The Climatic-Touristic Potential of the Romanian Black Sea Coast during Summer, Established according to the Indices of Burnet, Clausse-Guérout and Sarramea *(M.-L. Lungu, D.C. Ilieș, I. Josan, M. Ungureanu, Z. Prefac, O. Gaceu, R. Mateescu)*	**"Cercetări Marine" Issue no. 46** **Pages 31-47**	**2016**

THE CLIMATIC-TOURISTIC POTENTIAL OF THE ROMANIAN BLACK SEA COAST DURING SUMMER, ESTABLISHED ACCORDING TO THE INDICES OF BURNET, CLAUSSE-GUÉROUT AND SARRAMEA

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ABSTRACT

This paper presents the climatic-touristic potential of the Romanian Black Sea Coast during warm season, based on daily weather data collected between 1981 and 2010 from the weather stations of Mangalia, Constanta, Medgidia, Gura Portiței, Sulina and Tulcea. The dates obtained from those six weather stations have been processed through three basic indices applied in tourism climatology: the spa climate index of L. Burnet (1963), the touristic-climatic index Clausse - Guérout (1955) and maritime-climatic index I. Sarramea (1980). Analyzing and interpreting the values of these indices we have concluded that, the Romanian Black Sea Coast records an high climatic-touristic potential in warm season. The most favorable month is July, for all romanian seaside, followed by August and June. This study includes the months of May and September (even if these are located outside of the summer season). Although, there is an climatic-touristic potential lower than the months of the summer season, both in May and in September there are favorable conditions for the practice of spa activities. September is favorable to helio-marine therapy than May (mostly because, in May, the water temperature is colder) and May is more favorable to aerotherapy and heliotherapy.
***Keywords**: climatic-touristic potential, Black Sea Coast, summer season*

AIM AND BACKGROUND

Currently, the tourism is one of the largest and most dynamic industry in the world. From all the factors that contribute to the development of this industry, the climate is one of the most important, as it provides the necessary framework for performing of tourist activities, contributing to the health and comfort of the human body, also determines, in a large extent, forms and types of tourism in a given area etc. Knowledge of climatic-touristic potential of the region is extremely important for both the tourism industry and tourists alike, with a decisive role in planning vacations, developments of tourism offers, establish a tourism development model of an area etc. Therefore, the climate, weather and tourism are interconnected in various ways, at local, regional and global[1]. The climate and weather in one region can attract or repel tourists, therefore, knowing the conditions of interaction between the tourist and the environment are particularly important for the tourist development of an area.

In the current context, when the irrational exploitation of natural resources has led to environmental degradation, and as such, to the occurrence of the risk phenomena (climate, geomorphological, hydrological etc.), it is particularly important to know the climatic-touristic potential of a region[2]. Globally, there are more frequent some extreme climate events (strong winds, droughts, heatwaves, floods etc.)[3-6], hindering tourism development of areas where these occur, thus redirecting tourist flows to other destinations, safer and more comfortable in terms of climate. The risk phenomena, both natural and anthropogenic ones, can affect the entire geosystem. One of the most acute problems of the contemporary world is the environmental pollution[7], therefore, it requires a sustainable management of natural resources, implicitly of natural attractions, as a unique solution for the protection and conservation of ecosystems and biodiversity[8-9]. Albeit this study does not approach of these issues, we should mention the importance of researching this aspects in terms of impacts on climatic-touristic potential of an area.

The present paper has as principal aim highlighting the climatic-touristic potential of the Romanian Black Sea Coast**,** based on data recorded at weather stations: Mangalia, Constanta, Medgidia, Gura Portiţei, Sulina and Tulcea in the period 1981 - 2010. The touristic favorability of this area was analyzed through three basic indices used in touristic climatology: the Burnet's spa index (1963)[10], the touristic-climatic index of Clausse - Guérout (1955)[11] and I. Sarramea's maritime-climatic index [12].

MATERIALS AND METHODS

Meteorological data used in this research were collected from the six weather station situated in the Romanian Black Sea Coast**,** respectively: Mangalia, Constanța, Medgidia, Gura Portiței, Sulina and Tulcea (Figure 1), that are headed by representatives of the National Meteorology Administration (NMA) and meets the conditions of representativity imposed by Meteorological Organization World (WMO).

In touristic climatology numerous indices and methods are used to highlight the climatic-touristic potential of a region, but each has own limitations due to the fact that its can only be applied to certain regions, do not explicitly indicate the degree of climatic-touristic favorability or require an increased volume of data. Also, some indices are expressed in units of measurement that do not correspond to the International System of Units thus generating erroneous results because of mathematical incompatibilities in calculus[13].

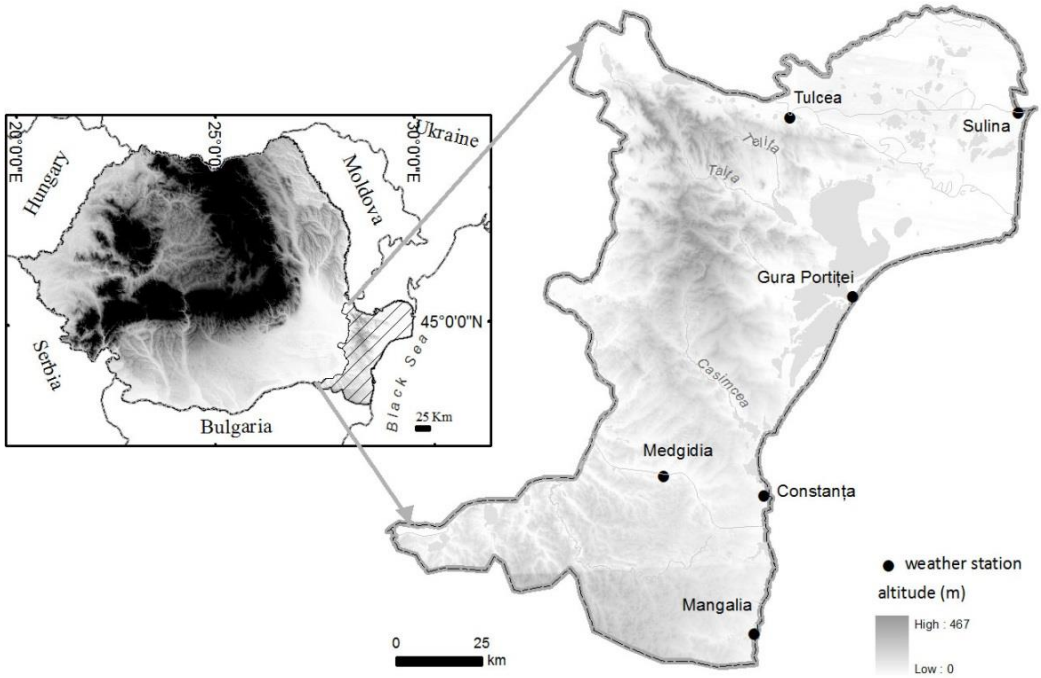

Fig. 1. Romanian Black Sea Coast location

The most used indices have been elaborated by: Missenard, Clausse and Guérout (1955), Thom (1959), Burnet (1963), Poulter (1962), Hughes (1967), Rivolier et al. (1967), Davis (1968), Flocas (1975), Sarramea (1980), Mierczkowski

(1983, 1985), Marchand (1986) etc. Among the methods, most commonly used are: Fedorov - Ciubukov (1949), Baibakova et al. (1964), Crowe et al. (1975), Besancenot - Mounier - Lavenne (1978), Barbierre (1981) etc. Of these, Clausse-Guérout (1955), Burnet (1963), Poulter (1962), Hughes (1967) indices, and the methods developed by Chubukov (1949) and Baibakova (1964) were imposed on romanian territory by Fărcaş (1968, 1970)[14-15], Teodoreanu (1984)[16], Dragotă (1999)[17], Popescu (2010)[18], Gaceu (2010, 2011)[19-21], Lungu et al. (2012) etc.

For highlighting the climatic-touristic potential of the Romanian Black Sea Coast during warm season, have been used three of the best known elementary indices applied in touristic climatology:

a) Spa climatic index (SCI) elaborated by L. Burnet (1963), which attempts to assess quality of the tourist season through the formula:

SCI = $\boldsymbol{N/T}$, where:

N = the number of rainy days in the summer season;

T = the average air temperature in that period (°C).

If the index is less than 3, the tourist potential is high; if values are between 3 and 8, the potential is satisfactory and if it exceeds the 8, the potential is reduced.

The main disadvantages of this formula are:

- indicated value is an arbitrary number, without absolute significance, respectively can not be concluded that in a complex the touristic activities are, for example, five times more favorable than in another place, but just there are more favorable conditions;

- it does not take in consideration other climate elements (wind, sunshine duration, humidity etc.), which is why can give misleading results when is applied to other regions than those in the mediterranean[21].

b) Touristic climatic index (TCI) elaborate by R. Clausse and A. Guérout, calculated using the formula:

I = (S+T-5D)/5, with:

S = duration of sunshine (hours);

T = average monthly temperature (ºC);

D = duration of precipitations (hours) in daytime between 7am and 7pm.

c) Maritime climatic index (MCI) proposed by I. Sarramea (1980):

ICM=(T+Te+I) – (N+Nv+Nk+Ng+Nn), where:

T = average temperature of air (ºC);

Te = average temperature of the water sea (ºC);

I = average duration of sunshine (h/day);

N = number of rainy days;

Nv = number of days with strong wind (v>16 m/s);

Nk = number of days with fog;

Nn– number of days with snow;

Ng – number of days with ground frost.

Each parameter is determined as the monthly average. The favorable season for spa activities is indicated by a MCI value higher than 20. A negative result prevents any touristic activity, while positive in winter promotes tourism activities[21].

The analysis of these indices is based on data and meteorological observations recorded in 30 years (1981 - 2010), at six weather stations located in the in the Romanian Black Sea Coast**:** Mangalia, Constanța, Medgidia, Gura Portiței, Sulina and Tulcea**.** In order to highlight the climatic-touristic potential of the Romanian Black Sea Coast, this study includes the months May and September (even if these are outside the summer season - June, July and August -, because favorable conditions can be found in order to practice tourism, respectively spa activities).

RESULTS AND DISCUSSIONS

THE MONTHLY CLIMATIC-TOURISTIC POTENTIAL OF THE ROMANIAN BLACK SEA COAST

Corroborating the recorded values of the average air temperature and the number of rainy days (parameters that are found in the equation of Burnet's spa climatic index), we note that the time when each of them gets values conducive to tourism, is between May and September, with a obvious peak in July. Also, analyzing the data obtained for each weather station, it is found that, the mean air temperature calculated for the period from May to September evolves descending from south to north, respectively: Mangalia, 21.47°C, Constanta, 21.25°C, Gura Portitei, 21.05°C și Sulina, 21.01°C. For the other two weather stations, Medgidia and Tulcea, the average air temperatures included in the May- September interval are lower, 20.55°C, respectively 20.73°C, as they are geographically positioned at a certain distance from the seashore.

By analyzing the monthly climatic-touristic potential of the the Romanian Black Sea Coast, according to the spa climatic index (SCI) elaborate by Burnet (1963), we can note that the most favorable months for tourism are July and August, for all six weather stations, with index values located around 0.0 and 0.1. Follows the months of June, May and September, with the averages index of 0.03, 0.11, and 0.13. Winter months have the lowest potential for tourism because the temperatures are low and number of rainy days is high. The unfavorable month is January, at all six weather stations, the lowest values of Burnet index recorded in Medgidia (-24.28°C) and Tulcea (-20.18°C) (Table 1).

Table 1. The monthly spa climatic index of Burnet (1963) calculated for the Romanian Black Sea Coast (1981 - 2010)

Weather stations	SCI=N/T	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Gura Portiței	*N*	4.8	3.7	5.5	4.1	2.4	1.0	0.2	0.3	3.0	4.0	5.7	5.0
	T	0.4	1.7	5.9	11.0	16.9	21.3	24.3	24.2	18.7	13.6	8.1	1.9
	ICB	**13.09**	**2.24**	**0.93**	**0.37**	**0.14**	**0.05**	**0.01**	**0.01**	**0.16**	**0.30**	**0.70**	**2.65**
Sulina	*N*	3.6	3.4	4.3	2.9	1.3	0.4	0.0	0.0	0.9	3.6	4.0	5.0
	T	0.9	2.0	5.7	10.6	16.9	21.2	24.1	24.1	18.7	13.6	8.3	2.9
	ICB	**3.99**	**1.68**	**0.75**	**0.27**	**0.08**	**0.02**	**0.00**	**0.00**	**0.05**	**0.27**	**0.48**	**1.71**
Tulcea	*N*	6.0	5.2	7.4	4.5	1.9	0.8	0.6	0.3	2.4	6.2	6.9	7.0
	T	-0.3	1.8	6.0	11.0	17.3	21.4	24.1	23.4	17.5	11.9	7.0	1.3
	ICB	**-20.18**	**2.92**	**1.23**	**0.41**	**0.11**	**0.04**	**0.03**	**0.01**	**0.13**	**0.52**	**0.99**	**5.41**
Medgidia	*N*	6.7	4.6	7.3	5.5	2.5	1.2	0.3	0.3	3.1	6.6	6.9	7.6
	T	-0.3	1.9	6.0	10.6	16.8	21.3	23.6	23.5	17.6	12.2	7.2	1.4
	ICB	**-24.28**	**2.41**	**1.21**	**0.52**	**0.15**	**0.06**	**0.01**	**0.01**	**0.18**	**0.54**	**0.96**	**5.42**
Constanța	*N*	7.0	6.1	7.1	4.9	2.1	0.2	0.0	0.2	2.6	5.4	7.1	7.0
	T	1.1	2.9	6.8	10.8	16.9	21.6	24.4	24.4	19.0	13.6	8.6	3.0
	ICB	**6.36**	**2.09**	**1.05**	**0.46**	**0.12**	**0.01**	**0.00**	**0.01**	**0.13**	**0.40**	**0.82**	**2.31**
Mangalia	*N*	6.3	5.6	6.6	4.5	1.5	0.0	0.0	0.0	2.0	5.0	6.4	5.5
	T	1.3	3.3	7.0	11.0	17.0	21.8	24.7	24.7	19.1	13.5	8.5	3.0
	ICB	**4.81**	**1.70**	**0.94**	**0.41**	**0.09**	**0.00**	**0.00**	**0.00**	**0.10**	**0.37**	**0.74**	**1.84**

Data source: NMA Archive

In conclusion, after analyzing data about the number of rainy days and the average air temperature during the warm season (May-September) between 1981-2010 (according to which it was determined the Burnet's spa climatic index), we can observe that the Romanian Black Sea Coast has a high touristic potential. The evolution of the monthly spa climatic index at all six weather stations on the Romanian Black Sea Coast can be seen in Figure 2.

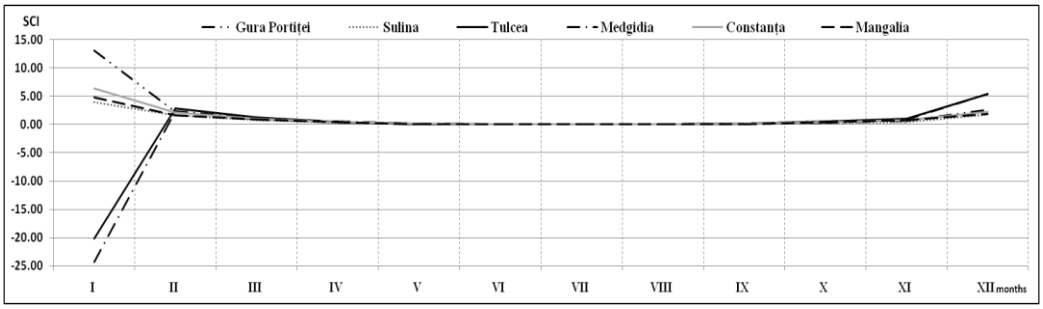

Fig. 2. The evolution of the monthly spa climatic index for the Romanian Black Sea Coast (1981 - 2010) (*Data source: NMA Archive)*

The analysis of climatic touristic potential based on the formula developed by R. Clausse and A. Guérout is more complex because it takes into account three meteorological parameters with a greater impact on the tourism potential of the warm season (May to September), ie monthly average temperature (ºC), duration of

sunshine (hours) and duration in hours of rainfall during the day between the hours of 7am and 7pm. This index allows to establish optimal duration for tourism season and outdoors cures during the warm season. Using the data from Table 2, it can get the value of touristic- climatic index (TCI) from all six weather stations analyzed for the entire warm season (May-September), but also for each month in part. With July being the hottest month, the touristic climatic index reaches the maximum value at all six weather stations, registering the highest degree of favorability for sunbathing. In terms of spatial distribution, the climatic - touristic potential decreases from southern to northern seaside. Thus, the highest values of TCI in July are registered at Mangalia (74.57 points), followed by Medgidia (73.42 points), Constanta (73.08 points), Sulina (72.92 points), Tulcea (69.72 points) and Gura Portiţei (66.28 points). Follows August, with a high value of the touristic-climatic index (more than 64 points) at all weather stations analyzed. Similarly to the previous month, the highest values are recorded in southern coastline, at Medgidia (70.50), Mangalia (69.79) and Constanța (68.29), and the lowest at Gura Portiței (64.07) și Tulcea (67.59). An exception is Sulina, with a high value of index (68.25), close to that of Constanța in August (68.29) (Table 2).

In the month of June, the climatic touristic potential is kept at a high level, especially in southern coastline near the shoreline (Mangalia, 68.03; Constanta, 66.10), in contrast to those in the north coast (Tulcea, 63.02; Gura Portiţei, 61.21). Only Sulina values are within the southern coastline with 65.87. May and September recorded a satisfying tourism potential, with more favorability for May, because of longer durations of sunshine. In the winter season, touristic-climatic potential is lower, due to low air temperatures, reduced number of hours of sunshine and the large number of hours of rainfall during the day. The less favorable months are December and January, for all six weather stations, followed by November and February (Figure 3).

Table 2. The monthly touristic-climatic index (TCI) of Clausse - Guérout (1955) calculated for the Romanian Black Sea Coast (1981 - 2010)

Weather stations	I=S+T-5D/5	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Gura Portiței	*S*	90.76	111.97	159.83	219.03	289.38	299.18	319.11	306.04	217.53	166.28	100.10	79.69
	T	0.37	1.65	5.88	11.01	16.85	21.28	24.29	24.15	18.70	13.55	8.15	1.90
	D	4.54	4.02	3.67	3.22	3.06	2.88	2.40	1.97	3.03	4.22	4.23	4.12
	I	**13.68**	**18.70**	**29.47**	**42.79**	**58.19**	**61.21**	**66.28**	**64.07**	**44.21**	**31.75**	**17.42**	**12.20**
Sulina	*S*	81.26	107.65	161.29	222.96	308.34	322.10	352.33	326.64	221.25	164.42	100.12	72.04
	T	0.91	2.02	5.69	10.62	16.91	21.24	24.05	24.11	18.72	13.56	8.29	2.91
	D	4.40	3.90	3.55	3.13	3.02	2.80	2.36	1.90	2.98	4.09	4.33	4.26
	I	**12.03**	**18.04**	**29.85**	**43.59**	**62.03**	**65.87**	**72.92**	**68.25**	**45.01**	**31.51**	**17.35**	**10.73**
Tulcea	*S*	85.58	113.70	170.82	224.80	300.98	314.15	340.40	326.80	228.63	168.24	98.47	70.60
	T	-0.30	1.78	5.98	10.97	17.32	21.37	24.05	23.37	17.54	11.90	7.00	1.29
	D	5.20	4.33	4.39	4.10	4.03	4.08	3.17	2.44	4.05	4.40	4.64	5.05
	I	**11.86**	**18.77**	**30.97**	**43.05**	**59.63**	**63.02**	**69.72**	**67.59**	**45.18**	**31.63**	**16.45**	**9.33**
Medgidia	*S*	80.88	112.85	173.00	233.49	305.58	328.29	358.93	340.74	231.98	169.53	109.38	78.32
	T	-0.28	1.89	6.04	10.58	16.83	21.30	23.59	23.45	17.61	12.23	7.21	1.41
	D	5.19	4.30	4.22	4.11	4.00	4.07	3.08	2.34	4.01	4.33	4.70	5.01
	I	**10.93**	**18.65**	**31.59**	**44.70**	**60.48**	**65.85**	**73.42**	**70.50**	**45.91**	**32.02**	**18.62**	**10.93**
Constanța	*S*	82.65	111.26	153.01	219.33	296.04	325.72	354.58	327.01	218.90	161.38	107.61	80.25
	T	1.10	2.94	6.79	10.79	16.85	21.57	24.39	24.45	19.02	13.58	8.65	3.02
	D	4.77	4.37	3.89	3.69	3.67	3.36	2.71	2.01	3.54	4.45	4.67	4.44
	I	**11.98**	**18.47**	**28.07**	**42.33**	**58.91**	**66.10**	**73.08**	**68.28**	**44.04**	**30.54**	**18.58**	**12.21**
Mangalia	*S*	83.92	112.44	154.88	222.12	301.46	333.93	361.13	334.65	222.61	162.88	108.99	81.40
	T	1.30	3.28	6.99	10.97	17.02	21.81	24.65	24.75	19.12	13.54	8.55	3.01
	D	4.05	3.55	3.56	3.40	3.21	3.12	2.59	2.09	3.37	3.98	4.43	4.45
	I	**12.99**	**19.59**	**28.81**	**43.22**	**60.49**	**68.03**	**74.57**	**69.79**	**44.98**	**31.30**	**19.08**	**12.43**

Data source: NMA Archive.

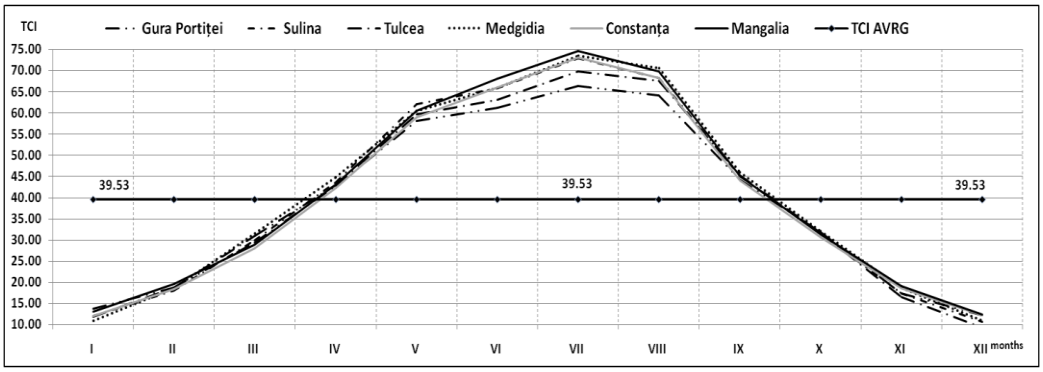

Fig. 3. The evolution of the monthly touristic-climatic index of Clausse - Guérout (1955) (1981 - 2010) *(Data source: NMA Archive)*

Relating to the whole warm season, respectively May-September interval, we can say that the Romanian Black Sea Coast has a high tourism potential. The most favorable touristic-climatic conditions, accordance with the values registered by TCI, are at Sulina (68.82 points), due to reduced number of hours of rainfall during the day (2.61 hours) and the high number of hours of sunshine. At the opposite pole lies Gura Portiţei weather station with the lowest TCI (58.79 points), followed by Tulcea (61.03) (Table 3). This is due, in particular, to weather instability, with negative effects on tourism potential.

Table 3. Average values for the summer season (mai-sepembrie), for the elements calculated for the determination of the climatic- touristic index in the Romanian Black Sea Coast (1981 - 2010)

Weather stations	The average of the summer season			
	S (hours)	T (°C)	D (hours)	ICT
Gura Portiței	286.25	21.05	2.67	58.79
Sulina	306.01	21.01	2.61	68.82
Tulcea	302.19	20.73	3.55	61.03
Medgidia	313.10	20.55	3.50	63.23
Constanța	304.45	21.25	3.06	62.08
Mangalia	310.76	21.47	2.88	63.57

Data source: NMA Archive.

The evolution of multiannual seasonal averages values for TCI, recorded at all six weather stations analyzed, can be observed in Figure 3. According to this index, the Romanian Black Sea Coast is characterized by a high climatic-touristic potential in warm season (May to September), the most favorable months being July and August.

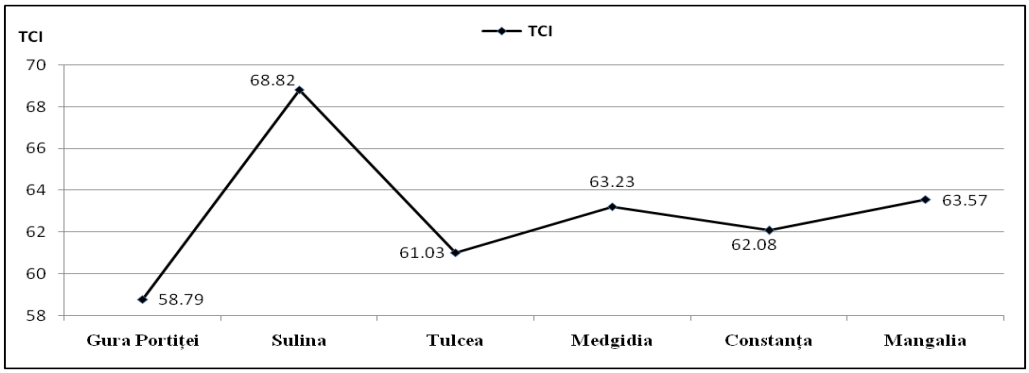

Fig. 3. The evolution of average values of the climatic-touristic index (TCI) for the warm season (May-September (TCI) in the Romanian Black Sea Coast (1981 – 2010).
(*Data source: NMA Archive)*

For a more complex characterization of the climati- touristic potential of Romanian Black Sea Coast has been taken into account the marine-climatic index proposed by Sarramea (1980). This propose to analyze, in addition to the other two indices (Burnet's spa index and touristic-climatic index Clausse-Guérout) the following elements: sea water temperature (Te); number of days with strong winds (v> 16 m / s); number of days with fog (Nk); number of days with snow (Nn) and number of days with ground frost (Ng).

Analyzing the monthly evolution of these parameters (according to which it was determined the maritime-climatic index of Sarramea) for the period 1981-2010, it was found that favorable interval for balneary activities is May-September. The values shown in this range is above the annual average of 23.0 points (Table 4). July and August are the most favorable for all six weather stations, due to high air temperatures and sea water, long duration of sunshine, on the background of low number of days with rain and strong wind. The maximum value of this indicator is at Mangalia in August (60.30). Also at Mangalia was recorded the highest value in July, 60.05 points. At the other stations, the index value is high, both in July and August, more than 56 points. Follows June, with values above 48 points; the highest values of marine-climatic index are registered in southern coastline, at Mangalia (52.04 points), Constanta (51.16 points) and the lowest in northern coastline, or at large distance from the seashore (Tulcea, 48.71 points; Medgidia 48.84 points).

Table 4. The monthly marine-climatic index (MCI) calculated for the Romanian Black Sea Coast (1981 - 2010)

Weather stations	MCI	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Gura Portiței	T+Te+I	9.48	10.93	16.77	26.21	39.46	50.61	58.46	59.45	49.13	37.81	25.16	13.65
	N+Nv+Nk+Ng+Na	21	16	11	6	3	1	0	0	3	6	13	23
	MCI	-11.58	-5.10	6.10	20.37	36.30	49.51	58.30	58.99	45.86	31.91	12.19	-8.92
Sulina	T+Te+I	9.72	11.15	16.63	25.94	40.13	51.35	59.29	60.07	49.27	37.75	25.30	14.41
	N+Nv+Nk+Ng+Na	14	11	9	5	2	1	0	0	3	6	9	15
	MCI	-4.15	-0.28	7.83	20.74	38.10	50.45	58.93	59.64	46.64	31.75	16.17	-0.65
Tulcea	T+Te+I	8.65	11.13	17.22	26.36	40.30	51.21	58.91	59.34	48.34	36.21	23.96	12.75
	N+Nv+Nk+Ng+Na	32	21	18	9	5	3	2	3	6	14	21	36
	MCI	-22.85	-9.74	-0.34	17.52	35.80	48.71	56.97	56.41	42.71	22.25	2.79	-22.75
Medgidia	T+Te+I	8.52	11.21	17.36	26.26	39.96	51.61	59.04	59.87	48.52	36.58	24.53	13.12
	N+Nv+Nk+Ng+Na	34	21	17	11	5	3	2	3	5	13	21	35
	MCI	-25.55	-10.03	-0.07	15.76	34.79	48.84	56.77	56.64	43.92	23.92	3.83	-21.72
Constanța	T+Te+I	9.95	12.20	17.46	25.99	39.68	51.79	59.70	60.43	49.49	37.68	25.91	14.79
	N+Nv+Nk+Ng+Na	25	18	14	8	3	1	1	1	3	9	15	27
	MCI	-14.91	-5.94	3.53	18.16	37.01	51.16	59.20	59.43	46.46	29.18	10.74	-11.78
Mangalia	T+Te+I	10.20	12.58	17.72	26.27	40.02	52.30	60.18	60.97	49.72	37.69	25.85	14.82
	N+Nv+Nk+Ng+Na	24	17	11	7	2	0	0	1	3	8	14	23
	MCI	-13.53	-3.92	6.82	19.64	37.88	52.04	60.05	60.30	47.19	29.49	12.05	-8.35

Data source: NMA Archive

Following the evolution of the monthly marine-climatic index (Figure 5), we can see that May and September have an satisfactory tourism potential, with more favorability for the latter one which records values of marine climatic index between 42 and 47 points . In the winter season, the touristic potential is very low, the index recording negative values in all three winter months at all stations.

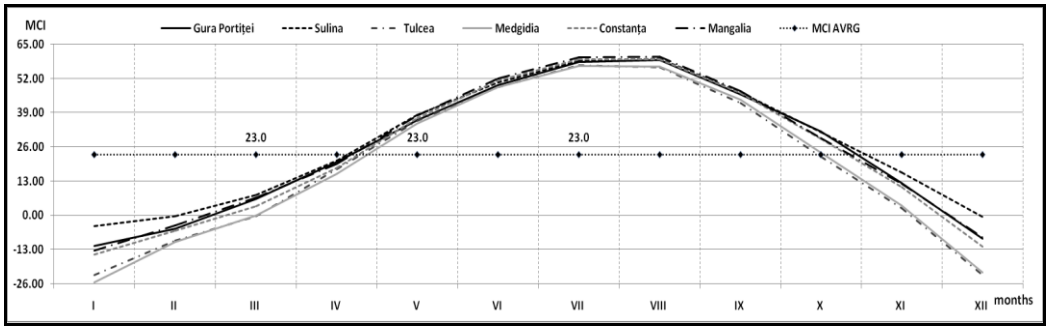

Fig. 5. The evolution of the monthly marine-climatic index (MCI) (1981 - 2010) (*Data source: NMA Archive)*

Using the data from Table 5, we can get the value of marine-climatic index at all six weather stations for the entire summer season (May-September). According to the obtained values of MCI, we can say that the most favorable climatic touristic conditions characterize the southern coastline, respectively Mangalia (51.49 points) and Constanta (50.65 points). Also, Sulina index value is high, 50.75 points, due to low precipitation level in summer. At the opposite pole are weather stations Tulcea and Medgidia, with 48.12 points, respectively 48.19 points, due to the mainland character and weather instability, with negative effects on tourism potential.

The evolution of multiannual seasonal averages for MCI, recorded for all six weather stations, can be viewed in Figure 6. According to the marine-climatic indices, the Romanian Black Sea Coast is characterized by a high touristic climatic potential in warm season (May-September).

Table 5. Average values for the warm season (May - September), for the elements calculated for the determination of the maritim-climatic index (MCI) in the Romanian Black Sea Coast (1981 - 2010)

Weather stations	The average of the summer season		
	T+Te+I	N+Nv+Nk+Ng+Nn	MCI
Gura Portiței	51.43	1.63	49.79
Sulina	52.03	1.27	50.75
Tulcea	51.62	3.5	48.12
Medgidia	51.8	3.61	48.19
Constanța	52.22	1.57	50.65
Mangalia	52.64	1.15	51.49

Data source: NMA Archive.

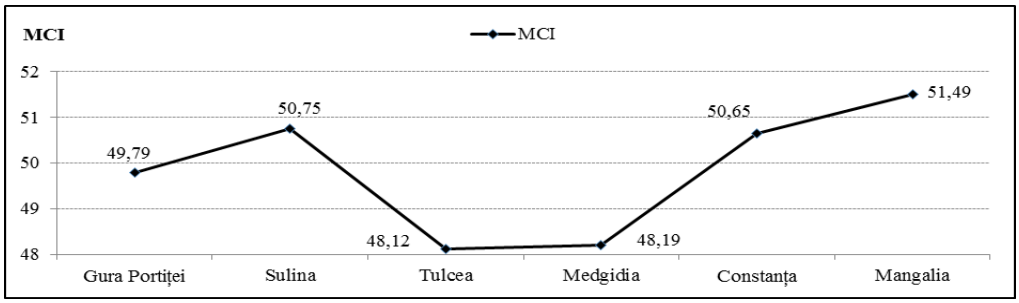

Fig. 6. The evolution of the average values of the marine-climatic index (MCI) in the warm season (May-September), for the Romanian Black Sea Coast (1981 - 2010).
Data source: NMA Archive

THE SEASONAL CLIMATIC-TOURISTIC POTENTIAL OF THE ROMANIAN BLACK SEA COAST

By analyzing the touristic climatic seasonal potential (May-September) it was found that the Romanian Black Sea Coast has an high tourism potential, supported by the Burnet spa's index value recorded in all warm seasons in the analyzed period (1981-2010) (Table 6) with a multi-seasonal average of 0.05. For the analysis on

May-Septembre interval, we note the evolution of the index in the range of average values, between 0.03 to 0.08, for all six stations considered.

Table 6. The spa climatic index of Burnet in the summer season (May-September) calculated for the Romanian Black Sea Coast (1981-2010)

Weather stations	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Gura Portiței	0.08	0.07	0.06	0.02	0.06	0.06	0.06	0.03	0.06	0.03	0.05	0.05	0.11	0.08	0.06
Sulina	0.02	0.01	0.02	0.07	0.01	0.03	0.02	0.03	0.03	0.01	0.04	0.01	0.04	0.02	0.01
Tulcea	0.00	0.09	0.04	0.06	0.07	0.10	0.00	0.08	0.06	0.08	0.04	0.09	0.06	0.07	0.05
Medgidia	0.07	0.08	0.05	0.05	0.08	0.06	0.07	0.07	0.08	0.10	0.06	0.09	0.06	**0.16**	0.10
Constanța	0.01	0.02	0.03	0.05	0.05	0.02	0.02	0.07	0.03	0.02	0.02	0.07	0.05	0.07	0.04
Mangalia	0.01	0.01	0.01	0.03	0.02	0.03	0.03	0.04	0.01	0.01	0.02	0.04	0.06	0.04	0.06

Weather stations	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Gura Portiței	0.05	0.02	0.09	0.05	0.05	0.05	0.13	0.10	0.13	0.10	0.06	0.06	0.05	0.09	0.09
Sulina	0.05	0.02	0.01	0.01	0.01	0.02	0.02	0.05	0.10	0.02	0.06	0.02	0.01	0.02	0.01
Tulcea	0.11	0.02	0.05	0.07	0.10	0.06	0.07	0.03	0.06	0.05	0.07	0.00	0.05	0.05	0.07
Medgidia	0.04	0.08	0.08	0.09	0.10	0.05	0.07	0.06	0.12	0.08	0.04	0.05	0.05	0.05	0.08
Constanța	0.07	0.02	0.08	0.05	0.07	0.01	0.07	0.05	0.07	0.08	0.05	0.04	0.11	0.09	0.05
Mangalia	0.03	0.00	0.07	0.05	0.04	0.00	0.04	0.05	0.02	0.06	0.04	0.03	0.11	0.05	0.02

Data source: NMA Archive

The maximum value of the index was registered in 1994 at Medgidia (Figure 7), when was recorded the maximum average number of rainy days for this period (3.20 days with rain), reported to minimum average air temperature (19.58°C). In conclusion, we can say that the Burnet spa climatic index (SCI) is significantly affected by both the temperature and especially the number of rainy days.

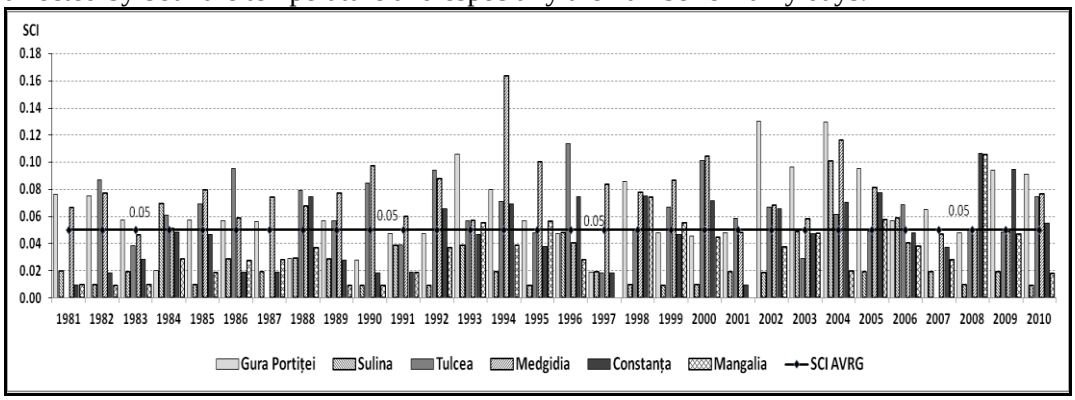

Fig. 7. Variability of the climatic-tourist potential in the warm season for the Romanian Black Sea Coast (1981 - 2010) highlighted by Burnet index
(Data source: NMA Archive)

The analysis of the seasonal touristic climatic potential (May-September) based on the marine-climatic index generates conclusion that the Romanian Black Sea Coast records an high tourism potential in all the warm seasons of the considered period (1981-2010), with a multiannual seasonal average of 49.8. In light of the average annual values for the six months considered (May to September), at all six stations weather, it may be noted that the maritime-climatic index evolves within the values of 43.7 and 54.1 (Table 7). The maximum value of the index was registered in 1989 at Mangalia, when it was recorded the maximum average air temperature of 21.96 ° C., related to the minimum number of days with rain in the analyzed period (0.20 days). The lowest seasonal marine-climatic index was registered in 2004 at Medgidia, when was recorded the coldest average temperature of 18.94 °C and the highest average number of rainy days (2.20 days with rain).

Table 7. The marine-climatic index (MCI) in the warm season (May-September) calculated for the Romanian Black Sea Coast (1981 - 2010)

Weather station	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Gura Portiței	50.2	48.9	50.3	48.9	48.6	50.3	49.8	50.2	50.8	50.6	50.1	50.2	48.6	48.2	49.2
Sulina	50.4	51.9	51.4	47.7	49.8	51.1	52.0	51.6	51.4	52.6	49.2	52.2	50.6	48.9	51.6
Tulcea	49.6	46.8	49.4	45.1	45.8	49.2	50.8	45.8	49.4	48.4	48.7	48.4	48.9	46.1	48.0
Medgidia	49.7	45.0	50.1	47.0	47.1	49.9	48.9	48.9	49.6	46.9	49.2	47.5	48.8	44.9	45.8
Constanța	52.3	51.2	52.1	48.0	50.1	53.0	51.6	51.0	53.2	51.4	51.5	50.4	51.4	48.6	49.1
Mangalia	52.6	51.3	52.4	48.6	50.5	53.1	51.6	51.9	**54.1**	52.1	51.8	51.3	51.2	49.8	49.4

Weather station	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Gura Portiței	49.4	51.2	50.3	50.5	50.9	50.5	47.9	49.3	46.5	48.4	50.5	51.1	50.6	50.6	50.0
Sulina	49.1	52.0	52.5	52.5	52.5	50.0	51.0	49.0	45.2	48.0	48.7	52.6	51.5	52.0	52.2
Tulcea	46.6	50.2	46.1	49.1	46.5	48.1	48.0	49.0	45.1	47.6	49.5	51.7	46.9	48.9	48.5
Medgidia	48.1	49.0	49.9	48.6	47.5	49.8	46.7	49.0	**43.7**	46.0	50.0	49.9	48.9	50.0	48.2
Constanța	49.5	52.2	50.0	51.6	52.1	52.2	49.7	50.1	46.6	48.0	50.9	51.0	48.6	50.3	50.6
Mangalia	51.1	52.7	51.3	52.4	52.7	53.0	50.8	51.3	48.6	48.8	52.1	51.4	50.6	52.6	52.5

Data source: NMA Archive

Following the evolution of seasonal mean values recorded by marine-climatic index (Figure 8) in the period 1981-2010, we see that the lowest values, below the seasonal average multiannual of 49.8, were recorded in the years 1984, 1985, 1994, 2002-2005 and 2008 (Figure 8). In conclusion, we can say that in warm season, the marine-climatic index is significantly affected by the air temperature, sea water temperature, sunshine duration and, especially, the number of rainy days.

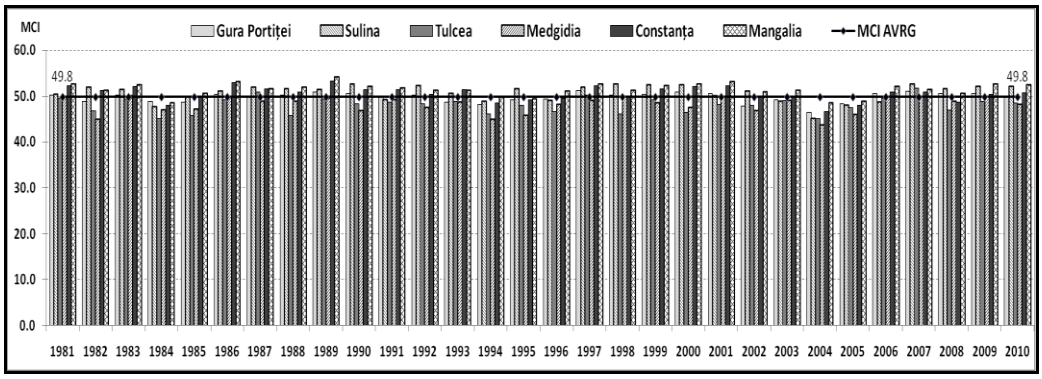

Fig. 8. Variability of the climatic tourist potential in the warm season for the Romanian Black Sea Coast (1981 - 2010) highlighted by the marine climatic indices (Data source: NMA Archive)

CONCLUSIONS

Interpreting the touristic climatic potential for the Romanian Black Sea Coast (1981 - 2010), based on climatic indices developed by Burnet (1963), Clausse - Guérout (1955) and I. Sarramea (1980), we can draw the following conclusions:

a) According to the spa climatic index values (SCI), we can note that the Romanian Black Sea Coast has a high tourism potential between May to September. The most favorable months for tourism are July and August, for all six weather stations, with index values located around 0.0 and 0.1.

b) According with touristic-climatic index (TCI) values, the Romanian Black Sea Coast records an high tourism potential in the the warm season (May-September), the most favorable month being July for all six weather stations. Analysing seasonal mean values for the entire period (1981-2010), we find that the most favorable touristic-climatic conditions are recorded at Sulina (68.82 points), due to reduced number of hours of rainfall during the day (2.61 hours) and the high number of hours of sunshine. At the opposite pole is Gura Portiței weather station with the lowest TCI (58.79 points), followed by Tulcea (61.03). The south and central part of the coast recorded a high multiannual seasonal average, respectively: Mangalia, 63.57; Constanta, 62.08; Medgidia 63.23.

c) According to the marine-climatic index (MCI), the Romanian Black Sea Coast is characterized by a high touristic climatic potential in warm season (May-September), most favorable months being July and August, for all six weather stations. The maximum values of this indicator were reached at Mangalia in August (60.30) and July (60.05). Following the spatial distribution of values of this index, we find that these are decreasing from south to north, just Sulina having high values, apropiate to the south coast.

d) Following the evolution of annual seasonal mean values of marine-climatic index, we see that in some years (1984.1985, 1994, 2002-2005 and 2008) were recorded values below multiannual seasonal average of 49.8, which shows that this index is affected, in particular, by the number of rainy days.

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