Geophysical Research Abstracts
Vol. 12, EGU2010-7877, 2010
EGU General Assembly 2010

Analysis of the 2006 block-and-ash flow deposits of Merapi Volcano, Java, Indonesia, using high-spatial resolution IKONOS images and complementary ground based observations

Jean-Claude Thouret (1), Avijit Gupta (2), Soo Chin Liew (3), Gert Lube (4), Shane J. Cronin (4), and Dr Surono (5)

(1) PRES Clermont Université, Université Blaise-Pascal, CNRS UMR6524, Laboratoire Magmas et Volcans, Clermont-Ferrand, France (thouret@opgc.univ-bpclermont.fr), (2) School of Geography, Faculty of Environment, University of Leeds, Leeds LS2 9JT, United Kingdom (avijit@foxhill.demon.co.uk, (3) Centre for Remote Imaging Sensing and Processing (CRISP), National University of Singapore (NUS), Blk SOC1 Level 2, Lower Kent Ridge Road, Singapore 119260 (scliew@nus.edu.sg , (4) Volcanic Risk Solution, Institute of Natural Resources, Massey University, Private Bag 11222, Palmerston North, New Zealand (S.J.Cronin@massey.ac.nz) , (5) CVGHM Center of Volcanology and Geologic Hazard Mitigation, Jalan Diponogero, Bandung, Java, Indonesia (surono@vsi.esdm.go.id)

On 16 June 2006 an overpass of IKONOS coincided with the emplacement of an active block-and-ash flow fed by a lava dome collapse event at Merapi Volcano (Java, Indonesia). This was the first satellite image recorded for a moving pyroclastic flow. The very high-spatial resolution data displayed the extent and impact of the pyroclastic deposits emplaced during and prior to, the day of image acquisition. This allowed a number of features associated with high-hazard block-and-ash flows emplaced in narrow, deep gorges to be mapped, interpreted and understood. The block-and-ash flow and surge deposits recognized in the Ikonos images include: (1) several channel-confined flow lobes and tongues in the box-shaped valley; (2) thin ash-cloud surge deposit and knocked-down trees in constricted areas on both slopes of the gorge; (3) fan-like over bank deposits on the Gendol-Tlogo interfluves from which flows were re-routed in the Tlogo secondary valley; (4) massive over bank lobes on the right bank from which flows devastated the village of Kaliadem 0.5 km from the main channel, a small part of this flow being re-channeled in the Opak secondary valley.

The high-resolution IKONOS images also helped us to identify geomorphic obstacles that enabled flows to ramp and spill out from the sinuous channel, a process called flow avulsion. Importantly, the avulsion redirected flows to unexpected areas away from the main channel. In the case of Merapi we see that the presence of valley fill by previous deposits, bends and man-made dams influence the otherwise valley-guided course of the flows. Sadly, Sabo dams (built to ameliorate the effect of high sediment load streams) can actually cause block-and-ash flows to jump out of their containing channel and advance into sensitive areas.

Very-high-spatial resolution satellite images are very useful for mapping and interpreting the distribution of freshly erupted volcanic deposits. IKONOS-type images with 1-m resolution provide opportunities to study and map the meter-scale detail of volcanic deposits. When such high-spatial-resolution satellite remote sensing data are combined with in situ field work, geomorphic analyses can be applied that allow us to more fully understand the dynamics and hazards of eruptions. In the case given here, IKONOS imagery allowed two qualitative hazard assessments for block-and-ash flow activity in drainages around Merapi.

Firstly, the interpretation of IKONOS images provides insights in factors that control the propagation of secondary flows as the avulsion of the main flows is driven by longitudinal change in channel capacity due to increased sinuosity in the valley and decreased containment space. Secondly, the sinuosity and obstacles (including Sabo dams) may create over bank flows over adjacent low relief, allowing them to reach unexpectedly vulnerable areas distant from an active dome and away from the volcanically active valleys. Hazard assessment should therefore consider the geometry of secondary channels outside the principal valleys.