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The Statistical Characteristics of Tourism Climate Index in Kakheti (Georgia)

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ABSTRACT

The statistical characteristics of the monthly mean, annual and half year values of the Tourism Climate Index of tourism (TCI) and its components for four points of Kakheti (Telavi, Dedoplistskaro, Kvareli and Sagarejo) in the period from 1961 through 2010 are represented. In particular, the changeability of the indicated bioclimatic parameters into 1986÷2010 in comparison with 1961÷1985 is studied, and also the trends of values of TCI for higher enumerated points are investigated.

Key Words: Bioclimate, Tourism Climate Index.

Introduction

Tourism industry is an important segment of the world economy and its development in many respects it depends on the geographical arrangement of locality, topography, landscape, plant cover, fauna, ecological state of environment, weather, climate, etc. Weather and climate form biometeorological and bioclimatic composing of human living environments and in many respects define the attractiveness of locality both for the inhabitants of this locality and for visitors (Matzarakis, 2006 [1]).

There are more than 200 biometeorological and bioclimatic indices, which determine the influence of meteorological and climatic factors on the health of people (Air Equivalent-Effective Temperature – EET, Air Effective Temperature - ET, Wet-Bulb-Globe Temperature - WBGT, Wind Chill – WCI, Cooling Power – CP, Subjective temperature index –STI, Perceived temperature - PMV, Physiologically Equivalent Temperature - PET, Standard Effective Temperature - SET, Physiological Subjective Temperature and Subjective Temperature - MENEX, Universal Thermal Climate Index – UTCI, etc.) [2-5, http://www.igipz.pan.pl/Bioklima-zgik.html]. With the use of different indices in the last century a study of bioclimate in many countries of world [5-18], including Georgia [19-24] is carried out.

For example, in the work [13] using the thermal stress of 288 synoptic stations, the bioclimatic conditions throughout Iran were interpolated using a Simple Kriging method. The results of this study showed that the bioclimatic conditions are immensely varied spatially and temporally, such that in specific times all bioclimatic conditions can be seen in Iran. Also, during the year, each place can experience different bioclimatic conditions. Based on UTCI, extreme cold and extreme heat stress are the only bioclimatic conditions that do not exist during the year. However, based on PET, all bioclimatic conditions exist during the year. Also, July and January, respectively, are the hottest and coldest months of the year. Based on UTCI in April, October and November, more than 70% of Iran has comfortable conditions, whereas PET showed that in March and October 24.6 and 23.7% experienced comfortable conditions

respectively. It seems that the obtained results of PET index have high efficiency in relationship with UTCI index to show Iran's bioclimatic conditions.

The estimation of thermal stress for the athletes - participants of the forthcoming Summer Olympic Games in Tokyo in 2020 is carried out in [15]. For the analysis, indices like Physiologically Equivalent Temperature (PET) and mPET (modified PET) are applied. The results show that this kind of event may not be appropriate for visitors, if it is placed during months with extreme conditions. For Tokyo, this is the period from May to September, when conditions cause strong heat stress to the visitors for the vast majority of hours of the day. A more appropriate time would be the months from November to February or the early morning and the late afternoon hours, when thermally comfortable conditions are much more frequent. The methods that are applied here can quantify the thermal conditions and show limitations and possibilities for specific events and locations. Should the organizers still want to have these competitions organized during these months with extreme conditions, they should promote and propose all possible countermeasures for the spectators, workforce, and athletes.

In the work [23] the comparative analysis of mean-daily values of EET into Tbilisi (3 meteorological stations - Vashlijvari, Tbilisi state university, Tbilisi airport) and in Kojori (mountain health resort settlement in 10 km from the center of Tbilisi) is carried out. In particular it is shown that values of EET in the urbanized part of the city (Vashlijvari, State University) differ significantly from their values after the feature of city (Airport, Kojori); in Kojori are not observed negative for the health of people high values EET, which fall into the range by "Warmly".

Results of the statistical analysis of the mean monthly data about the values of air effective temperature on Missenard (ET) in two diametrically opposite located on the latitude geographical regions of Georgia: autonomous republic of Adjara (below - Adjara) and Kakheti region (below - Kakheti) in the work [24] are represented. The period of a study: 1961-2010. Values of ET expected according to the data of four meteorological stations of Adjara (Batumi, Kobuleti, Khulo, Goderdzi crossing) and Kakheti (Telavi, Dedoplistskaro, Kvareli, Sagarejo). The intra-annual distribution of values of ET is studied, their repetition on the categories of ET is obtained, detailed information about the categories of mean monthly values of ET, and also their upper and lower levels 99% of confidence interval is given, etc.

Several indices have been developed to assess the suitability of climate for tourism activities [9, 25-33]. The most widely known and applied index is the tourism climate index proposed by Mieczkowski [26]. This index is combination of seven factors and parameters. Mieczkowski's "Tourism Climate Index" (TCI) was designed to use climate data, being widely available for tourist destinations worldwide. Data about TCI are using for the information of "Average Tourist" and can be useful for the planning developments of mass tourism.

In some work the criticism of TCI is noted. Thus, in the paper [39] the Holiday Climate Index (HCI) was developed and discuss the design of the HCI and how the limitations of the TCI were overcome. It then presents an inter-comparison of the results from HCI:Urban and TCI for geographically diverse urban destinations across Europe. The results illustrate how the HCI:Urban rates the climate of many cities higher than the TCI, particularly in shoulder seasons and the winter months, which is more consistent with observed visitation patterns. The authors note, that the results empirically demonstrate that use of the TCI should be discontinued.

However, in our opinion, until is revealed united bioclimatic index for the tourism, use of TCI, in spite of its deficiencies, it is nevertheless useful (at least, is a possibility of the comparison of the level of bioclimatic comfort for the "Average Tourist" in the different countries).

TCI (frequently together with other bioclimatic indices) sufficiently long ago is used in many countries of the world [25, 27, 29-40], including Black Sea-Caspian region countries, such as Moldova [16], Iran [41-48], Turkey [49,50], Russia (Sochi, Krasnaya Polyana, Anapa, Tuapse, Primorsko-Akhtarsk, Taganrog, Kislovodsk, Makhachkala) [51]. Many studies are executed into the latter several years [16, 35-38, 40, 45-48, 51, 56-59, etc.].

Article [36] focuses on the role of climate in tourism seasonality and attempts to assess the impacts of climate resources on China's tourism seasonality by using TCI. Seasonal distribution maps of TCI scores indicate that the climates of most regions in China are comfortable for tourists during spring and autumn, while the climate conditions differ greatly in summer and winter, with "Excellent", "Good", "Acceptable" and "Unfavorable" existing almost by a latitudinal gradation. The number of good months throughout China varies from zero (the Tibetan Plateau area) to 10 (Yunnan Province), and most localities have five to eight good months. Moreover, all locations in China can be classified as winter peak, summer peak and bi-modal shoulder peak. The results will provide some useful information for tourist destinations, travel agencies, tourism authorities and tourists.

To assess Tourism Climate Index in Iran, 54 weather stations were selected [48]. The results have been generalized in 12 monthly world maps using ArcGIS10.1. According to the results, April and October are the best time for tourism during the year, actually more area of Iran has the good potential during these months. In January and February, potential of TCI decreased and the lowest area are located in suitable class. While, based on Scott and Mc Boyle classification summer peak, dry season peak, Bi-modal shoulder peak and winter peak can be seen in Iran, most of Iran is classified in Bi-modal shoulder peak. South, south east and west of Iran have the best condition in winter peak. The peak in dry seasons including dry and without rainy seasons have the best situations in west north and east parts of Iran. Bi-modal shoulder peak, in spring and autumn, are seen in north, all east and center of Iran toward west and west east.

In the South and Nord Caucasus regions the average monthly values of TCI were calculated for Georgia (Tbilisi, Batumi, Anaklia, Telavi, etc.), Armenia (Yerevan), Azerbaijan (Baku), Russia (Kislovodsk, Pyatigorsk, Nalchik, etc.) [51-59].

Results of investigation of monthly values of the Tourism Climate Index (TCI) in some localities of Georgia (21 localities) and North Caucasus (Russia, 6 localities) in [58] are represented. Height of these localities varied from 3 to 2194 m above sea level. Correlation and regression analysis of the connection of mortality by cardiovascular deceases in Tbilisi with the values of TCI and its separate components is carried out. This analysis confirmed the representativeness of the use of the scale of TCI as bioclimatic indicator for the investigated region (as a whole, with an increase of values of TCI it is noted the decrease of mortality). The statistical characteristics of values of TCI are represented. In particular it is obtained that with an increase of the height of locality, as a whole occurs the passage of bimodal intra-annual distribution of TCI to the single-modal. The vertical distribution of values of TCI on the average in the year, in the warm and cold periods, and also in the central months of year is studied. The detailed information about the categories of TCI for all investigated localities is represented.

The number of works is dedicated to the study of the influence of climate change to the TCI changeability [16, 27,31,45,47,51,56, etc.].

In the work [16] it is noted, that the actual values of TCI and the ones anticipated for the future indicate, for the Republic of Moldova, an increasing bioclimate favorability for all forms and types of tourism.

The paper [47] first calculates the monthly TCI for 40 cities across Iran for each year from 1961 to 2010. Changes in the TCI over the study period for each of the cities are then explored. Increases in TCI are observed for at least one station in each month, whilst for some months no decreases occurred. For October, the maximum of 45 % of stations demonstrated significant changes in TCI, whilst for December only 10 % of stations demonstrated change. The stations Kashan, Orumiyeh, Shahrekord, Tabriz, Torbat-e-Heidarieh and Zahedan experienced significant increases in TCI for over 6 months. The beginning of the change in TCI is calculated to have occurred from 1970 to 1980 for all stations. Given the economic dependence on oil exports, the development of sustainable tourism in Iran is of importance. This critically requires the identification of locations most suitable for tourism, now and in the future, to guide strategic investment.

Analysis of the dynamics of the "Excellent (80-89)" TCI values did not reveal any changes during 1977-2014 [51]. The number of "Ideal (90-100)" days increased insignificantly in all points except Sochi.

In the work [56] it was shown that in period 1986-2010 in comparison with period 1961-1985 in average for 4 seaside and alpine points of Adjara (Batumi - capital of Adjarian Autonomous Republic, Kobuleti, Khulo and Goderdzi) substantial changes of the values of TCI was not observed.

This study develops a long-term average TCI for 4 stations of Kakheti region of Georgia and explores the trends in TCIs over a 50-year period (1961-2010), monthly, seasonally and annually, for each of the cities studied.

Study Area, material and methods

Study area - Kakheti region of Georgia (below - Kakheti). Kakheti is located in the eastern part of Georgia. Area - 11375 km^2, population - 314.7 thous. pers., (including of urban - 71.4 thous. pers.), the capital of region - Telavi (population - 19.8 thous. pers.) [www.geostat.ge].

A visit to Kakheti can be a fascinating experience because of its beautiful mountain landscapes, stunning regions, ancient world temples and monasteries, picturesque valleys and rivers and home to amber grapes that grows under the warmth of the sun. Kakheti is not only famous as a tourism destination, but it is also locally recognized as Georgia's center for winemaking.

Studies for four cities of Kakheti (Telavi, Dedoplistskaro, Kvareli and Sagarejo) are carried out. Table 1 presents information about coordinates and heights of the locality of 4 meteorological stations in Kakheti, whose data were used in the work. Fig. 1 for the clarity depicts the map of the arrangement of the indicated meteorological stations. These cities that are located from 450 to 800 meters above sea level, are open to fresh and pure air because of this.

Table 1

Coordinates and heights of the 4 meteorological stations in Kakheti

Location	Latitude, N°	Longitude, E°	Height, m, a.s.l.
Telavi	41.93	45.48	568
Dedoplistskaro	41.47	46.08	800
Kvareli	41.97	45.83	449
Sagarejo	41.73	45.33	802

Fig.1. Locations of four meteorological stations in Kakheti

In the work the Tourism Climate Index (TCI) developed by Mieczkowski [26] is used. TCI is a combination of seven parameters, three of which are independent and two in a bioclimatic combination:

$$TCI = 8 \cdot Cld + 2 \cdot Cla + 4 \cdot R + 4 \cdot S + 2 \cdot W$$

Where Cld is a daytime comfort index, consisting of the mean maximum air temperature Ta, max (°C) and the mean minimum relative humidity RH (%), Cla is the daily comfort index, consisting of the mean air temperature (°C) and the mean relative humidity (%), R is the precipitation (mm), S is the daily sunshine duration (h), and W is the mean wind speed (m/s).

In contrast to other climate indices, every contributing parameter is assessed. Because of a weighting factor (a value for TCI of 100), every factor can reach 5 points. TCI values >= 80 are excellent, while values between 60 and 79 are regarded as good to very good. Lower values (40 – 59) are acceptable, but values < 40 indicate bad or difficult conditions for understandable to all tourism.

Table 2 presents information about the categories of TCI depending on its values. In the right column of table are given frequently used below the shortened versions of these categories.

Table 2

Categories of TCI

TCI	Category	Categ.	TCI	Category	Categ.
90 ÷ 100	Ideal	Ideal	40 ÷ 49	Marginal	Marg.
80 ÷ 89	Excellent	Excell.	30 ÷ 39	Unfavorable	Unfavor.
70 ÷ 79	Very Good	Very Good	20 ÷ 29	Very Unfavorable	Very Unfavor.
60 ÷ 69	Good	Good	10 ÷ 19	Extremely Unfavorable	Extr. Unfavor.
50 ÷ 59	Acceptable	Accept.	- 30 ÷ 9	Impossible	Imposs.

For the indicated localities the monthly average values of TCI in the period from 1961 through 2010 with the use data of Georgian National Environmental Agency [60] are calculated.

For the data analysis the standard statistical methods of the studies were used [61]. Designations and reduction – conventional. The difference between the mean values of TCI into 1986-2010 and 1961-1985 with the use of Student's criterion was determined (level of significance not worse than 0.15).

Results and discussion

Results in the Table 3-7 and Fig. 2-12 are presented.

Table 3 and in Fig. 2-4 presents the generalized statistical data about the values of TCI and its components for four points of Kakheti. The results of the analysis of these data are given below.

TCI (Table 3, Fig. 2,3).

Mean annual values of TCI varied from 60.4 (Kvareli, Good) to 63.3 (Sagarejo, Good). Range of a change of the mean values of TCI into the cold half-year - from 50.6 (Dedoplistskaro, Accept.) to 52.0 (Telavi, Accept.). In the warm half-year the smallest mean value of TCI is observed in Kvareli (69.0, Good), and greatest - into Sagarejo (75.2, Very Good).

Minimum and maximum monthly value of TCI according to all data of observations (600 cases) is noted into Sagarejo and respectively compose 27 (Very Unfavor.) and 96.0 (Ideal). Minimum and maximum mean in 50 years value of TCI is observed into Dedoplistskaro, respectively: (43.8, Marg.) and (81.1, Excell.).

Table 3

Data of TCI and TCI components in four locations of Kakheti

Parameter	All data					Mean 1961-2010	
	Mean Year	Mean Cold	Mean Warm	Min	Max	Min	Max
Telavi							
TCI	62.0	52.0	72.0	31.0	90.0	47.0	79.2
Cld	3.3	2.4	4.2	1.5	5.0	2.0	4.9
Cla	3.0	1.8	4.2	1.0	5.0	1.4	5.0
R	3.2	3.9	2.5	0.0	5.0	1.7	4.4
S	2.6	1.8	3.4	0.5	5.0	1.6	4.0
W	3.2	3.1	3.2	1.5	5.0	2.2	4.4
Dedoplistskaro							
TCI	62.5	50.6	74.3	29	93	43.8	81.1
Cld	3.3	2.3	4.2	1.0	5.0	1.7	5.0
Cla	2.8	1.7	3.9	0.0	5.0	1.2	5.0
R	3.6	4.1	3.1	0.0	5.0	2.2	4.5
S	2.6	1.8	3.4	0.5	5.0	1.5	4.0
W	3.0	2.7	3.3	0.0	5.0	1.8	4.2
Kvareli							
TCI	60.4	51.9	69.0	31.0	91.0	44.9	75.0
Cld	3.3	2.6	4.0	1.0	5.0	1.9	5.0
Cla	3.1	1.9	4.3	1.0	5.0	1.5	5.0
R	2.7	3.4	2.0	0.0	5.0	1.2	4.1
S	2.6	1.7	3.5	0.5	5.0	1.4	4.1
W	3.2	3.4	3.0	1.5	5.0	2.2	4.7
Sagarejo							
TCI	63.3	51.4	75.2	27.0	96.0	44.9	79.9
Cld	3.4	2.4	4.4	1.0	5.0	1.8	5.0
Cla	2.8	1.7	4.0	1.0	5.0	1.3	5.0
R	3.2	3.7	2.6	0.0	5.0	2.0	4.3
S	2.8	2.0	3.6	1.0	5.0	1.7	4.2
W	3.2	2.9	3.5	1.5	5.0	2.1	4.2

Fig. 2. Mean values of TCI and their 99% confidence interval in four locations of Kakheti.

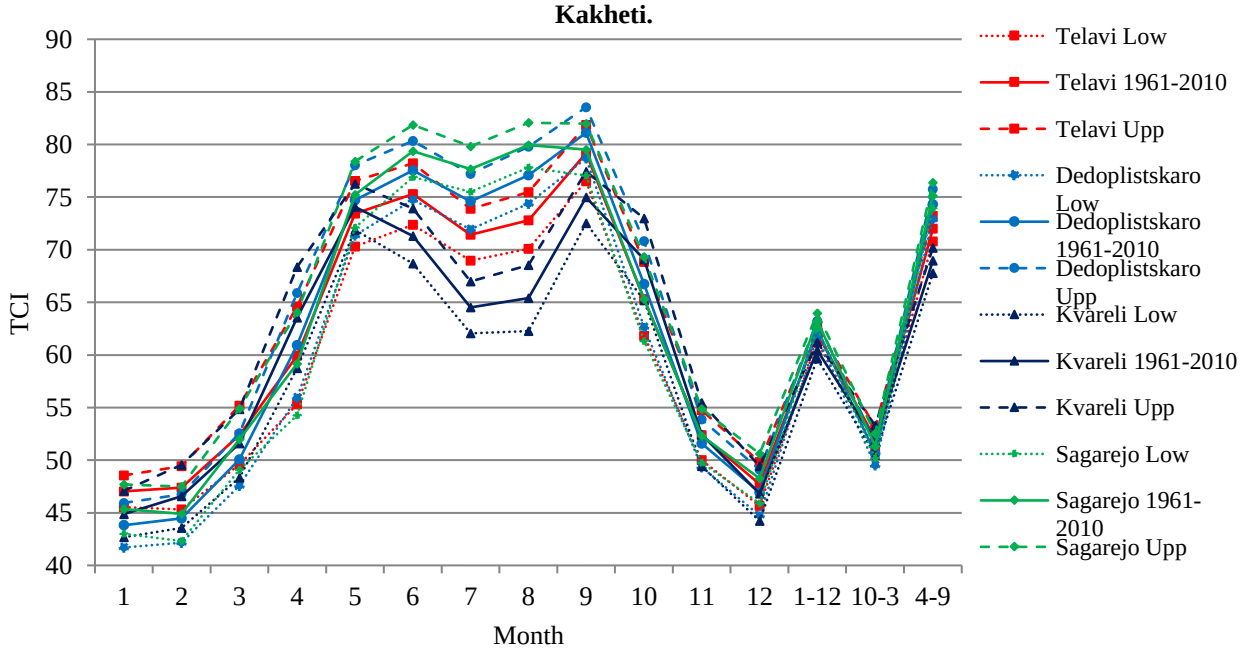


Fig. 3. Min and Max values of TCI in four locations of Kakheti in 1961-2010.

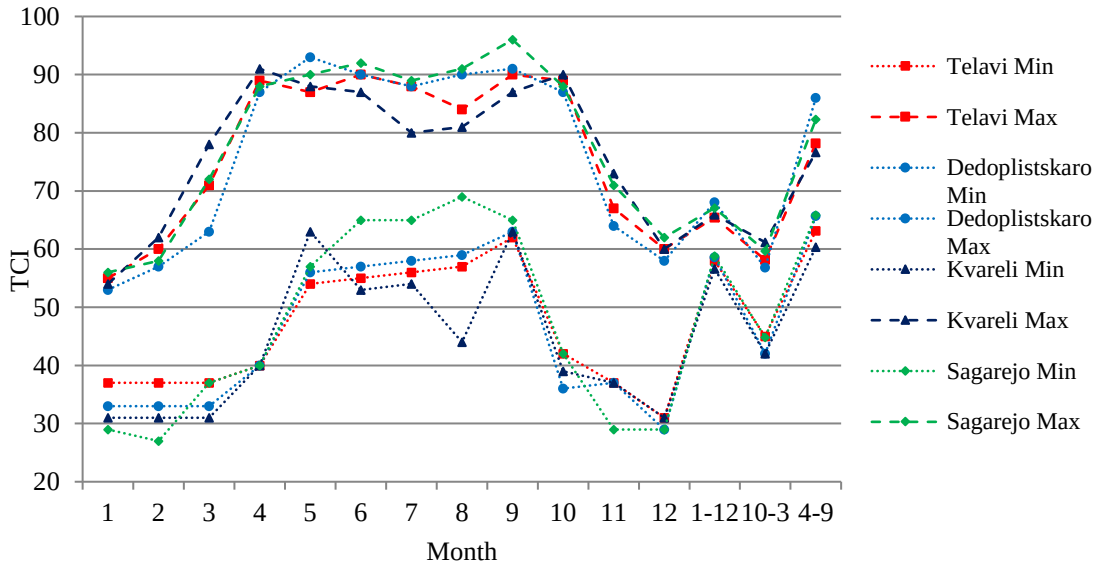
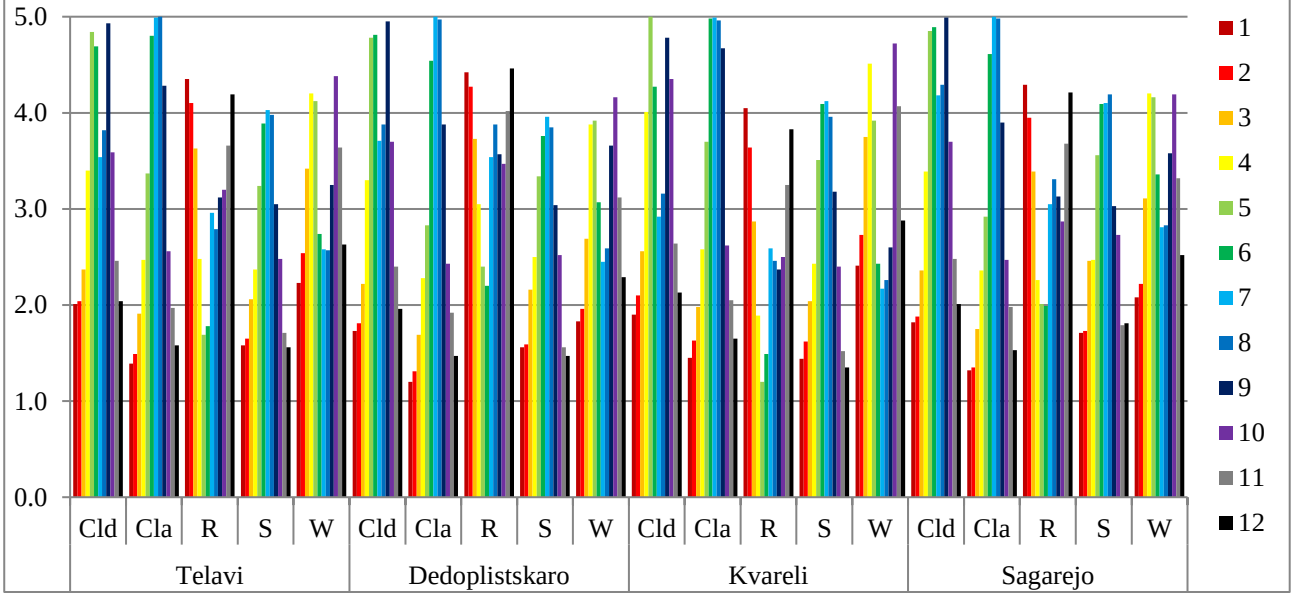


Fig. 4. Mean monthly values of TCI components in four locations of Kakheti in 1961-2010. Numbers and colored squares - months of year.



The range of changes of TCI for four points of Kakheti (Fig. 2, table 4) is the following:

Telavi, mean monthly values of TCI - from 47.0 (January) to 79.2 (September); Low – 45.3÷76.5; Upp – 48.6÷81.8; mean annual value of TCI - 61.3≤62.0≤62.7; TCI into the cold half-year - 51.0≤52.0≤53.1; TCI into the warm half-year - 770.8≤ 72.0≤73.2.

Dedoplistskaro, mean monthly values of TCI - from 43.8 (January) to (81.1, September); Low – 41.7÷78.7; Upp – 45.9÷83.5; mean annual value of TCI – 61.7≤62.5≤63.2; TCI into the cold half-year – 49.5≤50.6≤51.7; TCI into the warm half-year – 72.9≤74.3≤75.8.

Kvareli, mean monthly values of TCI – from 44.9 (January) to (75.0, September); Low – 42.7÷72.5; Upp – 47.1÷77.4; mean annual value of TCI – 59.7≤60.4≤61.2; TCI into the cold half-year – 50.5≤51.9≤ 53.3; TCI into the warm half-year – 67.8≤69.0≤70.2

Sagarejo, mean monthly values of TCI – from 45.4 (January) to (79.9, August); Low – 42.3÷77.8; Upp – 47.5÷82.1; mean annual value of TCI – 62.5≤63.3≤64.0; TCI into the cold half-year – 50.2≤51.4≤52.5; TCI into the warm half-year – 73.9≤75.2≤76.4.

The intra-annual distribution of mean monthly values of TCI in the indicated points is the following: Telavi - bimodal with the extrema in May-June and September; Dedoplistskaro - bimodal with the extrema during June and September; Kvareli - bimodal with the extrema during May and September; Sagarejo - unimodal with the plateau from June through September. All four distributions, as in Tbilisi, Baku and Yerevan [55], take the form of ninth power polynomial (Fig. 2 and 5, Table 4).

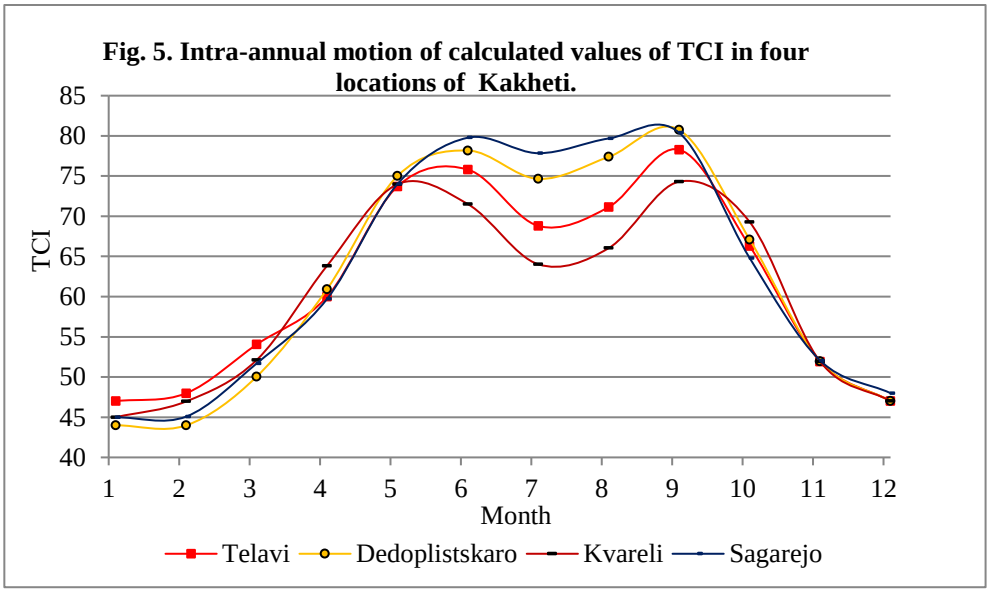


Fig. 5. Intra-annual motion of calculated values of TCI in four locations of Kakheti.

Table 4

Coefficients of the equation of the regression of the intra-annual motion of mean monthly values of TCI for four points of Kakheti

Equation of regression, coefficients	$TCI = a \cdot X^9 + b \cdot X^8 + c \cdot X^7 + d \cdot X^6 + e \cdot X^5 + f \cdot X^4 + g \cdot X^3 + h \cdot X^2 + i \cdot X + j$, (X-Month)			
	Telavi	Dedoplistskaro	Kvareli	Sagarejo
a	-0.000315	-0.000212	-0.000133	-0.000238
b	0.01834	0.01215	0.00763	0.01378
c	-0.4526	-0.2953	-0.1843	-0.3383
d	6.1767	3.9584	2.4329	4.5958
e	-50.995	-31.997	-19.161	-37.804
f	261.87	160.37	92.426	193.59
g	-828.6	-494.5	-271.0	-611.6
h	1542.5	899.2	465.5	1139.2
i	-1509.7	-865.0	-421.5	-1118.6
j	626.2	372.2	196.5	475.8
R^2	0.9974	0.9998	0.9979	0.9989

Table 5

Category of mean monthly values of TCI and their 99% confidence interval in four locations of Kakheti in 1961-2010

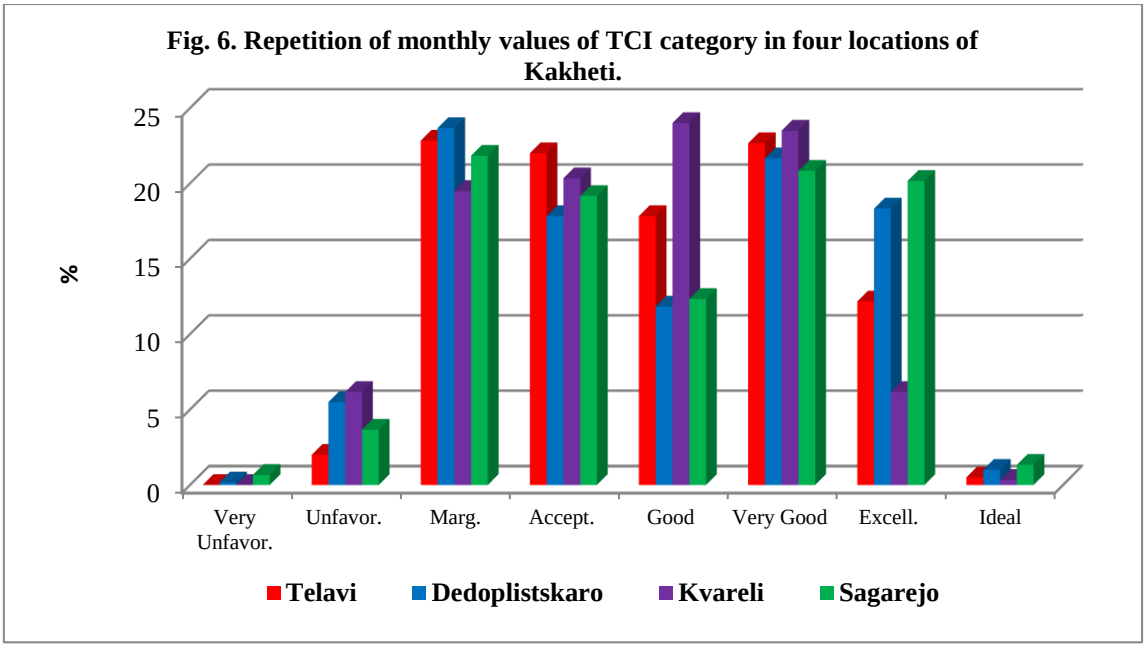
Location		Cold period					
	Month	1	2	3	10	11	12
Telavi	Low	Marg.	Marg.	Marg.	Good	Accept.	Marg.
	Mean			Accept.			
	Upp			Accept.			
Dedoplistskaro	Low	Marg.	Marg.	Marg.	Good	Marg.	Marg.
	Mean			Accept.	Good	Accept.	
	Upp			Accept.	Very Good	Accept.	
Kvareli	Low	Marg.	Marg.	Marg.	Good	Marg.	Marg.
	Mean			Accept.	Good	Accept.	
	Upp			Accept.	Very Good	Accept.	
Sagarejo	Low	Marg.	Marg.	Marg.	Good	Marg.	Marg.
	Mean			Accept.		Accept.	Marg.
	Upp			Accept.		Accept.	Accept.
		Warm period					
	Month	4	5	6	7	8	9
Telavi	Low	Accept.	Very Good	Very Good	Good	Very Good	Very Good
	Mean	Accept.			Very Good	Very Good	Very Good
	Upp	Good			Very Good	Good	Excell.
Dedoplistskaro	Low	Accept.	Very Good	Very Good	Very Good	Very Good	Very Good
	Mean	Good		Very Good			Excell.
	Upp	Good		Excell.			Excell.
Kvareli	Low	Accept.	Very Good	Good	Good	Good	Very Good
	Mean	Good		Very Good			
	Upp	Good		Very Good			
Sagarejo	Low	Accept.	Very Good	Very Good	Very Good	Very Good	Very Good
	Mean	Accept.		Very Good		Very Good	Very Good
	Upp	Good		Excell.		Excell.	Excell.

Table 6

Category of Min and Max values of TCI in four locations of Kakheti in 1961-2010

Location		Cold period					
	Month	1	2	3	10	11	12
Telavi	Min	Unfavor.	Unfavor.	Unfavor.	Marg.	Unfavor.	Unfavor.
	Max	Accept.	Good	Very Good	Excell.	Good	Good
Dedoplistskaro	Min	Unfavor.	Unfavor.	Unfavor.	Unfavor.	Unfavor.	Very Unfavor.
	Max	Accept.	Accept.	Good	Excell.	Good	Accept.
Kvareli	Min	Unfavor.	Unfavor.	Unfavor.	Unfavor.	Unfavor.	Unfavor.
	Max	Accept.	Good	Very Good	Ideal	Very Good	Good
Sagarejo	Min	Very Unfavor.	Very Unfavor.	Unfavor.	Marg.	Very Unfavor.	Very Unfavor.
	Max	Accept.	Accept.	Very Good	Excell.	Very Good	Good
		Warm period					
	Month	4	5	6	7	8	9
Telavi	Min	Marg.	Accept.	Accept.	Accept.	Accept.	Good
	Max	Excell.	Excell.	Ideal	Excell.	Excell.	Ideal
Dedoplistskaro	Min	Marg.	Accept.	Accept.	Accept.	Accept.	Good
	Max	Excell.	Ideal	Ideal	Excell.	Ideal	Ideal
Kvareli	Min	Marg.	Good	Accept.	Accept.	Marg.	Good
	Max	Ideal	Excell.	Excell.	Excell.	Excell.	Excell.
Sagarejo	Min	Marg.	Accept.	Good	Good	Good	Good
	Max	Excell.	Ideal	Ideal	Excell.	Ideal	Ideal

Fig. 6. Repetition of monthly values of TCI category in four locations of Kakheti.



Tables 5 and 6 present detailed information about the categories of the values of TCI (mean, min, max, 99% confidence interval) in four points of Kakheti in different months. As it follows from this table, as a whole, minimum values TCI correspond category "Very Unfavor.", and maximum - "Ideal". On the average, intra-annual variations of the values of TCI in Kakheti correspond to categories "Marg." and " Very Good – Excell.". For the clarity Fig. 6 depicts the histogram of repetition in four points of Kakheti of categories TCI. As it follows from this figure, in the overwhelming majority of the cases the categories in the range "Marg." - "Ideal" are observed. Thus, bioclimatic conditions in Kakheti for the so-called "Average Tourist " are favorable entire year.

Fig. 7. Difference between the mean values of TCI into 1986-2010 and 1961-1985 in four locations of Kakheti.

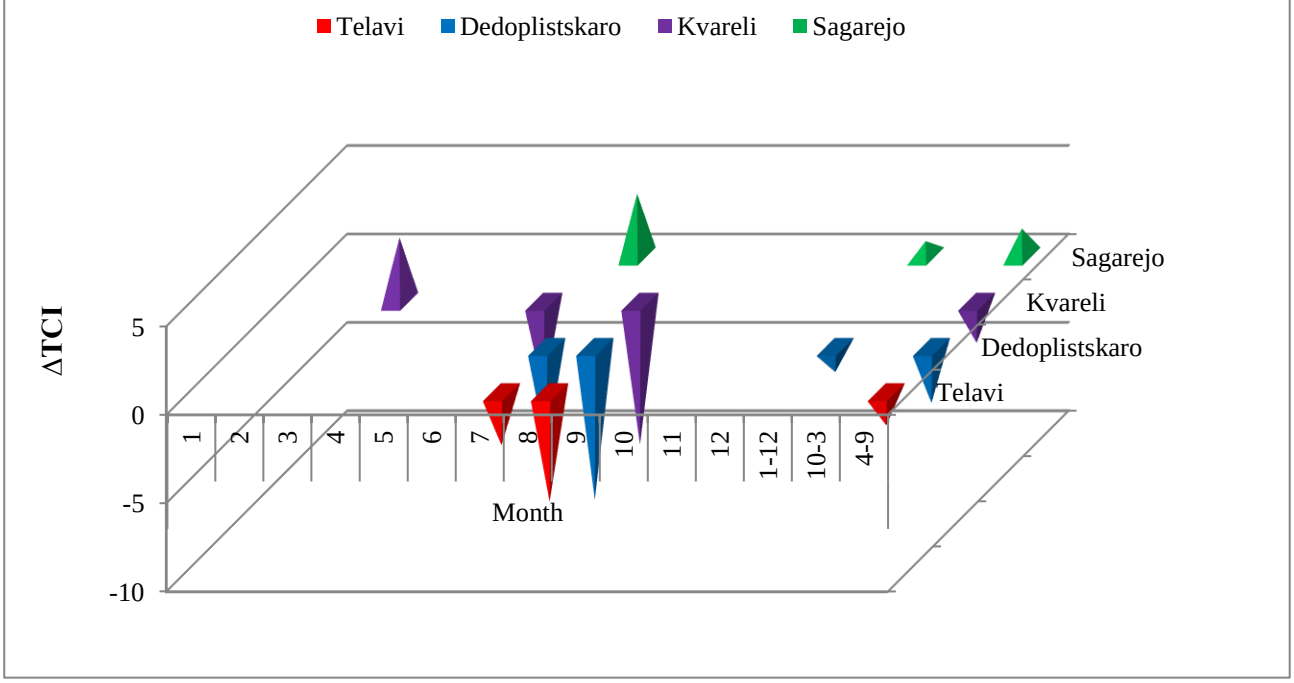


Fig.8. Trend of TCI in Telavi.

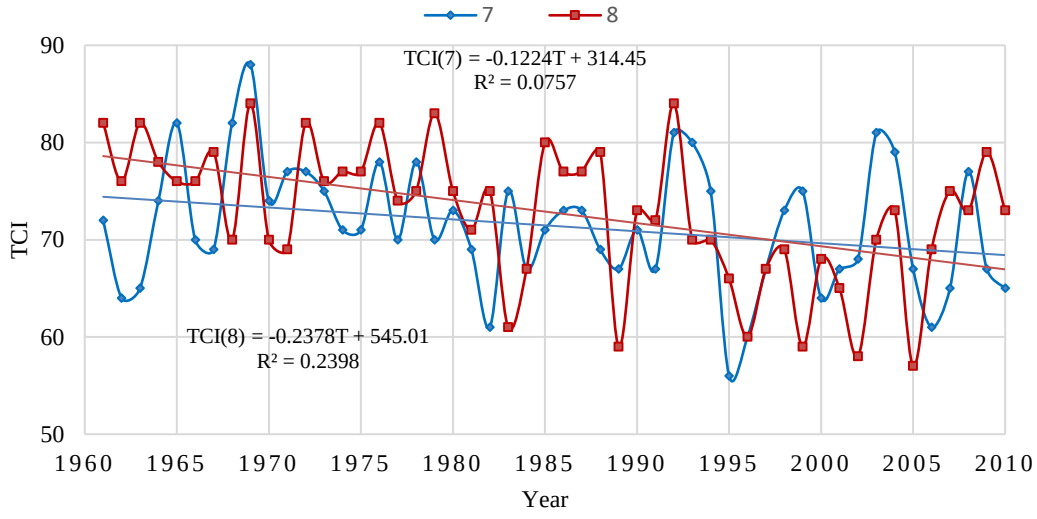


Fig. 9. Trend of TCI in Dedoplistskaro.

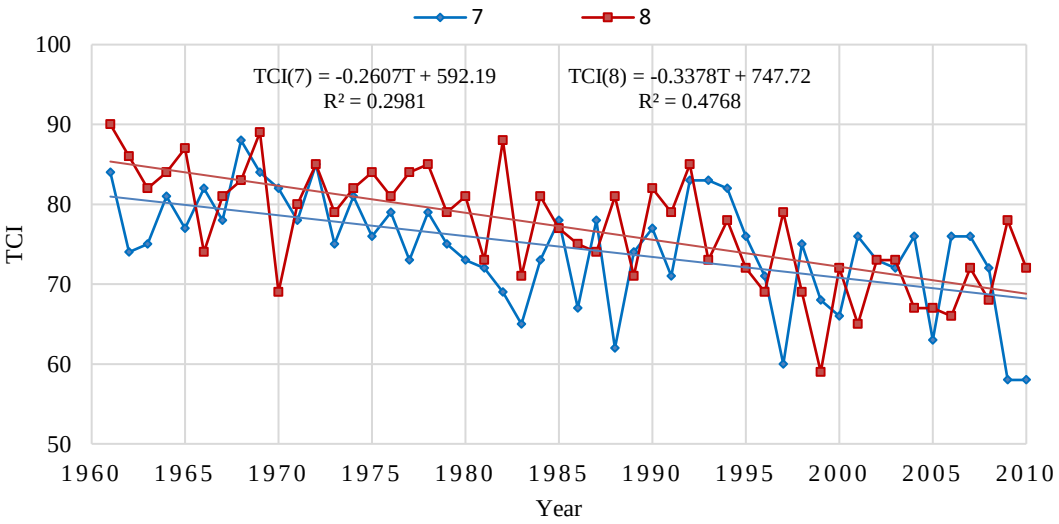
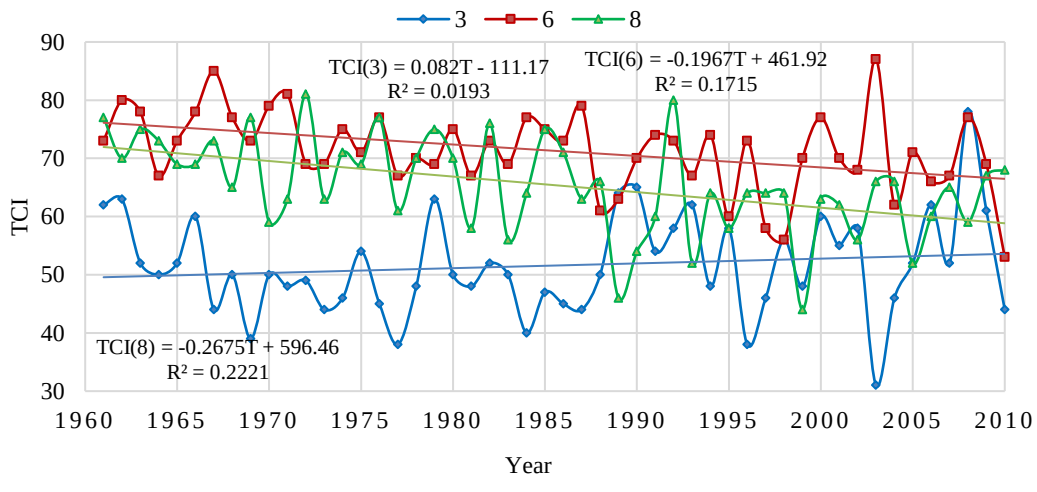


Fig. 10. Trend of TCI in Kvareli.



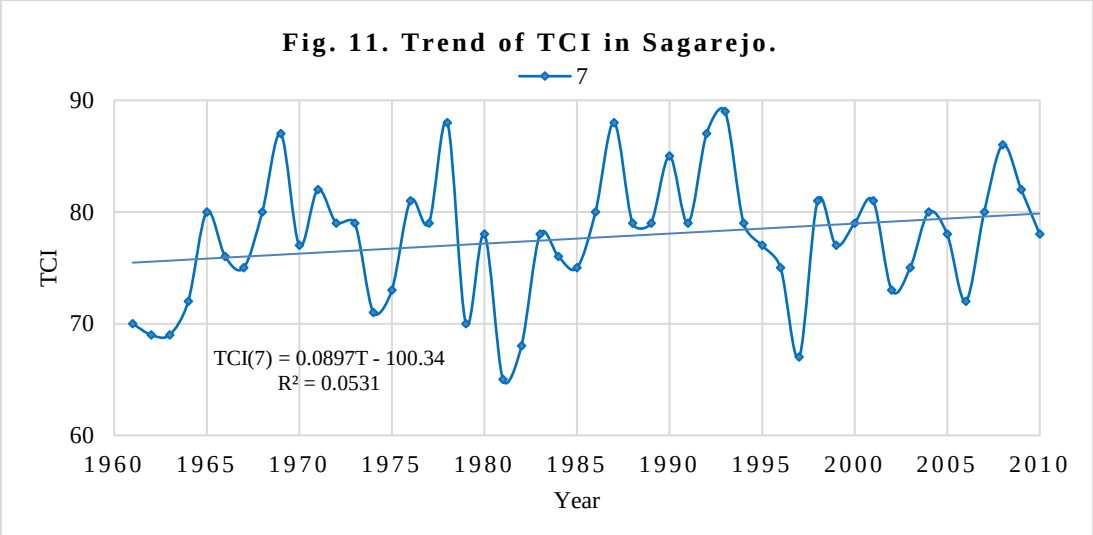


Fig. 11. Trend of TCI in Sagarejo.

The changeability of mean monthly values of TCI in 1986-2010 in comparison with 1961-1985 in the enumerated points of Kakheti in the separate months is the following (Fig. 7): Telavi - July and August (in both cases - decrease, with reduction in the category to one step); Dedoplistskaro - July and August (in both cases - decrease, with the decrease of category TCI to one step during August); Kvareli - March (increase, with an increase in the category TCI by one step), June and August (decrease, with reduction in the category to one step during June); Sagarejo - July (increase in the limits of one and the same category). The graphs of linear trend of TCI in the period from 1961 through 2010 for the indicated points in Fig. 8-11 are depicted.

Fig. 12. Difference between the mean monthly values of TCI components into 1986-2010 and 1961-1985 in four lications of Kakheti. Numbers and colored squares - months of year.

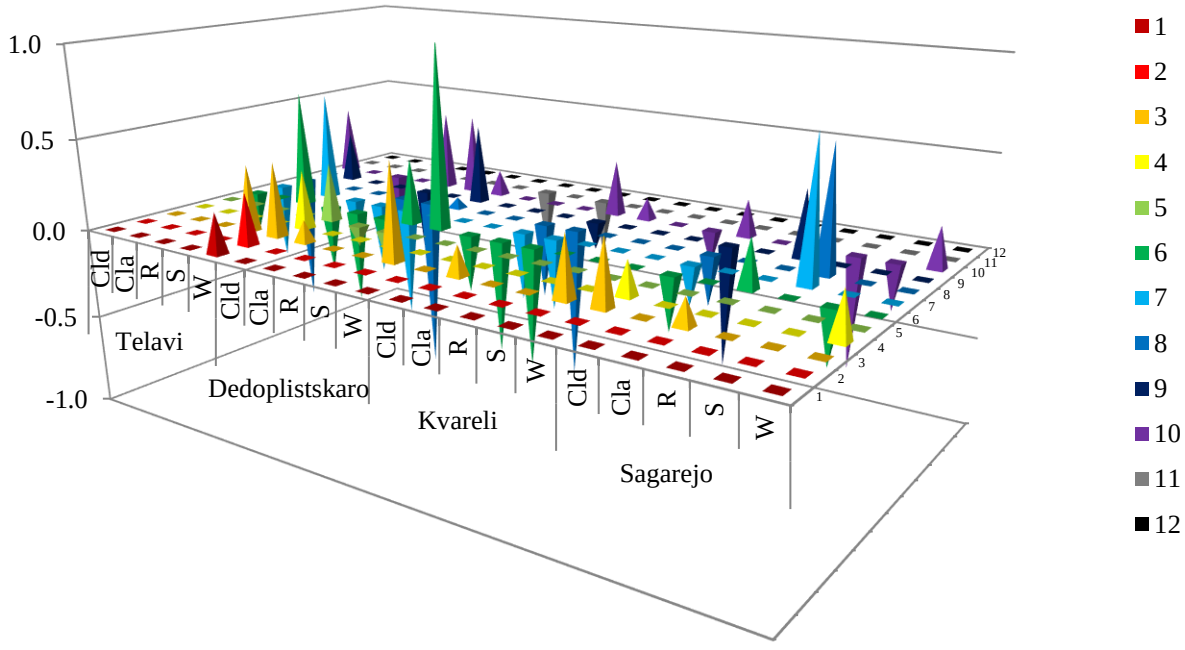


Table 3 and Fig. 4,12 presents information about the values of the components of the Tourism Climate Index and their changeability in 1986-2010 in comparison with 1961-1985. In particular, the range of mean for entire period observations of the values of components of TCI and their changeability in the second period of time in comparison with the first for four points of Kakheti are following:

Telavi

Cld: 2.0÷4.9 (January, February, December and September respectively). Changeability is observed from June through August (decrease), also, during October (increase);

Cla: 1.4÷5.0 (January and July, August respectively); Changeability is observed only during September (increase);

R: 1.7÷4.4 (May and January, respectively). Changeability is observed during June and July (increase), and also during October (decrease);

S: 1.6÷4.0 (December, January and July, August respectively). Changeability is observed during March (increase) and during June, July (decrease);

W: 2.2÷4.4 (January and October respectively). Changeability is observed in January- May, and October increase), and also in June- September (decrease).

Dedoplistskaro

Cld: 1.7÷5.0 (January and September, respectively). Changeability is observed during March and October (increase), and also from May through August (decrease);

Cla: 1.2÷5.0 (January and July - August, respectively); Changeability is observed during May (decrease), and also during June and August - September (increase);

R: 2.2÷4.5 (June and December, respectively). Changeability is observed during June (increase) and November (decrease);

S: 1.5÷4.0 (December and July, respectively). Changeability is observed during March (increase) and during June (decrease);

W: 1.8÷4.2 (January and October respectively). Changeability is observed during June-August and during November (decrease).

Kvareli

Cld: 1.9÷5.0 (January and May, respectively). Changeability is observed during March and October (increase), and also from June through September (decrease);

Cla: 1.5÷5.0 (January and June-August, respectively). Small changeability is observed only during October (increase);

R: 1.2÷4.1 (May and January, respectively). Changeability is not observed;

S: 1.4÷4.1 (December, January and June-July, respectively). Changeability is observed during March (increase) and during October (decrease);

W: 2.2÷4.7 (July and October, respectively). Changeability is observed during March, April and October (increase), and also in June- September (decrease).

Sagarejo

Cld: 1.8÷5.0 (January and September, respectively). Changeability is not observed;

Cla: 1.3÷5.0 (January and July-August respectively); Changeability is observed during March, June and September (increase);

R: 2.0÷4.3 (May-June and January, respectively). Changeability is observed during July-August (increase) and during October (decrease);

S: 1.7÷4.2 (January- February and August, respectively). Changeability is observed during June and October (decrease);

W: 2.1÷4.2 (January, and also April- May and October, respectively). Changeability is observed during April and October (increase).

Table 7

Number of days in year of various category of TCI in four locations of Kakheti in 1961-2010, 1961-1985 and 1986-2010

Location	Telavi			Dedoplistskaro			Kvareli			Sagarejo		
Period	1961-2010	1961-1985	1986-2010	1961-2010	1961-1985	1986-2010	1961-2010	1961-1985	1986-2010	1961-2010	1961-1985	1986-2010
Very Unfavor.	0	0	0	1	0	1	0	0	0	2	2	2
Unfavor.	7	9	6	20	17	23	23	24	21	17	17	10
Marg.	83	78	89	86	84	89	71	67	75	77	77	83
Accept.	80	86	74	65	72	58	74	75	73	78	78	62
Good	65	57	73	43	35	51	88	85	90	41	41	49
Very Good	83	82	84	79	69	89	86	89	83	74	74	78
Excell.	44	52	37	67	83	51	23	23	22	71	71	77
Ideal	2	1	2	4	5	2	1	1	1	5	5	5
Marg.-Ideal	358	357	359	345	348	341	343	341	345	349	346	353
% from year	98.0	97.7	98.3	94.3	95.3	93.3	93.8	93.3	94.3	95.7	94.7	96.7
Month in year (mean)	11.8	11.7	11.8	11.3	11.4	11.2	11.3	11.2	11.3	11.5	11.4	11.6

Table 7 presents the data about the average number of days per annum in Kakheti with different category of TCI in three periods of time. As follows from this Table, in 1986-2010 in comparison with 1961-1985 the average number of days per annum with the categories of TCI "Marg." and higher, with those causing for the "Average Tourist" favorable bioclimatic situation, in the separate investigated points it changed as follows: Telavi - practically invariability (357 and 359 days, respectively); Dedoplistskaro - insignificant decrease (348 and 341 days, respectively); Kvareli - practically invariability (341 and 345 days, respectively); Sagarejo - small increase (346 and 353 days, respectively).

Thus, the greatest effect of the process of climate change in the conditions of Kakheti [60] appeared in the changeability of the number of days per annum with the categories of TCI "Marg." and higher in Dedopdistskaro and Sagarejo. In this case, into Dedoplistskaro is observed insignificant worsening in the favorable bioclimatic conditions for the "Average Tourist " (decrease of favorable days to 2.0 %), and into Sagarejo - small improvement (increase in the favorable days by 2.0 %).

It is remarkable, which under the conditions of Kakheti of this significant changeability of the TCI as in some points of Adjara (Khulo and Goderdzi [56]), is not observed. I.e., it is present the need for the detailed study of climate change (and also bioclimate) not only on global, but also regional and local scales.

Conclusion

Climate has a strong influence on the tourism and recreation sector and in some regions represents the natural resource on which the tourism industry is predicated. In this work the determination of the climatic potential of tourism to four location of Kakheti (Georgia) into the correspondence with that frequently utilized in other countries of the “Tourism Climate Index” (TCI) is carried out.

In the future we plan a more detailed study of the climatic resources of this and others regions of Georgia for the tourism (mapping the territory on TCI, long-term prognostication of TCI, determination of other contemporary climatic and bioclimatic indices for tourism).

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კახეთში (საქართველო) ტურიზმის კლიმატური ინდექსის სტატისტიკური მახასიათებლები

ა.ამირანაშვილი, ლ.ქართველიშვილი, ა.მატზარაკისი

რეზიუმე

ნაშრომში წარმოდგენილია ტურიზმის კლიმატური ინდექსის (TCI) საშუალო თვიური, საშუალო წლიური და საშუალო ნახევარწლიური მნიშვნელობები კახეთის ოთხი პუნქტის (თელავი. დედოფლისწყარო, ყვარელი, და საგარეჯო) 1961÷2010 წ.წ. პერიოდის მიხედვით. კერძოდ, შესწავლილია აღნიშნული ბიოკლიმატური პარამეტრების ცვლილება 1986÷2010 წლებში 1961÷1985 წლებთან შედარებით.

Статистические характеристики климатического индекса туризма в Кахетии (Грузия)

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Резюме

Представлены статистические характеристики среднемесячных, годовых и полугодовых значений климатического индекса туризма (TCI) и его составляющих для четырех пунктов Кахетии (Телави, Дедоплисцкаро, Кварели и Сагареджо) в период с 1961 по 2010 гг. В частности, изучена изменчивость указанных биоклиматических параметров в 1986÷2010 гг. по сравнению с 1961÷1985 гг., а также исследованы тренды значений TCI для выше перечисленных пунктов.