Japan Geoscience Union Meeting 2014
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HDS06-01 会場:422 時間:5 月 2 日 09:00-09:25

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

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.

キーワード: natural hazards impacts, social and economic consequences, natural-technological risk, natural-technological disaster
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
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.

キーワード: natural disaster, social impact, history of disasters, ancient egypt
Keywords: natural disaster, social impact, history of disasters, ancient egypt

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# Relationship between social and natural disasters
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.

キーワード: geodynamics, society, magnitude of disaster, interaction of disasters, impact of society
Keywords: geodynamics, society, magnitude of disaster, interaction of disasters, impact of society

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

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.

キーワード: natural hazards, model, numeric equations, stability
Keywords: natural hazards, model, numeric equations, stability

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# 震災によって作られた俳句の理解に関する研究
# Studies on the understanding of haiku composed by earthquake disaster of East Japan on 11. 3. 2011

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震災によって作られた俳句の理解に関する研究
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2011 年 3 月 11 日に東日本は震災と福島原子力第一発電所の被害により、大きな影響を受けた。この震災の後に多くの俳人が、地震と原子力発電所の事故による影響を俳句に詠んだ。これらの俳句のうち、雑誌に発表された 234 句を収集しホームページに公表したものをデーターとすることにした。これをコピーし、俳人と一般人の 19 人に見せ、理解できる句と、感動した句を選んでもらった。合計で 2354 句が選ばれた。一人平均で 124 句が選ばれた。

俳句に対する理解は平均 10.1 人で、8 人に最大値を持ち、13 人にもう一つの山を持つ 2 峰型の分布をなした。半数以上の人が理解できた句は 132 句 (56.4 %) と比較的多く、俳句は現在でも日本人に理解できる心の伝達手段であることが分かった。また、感動した句は 0 に最大値を持ち、平均 1.4 人で、人数の増加に伴い減少する分布を示した。2 人以上の人が一致して感動した俳句は 91 句 (38.9 %) であった。多くの人に均等に感情を伝えるには、難しい手段であることが分かった。評価した人数と感動した人数の相関を取ると、0.515 で、弱い関連を示した。このことは多くの人が理解できた俳句が、感動を与える俳句ではないことを示している。

俳句会での評価方法に従い、理解できた俳句に 1 点、感動した句に 2 点を与え、総合点を計算した。総合点と感動した人数の相関は 0.731 を示し、少し強い関連が得られた。これは、2 点と言う得点加算の結果である。それほど強い関連でないことから、感動した句には個人差が影響し、評価者間で一致しなかったことを示す。

回答者を要因にして主成分分析を行なうと、固有値 1.0 以上で 6 軸が得られた。このことは回答者による評価の違いが多く有ることを示している。最大固有根は最大の説明力を持つ軸であり、評価の厳しさを示すことが分った。残りの 5 軸は俳句に対する評価者の好みが現れたものと思われる。

最も評価が高かった俳句は 21 点を獲得し以下の 3 句であった。
①泥の遺影泥の卒業証書かな　曽根新五郎
②淡雪や瓦礫めくりて母探す　柏原眠雨
③泣きはらす子らにひかりあれ卒業歌　上郡長彦
①は津波に拠って泥だらけになった死んだ人の写真と、死んだ人の卒業証書が被災地に散らばっている光景であった。
②は地震で壊れた自宅や近所を、瓦礫を除去しながら、行方不明の母を捜すところへ、雪が降ってきた情景であった。
③は卒業を迎えた生徒が泣きながら、卒業歌を歌っているので、この子らに光あれと祈る句である。
何れも悲しさに心を打たれたものと思われる。

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震災俳句：http://blog.goo.ne.jp/humon007/e/fcc6b3e8f8dc3ca1cbc6a2177d6d0637

謝辞：俳句の調査には蔵前俳句会 (東京工業大学) とブルーリッジ俳句会 (バージニア州ロアノク市) の協力を得た。

キーワード: 東日本大震災, 俳句, 理解と感動
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
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.

キーワード: structurally controlled landslides, geohazard, philippine fault, discontinuities, landslide mapping, structures
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

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.

キーワード: alluvial fan, natural hazard mapping, geohazard, GIS, Aurora, Philippines
Keywords: alluvial fan, natural hazard mapping, geohazard, GIS, Aurora, Philippines

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# Strong Explosive Eruptions of Kamchatkan Volcanoes in 2013

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.

キーワード: explosive eruption, volcano, Kamchatka, Sheveluch, Klyuchevskoy
Keywords: explosive eruption, volcano, Kamchatka, Sheveluch, Klyuchevskoy