The climate strongly influences human health and life, as well as the development of tourism activities. The climate is one of the criteria that defines the tourism development and it is also one of the factors that determines the success of travel agency. This paper refers to the relationships of climate factors and tourism in Tay Nguyen. This paper used data collected from 12 meteorological stations for the period 1980-2011 (31 years) and applied the assessment of bioclimatic model of Mieczkowski (1985) with an improvement from group of author Daniel Scott, Geoff McBoyle and Michael Schwartzentruber (2004). The results showed that tourism potential of Tay Nguyen is quite high, but traveling during the rainy season (summer) in Tay Nguyen is considered less advantageous than the dry season (winter) because of a large number of rainy days.

Keywords: tourism bioclimatic resources; Thermal comfort zone; TCI method; Tay Nguyen.

Introduction

Tourism plays an important role in the global economy. In 2013, tourism revenue reached US$1,159 billion (UNWTO 2014). Therefore, tourism development attracted many scientific researches with different perspectives, including the studies of human health climate in tourism activities. The research results show that climate has closely tied to the reproductive, health and mental state of human (Phong Dao Ngoc, 1972) and climate is the determining factor in tourism, plays an important role in the three stages of a trip, which are before, during and after the migration process.
Figure 1. Geographic location of Tay Nguyen

Geographic location

Tay Nguyen is the mountainous and highland area of Vietnam (including five provinces: Kontum, Gia Lai, Dak Lak, Dak Nong, Lam Dong) with geographic coordinates from 107°17' – 108°00' of east longitude and 11°54' – 15°10' north latitude. Tay Nguyen has a highland – monsoon tropical climate (Fig 1). The climate of Tay Nguyen is divided into two seasons: the dry season (winter) and the rainy season (summer). The dry season starts from March to April and is quite cool but not too cold. Rainy season starts from May to October and has a warm climate. Tay Nguyen tourist season takes place throughout the year.

According to the research results of Toan Ngoc Pham, Dac Tat Phan (1980); Ngu Duc Nguyen, Hieu Trong Nguyen (1985), Tay Nguyen has annual large amount of radiation, total radiation is around 120-140 kcal/cm²/year, hours of sunlight are 2097.9 – 2484.3 hours/year, average temperature is 22 - 24°C, humidity >80%. These are advantages for tourism

Methodology

Tay Nguyen is the mountainous and highland area of Vietnam (including five provinces: Kontum, Gia Lai, Dak Lak, Dak Nong, Lam Dong) with geographic coordinates from 107°17' – 108°00' of east longitude and 11°54' – 15°10' north latitude. Tay Nguyen has a highland – monsoon tropical climate (Fig 1). The climate of Tay Nguyen is divided into two seasons: the dry season (winter) and the rainy season (summer). The dry season starts from March to April and is quite cool but not too cold. Rainy season starts from May to October and has a warm climate. Tay Nguyen tourist season takes place throughout the year.
development in Tay Nguyen. Besides, Tay Nguyen has steadfast relationships in – socio-economic and ecological environment with the South Central Coast provinces (east), southern Laos and northeast Cambodia (west), East Vietnam and the Mekong Delta (south). Therefore, Tay Nguyen have favorable conditions to expand exchanges with many domestic and international areas.

Methods

This paper uses method of analysis and the identification of tourism bioclimatic index invented by Mieczkowski (1985) with the improvement of group of authors including Daniel Scott, Geoff McBoyle and Michael Schwartzentruber (2004) to determine the extent of influences of climate factors for outdoor tourism operations. The tourism bioclimatic index is determined by the formula:

\[
TCI = 8CID + 2CIA + 4P + 2S + W
\]

The relationship of the parameters in the formula above is shown in Table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Climate variables</th>
<th>Influence on TCI</th>
<th>Level of contribution (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CID</td>
<td>maximum daily temperature &amp; minimum daily relative humidity</td>
<td>Description of thermal comfort when tourist activity takes place with maximum</td>
<td>40</td>
</tr>
<tr>
<td>CIA</td>
<td>mean daily temperature &amp; mean daily relative humidity</td>
<td>Description of thermal comfort within 24 h including sleeping</td>
<td>10</td>
</tr>
<tr>
<td>P</td>
<td>total precipitation</td>
<td>Reflecting negative impact of tourist activities in the outdoors</td>
<td>20</td>
</tr>
<tr>
<td>S</td>
<td>total hours of sunshine</td>
<td>As the rate of positive contributions for travel, but underlying the negative because of the risk of sunburns and more uncomfortable on hot days</td>
<td>20</td>
</tr>
<tr>
<td>W</td>
<td>average wind speed</td>
<td>Positive in nature because of the cooling effect in hot zone</td>
<td>10</td>
</tr>
</tbody>
</table>

Results and Discussion

The TCI index (table 2) was calculated based on the measured data of 12 meteorological stations in Tay Nguyen in the period 1980-2011.

Results of calculation in table 2 show that Tay Nguyen has a great tourism potential, annual average TCI is about 60-74% (good to very good). The highest TCI is Lien Khuong (74%) and lowest is An Khe (52%), but at acceptable level. Although the tourism potential of the region is at average level but this potential distribution is not the same between different times of the year. Summer is usually considered to be relatively favorable for tourism activities but in Tay Nguyen summer is rainy season (from May to October). Thus, the potential of tourism climate in Tay Nguyen concentrates on the dry season (January to April). Most of provinces in region have TCI achieved good (60-70%), very good (70-80%), excellent (80-90%) in the winter (dry season). Meanwhile, most of June, July, August, September, October in the summer, TCI reach acceptable levels (50-60%), in some places, TCI only limit (<50%), for example, Pleiku’s TCI was 46-48% in three months in summer (July to
September). However, compared with the calculated results to the global TCI of Bas Amelung, Daniel Scott (2005), the lower potential for tourism in the summer in the Tay Nguyen is appropriate. The reason is that according to the thermal comfort criterion of climates if the weather is too hot, it does not fit with activities of human body and hinder process of heat exchange. CID and CIA indexes often exceed the threshold of thermal comfort. Besides, rainy weather usually brings inappropriate conditions for tourism activity outdoors. In Tay Nguyen this indicator is usually low-value, even negative (Kon Tum, Pleiku, Buon Ma Thuot, Dak Nong and Bao Loc).

TCI variability of Tay Nguyen shows mostly one maximum and one minimum. The maximum appears in the dry season from December to February and

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<tr>
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Figure 2. TCI variability and components in Tay Nguyen meteorological stations
Figure 2. TCI variability and components in Tay Nguyen meteorological stations (continued)
minimum appears on July-September. This variability exists in large parts of the area. CID and CIA played a special role in this variables. High sunshine hours and rainfall contributed to the annual TCI variation. Representatives of this case can be seen at the stations of Kontum, Pleiku, Buon Ma Thuot, Dak Nong, Bao Loc and Da lat.

The annual TCI variability also has two maximums, the main maximum falls in February and March (dry season), the sub maximum falls last months of rainy season and the beginning of dry season. In this variability, CID plays the most important role, because Tay Nguyen summer is often cooler but hampered by heavy rainfall, the typical stations are Dak To, An Khe, Ayun Pa.

**Conclusion**

The application of Mieczkowski’s tourism bioclimatic model within Tay Nguyen, Vietnam once again affirms that tourist activities are not only impacted by the thermal state of the atmosphere but also by the other factors, such as rain, sun and wind that are less or not related to the thermal state of the environment. The research result shows that Tay Nguyen has a high tourism potential, almost all monthly indexes of the region are considered acceptable for tourism industry, except of July, August and September in Pleiku, October in An Khe, November in M’drac, August in Buon Ma Thuot and June in Dak Nong. Traveling during the rainy season (summer) in Tay Nguyen is considered less advantageous than the dry season (winter), by a sizable number of rainy days.

However, in a humid tropical climate rainfall is the basis for vegetation formation and the diversity of fauna and flora. It ensures the great abundance of local fruits and beautiful flowers. All seasons of the year attract tourists from all over the world.

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**References**


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