Characteristics of the Summer Drought 2007 in Romania

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Abstract

Characteristics of the summer drought 2007 in Romania. Romanian's temperate – continental climate has four seasons with two extremes warm, sometimes hot, torid summers and cold, sometimes frosty winters. Transitional seasons are spring and autumn, bearing some traits of the two extreme seasons. Global warming has enhanced the general atmospheric circulation creating unspecific weather and climate aspects both worldwide and in Romania. As a result, there are great climatic variations in the seasonal evolution. The summer of 2007 is relevant in this respect, with June and July averages having deviations of 17°-20°C against the multiannual mean, due to the almost continuous persistence of tropical heat waves. So, these two months proved to be the warmest ones within the last seven decades. The heat peak was on June 26, 2007 and July 15-24, 2007, with a record high over 42°C and 44.3°C, respectively for these months in Romania. The heat interval staying in continuously destroyed nearly 60% of the stalky cereal crops of hoeing crops, wells got dry, having a severe negative effect on the economy and the population's health.

Key-words: *heat phenomena, summer, Romania.*

Introduction

Romania, a temperate-continental climate country, is characterised by the presence of the four seasons: two extreme seasons namely the warm summer, sometimes hot and the cold winter, sometimes frosty, as well as the two transition seasons – spring and autumn, in which the climate characteristics of the two extremes are mixed.

The intensification of the general circulation of the atmosphere as a result of the climate warming, determines large unperiodical variations in the evolution of the seasons. A relevant example is given by the summer 2007, when the maximum daily temperatures of June, July and less August registered deviations of over 20°C against the multiannual means, which led to the occurence of the drought days. (temperatures over 35°C).

The phenomena is due to the almost continuous persistence of the tropical heat waves, so that, the two summer months, June and July, were the warmest out of the last seven decades. As a result, many material damages and human victims were recorded. This determined us to consider them as climate anomalia, and the respectiv phenomenon, the drought, as meteo-climate hazard[1].

In order to better understand the specific drought aspects of te summer 2007 in Romania, we shall focus briefly on the general climate characteristics of the two months, June and July, in which the drought occured.

June is the first summer month, with the most unstable weather of the year; is the rainniest month in which the maximum annual rain gauge is recorded. In this month clear sky and warm days alternate with grey sky, cold and rainy days. Also, both tropical days and nights and frosty days are possible.

Termic contrasts are characterised by tropical heat waves (with temperatures of over 30-35°C), and by polar cold waves (with temperatures of -1, -2°C). In the XX century, in June was recorded only one

[1] *The term of "drought" comes from the latin word canis (dog), known since the Romans time, who considered that this is caused by the Sirius Constellation (Canis or Dog Constellation). The Romans considered the drought to be an astronomic phenomena which appears in the period in which the the Sirius star rises and sets together with the Sun, between 22 July and 23 August, period which was considered malefic: „the seas were boiling, the wine became sour, the dogs became mad, all the cretures became enervated", and the high temperatures caused insolation and serious burns iar temperaturile ridicate cauzau insolaţie şi arsuri grave to people, animals, plants, fruits, vegetables, etc.; forests drying phenomena and natural fires on spreaded areas, as in the summer 2007 were noticed.*

case of temperatures of 42°C/29 June1938 at Oravița, in the south-west of the country and two cases with temperatures ≥40°C: 40.0°C at Giurgiu, on the Dunăre and 40.3°C at Bucureşti-Filaret, in the capital city. The greatest number of days with negative temperatures was of 13 cases in June 1950, when -20°C were recorded at Gheorgheni and -2.7°C at Buzău Turn, both values recorded in closed intracarpathic depression, the last one being the top negative temperature for June in the country.
The rain gauges contrasts are characterised by multiannual mean values of 500-600 mm in in the plain regions and around 1000 mm in high mountainous regions (>2000 m altitude), and also by values which the fallen water quantity was of 0.1-5 mm/month, yet, the absolute maximum quantities in 24 hours recorded exceptional values (200->300 mm): 348.9 mm/26 June 1925 at Ciupercenii Vechi, in the south-west of Oltenia
July is the hottest month of the summer for the all the regions of the country situated under 1800-2000 m altitude. In this month tropical nights and days are recorded, as a result of the relatively frequent heat waves, reason for which this month is called also the **Stove Month.**
From a termic point of view, in the XX century, in this month were recorded 220 cases with temperatures ≥40°C in south and south-east Romania, the most being in 1985. The most frequent situations were noted at Turnu Măgurele (16 times), Roşiorii de Vede (14 times), Giurgiu (13 times), Zimnicea şi Bechet (10 times each), Călăraşi (9 ori), Bucureşti-Filaret (8 times) etc.
The largest number of days with temperatures >40°C were recorded on 5 July 2000, at 42 meteorological stations. On the same date was recorded the absolute maximum temperature of July in the country, of 43.5°C at Giurgiu, with only 1°C less than the top temperature recorded in the country (44.5°C/10 August1951). And also in XX century was recorded in July the longest period of tropical days (24 days/August1904 at Drobeta Turnu Severin).

Discussion
Drought characteristics of June 2007
This month drought comes after a warm mediteranean winter and an early spring (which started in the second decade of February). In the first half of June, the temperatures were lower than the multiannual mean. The first heat wave occured during 17-26 July 2007, which marked the beginning of the summer, and the maximum drought intensity was achieved on 26 June 2007 (Figure 1).

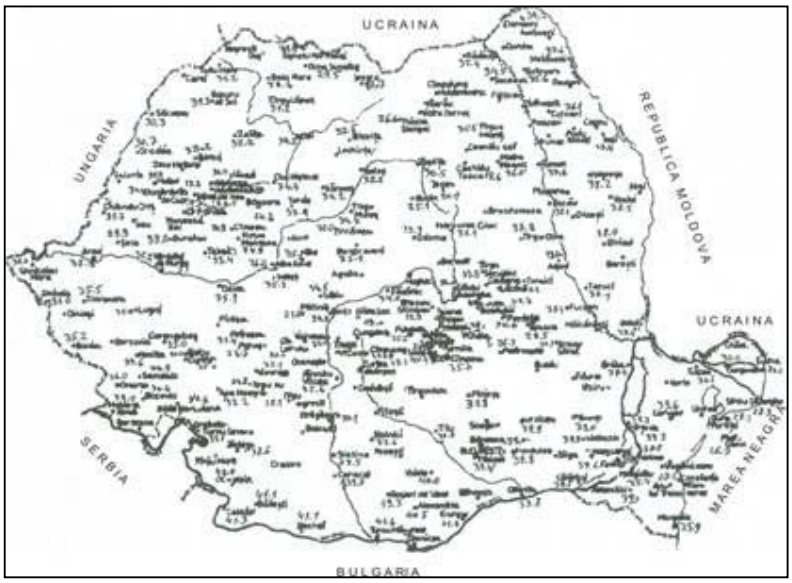

Figure 1. Maximum air temperature values recorded in Romania on 26 June 2007

In this month, the drought lasted 13 days, while the moisture-temperature index (MTI) reached the critical threshold of de 80 units, especially in the south and south-east of the country.
The drought was felt in all the country, but with ***the highest values in the southern regions and especially in the soth-west Oltenia where termic values of 36-42°C were recorded***: 36.8°C at Craiova, 41.1°C at Băileşti and Bechet; 41.3°C at Calafat; 41.6°C at Turnu Măgurele; 41.9°C at Giurgiu and 42.0°C at Cuşmir, all on 26 June 2007; the last value of 42°C equaled the old termic record of this month in Romania at Oravişa on 29 June 1938. It is noteworthy that the maximum June

2007 temperatures were with 3-4°C higher than those in June 2000, the year of the second largest drought, after the one in 1945-1946, but when no temperature higher than 40°C was recorded.
The drought occured during the mid vegetation period and as a result ***the consequences were drastic***: the electricity consumption recorded a top national level for the warm season, with around 500 MW/day more than ussually; the drought destroyed 60% of the cereal crops at the country level and the weedings, dried the meadows, dried the fountains, affected the zootechnical sector, lowered the level of the water in the rivers and the navigation on the Danube was impeded; the critical values of the MTI (maximum of 87.7/26 June 2007 at Băileşti) (Figure 2), caused 30 deaths in the country.

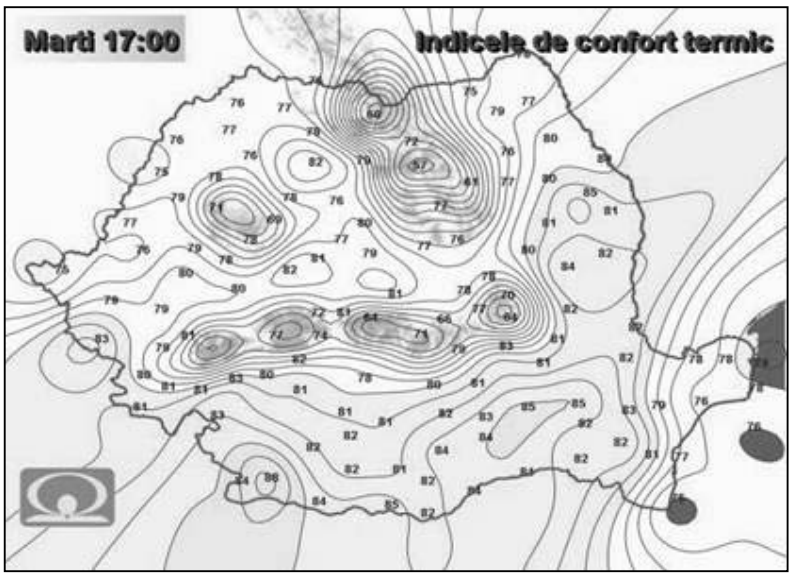

Figure 2. 26 June 2007 - MTI Values Repartion, 17:00 hours Romanian Summer Time,
At maximum heat wave apogee time (source ANM).

Characteristics of July 2007 Drought
The characteristic temperatures of July were felt starting with the second half of June. In July four heat waves were produced between the periods: 2-4; 8-10; 15-24; 27-30 July 2007. The most intense heat wave was during 15-24 July 2007 out of the entire meteorological observation of this month. The maximum drought intensity occured at the end of the period on 24 July (Figure 3).

Figure 3. Maximum air temperature values recorded in Romania on 24 July 2007

The maximum temperature of July evolved as follows: during XX century, it has risen with 0.6°C, from 42.9°C/5 July 1916 at Alexandria, to 43.5°C/5 July 2000 at Giurgiu, in 84 years respectively. Unlike this, in XXI century, only in the first 7 years, the maximum temperature has risen with 0.8°C, from 43.5°C/5 July 2000 at Giurgiu, to 44.3°C/24 July 2007 at Calafat, the absolute termic record in the country for this month.

We note that, ***in July 2007, for the first time the termic threshold of 44ºC is surpassed at 49 stations (by 7 stations more than in July 2000)***. The statistics is as follows: at 22 stations, te respective values ranged between 40.0°C and 40.9°C; at 11 stations, between 41.0°C and 41.9°C; at 7 stations, between 42.0°C and 42.9°C; at four stations betwen 43.0 and 43.9°C and at 5 ***stations, over 44°C***: ***Băileşti, Moldova Nouă şi Moldova Veche, 44.0°C; Bechet 44.2°C and Calafat, 44.3°C***, which represents the ***termic record of this month.***

The consequences of July drought were more drastically.

Thus, the June drought worsened, which caused the crops distruction, dried the meadows and mortality among the animals, dried the fountains and the water courses so that the level of the Danube reached the minimum levels impeding even more the navigation; natural fires of forest and vegetation, doubling the electricity consumption due to overusing the air conditionning and home appliances, which caused many electricity blackouts. .

The moisture – temperature index (MTI) values reached and surpassed the critical threshold of 80 units in the entire country, being recorded even in the mountain area values (Figure 4), which caused 33 deaths among the population only in this month.

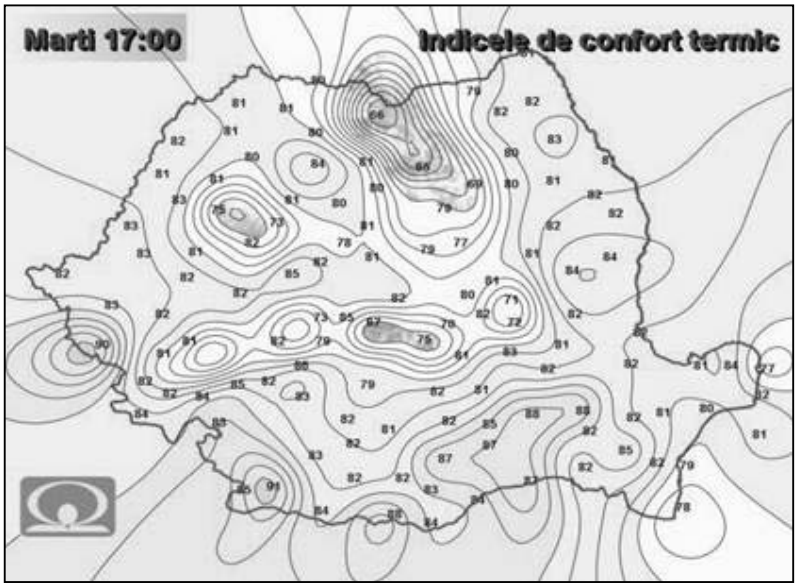

Figure 4. MTI Values Repartition on 24 July 2007, 17:00 Hours Romanian Summer Time (source ANM)

Starting with July 2007 the population warning codes on maximum temperature and MTI values were initiated as follows:

– *Yellow code (low risk) representing 33-38°C and MTI ≤65 unități;*
– *Orange code (medium risk, alert state): temperatues 38.1-40.0°C MTI 66-79 units;*
– *Red code (high risk): temperatures >40°C and MTI ≥80 units*

Synoptic causes of summer 2007 drought

In July 2007, the beginning of the drought occured on 17 June, when a large area of Iceland origin penetrated thorugh a talweg over the Atlantic Ocean, Western Europe and North Africa, favouring a circulation of warm and dried tropical continental air over Romania, situation very well shown in the ground synoptic situation (Figure 5), as well as by the termic field at 850 hPa level (Figure 6).

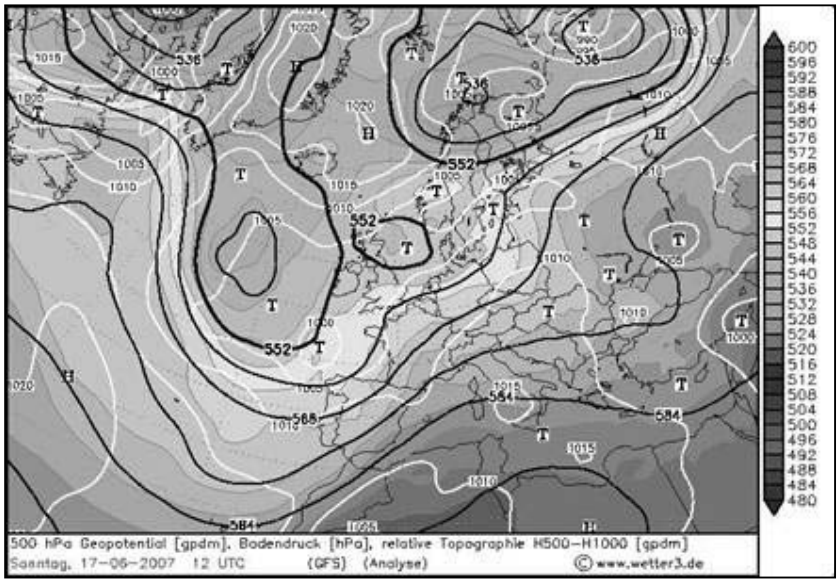

Figure 5. Ground Synoptics, Geopotential Field at 500hPa (5500 m altitude) Isobaric Area Level and Relative Topography RT 500/1000 hPa on 17 June 2007, at heat wave start (source Karten Archiv).

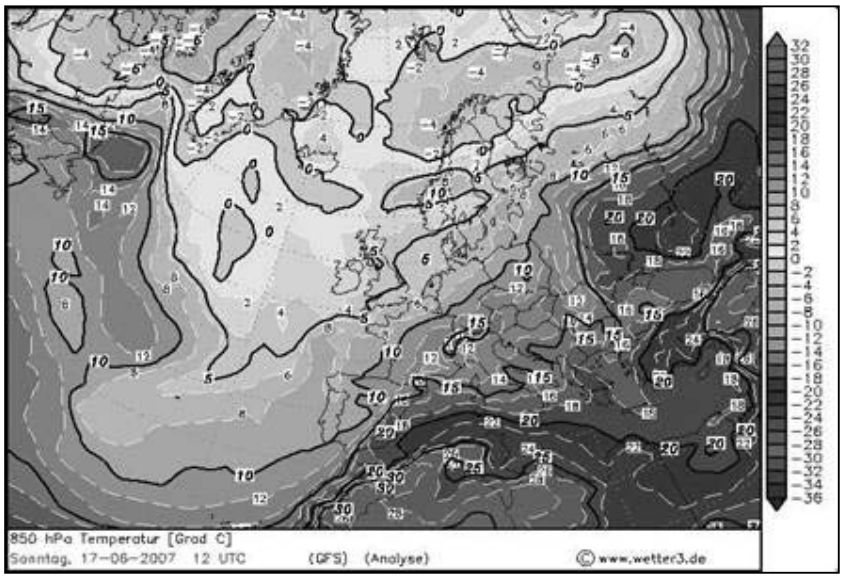

Figure 6. Termic Field at 850hPa Isobaric Area Level (1500 m altitude), on 17 June 2007, 12:00 UTC (source Karten Archiev)

The maximum intensity of this drought which was reached on 26 June 2007, was caused by the presence of a cyclonic weak-positioned habitat in Northern Italy which increased the African tropical-continental air advection over South Italy and Balcanic Peninsula (Figure 7).

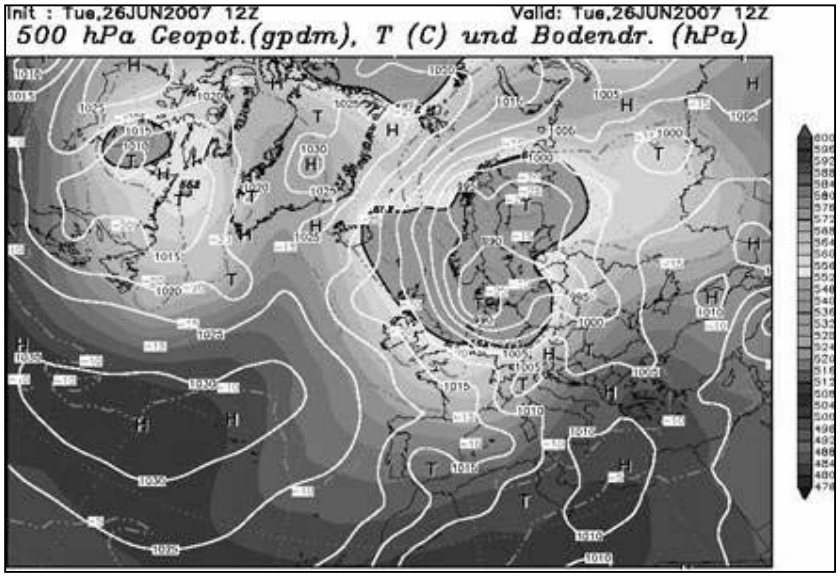

Figure 7. Ground and Altitude Synoptics at (5500 altitudine) Level on 26 June 2007, 12:00 Hours UTC, when maximum warming phase of June 2007 occured (source Karten Archiev)

The termic field at 850 hPa level (Figure 8) stresses out the isoterm of 25°C which is positioned over South-East Oltenia and Muntenia, at around 5000 m altitude, evidencing the advancement of termic equator towards north. By contrast with the warm air mass, the cold air mass appears from North-West Europe which dislocated in 24-48 hours, the preexisting warm air, together with producing severe meteorological phenomena: wind intensifications, strong winds and hail, storms and heavy rains etc., which teared apart the aerial cables, rended the roofs (e.g. at Drobeta-Turnu Severin and Târgu Jiu), and the Danube surface, in the vicinity of Drobeta-Turnu Severin station, a 15 minutes water spout was produced.

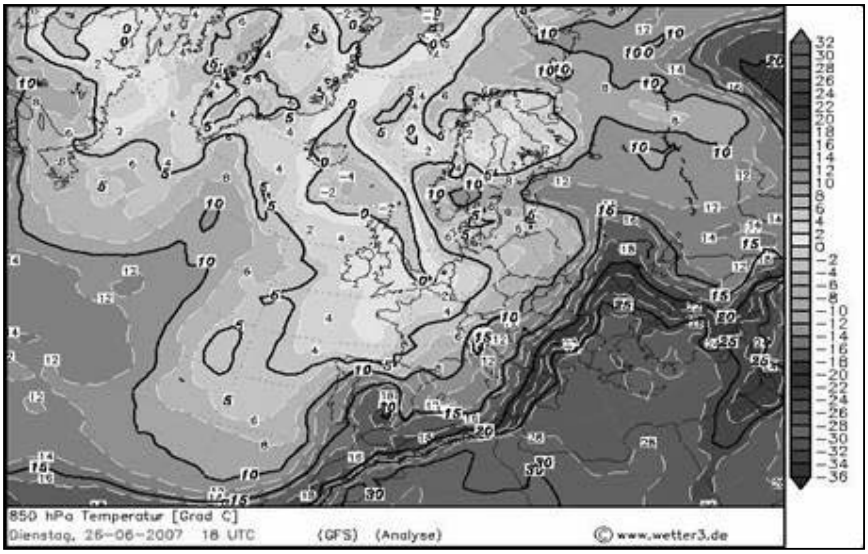

Figure 8. The Altitude Termic Field at 850 hPa (around 1500 m altitude) Level on 26 June 2007,18:00 Hours UTC, at the time of maximum phase of warming process
(source Karten Archiev)

In July 2007, the most intense warming started since 15, but the apogee was reached on 24 July 2007.
On 15 July 2007, the synoptics was typical for the positive Phase of North-Atlantic Oscilation (NAO +) (Figure 9).

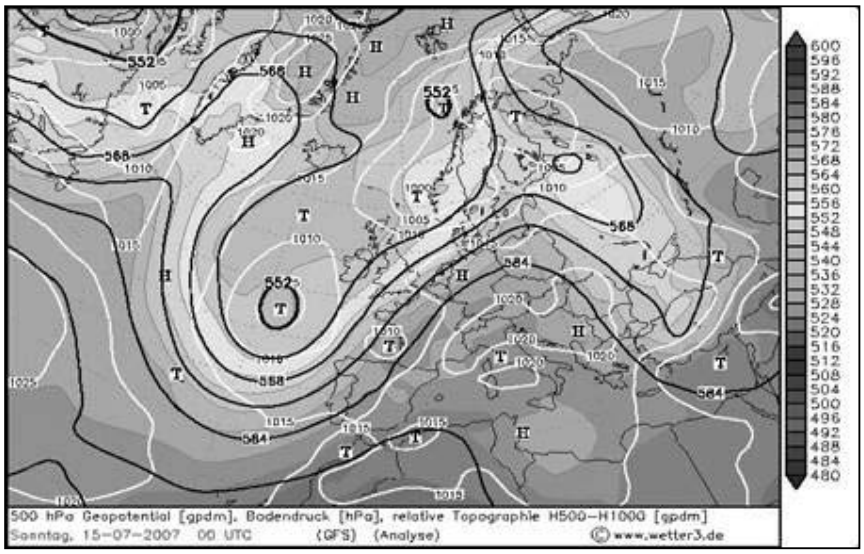

Figure 9. Ground synopsis, Geopotential Field at 500 hPa Isobaric Area and Relative Topography RT 500/1000 hPa on 15 July 2007, 18:00 hours UTC (source Karten Archiev)

So, one may note how the Iceland Depression covers by the two lobes, with the middle value of 1000 hPa, the Atlantic Ocean and the Scandinavian Peninsula respectively; the Azoric Anticyclone has moved onto the continent and joined with the Nort-African Anticyclone, with a 1020-1025 hPa value, which covers around 2/3 of Europe (the southern part).
The termic field at 850 hPa (around 1500 m altitude) level (Fig, 10) shows a nucleus of tropical continental air of saharian origin with temperatures of 30°C, which moves towards the South-east of the continent; the air temperature at 2 m level was of 35-37°C. The synoptics favourised the expansion of warm air over Romania.

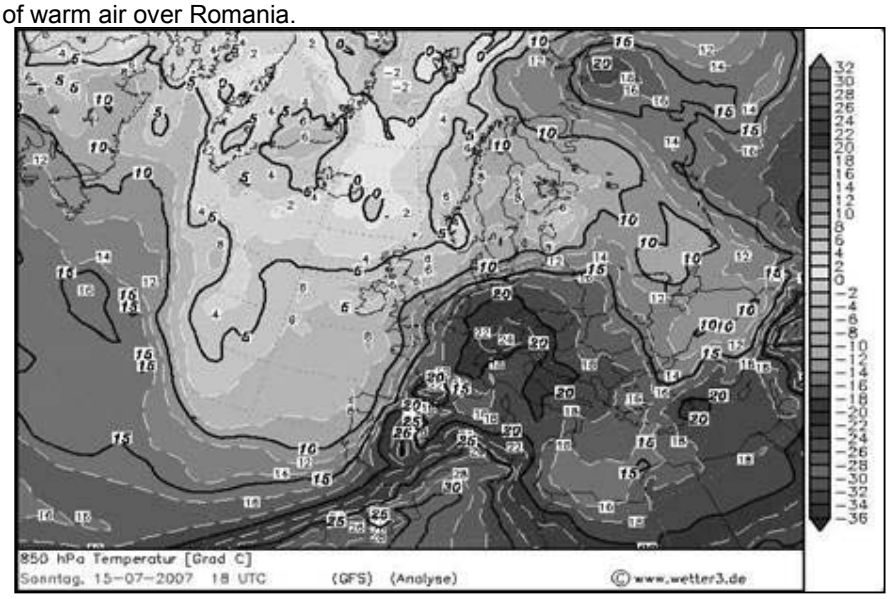

Figure 10. The Termic Field at 850 hPa Area Level, on 15 July 2007, 18:00 Hours UTC when the warm wave was initiated (source Karten Archiev)

On 24 July 2007 when the most instense warming for this month in Romania was produced, the synoptics at the 500 hPa isobaric area was characterised by the prevailing of the tropical continental air from the North Africa, and the relative topography field 500/1000 shows the movement of warm air into the inferior troposphere much north of Romania (Figure 11).

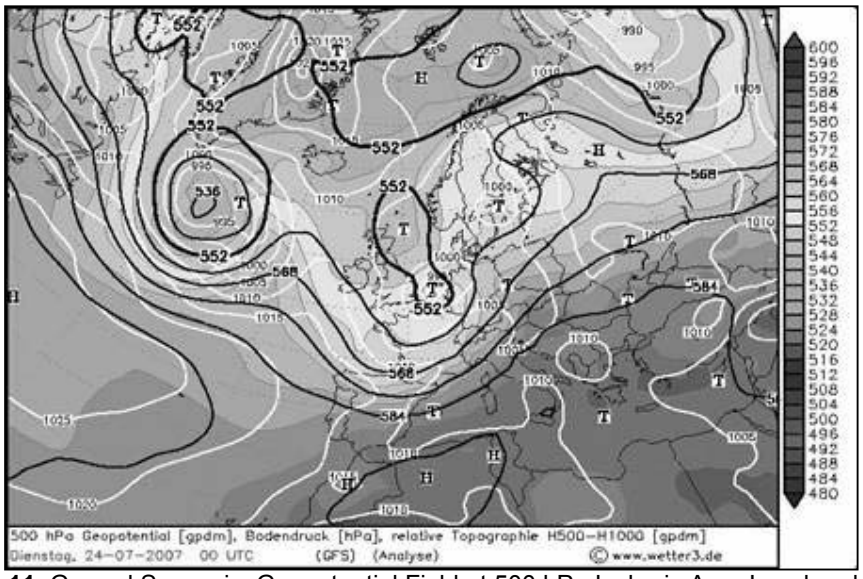

Figure 11. Ground Synopsis, Geopotential Field at 500 hPa Isobaric Area Level and Relative Topography RT 500/1000 hPa on 24 July 2007, 18:00 Hours UTC (source Karten Archiev)

The termic field at 850 hPa (around 1 500 m altitude) isobaric area level is characterised by the presence of the 24°C isoterm, and south of Danube, of the 25°C one, which indicates the movement of warm air over Romania. During the dat of 24 July 2007, between 16 şi 18 hours Romanian Summer Time, at the groundlevel the maximum warming phase was produced, when many of the recorded temperatures became absolute maximum termics of July for Romania. The apogee of this phase occured at 18:00 hours UTC (21:00 hours Romanian Summer Time), when over the south-west Romanian territory the 30°C isoterm was positioned, at 850 hPa level (around 1500 m altitude) (Fig. 12), situation not seen until then. The warming process enhaced also due to the moving forward of the cold front coming from West Europe towards Romania, which led to warm air dislocation and its comprimation.

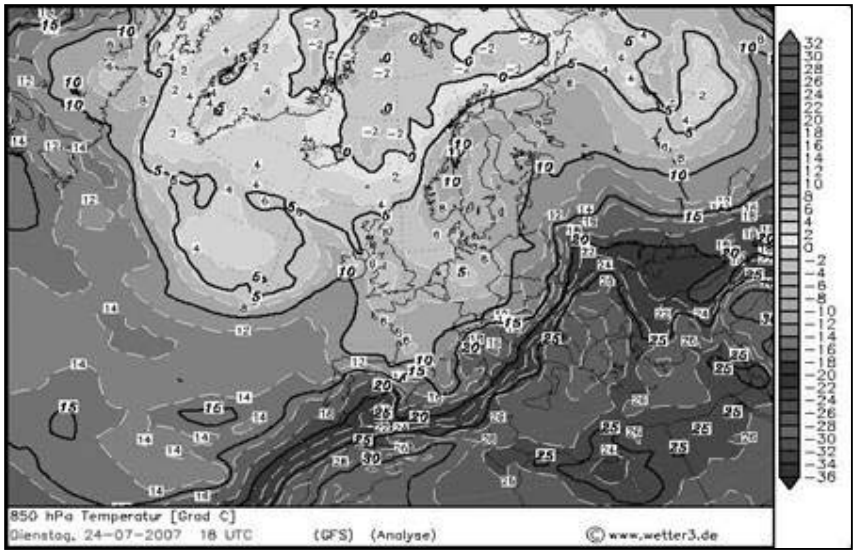

Figure 12. Termic Field at 850 hPa Area Level (around 1 500 m altitude), on 24 July 2007, 18:00 hours UTC, at the height of warm wave maximum phase
(source Karten Archiev)

The cold was produced in the night of 24/25 July 2007, when the temperatures dropped with 10-15°C compared with the day before, but the maximum values were maintained high, surpassing locally 35°C and on 25 July, and the minimum ones 25-27°C.
Starting with 26 July.2007, the weather came back to normal, and during 5-7 July 2007, rains fell down causing flooding in Suceava and Iaş counties.
A warmth peak was recorded in August (22-25 August), but the respective recorded values did not reach the threshold of 40°C. This was the the last warmth wave when, on 24 August 2007 values ≥38°C were recorded: 38.0°C at Băileşti; 38.2°C at Bechet at 38.9°C at Calafat.
It is clear hat the drought periods cannot be explained only through the atmospheric dynamics but also through some astronomic causes. For example, in the specialised literature is considered that the *Eris Planet* or the planet with 50 names (*Nibiru, Marduk, Nemesis, Gods'Planet, Kingdom's Planet,Cross Planet, Red Planet* etc.) how the antique civilations called it, has an tremendous influence on the terestrial warming. It has an evolution around the Sun of 3 600 earth years and, thus, once every 3 600 years enters our solar system causing the atmosphere warming and the icebergs' meltdown. The calculus have shown that the maximum proximity of this planet to the Earth will happen between 2010-2012, when the warming processes, droughts as well as other phenomena (volcano erruptins, earthquakes) shall be exacerbated.

Conclusions
The data presented with respect the summer 2007 drought ***constitutes indices on the climate system variability***, which suggest some possible climate changes, stressed out by the occurence of some atypical meteo-climatic phenomena for the temperate-continental area of Romania, such as:
– the two weeks earlier occurence of the summer month temperatures;
– the vertically expansion of hot air layer with temperatures >30°C up to 5000 m altitude;
– the increase of the frequency and intensity of the warmth wave in the warm season, from 2-3 cases/decade, to 5-6 or more (the frequency growth trend for June is around 10 times more than the last century);
– the increase of drought periods from few days to around 2 weeks (13 days in June and 10 days in July);
– the increase of tropical summer nights and days frequency;
– the early occurence of warmth waves in south-west Oltenia which following the warm air infiltration through the Danube Gorge and Timok Valley;
– the occurence of some warmth waves during the winter time, which enhances the drought, intense heat and fires phenomena for the next seasons;
– the increase of frequency and duration of the droughts;
– the increase of minimum temperatures and reaching new maximum monthly temperatures;
– the intensification of dryness processes especially in the south-west Oltenia etc.

All these phenomena determined by natural causes (climate system variability and astronomical causes) as well as by the anthropic causes provoke perturbations of the normal weather and climate evolution cycle leading to large material and human life losses.

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