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Case study

Effect of climate change impact on tourism: A study on climate comfort of Zayandehroud River route from 2014 to 2039

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ABSTRACT

Climate is an important factor in tourism development, and regarded as invaluable asset in tourism globally. Climate change is currently recognized by most governmental institutions and scientists state this as an important social and environmental issue ahead of the world population, and resources. Here attempts have been made to investigate and analyze the vision and status of tourism climate comfort of Zayandehroud River route at present, and from 2014 to 2039, using HadCM3 model for two A1B and B1 emission scenarios, by PET climate comfort index. The output of the model shows that the ascending trend of temperatures and thereby increased levels of climate comfort can be observed in all stations. The statistical analysis of pet index during 2014–2039 shows a positive trend, followed by a reduction in number of climate comfort days ($18 < PET < 29$). This indicates that some tourism destinations at the western part of the river are at risk of reduction in number of climate comfort days, because of a higher warming in western areas with a mountainous and colder climate. The impacts of these changes are clear on tourism resources.

1. Introduction

Tourism is a powerful force of change in the economy in both developed and in less developed countries (Gumus, Eskin, Veznikli, & Gumus, 2007). The role of tourism in the economic development of cities, and in bringing several benefits to the local are well recognized globally. The number of international tourists increased from 25 million from 1950, to 903 million in 2007; and it is estimated to reach 1.6 billion in 2020. Tourism income reached 865 billion dollars and predicted to get above 2 trillion dollars (UNWTO, 2001).

Economists believe that tourism is one of the most-promising industries from which the Third World can benefit to substitute other industries (Telfer & Sharpley, 2007). Tourism industry in Iran enjoys a high potential for development. Among other countries, based on the report by World Tourism Organization, Iran is the 10th country in terms of archeological and historical attractions, and is the 5th country in terms of natural attractions. Iran is also one of the safest countries of the region, and the world in terms of security for foreign tourists.

Tourism is influenced by many factors; weather and climate are two of them (Abegg, 1996; Matzarakis, 2006; Scott, 2011). The knowledge of climate parameters, thresholds, their appropriateness for tourism and recreation are basic information about possibilities for touristic activities and recreation. Actual information and the appropriate climate for tourists, tourism industry, tourism organizers, agents, tourism planners, and investors, especially, during the period before, holidays, and turnover are useful and vital (Farajzadeh & Matzarakis, 2012).

According to the climate change's scenarios, which is suggested by the Intergovernmental Panel on Climate Change (IPCC), the mean world temperature is rising. These publications conclude that climate is an important consideration for tourists' destination decisions and that climatic variables can explain tourists' flows (Hamilton, Maddison, & Tol, 2005, Hamilton & Tol, 2007, IPCC, 2007). Most of the studies, so far, showed the effect of climate change on water, forests, and agriculture, but the importance of tourism, the relative shortage of studies on consequences of climate change on Iran's tourism is to be studied further.

The link between climate change and tourism implies complex interactions, and can be described as two-way relationship. Tourism activity contributes to climate change (Nicholls, 2006). The UNWTO (2008) estimates that emissions from global tourism, including transport, accommodation, and tourism activity subsectors make up 5% of total CO_2 emissions. The major contributor is the private automobile, and air transport (Chapman, 2007), followed by other forms of transport, and the accommodation subsector (UNWTO, 2008). Further, climate change significantly affects the tourism industry, most importantly due to its effect on the attractiveness of tourism destinations and tourist flows (Amelung, Nicholls, & Viner, 2007, Lise & Tol, 2002). Tourism depends on natural resources, such as, water, coastlines, landscapes and biodiversity. These influence the potential attraction of destinations.

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However, climate change threatens the loss of some of these relevant natural resources (Gössling & Hall, 2006).

The aim is effective and purposeful investigation of the way how climate-tourism conditions, based on regional climate simulations, can affect the decision making for vacation, time, and area. Another objective is to gain access to the available climate information for the present and for predicted conditions in the future. A specific target, is also to examine the impact of climate change on tourism climate comfort index in Zayandehroud River route from 2014 to 2039.

2. Study area and its pattern of tourism

One of the most beautiful and pleasant tourist attractions in Iran is the Zayandehroud River margin. According to Fig. 1, Zayandehroud, the largest internal river of Iranian central plateau, originates from altitudes of Zardkouh Bakhtiari situated in southwest of Isfahan province, and pours into Gavkhouni swamp, 140 km off the southeastern Isfahan. This river has distinctive capabilities, in terms of tourism, including beach sports, ecotourism, and historical tourism (bridges) capable of attracting numerous domestic, and foreign tourists when planned properly.

Most of the international and domestic tourists are interested to visit Isfahan as one of their first destination in Iran. The number of international tourists visiting Isfahan increased during 2002 to 2006, and 2008–2010 and shows a decrease during 2007–2008. In their opinion, the low water levels of the Zayandehrud River with an almost dry river bed may be one reason for this, but international political conflicts may also be playing a role (Schramm & Davoudi, 2014).

According to statistics of Isfahan Handicrafts and Tourism organization 3,300,000 domestic and 80,000 international tourists visited the province of Isfahan in 2010.

Although the number of tourists in Isfahan province in comparison with other places in Iran is high, this is not high according to tourist's potentials available in this area. For example its diversity, unique natural and climatic conditions, in addition to cultural and historical monument, the region is also very well suited for other types of tourism activity, e.g. nature tourism, ecotourism, religious tourism (with the city of Isfahan as the cultural capital of the Islamic world) (Emco, 2007) and sports tourism (Karimi, 2008).

In the whole region, especially in and around the city of Isfahan, the locals' eagerness to receive and/or greet tourists is another positive aspect and/or potential for tourism. Within the relatively small region, both mountainous and desert areas can be visited in addition to the cities. A number of different types of tourism and recreational activities are possible due to this diversity. For example, in the western areas these activities include hiking, sailing, fishing, skiing, golf, and swimming, biking, camping and picnicking by the water.

The eastern areas are well suited for activities such as observing animals in/at the water, stargazing at night, motocross and dune bugging on the sand hills, flying gliders, as well as camel and horseback riding. According to the analysis of Abdollahi (2007), the Gavkhuni area, where the river ends in a salt lake, is one of Iran's most significant tourist areas. With its many and varied tourist attractions, such as the sand dunes, wetlands, traditional and historical monuments, the different animal species, and the various possibilities for day trips, it has much to offer tourists as a holiday destination. Especially by establishing national parks and offering many of the above activities, including walking, taking photographs and filming, the center of the catchment area, near the aforementioned cities, could be particularly attractive to a combination of cultural and nature tourism.

Isfahan Province, with its potentials listed above, also has good prerequisites for further developing tourism, according to the analyses of Karimi (2008) and Abdollahi (2007).

One of the most important tourist aspects of the area is the variety of climatic conditions. For example, during September the tourists can experience summer with hot days and swimming at the east of the area and the cool days with a potential of hiking at western mountainous area. The region has a distinguished four seasons and also if the tourists travel from south-east to the northwest of the basin, they can experience four seasons with different climatic conditions at the same time. It is because of extreme variability of the climate in the area from hot deserts in the east to cold mountains at the west.

2.1. Data

Thirteen synoptic meteorological stations were located in the province, 5 of them are in river route (Fig. 1). Table 1 lists geographic positions of the used synoptic meteorological stations of the Zayanderud river route considered in the analysis. These stations were located in different subclasses of arid and semi-arid climates of the province based on extended De Martonne classification. The climate data, was obtained from the I.R. of Iran's Meteorological Organization (IRIMO). The data consisted of maximum- and minimum-temperatures, precipitation, relative humidity, wind speed, solar radiation, and vapor pressure.

3. Methods

3.1. Physiologically equivalent temperature (PET)

The most relevant parameters are used in the analysis, interpreting the climate components in tourism and recreation (physical, thermal, and esthetic), that describe the so called climatic tourism potential (de Freitas, 2003; Matzarakis, 2006, 2007).

Firstly, thermal conditions were studied, i.e., bioclimatic conditions because these parameters represent the most important factors for tourism, and recreation.

At present, there are some more popular physiological thermal indices derived from the human energy balance (Höppe, 1993; Spagnolo & De Dear, 2003) that is PET, is chosen (Table 2) to describe the thermal component of climate.

PET is temperature, where body temperature in a closed space in a sedentary position (with no wind, or solar radiation) and rate of metabolism by a light task (80 W) and the non-conductivity value of clothes at (9.0 clow) are in balance with central temperature of human body.

Instead of using monthly mean values, the frequencies of these parameters are calculated in high temporal resolution of 10 days, each month is divided into three time intervals.

To calculate PET, it is necessary to determine the meteorological parameters, which are important for human energy balance at a human-bio meteorologically significant height, e.g. 1.1 m above ground (mean height of a standing person's gravity center in Europe). Dominant meteorological parameters influencing the human energy balance, including air temperature, vapor pressure, wind velocity, and mean radiant temperature of the surroundings (Matzarakis, 2001, Matzarakis, Mayer, & Iziomon, 1999). The human-biometeorological radiation model RayMan was developed by Matzarakis, Rutz, and Mayer (2000) to calculate the PET index. The thermal environment expressed in terms of PET is calculated by the radiation and energy balance model RayMan (Matzarakis, 2007). The variables are employed at daily scale, for each of which daily mean has been calculated. After entry of required parameters and calculation of their output, PET results are investigated for each day, and each year, separately in 10-day classes. For example, in the first 10 days of studied years, what percentage of PET lies within the temperature range of 18–29 °C (comfort temperature)?

The second stage deals with evaluation of impacts of climate change on the tourism of studied regions from 2014 to 2039. In this section, using daily data of minimum- and maximum-temperatures, precipitation, and radiation in the studied stations, and HadCM3