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CPS Paper

From skepticism to conviction: The emerging statistical methodologies in integrating satellite and reanalysis data with station data.

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Brief Description

Africa faces a significant challenge due to its inadequate weather station network, which falls far below the recommended density of the World Meteorological Organization.

Historically, meteorological and climate research heavily relied on ground-based station data, but limitations like sparse coverage and biases have driven a shift towards integrating satellite and reanalysis data.

This transformation, from skepticism to conviction, highlights the growing recognition of the value in merging satellite and reanalysis data with traditional station data.

While promising, this shift introduces challenges in data harmonization, validation, and the development of robust statistical methodologies.

Recent research has bolstered confidence in using satellite-based products across various applications.

This study focuses on emerging statistical methodologies for integrating satellite and reanalysis data with station data, with a specific comparison of daily temperature records from CHIRTS satellite and station-based data in Ghana.

The results indicate that CHIRTS outperformed ERA5, showcasing its potential in meteorological parameter estimation.

As we face the uncertainties of climate change, leveraging integrated data sources and evolving statistical methodologies is crucial for gaining a comprehensive understanding of our changing climate and addressing its impacts effectively.

Abstract

Africa has just one-eighth the minimum density of weather stations recommended by the World Meteorological Organization, which means there is a problematic lack of data about dozens of countries that are among the most vulnerable to climate change. Historically, meteorological and climate research predominantly relied on ground-based station data, but inherent limitations, such as sparse coverage and potential biases, have prompted a paradigm shift towards the integration of satellite and reanalysis data. This shift, from skepticism to conviction, reflects the growing recognition of the value and potential inherent in merging satellite and reanalysis data with traditional station data. This transformation, while promising, introduces challenges in data harmonization, validation, and the development of robust statistical methodologies. The growing body of research into the validation and evaluation of satellite products at various regions is increasingly building confidence in the use of satellite based products for various applications.

This study highlighted emerging statistical methodologies in integrating satellite and reanalysis data with station data and also compared the daily temperature records from 2001 to 2015 from the CHIRTS satellite and station-based temperature network with temperature data records of at least 15 years' duration from three locations in Ghana. To evaluate CHIRTS performance, the station data were also contrasted with ERA5 temperatures. On the daily and monthly basis, the CHIRTS estimates showed good agreement with the station data than on the annual levels.

The CHIRTS dataset generally exhibited better correlations, lower errors, and more favorable Nash-Sutcliffe Efficiency values compared to ERA5, indicating its better performance in estimating and predicting meteorological parameters at these stations. As we move forward in this era of climate uncertainty, harnessing the full potential of integrated data sources is paramount. The evolving landscape of statistical methodologies plays a pivotal role in this endeavor, facilitating a more comprehensive understanding of our changing climate. By bridging the gap between

skepticism and conviction, we are better equipped to address the pressing issues of climate change and its far-reaching impacts.