ATMOSPHERIC PRESSURE PATTERNS IN THE VAD-BOROD DEPRESSION

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Abstract
The analysis of the periodic and nonperiodic variations of air pressure was performed using meteorological data recorded at the Borod weather station, between 2000 and 2014. The processing, analysis and interpretation of air pressure data has shown great changes in the values of this climatic parameter over the years, as well as the role played in its evolution by atmospheric dynamics.

Key words: atmospheric pressure, atmospheric pressure distribution, maximum and minimum pressure.

INTRODUCTION

Understanding atmospheric pressure patterns and distribution is important because it helps explain general and local atmospheric circulation genesis, which is also important for the population's health status, for bioclimatology, for weather forecasts etc.

Atmospheric pressure does not have a constant value, it shows periodic and nonperiodic variations. Periodic variations represent the key factor in weather forecasting. They result from turbulent air flows, as well as from heating and cooling processes in the troposphere. The nonperiodic variations of air pressure are of thermal and dynamic nature, thus they can occur overnight depending on how thermal changes occur or baric systems move (Măhăra, 2001; Gaceu, 2002, 2005; Moza, 2009; Pereş, 2012; Dumiter 2007).

MATERIAL AND METHODS

The study of the atmospheric pressure in the Vad-Borod depression corridor was based on data recorded at the weather station located within the corridor, in Borod, over a period of 15 years (2000-2014).

The data were obtained from the archives of the National Meteorological Administration (N.M.A.).

The analysis of atmospheric pressure patterns was based on establishing the mean values of the analyzed climatic parameter; highlighting of extreme values (the lowest and highest monthly and annual means, absolute minimum and maximum values) which represent the phenomenon's possible variation limits; deviation of the climatic parameter against the multiannual mean.

RESULTS AND DISCUSSION

Atmospheric pressure annual and multiannual means

The multiannual (2000-2014) mean value of air pressure in the Vad-Borod depression is 977.9 hPa (mb). The annual means varied from one year to another. Thus, the lowest annual mean value was 975.5 hPa, recorded in 2010, a close value was recorded in 2013, an annual mean of 976.3 hPa. The highest mean value was 980.2 hPa, recorded in 2011 (see Figure 1). The amplitude of the annual means is 4.7 hPa.

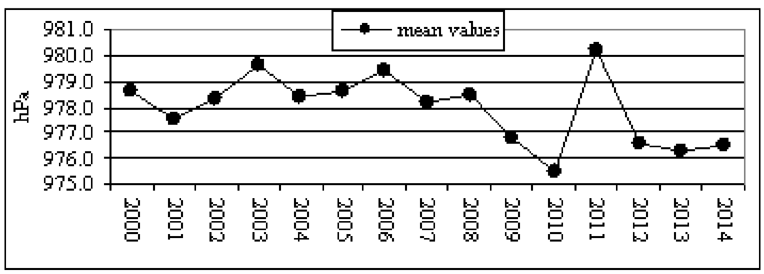
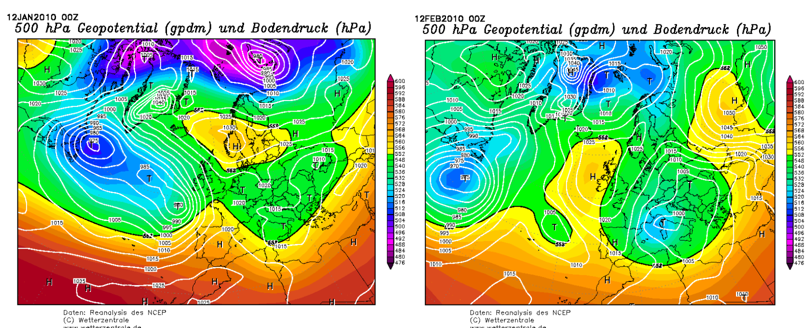


Fig. 1. Air pressure annual mean values in Borod, 2000-2014

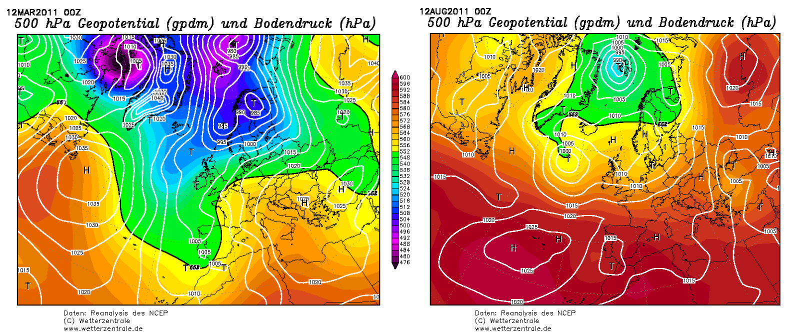
The low atmospheric pressure values recorded in 2010 and 2013 show years with intense, frequent and persistent cyclone activity, while in the years with higher atmospheric pressure values anticyclonic regimes prevailed, as it happened in 2011. In Figures 2 and 3 atmospheric pressure charts can be seen. Thus, in Figure 2, there are two atmospheric pressure charts, each for a day from the first two months of 2010, when, for the most part of the year, the atmospheric pressure over our country was low.



a. b.

Fig. 2. Atmospheric pressure and 500 hPa geopotential chart, on 12.01.2010 (a) and on 12.02.2010 (b) (source: www.wetterzentrale.de)

In Figure 3, the two charts show the atmospheric pressure for two days in 2011, one in March and the other in August. For the most part of that year there were stable air masses over our country.



a. b.

Fig. 3. Atmospheric pressure and 500 hPa geopotential chart, on 12.03.2011 (a) and on 12.08.2011 (b) (source: www.wetterzentrale.de)

The annual air pressure means show deviations from the multiannual mean. Figure 4 shows this deviation for each of the 15 years of the study. It can be see that there were more years with positive deviations, their share is 60.0%. Negative deviations were recorded in 6 years, which means a share of 40.0%. In the period of the study there was not even one year with no deviation from the multiannual mean (977.9 hPa) (see Fig. 4).

Looking at the periods with positive and negative deviations, two distinct periods, with years of consecutive positive or negative deviations from the multiannual mean, can be noticed. Thus, between 2002 and 2008, there were 7 consecutive years with positive deviations, while negative deviations occurred for 3 and 2 years, between 2012-2014 and 2009-2010 respectively (see Fig. 4).

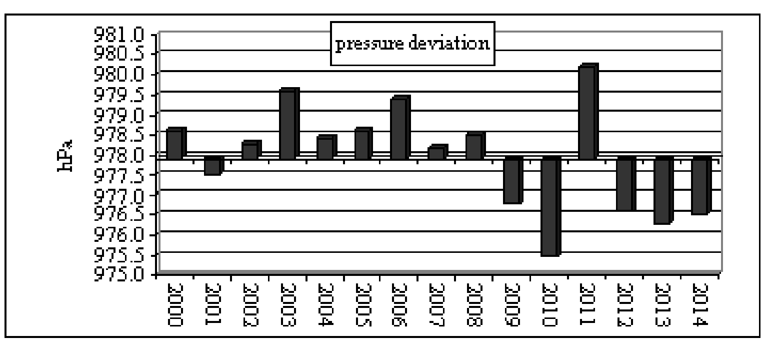


Fig. 4. Deviations of annual air pressure means from the multiannual mean in Borod, 2000-2014

The analysis of the annual mean values of atmospheric pressure shows that even though the number of positive deviations is higher than that of the negative ones, the values of negative deviations are usually higher than those of the positive ones. Thus, the highest negative deviation is -2.4 hPa, while the highest positive one is 2.3 hPa (see Table 1).

Table 1

Air pressure means, deviations and amplitude of annual means in Borod

Multiannual mean (hPa)	Highest annual mean (hPa)	Lowest annual mean (hPa)	Highest positive deviation (hPa)	Highest negative deviation (hPa)	Amplitude of annual means (hPa)
	Year	Year			
977.9	2011	2010	2.3	-2.4	4.7
	980.2	975.5			

Source of data: N.M.A. Archives

Monthly patterns of atmospheric pressure

The evolution of atmospheric pressure from one month to another is in strong correlation both with air temperature but mainly with atmospheric dynamics, that is, the distinct air pressure characteristics of air masses that reach the latitude of the area included in the study.

The multiannual monthly air pressure mean values are highest in the cold season of the year, with the highest mean values reached in October, 980.5 hPa, and December, 980.2 hPa. The high air pressure values recorded in the cold period of the year are due, on the one hand, to low air temperatures, and, on the other hand, to the high frequency of anticyclones, which bring stable, high pressure air masses over the latitudes of the area included in the study.

The lower monthly mean values occur in the warm period of the year, with the lowest mean value in April, when the air pressure recorded was 975.5 hPa (see Figure 5). The low values in April are due to the atmospheric dynamics, as in this period of the year the frequency of cyclones is higher, and the temperature is increasing after the cold months.

The monthly air pressure mean values vary little both in summer and in winter, so the amplitude of the multiannual monthly air pressure means is 5.0 hPa (see Fig. 5).

In April, the month with the lowest multiannual monthly mean, the air pressure varied between 980.5 hPa in 2007 and 969.0 hPa in 2012, which gives an amplitude of 11.5 hPa for this month.

Beginning with April, air pressure starts to increase, thus for May the multiannual monthly mean value is 976.4 hPa. The highest air pressure mean for this month was 979.8 hPa, in 2011, and the lowest 972.2 hPa, in 2010, which means an amplitude of 7.6 hPa. The amplitude for June is lower than that of May, as the highest mean was 980.5 hPa, in 2000, while the lowest mean value was 973.6 hPa, in 2010, so the amplitude is 6.9 hPa. The multiannual mean value for June is 976.9 hPa. In July, air pressure decreases. This is due to the fact that in this month the highest multiannual monthly air temperature mean is recorded (19.2ºC) (Moza Ana, 2009).

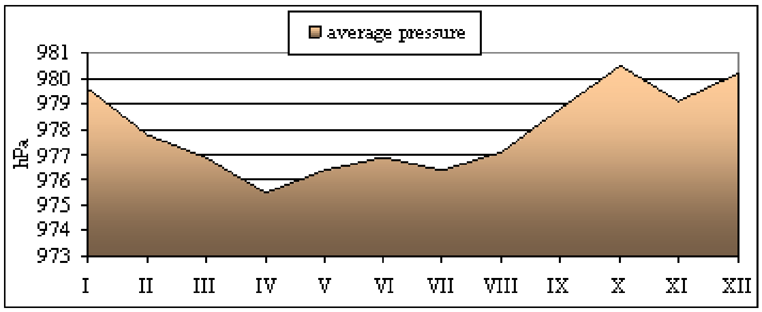


Fig. 5. Monthly evolution of atmospheric pressure in Borod, 2000-2014

Thus, in the warmest month of the year, the multiannual monthly air pressure mean value is 976.4 hPa. From one year to another the monthly mean value varied between 980.8 hPa, in 2006, and 973.6 hPa, in 2000 and 2011, which means an amplitude of 7.2 hPa. In August, there is a slight increase against the previous month, 0.7 hPa, which means a mean value of 977.1 hPa. The highest monthly mean was recorded in 2000, 979.6 hPa, and the lowest in 2006, 973.2 hPa, which results in an amplitude of 6.4 hPa. The multiannual monthly mean value for September is 978.8 hPa, with the highest monthly mean in 2004, 981.9 hPa, and the lowest air pressure mean in 2001, 974.8 hPa, so the amplitude for this month is 7.1 hPa.

In October, the air pressure mean varied from one year to another, the highest value was recorded in 2005, 985.1 hPa, and the lowest one, 976.1 hPa, in 2012, which gives an amplitude of 9 hPa for this month.

Maximum and minimum atmospheric pressure values

Comparing the extreme mean values and the absolute extreme values of the air pressure in Borod, it can be seen that the nonperiodic variations of air pressure are much higher than the periodic ones.

Over the 15 years included in the study, the absolute minimum pressure in Borod was 947.7 hPa, recorded on 17 December 2011.

The absolute maximum pressure was 1002.7 hPa, recorded on 30 December 2008 (see Table 2). This means that the amplitude of absolute values was 55 hPa. It is interesting to notice that both the absolute minimum value and the absolute maximum one were recorded in December.

The maximum air pressure values are caused by stagnating anticyclones in this area, which results in colder, more stable air masses, and in higher and higher pressure.

Looking at the monthly absolute minimum values, it can be seen that the high values were recorded in the summer months (June, July, August), thus, the highest value was recorded on 31 August 2010, the value of 965.2 hPa (see Table 2). The high values of absolute minimum pressures occur in the summer months due to the shallow vertical extent of low pressure centres in the summer season, as compared to their great extent in the cold season (Erhan, 1979).

Table 2

Absolute maximum and minimum atmospheric pressure values in Borod, 2000-2014

Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Min. Pres.	950.2	948.6	951.0	952.9	956.8	962.5	963.1	965.2	960.9	953.8	952.0	947.7	947.7
Date	24.09	05.03	24.08	05.00	16.10	01.10	05.07	31.10	06.01	27.12	22.08	17.11	17.12.11
Max. Pres.	1001.7	1002.5	995.4	991.9	989.5	989.5	986.3	988.3	991.9	995.7	997.8	1002.7	1002.7
Date	24.06	17.08	08.11	04.05	04.06	19.00	05.06	21.10	10.06	22.00	13.11	30.08	30.12.08

Source of data: N.M.A. Archives

The low values of the absolute minimum pressure occur in the winter months, with the lowest values in December, that is, a minimum air pressure of 947.7 hPa, recorded on 17 December 2011, followed by 948.6 hPa, recorded on 5 February 2003, then by January, with a value of 950.2 hPa, on 24 January 2009 (see Table 2).

Looking at the absolute maximum values of atmospheric pressure, it can be seen that the low absolute maximum values are recorded in the summer months, thus, the lowest pressure occurred on 5 July 2006, the value of 986.3 hPa, followed by August, with an air pressure value of 988.3 hPa, recorded on 21 August 2010, then by June, with a value of 989.5 hPa, on 19 June 2000 (see Table 2). The high values of absolute maximum pressure occur in the cold season, with the highest values December, that is, 1002.7 hPa, recorded on 30 December 2008, followed by February, with a close value, 1002.5 hPa, recorded on 17 February 2008 and by January, with an absolute maximum of 1001.7 hPa, recorded on 24 January 2006.

CONCLUSIONS

The multiannual mean value of atmospheric pressure in the Vad-Borod depression is 977.9 hPa. The lowest annual mean value was 975.5 hPa, recorded in 2010, as a result of intense cyclonic activity in that year, and the highest value was 980.2 hPa, recorded in 2011, as a result of prevailing anticyclonic regimes. The amplitude of the annual means is 4.7 hPa.

The annual mean values show deviations from the multiannual mean of air pressure, with more positive deviations, a share of 60.%, than negative ones, 40.0% of the years.

Over the year, air pressure has the highest values in the cold season. This is due to low air temperature and the high frequency of anticyclones, which bring stable, high pressure air masses over the latitudes of the area included in the study. Thus, the highest multiannual mean values occurred in October (980.5 hPa) and December (980.2 hPa). The lowest multiannual monthly mean values occur in the warm season of the year, with the lowest in April (975.5 hPa), which is due to the high frequency of cyclones and to rise in temperature against the previous months. The variations between summer and winter are small, the amplitude is 5.0 hPa.

During the 15 years included in the study, the absolute minimum pressure was 947.7 hPa, recorded on 17 December 2011, and the absolute maximum was 1002.7 hPa, recorded on 30 December 2008. This means that the amplitude of the absolute values was 55 hPa.

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