PRESENT ENVIRONMENT AND SUSTAINABLE DEVELOPMENT, VOL. 7, no. 2, 2013

INTERANNUAL VARIATION OF THE AVERAGE VALUES OF THERMO-HYGROMETER INDEX ON THE SOUTH DOBROGEA TERRITORY

Elena Grigore[1]

Keywords: time variation, temperature-humidity index, bioclimatic comfort.

Abstract. Interannual variation of the average values of thermo-hygrometer index on South Dobrogea territory. The bioclimatic factor is a useful tool in scientific research because it provides a wide range of assessment techniques of either positive or negative influences that a climate of a region may have on human health. This study focuses on the analysis of the thermo-hygrometric index (THI), which was calculated according to air temperature and humidity value variations throughout the year, to provide information on the extent and intensity of the area of bioclimatic comfort and/or discomfort in Southern Dobrogea tableland area, subjected to various climatic influences.

Introduction

Scientific studies have confirmed, in time, that the climate influences both the activities of all living beings and human society (Ciulache, Ionac, 1998), although the relationships between its components are highly complex.

The bioclimatic researches, made over time, have confirmed that the subjective perception which the human body feels regardless of the environmental conditions (Ionac, 2007) is the basis for the definition of the state of bioclimatic comfort or discomfort, that may best be quantitatively and qualitatively expressed by means of various biometeorological/bioclimatic indices.

For example, the thermal comfort perceived by the human body is actually a condition of mental and physical wellbeing of man, resulting from the relationships and exchanges taking place between humans and their living environment, i.e. the place where they live and perform their regular activities.

The bioclimatic analyses actually express the climatic influences on human health, both by the individual manifestation of the climatic characteristics and by the simultaneous action of two or more such influences.

The bioclimatic factor, seen as a tool, becomes an *"important component in the treatment of climate",* because it highlights the relationship effect between the

[1] Assistant Ph.D., University of Bucharest, ela_zigzag@hotmail.com

following climatic parameters: air temperature, relative humidity and wind speed. But the bioclimatic factors are not entirely responsible for the human comfort, because beside them, subjective factors may participate in the individual heat exchange reactions, that impose and put to test the various states of comfort and well-being, which may greatly vary between individuals.

This analysis aims to provide a synthetic and suggestive image regarding the progress in time, over a period of 30 years (between 1971 and 2000) and the spatial extent of bioclimatic comfort/ discomfort in South Dobrogea tableland area.

1. Input data and methods

The basic information of this study was provided by the Dobrogea Regional Meteorological Centre (in Constanţa) and the National Administration of Meteorology (in Bucharest), on air - temperature (°C) and relative humidity (%) values, recorded over a period of 30 years, at six meteorological stations (Hârşova, Cernavodă, Adamclisi, Medgdia, Constanţa, Mangalia).

The database was then enriched by calculating the corresponding THI index values, and by comparing the resulting values to the standard reference values of the above-mentioned bioclimatic index. In the development and completion of this study, I relied mainly on the recorded meteorological data, but also on the prior specialized references of bioclimatic research work, which developed different methods of measurement and analysis. From this point of view, the present study focuses on the qualitative and quantitative analysis of bioclimatic and meteorological data series representative of a long-term interval and important area of interest (Grigore, 2012).

The main research methods were *the processing and the interpretation* of the meteorological and bioclimatic data, obtained by mathematically calculating the average values, frequencies, mean duration of intervals etc. and *their graphical representation*, providing clear synoptic patterns of variation for all parameters of interest of the TH index, allowing a rapid understanding of the information, especially through case-studies emphasizing the bioclimatic variability.

Of course, if taking into account the applicability limits of the formulas for the calculation of each bioclimatic index, the resulting values obviously referred to typical seasonal months (Winter, Spring, Summer, Autumn), and the accompanying graphical representations provided a highly suggestive image on the intensity and extent of bioclimatic risk areas by over-cooling or over-heating processes of the South Dobrogea territory.

In specialized literature, the THI index is considered as an approximate variant of Thom's discomfort index, being ranked as one of the best indicators of the effective temperature, which expresses the combined effect of air- temperature and relative humidity on human health, but also of the air movements in the region.

Therefore, W.J. Kyle concluded that the THI index (Kyle, 1994), unlike the Thom's index, allows the classification of the conditions and types of weather, both for thr hot season and the cold season, as well as the excessively hot or cold conditions.

The Temperature-Humidity index (THI) indicates the conditions under which certain values of atmosphere moisture affects human thermoregulatory mechanisms, thus intensifying the state of bioclimatic discomfort due to either over-heating or over-cooling conditions.

Actually, it expresses the real ambient temperature that is effectively being perceived by the human organism, under specified conditions of humidity and air temperature, calculated through Kyle's mathematical formula (Ionac, Ciulache, 2008):

$$\mathbf{THI\ (°C) = T_{usc} - (0.55 - 0.0055 \times UR) \times (T_{usc} - 14.5)}$$

where: T_{usc}= air temperature (°C) measured on dry-bulb thermometer; UR = relative air humidity (%)

The identification of the areas of bioclimatic comfort and/or discomfort, that best express the physiological sensations of heat or cold stress, in any point and moment of the year was possible mainly due to the variation scale of the THI values (Table 1) (Ionac, Ciulache, 2008).

Tab. 1 - Limits of applicability and the THI threshold values (^{0}C) corresponding to different types of bioclimate

Indices THI - °C -	Bioclimatic type	Type of bioclimatic comfort / discomfort
– 20 < THI ≤ – 10	Excessive cold	**Bioclimatic discomfort due to overcooling**
– 10 < THI ≤ – 1.8	Very cold	
– 1.8 < THI ≤ + 13	Cold	
+ 13 < THI ≤ + 15	Cool	
+ 15 < THI ≤ + 20	Comfortable	**Bioclimatic comfort**
+ 20 < THI < ≤ 26.5	Hot	Section 1.01 Bioclimatic discomfort by heating
+ 26.5 < THI ≤ + 30	Very hot	
THI > + 30	Sultriness	

The bioclimatic indices have been calculated by means of electronic computer programs based on the introduction of mathematical formulas of reference for each bioclimatic parameter (Bucerzan, Vulpe, 2006). Useful elements in calculations were also previously adapted to the system of units used in Romania (Ionac, Ciulache, 2008). The delimitation of bioclimatic risk areas was based on the variation scales

generally accepted at international level, which call for the harmonization of all the bioclimatic indices calculated at any scale and area of reference.

1. Results and discussions

The large inter-annual variability of the THI index values is mainly due to the constantly changing weather types, determined by the continuous shift in the types of air circulation or the influence of local climate factors (the thermal influence of sea water, the excessive heating / cooling of air and the decrease of water vapor content over land surfaces within the Dobrogea plateau).

This study actually highlights the large bioclimatic differences from one meteorological station to another, from one period to another and from one year to another, for the entire period of analysis (1971-2000). The variation of bioclimatic types, as reflected by the THI index values, are graphically shown in synoptic tables, by means of colors corresponding to the various classes of values and/or bioclimates (Tables 3, 4, 5, 6).

By analyzing the THI index values that were obtained through mathematical calculations, in accordance with threshold variations, we can see that they indicate the predominance of ***bioclimatic discomfort by cooling*** processes from October until April. The associated types of bioclimates actually being perceived by the human body fell into the chilly, cold and very cold classes.

The bioclimatic comfort becomes dominant in May, to a 100% weather type share, especially in the western and central parts of the analyzed territory. It is also present in June, in proportion of 70% and scarcely reappears in September in proportion of 93%.

The bioclimatic discomfort by heating dominates the summer months (July, August), the sensation perceived by the human body falling into the warm class type.

By analyzing the THI index values calculated, according to their limits of applicability shown in Table 1, for all months of the period of reference, we found that, on the South Dobrogea territory, they vary from a minimum value of –6.85°C at Hârşova (in February 1985) (Table 2) to a maximum value of +24.86°C at Mangalia (in August 1997) (Table 4).

Also, the THI multi-annual average for the period of reference ranged between +0.15°C at Hârşova, in January, and +21.53°C at Cernavodă, in July. If looking at Table 2, we also notice that the sensation of cold prevailed in the winter months in 94% of cases and only in 6% of cases, the bioclimatic perception indicated very cold conditions that prevailed all through the analyzed period in the western and central parts of the South Dobrogea plateau.

The analysis of the THI values obtained through mathematical calculations for the winter months of the period of reference, also indicates that, in the South

Dobrogea Plateau area, they ranged from a lowest value of -6.85°C at Hârşova, in February to a maximum value of +7.98°C in Mangalia, in December 1982. Even if in some analyzed years, the sensation of cold is also being felt, when looking at the average corresponding values of winter months during the period of reference, we can identify positive values, with a variation from +0.15°C at Hârşova to +4.48°C in Mangalia, including all the analyzed territory in the bioclimatic cold area.

The synoptic Table 3 showing the spring months variations of the THI, reveals the predominance of bioclimatic discomfort due to over-cooling conditions in March-April and the onset of bioclimatic comfort in 75.8% of cases in May, when the cold sensation is also present in 24.2% of cases, predominantly on the Black Sea Coast.

The THI values calculated, according to the thresholds of variation for the spring months (March, April and May) of all the period of analysis, indicate a variation of annual averages from a minimum of +0.01°C at Adamclisi, in March 1987, to a maximum of +18.31°C at Hârşova, in May 1996.

Tab. 2 – The inter-annual variation of the average values of the THI index (^{0}C) in the winter months (December, January, February) in South Dobrogea (1971 – 2000)

Year / Period	WESTERN DANUBEAN AREA						CENTRAL CONTINENTAL AREA						EASTERN SEASIDE AREA					
	HARŞOVA			CERNAVODĂ			ADAMCLISI			MEDGIDIA			CONSTANŢA			MANGALIA		
	12	01	02	12	01	02	12	01	02	12	01	02	12	01	02	12	01	02
1971	3,25	2,35	2,16				3,51	2,58	2,03	3,21	2,83	2,23	4,44	4,71	3,49	4,75	4,87	3,37
1972	2,28	- 1,19	1,69				1,49	- 1,19	1,14	2,40	-0,72	1,17	3,94	0,39	1,06	3,66	0,97	0,89
1973	0,46	- 1,00	4,03				2,20	- 1,46	4,41	1,83	-0,54	4,68	3,41	0,47	5,14	4,13	0,94	5,30
1974	3,09	- 1,65	3,73				3,57	- 1,93	3,51	3,41	-1,09	3,76	5,19	- 0,26	4,10	5,50	0,35	4,25
1975	0,82	2,56	1,41				1,61	2,70	0,71	1,64	2,94	1,25	3,14	4,62	2,53	3,77	4,40	2,45
1976	2,85	0,58	-2,11				3,64	2,33	-1,44	3,41	1,47	-1,28	5,01	2,75	-0,45	5,36	3,53	0,61
1977	-1,18	0,49	5,87				-0,72	1,62	7,07	-0,98	1,30	6,42	3,94	2,40	6,74	1,83	2,85	6,93
1978	1,42	0,19	1,27				2,66	0,73	1,72	2,61	0,33	1,97	3,88	1,77	2,74	5,09	2,24	3,49
1979	4,19	- 0,71	1,56				5,10	1,02	2,02	4,84	0,68	2,51	6,53	1,93	2,91	6,75	2,31	4,10
1980	1,30	- 2,22	0,31				2,14	- 1,27	-0,04	2,23	-1,18	0,75	3,97	1,15	1,34	4,62	1,49	2,29
1981	3,60	- 1,08	0,65				4,23	- 0,89	1,44	4,44	- 0,14	1,96	5,90	1,36	2,94	7,20	1,85	3,86
1982	4,94	- 0,91	-1,37				5,49	- 0,35	-1,18	5,96	- 0,26	-0,36	7,20	1,52	0,99	7,98	2,44	1,93
1983	-0,03	2,33	1,53				5,12	3,19	1,89	2,15	3,50	2,72	7,20	5,07	5,11	4,67	5,66	4,06
1984	0,33	2,42	0,28				0,47	2,55	-0,15	1,47	3,23	1,51	3,37	4,01	1,54	3,44	4,75	2,75
1985	2,28	- 4,81	-6,85				3,88	- 3,27	-5,86	3,63	- 2,57	-5,44	2,40	- 0,36	-2,89	5,83	- 0,23	-3,31
1986	-0,34	1,76	-1,27	0,58	2,59	-1,09	0,83	2,66	-1,07	0,70	2,75	-0,25	5,10	4,16	0,71	2,67	4,55	1,44
1987	0,22	- 3,95	-0,58	0,53	- 2,98	0,13	0,80	- 2,88	0,13	1,28	- 2,59	-0,13	2,51	- 0,54	1,20	3,18	0,17	1,37
1988	1,25	2,07	1,83	1,00	2,64	2,54	1,94	2,44	2,23	1,89	2,87	2,98	3,14	4,44	3,73	4,01	4,51	3,13
1989	2,33	1,14	4,85	3,39	0,67	5,24	3,60	1,64	5,21	3,90	1,48	5,18	3,26	2,35	5,93	5,61	3,05	5,71
1990	3,02	3,98	5,01	3,12	- 1,94	5,08	2,99	- 0,54	5,12	3,78	- 0,54	5,47	5,29	1,23	6,31	6,20	2,57	6,58
1991	-2,03	1,36	-0,07	-2,22	1,79	0,45	-2,03	1,73	-0,15	-1,94	2,36	0,89	5,34	2,91	1,08	0,44	3,28	2,26
1992	-0,12	0,10	0,85	0,10	0,19	1,84	0,10	0,45	1,52	0,56	0,56	1,78	-0,33	2,14	2,75	2,11	2,62	2,32
1993	3,77	1,31	1,64	4,40	1,75	0,96	4,59	2,25	1,21	4,65	2,49	1,39	2,50	3,35	2,90	5,97	3,12	2,66
1994	1,85	4,28	3,21	2,07	4,16	3,16	2,02	4,31	2,67	1,88	4,17	2,61	5,88	5,36	3,57	4,28	5,44	3,77
1995	0,35	0,17	6,20	0,39	0,10	6,39	0,54	- 0,14	6,19	0,46	- 0,22	6,15	3,92	2,33	7,24	3,60	2,33	6,46
1996	0,84	- 1,44	-0,81	1,13	- 2,12	-1,28	0,84	- 3,09	-1,37	1,25	- 2,61	-1,36	2,52	- 0,71	0,38	3,63	- 0,43	0,47
1997	1,32	- 2,03	1,87	2,33	- 1,84	2,78	2,59	- 1,37	2,84	2,30	- 1,84	2,18	3,21	- 0,50	3,62	4,37	1,08	3,95
1998	-2,99	1,97	2,85	-1,27	3,10	4,19	-1,65	2,93	4,08	-1,75	2,68	3,26	-0,25	4,13	3,94	0,72	4,53	4,58
1999	3,15	0,71	2,54	4,91	1,89	3,97	4,86	2,02	3,39	4,46	2,55	3,91	5,85	2,83	4,25	6,56	3,76	4,54
2000	3,98	- 4,08	2,83	5,50	- 2,48	4,49	5,16	- 3,28	3,72	4,80	- 2,90	3,75	6,32	- 1,18	5,01	6,66	- 0,27	4,98
1971 - 2000	**1,54**	**0,15**	**1,50**	**1,73**	**0,50**	**2,59**	**2,38**	**0,51**	**1,76**	**2,34**	**0,69**	**2,05**	**4,12**	**2,12**	**2,99**	**4,48**	**2,62**	**3,23**

12 – December; 01 – January; 02 – February.

The above-mentioned synoptic table highlights the prevalence of bioclimatic discomfort conditions by cooling processes, with cold sensations dominating, but

also with chilly sensations on the southern Romanian seaside area, in the area of Mangalia resort town.

Tab. 3 – The inter-annual variation of the average values of the THI index (^{0}C) in the spring months (March, April, May) in South Dobrogea (1971 – 2000)

Year / Period	WESTERN DANUBEAN AREA						CENTRAL CONTINENTAL AREA						EASTERN SEASIDE AREA					
	HARŞOVA			CERNAVODĂ			ADAMCLISI			MEDGIDIA			CONSTANŢA			MANGALIA		
	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05	03	04	05
1971	5,08	11,18	16,99				4,77	10,10	15,91	4,62	10,24	16,48	4,80	9,81	15,96	4,74	9,06	15,50
1972	6,67	14,16	16,50				6,34	13,41	15,86	5,97	13,52	16,20	5,50	12,02	15,90	4,59	11,17	15,22
1973	3,89	11,67	16,15				3,07	10,65	15,59	3,82	10,85	15,85	4,31	10,02	14,76	4,00	9,63	14,58
1974	5,71	9,60	15,60				4,67	8,54	14,83	5,27	8,78	15,19	4,69	8,53	14,58	5,33	8,46	13,86
1975	8,48	12,47	17,36				8,62	11,95	16,01	8,30	12,14	16,61	7,87	11,79	16,43	7,43	11,05	15,87
1976	3,82	11,44	15,76				4,01	11,20	15,12	3,70	11,07	15,34	3,57	10,42	14,75	4,07	9,63	13,69
1977	6,85	10,81	15,88				6,46	10,18	15,00	6,28	10,39	15,74	6,33	9,91	15,05	6,39	9,92	14,41
1978	6,51	10,96	14,76				6,46	10,19	14,41	6,42	10,34	14,50	6,13	10,01	14,59	6,23	9,81	14,32
1979	8,25	11,22	17,49				8,64	10,61	17,03	8,09	10,64	17,01	7,08	9,89	16,89	7,12	9,69	16,31
1980	2,80	10,05	14,68				2,52	9,63	14,50	3,01	9,90	14,41	3,25	9,36	14,31	3,73	9,36	13,96
1981	6,46	10,10	15,37				6,83	9,87	14,32	6,74	10,07	14,50	7,02	10,16	14,76	7,11	10,38	14,41
1982	4,74	9,66	16,25				4,22	8,97	15,84	4,92	9,40	15,75	5,39	9,30	15,20	5,96	9,67	14,92
1983	7,16	12,92	17,51				7,35	12,65	17,12	7,39	12,27	17,10	7,30	11,36	16,84	7,16	10,76	16,59
1984	3,82	9,30	16,88				3,08	8,33	16,68	4,22	9,22	16,39	4,19	8,89	15,32	4,63	9,30	15,22
1985	2,33	12,30	18,09				2,09	12,15	17,71	2,26	12,18	17,69	1,61	11,16	16,73	2,53	10,85	16,54
1986	4,56	12,84	16,69	4,50	12,72	16,49	4,07	12,37	16,20	4,65	12,17	16,30	3,88	11,29	16,36	4,10	10,55	15,19
1987	0,39	9,78	15,11	0,14	9,66	14,50	0,01	9,37	14,04	0,01	9,64	14,32	0,28	8,80	13,48	0,53	8,14	13,04
1988	6,14	9,75	16,08	6,33	9,81	15,88	5,86	9,08	15,12	6,39	9,81	15,76	6,46	9,60	15,92	6,37	9,30	15,31
1989	9,00	13,45	15,66	9,39	13,53	15,85	8,91	13,22	15,00	9,05	13,19	15,50	8,73	12,60	15,30	8,18	12,44	14,50
1990	10,10	11,10	15,66	10,29	11,43	15,64	10,05	10,96	15,25	10,37	11,36	15,23	9,65	11,12	14,94	9,09	10,71	14,32
1991	5,12	10,63	14,04	5,00	10,16	14,06	4,49	9,72	13,61	5,12	10,21	14,32	4,83	10,20	14,40	4,74	9,54	13,94
1992	6,60	11,81	15,34	6,81	11,43	15,07	6,40	11,20	14,66	6,80	11,28	14,92	7,06	10,63	15,00	6,48	9,39	14,31
1993	3,77	10,76	16,36	3,60	9,98	16,03	3,71	9,84	15,47	3,66	9,67	15,79	4,58	9,42	15,23	4,28	9,30	14,68
1994	8,19	13,26	17,71	8,64	12,81	17,11	8,36	12,34	16,87	7,87	12,64	17,17	8,19	12,12	16,36	8,07	11,63	15,64
1995	7,12	11,63	15,40	7,43	11,45	15,08	6,65	10,80	14,68	7,20	10,87	14,93	7,73	11,15	14,93	7,20	10,73	14,68
1996	1,94	10,49	18,31	1,59	9,95	17,99	0,62	9,15	17,84	1,02	9,39	17,99	2,29	9,30	17,31	2,35	8,26	16,33
1997	5,89	7,99	17,42	6,12	8,03	17,38	5,35	7,38	17,32	5,33	7,61	17,17	6,11	8,15	17,01	5,78	7,70	15,83
1998	5,00	14,15	16,26	6,06	14,33	15,94	5,27	13,99	15,52	5,38	14,01	15,78	6,11	13,44	15,48	5,90	12,36	15,13
1999	7,07	12,40	15,83	7,81	12,52	15,54	7,33	12,30	15,27	7,55	12,41	15,43	7,45	12,11	15,46	7,33	11,58	15,01
2000	6,24	13,77	17,40	7,20	13,67	17,00	6,01	13,33	16,74	6,53	13,20	16,92	6,60	12,04	16,84	6,83	11,58	15,99
1971 - 2000	**5,65**	**11,38**	**16,28**	**6,06**	**11,43**	**15,97**	**5,40**	**10,78**	**15,65**	**5,59**	**10,94**	**15,87**	**5,63**	**10,48**	**15,53**	**5,60**	**10,06**	**14,97**

03 – March; 04 – April; 05 – May.

The THI average values of the analyzed period (1971-2000) indicate a variation between +5.40°C at Adamclisi and +16.28°C at Hârşova, including the territory of reference in the area of bioclimatic discomfort due to over – cooling in 72.3% of cases, out of wich the cold conditions total a frequency of 66.7%, and the chilly conditions, a frequency of 5.6%. The bioclimatic state of comfort is present only in 27.7% of cases.

Table 4 shows an alternation between bioclimatic comfortable and over-heating conditions, with warm perceptions prevailing at a rate of 38.6% and 61.4% respectively.

The analysis of mathematically calculated THI values for the summer months over the entire period of reference (1971-2000), shows that on the Southern Dobrogea Plateau area, the value differences range from a minimum of +17.12°C at Adamclisi, in August 1976 to a maximum of +24.86°C at Mangalia, in August 1997.

The same synoptic table also indicates, in terms of the average THI values corresponding to summer months, a variation between +19.11°C at Adamclisi and

+21.53°C at Cernavodă, including the analyzed territory in the area of bioclimatic discomfort due to over – heating processes all through the summer-time period (July – August).

Tab. 4 – The inter-annual variation of the average values of the THI index (^{0}C) in the summer months (June, July, August) in South Dobrogea (1971 – 2000)

Year / Period	WESTERN DANUBEAN AREA						CENTRAL CONTINENTAL AREA						EASTERN SEASIDE AREA					
	HARŞOVA			CERNAVODĂ			ADAMCLISI			MEDGIDIA			CONSTANŢA			MANGALIA		
	06	07	08	06	07	08	06	07	08	06	07	08	06	07	08	06	07	08
1971	19,65	20,17	21,05				18,56	19,66	20,39	19,35	19,85	20,15	19,41	20,11	21,45	18,72	19,76	20,84
1972	20,11	21,39	20,57				19,67	21,20	20,13	20,32	21,43	20,52	20,29	21,96	21,40	19,91	21,84	21,13
1973	18,45	21,21	19,34				17,87	20,67	18,70	18,19	21,05	19,12	18,44	21,26	19,91	18,16	20,58	19,74
1974	19,08	20,19	20,71				18,53	19,91	20,23	18,84	20,08	20,43	18,09	19,26	20,92	17,32	18,55	20,38
1975	20,52	21,83	20,83				19,51	20,63	19,64	20,24	21,40	20,28	20,37	21,89	21,01	19,80	21,69	20,78
1976	18,28	20,34	17,61				17,48	19,49	17,12	18,01	19,91	17,37	18,16	21,05	18,70	20,49	20,49	17,73
1977	18,92	21,26	20,40				17,86	20,23	19,87	18,68	21,09	20,10	18,62	21,30	20,67	18,52	20,74	20,10
1978	19,12	20,07	19,12				18,43	19,89	19,01	18,78	19,76	18,75	19,27	20,42	19,88	18,84	19,93	19,27
1979	21,04	19,59	20,14				20,55	19,18	19,80	20,43	19,29	19,69	20,69	20,40	20,98	20,00	20,07	20,47
1980	18,64	20,72	19,55				18,69	20,80	19,47	18,49	20,30	18,89	18,79	20,57	20,22	18,20	19,67	19,72
1981	20,92	20,12	19,77				20,15	19,70	19,77	20,04	19,64	19,45	20,38	20,55	20,63	20,62	20,91	20,70
1982	19,52	20,10	20,57				19,18	19,27	19,90	19,20	19,47	20,02	19,09	20,15	21,22	18,56	19,99	20,84
1983	18,95	21,41	19,36				18,12	21,05	18,86	18,58	21,09	19,12	18,98	21,65	19,98	18,88	21,92	20,10
1984	18,64	19,55	18,98				18,39	19,54	18,85	18,39	19,45	18,81	18,45	19,98	19,60	18,39	20,37	19,94
1985	18,86	20,25	20,88				18,54	20,01	20,63	18,98	20,27	20,92	18,63	20,16	21,60	17,88	20,24	21,74
1986	19,86	20,03	21,60	19,64	20,49	22,01	20,05	20,05	21,49	19,67	20,19	21,39	20,48	21,13	22,17	20,62	20,62	21,57
1987	20,07	22,47	19,43	20,14	22,59	19,60	19,51	21,61	19,03	19,64	21,68	19,01	19,36	22,32	19,72	18,50	21,35	19,30
1988	19,77	23,07	21,17	19,45	23,18	21,78	18,77	22,41	21,08	19,24	22,62	20,75	19,30	23,16	22,05	18,64	22,05	21,35
1989	18,58	20,55	21,53	18,57	21,13	21,84	17,64	20,14	21,00	18,16	20,35	21,17	18,20	21,13	21,79	18,14	20,75	21,44
1990	19,62	21,58	20,79	20,00	22,14	20,97	19,09	21,03	20,27	19,35	20,88	20,07	19,62	21,66	21,39	18,95	21,01	20,71
1991	19,45	22,19	20,71	19,37	21,55	20,04	19,10	21,61	19,93	19,41	21,83	20,21	19,57	22,45	21,05	19,35	22,33	21,22
1992	19,94	20,84	23,25	19,49	20,43	22,66	18,98	20,10	22,43	19,56	20,38	22,96	19,96	21,18	23,27	19,35	20,99	23,14
1993	19,64	20,03	20,55	19,90	20,55	20,92	19,21	19,86	20,27	19,89	20,23	20,58	19,37	19,91	21,17	19,06	19,33	20,71
1994	19,93	22,29	21,84	19,31	21,89	21,79	18,94	21,64	21,34	19,51	22,46	21,61	18,64	22,60	22,41	18,52	22,53	22,19
1995	20,47	21,78	20,31	20,46	21,73	20,39	20,37	21,83	20,43	20,57	21,91	20,27	20,97	22,82	21,17	21,06	22,47	21,26
1996	20,37	21,09	20,02	19,88	20,99	19,95	20,22	21,32	20,36	20,43	21,66	20,35	19,57	21,56	21,37	19,36	20,97	21,22
1997	20,09	20,76	19,51	19,99	20,80	19,39	19,88	20,60	19,06	20,01	20,85	19,36	20,07	21,18	20,35	20,07	21,12	**24,86**
1998	20,19	22,05	21,56	20,51	21,26	21,28	20,20	21,61	21,22	20,41	21,59	21,46	20,07	21,61	22,31	20,33	21,20	22,32
1999	21,44	23,32	21,88	20,55	22,32	21,00	20,53	22,26	20,96	21,09	22,98	21,40	21,48	23,95	21,97	20,80	23,32	21,84
2000	20,09	22,68	21,83	19,53	21,98	21,17	19,32	22,14	21,32	19,86	22,57	21,69	19,74	22,04	22,28	19,34	20,80	21,52
1971 - 2000	**19,67**	**21,09**	**20,49**	**19,78**	**21,53**	**20,98**	**19,11**	**20,64**	**20,08**	**19,45**	**20,87**	**20,19**	**19,46**	**21,31**	**21,09**	**19,21**	**20,91**	**20,93**

06 – June; 07 – July; 08 – August.

For the autumn period, Table 5 reveals an alternation between bioclimatic discomfort conditions due to over - cooling processes, and the bioclimatic state of comfort, but also the appearance of some small bioclimatic discomfort islands of heat stress. The prevailing bioclimatic sensations which are currently being felt during the autumn months are the cold ones (55.7%), followed by comfortable conditions (32.5%), cooling (10.7%) and warm perceptions (1.1%).

The synoptic table for the autumn months also indicates a marked difference between the minimum and maximum values that were recorded, that is a difference of +20.81°C, leading to the conclusion that autumn is the most unstable period of the year. The lowest value in the region reached +0.59°C at Cernavodă, in November 1988, and the highest value rose to +21.40°C at Constanţa in September 1994. The average THI values of the entire period of reference (1971-2000) range from a minimum of +5.87°C at Hârşova to a maximum of +17.75°C at Constanţa.

Tab. 5 – The inter-annual variation of the average values of the THI index (^{0}C) in the autumn months (September, October, November) in South Dobrogea (1971 – 2000)

Year / Period	WESTERN DANUBEAN AREA						CENTRAL CONTINENTAL AREA						EASTERN SEASIDE AREA					
	HARŞOVA			CERNAVODĂ			ADAMCLISI			MEDGIDIA			CONSTANŢA			MANGALIA		
	09	10	11	09	10	11	09	10	11	09	10	11	09	10	11	09	10	11
1971	15,34	10,08	6,37				15,12	10,43	7,20	13,62	10,45	6,98	16,71	11,46	8,00	16,62	11,00	8,20
1972	15,72	10,18	7,30				15,36	10,23	7,47	15,48	10,51	7,56	16,74	12,02	8,64	16,55	12,03	8,35
1973	17,40	11,73	4,90				17,23	11,75	5,67	17,29	12,01	5,41	18,01	13,22	6,37	18,03	13,15	7,00
1974	17,37	14,13	5,66				17,03	14,07	5,66	16,96	14,23	5,84	17,95	15,27	7,61	17,66	15,12	7,69
1975	18,89	11,79	4,35				18,15	11,65	4,56	18,39	11,96	4,76	19,30	13,61	6,60	18,75	13,61	7,02
1976	15,99	10,62	7,92				15,69	10,60	7,86	15,78	11,03	8,02	16,76	12,07	8,47	16,43	12,45	8,86
1977	15,52	10,70	9,36				15,08	10,96	9,92	15,11	10,58	9,54	16,38	11,70	10,85	16,18	11,66	11,10
1978	16,10	11,52	5,01				16,09	11,95	5,61	15,83	11,84	5,65	16,92	13,01	6,79	16,81	12,81	7,60
1979	17,55	9,78	7,35				17,48	9,70	7,64	17,19	10,23	7,84	18,21	11,94	9,01	18,12	11,99	9,45
1980	15,46	13,17	5,48				15,64	13,41	6,65	15,36	13,24	7,02	16,78	14,50	8,35	16,40	14,31	8,64
1981	16,97	13,95	4,38				16,63	14,04	5,06	16,78	13,86	5,27	17,94	15,43	6,65	18,10	15,30	7,51
1982	18,79	12,30	5,61				18,28	12,35	5,90	18,21	12,60	6,33	19,54	14,67	8,71	19,38	15,02	9,03
1983	17,48	11,37	1,70				17,13	11,47	3,76	17,22	11,53	3,82	18,40	12,81	5,67	18,44	12,93	6,29
1984	18,61	14,23	6,05				18,44	14,59	6,23	18,13	14,33	6,97	19,04	15,12	8,31	19,41	15,43	9,20
1985	16,18	10,01	5,61				16,26	10,25	6,37	16,48	10,26	6,51	17,31	11,65	8,13	17,31	11,61	9,11
1986	17,27	10,60	4,87	15,34	10,76	4,55	17,29	10,69	4,57	17,22	11,12	4,86	18,19	12,41	8,98	17,67	12,14	6,60
1987	17,96	10,03	7,94	15,72	9,98	7,98	17,84	9,33	7,78	17,60	10,18	8,29	18,66	11,82	7,02	18,25	11,43	9,11
1988	17,02	10,01	1,01	17,40	10,06	0,59	16,85	9,92	1,30	16,91	10,27	1,50	17,89	11,87	3,44	17,00	11,58	3,33
1989	16,19	12,05	5,36	17,37	12,12	5,48	15,85	11,68	5,25	16,10	11,91	5,69	17,21	12,87	7,24	17,15	12,64	7,11
1990	16,40	12,14	8,81	18,89	12,60	9,79	16,27	12,18	9,96	16,24	12,51	10,19	17,18	13,77	11,21	16,84	13,61	11,14
1991	17,27	12,28	6,70	15,99	12,46	6,93	16,91	12,20	6,51	16,97	12,45	6,93	17,92	13,39	8,20	17,79	13,33	8,40
1992	16,44	13,16	7,74	15,52	13,53	7,98	16,26	13,65	7,94	16,32	13,64	8,08	17,20	14,50	9,13	16,93	14,76	9,01
1993	16,69	13,82	1,79	16,10	13,88	2,26	16,79	13,88	1,64	16,75	13,95	2,75	17,03	14,50	5,10	16,34	14,31	5,01
1994	20,61	12,20	5,53	17,55	12,42	5,92	20,22	12,03	5,77	20,37	12,40	5,56	21,40	13,96	7,42	21,38	13,85	7,55
1995	16,45	10,94	3,95	15,46	11,25	3,76	16,55	10,99	3,44	16,67	11,04	3,56	17,57	12,37	4,70	17,56	12,18	5,50
1996	14,67	11,74	9,66	16,97	11,74	9,91	14,77	11,47	9,79	14,86	11,49	9,70	15,87	12,98	11,14	15,82	12,76	10,90
1997	14,50	10,40	6,66	18,79	10,78	7,48	14,41	10,36	7,12	14,50	10,53	7,18	15,84	11,94	8,33	15,76	11,65	8,86
1998	16,43	12,42	3,79	17,48	13,25	4,92	16,13	13,03	4,19	16,40	13,12	4,76	17,96	14,50	6,32	17,87	14,59	6,79
1999	17,82	11,85	5,37	18,61	12,56	6,90	17,70	12,10	6,19	17,71	12,61	6,79	18,95	13,76	7,98	19,08	13,85	8,42
2000	16,42	11,79	10,07	16,18	12,49	10,50	16,39	12,03	5,94	16,74	12,17	10,41	17,67	13,51	11,42	17,45	13,20	11,42
1971 - 2000	**16,85**	**11,69**	**5,87**	**16,89**	**11,99**	**6,33**	**16,66**	**11,76**	**6,09**	**16,70**	**11,93**	**6,46**	**17,75**	**13,21**	**7,85**	**17,56**	**13,14**	**8,14**

09 – September; 10 – October; 11 – November.

Conclusions

The use of weather and climate information in public health requires some minimal knowledge of the main mechanisms of biometeorological and bioclimatic influence on the human body, and that is why it probably became part of studies aiming at the formation of specific cultural environments which may prove useful in the protection and preservation of human health.

Bioclimatology is a domain of interference between different research areas of physical and biological sciences, and because of its complexity, it gradually turned into a theme of priority in various international and national programs.

The information resulting from the present study provides a brief and suggestive image of the degree of spatial extension and time evolution of the thermo-hygrometric index (THI) in an Romanian area with various climatic influences, and its analysis indicates that in the South Dobrogea area, **the bioclimatic discomfort conditions through cooling** processes prevailed all through the period of reference (1971-2000), with colder bioclimates present in 59% of cases. The bioclimatic comfortable conditions have, instead, a frequency of only 25%, and the bioclimatic discomfort conditions due to over - heating is present in a proportion of 16% of cases, the warm sensation being the most frequent of the kind, over the entire territory of analysis.

References

Kyle W.J., (1994)*, The human bioclimate of Hong Kong,* Brazdil R, Kolář M. (eds.) Proceedings of the Contemporary Climatology Conference, Brno. TISK LITERA, Brno, pp.345-350

Bucerzan D., Vulpe Ana (2006) – *Lecţii de Excel*, Editura Albastră, Cluj Napoca

Ciulache S., Ionac Nicoleta (1998) - *Climatologie comportamentală*, Editura Universităţii din Bucureşti, Bucureşti

Grigore Elena (2012) - *Potenţialul bioclimatic al Podişului Dobrogei de Sud*, Editura Universitară, Bucureşti.

Ionac Nicoleta (2007) - *Stressul bioclimatic în Dobrogea*, vol. Lucrările Seminarului Geografic "Dimitrie Cantemir", nr. 27/2007, Editura Universităţii "Al.I. Cuza" din Iaşi, pag. 128-134.

Ionac Nicoleta, Ciulache S. (2008) - *Atlasul bioclimatic al României*, Editura Ars Docendi, Bucureşti.