Verification of the seasonal forecast for summer 2024 in Bulgaria

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1. Verification of the seasonal forecast for summer 2024

Tables 1 and 2 show the regular Bulgarian seasonal forecast for the summer season JJA 2024 issued in March (Month-3), April (Month-2), and May (Month-1) 2024 and for the individual months of the summer season issued back down to 3 months prior to the forecast month. The column "Index" 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 2024.

2024	Month Season	Forecast -1	Forecast -2	Forecast -3	Index	Score -1	Score -2	Score -3
Tempera-ture	June	1	1	1	2,00	3	3	3
	July	2	1	1	2,00	4	3	3
	August	1	1	1	2,00	3	3	3
	Summer	2	1	1	2,00	4	3	3

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

| 2024	Month Season	Forecast -1	Forecast -2	Forecast -3	Index	Score -1	Score -2	Score -3
Precipita-tion	June	-1	-1	-1	-1,11	4	4	4
	July	-1	-1	-1	-0,52	4	4	4
	August	-1	-1	-1	-0,89	4	4	4
	Summer	-1	-1	-1	-1,23	4	4	4

In average the forecast for temperature scores 3.2 which is very good. In average the seasonal precipitation amount forecast scores 2.0 which is a perfect forecast. The national forecast for precipitation actually diverged from the MedCOF/SEECOF forecast which was favoring wet summer – 50% chance. The national forecast for Bulgaria was

produced as usual, based on subjective evaluation of the online map products of leading global centers such as the ECMWF and the multi-model ensemble of the C3S service.

The MedCOF/SEECOF forecast for summer 2024 was giving 50% chance for above normal for both temperature and precipitation. From my point of view 50% probability for a category for the seasonal precipitation amount is an overconfident forecast for the region of Europe and this matches well its poor score. The temperature forecast is good but in the age of a rapid global warming it is easy to predict confidently a warm summer season.

In the evaluated summer forecast for the summer of 2024f it was said that it could have been expected to have a summer season 2024 similar to the summer of 2023. The summer of 2023 was with temperatures above normal (1.98) and with precipitation near normal but to the drier side (-0.49). Summer 2024 therefore was as warm or even slightly warmer (2.0) and as dry or drier (-1.23) than the summer of 2023.
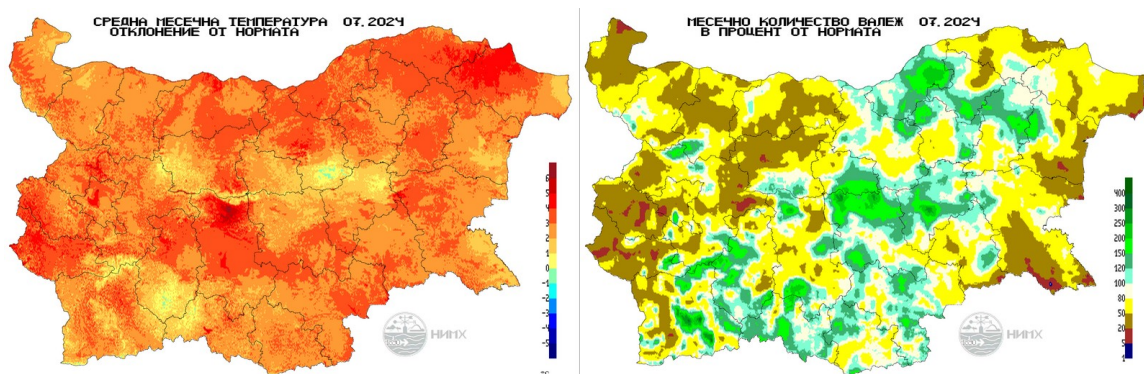
Figure 1, 2, 3, and 4 show maps of the departure from normal (1991-2020) of the seasonal/monthly mean temperature (left) and the seasonal/monthly amount of precipitation in percent of normal (1991-2020) (right) for the summer season as a whole (Fig. 1) and the individual months of June 2024 (Fig.2), July 2024 (Fig.3), and August 2024 (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.
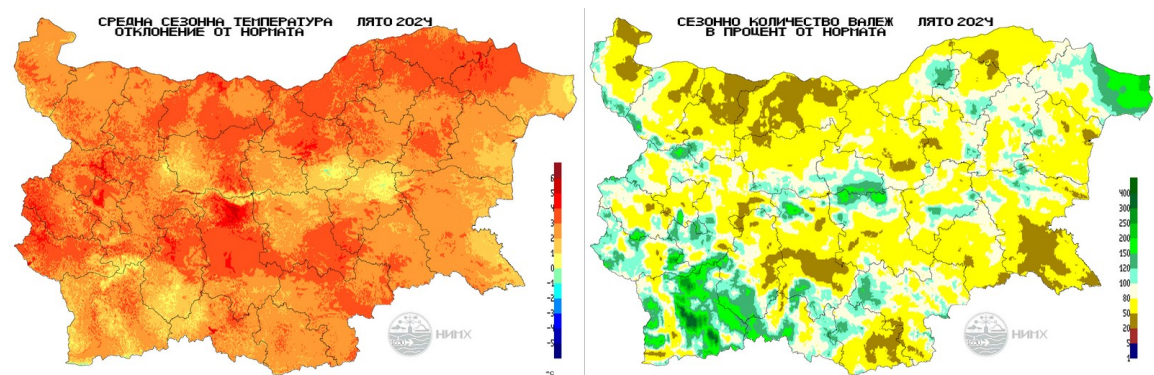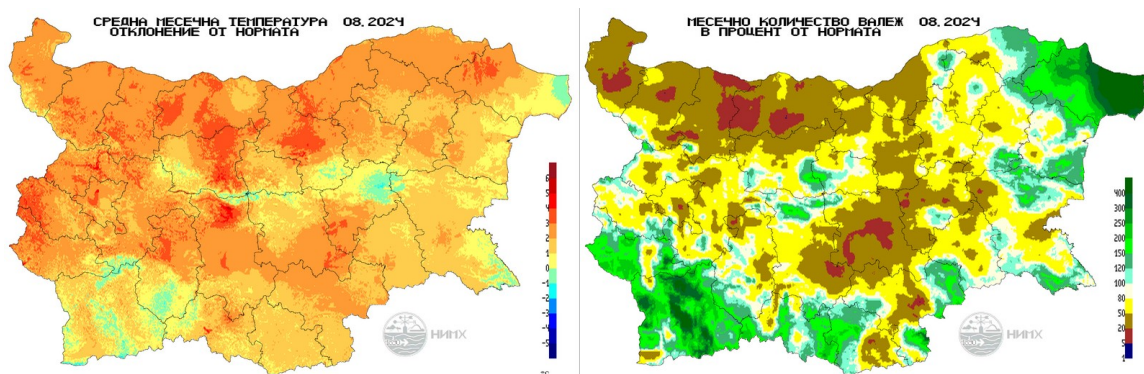

Figure 1: Departure of the seasonal mean temperature from normal (1991-2020) (left) and seasonal amount of precipitation in percent of normal (1991-2020) (right) for summer (June-July-August) 2024.
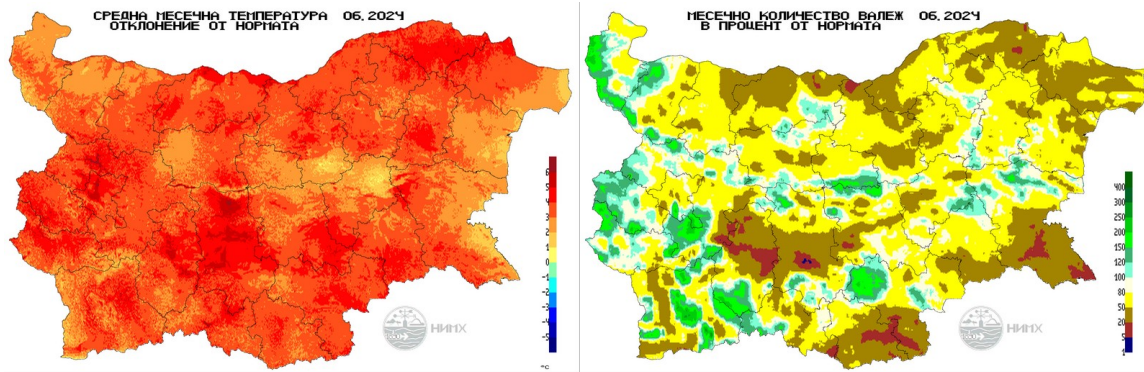
Figure 2: Departure of the monthly mean temperature from normal (1991-2020) (left) and monthly amount of precipitation in percent of normal (1991-2020) (right) for June 2024.


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 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 August 2024.

2. Extreme events

The month of June 2024 is the warmest month of June in Bulgaria since 1930 and the driest for the last 30 years. The month of July 2024 is almost as warm as the warmest month of July since 1930 – July 2012. In terms of precipitation it is as dry as July 2023. August 2024 is among the warmest months of August since 1930 and among the driest for the last 10 years. As a result the summer of 2024 is among the warmest if not the warmest since 1930 and among the driest since the beginning of the 21 century. There was again a long heat wave in July and August but there are no registered record maximum temperatures. Due to the heat and the drought the fire season was busy in July and August. The crops also experienced heat and drought stress which reflected in the yields.
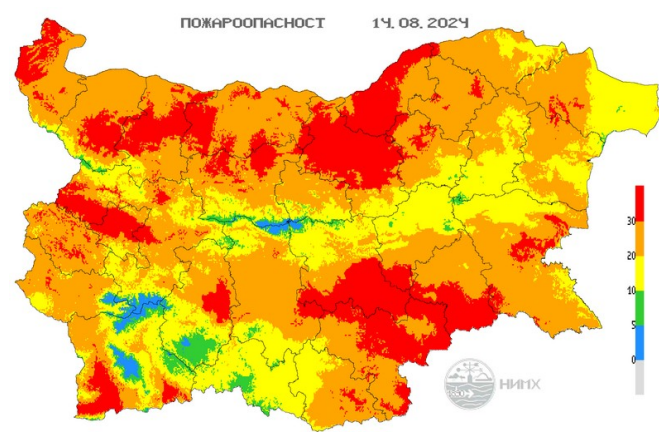
Figure 5: Fire weather index on 14 August 2024.

3. Explanations
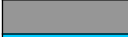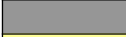
3.1 Regular seasonal forecasting in Bulgaria

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:

■	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

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:

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 , https://weather.bg/index.php?koiFail=bg2&lng=0).