Land slide and living conditions of minority in the northern part of mountain area, Nepal

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In Apr.2015, M7.8 earthquake occurred in Nepal. It was confirmed the building damage in an urban area and the landslide damage in a mountainous region by a field survey in 2015. Especially, in mountainous region, we found the minority people who can't get accident support. So, today, I will talk about the field survey results in Nepal.

Keywords: seismic hazard, land slide, minority, satellite image

Quaternary research for the studies of earthquake hazards

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Quaternary sciences are multidisciplinary researches on the history of the nature and the human during the most recent geologic epoch and present. The knowledge from the most recent past of the nature is the key to understand the future. The scientific output on climate and environmental changes has been the largest contribution from the Quaternary sciences. In these days, however, the Quaternary information on natural hazards and their risks are getting more and more important. For the 19th INQUA (International Union for Quaternary Research) Congress in Nagoya in 2015, the theme of the congress was "Quaternary Perspectives on Climate Change, Natural Hazards and Civilization" and one of the main topics was "Quaternary Research for the Reduction of Risks from Natural Hazards". After the severest earthquake and tsunami hazards in the past decade, it was very appropriate to recognize research on natural hazards as one of the important tasks of Quaternary research.

The most significant natural hazard research within INQUA has been carried out by the Neotectonics Commission since 1970s and by its successor, the Paleoseismicity Group since 2003 in the Terrestrial Processes, Deposits, and History Commission. The Japan Association for Quaternary Research has set up the Research Committee on Tectonics to correspond to the INQUA's research group. One of the most important achievements of the INQUA Paleoseismicity Group is the Environmental Seismic Intensity Scale (ESI 2007). Since 2008, the group has revised and validated the ESI 2007 with paleoseismic records and made the ideas about EEE (Environmental Earthquake Effects) very clear and popular among earth scientists. The IAEA TECDOC-1767, "The Contribution of Palaeoseismology to Seismic Hazard Assessment in Site Evaluation for Nuclear Installations" prepared by the group leaders sets an important milestone of Quaternary research for earthquake hazards.

The INQUA Paleoseismicity Group submitted a proposal for 2016--2019 research project to INQUA. The proposal is seeking for better understanding on surface ruptures and fault displacement associated with earthquakes. Development of more reliable remote sensing methods will help complete mapping of the coseismic fault ruptures. Building up a thorough catalog of coseismic ruptures together with the complete mapping will enable to improve scaling laws between fault length or fault displacement, and earthquake magnitude. The scaling law for the end members of smaller magnitude earthquakes is to be improved with the results.

Two earthquakes with surface ruptures in 2014 gave a strong motivation for the project proposal. One is the August 24, 2014 South Napa earthquake (Mw 6.0) in California and another is the November 22, 2014 Nagano-ken-hokubu earthquake (Mw 6.2). The South Napa earthquake ruptures were 12.5 km long and partly followed previously mapped the West Napa fault. The largest right-lateral offset was 46 cm. The Nagano-ken-hokubu earthquake ruptured about 9 km long northernmost portion of the 26 km long Kamishiro fault in the north end of the Itoigawa-Shizuoka tectonic line active fault system with up to 80 cm vertical separation on reverse faults. The significant surface ruptures were not common for these smaller earthquakes of magnitude around 6.0. We need to know the mechanism of the appearance of clear surface ruptures with smaller magnitude earthquake through complete mapping of the ruptures. In addition, the Earthquake Clearing House after the South Napa earthquake was very useful for the collection and dissemination of surface ruptures and damage records as well as for the effective coordination and cooperation among many survey teams.

Keywords: Quaternary, earthquake, active fault

Geo-informaion and enactment of the law

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1. Characters of the Japanese Islands
Based on the Japanese geological and geographical characteristics, geo-information of the underground are very important for geo-hazard, constructions, industry development, exploitation of resources, environmental safeguard in Japan.
2. Social problems
Judging from the condition of database and utilization of the geo-information in Japan, the technological development and the enactment of law for geo-information are the pressing problems.
3. Enactment of the law and its effect
Although there are some lows about geography, ocean, water, there is no low about geo-information. Some foreign countries have the law for geo-information. Therefore, the law to utilize the geo-information is required in Japan.
4. Activities in the future
The academic societies should work for the technological development of geo-information, cooperating with the Science Council of Japan and the Japan Academic Network for Disaster Reduction. The local public bodies should use the geo-information for the safe life of the people.The public opinion about geo-information should be formed. The Member of the Diet and the administrative organs should recognize the importance of the geo-information, and they should make the law and carry the law into effect. These all activities will access the utilization of the geo-information for the safety and development of Japan.

Keywords: geo-information, enactment of low, public intelligence

Real-time forecasting of near-field tsunamis: current status of tsunami early warning and technology developments for future improvement

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Around Japan, many earthquakes and tsunamis occurred and damaged the near-field coastal communities. Since the source area is close to the Japanese coasts, the resulting tsunami comes in a short time, 5-30 min after an earthquake occurrence. One of the most effective countermeasures to mitigate the tsunami disasters is real-time tsunami forecasting. Rapid and accurate tsunami prediction and its appropriate dissemination to the residents of coastal region as tsunami early warning will help their decisions about evacuation. In this presentation, I will explain tsunami early warning issued by Japan Meteorological Agency (JMA) during the 2011 Tohoku earthquake (magnitude 9), and the improvements to overcome the shortages. Then, I will review tsunami-forecasting technologies that are developed in the seismology, coastal engineering, and geodesy fields.

Several geophysical observation data are available for real-time tsunami forecasting before tsunamis arrive at the near-field coasts. For example, seismic waves propagate much faster than tsunamis, and thus seismic magnitude based on the data is useful for issuance of tsunami warning soon after an earthquake. Another beneficial observation is offshore tsunami measurements, such as cabled ocean-bottom pressure sensors and GPS buoys. They can detect tsunamis directly, resulting in reliable update of tsunami warning. JMA, who has responsibility for issuing tsunami warnings in Japan, designed warning procedure by taking into account the strong points of those observation data. When the 2011 Tohoku earthquake occurred, JMA issued and updated tsunami warning promptly. However, a couple of shortages were highlighted, such as underestimation of tsunami-height prediction in the first warning due to magnitude saturation. To overcome the shortages, JMA has made several improvements and installed the new functions into the tsunami warning system.

In the research phase, tsunami monitoring and forecasting technologies are being developed and improved. One of the monitoring developments is large-scale and dense offshore seafloor earthquake and tsunami observation networks. Another monitoring development is improvement of GPS buoy in order to deploy it at more offshore region than the present limitation distance from the coastal line. In tsunami-forecasting technology development, several geophysical data are used. Real-time analysis methods of inland seismic and/or GNSS data are improved for estimating not only point source solution (magnitude and hypocenter location), but also finite source information (spatial size and slip distribution) that affects tsunami forecasting greatly. On the other hand, tsunami-forecasting methods that use offshore tsunami data are developed and improved by several kinds of approaches (e.g., tsunami source inversion or data assimilation technique). In addition, several researchers propose joint use of different kinds of geophysical data for compensating shortage of each data. Moreover, high-speed computing technology such as supercomputer and GPU are recently used for nonlinear tsunami simulations. Hybrid use of the real-time source estimation and the high-speed tsunami calculation will realize real-time tsunami inundation forecasting that will support not only tsunami evacuation behaviors, but also quick estimation of tsunami-damaged area resulting in support of early recovery from tsunami disasters.

As mentioned above, many technologies relating to real-time tsunami forecasting are developed and

improved. I consider that we, people who experience the Great East Japan Earthquake, should continue the technology developments and conduct the careful performance tests towards the installation into tsunami warning system for the mitigation of future tsunami disasters.

Keywords: Tsunami early warning, Real-time tsunami forecasting, Offshore tsunami observation, Near-field tsunami, Disaster mitigation

Learn the origins of the land and face the natural disaster

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Local resident's understanding and agreement as well as a central government, a local government and a related enterprise are indispensable in order to promote sustainable regional development and social overhead capital by establishing both disaster prevention and environmental protection. In this lecture, I will speak about the importance of knowing the advantage and the weakness from the origins of the land in which the people live there and facing the natural disaster, introducing an outreach activity of our Society.

Keywords: natural disaster, origins of land, outreach activity

Issues on heavy rainfall forecast and disaster information detected from events with band-shaped precipitation systems

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In Japan, single or several band-shaped precipitation systems (BPSs) with the width of 20~50km and the length of 50~200 km occur especially during the rainy season, and stagnate almost in the same area for several hours, which often causes heavy rainfall. Except for heavy rainfall directly associated with typhoons, it was statistically examined that about two third of heavy rainfall events are caused by BPSs, and this rate increases about three fourth for the rainy season (Tsuguti and Kato 2014). The formation processes of BPSs in Japan are majorly classified into two types; one is the break line type in which convective clouds simultaneously generate over a local front formed by the terrain effect and so on, and the other is the back-building type in which convective clouds successively generate on the low-level upstream side. The former example is the heavy rainfall event of Izu Oshima Island in 2013, and the latter is that of Hiroshima in 2014. Here, the accuracy of present numerical prediction for these examples including the 2015 Kanto-Tohoku heavy rainfall is introduced, and some issues on disaster prevent information produced using the prediction are discussed with showing areas where BPSs can likely to occur with high frequency.

The heavy rainfall event of Isu Oshima in 2013 was caused by a BPS occurring over a local front that was formed between cold outflow from Kanto Plain, and warm and humid inflow from the surrounding of Typhoon 1326. The same mechanism can be applied to that of Izu Peninsula associated with Kanogawa Typhoon in 1959. It is needless to say that the location of predicted local front determines the accuracy of heavy rainfall prediction. Most of the front initiated from Kanto Plain is, however, located over the sea, and it is not necessary to pass over islands and Izu Peninsula, which suggests that some ideas are need for disaster prevent information.

In the 2014 Hiroshima heavy rainfall, low-level humid air continuously flowed into the surrounding of the boundary between Hiroshima and Yamaguchi Prefectures, over which convective clouds successively formed, and single BPS was organized. Different initial conditions of numerical predictions yielded different precipitation amounts; however, predicted rainfall areas hardly changed because the inflow region of low-level humid air could be specified. On the other hand, in the 2015 Kanto-Tohoku heavy rainfall since low-level humid air widely flowed into Kanto Plain from the southwest, many BPSs formed over different regions of southern Kanto, which caused 24 hourly accumulated precipitation amounts exceeding 500 mm in northern Tochigi Prefecture. Such a heavy rainfall area was successfully predicted in northern Kanto; however, its detail location was changed in numerical predictions with different initial conditions. This suggests that the disaster prevent information on heavy rainfall associated with BSPs could be broadcasted for wide areas of northern Kanto.

Present numerical predictions are difficult to quantitatively and directly reproduce BSPs; however, understanding of favorable atmospheric conditions for BSP formation is proceeding (Kato 2014; 2015). In the Kanto-Tohoku heavy rainfall case, numerical models could predict heavy rainfall in northern Kanto before 24 hours, while favorable atmospheric conditions for BSP formation could be predicted before further 12 hours. A statistical study on the appearance frequency of favorable atmospheric conditions for BSP formation showed that high rates of about 9 % were analyzed in western Kyushu during the warm season, while it was about 1 % in Kanto. This low rate well corresponds to the fact that heavy rainfall associated with BSPs was rarely observed in Kanto. These results indicate that the disaster prevent information for areas where heavy rainfall

associated with BSPs was observed with low frequency should be discussed and the edification for its understanding is necessary.

Keywords: heavy rainfall, band-shaped precipitation system, numerical prediction, disaster prevent information

Personal opinion after the investigation on Kinu-river floods with Kanto and Tohoku heavy rain in 2015

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Our research team conducted an investigation on the Kinu-river flood events occurred on September 10th, 2015, and we have uploaded our reports relatively early stage on the internet (the first report was open public at 9pm on September 14). The media rushed to the scene after a long time in the metropolitan area, so that it seems that there was sufficient amount of information delivered to the public. However, the information that is really needed were often missing, and there were misunderstandings or a hoax that caused confusion. What to be done by the experts are: to capture the events from the eyes of a professional and to provide information such as the media would be overlooked and/or to sort the information closer to the truth. This time, we had special attention, i.e., while investigating the scene if needed, we collected and analyzed real-time data which exist fairly accessible today and interpreted them in objective manner, and all of them were performed as quickly and accurately as possible. Based on that, after the first report on September 14th night, we went to the secondary survey on 15th, and updated the second report on 19th morning, and went for the third survey on the same day. In these works, our team force was extremely important, and I want to thank again to the students and the staffs that have been involved. On the other hand, it was found that as well as our team, there was a number of research groups doing similar. Among them, a group led by Associate Prof. Shirakawa in the University of Tsukuba conducted a month-long afflicted survey, and Associate Prof. Sayama in Kyoto University estimated the maximum inundation depth by using the latest GPS technology. While these individual activities were indeed remarkable, there was a limit to those activities, and some of overlaps and lacks were inevitable as a whole. Therefore, it is very important to provide a forum for information exchange and traffic control by the leadership of academic societies such as one done in this time by the joint investigation group by Japan Society of Civil Engineers and Geotechnical Engineering Society.

Keywords: September 2015 Kanto and Tohoku heavy rain, Kinu-river floods

Flood disaster studies by Japanese geographers and the activity of the Association of Japanese Geographers to the 2015 September heavy rainfall disaster in Kanto and Tohoku

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In the geography in Japan, flood disaster studies were done in geomorphology and in agricultural geography in the case of the Typhoon *Kathleen* of 1947, the Kanogawa Typhoon (Typhoon *Ida*) of 1958. It is well-known that the damage area in Nobi Plain by the Isewan Typhoon (Typhoon *Vera*) of 1959 had been shown in a geomorphological map which was made by a geographer three years before the disaster. After that, Japanese government has been executing some mapping projects of the natural hazard potential distribution such as the Land Condition Map, the Geomorphological Map for Prediction of Flooding, the Natural Land Classification Map, etc. A lot of result maps are published through website today. Based on this situation, the activity of the Association of Japanese Geographers (AJG) responding to the 2015 September heavy rainfall disaster in Kanto and Tohoku is introduced and what the JpGU should do on the occasion that a big disaster occur is discussed.

Keywords: geomorphological mapping, flood, hazard map, disaster management

Lesson learnt from Sakurajima's unrest event and eruption at Kuchinoerabujima in 2015

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After an eruption at Kuchinoerabujima on May 29, 2015, Japan Meteorological Agency (JMA) upgraded the alert level up to 5 (maximum, evacuation), all the residents evacuated from the island volcano. I addition to this, swarm of volcanic earthquakes associated with rapid inflation of the ground of Sakurajima pushed JMA to upgrade the alert level to 4 (evacuation of residents requiring assistance) and 77 residents evacuated from 3 villages of Sakurajima. In this paper, I will describe volcanic activity of the volcanoes and evacuation, and discuss on further advance of research to mitigate volcanic hazards.

Keywords: Forecasting of volcanic eruption, Evacuation, Mitigation of volcanic hazard

