

# Climate change effects study in Păltiniș resort, Cindrel Mountains, Romania

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## Abstract

The Romanian Carpathians, through their spatial positioning and the versants exposure, differentiate receive and transform the solar energy, and through the orientation up against the general circulation of the air masses they represent barriers that are difficult to overcome. If the altitude, the exposure and slope of the versants, together with the relief configuration determine the quantitative modification and that of the type of precipitations, the lithology generates geomorphological hazards that are based on pluviometry phenomena.

Romanian mountain tourism is directly affected by climate changes, given that the ski area directly depends on the length and thickness of snow and tourist activities depends, throughout the year, of the manifestations of violent risky weather events (storms, excess rainfall, windy, blizzard and altered humidity-temperature comfort index values).

Tourist Area Păltiniș - Cindrel is located in the southern of Sibiu County. Păltiniș resort of national interest was set at 1400-1452 m altitude, and the natural conditions present significant potential of international approval as a receiving area for tourists. Tourism management must be adapted to climate's excessive non-routine events, by reducing its effects in order to ensure normal functioning of tourism activities and tourism consumers' safety.

The temporal analysis of the effects of precipitations on the components of the natural and socio-economic environment takes into account the multiannual, annual, semi-annual, seasonal, and monthly regime, but especially the precipitations that fell during a 24 hours interval. It is interesting the analysis of both the quantity, and of the frequency with which the precipitations register the transition through various characteristic thresholds. According to this analysis we were able to determine the vulnerability to precipitations of the studied territory.

The characterization of the effects produced by long-term rains, as well as rain showers, was done from the point of view of the risk they induce in the natural and anthropic environment. Of interest for this analysis are the precipitations that fall during the vegetation period and which affect the crops, but also those that overlap from a temporal point of view with the melting of the snow layer.

In analysing the bioclimatic characteristics of Păltiniș resort several indicators were selected (resulting from combining several climatic factors), relevant to stress level of favourable climate of the area: thermal comfort index or TEE, temperature-humidity index (THI), bioclimatic stress index of skin, lung and global.

The study of the meteorological parameters registered in Păltiniș area are proof of the privileged habitat that the resort has, both from the point of view of the landscape, and from that of the climatic conditions.

## Keywords

Climat change, bioclimatic characteristics, climatic index, mountain tourism

## 1. Introduction

Tourism is, by its nature, an activity that takes place in connection with rhinestone surrounding natural and social environments. Analysing the relationship between them, it is observed that most often priorities are economic benefits and the negative consequences on the environment and society are forgotten. Sustainable development management is the process through which it is anticipated and coordinated, are lead and planed, assessed and controlled the activities of change in which the exploitation of resources, coordination of investments and development orientation of technical and institutional changes are compatible and allow the needs and aspirations of the present generation without compromising the ability of future generations to meet them in turn (Amengual, A., 2011).

Management of sustainable development aims at a new balance between the issues of environmental conservation, economic growth and social equity. The management of sustainable development in tourism is focused on objectives that highlight the need to take account of cost-benefit analysis not only in a microeconomic dimension, but also in macroeconomic stability.

In sustainable development, tourism plays a key role contributing to a high rate of economic recovery to boost and Romania. Raising the tourism product from the values enshrined in the corresponding standards and preferences of Romanian and foreign tourists involves initiating and promoting actions that include, on the one hand, workflows education and training of a mentality appropriate current type of development, and on the other hand, emphasis on sustainable development in regions of tourist reception. Regarding the sustainable development of tourism in Romania, one of the most important strategies of sustainable development refers to the Romanian Carpathians. Strategy for sustainable development of the Carpathians aims at developing a continuous process of awareness, increase of institutional capacity for sustainable tourism education and training at all levels. It aims to reduce the imbalance between favoured mountainous regions and disadvantaged, marked by permanent natural constraints, targeting the whole issue of economic, social, cultural and environmental (Povară R., 2001).

The need for sustainable development according to the 2013 National Strategy for Sustainable Development 2020-2030 starts from the observation that at the end of the first decade of the XXI century, after a long, traumatic transition to pluralistic democracy and market economy, Romania still has to overcome significant gaps to other member states of the European Union, while seeking to absorb and put into practice the principles and practices of sustainable development in the globalized context.

Despite all the progress in recent years, it is a fact that Romania's economy still relies on intensive consumption of resources, a society and administration that is still seeking for a shared vision and a natural capital affected by the risk of damage that may become irreversible. The concrete objectives allow passing, in a reasonable time and realistic, to the model of development generated by added value, propelled by interest in knowledge and innovation, oriented to continuous improvement of the quality of people's lives and their relationships, in harmony with the natural environment. Mountain tourist destinations are perceived by tourists as a functional and unitary system, which must be efficient. An efficient tourism management must be based on a solid concept to promote a tourism destination economically viable, able to impress and satisfy customers, contribute to the controlled development of the territory. At the regional level, it must be taken into account the complementarity of the mountain adjacent areas (Ferenc Ács, 2020). Thus, the strategy of development of mountain tourism in any area should include approaches such as:

- management and conservation of the natural environment;
- arranging and equipment of natural space according to customer expectations;
- ensuring security for tourists;
- attracting customers, by balance between what offers the travel services provider and customer expectations.

The fundamental principle underlying the sustainable development of mountain tourism is keeping the balance between protecting the mountain and the natural setting (Gomez-Martin M., B., 2005). Tourism activity development brings a series of economic and social benefits:

- generates jobs locally (directly in the tourism sector or related sectors);
- stabilizes the local population and contributes to improving the rural demography and in the mountainous area;
- stimulates the local economy through the development of infrastructure and tourism services (accommodation, food, transport, recreational facilities, handicraft, crafts);
- stimulates the rural economy by creating or increasing demand for agricultural products that are necessary to ensure tourist services;
- boosts the development of infrastructure, which brings benefits to the local population;
- stimulates the development of peripheral areas through capital inserts;
- on the conditions of normal growth, tourism can lead to self-financing mechanisms of development from which can benefit the administrators of protected areas as a tool for conservation;
- supports the activities of natural and cultural heritage conservation, by convincing authorities and the public on the importance of protecting the natural areas and recovery of traditions, customs, crafts and costumes.

## **2. Material & Methods**

Tourist Area Păltiniș - Cindrel is located in the southern county of Sibiu and overlaps administrative units Sibiu, Poplaca and Rășinari, revolving around a major urban centre, Sibiu municipality, to which Păltiniș resort is located 30 km direction SV. Păltiniș resort of national interest was set at 1400-1452 m altitude, and the natural conditions present significant potential of international approval as a receiving area for tourists.

Mountain area of the tourist zone Păltiniș - Cindrel overlaps over metamorphic rocks that make up the bulk of the Cindrel Mountains. The relief of Păltiniș - Cindrel is stepped, moving from mountain area of the Cindrel Mountains, with the predominant destination forest and grazing on hills and pastoral purpose fruit tree piedmont and plateau areas with predominant fruit growing and cereal destination.

Main natural resource for tourism area analyzed is the Cindrel which runs north valleys and aligns the Sadului and Beautiful, the greatest heights in Oncești Peak (1717m), Beșineul (1962m) Rozdești (1954m) Niculești (2036m) Cindrel (2244m) Șerbota Mare (2009m) and Oașa Mare (1734m).

The mountain area includes morphological parts having a significant impact in terms of landscape-tourism, particularly valued by Păltiniș tourist complex that looms on the inter-formed valleys Dăneasa and Sentina at an altitude of 1400m. Cindrel have no steep or sharp bumps interfluvial space. Large floodplains, looking slightly rounded plateaus with some inflections, from 2,000 m to 900 m below, the hilly stage and pre-mountain hollows. Landforms rounded character is a direct consequence of lithology and tectonic movements that stimulated fluvial erosion and cryo-nival. The glacial relief of Cindrel is represented by glacial basins and valleys that occur at the head of the valleys Cibin, Dobra and Sebeș. Modeling ice quaternary was not strong enough, due to lowered altitude so that only circuses, more with nival character or nivo-glacial are several buckets suspended beneath the peak. Cindrel housing glacial lakes (Great Iezer, Small Iezer and Iujbea) with names identical to the circus or the cauldron in which they were formed.

The appearance of the Păltiniș resort was due to the desire manifested in the 80s and 90s of the nineteenth century by a series of important personalities of the Saxon community to establish a health resort in the mountains near Sibiu, as a natural consequence of touristic pioneering activities conducted by the Transylvanian Carpathian Association – SKV. By the nature of his job, the lawyer Gustav Conrad was a connoisseur of an extensive complex of Cindrel mountains so as to he was able to identify the area a place and suggested placing the resort in a mountainous area of woodland that belonged to Cristian, namely in a ravine located on the south-western saddle between the peaks and Oncești and Păltiniș, at an altitude of 1400 meters. In addition to the proposed crossing, a cart road connected the mountain area of Cristian and Rășinari of Sadu Valley, snaking over Șteflești peak toward the Beautiful Valley.

Near glen chosen by Gustav Conrad, resurfaces a beautiful stream with clear water and cold whose name gave the inhabitants of German ethnicity of Cristian was Hohe Rinne (chute up in height), hence the name in German of resort and then Păltiniș peak (1470 m attitude) in close proximity (having originally sycamores which grew in the area) Romanian gave the name of the resort.

The chalets results thus represented a unique combination between the beautiful architecture of the villas Alpine region of Tyrol woodworking craft proved particularly Romanian builders. Many of the joints beams and wooden beams used in the buildings were made without nails, resulting in a particularly resistant structure.

The resort was frequented until 1926 only in summer and in winter 1912-1913 and made an appearance at Păltiniș skiers, foretelling the future success of winter sports. Access is on foot, horseback, wagons or resort omnibuses, horse-drawn.

In 1962 the hotel was built (called nearly half a century) Tourists House, in memory of beautiful wooden buildings built in 1895 and demolished in 1960.



Fig. 1 Tourists House Ensemble in the 1960s

Source: personal archive of Dr. Dragoteanu Mircea Cluj-Napoca

At the beginning of 70s, after the reestablishment of Sibiu County, under the jurisdiction of leadership with a larger opening for tourism in Sibiu, Păltiniș had a prosperous period for modern landscaping. In addition to some municipal works and infrastructure, needed for normal operation was successful arrangement slopes Oncești 1 (high slope) and Oncești 2 (pit); construction of the first facilities cableway (chairlift to Oncești, the pit lift and baby-lift in Plat - now abolished); link the resort to the forest roads of the Valley Dane (Cibin Gorge), Sadu Valley, Valley Ștezii (by Șanta) and the link between Sadu Valley and Valley of the Beautiful - Saddle Șteflești that provides Păltiniș connection to DN 67C, in Sebeș Valley (route old King's Road - Transalpine) contributing to the removal of the resort in a position to be a bottomed place. As a result of these measures, Păltiniș began to show their true meanings modern, falling gradually into his role normally important tourist centre of the Massif Cindrel and mountains between Olt and Jiu, the number of visitors and skiers from all over the country increasing substantial. This demonstrates that through relevant measures, the skilful use of local conditions and possibilities of urban suitable merged with the tourism and sports Păltiniș presents a number of conditions latent development, fulfilling current requirements for a resort versatile, of big future. Leaving from this period, it began to be ever more clearly that enlargement made are far from sufficient, that Păltiniș can become a more attractive destination for many tourists, and the openings to areas of the ski, free from the Glade Găujoara, Old Peak and Peak Surdu should enter into function as soon as possible. This is when they appeared in Romania, in the urbanism projects of the mountain resorts, modern systems for calculating the optimal capacity of these settlements, experience from the Alps, the figures hovering on average approx. 50% of the total number of skiers possible in case of Păltiniș studies drawn setting optimal number of seats for the first stage at about 5,000 tourists accommodated. In 1975, taking advantage of a favourable moment when the Ministry of Tourism of the time fund such works, it starts the construction of the lift cable for tourists, Păltiniș (Chalet No. I) - Valley Dăneasa - Bătrâna, with length of approximately 2.5 km, starting from the peak. Unfortunately, due to organizational inconsistencies facility has not been realized, leaving only executed deforestation ski slope, still visible today.

In 1972, construction works will begin at the Hotel Cindrel which lasts until 1976. After 2000, the resort flourish bipolar with the construction of holiday homes in the Hermitage Păltiniș, because in 2010 with the construction of the Arena Platoș achieve a number of hostels around it, making it possible to preserve what's left of the old resort, House of Cure and House Monaco.

Hotel Cindrel in 2005 enters a process of modernization and extension of government funding, work place opening in May 2009.

Home of Tourists passed during 2008 - 2012 through a process of expansion and modernization funded in part with European funds obtained from the company SC Păltiniș S.A. ROP of MDRT, and in 2013 became Hohe Rinne Păltiniș Hotel & SPA.

Among the geographical factors, the relief has a determinant role in the rainfall regime, establishing itself by altitude, slope orientation, slope and configuration of its forms. The altitude causes vertical change of all climatic elements. Rainfall grows, as the altitude increases, up to a certain height called pluviometrical optimum beyond which begin to decrease. The slopes print differences between the southern slopes that receive lower amounts of precipitation, compared to the north, where rainfall is higher. The slopes safe from the general circulation of the atmosphere (eastern slopes) receiving smaller amounts of rainfall, compared to Westerners. Tilting the slopes has a role in the differential heating surfaces with different slopes, hence resulting in the role in rainfall distribution. Climate change causes relief configuration

elements (Basarin Biljana, 2017). The forms concave (depression, colour valley) temperature inversions occur frequently, persistent frost, wind is less and less rainfall. The convex shapes (ridges, peaks), the wind speed increases and orographic convection, with significant implications in enhancing rainfall. The mountainous area has a specific climate with average annual temperatures lower in this case are typical rainfall and cool summers with cold winter with heavy snowfall and snow longer. The hilly summers are hot, relatively frequent rainfall, as warmer intervals.

General circulation of the atmosphere is characterized by high frequency of intake air temperate oceanic in the West, especially in warm weather and low frequency of continental temperate air from the northeast and east (Brown D.,R., 2007). The air temperature is influenced much relief altitude. Meteorological data collected by the weather station Păltiniș (1453m) indicates an average annual temperature oscillating around 5°C. The average temperature in July is 13.4°C in Păltiniș and 7-8° in the ridge area. Highs exceeded 30°C and 22°C in Păltiniș on the highest peaks. Average number of days of frost is 155.2 in Păltiniș and over 200 in the ridge of the mountains. Rainfall is generally higher as the altitude is higher. Average annual Păltiniș is 906,1mm and 1200 mm on the highest peaks; monthly average amounts biggest fall in June and are 153mm to 150mm Păltiniș and around 2,000m. The lowest average monthly falls in February, 41.5 mm in Păltiniș and 50 mm in high mountain area. The highest amounts of rainfall in summer are frequently accompanied by thunder. Maximum levels have fallen in 24 hours cumulative 98.3 mm in Păltiniș resort.

Winds are influenced much relief. Păltiniș prevailing winds from the W, SW and E, and the highest peaks of V and NV winds dominate. The average annual frequency of calm is small mountainous sector, 18.3% to the resort. Annual average speeds range between 1.5 and 6.5 m/s at the resort. In late winter and early spring from the mountain beat "Big Wind" warmer, causing heating sharp and sudden melting of snow.

Considering the specific agro-pastoral area of the territory Păltiniș - Cindrel, environmental quality improvement component depends on encouraging environmentally friendly practices. In Păltiniș perimeter there are two types of habitats which alternate in the landscape.

One is likely forestry and is represented by boreal forests of spruce and the other is secondary meadows Mountain (located to an altitude of 1500 m) that in the area studied are much depleted species due to overgrazing intense sheep made in the past and federalization. Deforestation portions of spruce forest for the installation of new ski tracks not in any way lead to considerable damage to habitats Cindrel perimeter. Not creating Ski resorts or extending the existing ones is the main factor that leads to the destruction of forest habitats and mountain meadows, on the contrary. The two phenomena currently create irreparable damage in the Carpathian scale deforestation and overgrazing general are sheep.

In analysing the bioclimatic characteristics of Păltiniș resort and its rural surrounding areas several indicators were selected (resulting from combining several climatic factors), relevant to stress the level of favourable climate of the area studied: thermal comfort index (also called Missenard index) or TEE, temperature-humidity index (THI) and bioclimatic stress index of skin, lung and global. From the analysis of climate data string of Păltiniș weather station situated at an altitude of 1443 m, between 2005-2020, for June, July, August and September at 13 hours (when tourism activity is particularly intense), the conclusions are the following: thermal comfort (even at lunch hours) is reached with low frequency in all summer months. Thus, in July thermal comfort is recorded at Păltiniș with a frequency of 2%; heat discomfort is not reached as a monthly average in Păltiniș (rather as a daily average) yet discomfort by cooling reaches high values: 29% in July. The highest monthly average equivalent temperature was registered in July 2005 when heat discomfort reached on 6<sup>th</sup>, 7<sup>th</sup>, 11<sup>th</sup> and 23<sup>rd</sup> of July. This existing situation in Păltiniș is due largely to relatively low air temperatures and wind speeds above 3.5 m/s. At speeds above this value, wind is an unfavourable element of thermoregulation.

The temperature-humidity index for Păltiniș was calculated at 13 hours (June, July, August and September between 2005 and 2020) and only the feeling of comfort was recorded. From the analysis of calculations resulting data it can be observed that almost the entire year period falls into a state of thermal comfort. In two months of the period under review, July 2013 and August 2008, there have been quite high and average values and in none of the days had the critical threshold of 80 units been reached, but only the alert status.

The use of this index reveals that in the studied area periods inducing positive effects on the human body exist throughout the year. This allows tourist activities throughout the year with their differentiation depending on the season and preferred activities.

Temperature-wind index was calculated at 13 hours (in all the months of the year, although the negative effects exist only in the winter) in the period 2005-2020 for Păltiniș weather station. It was found that the monthly mean values had only recorded the feeling of comfort and light discomfort (in January, February,

March, April, November, December), but there were days when the index had negative values. Thus, in February 2009 the lowest average was registered ( $-3.5^{\circ}\text{C}$ , increased discomfort) and on the 12<sup>th</sup> and 13<sup>th</sup> calorie stress had been observed.

Bioclimatic Stress Indices highlights the main meteorological factors influence on the human body and how it reacts to maintain steady heat (warm-blooded), i.e. constant temperature of the human body. Bioclimatic stress has three components: cutaneous stress, lung stress and global stress (De Freitas, C., R., 2008, Lise, W., 2002). To calculate these indices it is used the average daily values for the following climatic parameters: temperature ( $^{\circ}\text{C}$ ), atmospheric water vapor pressure (hPa) and wind speed (m / s). For Păltiniș, were obtained monthly average of skin stress that reveals bioclimatic with hypertonic stress in January, February and December, and the rest of the year balanced. In 2005 in June, July, August and September were recorded hypotonic stress. Five months (April-June and September-October) are relaxing with a tonic effect, stimulant, training and the opportunity to spend time outdoors through specific tourist activities (hiking, cycling). In terms of lung stress index (which has value 20) is also reduced, it varies with altitude less than index stress skin. The balanced months of the year are May-June and September-October. The interval from November to April index recorded a desiccant, positive, stimulating action, drive and conducive to winter sports.

### 3. Results & Discussion

Climate is an important constituent of tourism's natural potential, promoting or inhibiting the organization and conduct of tourism activities. Climate often imposes how to conduct tourism activities. Many types of recreational activities are dependent on climate: heliotherapy depends on the sunshine duration, skiing depends on the thickness and duration of the snow cover, etc. (Teodoreanu Elena, 2002). In terms of touristic potential, the climate must be viewed in two ways: as a landscape factor and as the influence exerted by it on the human body. The impact of climatic elements manifests very differently on the people's bodies that participate in the phenomenon of tourism, causing a "selection" of the categories of people who can benefit from a stay in the ambience of various natural regions from a physiological point of view.

There is a local climate for every place, characterized by a certain regime of meteorological factors to which the natives' bodies are acclimated. For those people that come for treatment or for rest in a balneary resort, the weather acts on their bodies in the first days by adaptation and acclimatization reactions, more or less intense, depending on the geographical area from which the subject is coming. In determining the climate's favourability for tourism in Păltiniș resort and its surrounding areas, it is necessary to know the values of the bioclimatic indices. The most often used climatic parameters are temperature, air humidity and wind speed. They are used in different combinations and formulas and the targeted result are the same every time – determining the degree of climatic comfort for the touristic activities' participants, and the main types of topoclimate, favourable or less favourable for performing touristic activities or human activities in general.

The state of comfort is stimulative for rest and practicing various touristic activities. The state of discomfort - depends on the intensity of the climatic factors' actions – this can translate into stress that can be reduced, stimulative, of adaptation and acclimatization, but also an increased long lasting stress that can induce danger for human health or as in this instance for tourists.

In analysing the bioclimatic characteristics of Păltiniș resort and the near rural areas, several indicators were selected (resulted from combining several climatic factors), relevant to point out the level of the climatic favourability of the studied area: the thermal comfort index (also called the Missenard index) or TEE, the temperature-humidity index (THI) and the bioclimatic stress index, cutaneous, pulmonary and global.

We consider that the monthly multiannual averages from the last 25 years are enough for highlighting the dynamics of climatic phenomena and their influence on activities and types of tourism, a period in which there are more arguments in terms of climate indicating favourability of climate for tourism in the Cindrel Massif. For the tourism operator it is worthy of note that some extreme values of climatic elements can be stressful for tourists (long exposure to strong radiation, cold, heat, dryness, moisture, strong wind, low pressure). Also, some excessive weather variations produced in a short, sudden time are considered stressful for the body. Bioclimates form the basis for the climatotherapy's existence and development, the climatic treatments and tourism (Thompson D., R., 1997).

*The Missenard index* or the temperature effective equivalent index ( $^{\circ}\text{TEE}$ ) reflects the actual temperature felt by the body at a time, under certain conditions of temperature, degree of humidity and air movement in the atmosphere. This index allows the weather conditions of the moment, to dose the indicated heat capacity of air for the tourists' bodies, so that at the end of the treatment to obtain a trained and a tough body, from a thermic point of view. It is considered that the thermal comfort zone (neutral zone) is between  $16.8^{\circ}$  and the effective equivalent temperature of  $20.6^{\circ}\text{C}$  ( $^{\circ}\text{TEE}$ ). Between this temperature range, under normal conditions and a relaxed dress code, whose albedo is an average one in a position of rest, the body does not register significant gains or losses of heat. Below or above this range, the body has the feeling of cold or heat, which brings metabolic changes in order to maintain internal body temperature (thermal homeostasis) constant (Becancenot, 1974). The classification of air baths according to the TEE includes as follows: cold air baths  $1^{\circ} - 8.9^{\circ}\text{TEE}$ ; moderate cold air baths  $9^{\circ} - 16.8^{\circ}\text{TEE}$ ; comfortable air baths  $16.9^{\circ} - 20.8^{\circ}\text{TEE}$ ; moderate warm air baths  $20.9^{\circ} - 22.9^{\circ}\text{TEE}$ ; hot air baths  $23 - 27^{\circ}\text{TEE}$ ; very hot air baths  $> 27^{\circ}\text{TEE}$ .

From the analysis of data string climate stations in the studied area, located at an altitude of 1453 m (Păltiniș meteorological station), between 2005-2020 for June, July, August and September at 1 PM (when tourism activity is particularly intense), the conclusions are: thermal comfort in Păltiniș (even at lunch hours) is performed with low frequency in all summer months. Thus, in July, thermal comfort is recorded at Paltinis with a frequency of 2%; heat discomfort is not reached as a monthly average in Paltinis (just as a daily average) and discomfort by cooling achieves very high values: 29% in July. The highest monthly average equivalent temperature was registered in July 2005 when discomfort heat was reached on 6, 7, 11 and July 23. The existent situation in Păltiniș is due largely to relatively low air temperature, and wind speeds above 3.5 m / s. At speeds above this value, wind is an unfavourable element of thermoregulation.

Table 1. The Frequency (%) of the equivalent effective temperatures ( $^{\circ}\text{TEE}$ ) in Păltiniș Resort for the period 2005-2020 at 1 PM)

Months	Thermal comfort	Discomfort-Heating	Discomfort-Cooling
June	0,1	-	29,9
July	2,0	-	29,0
August	2,8	-	28,2
September	0,8	-	29,2

Source: processed weather forecast data

*The temperature – humidity Index (THI)* is calculated dimensionless (in units) taking into account the temperature and the relative humidity of the air. Significant values start from the threshold where the discomfort is high (80 units respectively  $40^{\circ}\text{C}$ ). Depending on the values obtained by calculations for THI (expressed in value units) the following states may be established:  $\leq 65$  - state of comfort; 66-79 – state of alert;  $\geq 80$  –state of discomfort.

THI values, that range from  $<40$  to  $> 85$  reflect the physiological sensations of thermal comfort felt by the human body through the combination of the physical processes of heat transmission by radiation, convection and evaporation of water from the skin.

The Temperature-humidity index was calculated at 1 PM (in June, July, August and September 2005-2020) for Păltiniș station and there was only recorded a state of comfort.

From the analysis of the data resulted from calculations in the studied region, it appears that almost the entire period of the year falls into a state of thermal comfort. In two months, July 2013 and August 2008, there were quite high average values and in any of those days the critical threshold of 80 units was not reached, but only the alert status.

The use of this index reveals that, in the studied territory, the periods which induce positive effects on the human body are throughout the year. This allows tourist activities throughout the year, with their differentiation depending on the season and the participants' preferences.



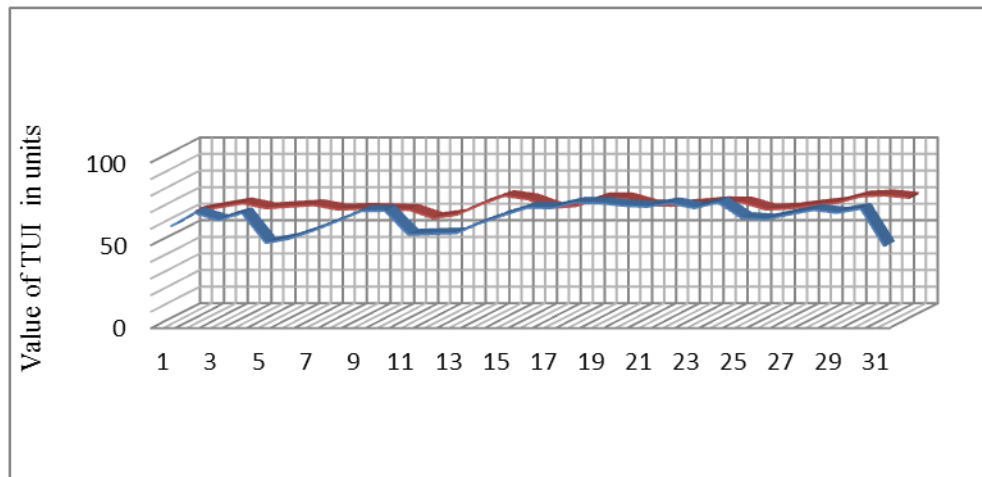


Fig. 2. The daily value of the temperature-humidity index in Păltiniș in July 2013 and August 2008  
Source: processed weather forecast data

The wind chill index IR is called the equivalent temperature of wind chill power- IR. This is the temperature that air would reach at some certain values of the wind speed (Ionac N., 2008).

Table 2. The wind chill power, the equivalent temperature of the wind chill power and the induced physiological effects of the latter

Wind Chill Power $P(W/M^2)$	Equivalent temperature of wind chill IR ( $^{\circ}C$ )	Physiological effects
$P = 200-399$	$IR > +10$	No discomfort
$P = 400-599$	$+9,9 > IR > -0,9$	Slight discomfort
$P = 600-799$	$-1 > IR > -9,9$	Emphasized Discomfort
$P = 800-999$	$-10 > IR > -17,9$	Very cold
$P = 1000-1199$	$-18 > IR > -28,9$	Hypocaloric stress
$P = 1200-1399$	$-29 > IR > -49,9$	Frostbite discomfort in prolonged exposure conditions
$P > 1400$	$IR < -50$	The risk of instant frostbite

Source: processed after Ionac N. 2008

P value's intervals correspond to certain interval values of IR. The effects of P (and the related IR) on human physiology depend on the intensity of caloric losses suffered by the human body.

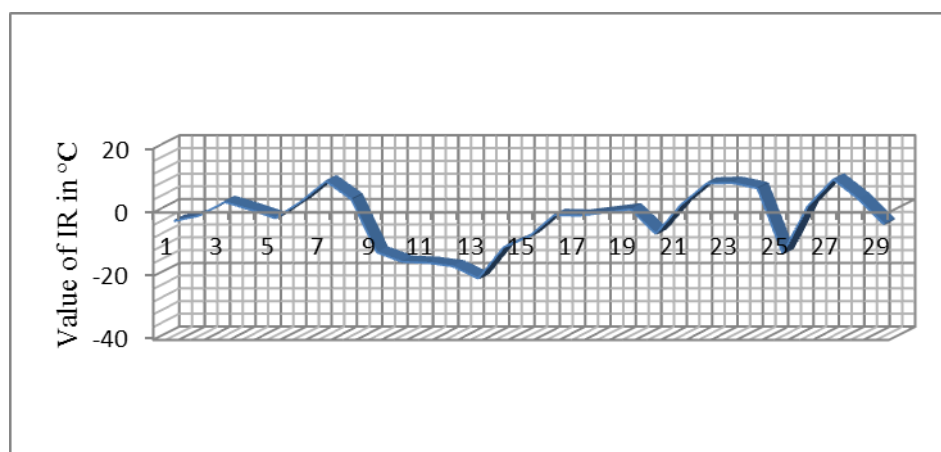


Fig. 3. Daily value index of wind chill power IR ( $^{\circ}C$ ) in February 2009 in Păltiniș  
Source: processed weather forecast data

The temperature-wind index was calculated at 1PM (in all months of the year, although the effects are negative during winter) in the period 2005-2020 for Păltiniș station. It was found that the monthly average values recorded only the state of comfort and light discomfort (in January, February, March, April, November, December), but there were days when the index recorded negative values. Thus, on February



2009 the lowest average value was registered ( $-3.5^{\circ}\text{C}$ , increased discomfort) and hypocaloric stress in days 12 and 13.

*Bioclimatic stress indices* outline the influence of the main meteorological factors on the human body and how it reacts to maintain steady heat (warm-blooded), meaning the constant temperature of the human body. Bioclimatic stress has three components: cutaneous stress, pulmonary stress and global stress. To calculate these indices, the following diurnal average values are used for the following climatic parameters: temperature ( $^{\circ}\text{C}$ ), atmospheric water vapors pressure (hPa) and wind speed (m / s).

*The cutaneous bioclimatic stress index* gives the feeling of cold or heat produced in the skin's mechanism to maintain constant body temperature (thermoregulation), by the process of thermogenesis (heat production) or by the process of thermolysis (heat loss).

Depending on the values obtained by calculating the chill index, the following ranges were established: 0-299 - hypotonic index, during summer, requests triggering thermolysis during summer; 300-599 - relaxing index, optimal treatment of the weather; 600 - 1500 -hypertonic index, during winter, requires triggering thermogenesis during the cold season (Gaceu O., 2003).

For Păltiniș, monthly average values of the cutaneous stress were obtained, values that reveal a bioclimate with hypertonic stress in January, February and December, and a balanced one in the rest of the year. In 2020 in June, July, August and September hypotonic stress was recorded.

*The pulmonary bioclimatic stress index* comprises three steps, depending on the values of the vapor pressure water. When  $e < 7,5\text{mb}$  stress is manifested by the tendency of dehydration or molecular concentration of blood (usually in winter), and when  $e > 11,7\text{mb}$  stress is manifested by a tendency of hydration or plasma dilution (in summer). When it is between 7.5 to 11.6 mb stresses is balanced. When the values of  $e > 31,3\text{mb}$ , breathing difficulties arise.

In our country, this stress is conventionally expressed by values ranging between 0 and 40 (Omu Peak). For Păltiniș, its value is 20. On the basis of the daily values' analysis of vapor pressure at 1 PM, in the range from 2005 to 2020, it was showed that Păltiniș in January, February, March and April recorded desiccant stress; in May, June, September, October, November and December recorded balanced stress, and moisturizing stress in July and August.

*The Global bioclimatic stress index* is the result of the previous two stresses, and a more accurate element of reference, because it attempts to present the request of global bio-climate over the body, attacked simultaneously on the skin and lungs, in the changed conditions of the natural environment by moving from one geographical area to another. In Păltiniș the value of this index is 42.

#### 4. Conclusions

21<sup>st</sup> century's challenge is climate change. This has three distinctive traits: cumulative character, irreversible effects and global manifestation. Romanian mountain tourism is directly affected by these changes, given that the ski area directly depends on the length and thickness of snow and tourist activities are subject, throughout the year, of the manifestations of violent risky weather events (storms, excess rainfall, windy, blizzard and altered humidity-temperature comfort index values). Tourism management must be adapted to climate's excessive non-routine events, by reducing its effects in order to ensure normal functioning of tourism activities and tourism consumers' safety.

In terms of climate change, adaptation is of great importance to the tourism product at the weather conditions offered by vulnerable areas, as is the case of mountain areas. In terms of bioclimatic, the characterization by bioclimatic indexes (index of equivalent temperature, temperature-humidity index and temperature-wind and bioclimatic stress index) Păltiniș resort and surrounding areas highlights that there is a very favourable bio-climate for tourism. So far, Păltiniș was shaped primarily for recreation, for tourism, except the early period, when the resort had balneary purpose. The strong sunlight, the small amounts of cloudiness and air pressure, moderate values of bioclimatic indices can be valued for treatment and prophylactic treatment of sunbathing and aero therapy. With a high bioclimatic potential, Păltiniș and adjacent area may become not only places of interest, but the interest of the SPA, regaining their place in the national tourism circuit.

A special problem in the case of Păltiniș resort is the big coverage of the landscape/perspective by boreal forests of spruce and as we know, one of the most important points of tourist attractiveness of a mountain ski resorts is the landscape it offers.

The mountainous area of Sibiu falls into the category of non-conventional destinations, being frequented by relatively young people who opt for hiking or sports, as well as those who prefer rest and recreation in

the natural environment. A special category of foreign/non-local tourists represent those who combine many types of tourism (leisure, cultural, business, visits to relatives and friends, events) and who change in the course of a holiday, more/various destinations and accommodations.

The priority on the development of Păltiniș - Cindrel resort and surroundings is the development of the ski area. Păltiniș is a settlement with predominantly tourist functions, the importance of which will be amplified in the future.

The majority of Păltiniș resort's accommodations are in hotels, while approx. 20% are in pensions and the remaining ones (vs 'the rest are rest houses') rest houses. This is relatively unfavourable for a mountain resort frequented largely by young people (44% of tourists throughout the county are between 26 and 45 years), whose incomes and interests are not consistent with the offer of accommodation and food in the resort. The offer of hotel accommodation and meal at the restaurants is more appropriate to/for foreign tourists, which however account for only 30% of the visitors to the county, which is offering few activities, thus foreign tourists have an average duration of stay of less than the domestic ones (2.67 days vs 3.28 days for foreign and Romanians respectively). The administrative territory of Păltiniș resort has an area of 296 ha, which offers potential for development for at least 3000 people (calculated with an average population density of 20 person / ha for the actually built area, which is specific to other/some settlements in the area and taking into account that it is 1/2 of the total area of the resort), that is, approx. 6 times its current capacity of receipt/accommodation. The maximum occupancy of the accommodation units is of the order of 5,000 seats, estimated relative to the ski area, valued at a total capacity of approx. 7000 skiers. Assuming the resort accommodates 50% of the area's total capacity (10,000 people) and rate of occupancy in the resort is at maximum 70%, the other half is supposed to be made up of tourists staying in nearby localities/settlements and of one-day tourists.

Creating and expanding ski resorts integrated in local ecotourism networks provides numerous jobs and business opportunities for local communities which weakens this kind of pressure on the environment and, most importantly, motivates communities to conserve the landscape and to preserve the attractiveness of the tourist area in question.

From this exact consideration, the resort has much to suffer, the actual ski area having very little to offer. It is why making a small study of skiing among the skiers from different counties of Transylvania, other than Sibiu, we found that less than 3% of subjects know the resort and only 1% would prefer to go to Păltiniș for winter sports. The resort is known for its lack of wide, refreshing or spectacular landscapes, unlike what tourists can find in the mountain locations on the outskirts of Transylvania (Poiana Brașov, Băișoara, Toplița, Căvnic etc.). Thus, Păltiniș has become largely a local ski resort – of Sibians – which strongly limits its future prospects from this point of view.

The development of tourism strategies involves a complex process that requires a mature ecologic, economic and social spirit from/of all public and private actors that are involved in decision-making stages of initiation, adoption and implementation of action programs. Reflecting management on a sustainable basis, natural and anthropic tourism potential can gain in the manner of preservation and development of an environmentally sound way, sustainable.

## References

- Amengual, A., Homar, V., Romero, R., Alonso, S. and Ramis, C., (2011), Projections of the climate potential for tourism at local scales: application to Platja de Palma, Spain, *Journal of Climatology*, volume 32, issue 14
- Basarin, Biljana, Lukić, T., Mesaroš, M., Pavić, D., Đorđević, Jasmina and Matzarakis, A., (2017), Spatial and temporal analysis of extreme bioclimate conditions in Vojvodina, Northern Serbia, *International Journal of Climatology*, Volume 38, Issue 1
- Brown D., R., Petcova Nadezhda, (2007), Snow cover variability in Bulgarian mountainous regions, 1931–2000, *International Journal of Climatology*, Volume 27, Issue 9
- De Freitas, C., R., Scott, D., McBoyle, G., (2008), A second generation climate index for tourism (CIT): specification and verification, *Journal of Biometeorology*, 52:399–407
- Ferenc, Ács, Zsákai, Annamária, Kristóf, Erzsébet, Szabó, Amanda, Imola and Breuer, Hajnalka, (2020), Human thermal climate of the Carpathian Basin, *International Journal of Climatology*, Volume 41/S1
- Gaceu, O., (2003), *Indicele biomedical agresiv, Indici și metode cantitative utilizate în climatologie*, Publisher University of Oradea, 2003

- Gomez-Martin, M., B., (2005) Weather, climate and tourism - a geographical perspective, *Tourism* 32(3):571–591
- Ionac, N., Ciulache, S., (2007), *Esențial în meteorologie și climatologie*, Publisher University, Bucharest
- Ionac, Nicoleta, Ciulache, S., (2008), *Atlasul Bioclimatic al României*, Publisher Ars Docendi University of Bucharest, Bucharest
- Lise, W., Tol, R., S., (2002), Impact of climate on tourism demand, *Climate Change*, 55(4):429–449
- Povară, R., (2001), *Biometeorologie și bioclimatologie*, Editura du Goeland, București
- Teodoreanu Elena, (2002), *Bioclimatologie umană*, Academy's Publisher, Bucharest
- Thompson D., R. and Perry, A., (eds), (1997), *Applied climatology, principals and practice*, Routledge (London), 1997