Global Volcano Monitoring Infrastructure Database
GVMID 1.0

USER MANUAL

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1. Introduction

The Global Volcano Monitoring Infrastructure Database (**GVMID**), is aimed at documenting and improving capabilities of volcano monitoring from the ground and space. GVMID is closely related to WOVOdat (Newhall et al., 2017; Costa et al., 2019) and WOVO (World Organization of Volcano Observatories), and presently hosted at the Earth Observatory of Singapore.

GVMID (https://wovodat.org/gvmid/home.php) should provide a snapshot and baseline view of the techniques and instrumentation that are in place at various volcanoes, which can be use by volcano observatories as reference to setup new monitoring system or improving networks at a specific volcano. These data will allow identification of what monitoring gaps exist, which can be then targeted by remote sensing infrastructure and future instrument deployments.

GVMID is being built in parallel with other volcanological databases and can be linked to WOVOdat, Smithsonian' GVP, and other database through *Volcano Number* (VNum, GVP' volcano unique identifier).

GVMID will certainly not going to duplicate the databases of individual observatories or data centers, but instead, to bring key information of the varied volcano monitoring infrastructure datasets together as community database, where they can be searched and used for various purposes as described above.

Please also note that the data stored and displayed in GVMID does not reflect the current or real-time operational volcano monitoring infrastructure and that the ownership of the data remains with the data contributors.

Volcano hazard forecasts can be improved by a comprehensive and well-designed monitoring infrastructure (e.g., Winson et al., 2014). The accurate and completeness of the information stored in GVMID rely on active participation of data contributors to input their data and their periodic updates through time. We invite active contribution from volcano community to the development of GVMID.

2. Database schema and structure

GVMID is a Database of volcano monitoring infrastructure which contains information about monitoring networks, stations, and instruments. The instruments types include those that record changes in seismicity, ground deformation, gas emission, thermal and other parameters that manifested volcanic activities.

The database is created following the structure and format as described in the WOVOdat 1.0 report of Venezky and Newhall (USGS Openfile report 2007-1117), updated in WOVOdat

2.0 (https://www.wovodat.org/doc/database/2.0/wovodat20_doc.pdf). The Data in GVMID is organized in a MySQL hierarchical relational database management system where all available instruments in a specific volcano will be linked through station and network to the "volcano" as the parent table (Figure 1).

Detail description on the technical insight of the database can be access in the *Documentation* menu. People who wish to know more about the database structure may thus use this document as a reference, where each table of the database, the fields, indexes, links and constraints are described.

Nearly all data in GVMID are time-stamped and georeferenced, so that they can be studied in both space and time.

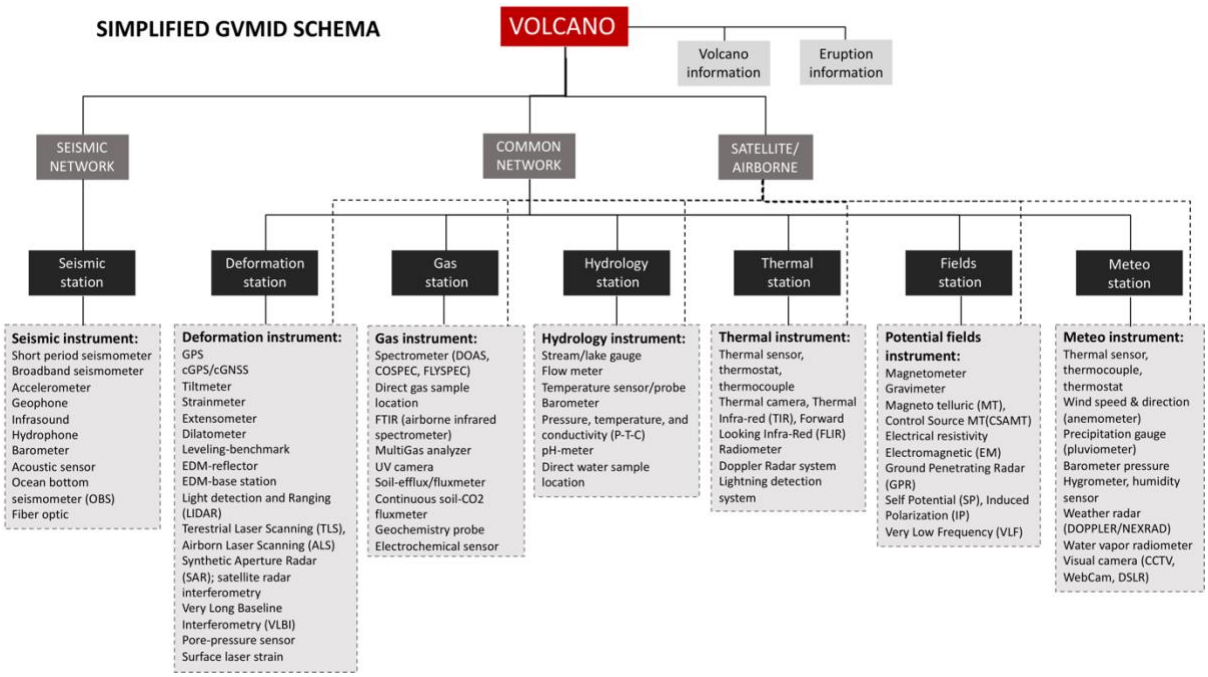

Figure 1. *Hierarchical and relational database schema of GVMID, where each volcano monitoring instrument can be linked to volcano through station and network.*

3. Submit data

GVMID database system uses xml format for its input data file. Any other data format would be converted into xml prior uploaded into the database. Once the original format is recognized, a built in script will be able to convert data into XML format to be then uploaded into MySQL database. User will require to login with their user account before upload their data, this is to record and acknowledge them as data uploader.

As anticipation of various data formats coming from different observatories, we provide interactive tools for users to submit data following an Excel template format (https://wovodat.org/populate/gvmid_input.php). The data will be converted into WOVOdat XML common formats (WOVOml), uploaded and stored in the database system.

The monitoring infrastructure metadata that can be archived in the GVMID include e.g. station location, dates of station operation, instruments, source of data (data owner/contributor, catalogue, reference), and data acquisition settings.

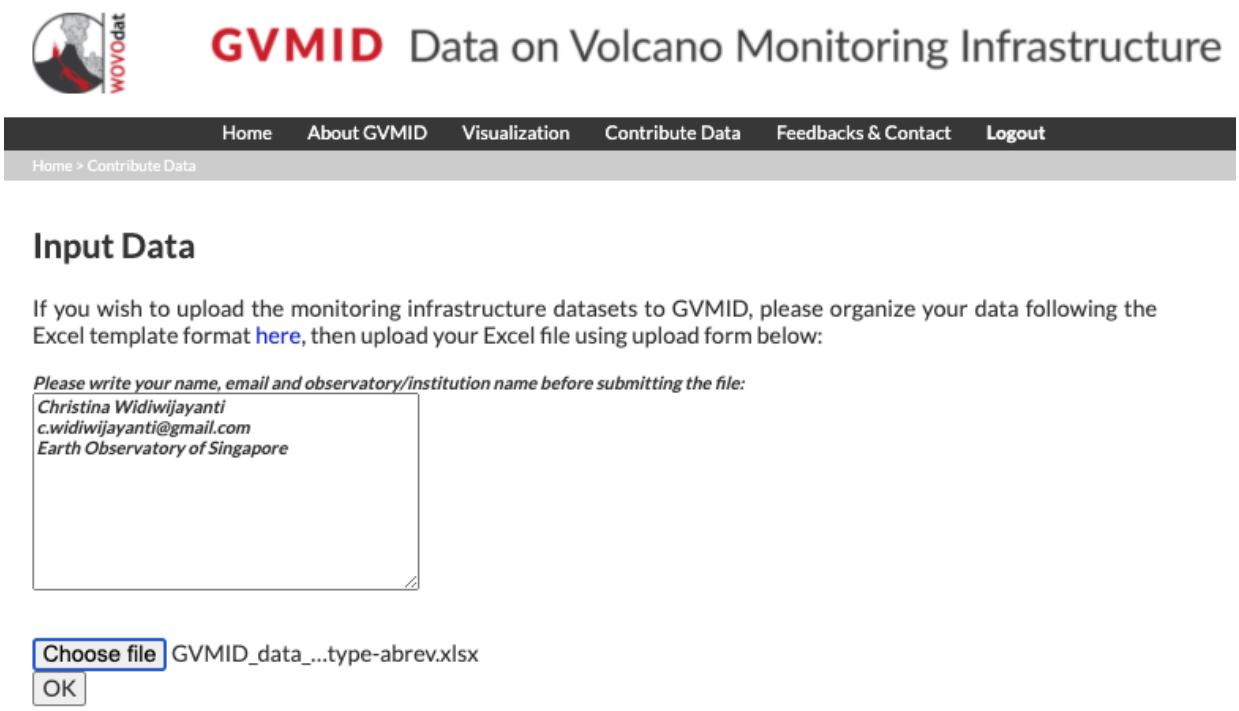

Figure 2. GVMID *interface for contributing data.*

4. Data visualization

GVMID visualization tools will help users to interactively query and view monitoring infrastructure datasets at volcanoes worldwide. Currently there are 2 type of visualization level:

(a) Worldwide volcano map (https://wovodat.org/gvmid/index.php?type=world)
Number of monitoring stations installed within 30km from each volcanic vent will be displayed in circle colours overlaid on Google map. Interactively, user can select different monitoring data types and using criteria provided in the filter panel that include time range, data source, and selected area (Figure 3). User will be directed to single volcano visualization when clicking at the volcano' icon.

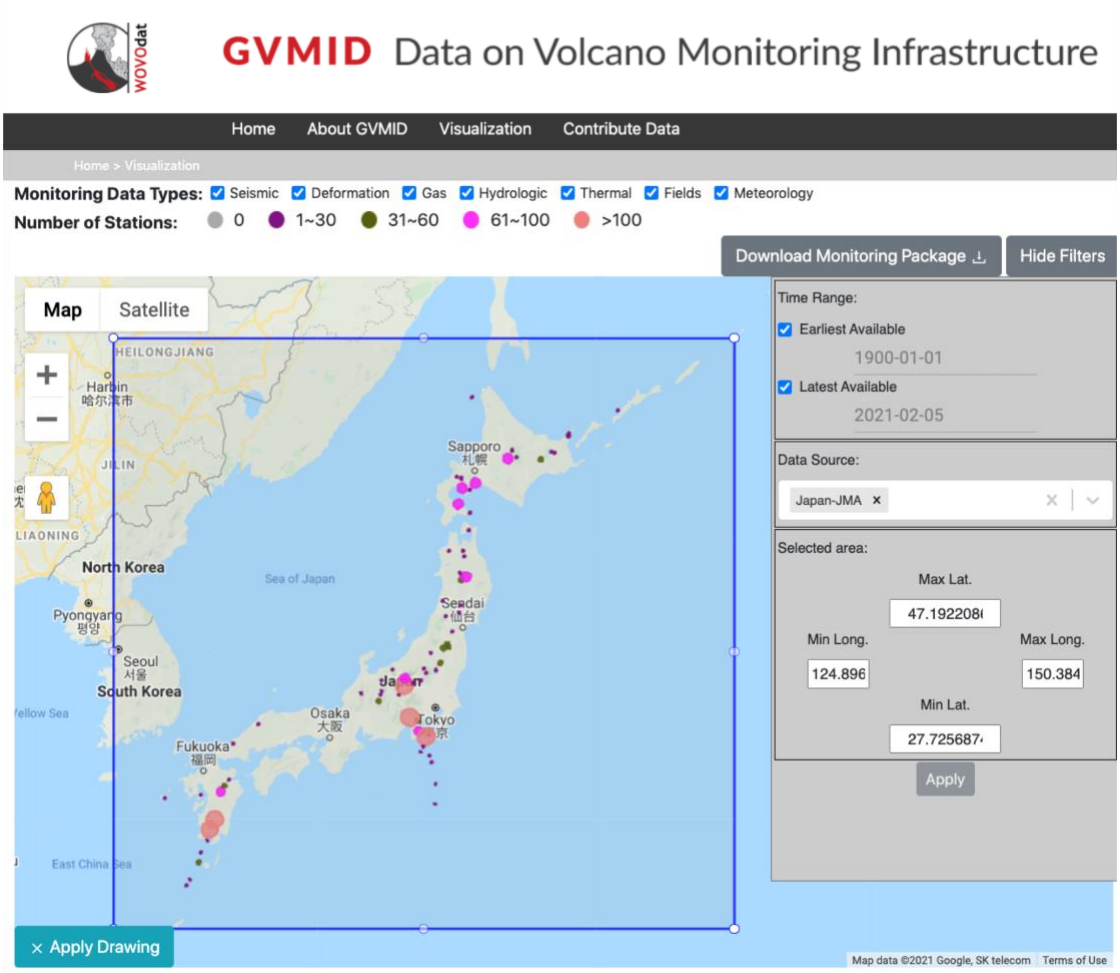

Figure 3. *Worldwide volcano map visualization displaying number of monitoring stations installed within 30km from each volcano vent (circle colours). Interactively, user can select different monitoring data types and using criteria provided in the filter panel that include time range, data source, and specify rectangle bound or type in latitude/longitude coordinates in the filter box to create area of selection.*

(b) Single volcano map
(https://wovodat.org/gvmid/index.php?type=single&vd_num=282080)
At volcano level, the detail station locations and available instruments installed within 30km from the volcanic vent will be displayed with different icon shapes and colours, overlaid on top of Google map (Figure 4). User can select criteria with options in the filter panel, e.g. time range, selected area of interest, type of installation, data source, type of instrument, etc.
A popup box will appears when user clicking at each station's or instrument's icon on the map, where detail information about station/instrument will be displayed below the Google map, please scroll down.

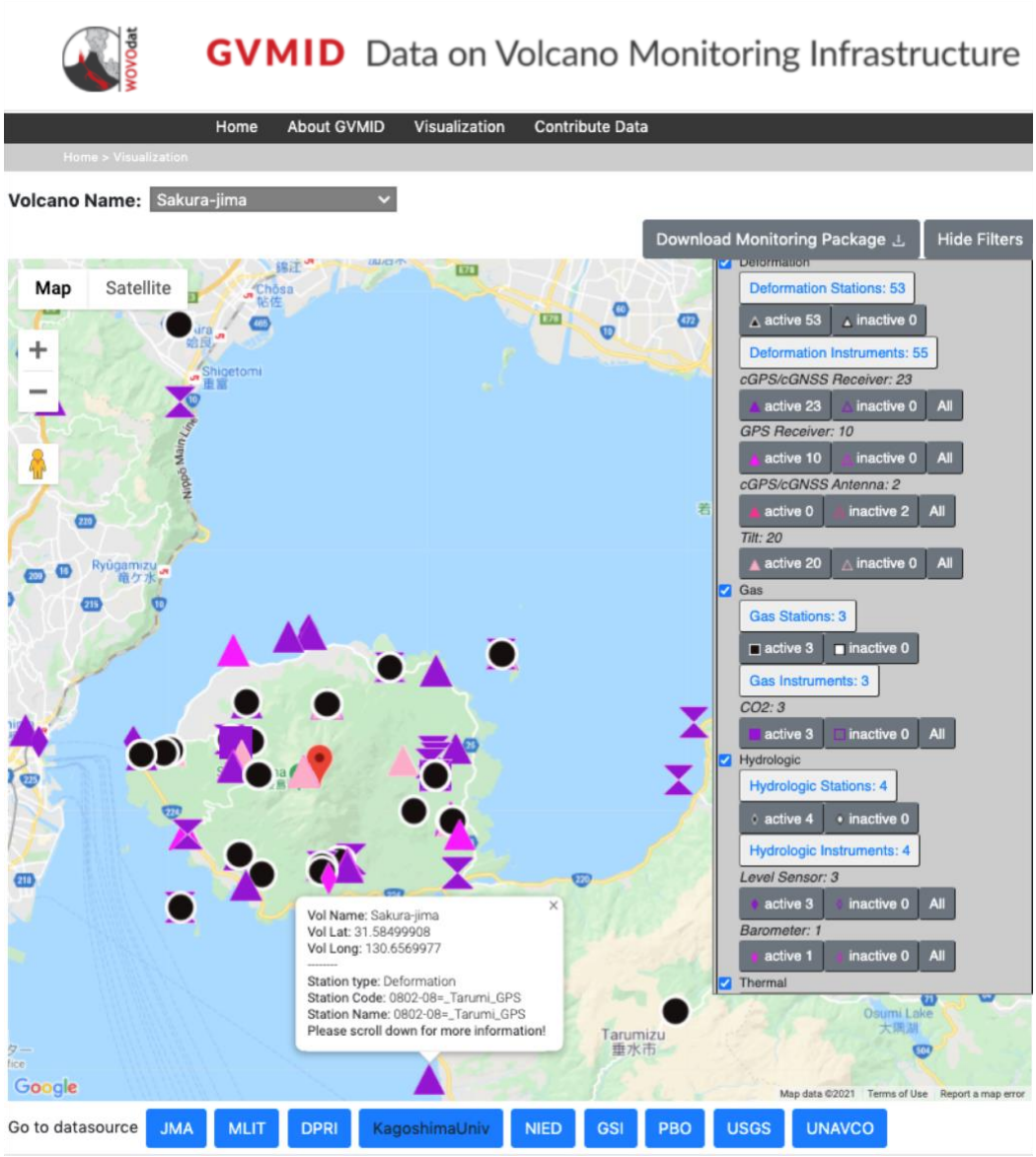

Figure 4. *Example of single volcano visualization tool for Sakura-Jima displaying map location of monitoring stations installed within 30km from the vent (colour icons). User can select criteria with options in the filter panel, e.g. time range, selected area of interest, type of installation, data source, type of instrument, etc.*

5. Data search and download

User can search and select information about volcano monitoring metadata by applying criteria in the filter panel or by clicking specific station/instrument icon on the single volcano visualization menu. Detail information about station/instrument information will be shown below the Google map and can be individually downloaded in a CSV format file (Figure 5). By clicking *"Download Monitoring Package"* located at the upper-right of the webpage, user will receive sets of spreadsheet with detail station and instrument from the individual volcano.
As for the worldwide volcano map, by clicking *"Download Monitoring Package"* located at the upper-right of the webpage, user will receive sets of spreadsheet of the detail information about stations within the selected area and time range.

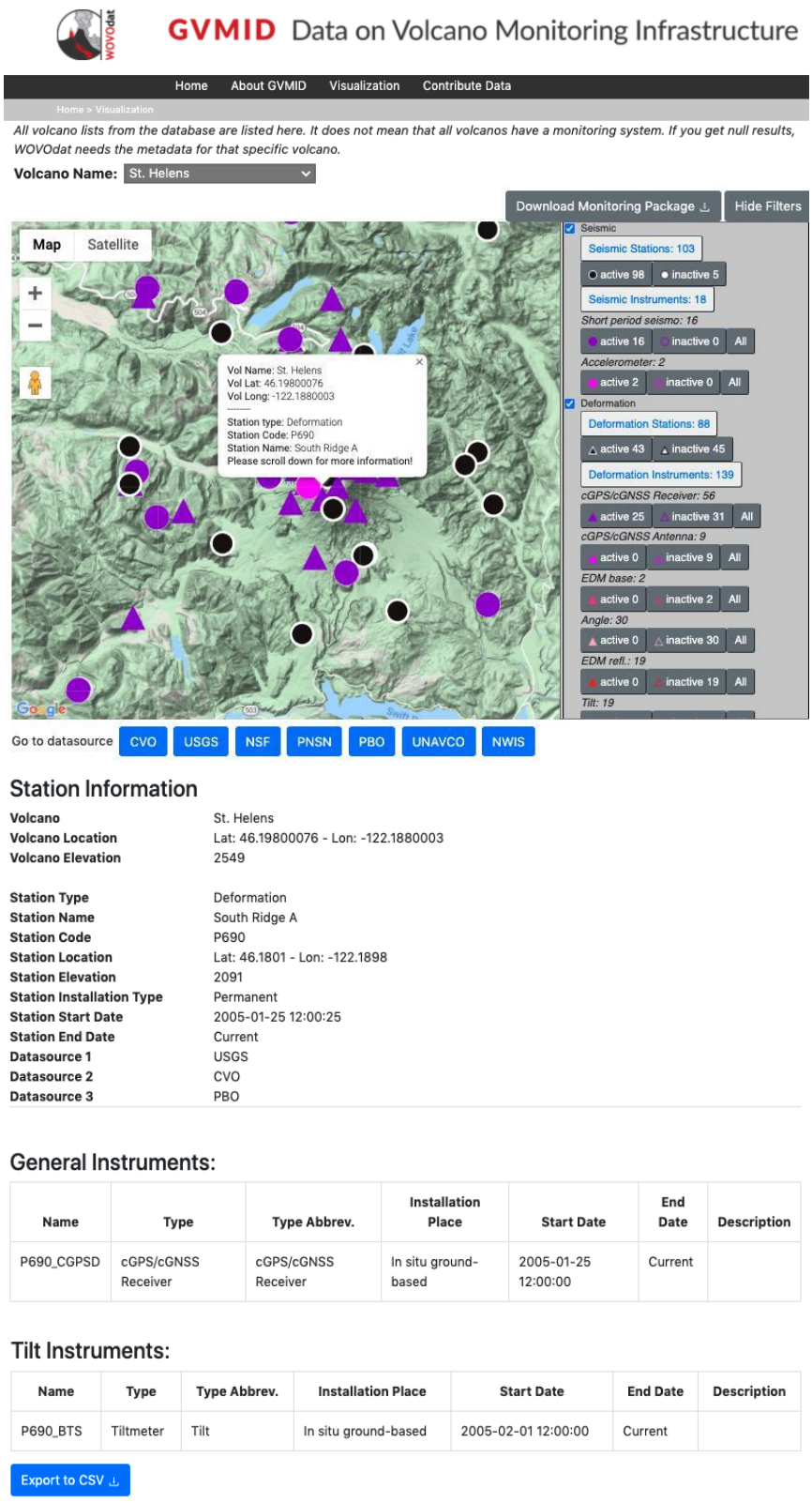

Figure 5. *Example of single volcano visualization tool for St. Helens displaying popup box of deformation station P690, where cGPS/cGNSS and tiltmeter instruments were installed. User able to download the detail information on selected station and instrument by clicking blue button "Export to CSV" at the lower page or download the entire monitoring infrastructure metadata of the volcano by clicking at "Download Monitoring Package" at the upper-right side of the page.*

6. Feedbacks & Contact

If user wish to contact GVMID developer' team or to give any feedback to improve the GVMID web interface functionality and design, database schema and format structure, or documentation, please submit through the online form (Figure 6).
Link: https://wovodat.org/populate/contact_us_form_gvmid.php

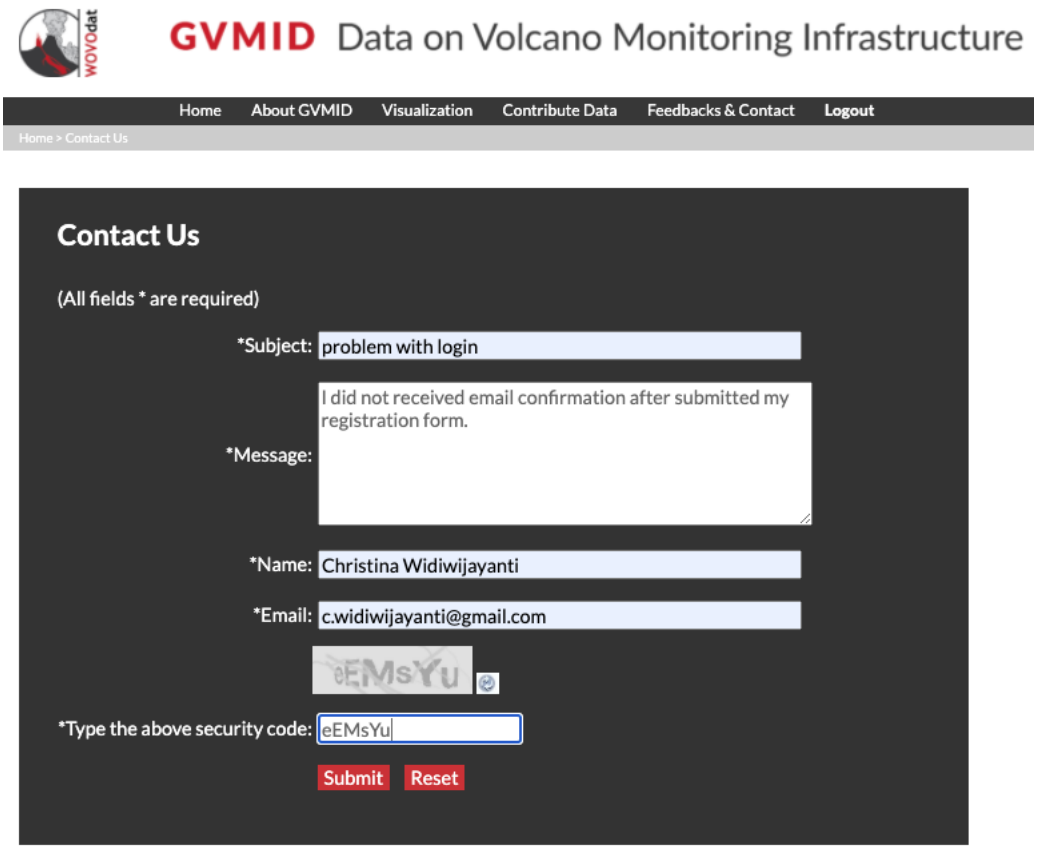

Figure 6. *If you wish to contact us or submit your feedbacks, please fill in the online form as shown above and complete with your full name and email address.*

References

Costa, F., Widiwijayanti, C., Win, N.T.Z., Fajiculay, E., Espinosa-Ortega, T. and Newhall, C.G.(2019), "WOVOdat – the global volcano unrest database aimed at improving eruption forecasts", Disaster Prevention and Management, Vol. 28 No. 6, pp. 738-751, https://doi.org/10.1108/DPM-09-2019-0301

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Venezky, D.Y. and Newhall, C.G. (2007), “WOVOdat design document: the schema, table descriptions, and create table statements for the database of worldwide volcanic unrest (WOVOdat Version 1.0), open-file report”, Version 1, available at: https://doi.org/10.3133/ofr20071117

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