Japan Geoscience Union Meeting 2014
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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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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