TWO WINTER SYNOPTIC SITUATIONS WITH IMPORTANT DIFFERENCES OF AIR TEMPERATURE DISTRIBUTION IN THE SOUTHWESTERN PART OF ROMANIA

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ABSTRACT. Two Winter Synoptic Situations with Important Differences of Air Temperature Distribution in the Southwestern Part of Romania. The present study analyzes the differences reported between the Banat and Oltenia regions in the air temperature distribution in two synoptic periods from 2012-2013 winter, respectively from 9 to 11 of December 2012 and from 24 to 26 of December 2012. The first period was characterized by very low temperatures in Banat and values much higher in Oltenia, while during the second period, the temperatures were very high in Banat and much lower in Oltenia. Atmospheric circulation associated with orographic barrier was responsible for the differences registered between the two regions.

Keywords: temperature, winter, Southwestern Romania, orographic barrier.

1. INTRODUCTION

In terms of climate, both geographical and historical province of Southwestern Romania, Banat and Oltenia, are located, in the provincial climate with Mediterranean influences (Geografia României, I, Geografia Fizică, 1983). One of the features of Banat and Oltenia climate refers to the relatively mild winters in this part of Romania (fig. 1).

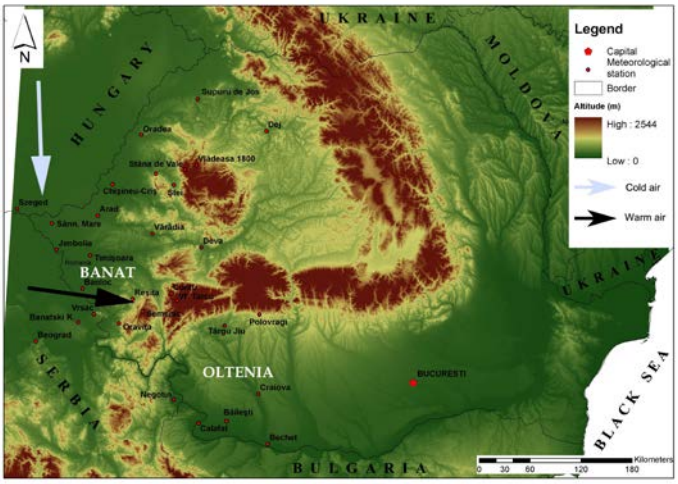

Fig. 1. ***Landscape configuration and location of weather stations in the study area***

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This paper analyzes two synoptic situations in the winter of 2012-2013 when the weather evolution, especially air temperature, was characterized by major differences between the two regions.

2. DATABASE AND METHODS

In order to follow the ground and altitude synoptic developments we have used daily and hourly mean and extreme values of air temperature from several meteorological stations in Romania and Serbia, sounding data (Belgrade and Szeged), as well as synoptic, satellite and snow cover maps (online sources). After tracking and comparison of the spatial distribution of air temperature values in Banat, Oltenia and in the mountain area, that separates the two regions, we have made a detailed synoptic analysis, both at ground and altitude levels. Daily minimum temperatures recorded at weather stations at 06 UTC were considered for the period 9 - 11 December 2012, while daily maximum temperatures at 12 UTC were considered for the period 24 - 26 December 2012. Extreme hourly values were then compared with multiannual monthly extreme temperatures recorded in weather stations in those areas (Sandu et al., 2008). A very important issue was tracking the altitude distribution, especially in the lower troposphere, of air temperature, relative humidity and wind direction and speed. All these were achieved by consulting the data transmitted by atmospheric radio-soundings observed at the closest observatories to the study area: Belgrade and Szeged.

3. RESULTS

In terms of climate, the southwestern Romania has, as main winter feature, temperatures that are among the highest in the country, with mean annual of daily maximum temperatures for December around 4°C, respectively mean annual values of daily minimum temperatures for the same month around -2 ...-3°C. Thus, over the period 9 - 11 December 2012 there have been recorded very low temperatures in Banat and much higher in Oltenia, while, from 24th to 26th of December 2012, temperatures were very high in Banat, and they have been noticeably low in Oltenia. In both periods, air temperature values were considerably below or above the average climatic values for December.

3.1. Period of 9 to 11 December 2012

In Banat region, in that interval, the air temperature was defined by unusually low values. Thus, on December, 10, the daily minimum temperature have decreased up to -22.0^{o}C at Jimbolia (90 m altitude), -21.4^{o}C at Banloc (82 m) and -17.3^{o}C at Timişoara (88 m).

Some very low values were recorded as well in the Serbian Banat region: -21.3°C at Vrsac (83 m) and -18.0°C at Banatski Karlovac (90 m). In Oltenia, the daily minimum values were much higher, up to -0.3°C at Tg. Jiu (203 m). In the mountain area, the minimum daily temperature varied between -13.4°C at Semenic (1432 m) and -15.2°C at Vf. Ţarcu (2180 m).

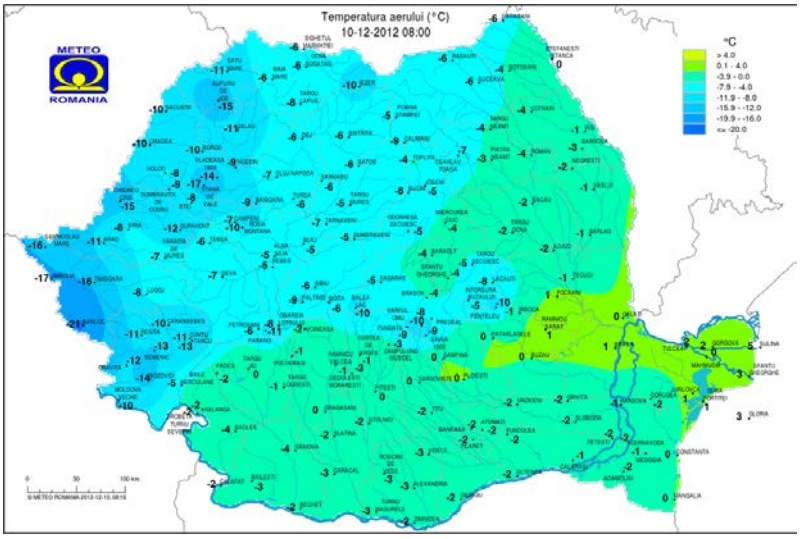

Fig. 2. ***Air temperature distribution in 10.12.2012 in Romania at 06 UTC (source: www.meteoromania.ro)***

The air temperature spatial distribution in Romania, at 06 UTC (fig. 2), indicated the same differences between Banat region, with very low values and Oltenia, with much higher values. The map revealed that, between Banloc (-21°C) and Tg. Jiu (0°C), for a straight-line distance of 175 km has been recorded a temperature difference of 21°C. Very low values have been also recorded in the entire Western Plain and Hills region, but also on the western side of Apuseni Mountains: -15°C at Chişineu Criş (96 m) and at Supuru de Jos (162 m), respectively -17 °C at Stâna de Vale (1108 m).

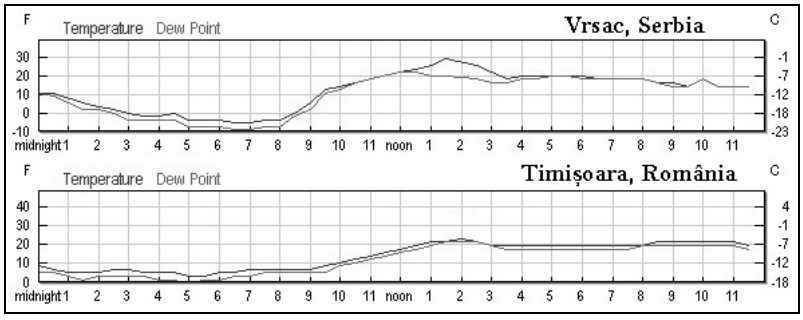

Fig. 3. ***Hourly air temperature data recorded at Vrsac and Timişoara in 10.12.2012 (source: www.wunderground.com)***

The hourly temperature values at Vrsac (station situated at 32 km SSE of Banloc) shows that the minimum value recorded on December 10, 2012 has been recorded just before 06 UTC, followed by a small increase at noon (fig. 3). At Timişoara (located 44 km East of Jimbolia), the daily minimum temperature has been recorded almost two hour earlier, according to the advance direction of cold air mass.

The lowest minimum temperatures of 10.12.2012 are much different from the

annual averages of daily minimum values of December, which are between -1...-3°C in the Western Plain and Western Hills, -2...-5°C in Oltenia and between -4 and below -10°C in the Western Carpathians and Retezat-Godeanu mountains from Southern Carpathians.

In the studied area, on December 10, 2012, on the sea level pressure map (fig. 4) one could see an advancing ridge of high pressure from the central Europe, moving from WSW to ESE, which was following after a Mediterranean cyclone that has generated heavy snowfalls for the entire Balcanic Peninsula, including Romania, between 08-09.12.2012.

Due to those snowfalls, a consistent layer of snow has been formed, with thickness values between 16-41 cm in Banat, 6-35 cm in Oltenia and 22-109 cm in the mountain area that separates the two regions. Then, above Serbian territory a small anticyclone has been developed, with a central pressure value of around 1015 hPa.

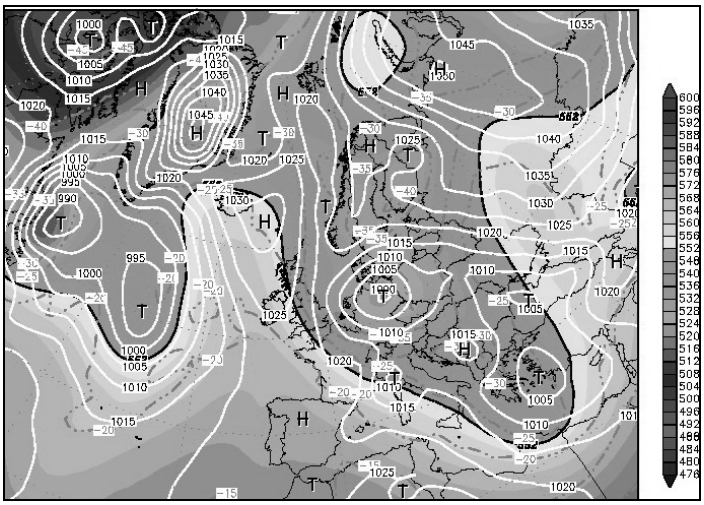

Fig. 4. ***The map of pressure field at the ground level (hPa) and of 500 hPa geopotential isobaric surface (gpdm) in 10.12.2012, at 06.00 UTC (source: www.wetterzentrale.de)***

In the higher level of the troposphere, the atmospheric circulation was mainly NW, NNW and N, with low or moderate speeds (fig. 5): 12-19 m/s at the isobaric standard pressure level of 300 hPa (8840 m), 4-10 m/s at 500 hPa (5380 m), 8-11 m/s at 850 hPa (1390 m), 8-9 m/s at 925 hPa (731 m).

One can also notice that all isobaric surfaces are much lower than their average elevation. From 300 hPa level streamline and wind speed map, is remarkable the strong meanders towards south, over Central and Southern Europe, of Polar Jetstream Current, with its peak reaching close to North Africa. The same sounding data showed that the temperatures were around -50°C at 300 hPa, -29°C at 500 hPa, -7...-9°C at 850 hPa and -4...-7°C at 925 hPa. If we refer only to the lower troposphere (0-2000 m), which also includes the atmospheric part close to the highest peaks of the mountain region in the studied area, one can notice that temperature inversion is specific at Szeged and Belgade, but it is more developed over at Szeged (up to 1000 m and between 79 and 427 m, respectively).

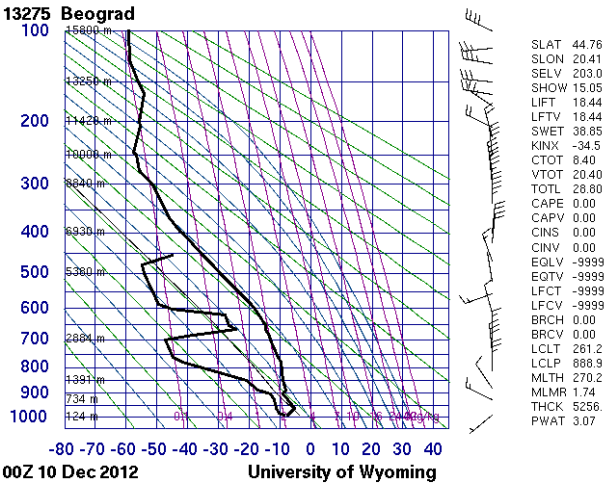

Fig. 5. ***Stüve diagram for surface-100 hPa layer according to the sounding data from Belgrade in 10.12.2012, at 00.00 UTC (source: www.weather.uwyo.edu)***

The presence of a cold and very dry air mass, which is present at 2000 m altitude, was defined by a relative humidity of only 5-7%, registered also on the sounding data from Belgrade and from Szeged.

3.1. Period of 24 to 26 December 2012

In Banat, the interval of 24-26 December 2012 was defined by very high temperatures. On December 25, the highest maximum temperatures have reached values of 19.0°C at Oraviţa (308 m) and 18.4°C at Reşiţa (279 m). Also, high maximum values have been registered in Serbian Banat: 15.3°C at Vrsac and 13.5°C at Banatski Karlovac. In addition, at least for Vrsac station, a local wind called *Košava*, was identified, with speed up to 18.2 m/s, from SSE direction. In the mountain area have been recorded 9.2°C at Semenic (1432 m), 11.0°C at Cuntu (1447 m) and 4.1°C at Vf. Ţarcu (2180 m). In the southern part of Oltenia Plain and in Danube Meadow, the daily maximum temperatures were much lower: -2.7°C at Băileşti (57 m), -2.4°C at Calafat (61 m) and -1.8°C la Bechet (36 m). The air temperature spatial distribution in Romania at 14 UTC is presented in figure 6.

Thus, between Oraviţa (19°C) and Calafat (-3°C), for a straight line distance of around 165 km has been noticed a difference in temperature of 22°C. High values were recorded onto large surfaces of Western Plain and Western Hills, situated north of Mureş River, and also in the depressions of western part of Apuseni Mountains: 10°C at Oradea (136 m) and at Chişineu Criş (96 m), 13°C at Dumbrăviţa de Codru (575 m), 15°C at Ştei (278 m).

In the mountain area the temperatures were also, much higher the normal multiannual values associated with the month of December: 9°C at Stâna de Vale (1108 m) and 3°C at Vlădeasa 1800 (1836 m), in Apuseni Mountains; 9°C at Semenic (1432 m), in Banatului Mountains; 10°C at Cuntu (1447 m) and 3°C at Vf. Ţarcu (2180 m), in Ţarcului Mountains.

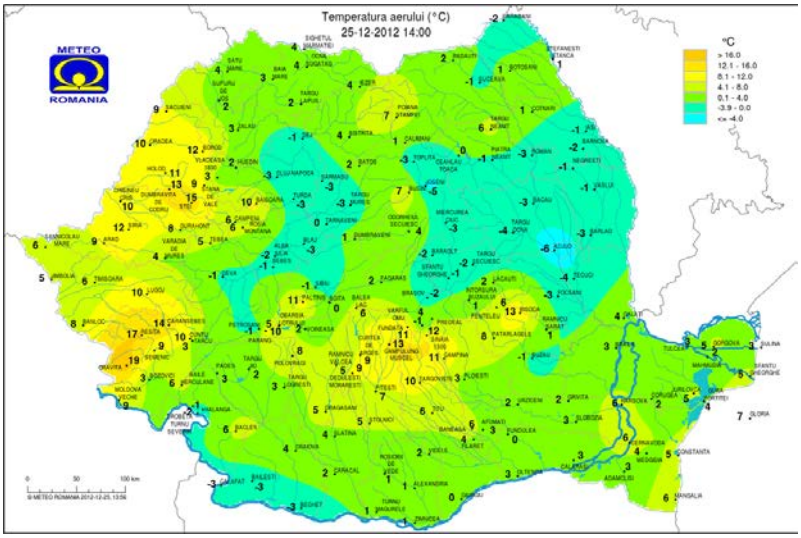

Fig. 6. ***Air temperature spatial distribution in 25.12.2012, at 12.00 UTC (source: www.meteoromania.ro)***

In the lower southern part of Oltenia, the thermic values have dropped up to -3°C, while in the Oltenian Sub-Carpathians, at Polovragi (531 m), have reached 8°C.

The highest recorded values on December 25 are much different from the annual mean averages of daily maximum temperatures of December, which usually are between 2 ... 4°C in Western Plain, Western Hills and Oltenia, respectively between -4 and 2°C in the Western Carpathians and in the Retezat-Godeanu group from Southern Carpathians. On December 25, on the ground level, over most of Europe (except its northwestern and western regions) an anticyclone field was present, with the center focused on the central part of Mediterranean Sea (1025 hPa) and another localized over the Russian Plain (1035 hPa). In the studied area the atmospheric pressure was around 1018 hPa (fig. 7).

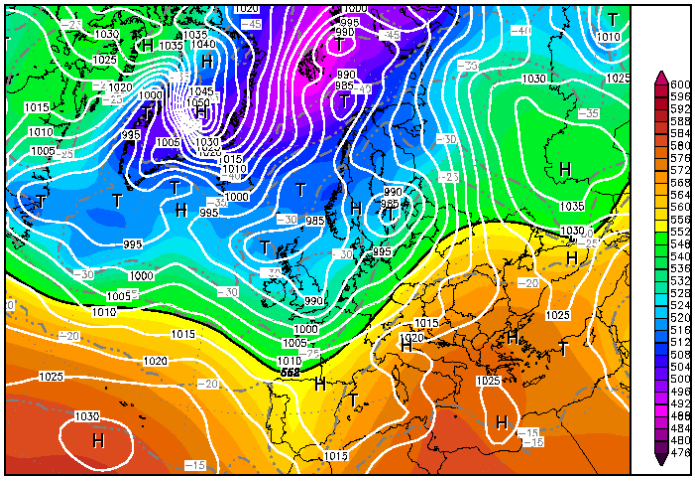

Fig. 7. ***The map of pressure field at the ground level (hPa) and of 500 hPa geopotential isobaric surface (dmgp) in 25.12.2012, at 12.00 UTC (source: www.wetterzentrale.de)***

A special situation was associated to the night of December 24/25, when the studied area was crossed from West to East, by a warm atmospheric front. The snow cover was quite thin in the lower areas from Banat (1-4 cm), but more consistent in the mountains (85 cm at Semenic) and in Oltenia (up to 11 cm). In the altitude, both on the 500 hPa (5720 m) and on the 850 hPa (1513 m) geopotential surface a warm ridge of high pressure, originated in northern Africa. It extended over the Italian and Balcanic peninsulas, and over the most part of Central Europe.

The sounding data from Belgrade indicate that a thermal inversion was developed between 270 and 540 m on December 25, at 12 UTC. Much higher, in the altitude, the temperature was still high up to 4000 m (-5.3°C). The atmospheric circulation for the entire of the troposphere, except the first 600 m above ground, was from the western sector, and the speed varied between 15 and 20 m/s (fig. 8). One can notice the low relative air humidity, with values mostly under 30 % up to 8500 m in altitude.

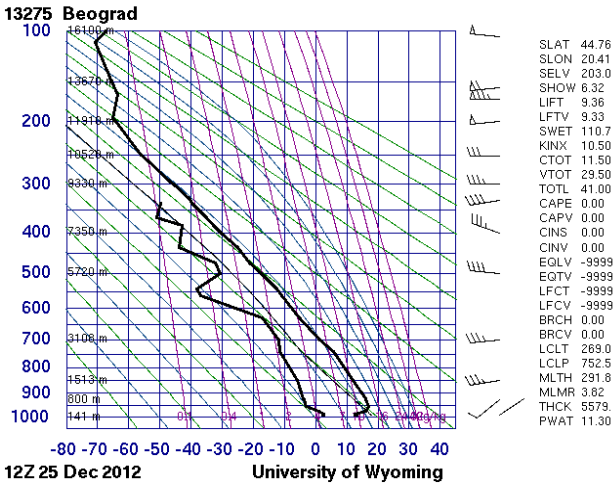

Fig. 8. ***Stüve diagram for ground-100 hPa layer according to the radio-sounding from Belgrade in 25.12.2012, at 12 UTC (source: www.weather.uwyo.edu)***

4. CONCLUSIONS

In the paper two synoptic situations during the 2012-2013 winter season were analyzed, in order to explain the very strong thermal differences between two contiguous regions from SW Romania, respectively Banat and Oltenia. Thus, temperature differences of 21 - 22°C were recorded for a straight line distances of about 165-175 km.

Also, the absolute temperature amplitudes of December 2012, for several meteorological stations from Banat have exceeded 30°C: 32.4°C at Banloc, 31.5°C at Oraviţa, 30.8°C at Jimbolia and 30.7°C at Reşiţa. If we consider the region of Banat as a whole, the absolute monthly thermic amplitude was of 41.0°C: -22.0°C at Jimbolia (December 10) and 19.0°C at Oraviţa (December 25).

The weather situation on December 9-11 2012, with very low temperatures in Banat and Crişana, and with high temperatures in Oltenia is quite rare. Over the central and eastern sector of Pannonian Depression is noticed the penetration of very cold and dry arctic air from NNW, on a track parallel to the mountain range from western Romania (Apuseni, Poiana Ruscă, Banatului and Ţarcului Mountains). An interesting issue is that the cold air mass hasn't occupied the Transylvanian Depression, through the two classical tracks: Someşului Gate and Mureşului Valley. The higher temperatures from the mentioned corridors prove it: -6°C at Dej (232 m), -7°C at Vărădia (156 m) and Deva (231 m). Therefore, the cold air has "leaked" along the western border of Western Carpathians, which, together with the NW sector of Retezat-Godeanu mountain group, had a barrier role for the very cold air, which came from northern Europe (fig. 1). The very strong cooling process was favored also by the thick snow cover, recently fallen, having a consistent thickness.

The weather situation of December 24-26, with strong heating process in Banat (19,0^{o}C at Oraviţa in 25.12.2012), is more common than the previous one. However, these situations are still unusually, with low temperatures in southern part of Oltenia (around -3^{o}C at Băileşti and Calafat). In this case, the orographic obstacle, represented by the Banatului Mountains and Retezat-Godeanu Mountains forced the warm tropical air mass from West to overcome this obstacle, passing over the cold air from the lower areas of Oltenia and Muntenia (fig. 1). Despite, the exceptional warming process from the middle of the last decade of December 2012, the average monthly air temperature values in the whole studied area showed negative deviations from the mean climatic data. The deviation values were between 0 and -1.5°C in Banat and between -0.5 and over -3.0°C in Oltenia. The largest negative deviations have been recorded in western part of Banat and in the southern part of Oltenia.

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