

Advancing volcano science and hazard mitigation with multi-parameter satellite datasets: Vision for a global volcano satellite observatory

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There are more than 60 satellites in orbit that are routinely observing volcanic activity. Satellites have detected activity at more than 411 volcanoes between 1978 and 2021 manifest as ash, thermal, and gas emissions, ground displacement, and surface and topographic change. Satellite data has greatly increased the number of volcanoes with known activity—for example, the number of volcanoes known to be deforming increased five-fold between 1997 and 2017. Satellite data are being used by volcano observatories operationally and synergistically with ground sensors to fill gaps in ground networks, evaluate noise in the ground observations, and decide alert levels. Remote sensing data complement ground monitoring but won't replace it. Technological developments are making satellite data ever more useful for volcanology, including higher spatial resolutions (less than 0.5 m/pixel), constellations of satellites and geostationary satellites reducing revisit times to hours (or even minutes), and automated processing and detection of anomalies from petabytes of data using machine learning and artificial intelligence. Yet, satellites are still not always collecting the optimal types of data at the relevant volcanoes with sufficiently high temporal and spatial sampling to facilitate eruption forecasting. We propose a vision for how the volcano remote sensing community could work together with volcano observatories, space agencies, and companies to improve the utility and uptake of satellite data by 2030. Specifically, we need (1) global coordination of background satellite observations (as done for polar regions) and eruption response, (2) open data being rapidly distributed during crises, (3) communication tools and forums for discussion of satellite data, (4) integrated ground and satellite databases of unrest, and (5) global capacity building. This contributes to the development of an integrated, international, global remote sensing geohazard monitoring effort for disaster risk management as part of the Committee on Earth Observation Satellites (CEOS) Volcano Demonstrator project.