

Balneary Area of South Maritime Dobrudja – Considerations about Climatic Conditions and Cutaneous Climatic Stress

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Abstract: South Maritime Dobrudja, known in the literature as the Southern coast of the Black Sea balneary seaside benefits of particular climatic conditions, due to the interaction of the sea and land, which create excellent conditions for tourism activities. The association between marine and plateau environment has offered and will continue to offer natural reserves for an adequate capitalization of the area, in terms of balneary climatic. By analyzing the combination of climatic factors and weather events we can state the values and regimes of meteorological elements underlying the genesis of a climatic system. Romanian seaside is regarded as a unique landscape, as a spatial interference area of forms and characters specific of two environments, well defined, marine and lacustrine environment, plateau and dry land environment. Romanian coastline provides an ideal environment for the practice of sunbathing (heliotherapy) and air baths (aero therapy). For further development of tourism it is necessary to be known the manifestations of indexes indicating the state of comfort or discomfort the human body is subjected to. Analysis of cutaneous climatic stress allows the identification of the periods of the year when the sensations of heat and cold affect the human body and the thermoregulation. Sensations felt on the skin are due to direct contact with air, but depend on the air temperature and air flow rate.

Key words: climate, weather conditions, climatic parameters, cutaneous climate stress, adaptation, balneary area, south maritime Dobrudja.

1. Introduction

Scientific research, made over time, confirmed that a geographical environment is put into value through climate features, generally, expressed as being the result of the interaction of an array of factors, that participates, at the same time to the genesis of climate in different proportions in terms of quantity and quality.

Thereby, *solar radiation* is analyzed as the primary energy factor, *atmospheric circulation* as secondary energy factor, and *active surface* (subjacent or terrestrial) as

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transformation factor and accumulator of thermal energy. By analysing the combination of climatic factors and weather events we can state the values and regimes of meteorological elements underlying the genesis of a climatic system.

In the specialized literature, Southern Dobrudja by its geographic location in South-Eastern Romania, by appearance and low altitudes (70 - 250 m), by specific climate and topoclimate was placed in *the semiarid temperate climate sector* (Ciulache, 2004), with continental character in the southwest, west and central part and a maritime character in southeast and east. This latter type of character, maritime, covers the territory analysed in this study, respectively South Maritime Dobrudja (Southern coast of the Black Sea balneary seaside; Figure 1).

Also, about the landscape of coastline is said that there is no equivalent along the almost 80,000 km of coasts of the European continent. For this reason, Romanian seaside is regarded as a unique landscape, as a spatial interference area of forms and characters specific of two environments, well defined, marine and lacustrine environment, plateau and dry land environment. Thereby, this area corresponds to a strip of coastal land, narrow of 15 – 25 km, located along the Black Sea coast, under the direct influence of sea water and the lacustrine environment, which requires a manifestation of reducing the arid accents and atmospheric precipitation quantities and an increase in air humidity, wind speed and insulation (Ciulache & Torică, 2007).

Stress factors are important tools for assessing the potential positive or negative effects that the climate of a region can have on human health, because thermal comfort represents a psycho-physical condition of welfare of human individual in relation to the environment in which they live and operate (Ionac, 2007). In this sense, particular attention should be paid to all those negative influences, expressed either by values or large amplitudes of variation, either by extreme regimes, which impose to human organism extensive physiological stress adaptation and control.

Of all the physiological stressors, cutaneous climate stress is aggressive, due to spatial variation and over time, because man cannot avoid the influence of cold or warm weather, dry or wet, etc. regardless of the protective measures taken (Teodoreanu, 1984a; 2002b, Tromp, 1974; Kyle, 1992; Perry, 1986; Pearson, 2013).

Many researchers have concluded that the human body reacts to weather changes and at climatic variations, reason that led to the development of analytical systems, who managed by research variations in climatic parameters at a scale of reference, to highlight periods of comfort and discomfort the human body undergoes.



Figure 1. The geographical position of the balneary area of Southern Marine Dobrudja within the South Dobrudja Plateau (Grigore Elena, 2012)

2. Input data and methods

South Maritime Dobrudja or the Black Sea balneary seaside is known as a tourist area of national and international importance. To support conducting under proper conditions of specific tourism activities is important to use the results obtained from the analysis of various bio meteorological and bioclimatic indices that may indicate the periods of bioclimatic comfort or discomfort.

This study aims to highlight periods of comfort and discomfort the human body is subjected to at the level of territory in question, based on information about the temperature of the air and air flow speed obtained over a period of 30 years (1981–2010) at the two weather stations, providing a summary of the degree of manifestation, following the analysis and conclusions on cutaneous climate stress.

The basis of information of this study was provided, in the first step, by the existence of meteorological information base of the National Administration of Meteorology (A.N.M) and the Regional Meteorological Centre of Constanta (C.M.R.D.) on temperature (°C) and relative humidity (%) of air, wind speed (m/s), atmospheric nebulosity (tenths), atmospheric precipitation (mm/year), the duration of bright sunshine (hours) obtained during 30 years from two meteorological stations (Constanta, Mangalia) (Data processed after the archive of A.N.M. and C.M.R.D., 1981–2010).

The base was enriched following the analysis of index values, achieved through mathematical calculations and analysis of climatic index thresholds. In the development and completion of this study, I relied on the existence and exploitation of meteorological data. From this point of view the present study was based on qualitative and quantitative analysis of climatic and meteorological data strings representing actually, a useful tool for many areas of interest (Grigore, 2012).

Cutaneous climatic stress refers to the sensation of heat and cold that the organism feels in the process of thermoregulation. These sensations are achieved on the skin, in direct contact with air, it depends on the air temperature, air humidity and air currents speed. Over time this stress index has seen many forms of expression, the latest one being the formula for degrees Celsius.

The calculation formula was first developed by Paul Allman Siple and Charles Passel in 1945: $SSC = [(10\sqrt{v} + 10,45 - v) (33 - t)]$; v = wind speed (m/s); t = air temperature (°C) $33 - t$ = difference between normal skin temperature and air temperature, and subsequently processed and completed by the French bio climatologist Jean-Pierre Besancenot and cited, in the Romanian specialty literature, by Stoicescu & Munteanu (1976); Teodoreanu (1984; 2002); Măhăra (1994); Bololoi (2003); Ionac & Ciulache (2008). Also, according to the calculated value of the index and the character, there have been established these limits of applicability useful in bioclimatic analysis (Table 1):

Table 1. The limit of applicability of the cutaneous bioclimatic stress with the corresponding indexes.

SSC <kcal/m²/h>		Index	Index Character
0 - 299	0 - 149	-2	hypotonic index which requests triggering the thermolysis in summer
	150 - 299	-1	
300 - 599	300 - 599	0	relaxing index
> 600	600 - 899	+1	hypertonic index which requests triggering thermogenesis in winter
	900 - 1199	+2	

2. Discussions and results based on the climatic analysis and cutaneous stress index values

The association between marine and plateau environment has offered and will continue to offer natural reserves for an adequate capitalization of the area, predominated, in terms of balneary climatic. Romanian coastline provides an ideal environment for the practice of sunbathing (heliotherapy) and air baths (aero therapy). For this reason to facilitate the understanding of the interference of climatic elements that creates this unique environment I made a centralization of average

values of climatic parameters affecting the analyzed territory and presented in the table below (Table 2).

This environment represents according to the climatic analysis, the place with the highest luminosity in our country, with high solar radiation, with a special manifestation of sea breezes. Thereby, the manifestation of sea breezes during the day and the dry ones during the night provides in summertime climatic conditions with reduced nebulosity, high air moisture, high atmospheric pressure, conditions that exert a beneficial influence on the human organism.

Table 2. Monthly and annual averages of climatic parameters specific to South Maritime Dobrudja

Climatic parameter / measurement unit	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Annual average
<i>Air temperature - °C</i>	1.2	1.9	4.6	9.7	15.3	20.0	22.1	21.8	18.0	12.9	7.3	3.2	11.5
<i>Relative air humidity - %</i>	84.3	82.5	82.7	82.1	80.3	77.6	76.3	77.2	79.0	81.7	84.7	85.3	81.1
<i>Atmospheric nebulosity - tenths</i>	6.7	6.6	6.4	6.0	5.0	4.0	3.0	2.9	3.6	5.0	6.2	6.7	5.2
<i>The duration of bright sunshine - hours</i>	68.6	81.6	123.5	172.1	254.4	282.9	315.8	300.6	233.3	166.2	85.6	61.7	2146.5
<i>Atmospheric precipitation - mm/year</i>	28.8	25.8	28.5	31.9	34.2	40.9	34.7	33.0	34.2	35.0	40.2	34.8	402.2
<i>Wind speed - m/s</i>	4.5	4.6	4.3	3.9	3.4	3.4	3.3	3.5	3.8	4.4	4.3	4.4	3.9

Data processed after the archive of A.N.M. and C.M.R.D., 1981-2010

Thermal averages of 11.6°C at Constanta and 11.4°C at Mangalia, are higher on the coast than in regions distant from the shore and present, also, reduced annual and diurnal amplitudes. Slow manifestation of cooling and heating processes of surface water determines that October to be with 3.0°C to 4.5°C warmer than April. Thereby, annual thermal amplitude is lower, number of excessively hot days is reduced, and the number of frost-free days is higher than in mainland Dobrudja. The values of the cold thermal semester show that the months of the first part of the semester have high values compared to neighboring regions, because of the warm air from coming from the Black Sea. At the end of the cold period (March - April) the values decrease in comparison with the surrounding regions due to the action of sea water, which is colder than the land. Therefore, the autumn and winter along the seaside are warmer. In their turn, atmospheric precipitations, that fall highly irregular and in variable amounts, respectively 392.2 mm/year at Constanta and 412.2 mm/year at Mangalia, provide a very high relative humidity, which regardless the month exceeds 75%, and during the summer is about 15% higher than on the mainland. Annual average

nebulosity presents the lowest values, respectively 5.4 tenths at Constanta and 5.0 tenths at Mangalia, and in the summer months is much lower compared to the regions lying further from shore, because of the prevailing downward movement of air, which leads to the collapse of clouds (Grigore, 2012).

Regarding the rest of the climatic characteristics, the air is rich in aerosols, the sky is often sunny (average number of sunny days in a year is 135), recorded caloric value reaches the maximum per country (about 122910 cal/cm²year), the duration of sunshine is 2260.2 hour at Constanta and 2032.8 at Mangalia (Ionac, 2007).

The winds are characterized by higher speeds than in mainland of South Dobrudja, due to the reduced coefficient, characteristically to large areas of water. During the summer months when thermal contrast between the sea and land is strong, and the general circulation of air masses is less intense, winds from the east predominate during the day and west ones during the night (corresponding to breezes circulation).

Looking at the annual averages obtained by mathematical calculations of cutaneous climatic stress and its character for climatologically observation hours 01⁰⁰ and 13⁰⁰ on the southern Black Sea coast, we have found the following: during the night, for six months, the hypertonic character dominates, four months the relaxing character and two months hypotonic, and during the day for five months dominates the hypertonic character, four months relaxing character and three months hypotonic (Table 3, Figure 2 and Figure 3).

Table 3. Index and character of cetaceous climatic stress (SSC) for 01⁰⁰ hour and 13⁰⁰ hour

<i>hour 01⁰⁰</i>				<i>hour 13⁰⁰</i>			
<i>month</i>	<i>SCC - kcal/m²/h</i>		<i>Bioclimate type</i>	<i>month</i>	<i>SCC - kcal/m²/h</i>		<i>Bioclimate type</i>
I	889.3	(+1)	hypertonic	I	831.6	(+1)	hypertonic
II	851.2	(+1)	hypertonic	II	800.2	(+1)	hypertonic
III	787.2	(+1)	hypertonic	III	728.7	(+1)	hypertonic
IV	617.3	(+1)	hypertonic	IV	532.5	0	relaxing
V	442.5	0	relaxing	V	387.6	0	relaxing
VI	367.8	0	relaxing	VI	255.1	(-1)	hypotonic
VII	296.6	(-1)	hypotonic	VII	185.9	(-1)	hypotonic
VIII	282.1	(-1)	hypotonic	VIII	171.8	(-1)	hypotonic
IX	388.7	0	relaxing	IX	330.1	0	relaxing
X	513.2	0	relaxing	X	437.1	0	relaxing
XI	668.4	(+1)	hypertonic	XI	651.6	(+1)	hypertonic
XII	827.2	(+1)	hypertonic	XII	799.8		hypertonic

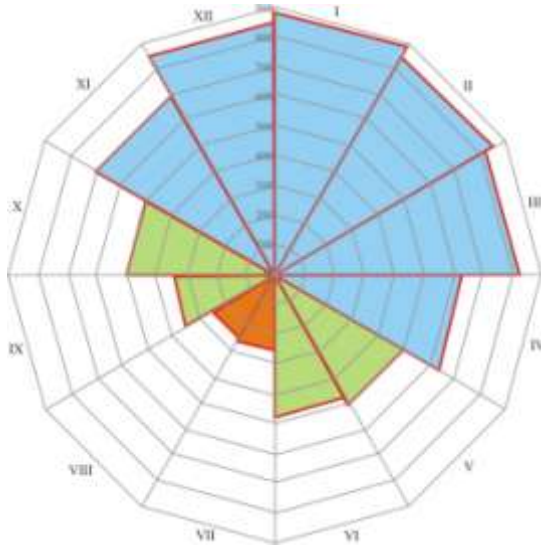


Figure 2. Radar chart of the representation of monthly average values of cutaneous climatic stress at 01⁰⁰ hours

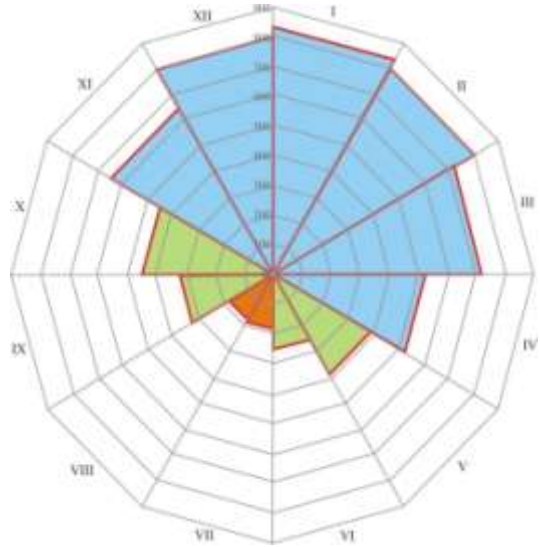


Figure 3. Radar chart of the representation of monthly average values of cutaneous climatic stress at 13⁰⁰ hours

Source: Data calculated by the author

Also, at a variation of the index values from 0 to 299 kcal/m²/h, we have found that in the summer months (June – 265.1 kcal/m²/h; July – 195.9 kcal/m²/h; August – 181.8 kcal/m²/h) weather conditions are favorable for triggering thermolysis, meaning that mechanisms by that the human body reduce the possibility of overheating are set in motion, such as sweat. Also, it is found that regardless of the season and variation of the average monthly values of cutaneous climatic stress, overnight this index has higher values than during the day, because the sea through its simple presence presents a moderator effect on the climatic and bioclimatic conditions.

For the summer months comfort index value was set at -1, so they present a hypotonic character. According to the scale of values, at over 600 kcal/m²/h, we are dealing with a hypertonic index which requires triggering thermogenesis, which is possible in winter. Thereby, in winter this hypertonic stress is manifested by chills.

3. Conclusions

Weather is a condition of life and an environmental resource, so that, meteorology as a science presented and will present a particular interest for scientific researchers. By conducting this study I wanted to bring to the attention, of both those in the field and the general public, climatic conditions of the region under study, spatial distribution and annual regime of the monthly average values of cutaneous climatic

stress, because the southern coast of the Black Sea is an important tourist area of Romania.

Due to the low air temperature and wind speed relatively high, burning from tissues are stimulated, which increases the metabolism, constriction of peripheral vessels and decreased resistance to infection. From the biological point of view, cold and movement have a stimulating effect and stimulate the physiological functions, strengthens muscle tone, increases vitality, thereby installing the hypertonic stress.

On the contrary, in a warm period, for example, atmospheric calm prove to be of a sedative and depressing character, hypotonic stress occurring. An average relaxing relationship between environment and organism expresses a state of comfort, a functional non-solicitation of the body. Throughout the year, the ratio between the number of months with hypertonic, relaxing – neutral and hypotonic character varies, with altitude and local geographic features.

The detailed climatic approaches based on the analysis of specific indices, express the degree of physical and psychological comfort of people, objectively, providing a suggestive, synthetic and representative image of the degree of spatial extension and the manifestation of analysed index and the perception of the human body. Bioclimatic factors are, as I said, *evaluation indicators* of different negative bioclimatic effects or positive from a certain territory.

In this sense, the bioclimatic specific to studied area, portion of the Black Sea coast between Constanta city (north) and Vama Veche (in the south), is favourable for outdoor activities, but should not be missed paying special attention to clothing and human organism protection, because any kind of exposure to the environment in some cases affects the movements and human reactions and lowers resistance to various climatic factors influence.

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