remote sensing

Editorial

Editorial for Special Issue "Remote Sensing of Precipitation: Part III"

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1. Introduction

This Special Issue of Remote Sensing, which is the third in a series entitled "Remote Sensing of Precipitation", comprises a collection of ten papers devoted to remote sensing applications for measuring precipitation; these include new satellite technologies for the remote sensing of precipitation, the validation of satellite-based precipitation estimates using rain gauge measurements and surface radar estimates, and comparisons between gridded precipitation data.

The next section summarizes the individual articles presented in this Special Issue, in alphabetical order based on the first author's name.

2. Overview of Contributions

Frank et al. [1] aimed to evaluate the accuracy of ERA5 precipitation products for two ecoregions of the Canadian Prairies and compare them with monthly means measured from 1981 to 2019 at ten weather stations. Their study assessed intraseasonal variability in precipitation and identified dry and wet periods based on the annual Standardized Precipitation Index (SPI). A significant relationship between in situ data and ERA5 data was observed in nine of the ten weather stations analyzed. The analysis of wet and dry periods, based on the SPI derived from ERA5, and the comparison of these data with events associated with the El Niño-Southern Oscillation (ENSO) showed that from the ERA5 data and the derivation of the SPI, it was possible to identify temporal anomalies with consistent patterns that can be associated with historical events.

Ghorbanian et al. [2] aimed to quantify the competence of six gridded precipitation products (GPPs), at multiple time scales (daily, monthly, and yearly), using over 1.7 million in situ observations throughout Iran over the past two decades (2000–2020). Both continuous and categorical metrics were implemented to assess precipitation intensity and occurrence based on the point-to-pixel comparison approach. Although not all metrics support the superior performance of any specific GPP, the findings suggested that the Global Satellite Mapping of Precipitation (GSMaP) provides better estimates of daily precipitation. Based on the obtained continuous metrics, all the GPPs showed better performance in the dry months, while this was not the case for the categorical metrics.

Hartke and Wright [3] sought to provide insight into interpolated gauge product accuracy at low gauge densities using a Monte Carlo interpolation scheme at locations across continental U.S. and Brazil. They hypothesized that errors in interpolated precipitation estimates from the GPM (Global Precipitation Measurement) mission increased drastically at low rain gauge densities and at high distances from the nearest gauge. The results showed that the Integrated Multi-satellite Retrievals for GPM (IMERG) product had comparable precipitation detection performance to interpolated gauge data at very low gauge densities (i.e., less than 2 gauges/10,000 km^2), and that IMERG often outperformed interpolated data when the distance to the nearest gauge during interpolation was greater than 80–100 km.

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In a comprehensive analysis of the Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (PERSIANN) products, Hsu et al. [4] evaluated the capability of these precipitation estimates to represent precipitation characteristics over Luzon, which is the largest island in the Philippines. The analyses focused on monthly and daily timescales from 2003 to 2015, and adopted surface observations from the Asian Precipitation Highly Resolved Observational Data Integration Towards Evaluation of Water Resources (APHRODITE) platform as their evaluation base. Among several satellite precipitation products, PERSIANN-CDR was observed to more effectively qualitatively and quantitively estimate spatiotemporal variations in precipitation over Luzon for the majority of the examined features, with the exception of extreme precipitation events.

Kidd et al. [5] outline the Time-Resolved Observations of Precipitation structure and storm Intensity with a Constellation of Smallsats (TROPICS) mission and provided a description of the retrieval scheme for the Millimeter-wave Sounder (TMS). They present the initial results of precipitation estimates using the Precipitation Retrieval and Profiling Scheme (PRPS). The TROPICS mission consists of a Pathfinder CubeSat and a constellation of six CubeSats, providing a low-cost solution to the frequent sampling of precipitation systems across the Tropics. These results showcase the potential of the TMS instrument for the retrieval of precipitation data. The PRPS has been modified for use with the TMS instrument using a database comprising observations from current sounding sensors. In terms of monthly precipitation estimates, the results fall within the mission's specifications and are similar in performance to retrievals from other sounding instruments, and at an instantaneous scale, the results are very promising.

Using a set of site-based interpolation data, Liu et al. [6] evaluated the accuracies of six satellite precipitation datasets, at different temporal scales (daily, monthly, and yearly) in mainland China from 2001 to 2015. In terms of mean precipitation, IMERG–F was found to be superior to the other data in all areas. IMERG products and PERSIANN–CDR performed better than the other products at all scales, and were most suitable for precipitation research in mainland China. Some satellite precipitation products performed better in summer than in winter; however, the error was larger in seasons with more precipitation.

A simple statistical model was introduced by Oliveira and Roca [7] to characterize the distribution of uncertainty in gridded multi-platform satellite precipitation products. With a view to improving the existing framework and better understanding the uncertainty of the daily $1^{\circ} \times 1^{\circ}$ scale, the authors assessed the effectiveness of simple decomposition of uncertainty, under an additive error model assumption and as a sum of two Gaussian distributions. The following three types of uncertainty were considered: (i) constellation change-induced uncertainties, (ii) sampling uncertainties, and (iii) uncertainties related to comparisons with rain gauge network data.

Peinó et al. [8] aimed to simultaneously evaluate precipitation estimates obtained from the three IMERG runs (Early, Late, and Final) at different time scales (half-hourly, hourly, daily, monthly, seasonal, and annual), taking the automatic stations of the Meteorological Service of Catalonia as a reference. Additionally, to validate the IMERG estimates at the highest temporal resolution (30 min) according to different orographic features and different climatic conditions, and according to different precipitation intensity thresholds, their study considered the period of 2015 to 2020 and focused on the region of Catalonia, in the northeastern region of the Iberian Peninsula.

In their study, Ramadhan et al. [9] aimed to evaluate the performance of GSMaP version 08 over the Indonesian Maritime Continent (IMC) using near-real-time and post-real-time rain gauge (RG) observations from December 2021 to June 2022. Assessments were carried out on data from 586 rain gauge (RG) stations using a point-to-pixel approach. The accuracy of GSMaP version 08 was evaluated in terms of timescales, variations in intensity and extreme events, and the effect of elevation. In addition, this research examined the ability of GSMaP to capture data on diurnal patterns over the IMC.

Wang et al. [10] validated IMERG version V05B and V06B precipitation products from the GPM mission against ground-based observations from the Kwajalein Polarimetric

S-band Weather Radar (KPOL), deployed at Kwajalein Atoll in the central Pacific Ocean. This validation study indicated that precipitation rates from both IMERG V05B and V06B are underestimated with respect to surface radar estimates, but to a lesser extent in V06B compared to V05B. IMERG V06B outperforms V05B, exhibiting reduced systematic bias and improved precipitation detectability.

3. Conclusions

This Special Issue aimed to inform and update the precipitation science community on current progress in the remote sensing of precipitation through the presentation of state-of-the-art data sources and technological advances, as well as relevant methodological approaches. We hope that this collection of papers will stimulate further research in precipitation science.

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