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ITU - TEMPERATURE HUMIDITY INDEX BETWEEN COMFORT AND DISCOMFORT. RECORDED VALUES IN 2007 SUMMER FOR MOLDAVIA REGION

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Abstract: We often use the air temperature as an indicator of how comfortable we will feel when we are involved in sports or other physical activities. However, the air temperature is only one factor in the assessment of thermal stress. Human thermal comfort depends on environmental and personal factors. The four environmental factors are: airflow (wind), air temperature, air humidity, and radiation from the sun and nearby hot surfaces. The personal factors are the clothing being worn and the person's level of physical activity.

Introduction

The ambient depends not only on air temperature and moisture, but on its relative moisture also, which affects the speed of the evaporation of perspiration and the default speed cooling of the body. At 27 °C the environment can be very pleasant if the relative moisture is only 20%, but very unpleasant if its value is of 70% or more. Other factors are the human body radiation and wind speed and the result can be neglected when we evaluate the personal comfort (human) in closed rooms.

Lack of comfort can be attenuated through ventilation or air conditioning installations. The Temperature-Humidity Index (ITU) can be calculated based on the relationship below.

$ITU= (T_{us}*1,8+32)-(0,55-0,55UR/100)[(T_{us}*1,8+32)-58]$

T_{us}- temperature of dry air

UR- relative humidity

In normal conditions of thermal environment, the main mechanism of the body heat loss is followed by radiation, evaporation and convection. The order

mentioned may be essential change in different conditions, such as strong cold, excessive heat, high humidity, and wind to high speeds.

The process of the perspiration vaporization must be intensified especially at high temperatures (Fig.1). If you add in physical effort, and the air is dry enough to be able to receive water vapors, the rate of evaporation of transpiration may be over 1,000 ml/hour. Evaporation (vaporization) as a mechanism of heat loss is increased through the emphasis of air temperatures and currents of air.

The rate of temperature change is directly correlated to the rate of heat change within the body.

$$\frac{\Delta Q_{TOT}}{\Delta t} = C\frac{\Delta T}{\Delta t}$$

The heat change depends on the heat originated in the body (basal/basic metabolic heat ΔQbas and the heat production while doing external work ΔQext). "C" is the heat capacity of the human body, which derives from the specific heat c=0.83 kcal/ºC kg. For a typical body mass of m=70 kg,

$$C = c \cdot m = 58kcal/^{\circ}C$$

$$\frac{\Delta Q_{TOT}}{\Delta t} = \frac{\Delta Q_{met}}{\Delta t} = \frac{\Delta Q_{bas}}{\Delta t} + \frac{\Delta Qext}{\Delta t}$$

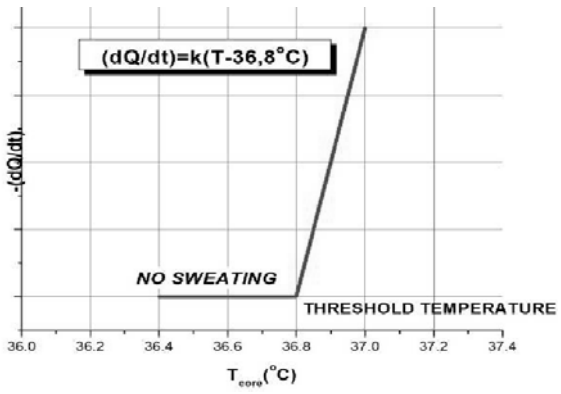

Fig.1 - Rate of heat loss due to sweating as a function of core temperature (body intern temperature).

1. Experimental method

Data were analyzed- temperature and moisture from 23 meteorological stations in Moldavia region; we selected the highest maximum temperatures and through the analyses of the mesoscalar and synoptic situation we managed to make a characterization of the "warm season" of 2007 in Moldavia.

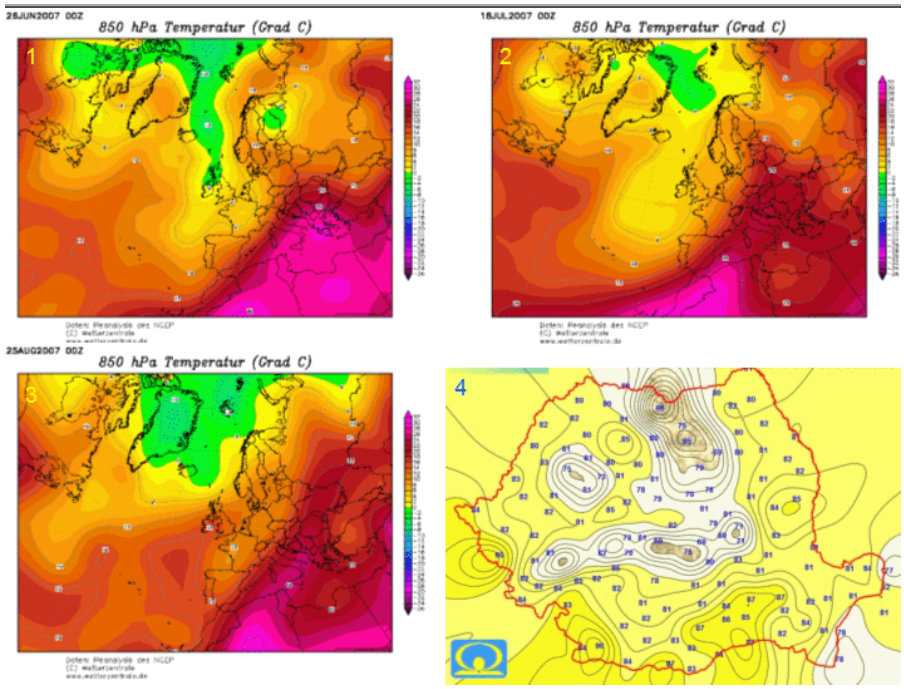

Fig.2 - The temperature at 850 hPa on 26th of June 2007 at 00 UTC, 18th of July 2007 at 00 UTC, 25th of August 2007 at 00 UTC and map index values of thermal comfort of 24th of July 2007

The critical value 80 of the Temperature Humidity Index ITU, in Moldavia, was reached and exceeded in percentage of approximately 25% of the days from the warm season (the months of June, July and August). The high temperature recorded in those periods (were responsible for achieving and overcome ITU) was due to this synoptic scale, North African depression, in the south and central - east of the continent, and therefore in our country too (Fig.2).

2. Results and discussions

The first registrations of exceeds of this index were at the end of June: on the 22nd, in southern Moldavian region (district Vrancea: Focsani meteorological station recorded 36 ºC, (10 ºC higher comparing the norm of this period) and on the 26th June when the ITU were overcome all Moldavia region - less Suceava.

In July, the maximum value of temperatures should be normally situated between 22 and 28 ºC. The month of July has been characterized by a long hot, canicular (dog-days) in southern and eastern Moldavia. In this month there were recorded 13 days in which this index was passed. Of these, it is remarked the range between the 16th and the 25th of July in which ITU has been passed in 10 consecutive days - in the first two days in the Eastern regions and then in all Moldavia. In this period, the maximum air temperature recorded at the weather stations has reached values of 33/34 ºC in the north (Radauti-Suceava County) and up to 41 ºC in the south and east (Iasi, Vaslui, Galati and Vrancea County).

County	The monthly maximum temperature in 2007			
	MAY	JUNE	JULY	AUGUST
SUCEAVA	29,0 °C (Suceava)	34,5 °C (Suceava)	36,0 °C (Suceava)	37,7 °C (Radauti)
NEAMT	34,1 °C (Roman)	37,6 °C (Roman)	38,3 °C (P. Neamt)	37,4 °C (Roman)
BACAU	33,1 °C (Bacau)	38,4 °C (Bacau)	40,3 °C (Bacau)	37,9 °C (Tg. Ocna)
VRANCEA	32,5 °C (Focsani)	39,0 °C (Adjud)	41,1 °C (Focsani)	37,9 °C (Focsani)
BOTOSANI	33,9 °C (Stefanesti)	37,6 °C (Stefanesti)	37,5 °C (Botosani)	37,2 °C (Stefanesti)
IASI	36,0 °C (Iasi)	37,4 °C (Iasi)	40,1 °C (Iasi)	38,1 °C (Iasi)
VASLUI	34,8 °C (Vaslui)	38,5 °C (Vaslui)	40,8 °C (Vaslui)	38,2 °C (Barlad)
GALATI	33,2 °C (Galati)	37,8 °C (Galati)	40,5 °C (Galati)	40,4 °C (Galati)

Tab.1 - Representation of the highest maximum temperature recorded at the county meteorological stations.

It followed another interval when the critical value of 80 was reached and exceeded: in August, and especially in the second half of this month, when the normal maximum temperature would be between 21 and 27 ºC. The first exceed of ITU has been recorded on the 18th of August in southern Moldavia (district Vrancea- Adjud: T = 33 ºC) and it spanned from the 20th to the 25th of August, when it was reached again, at first in the south and then, gradually, expanded

throughout Moldavia (the 24th and the 25th of August- Galati and Vrancea Counties have reached the maximum temperature of 40 ºC, with values exceeding 12 ºC higher then the norm).

The summer season of 2007 and the maximum air temperatures recorded in this period (Tab.1) (constituting the temperature record in most points values) led at intervals, quite high, which showed discomfort on the human body, being the most representative of those 10 days consecutively in July and 6 consecutive days in August.

Conclusion

Human thermal comfort depends on environmental and personal factors. The four environmental factors are airflow (wind), air temperature, air humidity, and radiation from the sun and nearby hot surfaces. The personal factors are the clothing being worn and the person's level of physical activity. Thermal sensation is also significantly affected by acclimatization/adaptation: it has been shown that people living in hot climates feel comfortable at higher temperatures than those living in cooler climates.

In hotter conditions the body must shed heat to maintain thermal equilibrium. The cooling effect of evaporation of sweat from the skin becomes an important factor. The efficiency of this cooling depends on the humidity of the air. A high humidity reduces significantly the effectiveness of evaporative cooling. The amount of clothing will also affect this cooling efficiency due to its restriction of the air flow over the skin. Fabrics with low vapor permeability (those that don't "breathe") will increase the humidity of air near the skin.

We often use the air temperature as an indicator of how comfortable we will feel when involved in sports or other physical activities. However, the air temperature is only one factor in the assessment of thermal stress. In climates where other important factors, especially humidity, can vary widely from day to day, we need more than just the temperature for a more realistic assessment of comfort. However it is useful to be able to condense all the extra effects into a single number and use it in a similar way to the way we used the temperature.

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