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The Climatic Risk of Intense Weather Cooling in April Across South-Western Romania Case Study: Extreme Weather Cooling and the Frosts within the 07 – 09.IV.2003 Interval

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Abstract
Even though April is regarded as the first month of the warm season, which begins after only 10 days from the winter solstice, the air temperature rises rapidly, and the transition into spring is swift and frequently occurs prematurely. Under the conditions of global warming, in south-western Romania it is observed a rise in the recurrence of warm April months or even extremely warm, and the growing tendency of air temperatures. However in some years late spring chills and powerful frosts arise which perturbs the vegetation in advanced stages of development. Consequently, the destructive effects are intense and the damages brought upon the economy are significant, having an impact on the tree, grapes, vegetables and even cereals crops. The study addresses in particular the event of the most intense cooling of April amongst the entire recorded history of meteorological data in Romania and is part of an extended series of essays regarding the weather variability in south-western Romania. It aids undergraduates, postgraduates, climatologists and every specialist interested in climate change.

Keywords: Late Spring Weather Cooling, Late Frosts, Late Snowfalls, Atmospheric Blockage Circulation.

Introduction

During April the multiannual monthly averages measured between 7.7°C and 12.0°C at Bechet, while the monthly medium across the whole region was 9.9°C, registering a general increase of 6.1°C compared with March. In some areas the rise is bigger than 6.1°C, for example at Bechet where the increase is of 6.4°C. The big averages values are recorded in the west and south of the following regions: 12.0°C at Bechet, 11.9°C at Dr. Tr. Severin and Baileşti, 11.8°C at Calafat, 11.6°C at Caracal and 11.5°C at Craiova. On Olt's couloirs at Rm. Vâlcea (10.8°C) Dragaşani (10.9°C) and Slatina (11.4°C) are detected high values due to some local causes (fig. 1).

Small temperature values are recorded in Gorj County with a prolonging of this area of low temperatures towards south-west up to Balaciţei Plateau at Bâcleş (10.2°C – smaller value than at Tg. Logreşti, Polovragi and Tg. Jiu).

The monthly average of April for the entire region is 9.9°C, registering an increase of 6.1°C compared with March, considered the highest of the entire year. This spectacular temperature rise has as an effect a true ,,explosion" of vegetation, the whole biosphere being reborn starting from the first days of April, the blossoming of trees arises in the first decade and the entire vegetation carpet starts to develop rapidly. For the autumn harvests important phenophases occurred in their overall development, while the ,,raw green" colour specific to April is owed to the moderate thermal regime of this month. The increase in air temperature during the following months determines a gradual change in the vegetation colour as a consequence of the specific summer phenophases which leads to a maturing process of plants. This important thermal leap, which specifically arises across the European continent, determines a rapid establishment of spring which makes us believe the transition into spring is brisk and is a powerful bio-stimulant for every biotype.

The thermal leap is firstly due to the occurrence of the spring equinox on the date of 21.III, the moment when the Sun crosses the celestial equator passing from the austral hemisphere of the celestial sphere into the boreal part, which consequently leads to a significant change in the Earth – Sun geometry and develops a positive daily heat budget. As a consequence the type of air masses circulation above the northern hemisphere is substantially changed in comparison to the cold season.

April is extremely fickle from a thermal regime standpoint, as a result low temperatures and late frosts can be generated during some years even in the last day of the month.

The absolute thermal maxima is of 35.5°C recorded at Bechet, on 10.IV.1985 and which also represents the absolute maxima for the whole country, a value attributed to heat waves *and which therefore surpassed the previous absolute April maxima, of 33.5°C measured in 1909 at Calafat (table nr. 1)*.

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Tab. no. 1 – Medium, maximum and minimum absolute values of temperatures in April recorded in Oltenia, within the 1894-2012 interval (°C)

Weather station	T med	T max-IV	Year/day	T min-IV	Year/day
Dr. Tr. Severin	11.9	31.7	1934/x	-4.6	1933/x
Calafat	11.8	34.5	1985/10	-3.0	1905/x
Bechet	12	**35.5**	1985/10	-3.6	2002/8
Baileşti	11.9	35.1	1985/10	***-2.9***	1997/10; 2012/2
Caracal	11.6	33.6	1985/10	-4.0	1899/x;1905/x
Craiova	11.5	31.8	1985/10	-5.5	1913/x
Slatina	11.4	31.7	1985/10	-4.2	2003/7
Bâcleş	10.2	28.9	1985/10	-7.8	2003/7
Tg. Logreşti	10.3	28.7	1998/9	**-8.6**	2003/7
Dragaşani	10.9	30.2	1934/x	-4.5	1936/x
Apa Neagra	10.1	28.8	2003/30	-7.2	2003/7
Tg. Jiu	10.9	31.8	1926/x	-6.2	2003/7
Polovragi	10.4	**26.6**	2012/30	-5.1	1995/12
Rm. Vâlcea	10.8	30.6	1950	-5.2	1905/x; 2003/7;9
Voineasa	7.7	27.7	2012/30	-7.2	2003/7
Parâng	2.3	19.2	2012/30	-14.4	1944/x
Media Oltenia	9.9	30.4		-5.9	
Corabia*		32.6	1909/x	-3.8	1899/x
Braniştea*		29.4	1943/x	-3.0	1942/x
Aninoasa*		28.9	1950/x	-3.5	1949/x
Strehaia*		31.0	1934/x	-6.0	1933/x
Studina*		31.0	1899/x	-6.0	1899/x
Baia de Arama*		30.6	1909/x	-6.0	1896/x

Source: CMR Oltenia[1] archive

After 76 years we witness a surpass of 2.0°C for all maximum temperature values in April. On the same day (10.IV.1985) a maximum temperature value, almost as high, 35.1°C was recorded at Baileşti. April is therefore the first month of the year in which the air temperature can reach and exceed 35°C.

At the same time on the date of 10.IV, at only 20 days after the spring equinox can also represent the first day of the year in which in Romania heat waves can develop.

[1] Weather stations * are part of the old national meteorological network and functioned before 1950, whilst /x signifies the absence of the recorded day.

The temperature average[2] *of monthly maximums* is 30.4°C, registering a rise of 3.9°C compared with the absolute maximum averages of March (table nr. 1).

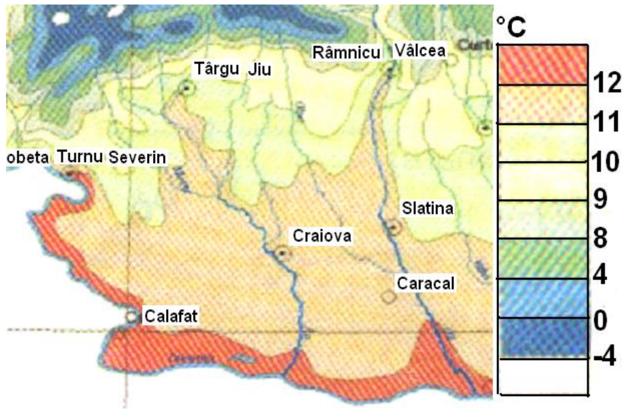

Fig. 1 The territorial repartition of average air temperature values, in Oltenia, on April for the 1961-2000-time frame
(adapted after Romanian Climate, 2008)

The absolute thermal minimum of April in Oltenia was -8.6°C recorded on 7.IV.2003 at Tg. Logreşti, confirming the tendency of surpassing the thermal extremes both ways. Regarding April, an increase of monthly thermal minimums was registered. Therefore, low values close to the one mentioned, but higher, were measured at Voineasa: -6.0°C on the date of 2.IV.1965, -5.9°C on 5.IV.1970, -5.6°C on 12.IV.1996 etc. corroborating the weather warming for April. Usually, the monthly thermal minimums occur during the first decade of the month, however the growing climatic variability has led to the monthly thermal maximums to be registered, for some years, in the first decade, whilst the monthly minimums were recorded on dates situated near the middle of the month or even in the last decade or pentad, for example -3.2°C at Tg. Logreşti on the date of 29.IV.1984.

The supreme amplitude of temperature in April across Oltenia was of 44.1°C.

The absolute monthly thermal minimum average in April was -5.9°C, measuring an increase of 15.3°C in comparison to the absolute minimum thermal averages of March.

The variation graphs of air temperatures during April within the 1961-2012 time frame, points a linear tendency of increase, across all weather stations located in every relief levels (with some insignificant exceptions). We exemplify the air temperature variation in April at Craiova (fig. 2).

[2] The averages were calculated for the 1901-1990 interval.

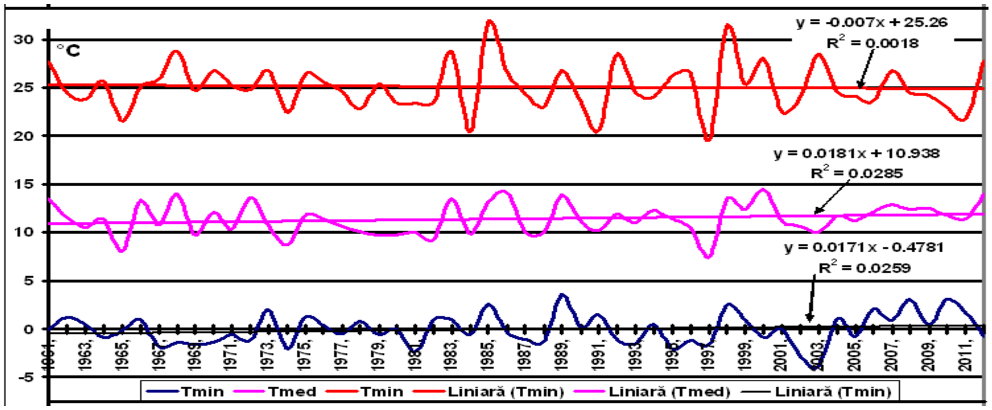

Fig. 2 Air temperature variations, in April, at Craiova within the 1961-2012 interval

The monthly thermal averages had the most rapid and highest growth (ascent of 0.0285≈0.03), minimums (gradient 0.0259 ≈ 0.03), while maximums slightly decreased (gradient -0.007 ≈ -0.01).

Amid the *warmest April months* we quote the following years: 1899, 1909, 1926, 1934, 1943, 1950, 1968, 1983, 1985, 1992, 1998 and 2003. Amongst the *coldest April months* we recall the years: 1913, 1933, 1942, 1949, 1955, 1967, 1968, 1974, 1981, 1995 and 2002.

April is the first month of the warm season and most characteristic for the spring season and agricultural year. The thermal and pluviometric regime of April depends essentially on the agricultural assessment in its entirety. The late sprig chills are sometimes associated with late snows, popularly named *lamb's snow* or powerful late spring frosts. If all these hazardous phenomena arise after warm winters in which the vegetation began to develop during winter, these can disturb it in advanced stages of development and consequently the destructive effect of these is significant, inflicting considerable damages.

In this context we exemplify the *late spring frost on 08.IV.2002* which appeared after the warmest winter recorded in Oltenia in the history of recorded meteorological data (winter 2001-2002). The vegetation began to develop even from February, on 08.IV every fruit had formed, and apricots (species of fruit stones with early blooming and very reactive to temperature conditions) had a longitudinal diameter of 2 cm. The negative temperatures had installed starting with 12 am and lasted until 08 am, and consequently, the destruction in the yield of fruits, grapes and vegetables were massive.

The droughts of April, often associated with high air and ground level temperatures are extremely destructive and gravely affects the crops, not only the autumn ones which remain full-grown and on certain areas even wither, but also the spring ones which are delayed to spring and those which arose are postponed through stagnation or forced premature phases.

The torrential rainfall in April are exceptionally intense during some periods, and the fast snow layer melting from the mountain regions partly due to weather warming and on the other hand due to the water release under the influence of liquid precipitations derived from rainfall and sleet which practically ,,inject" in the depth of the snow layer a great quantity of heat, leading to floods on extended areas within the catchment areas of rivers across Romania and, in the last years, even alongside Danube.

For that reason we recall *the floods from April 2006* which started in the west of the country and then encompassed huge areas from every region of Romania, while along the Danube embankments caved in and several localities were completely flooded.

The processes of weather cooling in April, are exceptionally intense and recurrent in north-eastern and eastern regions of the country, however in the last years even covered the whole country. Usually, these are not singular local phenomena, but occur over large regions of Europe.

Similarly to the above, but on the contrary, *the weather warming processes in April*, are extremely powerful and frequent in south-western and western Romania, however in the last years even covered the whole country. Usually, these are not singular local events, but are manifested over a large part of Europe.

Furthermore we will analyse the strong weather cooling on 07.IV.2003 when in Oltenia were registered the absolute thermal minimums of this month at seven different weather stations (four of which situated in the Getic Piedmont: Slatina, Tg. Logreşti, Apa Neagra and Bâcleş, one in Gorj Subcarpathians– Tg. Jiu, one in Vâlcii Subcarpathians– at Rm. Vâlcea which equalled the old absolute minimum of this station measured in 1905 and one in the homonym intermountain depression - Voineasa, table nr. 1).

Intense weather cooling on the date of 07.IV.2003.

At soil level, the positioning of the main action baric centre of the atmosphere above Europe, on the precedent day of cooling at 00 UTC, shows that hovering above the eastern basin of the Black Sea was situated a cyclone, of Mediterranean origins, with centre values under 990 hPa (fig. 3). Above UK and western Scandinavia was present an anticyclone filed, with centre values of over 1030 hPa (this is in fact a ,,branch" of the Azores High with which is united through an anticyclone belt).

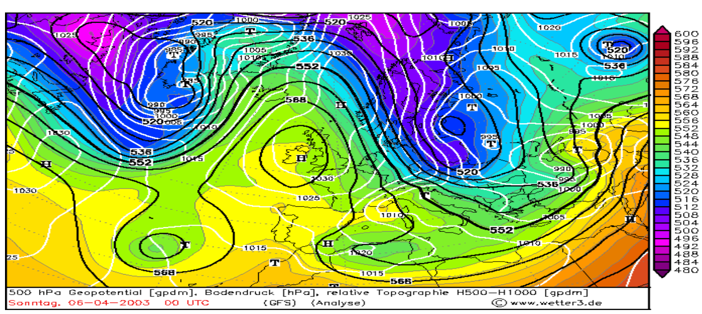

Fig. 3 The synoptic conditions at soil level and in altitude at 500 hPa level superimposed over the relative baric topography TR500/1000 on 06.04.2003 at 00 UTC.

(after http://www.wetter3.de/Archiv/)

The Iceland Cyclone was situated in the west of Iceland, presenting core values of 985 hPa over the Greenlandic coasts.

In altitude at a 500 hPa level it is observed a nucleus of low geopotential very deep, positioned over the Baltic Countries with centre values of 512 damgp, above Great Britain a nucleus of high geopotential with centre values of 576 damgp, while hovering over Greenland and towards the Canadian coast a nucleus of small geopotential with core values under 512 damgp.

Under these circumstances the air circulation within the inferior troposphere, above the greater part of Europe, is a circulation of obstruction (the characteristic isohypse of 552 damgp takes the form of Greek letter ,,Ω”). This location of the atmospheric blockage in Western Europe, determines for Romania, which is situated on the anterior side of the obstruction, a strong advection of cold continental polar air mass (cPk), even extremely cold from the Scandinavian Peninsula.

The thermal field examination at the 850 hPa[3] level (fig. 4), illustrates that on this date the cold air advection over Central and Eastern Europe the isothermal of 0°C extended up to the southern half of the Balkan Peninsula and southern Marmara Sea over north-western Small Asia. At the same level the isotherm of -5°C was expanded across north and north-western Romania, whilst the one of -10°C is over Poland, Austria and western Hungary.

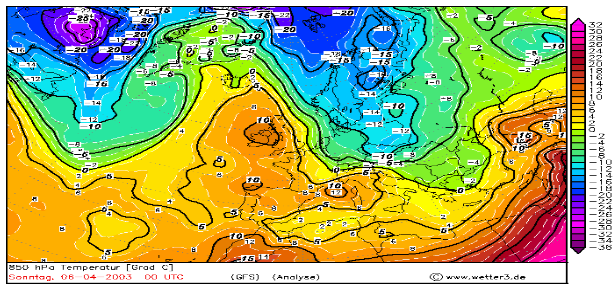

Fig. 4 Thermal field at a 850 hPa level (circa 1500 m altitude) on 06.04.2003 at 00 UTC.
(after http://www.wetter3.de/Archiv/)

The synoptic condition is specific to a winter month and usually determines an extreme weather cooling in the eastern half of Europe, inclusively Romania.

At ground level the positioning of the main action baric centre of the atmosphere above Europe was the following: The Cyclone which during the precedent day was situated over the eastern basin of the Black Sea was now displaced towards north and was located over Ukraine and Poland (core value of 990 hPa), the anticyclone field situated the previous day across Great Britain and the western era was now shifted completely over the Scandinavian Peninsula (core values of over 1030 hPa), therefore becoming a Scandinavian Anticyclone, while in its eastern half the air mass was extremely cold (fig. 5).

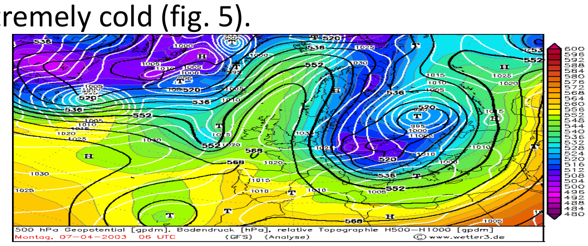

Fig. 5 The synoptic conditions at ground level and in altitude at the level of 500 hPa overlaid on the relative baric topography TR500/1000 on 07.04.2003 at 06 UTC.
(after http://www.wetter3.de/Archiv/)

[3] The analysis of temperature chart at the 850 hPa level is important because there is a natural correlation between air temperature values at this level and those from 2 m above ground, constituting a good indication of values which are recorded in the thermometric cover at 2m from the terrestrial surface.

Vol. 1 , No. 1, 2014, E-ISSN: 2313-769X © 2014 KWP

The Azores High was extended towards the coasts of Great Britain (with the centre value of over 1030 hPa), while across the Mediterranean Sea was present a brand new Mediterranean Cyclone (centre values of 1000 hPa) formed in the occlusion stage of the anterior one which moved towards north.

In altitude at the 500 hPa level the nucleus of low geopotential shifted towards south-east, leading to an increase of the geopotential and as a consequence the centre values now measured little under 520 damgp. The atmospheric obstruction over Western Europe relocated slightly to the east, its isohypse of 552 damgp was now positioned over half of the Scandinavian Peninsula passing over from north to south. The northern descent of the cold air advection was now more accentuated than in the previous day.

This positioning of baric centres at soil level and in altitude constitutes a veritable mechanism of fast advection of extremely cold air from Scandinavian Peninsula towards Central and Eastern Europe.

The thermal field examination at the 850 hPa level on the date of 07.IV.2003 at 06 UTC, shows an intense advection of exceptionally cold air within the inferior troposphere, the isotherm of -10°C was now situated across north-western Romania and above the northern half of Balkan Peninsula presenting two lobi as a result of the blocking orographic effect of Southern and Inner eastern Carpathians. Above Central Europe it is observed the isotherm of -14°C (fig. 6).

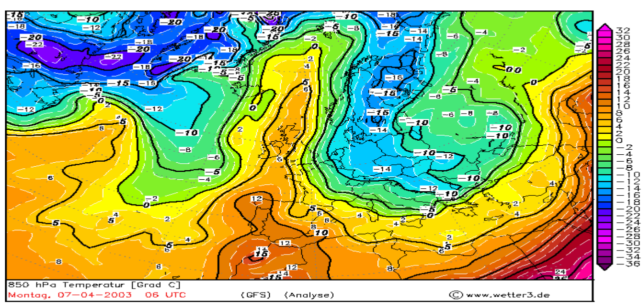

Fig. 6 Thermal field at 850 hPa level (circa 1500 m altitude) on 7.04.2003 at 06 UTC.
(after http://www.wetter3.de/Archiv/)

As a consequence of this intense weather cooling event the powerful frosts and the negative temperatures, both at night and in the morning, were recorded on three consecutive days (on 07, 08 and 09.IV.2003), in the mountain regions snow blizzard occurred and a snow layer formed which measured a thickness of 18 cm on the date of 07 and 33 cm of 08 and 09.IV, but disappearing through the melting process on the date of 13.IV. (table nr. 2) .

Tab. no. 2 – Temperature values (°C), phenomena and snow layer (cm, discontinuous=dis.) in Oltenia recorded within the 07-09.IV.2003 interval.

Date	07.IV.2003		08.IV.2003		09.IV.2003			
Weather Station	Tmin	Tmax	Tmin	Tmax	Tmin	Tmax	Phenomena	Snow layer
Craiova	-3.9	3.2	-3.8	7.9	-1.5	12.6	Dim snowfall and Frost	<0.5
Baileşti	-2.6	4.6	-1.1	7.7	-2.5	14.4	Frost	
Bechet	-1.2	3.2	-1.4	8.2	-1.9	14.3	Frost	
Calafat	-1.2	5.7	0.0	7.9	-1.2	14.5	Frost	
Tg. Jiu	-6.2	5.6	-3.6	7.1	-7.2	11.9	Frost	
Apa Neagra	-7.2	5.4	-5.8	6.2	+6	11.6	Frost	
Polovragi	0.0	3.0	-	3.6	-	3.6	Frost	
Tg. Logreşti	-8.6	4.4	-7.4	5.8	-7.1	11.2	Frost	
Dr. Tr. Severin	-3.0	5.5	+0.6	6.6	+2.1	13.2	Frost	
Halânga	-6.0	6.0	-2.8	7.2	-4.9	13.3	Frost	
Bâcleş	-7.8	3.4	-4.4	6.4	-4	11.7	Frost	
Slatina	-4.2	3.7	-3.4	7.4	-2.3	12.1	Frost	
Caracal	-3.0	3.5	-2.7	7.5	-2.1	12.4	Dim snowfall and Frost	
Rm. Vâlcea	-5.2	4.8	-3.3	7.2	-5.2	11.2	Frost	
Dragaşani	-4.0	4.2	-4.2	7.0	-2.3	11.1	Frost	
Voineasa	-7.2	1.6	-4.0	-3.8	-4.6	8.3	Frost	
Ob. Lotrului	-	-	-	-	-10.6	0.2	Snowfall	60
Petroşani	-9.2	1.6	-3.4	0.4	-8.8	6.4	Snowfall	dis, 17, 7
Parâng	-12.9	-7.2	-11.5	-6.6	-13.1	-1.9	Snowfall and blizzard	18, 33, 33

Processed data CMR Oltenia

Within the Subcarpathian area and the eastern region, the weather cooling and frosts began from de 06.IV. and continued up until 10.IV.

Hoarfrost occurred across the whole region, freezing in the air and at ground level on extended areas, leading to massive devastating effects. These events of climatic risk took place in the course of 5 days, and only three consecutive days for the entire region Oltenia. In the second half of March 2003 the thermal maxima ranged from values of 20.0°C and even over 20°C, while the first days of April the thermal maxima reached and easily exceeded 21.0°C. As a consequence, the vegetation carpet and agricultural crops had already begun to develop.

The weather approached the thermal standard beginning with the date of 12.IV. The expansion of cold air and negative temperatures during the morning of 07.IV.2003 was so large that only with the exception of Iberian Peninsula the whole continent was covered (fig. 7).

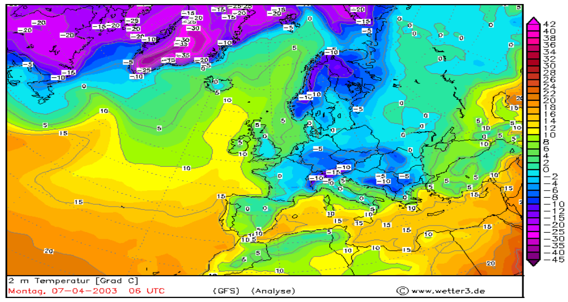

Fig. 7 The air temperature chart above Europe, at a height of 2 m, at 06 UTC on the date of 07.IV.2003.

(after http://www.wetter3.de/Archiv/)

Conclusions

In April the climatic variability rose significantly, compared with the last century, and this increase is a consequence of the global warming phenomena.

Oltenia was amongst the hottest areas of the country and the frequency of warm winters amplified due to the early arrival of spring, which in turn has become more common. Under these circumstances, the vegetation development of crop plants and of the vegetation carpet starts early on from the winter months, more regularly from February.

Consequently, the late weather cooling sometimes associated with snowfalls and recurrent frosts produce important damages.

These constitute a climatic risk with enormous destructive potential.

The most powerful cooling events occur as a result of the formation of some atmospheric circulation blockage, which determines the advection of cold air from the northern continent towards Central and de South-Eastern Europe.

The emergence of this type of circulation is favoured by the presence of Gulf Stream in the North Atlantic which aids the extension towards north, over Western Europe a warm front of Azores High and the development of an anticyclone centre in North Atlantic. As a result an atmospheric obstruction arises, while on the backside of the blockage an advection of extremely cold air (cPk) is produced over Central Eastern and South-Eastern Europe.

As a result of the above analysed point, we conclude that one of the important effects of global warming is the increase of climatic variability and outperforming thermal extremities (both minims and maxims) for every season (Marinica I., 2003, 2006; Bogdan O. et all 2007, 2010).

April recorded the absolute thermal maxima for the entire country, in Oltenia (10.IV.1985), while the most intense cooling in the country's south-western parts was recorded on 07.IV.2003.

The spring arrival in 2003 was late not only because of this late lasting cooling but also because of the cold February 2003, even though March 2003 was warmer than average.

The environment coefficient of spring arrival in Oltenia was of 171.1°C with a deviation of -33.1% from the average, while the sum percentage contribution of daily positive temperatures average from March measured on average a 65.6%, of the first 10 days of April was of 33.5% and of February of only 1.6%.

Vol. 1 , No. 1, 2014, E-ISSN: 2313-769X © 2014 KWP

References

Marinica, I. (2003), Fenomene meteorologice extreme în Oltenia, Editura MJM, *Craiova.*

Marinica, I. (2006), Fenomene climatice de risc în Oltenia, Editura Autograf MJM, Craiova

Bogdan, O., Marinica, I. (2007), Hazarde meteo-climatice din zona temperata geneza and vulnerabilitate cu aplicaţii la România, *Editura Universitaţii Lucian Blaga Sibiu.*

Bogdan, O., Marinica, I., Floriana, M. A. (2010). *Indexes of Spring arrival beetwin 2000 and 2010*, Abstract Book of the 1st Romanian-Bulgarian-Hungarian-Serbian Conference. *Geographical Research and Cross – Border Cooperation within the Lower Basin of the Danube, organized by University of Craiova, West University from Timisoara $ Institute of Geography, Bucaharest, Craiova Septembe*r, 23-26, 2010. Editura Beladi, pag 25.