Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SVC49-01 Room:201A Time:May 19 09:00-09:15

Overview of interpretation microtopography of volcano

Tatsuro Chiba[1*], Kenichi Arai[1], Hisashi Sasaki[1], Hiroshi Kishimoto[1], Shiho Hirotani[1]

[1]Asia Air Survey Co., Ltd.

For disaster prevention and mitigation of disasters caused by the volcanic eruption is an effective measure to clarify the characteristics of the volcanic activity in the past, to know in advance the range of high-risk and hazard maps. To do this, grasp of past performance is a challenge for each volcano. Sediments that make up the surface of the volcano What kind of thing is, somewhere, how far has reached the position of the crater, the volume it is important to know how much. However, the eruption interval is covered with trees for longer, even in aerial photographs and field survey, it was difficult to grasp has been often.

Detailed data of the terrain recent advances in airbone LiDAR, and to eliminate the influence of the trees have been able to obtain. In addition, the use of three-dimensional map of red as a method to represent data microtopography of LiDAR-DEM, the use of field survey and interpretation microtopography progresses, the discovery of volcanic activity and vent, previously unknown.

With interpretation and field survey shows an example of a red relief image map using laser 1mDEM . We want to show a manual of interpretation microtopography with red relief image map.

Keywords: microtopography, LiDAR, RRIM, lava flow, pyroclastic flow, hazard

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SVC49-02 Room:201A Time:May 19 09:15-09:30

Recapitulation on the development of an unmanned ground vehicle "Mobile Observatory of Volcanic Explosion (MOVE)"

Akio Goto[1*], Hiromitsu Taniguchi[1], Mie Ichihara[2]

[1]Center for Northeast Asian Studies, Tohoku University, [2]Earthquake Research Institute, University of Tokyo

To observe volcanic explosions safely from near we developed an unmanned ground vehicle "Mobile Observatory of Volcanic Explosion (MOVE)", as one of a main project in Grants-in-Aid for Scientific Research "Dynamics of Volcanic Explosion" conducted from 2002 for 5 years. Since then we repeated its trial and improvement to make ready for coming eruptions, but without an opportunity for it, ten-year durable period passes. The installed equipment is out of date now and some of their repair parts are out of stock. We consider it is unrealistic to maintain MOVE anymore. Here we recapitulate the MOVE project to terminate it.

We planned to remodel an existing remote-controlled vehicle, and selected power shovel MPX10 by Hitachi Construction Machinery Co., Ltd. designed to work at dangerous disaster site under operator's eyes within 100m distant. We initially installed four cameras and enhanced wireless controlling system to operate MOVE from 2 km distant. The operator runs MOVE based on transmitted camera images. The position of MOVE is displayed on the map at the operation base using transmitted GPS data. To enhance the controllability two cameras for monitoring tiltmeter and viewing back, respectively, are added later.

To catch wide amplitude and frequency range pressure waves, four pressure sensors with different properties were installed; piezo-electric pressure transducer, gauge-type pressure sensor, low frequency condenser microphone and a differential pressure sensor. A quick-response thermocouple was also installed to measure the temperature of volcanic blast and surge. Acquired signals are stocked into the installed multimedia acquisition system and simultaneously displayed at the operation base graphically. The stocked digital data can be sent to the observation base on demand.

A heat insulation box was mounted to contain remote-controlling and observation equipment and their power supplying batteries. A grapple was substituted into bucket on end of the arm to remove obstacles, install an observation system on the ground and collect rock samples.

We also developed operation base car equipped with operation system and telescopic antenna pole. It shortened the setting up and closing time greatly, made operation possible even under bad weather and extended flexibility to select operation base location.

During the past ten years we maneuvered only four times on volcanoes, two times each at Aso volcano and at Izu Oshima. In addition to the cost problem, there seemed no other appropriate test field to apply MOVE. Through the maneuvers we recognized that it is much difficult to run MOVE on volcanoes than expected. Especially disconnection of image transmission radio by topographic interruption is serious. Even on Aso volcano we could not complete to run MOVE to crater rim. On Izu Oshima, to the contrary, we avoided radio disconnection by moving the operation base car to new position where there was no topographic interruption against MOVE and succeeded in running it to crater rim. We confirmed over 2.3km remote controlling is possible if there is no topographic interruption to hinder radio transmission.

It is hard to say we achieved our aims satisfactory without bringing MOVE into observation. But we clarified hurdles such as restriction by radio law and necessity of operating organization, in addition to technological difficulties. We are also sure we have blazed a trail for future unmanned exploration. In fact some unmanned vehicles, such as SKY-1 and Homura, have been developed later for volcanic observation, and "Observation Robot Symposium and Field Experiment in Izu-Oshima Volcano" is annually held since 2009. We hope unmanned observation will be practical and the pioneering MOVE project will receive recognition in the future.

Acknowledgements: We are grateful to engineers of Hitachi Construction Machinery Co., Ltd. and IHI Aerospace Co., Ltd., who constructed MOVE, and all participants who supported our activities.

Keywords: volcanic explosion, unmanned observation, remote controlling

SVC49-03 Room:201A Time:May 19 09:30-09:45

The G-EVER next-generation real-time volcanic hazard assessment system

Shinji Takarada[1]*

[1]Geological Survey of Japan, AIST

The Asia-Pacific Region Global Earthquake and Volcanic Eruption Risk Management (G-EVER) Consortium among the Asia-Pacific geohazard research institutes was established in 2012. There are currently 4 working groups that were proposed in the G-EVER Consortium. The next-generation volcano hazard assessment WG is planning to provide a useful system for volcanic eruption prediction, risk assessment, and evacuation schemes at various eruption stages. The assessment system is planned to be developed based on volcanic eruption scenario datasets, volcanic eruption database and numerical simulations. Defining volcanic eruption scenarios based on precursor phenomena leading up to major eruptions of active volcanoes is quite important for the prediction of future eruptions. A high quality volcanic eruption database, which contains compilations of eruption dates, volumes and styles is important for the next-generation volcano hazard assessment system. Formulating international standards on how to estimate the volume of volcanic products (eg. tephra and pyroclastic flow deposits) is needed in making high quality volcanic eruption database. Spatial distribution database of volcanic products (eg. tephra and debris avalanche distributions) that are encoded on Geographic Information System (GIS) is necessarily for more precise area and volume estimation and risk assessments. For example, tephra fall distribution database of major eruptions in the world with estimated total volume, column height and flux are important for the future tephra fall risk assessment during volcanic eruptions. The volcanic eruption database is developed based on past eruption results, which only represent a subset of future scenarios. Therefore, numerical simulations with controlled parameters are needed for more precise volcanic eruption predictions. The "best-fit" parameters of the past major large-scale eruptions in the world have to be estimated and the simulation results database should be made. Using these best-fit parameters is quite useful for emergency situation especially when similar-style eruptions happened before.

The use of the 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 timeline and GIS technology. Similar volcanic eruptions scenarios should be easily searchable from the eruption database. Using the volcano hazard assessment system, prediction of the time and area that would be affected by volcanic eruptions at any locations near the volcano would be possible, using numerical simulations. The system should estimate volcanic hazard risks by overlaying the distributions of volcanic deposits on major roads, houses and evacuation areas using a GIS enabled system. The next-generation real-time hazard assessment system would be implemented with user-friendly interface, making the risk assessment system easily usable and accessible online.

Keywords: next-generation, real-time, vocanic hazards, G-EVER, simulation, database

Japan Geoscience Union Meeting 2013
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SVC49-04 Room:201A Time:May 19 09:45-10:00

For the next generation volcanic Sabo planning

Hideyuki Itoh[1*]

[1]Iwate Prefectural University

More than 20 years passed after the master plan of Volcanic Sabo (disaster mitigation) was created. Constructions works, warning system installation and various disaster mitigation plan associated with the master plan were developed for more than 27 domestic volcanoes. These plans have been created with new technical development including the numerical simulations.

In this presentation, an overview of volcanic Sabo planning that has been developed, and suggested several problems to planning of it.

Keywords: volcanic Sabo plan, numerical simulation, New technology, GIS

SVC49-05 Room:201A Time:May 19 10:00-10:15

Numerical study on time-series of ash concentration in the atmospheric boundary layer during the eruptions at Mt. Shinmo

Yasuo Hattori[1*], Hitoshi Suto[1], Yumiko Go[2], Kiyoshi Toshida[1], Hiromaru Hirakuchi[1], Shuji Ishihara[2]

[1]Central Research Institute of Electric Power Industry, [2]Denryoku Computing Center

An estimation of ash concentration in the planetary boundary layer (PBL), is of practical interest in discussion on volcanic ash impacts on critical infrastructure. For estimating ash concentration in the atmosphere, numerical simulations with an ash transport- and deposition-model have become a powerful tool (e.g. Folch 2012). However, the ash concentration in the PBL, where the ash transport processes strongly depend on meteorological conditions, has not fully discussed, while that for the atmosphere and the ground deposition have been actively examined.

In the present study, we consider a test case corresponding to the eruption at Mt, Shinmoe-dake on January 2011; the eruption column height is approximately 8000m and the total mass flow rate is about 5e9 kg during 2 hr.

We have used two models to represent the interaction between dispersion- and meteorological- processes: one is the CRIEPI weather forecasting and analysis system, NuWFAS, which consist of a numerical weather model, WRF, and some pre- and post-processing tools; the other is an ash transport- and deposition-model, Fall3D. The numerical weather-model parameters, such as the horizontal- and vertical-grid spacing and PBL scheme, are set to correctly predict advection and turbulence diffusion processes in the PBL, which are chosen through the sensitively test.

After verifying the capability of this setup through the comparison with the observations of isomap of ash deposition, we discuss the predicted ash concentration in the atmospheric surface layer in detail; the time-series of ash concentration near the ground, especially near the vent, depict complex wave forms and there values fluctuates; this is due to the change in the advection and turbulence diffusion processes of volcanic ash.

More details will be presented in the presentation, and we believe that our study must be helpful to comprehend essential characteristics of ash transport process in the PBL.

Keywords: Volcanic ass dispersion, Ash transport- and deposition-model, Numerical weather prediction, Advection, Turbulence diffusion

Japan Geoscience Union Meeting 2013
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SVC49-P01 Room:Convention Hall Time:May 19 18:15-19:30

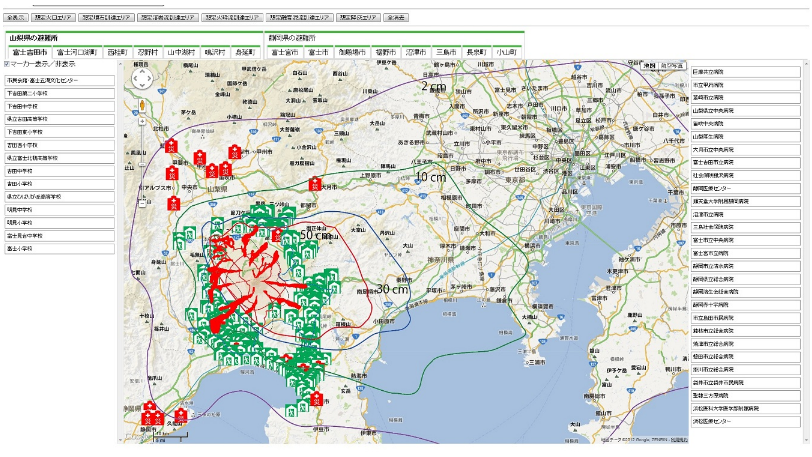
The Development of a Web-based Volcano Hazard Map by Integrating into the Disaster Medicine Information-Sharing System

Yasuhiro Ishimine[1]*

[1]National Institute of Public Health

On the basis of the lessons learned from the Tohoku Earthquake and Tsunami Disaster occurred on 11th March, 2011, National Institute of Public Health are now developing a cloud-based information-sharing system to facilitate medical support teams to effectively and efficiently distribute a limited number of staff and resources during large-scale disasters. The mapping of relevant facilities, such as evacuation shelters and hospitals, is the key function of the information-sharing system because the understanding of geographical relationships is the first step to visit and work in an unfamiliar area during disasters. The system is also able to display the hazardous areas such as inundated lands due to tsunami and the debris-covered areas due to landslides. That means we can apply the information-sharing system to volcanic eruptions to display the potentially hazardous areas, although most previous hazard maps for volcanic eruptions have been printed on paper. In my presentation, I will show an example of the application by using the hazard map of Mt. Fuji, which has been published by Mt. Fuji Volcanic Disaster Prevention Conference in 2002 (See Figure 1).

Keywords: Hazard Map, GIS, Volcanic Eruption, Mt. Fuji, Disaster Medicine, Public Health



Japan Geoscience Union Meeting 2013
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SVC49-P02 Room:Convention Hall Time:May 19 18:15-19:30

Proposal of practical use of unmanned observation robots in the next Izu-Oshima eruption

Kazuto Saiki[1]*

[1]Graduate School of Science, Osaka University

In the case of a volcanic eruption, in order to carry out evacuation guidance, it is important to observe the changing situation from just after the eruption to the completion of evacuation. In the 1986 eruption of Izu-Oshima, the explosive eruptions occurred at the unexpected points such as caldera floor and outside of a caldera. Therefore, volcanologists could not approach the vents and the opportunity of observation to gain the precious data for scientific understanding of the eruption phenomenon or disaster mitigation was lost. Moreover, during the evacuation from the island, the situation of the eruption had not been announced correctly to residents, and the mistaken information that the lava flow cut off the traffic between Okada-Motomachi was spread. Today, 20 years or more pass since a previous eruption in Izu-Oshima, and it has become the time to prepare the next eruption. In order to improve the situation at the time of the next eruption, development of the new observation robot which can respond immediately to an eruption and the establishment of an operation framework are required. From such a viewpoint, the author started Izu-Oshima Unmanned Observation Robot Symposium in 2009. This symposium is intended to bring together experts developing unmanned observation robots from different study fields such as volcanology, space engineering, and disaster relief to Izu-Oshima and to provide them the opportunity of field tests and exchange of knowledge to make them accelerate the development of the robots and the establishment of the operation framework. For these four years, many participants gathered to perform field test and to have an active information exchange. 8 UGV and 2 UAV from 9 research groups (2009), 5 UGV and 2 UAV from 5 groups (2010), 13 UGV and 3 UAV from 9 groups (2011), and 13 UGV and 6 UAV from 10 groups (2012) participated in the symposium. It can be said that the symposium grew up to be the biggest one as a field-test meeting for the volcano observation robot. At the presentation, the results so far and a future view will be shown. For further detail of the symposium in the current fiscal year please refer to the following URL (http://oshimarobot.web.fc2.com/index.html).

Keywords: Izu-Oshima, unmanned observation robot, robot, volcano

Japan Geoscience Union Meeting 2013
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SVC49-P03 Room:Convention Hall Time:May 19 18:15-19:30

geopark & volcanic activity

Kazuyuki Nakagawa[1*]

[1] JijIPress

The geopark started in 2008 in Japan.
5 societies take part in the planning. The Volcanological Society of Japan, The Geological Society of Japan, The The Japan Association for Quaternary Research, the Association of Japanese Geographers, Seismological Society of Japan.
Earth science knowledge has told that it is indispensable to a geopark.
In 2012,25 geoparks is located in Japan.
There is an active volcano in the geopark of 11.
There are also seven geoparks which can enjoy the scene related to volcanic activity.
The sightseeing and the volcano disaster prevention which have sometimes so far been opposed to each other work together at Geoparks.
In the eruption of the Kirishima volcano in 2011, receive coverage from the sightseeing persons concerned. ”Mt. Shimmoe is a valid volcano.
It was chosen as the geopark and it was said that erupting because the volcano is made sale was natural.”
The measure for volcano disaster prevention in each geopark is surveyed.

Keywords: geopark, volcano, disaster, geotour

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SVC49-P04 Room:Convention Hall Time:May 19 18:15-19:30

The Eruption Scenario of Bandai Volcano by the topographic Analysis

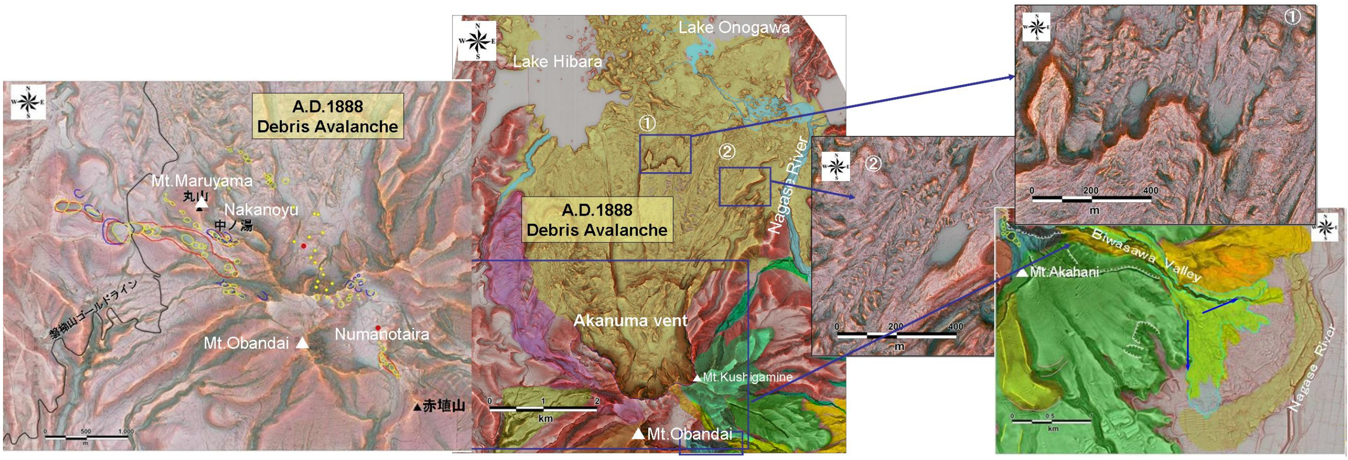
Kenichi Arai[1*], Tatsuro Chiba[1], Hiroshi Kishimoto[1], Shiho Hirotani[1]

[1]Asia Air Survey Co., Ltd.

Making a Red Relief Image Map based on terrain analysis using LiDAR data of Mt.Bandai Volcano. I checked local records, etc. Based on the report and recent topographic analysis after the eruption of Mt.Bandai A.D.1888 eruption, I have confirmed traces of volcanic topography and sediment movement caused by the eruption which had not been previously known.

In addition to soil movement due to the collapse of the mountain forming a natural dam in the foothills north, at Mount Bandai after the A.D.1888 eruption, the sediment transport and repeating pyroclastic surge toward the swamp biwa southeastern foot, mudflow type eruption crater occurred important information such as the review is considered to have been, a scenario that forms the basis of measure eruption volcanic eruption was obtained.

Keywords: LiDAR, Erution Scenario, Volcanic Disaster, Terrain analysis, Red Relief Image Map, Lahar



Japan Geoscience Union Meeting 2013
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SVC49-P05 Room:Convention Hall Time:May 19 18:15-19:30

Eruption Scenarios and Volcanic Risk Mitigation Strategies of Hokkaido Komagatake Volcano, Northern Japan

Mitsuhiro Yoshimoto[1*]

[1]Department of Natural History Sciences, Faculty of Science, Hokkaido University

During the 350 years, four major eruptions of Hokkaido-Komagatake volcano occurred in 1640 1694, 1856 and 1929. The 1929 eruption was one of the largest magmatic eruptions in Japan in the last 100 years. The disaster management for volcanic disaster of the volcano has carried out since 1980, although volcanic activities have been inactive since 1942. Because no major precursor activity was recognized prior to 1929 plinian eruption, so for the suspected future eruption, it is necessary to cooperate with wide area for quickly and smoothly evacuation. Komagatake Volcanic Disaster Prevention Council organized by five local governments in 1980 has prepared disaster management plans on the assumption that a future eruption is similar scale of the 1929 eruption, and produced hazards map for the volcanic disaster which is the first map for a volcanic disaster in Japan. The Plan was revised entirely in 2004 based on the experiences incurred at the time of the 2000 Usu eruption and the 1998-2000 Komagatake eruptions.

In this presentation, I show the volcanic risk mitigation strategies of Hokkaido-Komagatake volcano, and examine the eruption scenarios based on the revised eruption history of the volcano.

Keywords: Hokkaido-Komagatake Volcano, Eruption Scenarios, Volcanic Risk Mitigation

SVC49-P06 Room:Convention Hall Time:May 19 18:15-19:30

Integration of stochastic models for long-term eruption forecasting into a Bayesian event tree scheme

Alexander Garcia-Aristizabal[1], Jacopo Selva[1], Eisuke Fujita[2*]

[1]INGV, [2]NIED

Eruption forecasting refers, in general, to the assessment of the occurrence probability of a given eruptive event, whereas volcanic hazards are normally associated with the analysis of superficial and evident phenomena that usually accompany eruptions (e.g., lava, pyroclastic flows, tephra fall, lahars, etc.). Nevertheless, several hazards of volcanic origin may occur in noneruptive phases during unrest episodes. Among others, remarkable examples are gas emissions, phreatic explosions, ground deformation, and seismic swarms. Many of such events may lead to significant damages, and for this reason, the risk associated to unrest episodes could not be negligible with respect to eruption-related phenomena. Our main objective in this paper is to provide a quantitative framework to calculate probabilities of volcanic unrest. The mathematical framework proposed is based on the integration of stochastic models based on the analysis of eruption occurrence catalogs into a Bayesian event tree scheme for eruption forecasting and volcanic hazard assessment. Indeed, such models are based on long-term eruption catalogs and in many cases allow a more consistent analysis of long-term temporal modulations of volcanic activity. The main result of this approach is twofold: first, it allows to make inferences about the probability of volcanic unrest; second, it allows to project the results of stochastic modeling of the eruptive history of a volcano toward the probabilistic assessment of volcanic hazards. To illustrate the performance of the proposed approach, we apply it to determine probabilities of unrest at Miyakejima volcano, Japan.

Keywords: Volcanic unrest, Eruption forecasting, Bayesian event tree, Stochastic models, Miyakejima volcano

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SVC49-P07 Room:Convention Hall Time:May 19 18:15-19:30

Terrain analysis of an active volcano using oblique photogrammetry

Hisashi Sasaki[1*], Kenichi Arai[1], Shigenori Fujimaki[1], Yumiko Yamaguchi[1], Manabu Maya[1]

[1]Asia Air Survey Co., Ltd.

Volcanic eruptions often cause topographic changes, such as the destruction of an edifice due to an explosive eruption. For volcanic hazard mitigation, it is important to quickly measure these topographic changes. When a volcano erupts explosively, an airplane cannot fly directly over a crater to carry out aerial photography and LiDAR measurements. In order to obtain information regarding topographic changes, we can take many oblique aerial photos from an airplane and a helicopter, but it is difficult to obtain spatial information such as the spread area of pyroclastic flow deposits from oblique aerial photos. Therefore, we have developed a new system for real-time monitoring of volcanic activity. Our system can generate a three-dimensional model from many oblique photos. The three-dimensional models are generated by an image correlation method. From this data, we can estimate the volume of ejecta and analyze topographic changes. We analyzed a lava dome from the 2011 eruption of Shinmoedake volcano, Kirishima volcanic group, Japan. We measured the elevation of the summit of the lava dome and the distance of the lava spread area, and estimated lava thickness from cross sections generated from the three-dimensional data. Our measurements were consistent with results of airborne synthetic aperture radar (SAR) and photographic surveying using oblique aerial photographs. The accuracy of this system is sufficient for effective volcano monitoring. This system can be used to conduct a time series analysis of the formation and movement of craters or growth of lava dome.

Keywords: oblique photogrammetry, active volcano, terrain analysis, modelization, disaster prevention, disaster investigation

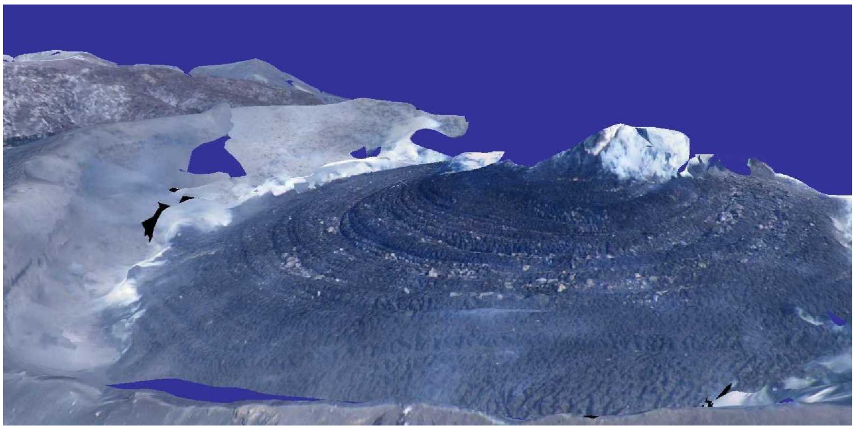
Fig.1 Three-dimensional model generated from oblique aerial photo

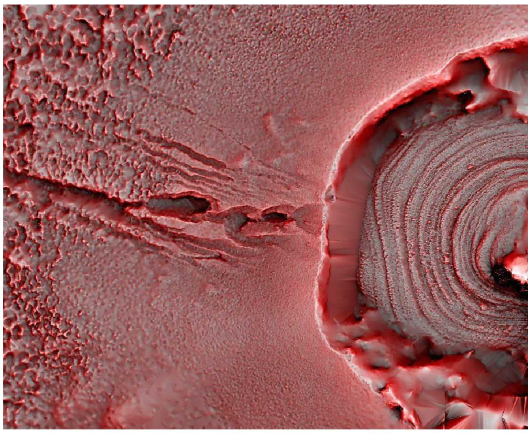
Fig.2 Red Relief Image Map

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Quantitative estimation of topographical change caused by 1986 eruption at Izu-Oshima

Naohiro Heya[1*], Kazuto Saiki[1]

[1]Graduate School of Science, Osaka University

The 1986 eruption at Izu-Oshima produced three types of lava flow (LA, LB, and LC) from different craters. In order to test the algorism for a numerical simulation of lava flow in the near future, we made a digital elevation model (DEM) of Izu-oshima before eruption and measure the topographical change by subtracting a DEM before eruption from that after eruption. The post-eruption DEM has already been published as "Digital Map 10m Grid (Elevation of active Volcanos) " by The Geospatial Information Authority of Japan (GSI). On the other hand, there is no published pre-eruption DEM. We digitized a topographical map (paper map) published in 1981. We made a digitizing assist software with Processing language and digitize the shape of contour lines of the topographical map. Then the data was resampled into 1 m mesh DEM with kriging method by a mesh resampling software that we made with IDL language. Kriging is a group of geostatistical techniques to interpolate the value of a random field, based on a stochastic model of the spatial dependence quantified by the variogram. To estimate an amount of shift between the pre-eruption DEM and the post-eruption DEM, we searched for shift-parameters for the match by shifting the area of post-eruption DEM at eastern caldera, which is not topographically affected by eruption, ranging +-50 m horizontally with 1 m intervals and +-30 m vertically with 0.1 m intervals and checked the difference between the pre- and post- eruption DEMs at the area. When we shifted the post-eruption DEM 29 m to the South, 31 m to the West, and 0.8 m downward, the average of absolute difference of elevations took minimum value 2.09 m. Because the value does not match the amount of shift by plate sliding, it requires consideration. Using the matched DEMs and a boundary shape of Lava A interpreted by Google Map's satellite image we estimated the volume of Lava A by multiplying grid area (10 m x 10 m) and the difference of elevation between the DEMs and obtained the value 6.6 x 10^5 m^3. The estimated volume is a little larger than the value (5.5 x 10^5 m^3) estimated by Nagaoka (1988) and that (2.3 x 10^5 m^3) by Endo et al. (1988). We estimated also the amount of deposition by Lava B and a scoria cone and obtained the value 38 m maximum. We found a new landslide at Kengamine and confirmed it by Google Map's satellite image interpretation.

Keywords: lava flow, topographical change, DEM

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Particle fallout from a eruption column - an analysis using Tephra2

Kazutaka Mannen[1*], Charles B. Connor[2]

[1]Hot Springs Research Institute of Kanagawa Prefecture, [2]University of South Florida

Tephra fall simulations sometimes give significantly inconsistent results from observed data. One of the sources of the error is the source model, which depicts the amount of particle released from a certain height of an eruption column. In this study, we modeled particle source of the 1986 Izu-Oshima eruption based on tephra fall simulation and observed data.

We calculated mass contribution (c_{ij}) of a certain height interval in the eruption column (i) to a certain observation point (j) using a tephra fall simulation code Tephra2. When the amount of released particle is r_i, amount deposit at a site j (S_j) equals to Sigmacijri. In this study we set evaluation function, which is the representative degree of fitness between calculated (S_{cj}) and observed (S_{oj}) S_j as E = log(S_j/S_{oj}). Then we obtained a set of r_i that shows minimum E using grid search.

Our result shows that most significant particle discharge takes place at 2 to 3 km high and up to 90% of released particle from the vent is lost from the column at this height. The particle of -2 and -3 phi also released from 6 to 7 km high and approximately 20% of released particle from the vent is lost from the column at this height. For the particles smaller than -2 phi, particle release more than several km in height is not known because these went beyond the island's shore and fell to the sea. For particles larger than -3 phi, particle release from several km high is not significant.

From the previous studies, height of the 1986 Izu-Oshima eruption column is considered to be 13km in maximum and 10km in most of the time. Thus the particle release from 6 to 7 km high implied in this study could be interpreted as particle from the umbrella cloud. On the other hand, the particle release from 2 to 3 km high may take place plume bending due to the high wind at the altitude.

Keywords: eruption column, volcanic ash, Izu-Oshima, tephra fall, simulation, Tephra2