

Precipitation Extremes Monitoring using Global Satellite Mapping of Precipitation (GSMaP) Product

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Natural hazards caused by weather and climate tend to increase in recent years, and it is recognized that there is a need to better utilize and improve the monitoring of extreme weather and climate events from space. Recently, satellite-based precipitation datasets have been developed to achieve higher spatial and temporal resolutions using combined data from passive microwave (PMW) sensors in low Earth orbit and infrared (IR) radiometers in geostationary Earth orbit. Global Satellite Mapping of Precipitation (GSMaP) is a blended PMW-IR precipitation product and has been developed in Japan for the Global Precipitation Measurement (GPM) mission. In this study, detections of drought and heavy precipitation events are examined using standardised precipitation index (SPI) and a statistical value, to demonstrate a capability of the GSMaP. Such efforts will contribute to precipitation extremes monitoring activities using satellite data, such as the World Meteorological Organization (WMO) Space-based Weather and Climate Extremes Monitoring Demonstration Project (SEMDP) with focus on monitoring drought and heavy precipitation in countries of the South-East Asia and the Pacific.

In this study, GSMaP Near-real-time Gauge-adjusted Rainfall Product (GSMaP_Gauge_NRT) for algorithm version 6 is used. This product is adjusted using an optimization model with parameters calculated from data during the past 30 days. As for weather and climate extremes, here it is defined as an extreme precipitation, when a mean rainfall for a specified period is higher than a threshold based on the percentiles (ex. 95th, 99th percentile). Whereas, drought is diagnosed based on SPI over 1, 2 and 3 months. Percentiles and SPI are calculated in 0.1x0.1 grid at lat/lon resolution from the dataset during 18 years from April 2000 to March 2018. To demonstrate feasibilities of GSMaP_Gauge_NRT (v6) for climate extremes monitoring, we evaluated past cases of drought and heavy rainfall.

The first case is drought in south-eastern Australia during July-September 2007. A drought area where 3-month SPI is less than -1.2 spreads widely around the south of Australia. The detected drought area is roughly consistent with an area above 9th decile (Very Much Below Average) shown by the Bureau of Meteorology (BoM) in Australia. However, because there are few rain gauges in Western Australia's eastern part, distributions between both are different. The second case is heavy rainfall events in western and eastern Australia in December 2010. Monthly mean precipitation exceeds 95th percentile in western and eastern Australia. These detected heavy rainfall area roughly corresponds to an area below 2nd decile (Very Much Above Average) shown by the BoM. The last case is heavy rainfall events in Malay Peninsula in December 2014, which extreme rainfall caused widespread flooding over Thailand and the east coast of Peninsular Malaysia. Time-fluctuation of GSMaP_Gauge_NRT (v6) daily precipitation averaged over these areas is roughly in good agreement with that of CPC Gauge Analysis. A series of heavy rainfall events beginning on 14 December 2014 can be confirmed from space-based observations. Especially, pentad precipitation for 22-26 December 2014, is higher than 99th percentile over large portion of Peninsular Malaysia. Actually, floods caused by heavy rain hit in this area.

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