DETERMINATION OF AIR TEMPERATURE IN AGRICULTURAL LAND BASED ON REMOTE SENSING AND GIS DATA IN THE CASE OF JIZZAKH REGION

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Abstract

This article aims to investigate the correlation between land surface temperature (LST) predictions derived from POWER (Prediction of Worldwide Energy Resources) data and the actual measurements obtained from meteorological stations in the Jizzakh region, Uzbekistan. The study focuses on LST 2 meters above the land surface and examines the predictive accuracy for maximum daily temperature and minimum temperature. Through a comprehensive analysis, high correlation coefficients of 0.95 and 0.81 are observed for maximum daily temperature and minimum temperature, respectively. This research provides valuable insights into the utility of remote sensing data for LST prediction and establishes the potential for improving temperature assessments in the Jizzakh region.

Keywords : land surface temperature, POWER data, meteorological station data, Jizzakh region, Uzbekistan, correlation, prediction, remote sensing.

Introduction. The accurate estimation of land surface temperature (LST) is essential for various applications, including climate modeling, agriculture, and urban planning. Land surface temperature (LST) is a critical parameter in understanding the dynamics of Earth's surface and its interactions with the atmosphere. Accurate and reliable assessment of LST is essential for various applications, including climate modeling, environmental monitoring, urban planning, and agricultural management. Traditionally, LST measurements have heavily relied on ground-based meteorological stations, which provide localized data but have inherent limitations in capturing the full spatial and temporal variability of surface temperatures [1].

The aim of this study is to investigate the potential of utilizing POWER data for predicting LST 2 meters above the land surface and compare it with measurements obtained from meteorological stations. The study focuses specifically on the Jizzakh region in Uzbekistan, an area characterized by diverse land cover and significant variations in temperature patterns. By comparing the predicted LST derived from POWER data with the actual measurements from meteorological stations, we aim to evaluate the accuracy and reliability of remote sensing-based LST estimation in this specific region [2].

In this paper, we will present a detailed analysis of the correlation between the LST predictions derived from POWER data and the measurements obtained from meteorological stations in the Jizzakh region, Uzbekistan. We will quantify the strength of the correlation using statistical measures such as the correlation coefficient (r-square) and examine the spatial and temporal patterns of the datasets. Furthermore, we will discuss the implications of the observed correlation and explore the potential applications of remote sensing-based LST prediction in the Jizzakh region [3-5].

2. Data Sources and Methodology

2.1 POWER Data

The Prediction of Worldwide Energy Resources (POWER) project, developed by NASA's Langley Research Center, provides a comprehensive database of satellite-based data, including land surface temperature (LST) measurements. The POWER dataset encompasses a wide range of meteorological and climatic parameters, derived from various satellite sensors and models, and covers global spatial coverage with temporal resolutions varying from hourly to monthly [7].

The POWER data offers several advantages for LST prediction and analysis. It combines multiple satellite observations, including those from MODIS (Moderate Resolution Imaging Spectroradiometer), CERES (Clouds and the Earth's Radiant Energy System), and MERRA-2 (Modern-Era Retrospective analysis for Research and Applications, Version 2), to provide accurate and reliable LST information. The satellite sensors capture thermal radiance emitted from the land surface, which is then processed and converted into LST using advanced algorithms and calibration techniques [6].

2.2 Study area

Jizzakh Region is one of the regions of Uzbekistan. It is located in the center/east of the country. It borders with Tajikistan to the south and south-east, Samarqand Region to the west, Navoiy Region to the north-west, Kazakhstan to the north, and Sirdaryo Region to the east. It covers an area of 21,210 km². The population is 1,443,408 (2022 estimate) with 53% living in rural areas.

The regional capital is Jizzakh (pop. 179,200, 2020). Other major towns include Do'stlik, Gagarin, G'allaorol, Paxtakor, and Dashtobod. Jizzakh Region was formerly a part of Sirdaryo Region but was given separate status in 1973.

Figure 1. The location of Jizzakh region.

The climate is a typically continental climate, with mild winters and hot, dry summers. The Zaamin National Park, formerly Guralash Reserve, on the western slopes of the Turkestan Range and known for its unique fauna and flora, is also within the region. Wildlife is extremely rich here; in spring and in summer, alpine meadows are with a multitude of colors: bright-red tulips and snow-white acacias. In autumn the hills are magnificently decorated with the gold-colored domes of the hazelnut trees, columns of birch-trees, towering plane trees, and green thickets. High in the mountains, in the upper part of the Guralashsoy gorge, is a nesting-place of black storks. These rare birds are the pride and joy of Uzbekistan. They are written down in the "Redbooks" in many countries as an endangered species. Early in the spring when the Arnasoy depression is flooded, flocks of ducks, wild geese, pelicans and grey herons are found here. This territory serves as a nesting place for rose-coloured starlings, shrikes, and sandpipers.

2.3 Correlation Analysis

To assess the relationship between the predicted land surface temperature (LST) derived from POWER data and the measured LST from meteorological stations, a correlation analysis was conducted. The correlation coefficient, commonly represented by "r" or the coefficient of determination (r-square), quantifies the strength and direction of the linear relationship between two variables [2].

$$r = n(\sum xy) - \sum x \sum y / \sqrt{[n(\sum x2 - (\sum x)2)] * [n^* (\sum y2 - (\sum y)2)]} \quad (1)$$

r = The Correlation coefficient

n = number in the given dataset

x = first variable in the context

y = second variable

$$R^2 = [(n\Sigma xy - (\Sigma x)(\Sigma y))/(\sqrt{n\Sigma x^2 - (\Sigma x)^2} * \sqrt{n\Sigma y^2 - (\Sigma y)^2})]^2 \quad (2)$$

3. Results and Discussion

In this study, a high correlation coefficient of 0.95 was observed for the maximum daily temperature, indicating a strong positive linear relationship between the predicted LST from POWER data and the measured LST from meteorological stations. Results showed a nice correlation between two datasets. All statistical analysis was done in Microsoft Excel program.

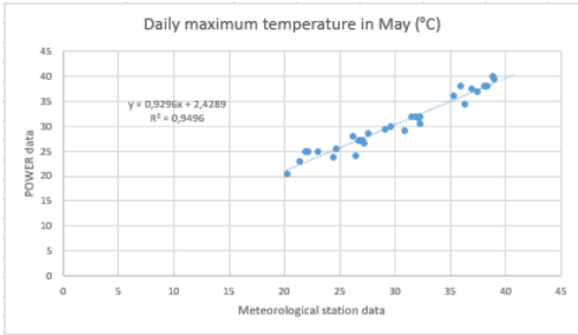

Figure 2: Daily maximum temperature in May

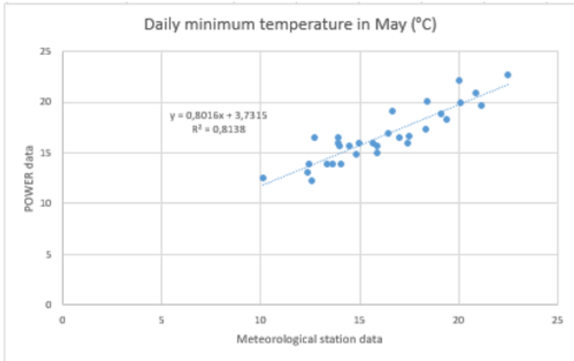

Figure 3: Daily minimum temperature in May

4. Conclusion

By conducting this research, we aim to contribute to the growing body of knowledge on remote sensing-based LST estimation and its practical applications. The findings of this study will not only enhance our understanding of LST dynamics in the Jizzakh region but also provide valuable insights for future LST monitoring and prediction efforts in similar regions worldwide. The article concludes by summarizing the main findings, emphasizing the strong correlation coefficients observed between the predicted LST derived from POWER data and the measured LST from meteorological stations in the Jizzakh region, Uzbekistan. The research demonstrates the potential of remote sensing data as a valuable tool for LST prediction and highlights its significance for temperature monitoring and assessment.

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