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Social and economic consequences of March 11, 2011 Tohoku disaster in Japan
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The last two years set a sad record in the number and scale of natural disasters and clearly demonstrated high vulnerability of the global economy to their impact. The most serious consequences have the so-called natural-technological disasters that have place when natural hazards trigger accidents and disasters at technological objects such as nuclear power plants, chemical plants or oil refineries and pipelines. Natural-technological disasters caused by earthquakes and devastating tsunamis have the most serious impact. One of the most large-scaled natural-technological disasters occurred on March 11, 2011 in Japan as a result of a massive 9.0-magnitude earthquake off the northeast coast of Honshu Island, that caused a more than 30-meter tsunami. A distinctive feature of such events is their synergistic nature with a disaster impact on the technosphere, resulting in simultaneous occurrences of numerous technospheric accidents. This disaster was yet another tragic confirmation of the vulnerability of modern techno-sphere and society, even such a highly developed one, as the Japanese, to the impact of natural hazards. The greatest number of fatalities and losses was caused in the Miyagi, Iwate, Fukushima, Chiba, and Ibaraki prefectures. The infrastructure in the north-east of the country is damaged to a considerable extent (more than 130 thousand houses have been completely or partially destroyed, another 265 thousand homes were seriously damaged, thousands of miles of communications, roads and railways, more than 70 bridges were destroyed). With a total damage between 400-700 billion USD in total losses and approximately 19000 deaths and almost 6000 injures, this disaster proved to be the most expensive and the most destructive on record (earthquake-report.com/2012). Of these, direct losses will reach between 294 billion USD and 374 billion USD. The earthquake and tsunami caused a number of technological accidents, including accidents at "Fukushima-1" and "Onagava" nuclear power plants, explosions and fires at refineries in Chiba, and at a petrochemical plant in Sendai, a number of other fires, railway, water, road, and other accidents. 148 lives have been lost in fires, 260 houses have been destroyed by fires.

The most serious consequence of the Tohoku event was a series of accidents at "Fukushima-1" nuclear power plant, which resulted in several leaks of radioactive substances into the atmosphere and the ocean. The accident was initially assigned to the 5-th, and later to the highest 7-th level of danger on 7-point International Nuclear Event Scale (INES). Right after the accident people (about 77 thousand) were evacuated from the 20-kilometer zone around the power plant, and the presence of people in the exclusion zone was prohibited. Later the evacuation area was extended to 60 kilometers.

About 41 percent of economic losses (including both direct and indirect losses) were caused by earthquake, about 36 percent by tsunami and about 23 percent due to the Fukushima disaster. The disaster had an impact on economic development not only in Japan but also in other countries. Many Japanese companies have suffered significant losses. The NPP Hamaoka situated in the Shizuoka Prefecture (200 km from Tokyo) with a predicted high probability of massive earthquake, was stopped. However, Japan, as well as Russia, does not intend to completely abandon nuclear power. Meanwhile some other countries declared a revision of their atomic energy programs. For example, the German government announced the decision to stop the operation of all the country's nuclear power plants by 2022.

Hopefully the lessons of the disaster will contribute to the increasing of safety of nuclear power plants and other high-risk facilities. One of the main lessons of this tragedy lies in the fact that while placing, constructing and operating such facilities, it is necessary to consider carefully the potential impacts, including natural hazards.

キーワード: natural-technological disaster, social losses, economic consequences, disaster prevention, vulnerability
Keywords: natural-technological disaster, social losses, economic consequences, disaster prevention, vulnerability

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企業と地域コミュニティの災害軽減に関する考察〜東日本大震災からの教訓
Protecting industry and communities: Lessons from the Great East Japan Earthquake of 11 March 2011

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This paper presents the preliminary results and analysis of an ongoing study of impacts of the Great Eastern Japan earthquake and tsunami of 11 March 2011 on industry in Miyagi, Ibaraki and Chiba Prefectures. This study is a joint effort by the Disaster Prevention Research Institute of Kyoto University and the Joint Research Centre of the European Commission. The study involved a series of field trips to the affected areas, interviews with government officials and interviews and visits with industry owners /operators. The purpose of the study is to assess performance of risk management practices including mitigation, preparedness and response measures to deal with the earthquake and tsunami; impacts on the community of any pollution incidents or chemical accidents ensued, as well as overall economic and supply chain impacts on industry.
Keywords: NaTech, Economic Impact, Business Contituity, Community Protection

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東日本大震災後の沿岸域における土地利用計画の再考
Re-thinking of Land use planning at coastal area in Japan after Tsunami disaster

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1. Introduction

One of the five most powerful earthquakes in the world since modern record-keeping, which was a magnitude 9.0 (Mw) undersea megathrust earthquake off the coast of Japan, occurred at 14:46 JST (05:46 UTC) on Friday, 11 March 2011 (Ministry of Land, Infrastructure, Transportation and Tourism, Great East Japan Earthquake report (106), 6 Feb. 2012). The earthquake triggered powerful tsunami waves that reached heights of up to 40m in Miyako, Iwate Prefecture, and which, in the Sendai area, travelled up to 10km inland. The Japanese National Police Agency confirmed 15,860 deaths, 6,011 injured, and 3,281 people missing, as well as over 372,000 buildings damaged or destroyed. Although most coastal area has invested the huge seawalls which stand up to 12 m high, the tsunami simply washed over the top of some seawalls, collapsing some in the process. This tsunami was beyond the assumption scale of the seawall design greatly, but the equivalent scale tsunami was occurred at same area in the past several times, e.g. 869 Jogan tsunami, 1896 Meiji-Sanriku tsunami, 1933 Sanriku tsunami, etc.

2. Why is the history repeated?

Japan is narrow and steep mountainous island country surrounded by the sea. About 35% of populations are concentrated in coastal lowland area, almost same as inundation area of this 2011 tsunami, within 10km from coastline and up to 30m from sea level. In this Sanriku area, people moved to hills after every tsunami disaster, however they gradually back to lowland again. Even if a lot of monuments, which warned of the danger of the tsunami, were left, the memory of their danger has gradually faded and the history has been repeated over and over again. While some villages, which keep staying on the hills, have avoided this 2011 tsunami disaster.

3. Design with nature

One of the big issues of land use in coastal area is that the city area got too close to the sea. Because the population has been increased until in 2005, we needed to develop more urban area and farmland. The development of coastal area brought economic growth. But the expanse of the city resulted in the increase of enormous cost to maintain their infrastructures, e.g. roads, water and drainage services, and seawall to protect the properties. These developments destroyed natural settings in coastal area and their ecosystem services, especially from coastal sand dune. One of the most important ecosystem services of coastal sand dune is the coastal defense as natural dike. In Netherland, the coastal sand dune is strictly protected instead of seawall. In addition with the coastal defense, coastal sand dune supply dune water as drinking water in Netherland. Everard et. al. (2010) showed that the coastal sand dune provided not only support biodiversity, but also a wide range of ecosystem services. In Japan, most coastal dunes were lost caused by erosion, development, planting coastal forest, and establishment of seawalls. But now, Japanese populations have decreased to since 2005. Especially in the Tohoku region, populations decreased to since 1970s and the abandoned farmlands have rapidly increased since 2000. We should consider the setback from the coast and the restoration of coastal sand dunes as reconstruction plan. In this plan, the seawalls are not necessary, coastal forest moving to more inland area where will work well, and landfilled road, which stands seaside of the city, being inner dike instead of the seawalls. 2011 Tsunami disaster has showed that the liner protection, e.g. huge seawall, could not prevent their damage. The new reconstruction plan should be made effective configuration of these multiplex defense structures of land use to reduce the damage of tsunami, considered the landscape, population trend and future vision.

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An estimate of the risk of accidents
An estimate of the risk of accidents

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An estimate of the risk of accidents
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An analytical dependency of the risk value from the characteristics of inaccuracy of the coming events, which are particularly connected with natural hazards, is proposed. It is noted that algorithm of risk management to realization of the event should contain the operations of the process partition on controlled stages.

The theory of the risk was broadly developed and used at the end of 19th century, due to development of mathematicians and statistics. For undertaking numerical calculation of risk, game theory, theory of chances, theories of the catastrophes and decision making are used. The risk is objective and exists in any sufficiently complex system, so the development of approaches to risk assessment is important for environmental, economic, technical applications, and many other branches of human activity.

The following determinations of the risk are known: in sociologies it is a possible danger, loss, or failure; in mathematician it is a feature of a statistical process, expressing loss. Covering a wide range of human activities and spheres of its existence, it can be assumed that the risk is the uncertainty in the realization occurrence of a possible event. Nuance in above definition of risk is to emphasize the difference between the amount of risk and the value of the probability of an event. For example, if the risk is zero, the event is sure to be done. However, if the probability of its occurrence is zero, it means that the event will not happen.

In an effort to maintain a formal risk assessment tool, you should find an universal mathematical operation that expresses the value of risk by any objective characteristic stability of the event. In physics there is the concept of entropy, the information on which is a measure of the uncertainty of the event. From general considerations, we can assume that an increase (decrease) in the instability of the events will increase (decrease) the risk. On the other hand, the more we know about the history of the origin of the event, the less is uncertainty in the prediction of new developments. Thus, the expectation, based on knowledge of the previous information allows us to apply the exponential dependence of the risk from entropy. This nonlinear correlation indicates only a principle of correspondence of the risk value and the entropy and does not contain an exhaustive level of strictness. The proposed mathematical operation is used as a tool for the systematic ordering of material related events, and provides a convenient way of interpolation with other conditions, which allows to refine the knowledge and set goals for the experiments.

The use of the exponential correlation is that it is being used, along with multiple feature of the real condition, can estimate a quality of results and extrapolations of an approaching event. Such a calculation indicates an amount of risk that an entity may operate.

Thereby, the role of the subject is not reduced to a passive contemplate, it allows you to create sensibly, acting responsible. This constructive approach is especially important when working with a large number of realities, where only limited range of situations and estimated treatment effects on individual attention given the opportunity to obtain useful conclusions.

キーワード: risk, natural hazards, environmental, entropy, mathematicians, statistics
Keywords: risk, natural hazards, environmental, entropy, mathematicians, statistics

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災害復興と観光　–宮城県石巻市を事例として–
Post-Disater Reconstruction and Tourosm –the csce of Ishinomaki City, Miyagi Prefecture

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本報告は 2011 年 3 月 11 日以降の被災地における地域の状況及びその推移について、自身が被災者である報告者の視点を織り交ぜながら、社会学的及び社会心理学的に考察を加えようとするものである。巨大な自然災害後の地域社会の復興過程において人間の営為、とりわけ移動、交流がどのようになされたのか。また、ツーリズムはその中でどの様な役割を果たしうるのか。被災地として最も大きな物的・人的被害を受けた自治体の一つである宮城県石巻市を事例として報告する。

被災者の状況と被災地の復旧段階

被災者のおかれた状況によって、現地の一年間の復旧過程は主に４つの段階に分けて理解することができる。生存の確保の時期、生活の確保の時期、生計の確保の時期、生活環境の整備の時期、の４つの段階である。

被災者心理と支援活動

被災者の緊張感は時間の経過とともに低減する。緊張感は感受性を高める働きを持つ。このことは来訪者に対する被災者の感情と密接な関係を持つと考えられる。

ボランティアかツーリストか

震災直後多くのボランティアが来訪し、復旧に大きな役割を果たした。大手の旅行会社をはじめ多くの「ボランティアツアー」が企画実施された。被災者の中には、被災状況を観光されることに少なからぬ抵抗感を持つ者もいる。しかし、一方では観光は復興に重要な役割を果たしうる現象でもある。

“ Reconstruction Support Tourism ”

被災地をめぐる観光の復興に対する役割に注目して、これを“ Reconstruction Support Tourism ”(以下ＲＳＴ）と呼ぶことを提唱する。一部に、自然災害を含めて本来当事者或いは人類にとって好ましからざる事象をめぐる観光を“ ダーク・ツーリズム ”と呼ぶ傾向があるが、少なくとも被災地の訪問のすべてにこの語を用いるのは極めて不適切と考えられる。

知の集積の必要性

ＲＳＴの例としては、ボランティアツーリズムなどがあげられるが、ひとつの可能性として考えられるものの中に、防災研修ツアーがある。こうしたツアーを実施するためには、現地に災害や防災に関する大きな知の集積が必要であると考えられる。本ミーティングに参加されている皆様の協力をお願いしたい。

キーワード: 災害復興, 観光, ボランティア, 復興支援, 緊張感, 被災者の感受性
Keywords: post-disaster reconstruction, tourism, volunteer, reconstruction support, stress level (degree of tension), sensitivity of disaster victims

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2011 Japan tsunami hydrograph and flow velocity measurements from survivor videos using LiDAR

2011 Japan tsunami hydrograph and flow velocity measurements from survivor videos using LiDAR

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On March 11, 2011, a magnitude Mw 9.0 earthquake occurred off the coast of of the Tohoku region causing catastrophic damage and loss of life in Japan. Numerous tsunami reconnaissance trips were conducted in Japan (Tohoku Earthquake and Tsunami Joint Survey Group). This report focuses on the surveys at 9 tsunami eyewitness video recording locations in Yoriisohama, Kesennuma, Kamaishi and Miyako along the Sanriku coast in Japan and the subsequent video image calibration, processing, tsunami hydrograph and flow velocity analysis. Selected tsunami video recording sites were visited, eyewitnesses interviewed and some ground control points recorded during the initial tsunami reconnaissance from April 9 to 25.

A follow-up survey from June 9 to 15, 2011 focused on terrestrial laser scanning (TLS) at locations with previously identified high quality eyewitness videos. We acquired precise topographic data using TLS at nine video sites with multiple scans acquired from different instrument positions at each site. These ground-based LiDAR measurements produce a 3-dimensional point cloud dataset. Digital photography from a scanner-mounted camera yields photorealistic 3D images. Integrated GPS measurements allow accurate georeferencing of the TLS data in an absolute reference frame such as WGS84. We deployed a Riegl VZ-400 scanner (1550 nm wavelength laser, 42,000 measurements/second, <600 meter max range) and peripheral equipment from the UNAVCO instrument pool.

The original full length videos recordings were recovered from eyewitnesses and the Japanese Coast Guard (JCG). Multiple videos were synchronized and referenced in time (UTC). The analysis of the tsunami videos follows a four step procedure developed for the analysis of 2004 Indian Ocean tsunami videos at Banda Aceh, Indonesia (Fritz et al., 2006). The first step requires the calibration of the sector of view present in the eyewitness video recording based on visually identifiable ground control points measured in the LiDAR point cloud data. In a second step the video image motion induced by the panning of the video camera was determined from subsequent raw color images by means of planar particle image velocimetry (PIV) applied to fixed objects in the field of view. The third step involves the transformation of the raw tsunami video images from image coordinates to world coordinates. The mapping from video frame to real world coordinates follows the direct linear transformation (DLT) procedure (Holland et al., 1997). Finally, the tsunami surface current and flooding velocity vector maps are determined by applying the digital PIV analysis method to the rectified tsunami video images with floating debris clusters resulting in instantaneous tsunami velocity vector fields. Tsunami currents up to 10 m/s per second were measured in Kesennuma Bay making navigation impossible.

キーワード: tsunami, Tohoku 2011, LiDAR, Japan, earthquake
Keywords: tsunami, Tohoku 2011, LiDAR, Japan, earthquake

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Natural Hazards and Nuclear Power Plants: measures to minimize the risk of a nuclear accident

Natural Hazards and Nuclear Power Plants: measures to minimize the risk of a nuclear accident

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In the aftermath of Fukushima natural-technological disaster the global opinion on nuclear energy divided even deeper. While Germany, Italy and the USA are currently reevaluating their previous plans on nuclear growth, many states are committed to expand nuclear energy output. In China and France, where the industry is widely supported by policymakers, there is little talk about abandoning further development of nuclear energy. Moreover, China displays the most remarkable pace of nuclear development in the world: it is responsible for 40% of worldwide reactors under construction, and aims at least to quadruple its nuclear capacity by 2020. In these states the consequences of Fukushima natural-technological accident will probably result in safety checks and advancement of new reactor technologies. Thus, China is buying newer reactor design from the USA which relies on advanced ”passive safety systems”.

Nuclear industry has drawn lessons from previous nuclear accidents where technological and human factors played crucial role. But the Fukushima lesson shows that the natural hazards, nevertheless, were undervalued. Though the ongoing technological advancements make it possible to increase the safety of nuclear power plants with consideration of natural risks, it is not just a question of technology improvement. A necessary action that must be taken is the reevaluation of the character and sources of the potential hazards which natural disasters can bring to nuclear industry. One of the examples is a devastating impact of more than one natural disaster happening at the same time. This subject, in fact, was not taken into account before, while it must be a significant point while planning sites for new nuclear power plants.

Another important lesson unveiled is that world nuclear industry needs advanced mechanisms of international oversight. The urgent necessity is to develop and adopt a joint mechanism for international consultation in case of serious accident at a nuclear power plant. It is necessary to work out the list of constraining provisions for building and operating nuclear plants in regions where potential risks of natural-technological catastrophes exist. These provisions should include risk estimate for every particular region, as well as the list of preventive measures to secure the safe operation of nuclear plants located at those sites. As it was stated before, the synergy effects of more than one potential hazard must be taken into account.

The main goal of my report is to represent possible methods for mitigating safety risks associated with natural hazards and technological disasters, review the effectiveness of existing oversight mechanisms, and encourage a cooperative discussion on these issues.

キーワード: Natural hazards, Technological disaster, Synergy effect, Nuclear energy policy, Safety risk evaluation
Keywords: Natural hazards, Technological disaster, Synergy effect, Nuclear energy policy, Safety risk evaluation

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An Example of a Historical Natural Disaster and its Influence on the Japanese-Russian Relations

An Example of a Historical Natural Disaster and its Influence on the Japanese-Russian Relations

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A series of powerful Ansei Great Earthquakes hit Japan at the end of 1854 ? beginning of 1855. They started on 23 December, 1854 with the Ansei-T?kai Quake, which had a magnitude of 8.4; its epicenter ranged from the centre of Suruga Bay to the south-east into the ocean. It was followed by the Ansei-Nankai Quake on 24 December. The consequences of these earthquakes and the following tsunami were terrible for Japan: more than 20,000 buildings were destroyed, many people (about 30,000) died in several Japanese regions. But this horrible natural disaster also had some different consequences. At that time frigate Diana, the flagship of the Russian diplomatic mission, stayed in Shimoda: the leader of the mission admiral Yevfimy Putyatin was conducting long and difficult negotiations trying to start the official relations between Russia and Japan, when Shimoda was hit by the tsunami. Several members of the mission described their impressions in their memoirs. For example, the chaplain Vasily Makhov wrote: "Water from the bottom of the sea drilled and boiled as in cauldron, its waves swirled, rised and spilled into the splashes; billows came from the sea one after another, one stronger than another with unusual noise and furious roar pressed water, captured the coasts, instantly flooded the place father and father ? bigger and bigger..." Shimoda was almost completely destroyed (only 16 houses survived the disaster). Diana was also seriously damaged and soon sank in a storm while sailing to Heda village for repairs. The crew had to move to the shore, and was quartered in Heda. Putiatin asked to provide his expedition with materials and workers for building a new ship so as Russian sailors could return to their homeland, and Japan agreed. Works were carried out in Heda with the help of plans salvaged from the Diana, and required a cooperation of Russian sailors and Japanese carpenters. In about two months a two-masted schooner was built, which was christened Heda in honor of the city that helped with its construction. The Heda was the first western-style ship built in Japan, and thus can be called a "grandfather" of a Japanese oceanic navy. On 26 January, 1855 the Russian-Japanese negotiations were successfully concluded, and the Treaty of Shimoda was signed, marking the start of official relations between Russia and Japan. Thus a terrible natural disaster framed one of the most vivid pages in history of the Japanese-Russian relationship.

キーワード: natural disasters, earthquake, japanese-russian relations, tsunami, Shimoda
Keywords: natural disasters, earthquake, japanese-russian relations, tsunami, Shimoda