

## CLIMATIC CHANGES ON REGIONAL PLAN IN OLTENIA AND THEIR EFFECTS ON THE BIOSPHERE

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**Abstract.** *In the paper there is analysed the evolution of climatic phenomena of extreme type, which have affected Oltenia especially after the year 2000. These phenomena have been more and more intense exceeding continuously the known limits since systematic meteorologic observations have been made in Romania. They have affected a big part of the country and especially the south and east. Among these, there are analysed the warming waves during which record absolute maximum temperature had been recorded, marking an important saltation in the evolution of temperatures, which, in the context of the global climatic warming, have important significances. Droughty periods and those excessively rainy as well as warm winters have become more frequent. The consequences of this evolution have been experienced in all the fields. The paper is addressing to specialists in the field of climatology, meteorology, biology, to candidates for doctor degrees and master degrees, to students and to all those interested in the climatic evolution problem and the effects on the biosphere.*

**Keywords:** *warmth wave, absolute maximum temperatures, monthly average temperatures, canicular days, index of thermic comfort, (ITH-index of temperature-humidity comfort), drought, biosphere.*

**Rezumat.** *Schimbări climatice pe plan regional în Oltenia și efectele lor asupra biosferei. În lucrare este analizată evoluția fenomenelor climatice de tip extrem, care au afectat Oltenia în special după anul 2000. Acestea au fost din ce în ce mai intense depășind continuu limitele cunoscute de când se fac observații meteorologice sistematice în România. Au afectat o mare parte a țării și în mod deosebit sudul și estul. Dintre acestea sunt analizate valurile de căldură în timpul cărora au fost înregistrate temperaturi maxime absolute record, marcând un important salt în evoluția temperaturilor, care în contextul încălzirii climatice globale au semnificații importante. Perioadele de secetă și cele excesiv de ploioase ca și iernile calde au devenit mai frecvente. Consecințele acestei evoluții au fost resimțite în toate domeniile. Lucrarea se adresează specialiștilor în domeniul climatologiei, meteorologiei, biologiei, doctoranzilor, masteranzilor, studenților și tuturor celor interesați de problemele evoluției climatice și efectele asupra biosferei.*

**Cuvinte cheie:** *val de căldură, temperaturi maxime absolute, temperaturi medii lunare, caniculă, indicele de confort termic ITU, secetă, biosferă.*

### INTRODUCTION

We have tackled the climatic aspects in this paper from Oltenia whose evolution in certain years have exceeded with much the specific limits known for the climate of Oltenia which can be considered as **indexes of climatic changes** in full display on the whole Planet, not only Oltenia or Romania. Some researchers consider that these phenomena can be considered **climatic changes** if they have manifested for several decades.

The intergovernmental Group of experts, regarding the climate warming (GIEC) in the report published at Paris on the second of February, 2007, after a meeting with closed doors, which lasted a week, has drawn the conclusion that the **climatic changes in the World have taken place in proportion of 90 % because of human actions.**

More than 20 years ago, BROWN et al. (1987) were speaking about **the thresholds of climatic change** with reference to the rise of the level of carbon dioxide from the atmosphere- the main „guilty” gas of intensification of the green house effect. As a result of the global atmosphere warming (more evident after the year 1978), have taken place: reduction of the ozon layer in the atmosphere above Antarctica, „the holes” in the ozon layer (the protecting shield of life on Earth), the warming with 2.2-3.3°C of the permafrost under the arctic Tundra, the more and more accelerated disappearance of some species of plants and animals, the growing of the consume of resources and the diminution of perspectives of the next generations. etc. The cited authors show that the **natural thresholds** can be defined with a certain precision, and the consequences of their infringement are visible throughout the World. As in climatology, the climatic parametres which define the natural normal state of the terrestrial climate are natural thresholds; the continuous and gradual exceeding of these, moot the question of accepting the idea of **change of climate** (with the main major aspect, the global warming of atmosphere with a series of risks and consequences), an idea already accepted by more and more scientists at the global level, whose effects are stronger from year to year. The two authors term the present state of evolution of the Planet **a cataclism in display**, determined by the action of man. At present, it is spoken about the six mass **extinction** of the species of plants and animals after the disappearance of the Dinosaurs. Numerous scientific papers from Romania make evident a series of changes appeared at the level of the whole country or regional.

We specify that the terms of **change of climate** and that of **climatic variability** are not contradictory, along the time the climate of the Earth has suffered numerous changes, but all of these are included in the more general term of **natural climatic variability.**

The Swedish scientific chemist SVANTE ARRHENIUS (1859-1927), who received the Nobel Prize for Chemistry in 1903, foreseen, with more than 110 years ago, that the green house effect<sup>1</sup> will appear on the Planet due to the carbon dioxide.

This effect has been studied by scientists, beginning with the year 1955. Since 1975 it has been the object of some important projects of administration of its effects, and by the global warming it has got a world dimension. In June 2005, Academies of Sciences from 11 big states (those included which produce the biggest part of the green house effect gas), have confirmed definitively, by a common official statement, the consensus of the world scientific elite on the reality of the **global warming phenomenon**, and of human responsibility for this and the urgency to act adequately until it is not too late. The public opinion is more and more conscious of climatic changes and more alarmed about their effects. A good part of scientists appreciate that the **global climatic changes** and the **global climatic warming** will constitute the "obsession of the future century" or maybe even more.

On the basis of data provided by the National Meteorological and Hydrological Services and by other Institutions, OMM<sup>2</sup> there has been established that:

- In 12 of those 13 years of the period 1995-2007, the global temperature near the surface of soil (at the height of 2m) were among the highest from the beginning of the instrumental recordings, in the sixth decade of the XIX th;
- Average global temperature has raised with 0.74°C since the beginning of the XX-th Century;
- Mountain glaciers and the surface covered with snow are in diminution in both terrestrial hemispheres ;
- At the global scale, the sea level has raised, on average, with 1.8 mm/year in the interval 1961-2003, but with 3.1 mm/year starting with the year 1993;
- In the last 25 years, the marine ice from the Arctic Ocean has diminished with 17% and it will disappear on the summer period in the next 30-40 years;
- The amount of carbon dioxide has raised with 36% to the beginning of the Industrial Revolution, but significant raises have been also recorded in the case of other gases with green house effect, such as the methane.

## MATERIAL AND METHODS

We have used the existing data in the archive CMR Oltenia, the results of the current working out and we have carried out a series of process and statistic analyses. We have used the criterion of Hellmans's classification at the specification of types of time. The data and the maps from the satellite were particularly useful. The material used in the present paper is formed of the recorded data in the period 2000-2007. The temperature was recorded in standard conditions in conformity with the methodology OMM. The precipitations were measured with the pluviometer and the recording rain gauge. The data were recorded, monitorised and analysed in conformity with the current methodology in the field of weather forecast.

## RESULTS AND DISCUSSIONS

As a result of centralization and processing of these data, we have identified a few aspects of the weather manifestations in Oltenia, which can be considered as **climatic changes at regional level**: waves of **warming**, rainy periods, very cold or very warm winters, some particular climatic aspects during the year 2007 which had some effects on the flora and fauna in this zone.

### *Waves of warming*

In the course of the year 2000, a series of special phenomena were recorded, such as: massive warming in summer, intense canicula<sup>3</sup>, dryness<sup>4</sup> and drought.

In the period I.I.2000-I.IV.2001, in Oltenia, there was a period of intense canicula which provoked a drastic drought, in which two absolute thermic records were also recorded for Romania. The summer of the year 2000 marked for Oltenia as well as for the whole Romania, canicula on long periods of time associated by drought. The drought evolved slowly in the first months of the year (January, February, March), being marked with precipitations with much below the normal level. The coming of the spring was early still in the course of the month February, so that then, towards the end of April, late white frosts appeared, too. The spring months followed, April and May, with extremely little precipitations. At the end of the month of June, the canicular days began to appear. In July and August, the periods of prolonged canicula succeeded with short intervals of time, in which the weather „cooled off” slightly to the precedent days with canicula. In the canicular periods, the temperature has remained raised even in the course of nights, too.

In Romania, a **thermic record** was registered for the month of June on the date of July, the fifth, at Giurgiu, of **43.5°C**, which has become *the absolute maximum* of the month of July on the whole country.

<sup>1</sup> These gases retain the excess of heating from the atmosphere as wind screen of a car retains the Sun heating penetrating inside (publication on-line *Earth Observatory*).

<sup>2</sup> WMO= World Meteorological Organization

<sup>3</sup> *Canicula phenomenon* is recorded if the air temperature reaches 35°C.

<sup>4</sup> Dryness phenomenon is recorded if five days running, it does not rain, or if rained, the amount of precipitations did not exceed the respective daily average. (according to Hellmann, cited by Donciu in 1928).

The special intensity of the canicula has coincided with the year of the *solar maximum activity* (which it is repeated once at about 11 years, but this maximum was special of *secular type*, as the astronomers characterize it as that from 1946, but more intense than the last one) which, has amplified the thermic affects and the canicula. The peak of the canicula was situated in the interval of 4-5 July 2000. We present a few aspects of this exceptionally warm summer:

#### ***The canicula in the month of June 2000***

In the month of June three periods of canicula were recorded in which I.T.H. (index of temperature-humidity exceeded 80 units in the most part of Oltenia. These periods were: 4-10 June (in which the canicula manifested, especially in the south of Oltenia), June 13th-16th and June 21st-25th.

A few essential aspects referring to this month:

- In the most part of Oltenia, the warmest days were June 23rd, 24th and 25th;
- The biggest maximum value of the air temperature 38.7°C, recorded on the date of 23rd of June at **Băilești**;
- The biggest I.T.H.<sup>5</sup> was 86.1, recorded at Caracal on the date of 23 rd June;
- The biggest number of canicular days in June was 12, recorded at Caracal;
- The canicula in the month of June, 2000, provoked the appearance and installation of drought. All monthly average values of temperature in the month of June 2000 exceeded normal average values with positive deviation of +1.3°C (at Bechet and Calafat in Dolj County) and up to +4.3°C (at Apa Neagră in Gorj County) and Băcleș in Mehedinți County);

• The smallest amounts of precipitations (<5 l/m<sup>2</sup>) fell at Cozia Peak, Tg. Jiu, Rm. Vâlcea, Drobeta-Turnu Severin, Halânga, Băcleș, Slatina, Caracal (and in general in the whole Olt County) in majority, the precipitations fell at the beginning of the month (and in some zones, even on the date of first June). The most part of precipitations fell in one single day with negligible effect;

• The highest monthly average temperature in the month of June 2000 was 23.3°C recorded at Băcleș;

• The smallest number of days with precipitations was 1, recorded in the hills of Mehedinți, at Băcleș and these fallen on the date of first June, 2000. The biggest number of days with precipitations was 9, recorded at Craiova, at the south limit of the hills, but here the total monthly quantity was just 12.0 l/m<sup>2</sup> (of which 10.0 l/m<sup>2</sup> fell on the date of first June 2000). The majority of the precipitations fell on the date of first June, 2000 in 47.8 % of the localities of Oltenia. The majority of the precipitations fell in the last three days of the month of June, 2000 in 39. 1% of the localities of Oltenia. In 30.4% of the localities of Oltenia, the total monthly precipitations were below 10 l/m<sup>2</sup>. The bigger or equal precipitations with 30 l/m<sup>2</sup> were recorded only in the mountain zone. No other total monthly quantity of precipitations exceeded 40 l/m<sup>2</sup> (40.0 l/m<sup>2</sup> was recorded at a single Meteorological Station, The Negovanu Peak). In 52.2% of the localities of Oltenia, the quantity of fallen precipitations was below 20 l/m<sup>2</sup> in the whole month of June 2000 (Source-processed data), it means that in the conditions of this month particularly hot, the quantity of precipitations was insignificant.

#### ***The canicula in the month of July 2000.***

In the month of July 2000, two periods of canicula particularly intense were remarked, namely:

- First period-in the interval from July 2nd to 12th 2000;
- Second period-in the interval from July 22nd to 27th 2000.

We present a few results from the processing of data:

• The maximum temperatures reached and exceeded 43°C (43.0°C at Bechet, 43.1°C at Băilești, 43.2°C at Calafat);

• ***The maximum temperature of the month of July 2000*** for Oltenia was 43.2°C recorded on the date of July 4th .2000, at Calafat, which is very near to the absolute monthly maximum of the month of July and it **is a new thermic record for Oltenia**;

• The biggest number of days with Tmax. ≥ 30°C was 19 recorded at Halânga, in Mehedinți County, Băilești in Dolj County and Caracal in Olt County;

• The biggest number of days with Tmax. ≥ 33°C was 15 recorded at Bechet, in Dolj County;

• The biggest number of days with Tmax. ≥ 35°C was 12 recorded at Calafat and Bechet, in Dolj County;

• The biggest number of days with Tmax. ≥ 40°C was 5 recorded at Bechet, in Doly County;

• The hottest days in Oltenia were on the date of 4th and 5th .07.2000, when the maximum temperatures exceeded 40°C in the whole Oltenia except the mountain zone.

<sup>5</sup> ITH = index of temperature – humidity comfort. This measures the comfort or lack of comfort felt during the summer by the persons who work in rooms without a rapid air circulation. It can be calculated on the basis of one of the following formulas: ITH = 0.4 (Tdry + Twet) + 15; ITH = 0.55 Tdry + 0.2 Tdew + 17.5;

ITH = Tdry – (0.55 – 0.55 RH) (Tdry – 58) where Tdry is the air temperature read at the dry thermometer in Fahrenheit degrees, Twet = is the air temperature read at the wet thermometer in Fahrenheit degrees, Tdew is the temperature of the dew point in Fahrenheit degrees, and R H is the relative humidity expressed in decimal fractions, that is, for example, instead of 35% it will be taken 0.35 (STRAHLER 1973).

***The characteristic thresholds of values for ITH are: I.T.H. 65 or lowerr-reduced risk; I.T.H. 66-79-alert state; I.T.H. 80 or overe-high risk*** (STRAHLER 1973).

Toward east and south-east of Oltenia, the canicula was the most intense since meteorological observations have been made.

To be noticed that the **old absolute maximum monthly temperature of the month of July for Oltenia**, of 41.8°C recorded at Strehăia, Mehedinți County, on the same date in July 5th 1916, was reached and exceeded in many localities of Oltenia, thus: 41.8°C/04.07.2000 at Apa Neagră in Gorj County, 42.1°C/04.07.2000 at Halânga in Mehedinți County, 42.3°C/04.07.2000 at Caracal in Olt County, 42.4°C/04.07.2000 at Vânu Mare in Mehedinți County, 42.6°C/04.07.2000 at Drobeta-Turnu Severin, Mehedinți County, 43.0°C/05.07.2000 at Bechet, 43.1°C/04.07.2000 at Băilești, 43.2°C /04.07.2000 at Calafat, all of these in Dolj County.

The **hottest day for Oltenia** of the summer of the year 2000 was the day July **4th 2000**, which is, in fact, the hottest day of the month of July in the last 84 years. The value of 43.2°C is very near to the absolute monthly maximum temperature of the month of July.

The very high temperatures have also influenced the maximum monthly values of the **ITH**, which reached 89.7 unities in the south of Oltenia, at Bechet. This is the value of **absolute record** of this index of thermic comfort not only for Oltenia, but even for the whole country.

**I.T.H. max.** recorded in **July 2000** as well as for the whole warm period of the year 2000 (remained unexceeded till at present), was 89.7 recorded on the date of July 5th, 2000 at **Bechet in the south of Oltenia**. A near value was recorded in the preceding day July, 4th, 2000 in the same locality, Bechet, 89.3. Other near values to that maximum were 89.4 at Apa Neagră in Gorj County on the date of July 4th, 2000 and at Caracal on the date of July, 5th, 2000; 88.7 at Caracal on the date of July, 4th, 2000; at Calafat 87.4 on the date of July, 4th, 2000; 86.8 on the date of July, 4th, 2000 at Slatina and 86.0 on the date of July 5th, 2000 at Calafat (source, processed data).

*In the second period of canicula<sup>6</sup> of the month of July* (July, 22nd-27th, 2005), near values to that maximum were recorded at Bechet 88.1 on the date of July 25th, 2000; 89.2 on the date of July, 26th 2000; 86.6 on the date of July 26th, 2000 at Calafat, and 86.0 on the date of July 26th, 2000 at Caracal (in conformity with the processed data from the archive of the Romanian Meteorological Committee, Oltenia).

There was observed that in the second period, the canicula was particularly intense in the south of Oltenia, and in the first period, the canicula was particularly intense near the whole Oltenia. In total, in the month of July, 16 days of canicula were recorded. If we shall compare the average temperature values from those two periods of canicula with those normal, we find out positive deviations of 1-4°C, the smallest positive deviation was +0.8°C at Tg. Logrești, and the biggest +3.9°C at Parâng, in the mountain zone.

The very raised temperatures of over 40°C in the plain and piemont region, of nearly 40°C in Subcarpathians, of over 35°C in the intramountain depressions and of over 25°C in the mountain regions have determined the appearance of, drought<sup>7</sup>, too.

In the month of July the drought was particularly intense on long periods of time. Significant precipitations fallen in the afternoon of the day July, 12, 2000, in the night of 12/13.07.2000 and on the date of July 13th, 2000 (exactly at one year since the torrential rain in the Mehedinți and Gorj Counties which brought in 36 hours quantities of precipitations near to the absolute maximum of the month of July), but without effect on the agricultural crops which had already been compromised.

The monthly quantities of precipitations in July 2000, at some stations, compared to those normal ones, were in surplus, but their repartition in time was particularly ununiformly, being totally useless as we can see further. The July month 2000 is an example of month in which, at some stations, the precipitations were in surplus, but totally useless because of the repartition particularly ununiformly and of the canicula.

*The monthly maximum quantity in July 2000*, was 101.0 l/m<sup>2</sup> at Băcleș in Mehedinți County, of which 77.0 l/m<sup>2</sup> fallen in the same interval of instability, that is 76.2% of the monthly total. The smallest monthly quantity of precipitations in July was 27.0 l/m<sup>2</sup> at Caracal, Olt County, of which 22.0 l/m<sup>2</sup> has fallen in the night of 12/13.07, that is 81.5% in this interval of instability. The biggest percentage of the monthly total of the month of July in this interval of instability was recorded at the Cozia Peak, where 90.6% of precipitations has fallen in the night of 23/13.07.2000, and the smallest percentage was 44.9% at Apa Neagră. The weather was getting warm and then rapidly, in just 10 days after these rains, the canicula was installed again.

#### *The canicula in the month of August 2000*

In the month of August 2000, too, canicular periods associated with drought were produced. Thus, in this month, two canicular periods were recorded:

- First period 03.08-07.08.2000;
- Second period 18.08-24.08.2000. The processing of data has lead to the following conclusions:
  - The biggest number of days with T max  $\geq 30^{\circ}\text{C}$  was 26 days recorded at Drobeta-Turnu Severin and Halânga;
  - The biggest number of days with T max  $\geq 33^{\circ}\text{C}$  was 20, recorded at Băilești;
  - The biggest number of days with T max  $\geq 35^{\circ}\text{C}$  was 14, recorded at Băilești and Drobeta-Turnu Severin;

<sup>6</sup> The canicula phenomenon is recorded when the air temperature reaches (or exceeds) the value of 35°C.

<sup>7</sup> The total absence of precipitations, for a period of 14 days running in the cold season (October-March) or at least 10 days running in the warm season (April-September), defines the term of drought (or atmospheric drought) (according to Hellmann cited by Donciu in 1928).

- The biggest number of days with  $T_{\max} \geq 40^{\circ}\text{C}$  was recorded at Drobeta-Turnu Severin, Băilești, Calafat and Bechet;

- *The warmest day in the month of August 2000*, was the day of 23.08.2000 when at four meteorological stations, Drobeta-Turnu Severin, Băilești, Calafat and Bechet from Oltenia, maximum temperatures bigger or equal to  $40^{\circ}\text{C}$ . were recorded;

- The most intense canicula in the month of August 2000 was in the period 19–24 August;

- In Oltenia, the longest compact period of canicula was recorded at Drobeta-Turnu Severin, in the period 11-25.08.2000, that is **15 days running of canicula**. A mention should be made that at south of Târgul Logrești, in the Getic Piemont the second period of canicula of the month of August was installed, beginning with the days of 11, 12, 13.08.2000, and it lasted between 12 and 15 days running.

There was observed that, in comparison with the month of July, the number of the days in which the values of maximum temperature have exceeded the thresholds of  $30^{\circ}\text{C}$ ,  $33^{\circ}$ . When  $35^{\circ}\text{C}$  was higher, but, the number of the days, in which the maximum temperature has exceeded  $40^{\circ}\text{C}$ , was smaller, have permitted us to draw the conclusion that *the intensity of the canicula in the month of August has diminished to that from the month of July*. Then raised values of the air temperature determined maximum values of the I.T.H. max. Index in those two periods of canicula of the month of August 2000.

Analysis of these data shows that:

- I.T.H. max. was 89.2 recorded on the date of 23.08.2000 at Caracal in the second period of canicula; this is near to the maximum value 89.7, recorded on the date of 05.07.2000 at Bechet in the south of Oltenia;

- In the first period of canicula, I.T.H. max. was 84.9, recorded at Caracal on the date of 06.08.2000, being near to that from the first period;

- Number of days, in which canicula was recorded in Oltenia, in the month of August, was 12;

- The biggest number of days in which the I.T.H. max. Index has exceeded the critic threshold of 80, in the month of August, was 23 recorded at Caracal in Olt County;

- In total, in the course of the summer of the year 2000, 46 days were recorded in which the maximum temperature exceeded  $33^{\circ}\text{C}$  of 92 days, that is a percentage of 50% so, half of the summer days were canicular;

- The high values of the air temperature indicate *the presence of the drought in the month of August 2000*.

The month of August 2000 was particularly droughty, and the effects of drought was much amplified by the canicula, of which a few conclusions result:

- The average monthly values of temperature have exceeded the average thermic monthly normal values with positive deviations comprised between  $+1.3^{\circ}\text{C}$  at Tg. Logrești up to  $+4.6^{\circ}\text{C}$  at Apa Neagră in Gorj County. Particularly big differences were also recorded at Bâcleș in Mehedinți County ( $4.2^{\circ}\text{C}$ ) and at Calafat in Dolj County ( $+4.0^{\circ}\text{C}$ );

- The biggest exceeding of the normal monthly average temperature from the whole summer course of the year 2000, was produced at Apa Neagră in Gorj County in the month of August, where the monthly average value exceeded the normal value with  $+4.6^{\circ}\text{C}$ ;

- At 13 meteorological stations the fallen precipitations in the whole month of August were below  $7 \text{ l/m}^2$ . It means that a percentage of 56.5 % of the localities of Oltenia has had a total monthly quantity of precipitations smaller or equal to  $7 \text{ l/m}^2$ . In 73.9 % of them, the fallen precipitations were smaller or equal to  $21.0 \text{ l/m}^2$ ;

- With the exception of the mountain region, the biggest monthly fallen precipitations was  $64.0 \text{ l/m}^2$  at Tg. Logrești, of these,  $23.0 \text{ l/m}^2$  there were fallen on the date of 08.08.2000 and  $38.0 \text{ l/m}^2$ , on the date of 24.08.2000 that is,  $60.1 \text{ l/m}^2$  has fallen only in two days and in the most part of the month, drought and canicula dominated;

- In many localities of Oltenia, there was recorded just one day with rain and that below  $5 \text{ l/m}^2$  (ex. Slatina only  $0.6 \text{ l/m}^2$  recorded on the date of 29.08);

- In the localities in which the drought was particularly intense, the fallen precipitations represented values between 1.28% (Slatina) and 11.64% (Apa Neagră) of the normal values of the month of August. As the preceded months were droughty, we draw the conclusion that the drought in the month of August was amplified very much.

**Rainy periods** - The rains in the year 2005

The quantities of the fallen precipitations not only in Oltenia but even in the whole country, characterize the year 2005 as being the **most rainy year** since meteorological observations have been made. For example, the fallen precipitations at the Craiova Meteorological Station totalize, in this year,  $1079.0 \text{ l/m}^2$ , exceeding with  $286.6 \text{ l/m}^2$  the annual record value of  $792.4 \text{ l/m}^2$  of the most rainy year 1972, recorded before 2005.

The fallen torrential rains in intervals particularly rainy, repeatedly, which effected Romania in the spring, summer and autumn of this year (2005) are a confirmation of the climatic changes which affect the whole Planet.

In Oltenia (as well as in the whole Romania) in the year 2005, in all the months, the precipitations were excedentary and the monthly averages of temperature were below the norm.

**Cold winters or particularly warm**

*The winter 2005-2006* was particularly cold. The cold wave in the interval 24-27 January determined frequent minimum temperatures below  $-25^{\circ}\text{C}$  in Oltenia, too, and in the country even below  $-35^{\circ}\text{C}$ , producing significant material damages due to the frost, the death of 9 persons at the level of the whole country (data published in the press) and many others were frost-bitten and some of their members were amputated because of grave injuries.

For all that, we can appreciate that the intensity of this cold climatic wave as well as its frequency diminished to the period before 1970 when in Oltenia exceptional values of low temperatures were recorded ( $-35.3^{\circ}\text{C}$  at Craiova in the night of 24/25 January 1963-absolute thermic minimum in the Romanian Plain). This cold climatic wave, the most important in the cold season for our country, is produced in the third decade of the month of January (as a rule between 23-27 January) with a nearly mathematic precision and it is called by people „The Frost of the Twelfth Day” (according to old Calendar, the Twelfth Day was celebrated around this date). This diminishing, too, of its intensity is a consequence of the global warming and an important aspect of climatic changes at regional level.

In the winter 2005-2006 the waters of the Black Sea frozen in the littoral zone on an appreciable distance permitting the skating. Intense frozen phenomena were recorded on the Danube and the intervention of the ice breakers was necessary, and after that, the ice packs blocked and made difficult the fluvial navigation for a few weeks.

In April 2006, catastrophic floods were produced along the Danube, particularly grave in the Romanian sector as a result of the cumulation of the rich precipitations fallen in the hydrographic basin of the Danube River, with water proceeded from the rapid melting of the snow layer due to the rapid warming of the weather at the level of the whole European continent.

*The winter 2006-2007*, was the warmest in the history of systematic meteorological observations effected in the country and on the continent. We present a few characteristics of this winter.

- in the southern half of our country and especially in Oltenia, the snow layer lacked completely;
- particularly warm weather to normal predominated and daily averages of temperatures were bigger to normal with  $2-9^{\circ}\text{C}$ ;
- the soil was thawed on big intervals of time and just sporadically the frost was produced. The specific phenomena of winter were sporadic and they were recorded only in the mountain and Subcarpathian zone;
- though maximum values of exceptional temperature were not recorded, at least from thermic minima point of view in the air and on the soil, as well as of the averages which had the most frequent values over normal, the winter can be considered as exceptional, a real *winter of Mediterranean type*, aspect unrecorded in Oltenia (and Romania) in the last 120 years (in conformity with the data from archives).

#### ***Climatic aspects in the year 2007***

In this year, in Oltenia, the weather was particularly capricious. Among the weather aspects, we mention the most important ones:

- there were about 90 days of extreme drought, which affected the biosphere profoundly;
- there were six warm waves in the intervals: 19-26 June, 2-4 July, 8-10 July, 15-24 July, 27-30 July, 22-25 August. Two of them were of a special intensity, the one in the interval 19-26 June, and the one in the interval 15-24 July.
- twice during this summer in June and July, the vegetation on the lawns became dry, numerous forest fires affected Oltenia and the country, the fires were produced nearly in all the countries on the continent, all agricultural crops were affected in a considerable proportion. The phreatic layers dried up, many localities remaining without water supply. As a result there was produced mortality among domestic animals due to lack of food and water. People suffered and the price of vegetables and fruit was high all the summer. The Danube level diminished considerably, putting problems to navigation. The violent drought in the most important month of summer determined the Governmental authorities to consider that this drought was more serious than the most serious drought from the passed century, the one from the years 1945-1946. The Government of Romania drew up a plan of antidrought measures. Due to this, in some localities, drillings of great depth were performed for water supply, the water supply with cistern was not a viable solution. MARINICĂ, 2006).

#### ***Conclusions on the warm wave in July, 2007:***

„In Romania, since meteorological measurements of the air temperature in standard conditions have been effected (in meteorological shelter at 2 m above the soil), for the month of July, 220 cases with maximum temperature greater or equal to  $40^{\circ}\text{C}$  were recorded. These values were recorded in the south or south-east of the country, especially after the year 1985. The most frequent situations were reported at Turnu Măgurele (16 times, Roșiori de Vede (14), Giurgiu (13), Bechet and Zimnicea (10), Călărași (9) and București-Filaret (8).

Also for the month of July, the absolute maximum temperature at the meteorological stations were recorded in most part in the period 4-5 July 2000 and they exceeded  $42^{\circ}\text{C}$ . On the 5th of July 2000, at Giurgiu, there was recorded  $43.5^{\circ}\text{C}$  this being the absolute maximum temperature on the country, of the month of July till in 2007. In July 2007, till at present, this record was exceeded on July 24th, at Calafat, where  $44.3^{\circ}\text{C}$  were recorded. On the same day, greater temperatures or equal to  $44^{\circ}\text{C}$  were still recorded at Bechet ( $44.2^{\circ}\text{C}$ ), Moldova Nouă (at Moldova Veche  $44.0^{\circ}\text{C}$ ) and Băilești ( $44.0^{\circ}\text{C}$ ).

From the analysis of data from 9 meteorological stations with data of over 100 years and representatives for the territory of Romania it was found out that the maximum duration of the interval with tropical days (daily maximum temperature greater or equal to  $30^{\circ}\text{C}$ ) in the month of July was 24 days in the year 1904, at Drobeta-Turnu Severin. Big periods were also recorded in 2002 at other stations in the south of the country, namely: 22 days at București-Filaret, 19 days at Călărași and 12 days at Constanța.

These results confirm one of the conclusions of the fourth Report of IPCC, in conformity with which an increase of the frequency and intensity of the extreme phenomenon of weather was made evident as a result of the

intensification of the global warming phenomenon of climate (also in conformity with those presented on the Site of ANM, inmh.ro in July 2007).

#### ***The excessive rainy winter of the year 2007***

- The last two days of the month of July and the month of August brought important rains quantitatively: there were 5 periods with rains, without having an importance of improvement the situation in agriculture. These rains were beneficial for the straightening of the water supply of many localities, they determined the restoration of vegetation on lawns and straightened the conditions of food for animals. As a result, the programme of anti drought measures was given to „forgetting” and until October 15th, 2007 it was not discussed in the Romanian Parliament any more. The price of panification wheat raised considerably, thus, on the date of October 16th, 2007, the price of wheat was 260 €/t, on the same date there was foreseen that the price will be 300 €/t, and in 2006, on the same date, it was 110 €/t.

#### ***Effects on the biosphere***

Climate warming has major implications on the flora and fauna. It can lead, in time, to the modification of the *vegetation belts* and the changing of biotope areas of certain species of animals.

The ecologist Robert Barbault was stressing „There have always been climatic variations, but these changes are very rapid and do not permit the species to adapt themselves. Some of them will disappear, some of them will profit”.

*The mild winters* disturb the natural cycles and provide a sign of the global warming phenomenon and some plants bloom too early. Thus, in the winter of the year 2006-2007, in Oltenia, the snow drops (*Galanthus nivalis* L.) bloomed still from the end of December and in the course of the month of January. In literature of specialty the blooming period of the snow drop is February-March. At the same time, the spring crocus (*Crocus* sp.) appeared much earlier than their optimum blooming period.

The fruit trees are subjected to the risk of an accelerated blooming, which might put them in danger in the case of a return of cold. And it is not just a fearing, as the coming early of the spring, frequently in the last decade (produced nearly in each year) and the increase of the spring late white frost as well as of the days with the late frost in the air and at the soil produced frequent important damages in the fruit orchards and vegetable crops, aspect frequently met in Oltenia.

Sometimes in the second part of the month of August there was observed the blooming of the fruit trees, followed by fruit-bearing (we cite for example, that in August 2007 in the Gorj Subcarpathians the sweet cherries bloomed, they beared fruit and then in November they ripened, -evidently that they were not fruits of corresponding quality due to the gradual cooling of the weather). Flowers appeared, too, in cherry trees and wax cherry trees in Dolj County (Secui) in the month of August. Due to warming, some infectious agents can also be spread which provoke diseases in plants. It is known the fact that as far back as in the years 1960, the disease of the Dutch elm trees destroyed nearly all the elm forest. The agent of the disease was rapidly spread by insects and it adapted itself to the new conditions of environment. In Oltenia, too, the elm tree is nearly on the way to disappear.

Life of animals is in closely correlations with the climatic and meteorological conditions, each species reacting in its own way. Along the evolution, animals have developed their capacity to react promptly to each stimulus meant to affect their life in a smaller or greater extent. This capacity has become hereditary contributing to the survival of the individual and the perpetuance of species.

Studying the behavior of animals as concerns certain meteorological phenomena, people have observed some manifestations with a prognostic character of the weather. Not only the vertebrate animals have a specific behavior, but also the invertebrates. Thus, insects, besides the born reflexes connected with nutrition, reproduction, have also protection reflexes. An aspect of these is represented by the reaction to the changes of meteorological conditions. They have learned to be good meteorologists, they are able to sense the meteo changes and to hide themselves, thus, avoiding the influences provoked by the wind, rain an excessive warmth etc. (CHIMIȘLIU, 1990-1993). It is known that climatic changes influence the biology, ecology and the areal of species.

One of the drawbacks of the warm winters is a difference between the peak of reproduction of insects, earlier than usually, and the reproduction period of birds. Consequently, some insects multiply more because they do not serve as food for the chicks of birds. Thus, the caterpillars appeared already in France with much earlier of the months of March and April, an usual period for them.

In the warm and droughty years certain pests of plants such as caterpillars develop rapidly, destroying totally the leaves of the trees and increasing in this way the effect of the canicula during the summer. In some warm summers many localities (Craiova included) were invaded by caterpillars and mosquitoes which obliged the people to keep the windows closed almost permanently. In the vegetable orchards in the droughty years a massive attack of the pest *Hylemya antiqua* = *Delia antiqua* (Meigen) and certain aphids were produced.

Thus, in Oltenia, the snails (*Helix pomatia*) were active on the whole course of the winter 2006-2007, and in warm years, in the warm springs, in the droughty summers and warm and dry autums *Helix pomatia* develops very much so that its attack, in the vegetable orchards, especially in spring, produces real havocs. Victims of the modification or the disappearance of the natural habitat., of the multiplication of the parasites or the increase of pollution, because of high temperatures, are also the bees. The European and American apiculturists are more and more upset because whole colonies of bees have disappeared in the course of the last years. The mortality rate has reached, here and there, even 50%, especially in the winter end period. Several teams of researchers try to find out the causes for

which the bees disappear massively. Possible ecological causes might be: electromagnetic waves, alimentary deficiency, pesticides or parasites: A few researchers reached the conclusion that the parasite "varroa", in combination with others, is the main killer of the colonies of bees in several parts of the world.

At some time or other, Albert Einstein was emphasizing: "When the bees disappear, the man will have no more than four years to live" In the last 15 years a third of the colonies of bees of the Planet already disappeared

They play a decisive role in nature in the conditions in which they contribute, through pollination, to the survival of 80% of the species of plants, thus assuring 35% of the man food. "According to our estimates, around 30% of the species of existing bees in Europe are in danger, what it means very much", Bernard Vaissière was saying, researcher at the French Institute for Agronomical Research (INRA).

Mortality serious problems of the families of bees have appeared especially after the year 1990, when the great frequency of the warm winters in which, sometimes, rapid penetration of cold air that determine the sudden lowering of temperature and surprises the bees unorganized in the „winter ball „as well as due the massive attacks of pests of which we wrote above, have made that the number of those dealing with apiculture to decrease considerably.

In the last years, in Oltenia, too, modifications of the areas in some species of animals were observed. Thus, the scorpion (*Euscorpium (Euscorpium) carpathicus* (LINNAEUS 1767)) met, not long ago, just in the Băile Herculane zone, in the last 10 years the specie has extended its areal up to Dolj County in the zone of the localities Argetoaia and Scaiești, being frequent enough.

The species *Mantis religiosa* (LINNAEUS 1758) which in the years 1980-1985 was a rear enough insect, existing in the south-west of Dolj County (Ciuperceni-Calafat zone), gradually, it has been observed at Segarcea, and in the last years it is met sporadically at Craiova, too, or even in localities situated to the north of Craiova.

Another rare insect *Ascalaphus macaronius* (SCOPOLI 1763), specific to the zone Băile Herculane and Mehedinți County, where the climate has Mediterranean influence, it has appeared in Dolj County. In the year 1996 it was observed at Vâlcom, in 2006 at Bucovăț, and this year (2008), at the end of the month of June, it was observed even in Craiova on flowers in front of a block of flats situated in the street Calea București.

Not only the invertebrates have extended their areal, but also vertebrate animals such as: the viper with horn, the hermany turtle (*Testudo hermanni* GMELIN 1789), the golden wolf (*Canis aureus* (LINNAEUS 1758)) etc. Thus, the golden wolf, originated from the steppes of Asia, came to Romania from Bulgaria, in the year 1923 on the frozen Danube at Seaca de Câmp, has multiplied and it has extended its areal up to the north of Craiova, provoking sometimes damages in the game effectives.

During the periods of canicula in the warm summers in Oltenia significant damages were recorded in the field of pisciculture, due to the asphyxia of fish in lakes.

Warm winters and early springs also disturb the migration phenomenon of birds. "The swallows winter at present, in France instead of going to Africa", declared Philippe Dubois, scientist, manager with the programme "Avifauna and climatic change". Migratory aquatic birds were observed in the winter 2006-2007 on the lake at Bistreț, which did not migrate any more, finding here food conditions.

Desertification effects in the warm and droughty summers are more and more intense especially in the south of Dolj County (such as, for example, in the locality Mârșani and many others) has increased the number of sand storms and the moving sand dunes have appeared. We cite, for example, that in the summer 2007 at Mârșani, the sand dunes "flew" from the field up to the cemetery, burying it up to the fence and it is not the only locality where such phenomena occurred. The dust and sand carried by the wind penetrate more and more frequently into the houses of people, affecting their life and health.

The drought has socio-economic implications .too. It has lead to the high prices of foods ,and even if ,on average, the index of consuming prices has not marked spectacular saltations (though approximately its doubling to the target established initially might be named so), in the urban medium, certain foods have recorded rices 20-50% (milk, sorts of cheese etc.). Such evolution is of nature to provoke a series of pressures on the people incomes, leading to strikes and a series of social problems.

## CONCLUSIONS

**Significant climatic modifications** which constitute, at the same time, **the indexes of climatic changes at regional level**, in Romania and which have been observed in Oltenia in the analyzed period, are:

- Increase of frequency and intensity of the warm waves in the warm season from 2-3 on a decade to 5-6, or even more; for the month of June, the present tendency is of reaching at the increase of frequency of almost 10 times to the past century;
- Increase of duration of the canicular periods from a few days to 2-3 weeks or even more;
- Increase of number of summer days <sup>8</sup>, number of tropical days and nights;

<sup>8</sup> Se numește **zi de vară**, ziua în care temperatura maximă a aerului atinge 25°C. Se numește **zi tropicală**, ziua în care temperatura maximă a aerului atinge 30°C. Se numește **noapte tropicală**, noaptea în care temperatura minimă a aerului nu scade sub 20°C.



- Appearance, excessively early, of the intense waves of canicular warmths in the south-west of our country (Oltenia), still from the first decade of the month of April, that creates the impression that the spring has disappeared and suddenly begins the summer;
- More frequent appearance of the warm winters from 1-2 on a decade to 2-4 or even more, the tendency being on the increase, and some winters (for example, that from 2006-2007), have Mediterranean aspect in the south of the country and especially in Oltenia);
- More and more reduced frequency of winter climatic phenomena or the disappearance of these;
- Increase of frequency and duration of the droughts as well as the extension of the surface affected by this;
- Intensification of phenomena and processes of aridisation in the south of Oltenia, as a direct consequence of those above shown;
- Diminution of intensity and reduction of the frequency of cold waves in winter and their absence in some winters;
- Excessively warm and droughty summers .
- The early springs and long and warm autums will be more and more frequent.
- All of these have important effects on the biosphere.
- ***Oltenia is among the most affected surfaces in the country***, in which the climatic changes have a strong impact on the environment and the whole biosphere.

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