Data from Past Eruptions Could Reduce Future Volcano Hazards

Optimizing the Use of Volcano Monitoring Database to Anticipate Unrest; Yogyakarta, Indonesia, 26–29 November 2018

Java's Mount Merapi volcano (right), overlooking the city of Yogyakarta, is currently slowly extruding a dome. Mount Merbabu volcano (left) has not erupted for several centuries. Participants at a workshop last November discussed the development and use of a volcano monitoring database to assist in mitigating volcano hazards. Credit: Fidel Costa

By Fidel Costa, Christina Widiwijayanti, and Hanik Humaida 25 March 2019

In 2010, Mount Merapi volcano on the Indonesian island of Java erupted explosively—the largest such eruption in 100 years. Merapi sits only about 30 kilometers from the city of Yogyakarta, home to more than 1 million people. The 2010 eruption forced more than 390,000 people to evacuate the area,

and it caused 386 fatalities. In the past few months, the volcano has started rumbling again, and it is currently extruding a dome that is slowly growing.

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Will Merapi's rumblings continue like this, or will they turn into another large, explosive eruption (https://eos.org/project-updates/forensic-probe-of-balis-great-volcano)? Answering this question largely depends on having real-time monitoring data covering multiple parameters, including seismicity, deformation, and gas emissions. But volcanoes can show a wide range of behaviors. A volcanologist's diagnosis of what the volcano is going to do next relies largely on comparisons to previous cases and thus on the existence of an organized and searchable database of volcanic unrest.

For over a decade, the World Organization of Volcano Observatories (WOVO) has contributed to the WOVOdat (https://www.wovodat.org/) project, which has collected monitoring data (https://eos.org/project-updates/enhancing-safety-in-a-volcanos-shadow) from volcanoes worldwide. WOVOdat has grown into an open-source database that should prove very valuable during a volcanic crisis. However, there are many challenges ahead to reaching this goal:

How do we standardize and capture spatiotemporal data produced in a large variety of formats and instruments?

How do we go from multivariate (geochemical, geophysical, and geodetic) signals to statistically meaningful indicators for eruption forecasts?

How do we properly compare periods of unrest between volcanic eruptions?

Participants at an international workshop (https://wovodat.org/about/workshop2018.php) last November discussed these and other questions. The workshop was organized by the Earth Observatory of Singapore and the Center for Volcanology and Geological Hazard Mitigation in Yogyakarta. An interdisciplinary group of over 40 participants, including students and experts from more than 10 volcano observatories in Indonesia, the Philippines, Papua New Guinea, Japan, France, Italy, the Caribbean, the United States, Chile, and Singapore, gathered to share their expertise on handling volcano monitoring data, strategize on how to improve on monitoring data management, and analyze past unrest data to better anticipate future unrest and eruptions.

Participants agreed on the need for a centralized database that hosts multiparameter monitoring data sets and that allows efficient data analysis and comparison between a wide range of volcanoes and eruption styles (https://eos.org/research-spotlights/a-promising-new-tool-for-forecasting-volcanic-hazards). They proposed the following actions to optimize the development and use of a monitoring database:

develop automatic procedures for data processing, standardization, and rapid integration into a centralized database platform

develop tools for diagnosis of unrest patterns using statistical analytics and current advancement of machine learning techniques

explore different variables, including eruption styles, morphological features, eruption chronology, and unrest indicators, to define “analogue volcanoes” (classes of volcanoes that behave similarly) and “analogue unrest” for comparative studies

develop protocols to construct a short-term Bayesian event tree analysis (https://eos.org/research-spotlights/a-new-tool-to-better-forecast-volcanic-unrest) based on real-time data and historical unrest

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Volcano databases such as WOVOdat (https://www.wovodat.org/) aim to be a reference for volcanic crisis and hazard mitigation and to serve the community in much the same way that an epidemiological database serves for medicine. But the success of such endeavors requires the willingness of observatories, governments, and researchers to agree on data standardization; efficient data reduction algorithms; and, most important, data sharing to enable findable, accessible, interoperable, and reusable (FAIR (https://www.go-fair.org/fair-principles/)) data across the volcano community.

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