Evaluation of GSMaP Satellite Rainfall Dataset in Jakarta, Indonesia

○Bambang PRIYAMBODHO(Toyama Prefectural University)
Shuichi KURE (Toyama Prefectural University)

1. Introduction

Jakarta, as a capital city of Indonesia, is located in the western part of Java. The city is considered as one of the most vulnerable cities to climate-related disasters and has experienced many floods in the past. It is important for Jakarta to develop a real time flood forecasting system in order to prepare the flood event with some lead times. In this study, we analyzed satellite rainfall dataset (GSMaP) and compared satellite and ground station rainfall.

2. Study Area

Jakarta is located in West Java, Indonesia and total covering in this study area is 1,346.6 km^2 includes the Jakarta city. There are 13 main rivers flowing through the region. and the longest one is Ciliwung River as shown in **Figure 1**. Five rainfall stations were located in this study area.

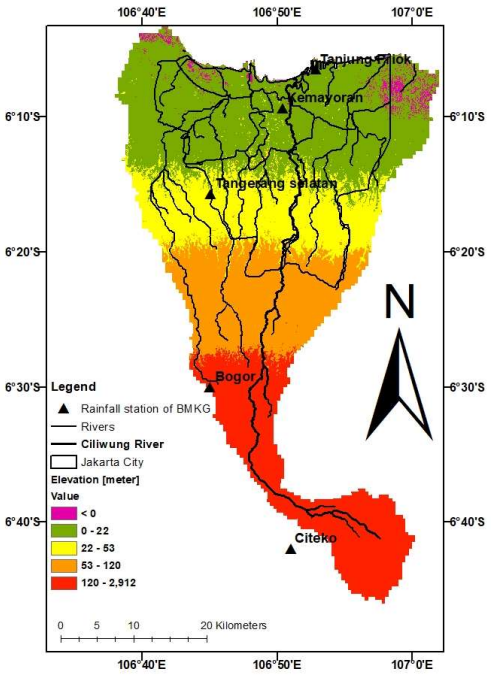

Fig. 1 Study Area

3. Dataset

1) GSMaP rainfall data

The GSMaP project was implemented in 2002 to develop rainfall rate retrieval algorithms and produce high-resolution global precipitation maps based on satellite data.[1)] GSMaP products were distributed by Japan Aerospace Exploration Agency (JAXA) Global Rainfall Watch. In this study, we evaluated GSMaP products (NRT, MVK ang Gauge). The data were compared with ground observation data. GSMaP MVK is a reanalysis of GSMaP NRT, and has a resolution of 0.1°/1 h with a domain covering 60°N to 60°S. GSMaP gauge is a gauge-calibrated rainfall product.

2) Ground observation

Hourly rainfall data for the target area were obtained from BMKG. We evaluated uncertainties in hourly satellite precipitation data from the Citeko (Bogor), Darmaga (Bogor), Pondok Betung (Tangerang), Kemayoran (Jakarta), and Tanjung Priok (Jakarta) stations, for January and February in 2015–2018.

4. Results

We compared the accuracy of the GSMaP products and observation rainfall data in the study area. Statistical validation methods used as evaluation indexes included RMSE and CC; these were employed to measure the correspondence between GSMaP and observation rainfall data. RMSE was used to compare the amount of error between the GSMaP and observation datasets, while CC represents the correlation between the data sets.

As an example, **Figure 2** compares the GSMaP gauge and hourly observation rainfall data in

January and February, 2015, for Kemayoran station. The timing of the GSMaP NRT and observation rainfall data were relatively matched well. However, this comparison is the best case in the all comparisons. **Table 1** shows that the accuracy of the NRT, MVK and gauge dataset. It can be seen from the table, the accuracy was still not particularly high, so bias correction of the GSMaP data will be necessary before using them as input data in the flood inundation simulations. These bias correction and flood inundation simulations will be conducted in the near future.

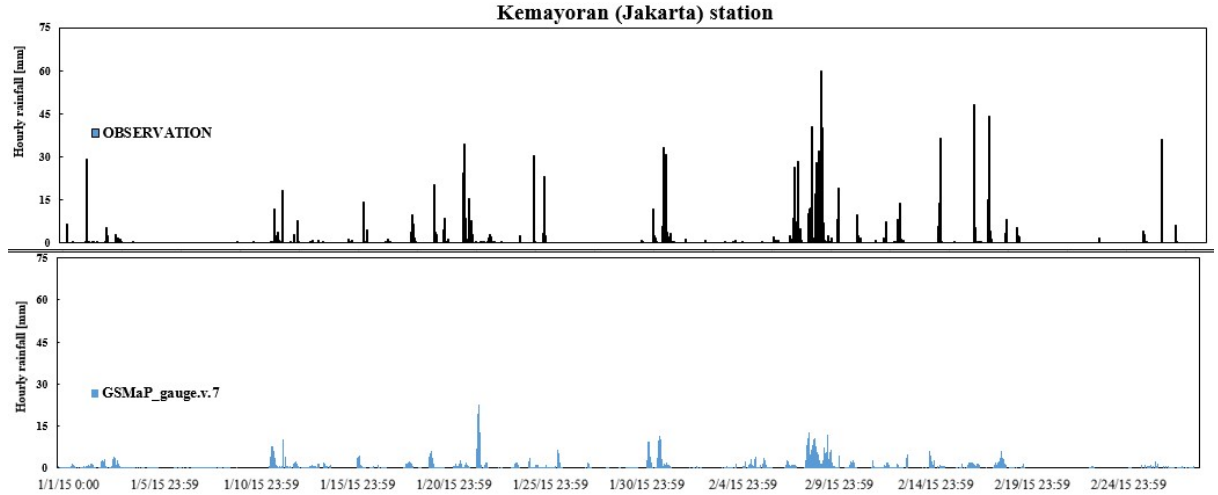

Fig. 2 Comparison of hourly precipitation between GSMaP gauge.v7 and observation

Table 1. Root Mean Square Error (RMSE) and correlation coefficients of Hourly rainfall data of GSMaP

Period	Station	GSMaP NRT.v6		GSMaP NRT.v7		GSMaP MVK.v7		GSMaP gauge.v7	
		RMSE (mm)	Correlation coefficients (CCs)	RMSE (mm)	Correlation coefficients (CCs)	RMSE (mm)	Correlation coefficients (CCs)	RMSE (mm)	Correlation coefficients (CCs)
January - February 2015	Citeko (Bogor)	3.805	0.058	-	-	4.305	0.041	2.852	0.093
	Darmaga (Bogor)	3.040	0.069	-	-	3.539	0.001	2.761	0.037
	Pondok Betung (Tangerang)	4.848	0.002	-	-	5.386	0.001	4.247	0.041
	Kemayoran (Jakarta)	4.394	0.321	-	-	4.880	0.124	4.338	0.348
	Tanjung Priok (Jakarta)	4.450	0.273	-	-	4.362	0.350	4.322	0.342
January - February 2016	Citeko (Bogor)	3.835	0.000	-	-	3.815	0.069	3.349	0.109
	Darmaga (Bogor)	4.705	0.069	-	-	4.838	0.084	4.576	0.036
	Pondok Betung (Tangerang)	2.977	0.022	-	-	3.288	0.029	2.474	0.047
	Kemayoran (Jakarta)	1.754	0.332	-	-	1.625	0.417	1.565	0.359
	Tanjung Priok (Jakarta)	2.459	0.365	-	-	2.725	0.385	2.141	0.367
January - February 2017	Citeko (Bogor)	3.360	0.016	-	-	3.344	0.017	3.061	-0.008
	Darmaga (Bogor)	4.230	-0.012	-	-	4.224	-0.011	3.011	-0.003
	Pondok Betung (Tangerang)	3.050	0.008	-	-	3.317	-0.012	2.477	-0.007
	Kemayoran (Jakarta)	2.468	0.155	-	-	2.699	0.172	2.225	0.252
	Tanjung Priok (Jakarta)	3.999	0.087	-	-	4.046	0.113	3.827	0.092
January - February 2018	Citeko (Bogor)	3.457	-0.016	3.432	-0.023	3.415	-0.006	3.355	0.040
	Darmaga (Bogor)	2.401	0.027	2.348	0.040	2.378	0.057	2.544	0.082
	Pondok Betung (Tangerang)	1.936	-0.009	2.101	-0.009	2.020	-0.010	1.905	0.023
	Kemayoran (Jakarta)	1.731	-0.009	1.877	-0.002	1.863	-0.002	1.816	0.007
	Tanjung Priok (Jakarta)	2.973	-0.015	3.153	-0.012	3.332	-0.008	2.827	0.004

Acknowledgments

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References

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Key Words: Jakarta, Indonesia, GSMaP