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TRMM Applications for Rainfall-Induced Landslide Early Warning

A. Dok (1,2), H. Fukuoka (2), and Y. Hong (3)

(1) Kyoto University, Disaster Prevention Research Institute, Reseach Center on Landslides, Kyoto, Japan (atitkagna.dok@gmail.com), (2) Kyoto University, Disaster Prevention Research Institute, Reseach Center on Landslides, Kyoto, Japan (fukuoka@scl.kyoto-u.ac.jp), (3) The University of Oklahoma, Norman, OK, USA

Early warning system (EWS) is the most effective method in saving lives and reducing property damages resulted from the catastrophic landslides if properly implemented in populated areas of landslide-prone nations. For predicting the occurrence of landslides, it requires examination of empirical relationship between rainfall characteristics and past landslide occurrence. In developed countries like Japan and the US, precipitation is monitored by rain radars and ground-based rain gauge matrix. However, in developing regions like Southeast Asian countries, very limited number of rain gauges is available, and there is no implemented methodology for issuing effective warming of landslides yet. Correspondingly, satellite precipitation monitoring could be therefore a possible and promising solution for launching landslide quasi-real-time early warning system in those countries. It is due to the fact that TMPA (TRMM Multi-satellite Precipitation Analysis) can provides a globally calibration-based sequential scheme for combining precipitation estimates from multiple satellites, and gauge analyses where feasible, at fine scales (3-hourly with 0.25°x0.25° spatial resolution). It is available both after and in quasi-real time, calibrated by TRMM Combined Instrument and TRMM Microwave Imager precipitation product. However, validation of ground based rain gauge and TRMM satellite data in the vulnerable regions is still not yet operative. Snake-line/Critical-line and Soil Water Index (SWI) are used for issuing warning of landslide occurrence in Japan; whereas, Caine criterion is preferable in Europe and western nations.
Herewith, it presents rainfall behavior which took place in Beichuan city (located on the 2008 Chinese Wenchuan earthquake fault), Hofu and Shobara cities in Japan where localized heavy rainfall attacked in 2009 and 2010, respectively, from TRMM 3B42RT correlated with ground based rain gauge data. The 1-day rainfall intensity and 15-day cumulative rainfall (snake line) were independently plotted to investigate the impact of short-term rainfall intensity and accumulated effective rainfall volume respectively for obtaining some probabilistic threshold. Japanese SWI was also tested to distribute threshold regarding to highly nonlinear rainfall patterns in predicting the landslide occurrence through the plot of total water of 3 serial tank models and daily precipitation.
As a result, the snake line plots using TMPA work well for landslide warning in the selected cities; while SWI plots shows unusual peak value on the day of the debris flow occurrence. Graph of daily precipitation vs SWI implies possible zone of critical line, and second peak appearance 1 day before, indicating possibility of early warning.