

THERMIC CHARACTERIZATION OF THE YEARS AND MONTHS OF THE AGRICULTURAL PERIOD 1992-2009, AT ORADEA

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Abstract

In the present paper, we used the average monthly and annual values of the air temperature, corresponding to the weather station Oradea. The thermic characterization of the years and months of the agricultural period 1992-2009 was based on Hellman's criterion. The characterization was carried out on agricultural years (range from October to September), and not calendar-based. The result was that the analyzed period was a warm period compared to 1931-2007. The number of warm years exceeded a lot the number of cold years, the warmest year being 2007. The number of warm months was also more than double compared to the one of cold months. The most significant warming has occurred in the spell 2000-2009.

Key words: air temperature, thermic character, deviation, multiannual average.

INTRODUCTION

The air temperature is an essential climatic element in the climatological analysis of a region. It is the result of the interaction between solar radiation, atmospheric circulation and land surface. As a result, it varies space-time depending on the latitude, altitude, local and general circulation of the atmosphere, but also the type of landform, soil, vegetation, hydrography etc. (The Climate of Romania, 2008).

At the Oradea weather station, the multiannual average temperature exceeds 10°C (10.2°C during 1931-2007) due to station location in the plain area, where temperatures are higher due to lower altitudes. Compared to other climatic regions of the country, the Northern part of the Crișurilor Plains – where the Oradea weather station is located – has a moderate climatic character, due to the oceanic climate influences to which the north-western regions of the country are exposed (Cristea, 2004; Șerban, 2010).

MATERIAL AND METHODS

In the present paper, we used the monthly and annual average values of the air temperature, corresponding to the weather station Oradea. The data came from the archives of the National Administration of Meteorology.

The thermal characterization of the years and months of the agricultural period 1992-2009 was based on work method proposed by the German climatologist Hellman (the so-called "Hellman criterion"). Due to the location of the station in the agricultural region of the Crișurilor Plain,

the thermal characterization was carried out on agricultural years (ranging from October to September), and not calendar-based. Therefore, this study has a practical purpose, with an agro-horticultural utility. The study of air temperature on agricultural years can be used in understanding the role that the temperature plays in physiological processes of crop plants, both the external (open field) and the internal ones (polyethylene tunnels, greenhouses). Temperature has, thus, an important role in the fructification and production processes, being responsible for obtaining high yields and good quality (Domocoş, 2011).

According to the Hellman's criterion, for the thermal characterization of a time period of months or years and for emphasizing the non-periodic variations of air temperature, we compare the oscillations of the values from any year (or month) with the average of several years, considered "normal". The resulted deviations are contained within certain limits and are expressed in degrees Celsius (Fărcaş, 1988).

Based on the deviations thresholds it can be established the thermal character of the months and years of the considered period. The climatologist Hellman has established the following limits for the monthly and annual deviations of air temperature (table 1):

Table 1

Thermal character of months and years according to Hellman's criterion
(Source: Fărcaş, 1988).

Monthly deviations (°C)	Yearly deviations (°C)	Qualificative (Rating)
over 10	over 5	Excessively hot
between 5 and 10	between 2,5 and 5	Very hot
between 2 and 5	between 1 and 2,5	Hot
between 1 and 2	between 0,5 and 1	Warm
between -1 and 1	between -0,5 and 0,5	Normal
between -2 and -1	between -1 and -0,5	Cool
between -5 and -2	between -2,5 and -1	Cold
between -10 and -5	between -5 and -2,5	Very cold
under -10	under -5	Excessively cold

RESULTS AND DISCUSSIONS

For the thermal characterization of years and months in the period 1992-2009, at the weather station Oradea, deviations were calculated for these years/months in comparison to the multiannual average of the period 1931-2007. The thermal character of the years within the analyzed period is found in table 2.

9 normal years in terms of thermal conditions were registered - 5 hot years, 3 warm years and a single cool year - at the weather station Oradea

during 1992-2009. Not only excessively hot or very hot years were reported during this time, but also cold, very cold or excessively cold years. The number of warm years (8) exceeded a lot the number of cold years (1).

Table 2

Thermal character of agricultural years of the period 1992-2009, at the Oradea weather station.

Thermal qualitative	Excessively hot	Very hot	Hot	Warm	Normal	Cool	Cold	Very cold	Excessively cold
Years	-	-	1994	1998	1992	1996	-	-	-
			2001	2000	1993				
			2002	2008	1995				
			2007		1997				
			2009		1999				
					2003				
					2004				
					2005				
				2006					

On the graph in figure 1 we see that there are periods of consecutive years with positive air temperature deviations and periods of consecutive years with negative deviations. The annual periods with positive deviations last from 2-4 years to a maximum of 7 years. The longest period with positive deviations was 1998-2004. Between 1992 and 2009 there was a single period of consecutive negative deviations of air temperature: 1996-1997 (2 years).

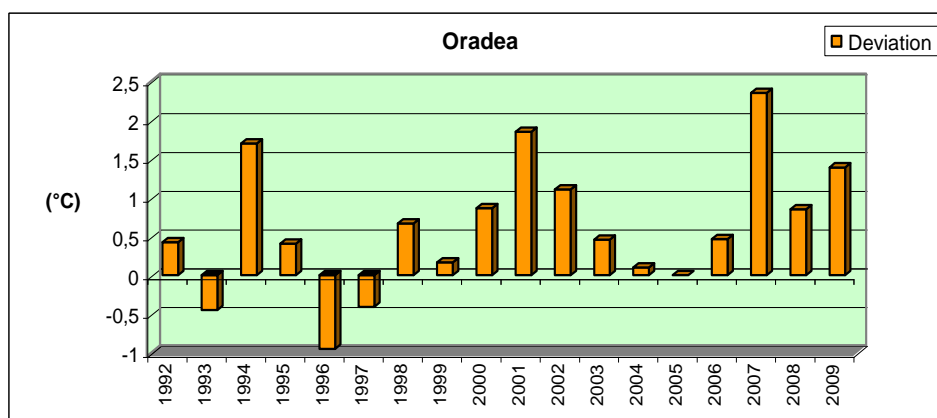


Fig. 1. Warm, normal and cold agricultural years based on Hellman's criterion, at the Oradea weather station (1992-2009).

The small number of cold years is due to the location of the analyzed period within the overall increase spell in air temperature around the Globe;

many stations in our country and in the world have recorded this phenomenon in recent years (Litynski et.al., 2003; Luterbacher, Xoplaki, 2003; Tudose, Moldovan, 2006; Măhăra, 2006; Vasenciuc, Dragotă, 2002; Teodoreanu, 2007; Șerban, 2010).

The warmest agricultural year was 2007, when its thermal deviation compared to the multiannual average rose to +2.4°C. Other warm years, with large positive deviations were 2001 (+1.9°C deviation) and 1994 (+1.7°C). The coldest year was 1996, with a deviation of -1.0°C compared to the multiannual average. It is noted, in this case, the large positive deviation of the warmest year compared to the negative one of the coldest year.

Table 3

Thermal character of months in the agricultural period 1992-2009, at the Oradea weather station.

Years	Number of months		
	WARM	NORMAL	COLD
1992	3	8	1
1993	1	7	4
1994	8	3	1
1995	2	9	1
1996	2	5	5
1997	1	6	5
1998	6	4	2
1999	6	3	3
2000	5	5	2
2001	8	2	2
2002	8	2	2
2003	5	5	2
2004	2	7	3
2005	3	7	2
2006	3	6	3
2007	10	1	1
2008	7	4	1
2009	7	5	0
Total	87	89	40

In table 3 it is shown the thermal character of the months belonging to the analyzed period 1992-2009. It is noted that the most months were normal in terms of heat. The number of warm months also recorded a very high value. It was more than double (87) compared to the number of cold months (40). In this table, the total number of warm months includes all the months that were rated as "warm" to "excessively hot", and the total number of cold months, all that were rated from "cool" to "excessively cold".

The year with the most "normal" months was 1995. The year with the warmest months was 2007 and the years with the coldest months were 1996 and 1997. The longest period of consecutive warm months was *November 2006 – August 2007* (10 months).

In the analyzed period, there existed 3 months, which were "very hot" and 2 "very cold" months. The hottest month was *January 2007* (with a deviation of +6.3°C over the multiannual average) (fig. 2), followed by August 1992 (+5.2°C) and January 1994 (+5.1°C). The coldest month was *February 2003* (-6.3°C deviation), followed by December 1998 (-5.8°C deviation). There have not been recorded excessively hot or excessively cold months in the analyzed period.

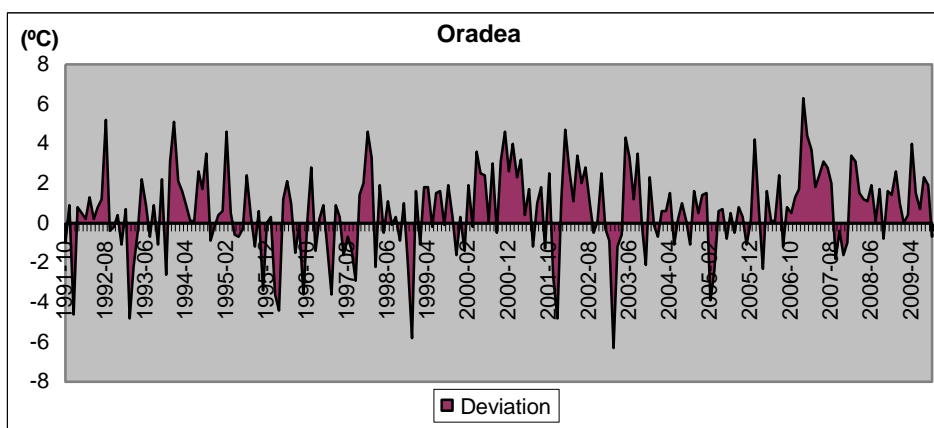


Fig. 2. Monthly thermal deviations of the agricultural period 1992-2009, compared to the monthly multiannual average, at the Oradea weather station.

In the figure 2 it can be noted the very large number of months with positive deviations compared to the one of the months with negative deviations, especially in the second half of the analyzed period (the period 2000-2009), when the warming was most pronounced.

CONCLUSIONS

The analyzed period, 1992-2009, was a warm period compared to 1931-2007. This conclusion coincides with the general growth trends of air temperature around the Globe, reported in recent years. The number of warm years, based on the Hellman's criterion, exceeded a lot the number of cold years. The warmest agricultural year was 2007, when its thermal deviation compared to the multiannual average stood at +2.4°C. The annual periods with positive deviations lasted from 2-4 years to a maximum of 7 years.

The number of warm months was also more than double compared to the one of cold months. The longest period of consecutive warm months was November 2006 – August 2007 (10 months). The most significant warming occurred in the period 2000-2009.

The study of air temperature on agricultural years can be used in understanding the role that temperature plays in physiological processes of crop plants, both the external (open field) and the internal ones (polyethylene tunnels, greenhouses).

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