Effects and extent of pyroclastic and lahar deposits of the 2010 Merapi eruption in one active catchment analyzed from HSR imagery

Akhmad Solikhin[1], Jean-Claude Thouret[2], Jean-François Oehler[3], Avijit Gupta[4], Dewi Sri Sayudi[1], Soo Chin Liew[5]

[1]Center for Volcanology and Geological Hazard Mitigation, Indonesia, [2]Université Blaise Pascal, Laboratoire Magmas et Volcans, France, [3]Altran Ouest, Technopôle Brest Iroise, France, [4]University of Wollongong, Australia, [5]Centre for Remote Imaging, Sensing and Processing, National University of Singapore, Singapore

E-mail: aksolikhin@vsi.esdm.go.id

The 26 October-23 November 2010, eruption is Merapi's largest event (VEI 4) over the past 140 years. We assessed the extent and effects of the deposits from pyroclastic density currents (PDCs) and lahars from this eruption, using high-spatial-resolution (HSR) imagery (from GeoEye and SPOT-5 satellites). We have mapped PDC deposits in particular the longest pyroclastic flows and most widespread pyroclastic surges across the Gendol-Opak catchment on the Merapi's south flank. We investigated the relationships between the topography, the morphology of the river channel, and the apparent behavior of the PDCs, as deduced from over-banking processes. We show that HSR imagery enables mapping with unprecedented detail the effects of the 2010 eruption across the most devastated catchment on Merapi.

The 2010 pyroclastic deposits cover an area of ~27 km^2 in the Gendol-Opak catchment, i.e. 35% of the total deposit area. From observed thickness of deposits in the field, we estimate the volume of PDCs mantling the south flank to range between 62 and 82 million m^3 i.e. about 70% of the entire volume of 2010 PDC on Merapi. We analyze how unconfined PDCs with over-bank and veneer facies, as well as two types of surges have mantled widespread areas on both sides of the Gendol valley which contain the confined PDC deposits. Geometric and geomorphic characteristics that allow over bank and veneer deposits beyond the main valley are: limited cross-sectional areas under 1500 m^2 and the decreasing longitudinal rate of channel confinement. Subsequent lahars six months after the eruption have devastated several villages along the Gendol River 20 km from the summit on the ring plain where 66 houses in an area 0.16 km^2 were destroyed and led to the evacuation of 300 people. Small areas down-valley was affected by over-bank lahars once pyroclastic deposits were remobilized 3.8 km farther than the PDC front. The over-bank and avulsed lahars can be attributed to low-gradient (0.04 m/m), meandering river (sinuosity index of 1.25) across the lowest-angle (<2°) ring plain and the limited capacity (200-300 m^2) of river channels. Lahars now threaten the area of the iconic Prambanan temple farther down the Opak River.