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Studi Ketelitian Data Hujan Satelit Berdasarkan Variabilitas Spasial dan Topografi
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INTISARI

Curah hujan merupakan variabel hidrologi penting dalam pengelolaan sumber daya air, sementara keterbatasan jaringan stasiun hujan dapat membatasi ketersediaan data yang representatif secara spasial. Produk presipitasi satelit, seperti GPM-IMERG dan GSMaP, dapat menjadi alternatif untuk melengkapi data pengamatan, tetapi masih memiliki bias sistematis. Penelitian ini bertujuan mengevaluasi ketelitian GPM-IMERG dan GSMaP terhadap data pengamatan pada skala bulanan di DTA Waduk Wonogiri, menilai efektivitas metode koreksi bias *Linear Scaling*, *Linear Regression*, dan *Empirical Quantile Mapping*, serta menganalisis pengaruh variabilitas spasial dan topografi terhadap ketelitian data satelit sebelum dan sesudah koreksi.

Penelitian menggunakan pendekatan *point-to-pixel* dengan data curah hujan satelit dan pengamatan harian periode 2003–2019 dari 17 pos pengukuran hujan. Data curah hujan harian diakumulasikan dan dievaluasi pada skala bulanan menggunakan koefisien korelasi (R), *Nash-Sutcliffe Efficiency* (NSE), *Root Mean Square Error* (RMSE), dan *Relative Bias* (RB). Hasil menunjukkan bahwa sebelum koreksi, kedua produk satelit mampu mengikuti pola perubahan curah hujan dari waktu ke waktu, tetapi masih memiliki bias sistematis dan ketelitian yang bervariasi antar lokasi. GSMaP memiliki nilai R lebih tinggi pada mayoritas lokasi, dengan nilai maksimum 0.91 pada *grid* 6 (Jatisrono-2), sedangkan GPM-IMERG menunjukkan kinerja NSE yang lebih baik karena tidak menghasilkan nilai NSE negatif. GPM-IMERG cenderung *underestimate* pada curah hujan tinggi dan *overestimate* pada curah hujan rendah, sedangkan GSMaP umumnya *overestimate*.

Setelah koreksi, *Linear Scaling* efektif menurunkan RB mendekati nol, *Empirical Quantile Mapping* memberikan kinerja paling konsisten dengan NSE positif di seluruh lokasi, sedangkan *Linear Regression* menunjukkan hasil paling tidak konsisten. Zonasi hulu, tengah, dan hilir tidak menunjukkan perbedaan kinerja koreksi data hujan satelit yang signifikan (*p-value* > 0.05). Pada GSMaP hasil koreksi *Linear Scaling* terdapat korelasi negatif kuat dan signifikan antara elevasi dan NSE ($\rho = -0.80$). Dengan demikian, ketelitian data hujan satelit dipengaruhi oleh karakteristik produk, metode koreksi, dan kondisi topografi pada lokasi tertentu.

Kata kunci: GPM-IMERG, GSMaP, koreksi bias, DTA Waduk Wonogiri, ketelitian.

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ABSTRACT

Rainfall is an important hydrological variable in water resources management, while the limited distribution of rain gauge stations often restrict the availibility of spatially representative data. Satellite precipitation products, such as GPM-IMERG and GSMaP, can serve as alternatives to complement ground observations, although they still contain systematic biases. This study aims to evaluate the accuracy of GPM-IMERG and GSMaP against ground observations at the monthly scale in the Wonogiri Reservoir catchment area, asses the effectiveness of the Linear Scaling, Linear Regression, and Empirical Quantile Mapping bias correction methods, and analyze the influence of spatial and topographic variability on satellite rainfall data before and after correction.

The study employed a point-to-pixel approach using daily satellite rainfall data for the 2003–2019 period and observation from 17 surface rain gauge stations. The daily data were aggregated and the cccuracy was evaluated at the monthly scale using the correlation coefficient (R), Nash-Stucliffe Efficiency (NSE), Root Mean Square Error (RMSE), and Relative Bias (RB). The results showed that, before bias correction, both satellite products were able to capture the temporal variation of rainfall but still exhibited systematic biases and varying accuracy across locations. GSMaP showed higher R values at most locations, with a maximum value of 0.91 at grid 6 (Jatisrono-2), whereas GPM-IMERG showed better NSE performance, as it did not produce negative NSE values. GPM-IMERG tended to underestimate high rainfall and overestimate low rainfall, while GSMaP generally tended to overestimate rainfall.

After bias correction, Linear Scaling effectively reduce RB close to zero, Empirical Quantile Mapping provided the most consistent performance, with positive NSE values across all locations, while Linear Regression showed the least consistent results. The division of the catchment into upstream, middle, and downstream zones did not show statistically significant differences in performance of corrected satellite rainfall data (p-value > 0.05). For GSMaP corrected using Linear Scaling, a strong and significant negative correlation was found between elevation and NSE ($\rho = -0.80$). Therefore, the accuracy of satellite rainfall data is influenced by product characteristics, bias correction methods, and topographic conditions at specific locations.

Keywords: GPM-IMERG, GSMaP, bias correction, Wonogiri Reservoir catchment area, accuracy.