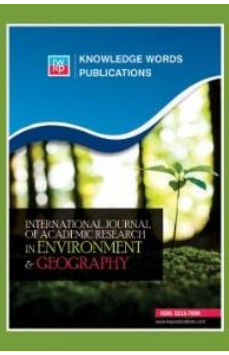

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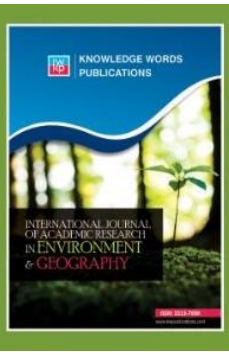

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Considerations upon the Air Temperature Characteristics in Oltenia in December

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Abstract

The study analyzes the temperature regime on December in the south-western Romania, emphasizing the significant variations in the air temperature. Typically, this month begins with a cooling in the first days, but generally, within the 10 – 15 days, it retains the characteristics of November. In some years, the cooling is followed by a late heat wave, while the last important cooling in December occurs within December 30th – December 31st. For all the meteorological stations, the trend of the air temperature variation is decreasing, emphasizing the natural climate cooling due to the coldest month of winter - January. The climate warming is determined by the fact that, after 1997, there were not recorded monthly minimum temperatures < -26.0 °C and the frequency of the maximum values ≥ 20.0 °C and also the temperature during the warm periods of this month increased. The frequency and intensity intervals with snow expansion decreased considerably and their duration has become insignificant. In Oltenia, the absolute maximum air temperature in December is 21.6 °C, being recorded in the Subcarpathians, at Polovragi, on December 4th, 1985, exceeding after 82 years, the old absolute maximum of 21.5 °C recorded in 1903 at Corabia in the extreme south-eastern. For Oltenia, the absolute minimum air temperature of -28.5 °C was recorded 68 years ago, at the interference area of the Piedmont Plateau with the high Balaciţa Plain, at Strehaia (in the Mehedinti County) on December 15th, 1948. For all the meteorological stations, the absolute minimum temperatures recorded before 1950, were not exceeded, these climate records remaining so far. The study is useful to everyone interested in the evolution of the air temperature on December.

Keywords: Cold Waves, Absolute Minimum Temperatures, Absolute Maximum Temperatures, Winter Heat Waves.

Introduction

December is the first month of winter and in most years, in its first half, the weather is warm enough, with maximum and slightly negative minimum and positive temperatures in some mornings. In December, one can see a wide range of climatic phenomena, such as: drizzles, heavy snowfalls and blizzards.

The monthly average temperatures are between -1.9 °C at Voineasa and 1.4 °C at Dr. Tr. Severin. High average values (≥ 1.0 °C) were recorded in the west and south-west (1.0 ° C at Calafat, 1.4 ° C at Dr. Tr. Severin). In the southern half of the Olt County, at Caracal, the cold continental influences can be felt, that is why the monthly average is -0.1 °C. In the large Olt Valley, there are frequent intrusions of warm air from the north, from the Transylvanian Basin, and therefore the average temperatures are higher: 0.3 °C at Slatina, 0.6 °C at Dragaşani and 0.5 °C at Rm. Valcea (much higher than those at Craiova, Baileşti and Bechet). The ‚fohn' descendants of cold air from the northern mountain ranges determine the low average temperatures at Gorj and at the east of Vâlcea County untill the Balaciţa Plateau: 0.1 °C at Polovragi, Tg. Logreşti, Apa Neagra, Tg. Jiu and -0.4 °C at Bâcleş.

The monthly average temperature for the entire region is -0.1 °C, registering a decrease of 5.0 °C comparing to November (Tabel no.1)

The absolute monthly maximum temperature in December, for Oltenia, is 21.6 °C, recorded at Polovragi on December 4th, 1985, exceeding after 82 years, the old absolute maximum of 21.5 °C, recorded in 1903 at Corabia in the extreme south-east, while in the mountain area, it was 15.0 °C at Parâng, recorded in 1942. Values ≥ 20.0 °C were also registered at Bechet: 20.0 °C on December 28th, 2000, Calafat: 20.5 °C in 1915, Slatina: 20.7 °C in 1898 and 21.2 °C on December 18th, 1989 and 20.5 °C in 1957, Tg Jiu: 20.0 °C on December 5th, 1986. The monthly maxima of temperature are usually recorded in the first decade of December and sometimes in the second one.

Table no. 1 – The multiannual monthly averages (Tm = average calculated for the period 1901-1990), absolute maximum temperature (Tmax) and absolute minimum temperature (Tmin) recorded in December at Oltenia during 1894 – 2012 (°C), (Hm = the altitude of the meteorological station, Δ = XI-XII, decrease of the monthly average temperature from November to December).

the meteorological station	**H_m**	**Tm**	**Δ=XI-XII**	**Tmax**		**Tmin**	
				°C	**year/day**	**°C**	**year/day**
Dr. Tr. Severin	77	**1.4**	-5	21.4	1989/18	-22.0	1931/x; 1933/x
Calafat	66	1.0	-5	21.2	1989/18	-21.8	1948/x
Bechet	65	0.4	-5.2	20.5	1957/x	-22.4	1997/18
Băileşti	56	0.4	-5.1	20.1	2011/5	-20.5	1997/18
Caracal	112	-0.1	***-5.6***	18.9	1915/x	-26.0	1902/x
Craiova	190	0.1	-5.4	19.5	1915/x	-26.0	1906/x
Slatina	165	0.3	-5.3	20.7	1898/x	-27.0	1941/x
Bâcleş	309	-0.4	-5.2	18.4	1986/5	***-19.0***	1997/19
Tg. Logreşti	262	0.1	-4.7	19.2	1985/4	-22.4	2002/21
Dragaşani	280	0.6	-5	19.3	1915/x	-26.6	1941/x
Apa Neagra	250	0.1	-4.7	19.8	1989/18	-25.0	2014/30
Tg. Jiu	210	0.1	-5	20.0	1986/5	**-26.9**	1940/x
Polovragi	546	0.1	-4.7	**21.6**	1985/4	-21.6	1997/18
Rm. Vâlcea	243	0.5	-4.7	18.3	1930/x	-23.2	1948/x
Voineasa	**587**	***-1.9***	**-4.1**	***14.6***	1985/6	-19.7	1953/x
Parâng	1585	-3.7	**-4.1**	15.0	1942/x	-22.6	1941/x
the multiannual averages Oltenia		**-0.1**	**-5.0**	**19.3**		**-23.6**	
Corabia*	43	-		21.5	1903/x	-23.5	1902/x
Braniştea*	83	-		-	-	-	-
Aninoasa*	161	-		17.3	1953/x	-26.0	1948/x
Strehaia*	140	-		18.4	1953/x	**-28.5**	1948/**15**
Studina*	90	-		21.3	1903/x	-26.0	1948/x
Baia de Arama*	360	-		18.0	1915/x	-25.0	1898/x
Novaci*	680	-		17.5	1953/x	-	-

Source: processed data from CMR Oltenia

The absolute monthly minimum temperature in December is -28.5 °C, being recorded 68 years ago at the interference between the Getic Plateau and the high Balaciţa Plain (Mehedinți

County) on December 15th, 1948[1] at Strehaia and in the mountain area -22.6 °C at Parâng, in 1941. For all the meteorological stations, the absolute minimum temperatures recorded before 1950 were not exceeded, these remaining climate records so far. Minimum temperatures under -25.0 °C were also registered: -27.0 °C at Slatina in 1941, -26.0 °C at Caracal and Studina in 1902, -26.0 °C at Anina in 1948, -26.0 °C at Craiova in 1906. Usually, the monthly minimum temperatures are recorded in the last decade or last pentad of the month, but there were years when they were registered even in the first decade.

Results and Discussion

The absolute monthly air temperature for the entire region Oltenia, in December is 54.9 °C, 5.7 °C higher than in November, being the second value in the calendar year after the one in January.

December is the first month of the year when the monthly maximum temperatures in Oltenia fall below 25 °C and the first month of the cold season when daily minimum temperatures fall below -28.0 °C[2].

The decreases of the monthly average temperature in December, compared to the last month of autumn, are between -4.1 °C to -5.6 °C at Voineasa and Parâng and -5.6 °C at Caracal, while the decrease of the general monthly average is of -5.0 °C, being the third largest decrease of temperature after that from October to September and November to October (Table no. 1). The decrease of the average temperature for the entire region also continues in January with a difference of -2.7 °C (Tm. January – Tm. December), then starting February, the monthly averages begin to increase.

Over the last 50 years, many of the monthly minimum temperatures at the meteorological stations, as well as the maximum monthly temperatures, were recorded after 1990, although the phenomena related to the global warming climate: hot summers and waves of intense heat, warm winters, winter floods etc. were intense, thus, allowing us to conclude that *the increase of the minimum and maximum extreme temperatures is another characteristic of the global warming.*

Among the excessive warm months of December, when the air temperature has reached or exceeded 20.0 °C in Oltenia, we can mention the ones in 1903, 1915, 1957, 1985, 1986, 1989, 2000, 2011, 2014 and 2015. A special mention is made for December 2015, being a very hot month for the entire region of Oltenia, where although there werent recorded maximum for the monthly absolute temperatures, the average temperatures had a ≥ 5.0 °C deviation from the annual average, for 68.8 % of the meteorological sations in Oltenia while the general average for the region is 4.9 °C, exceeding 5.0 °C the annual average. These allow us to consider that *December 2015 was the warmest of all the period of meteorological observations*. Thus, the translation from the autumn season to the winter was confirmed, (Bogdan et al., 2014).

[1] The date of January 15th is identified after the date of the coldest air advection at the 850 hPa level, after the maps made the European Center.

[2] ***For Romania, the monthly absolute minimum temperature is -34.5 ° C in December registered on December 25th, 1998 at Întorsura Buzăului, while the absolute maximum temperature in December, for the whole country*** is 23.4 ° C, recorded at Câmpina on December 5th, 1985 (a bridge between the Subcarpathians and the Romanian plain, a valley sheltered from the strong winds in the plain). The meteorological stations marked with an asterisk (*) are part of the old meteorological network, which operated before 1960.

This very hot month has confirmed, at regional level, the global climate record of 2015, which was mentioned by the British Meteorological Institute and which announced on *November 9th,* 2015[3] *that in 2015, the global average air temperature will be by 1.0 °C higher than in the preindustrial era*, (AFP). Based on the data recorded between January and September, the HadCRUT program, managed together with Met Office and Climatic Research Unit of the University of East Anglia show that "the global average temperature in 2015 will be 1.02 °C above the one in the preindustrial era" (1850 – 1900). The agreement reached by countries at COP21 (November 30th – December 11th, 2015) should lead to limiting the global temperature increase to 2.0 °C comparing to the pre-industrial temperature. "We saw a strong El Nino phenomenon developed in the Pacific Ocean this year, which will have an impact on the global temperatures," said Stephen Belcher, Director of the Met Office Hadley Center. "We also had the past similar events, but it is the first time we reach the threshold of 1.0 °C and it is obvious that the present human influence on climate leads to an unknown territory" (http://www.agerpres.ro/mediu/2015/11/10/ 0). The number of warm December months exceeds that of cold December months, thus, confirming the climate warming.

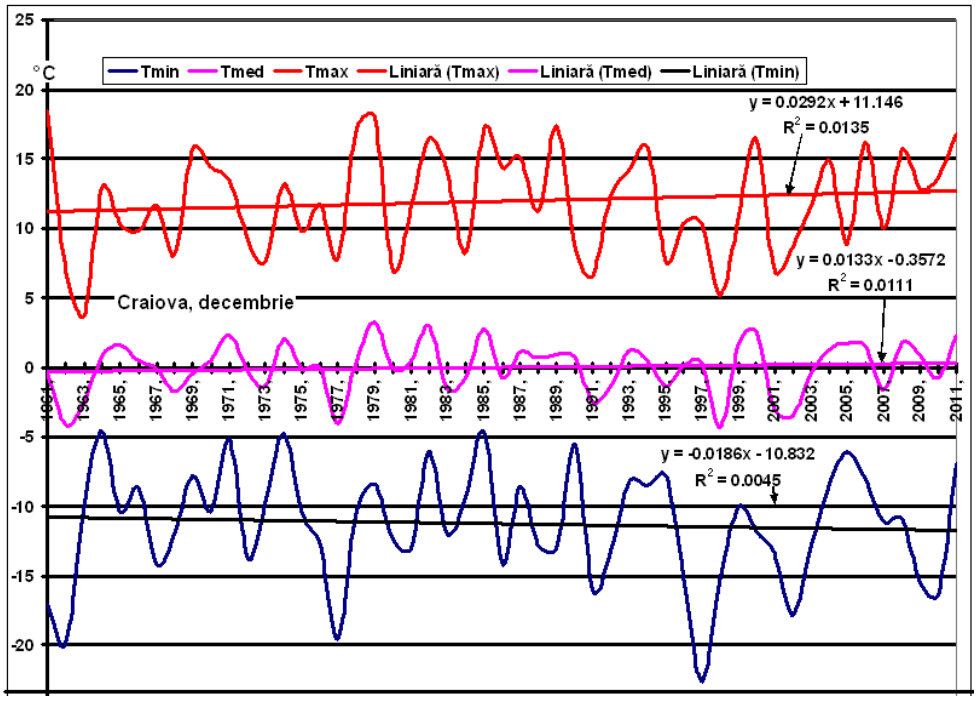
Among *the excessive cold months of December when the air temperature was ≤ -20.0 °C*, in Oltenia (even ≤ -30.0 °C at some stations in the hills and the Sub-Carpathians), we mention the ones in 1898, 1902, 1906, 1931, 1933 1940, 1941, 1948, 1962, 1977, 1986, 1996, 1997, 2001 and 2002.

The air temperature variation graphics in December (the minimum monthly temperature, the monthly average temperature and maximum monthly temperature) for the period 1961 – 2012 indicate a linear trend of slight increase for almost all the meteorological stations in all the relief levels.

We illustrate with the air temperature variation in December at Craiova (Figure no. 1).

The maximum monthly temperatures had the fastest and highest growth (with a slope 0.0292 ≈ 0.03), the monthly average temperature (with a slope 0.0133 ≈ 0.01), which confirms the trend of climate warming in this month. An exception to this station are the minimum monthly temperatures with slightly decreasing slopes (with a slope -0.0186 ≈ -0.02). In some years, the intense cooling of weather starts from the first decade of May, but the frequency of such situations tends to obviously decrease after 1978.

[3] One month before the Climate Conference in Paris (COP21)



Source: processed data

Figure 1. Air temperature variation in December at Craiova, during 1961-2012.

Further, we will analyze the synoptic causes of the most intense and earliest cold wave of December recorded between December 14th – December 17th, 1948, with a maximum intensity air cooling in Oltenia in the morning of December 15th, 1948, during which it was recorded the absolute minimum temperature of December: -28.5 °C December at Strehaia.

The synoptic situation analysis of the land surface at 06 o'clock UTC, on December 15th, 1948.

The synoptic context at the earth surface where it was produced the maximum intensity of air cooling in Oltenia (determined by this intense cold wave) was as follows: on December 15th, 1948 at 06 hours UTC (08 OIR), the half of the north-western Europe was under the influence of the large Iceland Cyclone, centered east of Iceland, with values below 985 hPa in the center. Most of Europe was under the influence of the large anticyclone belt formed between the Azores Anticyclone, with values of more than 1025 hPa at the center and the Eastern European one, with very well developed values at the center of more than 1045 hPa, centered over the Russian Plain and united towards east with the Russian-Siberian one. The dorsal of the East European Anticyclone was extended towards west (105 hPa level curve - Figure no. 2) over Italy and the Mediteranean to North Africa. As a result, the distribution of this pressure field (and in conjunction with the distribution of the geopotential field at 850 hPa level - Figure no. 3) in the lower troposphere, the air circulation was north-eastern sending a particularly cold air mass towards Oltenia. The night was clear, lasting 15 hours, which determined the continuation and improvement of the air cooling in the Oltenia Plain.

In altitude, at 500 hPa geopotential surface level, most of continental Europe was under the influence of a high geopotential field, while the atmospheric circulation was a jam (the letter ,,Ω,, shape of the 560 damgp level curve - Figure no. 2).

As a result of this type of movement under the Coriolis force, the geopotential talweg and the low geopotential core situated above the Black Sea and Romania, continued the relegation movement towards south-west, causing the continuation and even intensification of the very cold air advection over Romania.

At the 850 hPa isobaric level, the east and north-east movement was continued, while the wide extremely cold air with values below -10.0 °C (above the south-eastern Romania and western Black Sea) has the -12.0 °C isotherm placed above the south-eastern Oltenia Plain (Figure no. 3). These explain the absolute minimum of -28.5 °C at Corabia, also adding the thermic inversion effect in almost all winter, which determines the drain of the cold air on the low forms of relief and the one with higher temperatures on the higher forms of relief.

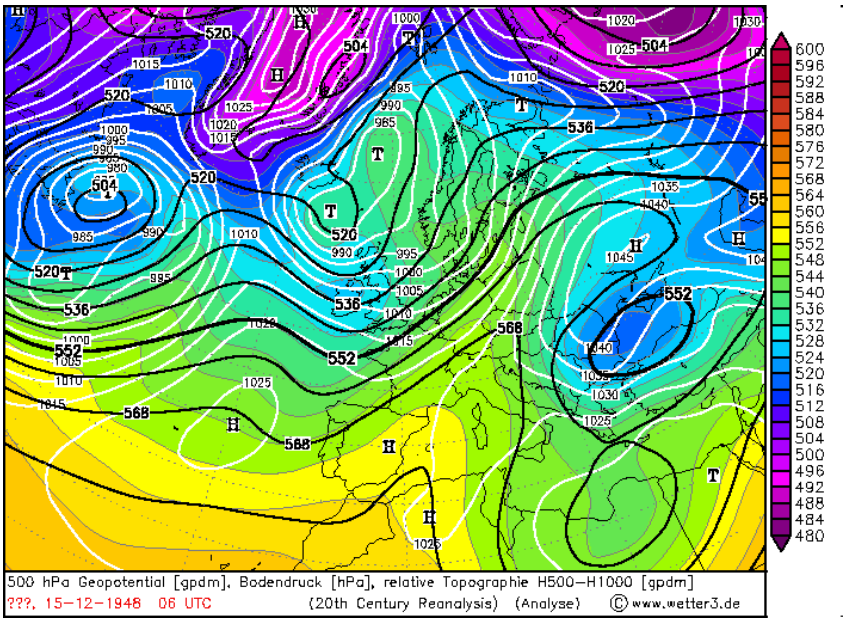


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Figure 2. The synoptic situation at the land surface, at 06 o'clock UTC on December 15th, 1948 superimposed on the geopotential field at 500 hPa level and the relative topography field (H500-H1000 TR)

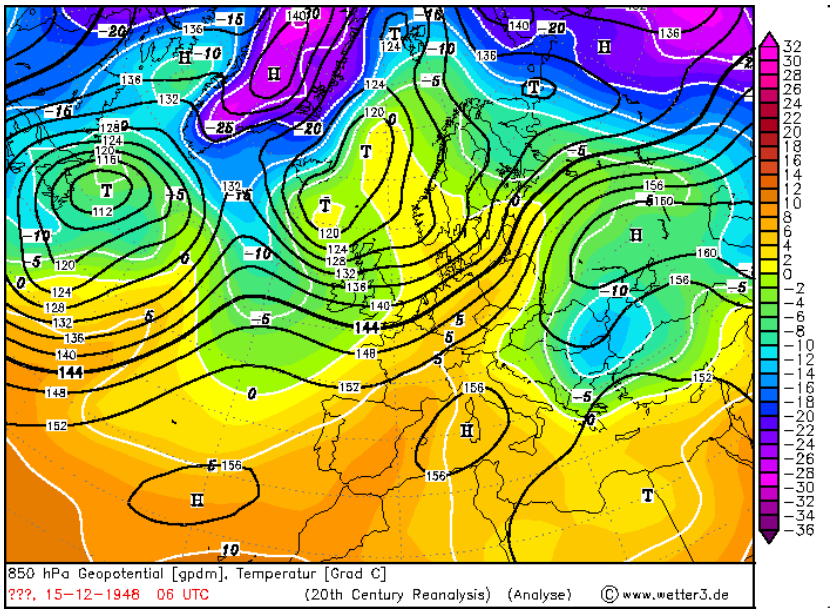

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Figure 3. The synoptic situation at the 850 hPa geopotenţial surface and the temperature field at this level on December 15th, 1948, at 06 o'clock UTC

The analysis of the sinoptic context in which the absolute maximum air temperature produced on December: 21.6 °C recorded in the Subcarpathian at Polovragi on December 4th, 1985. Between December 3rd – December 9th, 1985, a winter wave of heat affected most Europe. In Oltenia, the maximum monthly temperatures of December 1985 were recorded during December 4th - December 7th,1985. The absolute maximum temperature for Oltenia was 21.6 °C, registered at Polovragi on December 4th, 1985 (Table no. 2). The maximum temperatures recorded in this period, at Tg. Logreşti and Voineasa meteorological stations became maximum absolute temperatures up to now. Afterwards, the maximum monthly temperatures recorded in 1986, 1989 and 2011 have become climate records for the meteorological stations at Tg. Jiu, Bâcleş (1986), Dr. Tr. Severin, Apa Neagra, Calafat (1989) and Baileşti (2011), according to the Table no.1 and thus, confirming the upward trend of climate warming in Oltenia and in the first month of winter.

Table no. 2, The maximum monthly temperatures (° C) recorded at the meteorological stations in Oltenia during December 4th – December 7th, 1985. (The values from the meteorological stations marked with (*) are maximum absolute temperatures until present).

Stația meteorologica	Tmax	Data	Stația meteorologica	TMax	Data	Stația meteorologica	TMax	Data
Dr. Tr. Severin	20.3	5.XII	Craiova	17.2	5.XII	Polovragi*	21.6	4.XII
Calafat	19.7	5.XII	Slatina	16.6	5.XII	Rm. Vâlcea	17.1	4.XII
Bechet	18.6	4.XII	Bâcleş	16.0	6.XII	Voineasa*	14.6	6.XII
Baileşti	19.7	5.XII	Tg. Logreşti*	19.2	4.XII	Parâng	13.0	5.XII
Caracal	17.0	5.XII	Apa Neagra	16.0	6.XII	Ob. Lotrului	10.5	6.XII
Dragaşani	17.0	4.XII	Tg. Jiu	15.7	7.XII	Petroșani	14.5	7.XII

Processed data from the archive of CMR Oltenia

The maximum intensity of this heat wave, for Oltenia, was registered on December 4th, 5th, 6th and 7th, 1985, while the regional climate record was registered on December 4th, 1985.

The analysis of the *synoptic situation on December 4th, 1985.*

At the Earth surface level, the northern half of Europe was under the influence of a wide field of the Icelandic Cyclone which presented two centers of low pressure: one west of the UK, with values below 1000 hPa and another one over the southern Scandinavia, with values below 995 hPa (Figure no. 4). The southern continent was dominated by a wide field made of the Azores Anticyclone (with values above 1025 hPa at the center) and the North-African one which presented a wide center over Italy and Central Mediterranean Sea with values over 1030 hPa. For Oltenia, in the lower troposphere, the air circulation was towards south and west, advecting warm air masses cT (continental tropical) from the North Africa, which determined warm and sunny days and warm nights with positive minimum temperature, sometimes close to 10.0 °C or above .

In altitude, at the isobaric surface of 500 hPa (5000 m altitude) (as shown in Figure no. 4), the north of the continent was under the influence of a low geopotential field with a wide low geopotenţial core positioned above the northern Scandinavia, with values below 512 damgp. This type of synoptic situation causes south-western atmospheric circulation called '*continental tropical circulation*' (CT) and its effect is the advection of warm air over the North Africa throughout the whole tropospheric column in the inferior troposphere (below 500 hPa until the land surface).

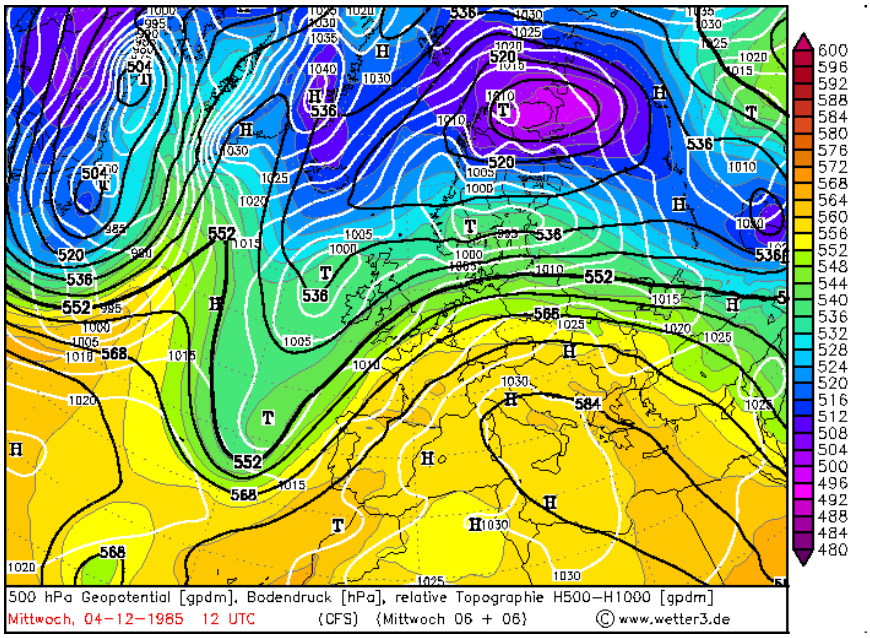

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Figure 4. The synoptic situation at the land surface on December 4th, 1985 at 12 o'clock UTC overlaid on the geopotential field at 500 hPa level and the relative topography field (H500-H1000 TR)

The occurrence of such winter circulation determines intervals with warm and sunny weather, while their great persistence is specific to warm winters. The intervals with hot

weather during winters are called *'warm windows of winter'*. These have particular benefits for the entire biosphere, determing the feeding of hive bees, of the wildlife and the vegetation phases resumption of the autumn crops and vegetation cover, in general. Their long persistence, especially when they are followed by a sudden and intense cooling weather, which capture hives disorganized, growing crops in advanced stages of vegetation (as in December 2015) etc., can determine *climatic and agro-climatic risks, extremely destructive*.

The analysis of temperature field at 850 hPa level shows the massive air advection, particularly warm, in the Northern Africa that covered almost the entire continent of Europe, extending to the south of the Scandinavian Peninsula (Figure no. 5). In the Figure no.5, it is presented a true picture of the winter heat wave, its maximum extension which affectated Europe during December 3rd – December 9th, 1985. Above Oltenia and Muntenia, at this isobaric level (at about 1500 m altitude), it can be noticed the +12.0 °C isotherm, which persisted into the following three days (December 4th, 5th, 6th, 1985), moving slowly eastward, this explaining the achievement of the high maximum temperatures in Oltenia.

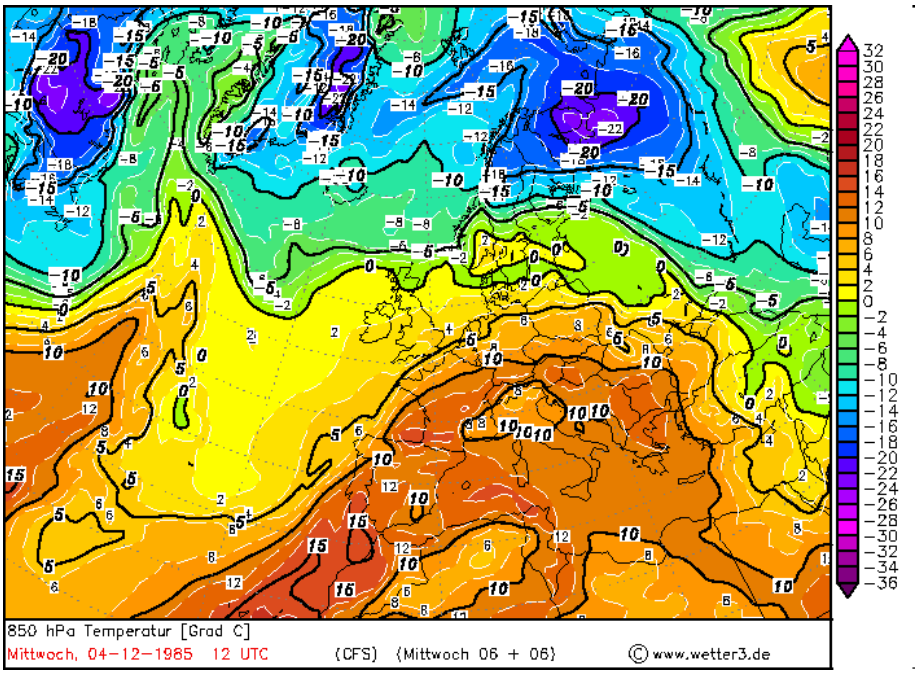

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Figure 5. The temperature field over Europe at the geopotential area of 850 hPa on December 4th, 1985 at 12 o'clock UTC

Conclusions

In Romania, the highest temperature values in December were recorded, over time, in the south-east half of the country. The aspect is related to the way of appearance and development of the heat waves, these appearing first, in the west and south-west and later, the atmospheric circulation intensifies and the heatwave is slowly moved eastward, contributing to the exposure of the warm air advection of the south-eastern regions a longer time, raising the air and soil temperature.

In addition, the extreme maximum temperature values are recorded in the high relief forms, in the relatively closed Sub-Carpathian depressions (eg. Polovragi, Câmpina etc.), where the air ventilation is reduced, while the thermic inversion and sunstroke have important effects in their implementation. The winter heat waves are usually caused by the ***tropical continental*** *circulation* that determines the advection of the extreme warm air from North Africa towards Oltenia and further on, the air circulation carries the warm air wave to the south-eastern Romania. As a result, it may be concluded that the south-west circulation determines a type of *extreme weather* in Oltenia and the south of Romania – *a warm weather with exceptional maximum temperatures*, even in winter, not only in summer.

The lowest temperature values are determined by the extreme cold air advections from the north-east of the continent which bring the cold arctic air mixture (frequently) with the cold polar continental one (A + CPK), caused by the retrograde advance of the East European Anticyclone ridge, often united with the Russian-Siberian one. Another type of circulation that causes intense weather cooling is the *northern circulation*, with a Scandinavian slope which develops at the periphery of the Scandinavian Anticyclone. Both types of circulation are often associated with the blockage circulation in the continent. The dissapearing of the blockage leads to transformation in another type of circulation and air temperature increase by changing the advection and of air mass. For Oltenia, these types of circulation determine the appearance of an *extreme weather type, opposite to the first case – a very cold weather, frosty during nights and mornings* with exceptional minimum temperatures, freezing deep soil, of water in rivers and lakes and in some years, the freezing of the Black Sea [4]. This second type of extreme weather is a *climatic risk and agro-climatic extremely dangerous,* which can cause significant economic damages, mortality among the animals and people, and even fire-housing by forcing the heating systems, which may cause fire buildings.

In conclusion, the climate of Oltenia, in December, evolute between these two extreme directions, but the climate warming has increased the number of months of warm December, of warm winters, December months often without snow, when sometimes the snowdrops, lily flowers, roses and even fruit trees flourish.

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[4] *The Old chronicles* speak about the early coming of winter and exceptional strong frosts, which were lasting almost the whole winter, and the Danube was freezing and one could pass over it with sleds, waggons or carloads. All ancient writings speak about the generalized frosts at the Black Sea, issues which, since 1900, have been reported only at low intensity, for short periods of time. All these changes are connected to the climate warming which is more obvious in winter as well.

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