

Temperature – Humidity Index (THI) within the Oltenia Plain between 2000 and 2009

Alina VLĂDUȚ¹

¹ Department of Geography, str. Al. I. Cuza, nr. 13, Craiova, Romania, vladut_alina2005@yahoo.com

Received on <December 15, 2010>, revised on <January 23, 2011>, accepted on <February 20, 2011>

Abstract

Temperature-humidity index, also known as thermal comfort index, represents an extremely used index in mass-media nowadays; it renders an apparent temperature, namely the temperature felt by human body that cools slower at higher values of the relative humidity due to the reduction of the evaporation rate. THI is calculated on the base of several formulas, which corroborate air temperature and relative humidity, the critical threshold being 80. By analysing the statistical data supplied by the Regional Meteorological Center Craiova, it comes out that the years with the highest number of days with THI values above 80 are 2000, 2001, and 2007 for the entire studied territory, when, during summer, the region was affected by numerous heat waves, which led to the frequent exceeding of the 40°C value. The most affected area is located in the central-southern and eastern parts of the Oltenia Plain – 51 days with THI > 80 at Caracal in 2000, 47 days with THI > 80 at Bechet in 2001, and 41 days with THI > 80 at Băilești in 2007. Regarding the monthly distribution, the most problematic months are, of course, July and August, when it is favoured the penetration of certain extremely hot air masses from northern Africa, as well as thermal convection. During the analysed decade, the highest monthly number of days with values above the threshold was registered at Caracal in August 2000 – 23, at Bechet in August 2001 – 25, and at Băilești in July 2007 – 20. On the whole, in the 10 analysed years, we remark Băilești – 76 days in July and 90 in August, Bechet – 84 days in July and 83 in August, and Calafat – 77, respectively 70 days. Increased values of THI mainly affect children and elderly people or those suffering of different diseases. At values lower than 70 of the THI, most of the people feel comfortable, at values comprised between 75 and 80, about half of the population feels thermal discomfort, while at values above 80, even if the discomfort sensation is not obvious, it is recommended to take adequate protection measures.

Keywords: *temperature-humidity index (THI), comfort, discomfort, critical threshold, the Oltenia Plain*

Rezumat. Indicele de temperatură – umezeală (ITU) în Câmpia Olteniei în perioada 2000-2009

Indicele de temperatură – umezeală, cunoscut și sub denumirea de indice de confort termic, reprezintă un indice foarte des vehiculat în mass-media în ultima perioadă; acesta redă o temperatură aparentă și anume, cea resimțită de corpul uman, care se răcește mai lent la valori mari ale umezelii relative, ca urmare a reducerii ratei de evaporare. ITU se calculează pe baza mai multor relații care coroborează temperatura aerului cu umezeala relativă, pragul critic fiind 80. Din analiza datelor statistice furnizate de Centrul Meteorologic Regional Craiova, reiese faptul că anii cu cel mai mare număr de zile în care s-a depășit pragul de 80 unități sunt 2000, 2001 și 2007 pentru întreg perimetrul analizat, când în perioada de vară regiunea a fost afectată de mai multe valuri de căldură, care au dus la depășirea frecventă a valorii de 40°C. Arealul cel mai expus este cel situat în partea central-sudică și estică a Câmpiei Olteniei – 51 zile cu ITU > 80 la Caracal în 2000, 47 zile cu ITU > 80 la Bechet în 2001 și 41 zile cu ITU > 80 la Băilești în 2007. Ca distribuție lunară, lunile cele mai problematice sunt bineînțeles iulie și august, când este favorizată atât pătrunderea unor mase de aer foarte cald dinspre nordul Africii, cât și convecția termică. Raportat la decada analizată, la nivel lunar, cel mai mare număr de zile în care s-a depășit pragul critic s-a înregistrat la Caracal în august 2000 – 23, la Bechet în august 2001 – 25 și la Băilești în iulie 2007 – 20. Per total, în cei 10 ani analizați se remarcă Băilești – 76 zile în iulie și 90 în august, Bechet – 84 zile în iulie, respectiv 83 în august și Calafat – 77 și 70 zile. Valorile mari ale ITU afectează cu precădere copiii și persoanele vârstnice sau cu diferite afecțiuni. La valori mai mici de 70 ale ITU, cele mai multe persoane se simt confortabil, la valori cuprinse între 75 și 80, circa jumătate din populație resimte senzație de disconfort termic, iar la valori mai mari de 80, chiar dacă senzația de disconfort nu apare, se recomandă măsuri de protecție adecvate.

Cuvinte cheie: *indice de temperatură-umezeală (ITU), confort, disconfort, prag critic, Câmpia Olteniei*

INTRODUCTION

Among different weather events, human body reacts to temperature changes in the attempt of adapting to the environment. High temperatures, as

well as low temperatures have distinct effects on human health. During the warm season, but especially in the interval June-August, increased temperatures induced by the penetration of stagnant, warm air masses represent a significant public health problem in Romania, and especially in the

south of the country. This problem will be exacerbated in the near future by the synergistic effects of a warming climate, urbanization, and an ageing population (Luber and McGeehin, 2008). According to different climatic models, it is estimated that summer mortality will increase, even if people acclimatize to high warmth (Kalkstein and Greene, 1997, p. 84). Consequently, in 2000, the National Administration of Meteorology (NAM) started to calculate the temperature-humidity index (THI) and to emit warnings for the population (yellow, orange and red alarm codes).

Common thermal indexes are based on different meteorological factors, such as air temperature, air humidity, air velocity, sunshine (Segal and Pilke, 1981). The THI is a bioclimatic index used to illustrate the temperature felt by the human body, which is calculated by dividing the value of the THI by 2. It renders an apparent temperature, namely the temperature felt by the human body that cools slower at higher values of the relative humidity due to the reduction of the evaporation rate. Consequently, the sensation human body perceives depends not only on temperature, but also on humidity (Table no. 1). For example, we feel quite comfortable if there are 35°C but the relative humidity is only 20%, as the temperature we experience is 27.1°C. In case temperature remains constant but relative humidity increases (at 35°C and 100% relative humidity we feel a temperature of 40.4°C), there develops a discomfort sensation – fatigue, dizziness, heat cramps etc. (Table no. 2). Generally, most people feel comfortable if the index is below 70, but the discomfort sensation increases as the THI values increase (Encyclopædia Britannica, 2010). This issue is also increasingly present and debated in the Romanian literature in the field as well (Teodoreanu and Bunescu, 2007, 2008; Leontie et. al. 2008; Marinica and Marinica 2008; Marinica and Chimisliu, 2009, etc.).

Although all heat-related deaths and illness are preventable, many people are affected by extreme heat every year. However, in spite of the alarm signals triggered by the researchers and media, we consider that there still is an obvious lack of public recognition of the hazard induced by the exposure to extreme heat. For example, the County Health Directorates do not keep a statistics of the number of heat-related casualties, in spite of the fact that, at the international level, the effects of extreme temperature on mortality are considered a key issue.

DATA AND METHODS

The THI data correspond to the period 2000-2009 and they were supplied by Craiova Regional

Meteorological Center. There were analysed the THI values supplied by seven meteorological stations: Drobeta Turnu-Severin, Calafat, Bechet, Băilești, Craiova, Caracal, and Slatina.

There are two calculation methods of the aforementioned index, “a-dimensionally” or “in units” and in Celsius degrees. The threshold values are 80 units or 40°C, but, as the social impact is more obvious if the index is rendered in higher values, it is preferred to be expressed in units.

In Romania, the Temperature – Humidity Index (THI) is generally calculated according to the formula:

$$THI = (T \times 1.8 + 32) - (0.55 - 0.0055 U) [(T \times 1.8 + 32) - 58],$$

where

T = air temperature (°C), U = relative humidity (%).

If THI is: ≤ 65 it means comfort state; 66-79 it means alert state; ≥ 80 it means discomfort state (Dragotă, 2003, p. 47).

Another used formula is the one proposed by Thom (1959): $THI = 0.4 (td + tw) + 4.78$, where td = dry-bulb temperature, tw = wet-bulb temperature (°C, values indicated by the psychrometer), which represents the effective temperature index (Teodoreanu, 2003, p. 28).

There were also used other climatologic data – mean monthly temperatures, absolute maximum temperatures, temperature deviations etc. in order to render the real dimension of extreme heat.

RESULTS AND DISCUSSIONS

The Oltenia Plain, which represents the south-western extremity of the Romanian Plain, is frequently subject to the penetration of hot, dry or humid air masses originating in the north of Africa or the Mediterranean Sea basin. Consequently, there occur numerous phenomena that may be considered climatic risk phenomena or climatic hazards – heat waves, dryness or drought, rain showers etc. In the last 10 years, there was kept a strict evidence of the number of days with values of the THI > 80.

The annual situation

The mean annual number of days with the THI values above 80 oscillates between 22.1 (Băilești) and 9.9 (Craiova). The highest values are registered in the southern and western parts of the plain, while the lowest correspond to the northern extremity. Thus, the most exposed area is the Danube Floodplain – Calafat (18.3) and Bechet (20.8). Eastwards, the values are lower, less than 16 days, as the area in question is more exposed to the penetration of continental dry and hot air masses, which triggers lower values of the temperature-humidity index than in the south and west.

By analysing the data, it comes out that the years with the highest number of days with the THI values above 80 are 2000, 2001, and 2007 for the entire studied area, when, during summer, the region was affected by numerous heat waves, which led to the frequent exceeding of the 40°C value. The most

affected areas are located in the central-southern and eastern parts of the Oltenia Plain – 51 days with THI > 80 at Caracal in 2000, 47 days with THI > 80 at Bechet in 2001 and 43 days in 2000, and 41 days with THI > 80 at Băilești in 2007 (Fig. 1).

Table no. 1 The relation between environmental temperature (°C) and relative humidity (%) and the temperature felt by the human body

Temperature °C	Relative humidity (%)										
	100	90	80	70	60	50	40	30	20	10	5
15	17.5	17.0	16.5	16.0	15.5	15	14.5	14	13.5	12.9	12.7
18	20.2	19.6	19.0	18.4	17.8	17.2	16.6	16.0	15.4	14.8	14.5
20	22.2	21.5	20.8	20.1	19.4	18.7	18.0	17.4	16.7	16.0	15.6
22	24.2	23.4	22.6	21.9	21.1	20.3	19.5	18.7	18.0	17.2	16.8
25	27.5	26.5	25.6	24.7	23.7	22.8	21.9	20.9	20.0	19.1	18.6
28	31.0	29.9	28.7	27.6	26.5	25.4	24.3	23.2	22.0	20.9	20.4
30	33.5	32.2	31.0	29.7	28.5	27.2	26.0	24.7	23.5	22.2	21.6
32	36.1	34.7	33.3	31.9	30.5	29.1	27.7	26.3	24.9	23.5	22.8
35	40.4	38.7	37.1	35.4	33.7	32.1	30.4	28.8	27.1	25.4	24.8
38	45.1	43.1	41.1	39.2	37.2	35.3	33.3	31.4	29.4	27.4	26.5
40	48.4	46.2	44.4	41.9	39.7	37.5	35.3	33.2	31.0	28.8	27.7

Low risk
 Medium risk
 Increased risk
 Very high risk

Table no. 2 Effects of prolonged exposure to high temperature and humidity values

THI	Effects
27–32°C (54–64)	Caution – it is possible to feel a sensation of fatigue in case of prolonged exposure and activity. If a person continues the activity under such circumstances, there can appear heat cramps.
32–41°C (64–82)	Extreme caution – heat cramps and heat exhaustion are possible. If a person continues the activity under such circumstances, there can appear heat stroke.
41–50°C (84–100)	Danger – heat stroke is highly probable if continuing the activity.
> 50°C (>100)	Extreme danger – heat stroke is imminent.

Source: Dolj Public Health Directorate

The monthly situation

Extremely high temperatures and humidity values are characteristic to the warm season of the year. Thus, the threshold value of the THI is generally exceeded in five months, the interval May-September, but the frequency is by far greater in July and August, the warmest months of the year. Thus, the mean values for the interval 2000-2010, oscillate between 0.1 and 9 days per month. The highest monthly means generally correspond to July and August, while territorially, the most exposed

regions are located in the south – Calafat, Bechet and the central part of the plain – Băilești. Northwards and eastwards, the values decrease, and the greatest means do not exceed 6 days.

By summing up the entire number of days with values above the THI threshold, it results that there were registered 221 days at Băilești, 208 days at Bechet, and 183 at Calafat. For the western, northern and eastern extremities of the plain, the number of days is below 150.

With regard to annual variability, the greatest number of days with THI above 80 was registered in 2000, 2001, and 2007, at least in the south and centre of the plain – Calafat: 26 days (12 days in July and 14 in August 2000, 11 days in July and 16 days in August 2001), Bechet (16 days in July and 18 days in August 2000, 18 days in July and 25 days in August 2001), Băilești (11 days in July and 15 days in August 2001, 20 in July and 11 days in August 2007), Caracal (16 days in July and 23 in

August 2000). On the whole, at Băilești there were registered 76 days in July (34.4%) and 90 days in August (40.7%), while at the opposite pole, we mention Drobeta Turnu-Severin with 50 days in July (44.2%) and 35 in August (31%) and Craiova with 38 days in July (38.4%) and 47 days in August (47.5%) (Fig. 2). The higher percentages registered at the stations with a lower total number of days is induced by the fact that here May and September hold extremely reduced shares.

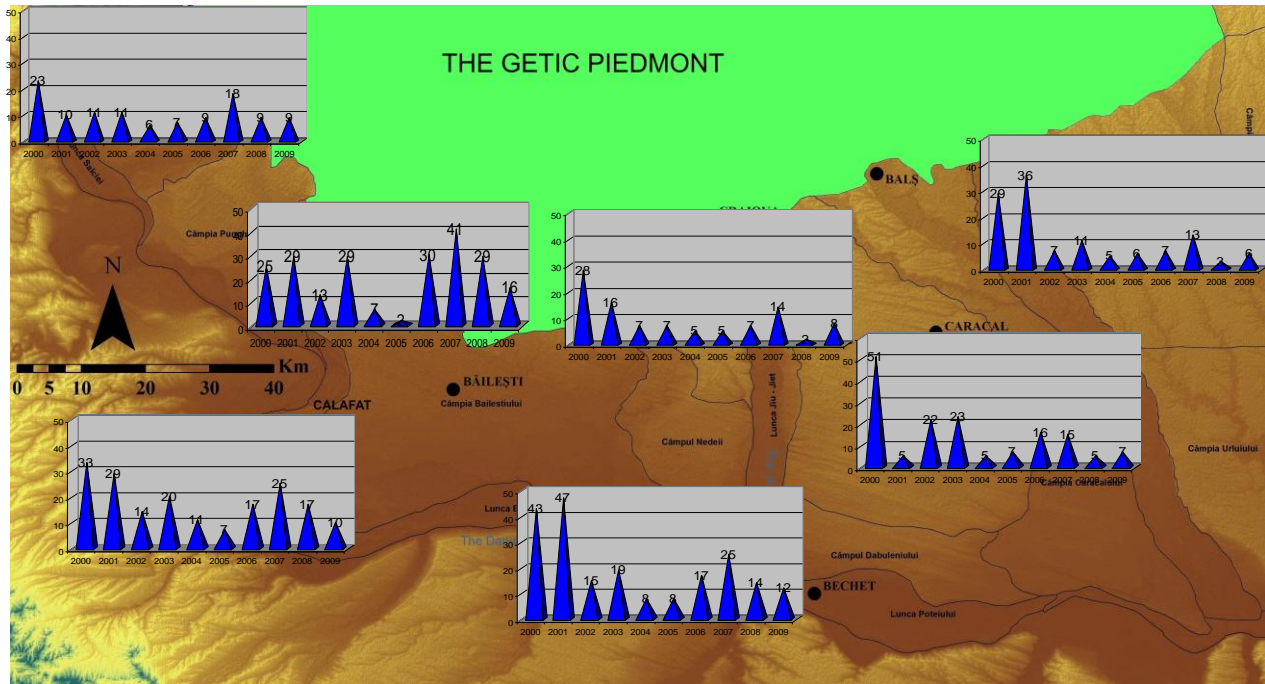


Fig. 1 The total number of days with the THI > 80 between 2000 and 2009

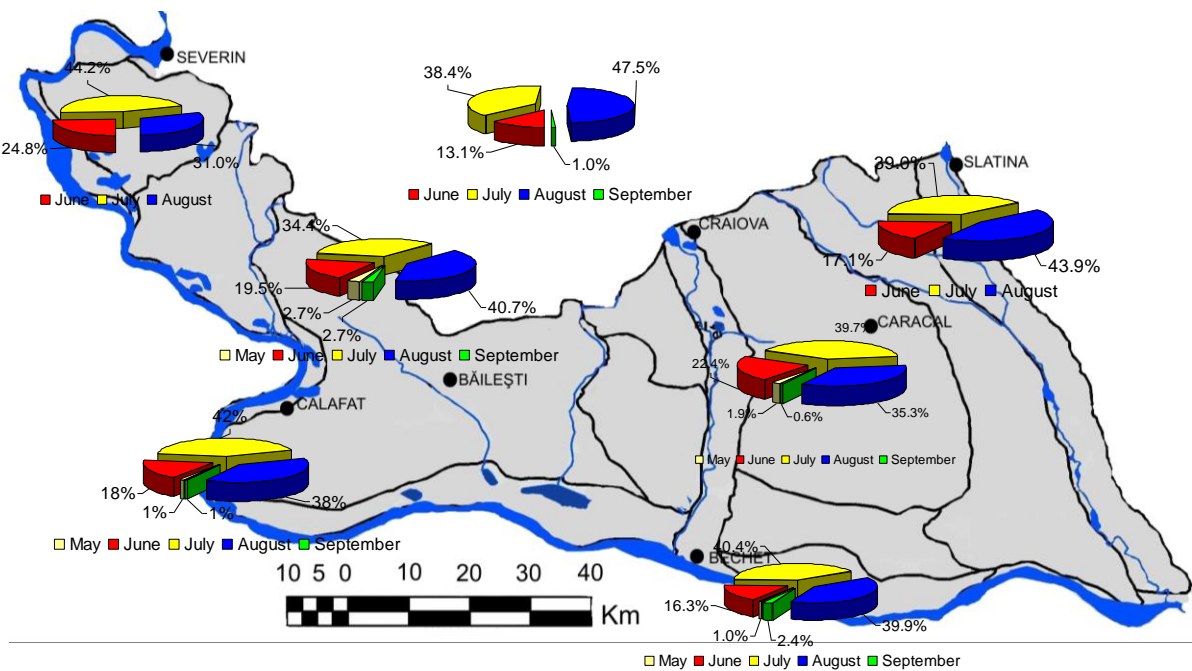


Fig. 2 Monthly shares of the total number of days with the THI > 80
Case studies June-August 2000

The entire mentioned interval registered extremely high maximum temperature values. Consequently, the number of days with temperatures above the 30°C oscillated between 16 and 18 within the entire plain in June, between 16 and 19 days in July, and between 21 and 26 days in August. As for the 40°C threshold,

July is the most problematic month, as there were registered 5 days at Bechet, 4 days at Caracal, 3 days at Calafat, and 2 days at the rest of the stations (Table no. 3). In August, there was registered one day with more than 40°C at all the meteorological stations, except for Slatina.

Table no. 3 The number of days with temperatures above certain thresholds, June-August 2000

Meteorological station	No of days with Tmax.≥... June		No of days with Tmax.≥... July			No of days with Tmax.≥... August		
	≥30°C	≥35°C	≥30°C	≥35°C	≥40°C	≥30°C	≥35°C	≥40°C
Slatina	17	9	18	9	2	21	8	0
Caracal	18	8	19	10	4	23	14	1
Craiova	16	6	15	7	2	23	14	1
Băilești	16	7	19	11	2	26	14	1
Calafat	16	7	18	12	3	25	13	1
Bechet	18	8	16	12	5	25	12	1
Dr. Tr. Severin	16	6	18	10	2	26	14	1

Source: *Oltenia RMC*

There were three canicular periods in June 2000 (Bogdan and Marinica, 2007), but the hottest days registered by the end of the month, between 23 and 25. The highest temperature of the month reached 38.7°C at Băilești on the 23rd, but all the maximum values exceeded 36°C; positive deviations oscillated between 0.9°C (Caracal) and 2.2°C (Craiova) (Table no. 4). The maximum value of the THI was registered at Caracal, on the 23rd, 86.1, while the lowest at Drobeta Turnu-Severin, 82.3, on the 24th.

July 2000 was by far the warmest month of the year both in terms of mean and maximum values. The heat waves penetrated in the area at the beginning and by the end of the month (2-10 and 22-27). As one may notice from Table no. 5, maximum temperature exceeded 40°C within the entire region, the highest values being registered in the Danube Floodplain, generally > 43°C, on the 4th of July.

Temperature deviations are generally lower than those registered in June, as the multiannual mean monthly values are quite increased – they varied between 0.8 (Slatina and Drobeta Turnu-Severin – located in the eastern, respectively western extremities of the plain) and 2.1°C (Caracal). At this last station, there was also registered the greatest number of days with THI>80, namely 16. We mention Bechet as well with 16 days. At these stations, there were recorded the highest values of the THI: Bechet – 89.7 and Caracal – 89.4 on the 5th of the month. In fact, all the maximum values of the THI were quite similar, as the lowest one was 84.2 registered at Drobeta Turnu-Severin.

Overall, the number of days with the THI values greater than the alarm threshold was higher in

August as compared to July. Here we mention Caracal with 23 days of 31 possible and Bechet with 18 days. The maximum values of the THI were also registered at Caracal, 89.2, and Bechet 87.8. Temperature deviations oscillated between 1.8°C (Slatina) and 2.6°C (Caracal) and except for Slatina, at all the other meteorological stations, deviations were higher than 2°C. Maximum values were registered all on the 23rd of August, the hottest day of the month, and they were generally 2°C higher in the western half of the plain (40.7°C at Calafat) (Table no. 6).

July 2007

Heat was a problem during the summer of 2007, higher temperatures than the multiannual average being registered also in May, June and August. This situation was largely induced by the action of the North African depression, which was located in the southern and central-eastern parts of the continent, including our country. On the background of the penetration of the tropical continental air, there occurred extreme temperatures.

Thus, maximum values exceeded 40°C within the entire plain region, the highest temperature being registered at Calafat, 44.3°C, which represents the new absolute maximum value for July in our country. There were also more than 44°C at Bechet and Băilești (Table no. 7), all the three values representing new temperature records for these meteorological stations. We also mention a new record number of consecutive dog days – 10, at all the stations from the region and one case of 10 consecutive tropical nights (Tmin>20°C) at Craiova.

Table no. 4 Thermal features of June 2000

Meteorological station	June 2000				
	No. of days with THI > 80	Max. value of THI / date	Max. temperature (°C) / date	Mean monthly temperature (°C)	Temperature deviation (°C)
Slatina	6	85.5/24	36.8/23	22.6	+ 1.2
Caracal	12	86.1/23	37.5/24	23.1	+ 0.9
Craiova	5	82.8/24	36.4/23	22.8	+ 2.2
Băilești	6	82.0/24	38.6/23	22.8	+ 1.5
Calafat	7	82.8/25	38.0/23	23.3	+ 1.8
Bechet	9	83.8/23	38.0/23	22.5	+ 1.1
Dr. Tr. Severin	9	82.3/24	38.0/23	23.2	+ 2.0

Source: Oltenia RMC

Table no. 5 Thermal features of July 2000

Meteorological station	July 2000				
	No. of days with THI > 80	Max. value of THI / date	Max. temperature (°C) / date	Mean monthly temperature (°C)	Temperature deviation (°C)
Slatina	8	86.8/4	41.0/4	23.8	+ 0.8
Caracal	16	89.4/5	42.3/4	25.0	+ 2.1
Craiova	8	84.5/5	40.5/4	23.9	+ 1.3
Băilești	6	84.5/4	43.1/4	24.3	+ 1.0
Calafat	12	87.4/4	43.2/4	25.1	+ 1.6
Bechet	16	89.7/5	43.0/4	24.6	+ 1.3
Dr. Tr. Severin	6	84.2/4	42.6/4	24.2	+ 0.8

Source: Oltenia RMC

Table no. 6 Thermal features of August 2000

Meteorological station	August 2000				
	No. of days with THI > 80	Max. value of THI / date	Max. temperature (°C) / date	Mean monthly temperature (°C)	Temperature deviation (°C)
Slatina	15	84.3/23	38.2/23	22.3	+ 1.8
Caracal	23	89.2/23	39.5/23	22.4	+ 2.6
Craiova	15	83.8/23	38.0/23	22.2	+ 2.5
Băilești	13	83.8/23	40.2/23	22.5	+ 2.3
Calafat	14	85.5/23	40.7/23	23.1	+ 2.3
Bechet	18	87.8/23	40.0/23	22.5	+ 2.0
Dr. Tr. Severin	8	85.6/23	40.2/23	23.0	+ 2.5

Source: Oltenia RMC

At the same time, there was registered the highest minimum temperature - 25°C at Calafat, on the 23rd of July and 24.6°C at Caracal on the 24th of July (Burada and Sandu, 2009). Temperature deviations oscillated between 3.0°C at Slatina and 4.3°C at Caracal, about 2°C higher than in the hot interval registered in 2000. Regarding the number of days with the THI > 80, we mention the western half of the plain with more than 10 days (the maximum number is 20 at Băilești), while in the east, there were only 8 – 10 days. The maximum values of the THI were almost 90, in some areas being reported even greater values.

Heat impact on human health state

The most debated heatwaves, due to the increased number of casualties, registered in the

last 50 years were those registered in New York in 1975 and in Western Europe in 2003.

With regard to the impact on the people's health state, mortality and morbidity are quite difficult to be exactly estimated, as there may be a serious delay between the weather event and death time. However, according to Haines et al. (2006), it is absolutely necessary to perform empirical observations of the relationship between short-term variations in weather and mortality over a long period of time in order to determine whether changes in health might be expected as a result of future changes in climate. Studies performed in various regions of the Globe have shown different values at which increases in heat related mortality begin depending on the acclimatization of the population on to local climate conditions (Keatinge et. al., 2000; Kalkstein and Greene, 1997; Curriero et. al., 2002).

Table no. 7 Thermal features of July 2007

Meteorological station	July 2007				
	No. of days with THI > 80	Max. value of THI / date	Max. temperature (°C) / date	Mean monthly temperature (°C)	Temperature deviation (°C)
Slatina	8	82.0/24	41.4/24	26.4	+ 3.0
Caracal	9	82.0/24	41.9/24	27.2	+ 4.3
Craiova	9	83.0/24	42.6/24	26.5	+ 3.9
Băilești	20	87.0/24	44.0/24	26.9	+ 3.7
Calafat	15	85.0/24	44.3/24	27.4	+ 3.9
Bechet	13	84.0/24	44.2/24	26.5	+ 3.2
Dr. Tr. Severin	11	83.0/24	42.2/24	26.4	+ 3.1

Source: Oltenia RMC

The increases in death rates that have been observed worldwide occur principally in the elderly and infants and they are mainly induced by cardiovascular and respiratory complications. This is why it has not been possible to develop a consistent standardized definition of a heatwave between populations that incorporates the intensity and duration of high temperatures and the population response (Hajat et. al., 2002, p. 367).

Certain studies published in Europe infer that mortality rises linearly as temperature increases and that even moderate heat can trigger excess deaths (Kunst et. al., 1993), but this greatly depends on other environmental conditions as well.

According to the data supplied by certain, unofficial rapports of Dolj, Olt and Mehedinti Public Health Directorates, there were registered an obvious increase of in the number hospitalized people. There was not kept a strict evidence of the morbidity and mortality state induced by the heat waves, but, overall, there were generally reported more than 100 calls per day and more than 10 hospitalization situations. Most people that needed medical assistance accused heat cramps and heat exhaustion – painful spasms usually in muscles of legs and abdomen, heavy sweating, weakness, fainting and vomiting etc., and in some cases even heat strokes that led to several fatalities.

CONCLUSION

Heat waves seem to become a constant climatic risk phenomenon in the south of the country during the warm season. Oltenia Plain represents one of the most vulnerable regions of Romania due to its positioning in the path of extremely hot air masses penetrating from Northern Africa. Consequently, in the last ten years, the region has registered new and alarming thermal records.

By analysing the temperature data, as well as the THI values, we may state that the most exposed part of the plain to such phenomena is the southern one, located along the Danube (Calafat, Bechet, Băilești). Thus, maximum temperatures for the studied interval

were equal or exceeded 44°C (July 2007), temperature deviations were higher than 3°C (also July 2007), while the number of days with the THI>80 was usually greater than ten days per month. When summing up the total number of days registered in ten years, we come to the conclusion that there were 221 days at Băilești, 208 days at Bechet, and 183 days at Calafat, which means about 6% of the total number of days. Overall, as monthly distribution of the days with the THI>80, we remark the same meteorological stations: Băilești – 76 days in July and 90 in August, Bechet – 84 days in July and 83 in August, and Calafat – 77, respectively 70 days.

The most problematic years were by far 2000 (the interval June-August) and 2007 (especially July), with the highest values at the level of the entire region. There should be also mentioned July and August 2001 (25 days with the THI>80 at Bechet in August, the greatest number of days registered in a month for the analysed period).

When it comes to the influence of such high values of the THI on human health, children and elderly people or those suffering of different diseases are mainly affected. At values above 80, even if the discomfort sensation is not obvious, it is recommended to take adequate protection measures:

- Avoid excess activity during periods of hot temperatures and high humidity.
- Drink plenty of fluids and replace lost electrolytes (potassium, sodium, chloride, etc.) with foods or supplements.
- Avoid the direct sun exposure – skin cannot loose heat effectively when burned.
- Wear loose-fitting clothing.
- Eat "light" foods such as fruit and vegetables and avoid heavy foods such as proteins, which increase body heat.
- Give the body time to adjust to warmer temperatures during the first hot days.

- If necessary, seek areas with cooler temperatures: air-conditioned buildings, forests, lakes or seashores.

Fortunately, the Romanian authorities imposed employers a set of measures (stipulated at the European level) to better cope with extreme heat periods – free water distribution for the employees (2 to 4 l per day), showers, reduction of physical activities, alternance of dynamic and static effort periods etc. Unfortunately, many people, who do not work for public or private companies or even the employers, do not respect these measures. Consequently, each summer, there are registered many casualties and fatalities that might be easily reduced.

ACKNOWLEDGEMENTS

This work was supported by the strategic grant POSDRU/89/1.5/S/61968, Project ID61968 (2009), co-financed by the European Social Fund within the Sectorial Operational Program Human Resources Development 2007 – 2013.

REFERENCES

- Burada, C. and Sandu, O. (2009), *The July 2007 Heat Wave in Oltenia (South-West of Romania) in the Context of Climate Change*, Geographia Technica, no. 1, Cluj Napoca
- Bogdan, Octavia and Marinică, I. (2007), *Hazarde meteo-climatice din zona temperată. Geneză și vulnerabilitate cu aplicații la România*. Edit. Lucian Blaga, Sibiu: 434 pp.
- Curriero, F. C., Heiner, K. S., Samet, J.M., Zeger, S. L., Strung, Lisa, Patz, J. A. (2002), *Temperature and mortality in 11 cities of the Eastern United States*, American Journal of Epidemiology, 155, 80–87;
- Dragotă, Carmen (2003), *Indicele de confort temperatură-umezeală (ITU)*, Indici și metode cantitative utilizate în climatologie, Edit. Univ. din Oradea, Oradea, p. 47;
- Haines, A., Kovats, R.S., Campbell-Lendrum, D., Corvalan, C. (2006), *Climate change and human health: impacts, vulnerability, and mitigation*, The Lancet 367 (9528), 2101-2109;
- Hajat, S., Kovats, R. S., Atkinson, R. W., Haines, A. (2002), *Impact of hot temperatures on death in London: a time series approach*, Journal of Epidemiology and Community Health, 56, pp. 367-372;
- Kalkstein, L. S. and Greene, J.S. (1997), *An evaluation of climate/mortality relationships in large U.S. cities and the possible impacts of a climate change*, Environmental Health Perspectives, vol. 105, pp. 84-93;
- Keatinge, W. R., Donaldson, G. C., Cordioli, E. (2000), *Heat related mortality in warm and cold regions of Europe: observational study*, BMJ, 321:795–800;
- Kunst, A. E., Looman, C. W. N., Mackenbach, J.P (1993), *Outdoor air temperature and mortality in the Netherlands: a time series analysis*, American Journal of Epidemiology, 137, pp. 331-341;
- Leontie, L., Timofte, A., Bostan, Diana Corina, Bostan, S. (2008), *ITU - Temperature Humidity Index between Comfort and Discomfort. Recorded Values in 2007 Summer for Moldavia Region*, Present Environment and Sustainable Development, nr. 2, Iasi, pp. 267-271;
- Luber, G., McGeehin, M. (2008), *Climate Change and Extreme Heat Events*, American Journal of Preventive Medicine, Volume 35, Issue 5 , pp. 429-435;
- Marinică, I. and Marinică, Andreea Florina (2008), *The Heat Wave of July 2007 and its effects on the Biosphere*. Muzeul Olteniei Craiova. Oltenia. Stud. și Com. Șt. Nat. 24: 211-220;
- Marinică, I. and Chimișliu, Cornelia (2009), *Considerations upon the Temperature Humidity Index in Oltenia in the Period 2000-2007*, Muzeul Olteniei Craiova. Oltenia. Stud. și Com. Șt. Nat. 25;
- Segal, M. and Pielke, R. (1981), *Numerical Model Simulation of Human Biometeorological Heat Load Conditions – Summer Day Case Study for the Chesapeake Bay Area*, Journal of Applied Meteorology, 20, no. 7
- Teodoreanu, Elena (2003), *Indici bioclimatici*, Indici și metode cantitative utilizate în climatologie, Edit. Univ. din Oradea, Oradea, p. 28;
- Teodoreanu, Elena and Bunescu, Iulia (2007), *Thermal Comfort*, Present Environment and Sustainable Development, nr. 1, Iasi, pp. 135-142;
- Teodoreanu, Elena and Bunescu, Iulia (2008), *Canicular days in the summer of 2007 in Iasi*, Present Environment and Sustainable Development, nr. 2, Iași, pp. 189-197;
- Thom, E.C. (1959), *The discomfort index*, Weatherwise, 12, pp. 57-60;
- www.britannica.com/EBchecked/topic/586706/temperature-humidity-index.