

Measuring changes to evolving crater morphology at Kelud volcano, Indonesia: 1963-2016 using historical topographic data and UAS photogrammetry

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Kelud volcano, East Java, has produced some of Indonesia's deadliest eruptions. The expulsion of water from the summit crater lake during the volcano's typically short explosive eruptions has created lahars that have caused widespread fatalities and destruction. Following a devastating eruption in 1919 that caused more than 5,000 fatalities, an extensive engineering project began to drain the crater lake via tunnels dug through the crater wall. Succeeding eruptions compromised the initial engineering project, and following the 1966 eruption that caused more than 200 fatalities, a new deeper tunnel was constructed, and the lake's volume was significantly reduced again. Kelud last erupted in 2014 with a large VEI 4 plinian eruption. The USGS/USAID-OFDA Volcano Disaster Assistance Program (VDAP) works to support the Center for Volcanology and Geological Hazard Mitigation (CVGHM) of Indonesia to mitigate volcanic hazards throughout the country. In March 2016, VDAP assisted CVGHM in conducting a small UAS photogrammetry survey of the crater of Kelud and the main outlet channel to create a high-resolution digital elevation model (DEM). The 2016 DEM has been used to estimate the current volume of the crater lake, to measure topographic changes to the crater following the 2014 eruption and to supplement LiDAR collected in 2014 to improve lahar inundation modeling downstream from the volcano. This is the second CVGHM-VDAP UAS photogrammetry project in Indonesia and this technology has shown great promise as a new tool for volcano monitoring, hazard assessment, and research. In addition to measuring changes to the crater following the last eruption in 2014, we investigate more than 50 years of morphological change within the crater of Kelud over the course of six eruptions. Historical topographic map collections were digitized and georeferenced to create a time series of volume and area changes to the crater before and after past eruptive episodes.



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