Oblique photogrammetry to measure lava volumes and extrusion rates

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Measurements of the volume and rate of growth of active lava flows and domes are key parameters of volcano monitoring. Often such measurements are hard to obtain quickly during eruptions due to hazardous conditions, lack of resources, or time constraints. Oblique photogrammetry is a powerful tool for monitoring volcanoes and characterizing topographic change, which provides an advantage of near-field remote sensing when conditions are unsafe. Traditionally, photogrammetry has been limited in versatility, due to the intensive data acquisition and processing needed to achieve high accuracy. However, considerable improvements in camera technology and photogrammetry software have dramatically reduced acquisition and processing time, and have moved oblique photogrammetry to a near real-time monitoring technique. Oblique photogrammetry provides a cost-effective means of producing topographic models, by utilizing imagery from standard digital cameras and by processing models using consumer grade software. From manual interpretation to automated pixel matching algorithms, oblique photogrammetry has proven successful at providing critical data during both routine monitoring and crisis response in varying conditions and types of eruptions. We present results from oblique photogrammetry surveys at Mount St. Helens, Redoubt Volcano, Kilauea Volcano (all USA), and Chaiten Volcano, Chile and discuss the practical strengths and weaknesses of this method, challenges encountered during each application, and suggested improvements for future surveys. The motivation behind improving our ability to measure the rate of lava extrusion is to better understand eruption dynamics, and particularly during lava dome effusion, to constrain the volume of potential collapsible material and measure effusion rate changes that may signify a transition from effusive to explosive activity.