Towards global standardization and automation in volcano monitoring: Enhancing eruption forecast, data access, and capacity building

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– in collaboration with WOVO observatories –

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HIGHILGHTS

Standardized, automated monitoring

- Automating volcano monitoring workflows is essential for reliable, efficient data processing, especially during crises to enhance early warning and timely decision-making.
- Standardized data ensures consistency, facilitates comparison with past unrest, and supports probabilistic eruption forecasting.
- This effort is driven by the development of open-source tools, fostering international collaboration and open science.

Integrated global monitoring resources

- **WOVOdat** and **GVMID** are complementary, open-access platforms that support comparative analysis, network design, and probabilistic eruption forecasting.
- This growing, collaborative database welcomes contributions from the global volcano community.

Global collaboration and capacity building

- strengthening partnerships,
- promote data sharing and usage, and
- build community capacity through training and exchanges.

WOVOdat – GLOBAL VOLCANO UNREST DATABASE

Access to WOVOdat

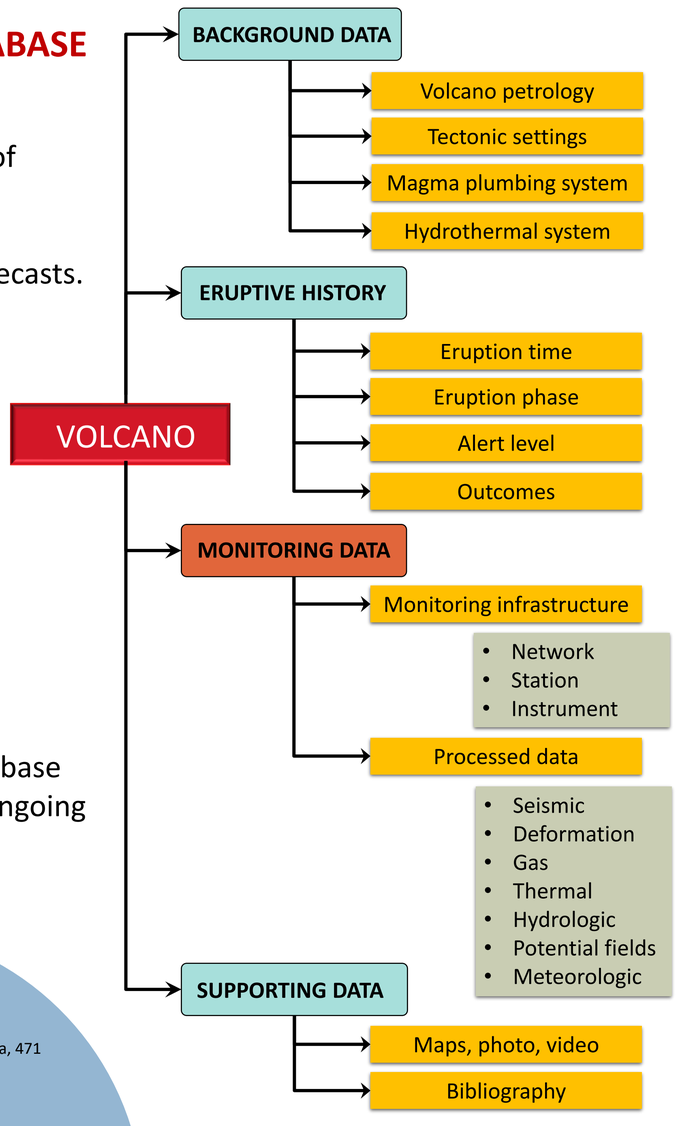
Open-access global historical volcano monitoring data, enable comparison of unrest within and across volcanoes, enhancing understanding of eruptive processes and improving eruption forecasts.

Data type and database structure

WOVOdat archives processed, time-stamped, and georeferenced monitoring data—such as earthquake events, GPS displacement, and gas emission rates—contextualised by metadata on station locations, instrument types, setup, and data processing details.

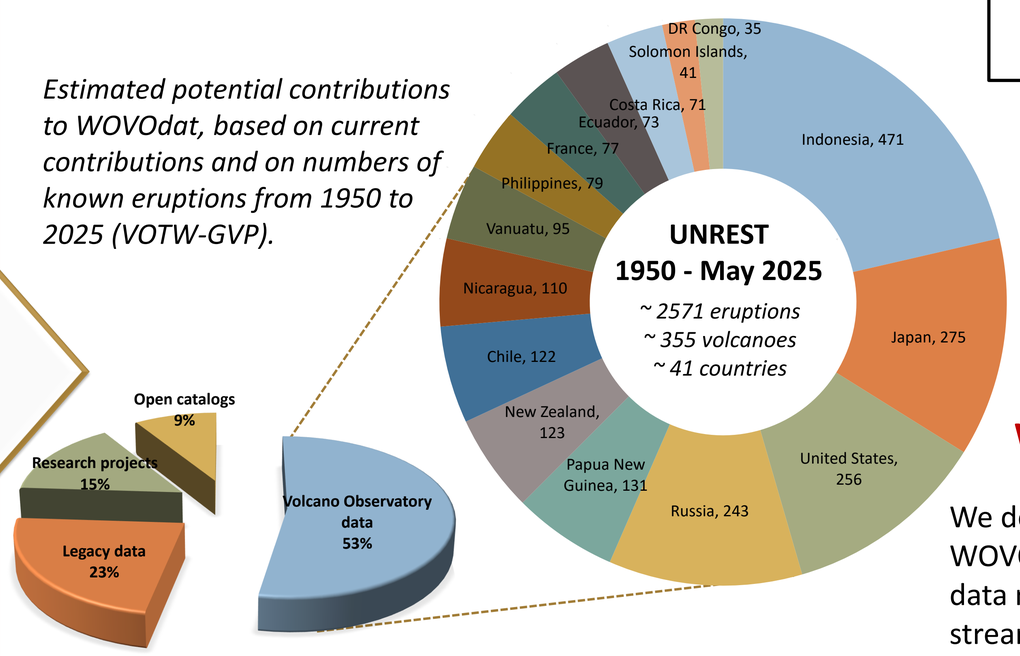
Data source

Main data contributor for WOVOdat will be volcano observatories, but we also explore data from open database and references (legacy data), as well as liaise with the ongoing research projects related to volcano monitoring.



Simplified database schema & type of data stored in the WOVOdat database.

Estimated potential contributions to WOVOdat, based on current contributions and on numbers of known eruptions from 1950 to 2025 (VOTW-GVP).



WEB SERVICE API

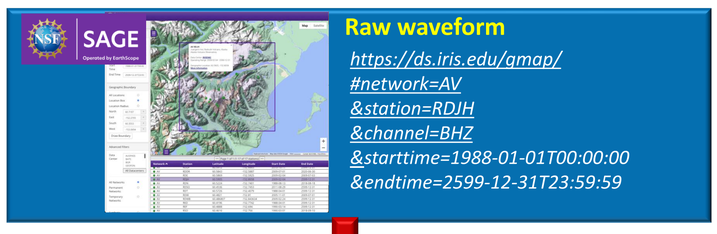
We developed the WOVOdat Web Service data retrieval system to streamline access to the database through structured queries and API integration. This tool simplifies data retrieval and enables efficient integration of large volcano datasets for further analysis.

WOVOdat Web Service Nang et al., 2025

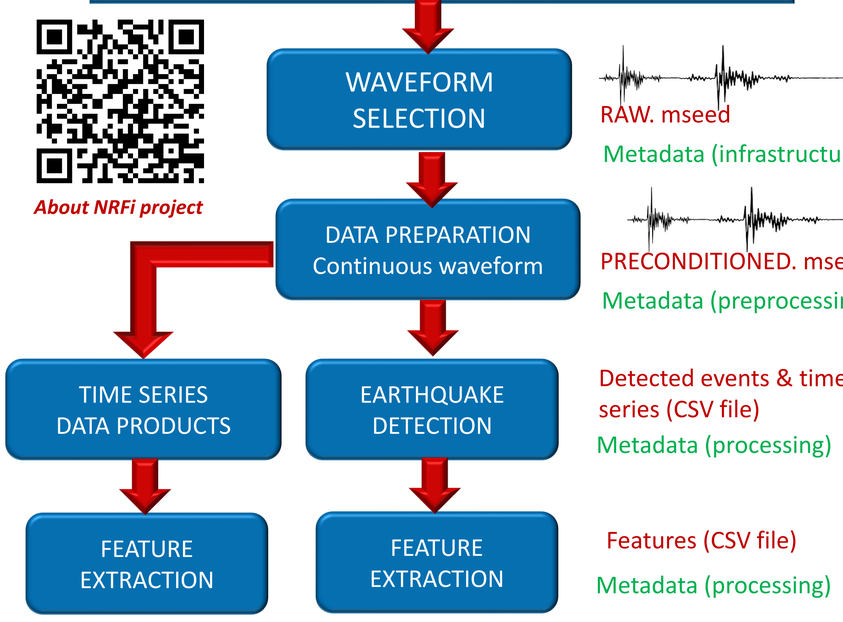
Towards standardizing and integration of the global historical volcano monitoring data for research and crisis response.

OPTIMISING DATA PROCESSING & STANDARDISING SEISMIC DATA PRODUCTS

- Develop **automated techniques** to improve early warning times for volcanic impacts.
- Establish a **standardised** models for volcano-seismic data using global seismic waveform archives.
- Create **open-source tools** and deliver training to strengthen community capacity.
- Contribute tools, data, and outcomes to the open-access plateforms, including the **WOVOdat** repository.



About NRFi project



Seismic data processing workflow

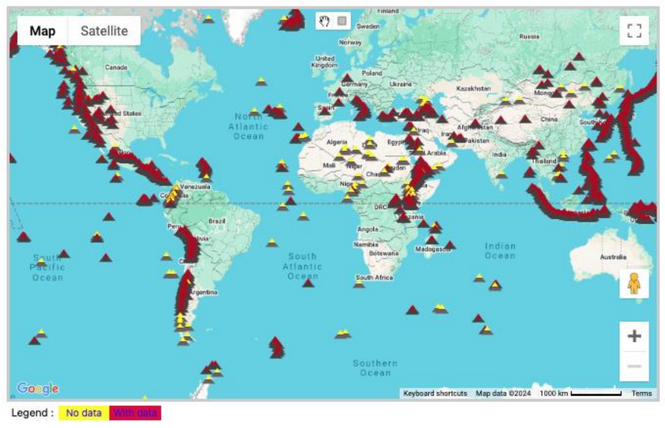
Identify seismic patterns across key volcanic activity stages—pre-eruption, eruption, and post-eruption—to track the evolution from background to unrest, eruption, and return to normal. Detect transitional seismic signatures to distinguish escalation and recovery phases, supporting improved forecasting and hazard assessment.

GVMID – GLOBAL VOLCANO MONITORING INFRASTRUCTURE DATABASE

About GVMID Widiwijayanti et al., 2024

- GVMID is integral part of WOVOdat, documents global ground- and space-based volcano monitoring infrastructure, including techniques, station types, and instrumentation.
- It provides insights to help observatories optimize network design, strengthen detection capabilities, address monitoring gaps, and integrate remote sensing and emerging technologies for improved eruption detection and early warning.

The use of GVMID Espinosa-Ortega & Taisne (2024)



Map of global Holocene volcanoes with historical unrest data in WOVOdat.

As of May 2025

- **WOVOdat** contains monitoring data from 1,477 volcanoes, including unrest records for 372 volcanoes and 2,735 eruptions.
- **GVMID** catalogs over 13,000 monitoring stations and 16,000 instruments across more than 550 volcanoes worldwide.

This growing collaborative database welcomes contributions from the global volcanology community.

Collaborating institutions, contributors, and funding agencies:

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