Verification of the seasonal forecast for summer 2022 in Bulgaria

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1. Verification of the seasonal forecast for summer 2022

Tables 1 and 2 show the regular Bulgarian seasonal forecast for the summer season JJA 2022 issued in March (Month-3), April (Month-2), and May (Month-1) 2022 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 2022.

2022	Month Season	Forecast -1	Forecast -2	Forecast -3	Forecast Index	Score -1	Score -2	Score -3
Tempera-ture	June	1	2	2	1.60	3	4	4
	July		1	1	1.87	1	3	3
	August			1	1.73	1	1	3
	Summer	1	2	2	1.91	3	4	4

Table 2: Scores of the seasonal forecast of seasonal amount of precipitation for summer 2022.

2022	Month Season	Forecast -1	Forecast -2	Forecast -3	Forecast Index	Score -1	Score -2	Score -3
Precipita-tion	June		-2	-1	0.67	1	0	0
	July		-1	-1	-1.36	1	4	4
	August			-1	0.12	1	1	2
	Summer		-2	-1	-0.27	1	0	3

In average the forecast for temperature scores 2.8 which is very good. In average the seasonal precipitation amount forecast scores 1.5 which is insufficient. There was no forecast in June and July and for the tables it was replaced with "no signal" (unpredictable).

The MedCOF/SEECOF forecast for summer 2022 was stating warm (70% chance for above normal) and dry (50% chance for below normal) season for the region of Bulgaria. The national seasonal forecast for temperature was in the same direction. The

MedCOF-SEECOF temperature forecast for summer 2021, for the region of Bulgaria, is "excellent" for temperature and good for precipitation thanks to the dry July.

In the last summer forecast it was said that the season should have been similar to summer 2021. The summer of 2021 was with temperatures above normal (1.91) and with precipitation near normal (-0.05). Summer 2022 therefore was indeed similar to summer 2021 both in terms of temperature (1.91) and precipitation (-0.27).
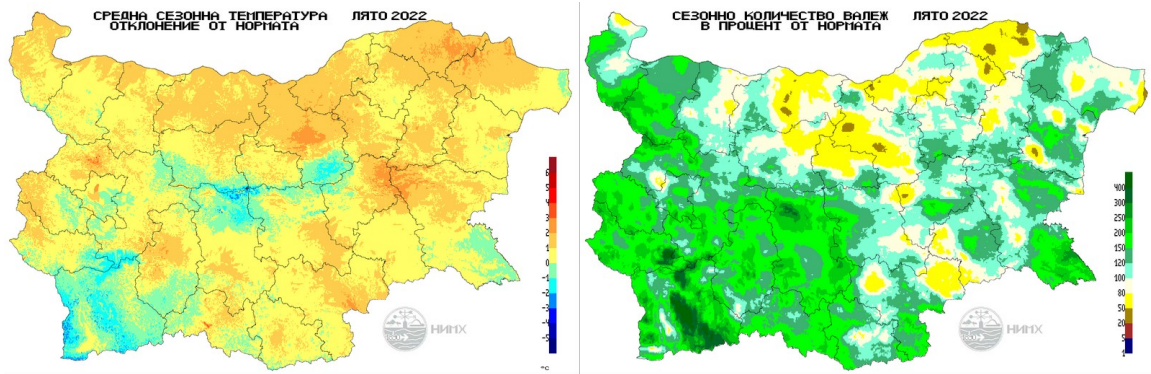

Figure 1: Departure of the seasonal mean temperature from normal (1991-2020) (left) and seasonal amount of precipitation in percent of normal (1991-2020) (right) for summer (June-July-August) 2022.

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 2022 (Fig.2), July 2022 (Fig.3), and August 2022 (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.
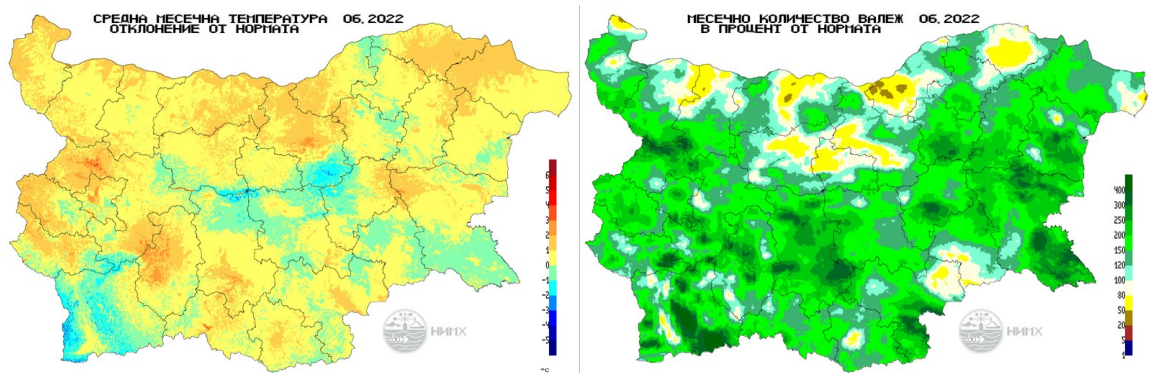

Figure 2: Departure of the monthly mean temperature from normal (1991-2020) (left) and monthly amount of precipitation in percent of normal (1991-2020) (right) for June 2022.
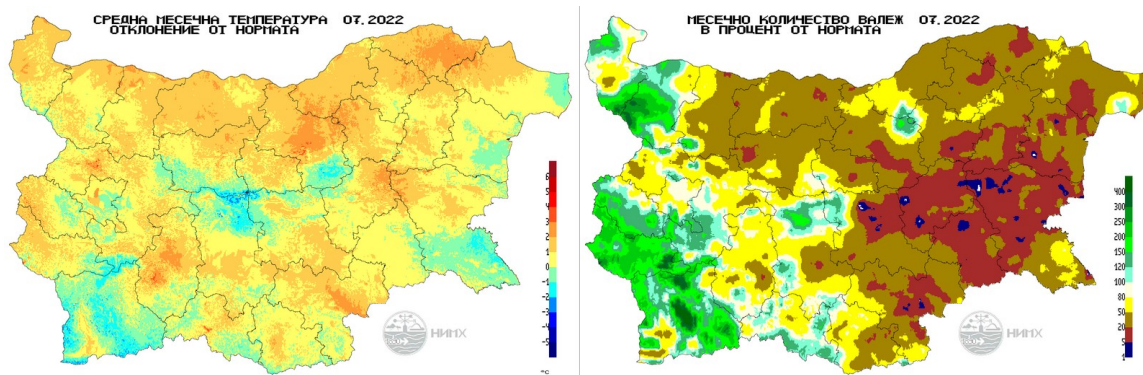
Figure 3: Departure of the monthly mean temperature from normal (1991-2020) (left) and monthly amount of precipitation in percent of normal (1991-2020) (right) for July 2022.
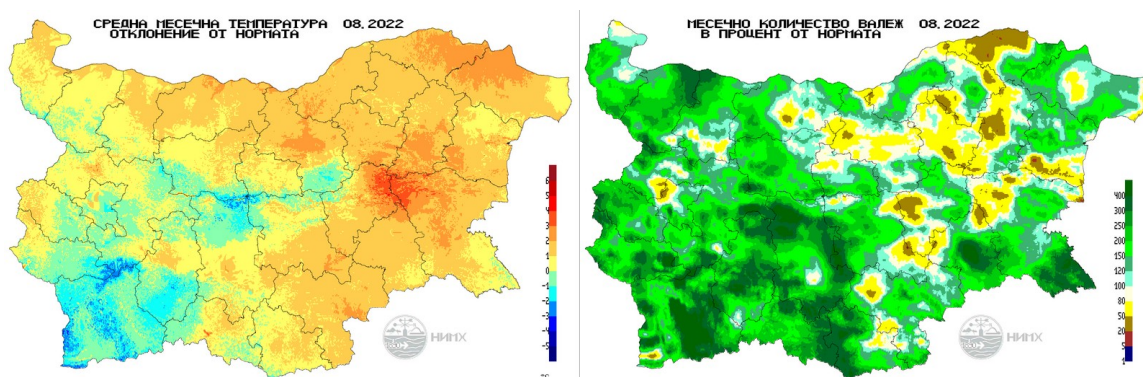

Figure 4: Departure of the monthly mean temperature from normal (1991-2020) (left) and monthly amount of precipitation in percent of normal (1991-2020) (right) for August 2022.

2. Extreme events

The month of July of 2022 was even drier than the moths of July of 2021 and 2020. The drought conditions in the height of the summer worsened the fire weather conditions. The fire weather index was at extreme levels at the end of July and the beginning of August similarly to summer of last year. Fire fighters were having busy fire season again. Figure 5 shows the extreme fire risk for 23 August 2022.

June was wet with thunderstorms and hail. There was flood from thunderstorm in Ruse at the Danube on 6 June and other hail storms later in the month. Figure 6 shows the lightnings in Bulgaria on 26 June – the most thundery day of the summer.
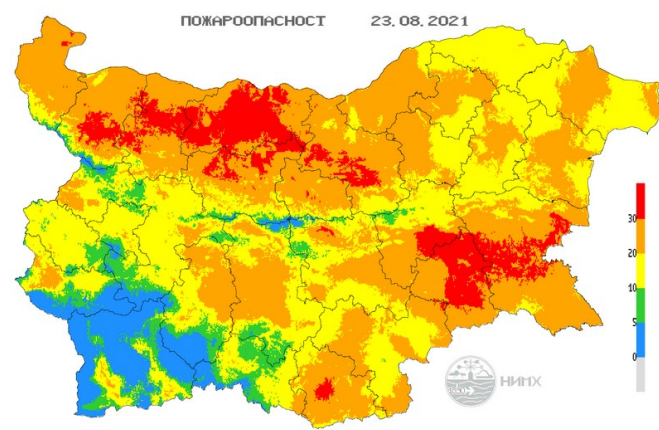
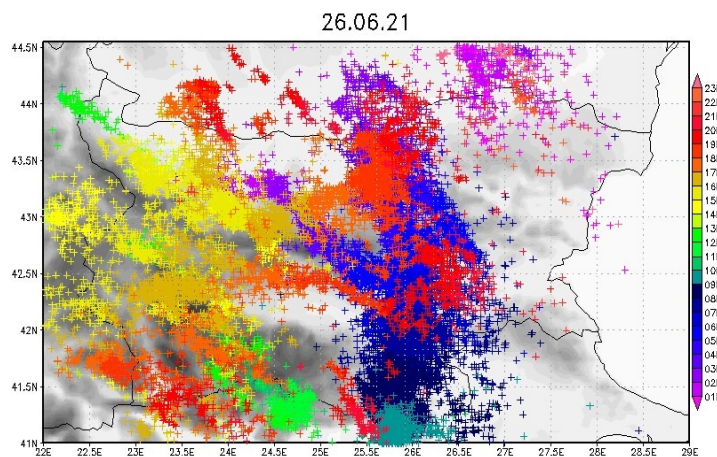**Figure 5**: Fire weather index on 23 August 2022.

Figure 6: Lightnings on 26 June 2022 (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:

■ (red)	warm	■ (dark green)	wet
■ (orange)	warm to normal	■ (bright green)	wet to normal
■ (gray)	normal	■ (gray)	normal
■ (light blue)	cold to normal	■ (pale yellow)	dry to normal
■ (blue)	cold	■ (yellow)	dry
□ (white)	not available	□ (white)	not available
■ (dark gray)	all categories are likely	■ (dark gray)	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:

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).