Analele Universităţii din Oradea, Seria Geografie Year **XXII**, no. **2/2012** (December), pp. **273-278**
ISSN **1221-1273**, E-ISSN **2065-3409** Article no. **222109-588**

CHARACTERISTICS OF THE WIND IN THE BÂRSA DEPRESSION

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Abstract: The article presents the involvement of the landscape in the forming of local manifestations of atmospheric circulation in the Bârsa Depression, with reference to wind frequency on the dominant directions, the state of atmospheric calm, the *„Braşovian foehn”* and wind velocity. The documentation stage was succeeded by the analysis, processing and interpretation of the data, which led us to the following conclusions: at depression level the dominant wind is from the west sector, the multiannual average frequency (%) of atmospheric calm slightly exceeds 20% on the Bârsa Plain (in Ghimbav) and the annual average wind velocity does not exceed 2.6 m/s in Ghibav in the studied time period.

Key words: Ghimbav, atmospheric calm, seasons, frequency, foehn, shelter.

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The characteristics of the hypoadjacent surface, especially of the landscape, creates a range of zone-specific behaviours of the winds, mostly affecting the direction and velocity. The movement of air currents is determined by the location and orientation of the main mountain peaks, passes, straits, valleys, which intensify the frequency of movement in said directions. On Bârsa Plain, near Ghimbav, the wind has an annual percentage of 77%, with a calm of 23% (figure 1).

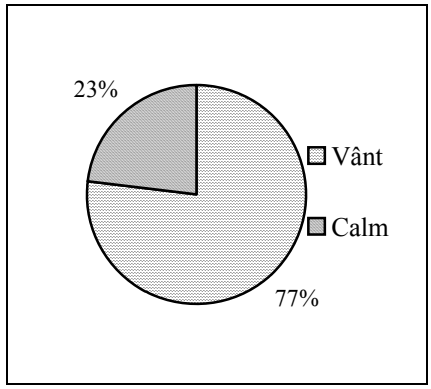

Figure 1. Multiannual average of wind and calm frequency (%),
at the Ghimbav Metheorogical Station, between 2000 - 2010
(Source: Ghimbav Metheorogical Station Archive)

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At depression level, on Bârsa Plain, the wind direction varies, it being dominated from the west sector, with an average annual frequency of aproximately 34%, the south-west, with a frequency of 17.7%, north-west, with a frequency of 8.8% and west directions, with a frequency of 8.1%, all having a contribution to this number (between 2000 - 2010). In the south-west of the Bârsa Depression, in the depressionary gulf Zărneşti - Tohan, the atmospheric circulation is led on the south-west (with a frequency of above 42%) towards north-east (with a frequency of above 38%) direction (Elena Mihai, 1975).The north of the depression, sheltered by the Baraolt Mountains, is protected from northen cold air masses, this direction having a low annual frequency, of aproximately 5%. At Ghimbav, this direction also has low annual frequency, of aproximately 8.1% , between 2000-2010 (table 1). The tall mountains located in the south of the depression form a barrier, blocking the southern air masses, this direction having an annual frequency of below 10%, 13.5% on Bârsa Plain (figure 2), according to our calculations, between 2000-2010. The atmospheric circulation of the eastern sector represents aproximately 20% of the total frequency, for the same time period.

In the lowest area of the depression, at Bod, the dominating directions are west (frequency of 20%) and north-east (frequency of 19%). The high mountain regions that border the depression, have the western direction as a characteristic, with a frequency of above 60% (Elena Mihai, 1975).

Table 1. Multiannual average of wind frequency (%),
at the Ghimbav Metheorogical Station, between 2000 - 2010
(Data source: Ghimbav Metheorogical Station Archive)

Direction	N	NE	E	SE	S	SV	V	NV
Frequency	8,1	9,1	11,8	6,1	13,5	17,7	16,2	17,5

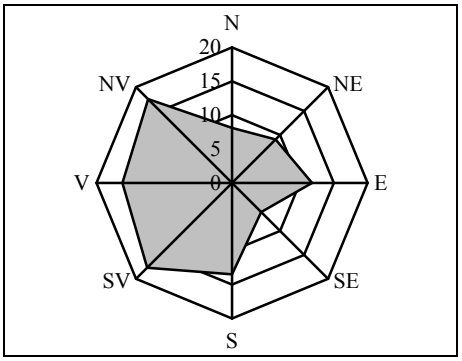

Figure 2. Multiannual average of wind frequency (%),
at the Ghimbav Metheorogical Station, between 2000 - 2010
(Source: Ghimbav Metheorogical Station Archive)

Table 2. Multiannual average of wind and calm frequency (%),
at the Ghimbav Metheorogical Station, between 2000 - 2010
(Data source: Ghimbav Metheorogical Station Archive)

Direction / Season	Wind (%)	Calm (%)
Spring	80,6	19,4
Summer	80,4	19,6
Autumn	76,6	23,4
Winter	70,4	29,6

Table 3. Multiannual average of wind frequency (%),
at the Ghimbav Metheorogical Station, between 2000 - 2010
(Data source: Ghimbav Metheorogical Station Archive)

Season \ Direction	N	NE	E	SE	S	SV	V	NV
Spring	7,7	8,8	12,5	6,3	13,6	18,3	15,8	17,0
Summer	9,0	9,5	7,4	5,1	12,9	18,0	19,4	18,7
Autumn	7,7	10,7	13,1	7,0	14,6	18,7	13,3	14,9
Winter	7,8	7,2	14,8	6,1	12,6	15,6	16,2	19,7

Analyzing the wind frequency by seasons, we can observe that the greatest frequencies are found on the eastern and western directions (figure 3).

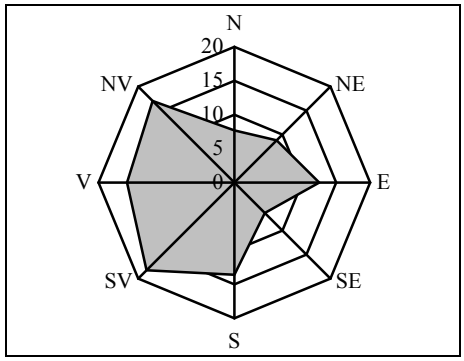

Figure 3. Multiannual average of wind frequency (%) in spring,
at the Ghimbav Metheorogical Station, between 2000 - 2010
(Source: Ghimbav Metheorogical Station Archive)

In spring, the dominant circulation is the western one, with a frequency of above 33%. The eastern circulation has a frequency of aproximately 20% (figure 4).

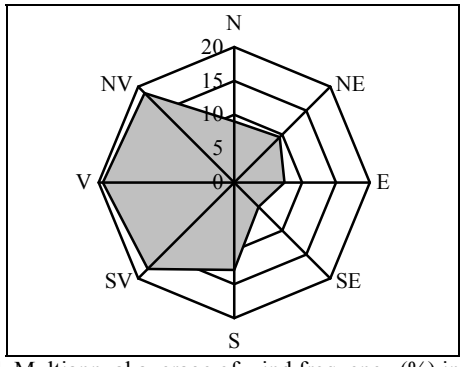

Figure 4. Multiannual average of wind frequency (%) in summer,
at the Ghimbav Metheorogical Station, between 2000 - 2010
(Source: Ghimbav Metheorogical Station Archive)

In summer, the dominant circulation is the western one, with a frequency of above 37%. The eastern circulation has a frequency of aproximately 15%.

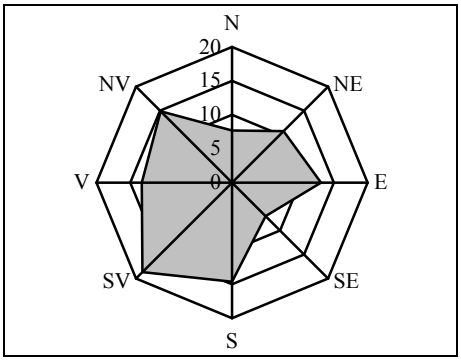

Figure 5. Multiannual average of wind frequency (%) in autumn, at the Ghimbav Metheorogical Station, between 2000 - 2010
(Source: Ghimbav Metheorogical Station Archive)

In autumn, the dominant circulation is the western one, with a frequency of above 30%.The eastern circulation has a frequency of aproximately 22% (figure 5).

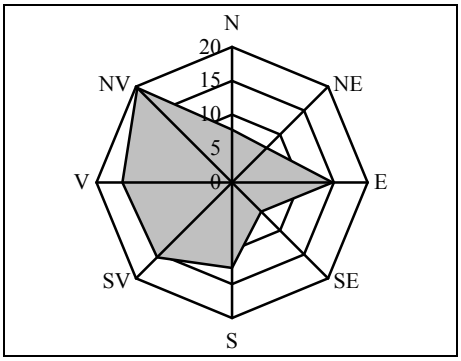

Figure 6. Multiannual average of wind frequency (%) in winter, at the Ghimbav Metheorogical Station, between 2000 - 2010
(Source: Ghimbav Metheorogical Station Archive)

In winter, the dominant circulation is the western one, with a frequency of above 33%.The eastern circulation has a frequency of aproximately 21% (figure 6).

Processing the information, we observe that the frequency on the southern direction is almost constant, 12,6 - 14,6 %. Thus, in the Bârsa Depression the foehn effect is formed, effect considered by some to be formed in the shelter of the Perşani Mountains, it being the cause of the decrease in rainfall in this compartment of the Braşov Depression. However, the Perşani Mountains represent more of a *„gateway"* for the oceanic air masses (M.Marcu, 2005), than an orographic barrier capable of generating the creation of the foehn, through low altitudes and proeminent fragmentation. N.Bordei-Ion (1988) stated that on the sides of the Perşani and Baraolt Mountains from Bârsa Country, located *„below the winds"*, conditions for the genesis of the foehn effect exist, though he considered it just a minor variant of the phenomenon, calling it *„the minor Foehn of the Carpatian Curve"*. In the Bârsa Depression, the foehn effect is formed only in the presence of downwards atmospheric movement from the high mountain edge in the south and south-west (Piatra Mare, Postăvarul, Bucegi, Piatra Craiului), on the Bucegi Mountains-Mount Postăvarul-Braşov city axis (M.Marcu, 2005), the dry, hot air descending from the high mountain areas to the low area of the depression , in Sânpetru, Hărman and Prejmer.

„The Braşovian foehn" (Marcu, 2005) presents a range of particular effects, including: sudden, intense heating and a low humidity level of the atmosphere, high wind velocity from the south-west, these frequently generating thawing and fast snow melting, followed by the increase in river flow, between January and March.

The atmospheric calm varies depending on seasons and the distribution of the landforms in the depression. In terms of seasons, winter has the highest frequency of atmospheric calm (29.6%, on Bârsa Plain), while spring has the lowest (19.4%, in Ghimbav). According to the landform distribution, we can observe the state of atmospheric calm of over 40% in the piedmont area, in the shelter of the mountain, but also the very low value of the calm in the lowest portion of the depression (2.5%, in Bod) (Elena Mihai, 1975), due to thermic stratification, the existance of thermic inversions, an amplified, intense ventilation and the presence of the Olt Valley. Between these values, the corridors, passes and gorges in the limitrophe mountain area have a calm frequency of under 10%, as a result of channeling and intensifying of the wind on their axis. The areas located at the foot of the mountain sides have a calm frequency of above 30%, while the high mountain areas located at the edge of the depression have a calm frequency of below 2%. During summer, the calm has a frequency of 19.6% (on Bârsa Plain) almost equal to the spring (19.4%), in autumn, it rising to 23.4% (Ghimbav).

The Bârsa Depression has a sheltering factor comparing to the mountain massifs on the edge of the depression, aspect emphasized by the velocity of the winds (figure 7).

Table 4. Monthly average velocity (m/s), at the Ghimbav Metheorogical Station, between 2000-2010
(Data source: Ghimbav Metheorogical Station Archive)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2000	2,3	1,5	3,2	3,0	2,7	2,8	3,3	1,9	2,0	1,7	1,5	1,8
2001	1,3	2,4	4,0	2,2	2,3	3,5	1,4	1,2	2,2	2,0	3,1	1,1
2002	1,5	2,9	3,4	2,3	2,1	1,9	2,0	1,9	2,2	2,3	1,7	1,9
2003	1,7	1,4	2,1	1,8	2,8	3,0	2,6	2,7	2,4	3,5	2,0	2,2
2004	1,9	3,7	3,4	2,8	2,8	2,4	2,2	2,2	2.3	2,4	2,8	2,3
2005	3,0	2,1	4,0	3,1	3,1	2,7	2,0	1,9	1,5	2,4	2,1	2,6
2006	2,1	2,5	3,6	2,9	2,8	2,4	2,2	2,4	2,3	2,1	2,3	1,6
2007	3,6	3,3	3,1	1,0	3,2	2,5	3,0	1,8	2,2	1,8	2,7	1,5
2008	2,1	2,3	4,2	3,1	2,4	2,5	2,3	2,1	2,1	2,4	2,3	2,9
2009	1,9	2,4	2,8	2,3	2,4	2,3	2,2	1,7	1,6	2,2	1,9	2,3
2010	1,9	2,2	3,3	2,3	2,4	1,1	0,9	1,5	1,9	1,8	2,2	2,0
Multiannual monthly average	2,1	2,4	3,3	2,4	2,6	2,4	2,1	1,9	2,0	2,2	2,2	2,0

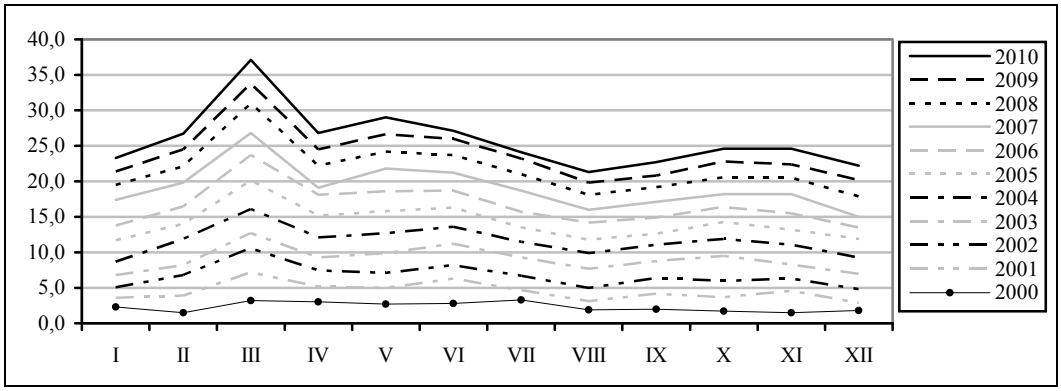

Figure 7. Monthly average wind velocity (m/s), at the Ghimbav Metheorogical Station, between 2000-2010
(Source: Ghimbav Metheorogical Station Archive)

By analyzing, processing and interpretating the data, we observed that on the Bârsa Plain, the multiannual monthly wind velocity has small and relatively constant values, with the exception of the month of March, when it exceeds 3 m/s.

In the depressionary space, the annual average velocity has values ranging from 1.9 to 2.6 m/s (figure 8), while in the high mountain area limitrophe to the depression it often exceeds 7 m/s. According to this sheltering factor, the depression is split in two regions: the piedmont region, which has a high sheltering factor, with a higher frequency of atmospheric calm and an average wind velocity of below 4% and the Bârsa depressionary plain, with a very low sheltering factor, with a low frequency of the atmospheric calm and an average wind velocity which can exceed in certain conditions 7 m/s. Analyzing the wind velocity by seasons, we can observe the following: during winter, the wind velocity has low values, below 3 m/s, (2.2 m/s, on Bârsa Plain), during spring, when there is a significant intesification of cyclonic circulation, the average wind velocity exceeds 4 m/s (aproximately 2.8 m/s in Ghimbav), during summer there are the lowest values of the average wind velocity, of under 3 m/s (2.1 m/s in Ghimbav), and during autumn the average wind velocity starts rising, up to 3-4 m/s (2.1 m/s. on Bârsa Plain). In the high mountain area, which borders the depression, the wind velocity frequently exceeds 14-15% during winter and 4 m/s during summer.

Table 5. The anual average velocity (m/s), at the Ghimbav Metheorogical Station, between 2000-2010
(Data source: Ghimbav Metheorogical Station Archive)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Velocity (m/s)	2,3	2,2	2,1	2,3	2,6	2,5	2,4	2,4	2,5	2,1	1,9

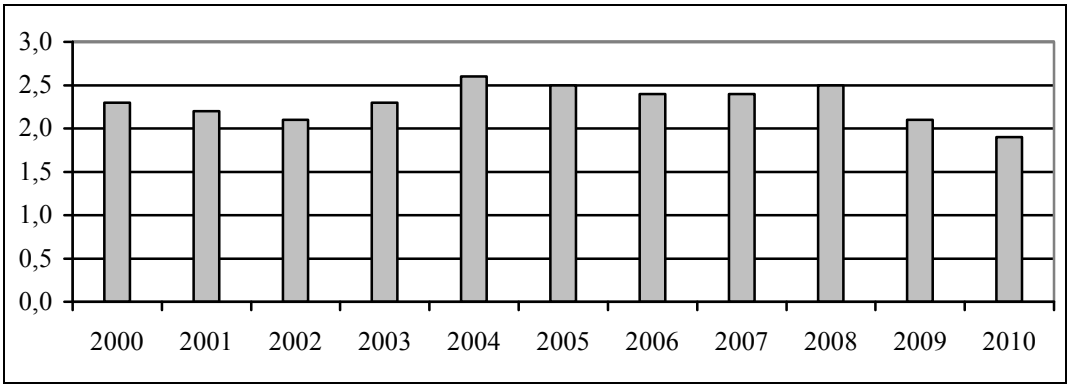

Figure 8. The anual average velocity (m/s), at the Ghimbav Metheorogical Station, between 2000 - 2010
(Source: Ghimbav Metheorogical Station Archive)

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Submitted: June 12, 2012 | Revised: August 23, 2012 | Accepted and published online September 21, 2012