A virtual community and cyberinfrastructure for collaboration in volcano research and risk mitigation

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VHub (short for VolcanoHub, and accessible at vhub.org) is an online platform for collaboration in research and training related to volcanoes, the hazards they pose, and risk mitigation. The underlying concept is to provide a mechanism that enables workers to collaborate online and to easily share information, modeling and analysis tools, and educational materials with colleagues around the globe. Collaboration occurs around several different points: (1) modeling and simulation; (2) data sharing; (3) education and training; (4) volcano observatories; and (5) project-specific groups. VHub promotes modeling and simulation in two ways: (1) some models can be implemented on VHub for online execution. This eliminates the need to download and compile a code on a local computer. VHub can provide a central warehouse for such models that should result in broader dissemination. VHub also provides a platform that supports the more complex CFD models by enabling the sharing of code development and problem-solving knowledge, benchmarking datasets, and the development of validation exercises. VHub also provides a platform for sharing of data and datasets. The VHub development team is implementing the iRODS data sharing middleware (see irods.org). iRODS allows a researcher to access data that are located at participating data sources around the world (a cloud of data) as if the data were housed in a single virtual database. Audio-video recordings of seminars, PowerPoint slide sets, and educational simulations are all items that can be placed onto VHub for use by the community or by selected collaborators. An important point is that the manager of a given educational resource (or any other resource, such as a dataset or a model) can control the privacy of that resource, ranging from private (only accessible by, and known to, specific collaborators) to completely public. VHub is a very useful platform for project-specific collaborations. With a group site on VHub collaborators share documents, datasets, maps, and have ongoing discussions using the discussion board function.

VHub is funded by the U.S. National Science Foundation, and is participating in development of larger earth-science cyberinfrastructure initiatives (EarthCube), as well as supporting efforts such as the Global Volcano Model. Emerging VHub-facilitated efforts include model benchmarking, collaborative code development, and growth in online modeling tools.

Delivering the UN Global Assessment of Risk Report for volcanoes

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The Global Assessment of Risk (GAR) report is published by the United Nations Office for Disaster Risk Reduction (UNISDR). The report implements the Hyogo Framework for Action (HFA) that aims to substantially reduce disaster losses by 2015 by building the resilience of nations and communities to disasters. The GAR is a 4 year programme to evaluate risk and identify global challenges.

A task force has been created under the umbrella of the Global Volcano Model to deliver the volcanic risk component of the next report, GAR15, to be published in 2015 at the World Disaster Programme meeting. The volcano model will complement other models in the report on: earthquakes, floods, cyclones and extreme weather, tsunamis, exposure and risk. We will build on the methodology employed in the World Bank funded GFDRR report (Aspinall et al. 2011) to evaluate volcanic risk and are working in collaboration with volcanologists worldwide to build this model. This methodology is being modified by a GVM task force on volcanic indices. Volcano data from key databases, such as the database of Smithsonian's Global Volcanism Program and VOGRIPA, will be used to provide a synoptic assessment of global volcanism from a hazard and risk perspective. The volcanological community is encouraged to contribute relevant information or analysis to this study through GVM. Progress towards gathering and analysing information for GAR15 will be presented.

Aspinall, W., Auker, M., Crosweller, S., Hincks, T.K., Mahony, S., Nadim, F., J. Pooley Sparks, R.S.J. and Syre, E. (2011) Volcano Hazard and Exposure in Track II Countries and Risk Mitigation Measures - GFDRR Volcano Risk Study. Bristol University Cabot Institute and NGI Norway for the World Bank: NGI Report 20100806; 309pp, 3 May 2011.

Volcanic eruption catastrophe loss modelling

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Catastrophe loss modelling, first developed at the end of the 1980s, has become a critical component of the global insurance industry for determining how to price and reserve catastrophe insurance. Catastrophe models involve the generation of a virtual set of catastrophes: the equivalent of the full population of extremes expected over some time period, such as 100,000 years. The models include footprints of one or more hazards, as well as how that hazard will cause loss to the exposure at risk through vulnerability functions. The first catastrophe models were developed for earthquake and hurricane but have now expanded to cover severe convective storms, windstorms, rainfall and storm surge related floods, tsunamis and wildfire. However less attention has been paid to the probabilistic modeling of volcanic eruption impacts, principally because the insurance industry has not yet suffered a significant loss from this cause. However with globalization and expanding populations in the vicinity of volcanoes the risk is rising and volcanic eruption should be included alongside the other classes of insured catastrophe consequences. The paper will consider where the economic and insurance risk is most concentrated, what needs to be included in eruption catastrophe loss modeling and how the different agents of eruption damage would be covered by insurance contracts. Catastrophe models of potential fatalities may also be needed to help manage large scale evacuation for cities in the vicinity of volcanoes. In the future it will be much easier for volcano scientists to supply their own probabilistic catastrophe loss models to be used by the insurance industry.

Asia-Pacific Region Global Earthquake and Volcanic Eruption Risk Management (G-EVER) Consortium: the new hazard mitigation activities

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The first Workshop on Asia-Pacific Region Global Earthquake and Volcanic Eruption Risk Management (G-EVER1) was held in Tsukuba, Japan from February 22 to 24, 2012. The workshop focused on the formulation of strategies to reduce the risks of disasters caused by the occurrence of earthquakes, tsunamis and volcanic eruptions worldwide. More than 150 participants attended the event. During the workshop, the G-EVER1 accord was approved by the participants. The Accord consists of 10 recommendations like enhancing collaboration, sharing of resources, and making information about the risks of earthquakes and volcanic eruptions freely available and understandable. The G-EVER Consortium among the Asia-Pacific geohazard research institutes was established in 2012. The G-EVER Promotion Team of GSJ was also formed on November 2012. The G-EVER Hub website (http://g-ever.org) was setup to promote the exchange of information and knowledge about volcanic and seismic hazards among the Asia-Pacific countries. Establishing or endorsing standards on data sharing and analytical methods is important to promote data and analyses results sharing. The major activities of G-EVER include participation in global risk reduction efforts such as the Global Earthquake Model (GEM) and Global Volcanic Model (GVM). The G-EVER international conference would be held every 2 years in the Asia-Pacific countries. On the other hand, one to two days G-EVER international symposium would be held annually. The 1st G-EVER International Symposium was held in Tsukuba, Japan on March 11, 2013. The 2nd Symposium is scheduled in Sendai, Tohoku Japan, on Oct. 19-20, 2013. Several G-EVER Working Groups and projects were proposed such as the following: (1) Risk mitigation of large-scale earthquakes WG, (2) Risk mitigation of large-scale volcanic eruptions WG, (3) Next-generation volcanic hazard assessment WG, (4) Active fault catalogue WG, and (5) Asia-Pacific region earthquake and volcanic hazard mapping project.

The Asia-Pacific region earthquake and volcanic hazard mapping project aims to make an advanced online information system, which provides past earthquake and volcanic hazards records (eg. age, location, scale, affected area due to earthquake, tsunami, ash fall, and pyroclastic flows, and fatalities), recent earthquake and volcanic eruption information, risk assessment tools for earthquake and volcanic eruption hazards, and links to global earthquake and volcanic eruption databases. The hazard mapping project is planning to make the system with the cooperation of the Asia-Pacific countries.

Challenges and perspectives in the creation of a reference numerical Global Volcano Model

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Volcanoes are extremely complex systems controlled by a huge variety of physical processes that include multiphase, multi-component flows with phase changes and flow regimes spanning from laminar to largely turbulent and from essentially incompressible to compressible with supersonic flow transitions and shock waves; solid system dynamics with complex rheology and large heterogeneities, with fracture propagation and gravity controlled collapses; space-time scales extending from the milliseconds of bursts to the centuries and millennia of magma chamber evolution, and from the microns characterizing phase nucleation and growth to the several km of the magmatic systems and the hundreds or thousands of km of gas and ash dispersion in the atmosphere; and pressure-temperature conditions from the extreme values inside the crust to those of the Earth surface. Further complicating the overall picture, most of a volcanic system is out of any direct observation, and can only be inferred indirectly. Those extreme challenges contribute to explain why the volcanological community has not developed yet global numerical reference models similar to those employed in seismicity or in meteorology. Nonetheless, the need for widely accepted and accessible computational codes is increasingly growing, as it is testified by the success of initiatives like VHub that provide wide access to advanced calculation resources. Here the challenges and perspectives for the creation of a reference numerical Global Volcano Model are discussed, together with some of the characteristics that such a new breaking-through resource in volcanology should possess.

Using Vhub to Apply Computational Models to Real-Case Scenarios for Volcanic Hazard Assessment

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A 12-day workshop on applying computational models to real-case scenarios for volcanic hazard assessment was held at the University of Colima, Mexico between 8-21 January 2013. The rationale behind the workshop was to provide instruction on the undertaking of quantitative volcanic hazard assessments using the VHub cyber-infrastructure platform (http://vhub.org), through which users can access simulation tools, tutorials, and support networks. 48 international participants and instructors attended from all regions of South, Central, and North America and the Caribbean bringing together experts covering four major discipline groups (geology, geophysics, mathematics, and geography), and including several senior scientists from international government institutions responsible for the mitigation of volcanic hazards. The schedule combined 4 days of lecture-based instruction, 3 days of field-based instruction studying deposits around the flanks of Fuego de Colima Volcano and 4 days of hands-on computational modeling sessions held at the Faculty of Science at the University of Colima. Workshop modules stepped through the complete process, from collection of rudimentary information about the volcano's past activity to providing a hazard assessment based on computational modeling using a suit of up-to-date simulation tools. Participants completed 4 projects using the VHub cyber-infrastructure platform: A forward simulation using Tephra2 using input parameters collected from the Plinian eruption of Colima in 1913; A probabilistic assessment using Tephra2, to determine the exceedance probability of 10kg/m2 or more of tephra fallout on the cities of Cuidad Guzman and Colima; A comparative analysis of pyroclastic density current runout at Colima using the energy cone model and Titan2D; And finally a sensitivity analysis of different input parameters for simulations of the Colima 2005 block-and-ash flows using Titan2D. The evaluation of learning outcomes has been assessed through analysis of the online entrance and exit surveys, as well by assessment of portfolio work undertaken by each group. A working group, set up on VHub, now provides a long-term available resource as well as an organizational and storage structure for data and dissemination of the results of all the workshop, including presentations, modeling exercises and tutorials, modeling data, and participant projects.

Strengthening volcanic ash hazard and risk assessment capacity in East New Britain, Papua New Guinea: A three year journey from volcano science to community planning and preparedness

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Understanding the potential magnitude, severity and impact of future volcanic eruptions on communities living in close proximity to volcanic sources is essential for any attempt to reduce natural disaster risk in Papua New Guinea. Geoscience Australia is working in partnership with the Rabaul Volcanological Observatory (RVO) to build the capacity of volcanologists to undertake volcanic ash dispersal modelling, to interpret the outputs and to incorporate the data where appropriate into a new series of volcanic hazard maps for a pilot province (East New Britain; ENB). A modified procedure for volcanic ash dispersal modelling (PF3D) was developed in 2009 by Geoscience Australia and its regional partners in Indonesia and the Philippines which modify the modelling procedure of FALL3D, a widely used and well validated volcanic ash dispersal model, in line with the needs of government agencies and emergency managers in the Asia-Pacific region. PF3D introduces a number of enhancements to the procedure for FALL3D that do not change the operation or functionality of the core model but increase its accessibility for volcanologists working in developing countries like Papua New Guinea. The three year program, funded by the Australian Agency for International Development (AusAID) provided training in the use and application of PF3D for RVO staff through the development of new volcanic hazard and risk information for ENB. A significant achievement for the program has been the continuous involvement of community groups who, through a series of workshops held in ENB, have been heavily involved in discussions around the kind of volcano science being undertaken, providing feedback on outputs and in driving the design and production of education and public awareness materials (books, posters etc) which will be used for communicating the outputs of the program in local schools and other community centres as part of a larger planning and preparedness campaign.

Global volcano model: progress towards an international co-ordinated network for volcanic hazard and risk.

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GVM is a growing international collaboration that aims to create a sustainable, accessible information platform on volcanic hazard and risk. GVM is a network that aims to co-ordinate and integrate the efforts of the international volcanology community. Major international initiatives and partners such as IAVCEI, the Smithsonian Institution - Global Volcanism Program, State University of New York at Buffalo - VHub, Earth Observatory of Singapore - WOVOdat and many others underpin GVM. Activities currently include: design and development of databases of volcano data, volcanic hazards, vulnerability and exposure with internationally agreed metadata standards; establishment of methodologies for analysis of the data (e.g. hazard and exposure indices) to inform risk assessment; development of complementary hazards models and creation of relevant hazards and risk assessment tools; dissemination of these tools for online application (via vhub.org); and model benchmarking/comparison activities. GVM acts through establishing task forces to deliver explicit deliverables in finite periods of time. GVM has a task force to deliver a global assessment of volcanic risk for UN ISDR, a task force for indices, and a task force for volcano deformation from satellite observations. GVM is organising a Volcano Observatory Best Practices workshop in 2013. A recent product of GVM is a global database on large magnitude explosive eruptions. There is ongoing work to develop databases on debris avalanches, lava dome hazards and ash hazard. GVM aims to develop tools that can help anticipate future volcanism and its consequences.

Volcanoes of the World 4.0: The volcano and eruption database of Smithsonian's Global Volcanism Program

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Volcanoes of the World 4.0 (VOTW4.0) is a relational database of recent volcanism compiled over the last four decades by Smithsonian's Global Volcanism Program (GVP). This online database is an updated digital version of the classic catalog Volcanoes of the World 3rd Edition (Siebert et al., 2010) that documents more than 10,000 known or suspected Holocene eruptions from over 1500 volcanoes. Information is contained within 32 interrelated data tables, and uses another 28 lookup tables to constrain and standardize the data.

Maintained fields at the volcano level describe names, location and coordinates, elevation, morphology, tectonic setting, major rock types, geologic age, volume, affiliated observatories, nearby population, subsidiary features, images, and references. Reports from the Smithsonian U.S. Geological Survey Weekly Volcanic Activity Report and the Bulletin of the Global Volcanism Network are also linked to each volcano. Volcanic activity is organized into eruptions, episodes, and events. Episodes within an eruption can be distinguished by time, location, or style of activity. The database also allows episodes of associated precursory or secondary episodes to be identified. Episode level data includes vent location descriptors, dating technique, and reported volumes of tephra and lava. Specific Events within dated episodes may be given more specific time stamps, data permitting. Examples of events include reports of explosive eruptions, pyroclastic flows, lahars, lava flow, debris avalanches, lava dome formation, bombs, and deformation. Tables of event details can also be linked, which is currently done in the case of fatalities, evacuations, and calculations of the volcanic explosivity index.

GVP attempts to capture all eruptions at all scales, and the database is dominated by small to moderate eruptions (90% of eruptions have a Volcanic Explosivity Index of less than or equal to 3). VOTW4.0 can be interrogated to research and model global volcanic patterns in space in time. Several complementary efforts (LaMEVE, WOVOdat, other chemical and physical databases under development) rely on VOTW4.0 for their backbone structure, naming conventions, and metadata standards such that one can envisage a powerful network of resources that may transform scientific discovery as well as the forecasting and management of volcanic hazards. The VOTW4.0 can be queried at all scales, from the eruptive history of a single volcano, to regional and global compilations, and downloaded from www.volcano.si.edu.

Considerations on the basis of an European Volcano Observations E-infrastructure: the EPOS experience

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Data generated by volcano monitoring are as heterogeneous as the complexity of the volcanic processes themselves. All over the world where volcanoes are active, several countries have invested resources to observe and monitor these living and threatening 'geophysical entities'. The Volcano Observatories are the starting point for the construction of universal knowledge about volcano behavior and volcanology in a broad sense.

In this context, each country has often developed its own monitoring and data collection techniques, used their own measurement units, data storage and processing, cartographic projection systems, languages, lexicon/glossary, hardware, standards, etc. This situation somehow constitutes an obstacle each time the volcanological community wants to combine its efforts to better understand how volcanoes work, forecast volcanic events, or improve volcanic hazard assessments and reduce volcanic risk.

EPOS, as the European project aimed at implementing and integrating European Research Infrastructure (RI) in the field of Earth Sciences, is the right matrix for coordinating all the efforts to overcome these obstacles. Starting from existing skills and knowledge, an international working group has been called to contribute to the implementation of the RIDE (Research Infrastructure Database for EPOS, http://www.epos-eu.org/ride/), which enabled volcanological community to make a first catalog of the Infrastructures, Facilities, Instruments and Sensors at an European level, with a world-wide accessibility and resonance through the Internet.

The ongoing work consists of a preliminary survey of the current data types available in the European volcanological community, with the goal of defining categories, formats, metadata and other technical details for the data available at all European Observatories. This latter categorization is a fundamental input to design and build a distributed e-infrastructure, which will allow the integration of the geographically distributed national/regional data centers (Observatories, research Institutions, etc.). In the EPOS framework, we refer to this e-infrastructure as the European Volcanologic Thematic Service.

In the presentation, it will be discussed the outcome of the ongoing technical metadata survey and its contribution to the implementation of the European Volcanologic Thematic Service.

Database analysis for the diagnosis of national capacities when coping volcanic crises

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A diagnosis on monitoring instrumentation at the institutions responsible for surveillance of volcanoes and training of the human resources is very timely because both play an important role when attending volcanic crises. On the other hand, communication among scientists and technicians from these institutions must be improved in order to establish institutional cooperation to help minimizing the effects of volcanic eruptions.

As outcome of this research, we introduce a web-based database, which contains information about active volcanoes at most Latin American countries and their volcano monitoring institutions, including the different types of instruments and a variety of features such as periodicity of monitoring. This database is a tool that allows evaluating in detail the national capacities when coping with volcanic crises. A Monitoring Index can be developed in order to assess volcanic risk along with other parameters. For selected Latin American countries we analyze those capacities. Updating of the data depends on every institution providing the data.

This application is currently hosted at the Instituto de Geofisica at UNAM in Mexico, and can be accessed remotely and updated in real time.

The design and implementation of this database is a part of the IAVCEI-funded project: Weaknesses and strengths in Latin America facing crisis: a research for improvement national capabilities.

A new global database of volcanic gas emissions

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Volcanic degassing plays a key role in controlling the style, duration and onset of volcanic eruptions. Accurate degassing budgets are crucial for understanding volcanic gas fluxes to the atmosphere and volatile recycling through subduction zones. Volcanic gases influence Earth's climate over various spatial and temporal scales and have notable impacts on human society and terrestrial environments. Precise estimates of global gas fluxes may also inform climate change policy, and counter claims that volcanic emissions exceed anthropogenic output of greenhouse gases.

Degassing is regularly monitored at many volcanoes worldwide, with sophisticated direct sampling and both ground and satellite-based remote sensing techniques. The literature contains a wealth of additional data, arising from campaign measurements of degassing, numerous petrological studies of magmatic volatiles, and various methods targeting proxies for gas fluxes. However, there is currently no existing inventory of volcanic gas emission measurements in an easily accessible form, such as an online relational database.

Inspired by the Deep Carbon Observatory's (DCO) DECADE initiative to estimate global volcanic CO_2 flux, we are building a new database that will incorporate all published degassing and volatile data for Earth's volcanoes. Appropriate metadata is carefully defined, to include detailed information pertaining to the volcano in question (e.g. composition, style of activity, tectonic setting, eruptive history) and also to address data quality issues. Numerous external factors influence the accuracy of gas emission measurements, and some categorisation or quantification of the uncertainty present in each data entry must ideally be included.

The database will be accessed and manipulated through a clear and easily navigable website. Functions allowing rapid visualisation and comparison of datasets from different time periods and regions will enable the database's use as a powerful reference tool, with searchable and downloadable content for more in-depth research. The data will be freely accessible to a wide range of end users, and closely linked to other online resources, including EarthChem and the Smithsonian Global Volcanism Programme. The structure of the GVP eruption and activity archive lends itself readily to the incorporation of emission and volatile data to both specific volcanoes and individual phases of activity; the structure of the EarthChem database is well-suited for compositional data of gas emission samples. Interoperability between the GVP and EarthChem databases will link and integrate activity, emissions, and geological samples and greatly facilitate multi-parameter studies of volcanoes, over selectable spatial and temporal scales. Short exemplar case studies are presented here. A key future objective is full integration of this new database with other existing online resources, such as WOVOdat, Global Volcano Model, GOOGAS, and IRIS.

Two global databases for dome-forming eruptions (DomeHaz and FlowDat): contributions to hazard assessments and potential for future use

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Dome-forming eruptions can extend for significant periods of time and can be dangerous; nearly all dome-forming eruptions have been associated with some level of explosive activity. Hazards related to these eruptions are numerous and often include mass flows: dome-collapse and column-collapse pyroclastic flows, ash-cloud surges, lahars, and debris avalanches.

Two global databases have been developed and are currently hosted on VHub.org: DomeHaz (https://vhub.org/groups/domedatabase/) contains information about 367 dome-forming episodes 1000 AD to present, including duration of dome growth, duration of pauses in extrusion, extrusion rates, and the timing and magnitude of associated explosions. FlowDat (https://vhub.org/groups/massflowdatabase) includes 257 pyroclastic flows and surges, and records run-out length, volume, cross-sectional and planimetric area, as well as other mobility information.

Analysis using the DomeHaz database has provided useful information regarding the relationship between volcanic composition and cyclicity of dome growth, the identification of patterns in eruptive frequency between different volcanoes, and the timing of large explosions in relation to dome growth. With FlowDat we investigate the relative merits and suitability of contrasting mobility metrics for different types of volcanic mass flows, show that these metrics can be used (with varying success) to predict the run-out of a PDC of given volume, explore the effect of topography, and examine the problem of compiling and generalizing mobility data from worldwide databases using a hierarchical Bayes model for weighting mobility metrics for use as model inputs. This is especially useful for calibrating models at data-sparse volcanoes.

Continuation of this work will include the compilation of a relational database, which can be used to assess probabilities of future eruption style for any dome-building volcano and the associated products and which will be continuously maintained and updated as part of the GVM project. A key component in creating a robust database is high-quality and complete data sets provided by the community. This paper serves as a call for participation from individuals, research groups and monitoring bodies for generating a global database on the hazards associated with lava dome eruption for community use.

A global morphometric database of composite volcanoes

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Volcano morphologies are the result of the interaction through time of constructive and destructive processes. Although shape and size are basic properties, there is no comprehensive database of volcano morphometry at a global scale. To this end, we have used the near–global SRTM DEM to construct a database of morphometric parameters of ∼750 composite volcanoes included in the Smithsonian Institution Global Volcanism Program database. Thus, our database considers most active and potentially active composite volcanoes of the World. The basal outline of each volcano edifice, a key factor, was defined applying an expressly developed algorithm (NETVOLC) that calculates the outline by minimizing a function based on slope breaks around the edifice. Another code (MORVOLC) then computes a set of morphometric parameters for each edifice. The parameters quantitatively describe edifice size (basal area, AB; basal width, WB; summit width, WS; height, H; volume, V), profile shape (height/basal width ratio, H/WB; summit width/basal width ratio, WS/WB), plan shape (ellipticity index, EI; irregularity index, II), slopes (several slope statistics, SLP) and number of secondary peaks (PK). In addition, ∼100 well defined and large summit craters/calderas were manually delineated and morphometric parameters for these were also extracted (width; depth; volume; elongation; slopes). Considering all volcanoes in the database, most size parameters, the average EI and II, and PK have strong positive asymmetric distributions; H, H/WB and WS/WB have weak positive asymmetric distributions; SLP parameters have symmetric to slightly negative asymmetric distributions. The range, excluding outliers, and median values are: V: 0.2–170, 16 km3; AB: 3–480, 61 km2; WB: 2–36, 8.8 km; WS: 0.2–10, 1.5 km; H: 100–2500, 1020 m; H/WB ratio: 0.01–0.28, 0.12; WS/WB ratio: 0.02–0.62, 0.19; average EI: 1.1–3.4, 1.7; average II: 1.0–2.3, 1.2; average SLP: 3–30, 17°; PK: 0–42, 5. A simple, semi–quantitative classification can be considered consisting of four main types: regular cones, irregular cones, complex edifices and shields. The first three types show a transition of increasing size and complexity, and of decreasing steepness, from regular to irregular cones and to complex edifices. Shields have sizes similar to complex edifices, but are flatter. One–third of shields have large summit craters/calderas, whereas only 10% of the other three types have them. More rigorous quantitative classifications can be obtained by statistical cluster analysis; we present some possible schemes. Correlations between parameters and regional variations are also discussed. We anticipate that the database will be useful for regional comparisons, for quantitative and systematic classifications, and as a tool for studies of associated volcanological processes.

WOVOdat Database: Progress Report 2013

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Since 2009, the World Organization of Volcano Observatories (WOVOdat) Database project has been hosted by Earth Observatory of Singapore. The main purpose of the project is to build a platform for easy access to the historical data of volcanic unrest which would be useful for observatory scientists during volcanic crises. The database stores processed monitoring data.

WOVOdat website www.wovodat.org provides tools for comparing unrest between a volcano and its analogues, or between several unrest episodes of one single volcano. Graphical tools for side-by-side comparisons are now operational. Later, WOVOdat will include tools for pattern recognition and event probability estimation.

WOVOdat also prepared a stand-alone or local server version of the WOVOdat system, including web based interfaces for data entry and visualization, which could be used by observatories for their own database system.

WOVOdat is developed for the community of volcano observatories. Uploading data can be done by observatory staff and/or by WOVOdat staff. Although the WOVOdat system development is finally completed, a huge amount of unrest data from many volcanoes remains to be uploaded. We are making progress, and invite your help.

First results from the Volcano Deformation Database Task Force

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Observations of surface displacements at volcanoes (both uplift and subsidence) are only one tool used to study volcanic activity, but they have played an important role in understanding magma movements and in forecasting during many eruptions (e.g. Kilauea, Mt. St. Helens, and Mt. Augustine, Alaska). On the other hand, many volcanoes also exhibit deformation without leading to an eruption, and some eruptions may not produce ground deformation or it might have been missed with the limited available datasets.

Forecasting can be improved from our aggregate knowledge of volcano behavior – for example, what are the properties of a deformation episode at a volcano that do or do not lead to eruption? It is currently difficult to assemble this type of aggregate knowledge, especially on a short timescale in response to a volcanic crisis. At the same time, we now have the opportunity to monitor all of the volcanoes of the world for ground deformation thanks to satellite Interferometric Synthetic Aperture Radar (InSAR). Although appropriate InSAR data have not yet been analized over all of the world's volcanoes, the number of known deforming volcanoes has more than tripled since 1997.

Thus, recognizing the need for global information on volcano deformation and the opportunity to address it (with InSAR and other techniques), we have established a Volcano Deformation Database Task force as part of Global Volcano Model.

The three objectives of our organization are:

1) to compile deformation observations of all volcanoes globally into a database that will be part of WOVOdat and the Global Volcanism Program of the Smithsonian Institution.

2) document any relation between deformation events and eruptions for the Global assessment of volcanic hazard and risk report for 2015 (GAR15) for the UN.

3) to better link InSAR and other remote sensing observations to volcano observatories.

We present the first results from our global study of the relation between deformation and eruptions, focusing on the southern Andes. We find that available InSAR data are rarely available in the critical days to weeks before the eruption of a volcano that has been dormant for decades to millenia. For example, while ground deformation was observed before the 2011 eruptions of Cordon Caulle and Cerro Hudson, the observations were too infrequent to see any change in the pattern or rate of deformation before the eruptions. Before 2011, Cordon Caulle and Cerro Hudson both erupted in the 20th century, but the 2008 eruption of Chaiten was preceeded by millenia of dormacy and still had no measured precursury deformation up to two weeks before eruption. New InSAR missions with more frequent observations along with ground observations from tiltmeters and GPS are essential to constrain whether there is a reliable deformation signal before eruption.

Development and analysis of a database of volcanic ash layers from IODP cores as a record of global explosive volcanism.

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Ocean drilling as part of the Integrated Ocean Drilling Program (IODP), Ocean Drilling Program (ODP) and the Deep Sea Drilling Program (DSDP) has collected over 366 km of core samples since 1966. This is a largely untapped source of information with global coverage of deposits throughout the oceans. We are using this source of information to generate a more complete record of global volcanism through time.

Volcanic ash layer data are gathered from literature, reports generated by IODP, as well as from searching the visual core description (VCD) archive. This process is complimented by a series of ground truthing campaigns to rigourously test the quality of these data and to get a feel for the amount of under/over recording of volcanic ash layers. During our recent ground truthing campaigns at the IODP repositories in Kochi Core Centre (Japan) and at Texas A&M University (U.S.A) we examined over 350 ash layers, to compare what is observed in the core with what is recorded in the shipboard VCD, reports and literature. We found they often differed, but by comparing the data source with the core photo it was often possible to identify these outliers. Due to this inconsistency, alternative approaches to data collection are being attempted to use the physical properties data to identify ash layers. This is intended to make ash layer identification and measurement more consistent, and create a more complete ash layer record.

Creation of this global dataset of ash layers through time will provide the required information for these layers to be translated into volcanic eruptions of varying magnitude, essentially forming a global time series of explosive volcanic eruptions. This can then be used to examine magnitude-frequency relationships and rates of activity change through time and space, as well as investigating physical relationships between volcanic activity and tectonics, glacial/interglacial periods and climate cycles.

Evaluation of observational infrastructure for measurement of volcanic ash from surface, air and satellite platforms

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The 2010 and 2011 eruptions in Iceland caused global economic losses and threatened national security in a number of European countries. In response, national governments called on scientists to provide as much information as possible on the location and amount of volcanic ash in the atmosphere. Consequently, many measurement techniques, originally conceived for measurement of gases, clouds and aerosol in the Earth' s atmosphere, were applied in an attempt to measure airborne volcanic ash characteristics. To date, the capability of these techniques for ash measurement has not been systematically evaluated.

The National Volcanic Ash Project (NVAP) is supported by the Norwegian Ministry of Transport and Avinor, and aims to provide a basis for decisions about future infrastructure investments related to the measurement of volcanic ash from surface and airborne platforms. Here we present an objective and systematic evaluation of various instrumental approaches, where the suitability and limitations are assessed in terms of detection limit, accuracy, temporal resolution, spatial resolution, ease of measurement, acquisition time and operational cost. The evaluation will guide potential future investments in regional surface measurement stations in Norway, for example, at airports and major cities.

Explosive volcanic eruptions: analysis of the LaMEVE database

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As a component of the Global Volcano Model (GVM), the Volcano Global Risk Identification and Analysis Project (VOGRIPA) aims to facilitate global volcanic hazard and risk assessment in an open access environment. The Large Magnitude Explosive Volcanic Eruptions (LaMEVE) database is the first and central component in this undertaking, and is now available to all online at www.bgs.ac.uk/vogripa.

The LaMEVE database comprises information on over 3000 volcanoes, with approximately 1900 Quaternary eruptions of magnitude or VEI 4 and above. Such eruptions can be catastrophic on regional and even global scales. We welcome input from the volcanological community to maintain this comprehensive database to ensure accuracy and sustainability.

Data regarding the VEI, magnitude and intensity of eruptions is recorded in the database. A good correlation is found between magnitudes and VEI, with 90% of VEI 4 to 6 eruptions having equal corresponding magnitudes (i.e. 90% of VEI 5 eruptions lie within the magnitude range of M5.0-5.9). Further analysis of the LaMEVE database has identified the issue of under-recording of eruptions, with 50% of eruptions recorded in about the last 20ka despite the dataset extending to the beginning of the Quaternary (2.58Ma). Under-recording varies by region, demonstrated by the dominance of Japanese activity in the database, with approximately 40% of all eruptions being from Japanese volcanoes. This illustrates the need for further research to gain a better understanding of global volcanism and its implications. The preservation potential of larger eruptions with more widespread deposits is observed, with a clear decrease over time in the recording of magnitudes 4 to 6. However, analysis of the magnitude-frequency relationship continues to identify proportionally lower frequencies of larger events. We have quantified the increase in under-recording back in time for different magnitude eruptions and empirically estimated the global frequency and its uncertainty assuming that volcanism is stationary. We have also examined deviations from a simple monotonic functional fit through the eruptions rate data to see if there is evidence for non-stationarity. We present a revised magnitude-frequency relationship for large magnitude global explosive activity which indicates a departure from a simple power law for M>6.5, supporting a reduced rate of eruption for these large magnitudes compared to extrapolation of the power law representing M<6.5 data.

Further databases concentrating on individual volcanic hazards as well as vulnerability are being prepared in a collaborative effort with numerous institutions. The hazards databases will be inter-related to permit the identification of locations at high risk and gaps in knowledge, and to allow scientists and disaster managers to analyse risk within a global context of systematic information.

Database of Quaternary volcanic and intrusive rock bodies in Japan

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Understanding the change of long-term volcanic activity such as migration of volcanic province is important to elucidate the volcanic activity during Quaternary. Therefore, it is necessary that the history of activity of volcanoes or volcanic cluster have been clarified on the geological timescale of several ten thousand to hundred thousand years. Our goal is to construct a geological database of Quaternary volcanoes in Japan using the latest data which have picked up not only the Quaternary volcanic rocks but also volcanic and intrusive rock bodies that haven't been checked in previous databases. Additionally, definition of lower boundary in Quaternary (Pliocene-Pleistocene boundary) have changed from 1.806 Ma to 2.588 Ma proposed by IUGS in 2009. Here we screened Quaternary volcanic and intrusive rocks from igneous rocks in all of Japan using published scientific papers, reports, geological maps and so on.

This database can be viewed on the browser, and it is linked to "Seamless Digital Geological Map of Japan (1:200,000)" and "Quaternary Volcanoes in Japan" on Reserch Information Database (RIO-DB) of AIST. Contents which based on geological reviews of each volcanic and intrusive rock bodies are "Volcano / Volcanic rock body name", "Geological unit name", "Reprentative location of volcano / volcanic body", "Volcano / Volcanic rock body type", "Activity period", "Main rock type", "Reason of an addition to database", and "List of references". By the way, this database also contains any volcanic and intrusive rock bodies what may be excluded from Quaternary depending on the further research. We hope this database can support a a research project for the volcanic hazard reduction, national land utilization (e.g. construction of nuclear facilities) and so on.

Newly-research data becomes obsolete in a few years in this age of rapid progress. Consequently, it is desirable that database is transmitted which always updated in the latest data under the control of responsible management system. We will publish the latest version to be updated on regularly that is available from http://unit.aist.go.jp/dgcore/db/QVDB/.

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Catalogue of Icelandic volcanoes

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Iceland has over 30 volcanic systems which have been active during the Holocene. During the last 100 years, about 30 eruptions have occurred. Volcanic activity is very varied in terms of eruption styles, eruptive environments, eruptive products and their distribution. Although basaltic eruptions are most common, the majority of eruptions are explosive, not the least due to magma-water interaction in ice-covered volcanoes. Icelandic volcanism has been investigated in a large number of studies, and the results reported in scientific papers and other publications. In 2010, the International Civil Aviation Organisation funded a 3 year project to collate the current state of knowledge and create a comprehensive catalogue readily available to decision makers, stakeholders and the general public. The work on the Catalogue began in 2011, and was then further supported by the Icelandic government and the EU. The Catalogue forms a part of an integrated volcanic risk assessment project in Iceland (commenced in 2012), and the EU FP7 project FUTUREVOLC (2012-2016), establishing an Icelandic volcano supersite.

The Catalogue is a collaborative effort between the Icelandic Meteorological Office (the state volcano observatory), the Institute of Earth Sciences at the University of Iceland, and the Icelandic Civil Protection, with contributions from a large number of specialists in Iceland and elsewhere. Once completed, it will be an official publication intended to serve as an accurate and up to date source of information about active volcanoes in Iceland and their characteristics.

The Catalogue is composed of individual chapters on each of the volcanic systems. The chapters include information on the geology and structure of the volcano; the eruption history, pattern and products; the known precursory signals and current monitoring level; associated hazards; and detailed descriptions of possible eruption scenarios. The probability of the eruption scenarios will also be depicted by probabilistic event trees. The chapters are illustrated with a number of figures, maps and photographs. The Catalogue will be published in early 2014 as an open web resource in English.

Failure forecasting in real-time: a forecasting model testing centre for capturing and sharing data and models

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Laboratory rock deformation experiments are a key tool for developing and testing eruption forecasting models. Worldwide there are a large number of rock deformation laboratories, each of which runs many experiments. Similarly there are a large number of theoreticians who develop constitutive and computational models for rock deformation. Here we consider how to open opportunities for sharing experimental data in a way that is integrated with multiple hypothesis testing. We present a prototype for a new forecasting model testing centre based on e-infrastructures for capturing and sharing data and models to expedite research. Here we outline our work on data assimilation in the EFFORT (Exploring Failure Forecasting in Real Time) project. EFFORT is a multidisciplinary collaboration which aims to determine the predictability of brittle failure of rock samples in laboratory experiments. The proposed forecasting model testing centre acts a hub for archiving, analysing and monitoring experimental data and models. It also provides facilities to share data and models. The testing centre uses a repository to store all of the data and models and a catalogue to store all of the corresponding metadata. Data transfer is achieved using the FAST (Flexible Automated Streaming Transfer) tool to upload periodically data from laboratories to the repository. Metadata are automatically created and stored in the catalogue, and data sharing is encouraged. Data is accessed through the Web. Users can create synthetic data, or select archive or real-time data and models via their metadata. User-defined models can be uploaded and stored with associated metadata, providing an opportunity to share models. Metadata describing each model are automatically created. Selected data and models are submitted to a High Performance Computational resource while hiding technical details. Results are displayed and stored allowing retrieval, inspection and aggregation. Benefits of the expected forecasting model testing are improved understanding of brittle failure prediction and its scalability to natural phenomena, accelerated and extensive testing and rapid sharing of insights, increased impact and visibility of research, and resources for education and training. We plan to extend the forecasting model centre to include volcanic data from different observatories. In the current prototype, we have made the first steps in that direction by integrating data from an Icelandic Observatory.

Quantifying the intensity of unrest: introducing the Volcanic Unrest Index (VUI)

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The observation and interpretation of volcanic unrest is a key element of eruption forecasting. Unrest is caused by the interaction of magma with surrounding rocks and fluids. This can result in detectable signals such as seismicity, ground deformation and/or hydrothermal/geochemical changes. The integration and interpretation of the multiple parameters is important for eruption forecasting and would enable the comparison of episodes, but is difficult due to the inherent complexity of the system, multiple monitoring techniques and a variety of data formats. No transferrable thresholds exist to divide the wide range of multivariate activity into "background" activity and "unrest", the terms commonly used in literature and Volcanic Alert Level (VAL) descriptions. To encapsulate the complete range of activity at a volcano during periods of quiescence (including background activity to heightened unrest), the description Non-Eruptive Volcanic Activity (NEVA) is used.

A tool to quantify the overall intensity of NEVA is presented here, called the Volcanic Unrest Index (VUI). Observations ranging from qualitative historical descriptions from past episodes to quantitative real-time monitoring data can be applied to a framework. Thresholds on the framework are tailored to each volcano individually, providing a definition of "unrest". A simple calculation results in an index summarising the intensity of activity. The creation of the VUI involved a wide literature search to ascertain the current state of knowledge of magmatic systems and processes. Multiple iterations with volcanologists from a range of volcanic settings, institutions and countries resulted in the tool presented here. The VUI

• rates the intensity of historical unrest activity, enabling comparisons of episodes over time,

• allows the rapid identification of activity reaching "unrest" status, therefore assisting with VAL changes,

• prompts the early collection and analysis of historical observations to ascertain the range of NEVA intensity, which feeds into eruption forecasting models, and

• assists with the communication of multitudinous, complex information simply and rapidly to non-scientists.

A case study is presented for Taupo Caldera (New Zealand), a rhyolitic volcano which most recently erupted in 232 AD. A multi-parameter catalogue of unrest over the past 140 years at Taupo has recently been completed. The VUI has been used to translate the complex information into an easily understood time-series plot, demonstrating the wide range of intensity of past activity at this volcano. This has helped communicate the history of NEVA at Taupo Caldera to non-scientists from a multi-agency planning group for the mitigation of risks involved with caldera unrest (the Caldera Advisory Group). The information transfer enables the end-users to have an increased understanding of the range of past and potential future volcanic unrest episodes at Taupo.

TephraProb: a user-friendly toolbox for the hazard assessment of ground tephra accumulation

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We present a toolbox designed to assist each step of the compilation of comprehensive hazard assessments for ground tephra accumulation using the advection-diffusion model TEPHRA2. This operating system-independent toolbox is displayed in the shape of graphical interfaces. Written in Matlab, a standalone-compiled version based on free libraries is also available. Key features of this toolbox are (i) modules to generate and collect necessary input data (i.e. calculation grid, wind data, eruptive history), (ii) modules to process grainsize data (i.e. total distribution, aggregation model), (iii) modules assisting the identification of eruptive scenarios based on the Global Volcanism Program in case limited field data is available, (iv) modules to statistically analyse wind profiles inferred from the NOAA NCEP/NCAR Reanalysis database, (v) modules to run the model in a range of fully deterministic to fully stochastic scenarios on single processors and cluster of computers, (vi) modules to process and display output data (i.e. probability maps for a given tephra threshold, isomass maps for a given probability of occurrence, hazard curves) and (vii) modules to export hazard maps (i.e. ArcGIS, Google Earth).

This toolbox allows for the assessment of the probability distribution of reaching a given tephra accumulation around a volcano using the following scenarios: One Eruption Scenario (OES) based on the statistical distribution of wind profiles, with all eruptive parameters determined deterministically; Eruption Range Scenario (ERS) based on the statistical distribution of both wind profiles and eruptive parameters, where a different set of eruptive parameters (i.e. erupted mass, plume height, grainsize distribution) is stochastically sampled within a user-defined range at each run of the model; One Wind Scenario (OWS) based on the statistical distribution of eruptive parameters within user-defined ranges, where one wind profile is deterministically chosen; Multiple Eruptions Scenario (MES) combines multiples OES, ERS or OWS to assess the accumulation of tephra from multiple eruptions in a given time period; Long-Lasting Eruption Scenario (LLES) assesses the accumulation of tephra from long-lasting eruptions by discretising length of the eruption into short pulses and by scaling mass eruption rates and erupted mass to the plume height of each pulse.

This new toolbox facilitates each step of the compilation of probabilistic hazard assessments for tephra fallout, from the gathering of input parameters from disparate sources to the post-processing of the output data. Additional modules for the processing of input parameters help the user to define the best scenario to adopt on a case per case basis (i.e. seasonal assessments, elaboration of scenarios with variable availability of field data, different eruptive styles). This toolbox is therefore an operative tool that can be used to rapidly produce comprehensive hazard assessments for tephra fallout.

Introduction to Using WOVOdat

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WOVOdat is a web-accessible database of worldwide historical volcanic unrest. Open user access will be launched during 2013 IAVCEI Kagoshima meeting, which allow registered user to navigate into WOVOdat website ($www.wovodat.org$). Through this website, users will be able to obtain general information about WOVOdat and find 4 first-level menu selections:

- $Documentation$: Users may consult and download documentations (user manual, SQL schema, XML format, table formats). A WOVOdat installable standalone package is available for observatories that want to adapt WOVOdat for their own data management.

- $Volcano(data)$: Registered users will be able to interactively query the database and view volcano monitoring data set. Visualization tools in WOVOdat presently enable comparisons of processed monitoring data, e.g., earthquake hypocenters, displacements, and gas flux time series from different episodes of unrest from a single volcano, or from unrest of different but analogous volcanoes. The data set is still in an early stage of population, but contains enough data to show users its potential.

- $SubmitData$: Currently we offer 3 options for users to contribute data: (a) free format or original observatory format, (b) WOVOdat CSV standard format, and (c) Customary/known CSV format. Data can also be contributed using an online form and uploaded into SQL database following WOVOdat XML standard format.

- $Contact$: We invite scientists from volcano observatories, universities, and research institutions to participate in the growing of WOVOdat database by sharing their data and their expertise in developing visualization tools. The email address for the WOVOdat developer team is given under *Contact*.

PHIVOLCS-VDAS: Adaptation of the wovodat schema for the volcano monitoring records of the Philippine

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The World Organization of Volcano Observatories database (WOVOdat) schema, conceptualized in the 2000 IAVCEI meeting at Denpasar, is currently under pilot adaptation in the Philippine Institute of Volcanology and Seismology (PHIVOLCS) in collaboration with the WOVOdat Project of the Earth Observatory of Singapore (EOS). A stand-alone version of the database package, of which the back-end database and core scripts were coded by the WOVOdat Project in Open Source MySQL and PHP, respectively, was operationalized in early 2012, enabling web-access of volcano monitoring data in the PHIVOLCS Intranet. Simply called the Volcano Database System, or VDAS, the adapted database strictly follows the WOVOdat-prescribed format for all table fields and their relationships, particularly the hierarchical parent-to-child data structure Volcano -> Network -> Station -> Instrument ->Data. The WOVOdat adaptation for VDAS began with customization of the database structure in order to incorporate records of volcanological data that did not fit or exist in the standard table fields. During this phase, one rule observed strictly was the addition of fields (columns) to a particular table without editing or deleting the standard structure. Volcano catalog numbers or CAVWs assigned by the Smithsonian Institution (GVP) database were adapted and new CAVW numbers were assigned to volcanoes not included in the database. Conversion scripts for standardizing data to WOVOdat formats were customized by the WOVOdat Project for VDAS to enable the automation of data population. Other packages adapted were visualization tools (beta version) and log-in security features. Data population into VDAS is on-going and functional tests on conversions scripts have been undertaken successfully. Presently, about 20 percent of legacy volcano monitoring data for Mayon, Bulusan, Taal, Kanlaon, Pinatubo and Hibok-Hibok Volcanoes have been uploaded to VDAS. Online data entry forms are now being scripted and planned in order to support data population from frontline Observatories on these volcanoes.

Japan's Volcanic Disaster Mitigation Initiatives: Work Projects of the Commission on Mitigation of Volcanic Disasters, VSJ and Volcanic Hazard Maps in Japan, 2nd Edition

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The Commission on Mitigation of Volcanic Disasters (CMVD) was organized by the Volcanological Society of Japan (VSJ) in 2004. The Commission ´s aim is to explore various issues regarding volcanic disasters mitigations, and to put forward suggestions or recommendations to the public. To realize this agenda, the Commission holds open conferences for researchers, specialists, administrative staff and the general public at the time of the VSJ semiannual assemblies to exchange ideas and opinions in a broad and mutually beneficial cooperative atmosphere. Past topics have ranged widely and include the following: (1) systems for monitoring and observing active volcanoes, (2) volcanic warning and alert levels, (3) disaster management systems in active volcanic areas, (4) eruption scenarios and event-trees for disaster risk assessment, and (5) disaster mitigation concepts for wide-areas in the event of large-scale eruptions. Every public forum is held in autumn at a local city or town adjacent to an active volcano. This is a good opportunity for local citizens, regional disaster management staff, mitigation professionals, and volcanologists to have dialogues or conduct questionnaires regarding steady or urgent threats from active volcanoes. The Commission members obtain valuable opinions, ideas and feedback from the local people living adjacent to volcanoes.

Another main project of the Commission is to review or verify the current volcanic hazard maps that have been published in Japan. Therefore, a database system of volcanic hazard maps in Japan was worked out collaboratively by the Disaster Information Laboratory, NIED and CMVD. The first version of Volcanic Hazard Maps in Japan was published in 2006, followed by an English supplemental version in 2007. The current second version was published in March 2013. Also the revised online version is open to the public on the NIED website (http://dil.bosai.go.jp/documents/v-hazard/).

National Guideline for Producing Volcanic Eruption Disaster Hazard Maps was published in 1992. Subsequently several hazard maps for active volcanoes were published. However, the number of maps greatly increased after the 1991 eruptions of Unzen and the 2000 eruptions of Usu and Miyakejima. These large disasters were strong driving forces and great motivators to improve the volcanic disaster mitigation plans and hazard maps.

The present hazard map database includes 160 volcanic hazard maps in digital high-resolution images and the reference handbooks published for 40 of the 110 active volcanoes. We expect this publication and database to be an effective information infrastructure for local government officials, disaster management organizations, and researchers to develop future volcanic disasters mitigation plans.

Estimating volcano hazard and exposure in the Lesser Antilles

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The potential catastrophic effects of future volcanic eruptions in the Lesser Antilles can be decreased by the utilisation of effective risk quantification measures and their subsequent incorporation into disaster risk reduction strategies. A volcanic risk study conducted by the Norwegian Geotechnical Institute (NGI) in collaboration with Bristol Environment Risk Research Centre (BRISK) on priority countries of the Global Facility for Disaster Risk Reduction (GFDRR) of the World Bank provides a possible way for this to be achieved. Their study produced a simple estimate of the risk posed to any one country by combining numerically assigned hazard levels and their related uncertainty levels with population exposure indices for each volcano. Our study applied this methodology to countries in the Lesser Antilles to establish risk levels and assess its usefulness in preparing for the threat of upcoming eruptions.

A database of recorded past eruptions was compiled using data from three sources: Volcanic Hazard Atlas of the Lesser Antilles, Smithsonian Global Volcanism Program and LaMEVE. This data was then used to calculate hazard and uncertainty scores for selected islands using the NGI methodology. Initial results have put into perspective the hazard level of each volcano but have also highlighted possible limitations in applying this methodology to regions with limited data. Scores were found to underestimate hazard levels due to the paucity of recorded eruption together with the disparity in recorded histories for this region. To account for this, future eruption scenarios were used in tandem with past eruption details to determine volcano hazard levels. Population exposure indices were calculated to determine the overall volcanic risk for each island. It is anticipated that further work will help clarify the appropriateness of this method for estimating risk in the Lesser Antilles.

A quantitative assessment of Holocene explosive eruption records: Applications to Eastern Pacific and Caribbean volcanic arcs

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The volcanological record of past eruptions provides the data required for understanding the regional characteristics of eruptive activity in the context of global volcanism. Unfortunately, its usefulness is limited by the incompleteness of the record due to underreporting as you go back in time, together with recent advances in dating, monitoring and field techniques. This study sought to assess the legitimacy of existing catalogues of eruption events for giving a balanced interpretation of volcanic activity. Specifically it examined the applicability of trends arising from global datasets to explaining regional variations in volcanism.

The Holocene eruption record for the Americas was compiled from the Smithsonian Global Volcanism Program Database. This data was manipulated in different graphical ways to compare patterns of volcanic activity and magnitude-frequency relationships. The Holocene dataset was found to underestimate the importance of low magnitude events placing undue emphasis on large eruptions. A smaller dataset encompassing the last 300 years gave a more balanced representation of explosive eruptive activity. Using this reduced dataset, differences were found in the explosivity patterns of the arcs studied suggesting variations in crustal dynamics. Overall, the global dataset gave a different trend from the regional datasets suggesting that its use in regional analyses would only hide variations in the Earth's crust.

These results have implications for hazard analysis. Understanding the limitations of Holocene datasets is essential for making unbiased interpretations. Regional variations in volcanism are significant and should deter generalisations about volcanic activity.

Volcanoes of Kurile-Kamchatka Islands Arc information system

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Volcanoes of the Kurile-Kamchatka Island Arc (VOKKIA) web-based information system as a part of the geoportal of the Institute of Volcanology and Seismology (IVS) FEB RAS has been developing since December 2010 (geoportal.kscnet.ru/volcanoes/). The system will integrate available volcanological data (geological, geophysical, petrological, geochemical, etc.), relating to the volcanoes of Kamchatka, Kurile Islands and adjacent water areas. The main sources of information for VOKKIA are the data from scientific publications. In addition, we use an information web and local IVS FEB RAS resources about volcanoes: catalogs, databases, geographic information systems, different archives and collections volcanological data in various digital formats. The system has scalable module structure. At present it includes the blocks: Volcanoes, Eruptions, Monitoring, Images, Geoservices, Bibliography. VOKKIA provides a single interface to all components of its information blocks and an easy access to heterogeneous attributive data and associated interactive map services. Currently, the system contains descriptions of 178 volcanoes, are active in the Holocene. First, VOKKIA is completing of information about the historical eruptions from scientific publications and operative information about current eruptions from the Kamchatkan Volcanic Eruption Response Team (KVERT). VOKKIA will allow integration of wide range of data on volcanoes in Kamchatka, Kurile Islands and adjacent seas into a single information environment available for the world scientific community and for Internet users.

IVS FEB RAS Geoportal for integration and increasing availability of volcanological data

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Local Spatial Data Infrastructure (SDI) of the Institute of Volcanology and Seismology (IVS) FEB RAS as a peripheral node of SDI of Russian Academy of Sciences was created in 2010 and has been developing since that time. The SDI is aimed at providing free access to the distributed spatial data, and is designed to provide data exchange and complex utilization of data in scientific research. IVS FEB RAS Geoportal as a single point of access to volcanological data is the main element of SDI (http://geoportal.kscnet.ru). Architecture of the geoportal is being developing on the base of free open source software (GeoNetwork, GeoServer, etc.) that is distributed under the GPL license (GNU General Public License), as recommended by the OGC (Open Geospatial Consortium). One of the most important geoportal functions is providing an opportunity for search of data and services. A metadata management system with metadata catalogue serves this purpose. The catalogue contains descriptions of information volcanological resources: databases, datasets, publications, geoinformation systems (GIS), maps, photos, video content etc. Metadata in the catalogue correspond to the international standards. This allows the system to exchange metadata with remote sources on the Internet through a mechanism of metadata harvesting. Geoportal provides access to WMS and Google Earth services of spatial data visualization and interactive thematic maps. One of the directions of geoportal development is creation of data collections and providing access to this data using modern web-technologies. Examples of these resources: Volcanoes of the Kurile-Kamchatka Island Arc (VOKKIA) information system, Active volcanoes of Kamchatka and Northern Kuriles catalogue, Holocene Kamchatka Volcanoes catalogue, Late Cenozoic Pacific Submarine Volcanoes database, archives of Kamchatkan Volcanic Eruption Response Team (KVERT), Earthquakes of the Northern Group of Kamchatka Volcanoes 1973-1996 database etc. Geoportal promotes systematization of a wide range of IVS scientific information and ensures its integration in the global science information space.

Volcanoes of Japan (Third edition) , a compiled map, published in 2013

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The Geological Survey of Japan issued the map (1:2,000,000), Volcanoes of Japan (Third Edition), covering volcanoes in the Quaternary Period in Japan. The first and the second editions were issued in 1968 and 1981. The second edition covered Quaternary volcanoes in land areas and submarine volcanoes only with eruption records. Due to changes to the definition of geologic period definitions (the base of the Quaternary Period was changed from ca. 1.8 Ma to 2.6 Ma) by IUGS in 2009, the third edition has a significantly greater number of volcanoes compared to the second edition.

The distribution map was created based on the Seamless Digital Geological Map of Japan at the scale of 1:200,000. Geological boundaries on the seamless geological maps were integrated or removed, because the seamless geological maps which had been created until 2012 adopt the later part of the late Miocene and Pliocene (from approximately 7 Ma to 1.7 Ma) as a single period classification. Extracting individual volcanic rocks of the Gelasian Stage (from ca. 2.6 Ma to 1.8 Ma), which has been newly included in the Quaternary Period, has been manually carried out.

A large number of land volcanoes have been added due to the redefinition of geologic periods. Quaternary volcanoes according to the former definition are based on website, Quaternary Volcanoes in Japan, by the Geological Survey of Japan. A large volume of unpublished age measurement data was also referred to in looking into active periods. In addition to these, there are some volcanoes which were not in the second edition but have been included in the third edition, because they were found to be in the Quaternary Period. Information on such volcanoes is essentially based on the database by Nishiki et al. (2012). There, possible volcanic bodies to be Quaternary only judged by stratigraphy, and those having some age data with relatively large error span showing to be at the last stage of Pliocene (younger than ca. 3 Ma) are also included. In this publication, each of them were individually considered and omitted if the reason to judge it to be Quaternary were poor.

In addition to obvious submarine eruption points, sites with which any volcanic phenomena such as discolored water, floating pumice and submarine hydrothermal activity are found, are displayed as submarine volcanoes.