

THE HEAT WAVE IN THE WESTERN PLAIN OF ROMANIA BETWEEN THE 6TH AND 8TH JULY 2015

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Abstract

This paper presents a case study on the heat wave produced in western Romania, between the 6th and 8th July 2015. In this period, a mass of hot and dry air, originating in North Africa, invaded southern, central and south-eastern Europe. In our country, the heat wave initially affected the western part (July 6th), then the entire territory of the country (July 7th and 8th). On July 9th, the air mass of tropical origin began to slightly retreat, being replaced by a mass of cold and moist air, which moved from the northwest of Europe.

In the Western Plain, the heat and thermal discomfort were felt most strongly on the days of July 7th and 8th, 2015. For the 8th July, the hottest day, ANM issued red code warning for two counties (Arad and Bihor), a warning rarely given by this authority. Of all Romanian regions, most affected by the heat were the western and south-western ones, as well as small areas of Moldavia. The heat was most intense in the counties of Arad, Bihor, Timiș (the western sector), Mehedinți, Botoșani and Bacău.

Key words: heat wave, warm air wave, air temperature, synoptic situation, mass of air, weather warning.

INTRODUCTION

Warm air waves are regarded as meteo-climate hazards because they can cause damage to agriculture, transport, forestry etc. and can affect health. Because they are often associated with drought, they affect flow rates of rivers and lakes, due to lack of rainfall and intense evaporation from water surfaces. As a result, the warm air waves indirectly affect energy industry, navigation, irrigation, fisheries etc. They also indirectly contribute to the accelerated soil erosion.

Warm air waves also affect ecosystems. When persistent, they contribute to the emergence of dry vegetation or forest wildfires, which in turn have major negative impact on many forms of life.

MATERIAL AND METHODS

In this paper, hourly meteorological data were used and analyzed, on air temperature, relative air humidity, atmospheric pressure, from a total of 13 weather stations located throughout the Western Plain, and also at its limit by the Western Hills. The 13 stations are: Satu Mare, Supuru de Jos, Săcueni, Oradea, Holod, Chișineu-Criș, Șiria, Arad, Sănnicolau Mare, Jimbolia, Timișoara, Lugoj, Banloc. Data from these stations were

compared with data from other weather stations in Romania, where the air temperature recorded the highest values in the study period.

The work methodology consisted in the analysis and interpretation of synoptic maps, air temperature distribution maps, maps that show territorial weather warnings, satellite images, which were taken from sites of specialized agencies, such as: the National Meteorology Administration (ANM) in Romania (<http://www.meteoromania.ro/>), Meteorological Centre in Karlsruhe, Germany (www.wetterzentrale.de), EUMETNET (<http://www.meteoalarm.eu/>), EUMETSAT (<http://www.eumetsat.int/>). They have helped to characterize the synoptic situation which brought to the emergence of the heat wave in the Western Plain. It also identified the areas with the highest thermal values in the country and the effects the situation of severe weather had on the population have also been studied.

All the meteorological data used in this paper come from the database of ANM Romania.

RESULTS AND DISCUSSION

During the last days of June and first of July 2015, a mass of continental-tropical, hot and dry air, originating in North Africa, invaded western Europe. In the following days, it shifted to central and eastern Europe, reaching our country on July 6th.

Thus, between the 6th and 8th July 2015, the mass of hot and dry air occupies southern, central and south-eastern Europe. In all these areas, the wave of hot air produced heat. On July 6th, the heat wave reaches northern Poland, on July 7th it hits Ukraine and on July 8th, the lower Volga basin (Fig. 1). In our country, the heat wave initially affected the western part (July 6th), then the entire territory of the country (July 7th and 8th).

On July 9th, the air mass of tropical origin began to slightly retreat to the south and south-eastern Europe, being replaced by a mass of maritime-polar, cold and moist air, which moved from the northwest of Europe and had its origins in the North Atlantic. Thus, on the 9th of July, the heat wave was leaving western Romania, whilst maintaining the hot weather in the south and southeast of the country. The thermal differences between the two air masses exceeded 15°C. On July 10th, the heat wave left Romania.

On the synoptic maps of July 6th to July 8th 2015, above the southern, central and south-eastern parts of Europe, as well as the Mediterranean and the Black Sea basins, there was a vast field of relatively uniform atmospheric pressure (barometric swamp), with pressure values close to normal (1013.3 hPa) (Fig. 2). It also notes the cyclonic core that replaced the hot air mass and which, on 7th July at 12 UTC, had its center in northern Britain. It was driven over Europe by the dorsal of the Azores Anticyclone.

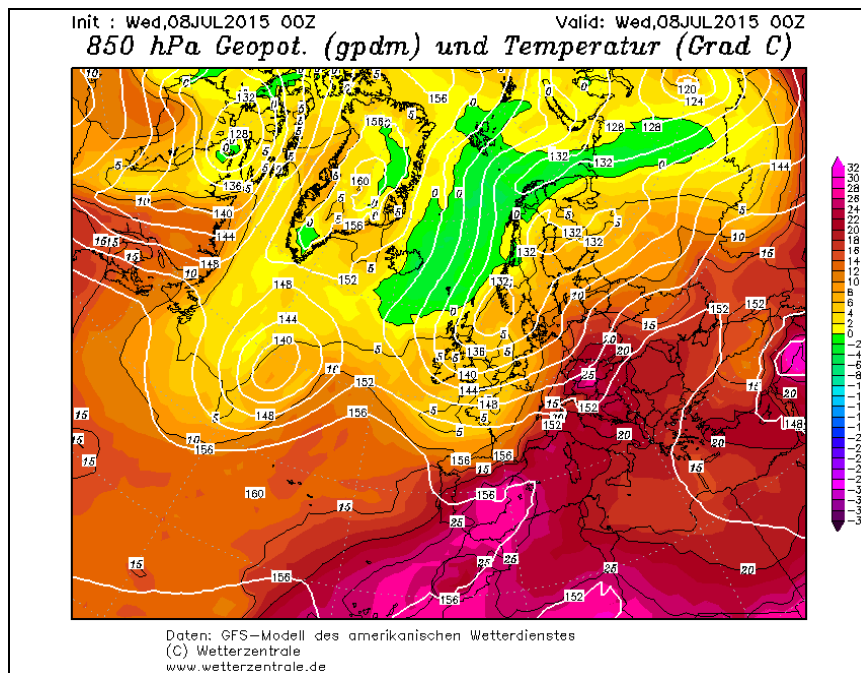


Fig. 1. The distribution of air temperature ($^{\circ}\text{C}$) and geopotential (gpm) at the isobaric surface level of 850 hPa, on July 8th 2015, at 00 UTC (Source: www.wetterzentrale.de).

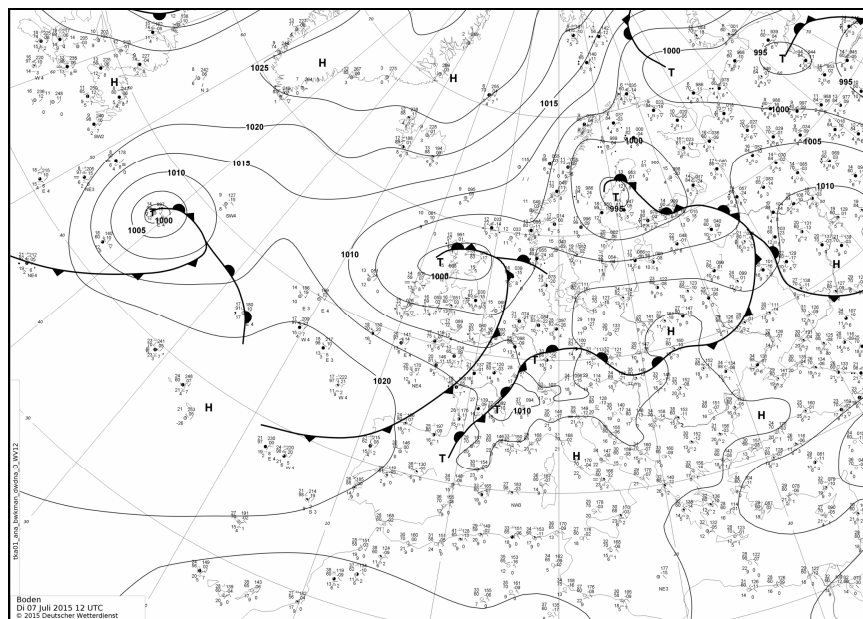


Fig. 2. The field of atmospheric pressure (hPa) at ground level over Europe, on July 7th 2015, at 12 UTC (Source: www.wetterzentrale.de).

Between the 5th and 8th July 2015, ANM issued several weather warnings. Thus, on July 6th a warning of yellow heat code was issued for the western and north-western regions of the country. For 7th-8th July, the phenomena mentioned in the warnings were "heat wave and critical thermal discomfort". As a result, for the 7th July, warnings of yellow code were issued for most of our country territory and orange code for the west of the country (Fig. 3). In the counties of Timiș, Arad, Bihor and Satu Mare maximum temperatures of 38-39°C were predicted and particularly serious thermal discomfort.

For the 8th July, ANM originally issued yellow and orange codes warnings for heat and then – as the hot weather has increased – a red code warning issued for two counties (Arad and Bihor), a warning rarely given by this authority (Fig. 4). Thus, in Banat, Maramureș, western and northern Transylvania, Moldavia (except Bukovina) – regions under orange code – were predicted maximum temperatures of 37-39°C and particularly serious thermal discomfort. In Arad and Bihor counties maximum temperatures of 38-39°C were predicted, which would approach the absolute records of temperature of Crișana region. For the rest of the country – under yellow code – temperatures of maximum 35-38°C were forecasted (Source: ANM, http://www.meteoromania.ro/anm/?page_id=92).

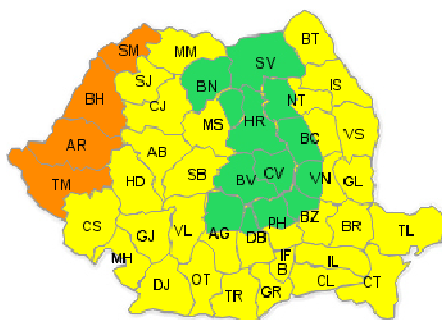


Fig. 3. The weather warning for July 7th 2015 (Source: ANM Romania, http://www.meteoromania.ro/anm/?page_id=92)

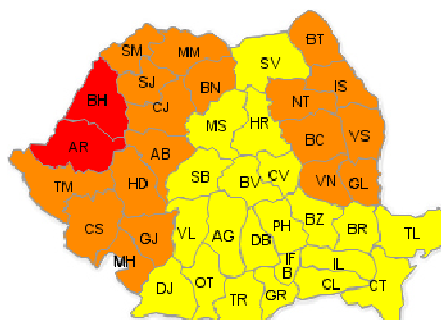


Fig. 4. The weather warning for July 8th 2015 (Source: ANM Romania, http://www.meteoromania.ro/anm/?page_id=92)

At the same time, the heat was strongly felt in the southern, central and south-east European countries. Thus, on July 8th, several countries to the west of Romania issued red code warnings of high temperatures: Slovakia, Hungary, Serbia, Slovenia, Croatia, Bosnia-Herzegovina (Fig. 5).

Of all Romanian regions, most affected by the heat were the western and south-western ones, as well as small areas of Moldavia. The heat was most intense in the counties of Arad, Bihor, Timiș (the western sector),

Mehedinți, Botoșani and Bacău. In the Western Plain, the heat and thermal discomfort were felt most strongly on the days of July 7th and 8th, 2015.

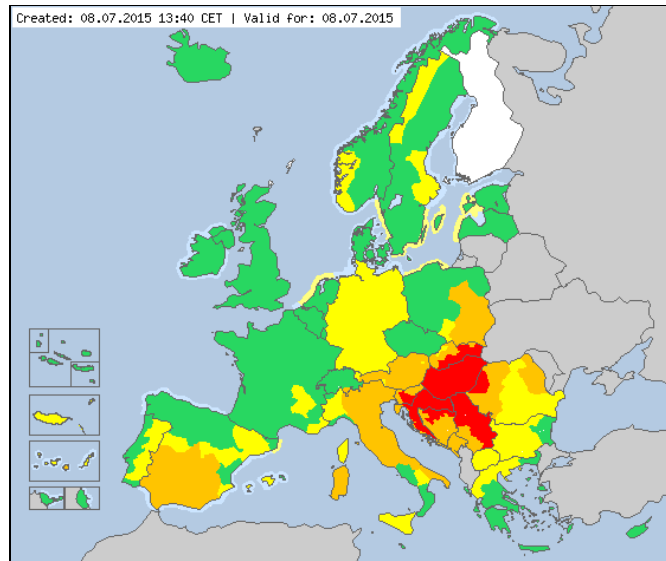


Fig. 5. The extreme weather warnings over Europe, for July 8th 2015
(Source: EUMETNET - Meteoalarm, http://www.meteoalarm.eu/index.php?lang=ro_RO)

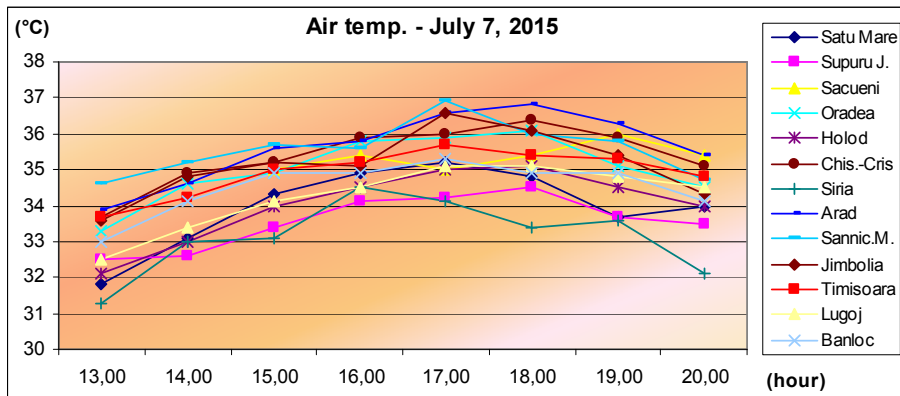


Fig. 6. Hourly air temperature in the Western Plain, on July 7th 2015, between 13:00-20:00 hrs.

In the afternoon of July 7th, between the hours 1:00 p.m. and 8:00 p.m., the 13 weather stations in the Western Plain recorded an air temperature between 31.3 to 36.9°C (Fig. 6). The figure shows that at most stations, the maximum temperature occurred within 5:00 p.m.–6:00 p.m. time frame. If on the plain territory south of the Mureș river the thermal

maxima were recorded at 5 p.m., at the north of Mureş the thermal maxima occurred generally at 6 p.m., except the stations Şiria (maximum at 4 p.m.) and Săcueni (at 7 p.m.). Daily maximum temperatures reached levels of 34.5-36.9°C in the plain region. Only the stations located at the boundary between plains and hills had the daily maxima slightly lower (34.5-35.1°C at Supuru de Jos, Holod, Şiria and Lugoj), at the other stations the maxima generally exceeding 36°C. In Oradea there were 36.1°C at 6 p.m. *The highest temperature was recorded at Sănnicolau Mare (36.9°C at 5 p.m.), then in Arad (36.8°C) and Jimbolia (36.6°C), so in the westernmost sector of the country.*

On the same day, in Romania, the highest temperature was recorded in Mehedinţi county, at the stations *Drobeta Turnu-Severin (37.7°C at 3 p.m.)* and *Halanga (37.0°C at 6 p.m.)*. The maximum value of 36.8°C was also reached at the stations Băile Herculane, Târgu Jiu and Râmnicu Vâlcea.

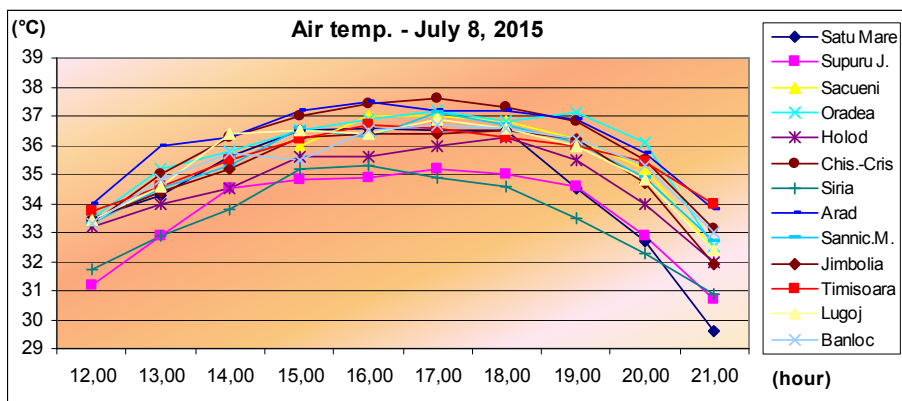


Fig. 7. Hourly air temperature in the Western Plain, on July 8th 2015, between 12:00-21:00 hrs.

In the afternoon of July 8th, between the hours 12:00 at noon and 9:00 p.m., at the weather stations in the Western Plain, the air temperature was between 29.6 and 37.6°C (Fig. 7). Compared to the previous day, within 1:00 p.m. and 8:00 p.m. time frame, the temperature was between 32.3 to 37.6°C. At most stations, the maximum temperature occurred within 4:00 p.m.–5:00 p.m. time frame, except Holod and Jimbolia stations (maximum at 6 p.m.). The daily maximum temperatures reached levels of 35.2-37.6°C in the plain, being higher than those of the previous day. At the stations located near the hills, the daily maximums were slightly lower (35.2-36.3°C at Supuru de Jos, Holod and Şiria), at all other stations they exceeding 36.5°C. *The highest temperature was recorded at Chişineu-Criş (37.6°C at 5 p.m.), then at Arad (37.5°C), Oradea (37.2°C), Sănnicolau Mare (37.1°C),*

Săcueni (37.0°C), Lugoj (36.9°C) etc. So, the heat was more intense in the Crișurilor, Aradului, Nădlacului and Arancăi Plains.

At the stations Chișineu-Criș and Arad, the air temperature reached and exceeded 37°C between the hours 3 p.m. and 6 p.m. and at Săcueni between 4 p.m. and 5 p.m.

Although the station Oradea is located at the boundary between the plains and hills, where the air temperature should be slightly lower, still, higher temperature values were recorded on the two days, because of the large built area of the city, which generates an "island of heat".

The highest temperature in the country, on July 8th, was recorded at *Botoșani* station (38.0°C at 4 p.m.) (Fig. 8), where the temperature remained at above 37°C between the hours 3 p.m. and 7 p.m. Other high thermal maximums in the country were recorded in Moldova Veche and Bacău (37.3°C), Deva and Focșani (37.2°C), Drobeta Turnu Severin (36.9°C), Turnu Măgurele and Cernavodă (36.8°C) etc.

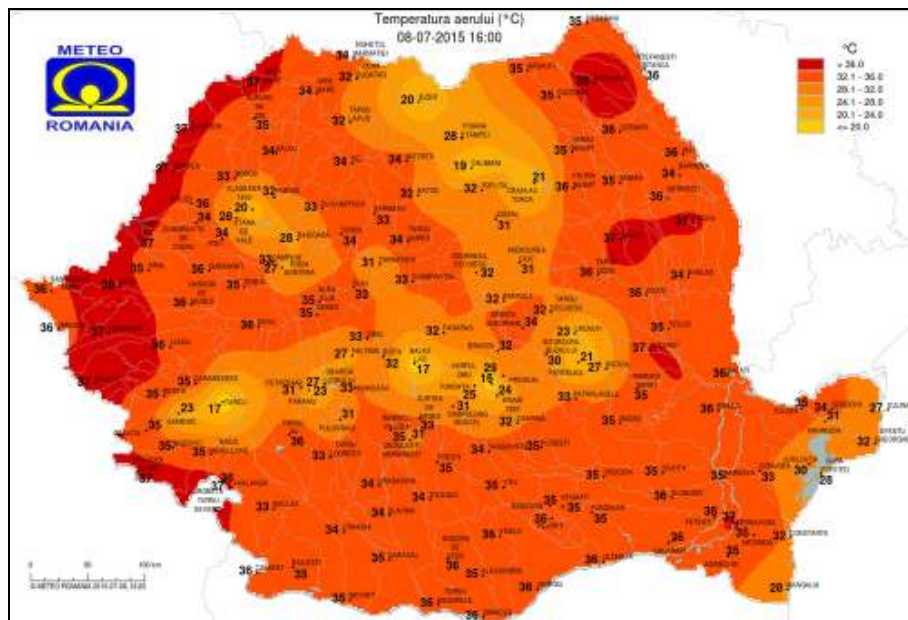


Fig. 8. The distribution of air temperature in Romania, on July 8th 2015, at 16:00 hrs. (Source: ANM Romania, http://www.meteoromania.ro/anm/?lang=ro_ro).

Across the country, on July 7th and 8th, the lowest air temperatures were recorded in the mountain areas and at the seaside (Fig. 8).

On the 9th of July, the air temperature dropped considerably, as a result of the entry of the mass of cold and wet air, which moved from the northwest of Europe. At the stations in the Western Plain, the temperature

difference between July 8th and 9th (calculated for 5 p.m.) was between 13.0 to 18.3°C.

Relative air humidity (r) frequently fell below 30% at the stations in the Western Plain, on 7th and 8th of July. Days with $r \leq 30\%$ at one of the observation hours represents a climatological parameter that indicates the high degree of air dryness. Thus, on the two days, the at most stations the relative humidity was $\leq 30\%$, except the stations Supuru de Jos, Săcueni and Holod on July 7th (r dropped to 31-32%), respectively Holod station on July 8th (r dropped to 34%). At the other stations, r reached minimum values of 21-30%. The lowest values were recorded at the hours 5 p.m.–6 p.m., i.e. within the time frame in which thermal maximums occurred. On July 7th, the lowest value of humidity (22%) occurred in Arad, at 6 p.m. On July 8th, the minimum value (21%) was recorded at the stations Șiria (the hours 5 p.m.–6 p.m.) and Oradea (7 p.m.–8 p.m.). On this day, the warmest, at many stations r dropped below 30% between the hours 2 p.m.–8 p.m. (Fig. 9).

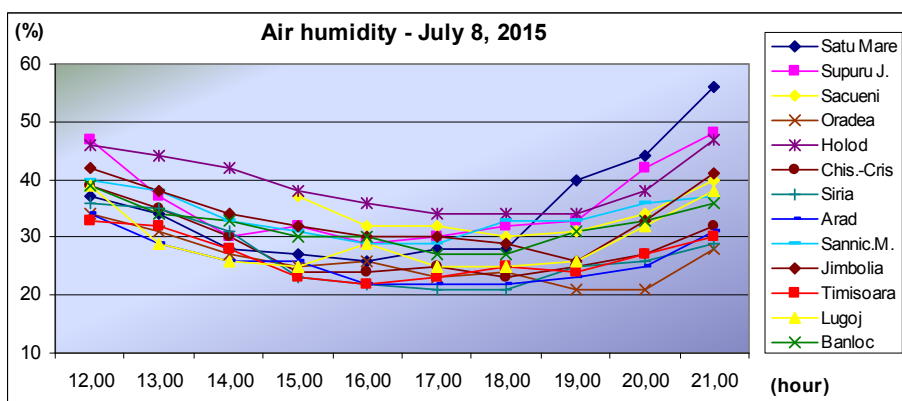


Fig. 9. Hourly relative air humidity in the Western Plain, on July 8th 2015, between 12:00-21:00 hrs.

Amid extremely high temperatures, the temperature-humidity comfort index (THI) reached and exceeded the threshold of 80 units in the Western Plain. This threshold indicates a discomfort for the human body, with a character of risk (Dragotă, 2003). The critical threshold has been reached and exceeded throughout the whole plain, on the 7th-8th of July. THI even reached values of 83-84 units at some stations (Săcueni, Holod, Sânnicolau Mare, Jimbolia, Satu Mare) (Source: ANM, http://www.meteoromania.ro/anm/?lang=ro_ro). The high THI values showed the particularly serious thermal discomfort felt by the population.

The effects of the heat wave were felt throughout the country. Thus, in the most affected regions, the trains ran at speeds lower by 20-30 km/h

compared to their normal traffic speed, and the heavy traffic was restricted on county roads. Several people needed medical care, accusing dizziness or fainting. Food units, especially producers in green markets have suffered material damage due to products alteration. In the village of Sînleani in Arad county, a harvested wheat field, with bales of straw, caught fire because of the heat. In other villages of the county (Sebiş and Țipari) several fires of dry vegetation were reported.

State institutions have taken immediate action to mitigate the negative effects of the heat wave. First aid points and distribution points of drinking water were arranged in cities. People were advised to leave their homes as little as possible, to avoid staying outdoors between the hours 11 a.m.–6 p.m. and to drink 2-4 liters of liquids daily (Sources: <http://www.aradon.ro/>; <http://www.bihon.ro/>; <http://stirileprotv.ro/>).

The atmospheric instability of the 9th of July manifested as strong wind, in some places with a squall aspect, showers, lightning and even hail in some regions of our country.

In the countries of central and southern Europe, the population hardly bore the heat and after its passage, strong squalls were reported. In the afternoon of July 8th, there was a tornado in Italy, at Venice (Source: <http://stirileprotv.ro/>).

CONCLUSIONS

The warm air from 6-8 July represented the first heat wave of the year 2015. Hot weather has persisted during the summer and autumn of 2015 for long periods, the heat periods of the interval July-September 2015 being considered – in our country – among the longest of the recent years.

We have to note that, compared to the temperatures shown in the current study and which were measured at weather stations, the felt temperatures in the major cities were higher, due to the numerous asphalt or concrete surfaces and relatively few green spaces. Basically, the thermal risk that the urban population was exposed to within 6th to 8th July 2015 was higher. We add the very low values of air humidity which have created a far greater discomfort, especially to the elderly and to people with pulmonary and cardiovascular disorders.

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