Present situation and problems of liquefaction hazard maps

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We collected the liquefaction hazard maps which local municipalities produced and published on Internet, extracted the elements such as indicated items and source information from the maps, summed up and categorized. Then we picked up some examples whose evaluation of liquefaction risk might be problematical while checking using other sources such as land condition maps, and concluded the problems of liquefaction hazard mapping.
According to “Hazard Map Portal Site” operated by Ministry of Land, Infrastructure, Transport and Tourism, total number of municipalities which have produced liquefaction hazard maps counts 317 among 1.718 of whole country (about 15 %). Preparation rates by prefectures are of uneven, suggesting that some guidance on production of liquefaction hazard maps for municipalities by prefectures with high rate might be performed. Most maps indicate evaluated liquefaction risks at 3-5 degree with an expression such as the liquefaction danger degree, a possibility of the liquefaction or tendency to liquefy. While 17 % maps indicate PL value as the indicator of liquefaction evaluation, one indicates PL value at 8 degrees. As for the unit of the hazard evaluation, polygon is 12 % where grid cell counts 87 %, among which cell size of 250 m is 41 % and of 50 m is 37 %. Concerning the main source information for evaluation, 34 % are using landform classification data, 27 % are based on core hole data and 40 % use both, where landform classification data are tend to be used in eastern Japan. As for the indicated items other than liquefaction risk, emergency transportation roads, organizations related disaster prevention such as municipality offices are fire departments and police stations, hospitals and shelters are typical. While maps of Hokkaido and western Japan tend to indicate liquefaction risk evaluation only, those of Hokuriku, Kanto and Tohoku tend to indicate much items, being more conscious of use after the occurrence of earthquake.
In the process of sum up and categorization, we checked the liquefaction risk evaluation by comparing with land condition maps, and picked out some examples with a possibility with the problem from the point of view of landform development. As a result, we found out that they include the following cases:
* risk evaluation doesn't correspond to the land condition and land history at all;
* random concentric high or low risk areas distribute in a part of an area where seems to have the same land condition;
* risk evaluation changes suddenly on a meaningless discontinuous line;
* evaluation of artificially modified land seems to be a problem:
We infer that one of the reasons of not high preparation rate of the liquefaction hazard map, unevenness of liquefaction risk evaluation and indicated items and problematic evaluation judged from land condition is that an appropriate manual for municipalities is not offered. Much of existing maps were produced based on "Liquefaction Area Zoning Manual" (the National Land Agency, 1999). However, the explanations such as the method for integration and coordination with the evaluation by core hole data and landform classification data and interpretation of landform classification and an artificially modified land on place are not sufficient. Besides, new liquefaction evaluation methods based on the later case studies have been proposed (e.g. Nakano et. al, 2015). Also, evaluation unit premises on 250 m grid cell. It seems necessary to create and provide new manual for production of liquefaction hazard maps from the angle of the recent technology trend.

Keywords: liquefaction hazard map, land condition, manual for creation of hazard map

About the liquefaction judgment by the standard penetration test

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The Tohoku district Pacific coast offshore earthquake that occurred on March 11, 2011 and its maximum aftershock caused liquefaction/fluidization phenomena of the stratum and the terrestrial wave phenomenon. Due to this earthquake, fluidization of embankment and embedding was observed not only in coastal areas but also in inland areas.After this disaster, the standard penetration test and the simple liquefaction judgment using penetration test specimens are rekindled, especially at the site of construction drilling. Also, in this earthquake disaster, the liquidization has occurred in the embankment/buried land of inland rivers and lakes, overturning the image that was supposed to occur in the coastal area, so oneself Concerned about the geological condition of the land currently living and the risk of liquefaction.Also, in the real estate related industry, we must recognize the necessity to pay attention not only to the land to be traded but also to the city unit. Currently, we are publishing free of bowling data on WEB on a municipal unit basis including the Ministry of Land, Infrastructure, Transport and Tourism, and it will not go all the way but it can be viewed if there is an Internet environment.Also, on the homepage of Chuo Kaihatsu Co., Ltd., drilling column map drawing software, section drawing software, liquefaction judgment software are downloaded free of charge and it is available at the general individual level. In the case where the continuous penetration test and the standard penetration test were carried out for the judgment result of this liquefaction simplified judgment software(CKC-Liq) using continuous penetration test data in liquefied/fluidized land conducted in April 2011.However, with regard to N-value implementation in liquefied/fluidized area, automatic falling equipment should not be used until it reaches the non-liquefaction/fluidized layer. This is because the weight of the automatic falling device is about 13.5 kg, so that an appropriate N-value can not be obtained.

Keywords: standard penetration test, consecutive penetration test, liquefaction judgment, liquefaction-fluidization

The relationship between tsunami damage by the 2011 off the Pacific Coast of Tohoku Earthquake and geographical condition such as landform clasification and land use on Sanriku Coast.

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This study summarized the relationship between tsunami damages caused by the 2011 off the Pacific Coast of Tohoku Earthquake and geographic condition such as landform classification, elevation and land use in Sanriku Coast area. In this study, GIS based overlay analyses were done at 16 small bays in Sanriku Coast. Tsunami damage levels were classified into three category such as building lost area (Rank1), destroyed area (Rank2) and inundation area (Rank3) by aerial photo interpretation. The authors tried to overlay between tsunami damage levels and other geographic data such as inundation depth, landform classification, elevation and land use using QGIS.

In the bays where all inundated area are completely destroyed (Rikuzen-Takata City and Ohtsuchi Town), the tsunami depths at coastline were over 10 meter. In the bay where tsunami damage degree decrease in inner land area (Ohfunato City, Kamaishi City and Miyako City), the tsunami depths at coastline were under 10 meter. The tsunami damage levels are closely related to inundation depths. Tsunami depths were about 4m at a boundary of building lost area (Rank1) and destroyed area (Rank2). Tsunami depths were about 1.5m at a boundary of destroyed area (Rank2) and inundated area (Rank3). The difference in landform of coastal areas influence the damage level of the hinterland area. And the tsunami damage degree was suddenly decrease at micro high lands of artificial structures and artificial cannels.

Keywords: Tsunami damage, landform classification, land use

Reconstruction of Aceh Paleotsunami Aceh Base on Science, history and interview.

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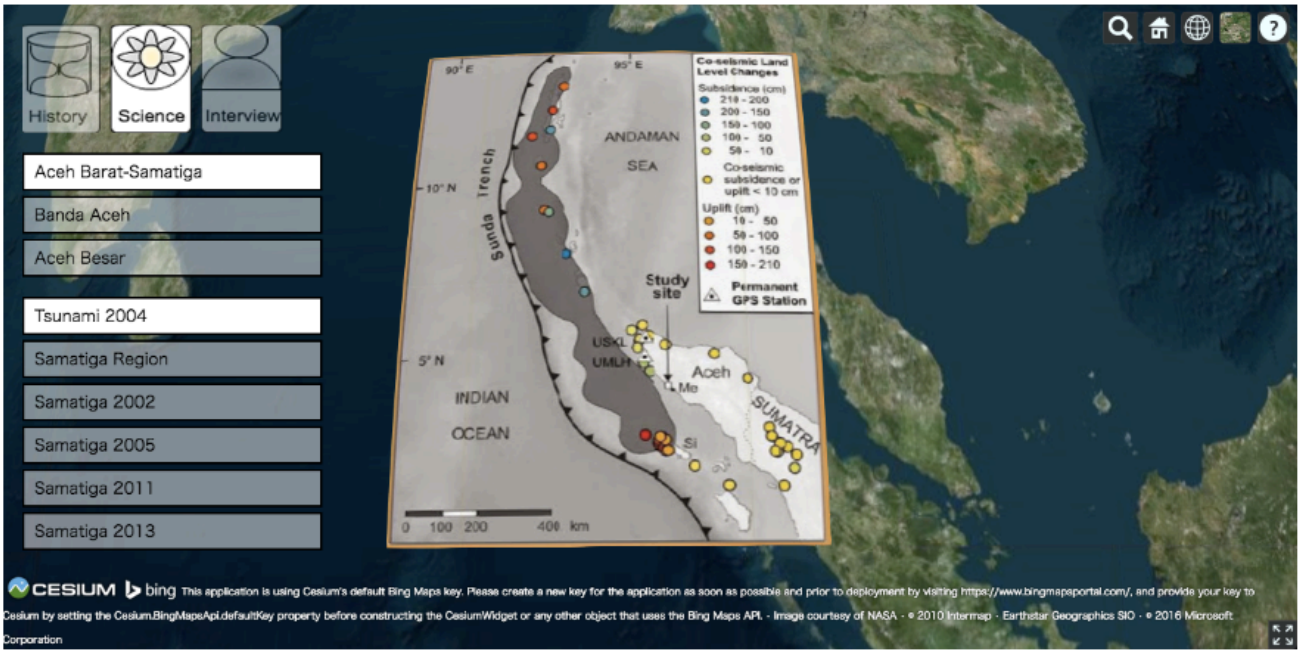
The Indian Ocean tsunami of 2004 is one of the biggest catastrophe of the last 100 years and has resulted in damaged infrastructure, loss of individual properties and environmental destruction in many coastal areas around the Indian Ocean region. And the death toll from the tsunami is estimated at more than 200,000 person with countless casualties. Moreover, scholar believe that the 2004 tsunami was simply one of many to have swept through in Aceh`s history. As such, there exists a body of local knowledge regarding these past tsunamis and earthquakes. The preservation and communication of this knowledge between generations has not, unfortunately, been prioritized. As such, there is a major information gap in most of the Aceh region resulting from the lack of continuity of this local historical knowledge. Had it been more widespread, this knowledge could have played a crucial role the 2004 tsunami, and it could be equally important for mitigating the risk in future disasters. Today, there are several ways to uncover the past tsunamis record of Aceh. One of them is paleotsunami, which combines a historical and scientific approach to create a record of the tsunami-history of a place. With paleotsunami, scientists can access the tsunami history of Aceh over thousand of years, i.e. by using carbon dating on tsunami sediment deposits, scientists can record a history of tsunami since the prehistoric period around 5000 years ago. When the tsunami causes sea water to flow inland, it creates horizontal sediment deposits, typically comprised of offshore and beach sand. These tsunami deposit act as geological evidence, which can be analysed using carbon dating to determine when the historical tsunami events occurred. Coastal geomorphology records can also detect past tsunami events by examining the evolution of the beach as an indication of past disturbances potentially caused by tsunamis. A third way to reconstruct the tsunami history of Aceh is through a historical approach. Ancient literature and personal prose manuscripts can provide written evidence of tsunami occurrences since 1000 years ago. By integrating paleotsunami with historical and scientific approaches, scientists can ensure more complete and precise records of tsunami occurrences in Aceh. In the future, develop Aceh Paleotsunami Digital Archive in the open data source platform is one of the ways to augment information regarding past disasters for the sake of higher quality global natural disaster information.

Keywords: paleotsunami, gap information, Disaster Risk Reduction, global information, digital archive

Aceh Paleotsunami



Increase of Tsunami risk on coastal areas in Shizuoka Prefecture associated with decadal urban area expansion and importance of public understanding of geomorphology.

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A Nankai trough earthquake (M8 or more)has occurred once every 90 to 150 years and the latest one occurred 70 years ago. The next earthquake is predicted to occur with about 70 % probability in the next 30 years (Shizuoka Prefecture, 2013). Coastal area in Shizuoka Prefecture has been developed rapidly as a part of the industrial area so-called Pacific belt zone. This study focuses on the analysis of decadal changes of DIDs distribution and geomorphology on three coastal lowlands in Shizuoka Prefecture, Hamamatsu, Shimizu , and Ukishimagahara lowlands, and discuss change of tsunami disaster risk.
The analysis was conducted by using GIS among following data. The results of land classification by aerial photo interpretation and elevation obtained from DEMs represent geomorphology. DIDs of 4 periods from 1960 to 2005 represent urban expansion. School locations and their established periods represent exposure with high vulnerability. Ansei-tokai earthquake tsunami inundation zone (Shizuoka Prefecture, 2001) and Nankai trough earthquake estimations of tsunami inundation zone (Shizuoka Prefecture, 2013) represent hazard.
DID’ s expansion in lowland is considered to be the combination of the following two tendencies. (A) Big community on the barriers became DID at first, then DIDs expanded on barriers. After DIDs filled up barriers, DIDs expanded to other geomorphology such as back marsh, fan, and sand mouth. (B)By impact of a city out of the plain, DIDs expanded from the edge part of the plain which is close to the city. Type A is observed in Shimizu, type B is observed in Ukishimagahara, both type A and B are observed in Hamamatsu.
As results of comparing among Ansei-tokai earthquake tsunami, Nankai trough earthquake tsunami, and DIDs in 1960, 1975, 1990, 2005 in each study area, inundated DID area has increased as year passed, which means tsunami disaster risk has increased in each area. In Shimizu, tsunami risk has been high in 1960 since sea side lowland has already been developed by 1960. Development after 1960 has been around hill with high elevation, risk gain has comparatively been low. In Hamamatsu, inundated DID area have been increasing from 1960 to 2005, which means tsunami risk has also been increasing. In Ukishimagahara, development started later than other lowlands and DIDs has expanded without considering geomorphology. It leads possibly to gain tsunami risk in the future. But it is not clear that tsunami risk in Ukishimagahara will be higher than another lowland since inundation area is the smallest of all.
Comparing among Ansei-tokai tsunami, Nankai trough earthquake tsunami, and school locations showed the following results. In Hamamatsu, 5 schools are located in Ansei-tokai tsunami inundation zone, 9 schools are located in Nankai tsunami. In shimizu, 3 schools are located in Ansei-tokai tsunami inundation zone, 5 schools are located in Nankai tsunami inundation zone. In particular, every inundated schools in Shimizu are elementary school, which means tsunami risk in Shimizu is particularly high.
Barriers are a few to ten and several meters higher than back marsh in each area. Considering that Nankai trough tsunami in each area is estimated a few to ten and several meters and that structures were especially vulnerable when the flow depth exceeded 2 m (Hayashi et al., 2013 etc), the fact that barriers are a few to ten and several meters higher than back marsh is important to reduce tsunami damage.

Ground condition on barrier excepting for the margin is also better than back marsh. Since barriers developed with parallel or arcuate form along a coastal line, it is helpful to image its distribution. In coastal lowland where high ground such as hills are distant, public understanding of geomorphology especially barriers and redevelopment of barriers such as moving vulnerable facilities including elementary schools which are located in inundation zone to barriers are important to do effective tsunami disaster prevention.

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Keywords: tsunami, coastal plain, Densely Inhabited District, geomorphology, disaster risk

Fatalitities for completely destrpyed houses ratio in the vicitnity of the surface faults associated with the 1927 Kita-Tango earthquake

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There are various processes where natural phenomena become disasters. There are various processes where natural phenomena become disasters. In the event of an earthquake disaster, the ratio of completely destroyed houses to dead people tends to increase with tsunamis and fires. In the case of traditional Japanese houses, if there is no tsunami or fire, the ratio of completely destroyed houses to the dead is about 1:10. However, in the case of earthquakes in which surface rupture appeared, the ratio increases. This suggests that in the case of the earthquake in which the surface rupture appeared, the process leading to a completely destroyed house is different. We focused on the 1927 Kita-Tango earthquake. This earthquake occurred in the northern part of Kyoto Prefecture and is the inland 7.3-magnitude earthquake. The Goumura fault and the Yamada fault appeared during this earthquake. We analyzed the characteristics of faults and damage using the data compiled for each settlement at the time and the list of victims.
We analyzed except for villages where there were many damage by fire.
Although the damage was great in the area with bad ground condition, it was revealed that fatalitities to the completely destroyed houseswas ratio is small, and there were many semi-buried houses for the completely destroyed houses. In the vicinity of the surface rupture, there are the huge damage in the area where the surface earthquake fault appeared, and it was found that fatalitities to the completely destroyed houseswas ratio is large. Conducted a field interview survey, we found that houses with multiple victims were located near the surface rupture. In conclusion, we suggest that the house breaks instantaneously and the number of victims increases with the acceleration at the appearing surface rupture.

Keywords: the 1927 Kita-Tango earthquake, Fatalitities for completely destrpyed houses ratio, surface rupture

