

# VARIATION OF AIR TEMPERATURE, ATMOSPHERIC PRECIPITATION AND WIND SPEED IN DOBRUDJA PLATEAU (1981-2010)

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## *Résumé*

Le climat du plateau de la Dobroudja est déterminé par sa position géographique en rapport aux centres barriques, par les unités aquatiques voisines (le Danube, la Mer Noire), par les formes de relief et leur altitudes et par les influences climatiques extérieures. La manière, dont les facteurs climatogènes se combinent, déterminent les valeurs de chaque élément météorologique aussi que leur régime qui, avec d'autres phénomènes météorologiques, génèrent un système climatique à part et différent pour le plateau de la Dobroudja par rapport aux régions adjacentes. L'individualité climatique est mise en évidence par la variation spatiale des principales composantes climatiques : température de l'air (9,8°C à Medgidia – 11,6°C à Constanța), précipitations atmosphériques (392,2 mm à Constanța – 472,1 mm à Adamclisi), vent (3 m/s dans le voisinage du Danube – 4,1 m/s à Constanța), aussi que par l'évolution spatiale de ces éléments climatiques.

**Mots-clés** : facteur climatogène, paramètre climatique, variation, plateau de la Dobroudja.

## 1. Introduction

Romania presents a territorial diversity of climatic particularities and a wide temporal variability of atmospheric processes and phenomena (*Ciulache, Ionac Nicoleta, 2004*). The physical and geographical complexity of Romanian territory is also visible on climatic conditions, which varies widely, from the alpine tundra ones, on the high peaks of the Carpathians, to those reminding of the Mediterranean one, in Dobrudja. Climatic individuality of Dobrudja is the result of complex interaction of radiative climatic factors, physical, geographical and dynamic factors (*Ciulache, Torică, 2003*).

Knowing the climatic factors, their direction, their intensity, and the weather conditions and manifestations helps to perform analyses of climatic variations, which can become a real and useful tool in the organisation of human society activities.

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## 2. General Considerations Regarding the Specific Climatic Factors of Dobrudja Plateau

The climate of Dobrudja Plateau is influenced by the geographical location, the complexity of the active area, the activity of the main barometric centres of action, etc. The climate of Dobrudja Plateau was characterised as *semiarid temperate* (Ciulache, 2004) which acquired moderate characteristics due to the Danube River (the presence of a valley and terraces in the west and the north) and pontic influences (Black sea in the east).

The geographical landscape of Dobrudja Plateau behaves itself as a peninsula, limited in the west and north by the Danube and The Black Sea in the east. The Dobrudja Plateau has a relief with an altitude lower than 500 m, which determined the classification of this geographical unit in the climate level of low hills and plateaus with altitudes below 500 m (the north imposes itself with a maximum altitude of 467 m – Măcin Mountains, Țuțuianu Peak).

The geographical unit is also classified with a climate level of plain with altitudes below 200 m (the south imposes itself with a maximum altitude of 210 m – Oltina Plateau, Movila lui Icușar and the altitude of the Black Sea shore falls below 50 m) (*Geografia României, vol.I, 2005*). Thus, this physiognomy explains the topoclimatic processes (Ciulache, 1971) that significantly contribute in the shaping of the climate of the analysed plateau.

Regarding the influence of barometric centres, the Dobrudja Plateau is in the contact area of the periphery of East European anticyclone, Azores anticyclone and Mediterranean cyclones with the pontic ones formed in the western sea basin (with a western and north-western general evolution). Additionally, the two water surfaces, by the descent processes of air, give rise to thermal barriers, with moderate air temperature and domination of the clear weather.

The mainland area is characterised by convective and radiative processes, which stimulate contrasts between thermal and rainfall conditions. Both aquatic surfaces, and the mainland, through the development of climatic contrasts and intensity of heating and cooling processes contribute to local air dynamics, nebulosity, reduction of the amount of atmospheric precipitation, appearance of dryness and drought phenomena or abundance of dew deposits etc.

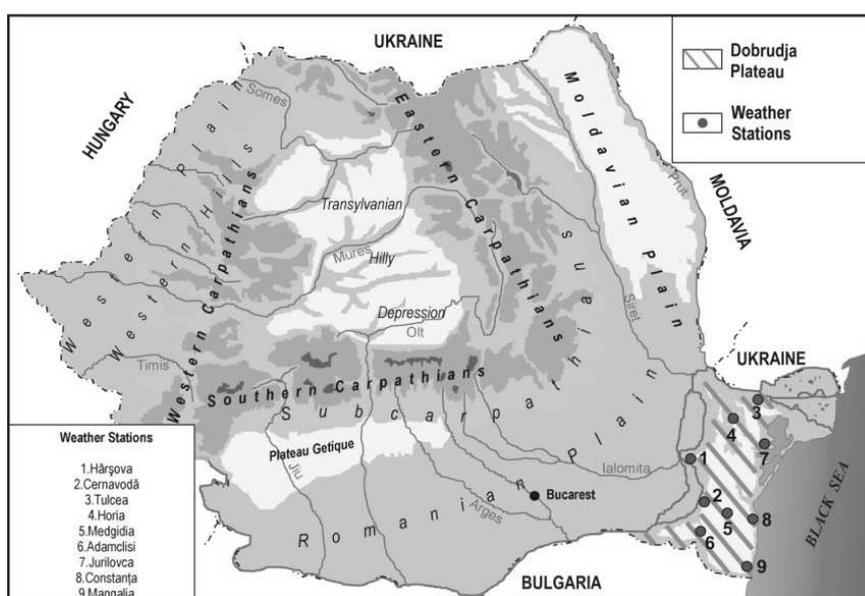
Thus, in terms of climate, the plateau has a climate with significant influences in northeast, Pontic influences in the east and southeast and sub Mediterranean influences in south and southwest.

## 3. Climate Monitoring and Utilized Weather Data

The present study aims to highlight a number of key factors and major regional variations in air temperature, atmospheric precipitation and wind

specific to the climate of Dobrudja Plateau, positioned in southeast Romania (*Figure 1*), between 27°20' and 29°41' eastern longitude and respectively 43°43' and 45°27' north latitude.

To achieve this aim and obtain a complex synthetic image, in terms of quality and quantity, a meteorological data fund was provided by A.N.M. archives (National Administration of Meteorology) and by C.M.R.D. (Dobrudja Regional Meteorological Centre), for a period of 30 years (1981-2010). These data are representative for weather stations from Danube area – Hârşova, Cernavodă, Tulcea; the mainland of the plateau – Horia, Medgidia, Adamclisi; Black Sea coast – Jurilovca, Constanţa, Mangalia (*Figure 1*).



*Fig. 1.* The geographical position of Dobrudja Plateau in Romania and the meteorological stations related to the plateau

#### 4. Identifying Regional Trends Based on Variation of Air Temperature, Atmospheric Precipitation and Wind

Annual regime of the main climatic parameters, analysed and presented in this study, and the climatic individuality imposed by them is highlighted by different methods of centralization and by graphical and cartographic representation of meteorological data (*Table 1, Figure 2*).

Regarding annual air temperature regime (*Table 1*), influenced by advection cooling of European anticyclones and local radiative ones, there is a general tendency of increase from north (+9.8°C at Horia) to the south (+11.4°C at Mangalia), along with the decrease in altitude, the diminishing of continental influences and increasing of Mediterranean influences. A tendency of decrease occurs from the east (+11.6°C at Constanța) to the west (+10.9°C at Hârșova) is due to the influence of the Black Sea (*Table 1, Figure 2a*).

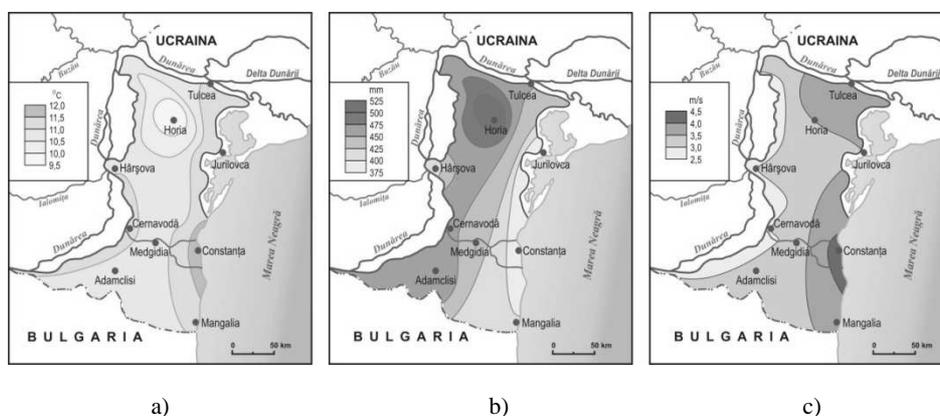
The mean temperatures of air for January (*Table 1*) register the following spatial variations: an increase from the north (−0.5°C at Jurilovca) to the south along the coast, positive values being recorded in Constanța (+1.0°C) and Mangalia (+1.4°C), highlighting the role of moderator of the Black Sea and that the greatest heat potential lies with the seawater; a decrease from south to north and from west to east inland, the lowest recorded temperature value was −3.2°C at Horia; insignificant variations in the south-central part of the plateau.

Tabel 1

**The annual variation of air temperature (°C), atmospheric precipitation (mm) and wind speed (m/s) at the meteorological stations from Dobrudja Plateau, during the period of 1981-2010**

Weather stations		Air temperature (°C)			Atmospheric precipitation (mm)	Wind speed (m/s)
		Annual	January	July		
Western Danubean area	Hârșova	10,9	−1,2	22,3	407,5	3,0
	Cernavodă	11,1	−1,7	23,0	467,7	3,0
	Tulcea	11,0	−1,5	22,7	458,3	3,9
Central Continental area	Horia	9,8	−3,2	20,8	510,0	3,5
	Medgidia	10,9	−0,5	22,0	436,8	3,1
	Adamclisi	10,7	−0,7	21,8	472,7	3,1
	Jurilovca	11,0	−0,5	22,6	398,0	3,5
Eastern Seaside area	Constanța	11,6	1,0	22,4	392,2	4,1
	Mangalia	11,4	1,4	22,0	412,2	3,8
<b>Annual average</b>		<b>10,9</b>	<b>−0,7</b>	<b>22,1</b>	<b>439,5</b>	<b>3,4</b>

*Data processed after the archive of A.N.M. and C.M.R.D., 2010*



**Fig. 2. The spatial distribution of mean annual air temperature ( $^{\circ}\text{C}$ ), of annual amount of precipitation (mm) and the annual average wind speed (m/s) at the meteorological stations related to Dobrudja Plateau, during the period of 1981-2010**

In July, the values of the mean air temperature indicate a moderate character when compared to the rest of continental surfaces in southern Romania. In the eastern, northern and western plateau, air temperature values exceed  $+22^{\circ}\text{C}$ , values visibly influenced by the aquatic surface. Inside the plateau, air temperature decreases to  $+20.0^{\circ}\text{C}$  (Table 1). Thus, the variation of air temperature indicates that, due to differences imposed by the heating of land and the influence of continental and water conditions, there is a downward trend in values from west to east through the whole territory of the plateau and a reduction from south to north, due to the influence of hot Tropical air.

The climatic individuality of Dobrudja Plateau is also highlighted by the atmospheric precipitation regime. Precipitation potential is influenced, in general, by the high frequency of continental anticyclones, except for the coastal strip, under the influence of Pontic cyclones where, sometimes, abundant rainfall occurs. Additionally, in the areas where the relief presents slopes with southern exposure, rain showers may occur in the hot season, accompanied by hail, local storms and large quantities of precipitations. Analysing the annual atmospheric precipitation regime (Table 1, Figure 2b), we found a general tendency of: decrease in the amount of rainfall from west (467.7 mm at Cernavodă) to east (392.2 mm at Constanţa); increase inside the plateau from the south (472.7 mm at Adamclisi) to the north (510.0 mm at Horia), due to the increase of altitude of the relief; increase along the coast from north (398.0 mm at Jurilovca) to the south (412.2 mm at Mangalia). In general, the amount of rainfall is low, with values below 500 mm, a situation which highlights, one more time, the pronounced semiarid temperate climate (Ciulache, 2005) of the analysed region.

Another climate component which illustrates the climatic potential is the wind, element involved in the production of dryness and drought phenomena. The wind is influenced by the geographical position of the region, relief altitude, the presence of the sea and the Danube river etc., climate factors which determines the direction of air currents, and the thermal contrast generates local winds. For example, in the hot season, because of weather conditions with a dry character, local hot winds occur, such as “Suhovei” or black wind, which manifests itself as some local mini cyclones causing dust storms (*Ciulache, 2004*).

The analysis of this climatic parameter indicates a rich wind energy potential, also highlighted by the annual average speed (*Table 1, Figure 2c*). The wind speed at the seashore, in the north area, reaches values over 4 m/s because sea surface presents no barriers, favouring strong winds, and in the south because of the cliff, which provides a shelter area, the speed drops below 4 m/s. In the continental sector of the plateau wind speed ranges, generally, between 3-3.5 m/s, constituting a particular energy potential; and along the Danube valley the wind speed presents no significant variation, maintaining at around 3 m/s.

## 5. Conclusion

Of all the geographical units in Romania, The Dobrudja Plateau is individualized by the highest degree of continentalism, and is being qualified under the category of hot, dry and windy areas. These climate features are similar to those of steppes of Ukraine and those of Prebalcanic Plateau found in the South (Bulgaria), to which the plateau is considered a transition zone (*Geografia României, vol. I, 2005*).

In Dobrodja Plateau, the manifestation of analysed climatic parameters, during the period 1981-2010, indicates a trend of increasing or decreasing predominantly on the North – South direction and West – East direction. Annual averages for the analysed period obtained in this study confirm the climatic characteristics of the region, presented in the geographic literature by various authors such as Ciulache Sterie (2003, 2004, 2005), Torică Vasile (2003), Ionac Nicoleta (2004), Bogdan Octavia (1993) etc. We conclude that the Dobroudja Plateau has a semiarid temperate climate type, with moderate characteristics in west and north due to the Danube and in the east due to Pontic influences.

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