Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

SVC51-01 Room:102B Time:May 21 15:30-15:45

The next-generation real-time volcano hazard assessment system

TAKARADA, Shinji[1*]

[1]GSJ, AIST

Many approaches have been employed to mitigate volcanic hazards. Next-generation approaches will focus on real-time volcano hazard assessment, which is useful for volcanic eruption prediction, risk assessments, and evacuation at the various stages during the volcanic eruptions. Development of a real-time hazard assessment system is a priority effort for the near future.

1. Volcanic eruption scenarios

Defining volcanic eruption scenarios based upon precursor phenomena leading up to major eruptions at active volcanoes is quite important for the future prediction of volcanic eruptions. Important datasets to use include precursor phenomena such as dates of minor eruptions, distribution of tephra fall deposits, amount of essential materials, chemical composition variations, volcanic tremors, and GPS measurement. Compiling volcanic eruption scenarios after the major eruptions is also important. For prehistoric volcanic eruptions, detailed geological field work and dating are essential. Eruption dates, vent positions, and distributions of each volcanic deposit should be examined. Eruption volumes of each deposit should be reevaluated using a standard estimation method based on the more precise distributions. Well-constrained volumes and eruption age data are important inputs in making a high-quality volume-age diagram for the probabilistic analysis of future eruptions.

2. Volcanic eruption database

A high-quality volcanic eruption database, which compiles eruption age, eruption volume, and eruption styles, is important for the next-generation volcano hazard assessment system. The Global Volcano Model project is an ongoing effort, which includes the compilation of volcanic eruption database and makes risk assessment worldwide. Distributions of deposits should be stored in a GIS-based format.

3. Simulations

The volcanic eruption database is made based on past eruption results, which only represent a subset of possible future scenarios. Hence, different distributions from the previous deposits are mostly observed due to the differences, such as vent position, volume, eruption rate, wind directions and topography. Therefore, numerical simulations with controlling parameters are needed for more precise volcanic eruption predictions. Numerical simulations of pyroclastic flows, debris avalanches, lava flows, tephra falls, ballistic, and lahars should be done for major past eruptions at the major active volcanoes, and key parameters should be evaluated. Currently, many numerical simulations, such as Energy cone, LaharZ, PDAC, Titan2D, and VolcFlow are used for volcanic gravity current assessments. Appropriate simulation model should be selected with the consideration on the model's merits and demerits and on the purpose of the assessment. Online numerical simulations are provided by the GEO Grid volcanic gravity flow system and the V-Hub project.

4. Volcanic hazard assessment system

The next-generation real-time volcano hazard assessment system is should be developed based on volcanic eruption scenario datasets, volcanic eruption database, and numerical simulations. The use of next-generation system should enable the visualization of past volcanic eruptions datasets such as distributions, eruption volumes and eruption rates, on maps and diagrams using the timeline and GIS technology. In the system, prediction of arrival time and area affected by volcanic eruptions at any locations near the volcanic area should be possible, using numerical simulations. The system should estimate the volcanic hazard risks by overlaying the distributions of the volcanic deposits on major roads, houses and evacuation areas using a GIS enabled systems. Probabilistic volcanic hazards maps at active volcanoes sites should be made based on numerous numerical simulations. The next-generation real-time hazard assessment system would be implemented as a user-friendly interface, making risk assessment system accessible online anywhere in the world.

Keywords: volcanic hazard, real-time, next-generation, volcanic eruption scenario, volcano eruption database, simulation

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Overview of numerical simulations for volcanic disaster management.

ITOH, Hideyuki[1*]

[1]Iwate Prefectural University

Numerical simulation is very useful for determining potential area of inundation, depth of the flow and the time required for the flow to reach a particular point. But when we perform simulations, it is important to understand the systematic of the procedure. But more important is to understanding the key conditions that control flow behavior. Only the scenarios can give the guidance to set the key conditions of the flow behaviors.

This paper presents an overview of diverse computer simulations which using actual volcanic disaster engineering. And the author suggested several problems to performing the simulation.

Keywords: disaster prevention, hazard map, numerical simulation, scenario

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Overview of airborne laser scanner(lidar) for volcanology

SASAKI, Hisashi[1*]

[1]Kokusai Kogyo Co., Ltd.

Airborne laser scanner (lidar) is very useful technic to acquire a high resolution digital elevation model (DEM). According to a review of 2000s studies, a high-resolution DEM acquired by airborne laser scanner contributed to development of volcanic geomorphology, volcanic geology and volcano geophysics. Airborne laser scanner is also effective for an investigation at the time of volcanic eruption. However, we should note an airplane may not fly. In addition, data sharing of a high-resolution DEM is an important problem for volcanologist.

Keywords: lidar, active volcano, terrain analysis, modelization, disaster prevention, disaster investigation

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Real time volcano hazard assessment by precise terrain model and experiments with shampoo

CHIBA, Tatsuro[1*], ARAI, Kenichi[1], KISHIMOTO, Hiroshi[1], HIROTANI, Shiho[1], SUZUKI, Yusuke[2]

[1]Asia Air Survey co., ltd., [2]Izu Peninsula Geopark Promotion Concil

Volcanic disaster, within the range occur when various substances are released from the crater during the eruption, to reach, human and social activities have been conducted. Range that does not impact residents, not build important social infrastructure is the ultimate volcano disaster prevention. However, the frequency of occurrence of volcanic eruption is low, around the volcano for a variety of land use is in progress, when the eruption occurred, it is necessary to an emergency evacuation. In order to perform proper evacuation, start early in the eruption, the position of the crater (1), type of eruption (2), based on the (eruption rate) scale of the eruption (3), expected to reach to achieve, to plan evacuation of "real-time volcanic hazard" is highly desirable.

However, to perform calculations in a short period of time ie real-time simulation, hardware-consuming and expensive with the advanced computing power. In particular, basaltic lava flows in order to change significantly the flow direction by microtopography, it is necessary to compute accurate terrain model. In the vicinity of volcanic eruption is considered to be construction of infrastructure such it is quite difficult.

Thus, in the (2009), were examined analog experiment model to create a precise topographical model of Izu-Oshima, using other liquids on the model forest. Cutting the plastic rigid polyurethane based on DEM detail by Airborne LiDAR, to create a topographical model that was printed in 3D inkjet printer the three-dimensional map red on its surface, on it, is a stream of the liquid variety, lava flows most picked out something close to.

This system, when the eruption occurred, it becomes clear even the position of the crater, which imitated the lava flow, is that which flows down the whiskey and water 50% of the shampoo, it is possible to predict the range of influence rough immediately is. The experimental results can be observed in three dimensions from any direction in 3D, it is easy you can not change the position of the crater, to change the runoff rate. In addition, this model experiment, because it does not use any power, can also be used in situations outside the assumption that the all electric power loss.

Reference:

Hiroshi MORI,Hiroshi KISHIMOTO,Yusuke SUZUKI and Tatsuro CHIBA(2009)A laboratory study of lava flow and debris flow on the 3D model of Izu-Oshima Volcano,Proceedings of the Volcanological Society of Japan,p168.

Keywords: volcanic hazard, hazard map, simulation, analog model experiments, red relief image map, LiDAR

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A Brownian Passage-TIME model for recurrent volcanic eruptions: An application to Miyakejima volcano

Alexander Garcia[1], FUJITA, Eisuke[2*], Warner Marzocchi[1]

[1]INGV, [2]NIED

The definition of probabilistic models as mathematical structures to describe the response of a volcanic system is a plausible approach to characterize the temporal behavior of volcanic eruptions and constitutes a tool for long-term eruption forecasting. This kind of approach is motivated by the fact that volcanoes are complex systems in which a completely deterministic description of the processes preceding eruptions is practically impossible. To describe recurrent eruptive activity, we apply a physically motivated probabilistic model based on the characteristics of the Brownian passage-time (BPT) distribution; the physical process defining this model can be described by the steady rise of a state variable from a ground state to a failure threshold; adding Brownian perturbations to the steady loading produces a stochastic load-state process (a Brownian relaxation oscillator) in which an eruption relaxes the load state to begin a new eruptive cycle. The Brownian relaxation oscillator and Brownian passage-time distribution connect together physical notions of unobservable loading and failure processes of a point process with observable response statistics.

The Brownian passage-time model is parameterized by the mean rate of event occurrence, mu, and the aperiodicity about the mean, alpha. We apply this model to analyze the eruptive history of Miyakejima volcano, Japan, finding a value of 44.2 (+/-6.5 years) for the mu parameter and 0.51 (+/-0.01) for the (dimensionless) alpha parameter. The comparison with other models often used in volcanological literature shows that this physically motivated model may be a good descriptor of volcanic systems that produce eruptions with a characteristic size. BPT is clearly superior to the Exponential distribution, and the fit to the data is comparable to other two-parameters models. Nonetheless, being a physically motivated model, it provides an insight into the macro-mechanical processes driving the system.

Keywords: volcanic eruption prediction, probabilistic models, Brownian-passage time model, Miyakejima volcano, periodicity