Verification of the seasonal forecast for summer 2023 in Bulgaria

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1. Verification of the seasonal forecast for summer 2023

Tables 1 and 2 show the regular Bulgarian seasonal forecast for the summer season JJA 2023 issued in March (Month-3), April (Month-2), and May (Month-1) 2023 and for the individual months of the summer 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 summer 2023.

		Forecast				Score		
2023	Month Season	-1	-2	-3	Index	-1	-2	-3
Tempera-ture	June	0	1	1	0.22	4	3	3
	July	1	1	1	1.98	3	3	3
	August	1	1	1	1.98	3	3	3
	Summer	1	1	1	1.98	3	3	3

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

		Forecast				Score		
2023	Month Season	-1	-2	-3	Index	-1	-2	-3
Precipita-tion	June	1			0.37	3	1	1
	July	1			-0.62	0	1	1
	August	-1			-0.32	3	1	1
	Summer	1			-0.49	2	1	1

In average the forecast for temperature scores 3.1 which is very good. In average the seasonal precipitation amount forecast scores 1.3 which is insufficient but reasonable because there was "no signal" forecast for lead times -3 and -2 months. The score for lead time -1 month is 2.0 which is good.

The MedCOF/SEECOF forecast for summer 2023 was stating warm (50% chance for above normal) and unpredictable for precipitation season for the region of Bulgaria. The national seasonal forecast for temperature was in the same direction. The MedCOF-SEECOF temperature forecast for summer 2023, for the region of Bulgaria, is “excellent” for temperature. It can not be scored for precipitation because of the “no signal” forecast.

In the last summer forecast it was said that the season should have been less warm and with more precipitation than the summer of 2022. The summer of 2022 was with temperatures above normal (1.91) and with precipitation near normal (-0.27). Summer 2023 therefore was warmer (1.98) and drier (-0.49) than the summer of 2022.

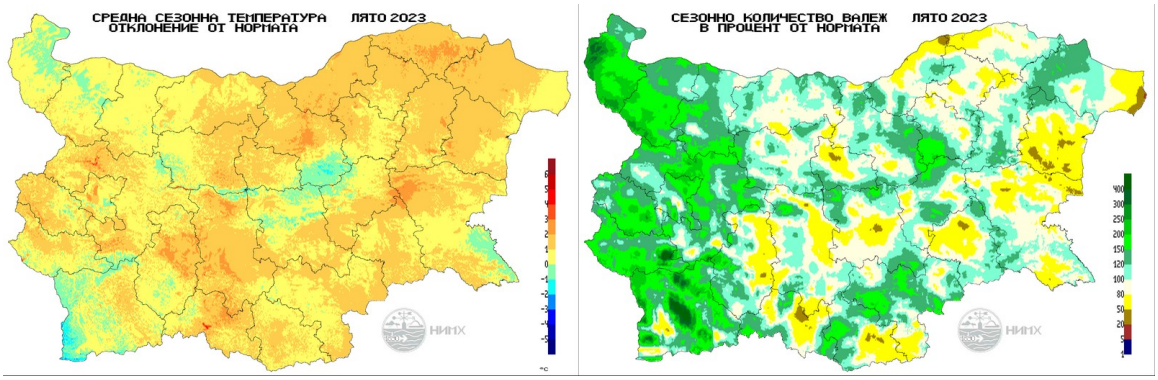


Figure 1: Departure of the seasonal mean temperature from normal (1991-2020) (left) and seasonal amount of precipitation in percent of normal (1991-2020) (right) for summer (June-July-August) 2023.

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 summer season as a whole (Fig. 1) and the individual months of June 2023 (Fig.2), July 2023 (Fig.3), and August 2023 (Fig.4). The maps are regular operational products of the Bulgarian weather service and from this year are given with reference to normal based on the period 1991-2020.

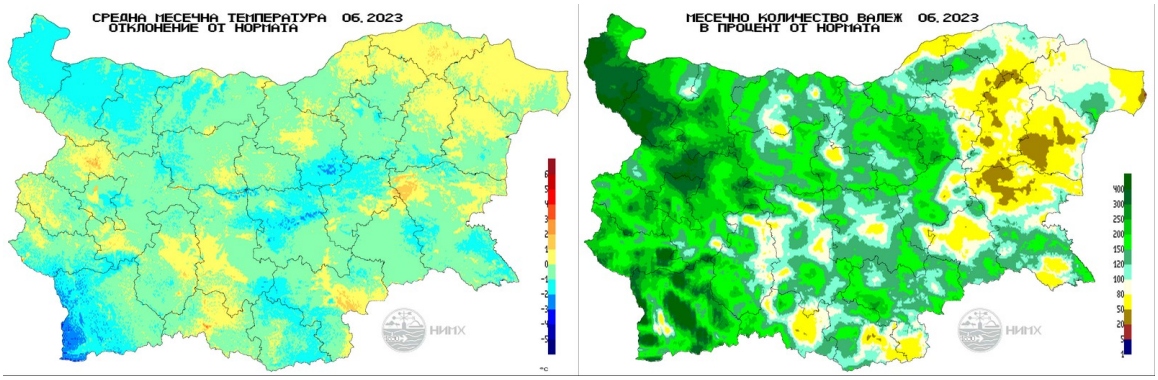


Figure 2: Departure of the monthly mean temperature from normal (1991-2020) (left) and monthly amount of precipitation in percent of normal (1991-2020) (right) for June 2023.

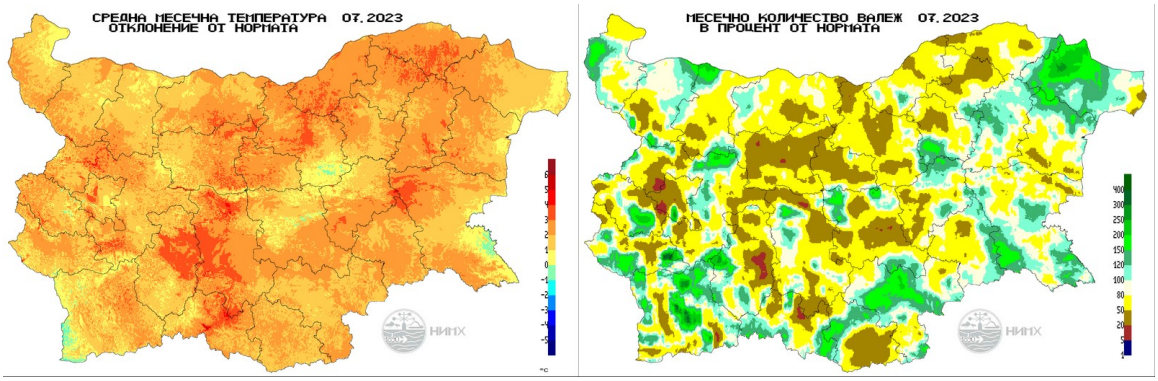


Figure 3: Departure of the monthly mean temperature from normal (1991-2020) (left) and monthly amount of precipitation in percent of normal (1991-2020) (right) for July 2023.

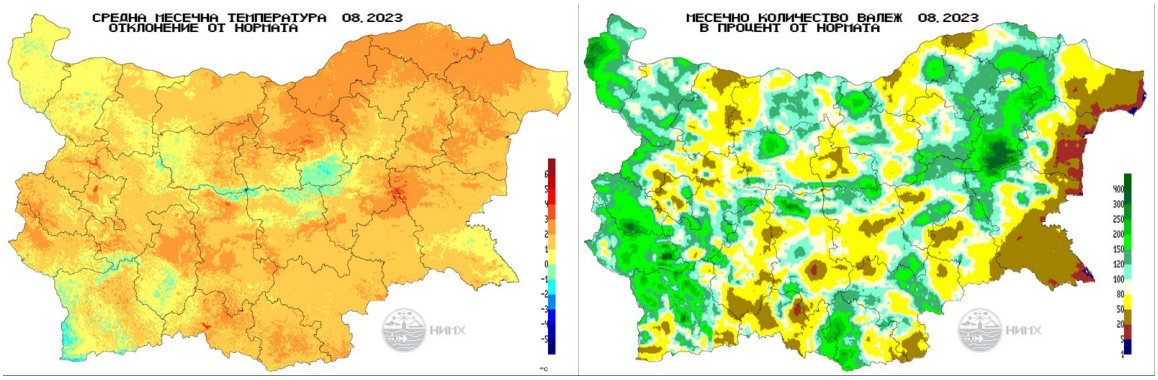


Figure 4: Departure of the monthly mean temperature from normal (1991-2020) (left) and monthly amount of precipitation in percent of normal (1991-2020) (right) for August 2023.

2. Extreme events

The month of June was with normal temperatures but the month of July of 2023 is one of the three hottest for the last 25 years. There was a long heat wave in the middle and late July that compared to the longest ever in Bulgaria. But there are no beaten monthly absolute maximum temperatures. The heat wave repeated in August but with lower strength. The maximum summer temperature is 43.0 °C in Ruse on 25 July. The above normal rain in West Bulgaria in June was the cause of local floods mostly in the northwest. Then in July and August the summer turned dry. In late August there were dry conditions in southeast where fire danger increased to extreme levels. It was also associated with sustained northeasterly winds. Figure 5 shows the extreme fire risk for 21 August 2023.

The hot weather in late August was broke by a cold front. A thunder storm on 30 August brought lightning activity in Ruse where 2 children were killed by a flash lightning at a stadium. Figure 6 shows the lightnings in Bulgaria on 30 August.

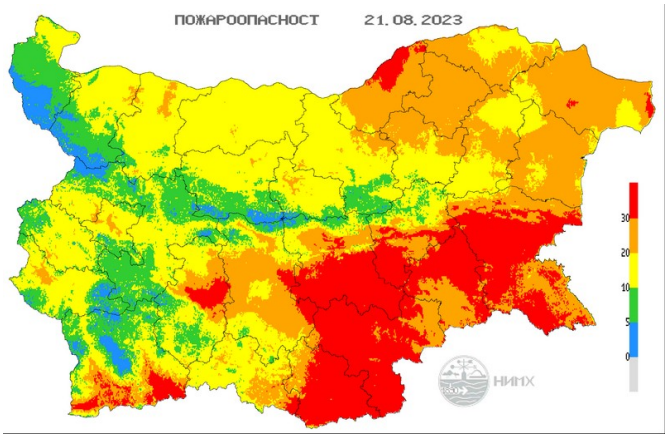


Figure 5: Fire weather index on 21 August 2023.

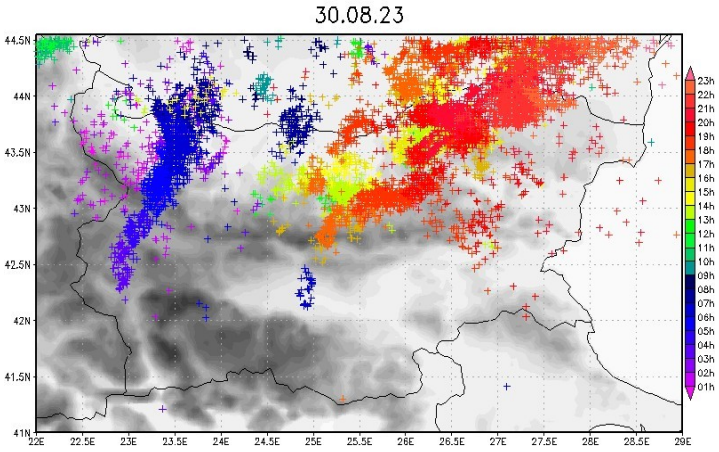


Figure 6: Lightnings on 30 August 2023 (from ATDNet, G. Anderson and D. Klugmann, 2014).

3. Explanations

3.1 Regular seasonal forecasting in Bulgaria

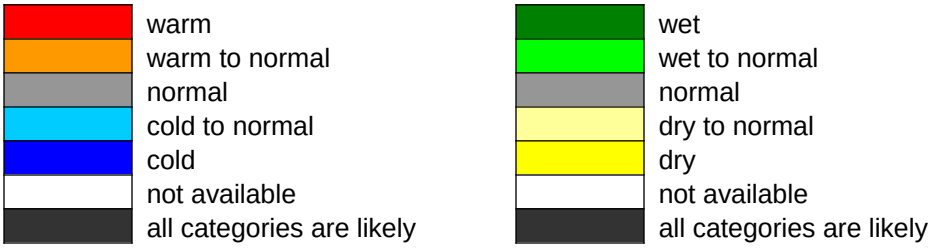
The National institute of meteorology and hydrology (NIMH) is the national weather service of Bulgaria. We have been producing regular seasonal forecast for our country since 2005. It is updated once a month at the end of the month as soon as all forecast materials become available. It is based on subjective 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, CPC

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.

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:

G. Anderson and D. Klugmann, 2014: A European lightning density analysis using 5 years of ATDnet data. *Nat. Hazards Earth Syst. Sci.*, 14, 815–829.

Monthly and yearly hydrometeorological bulletins 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).