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Original Article

Correlation Between the NASA's Tropical Rainfall Measuring Mission Data and Indonesia Meteorology and Geophysics Agency of Kalimantan Island

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Abstract. The island of Kalimantan, especially the East Kalimantan area, has been included in the discourse on the development of the State Capital of the Republic of Indonesia. It is necessary to carry out further scientific studies from various aspects, one of which is rainfall. The Meteorology and Geophysics Agency (BMKG) and NASA's The Tropical Rainfall Measuring Mission (TRMM) are agencies for measuring rainfall in Indonesia. The BMKG ground rainfall data recording still leaves a void given the limitations of recording at rain observation stations, while the TRMM satellite rainfall data can provide complete data. The purpose of the study was to analyze the equations and correlations of ground rainfall data BMKG and TRMM satellite rainfall data and analyze the feasibility level of TRMM satellite rainfall data to be able to represent BMKG ground rainfall data that is missing or out of reach of rainfall observation stations. Rainfall data was used for 20 years (1998-2019) at rain stations on the island of Borneo. Data were analyzed in the form of daily, 7 daily, monthly and yearly. The results of the correlation analysis showed that the greater the cumulative number, the greater the similarity of the BMKG and TRMM patterns, with the highest correlation value in the annual cumulative (0.661-0.909). TRMM rainfall data is considered capable and feasible as an alternative in filling in missing BMKG rainfall data, especially as a substitute for certain area data that is difficult to measure.

Keywords: rainfall, correlation, BMKG, TRMM, Kalimantan

1. Introduction

The island of Kalimantan, especially in the East Kalimantan area, has been included in the discourse on planning the development of the State Capital of the Republic of Indonesia, there is still much that needs to be studied scientifically from various aspects of climate and weather, one of which is rainfall. In the application of scientific calculations, rainfall is determined in mm/time which can be interpreted as the height of the surface inundation caused by the rain itself within hours, daily, weekly or annual time units [1]. Until now, the official rainfall data in Indonesia has been issued by the Meteorology, Climatology and Geophysics Agency (BMKG).

The Tropical Rainfall Measuring Mission (TRMM) is a National Aeronautics and Space Administration (NASA) space mission in the form of satellites to improve understanding of the distribution of rain in tropical and sub-tropical areas of the earth, including the provision of information related to rain and its release about global climate formation and information others have to do with rain and climate. This TRMM collaboration project is a joint project between Japan and the United States for tropical and sub-tropical rain research, from the official NASA website, the

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Precipitation Measurement Mission, you can see a variety of data presentations on climate and rain research results with hourly and daily data updates [2].

There are still very few studies that produce similarities and relationships between TRMM satellite data and BMKG ground data, so it demands the need to find a correlation between the two rainfall data. The recording of BMKG ground rainfall data still leaves data gaps given the limitations of recording at rain observation stations, while the TRMM satellite rainfall data provides complete data due to the ability of recording by satellite. By obtaining the equation and correlation relationship between the two rainfall data, it can provide additional information about whether or not the TRMM satellite rainfall data is appropriate to represent the missing rainfall data filling in the BMKG ground rainfall data, the lack of information reinforces the importance of conducting Bulk Data Correlation between the TRMM and BMKG Rain in the Kalimantan Island Region.

2. Materials and Methods

The study areas in this research are several BMKG Rainfall Observation Stations located on the island of Kalimantan, namely the Paloh rain station. The data used is secondary data with data collection methods from two sources, namely BMKG ground rainfall and TRMM satellite rainfall data. A comparison is made to see the magnitude of the similarity or similarity between data from BMKG and TRMM data. The first comparative analysis performed was the Pearson correlation analysis. In the correlation analysis, Curve Comparative is also carried out as a comparison of BMKG and TRMM rainfall data so that a comparison of rainfall data is obtained in graphical form. The next analysis is Linear Regression analysis, to see how big the relationship is between the two rainfalls data between BMKG data and TRMM data and get the coefficient of determination.

3. Results and Discussion

TRMM and BMKG rainfall data at each station were compared to see the linear equation and correlation value. The compared rainfall data is divided into daily, 30 daily (monthly), and based on the annual data.

3.1. Daily Data

The results of the correlation of daily BMKG and TRMM rainfall data are presented in Table 1 below:

Table 1. Daily Cumulative Correlation Value

Rainfall Station	Coefficient of Correlation
Nangapinoh	0,0609
Paloh	0,4147
Pangsuma	0,0824
Rahadi Oesman	0,0955
Siantan	0,0758
Supadio	0,3398
Susilo	0,4691

The results of the correlation analysis, it was found that from the seven rain stations analyzed in Kalimantan, the correlation value was from 0.06 to 0.47. From these results, it is stated that the uniformity of rainfall patterns between BMKG data and TRMM data on the same day shows a correlation with a low scale and a very low scale. A comparative data in graphical form is presented in the following graphic images as in Figures 1.

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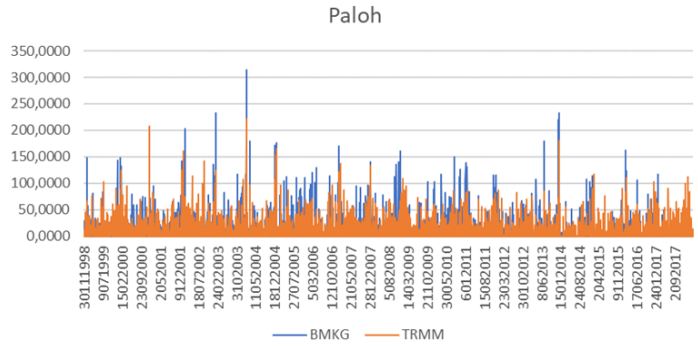

Figure 1. Comparison of Daily Cumulative at Paloh Station Rain Data

From the results of the comparison of the daily cumulative data graph of BMKG and TRMM shows that the data graph for each pattern has similarities, this is inversely proportional to the maximum value of each data which shows a significant difference, so that the value shows a small correlation value.

The next analysis is Linear Regression analysis. This analysis was conducted to see how big the relationship between the two-rainfall data was between the BMKG data and the TRMM data. The results of the Linear Regression analysis are presented in fig. 2.

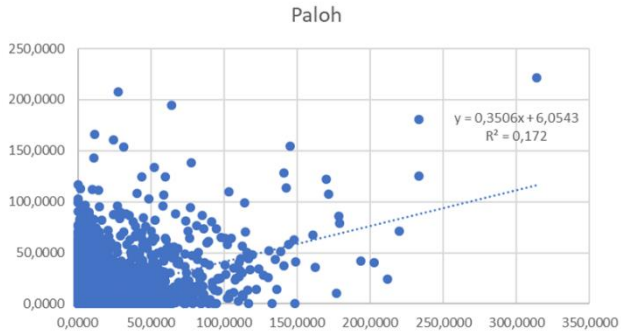

Figure 2. Daily Cumulative Paloh Station Linear Regression Graph

The results of the regression analysis show that the coefficient of determination or ability of a regression function can model the value of BMKG rainfall data from TRMM rainfall data which has a very low scale. From this it can be concluded that the daily rainfall data value of TRMM can only predict the BMKG value with an accuracy rate of 0.17.

3.2. Monthly Data

The results of the correlation analysis of BMKG rainfall data on TRMM rainfall data with cumulative 30 daily rainfall data are presented in Table 2 as follows:

Table 2. Correlation Value of 30 Daily Data

Rainfall	Coefficient of Correlation
Nangapinoh	0,7659
Paloh	0,8284
Pangsuma	0,3585
Rahadi Oesman	0,3918
Siantan	0,6855
Supadio	0,6855
Susilo	0,7150

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From the results of the correlation analysis, it shows that the correlation value which shows success is much better than the daily cumulative correlation value. The results of the 30-day cumulative correlation analysis have a low scale with a value of 0.35 – 0.82. The next data is a graphical comparison of rainfall data presented as follows (Figures 3) :

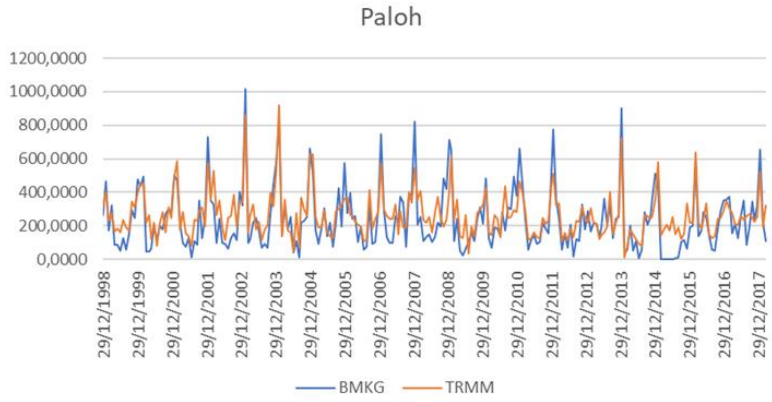

Figure 3. Comparison of 30-Day Paloh Station Rain Data

From the results of the comparison of the data graphs, it can be stated that the values of the BMKG and TRMM rainfall data have the same pattern, but the maximum value of the BMKG rainfall data has a higher tendency than the TRMM data. So this is considered to affect the 30 daily correlation value between BMKG and TRMM. The next analysis is Linear Regression analysi are presented as follows (Figure 4). From the results of the analysis that has been produced, it is stated that the coefficient of determination or the model's ability to predict BMKG rainfall data is with a value of 0.68 with a low to very high scale.

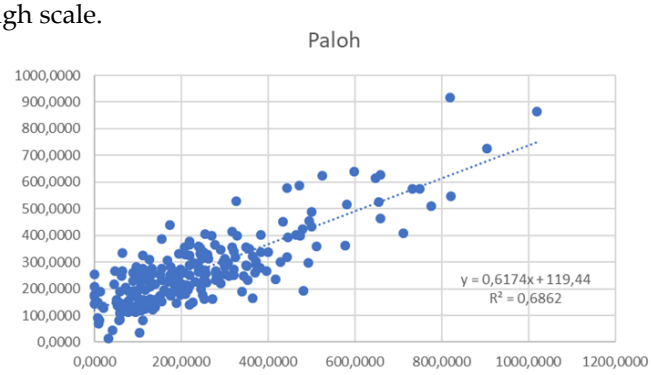

Figure 4. Linear Regression Graph Paloh Station Cumulative 30 Days

3.3. Annual Data

The results of the correlation analysis of BMKG rainfall data against TRMM rainfall data with cumulative annual rainfall data are presented in Table 3 as follows:

Table 3. Annual Data Correlation Value

Rainfall Station	Coefficient of Correlation
Nangapinoh	0,8865
Paloh	0,8811
Pangsuma	0,7017
Rahadi Oesman	0,6609
Siantan	0,9092
Supadio	0,8435
Susilo	0,8784

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From the results of the correlation analysis, it shows that the correlation value which shows success is much better than the daily cumulative correlation value. The results of the annual cumulative correlation analysis have a low scale with a value of 0.661-0.909. So it is stated that the value of the results of the annual correlation analysis is much better than the results of the daily cumulative value. A comparison of the graphs of rainfall data is presented as follows (figures 5):

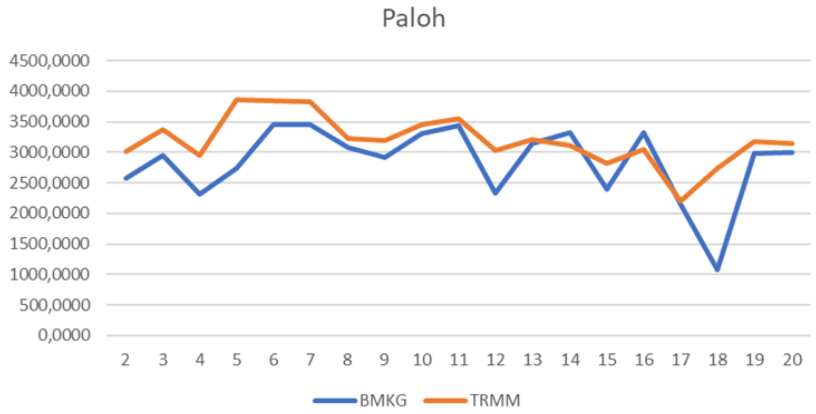

Figure 5. Comparison of Annual Paloh Station Rainfall Data

From the results of the comparison of the data graphs, it can be stated that the values of the BMKG and TRMM rainfall data have the same pattern, but the maximum value of the BMKG rainfall data has a higher tendency than the TRMM data. So this is considered to be able to affect the value of the Annual correlation between BMKG and TRMM.

The next analysis is Linear Regression analysis. This analysis was conducted to see how big the relationship between the two rainfall data was between the BMKG data and the TRMM data. The results of the Linear Regression analysis are presented as follows:

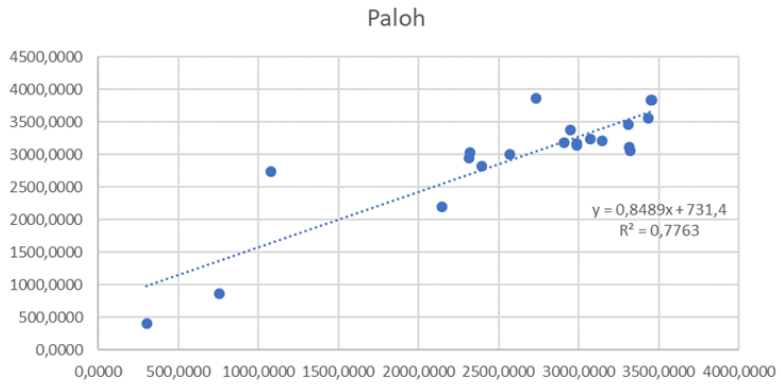

Figure 6. Annual Cumulative Paloh Station Linear Regression Graph

From the results of the analysis that has been produced, it is stated that the coefficient of determination or the model's ability to predict BMKG rainfall data is with a value of 0.77 with a high scale. To strengthen a conclusion in a study, it is considered necessary to compare the results of this study with the results of previous studies that have been carried out.

Through the results of the analysis and observations in this study, there is a similar pattern of the level of correlation between the BMKG and TRMM rainfall data, namely the correlation level at the higher rainfall level results in a very high correlation level. In this study, the density level in the annual rainfall data increases the correlation between BMKG and TRMM rainfall data is very high, ranging from 0.661-0.909 [3-5]. The pattern of the same level of correlation can be seen in the comparison chart which can be described in the following figures (fig. 7, fig. 8, and fig. 9).

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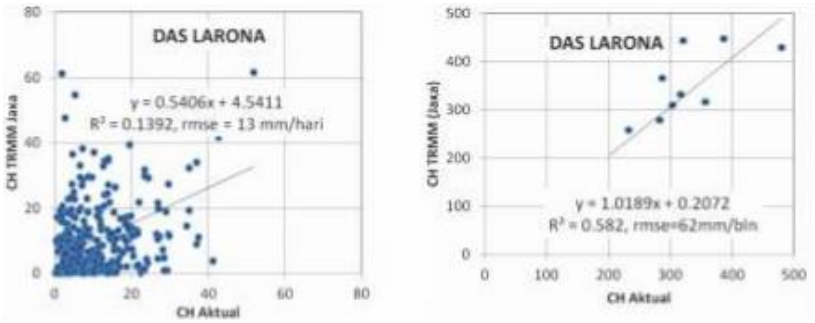

Figure 7. Correlation of TRMM rainfall data for daily (left) and monthly (right)

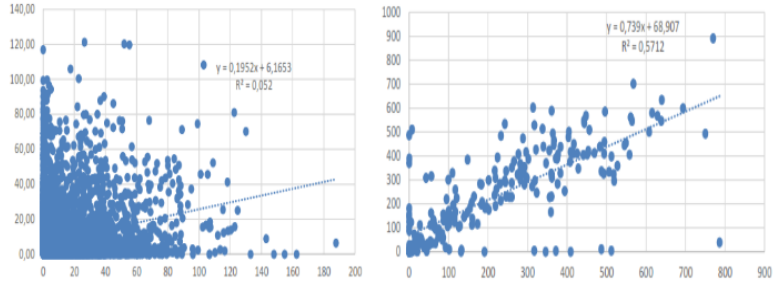

Figure 8. Correlation of BMKG and TRMM data for daily rainfall (left) and monthly (right)

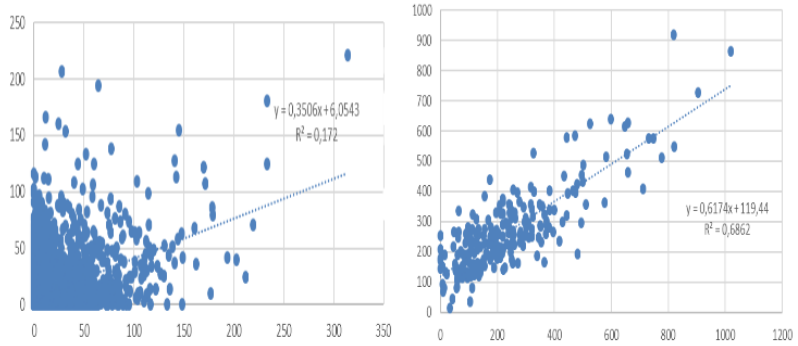

Figure 9. Correlation of BMKG and TRMM data for daily rainfall (left) and monthly (right)

4. Conclusions

The results of the analysis carried out are that the greater the rainfall, the greater the correlation between BMKG and TRMM. it is expressed as the highest value basically with 0.66 - 0.90, to create 30 daily is 0.35 – 0.82 and created daily with value 0.06 – 0.47. The Paloh rain station in the artwork has a moderate correlation. So it can be stated that this station has a good correlation value. The results of the analysis of 30 daily and annual rainfall data have a better correlation, this is very helpful considering the large amount of rainfall to collect missing rainfall data in daily rainfall data. Based on this, the TRMM rainfall data is considered feasible to fill in the missing rainfall data at the BMKG.

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