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THE SUITABILITY OF MOLDOVA CLIMATE FOR BALNEARY - CLIMATIC TOURISM AND OUTDOOR ACTIVITIES - A STUDY BASED ON THE TOURISM CLIMATE INDEX

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Key words: Tourism Climate Index, tourist stay, balneary - climatic tourism

Abstract. This study addresses a current issue concerning spatial and temporal analysis of Moldova's climate resources and is intended for the use of people involved in various tourism and related activities. For researchers in the field, the study will be a source of information, allowing comparison of the results obtained for other locations, and for practitioners an indispensable working tool. The motivation for the present study resides in the sparseness and ambiguity of the analysis of climate resources for tourism included in the assessment of the natural tourism potential of Romania. We aim to improve this approach by constructing for Moldova a statistically relevant, quantitative analysis of what climate offers the tourists. To achieve the proposed objectives, we used TCI and a climate database sufficiently detailed to capture climate patterns up to ten-days time intervals. We showed that in Moldova the May-September interval is the most favorable for developing all forms of tourism. We then customized the analysis at the level of each tourism resort. Our study is among the first in this region to use such analysis and provides clear research results to those involved in tourism to improve their decision-making process. The results are very important in supporting tourism in Moldova and will contribute to raising the economic potential of the region.

Introduction

Weather and climate exert important influences on the tourism sector worldwide (Smith, 1993; Perry, 1997; Boniface and Cooper, 2009), by affecting

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the length and quality of tourism seasons (Scott et al., 2004). Elements such as air temperature, wind, humidity, precipitation, cloudiness and duration of sunshine, snow layer etc., through their variability and trends, affect decisions made by tourists, their satisfaction and willingness to spend money, with consequences on the development of tourism companies and ultimately of tourist destinations.

For tourists, natural environmental factors such as weather and climate are highly important when they consider a particular tourist destination (Abegg, 1996). In the areas characterized by a temperate climate, sunshine, high sea water temperature and beach sand particularities are very important factors for summer tourism. Winter tourism on the other hand is highly related to the snow layer, a paramount factor in the decision making of tourists (Matzarakis, 2006). Winter sports are directly dependent on climatic resources. Without snow or negative temperature for producing artificial snow, the development of ski resorts would not have been possible (Gomez Martin, 2005). Certain outdoor tourism activities, such as hiking, rafting, golf, hunting, fishing, mountaineering are dependent on climatic conditions (Gomez Martin, 2005). Weather and climate play an important role in the three phases of a tourist stay: before, during and after its completion.

The regions characterized by high meteorological variability, with seasons that deviate from the normal characteristics (e.g. with rainy and cold summers, warm and snowless winters) introduce major financial risks in tourism activities. Weather conditions may affect or even change the daily schedule of a planned stay. Tourists are largely affected by excessive weather manifestations, such as heat, cold air advections, cold rains, high pressure drops, violent winds etc. (Ramezani and Palic, 2012). Perry investigated in 2001 the relationship between climate and tourism in the Mediterranean region and found that the occurrence of warm tropical air waves highly impacted tourism. The tourism industry is particularly sensitive to weather and climate variability (Curtis et al., 2011).

Knowledge on climate and weather developments facilitates a good planning of tourism activities (Matzarakis, 2006). Presently, there is a high need for bioclimatic information in the field of balneary - climatic tourism (Matzarakis et al., 2004; Matzarakis, 2006 and 2010). This information can be obtained from various sources (books, tourist guides, Internet etc.) and/or from weather forecasts (Matzarakis, 2006). Weather forecasting services should inform and warn in time (both managers of tourism activities and tourists) against the occurrence of episodes of bad weather, in order to reduce associated risks. Maureen and Jean (2001) argued for the powerful climate- tourism conditioning. The thermal and adjacent controls are strongest for both coastal and mountain regions and confer them a certain degree of tourist attraction.

The complex relationship between climate and tourism was analyzed in many studies using the Tourism Climate Index (TCI) proposed by Mieczkowski (1985).

The index combines seven climatic elements or parameters and is adapted for studies focusing on the temperate zone.

Many researchers have used TCI to conduct studies on the implications of climate in tourism. Presently, TCI is widely applied and validated worldwide. For example, Scott et al., 2004 used TCI to assess spatial and temporal distribution of climate resources for tourism in North America. Cengiz et al., 2008 evaluated based on TCI the climatic conditions of Çanakkale city and their impact on tourism activities. Ramezani and Palic, 2012 calculated for Ramsar, northern Iran, the TCI monthly averages for the period 1981 - 2005. Their results showed that the interval April to November is the most favorable for tourism, whereas excellent conditions for the development of tourism activities were identified for May. Conversely, the interval December to March shows unfavorable weather conditions for tourism because of lower temperature. Joksimović et al. (2013) calculated TCI for four stations in Montenegro (Herceg Novi - 40 m a.s.l., Podgorica - 49 m a.s.l., Kolašin - 944 m a.s.l. and Žabljak - 1450 m a.s.l.) and identified the summer months that meet the best conditions for tourism. Kovacs and Unger (2014) performed an assessment of the climate - tourism potential of four localities in Hungary (Szeged, Budapest, Siófok, Pécs), whereas Kovacs et al. (2014) evaluated the thermal comfort of the inhabitants of the southern Tisza Plain in Hungary. Amiranashvili et al. (2014) comparatively analyzed monthly TCI values in the South Caucasus countries (Baku, Tbilisi and Yerevan capital cities). Fang and Yin (2015) used data from 658 stations in China for the period 1981-2010 to show that in most regions of China climatic conditions are comfortable for tourists during spring and autumn. In summer and winter, the spatial variation of climatic conditions imposes a latitudinal distribution of tourism activities. The study shows that the number of months favorable for tourism in China ranges from 0 to 10 and the most attractive area, with the highest level of climatic comfort is the Yunnan Province, whereas the Tibetan Plateau is characterized by the lowest climatic comfort. Studies based on TCI are more numerous and are performed for multiple locations on different continents.

TCI was also used in studies aimed to forecast climatic tourism potential up to the year 2100. Scott and Mc Boyle in 2001, followed by Scott et al. (2004) projected the impacts of climate change on tourism for the North America territories. Amelung and Viner (2006), Hamilton and Tol (2007), Sabine et al. (2010), Amelung and Moreno (2012) used TCI to analyze and project (based on various scenarios) the climatic resources available for tourism in Europe. These studies predicted that climate change is likely to lead to an improvement of climatic resources for tourism in northern and central North America and Europe, paralleled by a deterioration of summer climatic resources particularly in southern tropical and subtropical areas.

For Romania and Moldova implicitly, there are no studies to date which use TCI in the assessment of climate resources for tourism. The present study is a novel approach addressing the potential of climatic resources of Moldova to be rendered valuable for tourism. This is done by employing a complex climate-tourism index, validated spatially (many studies with good results all over the world) and temporally (the temporal resolution equals ten-days intervals), and not by a series of bioclimatic indexes (e.g.: equivalent effective temperature - TEE, thermo-hygrometric index - THI, Wind-chill Index-Pr, Thom Discomfort Index - DI THOM, Relative Strain Index –RSI, Heat Index - HI, HUMIDEX Index - HUMIDEX, Summer SIMMER Index - SSI, Summer SCHARLAU Index - ISE, Winter SCHARLAU Index - ISH) whose general (or balneoclimatic) applicability in Moldova is deficient, irrelevant or even contrary to certain facts known and accepted by the scientific community (Mihăilă et al. 2016, Bistricean et al. 2017). The present study highlights the climate potential for tourism of Moldova, a region with tradition in balneary-climatic tourism, but where such tourism activities declined following the political, economic and social changes triggered in 1989. Through this study, we ultimately aim to bring Moldova's great potential for balneary-climatic tourism to the attention of the international public.

1 Study area

The investigated area is located in east – north eastern Romania and overlaps the territory of the historical province Moldova. Its physic-geographical limits are the valley of the Prut River in the east, the border with Ukraine in the north, the alignment of the Eastern Carpathian peaks in the west and the Romanian Plain in the south (Fig. 1). From the administrative point of view, the province of Moldova includes eight counties, i.e., Suceava, Botoşani, Neamţ, Iaşi, Bacău, Vaslui, Vrancea and Galaţi, with a total area of 40 837 km^2. In Moldova, landforms are distributed gradually from west to east in the following order: the Eastern Carpathians in the west, the Moldavian and Curvature Sub-Carpathians in the central part and the Moldavian Plateau in the east, continued towards the south with the north-eastern part of the Romanian Plain.

The three main bioclimatic zones follow a similar distribution pattern, i.e., west - east (Teodoreanu and Gaceu, 2013; Mihăilă, 2014).

The tonic-stimulant bioclimate characterizes 33.76 % of the total area of Moldova (Fig. 2). It generally corresponds to the mountain climate of the Carpathians, from the highest altitudes of Călimani (2103 m a.s.l.) and Ceahlău Mountains (1997 m a.s.l.), descending to altitudes of ca. 700-800 m, and in some cases (depressions or slopes with northern exposure) to lower altitudes. On the high mountain peaks tourist activities are supported by a number of meteorological stations, tourist huts and refuges (Ceahlău Toaca and Reţitiş Călimani weather

stations, Dochia, Rarău, Giumalău and Călimani tourist huts). This type of bioclimate is only characteristic to the Vatra Dornei balneary - climatic tourist

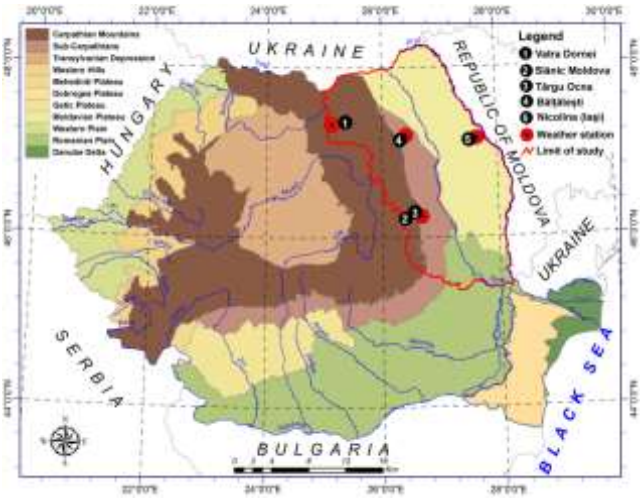

Fig. 1. Mathematical and geographical location of Moldova in Romania and relative to the major landforms of Romania; Location of the five balneary - climatic resorts and the neigh boring weather stations in Moldova

resort (also known as 'Moldova's Sinaia'), located in the Dorna Depression at the confluence of the rivers Bistrita and Dorna, at an altitude of 808 m a.s.l.. The resort benefits from a wide range of natural curative factors, such as mineral waters (carbonated, ferruginous, bicarbonated, sodic, magnesic, calcic, hypotonic), peat muds, highly negatively ionized air, added to the tonic-stimulant mountainous climate. The resort is indicated for the treatment of cardiovascular diseases, as well as rheumatic, post-traumatic, peripheral and central neurological diseases and a number of associated diseases. Vatra Dornei balneary - climatic resort had 47 accommodation units in 2015. The Bradul - Călimani spa complex is the only facility offering balneary - climatic medical consultations.

The sedative-indifferent bioclimate characterizes 35.9 % of the Moldova territory, particularly the altitudes between 700 - 800 m and 200-300 m a.s.l.. Slănic Moldova (also known as 'The Pearl of Moldova'), Târgu Ocna and Bălţăteşti resorts are located in this bioclimatic zone. *Slănic Moldova balneary* resort is situated at 530 m a.s.l. on the eastern slope of the Eastern Carpathians (Nemira Mountains), in a depression covered with deciduous and coniferous forests, in the Slănic River valley, a tributary of the Trotuş River. At Slănic Moldova, the sedative-indifferent bioclimate displays slightly tonic features.

Mineral springs, clean air free of allergens, the topoclimate of shelter and the microclimate specific to the Târgu Ocna salt mine are key features of this resort and used to treat illnesses of the digestive tract and respiratory system, or hepatobiliary diseases, metabolic and nutritional disorders, neurological peripheral disorders, as well as kidney and urinary tract and post-traumatic disorders. *Târgu Ocna balneary resort* is located at the contact between the Eastern Carpathians and the Moldova Sub-Carpathians in the Bacau County, the north-western part of the Caşin Depression, at the foothills of the Berzunți (north) and Nemira (south and west) Mountains, at an altitude of 260-280 m a.s.l., on the Trotuş River and its tributary Slănic. The most valuable natural curative and wellness factors are the salt mine, the fresh, ozonated air and the sedative-indifferent bioclimate. Târgu Ocna resort has three spa centers (two in the Măgura spa center and one in the salt mine, at the depth level IX). Târgu Ocna and Slănic Moldova resorts are located approx. 10 km apart. Bălţăteşti resort is located at 475 m a.s.l., in the Neamţ Depression, Moldova Sub-Carpathians, surrounded by hills covered with forests and orchards. This resort has a high therapeutic potential given by mineral waters, i.e., high concentration chlorinated, sulphurated, bromurated and iodurated waters, to which the sedative-indifferent bioclimate is added. It is indicated in the cure of rheumatic and post-traumatic disorders, peripheral neurological, gynecological and associated disorders. The *Bălţăteşti resort* had six tourist accommodation units in 2015. The curative center is administered by the Ministry of National Defense.

The turn-applicant bioclimate characterizes only 30.3 % of the territory of Moldova and overlaps its eastern and south-eastern parts. Nicolina balneary resort is located in this bioclimatic zone at an altitude of 143 m a.s.l. in the southwestern part of the Iaşi city. The resort uses mineral muds and sulphurated, iodurated, chlorinated, sodic, bicarbonate and hypothermal mineral waters, as alternative cure for rheumatic, degenerative and abarticular diseases, peripheral neurological, post-traumatic, gynecological, skin, respiratory and otorhinolaryngological (ENT) diseases. The balneary facilities consist of two components: the Nicolina hotel and the Unit for Balneary Treatment and Recovery of Work Capacity.

2. Data and methods

In this study we used daily values of the following meteorological elements and parameters: air temperature - daily averages, minimum and maximum values (°C), relative air humidity (%) - daily averages and minima, precipitation - daily sums (mm) cloudiness - daily averages (eights), the duration of sunshine - daily sums (hours), wind velocity - daily averages (ms^{-1}). These data span the period 1961-2015.

We used data from the following weather stations: for Vatra Dornei we used data available from the Vatra Dornei weather station, extended with the data from

the Poiana Stampei weather station; for Târgu Ocna resort, data from the Târgu Ocna and Slănic Moldova weather stations were employed; data from Târgu Neamţ weather station was used for Bălţăteşti resort and from Iasi weather station for Nicolina resort respectively. Meteorological data were provided by the National Meteorological Administration in Romania. Balneary - climatic resorts and the associated weather stations are located at distances lower than 20 km from one another, in almost identical topoclimatic environments. The thermal and hygric differences between the resorts and associated weather stations were quantified by hourly measurements performed between March 2015 and March 2016. These differences ranged between 0.9°C (Vatra Dornei - Poiana Stampei) and 0.1°C (Nicolina and Iaşi). In what concerns humidity, the differences ranged between 8 % (Vatra Dornei - Poiana Stampei) and 1 % (Târgu Ocna and Slănic Moldova). The correlation coefficients between the air temperature measured in the balneary resorts and the air temperature recorded at the neighboring weather stations ranged between 0.953 (Bălţăteşti and Târgu Neamţ) and 0.991 (between Nicolina and Iaşi), whereas relative humidity correlation coefficients between 0.716 (Bălţăteşti and Târgu Neamţ) and 0.958 (Slănic Moldova – Târgu Ocna).

For example, for Târgu Ocna and Slănic resorts, located at 18 km distance from one another in very similar geographical settings, the data from the Târgu Ocna meteorological station were used. The values recorded by the temperature and humidity sensors between March 2015 and March 2016 in the built perimeter of the Slănic Moldova resort were compared with data obtained from Târgu Ocna weather station. The hourly differences in temperature and humidity values between Slănic Moldova and Târgu Ocna were very low (for example, the mean temperature of the test time interval was 9.8°C at Slănic Moldova and 10.1°C at Târgu Ocna respectively, with a difference of 0, 3°C between the two resorts; the average relative humidity of the test time interval was 73.1 % at Slănic Moldova and 72.6 % at Târgu Ocna, with a difference of 0.5 % between the two resorts). Correlations between the measurement results at the two sites are very strong.

We considered the differences resulting from the measurements when we configured the meteorological - climatic database used to calculate daily and monthly values of TCI in all locations.

To relate the climatic conditions over the course of a year with tourism activities, the tourism climate index (TCI) was employed. In the analysis of the relationship between tourism and climate, Mieczkowski (1985) used two complex climate indicators and three simpler indicators. For the latter, he identified their impacts on tourism and established their share in the final TCI scores, according to (Tab. 1).

To determine TCI, we first calculated the five indicators included in its formula **(1)**:

$$TCI = 2[(4*CID) + CIA + (2*P) + (2*S) + W] \quad (1)$$

Therefore, each indicator of the five was given points ranging from 5 to 0: 5 points show that the indicator provides ideal conditions for tourism activities, whereas 0 points indicate very restrictive conditions (according to the thresholds found in the nomograms created by Mieczkowski in 1985).

For CID and CIA indicators we constructed correlation graphs on a two axes system, where the abscissa axis (OX) shows daily temperature maxima and averages and the ordinate (OY) displays daily humidity minima and averages. The intersection point of the axes thus shows the highest values for temperature, the lowest for humidity respectively. Five points were assigned to the intersection point of the axes, and the number of points reduced to zero the more temperature decreased on the abscissa and the more humidity increased on the ordinate.

Tab. 1. Climatic indicators representative for tourism (Mieczkowski, 1985)

Indicators	***Climatic variables used***	***Impact on tourism***	***Weight (number of points) in the model***
CID Daytime Comfort Index	Mean of daily temperature maxima (°C) and mean of daily relative humidity minima (%)	Warm and dry days can be ideal for tourist activities, provided that during the warm season the temperature should not exceed the thermal threshold of a tropical day; during the cold season, there are no restrictions for this thermal parameter.	40
CIA Daily Comfort Index	mean daily temperature (°C) and mean daily relative humidity (%)	Indicates thermal and hygric comfort over the full 24 hour period of a day	10
P Precipitation	Mean monthly sum of precipitation (mm)	High precipitation amounts, irrespective of the characteristics of precipitation, has a negative impact on tourist activities and stays	20
S Sunshine	Mean daily duration of sunshine (hours)	High sunshine duration is beneficial for tourism, with certain restrictions related to the intensity of ultraviolet and infrared radiation which may cause sunburn and discomfort on hot days.	20
W* Wind	Average daily wind speed (ms^{-1})	Wind has variabe effect: on warm summer days it lowers temperature and on cold winter days it enhances the sensation of cold and heat loss	10

In the case of W indicator, average daily wind speed ≤ 0,63 m / s was assigned 5 points, whereas average daily wind speed ≥ 10.7 m/s received 0 points.

For the months which received precipitation between 0 and 14.9 mm, the points assigned for P index were 5, and for the months characterized by precipitation amounts higher than 150 mm, 0 points were given. The S index was

assigned 5 points for the months with an average daily sunshine duration ≥ 10 hours, and 0 points for the months when the average daily sunshine duration was lower than one hour.

3. Results and discussion

The obtained indicators were included in the formula (1) to calculate the final TCI scores. These scores have a gradual impact on tourist activities at different thresholds.

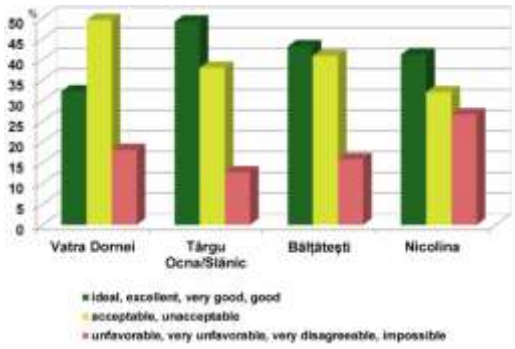

Fig. 2. Time (in %) for favorable, acceptable, less acceptable and unfavorable climate conditions for tourism between 1961 and 2015

3.1. The frequencies of annual TCI scores.

Based on the average annual TCI scores we found that climate conditions for the development of tourist activities are 'good' in Slănic Moldova and Târgu Ocna resorts (average annual TCI score = 61.4 %) and 'acceptable' in Bălţăteşti (TCI score = 58.5 %), Nicolina (TCI score = 55.5 %) and Vatra Dornei (TCI score = 54.0 %) resorts. The impact of climatic conditions on tourism refers to the sum of weather manifestations outlining the climatic image of a location, which influences tourist flows, affects the comfort or maintains the discomfort of tourists during a stay, and which also impacts on tourism infrastructure, on health condition of tourists and their planned budget etc. Therefore our data suggest that in Moldova the suitability of climate for tourism is acceptable to good, situated in the lower third of the favorability range. This supports our present attempt to show the stakeholders involved in tourism management that there is the need for a better planning of tourism activities, based on clear measures and paralleled by an adequate infrastructure, in order to improve the topoclimatic (the geographic

location) and microclimatic (the curative - treatment facilities and accommodation units) potential of these resorts.

At a higher level of detail, our results show that Slănic Moldova and Târgu Ocna are characterized by favorable conditions for tourism activities (from good to ideal) in 49.2% of the cases, whereas at Vatra Dornei these conditions are only met in 32.2 % of the cases, for the 1961 - 2015 time interval **(**Fig. 2).

Acceptable and marginal conditions have the highest weight at Vatra Dornei (49.6 %) and the lowest at Nicolina (32.1 %) for the analyzed timeframe.

Unfavorable conditions for tourism (different intensities, from unfavorable to impossible) have the highest weight at Nicolina (26.7 %) and the lowest at Târgu Ocna and Slănic Moldova (12.7%) in the 1961-2015 time interval.

A further analysis of the distribution of the TCI scores for all the possible ratings (from 9 to 0) highlights certain interesting features (Tab. 2). More specifically, for the Carpathians - Sub-Carpathians contact area (Slănic Moldova, Târgu Ocna, Bălţăteşti) TCI scores are most evenly distributed (particularly towards higher TCI ratings, indicating favorable climatic conditions for tourism).

Tab.2. Multiannual percentage scores of TCI at Vatra Dornei, Târgu Ocna / Slănic, Bălţăteşti and Nicolina, differentiated in intervals with different TCI ratings reflecting the impact of climate on tourism (1961-2015)

TCI scores	Rating	Description of the impact of TCI scores on tourist activities	Resort			
			Vatra Dornei	Slănic Moldova/ Târgu Ocna	Bălţăteşti	Nicolina
100 - 90	**9**	**Ideal**	**3,2**	**10,3**	**8,0**	**4,0**
89,9 - 80	8	Excellent	4,2	9,1	6,9	6,2
79,9 - 70	7	Very good	10,8	17,5	14,9	20,3
69,9 - 60	6	Good	14,1	12,3	13,4	10,7
59,9 - 50	5	Acceptable	23,7	19,3	20,7	13,8
49,9 - 40	4	Marginal	25,9	18,7	20,2	18,3
39,9 - 30	3	Unfavorable	12,6	8,0	10,2	14,0
29,9 - 20	2	Very unfvorable	4,8	4,4	4,9	10,7
19,9 - 10	1	Extremely unfavorable	0,5	0,3	0,7	1,8
9,9 - 0	**0**	**Impossibile**	**0,2**	**0,0**	**0,1**	**0,2**

The territories located outside the Carpathians and Sub-Carpathians (e.g. Nicolina) are characterized to a larger extent by climate excesses / risks that result in lower TCI ratings, indicating unfavorable conditions for tourism. In the Carpathian area (Vatra Dornei resort) our analysis highlights a concentration of TCI ratings in middle of the value range. These particularities are explained by the existence of climatic conditions specific to the Carpathian areas, marked by more

attenuated variations of climatic elements compared to the territories located outside of the Carpathians where climate variability is considerably more pronounced.

3.2. The frequencies of monthly TCI scores

The analysis of the annual evolution of TCI scores and ratings in the studied locations clearly shows that from November to March the average weather condition are not very permissive for tourism activities; however, between May and September there are no weather and climate - related restrictions on these activities. October and April are transition months, characterized by acceptable weather conditions for tourism, but with contrasting developments of annual TCI ratings (Fig. 3).

This analysis can be nuanced provided that it is applied to other types than balneary - climatic tourism, such as sports tourism. TCI, in all its complexity and coverage, has a number of limitations compared to the climatic travel schemes used by many specialists (Kovács et al. 2015; Matzarakis 2014 etc.), where other climatic elements or parameters are added, such as snow layer. For example, Vatra Dornei is a resort characterized by a complex tourist profile particularly based on balneary - climatic and sports tourism. In this area, unfavorable and marginal conditions for balneary - climatic tourism specific to the period November to March are ideal for sports tourism (sledding, skating, skiing - there are five ski slopes at Vatra Dornei).

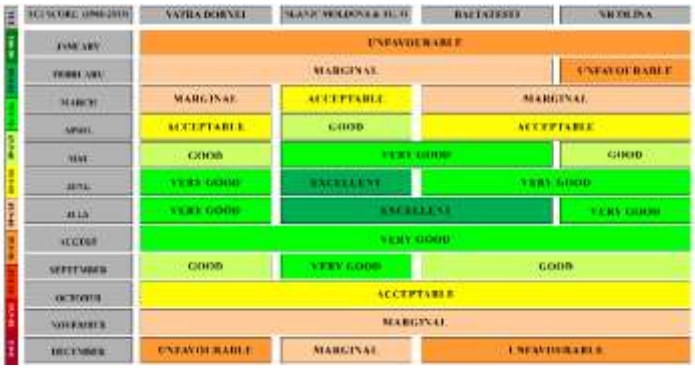

Fig. 3. The annual evolution of TCI scores and their influence on tourist activities in the balneary - climatic resorts of Moldova (1961 - 2015)

During this period, the most affected tourist activities are not the typical balneary activities (developed inside the treatment facilities), but the climatic curative adjacent activities (conducted in the open) which take place without

significant restrictions over the warm season of the year. Slănic Moldova (with one little promoted, known and used ski slope), Târgu Ocna, Bălţăteşti and Nicolina (which benefits from the Sărărie ski slope, mostly used by the residents of Iasi) resorts are mainly characterized by activities related to balneary tourism conducted inside treatment facilities. As a result, climatic conditions have a negative impact particularly during winter and some transition months, and on the climatic - curative activities (open-air cure, outdoor gym etc.) conducted in the open.

3.3. The frequencies of TCI scores at 10-day interval

Over the course of one year, an analysis performed at a 10-day temporal resolution reveals a more complex situation, i.e., climatic conditions are less favorable for tourism starting with the third 10-day interval of October until the third 10-day interval of March (Fig. 4). From April until the second 10-day interval of October tourism activities in Moldova are not conditioned significantly and negatively by average weather conditions. The transition from unfavourable to favourable climatic conditions in spring and vice versa in autumn does not occur simultaneously in the five studied locations, but with certain differences.

Fig. 4 also shows that that TCI scores are the highest at Slănic Moldova and Târgu Ocna, followed by Bălţăteşti resort, for almost all the 10-day intervals and months of the year. During the warm season (April to October), TCI scores are the lowest at Vatra Dornei and during the cold season (October to March) the most adverse climatic conditions for tourism are specific to Nicolina balneary resort.

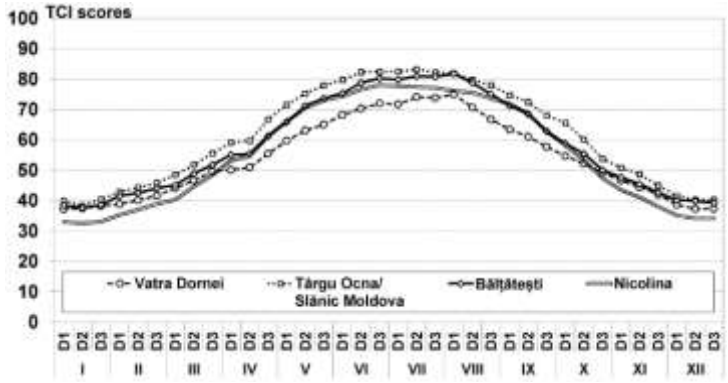

Fig. 4. Variation of TCI scores for 10-day intervals in the balneary - climatic resorts of Moldova (1961-2015)

Using the same level of analysis (10-day interval) and also based on Fig 5 that graphically shows the detailed annual evolution of the relationships between

climate conditions and tourism activities, we underline the following issues: TCI scores for continuous six 10-day intervals indicate at Slănic Moldova and Târgu Ocna ‘excellent‘ conditions for tourism; conversely, at Bălţăteşti, such conditions persist only during four 10-day interval of the year and do not occur in any of these intervals at Vatra Dornei and Nicolina.

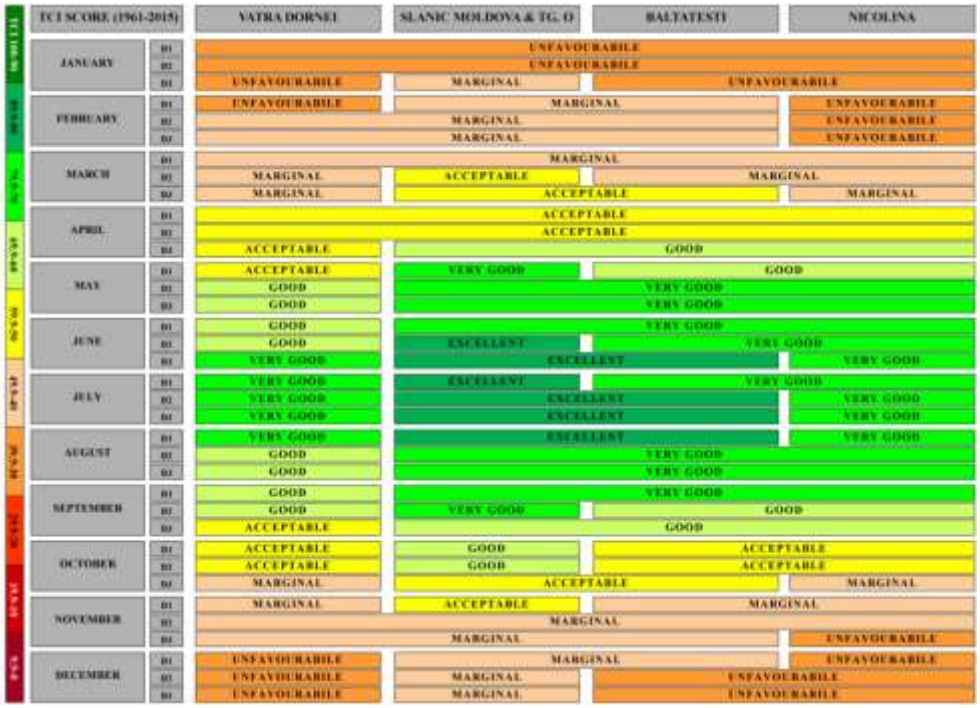

Fig. 5. Variation of the TCI scores for 10-day intervals and their impact on tourism activities in the balneary - climatic resorts of Moldova (1961-2015)

From the first 10-day interval (D1) of May until the second 10-day interval (D2) of early September weather conditions pose no restrictions for tourism at Slănic Moldova and Târgu Ocna, being ‘very good’ and ‘excellent’; these conditions are restricted temporally between D2 of May and D1 of September at Bălţăteşti and Nicolina, and between D3 of June and D1 of August at Vatra Dornei. TCI values included in the ‘unfavourable’ category are characteristic only of two 10-day intervals at Slănic Moldova and Târgu Ocna, of five 10-day intervals at Bălţăteşti and amount to seven 10-day intervals at Vatra Dornei and ten 10-day intervals at Nicolina. Furthermore, restrictive conditions for tourism (‘unfavourable’ and ‘marginal’) are characteristic of 16 10-day intervals at Vatra

Dornei and of 12 10-day intervals at Slănic Moldova and Târgu Ocna. Added to the two broad categories of conditions (restrictive, i.e., the 'unfavourable' and 'marginal' 10-day intervals and unrestrictive, i.e., the 'excellent' and 'very good' 10-day intervals), between D2 of March and D1 of May on the one hand, D2 of August and D1 of November on the other hand, a middle category of 10-day intervals interposes, where the relationships climate - tourism are 'acceptable' and 'good'.

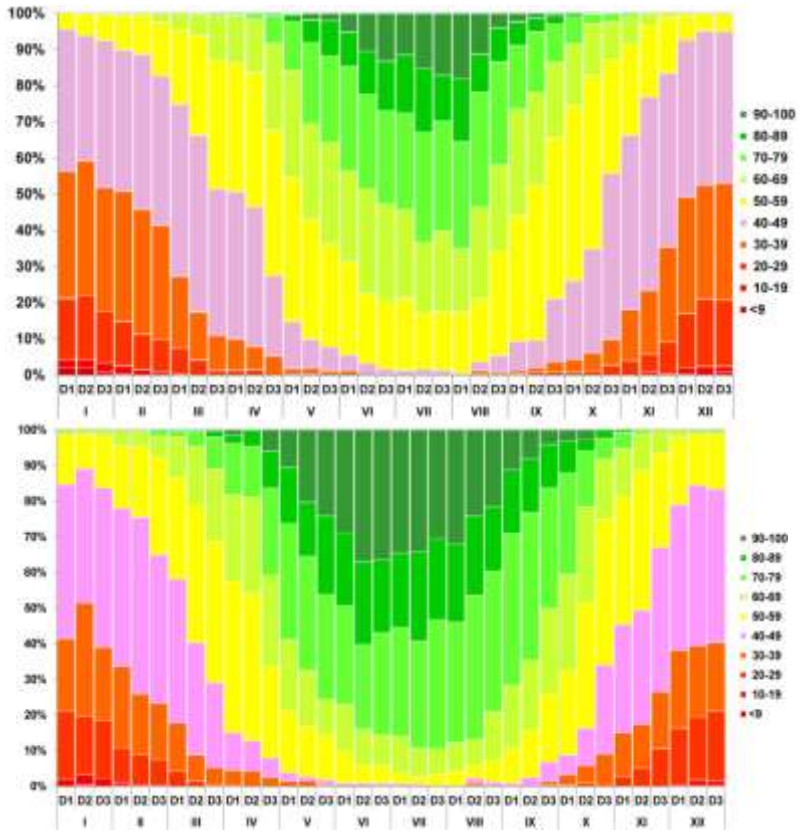

Fig. 6a, b. The monthly and 10-day interval frequency (%) of the number of days with different values of TCI in Vatra Dornei, Slănic Moldova and Târgu Ocna balneary - climatic resorts (1961-2015)

Slănic Moldova and Târgu Ocna, being 'very good' and 'excellent'; these conditions are restricted temporally between D2 of May and D1 of September at Bălţăteşti and Nicolina, and between D3 of June and D1 of August at Vatra Dornei.

TCI values included in the 'unfavourable' category are characteristic only of two 10-day intervals at Slănic Moldova and Târgu Ocna, of five 10-day intervals at Bălţăteşti and amount to seven 10-day intervals at Vatra Dornei and ten 10-day intervals at Nicolina. Furthermore, restrictive conditions for tourism ('unfavourable' and 'marginal') are characteristic of 16 10-day intervals at Vatra Dornei and of 12 10-day intervals at Slănic Moldova and Târgu Ocna. Added to the two broad categories of conditions (restrictive, i.e., the 'unfavourable' and 'marginal' 10-day intervals and unrestrictive, i.e., the 'excellent' and 'very good' 10-day intervals), between D2 of March and D1 of May on the one hand, D2 of August and D1 of November on the other hand, a middle category of 10-day intervals interposes, where the relationships climate - tourism are 'acceptable' and 'good'.

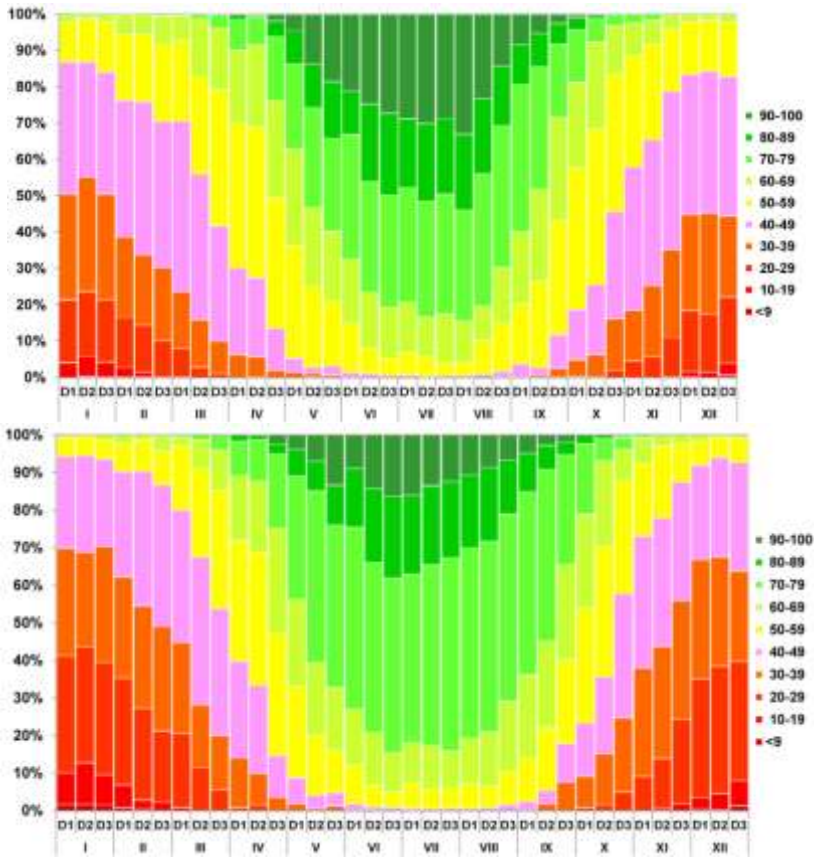

Fig. 6c, d. The monthly and 10-day interval frequency (%) of the number of days with different values of TCI in Bălţăteşti and Nicolina balneary - climatic resorts (1961-2015)

The simplified matrix of the complex relationships (often dual or controversial) between climate and tourism, shown in Fig. 5, is easy to read and interpret by anyone, due to the proposed color code. The separation of the year in 10-day intervals was also performed for purposes of utility and planning of tourist stays, given that tourist stays generally extend over ten days time intervals.

A more detailed picture on the 10-day interval frequency of days with different TCI scores is shown in Fig. 6 a-d. It can be observed that during winter months predominant are the days classified as 'less acceptable' to 'impossible' according to the TCI scores. For summer, the TCI scores show mostly 'acceptable' to 'ideal' days. During the transition seasons, the majority of the days fall between 'unfavorable' and 'good', whereas the frequency of days classified as 'very unfavorable' or 'very good' increases towards the beginning and end of these seasons.

Fig. 6 a-d completes Fig. 5, as it shows the true particularities of the climate of the studied locations. Therefore it is very useful for tourists who become informed of the probability of occurrence of the days with less desirable weather during their stay. This reality often contrasts with the 'climatic image' of a particular location, promoted by tourism agencies. Often this image is idealized, the climatic reality is 'cosmetized' for obtaining economic benefits.

Our findings are similar to results obtained by researchers who used the same index to assess the climatic potential for tourism in several locations in Montenegro (Joksimović et al., 2013), Hungary (Kovacs and Unger, 2014) or for larger territories such as the south of the Hungarian Tisa Plain (Kovacs et al., 2014). Only the aspects related to the local particularities of the climatic potential for tourism, imposed by regional and local geographic and climatic factors are different.

These particularities develop into other climates, namely the differentiation grows as we move away from Moldova's latitude or longitude, or as increasingly large differences in vegetation cover or landforms occur between the compared territorial entities. For example, between Moldova (which has a temperate transition climate characterized by frequent climatic extremes) and the Anatolian western coast with a Mediterranean climate (Cengiz et al. 2008), there are differences in the duration of the season with the most favorable climate for tourism (a longer season in the latter case), but also similarities (in what concerns the location of the most favorable season for tourism in an average year: May - September in Moldova, April - October in Çanakkale, Turkey). In northern Iran, where the climate changes from Mediterranean to subtropical desert, the annual interval most favorable for tourism is even more extended (April to November after Ramezani and Palic, 2012). Much towards the east, in China, the wide latitude and longitude development, the contrasting landforms and proximity to / or distance from the monsoon circulation systems give the climate a wider range of

particularities in relation to tourist activities, with climatic conditions ranging from impossible to ideal for these activities (Fang and Yin, 2015).

Therefore, our results are in good agreement with the climatic-tourism reality characterizing territories closer to Moldova and present an actual radiography of the bioclimatic and climatic-touristic reality of Moldova.

Conclusions

The multi-annual average TCI scores show that the best conditions for balneary-climatic tourism and outdoor tourist activities in Moldova are met at the contact between the Carpathians and the Sub-Carpathians (at Slănic Moldova and Târgu Ocna the multiannual average values of TCI are equal to 61.4 %), followed by the Sub-Carpathians (at Bălțăteşti the annual average values of TCI are 58.5 %). The annual average TCI values indicate slightly more restrictive climatic conditions for balneary-climatic tourism and outdoor activities at Nicolina (TCI - 55.5 %) and Vatra Dornei (TCI - 54.0 %) due to either climate excessiveness, i.e., characterised by hot summers and cold, frosty winters - Nicolina, or to the extended cold season with frequent thermal inversions or a cooler warm season – Vatra Dornei.

Knowledge on the dynamics of annual TCI values over successive 10-day intervals is very important for both national and international tourists. Therefore, this index is rendered suggestively through a very intuitive palette of colors. By reading the climatic-tourist diagrams provided, we observe in the case of a tourist stay for recreation and cure purposes in Slănic Moldova and Târgu Ocna resorts that good, very good and excellent weather conditions prevail from D3 of April until D2 of October. At Bălțăteşti, tourists engaged in health and recreation tourism are likely to benefit from good and very good weather conditions from D3 of April to D3 of September, and at Nicolina good and very good weather conditions dominate from D3 of April to D3 of September. At Vatra Dornei, good and very good weather conditions for practicing health tourism and outdoor tourist activities are generally encountered from D2 of May to D2 of September.

Climate-tourism diagrams, added to the diagrams of monthly and 10-day interval frequency of the number of days with different TCI scores or ratings are also very useful for stakeholders and managers of balneary-climatic and leisure / recreational tourism in the five locations studied. This is particularly important when we refer to investments in infrastructure, by taking into account correction of certain climatic restrictions or shortcomings. Furthermore, tour operators can manage tourist activities more effectively, and accommodation and treatment facilities can better adjust their infrastructure, planning and work schedule to the weather-climate developments within a year.

All these interconnection issues between weather-climate conditions and balneary-climatic and open air tourism, once known, addressed and solved, will likely contribute to the extension of tourist seasons, to identification of acceptable alternative solutions for the climatic intervals unfavorable for tourism, to a maximization of existing accommodation capacities and to higher quality services provide to tourists.

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