Global Dynamic Exposure and the OpenBuildingMap - Communicating Risk and Involving Communities

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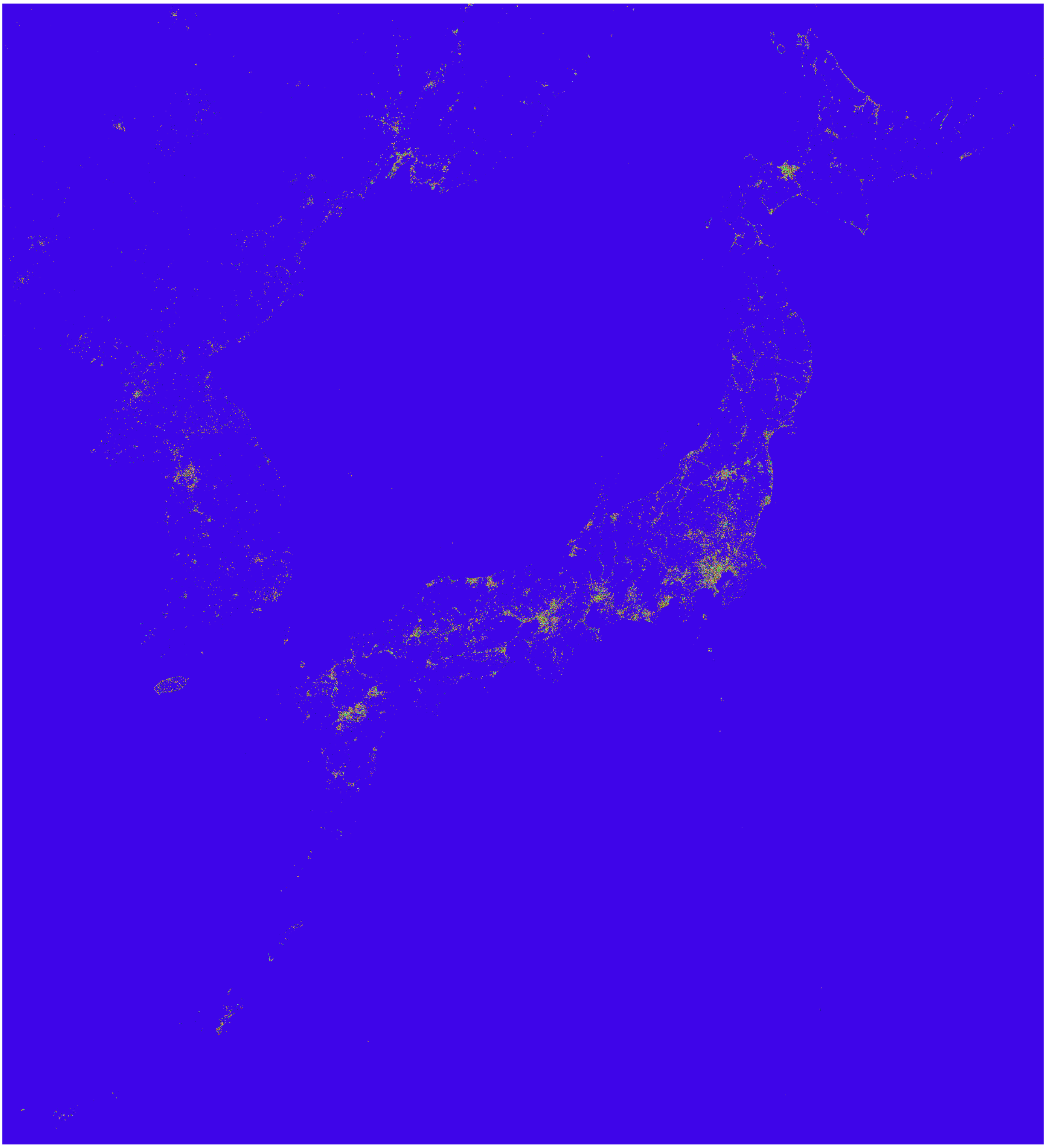
Detailed understanding of local risk factors regarding natural catastrophes requires in-depth characterization of the local exposure. Current exposure capture techniques have to find the balance between resolution and coverage. We aim at bridging this gap by employing a crowd-sourced approach to exposure capturing, focusing on risk related to earthquake hazard. OpenStreetMap (OSM), the rich and constantly growing geographical database, is an ideal foundation for this task. More than 3.5 billion geographical nodes, more than 200 million building footprints (growing by ˜100'000 per day), and a plethora of information about school, hospital, and other critical facilities allows us to exploit this dataset for risk-related computations.

We are combining the strengths of crowd-sourced data collection with the knowledge of experts in extracting the most information from these data. Besides relying on the very active OpenStreetMap community and the Humanitarian OpenStreetMap Team, which are collecting building information at high pace, we are providing a tailored building capture tool for mobile devices. This tool is facilitating simple and fast building property capturing for OpenStreetMap by any person or interested community. With our OpenBuildingMap system, we are harvesting this dataset by processing every building in near-realtime. We are collecting exposure and vulnerability indicators from explicitly provided data (e.g. hospital locations), implicitly provided data (e.g. building shapes and positions), and semantically derived data, i.e. interpretation applying expert knowledge. The expert knowledge is needed to translate the simple building properties as captured by OpenStreetMap users into vulnerability and exposure indicators and subsequently into building classifications as defined in the Building Taxonomy 2.0 developed by the Global Earthquake Model (GEM) and the European Macroseismic Scale (EMS98). With this approach, we increase the resolution of existing exposure models from aggregated exposure information to building-by-building vulnerability.

We report on our method, on the software development for the mobile application and the server-side analysis system, and on the OpenBuildingMap (www.openbuildingmap.org), our global Tile Map Service focusing on building properties. The free/open framework we provide can be used on commodity hardware for local to regional exposure capturing, for stakeholders in disaster management and mitigation for communicating risk, and for communities to understand their risk.

Keywords: Seismic Hazard and Risk, Exposure, Citizen Science, Big Data



Citizen Earthquake Science in Taiwan: From Science to Hazard Mitigation

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Taiwan is located at seismically highly active area, where is a convergent plate boundary zone between the Eurasian plate and the Philippine Sea plate. To bring seismology in a simple way to citizens at school and home, we are incorporating the Quake-Catcher Network (QCN) program into an educational seismic network that is maintained by teachers in more than 200 high schools in the whole island of Taiwan. We established a web-based educational platform so that users are encouraged to interact with these collected seismic waveform data and even to conduct further signal analysis on their own. In addition, to collect field observations for any earthquake-induced ground damages, such as surface fault rupture, landslide, rock fall, liquefaction, and landslide-triggered dam or lake, etc., we are developing an earthquake damage reporting system for public but particularly relying on trained volunteers who have taken a series of workshops, organized by this project. This Taiwan Earthquake Scientific Report (TSER) system is based on the Ushahidi mapping platform, which has been widely used for crowdsourcing. Some online games and materials for educational purposes on learning earthquakes will be ready in a near real-time manner for students and teachers. All These constructed products are now operated at the Taiwan Earthquake Research Center (TEC). With these newly developed platforms and materials, we are aiming not only to raise the earthquake awareness and preparedness, but also to encourage public participation in earthquake science in Taiwan.

Keywords: citizen science, crowdsourcing, Taiwan Earthquake Science Information System, Taiwan Earthquake Research Center

Japanese New Guidelines for the Information of the Prospect of Seismic Activity after Big Earthquakes and their Applications

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A big earthquake of M6.5 with maximum seismic intensity 7 in Japan Meteorological Agency (JMA) seismic intensity scale occurred in Kumamoto Prefecture at 21:26 on 14 April, 2016 (Japan Standard Time). That was the beginning of the sequence of "The 2016 Kumamoto Earthquake". After 18 hours of this earthquake, JMA issued prospect of aftershock activity that there was a possibility to suffer strong ground motion with JMA seismic intensity 5+ or 6- in some areas by aftershocks for about one week. The probability of aftershocks which cause JMA seismic intensity 6- in some areas was calculated to be 20% for the next 3 days from 16:00 on 15 April, and the number of the probability was announced by JMA. This prospect was based on guidelines determined by the Earthquake Research Committee (ERC) of the Headquarters of Earthquake Research Promotion (HERP) in 1998. However, after 10 hours of the issuance of the prospect, a bigger earthquake of M7.3 with JMA seismic intensity 7 occurred at 01:25 on 16 April in the same region as the first big earthquake of M6.5, and triggered distant earthquakes. The seismically active area was finally spread southwest to northeast up to about 150km long from Kumamoto Prefecture to Oita Prefecture. As this seismic activity was revealed that it was not a simple mainshock - aftershock patterns, JMA stopped issuance of the following information about prospect of aftershock activity. Instead of issuance of prospect, JMA called attention to people to high seismic activity and strong ground motion by big earthquakes on the basis of previous cases in that area.
With lessons learned from this, seismologists and JMA discussed under a framework of the HERP, and the ERC of HERP published new guidelines for the information of the prospect of aftershock activity after big earthquakes in August 2016. The points of the guidelines are followings.
(1) JMA calls attention to strong ground motion which is similar level to the first big earthquake for about one week after big earthquakes.
(2) If there were prior cases of foreshock - mainshock - aftershock series or earthquakes with similar magnitude which occurred in the short term near the big earthquakes, JMA calls attention to such cases.
(3) If active faults and assumed source regions of big thrust-type subduction-zone earthquakes existed near the big earthquakes, JMA explains the characteristics and calls keeping in mind them.
(4) After one week, if the active seismic activity continues, JMA issues aftershock probability. The probability is shown by magnification ratio which compares to the probability just after the biggest earthquake and before the big earthquakes.
(5) JMA uses a word "earthquake" instead of "aftershock" when JMA calls to attention to strong ground motion by aftershocks, because the word of "aftershock" gave some impression to people that bigger earthquakes would not occur.
We will introduce new Japanese guidelines and show some actual examples of its applications.

Keywords: Kumamoto Earthquake, Prospect of Seismic Activity, Aftershock Probability, Seismic Information, Aftershock

The influence of the Kumamoto earthquakes on public risk perception and trust toward authorities

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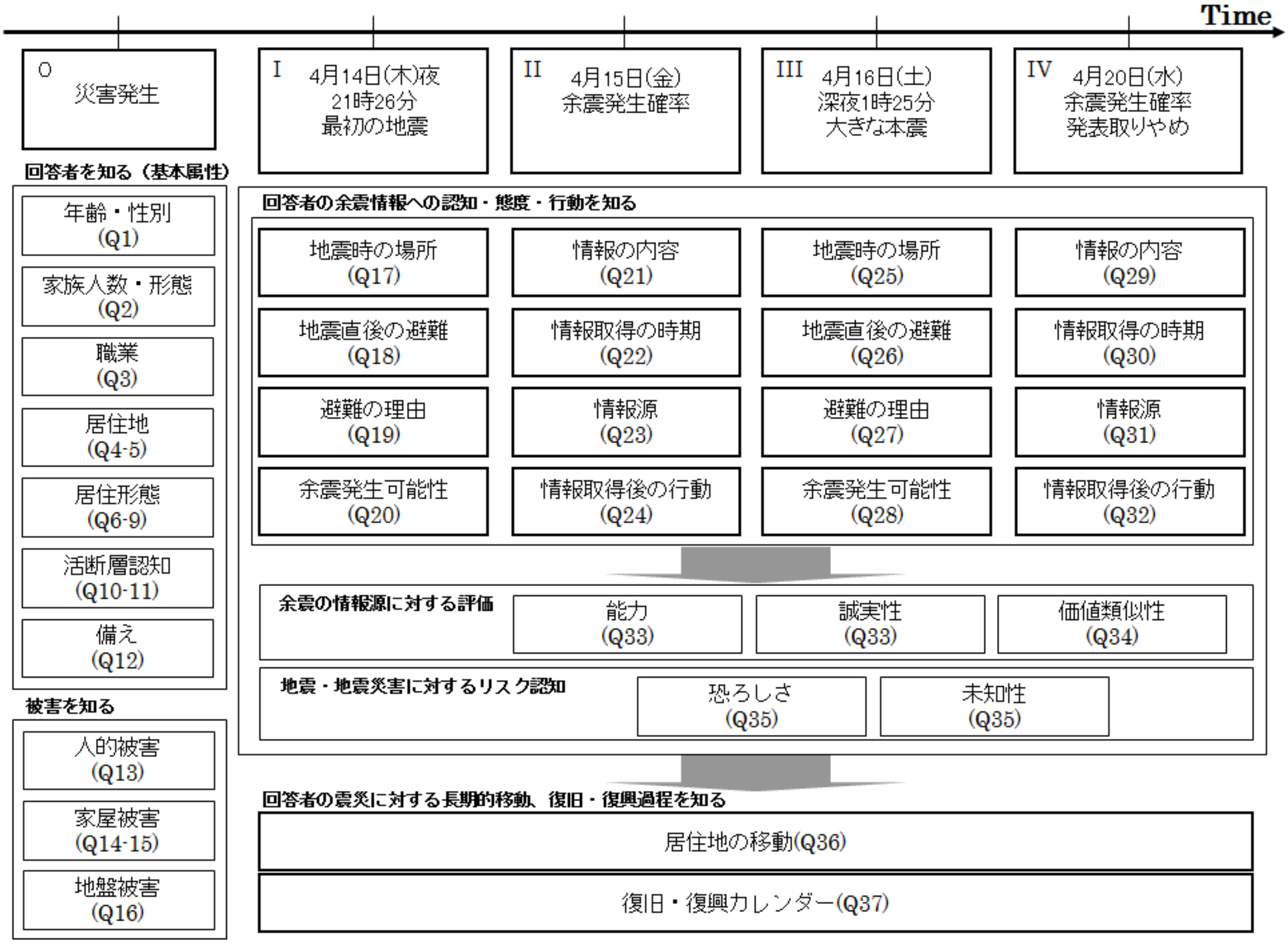
The magnitude 6.2 foreshock on the 14th of April and the magnitude 7.3 main shock on the 16th of April happened in the 2016 Kumamoto earthquakes. The main shock over than the magnitude 6.2 was not anticipated because the foreshock was considered to be the main shock. After the earthquakes, the meteorological agency changed the policy to discontinue the announcement of probability of aftershock occurrence. The experience of Kumamoto earthquakes and the policy change of risk communication may affect public risk perception of earthquake and trust toward authorities. For example, the Fukushima nuclear accident that was an unexpected disaster changed the perception of nuclear risk and trust toward the authorities (i.e. Government, electronic power company) to negative (Ohtomo et al., 2014). Social amplification of risk is occurred after the large-scale accident or disaster (Slovic et al., 1991). The social amplification makes people exaggerate risk perceptions and aversive reactions. The study examines how the people suffered from the Kumamoto earthquakes perceive an earthquake risk and evaluate trust toward authorities. In the study, the damages and coping behaviors after the foreshock, main shock, and the policy change of the meteorological agency were measured to investigate the influence on the risk perception and trust.
The mail survey was implemented from the end of November to the middle of December in 2016. Respondents were collected based on the level of earthquake damage and population ratio of areas in Kumamoto prefecture. The figure showed the framework of the questionnaire. The study analyzed the relationships between the damages and coping behaviors and risk perceptions of earthquake and trusts toward the government, meteorological agency, and local governments.
The study illustrates the patterns of coping behavior after the shocks and the policy change affected the risk perception and trusts, in addition to the level of earthquake damage. Especially, there might be differences between people who changed coping behaviors and people without change after the main shock. Implications for risk communication of earthquake are discussed herein.

Keywords: Kumamoto earthquakes, risk communication, risk perception, social amplification, trust


Time
O 災害発生
I 4月14日(木)夜 21時26分 最初の地震
II 4月15日(金) 余震発生確率
III 4月16日(土) 深夜1時25分 大きな本震
IV 4月20日(水) 余震発生確率 発表取りやめ
回答者を知る（基本属性）
年齢・性別 (Q1)
家族人数・形態 (Q2)
職業 (Q3)
居住地 (Q4-5)
居住形態 (Q6-9)
活断層認知 (Q10-11)
備え (Q12)
被害を知る
人的被害 (Q13)
家屋被害 (Q14-15)
地盤被害 (Q16)
回答者の余震情報への認知・態度・行動を知る
地震時の場所 (Q17)
地震直後の避難 (Q18)
避難の理由 (Q19)
余震発生可能性 (Q20)
情報の内容 (Q21)
情報取得の時期 (Q22)
情報源 (Q23)
情報取得後の行動 (Q24)
地震時の場所 (Q25)
地震直後の避難 (Q26)
避難の理由 (Q27)
余震発生可能性 (Q28)
情報の内容 (Q29)
情報取得の時期 (Q30)
情報源 (Q31)
情報取得後の行動 (Q32)
余震の情報源に対する評価
能力 (Q33)
誠実性 (Q33)
価値類似性 (Q34)
地震・地震災害に対するリスク認知
恐ろしさ (Q35)
未知性 (Q35)
回答者の震災に対する長期的移動、復旧・復興過程を知る
居住地の移動(Q36)
復旧・復興カレンダー(Q37)

The Importance of Seismic Death Risk Assessment Each Household Unit

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1.Introduction

The Kumamoto earthquake started with a foreshock at 21:26 in April 14, 2016. It had an Mj of 6.5 and a Japan Meteorological Agency (JMA) seismic intensity of 7 in Mashiki town (JMA 2016). The subsequent mainshock of which Mj was 7.3 occurred at 01:25 JST in April 16, 2016. Accordingly, the people staying in Mashiki town have experienced tremendous strong motions of a JMA seismic intensity of 7 twice a couple of days (JMA 2016). The 2016 Kumamoto earthquake resulted in the death of 50 people in the Kumamoto Prefecture (2016).

The highest death count was recorded in Mashiki town, where 19 people totally killed by collapsed buildings. The death count breakdown showed that 7 and 12 people killed during the foreshock and the mainshock, respectively. During a series of disasters, many people in Mashiki town evacuated to designated evacuation sites or rushed to their own cars immediately after the foreshock. It resulted that the foreshock activates residents to evacuate into safer sites and decreases killed people by the subsequent mainshock. We estimated that the total number of deaths caused by building damage from a series of shocks would reach to 45, if nobody could evacuate after the foreshock. Result, the death toll decreased by 26 people (Nakashima and Okada, 2016). Generally, most of people evacuated are prone to return home as time goes by. As a result, many people die at the time of a subsequent mainshock. It is important to provide death risk information to each household for the purpose of supporting their decision making of appropriate evacuation.

2.Method

We estimate the death risk of the household where the dead occurred due to collapse building. The death ratio of household was obtained by applying the equations of Nakashima and Okada (2008, 2016).

3.Risk Estimation for Household Unit

Using the proposed method, we estimate the death rate of each household for the main shock and the foreshock. Consider as an example that a house is built in the 1970s and three people stay there at the earthquake occurs. Assuming that the seismic intensity of the foreshock is 6.49 and the main shock is 6.77, the occurrence probability of wooden building damage in the foreshock is estimated to 12% at the damage degree of D4 and 6% at D 5 and 1% at D 6, and it increases to 16% at D4 and 18% at D5 and 12% at D6 in the mainshock. In addition, the probability of death increases to 3% in the foreshock and 15% in the main shock. Similar results were obtained for other households.

4.Conclusion

Such information about death risk each household unit will be useful for decision-making of the evacuation start immediately after the disaster.

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Keywords: The 2016 Kumamoto Earthquake, casualty, Risk assessment

Estimating Resource Management of Nursing Home Support in the Assumed Tokyo Metropolitan Earthquake

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Abstract
This study proposes elements for creating scenarios covering those needing support during a natural disaster, comprising: 1) coefficients for scenarios concerning those needing support during a disaster, and 2) quantitative damage estimation cases related to facilities for those needing support during a disaster. These elements have not been incorporated into conventional damage estimation. The scenarios were applied to Tokyo, which is assumed to be an area affected by earthquakes occurring directly beneath the Tokyo Metropolitan Area, to establish a support system and implement map training.

Estimate the Resources Damage

2011 East Japan Earthquake created disaster awareness in Japan more than ever before. The fact raises awareness more that the possible occurrence of the Mega Urban Earthquake, which directly hits Tokyo is expected 70% in 30 years. The research outcome is highly expected to implement the workable disaster response in social welfare field.
We constructed the geospatial data of social welfare facilities in Tokyo. 1609 facilities exist which contribute facility care services. We overlapped the layer of this map to the seismic intensity map of assumed Earthquake in northern Tokyo Bay, which is expected to bring the most severe damage. There were 12 types of facilities categorized by the class of social services; however, detailed classification is not necessary for disaster responders to consider the resource dispatch in emergency phase. So we re-classified those 12 to 5 focusing on the disaster vulnerabilities. Figure 2 shows the result of the analysis. There were 97.1% facilities are in the area of over intensity 5 upper, which means that 104,879 people might be affected; however their numbers contains self-reliant people. The important thing is to detect how much reliant people in the category named "Diverse Range of Caretakers" in order to implement the resource assessment properly.
As the outcome of this research Tokyo Metropolitan Social Welfare Council decided to improve resource management system based on our research outcomes; 1) construct operational posts of social welfare support in each administrative district, 2) develop task forces in order to be varied to suit the situation after disasters. The resource management model made it possible to vary the situation on real time basis. The goal of this study is to establish disaster reduction measures to avoid a national crisis by ividing the fluctuating and independent part: the former is addressed by disaster reduction policies, while the latter is tackled by proposing and implementing disaster reduction action plans. The research results were proposed in "study committee of broad welfare support for disasters in Tokyo" to facilitate better understanding of the assumed damage of those needing support and welfare facilities during earthquakes occurring directly beneath the Tokyo Metropolitan Area. The accomplishments of this study include proposing components for scenarios to be established concerning those needing support during a national crisis disaster. For this purpose, a study on the services of an organization structure, including expert volunteers, was led by the Tokyo Council of Social Welfare, which usually works for those who needs nursing care.

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Keywords: Tokyo Metropolitan Earthquake, Vulnerable population, Resource management

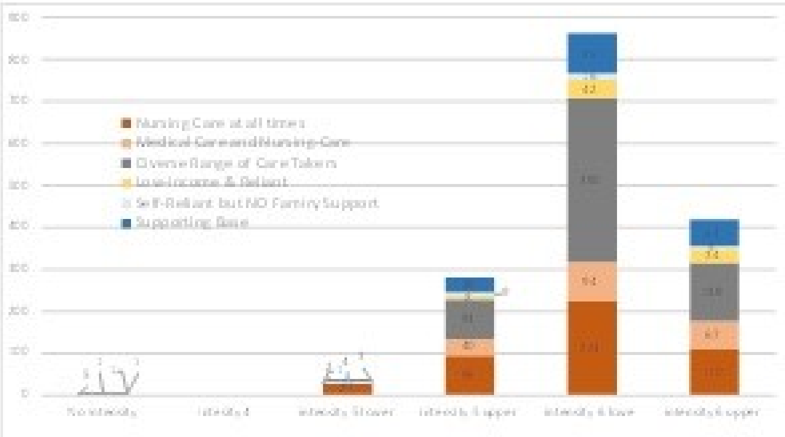

Fig. Social Welfare Facilities Classified in Assumed Seismic Intensity Scale of the Japan Meteorological Agency

Why do we need an aftershock forest for seismic disaster mitigation?

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Hazard and risk modelers are targeting several vastly different stakeholders or stakeholder in their model results: the scientific community, governmental institutions, engineers and the larger technical community, and finally the public.

Aftershock forecasting is one of the most successfully modeled in the scientific community but not well implemented in society. The 2016 Kumamoto Earthquakes were associated with many strong earthquakes. The largest quake with a magnitude (M) 7.3 occurred on April 16, 2016, which was 28hours after the M6.5 earthquake. The aftershock forecast issued by Japan Metrological Agency (JMA) immediately after the M6.5 event said very high probability, 3,000 times as high as usual probability. However this information might bring safety information for public because the name of “an aftershock” was misunderstood by public so that a coming quake would be smaller than the previous one. As a result, JMA has stopped issuing probabilistic aftershock forecast in a week after the strong event, but just says that there will be a strong ground motion and advises people to prepare the strong motion.

We will discuss how we should communicate such risk information to reduce natural disasters.

Keywords: Kumamoto Earthquake, Aftershock, Hazard forecast

Improvement of people's disaster image and awareness through disaster knowledge and lessons learned from social surveys –the 1995 Hanshin-Awaji(Kobe)EQ to the 2016 Kumamoto EQ

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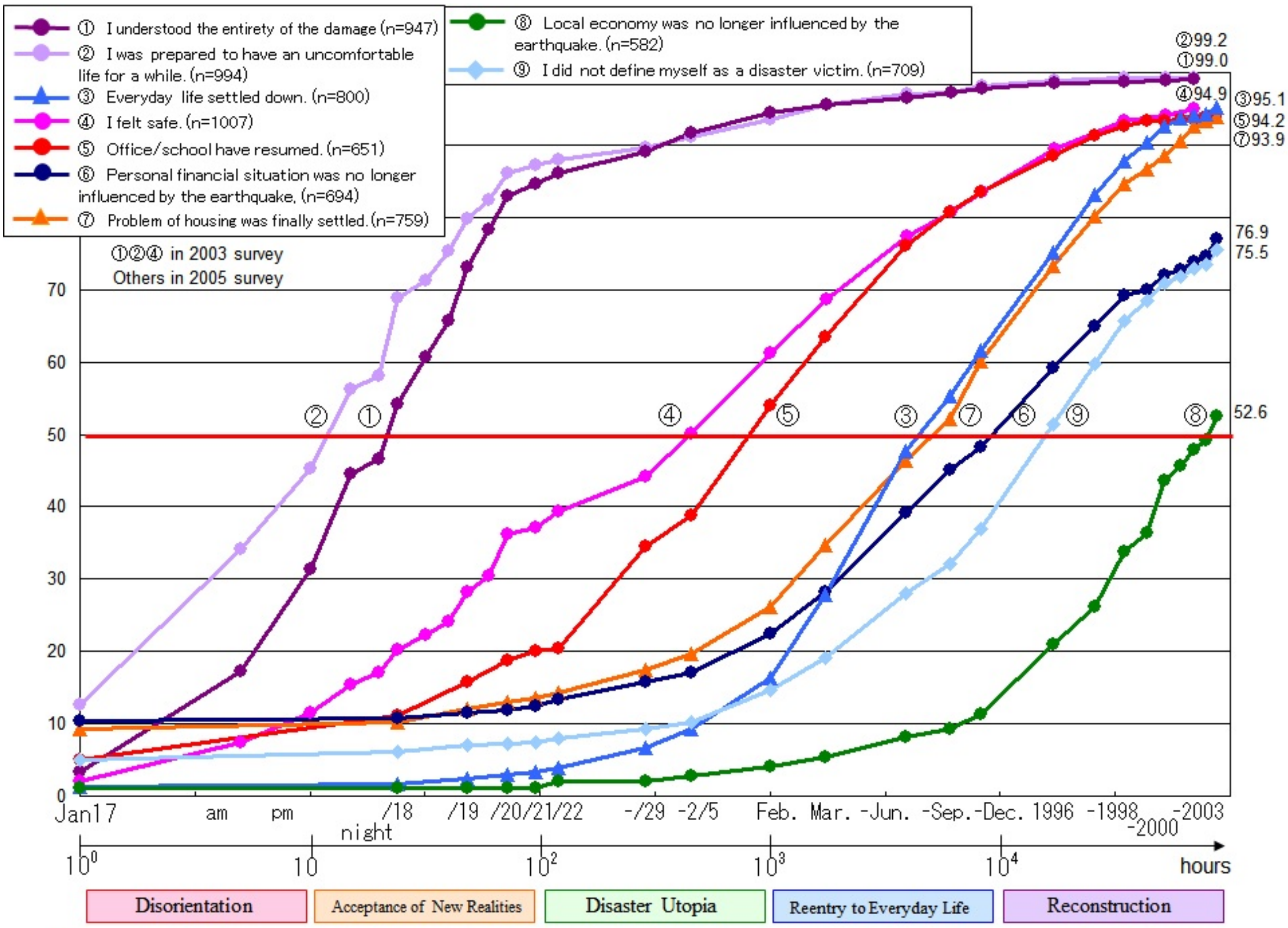
In this study, How can knowledge and lessons on victims' behavior and disaster recovery process after disaster occurred, which were clarified from reliable social surveys such as random sampled surveys, improve people’s capacity for imagination for disaster and awareness that disasters affect everyone (to be aware that natural disasters are common and think about what to do when it happens to you). The target disasters for the survey were the 1995 Great Hanshin-Awaji(Kobe) Earthquake, the 2004 Mid-Niiga Earthquake, the 2007 Chuetsu-oki Earthquake, the 2011 East Japan Great Earthquake and the 2016 Kumamoto Earthquake.
In this study, we are focuses on the results of the survey to the victims of the Kumamoto earthquake that was carried out in the fall of 2016 as a flash report. We compare the result of the survey of Kumamoto Earthquake with other surveys about Changing in the Victims’ residence after the disaster and life recovery process using recovery calendar method. Moreover, we also propose ways of risk communication between experts and citizens such as how these results of surveys contribute to improving people’s capacity for imagination for disaster and awareness that disasters affect everyone.

Keywords: awareness that disasters affect everyone, random sampled social survey, life recovery process, housing reconstruction, “life recovery calendar” method



Recovery Calendar (the 1995 Hanshin-Awaji(Kobe) EQ Survey in Jan./2003 and Jan./2005)

Environmental Progression: Extremes, Energy, and the Rate of Change

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As extreme climatic events increasingly dominate the global news cycle, there is a growing need to understand their origins and impacts. A debate rages over whether weather events are the result of climate change or simply occur in its context. The introduction to 'environmental progression' is an attempt to tackle these contradictions through an interconnected understanding of physical systems over time. Misunderstandings of cycles and equilibrium have led to a misguided view of the progression of our physical universe. If mankind is to address the challenges brought about by a changing world, we must first understand and accept the change we are addressing.

Keywords: Environmental Progression, Global Environmental Change, Global Climate Change