percent of normal (1961-1990) (right) for winter 2021 (December 2020 – January 2021 – February 2021) .

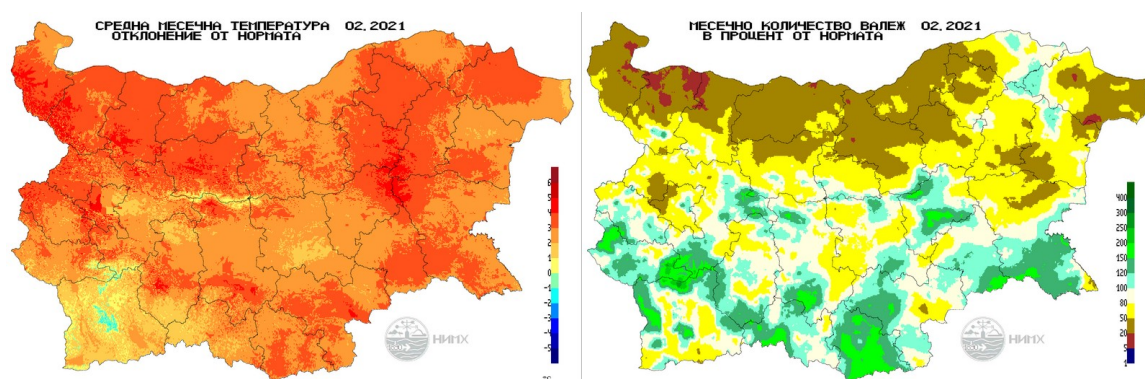
Figure 1, 2, 3, and 4 show maps of the departure from normal (1961-1990) of the seasonal/monthly mean temperature (left) and the seasonal/monthly amount of precipitation in percent of normal (1961-1990) (right) for the winter season of 2021 as a whole (Fig. 1) and the individual months of December 2020 (Fig.2), January 2021 (Fig.3), and February 2021 (Fig.4). The maps are regular operational products of the Bulgarian weather service and are therefore given with reference to normal based on the period 1961-1990.



**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 2020.



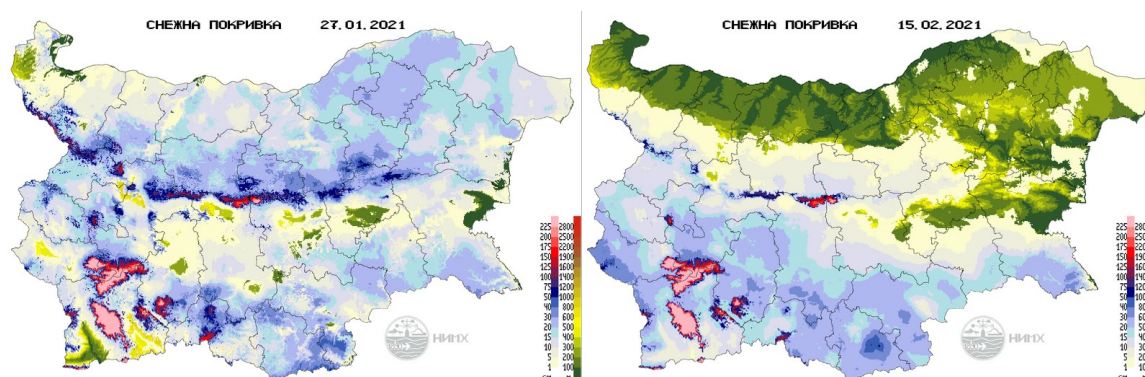
**Figure 3.** Departure of the monthly mean temperature from normal (1961-1990) (left) and monthly amount of precipitation in percent of normal (1961-1990) (right) for January 2021.



**Figure 4.** Departure of the monthly mean temperature from normal (1961-1990) (left) and monthly amount of precipitation in percent of normal (1961-1990) (right) for February 2021.

## 2. Extreme events

The winter of 2021 was extremely warm and extremely wet. It is among the three warmest and the three wettest winters for the last 70 years. January 2021 is also among the three warmest and the three wettest months of January for the last 70 years. There were at least two wet events in the month of January with abundant snow that cut electricity supply to regions and caused landslides on roads. The big monthly precipitation amounts and the winter warmth led to a lot of rain and filled the water dams – some of the at low levels due to the previous drought. Some of the water dams overflowed and caused floods downstream. The big rains continued in the beginning of February and caused floods in the southeast of the country. There was a big snow event in Southwest Bulgaria in middle February.



**Figure 5.** Snow depth on 27 January 2021 (left) and on 15 February 2021 (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




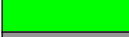










#### 3.2 Notation rules

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  $\pm 0.5$  we consider that the forecast is excellent (4), within  $\pm 1.0$  – very good (3), within  $\pm 1.5$  – 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. Latest issue available online ( <http://www.meteo.bg/meteo7/sites/storm.cfd.meteo.bg/meteo7/files/Bulletin.pdf> ) and older issues available on demand.

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