Application of GSMaP Product for Monitoring Rainfall Condition of Flood Events over Medan City, Indonesia

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Abstract

Flood is the most prevalent threatening disaster in Indonesia. One of the main causes of flood is rainfall. Urban area, such as Medan City has susceptibility due to flooding. Deli and Percut River across Medan City experienced frequent flooding due to small river flow capacity. Monitoring of rainfall is of fundamental essential in terms of flood disaster mitigation and early warning. Ground-based rain gauge is a conventional device to measure rainfall amount and considered as a point measurement. Satellite-based rainfall provides complement measurement over wide area having few or even no in situ data. The main objective of this study is to evaluate applicability of GSMaP product for monitoring rainfall condition of flood events in Medan City. In this study, we used GSMaP_MVK product and rain gauge data as a benchmark. The rain gauge data are derived from Polonia station. Three-hourly and daily rain gauge data were utilised for comparison with satellite data. We used 11 flood events data (from 2003 to 2010) over Medan City for analysis. Rainfall data of 10 days preceding and 2 days following flood events are considered in the analysis. We perform graphical comparison of rain intensity variations and utilise statistical indices to verify accuracy of the GSMaP_MVK product compared with rain gauge data. The statistical indices include continuous statistics (i.e. ME, MAE, RMSE and correlation coefficient) and categorical verification statistics (i.e. POD, FAR and TS). The results show that GSMaP_MVK product tends to underestimate against rain gauge data as indicated by negative value of ME. The MAE, RMSE and correlation coefficient are 0.65 (0.36), 1.76 (0.58), 0.31 (0.71) for 3-hourly (daily) data, respectively. While the POD, FAR and TS are 0.73 (0.97), 0.64 (0.42), 0.31 (0.58) for 3-hourly (daily) data, respectively. From the results, we can see that MAE and RMSE decrease as time step of accumulation increase from 3-hourly to daily, while correlation coefficient shows conversely. This is due to longer time of accumulation results in minimising detection of rainfall events fluctuation, thus normalise the errors. Shorter time step of accumulation capture higher variability of the rainfall events. The underestimation of GSMaP_MVK estimates might be due to its inherent bias and random errors that caused by several factors, such as sampling frequency, the diurnal cycle of rainfall, the non-uniform field of view of sensors and uncertainty of retrieval algorithm over coastal and non-coastal region (Adeyewa and Nakamura, 2003). There are also uncertainties of rain gauge itself that might be due to bias and random errors of the instrument and measurement. GSMaP product offers promising potentiality for the application of monitoring rainfall condition of flood events in Medan City.

Keyword: rainfall, flood, GSMaP, accuracy.