CHARACTERISTICS OF THE 2007 CANICULAR SUMMER IN ROMANIA

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Die Merkmale der Gluthitze aus dem Sommer des Jahres 2007 in Rumänien. Mit einem kontinental-gemäßigten Klima, kennzeichnet sich Rumänien durch die Anwesenheit der vier Jahreszeiten: zwei extreme u.z. warmer Sommer, manchmal heiß, und kalter Winter, manchmal frostig, sowie zwei Übergangsjahreszeiten – der Frühling und der Herbst, in denen sich die Klimamerkmale der ersten zwei gegenseitig durchdringen. Die Verstärkung der allgemeinen Luftzirkulation als Folge der Klimaerwärmung verursacht aber große unperiodische Veränderungen im Ablauf der Jahreszeiten. Ein konkludentes Beispiel stellt der Sommer des Jahres 2007 dar, als die höchsten Tagestemperaturen der Monate Juni, Juli und weniger August Abweichungen von über 20°C von den langjährigen Mittelwerten eingetragen haben, die das Erscheinen der heißen Tage (mit Temperaturen ≥ 35°C) verursachten. In der Arbeit sind die Klimamerkmale der Sommermonate 2007, im Vergleich zu den langjährigen Merkmale dieser Monate, untersucht, sowie die Ursachen die dazu getragen haben. Die Schlußfolgerungen heben die Tatsache hervor, dass in der Geschichte der rumänischen Meteorologie der Sommer des Jahres 2007 der heißeste war, mit zwei Werten in Juni, fünf in Juli, und eins in August. In Juni 2007 wurden 13 heiße Tage eingetragen und die Lufttemperatur (42°C/ 26.06.2007 bei Cujmir) hat den alten Rekord von 42.0°C / 29.06.1938 ausgeglichen, der bei Oravița im Süd-West Rumänien registriert wurde. In Juli 2007 wurden 10 heiße Tage eingetragen und die höchste Temperatur hat Werte von ≥ 40°C bei 49 Wetterwarten erreicht, bei fünf von denen die Werte ≥ 44°C waren: 44.0°C bei Băileşti, Moldova Nouă und Moldova Veche, 44.2°C bei Bechet und 44.3°C bei Calafat / 24.07.2007; dieser letzte Wert hat mit 0.8°C in nur 7 Jahren den alten Rekord des Monats Juli überholt. Die letzte Wärmewelle war in der Zeitspanne 22–25.08.2007, aber der Wert von 40°C wurde nicht mehr erreicht. Die Folgen der Gluthitze dieses Sommers waren zahlreiche, sowohl für die Umwelt (dauerhafte Dürre, schwache oder vernichtete Ernten usw.), als auch für die Gesundheit der Bevölkerung (der Temperatur-Feuchtigkeit Index hat die kritische Schwelle von 80 Einheiten überholt und 30 Todesfälle wurden in ganz Rumänien registriert).

1. INTRODUCTION

The climate of Romania is temperate – continental with four seasons; two of which are extreme, that is hot, occasionally torrid in summer and cold, sometimes frosty in winter. There are two transitional seasons – spring and autumn, which may show some traits common to the two extreme seasons.

As climate warming intensifies the general circulation of the atmosphere, the seasonal evolution presents big unperiodic variations. Such a situation happened in the summer of 2007, when the daily maxima of June, July and of a few August days registered deviations of over 20°C from the multi-annual mean temperatures, ringing about canicular days (≥35°C).

This phenomenon developed as waves of tropical heat kept steadily coming in, so that June and July became the hottest months, in the last seven decades. Having in view the great material losses and casualties caused by those dog days, we are justified in listing that summer's climatic anomalies under meteo – climatic hazards[1].

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[1] Canicular is a term originating from the Latin *canis* (dog). It is known from Roman Times, when people considered to relate to the Star Sirius – Canicular Sirius, Canis Constellation (Eng. dog days).

In order to get an insight into the specific aspects of the 2007 canicular events in Romania, a brief outline of the general climatic traits of June and July would be helpful.

June is the first summer month featuring the most unstable weather all over the year; it is the rainiest months with a peak pluviometric record. Clear skies and warm days alternate with overcast, cold and rainy days. One may experience tropical days and nights, as well as frosty days.

Thermal contrasts materialise in waves of tropical heat (30°–35°C) and of polar cold (–1°, –2°C). Three cases of extreme temperatures were recorded in the 20th century: on June 29, 1938 ≥ 42°C at Oravița in the south-east of Romania; ≥ 40°C at Giurgiu on the banks of Danube, and 40.3°C at Filaret station in Bucharest, the country's capital. The longest interval of negative temperature days occurred in June 1950 when, for 13 days in a row, they registered –20°C at Gheorgheni and –2.7°C at Intorsura Buzăului, both located in closed Intracarpathian depresssions, the last value representing a negative June thermal record for Romania.

Pluviometric contrasts have multi-annual means of 500–600 mm in the lowland plains and 1,000 mm in the high mountain regions (>2,000 a.s.l.) but also 0.1–5 mm/month. Exceptional quantities of rain/24 hrs: 348.9 mm on June 26, 1925 at Ciupercenii Vechi in the south-west of Oltenia region and 530.6 mm on August 29 at C.A. Rosetti in the Danube Delta, the last value being a record high in Romania.

July is the hottest month of the year in all of the country's regions below 1,800–2,000 m a.s.l. It is the time when relatively frequent waves of heat bringing in tropical days and nights.

In the 20th century there were 220 cases, most of them in 1985,of ≥ 40°C in the south and south-east of the country: at Turnu Măgurele (16 times), Roşiori de Vede (14 times), Giurgiu (13 times), Zimnicea and Bechet (10 times), Călăraşi (9 times), Bucureşti – Filaret (8 times), etc.

Most days with >40°C temoperatures were registered by 42 weather stations on July 5, 2000, with an absolute maximum for this country of 43.5°C at Giurgiu, actually by only 1°C below the absolute thermal record in Romania (44.5°C on August 10, 1951). July is the month with the longest interval of tropical days in the 20 century: 24 at Drobeta Turnu Severin in 1904.

2. CHARACTERISTIC FEATURES OF THE 2007 CANICULAR WEATHER

The torid June weather set in after a warm, Mediterranean-like winter followed by a very early and dry spring which began in the second decade of February.

In the first interval of June, temperatures were below the multi-annual mean. The first heat wave, which came between 17-26 ushered summer in, peak values being registered on June 26 (Fig. 1).

The torid weather lasted for 13 days, when the Temperature – Humidity Index (THI) reached the critical threshold of 80 units.

The excessively hot weather was being felt throughout the country, with maxima of 36–42°C in the southern region *e.g.*, in south –west Oltenia:

A temperature of 42°C equalled the old June record in Romania (29, 1938 at Oravița). Noteworthly, the June 2007 maximum values were by 3–4°C higher than in June 2000, the year of the second severe drought after the 1945-1946 one, although at that time there had been no temperatures above 40°C.

Canicular with the Romans was an astronomic phenomenon overlapping the July 22 – August 23 interval when Sirius rises and sets with the Sun, ill – amened period in their view, when sear borled, wine was soured by the heat, dogs grew mad, all creatures lost in vigour, the high temperatures causing insolation, severe burns in men, animals, planets, vegetables, fruit, etc.; forests withered and natural fires burst out over vast areas, a picture very similar to the summer of 2007.

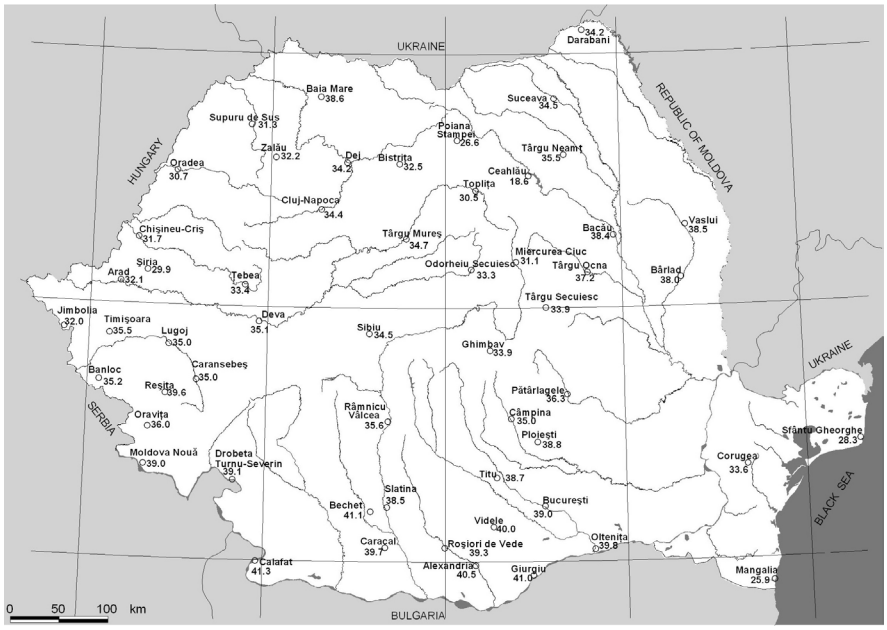

Fig. 1 – Maximum air temperature values recorded in Romania on June, 26, 2007.
(source: National Meteorological Administration).

3. THE AFTERMATH OF THE JUNE 2007 CANICULAR SUMMER

This extreme weather set on in the midst of the vegetation period, therefore it had dramatic consequences: the consumption was by ca 500MW/day above the normal summer value, a record high for Romania; 60% of the cereal crops and much of the hoeing crops were compromised, meadows withered, wells got dry, livestock suffered, too, the level of watercourses dropped and navigation on the Danube came to a halt; the critical THI values (with a peak of 87.7 at Băileşti on June 26) (Fig. 2) left 30 people dead in this country.

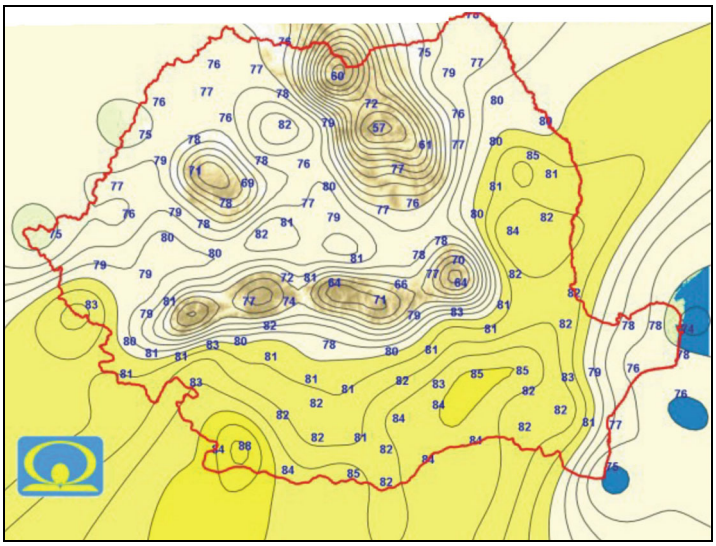

Fig. 2 – Temperature-Humidity Index (THI) value distribution of peak heat wave
on June 26, 2007, 17: 00 hrs Romanian Summer Time.
(source: National Meteorological Administration).

4. PARTICULARITIES OF THE JULY 2007 TORID WEATHER

As from the latter half of June, temperatures began resembling ordinary July values. The first heat waves hit the country on July 2–4, 8–10, 15–24 and 27–30, the last but one interval being the hottest, the meteorological observations of that month, indicating peak values on July 24 (Fig. 3).

Within a lapse of 84 years, maximum 20th-century July temperatures rose by 6°C: 42.9°C on July 5; 1916 at Alexandria and 43.5°C on July 5, 2000 at Giurgiu, while in the 21st century the increase was of 0.8°C only within the first seven years alone, from 43.5°C on July 5, 2000 at Giurgiu to 44.3°C on July 24 at Calafat, an absolute thermal record for this month in Romania.

Thus, it was for the first time in July 2007 that the thermal threshold of 40°C was crossed at 49 stations (by seven more than in July 2000).

Statistics show values of 40.0–49.0°C at twenty-two stations; 41.0–41.9°C at eleven stations; 42.0°–42.9°C at seven stations; 43°C at four stations and over 44°C at five stations: Băileşti, Moldova Nouă and Moldova Veche <44.0°C; Bucharest, 44.2°C and Calafat 44.3°C, a July thermal record.

5. THE AFTERMATH OF THE JULY 2007 TORID WEATHER

Consequences appeared to be even more dramatic than in June, as negative effects kept cumulating and augmenting the drought that had already destroyed crops, withered meadows killed livestock, dried up wells and depressed water levels down to a record low, affecting navigation on the Danube; fires burst out burning forests and vegetation, electricity consumption doubled as household and air-conditioned devices functioned at full capacity causing black-outs (Fig. 3).

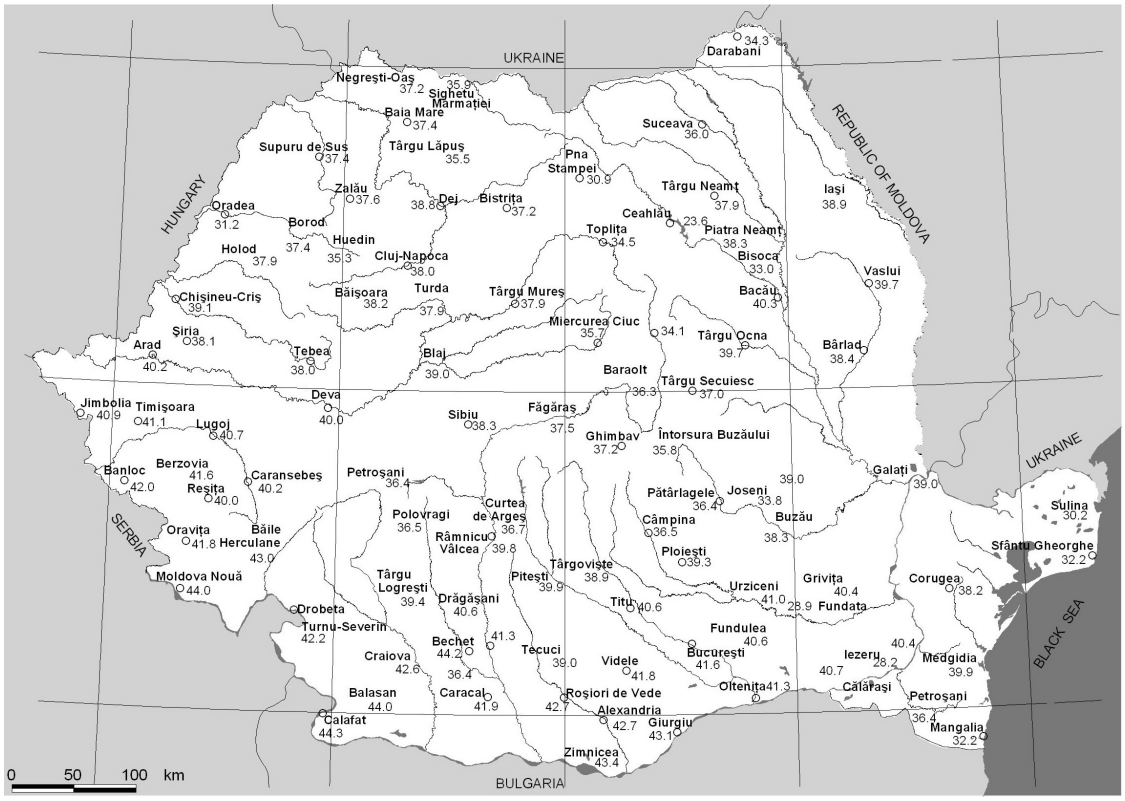

Fig. 3 – Maximum air temperature values recorded in Romania on July, 24, 2007.
(source: National Meteorological Administration).

The Temperature-Humidity Index (THI) reached and crossed the critical threshold of 80 units throughout the country, a value registered in the mountain region, too (Fig. 4), and leaving 33 people dead that month alone.

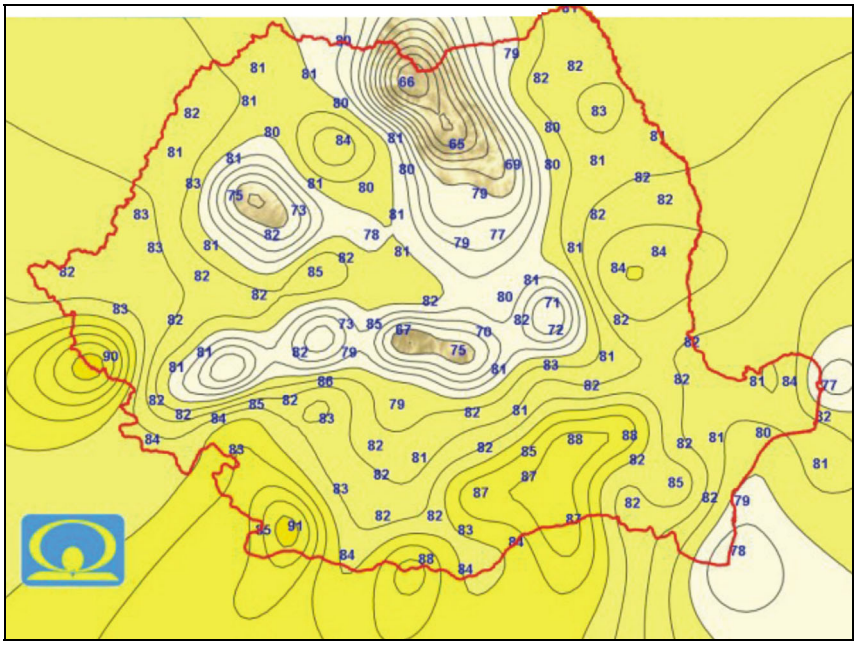

Fig. 4 – Temperature-Humidity Index (THI) value distribution on July 24, 2007, at 17: 00 hrs Romanian Summer Time. (source: National Meteorological Administration).

As from July, weather forecasters instituted warning codes for maximum temperature and THI values:

– yellow code (low risk): 33°-38°C and ≤ 65 THI units;
– orange code (moderate risk, state of alert): 38.1°-40.0°C and 66-79 THI units;
– red code (high risk): >40°C and ≥80 THI units.

6. A SYNOPTIC APPROACH TO THE CAUSES OF THE 2007 CANICULAR SUMMER

Dod days in June started to the 17th, when a vast Icelandic advection reached western Europe and Northern Africa carried by a talweg developed over the Atlantic Ocean, bringing hot and dry continental air currents to Romania. That situation is perfectly illustrated by the synoptic picture on the ground (Fig. 5) and the thermal field at 850 hPa (Fig. 6).

The canicular peak reached on June 2006 was the result of a weakly positioned cyclonic area in the north of Italy enhancing the tropical – continental African air advection over the south of Italy and the Balkan Peninsula (Fig. 7).

The thermal field of the 850 hPa level (Fig. 8) highlights the 25°C isotherm positioned on the south-eastern parts of Oltenia and Muntenia at some 5000 m altitude, illustrating the advance of the thermal equator northwards. A mass of cold air coming from North-Eastern Europe dislodged the preexisting warm air within 24-48 hours, unleashing severe meteorological phenomena: wind gusts, hail storms, torrential rains, etc. that tore air cables, snatched roofs (*e.g.* at Drobeta Turnu Severin and Târgu Jiu), causing a fifty-minute waterspout on the surface of the Danube in front of the Drobeta Turnu Severin watch post.

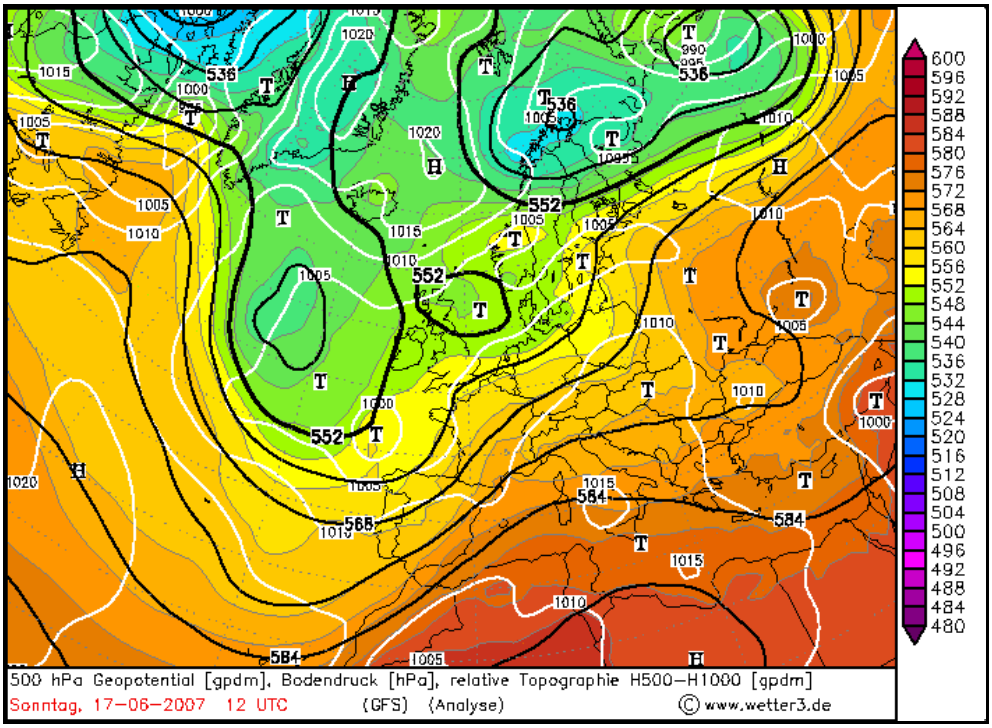

Fig. 5 – Ground Synoptics, Geopotential Field at 500hPa (5,500 m altitude) Isobaric Area Level and Relative Topography RT 500/1,000 hPa on June, 17, 2007, at heat wave start (source: *Karten Archive*).

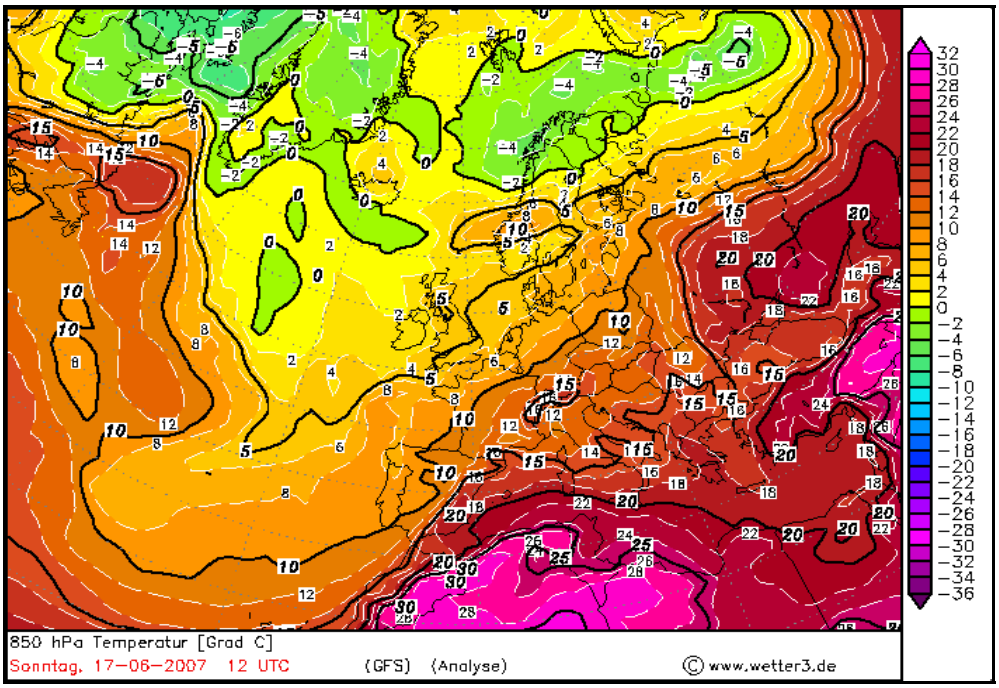

Fig. 6 – The thermic field at 850 hPa Isobaric Area Level (1,500 m altitude), on June, 17, 2007, 12:00 hrs UTC (source: *Karten Archive*).

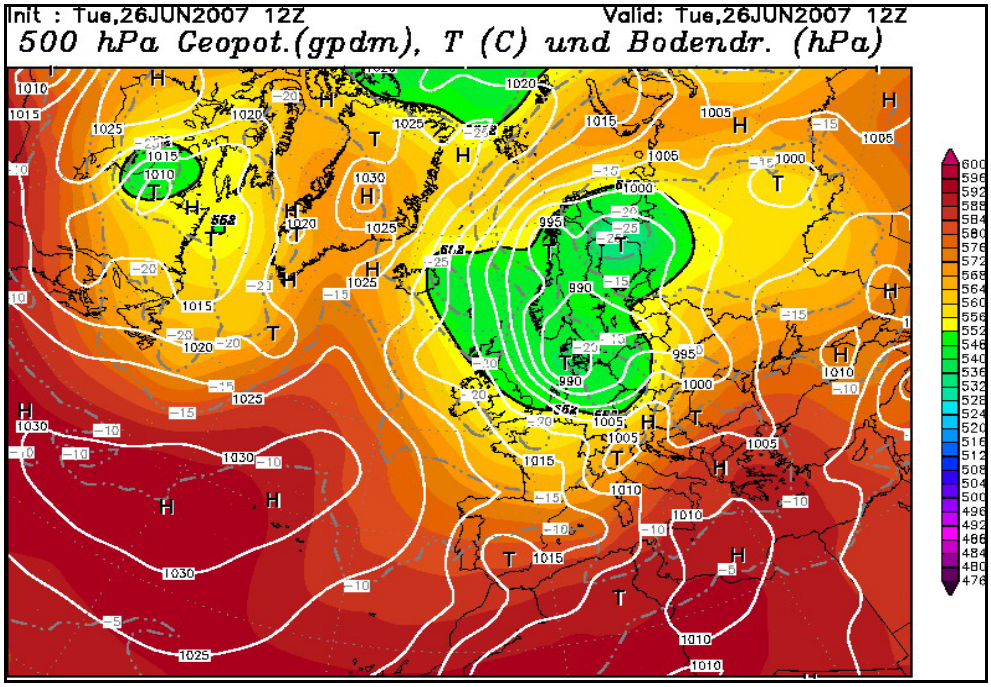

Fig. 7 – Ground and Altitude Synoptics Level at 5,500 m altitude on June, 26, 2007, 12:00 hrs UTC, when the maximum warming phase of June 2007 occurred (source: *Karten Archive*).

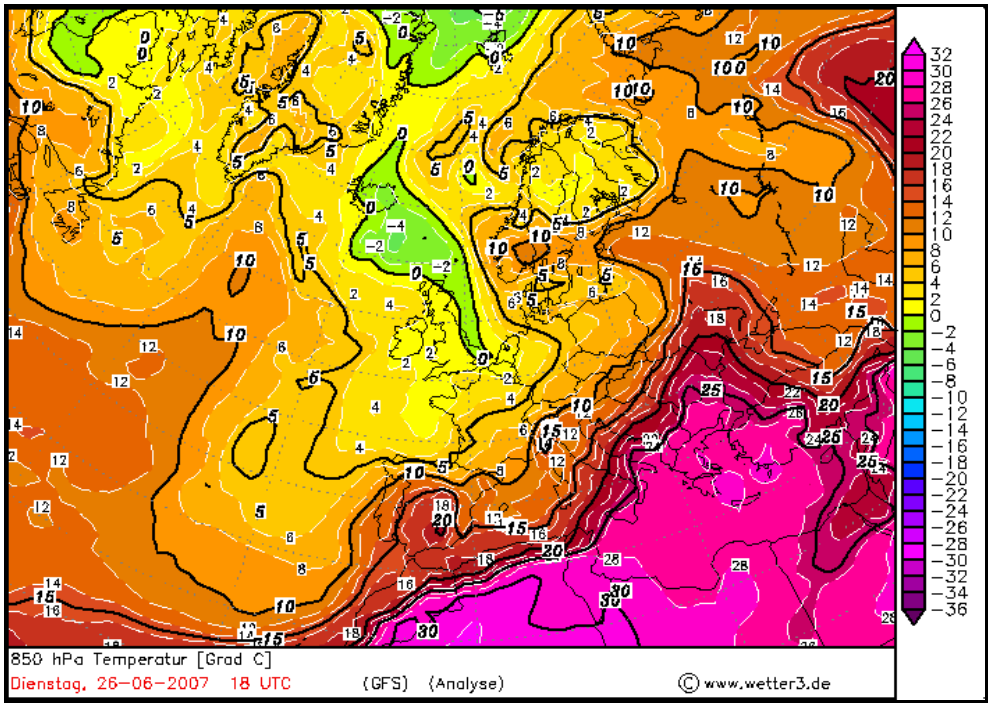

Fig. 8 – The Altitude Term Field at 850 hPa (around 1,500 m altitude) Level on June, 26, 2007,18:00 hrs UTC, at the time of maximum phase of warming process (source: *Karten Archive*).

The weather began heating up on July 15, the peak being reached on the 24th.

The synoptic situation on the 15th of July was typical of the positive phase of the North Atlantic Oscillation (NAO+) (Fig. 9).

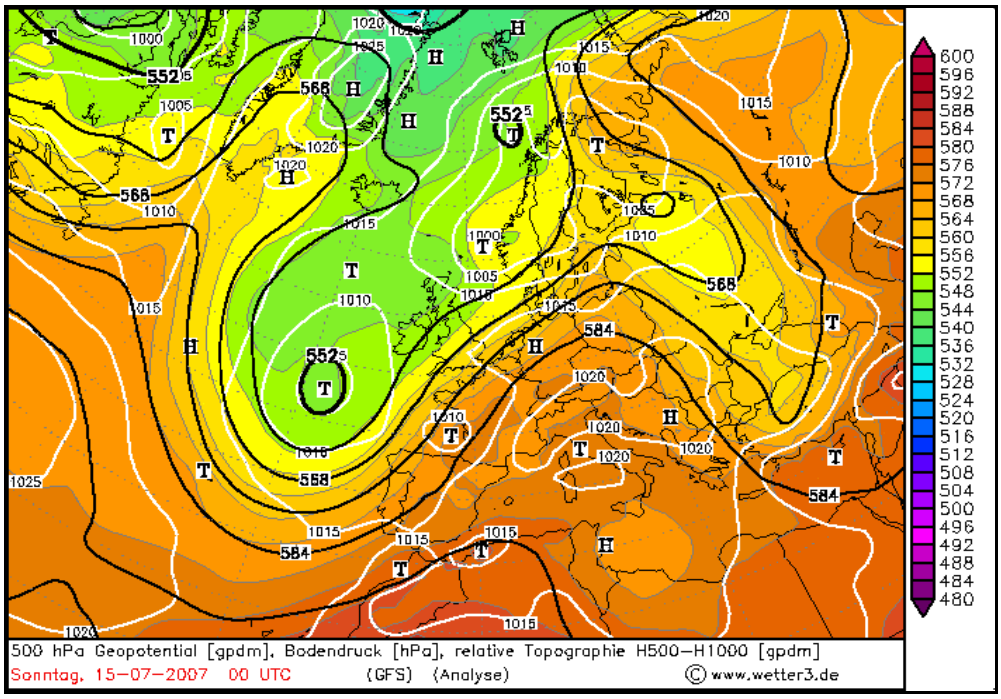

Fig. 9 – Ground Synoptics, Geopotential Field at 500hPa (5, 500 m altitude) Isobaric Area Level and Relative Topography RT 500/1,000 hPa on July, 15, 2007, 18:00 hrs UTC (source: *Karten Archive*).

It becomes obvious how the two lobes of the Icelandic Depression cover the 1000 hPa value in the centure of the Atlantic Ocean and the Scandinavian Peninsula; the Azore Anticyclone is pushed far northwards on the Continent, joining the North-African Anticyclone, centre value 1020–1025 hPa, which covers about two-thirds of Europe (east-southern part).

The thermal field of 850 hPa Area Level (ca 1,500 m alt.) (Fig. 10) indicates the presence of a tropical continental air core of Saharan origin and temperatures of 30°C, advancing towards the south-east of Europe; at a height of 2 m, the air temperature was 35°–37°C.

The synoptic situation favoured the expansion of the hot air over Romania as well.

On the 24th of July the synoptic situation on the level of the 500 hPa isobaric area indicated the prevalence of the North-Aftrican tropical continental air, the 500/1000 relative topographic field showing that the warm air advanced in the lower troposphere farthered most north of Romania (Fig. 11).

The thermal field at 850 hPa isobaric area level (ca 1, 500 m alt.) revealed the presence of the 24°C isotherm occurring south of the Danube, an indication of warm air advancing over Romania. On July 24, the maximum heating phase on the ground occurred between 16.00 and 18.00 hrs RST, when many of the temperatures turned out to be absolute July maxima for Romania.

The apex of this phase was reached at 18:00 UTC (21.00 RST, when the 30°C isotherm was positioned at the 850 hPa level (ca 1, 500 m alt.) over the south-western territory of this country (Fig. 12), a situation never encountered before. The warming process was enhanced also by the progression of a cold front coming from the west of Europe towards Romania and dislocating and compressing the warm air.

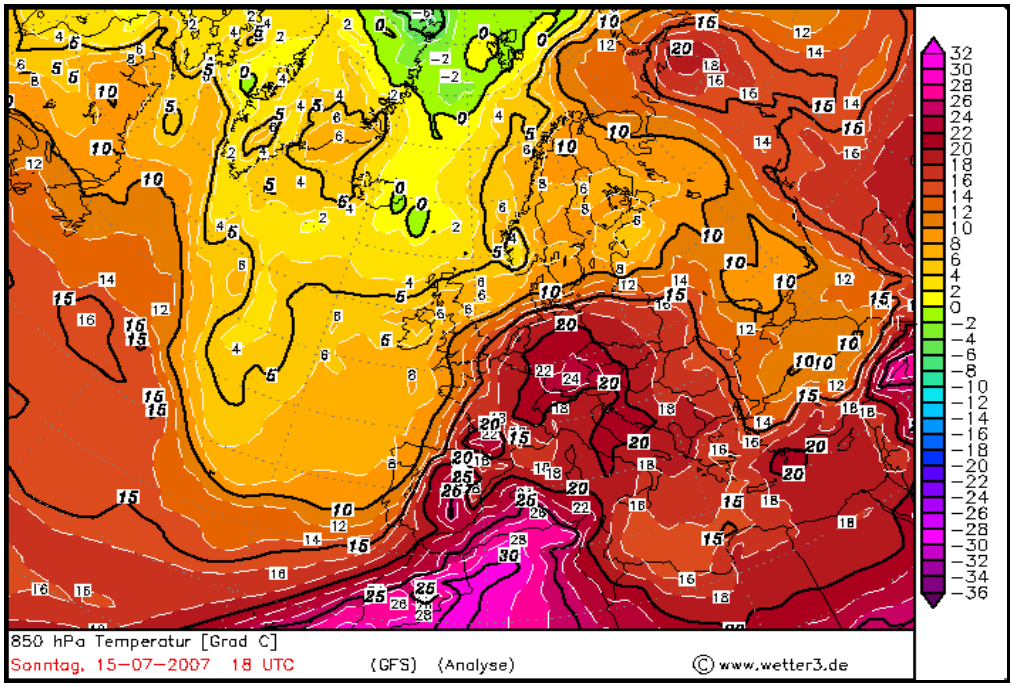

Fig. 10 – The thermic field at 850 hPa Isobaric Area Level (1,500 m altitude), on July, 15, 2007, 18:00 hrs UTC when the warm wave was initiated (source: *Karten Archive*).

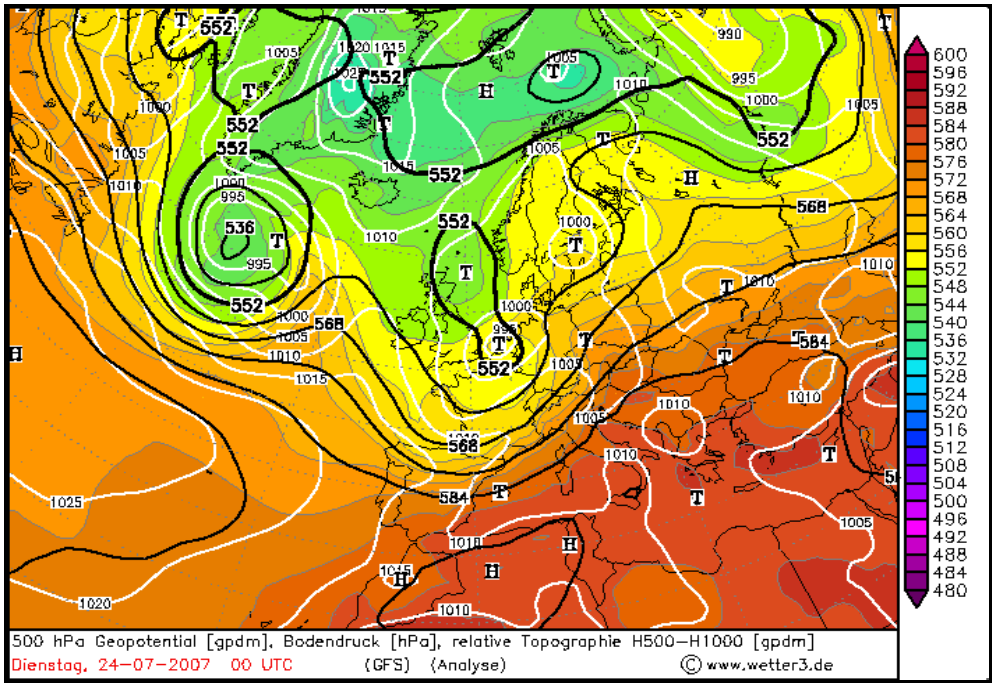

Fig. 11 – Ground Synoptics, Geopotential Field at 500hPa (5, 500 m altitude) Isobaric Area Level and Relative Topography RT 500/1,000 hPa on July, 24, 2007, 18:00 hrs UTC

(source: *Karten Archive*)

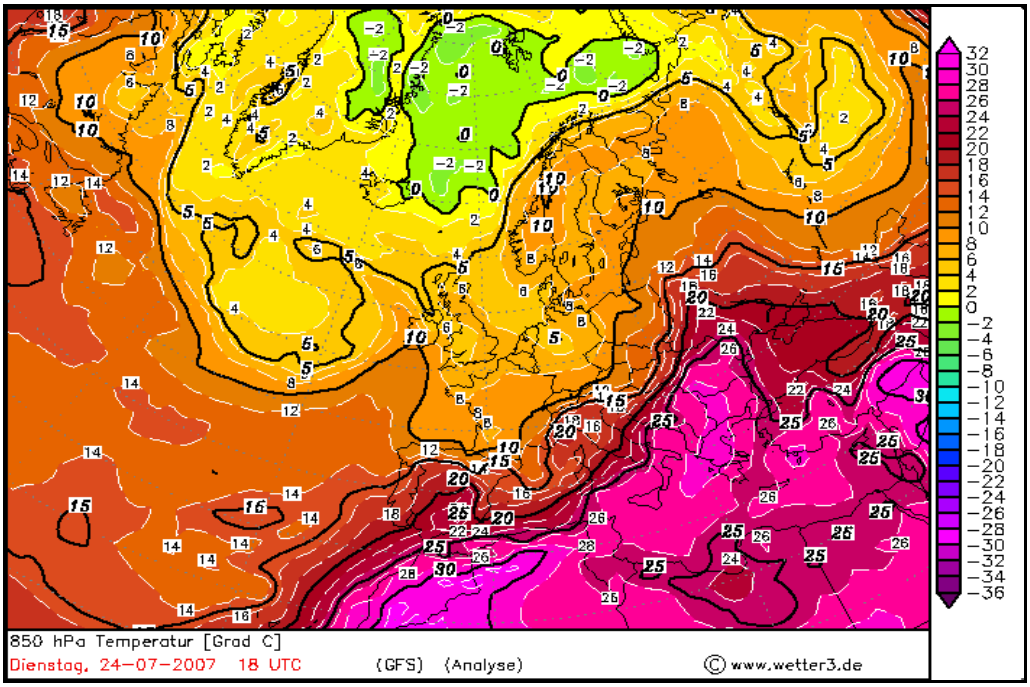

Fig. 12 – The thermic field at 850 hPa Isobaric Area Level (1,500 m altitude), on July, 24, 2007, 18:00 hrs UTC at the heigh of warm maximum phase (source: *Karten Archive*).

On the night of 24/25, the air began cooling up, while the temperature fell by 10-15°C against the previous day; however, maximum values continued to stay high, rising locally to over 35°C also on July 25, the minimum being 25/27°C.

As from the 26th of July the weather returned to normal, August 5/7 witnessing rainfalls associated with floods in Suceava and Iaşi counties.

The temperature shot up again in August (22/25) but not as high as 40°C. The last heat wave occurred on August 24 (≥38°C).

The fact is that canicular periods are not the work of atmospheric circulation and astronomic events alone. The specialist literature, for example, considers that Planet Eris, or the planet with 50 names (Nibiru, Marduk, Nemesis, Planet of the Gods, Planet of the Empire, Planet of the Cross, the Red Planet, etc.), given by the ancient civilisations, exerts an overwhelming influence on global warming.

Its evolution around the Sun equals 3, 600 terrestrial years, which means that it enters our solar system once every 3,600 years, heating the atmosphere and melting glaciers. According to calculations, Eris will be closest to Earth between 2010 and 2012, exacerbating warming processes, droughts and other phenomena (*e.g.* volcanic eruptions).

CONCLUSIONS

The 2007 canicular summer data discussed in this paper illustrate the variability of the climatic system, and suggest possible climate changes expressed by several meteo-climatic phenomena, atypical for the temperate-continental zone Romania is located in.

Some of these phenomena are listed below:

– summer temperatures occur two weeks earlier; the hot air layer (>30°C) rises up to 5, 000 m a.s.l.;

– the frequency and intensity of heat waves in the warm season have been increasing from 2–3 cases/decade in the 20th century to 5–6 or more higher in 21st century June;

– canicular intervals keep lengthening from a few days to nearly 2–3 weeks (13 days in June 2007 and 10 days in July 2007);

– tropical days and nights become ever more frequent;

– heat waves occur the earliest in the south-west of Oltenia, warm air penetrating along the Danube Gorge and the Timok Valley;

– heat waves are recorded also in winter, intensifying droughts, severe heat and fires in the following seasons;

– droughts become more frequent and last longer;

– higher minimum temperatures and new monthly maxima are being recorded;

– aridization processes in the south-west of Oltenia, and in other regions grow in intensity.

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