Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

MAG39-01 Room:502 Time:May 1 09:00-09:15

The trial which presupposes the surface ground motion using an underground seismograph; MeSO-net

SAKAI, Shin'ichi[1*] ; NAKAGAWA, Shigeki[1] ; HIRATA, Naoshi[1]

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We have been constructing an ultra dense seismic observation network; Metropolitan Seismometer Observation Network; MeSO-net. MeSO-net consists of 296 seismic stations. The signals from seismometers are sampled 200 Hz by a 24-bit analog to digital converter at the bottom of 20m-borehole. The surface ground motion differs from the waveform observed at the underground. Then, we tried presumption of the surface ground motion using an underground seismograph.

The present study is supported by two Special Projects for Earthquake Disaster Mitigation in Tokyo Metropolitan Area and reducing vulnerability for urban mega earthquake disasters from the Ministry of Education, Culture, Sports, Science, and Technology of Japan.

Keywords: groud motion, MeSO-net

MAG39-02 Room:502 Time:May 1 09:15-09:30

Attenuation Structure beneath Kanto Region using Maximum Amplitude

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Introduction

The seismic attenuation structure beneath the Japanese islands should be three-dimensionally complex to a similar degree as the velocity structure. Especially, in the Kanto region, the similarity with the velocity structure is unlikely to be seen in other parts of the Japanese islands because seismic attenuation implies inelasticity or scattering, whereas seismic velocity represents elastic properties. A precise estimate of the seismic attenuation leads to a better estimate of the strength of an earthquake source, in turn allowing for proper scaling. Information on seismic attenuation is also important in the simulation of strong ground motions. In this study, tomographic inversions are performed for the three-dimensional (3D) attenuation structure beneath the Kanto Region.

Data and Grid setting

In this study, tomographic inversions are performed for the three-dimensional (3D) attenuation structure beneath the Japanese islands from NIED Hi-net catalog. Vertical amplitudes of ground velocities reported between January 2004 and February 2009 are used in this study. Amplitudes from 11766 earthquakes are selected for P- and S-wave tomography. The number of the ray is 552,935 for P and 393052 for S, respectively. A grid with interval of 0.1 in Kanto region and 0.5 in other region is applied to this region at depths of every 5 km.

Results

We estimate regional detail attenuation structure in Kanto region using tomography method with NIED Hi-net maximum amplitude data. In Kanto region, a High-Q zone is clearly found along the upper boundary of the Philippine Sea slab, and below the slab, we found a distinct wedge mantle low-Q zone.

Keywords: Q, Attenuation Structure, Kanto Region

Japan Geoscience Union Meeting 2014
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MAG39-03 Room:502 Time:May 1 09:30-09:45

A highly attennuative zone beneath the Tokyo Metropolitan area.

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The material properties of the complex subduction zone beneath the Tokyo Metropolitan area can be estimated by the seismic attenuation Q of seismic waves observed at local seismic stations. Previous studies have provided us only with the large scale attenuation structure for all Japan (Jin & Aki, 2005; Nakamura et al., 2006; Edwards & Rietbrock, 2009) or only for the shallow part inside the Kanto basin (Kinoshita, 1994; Yoshimoto & Okada, 2009). In this study we aim to derive a detailed picture of the attenuation structure in the crust and upper mantle beneath the Kanto basin. The waveform data used in this study are recorded at the dense seismic array of the Metropolitan Seismic Observation network (MeSO-net). The station network is distributed on five lines with an average spacing of 3 km and in an area with a spacing of 5 km in the central part of Kanto plane. The 296 MeSO-net stations are equipped with a three-component accelerometer at a bottom of a 20-m-deep borehole, signals from which are digitized at a sampling rate of 200 Hz with a dynamic range of 135 dB. The attenuation of seismic waves along their path is represented by the $t*$ attenuation operator that can be obtained by fitting the observed seismic wave amplitude spectrum to a theoretical spectrum using an omega square source model. In order to accurately fit the spectral decay of the signal, only earthquakes that are recorded with intensity greater than 1 in the Japan Meteorological Agency (JMA) intensity scale are selected. The waveforms of 154 earthquakes were selected from the JMA unified earthquake list from January 1st 2010 to May 31st 2011. A grid search method is applied to determine the $t*$ values by matching the observed and theoretical spectra. The $t*$ data where then inverted to estimate a 3D Qp structure under the Tokyo Metropolitan area, using a layered initial Q model. Grid points were set at 15 km spacing in the horizontal direction and with 10 km spacing at depth. We implemented the 3D velocity model estimated by Nakagawa et al., 2012 and in addition we set the initial Q values at 116 for the 0 km grids and to 400 for all the grids below them. The obtained model suggests average Q values of 50∼100 inside the Kanto basin. Furthermore, a low Q zone is observed in the area where the Philippine Sea plate meets the upper part of the Pacific sea plate. This area is located at approximately 40 km depth, beneath the north-east Tokyo and west Chiba prefecture areas and is represented by Q values of 100∼200. Earthquakes occurring on the Pacific plate pass through this low Q area inside the Philippine sea plate and are attenuated significantly. Combined with the detailed velocity structure beneath the Kanto basin, our results help us to understand the material properties of the subducting plates. The implementation of our findings in strong motion simulation studies could help towards a better understanding of the damage area of future earthquakes and mitigate the disaster of the affected areas.

Keywords: attenuation, tomography, MeSO-net

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MAG39-04 Room:502 Time:May 1 09:45-10:00

Viscoelastic effects on stress on the active faults around the Tokyo metropolitan area after the 2011 Tohoku earthquake

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Beneath the Japan islands, the Pacific plate descends from the east and the Philippine sea plate descends from the south, causing interaction of two slabs at depth. The 2011 M9 Tohoku earthquake in northern Japan had a source region with a length of ~500 km and a width of ~200 km and forced broad lithospheric and mantle regions to deform. In addition, seismicity rates in the surrounding regions drastically increased. As the effect of the Tohoku earthquake on crustal deformation and seismicity in the Japan region is so large, it is required to quantitatively evaluate the temporal change of stress due to this earthquake. On the other hand, the mechanism of postseismic deformation is considered to be afterslip around the source region, viscoelastic stress relaxation in the asthenosphere and so on. Here, we investigate the effects of slab geometry and 3D heterogeneity on the inversion of inferred coseismic slip, the resulting broad coseismic deformation and the propagation of stress throughout the region.

We construct a 3-D finite element model (FEM) to generate Green functions for use in a coseismic inversion study that allows the influence of complex slab geometry as well as heterogeneities in elastic structure on inferred slip. We utilize the large, land-based Japan GPS array as well as seafloor geodetic constraints in the inversion. We are particularly interested in how coseismic seafloor constraints influence inversion results. Our FEM considers a region of 4500 km x 4900 km x 670 km, incorporating the Pacific and the Philippine sea slabs by interpolating models for the Tohoku region and the Nankai trough, as well as the Kuril, Ryukyu and Izu-Bonin arcs. As the geometry of the plate boundaries, we used the model interpolating the existing local plate boundary models. As the crustal thickness, we simply take the uniform value of 30 km for the continental plate and 6 km for oceanic plates. For the underlying mantle, we give the elastic constants according to the PREM model. The slabs are assumed to have 5 % higher P- and S-wave velocity than the surrounding mantle. The model region is divided into about 500,000 tetrahedral elements with average dimension ranging from 5-100 km. We also test the role of gravity on coseismic results, with initial results suggesting that gravitational loading is not an important factor because of the shallow dip of the upper Pacific slab. Based on the coseismic slip obtained by the inversion, we computed the temporal change of the Coulomb failure stress change on the active faults in the Tokyo metropolitan area considering viscoelastic relaxation in the asthenosphere. Our long-term objective is to study the influence of the Tohoku earthquake on evolution of stresses throughout Japan due to both coseismic and postseismic processes, the latter including afterslip and viscoelastic relaxation. An accurate accounting of coseismic slip is very important to such an endeavor.

Keywords: 2011 Tohoku earthquake, Coulomb failure stress change, Crustal structure, Active fault, Finite element modeling, Viscoelasticity

MAG39-05 Room:502 Time:May 1 10:00-10:15

Distribution and structures of blind thrust faults beneath the Tokyo metropolitan area

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We show subsurface geometries of several active blind thrusts beneath this highly urbanized area, based on tectonic landforms, high-resolution seismic reflection data, gravity anomaly data, and Quaternary stratigraphy. Deep seismic reflection profiles corroborate the notion that steeply dipping blind thrusts are reactivated normal faults originally formed by middle Miocene extensional tectonics. Despite very slow (less than 0.1 mm/yr) late Quaternary slip rates, our work suggests the presence of previously unrecognized faults that pose more seismic hazards to Tokyo and outlying communities, and urges more intense efforts to shed more light on the recent slip rates, magnitude and recurrence of the past earthquakes on them.

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MAG39-06 Room:502 Time:May 1 10:15-10:30

Tsunami damage in Tokyo Bay from the 1703 Genroku Kanto Earthquake

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The 1703 Genroku Kanto earthquake was a great inter-plate earthquake along the Sagami Trough on December 31st, 1703 and caused severe damage in southern Kanto region (Usami et al., 2013). For the tsunamis in Boso Peninsula, Hatori (1975, 1976) and Koyama (1982, 1983, 1987) investigated historical documents and stone monuments recording casualties, and Tsuji (2003) revealed the number of washed-away houses at each village.

For the tsunami in Tokyo Bay, Hatori (1976, 2006) estimated the tsunami heights as 2 m in his compilation of tsunami heights in the Kanto region. While this height has been often used for tsunami countermeasure in Tokyo Bay, the ground for this estimation is not clear.

On the other hand, the Cabinet Office (2013) concluded that no tsunami damage occurred in the eastern coast of Tokyo Bay, although some tsunami description is recorded in Edo, the capital in those days. It is necessary to conduct an investigation of tsunami damage along the coast of Tokyo Bay through historical documents.

The notice from Edo-Machi-Bugyo (Edo City Commissioners)to residences in Edo recorded that there were four major arrivals of tsunami along the Uchikawa River (Sumida River), and tsunami came up to the upper limit of the river. According to the “ Omurochuki ”, tsunami inundated up to the Eitai-bashi Bridge. There were seven ebbs and flows of tide. Tides were filled twelve times on the next day after the earthquake. “ Saihen-onkoroku ” recorded that the person(s) were thrown off their ship during their evacuation.

There is a document which recorded tsunami damage in Funabashi City, Chiba Prefecture. Petition from fishermen to public office, which was written 41 years after the 1703 Genroku earthquake, recorded that fishing boats and tools for fishermen such as fishing nets were washed away, and that fishermen requested the public assist for the poor catch of fish due to the lack of sea weeds.

“ Shiohama-Yuraigaki ” reported the origin of salt farm and its damage at Ichikawa City due to the subsidence accompanied by the 1703 earthquake. These historical records are materialized in 1756 and afterwards. The embankments were collapsed and the salt farm has been ruined. However, no tsunami damage is described. This document described storm surge damage on September 28, 1680. It says that 55 persons were killed in Kakemama-mura by the storm surge, 100 persons died and millets and household goods were completely washed away in Hanzaemon Ina ’ s territory. It seems that there was wide range and large-scale storm surge damage according to the historical record. Although the 1680 storm surge damage is recorded in detail, there is no record of the 1703 tsunami, indicating that the 1703 tsunami damage, if any, must be smaller than the storm surge of 1680.

We found the historical records which had not been used in previous tsunami studies, and revealed that the 1703 Genroku tsunami caused some damage in inner Tokyo Bay area. We would like to continuously collect historical-records and examine the tsunami damage and heights.

Acknowledgements
This study was supported by the Special project for reducing vulnerability for urban mega earthquake disasters from the Ministry of Education, Culture, Sports, Science and Technology of Japan.

Keywords: the 1703 Genroku Earthquake, Historical earthquakes, Tsunami

Japan Geoscience Union Meeting 2014
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MAG39-07 Room:502 Time:May 1 11:00-11:15

A new direction of the MeSO-net

HIRATA, Naoshi[1*] ; SAKAI, Shin'ichi[1] ; NAKAGAWA, Shigeki[1] ; KASAHARA, Keiji[2] ; KIMURA, Hisanori[3] ; HONDA, Ryou[4]

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We have developed the Metropolitan Seismic Observation network (MeSO-net) under the Special Project for Earthquake Disaster Mitigation in Tokyo Metropolitan Area (FY2007-FY2011) and maintain it by the Special Project for Reducing Vulnerability for Urban Mega Earthquake Disasters (FY2012-FY2016), which are supported by MEXT. The network consists of 296 seismic observation stations, from which data are continuously transmitted and recorded at a data management center in ERI. We developed an intelligent data transmission protocol for MeSO-net System, which is referred to as Autonomous Cooperative data Transfer (ACT)(Morita et al., 2010) . As culture noise in urban areas is very high, we use a 20-m-deep shallow borehole to install wide-band accelerometers but a signal-to-noise ratio is still low. A large number with short interval of station configuration helps us to obtain better resolution and high quality seismic data. We are now developing a new automatic data processing function in the MeSO-net: automatic event detection and P- and S-phase picking. We also develop a method to predict ground and building motions from the MeSO-met data.

Keywords: MeSO-net, accelerometer, continuous recording, Autonomous Cooperative data Transfer, automatic event detection, seismic tomography

MAG39-08 Room:502 Time:May 1 11:15-11:30

Overview of 'Maintenance and Recovery of Functionality in Urban Infrastructures'

NAKASHIMA, Masayoshi[1*] ; KOSHIKA, Norihide[2] ; KAJIWARA, Koichi[3] ; NOZAWA, Takashi[1]

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The 2011 Tohoku earthquake caused unprecedented damage to the island of Japan. The damage was spread to the Tokyo Metropolitan Area, hundreds kilometers away from the epicentral region, which sustained serious disruption, most notably to businesses. Measures have to be taken to reduce such disruption before the island of Japan receives another mega earthquake, which is expected by the middle of this century. Issues to be addressed:

1. Quantification of collapse margin of high-rise buildings.
2. Monitoring and prompt condition assessment of buildings.

The project deals with high-rise buildings which are prevalent in urban areas and focuses on the following three themes.

(1) Quantification of collapse margin of high-rise building structures.
(2) Monitoring and condition assessment for the health of buildings.
(3) Evaluation and monitoring of soil-foundation-structure interaction systems.

To achieve these goals, state-of-the-art theory and high-fidelity simulation are utilized, together with a series of large-scale tests as well as continuous observation of vibrations to actual structures. The project will offer technical guidelines and associated materials useful for the design, construction, and maintenance of buildings and urban infrastructure systems. A research team consisting of members from industry, academia, and government authorities has been formed to run the project most effectively.

鉄骨造試験体
の最終崩壊形

Japan Geoscience Union Meeting 2014
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MAG39-09 Room:502 Time:May 1 11:30-11:45

Urban Resilience

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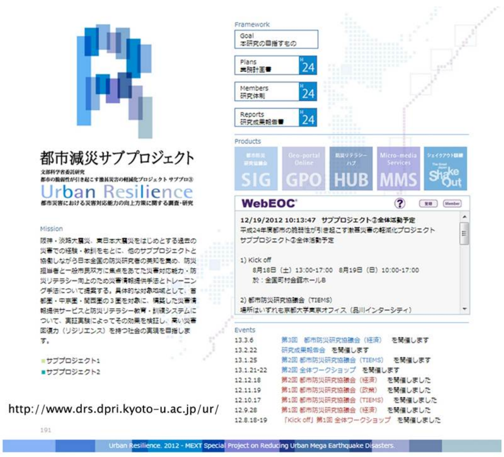
With a high probability in the first half of 21st century, Nankai Trough earthquakes will cause a tremendous amount of damage and losses which might exceeds Japanese national annual budget. In addition, we might take into account the possible occurrence of Tokyo Metropolitan earthquake which may cause a serious threat to our national security. It is virtually impossible to complete all the works needed to prevent those possible damage and losses due to these mega earthquakes before they will happen. It means that we need to develop a science and technology to minimize the resulting damage and losses due to these mega scale earthquake disasters and to realize high disaster resilience for quick and steady recovery based on the lessons taken from past earthquake disasters including 3.11 Tohoku Earthquake and Tsunami Disaster in 2011.

Recent progress in information and communication technology such as internet and mobile device with GPS should be adapted for effective disaster response and recovery. In this project, we will develop two ICT based system for creating common operational pictures among stakeholders. First system will be web-GIS system to provide an informational platform in which various kinds of information provided from seismology to social psychology will be mashed up for creating a new value. Second system will be Micro Media Service which will provide the information selected for each uses to meet their needs.

It is our ultimate goal to improve disaster preparedness of each individual who might be function as disaster response personnel or disaster victims. We will develop a Web portal site named as Disaster Literacy Hub to provide educational materials prepared for all disciplines related for earthquake disaster reduction based on the theory of instructional design.

All the academic achievements will be presented through the website shown below:



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MAG39-10 Room:502 Time:May 1 11:45-12:00

Past large earthquakes beneath metropolitan Tokyo: Issues for estimation of occurrence probability and disaster

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Two types of large earthquakes, great interplate (M~8) earthquakes along Sagami Trough and M~7 earthquakes beneath southern Kanto region, have caused damage in metropolitan Tokyo and are expected to occur in the future. The 1923 Taisho Kanto earthquake (September 1, M 7.9) and the 1703 Genroku Kanto earthquake (December 31, M~8.2) are the first type, and the typical example of the second type is the 1855 Ansei Edo earthquake (November 11, M~7.0).

The Cabinet office and the Earthquake Research Committee of the Japanese government recently re-examined the source area of the interplate earthquake along Sagami Trough, estimated that the maximum possible size would be M 8.6, and that the 1703 earthquake may be closer to the maximum size. Previous Kanto earthquakes have not been well studied; recent studies of tsunami deposits (Shimazaki *et al*., 2011, JGR) concluded that the 1293 earthquake (May 20) was the Kanto earthquake along Sagami Trough. The 1495 earthquake (September 3) has been considered as a fake earthquake, possibly confused with the 1498 Meio earthquake along Nankai Trough, but Kaneko (2012, Ito-shi Kenkyu) proposed that the 1495 earthquake was another interplate earthquake along Sagami trough. Studies of historical documents and tsunami deposits have revealed the recurrence of Kanto earthquakes. Details of each event, such as the source area or possibility of simultaneous rupture on Kozu-Matsuda fault, need to be studied to clarify the diversity of recurrent interplate earthquakes.

A hypothetical earthquake beneath Tokyo at the deeper plate interface, the northern Tokyo Bay earthquake, had been considered for disaster estimation of metropolitan Tokyo. Recent damage estimation by the Cabinet Office (2013), however, assumed an earthquake in the Philippine Sea Plate, which would cause similar seismic intensity with the 1855 Ansei Edo earthquake. The hypocenter of the 1855 earthquake has been studied on the basis of seismic intensity and damage distribution from historical literature, and various estimates ranging from a shallow crustal source to 100 km deep source within the Pacific Plate have been proposed. The seismic intensity distribution in Kanto region is strongly influenced on both deep and shallow subsurface seismic velocity structures, hence quantitative comparison with recent earthquakes or simulation on three-dimensional velocity structure would be necessary to accurately estimate the 1855 hypocenter.

The Earthquake Research Committee (2004) estimated the 30-year probability of M~7 earthquake in southern Kanto region as 70 %, on the basis of five earthquakes since 1885 and the Poisson process. The five events are: 1894 Meiji Tokyo earthquake, 1895 and 1921 Ibraki earthquakes, 1922 Uraga channel earthquake, and 1987 eastern Chiba earthquake. Among them, at least three (1921, 1922 and 1987) occurred in the Philippine Sea Plate, and one (1895) occurred in the Pacific Plate (Ishibe *et al*., 2012, Coord. Comm. Earthquake Prediction). For more accurate estimation of future probability, studies of older earthquakes from historical records and estimation of their epicenter, depth and earthquake types are required.

Keywords: Tokyo Metropolis, historical earthquake, Kanto earthquake, long-term forecast

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MAG39-11 Room:502 Time:May 1 12:00-12:15

Activity change of aftershocks of the Ansei Edo earthquake of November 11th, 1855

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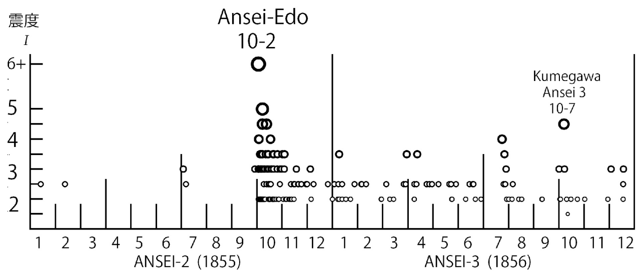
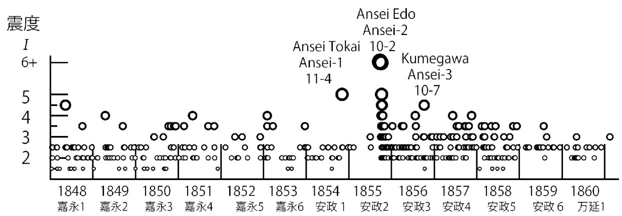
Ansei Edo earthquake occurred at 11 PM, November 11th, 1855 at a point just below the city zone of Edo (Tokyo at present). Due to this earthquake, it is suggested that more than 10,000 people were killed in Edo. The location of the epicenter, its magnitude, and its fault mechanism is still not clarified. In the present study, we studied on the activity change of aftershocks by using descriptions of felt earthquakes written in diaries. We made a data base of felt earthquakes occurred in the period between the beginning of the first year of Kaei (1848) and the end of the first year of Man-en (1860) in Kanto district including the Edo city zone. In general, more than ten kinds of diaries were kept in the Tokyo city zone. Most reliable one is "Reiken Kobo" which is the diary kept at the Edo Astronomical Observatory in Kudan-Ue street. Diaries with descriptions of felt earthquakes were kept at more than ten cities on the Kanto Plain. We compiled a database of those records of felt earthquakes. We gathered electronic 3,192 cards of records of felt earthquakes in total. It is clarified that earthquakes were felt at Tokyo 543 times in total. The left figure shows the diagrams of felt earthquakes at Edo in two two years from the beginning of 1855 to the end of 1856. We can recognize that the aftershock period is finished generally at May 1856. An eminent earthquake occurred at Tokorozawa, about 40 kilometers WNW of Tokyo, which is considered as an earthquake induced by the Ansei Edo Earthquakes (an aftershock in wider sense). The right figure shown diagram of felt earthquakes in the period of 13 years between 1848 to 1860. The activity of earthquakes induced by the Ansei Edo earthquakes continued up to the end of the year of Ansei 5 (1858).

Keywords: historical earthquake, earthquake in metropolitan zone, aftershocks, the 1855 Ansei Edo Earthquake





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MAG39-12 Room:502 Time:May 1 12:15-12:30

Compiling S-P times and first motion polarities for recent eqks and classification of the 1921 and 1922 eqks

ISHIBE, Takeo[1*] ; SATAKE, Kenji[1] ; MURAGISHI, Jun[1] ; TSURUOKA, Hiroshi[1] ; NAKAGAWA, Shigeki[1] ; SAKAI, Shin'ichi[1] ; HIRATA, Naoshi[1]

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We compiled S-P times and first-motion polarities for earthquakes in Kanto region, central Japan on the basis of seismic phase data from 1923 to 2011 provided by the Japan Meteorological Agency (JMA), and that for 3,086 earthquakes which occurred from April 1st, 2008 to June 5th, 2012, from the Metropolitan Seismic Observation Network (MeSO-net). The number of target stations, where these data can be comparable with 26 stations which had operated in early stage of instrumental observations is 69 by JMA, and 19 by MeSO-net and other networks.

These data would be helpful for determining hypocenters and focal mechanism solutions of old earthquakes with limited instrumental data by comparing with S-P times and first-motion polarities for old earthquakes. As an example of application, we then compiled the characteristics of S-P times and first-motion polarities in southwestern Ibaraki and northwestern Chiba regions where the inter-mediate depth earthquakes frequently occur, and inferred the hypocenters and focal mechanism solutions of the 1921 Ibaraki-Ken-Nambu (M7.0) and 1922 Uraga-Channel (M6.8) earthquakes. Eleven first-motion polarities for the 1921 event are inconsistent for inter-plate earthquakes between the Okhotsk and Philippine Sea plates, and between the Philippine Sea and Pacific plates. Fourteen first-motion polarities and six S-P times for the 1922 event are similar for intra-slab earthquakes within PHS in and around southwestern Chiba with strike-slip fault mechanisms. These results strongly suggest that both the 1921 and 1922 events were not inter-plate earthquakes but intra-slab earthquakes.

In Japan, instrumental observation started in 1870's and seismographs and phase data (e.g., arrival times of typical phases, maximum amplitudes, first-motion polarities) have been persisted while some data were lost due to the fire. On the basis of these data, source parameters (hypocenters, focal mechanism solutions, and magnitude) for old earthquakes with limited instrumental data were estimated and cataloged. Determining hypocenters and focal mechanisms as back as possible prior to the start of JMA catalog is important to discuss long-term changes in seismicity. In Kanto, this period is especially important because it corresponds several tens of years before the 1923 Kanto earthquake and damaging earthquakes frequently occurred. However, the determinations of source parameters for old earthquakes have some difficulties. By using S-P times and first-motion polarities for recent earthquakes as "template", the accuracies in hypocenter locations and focal mechanism solutions for old earthquake would improve.

Acknowledgements

We used phase data for earthquakes provided by JMA and that by the MeSO-net. We also used focal mechanism solutions for earthquakes provided by National Research Institute for Earth Science and Disaster Prevention and JMA, and a program modified from HASHv2 (Hardebeck and Shearer, 2002) to calculate the azimuths and take-off angles for first-motion polarities at each observation station. This study was supported by the Special project for reducing vulnerability for urban mega earthquake disasters from the Ministry of Education, Culture, Sports, Science and Technology of Japan.

Keywords: S-P time, first motion polarity, 1921 Ibaraki-Ken-Nambu earthquake, 1922 Uraga-Channel earthquake

MAG39-13 Room:502 Time:May 1 12:30-12:45

Field Survey for the Memorial Matters from the 1923 Great Kanto Earthquake in Central Kanagawa Prefecture

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Many memorial towers and monuments have been contracted for the heavy toll of life and for the restoration of villages or cities in Southern Kanto district. Death claimed a toll of about 105000 totally from the 1923 Great Kanto earthquake. These towers and monuments must be forever witnesses to the tragedy of the earthquake damage and spokesmen for the victim's dying wish "don't repeat such damages". However, most of them have been already forgotten by the citizens. We thought its sacrilege and must use them for the public education of earthquake disaster prevention. This manuscript is a report on the field survey for the memorial matters from the Great Kanto earthquake in Central Kanagawa Prefecture. The number of the matters is 126. This survey will be continued next two years in Western and Eastern Kanagawa Prefecture.

Keywords: memorial tower, Great Kanto Earthquake, Kanagawa Prefecture

MAG39-P01 Room:Poster Time:May 1 18:15-19:30

Composition of the subducted slab beneath Izu collision zone, Japan

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The Philippine Sea plate subducts northwesteward under the Honshu arc, Japan. The presence of the Izu-Bonin arc within the Philippine Sea plate causes a complex tectonic environment. In eastern Kanto area, an accretionary wedge composed of late Cenozoic sediments overlies the downgoing Philippine Sea plate. In western Kanto area, the Izu-Bonin arc has collided with the Honshu crust; remnant pieces of the Izu-Bonin arc such as the Tanzawa block were accreted to the Honshu crust. A megathrust separates the Philippine Sea slab from the Honshu crust. According to seismic servey (Sato et al., 2005), the megathrust fault separates the upper/middle crust from the Izu-Bonin arc beneath the Izu collision zone. Devastating M8-class earthquakes occur on the megathrust fault, and the epicenter of the Kanto earthquake of 1923 (M7.9) is located in the Izu collision zone. To evaluate seismic hazard in the Greater Tokyo Area of Japan we need to clarify the lithological properties of Izu collision zone.

This study presents an interpretation of the crustal structure of the Izu collision zone. This study infers that amphibole is a main constituent mineral of the subducted lower crust of the Izu-Bonin arc. Dehydration embrittlement process resulting from the dehydration of hydrous minerals (e.g. amphibole) in the subducting lower crust is expected, and it may have induced the microearthquakes by enhancing pore pressures along the pre-existing faults/fractures in the subducting lower crust beneath the Izu collision zone. Stability filed of amphibole within the gabbroic composition from the Tanzawa plutonic complex was calculated by Theriak-Domino software, and the phase diagram shows hot subduction can account for seismicity of the microearthquakes beneath the Tanzawa Mountains and the resulting dehydrated dry slab may therefore account for the observed absence of seismicity below the northern part of Tanzawa Mountains and Kanto Mountains.

Keywords: collision zone, slab

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Tsunami Heights of the 1854 Ansei-Tokai Earthquake Tsunami in Gokasho Bay Region, Mie Prefecture

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The Kumano-nada Sea coastal area has been repeatedly attacked by tsunamis from the Nankai Trough subduction-zone earthquake. For historical tsunamis, since this area is close to Kinki region, many historical records exist. For the recent 1944 Showa-Tonankai earthquake tsunami and the 1854 Ansei-Tokai earthquake tsunami, not only historical records and monuments but also many folklores still remain. However, the 1944 Showa Tonankai earthquake tsunami has a comparatively small scale, and is unsuitable for examining the average scale about the tsunami from the Nankai Trough. Based on above-mentioned reason, we studied for the 1854 Ansei-Tokai earthquake tsunami.

Gokasho Bay is a blockade inner bay which has typical ria coasts and drowned valleys. It is located in central Kii Peninsula and faced with the Nankai Trough. In this bay area, measurement points of the tsunami height for the 1854 Ansei-Tokai earthquake tsunami and the data on height were mainly based on historical records and oral traditions. In particular, in Konsa district, it is based on the words of the Bon festival dance currently kept in there called ”Shongai kudoki” or ”Tsunami kudoki”. Tsunami heights were measured by level measurement using laser range finder TruPulse360 and a hand level on the basis of the spot elevation given by 1/2500 topographical maps.

As a result, a total of 40 points of tsunami height were obtained in Gokasho Bay region. The average inundation height of whole bay area was approximately 4 - 5 m.

In Konsa, located in the most closed-off section of the bay, dendritic valley plains which have small-sized rivers spread. According to distribution of both inundation and run-up points by this research, it is supposed that tsunami ran-up to every valleys of those. Tsunami heights in Konsa ranged 4 - 11 m, and were higher than those in other districts. The maximum run-up height was 11.5 m in the valley of Ushirogochi.

Keywords: Gokasho Bay, 1854 Ansei-Tokai Earthquake Tsunami, tsunami height, run-up height, inundation height

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Publication of the Japan University Network Earthquake Catalog of First-Motion Focal Mechanisms (JUNEC FM^2)

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We determined focal mechanism solutions for 14,544 earthquakes that occurred in and around the Japanese Islands from July 1985 to December 1998 by using first-motion polarities reported by the Japan University Seismic Network, and compiled the Japan University Seismic Network Earthquake Catalog of First-Motion Focal Mechanisms (JUNEC FM^2). JUNEC can be obtained from ftp site provided by ERI: ftp://ftp.eri.u-tokyo.ac.jp/pub/data/junec/hypo/. JUNEC FM^2 also can be obtained via ftp site: ftp://ftp.eri.u-tokyo.ac.jp/pub/data/junec/mech/. The Earthquake Research Institute, the University of Tokyo has compiled observed data with the cooperation of universities and determined hypocenters amounting to about 190,000.

This catalog covers small-magnitude earthquakes (M$\geq$2.0) prior to the recent development of seismic observation networks and automated waveform data processing systems, and it will prove helpful in understanding the spatial and temporal heterogeneities of stress fields by combing recent focal mechanism solutions. Abundant focal mechanism solutions will be useful for statistical analyses. Their distribution is spatially and temporally heterogeneous, and it clearly reflects both the development of observation station network and spatial variations of first motion polarity report rate (i.e., first motion polarity report number / the number of picked onsets). Determined focal mechanisms are basically consistent with previously reported ones such as Full-range Seismograph Network of Japan (F-net; Okada et al., 2004) moment tensor solutions provided by National Research Institute for Earth Science and Disaster Prevention (NIED), or P-wave first motion focal mechanisms provided by the Japan Meteorological Agency (JMA) though some focal mechanisms are significantly different from them.

In Japan, an abundance of first-motion focal mechanism solutions for earthquakes have been determined after the 1995 Kobe earthquake (magnitude according to JMA-, M_{JMA} 7.3) through the development of the High Sensitivity Seismograph Network Japan (Hi-net). In addition, moment tensor solutions for moderate- to large-magnitude earthquakes have been routinely determined since 1997 using the F-net and improved data processing systems. These focal mechanism solutions have provided a good understanding of the fault structures and the local/regional stress fields in which earthquakes occur. However, focal mechanism solutions for earthquakes covering the Japanese Islands prior to the development of recent seismic observation networks have been very limited, barring a few studies (e.g., Ichikawa, 1961, 1971). Following the 2011 off the Pacific coast of Tohoku earthquake (moment magnitude according to the JMA, Mw9.0), the distribution of focal mechanism solutions has drastically changed especially in and around the source region. This indicates that stress fields or focal mechanism solutions are temporally variable. In light of this, data on the focal mechanisms of earthquakes extending as far back as possible are desirable in order to investigate intermediate- to long-term spatial and temporal heterogeneities of focal mechanism solutions and local/regional stress fields.

Acknowledgements
We used a program modified from HASH (Hardebeck and Shearer, 2002) to estimate the focal mechanism solutions and the pick files observed by Hokkaido University, Hirosaki University, Tohoku University, the Earthquake Research Institute of the University of Tokyo, Nagoya University, the Disaster Prevention Research Institute of the Kyoto University, Kochi University, Kyushu University, and Kagoshima University. We also used focal mechanism solutions for earthquakes provided by NIED and JMA. This study was supported by the Special project for reducing vulnerability for urban mega earthquake disasters from the Ministry of Education, Culture, Sports, Science and Technology of Japan.

Keywords: first-motion focal mechanism solution, Japan University Network Earthquake Catalog (JUNEC)

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Three-dimensional earthquake forecasting model for the Kanto district: Completeness magnitude of earthquake catalogs

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We started to construct a 3-dimensional (3D) earthquake forecasting model for the Kanto district in Japan under the Special Project for Reducing Vulnerability for Urban Mega Earthquake Disasters based on the Collaboratory for the Study of Earthquake Predictability (CSEP) experiments. Because seismicity in this area ranges from shallower part to a depth of 80 km due to subducting Philippine-Sea and Pacific plates, we need to study the effect of earthquake depth distribution.

We tried to construct a prototype of 3D earthquake forecasting model for the area based on the Relative Intensity model (Nanjo, 2011) which forecasts earthquake probabilities using historical data. For a large earthquake forecasting, we need a longer period of earthquake data than current studies. Therefore, we analyzed completeness magnitude (Mc) every 10 km in a depth from 0 to 100 km of earthquake catalogs of Utsu (1979, 1982), Japan Meteorological Agency (JMA) and National Research Institute for Earth Science and Disaster Prevention (NIED) which are partially covered from 1885 to 2013 by the Maximum curvature method (Wiemer and Wyss, 2000) to assess a quality of their catalogs considering a depth of hypocenters. In the case of JMA catalog, an average and its standard deviation of Mc for a year from 1923 to 1970's showed 3.7 and 0.4, respectively. Then, they decreased from 1970's to 2000, which means that quality of the catalog improved with time. After the 1980's, Mc showed heterogeneous distribution with depth. Mc in shallower depth are smaller than that in deeper one. For example, averaged Mc and its standard deviation from 2000 to 2010 is 0.25 and 0.14 with 0 to 30 km in depth against 0.67 and 0.10 with 60 to 100 km in depth. In this presentation, we discuss how use the heterogeneous catalog to develop a 3-dimensional forecasting model in Japan.

The authors thank JMA and NIED for their earthquake catalogs. This work is sponsored by the Special Project for Reducing Vulnerability for Urban Mega Earthquake Disasters from Ministry of Education, Culture, Sports and Technology of Japan.

Keywords: Three-dimensional forecasting model, Kanto district, Collaboratory for the Study of Earthquake Predictability, earthquake catalogs

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Sparse Modeling to Estimate Spatial Distribution of Ground Motion Required for Rapid Prediction of Structural Damages

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A rapid prediction of structural damages due to a large earthquake is important to prevent secondary disasters. The first step of the prediction is to estimate ground motion at a targeted construction from observed seismic data, and the second step is to predict structural damage using the estimated ground motion. An accurate damage prediction requires ground motions with spatially-high resolution although the spatial density of constructions is much higher than that of seismometers in urban area. We have been developing a statistical method to model such ground motions using seismograms obtained by a seismometer array. Our target is Tokyo metropolitan area in which seismogram of MeSO-net (Metropolitan Seismic Observation network) is available.

Mizusako[2013, graduation thesis] proposed a method based on the Taylor expansion, and applied it to MeSO-net data when the Great East Japan Earthquake occurred. This method was found never to account for ground motions higher than 0.15 Hz, which was insufficient when considering that the eigenfrequency of constructions is usually between 1-10 Hz. Mizusako[2013] determined the partial differential coefficients, which appear in the Taylor expansion, from five nearest observatories with a truncation of the first order, but a better selection of a truncation of order and a group of observatories, which is hereinafter called “ cluster ”, could more accurately explain ground motions higher than 0.15 Hz.

We propose an algorithm based on sparse modeling that automatically and objectively determine the truncation of order and the size of the cluster. Our algorithm adopts the lasso, which is able to select dominant partial differential coefficients owing to the L1-norm regularization term. Moreover, the group lasso is implemented on our algorithm in order to select the coefficients of the same order associated with different components. We will report initial results obtained by the proposed method, comparing with the results of Mizusako[2013].

Keywords: Sparse modeling, lasso, urban disaater, MeSO-net