MAJOR SUMMER-INDUCED THERMAL RISKS IN THE ALBA IULIA – TURDA DEPRESSION

CĂTĂLINA MĂRCULEȚ[1]

Major summer-induced thermal risks in the Alba Iulia – Turda Depression. The study deals with warm-season phenomena, featuring positive, sometimes extremely high temperatures that may have a negative influence both on people's health and economic activities. This category includes tropical waves of heat, absolute maximum temperatures, maximum frequency registered outside the specific interval of summer thermal regime: summer days, as well as tropical days and nights. The paper describes the conditions in which these phenomena occur, average and maximum occurrence rate and evolution trends likely to impair the economy at large, and especially the wide variety of crops covering large surface-areas in the Alba Iulia – Turda Depression enjoying a Föehn regime.

Key-words: absolute maximum temperatures, tropical waves of heat, summer days, tropical days, tropical nights.

1. Introduction.

The phenomena characteristic of the warm season of the year, that is, occasionally very high positive temperatures, may have a negative impact on people's health and on some economic activities. It is the case of the so-called summer temperature hazards/risks, such as the waves of tropical heat, the absolute maximum temperatures and the high incidence of summer days with different thermal characteristics that are not specific to the respective interval, e.g. typically summer days, tropical days and tropical nights.

2. Waves of tropical heat and absolute maximum temperatures.

Heat waves stand for severe warming, or massive advections of very warm air over vast territories at temperate latitude. These advections are driven by continental anticyclones originating from the South-East-Europe, South-East Asia, the Black Sea Basin, the Balkan Peninsula, North-West Africa, etc. Very high

[1] Institute of Geography, Romanian Academy, Bucharest, e-mail: cmarculet@yahoo.com

temperatures are sometimes carried by masses of hot tropical air entrained at the periphery of the Oceanic cyclones extended over Central and Eastern Europe. However, there are situations when the masses of air are moving from the southern sector through retrogression of the cyclones situated in the south-east of Romania (*Clima RPR*, I, 1962).

Severest warming is the result of the cumulated effect of warm, dry advections and excessive local warming in the conditions of reduced humidity and a clear sky specific to persistent anticyclonic activity.

As stipulated by the World Meteorological Organisation, heat waves imply episodes of at least five consecutive days of maximum temperatures, that is, at least by 5ºC higher than thermal maxima of climatological means over the 1961-1990 interval (*www.meteoromania.ro*).

The positive temperature extremes, associated to heat waves, represent climate-risk phenomena pretty often recorded in the corridor-shaped Alba Iulia-Turda Depression, a landform favouring the penetration of the hot tropical air from the south, furthermore enhanced by insolation-related local warming through the Föehn effects.

The absolute 20th - century **maximum temperatures** registered at Alba Iulia and Sebeș stations reached *42.5ºC (August 16, 1952) and 41.5º (July 4, 1950)*, respectively. Those values, uncommon both for the two above areas and the whole Transylvanian Depression, suggest the existence of favourable local physical-geographical conditions (corridor shape, low altitudes, and orographic shelter), as well as specific Föehn processes. Other absolute maxima in the Alba Iulia – Turda Depression stood below the 40ºC threshold: 38.2ºC at Turda (June 29, 1963) and 39.5ºC at Aiud (July 20, 1987).

Several episodes of excess warming were registered at Alba Iulia and Ighiu (39.7ºC) July 9, 1967; Sebeș (39.7ºC) August 11, 1994 and Ighiu (39.2ºC) July 25, 1987.

The massive warming spells (over 40ºC) of ***August 1952***, developing absolute maximum temperatures, were recorded by many stations, across Romania, at Alba Iulia as well. The absolute extreme values, thermal singularities as it were, in the month of August, were produced by a vast pressure low centred in the Pannonian Plain (Fig. 1), which entailed continental tropical masses of air from the south, causing massive heating between August the 15th and 17th.

This canicular episode registered absolute maxima in the west and south of Romania, affecting the largest area in this country (Bogdan, Niculescu, 1999).

Similar synoptic situations, tropical advections from the south and south-west, entailed in the forefront of some cyclones positioned in Central Europe, occurred on the 9th of July, 1947 and the 29th of June, 1963; the 20th and 25th of July, 1987 and the 11th of August, 1994 triggering other cases of absolute maximum temperatures registered at the weather stations in the Alba Iulia – Turda Depression.

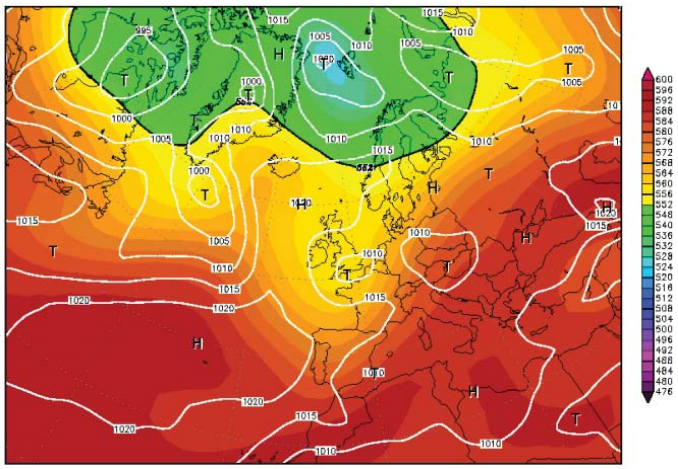

Fig. 1. Atmospheric pressure field on the ground and a geopotential field at 500 hPa, August 8, 1952, 00 hr GMT (source: Karlsruhe Weather Centre Archive, Germany).

However, *the event of July 4, 1950* looked somehow differently. The massive heating spells (41.5ºC at Sebeş) were caused by the joint effect of hot tropical advections from the south of Europe combined with hovering air and enhanced warming through persisting anticyclonic weather.

Although fairly seldom recorded, severe heat waves entail very high temperatures, occasionally absolute maxima even, with serious consequences: disturbed economic activities, black-outs, impairment of crops and jeopardising food supply to the population, causing human casualties – death through hyperthermia.

3. Summer days and their thermal characteristics.

The temperature regime peculiar to the Alba Iulia – Turda Depression can be assessed also by studying the frequency of days with temperatures above the specific summer thresholds and their territorial distribution.

A knowledge of these specific variables is of practical importance for the activity of various economic sectors, e.g. constructions, agriculture, food industry, transport, health, tourism, etc. The results obtained by profile studies have particular relevance, primarily for agriculture, they contributing to choosing the best type of crops and harvesting time. Very high temperatures also affect human health by intensely soliciting the cardio-vascular, digestive and nervous systems to adjust to an extreme situation.

These unusual warmings are of a synoptic nature, consisting in a vast thermal pressure field in the South or South-East Europe, or in cyclones carrying dry tropical air in the forefront.

Summer days occur in the warm period of the year and, conventionally, represent days with maximum temperature of 25°C or more.

Summer days totalling over 50 days/year, *on average*, are inversely proportional to altitude. Thus, fewest summer days are registered at Turda Station 427 m alt. (57.2 days/year), numbers gradually increasing up to 77.7 days/year at

Blaj Station – 334 m alt., and 79.0 at Ighiu and 86.9 at Aiud station situated at lowest altitudes. (Fig. 2).

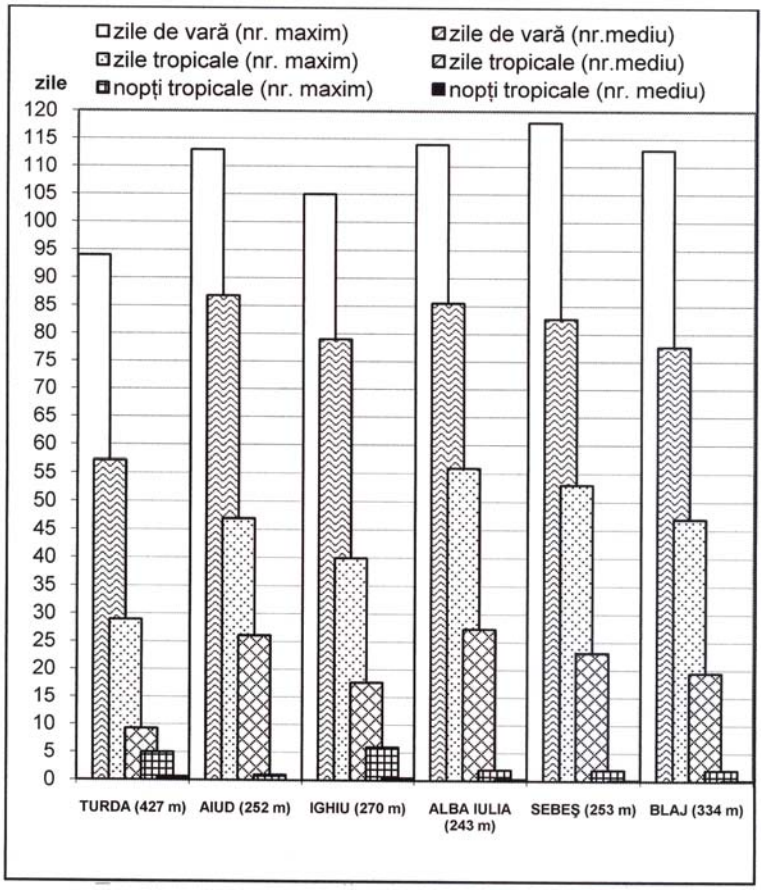

Fig. 2. Annual average and maximum number of summer temperature days.

The average interval of summer days in the Alba Iulia – Turda Depression is from April to October, mostly in July (the hottest month of the year), but also in August (17.1 days at Turda and 24.4 at Aiud (Fig. 3). The incidence of summer days is lower in June, September, May, April and October.

These are normal averages, but there were extreme cases of *annual maximum values* such as 94 at Turda and over 100 days at all the other stations located at lower altitude: Ighiu (105), Aiud and Blaj (113), Alba Iulia (114) and Sebeş (118).

The diagram of summer day numerical variation shows maximum values in the last year of the study period (1961-2003) at Sebeş and Blaj, as well as an obvious increasing trend in the annual number of summer days at all the three stations reported herein (Fig. 4).

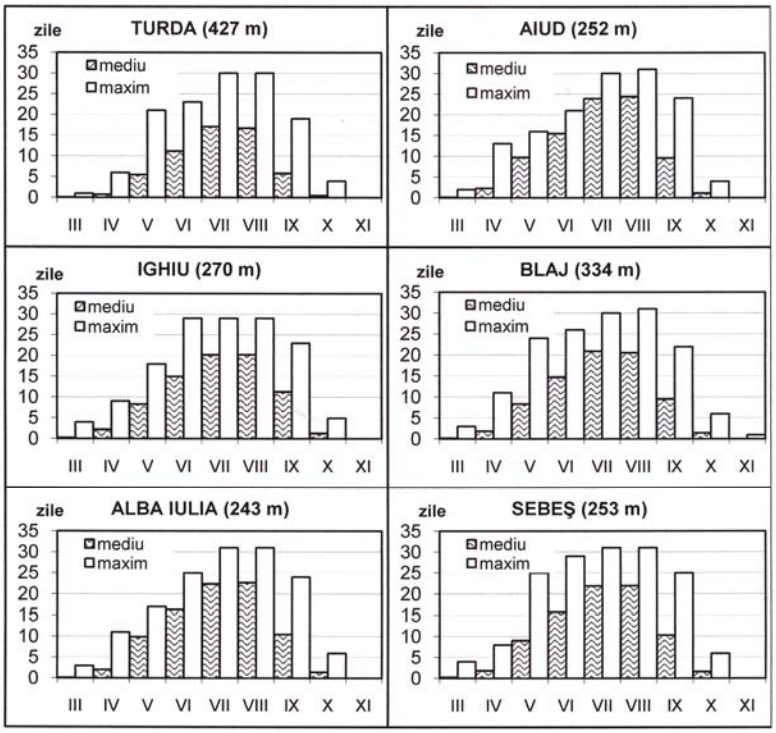

Fig. 3. Monthly average and maximum number of summer days (max. ≥25°C).

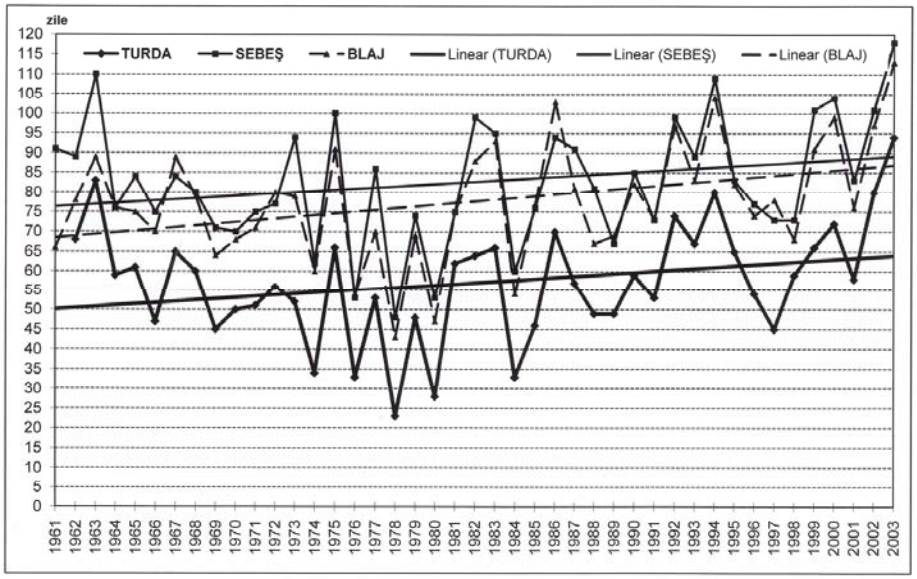

Fig. 4. Annual numerical variation of summer days.

According to the *monthly maxima*, the probability of summer day occurrence is from March at all the weather stations until November (Blaj). Most summer days were recorded in July and August, occasionally up to 31 days, as registered at Alba Iulia, Sebeş Blaj and Aiud, 29 at Ighiu also in June, just as in July and August. In the transition seasons, the maximum number of summer days was half that of September and May, up to 25 days at Sebeş. In April, maximum frequencies can be 4 - 6 times higher than the average value, up to one-third of the total number of days at Sebeş, and 1 - 4 summer days in March (Fig. 3).

Such early weather warming at the beginning of spring is actually a risk, liable to compromising crop plant phenophases. Blooming and fruitition in March or April might sometimes be followed by much lower temperatures, destroying flowers and the fruit of orchards and vineyards.

Tropical days (maximum temperatures ≥30°C) are caused by hot air advections moving from the South of Europe and by severe local warming against the background of persisting clear-sky anticyclonic weather.

The annual average number of tropical days is very different in the territory, it depending on altitude and other local physico-geographical conditions. Fewest such days (9.3 days/year) are registered at Turda Stations, nearly twice as many at Ighiu (17.7) and Blaj (19.5) and about three times more (26-27) at Alba Iulia and Aiud stations (Fig. 2). Frequencies of over 20 days/year are similar to West Plain values, attesting once more the role played by the relief configuration, that is a broadly open depression corridor in our case, which facilities the penetration of hot tropical air. The hills lining the Mureş Corridor in the west and east are better sheltered from these excessive warming spells.

In the Alba Iulia – Turda Depression the interval of tropical days is May to September, the highest incidence being recorded in August (Alba Iulia, Sebeş and Blaj) and July (Ighiu and Aiud) (Fig. 5), falling with altitude from 9-10 at Alba Iulia and Aiud, 6-7 at Ighiu and Blaj, to 3.7 at Turda stations. The frequency of tropical days decreases in June, September and May.

The annual maximum number of tropical days was two-three times higher than the average value, e.g. 29 days/year at Turda and 5-6 days/year at Alba Iulia (Fig. 5).

Plotting the diagram of the annual tropical days numerical variations over the 1961-2003 period reveals an increasing trend in the last 20 years, especially at Sibiu and Blaj stations (Fig. 6).

The monthly maximum number of tropical days, graphically illustrated also in Fig. 5, indicates possible occurrences in April even (one at Turda and Blaj and two at Ighiu station). Most such days occur in August rather than July due to the greater incidence of heat-induced anticyclonic weather. The August maximum frequency of 17 days at Ighiu and 29 at Alba Iulia was by three-four times higher than the average number of tropical days specific to this month. Maximum

frequencies: July 12-20 days, June 8-20, September with one-third of the total number of the month's days, and fluctuations of 3-12 days in May.

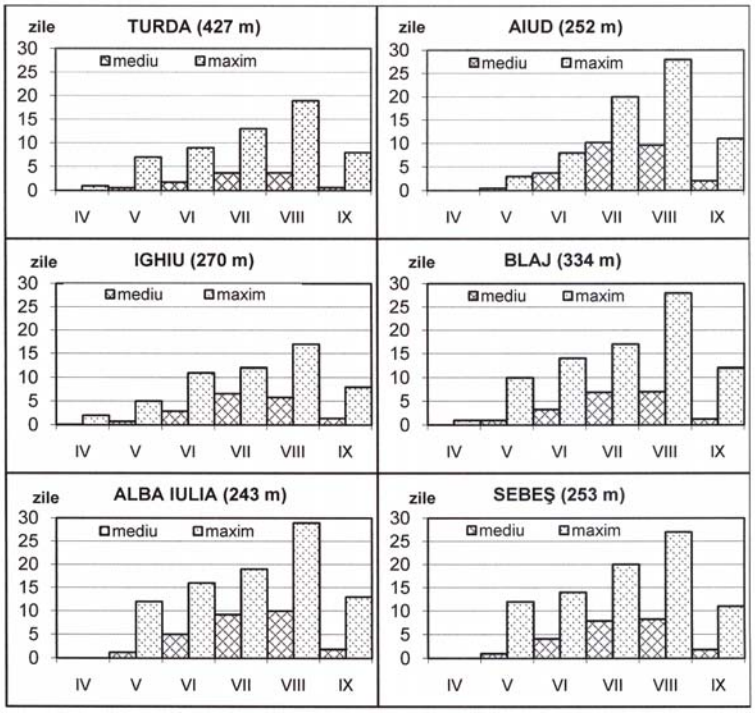

Fig. 5. Monthly average and maximum number of tropical days (max. ≥30°C).

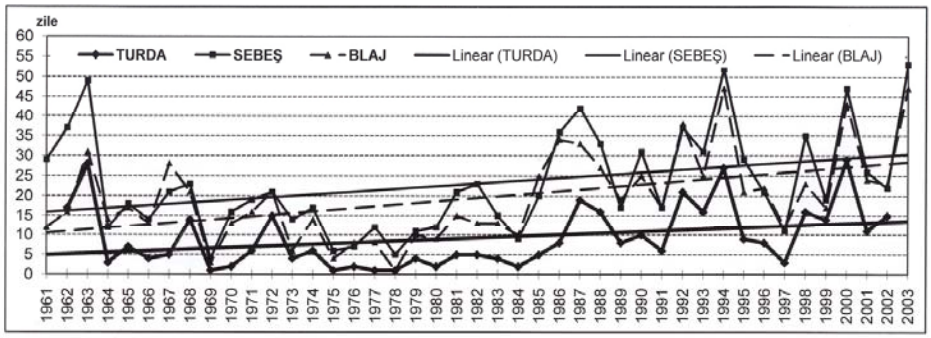

Fig. 6. Annual numerical variation of tropical days.

Whenever 30°C, a critical threshold for numerous plant species, is crossed and air and soil moisture is decreasing under a clear sky, conditions become

favourable to the onset of drought, affecting in some years also the Alba Iulia – Turda Depression and diminishing the quantity of crops.

Tropical temperatures of over 30-35°C hamper the development of plants by hugely reducing the balance of organic substance as respiration and transpiration losses are much higher than the quantity of organic substance synthesized by chlorophyll assimilation, hence lower productions in agriculture, cereals actually shriveling (Dragomirescu, Enache, 1998).

Spells of tropical temperatures detrimental to the evolution of plants: June 17 – July 1 1963; July 6-12 1968; July 12-26 1987 – with maxima over 39°C on July 20 (39.5°C at Aiud, 39.4°C at Alba Iulia stations); June 13 - July15 1992; June 27 – July 1 and July 23 - August 12, 1994 (maxima of 39.7°C on August 11 at Sebeş); July 2-9 and August 17-23 2000 etc. (Mărculeț, Mărculeț, 2010).

Tropical nights (min. temp. ≥20°C) are a very rare occurrence in the Alba Iulia – Turda Depression, totalling less than one day/year (on average). However, in some years, 5 or 6 tropical days at Turda and Ighiu stations, respectively were recorded, due to the higher influence of the Föehn, both stations lying close to the slopes of the Apuseni Mountains (Fig. 2).

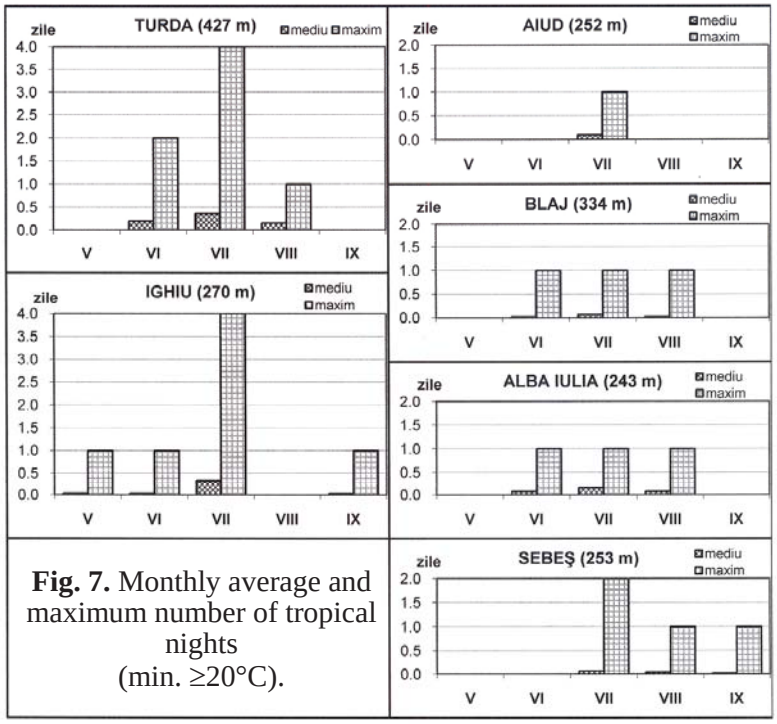

Fig. 7. Monthly average and maximum number of tropical nights (min. ≥20°C).

Tropical nights may occur from May to September, of subunit incidence (on average), maximum July values last for one day at Alba Iulia, Ighiu and Blaj and four days at Ighiu and Turda stations (Fig. 7).

In conclusion, the specific Föehn effects, hot tropical air advections, cumulated with strong insolation-related warming, may sometimes produce excessive temperatures that have a negative effect especially on the variety of crops grown in the Alba Iulia – Turda Depression.

REFERENCES

1. Bogdan, Octavia (1978), *Fenomene climatice de iarnă şi de vară*, Edit. Ştiinţifică şi Enciclopedică, Bucureşti, 120 p.
2. Bogdan, Octavia (1998), *Fréquence de réfroidissements et des réchauffements masiffs pendant le dernier siècle en Roumanie*, RRGéogr., **42**, p. 69-80.
3. Bogdan Octavia, Niculescu Elena (1999), *Riscurile climatice din România*, Inst. Geogr., Bucureşti, 280 p.
4. Bucur, Georgeta (1960), *Frecvenţa răcirilor şi încălzirilor maxime şi bruşte în R.P.R.*, MHGA, **5**, *4*, p. 305-309.
5. Dragomirescu, Elena, Enache, L. (1998), *Agrometeorologie*, Edit. Didactică şi Pedagogică, Bucureşti, 198 p.
6. Ion-Bordei, Ecaterina (1983), *Rolul lanţului Alpino-Carpatic în evoluţia Ciclonilor Mediteraneeni*, Edit. Academiei, Bucuresti, 136 p.
7. Mareş, C., Mareş, Ileana (1990), *Variabilitate climatică şi valori extreme de temperaturi*, Hidrotehnica, **35**, *8*.
8. Mărăşoiu, D. (2008), *Factorii dinamici ai riscurilor/hazardelor termice în emisfera nordică*, Revista Geografică, **XIV-XV**, Bucureşti.
9. Mărculeţ, Cătălina, Mărculeţ I. (2005), *Consideraţii asupra fenomenelor de uscăciune şi secetă din sud-vestul Depresiunii Transilvaniei*, Revista Geografică**, XI**-2004, p. 101-105, 3 fig., 1 tab.
10. Mărculeţ, Cătălina, Mărculeţ I. (2010), *Temperaturile şi culturile agricole în Depresiunea Alba Iulia – Turda*, Revista Georafică, **XVII**, p. 53-58.
11. Milea, Elena, Iliescu, Viorica, Doneaud, A., Stoica, C. (1971), *Unele corelaţii între singularităţile termice în R.S. România în perioada 1920-1960 şi tipurile de circulaţie atmosferică*, Cul. lucr. IMH/1968, p. 56-77.
12. Militaru, Florica, Ţepes, E. (1973), *Condiţiile sinoptice în care s-au produs zilele de vară (t ≥25°C) pe teritoriul Republicii Socialiste România*. Hidrotehnica 18, 2, p. 94-98.
13. Morariu, T., Bogdan, Octavia, Maier, A. (1980), *Judeţul Alba*, Edit. Academiei, Bucureşti, 180 p. 53 fig., 1 hartă color, sc. 1: 2 00 000, 6 tab.
14. Niculescu, Elena (1993), *Răciri şi încălziri masive în ultimul secol în România*, SC Geogr., **XL**, 73-81.
15. Stoenescu, St., Tepes, Elena (1969), *Frecventa noptilor tropicale pe teritoriul R.S. Romania*, Cul. lucr. IMH/1967, p. 197-207.
16. Tepeş, Elena (1969), *Frecvenţa zilelor cu temperatura maximă ≥ 25grade Celsius. "Zile de vară", pe teritoriul R.S.R.*, MHGA, 14(2), p. 96-101.

17. * * (1962), *Clima Republicii Populare Române,* **I**, Institutul Meteorologic, Bucureşti, 164 p.
18. * * (2008), *Clima României*, Administrația Națională de Meteorologie, Editura Academiei Române, Bucureşti, 365 p.
19. *www.meteoromania.ro*
20. www. wetterzentrale.de