Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

HDS06-01 Room:422 Time:May 2 09:00-09:25

Natural-technological disasters of recent years in Japan and Russia: social and economic consequences

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During the last decade, natural hazards impacts on people, the environment, urban and industrial areas, infrastructure and other technological systems were increasing, causing large social, environmental and economic damages in many countries. The number and severity of natural-technological accidents and disasters were also increasing all over the world, because of these impacts. The term ”natural-technological” applies to an accident (disaster) in the technosphere (including industrial plants, power stations, transport, infrastructure facilities, communication lines, etc.) triggered by any natural process or phenomenon. Their growth is accounted for: 1) by observed increasing in frequency and intensity of various natural hazardous events; 2) by much more complicated structure and complexity of modern technological systems and facilities exposed to natural hazards, and 3) by increasing advancement of economic activities and population into the regions at natural risk. The most severe consequences for people and the environment have the so-called Natech-accidents, which are accompanying by release of dangerous substances (like chemicals or oil), and accidents at nuclear power stations.

One of the most large-scaled natural-technological disasters having enormous social, environmental and economic consequences occurred on March 11, 2011 in Japan due to a massive 9.0-magnitude earthquake off the northeast coast of Honshu Island, which triggered a more than 30-meter tsunami. The disaster not only caused a large direct and indirect damage to the people (about 20 thousand fatalities) and economy of the country (more than $500 billion), but also influenced on regional, national and international development reaching a truly global scale. It clearly demonstrated high vulnerability of a human society and modern technosphere to natural disasters; even in a country like Japan that is highly developed and well-prepared to natural risks. A distinctive feature of events, such as of the 2011 Tohoku earthquake, is their multihazard and synergistic nature, as a disaster spawns a secondary disaster that increases the impact on people and technosphere, resulting in simultaneous occurrences of numerous technospherical accidents. The secondary effects of natural-technological accidents can be even much more serious, such as at ”Fukushima-1” nuclear power plant. These impacts are the more severe the higher are the population density and concentration of industrial facilities and infrastructure (especially hazardous and vulnerable objects) in disaster-affected areas. In addition, all rapid reaction forces and resources tend to be primarily fighting natural disaster; it limits the capability to eliminate secondary technological impacts, especially in those situations when transport facilities and required infrastructure are destroyed, and economic communications are broken.

The lessons of the Tohoku disaster should be taken into consideration while placing, constructing and operating nuclear power plants and other high-risk facilities. It is necessary to consider carefully possible intensity and frequency of all potential impacts, including natural hazards.

In Russia, natural-technological disasters with catastrophic consequences occur not so often. However, their possibility should be taken into account, especially in the economic development of areas at high natural risk, which is, for example, the Far Eastern region exposed to earthquakes, tsunamis, volcanic eruptions, floods, strong winds, storms, heavy rain- and snowfalls and other natural hazards. The most severe damages caused the Sakhalin earthquake in 1995, which was the most destructive in the Russian history. Severe social and economic consequences cause floods, for example, the flood in the autumn 2013. Natural-technological risk to the regions of Russia was evaluated using a database that was created by the author.

Keywords: natural hazards impacts, social and economic consequences, natural-technological risk, natural-technological disaster

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The Egyptian Tempest Stele: an Example of Ancient Natural Disaster

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Some Ancient Egyptian texts tell us about violent storms and rains. One of the most impressive ancient accounts of natural disasters is the so-called Tempest stele (1550 BC), which describes a very destructive storm happened under Ahmose I, the king of Egypt's 18 dynasty. The upper portion of the stele describes the catastrophe. Many essential details are given, such as the specific noise, overall darkness etc. Numerous houses were washed into the river; temples, tombs and pyramids were badly damaged. The main features of the storm can be highlighted: torrential rain; darkness; and loud noise, probably caused by a thunder or a wind, or both. It evidently occasioned large-scale flooding, property damage, and loss of life. After describing the events, the stele gives account of the restoration works made by the king to repair the damages made by this great disaster. There are Egyptologists who believe the stele to be propaganda put out by the pharaoh, the "tempest" being the depredations of officials of the embattled seventeenth dynasty of Egypt drawing upon the financial resources of the temples during the escalating conflict with the Hyksos. To my opinion, we don't have sufficient grounds to deny that the storm took place in reality. Nevertheless, the Tempest Stele actually is a political propaganda, because the main purpose of the erection of the stele was to draw attention to the role of the king in coping with the disaster. Traditionally, the king was responsible for maintaining maat (a cosmic order as opposed to chaos), and this responsibility included protection from natural disasters. The main point of the specific political context of the Ahmose I's times was the struggle of what would become the 18th Dynasty to establish its rule in opposition to the Hyksos. This effort required success on two levels: the human and the divine, which meant what would be classified as the natural world today. To simply liberate the land from Hyksos rule was a necessary but not sufficient step to legitimate one's rule. The king also needed to demonstrate divine blessing meaning that the cosmic order of the natural world had been restored as well as the political world had been. The storm commemorated by the Tempest stele is not the only example of heavy storms in Egypt. It seems that hazards of that kind were more common than we now believe. What makes the Ahmose stele unique is the description of the details of such a severe catastrophe, which go beyond what is usually experienced by a regular storm and therefore might be the oldest description of a natural hazard. The catastrophe described in the Ahmose I's Tempest Stele can be considered one of the most ancient examples of natural disasters, which caused a huge impact on the society. This is also a significant example of a political propaganda, reflecting the situation when government uses a catastrophe and its consequences to its own benefit.

Keywords: natural disaster, social impact, history of disasters, ancient egypt

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Relationship between social and natural disasters

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The problem of reducing the damage caused by geodynamic and social disasters is a high priority and urgent task facing the humanity. The vivid examples of the earthquake in Japan in March 2011 that generated a new kind of threat ? the radiation pollution, and the events in the Arabic world that began in the same year, are dramatic evidences. By the middle of this century, the damage from such disastrous events is supposed to exceed the combined GDP of all countries of the world. The authors have developed the first database to include the largest geodynamic and social phenomena that occurred on Earth before 2005. We suggest the following phenomenological model based on the database (uniform with respect to the quantitative classification). All disasters are classified by size using a single logarithmic scale suggested by Rodkin and Shebalin in 1993. The base consists of 2000 disasters. The following phenomenological model is proposed: 1. The scale of disasters does not decrease with time. (Earthquakes in China in 1556 and 1976; the tsunami after the Sumatra earthquake in 2004, which can be compared in regards to the level of consequences only with the World Flood or a series of floods that occurred approximately 13000 years BP). 2. There were a minimal number of disasters in the 15th century; during which there were not a single disaster with J = I and II; from that time the number of such disasters gradually increases; in the 20th century there were 20. 3.The number of disasters is characterized by cycles, which are a few thousand years long; the available longterm measurements confirm this (for example, the overflow of the Nile observed over more than 5000 years or deformations of the Earth surface in the last few thousand years based on the geodynamic, seismotectonic, and paleoseismic data). 4. Natural and social disasters together are distributed uniformly in time, while only natural and only social disasters are distributed nonuniformly, i.e. disasters group.

5. The proportion of the social disasters has a tendency to increase in time, which confirms the viewpoint of V.I. Vernadskii about the constantly increasing role of humans and society in the noosphere. It was shown that natural and social disasters are interrelated. The Earth from the point of view of the disaster theory evolves according to the definite laws of the unique bio-socio-geodynamics. The investigation and understanding of the nature of this mechanism that "mixes the disasters" will allow us in the future to formulate a scientific hypothesis and/or a law on the basis of the phenomenological model that we suggest in this work and use it in the system of expert global process management. In the aspects of modern methods of studying of the global disasters, the authors suggest an approach to understanding global disasters based on modern data. The global disaster is an event damage from which cannot be liquidated by the joint resource. Irreversible process of death of a modern civilization can become a consequence of a global disaster.

Keywords: geodynamics, society, magnitude of disaster, interaction of disasters, impact of society

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HDS06-04 Room:422 Time:May 2 10:05-10:20

The numerical model of natural hazards development in the environment stressed by opposing forces

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Natural hazards include earthquakes, tsunami, volcanic eruptions, floods, etc. The time of appearance of such significant events within hundreds of years can be considered as random. In most cases, the dangers' amplitudes are not amenable to prediction, i.e. their size is also random. From the mathematical point of view, the deposition of natural hazards is described by exponential dependence, which is connected with the involvement of the own "mass" of danger. In the presence of opposing forces in a first approximation, these processes are described by the Verhulst equation. It is a particular variant ($Q<0$, $A=L$) of the total autonomous differential equations of the 2nd order for the function x(t) on time t, i.e. $dx/dt=N+L*x+Q*x*x$, where N,L,Q are constants of equation with initial conditions t(n) and x(n).

The complete solution of this equation with arbitrary initial conditions has bulky appearance, although the logistic curve reflects it qualitatively quite well. However, these solutions allow us to reveal a violation of the principle of stability of numerical solutions of the logistic equation $x(n+1)=x(n)*(1+a*(1-x(n)))$, where $a=A*(t(n+1)-t(n))$, when the derivative dx/dt is replaced by the value for $(x(n+1)-x(n))/(t(n+1)-t(n))$.

It is shown that the instability of the processes with the opposing factors invoked by jumps of initial conditions on consecutive segments. For certain values of the parameters of the differential equation associated with capacity of the stressed environment, both volatile and deterministic modes of development of the variable x(t), normalized to unit, can be formed. An example of the Verhulst model with parameter A shows the dependence of the solutions x(t) at time intervals t(n+1)-t(n) and tabular values of x(n) and different a jumps of initial conditions. Negative inclinations of dependency associated with the tabular values x(n) are shown. Thus, there appears a situation, which leads to the release of the variable x from the corridor, normalized per unit, of sustainable values. For each a-case, the changes in the structure of x(t) in time look diverse and complex.

Therefore, the numerical logistic equation can be taken as a numerical model for the development of natural hazards in the geographical environment, characterized by capacity (option a) of a tension of opposing factors.

Keywords: natural hazards, model, numeric equations, stability

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Studies on the understanding of haiku composed by earthquake disaster of East Japan on 11. 3. 2011

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Studies on the understanding of haiku composed by earthquake disaster of East Japan on 11. 3. 2011

Aoki, Yoji (student of Open University of Japan), Chida Sosuke (Kurame Haiku Club), Jambor Kinuko (translator of Haiku International Association) and Hitoshi Fujita (Professor of Aomori University)

The damage of the Fukushima nuclear power plant and the East Japan big earthquake, the east part of Japan received big impact on the March 11, 2011. Many haiku poet composed haiku poems to the impact of the nuclear power plant accident and the earthquake disasters. Of these haiku what was published in the magazine, 234 haiku on the home page were to be used in the data. Copies of haiku were shown to 19 people of the general public and the poet, and we asked whether they can understand them, or they are impressed by them. 2354 haiku was chosen in total. 124 haiku was chosen average.

10.1 average people, understand of haiku and the distribution of the two-peaked mountain with 8 and 13 people was observed. Haiku understood by more than half of people were relatively large and 132 (56.4%), so it was found that haiku is yet the useful means of communication of mind for the Japanese today. As for the impressive haiku, it has the maximum value in 0 and at 1.4 person average, and decreases the distribution of people. 91 (38.8%) haiku were impressed by more than two people. To convey the emotion equally to many people, it showed difficulties. Taking the correlation of the number of people impressed with the number of people evaluated, it showed weak association of 0.515. The results suggested that haiku could be understood by a lot of people, but could give the impression variously.

According to the evaluation method in the Haiku Society, one point in haiku which was able to understand, to give two points to haiku that was impressed, we calculated the total score. Correlation of the number of people understood and the people impressed indicates 0.731, the stronger association was obtained. This is a result of the score added points. As it was not a very strong connection, so the individual differences affect the evaluation of haiku.

By the principal component analysis in the factors respondents, six-axis was obtained with eigen value greater than 1.0. This indicates that there are many different preferences in the evaluation by the respondents. The axis with maximum eigen value has the largest explanatory power, and showed the severity of the evaluation. We estimate 5-axis remaining as the evaluator's preferences for haiku.

The highest scored Haiku observed 2 haiku of 20 points.

(1) Mud certification of graduation, mud portrait digging under the debris by Tsunami (Sinogo SONE)

(2) Finding my mother in turning disaster's debris, light snow falling (Minu KASHIWABARA)

(3) Children crying bright hopes for their future a graduation ceremony (Nagahiko KAMIGORI)

(1) described the scenery that the photographs of deceased persons and the certification of diploma by deceased became muddy by the tsunami, people are digging them after the disaster in the damaged areas.

(2) described the scenery that light snow was falling, while people are removing the disaster debris of earthquake to find their mother of missing, at the neighborhood home.

(3) was praying for the pupil who were singing the graduation song with full of tears to be lighten

We thought that both of them were touched deeply by sadness.

Reference

Haiku: http://blog.goo.ne.jp/humon007/e/fcc6b3e8f8dc3ca1cbc6a2177d6d0637

Acknowledgments: Cooperation was obtained from Kuramae Haiku Club (Tokyo Institute of Technology) and Blue Ridge Haiku Association (Roanoke City, Virginia) for the investigation of haiku. The Haiku used in this study was introduced by the site.

Keywords: earthquake disaster of East Japan on 11. 3. 2011, haiku poet, understandings and deep impressions

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Hazard Mapping of Structurally Controlled Landslides in Leyte, Philippines Using High Resolution Digital Elevation Model

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Structurally controlled landslides are one of the most destructive natural hazards that have occurred in the Philippines. The 2006 Guinsaugon Landslide, which was produced by the displacement of the Philippine fault, is a classic example of such hazard that took more than 1,000 lives and displaced more than 19,000 residents in the municipality of St. Bernard, Southern Leyte. Frequent monitoring and assessment should be done across the Philippine archipelago. The purpose of this study is to locate structurally controlled landslide prone areas with the aid of Coltop3D, Matterocking and Conefall using a high resolution digital elevation model (5 m resolution Interferometric Synthetic Aperture Radar images). The study area is set in the municipality of Ormoc, Leyte where the Philippine fault also cuts through and trending northwest. Discontinuity sets were identified using Coltop3D software that simulates a 3D model of the digital elevation model showing the dip and dip direction of different discontinuities. Lineation analysis and rose diagrams were made to verify the discontinuity sets in the area. Matterocking computes and estimates the locations where rock instabilities can occur according to the identified discontinuity sets that may allow sliding. Conefall was then used to compute and estimate the potential rockslide extent. Results show that the area has zones of potential rockslides with generated simulation of rockslide propagation extent. There is a high probability of landslides in Ormoc area where continuous monitoring of such danger zones should be done.

Keywords: structurally controlled landslides, geohazard, philippine fault, discontinuities, landslide mapping, structures

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Developing Automatic Delineation of Alluvial Fans for Rapid Hazard Assessment in Aurora Province, Philippines

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On Nov. 14, 2004, flashfloods from Subsob River struck Barangay(village) Paltic in Dingalan, Aurora Province around 4 a.m. when most residents were asleep - leaving hundreds homeless and 135 people dead. The series of floods caused by Violeta, Winnie, and Yoyong until December 2004 killed at least 300 people in Dingalan, Aurora alone. Mud buried 300 houses and residents were forced to stay on rooftops or seek higher ground. Because of these incidents, measures were devised to improve available geohazard maps to raise public awareness about landslides, debris flows and alluvial fans. This study developed a method to rapidly identify alluvial fans, thereby, hastening geohazard mapping in the region. Alluvial fans are fan shaped geologic formations deposited from tributaries from a mountainous terrain which flows out from the sudden break of a slope. Intense rainfall increases the discharge of sediments and water on these areas which could induce disastrous events such as flooding and debris flows. In this study, manual and automated methods in delineating fans in Aurora Province were compared. Manual delineation of alluvial fan boundaries were done through the contour lines generated from the 10-meter synthetic aperture radar (SAR)-derived digital elevation model (DEM). However, manual mapping of alluvial fan boundary which makes use of topographic interpretation of geomorphic features is subjective and time consuming. Biases were addressed by the second method by including factors such as 1) fan area of slope ranging from 1 to 8 degrees, 2) contributing stream networks from fan apex to fan toe , and 3) the fan potential lateral extent within the buffer zones based on the relief of the sediment source area in the GIS-based model. The outputs were compared with the manually delineated fans. Manual delineation identified 14 alluvial apex of 14 alluvial fans in 6 municipalities affecting 36 barangays . On the other hand, automated method identified 183 apex of 126 alluvial fans in 7 municipalities affecting 105 barangays. Although greater number of fans and wider fan area were identified using the automated method, manual delineation is still needed to check the results especially in volcanic regions. In addition, inactive alluvial fans are not accounted by the automated method.

Keywords: alluvial fan, natural hazard mapping, geohazard, GIS, Aurora, Philippines

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Strong Explosive Eruptions of Kamchatkan Volcanoes in 2013

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There are 30 active volcanoes in the Kamchatka, and three of them (Sheveluch, Klyuchevskoy, and Karymsky) continuously active. In 2013, two of the Kamchatkan volcanoes ? Sheveluch and Klyuchevskoy - had strong explosive eruptions.

Powerful explosive eruption of volcanoes is the most dangerous for aircraft because in a few hours or days in the atmosphere and the stratosphere can produce about several cubic kilometers of volcanic ash and aerosols. Ash plumes and the clouds, depending on the power of the eruption, the strength and wind speed, can travel thousands of kilometers from the volcano for several days, remaining hazardous to aircraft.

The eruptive activity of Sheveluch Volcano began since 1980 (growth of the lava dome) and is continuing at present. Strong explosive events of the volcano occurred in 2013: on June 26, on October 18, and on December 03: ash plumes rose up to 10 km a.s.l. and extended about 200-400 km, respectively, to the south-west, south-southeast, and north of the volcano. A form of pyroclastic flow deposits with run-out 12 km accompanied these explosive eruptions. Ashfalls occurred at Klyuchi Village (on June 26) and Ivashka Village (on December 03). Activity of the volcano was dangerous to international and local aviation.

Klyuchevskoy volcano had two eruptions in 2013: moderate Strombolian explosive eruption from October 14, 2012, till January 15, 2013; and strong Strombolian-Vulcanian explosive and effusive eruption from August 15, 2013, till December 20, 2013. There were four lava flows to effuse on the north-west, west and south-western volcanic flanks. Probably a flank eruption began at the pass between Klyuchevskoy volcano and Kamen volcano on October 06. Culmination of strong Vulcanian explosive activity of the volcano occurred on October 15-20: ash column rose up to 10-12 km a.s.l. and ash plumes extended to the different directions of the volcano according to cyclonic activity in the this area. Phreatic ash plumes on the fronts of lava flows rose up to 5 km a.s.l. Weak ash falls were noted at Klyuchi Village on October 09 and 13, and Mayskoe Village on October 16. Activity of the volcano was dangerous to international and local aviation.

Keywords: explosive eruption, volcano, Kamchatka, Sheveluch, Klyuchevskoy