Pyroclastic flow and lahar hazards in populous, developing regions: Integrated TIR and SAR data analysis

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Using both thermal infrared (e.g., ASTER and Landsat) and radar sensors (e.g., RADARSAT-2 and TerraSAR-X) there is an opportunity to forecast future explosive volcanic activity in highly populated, developing countries. The research proposed here will refine models of surface composition and roughness on existing pyroclastic flow and lahar deposits at Merapi volcano in Indonesia and Shiveluch volcano in Russia. Each volcano has had numerous eruptions in the past decade that have produced many sizes and styles of flow deposits. It is hypothesized that through testing current remote sensing methods on these deposits, future eruptions can be better constrained at other volcanoes in different climates. Reduction of risk to people and property can be achieved by quantifying volcaniclastic and pyroclastic deposit pre-eruptive magma composition and crystal content, and volatile content and degassing conditions through deposit surface roughness. These conditions give insight to the magma system evolution, and future eruption style to aid in disaster management and decision-making (using digital elevation models combined with the results of the flow surface data modeling). Compositional data and crystal content will be derived using satellite thermal infrared spectral deconvolution methods described by Ramsey and Christensen (1998). Micron-scale surface roughness will be quantified by improving the vesicularity model developed by Ramsey and Fink (1999) using a two-component spectral deconvolution model applied to thermal infrared wavelengths. These results will be extended to larger morphology and block size measurements derived from radar (SAR) and thermal inertia data of the same flows and subsequently compared to previous ground and lab based studies of these deposits. This research aims to improve remote sensing modeling of explosive eruptions by also testing in humid climates with high cloud cover, increased vegetation, and commonly increased populations in harm's way. The data produced by this research will therefore be linked to past volcanic activity, and then incorporated with topographical data for volcanic hazard application to assess risk to local populations.