

GLOBAL CHANGE AND NATURAL HAZARDS IN PIRIN TOURIST AREA

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Abstract: Global change in the high mountains tourist areas in Bulgaria is accompanied by the expression of a number of extreme hydro-climatic events which jeopardize the tourism infrastructure in the resorts, as well as the life and health of tourists in the mountains. The report provides an analysis of observed changes in temperature and precipitation in the region of „Pirin“ National Park and related natural disasters. An investigation on the dynamics of tourist flows in different parts of the mountain in recent years is carried out and conclusions and recommendations regarding the increased risk of natural disasters in terms of climate change and the rapid development of tourism in the region are provided.

ГЛОБАЛНИ ПРОМЕНИ И ОПАСНОСТ ОТ ПРИРОДНИ БЕДСТВИЯ В ПИРИНСКИЯ ТУРИСТИЧЕСКИ РАЙОН

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Ключови думи: глобални промени, природни бедствия, туризъм

Резюме: Глобалните промени във високопланинските туристически райони на България са съпроводени от проявата на редица екстремни хидро-климатични събития, които поставят в риск туристическата инфраструктура в курортните селища, както и живота и здравето на туристите в планината. В доклада е направен анализ на наблюдаваните промени в температурите и валежите в района на Пирин и свързаните с тях природни бедствия. Изследвана е динамиката на туристопотоците в различните участъци на планината през последните години и са направени изводи и препоръки във връзка с повишения риск от природни бедствия, в условия на климатични промени и бързо развитие на туризма в региона.

Introduction

The main challenges for mountain regions related to global change are defined by Global Change and Mountain Regions Research Strategy as follow: Climate Change, Land Use, Cryosphere, Waters, Ecosystems Services, Biodiversity, Human Mobility and Health, Environmental Hazards(GLOCHAMORE, 2005).

The results from our previous investigations shows that Pirin mountain is an area with high level of concentration of natural hazards and with great diversity of valuable tourist resources for ski, spa, cultural and eco-tourism (Nikolova, 2003, Nikolova et al., 2010, Nedkov et al, 2010). During last decades we observe an general trend of increase of both, the risk from natural hazards and disasters and fast development and concentration of mountain resorts and infrastructure in some parts of the mountain as Bansko, Dobrinishte, Sandanski etc. This makes the study of the risk from natural hazards (avalanches, mass movements, landslides, torrents and flash floods, rock falls and forest fires etc.) in mountain resorts and theirs vicinity of basic importance for development of sustainable tourism

and environmental management practices, including the safer conditions for the people who live there and are exposed to significant threats in case of disaster.

The aim of this paper is to investigate the effect of global change (climate change and hydro-climatic hazards) on the current trends in the environmental changes and related to them risk from natural disasters for mountain resorts in "Pirin" National Park. The research goals are focused on an assessment of the natural and anthropogenic factors which increase the risk from natural hazards.

Data

An analysis on the climate change projections for the territory of Southwest Bulgaria is made on the base of the Fifth Assessment Report (AR 5), (IPCC, 2013) as well as the tools provided by KNMI Climate Change Portal.

The main data set in this investigation was provided by the National Park "Pirin" Directorate. It includes data about the observed natural hazards since 1980. It was found out that the main climate related hazards in the area are avalanches and floods. Data includes the number of flood events and avalanches (including number of people who lost their lives or who are injured), registered in frames of the park during the period 1980 – 2013 and data about number of tourist visitors by park regions during the period 2007 – 2012.

An extrapolation of the temperature and precipitation data for the area of Popovi Lakes in Pirin for the period 1900 – 2009 was provided by the World Bank Climate Portal. The dataset was produced by the Climatic Research Unit (CRU) of University of East Anglia (UEA).

In addition were used different publications, topographic and other maps and sources of information, which are cited in this paper.

Research approach

The investigation was carried out in the following steps: 1) Development of a GIS data base for investigated hydro-climatic hazards and data processing; 2) Analysis of the observed hydro-climatic hazards and tourist pressure; 3) Assessment of the exposure and vulnerability of tourist sites and resorts towards climate change and related to it disasters.

Risk assessment approach follows the basic methodology for natural hazards and risk analysis: hazard identification, exposure, vulnerability and risk assessment. Identification of natural hazards aims to define the type of hazards which cause main threat for the exposed assets. Identification of exposure aims to define the exposed to natural hazards resorts, tourist flows and tourist infrastructure. Geo-information methods for mapping of the natural hazards in the study areas are implemented for a vulnerability assessment.

Main terms used in the study are as follow:

Resorts. According the Act of Ministerial Council of R Bulgaria from 24 February 2012 there are the following types of resorts in the country (State Gazette 18, 2012): 1) Spa resorts of national (N) and of local (L) significance; 2) Climate mountain resorts of national (N) and of local (L) significance; 3) Climate sea resorts of national (N) and of local (L) significance. In spite that there is no a government standard developed to define "climate resort", there is a list of climate resorts in this document.

Hazard is "likelihood of an event to lead to disaster or loss of life, injury, property damage, social impacts, economic losses and environmental degradation" (United Nations, 2002). Measures of hazard are its intensity and probability in a specific geographical location.

Vulnerability is "The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard" (UNISDR (2007). Measure of vulnerability is potential impact. It depends on the *type of hazard*, system's exposure *and sensitivity*, its *resilience* and *adaptive capacity*.

Study Area

Pirin Mountain is protected area since 08.11.1962. It was established for protection of the landscapes, biodiversity and ecosystems. There are six functional zones in the park: biosphere reserves, natural landmarks and historical sites, drinking water, protected areas, recreation and tourist areas, high mountain grazing areas and transition area. Pirin (38 350 ha) is an UNESCO site according the Convention for Protection of the World Natural Heritage (1983) and it includes Biosphere reserves "Bauvi Dupki- Dzhindzhiritsa" (2873ha) and "Julen" (3156 ha). Park's buffer zone is 1087 ha. The share of territory with an elevation above 2500m is 7,8%, between 2000 and 2500 m -

49,1%, 1600-2000m – 30%, 1000-1600m -12,7% and 600-1000m – 0,4% (NP “ Pirin” Management ..., 2004).

Pirin Mountain is structurally part of the vast Macedonia-Thrace mountain massif. It's highest peak is Vihren (2914m) and there are 81 peaks with an elevation above 2500 m in frames of the mountain (Natural and..., 1989). During the Quaternary the high mountain regions above 2150–2300 m elevation were subject to mountain glaciations and glacial tongues on the north slopes reached down to 1100–1300 m. At present time there are two glacierets situated in the glacial cirques in Pirin: Snejnika glacieret in the Golemia Kazan cirque (1,25 km long, 1,2 km wide and 2 480 m a.s.l.) and Banski Suhodol glacieret (2,908 – 2 226 m a.s.l. with an area of 2,3 km², long 2,4 km and 1,5 km wide) (Gachev, 2011) and 176 glacial lakes. In Pirin is situated the highest glacial lake on Balkan Peninsula, Polejansko lake (2710 m).

The tourist resources of the National Park Pirin can be described as follow: 69 landmarks, 4 protected sites, 48 historical sites and high concentration of archaeological sites, 1250 of the architectural monuments are protected from the Low for protection of the cultural heritage (Natural and..., 1989). The expansion of the ski resorts grow fast during last years and generate an significant threat for the ecosystems in the National Park Pirin. The best demonstrated is this process in the area of Bansko.

In the area of NP “Pirin” are situated 1 resort of national significance and 8 of local significance. Of them 3 in Bansko, 2 in Gotse Delchev, 2 in Sandanski and 2 in Razlog municipality.

Results

Natural hazards identification

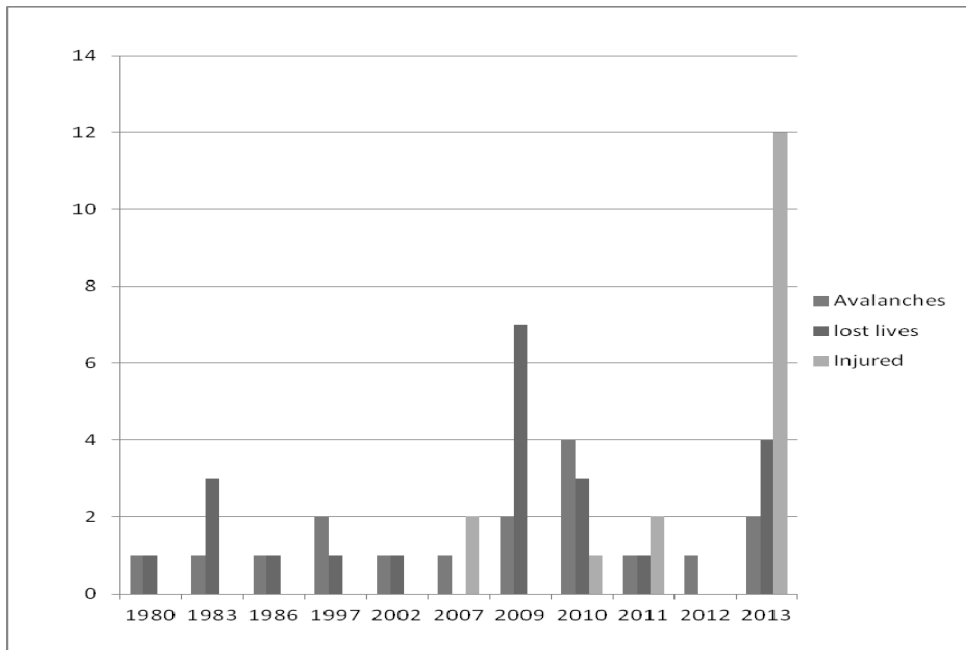
The main physical prerequisites for the observed natural hazards and disasters in the study area relates to the tectonic, morphometric, climatic and anthropogenic conditions. Pirin Mountain is a horst structure situated between Maritsa and East Vardar fault zones which. It is characterizes as an active seismic zone. Morphometric features of the territory are represented in 49% by an altitude of 2000-2500 m a. s. l. The slopes declination is distributed as follow: 20-30°- steep slopes (43,6%) and > 31° - very steep slopes (46,9%). As a result of active erosion processes are affected 102,3 ha and there are 33 sites with very high risk from avalanches. Flood hazard is generated in the catchments of Struma and Mesta Rivers (NP “ Pirin” Management ..., 2004).

From 17 avalanches registered in the period 1980-2013, 22 people lost their lives and 17 people were injured. The most disastrous in respect of number of events, caused human lives lost or injuries is 2010 with 4 events. The year with the most lost human lives (7) due to the avalanches is 2009 and the highest number of injured people (12) caused by the same reason is 2013 (fig. 1). The spatial distribution of the observed events shows that they are concentrate mainly in the Vihren park region (Fig.2), in the most active ski zones which serve the tourists from resorts Bansko and Dobrinishte.

Reducing of flood risk is enshrined in European Union policy via the acting Water Framework Directive (60/2000/EC) and the Directive on Assessment and Management of Flood Risk (60/2007/EC). It includes the following steps:

- 1) To conduct a preliminary risk assessment of flood risk by 2011 (it should be updated by December 2018);
- 2) To create maps of flood hazard and regions at risk of flooding by 2013 (it should be updated to December 2019), and
- 3) To develop plans for risk management by 2015 (it should be updated to December 2021).

In Bulgaria the implementation of first and second steps are almost finished and now the process is going on the final stage. As a result there are already preliminary maps of the flood hazard in the study area, available for all users on the web site of the West Aegean River Basin Directorate. Flood hazard is well expressed in the study area (Fig.3).



Source: NP Pirin Directorate, 2014

Fig. 1. Distribution of avalanches caused human lives lost or injuries during the period 1980-2013

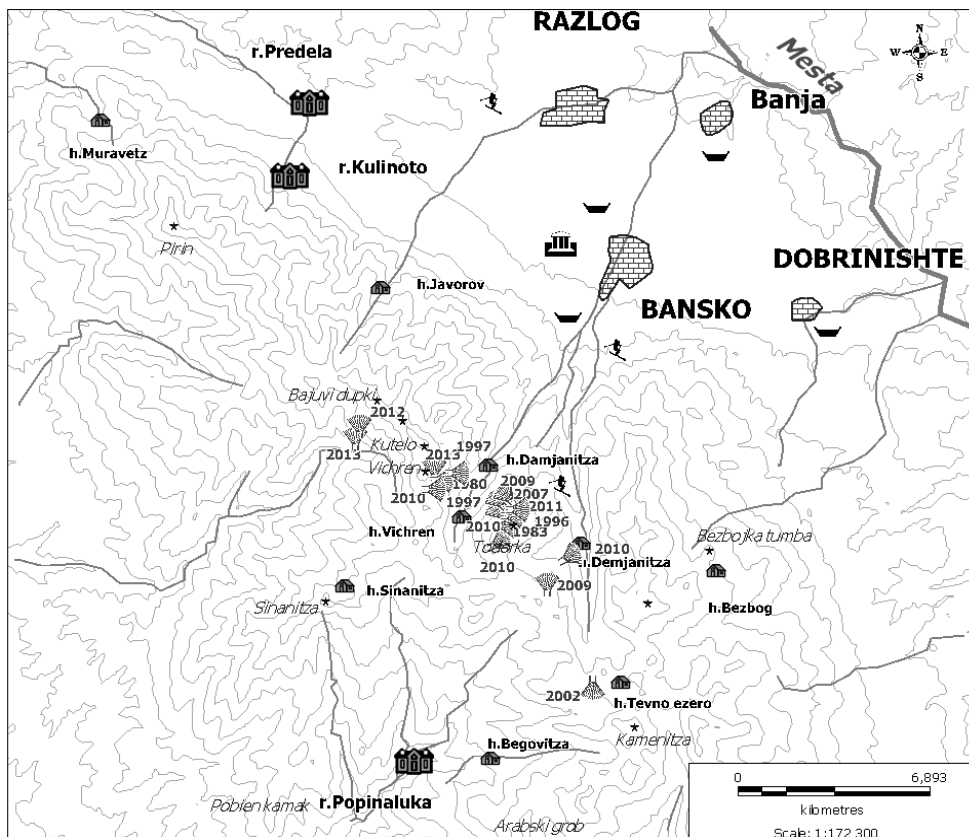


Fig. 2. Spatial distribution of avalanches caused human lives lost or injuries during the period 1980-2013

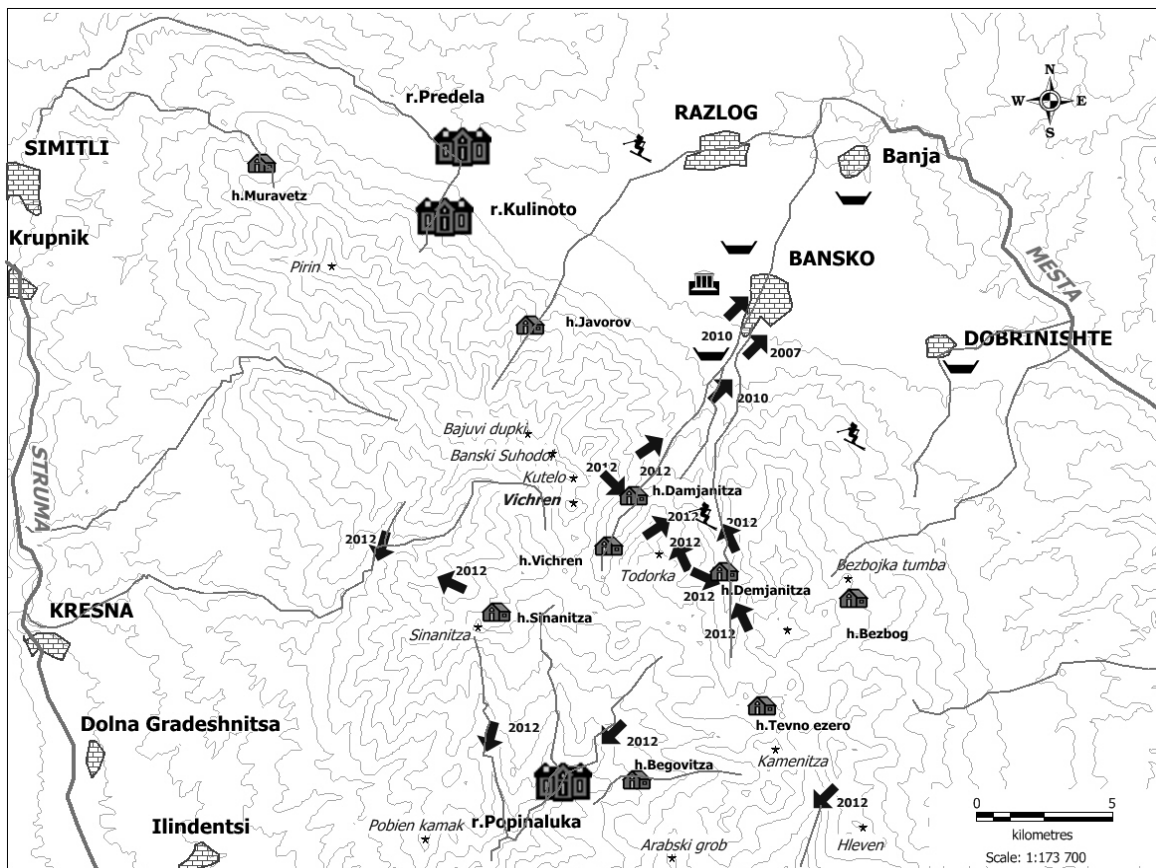


Fig. 3. Spatial distribution of flood events caused damages during the period 1980-2013

It is visible from Fig. 3, that the most devastating floods in the area are registered after year 2007 and the most affected are the catchments of Glazne River, which cross the ski resort Bansko, Sandanska Bistryrica River, which cross the spa resort Sandanski, Vlahinska River and Bistryrica River.

Recent devastating floods in Bansko were on 15-17 May, 2010 and on 28-29 October, 2012. A foreign tourist describes his impression of the flood from 15-17 May 2010 as follow: "The deluge was caused by waters from the Glazne river, which flows through the resort's eastern area, near dozens of newly-built three and four-star hotels. After several hours of rain on May 16, water levels soared and at about 2am on May 17, the Glazne river burst its banks, flooding hotels, cars and refuse bins, and indeed anything else in its path." Due to this event in Bansko „...about 20 houses and 10 hotels had been seriously hit“ (The Sofia Echo, 2010).



Pic. 1. Glazne River, Bansko, November 2009



Source:http://sofiaecho.com/2010/05/21/904092_

Pic. 2. Glazne River, Bansko, May 2010

Main prerequisites for flood risk are intensive rains and snow melting related to the observed climate changes, inappropriate maintenance of river beds (Pic. 1), massive deforestation due to the need of development of new ski infrastructure and overbuild territory in flood prone areas.

Resorts, tourists and tourist infrastructure exposure to natural hazards

In the study area there are nine resorts, one of national significance (Sandanski) and eight of local significance: Dobrinishte (Bansko), Eleshnitsa (Razlog), Bansko (Bansko), the area of “Gotse Delchev” hut (Bansko), the area of “Pazar Chair” (Gotse Delchev), the area “Predela” (Razlog), “Popina luka” (Sandanski), and the area of “Sinanitsa” hut (Gotse Delchev) (State Gazette, 2012). They all pertain to the Blagoevgrad administrative district where are situated 8,95% of countries’ sites for accommodation with 6,80% of the realized tourist nights (5,48% from them are foreign tourists).

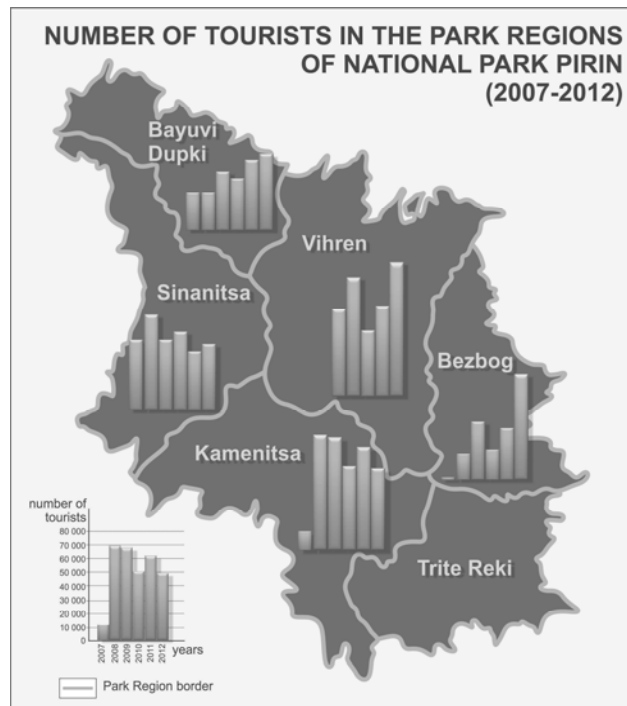


Fig. 4. Number of tourists by park regions (Source NP Pirin Directorate)

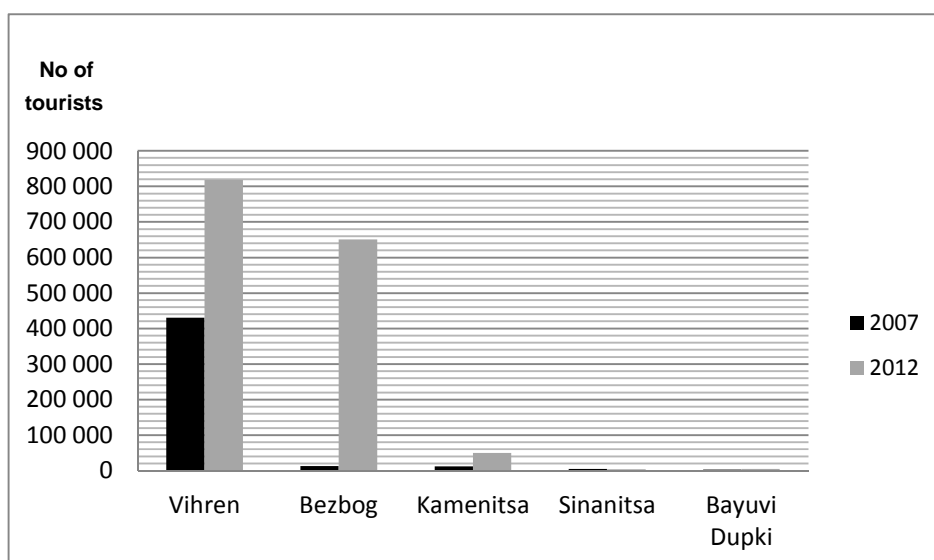


Fig. 5. Number of tourists in 2007 and 2012 by park regions (Source NP “Pirin” Directorate)

On Fig. 4 is represented the distribution of number of tourists in frames of NP "Pirin" by park regions and the dynamics of the tourist flows during the period 2007-2012. It is clear that the highest tourist pressure is observed in the park regions Vihren and Bezbog which correspond to the ski resorts Bansko and Dobrinishte (Fig. 5).

In the observed period of six years, the number of tourists in Vihren region increase from 430 000 (2007) to 818 000 (2012) and in Bezbog area – from 12 400 (2007) to 650 800 (2012). In Kamenitsa region, which corresponds to Sandanski spa resort also is observed an increase of tourists but in lower rate – from 11 558 (2007) to 49 850 (2012). The most of the territory of Bayuvi Dupki region is biosphere reserve and Sinanica region corresponds to the town of Blagoevgrad.

Observed increase of tourist pressure in the park is linked to the changes in tourist infrastructure in it. The transport infrastructure includes 1 road IV class, Bansko-hut "Vihren" (16,8 km), forest roads with density of 3,96 m/ha, park sites with capacity 270 cars, mainly in municipality of Bansko, 3 lifts and 3 cable lines with total length of 21 968 m and capacity of 4 400 prs/hour (to 2000) and 5 lifts and 6 cable lines with capacity of 5 924 prs/hour (2001-2003). There were totally 9 cable lines and 8 lifts with capacity of 10324 prs/hour to 2003. In 2011 only in Bansko there are 16 ski slopes (2 of them operate night time) with total length of 75 km and 9 lifts and 6 cable lines which operate on an elevation between 1000 and 2560m (Stoyanova, 2012).

Accommodation sites in NP "Pirin" in 2002 include 4 hotels with 214 beds, 12 huts with 1800 beds, 60 cottages with 123 beds, 2 camping sites with capacity for 160prs and other accommodation sites with 450 beds. In 2009 in Bansko municipality there are 332 hotels with 13 877 beds, 26 guest houses and 6 huts (Stoyanova, 2013).

Exposure and vulnerability of tourist sites and resorts towards climate change and related to it disasters

The analysis of the temperature and precipitation data for four thirty years periods, provided by the World Bank Climate Change Portal, shows a stable trend of increase of the temperature and decrease of the precipitations in the study area (Popovi Lake's). The observed changes in the average temperature for the period 1991-2009 is with 0,47°C higher than the average temperature for the period 1901-1930 (Fig. 1). The decrease of average precipitations sum between the same periods is 98,76 mm (Fig. 2) We have to keep in mind that these data are extrapolated for a mountain territory and they most probably do not provide precise values of the observed changes. However they show clear trends of the observed changes and these changes are most significant between the last two thirty years periods 1961-1990 and 1991-2009. The average temperature between the last two periods increase with 0,63°C and decrease in average precipitations sums is 29,78 mm (Nikolova, 2014).

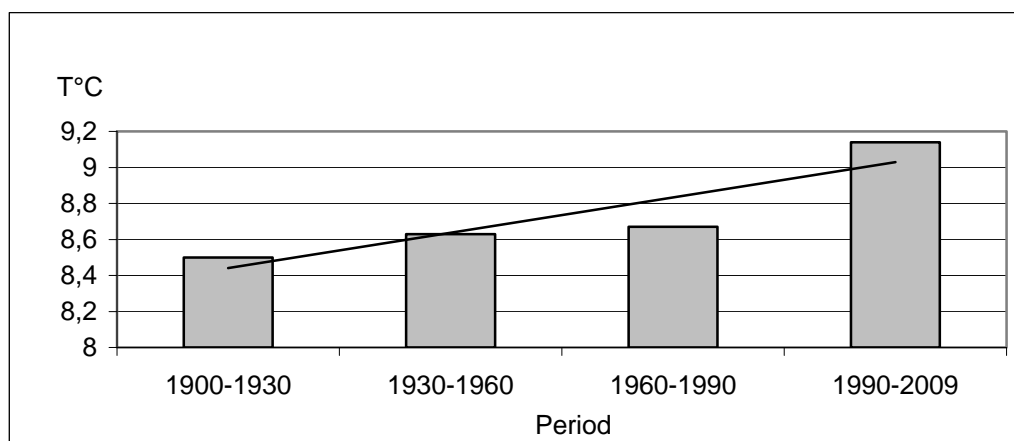


Fig. 1. Changes in average temperature in Popovi Lakes area, Pirin Mountain (1900-2009), (World Bank, Climate portal, 2014)

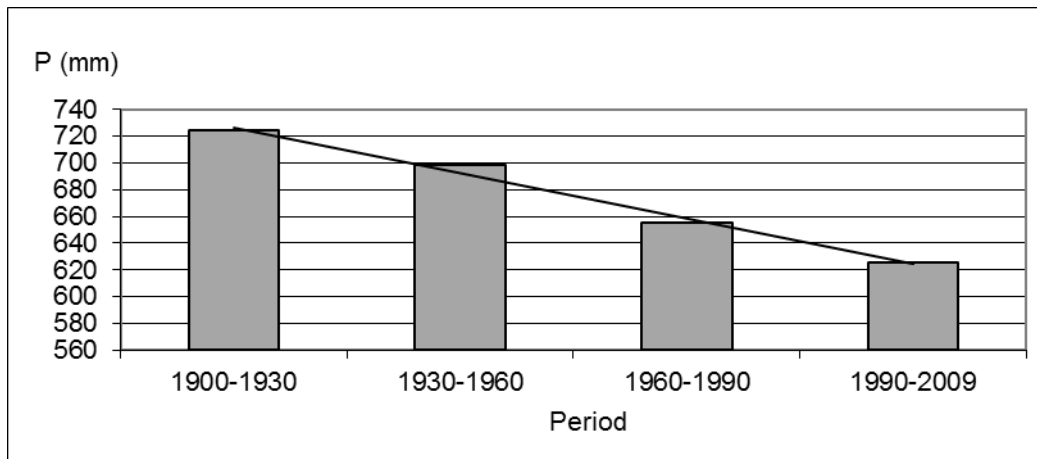


Fig. 2. Changes in precipitation sum in Popovi Lakes area, Pirin Mountain (1900-2009), (World Bank, Climate portal, 2014)

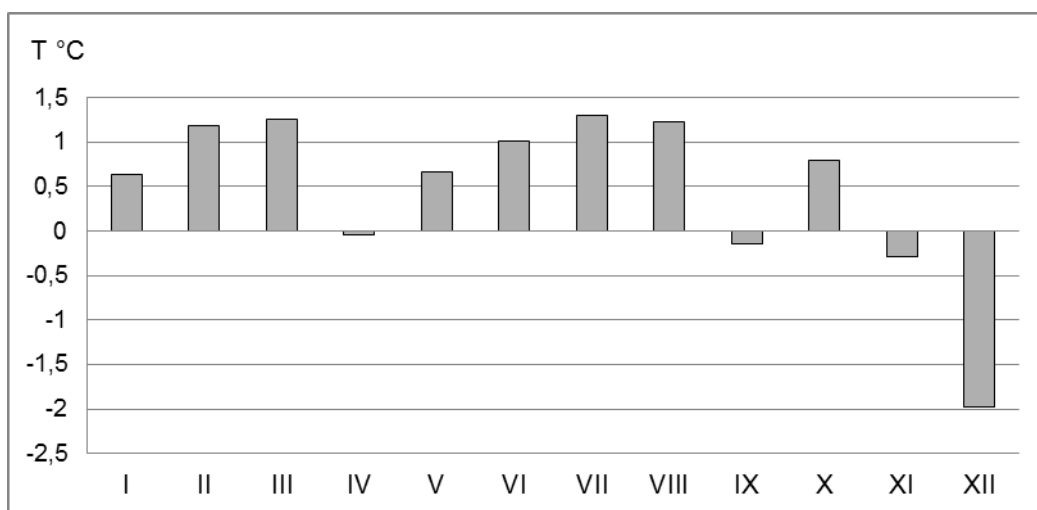


Fig. 3 Change of average monthly temperature between the periods (1961 - 1990) and (1991 - 2009) in Popovi lakes area, Pirin Mountain (World Bank, Climate portal, 2014)

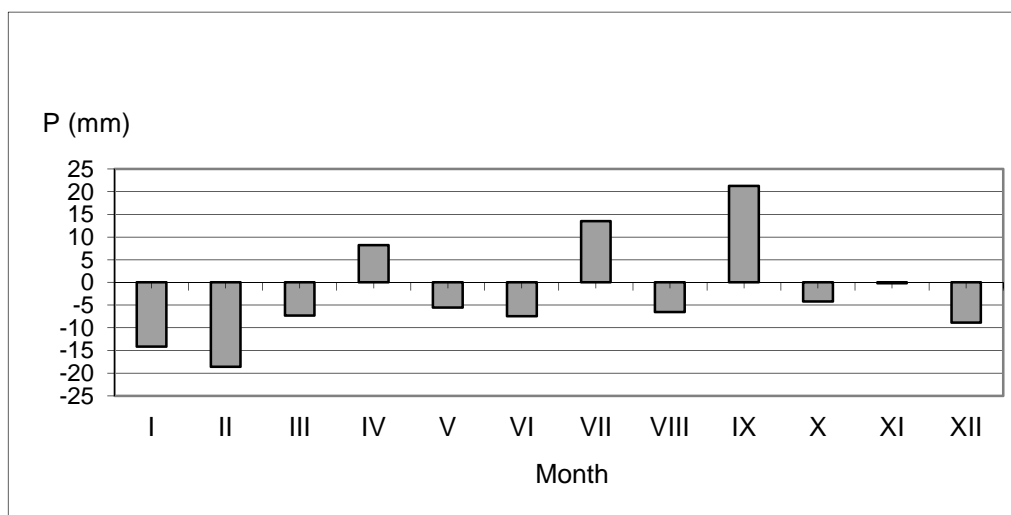


Fig. 4 Change of average monthly precipitation sum between the periods (1961 - 1990) and (1991 - 2009) in Popovi lakes area, Pirin Mountain (World Bank, Climate portal, 2014)

Monthly values of the observe changes shows an increase of the average temperature in eight months (Fig. 3) and increase of precipitation sums in only three months (April, July and September) (Fig. 4). The decrease of precipitations and increase of temperature is well expressed in January and

February, which could be a problem for the ski resorts. However up to now the artificial snow machines helps to solve this problem but in the future the situation could be changed.

Regional climate projections (RCP) for all RCP's scenarios also show an increase of average temperature and number of dry spill days for territory of Southwest Bulgaria of 1,5-2,0°C (RCP2.6), 2,0-3,0°C (RCP4.5), 3,0-4,0°C (RCP6), 4,0-5,0°C (RCP 8.5) and decrease of precipitations sum from 10% (RCP2.6, RCP4.5, RCP6) to 20% (RCP8.5) for the time horizon 2081-2100 (IPCC, 2013). Such significant changes will pose very serious risk for environment in the protected area and also for climate resources for tourism development. Changes of these rates will be associated with climate extremes, intensive rains and long drought periods. The risk from floods, avalanches and dry spills is very likely to increase in the time horizon to 2050 and it will pose respective treats to tourism in Pirin Mountain.

Conclusion

We may conclude that the process of higher mobility of people and increase of the visitors in the National Park Pirin is going on in a changing environment. The more frequent disasters in areas with increasing number of tourists exposed them to specific risk from climate related natural disasters like floods and avalanches. The most exposed are tourists from fast developed ski resorts like Bansko and Dobrinishte. At the same time increasing tourist infrastructure relates to environmental changes which do not support sustainable tourism practices. Deforestation and overbuilding lead to increasing risk from floods, erosion and debris flows in the mountain and its vicinities. Climate change is already detected and its future projections will very likely put new serious challenges, especially for winter tourism. It is very important the management of the Natural Park "Pirin" to put urgently in its agenda plan for adaptation to climate change and all natural disasters which may arise from them. The same need are faced and all mountain municipalities and resorts in the area.

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