26th International Congress on Modelling and Simulation, Adelaide, SA, Australia, 30 Nov–4 Dec 2025
mssanz.org.au/modsim2025

Spatial and temporal variation of surface temperature in China based on long-term reanalysis data

Yunfei Zhang [a], **Xiaojuan Li** [a,b], **Lianwang Yin** [b]

[a] *Beijing Laboratory of Water Resources Security, Capital Normal University, Beijing, China,* [b] *College of Resource Environment and Tourism, Capital Normal University, Beijing, China*
Email: 7112@cnu.edu.cn

Abstract: The analysis of spatial and temporal variations in land surface temperature (LST) is a crucial aspect of climate change research. China's climate system is highly complex and susceptible to the impacts of global warming, resulting in significant temperature changes over recent decades. Therefore, this study selected LST as a measurement and used a long-term reanalysis dataset spanning nearly 70 years from 1952 to 2022 to analyze the spatial and temporal characteristics and trends of LST changes in China. The study found: (1) From 1952 to 2022, the maximum LST in China increased by 0.3 K per decade, and the minimum LST increased by 0.5 K per decade. The increase of LST was faster than air temperature's. (2) The rising in maximum and minimum LST across most regions in China are expected to continue.

Keywords: *Land Surface Temperature, LST Change, long-term LST*

1. INTRODUCTION

The Intergovernmental Panel on Climate Change (IPCC) report indicates that global warming has topped 1.5℃ above pre-industrial levels. Similar to other regions in the world, China's temperature has experienced a significant increase over the past seventy years. ,While most studies are focusing on air temperature, there is still a research gap on LST. Moreover, for long-term temperature trend analysis, selecting a time span longer than 50 years is more meaningful (Song et al. 2021). This study assessed the spatiotemporal characteristics and trends of the maximum and minimum LST in China using a long-term reanalysis dataset from 1952 to 2022 The study aimed to strengthen efforts in addressing climate change threats and promoting sustainable development.

2. METHODOLOGY AND RESULTS

This study analyzeed long-term changes in maximum and minimum land surface temperature (LST) over China from 1952 to 2022 using ERA5-Land reanalysis data at a 10 km spatial resolution (Muñoz et al. 2021). To identify trends, the Sen's slope estimator and Mann-Kendall (MK) trend test were applied. The MK mutation test was used to detect abrupt changes in the time series. Additionally, the Hurst exponent, calculated using the R/S analysis method, was employed to assess the long-term persistence of LST changes.

As shown in Table 1, from 1952 to 2022, the maximum LST in China has increased annually by 0.0314 K. The minimum LST has risen annually by 0.0505 K. Meanwhile, the LST difference between maximum and minimum LST has decreased annually by 0.02 K.

Table 1 Increase in Maximum and Minimum LST by Year and Quarter from 1952 to 2022

Year/Quarter	Maximum LST Annual (K)	Maximum LST Decadal (K)	Minimum LST Annual (K)	Minimum LST Decadal (K)
Year	0.0314	0.3142	0.0505	0.5045
Spring	0.0340	0.3400	0.0188	0.1882
Summer	0.0285	0.2854	0.0122	0.1220
Autumn	0.0243	0.2426	0.0285	0.2848
Winter	0.0307	0.3070	0.0607	0.6070

As shown in Figure 1, during spring and winter, the Qinghai-Tibet Plateauexperienced the fastest increase in maximum LST. In summer and autumn, the Inner Mongolia Plateau and the middle and lower reaches of the Yangtze River Plain endured the most rapid warming in the country.

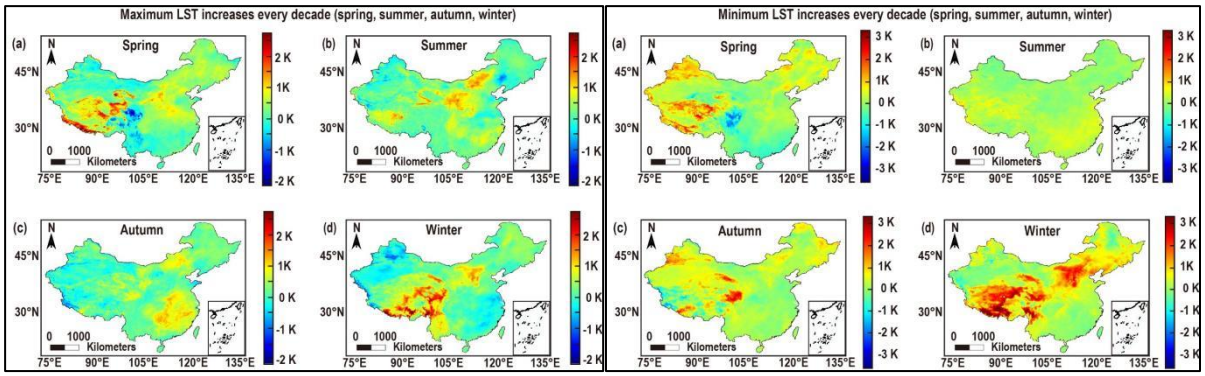

Figure 1 Spatial Distribution of Decadal Average Increase in Maximum LST and Minimum LST (Spring, Summer, Autumn, Winter) from 1952 to 2022

Figure 2 shows the spatial distribution of projected trends in change of maximum and minimum LST. Most regions in China are expected to continue warming. However, future decreases in maximum LST may occur in parts of the Qinghai-Tibet Plateau and Yangtze River Plain. Based on recent 20-year data, LST will continue rising in most areas, though declines in maximum or minimum LST are projected in parts of Northeast China, Central-South China, the Qinghai-Tibet Plateau, and the Yunnan-Guizhou Plateau.

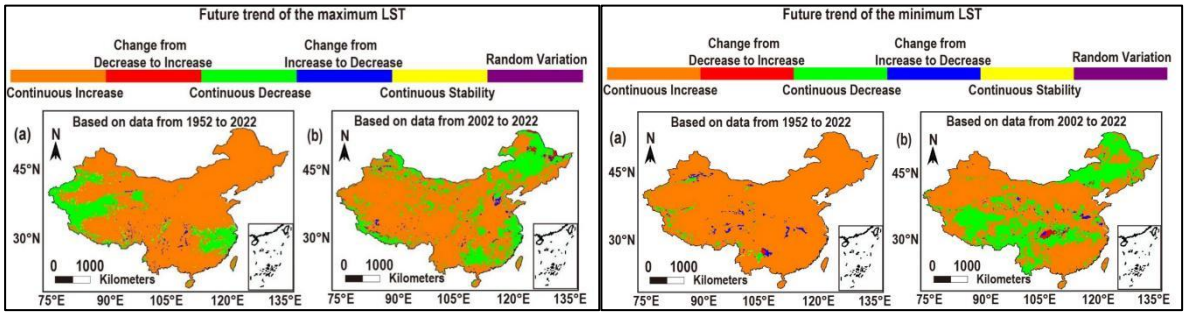

Figure 2 Future Trend of Maximum LST and Minimum LST

3. CONCLUSIONS

Using ERA reanalysis data, this paper analyzeed the spatiotemporal characteristics, trends, and influencing factors of maximum and minimum LST across China from 1952 to 2022. Over the period from 1952 to 2022, maximum LST in China has increased annually by 0.03 K. Minimum LST has increased annually by 0.05 K.

The Qinghai-Tibet Plateau region experienced the fastest increase of maximum LST in spring and winter while the fastest warming in summer and autumn occured in the Inner Mongolia Plateau and the middle and lower reaches of the Yangtze River Plain, respectively.

Maximum and minimum LST in most regions of China are projected to continue rising in the future. However, maximum LST is projected to decrease in the northwestern Qinghai-Tibet Plateau and the middle and lower reaches of the Yangtze River Plain, while decreases in minimum LST are less widespread.

4. REFERENCES

Muñoz-Sabater J et al. (2021) ERA5-Land: a state-of-the-art global reanalysis dataset for land applications. Earth Syst. Sci. Data, 2021. 13(9): p. 4349-4383.

Song Z et al. (2021) The spatiotemporal pattern and influencing factors of land surface temperature change in China from 2003 to 2019. International Journal of Applied Earth Observation and Geoinformation, 2021. 104: p. 102537.

