

STUDY OF THE INFLUENCES OF GEOGRAPHICAL FACTORS ON THE WIND SPEED AND FREQUENCY. STUDY CASE IN SW OF ROMANIA.

Anișoara Irimescu¹, Argentina Nertan¹, Cristian Irimescu¹, Carmen Dragota¹

¹ National Meteorological Administration
97, Soseaua Bucuresti –Ploiesti, nr. 97, sector 1, 031686 Bucharest, Romania
E-mail: anisoara.irimescu@meteo.inmh.ro

Abstract: The surveillance and the management of the wind resources in Romania represent an issue of national importance considering the fact that the natural potential of the wind is non-polluted resource. This activity requires a great number of observations points and stations of measurement and processing. The paper presents the study carried out in the National Meteorological Administration regarding the influences of geographical factors (location, relief, land cover/land use) on the wind speed and direction in the SW part of Romania. The working methods consisted in statistical analysis of the database climatic parameters (wind speed and direction) for the 1961 – 2000 period of 13 meteorological stations (situated in the SW mountainous region of Romania). The obtained results emphasized the important differences in the wind speed and frequency due to different local geographical conditions and variety of mountainous microclimate. The high baric gradients generate strong winds (with regional character) and the low baric gradients determine weak winds (with local character).

Keywords – wind speed, frequency, altitude, Carpathians, Romania

1. INTRODUCTION

This paper aims at contributing to the knowledge of those geographical factors which have an influence upon the wind speed and direction, using data from the National Meteorological Network's weather stations for the period 1961-2000, topographic maps and satellite-image data.

The analyzed geographical factors are localization, relief, and land cover/land use, particularly important in climatic analyses. The information obtained is useful for a rational management of the power resources.

The Carpathians, through their orientation, play the role of an orographic barrage. Thus, they mark the boundaries of several sectors under exterior climatic influences.

The studied region is located in the south-western part of Romania between the Danube, the Olt River and the Carpatho-Balkan Internal Curvature's orographic barrage.

2. INFLUENCES OF THE GEOGRAPHICAL FACTORS

It is well known that in the mountainous area the relief is rough and hardly accessible for the setting up of weather stations. In order to analyze the wind climatic characteristics in the south-western part of Romania, between the Danube, the Olt river and the Carpatho-Balkan Internal Curvature's orographic barrage, data recorded at 15 weather stations were used. The climatic parameters (among them the wind direction and speed) recorded at the weather stations are influenced by the regional physico-geographical conditions, as well as by the obstacles around the station. Thus, not all the stations are representative for one or more parameters.

The main relief units studied are the following: the southern frame of the Meridional Carpathians (respectively that of the Paring and Retezat-Godeanu groups), the Mehedinti plateau, the Getic Sub-Carpathians and the Getic Piedmont. The relief units are ranged in steps from south to north, in the shape of a large amphitheatre facing south.

The analysis of maps representing the mountain orientations and slopes shows that in the studied region prevail the slightly inclined slopes (0-15 degrees) and those facing east, south, and west, but also

the plane surfaces. The initial active surface has been seriously anthropogenically modified. Thus, a new active surface has appeared, which influences the radiation heat balance and respectively the climate and topoclimate genesis in a different way. In this context should be mentioned the development of human settlements, particularly the urban ones which appeared and widened, the anthropogenic relief formed following the lignite extraction at the Motru and Rovinari quarries, the embanked enclosure marking the Ceauru Lake on the Jiu river, the harnessed catchments along the Olt river, the crops of all kinds etc., which have replaced the old environment quality with a new one, thus making possible the coming out of new topoclimates, of anthropogenic origin.

The evolution of meteorological elements is a tenacious witness of the changes due to the economic activity, mirroring in general its negative aspects over the environment. Thus, the destruction of natural balance following the drastic decrease of forests and vegetal cover, which plays a moderating role for the climate, leads to the modification of wind parameters, in general, and as a consequence also in the studied region.

The Carpathians' altitude turns the latitudinal climatic zonality into an altitudinal climatic zonality, imparting to it proper characteristics. The Carpathian chain's direct influence on the wind is made evident by its orientation parallel with the main peaks. Thus, the climate of the Carpathian chain's limitrophe regions is influenced by the general atmospheric circulation, whose characteristics are strongly transformed by the Carpathians.

3. EVOLUTION OF THE WIND SPEED AND FREQUENCY

3.1. Wind frequency

The zonal circulation is rendered evident only at the stations on the high mountain peaks, where the western sector winds have the greatest frequency. In the low altitude regions on the outside of the Carpathian arch, the main wind directions are parallel with it.

The situation of the analyzed stations is as follows:

- at Caransebes station the winds from SE and S prevail, over 14%, as a consequence of its location in the Timis-Cerna couloir;
- at Baile Herculane station the N, NE, and S directions are predominant (as is also the opening towards the Timis river and Cerna river couloirs);
- at Drobeta Turnu Severin station the winds are canalized along the Danube, the prevalent directions being V and NV;
- the Tarcu and Cuntu mountain stations have predominant winds from N and S, while at Obarsia Lotrului station the NV winds prevail, and at Parang station those from South;
- in the Petrosani Intra-Carpathian depression, represented by the station bearing the same name, the winds from S prevail (directed by the depression opening on the Jiu river couloir towards South), while in the Voineasa depression the winds from SE and S are predominant (also canalized by the depression opening to the Lotrului valley towards East);
- the Apa Neagra station, located in the Mehedinti plateau, has winds from the West;
- at Targu Jiu station, which is not far from the Jiu river, the N and NE directions prevail;
- directed along the Olt river, the predominant winds at Ramnicu Valcea station have the following directions: N, NV, and S;
- at Polovragi station the winds from N, NV, and V prevail;
- at Targu Logresti station the winds from SV and NE have been recorded as predominant.

3.2. Atmosphere calm

The annual medium frequency of the calm varies according to the territory, the lowest values being recorded at those weather stations where the wind has high frequencies and speeds, as are Tarcu (11%) and Cuntu (37%) mountain stations. In the *Intra-Carpathian depressions* the calm frequency is higher than 70%, and at the low altitude stations it varies between 40 and 60%.

During the year a low frequency of the calm can be noticed at the mountain stations in the winter months and early spring, while at those located along the valley couloirs (Drobeta Turnu Severin, Baile Herculane, Ramnicu Valcea) the frequency is a little bit lower in the summer months and early autumn. Since the automatic stations were set operational, the atmospheric-calm frequency has decreased significantly. This fact is due to continuous measurements with sensors more accurate than the wind vane.

3.3 Wind speed

The wind speed is directly proportional to the horizontal pressure gradient. In general, the wind speed is higher in winter, when the pressure and temperature contrasts are greater. The degree of relief fragmentation and the roughness of the active subjacent surface have a strong influence upon the wind speed. Unlike the predominant wind-direction, the wind speed is subject to important modifications due to the local conditions (buildings, forests, crops).

Like the prevalent frequency, the wind speed is influenced by relief and also by other obstacles such as forests and tall buildings. As it can be noticed, in general, the high wind-speeds occur on the predominant directions.

According to the altitude levels, the medium wind-speed has the following values:

- below 500 m, the wind speed is between 1 m/s at Pades and 6 m/s at Drobeta Turnu Severin;
- the 500-1000 m level is characterized by speeds varying between 0.5 and 4.3 m/s, both values being recorded at Petrosani. It should be mentioned that the stations of this altitude level are also located in Intra-Carpathian depressions and influenced by the orographic barrage;
- the 1000-1800 m level is characterized by low speeds, between 0.4 m/s at Obarsia Lotrului and 4.6 m/s at Parang;
- above 1800 m (Tarcu station), the medium wind-speed is greater than 12 m/s because the obstacles are absent.

During the year, the highest monthly speeds occur in the March-April period, excepting the mountain stations where the maximum monthly mean speeds are recorded in February.

In Fig. 1 is shown the wind roses at the weather stations in the region, according to the altitude.

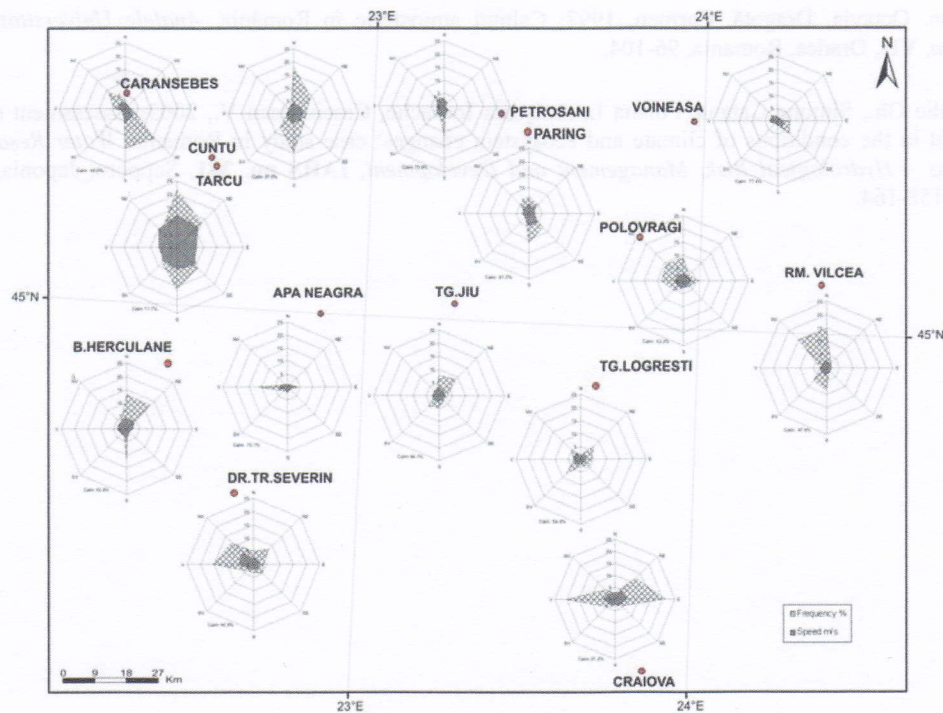


Figure 1. The wind roses at the weather stations in the region

4. CONCLUSION

One important conclusion is related to the level of objective representation of the weather stations.

The presence of the Carpathians makes us draw the following conclusions:

- * the wind direction renders evident, once more, the high frequency of winds towards north and west;
- * the wind has, in general, on the prevailing direction (north), relatively low values, below 3 m/s, excepting the weather stations located in valley couloirs (Baile Herculane, 4.3 m/s; Cuntu, 4.1 m/s) and, sometimes, in depressions. It is the case of the Targu Jiu – Campu Mare depression, the largest Sub-Carpathian depression, where the wind reaches 2-5 m/s. In the other Sub-Carpathian depressions, the small ones, owing to the orographic shelter, the wind speed towards north is of 1-1.5 m/s, favoring the intensification of insolation processes.
- * in comparison with the north direction, the wind speed towards west and north-west is higher by 0.5-1.0 m/s and not for all stations: Parang 1.9 m/s and 3.0 m/s respectively, Targu Jiu 2.2 m/s and 2.8 m/s respectively, Ramnicu Valcea 1.9 m/s and 2.2 m/s respectively, Polovragi 3.4 m/s and 3.2 m/s respectively, Targu Logresti 2.5 m/s and 3.2 m/s respectively, Drobeta Turnu Severin 5.4 m/s and 6.0 m/s respectively, the highest value at the inferior-altitude stations, below 500 m ;
- * excepting the mountain stations (Tarcu, Cuntu), at all the other stations the atmospheric calm has high values due to the orographic barrage which favors a shelter topoclimate: Drobeta Turnu Severin 44.9%, Ramnicu Valcea 47.8%, Caransebes 49.0%, Polovragi 53.2%, Baile Herculane 53.8%, Parang 61.2%, Targu Jiu 64.1%, Targu Logresti 64.4%, Petrosani 73.8%, Apa Neagra 75.1%, Voineasa 77.4%, and Obarsia Lotrului 80.9%.

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