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Analysis of Tourism Climate Suitability Period and Variation in Ningxia over the Past 39 Years: A Postprint

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Abstract

Utilizing meteorological data including daily daytime temperature, relative humidity, wind speed, and sunshine duration from 1980 to 2018 across all five prefecture-level cities in Ningxia, we calculated the number of days in the tourism climate suitability period employing the Temperature-Humidity Index, Wind-Chill Index, Clothing Index, and Comprehensive Comfort Index models, and analyzed their variation trends and underlying causes. The Comprehensive Comfort Index model results indicate that the tourism climate suitability periods for Shizuishan, Yinchuan, Wuzhong, and Zhongwei are relatively consistent, spanning from March 10 to November 7 with a duration of 243 days. Guyuan' s tourism climate suitability period extends from March 27 to October 29, lasting 217 days. The non-significant change in annual tourism-suitable days in Shizuishan, Wuzhong, and Zhongwei results from the equivalent magnitude of increase in suitable days during the initial and final periods and decrease during the "concave" period. The significant increase in annual tourism-suitable days in Yinchuan and Guyuan is primarily attributed to the increase magnitude of suitable days during the initial and final periods exceeding the decrease magnitude during the "concave" period. The significant increase in suitable days during the initial and final periods across all regions is caused by the combined effects of rising temperature, decreasing relative humidity, and differential changes in other elements. The significant decrease in suitable days during the "concave" period is caused by the combined effects of rising temperature (increase in high-temperature days), decreasing relative humidity, and differential changes in other elements. During the initial, final, and "concave" periods across all regions, the significant variation in temperature exerts the greatest influence weight on the significant variation in suitable days, reaching over 50%, while the influence weights of relative humidity, wind speed, and sunshine duration vary.

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Full Text

Preamble

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Abstract

Ningxia Hui Autonomous Region is rich in tourism resources and was rated as one of the 46 best tourism destinations in the world by *The New York Times*. A suitable tourism climate is an important factor for tourists when choosing destinations. Studying the suitable period and changes in Ningxia' s tourism climate is of great practical significance for tourism planning and design in the region. Based on the fact that most tourism activities occur mainly during daytime, the suitable period for tourism climate was calculated using daytime meteorological data of temperature, relative humidity, wind speed, sunshine hours, and other elements from five cities in Ningxia from 1980 to 2018, employing the THI, WCI, ICL, and CCI models. The changing trends of the suitable tourism period were further analyzed.

The CCI model results showed that the suitable tourism climate period for Shizuishan, Yinchuan, Wuzhong, and Zhongwei was identical, spanning from March 10 to November 10 and lasting 243 days. Guyuan' s tourism climate was suitable from March 27 to October 29, with a duration of 217 days. In Shizuishan, Wuzhong, and Zhongwei, changes in the number of suitable days throughout the year were not significant. This occurred because the increase in suitable days at the beginning and end periods was offset by the decrease in suitable days during the low period. Yinchuan and Guyuan showed significant increases in suitable days over the entire year, primarily because the increase in suitable days at the beginning and end periods exceeded the decrease during the low period.

The significant increase in suitable days at the beginning and end periods in each region resulted from the combined effects of temperature increase, relative humidity decrease, and other factors. The significant decrease in suitable days during the low period was due to the combined effects of temperature increase (e.g., increased number of hot days), relative humidity decrease, and other factors. At the beginning, end, and low periods, significant changes in air temperature had the greatest effect on significant changes in the number

of suitable days (where the change in suitable days exceeded 50%), while the influence weights of relative humidity, wind speed, and sunshine hours differed.

The results indicated that the WCI model calculated an extremely large number of suitable tourism days. Further exploration is needed to determine whether this is due to the use of daytime meteorological elements, particularly the higher daytime temperatures compared to daily average temperatures. This model does not consider adverse factors such as rainstorms and sandstorms, nor does it account for favorable meteorological landscape factors such as rime and snow. Therefore, these factors require further study and supplementation.

Keywords: tourism climate; suitable period; change trend; influence weight; Ningxia

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Results and Discussion

The analysis revealed distinct patterns across the five cities. For Shizuishan, Wuzhong, and Zhongwei, the net change in annual suitable days remained stable, as gains in the shoulder seasons were balanced by losses during the peak summer period. In contrast, Yinchuan and Guyuan exhibited statistically significant upward trends in total suitable days, driven by more substantial extensions at the seasonal margins.

The factor attribution analysis demonstrated that temperature variation was the dominant driver of significant changes in suitable days, consistently accounting for over 50% of the observed variation. Relative humidity, wind speed, and sunshine hours contributed with varying weights depending on the season and location. During the low period, the increasing frequency of hot days combined with decreasing humidity created conditions that reduced comfort despite overall warming.

The WCI model's output of exceptionally high numbers of suitable days warrants careful interpretation. This may reflect the model' s use of daytime-specific temperature data, which typically exceeds daily mean values and could artificially inflate comfort indices. Additionally, the current modeling framework excludes critical weather phenomena—both detrimental (severe storms, dust events) and beneficial (rime ice, snowscapes)—that substantially affect tourism experience and safety. Future research should integrate these elements to develop a more comprehensive assessment framework.

Figures and Tables

[Figure 1: see original paper] Calculation results of THI, WCI and ICL

[Figure 2: see original paper] Calculation results of CCI

Time distribution of the most suitable period, suitable period, less suitable period and unsuitable period of tourism climate

Influence weight of meteorological factors on significant changes of suitable days in key period

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