

CANICULAR DAYS IN THE SUMMER OF 2007 AT IAŞI

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Abstract: This article makes a climatic and bioclimatic presentation of the canicular days in the summer of 2007 in Iasi, especially for the month of July (16th- 30th of July) when the temperature exceeded 35°C.

Introduction

The summer of 2007 brought on the territory of Romania excessive temperatures which, although exceeded the absolute maximums at the stations in the south or east of the country only in a few cases, represented an exceptional phenomenon not only because of the high temperatures which very often exceeded 35°C, but also because of the length of the canicular period which extended beyond the usual 3 summer months.

The spatial dimension of the canicular days in 2007 covered the south-east of Europe- part of Romania and its neighbour countries, especially the plain, hill and tableland areas. For example, on 22nd of July have been registered 40°C in Bucharest, Iasi, Craiova, Belgrade, Athens, 39°C in Timisoara and Tulcea, 38°C in Sofia and 37°C in Botosani, Cluj and Budapest and the canicular period became conspicuous through its unusual length.

1. The temperature in june, july and august in Iasi

1.1 Monthly mean temperatures

During all summer months in 2007, the mean temperature was higher with 2...3 °C than the multi annual averages of the respective month, highlighting the feature of hot months.

The averages of the monthly maximum temperatures during the entire period of observation were higher with 2...6°C than the averages of the maximum temperatures in June, July and August of 2007, which shows that throughout the

last century we encountered hotter months than this year (eg. June 1946, July 1936, ¹²August 1946, August 1951).

On the other hand, the *averages of the minimum monthly temperatures* during the entire period of observation were with around 9°C lower than the means corresponding to the summer months in 2007, fact which shows the stressing character of the analyzed period, owing to the warm nights in summer this year.

This characteristic diminished the possibility for people to refresh themselves by night after the heat during the day.

1.2 Absolute maximum temperatures

On 27th of July 2007, the maximum temperature reached the multi annual absolute maximum value of 40°C registered on 27th of July 1909. The maximum values in the other two months of the summer of 2007 didn't reach the absolute maximum values from the entire period of observation, more exactly 38°C and 39°C, but were very close (37°C on 26th of June and 38°C on 24th of August 2007). The daily averages oscillated between 20...25°C in June and August and between 20...30°C in July, and the daily minimum values oscillated between 15...20°C.

1.3 Number of days with different features

The number of summer days (max. temp. $\geq 25^{\circ}\text{C}$) in all summer months was much higher than in the period of observations. Thus, all the days in June were summer days (30) in opposition with the multi annual average number of 18 days. In July were registered 28 in opposition with the multi annual average of 24.9 and in August 25 in opposition with 23.2 days.

The number of tropical days (max. temp $\geq 30^{\circ}\text{C}$) was almost double than the multi annual average value, more exactly: in June 17, in opposition with 5.3, in July 23, in opposition with 10.6 and in August 16, in opposition with 9.7.

The number of canicular (dog) days (max. temp $>35^{\circ}\text{C}$) was 1 in June, 12 in July and 3 in August.

Tropical Nights (min. temp. $> 20^{\circ}\text{C}$) were registered in 2007 only in July (4 days) and August (3 days), but the minimum temperatures registered towards morning were high enough, frequently 18-19°C (9 in June, 18 in July and 15 nights in August).

1.4 The length of extremely hot periods

In June there had been 5 periods with temperatures which reached during day time 30°C or even more (2-4 days successively): 8th-11th, 13th-16th, 18th-19th, 22nd-23rd, 25th-26th of June. In July there had been 4 waves of heat, but longer,

from 4 to 11 days (1st -4th, 8th -11th, 15th -25th and 27th -30th of July). In August, again 4 waves between 1-6 days (3rd -6th, 10th -12th, 16th -18th, 20th -25th of August).

The wave of heat started with differences from 2 to 7°C (when usually the temperature remained the same or rose smoothly from the previous day).

Periods with temperatures over 35°C were recorded in the following order: 1 day in June (on 26th of June), 5 periods in July (3rd, 8th -11th, 16th -22nd and 24th -25th and 30th of July) and 3 days in August (23rd -25th of August).

Out of these 3 summer months of this year (92 days, 55 of which with over 30°C and more other days with temperatures between 28-29°C) is evinced the wave of heat between 15th -30th of July, during which there were registered always temperatures between 35-38°C, 30°C and 34°C only on 15th, respectively 23rd of July and "only" 28°C on 26th of July (Chart 1). Another remarkable period was 16th -23rd of August, during which the temperature went down at 28°C only in 1 single day, on 19th of August.

We have to underscore the fact that daily maximum temperatures generally were registered after 3 PM (summer hour, around two hours distance from the passing of the Sun at the Meridian) and lasted few hours, till 6-8 PM, after that began to go down slowly, reaching values under 20°C only towards morning. This fact recorded the presence of a normal night, not a tropical one, which is not a fully precise registration giving the fact that during most part of the night the temperatures had been above 20°C.

The air humidity, relative humidity or steam pressure, showed that the hot air which was preserved in the region was very dry.

In this way, the frequency of days with relative humidity $\leq 30\%$ is at Iasi on an average of 6% at, at least one of the observation hours in July. In July 2007, the days with a relative humidity under 30% were over 97%. During most of the days, between 18th and 25th of July, the value of the humidity was 7-9 % by day.

Regarding the values of the steam pressure, as it is worldwide known, are maximum during summer months (the medium value in Iasi in July is 16.8 mb). But in July 2007, they oscillated by day between 2.4 and 12 mb and by night between 6.3 and 14 mb.

The sky was frequently clear or with spread clouds, very seldom partially overcasted and 4 days clouded. On 5th and 12th of July it was recorded a light rain and on 4th and 12th of July a small number of thunder and lightening.

Atmospheric pressure had values ≥ 1.015 mb in about a third of the month of July, particularly in mid July. The remaining days were marked by lower pressure, which shows the predominance of fields of relatively low pressure (minimum of 999 m, recorded on the day of July 5, at a temperature of 27°C). During July 18-26, atmospheric pressure was high, especially at the beginning of the period, declining gradually afterwards.

Wind speed reached a maximum of 5.8 m/s (at 1.5 meters from the ground) on July 10. Beyond that, during the hottest period of the month, the maximum of the day was 1.4 to 2.2 m / s. In the last days of July, 26th and 30th it was recorded a speed of 4.3 m / s. The route has been predominantly south and west (S, SSW, WSW, W).

2. Bioclimatic stress at high temperatures

The relationship between man and the outside temperature is achieved through an important property of the human body, namely thermo homeostasis (homoeothermic) which is its capacity to keep the body temperature constant between certain limits.

If these limits are exceeded, it produces a bioclimatic stress, with a skin initial component and, sometimes, a pulmonary component, but with effects on all vital organs and systems of the human body which is obliged to react quickly. Generally it is considered that the human body can not bear for long a temperature that exceeds the internal body temperature (38.0°C - liver's temperature) if it is untrained and without the benefit not only of natural defence measures, but also of external measures (cooling of the body and of the environment).

In the case of heat waves, the medium internal temperature of the body (around 37°C) as much as the external one (31...36°C) is likely to increase over normal, creating a dysfunction in the metabolic processes of the body. The first reaction, the alarm one, is a thermo discomfort felt almost immediately.

In bioclimatic papers, has been noted the existence of an area of thermo comfort, neutral or of thermo indifference in the relation between the environment, climate and the human body. This is a narrow area in which a human body, slightly dressed, relatively healthy, rested, doesn't lose nor receives heat, in other words, in which the process of thermo adjustment does not stress the human body.

The thermo comfort, expressed in degrees of temperature actually equivalent with °TEE, meaning the temperature actually felt by the human body depends not only on the air temperature (°C), but also on the air humidity, respectively on the quantity of steams from the atmosphere, expressed in relative humidity (%) or steam pressure (mb) and the speed of air currents (m/s). It is usually lower than the temperature read on the thermometer. Where they add the solar radiation also, the temperature actually felt by the body, expressed in °TEER is obviously higher than the temperature felt in shade.

At the moderate latitude it is considered to be thermo comfort between 17-18 and 21-22 °TEE. Over 22 °TEE it is considered discomfort by heating. The bioclimatic analysis referred to the month of July 2007, taking into account the values at the meteorology station in Iasi.

3. Bioclimatic indexes iniasi in july 2007

To characterize the dog-days in the summer of 2007 in Iasi we have analyzed the highest temperature and the relative minimum daily humidity, characteristic generally for the hours after the sun has past at the meridian, the minimum temperature and relative maximum humidity, which are recorded towards the end of the night, with one to two hours before the sunrise.

In determining the temperature actually equivalent during the day, we used the maximum wind speed, which is also registered during the day, due to thermo convection, low values from the level of the tool for the measurement of wind intensity (10 m) at 1.5 m from the microclimatic space, where the human life takes place.

For night hours, given the fact that generally the wind has a minimal speed, especially in the microclimatic space, we used the formula for determining bioclimatic indexes, based only on the temperature and air humidity.

The analyzed indexes were: the effective equivalent temperature, after Yakovenko monogram, 1927 (cf. Baibakova, 1964), the index after Thom's formula, 1958 (Tromp, 1974) and ITU (cf. Dragota, 2003) and also the index for the skin and pulmonary stress, after the formula and stairs presented by Besancenot, 1974 (cf. Teodoreanu, 2002).

3.1 Canicular hours during the day

The overcome of the thermo comfort limit was recorded, after both indexes (Yakovenko and Thom) in over two thirds of the month (19 days, after Yakovenko and 26 days after Thom, giving the fact that after this index, the wind speed was not taken in consideration- which usually decreases but the low values of the wind speed made the comfort differences after the two indexes minimal)(Chart 1).

After the ITU index, (used by weather bulletins prepared by the National Meteorology Agency) only on 13th and 31st of July has been registered comfort and on July 22 when was recorded a maximum of 40°C, the index ITU entered into the category of "state of discomfort ". In all the other days, was declared state of alert (between 65 and 80 units), being unable to distinguish, after this index, the days more or less comfortable. In fact, the very notion of state of discomfort is relative, while the state of alert, involving a potential danger, was recorded even for the days with a maximum temperature between 20...27°C, values absolutely normal for a summer period, or even for the days with light rain, that we have mentioned before. These observations make us note once again that this index is not representative for the bioclimatic stress the human body is exposed to in extremely hot days.

The skin stress which takes into account temperature and the wind is not practical for use at temperatures exceeding 330C (in its formula can be found the t-

33 component, making the index become negative at values of over 33°C). In July 2007, in Iasi, in 16 days, the index was negative, showing a very high stress (in particular the period July 16-25). But it took values below 300 conventional units in the rest of the days too, thus being characterized as hypotonic index, requiring the trigger of the thermo lyses. Exception made the day July 13, when the maximum temperature was of 20°C and the maximum wind speed of 3.6 m / s, which has placed the day in the category "relaxing index".

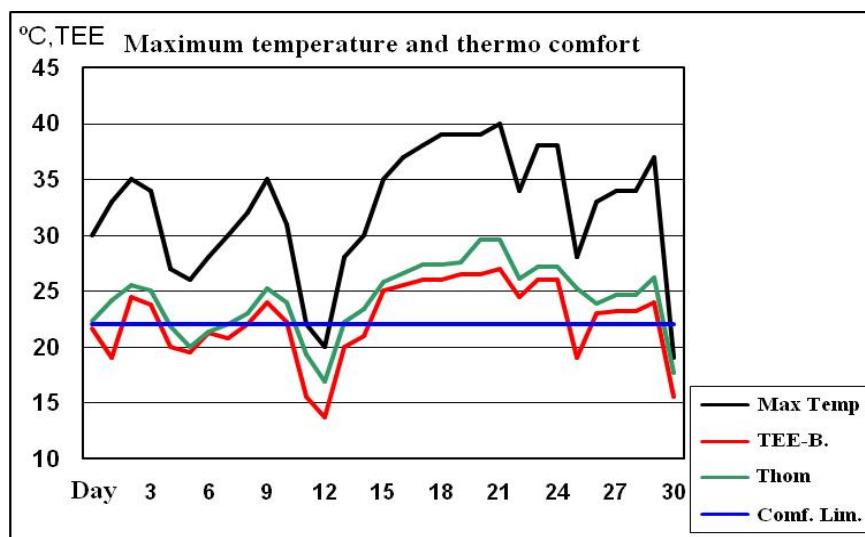


Fig. 1- Maximum temperature and thermo comfort

The pulmonary stress, which is determined on the basis of the values of water steam pressure, presented in all days, except for a few days (5th, 11th-12th, 23rd and 31st of July, when the steam pressure values have ranged these days in the category of "balanced index"), the aspect of dehydrating stress (actually typical for the winter period, when the air has a smaller quantity of water steams), which causes the mucous membrane to became dry and sometimes provokes breathing problems.

3.2 Canicular hours during the night

The minimum temperature oscillated between 11°C (July 13) and 24°C (July 23). Between July 20-23 had been noted tropical nights. But there were still another 13 days recorded with minimal temperatures of 18-19°C still 13 days were

recorded minimum temperatures of 18-19°C, so in total over half of the nights of July 2007 were very hot. The ITU index has showed a state of alert in the four days with the highest temperatures (July 20-23), in rest, state of comfort.

Skin stress was always hypotonic, indicating the necessity of thermo lyses during all nights in July. Pulmonary stress was dehydrating in most days, the air remaining dry during the night too, with the exception of 6 days, when the quantity of water steam was greater and so the stress was hydrating (≥ 7.5 m) and of 9 days, in which the corresponding category was "balancing" (4,1-7,4 m).

4. Canicular day's effects on the human body

The sustaining reaction of the body and its action of acclimation to the stress caused by heat, manifests through some physiological mechanisms: conduction, convection above the skin's surface, caloric radiation and evaporation. When the air's temperature outruns the temperature from outside and especially the one of the body, the first three mechanisms reduce their function, being incapable of transferring the heat. It remains the forth element to solve the problem: sweating, which consists on water evaporation function that cools the skin. There is a second effect concerning long exposure to sweating and that is dewatering and loss of mineral from the body (especially salt), which causes tiredness and destabilization of the circular system.

Without compensating the liquid quantity, the sweat is reduced and the body temperature grows followed by a feeling of weakness, tiredness, hypotension, hyperthermia, which represent the step to the third level, of exhaustion.

Pathogen aspects: they can react through head aches, nausea, eructation, reducing the physical force, apathy, lipothymy. Caloric shock, the syncope and caloric collapse represent medical emergencies.

The most vulnerable categories of people to great heat are young children, especially suckers, whose thermoregulation system is not hard-set yet, old people to whom vascular reactivity is slower, patients suffering of rheumatic affection, cardiovascular affection, renal affection, mental affection, sensitive to thermo variation and people who are not used to heat or who make physical effort on heat.

The heat wave's pathology has in addition: renal lithiasis, showing digestive anxiety, sometimes even epidemics, caused by increasing of the infection agents (bacteria and viruses) and by vectors that deliver illness (mosquitoes, flies), in particular, illness coming through gastro-intestinal tractus, transmitted through water, food, contaminated objects, lack of personal hygiene: hepatitis, salmonellas, botulism, dysentery, viral meningitis etc. Also, sunstrokes are often involved, by exposing too long in the sun, mental crisis for the patients with psychical problems; these caused especially by solar lightning radiation that excites the retina, oto-rino-

laringological affections as well, sequence of eating ice-cream, water and cold juices.

Usually, concerning heat waves during the summer, the emergency calls and hospitalizations are increasing rapidly, the morbidity grows and sometimes even death, especially for elder people with illnesses.

It is very important that when the statistical data in the hospitals and clinics from Iasi for the summer of 2007 will stabilize, to establish the plausible correlations between discomforts caused by heat and the pathogen aspects, in the same time or displaced, from the canicular days period.

We should point out that the analyzed data belongs to the meteorological station, which has its standard. The city as we know it as a “land of heat”, has the microclimate’s surface temperature higher than the one registered by the station, because of the concrete walls and asphalt that get extremely heated during the afternoon hours. In these conditions it is understood that the real temperature felt by the human body was higher than the one measured by us, the discomfort was greater and the skin and pulmonary stress was more powerful.

Conclusion

The summer of 2007 in Iasi was a particularly hot period, both by day and by night, with temperatures during the day much higher than the regular values of summer months, and with night temperatures which restricted the cooling of the air, this being extremely dry.

The longer the periods with temperatures far beyond the limits of comfort were, the stronger the bioclimatic stress was. Under the condition of extreme low values of the steam pressure, weak wind and clear sky it was registered thermo discomfort in more than half of the 3 summer months. Thus, out of the 92 days of the months of June, July and August, were recorded 83 summer days, 56 tropical days, 16 canicular days, 7 tropical nights and another 35 nights with minimums of 18-19°C.

It was particularly conspicuous the period July 16-30, when, with the exception of a few days with maximum temperatures of 28-34°C, were recorded 35-40°C even in the shade.

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