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

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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

SVC51-02 Room:102B Time:May 21 15:45-16:00

Overview of numerical simulations for volcanic disaster management.

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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

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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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SVC51-04 Room:102B Time:May 21 16:15-16:30

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

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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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SVC51-05 Room:102B Time:May 21 16:30-16:45

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

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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

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SVC51-P01 Room:Convention Hall Time:May 21 17:15-18:15

Volcanic activity and lava activity detection using MODIS data

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There are a lot of active volcanoes in the world. But it is difficult to monitor all volcanoes because of costs. However, we can monitor efficiently a lot of volcanoes using satellite remote sensing technologies, because a volcanic activity will cause the increase in surface temperature and satellite (whose sensor can observe the surface temperature) remote sensing can cover a large area on surface. Therefore, our purpose of this study is to create an adequate algorithm detecting thermal anomalies related to volcanic activities (especially lava activity witch causes serious damages involve human lives) using satellite data. The developed algorithm investigates the difference temperature behavior between a target point and reference points. Therefore, removing cloud is essential in our algorithm.

The developed algorithm has been applied to Mt. Merapi (Indonesia), Mt. Shinmoedake (Japan) and so on and we found the effectiveness of it and reduction of faint changes due to clouds. The details will be shown in our presentation.

Keywords: MODIS, surface temperature, volcanic and lava activity, Cloud detection, Mt. Shinmoedake, Mt. Merapi

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SVC51-P02 Room:Convention Hall Time:May 21 17:15-18:15

An attempt of estimating a possible lava flow distribution from Sakurajima Showa crater with a simple numerical model

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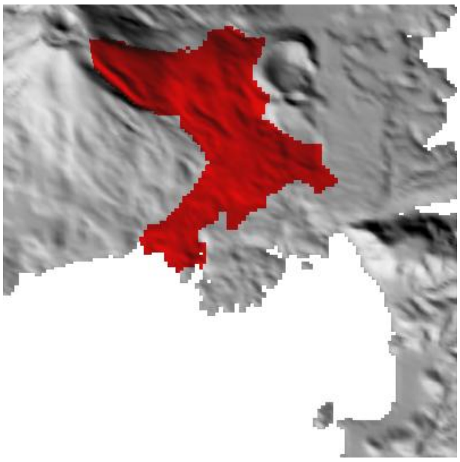
I will present a preliminary result of lava flow simulations conducted with a newly developed simple kinematic model discretized in a finite difference scheme. I estimated the distribution of a lava flow originated from Showa crater of Sakurajima Volcano because the volcanic activities at the crater have been significantly increased in these years.

The spreading speeds of lava flows are assumed to be directly proportional to the gradient of the topography including the effect of the depth of lava flows. The calculation domain is dynamically varied depending on the lava flow distribution to save computational time. The topography is described with a 50 m grid digital map of Sakurajima area published by Geospatial Information Authority of Japan.

The numerical results indicate that the distribution of lava flow that may be generated in near future is similar to the distribution of lava flow during the eruption in 1946 except that the simulation does not generate the lava flow that reaches Kurokami area throught a valley between Mt. Nabeyama and Mt. Gongenyama as shown in Figure.

Such a simple numerical model may be helpful for the civil defense officials during volcanic crises although it should be carefully validated by comparing its results with observational data obtained during actual eruptions and simulation results obtained from more sophisticated numerical models.

Keywords: lava flow, simulation, Sakurajima, Showa crater



SVC51-P03 Room:Convention Hall Time:May 21 17:15-18:15

Quick analysis system for debris flow hazard area after volcanic eruption

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After the eruption, it is well known that rainfall is more likely to trigger debris flow. In order to mitigate debris flow disaster, it is necessary to know the distribution of volcanic ash and to know the inundation area for the post-eruption debris flow. The authors have developed the quick analysis system for estimation of the debris flow inundation area. In the system, the number of the critical parameters are limited as far as possible depending on the sensitivity for the final results. It was actually utilized at the time of the 2011 Kirishima Eruption and succeeded in showing debris flow inundation area for 35 torrents almost within a week.

Keywords: Post eruption debris flow, 2 dimensional debris flow inundation simulation, The 2011 Mount Kirishima Eruption

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The single image photogrammetry system of using CCTV-camera and Digital elevation model

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The single image photogrammetry system of using CCTV-camera and Digital elevation model

Keywords: CCTV camera, Oblique airborne image, Ortho photo, DEM(Digital Elevation Model), Ash fall area, Single image photogrammetry

SVC51-P05 Room:Convention Hall Time:May 21 17:15-18:15

Particle source modeling using modified Tephra2; an application using Izu-Oshima 1986 eruption

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Modeling of particle release from eruption plume is critical to improve fallout forecast and also an important theme on physical volcanology. Gravity current model such as Bursik et al. (1992) has assumed particle release take place from the bottom of the horizontally spreading umbrella cloud. On the other hand, advection-diffusion models after Suzuki (1985) have modeled particle release from uprising eruption column.

In this study, a modified version of Tephra2, which is an advection-diffusion model including fallout from the umbrella, is used to obtain source parameters of the 1986B eruption of Izu-Oshima volcano. The best fit parameters such as column height, characteristic width of column, and distribution of particle release (expressed using two parameters of Suzuki function; A and lamda) are obtained as follows.

The best fit column height deduced to be 12km is consistent to the observation of the eruption; however, particle release from the umbrella is very limited and release from the column is significant. The characteristic column width is more than 1000m. This result may consistent to the fact that the eruption is a fissure eruption from more than 1km long vent system.

Keywords: eruption column, Izu-Oshima, tephra, ash fall