HDS06-01   Room:301A   Time:May 22 09:00-09:15

Lessons Learned from the 11 March 2011 Geart East Japan Earthquake and Tsunami: Perspectives from Filipinos in Japan

M.L. Martinez-Villegas[1], INOUE, Hiroshi[2]*, R.U. Solidum, Jr[1], H. Imai[2], B.C. Bautista[1], M.A.V. Bornas[1], P.J. Delos Reyes[1], A. Lanuza[1], M. Lasala[1], M.L.O.P. Melosantos[1], I.C. Narag[1], M.D. Pagtalunan[1], J.C. Salcedo[1], H. Penarubia[1]

[1]Philippine Institute of Volcanology and Seismology (PHIVOLCS), [2]National Research Institute for Earth Science and Disaster Prevention (NIED)

Three months after the 11 March 2011 Magnitude 9 earthquake that triggered one of the worst tsunami events ever experienced in Japanese history, a team of Filipino and Japanese scientists interviewed fifty (50) Filipinos who survived the event. The Filipino survivors were interviewed between June to August 2011. Most of the Filipinos interviewed have been residents of Japan for as short as 2 years to as long as 36 years. The purpose of the interviews was to gather first-hand survivors and eyewitnesses accounts of the so that valuable lessons from this event in terms of awareness, preparedness and response can be highlighted.

The video-documented interviews aimed to gather from the field, technical information on the impacts of the earthquake and tsunami. The interviews specifically focused on determining what worked and did not seem to have worked on the existing warning and communication system on the national level as well as community level during the event. The interviews took into account an understanding of both the hardware system and message content during emergencies as practiced in Japan. One significant observation is that the content of pre-disaster earthquake and tsunami awareness campaigns did not have much information on scenario impacts, timing between the earthquake occurrence and arrival of tsunami, and lacked emphasis on intuitive observations of the natural signs for people to understand the phenomena and make proper individual response. Pre-disaster activities put too much emphasis on evacuation drills and procedures and this led to much dependence on public address systems and sirens (once siren is heard, go to identified evacuation site). The existence of seawalls in some areas also provided false sense of security. The constant triggering-off of the public sirens even during minor earthquake events and "no impacts" observed even after issuance of warnings for possible tsunamis through time, may have also contributed to the kind of response by some people at the crucial time when the big event finally occurred.

Although very tragic in its impacts, the event gave the opportunity to review existing procedure and systems in the Philippine setting. The lessons learned can be used in the current earthquake and tsunami awareness and preparedness program in the Philippines that emphasizes understanding and observations of the natural signs especially for locally-generated events, and encourages the establishment of community-based early warning system.

Disaster Reduction Effort and Reconstruction after the 2011 Great East Japan Tsunami

SUPPASRI, Anawat[1*], Fumihiko Imamura[1], Shunichi Koshimura[1]

[1]Disaster Control Research Center, Graduate School of Engineering, Tohoku University

The 2011 Great East Japan tsunami caused damage in a wide range and affected to various aspects of tsunami preparedness and mitigation. Some important topics to reduce human damage for such a large event are awareness and evacuation. This paper introduces some lessons learned and presents reconstruction status for such damage reduction.

Field surveys were conducted in tsunami affected areas to observe present reconstruction status around Sendai city. Recently, Sendai city provided new tsunami hazard map adding more evacuation shelter including a coastal adventure park that survived the 2011 tsunami. Disaster memorial was built near Arahama coast. Sendai airport which was reopened since April 2011 provides tsunami inundation mark of 3 m at the 1st floor of the terminal. Sendai airport access line was reopened since October 2011 and also provides some space for a display of tsunami damage pictures. Concrete stairs were built along the Tohoku express way because there were many people survived by climbing it. Namiwake shrine which is famous for their legend of a historical tsunami in 1611 put a sign giving information of the legend due to a large number of visitors after the 2011 event. For other areas, overturned buildings in Onagawa town, shrine in Yuriage village will become a symbol of tsunami disaster. Rikuzen-Takata city has a plan to plant Sakura tree along the tsunami inundation limit of the 2011 tsunami. Iwanuma city has a plan to construct escape hills with 10-15 m height using tsunami debris. All of these afford would help to transfer a story of tsunami disaster to a next generation and promote better evacuation.

Because return period of a great disaster is much longer than human life, the mentioned issues will encourage awareness and evacuation of residence. Many attempts were observed in present reconstruction such as memorial park, hazard map and evacuation route. These will help to reconstruct a disaster prevention town and be ready for the next tsunami.

Keywords: Tsunami Disaster, The 2011 Tohoku tsunami, Disaster Reduction, Disaster Education, Reconstruction

Tsunami-deck: An introduction concept for a new type of tsunami evacuation shelter

MUHARI, Abdul[1]*, Shunichi Koshimura[1], Fumihiko Imamura[1]

[1]DCRC, TOHOKU University

The 2011 East Japan tsunami reveals many important lessons especially for the evacuation strategy. Limited available evacuation time request more distributed temporary evacuation place. For highly populated areas in addition to the flat topographic condition, Tsunami-deck is introduced as an option for vertical evacuation place. The basic idea was taken from real experience of 2011 tsunami where people used pedestrian bridge for evacuation. It is then enhanced by extended the space above the ground to accommodate more people without occupying land in the ground. We first examined the performance of pedestrian bridge along the tsunami affected areas in Hokkaido and Honshu. In total, 68 pedestrian bridges including the ones in train stations were analyzed. We found that pedestrian bridge will collapse if flow depth is higher than its height plus 2 m. In this sense, if pedestrian bridge will use for evacuation, than the height should be higher than at least the maximum predicted flow depth plus 2 meter. We then search the possibility to expand the space of bridges deck, and placed it at intersection. The rationale of this idea is to solve the congestion problem during evacuation by putting more evacuation place along the potential evacuation route. Limitations of Tsunami-Deck application is discussed from the result of numerical experiments of tsunami flow at intersection.

Keywords: 2011 Japan tsunami, tsunami evacuation, evacuation shelter

Study on Tsunami Evacuation Building Demand through the Agent Based Simulation of Tsunami Evacuation in La Punta, Peru

MAS, Erick[1]*, Fumihiko Imamura[1], KOSHIMURA, Shunichi[1]

[1]Graduate School of Engineering, Tohoku University

La Punta in Peru is a peninsula in the western part of the Callao province and is almost entirely surrounded by the Pacific Ocean, except on its northeastern side, where it is bordered by downtown Callao. It is one of the smallest districts in Peru, however with nearly 5,000 inhabitants it is exposed to a high risk due to tsunami. La Punta is a long peninsula with a narrow neck connection to the inland area. this connection is the entrance and exit of the district, therefore the only way out of the inundation area. Based on this constraint, authorities encourage their population to decide for the vertical evacuation to high buildings in the area. This community has a high awareness of tsunami despite the lack of experience of real tsunami events in the last decades. Risk information and education by the local authorities had played an important role. Among the countermeasures available for tsunami evacuation process, Tsunami Evacuation Buildings (TEBs) were pointed out in the evacuation plans as the official structures for vertical evacuation in case of tsunami. The total capacity of TEBs reported in the evacuation plan (7,130), far exceeds the number of residents in the area (4,370). Apparently the demand of capacity for a future evacuation is fulfilled, however the spatial location of these TEBs might affect the distribution of preferences and individual demand at the moment of the tsunami event. Therefore, to understand this issue, we developed an integrated tsunami evacuation simulator at the micro scale level. A stochastic analysis of several numbers of different simulated scenarios of population spatial distribution were conducted. Evacuation on foot and car is considered. Agents were given simple rules of goal and route selection, while the start time of evacuation is based on a random assigned value out of several possible distributions of evacuation for the population. It was observed that 5% of residents who were supposed to evacuate to the closest TEB in the available 20 minutes of arrival time of tsunami, were trapped in the flow due to a late evacuation decision. Moreover, the average number of evacuees in each building at the end of simulations versus the real capacity, shows that almost half of the available TEBs present an over demand. More evacuees than the expected capacity will end up at this locations. However, the other half of TEBs remained with available space in a range of 11% to even 95% of its available capacity. Future measures to avoid the disparity of shelter demand must be taken to ensure that a safe evacuation and an optimal use of resources for the support in shelters are obtained.

Keywords: tsunami evacuation, tsunami evacuation building, evacuation model, Peru

CONCEPTUAL DESIGN OF POLARIMETRIC SYNTHETIC APERTURE RADAR FOR NATURAL DISASTER MONITORING

Tien Sze Lim[1]*

[1]Faculty of Engineering & Technology Multimedia University Jalan Ayer Keroh Lama, Bukit Beruang 75450

Synthetic aperture radar (SAR) is an important and efficient earth observing tool using microwave frequencies. Optical aerial and satellite images have been used long time for such applications. Unfortunately, weather conditions limit the use of optical data. These facts have led to the development of microwave sensors. The main thrust of such research activities is due to the fact that microwaves can penetrate through clouds and has all-weather capabilities. This paper discusses the conceptual design of a circular polarized Unmanned Aerial Vehicle (UAV) Synthetic Aperture Radar (SAR) in collaboration with Center for Environmental Remote Sensing of Chiba University, Japan. The proposed system is capable to obtain high-resolution image for natural disaster monitoring such as flood and landslide. The UAVSAR system operates at L-band, full circular polarization (right and left), with 1m by 1m spatial resolution. Its unique features include compact in size, light weight and low power. Firstly, the high level design of the system will be discussed and the system specifications are presented. It followed by radar electronics design, which outlined the details transmitter and receiver subsystem. Finally SAR embedded processor, data acquisition system and antenna system will be discussed. The developed UAVSAR system will be utilized in Malaysia to reduce the geo-hazard damage caused by landslide and flood.

Keywords: Synthetic aperture radar

Methods for eruption prediction and hazard evaluation at Indonesian volcanoes

IGUCHI, Masato[1]*, SURONO, Surono[2], NISHIMURA, Takeshi[3], HENDRASTO, Muhammad[2], OHKURA, Takahiro[4], ISHIHARA, Kazuhiro[1], YOSHIMOTO, Mitsuhiro[5], NAKADA, Setsuya[6], HOKANISHI, Natsumi[6]

[1]DPRI, Kyoto Univ., [2]PVMBG, [3]Sci., Tohoku Univ., [4]Sci., Kyoto Univ., [5]Sci., Hokkaido Univ., [6]ERI, Univ. Tokyo

We report methods, based on geophysical observations and geological surveys, for the prediction of eruptions and the evaluation of the activity of 4 volcanoes in Indonesia. These are Semeru, Kelud, Guntur and Sinabung volcanoes. Minor increases in tilt were detected by borehole tiltmeters prior to eruptions at the Semeru volcano depending on the intensity of explosion earthquakes. The results show the possibility of prediction of the type and magnitude of eruption and the effectiveness of observation with a high signal-to-noise ratio. The establishment of background data is important for evaluating volcanic activity in long-term prediction. The cumulative volume of eruptive products is valuable for evaluating the potential for future eruption. The eruptive rate of the Kelud volcano is ca $2x10^6$ m^3/y (DRE), but the volume of the 2007 eruption was only $2x10^7$ m^3, suggesting a still high potential for eruption. Typical distributions of volcanic and local tectonic earthquakes were obtained around the Guntur volcano, where geodetic monitoring by continuous GPS observation is valuable. Based on geological surveys and dating, an eruption scenario is proposed for the activity of Mt. Sinabung, where phreatic eruptions occurred in 2010 after a historically long dormancy.

Keywords: short-term prediction, long-term prediction, eruption scenario

The cases and frequency of glacier lake outburst in the Bhutan Himalayas

KOMORI, Jiro[1]*

[1]Graduate School of Environmental Studies, Nagoya University

In order to keep accurate preparedness for and attention on the GLOF hazard mitigation, explorations of past cases of outburst are necessary. The frequency of the GLOF occurrence is still unknown, because major outbursts which caused significant damage on downstream are rare and the recorded period is only several decades. We have to collect data on past outburst events as much as possible including unpublished and unknown incidents. As is obvious in the trace of the GLOF, the outburst event leaves typical topographical and sedimentological features, i.e. 1) v-shaped trench, 2) huge debris fan deposition and 3) subsequent devastated river bed. Hence, these features can be used as the proof of past outburst events. As for the most recent case of GLOF, the 2009 Tshojo flood was studied. The flood which was initiated by lake water leaking, and water splash to the surface via a en-/sub- glacier, shows the potentially dangerous hazard. Attention to such outburst events from invisible source will be required in the future.

As for the evaluation of the frequency of the GLOF incident, besides the reported 6 cases in the previous study, we revealed a total of 15 outburst cases in the Bhutan Himalayas using field survey data, and Corona KH-4A, Hxagon KH9-9, Landsat7/ETM+, and ALOS/PRISM satellite data and the images in Google Earth. These 21 cases were found in the Kuri Chu Tibetan branch, Chamkhar Chu, Pho Chu, Mo Chu and Soe Chu. Ten cases of them, the lake outburst on the foot of cliffs with a hanging glacier is the most frequent cases. Seventeen of 21 cases occurred before the 1970's, while 4 cases are counted during from the 1970's to 2010. Hence, the current frequency of outburst occurrences does not seem to have increased. In order to the Further research which covers the minor outburst events has to be broadened at least the Sikkim and Nepal Himalayas.

Keywords: Glacier hazards, Global warming, GLOF, Topographic feature, Satellite data, Occurrence prediction

HDS06-08　　　　　　　Room:301A　　　　　　　Time:May 22 11:15-11:30

Study results of GLOF SATREPS Project in the Bhutan Himalayas

TSHERING, Phuntsho[1]*

[1]Nagoya University

During the recent decades the melting of glaciers and rapid expansion of glacial lakes have caused series of disasters in the entire Himalayan region. Bhutan lies in the eastern part of the Himalayan range and is not an exception. Ever since the 1994 GLOF due to a partial outburst from Lugge lake which claimed lives, devastated infrastructures and agricultural lands in downstream valley of Punakha-Wangdue, urgent need to study glacier and glacial lakes in the upper streams of the water basins remained the priority. In line with other researches in those areas, the researches on glacier and glacial lakes through Science and Technology Research Partnership Project for Sustainable Development has filled up the gaps and updated the only inventory that existed.

Through this project, ground verifications for many lakes which were considered to be potentially dangerous have been carried out. Studies on water volume, bottom lake topography through bathymetry survey, existence of ice bodies in the damming moraines, tracking changes in those dams both through ground checks and Remote Sensing data analysis were engaged. In addition to one or two existing Automatic Weather Stations in the higher elevations, we have installed another one at an elevation of 5230 m asl. recording around nine paramenters.

Keywords: glacial lake

Socio-Economic Factors Associated With Landslide Hazard: A case Study

LATEH, Habibah[1]*

[1]Universiti Sains Malaysia

Bukit Antarabangsa is one of the elite residential areas in Malaysia located in Ulu Klang, Selangor. The area has a high risk potential for landslide and several devastating landslide hazard occurred since 1993 caused a great concern for the safety of people and their properties. This study investigated on socio-economic aspects related to landslide. Data were collected from 64 randomly selected respondents using questionnaire and interview schedule. The results of the study reveal that high level of education, better job opportunities and higher income level caused most of the respondents to stay on highland area although they know that the area has a greater risk of landslide. It can therefore be concluded that most of the respondents were aware of the landslide but the attitude towards landslide risk is very low. The study also found that landslide tragedy in Malaysia has caused emotional and psychological trauma for residents who have survived.

Keywords: landslide hazard, trauma, socio-economy, awareness

Issues of landslide risk management for local community by Warning information of slope monitoring

SAKAI, Naoki[1]*, USUDA Yuichiro[1], MOROHOSHI Toshikazu[1], KOYAMA Toshifumi[2], FUKUOKA Hiroshi[3], HAZARIKA Hemanta[4], MURAKAMI Satoshi[5], WANG Gonghui[3], SAKAJO Saiichi[1]

[1]Earth Science and Disaster Prevention, [2]Kyoto University, [3]Kyoto University Disaster Prevention Research Institute, [4]Kyusyu University, [5]Ibaraki University

So many Landslide and flood disasters occurred during rainfall season every year in Japan. To reduce the damage, the hazard or risk maps are one of the important tools of local community. On the other hand, it is not shown on maps that the intense distribution of rainfall vary with time. This means that hazard area dynamically changes with time. And therefore we have studied the WebGIS system evolved with dynamic information based on warning information.

In this paper, we are going to discuss issues of landslide risk management by warning information of slope monitoring.

Firstly, worning information of slope monitoring is explained below.

we have described that we conducted two large-scale model tests under different condition of groundwater using rainfall simulator at NIED. Surface displacement, ground inclination, moisture content and groundwater level are measured in this test. Then we discuss about the mechanism of unstable slope initiation during rainfall. In addition, we examine the method to define the criteria of rainfall-induced landslides initiation by slope monitoring.

Secondly, landslide risk management is expressed below.

GIS is an essential technology for supporting the various phases of risk management. Especially, WebGIS can integrate various disaster risk information on internet directly and it is easy way for people to access disaster risk information. "e-Community Map", which we have developed as open source software based on WebGIS technologies, integrates geospatial data provided through interoperable data interfaces of various distributors and bottom-up data inputted by local communities. The system delivers dynamic, geo-registered maps using standard international geospatial HTTP protocol services (Web Map Service (WMS), Web Feature Service (WFS), Web Coverage Service (WCS) and etc.) via an interoperable environment. The local communities input their legacy information and tabulated data using PCs, GPS-equipped phones, and other tools. The system outputs maps, including printed maps for off-line communication and field surveys.

In the phase of disaster preparedness, "e-Community Map" is effective for understanding local environment and discussing action for disaster preparation. Local residents can compare and overlay various geospatial data and understand hazards and risks corresponding with them. Then, they can check out points of interests and input various data, photos and memos. In discussion, they can examine the adequacy of preparation and build cooperation with stakeholders. Finally, they make their own maps and maintained them through the participation. And they use their maps for individuals, families and children and improve their preparedness and relationship.

Keywords: landslide, monitoring, warning information, Disaster Risk Management, local community, e-Community

HDS06-11 Room:301A Time:May 22 12:00-12:15

Large-scale watershed modeling in Kelantan, Malaysia

TOSAKA, Hiroyuki[1]*

[1]The University of Tokyo

For the purpose of predicting and preventing inundations in the Kelantan watershed, Malaysia. We made a numerical watershed model by using the information about topography, vegetation, surface geology and human activities in the area. We present the results of the preliminary initialization phase simulation and some case studies.

Keywords: watershed, modeling, large-scale, Kelantan, Malaysia

HDS06-P01   Room:Convention Hall   Time:May 22 13:30-15:00

Monitoring of seismic activity in Philippine and Indonesia regions

PULIDO, Nelson[1]*, KUMAGAI, Hiroyuki[1], INOUE, Hiroshi[1], Renato U.Solidum[2], YAMASHINA, Tadashi[3], Ishmael C. Narag[2], Baby Jane T. Punonbayan[2], Melquiades S. Figueroa II[2], Arnaldo A. Melosantos[2], Suhardjono[4], MAEDA, Yuta[1]

[1]National Research Institute for Earth Science and Disaster Prevention, [2]Philippine Institute of Volcanology and Seismology (PHIVOLCS), [3]Kochi Univ., [4]BMKG

In this study we describe the implementation of an automated system for estimations of earthquake source parameters in Philippines and Indonesia using regional broadband seismic waveform data. This system is an updated version of the automated CMT inversion system originally developed for Indonesia (Nakano et al., 2010). The updated system can receive continuously near real-time waveform data at NIED, from 7 broadband stations in the Philippines, operated by PHIVOLCS, as well as 143 broadband stations in Indonesia (122 operated by BMKG and 21 by GFZ). The broadband stations in the Philippines are being deployed within the framework of a five years SATREPS project (2010-2014) entitled, 'Enhancing Earthquake and Volcano Monitoring Capabilities and Promoting Effective Utilization of the Disaster Information in the Philippines', managed by NIED. The BMKG stations in Indonesia include 17 stations originally deployed by NIED (JISNET network).

The data acquisition system at NIED is based on the seedlink and SeisComP programs developed by GFZ, which allow us the near real-time collection of data feeds in miniSEED format, from seedlink servers in PHIVOLCS (Philippines) and BMKG (Indonesia). This system receives the data in a ring buffer, and then archives it periodically. After an e-mail alert with event information is received, the automatic centroid moment tensor inversion calculation is performed by SWIFT. Then a manual check of the events is performed in a daily basis. In the SWIFT system the inverse problem is solved in the frequency domain for efficient computation. A double couple focal mechanism is assumed in the inversion to stabilize the solution by using data from a small number of seismic stations (Nakano et al., 2008). The SWIFT system has been updated to be able to process data from miniSEED format, which is a convenient format for data exchange with networks abroad.

As an example of the performance of our system we present results of estimations of source parameters of the February 6, 2012 Negros earthquake in the Philippines and its major aftershocks (NIED, 2012). This shallow thrust earthquake with a moment magnitude (Mw) of 6.7 occurred in the Tanon strait, Central Philippines, in a region where no earthquakes shallower than 50 km and with magnitude (Mw) larger than 5 have occurred in the last 36 years, according to the Global CMT Project catalogue. The SWIFT CMT solutions of the mainshock and its major aftershocks are spread in a region of approximately 70 km along the Tanon strait. These events highlighted the importance of a combined use of stations in Philippines and Indonesia to improve the accuracy of event locations in the SWIFT system.

References

Nakano, M., T. Yamashina, H. Kumagai, H. Inoue, and Sunarjo, 2010. Centroid moment tensor catalogue for Indonesia, Phys. Earth Planet. Inter., 183, 456-467, doi:10.1016/j.pepi.2010.10.010.

Nakano, M., Kumagai, H., Inoue, H., 2008. Waveform inversion in the frequency domain for the simultaneous determination of earthquake source mechanism and moment function. Geophys. J. Int., 173, 1000?1011, doi:10.1111/j.1365- 246X.2008.03783.x.

NIED, 2012. Off Negros Island, Philippines, February 6, 2012, 03:49 (UTC) (Mw 6.7), http://www.isn.bosai.go.jp/events/20120206034919/index.html (in Japanese).

Keywords: Philippines, Indonesia, Seismic activity, Broadband seismic network, 2012/2/6 Off Negros Island, Philippines earthquake, Monitoring, CMT

Free mode excitation of the Pacific Basin during the 2011 large Tohoku tsunami

HEIDARZADEH, Mohammad[1]*, SATAKE, Kenji[2]

[1]Faculty of Civil and Environmental Engineering, Tarbiat Modares University, [2]Earthquake Research Institute (ERI), University of Tokyo

Several studies showed that the March 2011 large tsunami offshore northeastern Japan caused long oscillations in the Pacific Basin persisting almost 4-5 days. Analysis of tide gauge records of this tsunami revealed that relatively high-energy waves caused by this tsunami persisted at least 3 days in the Pacific Basin. Therefore, speculations were made in the tsunami community attributing these long energetic oscillations to free-mode excitation of the Pacific Basin. Free mode excitation is the main source of long oscillations and sloshing inside closed or semi-closed basins which results in long-duration and energetic waves in the basins. This is typical of harbors and lakes. However, when the source is large like the one for the March 2011 Japan tsunami, free-mode excitation may occur in large basin like the Pacific Basin. It is clear that a basin as big as the Pacific one can have several eigen modes and that a particular tsunami source can excite one or some of the free modes.

To examine this hypothesis, here first we apply a numerical algorithm to estimate the free modes of the Pacific Basin. This algorithm is based on numerical modeling of tsunami and spectral analysis of the wave time-series recorded at different locations. We then study the spectral characteristics of the selected tide gauge records of the March 11, 2011 Tohoku tsunami to examine if some of the free modes of the basin are present in the tide gauge records or not. Comparative study is performed to determine the contribution of the free mode excitation of the basin to the total energy of the March 2011 tsunami.

Keywords: March 2011 Tohoku earthquake, Pacific Basin, Free mode, Spectral analysis, Sloshing, numerical modeling

Eruption Scenario of Sinabung volcano, North Sumatra, Indonesia

YOSHIMOTO, Mitsuhiro[1]*, NAKADA, Setsuya[2], HOKANISHI, Natsumi[2], IGUCHI, Masato[3], OHKURA, Takahiro[4]

[1]Faculty of Science, Hokkaido University, [2]Earthquake Research Institute, University of Tokyo, [3]Sakurajima Volcano Research Center, Disaster Prevention Research Institute, Kyoto University, [4]Institute for Geothermal Sciences, Graduate School of Science, Kyoto University

Sinabung Volcano is an andesitic stratovolcano located 40 km northwest of Lake Toba, North Sumatra The edifice consists mainly of multiple thick lava flows, lava domes and block-and-ash flow and associated surge deposits. The latest spine is located at the southern end of one of the summit craters trending in N-S. The youngest block-and-ash flow and associated surge deposits derived from the spine distributed at the southeastern flank are considered to be emplaced at ca. 1.1 ka, based on the radiocarbon ages of charcoals in the deposits. The flow deposits reached about 5 km southeast of the vent. Historical eruptions have not been reported prior to the phreatic eruptions during August-September 2010. The latest eruption caused panic among the people living around the volcano.

One of the plausible scenarios for future eruption may be proposed based on the eruption history and the chemical characteristics of the volcano. The geology of this volcano shows dome-forming lava extrusion or lava flowing, being associated with pyroclastic flows (block-and-ash flows or surges) and a debris avalanche, the latter which were generated from partial failure of the lava domes/flows or the upper part of the volcanic edifice. On the contrary, ashfall deposits suggesting relatively large explosive eruptions such as plinian- to subplinian-types were not found, implying no occurrence of large explosive explosions in this volcano throughout its history. Therefore, a dome-forming eruption or lava flowing near the summit is highly possible as a future eruption. During dome growth, partial collapse of the lava dome will generate pyroclastic flows (block-and-ash flows and surges). If a large lava dome grows at the summit crater, the most serious scenario will be a failure of the old and weak volcanic edifice due to the load of the dome. Relatively large-scale collapse of the volcanic edifice may generate a lateral blast preceding the pyroclastic avalanche, such as observed in the 1997 event at Soufriere Hills volcano, Montserrat, where the crater wall on which the growing lava dome overrode collapsed together with a part of the overlying dome. In this scenario significant earthquakes and the flank deformation would be expected several days or weeks before the failure as observed in Montserrat. If magma is less viscous due to low $SiO2$ content or higher temperature driven by a high effusion rate, lava will flow down on the flank from the summit crater, being associated with minor pyroclastic flows from the flow front. Evolution of scenarios may be tracked and judged by continuous monitoring of volcanic earthquakes and ground deformation.

Keywords: Indonesia, Sinabung volcano, Eruption Scenario, block-and-ash flow, Lava dome

Evaluation of activity of Guntur, Sinabung and Merapi volcanoes, in Indonesia based on continuous GPS observations

OHKURA, Takahiro[1]*, IGUCHI, Masato[2], Muhamad HENDRASTO[3], Umar ROSADI[3]

[1]AVL, Faculty of Science, Kyoto Univ., [2]DPRI,Kyoto Univ., [3]CVGHM, ESDM,Indonesia

Indonesia has 127 active volcanoes along its archipelago and the volcanoes have experienced tremendous disasters in the past with variety of eruption styles and appearance of volcanic disaster. Therefore, prediction of volcanic eruption and mitigation of volcanic hazards are urgently required. However, many active volcanoes are equipped with only one seismic station. For the mid- and long- term prediction and evaluation of post-eruptive activity, continuous observations of ground deformations are necessary. Therefore, we have installed GPS stations in Guntur, Sinabung and Merapi volcanoes, by a project "Multi-disciplinary Hazard Reduction from Earthquakes and Volcanoes in Indonesia" under the Science and Technology Research Partnership for Sustainable Development (SATREPS) started in 2009.

Guntur volcano complex is located 35 km SE of Bandung, West Java. The volcano was quite active, repeating volcanic explosions and effusion of lava flows in 18th and 19th centuries. Although Guntur volcano has been dormant in eruptive activity since 1847, seismicity s is active and this volcano is regarded as one of the high-risk volcanoes due to the dense population SE of the volcano. For the mid- and long-term prediction, continuous observations of ground deformation are necessary.

Mt. Sinabung is an andesitic stratovolcano (2460-m-high) located 40 km northwest of Lake Toba, North Sumatra. Historical eruptions have not been reported prior to the phreatic eruptions during August-September 2010. Although the eruptive activity declined after September, seismicity on and around the volcano was still high .

An explosive eruption occurred on October 26, 2010 at Merapi volcano in Central Java and the eruptive activity was followed by continuous occurrence of pyroclastic flow from the summit crater during the period from November 3- 5.

Four stations were installed around Gntur volcano in October 2009, Merapi volcano in December 2010 and Sinabung volcano in February 2011, where three stations are located on the volcano edifice and one at a base station at the foot of the each volcano. GPS stations on the edifice are connected to the base station via WLAN. We applied a PPP (precise point positioning) using GPS analysis software, GIPSY-OASIS II Ver.6.1 to the data of Guntur and Merapi volcanoes. In the analysis, JPL precise ephemeris is used, and dairy coordinates are calculated in the frame of ITRF2008. From the obtained coordinates, we can calculate baseline among stations. The GPS data at Sinabung volcano is being analyzed automatically using Leica GNSS Spider software.

As a result in Guntur volcano, inflation was detected 5 months prior to seismic crisis in September 2011, suggesting intrusion of magma beneath the volcano at that time. Also, inflation was detected in Merapi volocano, suggesting restart of magma accumulation just after the huge eruption in 2010. And almost no deformation has been detected in Sinabung volcano suggesting little possibility of imminent magmatic eruption.

Keywords: GPS, ground deformation, volcanic activity, Indonesia

Land form and flooding of central plain of Thailand in 2011

HARUYAMA, Shigeko[1]*

[1]Mie university

Result of landform mapping of the central plain of Thailand is showing several important landform units related with flooding, such as natural levees, back swamps, alluvial fans, former river courses, mad spits and delta, and the landform units are roles of flood expansion along the Chao Phraya River in 2011. The geomorphologic land classification map describing is showing the specific condition of flood inundation period, inundation depth and week points of dike break etc. in each micro-landform. Compared with inundation situation and recent land use change, flood risk near Bangkok Metropolitan area has been larger before.

Keywords: central plain of Thailand, flooding, landform, rimote sensing

HDS06-P06   Room:Convention Hall   Time:May 22 13:30-15:00

The detection of seismo-ionospheric phenomena: approaches and problems

SHAGIMURATOV, Irk[1*], Iurii Cherniak[1], Irina Zakharenkova[1], Nadezhda Tepenitsyna[1], Galina Yakimova[1]

[1]West Department of IZMIRAN, Kaliningrad, Russia

During several decades the effects related with seismic activity were extensively studied. The nonregular ionospheric variations, associated with pre- and co-seismic activity, were investigated by various radiophysical and in-situ measurements over different seismo-active regions. Nowadays one of the most effective tools for diagnostic of seismo-ionospheric phenomenon in a global scale is the method based on analysis of TEC variations obtained from global navigation systems signals (GPS/GLONASS). The influence on the ionosphere from ground is frequently weaker in compare with effects of solar or geomagnetic origin. By this reason it is very actual the problem of detection of seismo-ionospheric anomalies on the background of strong regular and quasi-regular variation of space weather parameters.

For analysis of seismo-ionospheric effects the traditional approach consists in statistical processing of long-term datasets, calculation of non-disturbed averaged diurnal variation of TEC, estimation of differences and anomaly recognizing. Many scientists studied seismo-ionospheric phenomena have reported about different precursors appearance for the same earthquakes.

Results of analysis of possible ionospheric anomalies associated with earthquakes of 2007-2011 was indicated that estimation of differences, obtained by traditional techniques can led to anomalies during seismo-quite periods, but strongly correlated with variations of solar ionizing radiation. Also similar effects can be caused by superimposing effects of waves in the ionosphere (planetary 2-3 day period waves, terminator waves, Poincare waves, etc).

In this work we analyze the influence of different factors (separate and superimposed) on the reliability of detection seismo-ionospheric anomalies. It was considered the specific temporal intervals used for background calculation and revealed most optimal variants. It is proposed several approaches in order to take into account the space weather factors and ionospheric waves during process of seismo-ionospheric phenomenon recognizing.

Keywords: ionosphere, GPS, seismo-ionospheric effects, space weather

HDS06-P07	Room:Convention Hall	Time:May 22 13:30-15:00

Use of multi-instrumental radiophysical measurements to study seismo-ionospheric effects

CHERNIAK, Iurii[1]*, ZAKHARENKOVA, Irina[1], SHAGIMURATOV, Irk[1], Olga Suslova[2]

[1]West Department of IZMIRAN, Kaliningrad, Russia, [2]I. Kant Baltic Federal University, Kaliningrad, Russia

Though lithosphere-atmosphere-ionosphere coupling has been intensively discussed for several decades, it does not mean that the ionospheric morphology above seismically active regions is investigated sufficiently well. Investigation of seismo-ionospheric phenomena is a rather complicated task which consists of the identification and localization of weak anomaly pattern at the background of ionospheric changes under various space weather conditions. Analysis of the previous works on lithosphere-ionosphere interactions confirmed the necessity to use simultaneous observations form several independent diagnostics tools in order to raise the reliability of the observed seismo-ionospheric effects. For the given research we propose to use integrated processing of the ionospheric data from different sources: total electron content (TEC) data obtained on the basis of regular GPS observations of IGS stations located in Japan region, ionospheric E and F2 layers peak parameters, derived from data of Japan ionosonde network and electron density profiles, obtained by FORMOSAT-3/COSMIC radio occultation measurements. It allows us to estimate the contribution of different parts of the ionosphere into the GPS TEC values and to reveal the ionospheric regions that are affected to a greater extent by the possible influence from below. There is also estimated the cross-correlation between spaced measurements and data obtained by different techniques. The proposed approach was applied to the case-study of Japan earthquake occurred on May 7, 2008 with magnitude of 6.9. The obtained results and further testing of the method are discussed in the report.

Keywords: ionosphere, seismo-ionospheric phenomena, TEC, ionosonde, radio occultation