Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-01 Room:302 Time:May 27 09:45-10:00

Clustering of intraplate earthquakes and foreshock activity

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Spatial and temporal clustering activity of earthquakes has the possibility of foreshocks or the initiation of future large events. We examine earthquake clusters for shallow intraplate earthquakes beneath the Japanese islands.

Pairs of earthquakes were linked through conditions based on origin time difference t and hypocentral distance d. We assume reasonably that the range of the time and distance of link-conditions depend on magnitude M, i.e., t(M) and d(M).

The result show that foreshock type clusters, which constitute with events occurring before the largest event, are larger in numbers than the mainshock-aftershock type clusters for clusters with many cluster members.

The 2004 Niigata-Chuetsu earthquake M6.8, the activity initiated from September 6, 2004, with the largest event M4.3, at the northern margin of the future rupture area was extracted as foreshocks. Also the 2008 Iwate-Miyagi Nairiku earthquake, the activity initiated from May 29, 2008, with the largest M4.8 in the Akita-ken was extracted as foreshocks. Because these foreshock activity occurred about half to 1.5 months before the mainshock around the future rupture area and the activity were not in continuous, it is difficult to identify clearly these activity as foreshocks. We show that the algorithm of linking method in this study has the possibility to detect objectively foreshock activity of large earthquake.

Keywords: earthquake cluster, single event, linking method, seismogenic layer, Omori-Utsu's formula

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-02 Room:302 Time:May 27 10:00-10:15

Earthquake Clustering Features Inferred from the Mean Proprieties of Interevent Times and Distances

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Interevent times between successive earthquakes are studied in space and time using data from Japan and southern California. The main objective is to depict general non-subjective clustering characteristics of interevent times that can be used to isolate clusters in observed seismicity. First, different declustering algorithms are applied to original data to estimate the residual background interevent time distribution. Then, clustering degree is measured using the distance between the obtained residual distribution and the whole distribution from the original data. Finally, the former analysis is carried out for different magnitude cutoffs and different time periods to take into account the completeness of magnitudes.

The preliminary results show that earthquake process is dominated by short and long term clustering. In contrast, the so-called background process occurs mainly at intermediate times. The same study applies to interevent distances and shows quite similar behavior in space.

The former analysis describes seismicity as the accumulation of local perturbations related to a unique mean field background processes characterized by the mean interevent time and the mean interevent distance. It highlights the importance of mean space-time proprieties in the estimation of objective and data inferred association measures between earthquake events. This study provides fundamental key tools for the elaboration of stochastic declustering strategies.

Keywords: Interevent times, Earthquake clustering, Background seismicity, Association measure

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-03 Room:302 Time:May 27 10:15-10:30

Investigation of the methods for prospective evaluation on earthquake activity (2nd)

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Subcommittee for the Methods for Prospective Evaluation on Earthquake Activity was established under the Earthquake Research Committee (ERC) in August 2009 to contribute the upgrade of evaluation on the current seismic activity by ERC by extracting characteristic features of the past seismic activity for prospective analysis, and is developing an evaluation method for temporal seismicity variation.

ERC established the methods to evaluate the probability of aftershocks occurrence in August 1998 and JMA announces after a large earthquake that it expects aftershock activity based on the method. But the present procedure has some problems on (1) forecast accuracy, (2) public understanding of probability of aftershocks occurrence, and (3) availability of aftershock information soon after the main shock.

We investigate relationships among the mainshock magnitude, aftershock activity, the magnitude of the largest aftershock, presence of secondary aftershock, etc, for the past earthquakes and develop a prospective evaluation method for aftershock activity. Since the largest aftershock often takes place within 24 hours after the mainshock, it is fatally important to announce early the prospect of aftershock activity. Firstly, the aftershock activity and the magnitude of the largest aftershock can be predicted from the moment magnitude of the mainshock. However, in some cases the number of aftershocks associated with mainshocks with almost the same magnitude differs by about six times. So, it is considered to renew the information on the basis of the number of aftershocks within three hours after the mainshock. Renewal of information may be necessary when an aftershock with many secondary aftershocks occurs.

As the first case of prospective evaluation, we examined characteristic features of the past seismic swarm activities occurred off eastern Izu Peninsula that have many seismic and geodetic data and developed an evaluation method for the swarm activity. We introduced it at JpGU Meeting 2010 and published it as a report, "The prediction method for seismic activity off eastern Izu Peninsula," in September 2010.

Keywords: ERC, Subcommittee for the methods for prospective evaluation, Prospective evaluation on earthquake activity, Prospective method of aftershock activity, Seismic activity off eastern Izu Peninsula

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-04 Room:302 Time:May 27 10:45-11:00

The attempt of re-making Japan earthquake catalog based on Japan seismic networks

Sadayuki Kitagawa[1], Takashi Yokota[2], Hiroshi UENO[2*], Yoshiro Ohta[2], Committee on Earthquake Database of Japan University SeismicObservatory Networks[3], Katsuhiko Shiomi[4], Shin Aoi[4]

[1]MEXT, [2]JMA, [3]University Seismic Observatory Networks, [4]NIED

Japan Meteorological Agency is making catalog of earthquake which occurred in and around Japan since August, 1923.

Since October 1997, we calculate hypocenter location and magnitude based on seismic data of related organization (JMA, universities, NIED and so on). But, until September 1997, we calculated hypocenter location and magnitude with only JMA seismic data. Therefore, the difference of the detectability of the earthquakes is remarkable on the boundary of October, 1997. Moreover, the detection accuracy of hypocenter location is different every age, because hypocenter determination method is different every age.

Then, we assumed that we re-calculated location of earthquake which occurred before September 1997, based on seismic data of "Earthquake Database of Japan University Seismic Observatory Networks (Umino et al., 2007)", NIED and JMA.

In this time, we will introduce a part of the recalculation result.

Finally, we have a plan to publish final result by the Headquarters for Earthquake Research Promotion.

Reference

Umino, N., S. Hirahara, J. Nakajima, K. Katsumata, M. Kosuga, N. Hirata, T. Kanazawa, S. Sakai, F. Yamazaki, K. Matsumura, S. Kimura, K. Uehira, K. Goto, R. Matsu'ura and K. Tsumura, 2007, Earthquake Database of Japan University Seismic Observatory Networks, abstract of Japan Geoscience Union Meeting 2007, S144-003.

Keywords: Earthquake Catalog, Database of Japan University Seismic networks

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-05 Room:302 Time:May 27 11:00-11:15

Stress regime in the Philippine Sea slab and the asperity of the Kanto earthquake

Junichi Nakajima[1*], Akira Hasegawa[1], Fuyuki Hirose[2]

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Two oceanic plates, the Philippine Sea and Pacific slabs, are subducting beneath Kanto, and seismogenesis are discussed in terms of dual subduction and resultant interaction (e.g., Wu et al., GRL, 2007; Uchida et al., EPSL, 2009; Nakajima et al., JGR, 2009; Nakajima and Hasegawa, JGR, 2010). However, stress regime in the Philippine Sea slab is poorly understood because of diverse seismicity as well as complex geometries of the two slabs. Here we determine focal mechanisms of small earthquakes in the Philippine Sea slab, and discuss stress regime with implications for the location of the Kanto asperity.

We determined focal mechanisms of 245 earthquakes occurring in the Philippine Sea slab from 2003 to 2010, and combined them with those determined by JMA. The obtained solutions indicate that stress regime is quite different between the northeast and southwest of the Tokyo bay. In the northeast, earthquakes nearby the slab surface occur under down-dip compressional stress regime, while those far from the slab surface have focal mechanisms with T axis in the down-dip direction. Earthquakes in the southwest have, however, T axis with a higher dip angle than the slab dip. Notably, such earthquakes occur only beneath the Kanto asperity.

Results of stres-tensor inversion show that sigma1 or sigma3 is parallel to the relative plate motion of the Philippine Sea slab, suggesting that stress regime in the slab is controlled mainly by the plate motion, not by local slab geometry. We further calculate the effect of a plate coupling along the Kanto asperity on intraslab stress regime. The obtained results suggest that stress regime generated by the plate coupling can explain the occurrence of the earthquakes with T axis with a higher dip angle. This spatial relation implies that the down-dip extension of the Kanto asperity is not locked at present and hence a large interplate earthquake would not occur there.

Japan Geoscience Union Meeting 2011
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SSS026-06 Room:302 Time:May 27 11:15-11:30

Numerical simulations of temperature field associated with subduction of two oceanic plates beneath Kanto district

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1. Introduction

The Philippine Sea plate is subducting beneath the North American plate in the NNW direction, and the Pacific plate is subducting below the Philippine Sea plate in the WNW direction beneath the Kanto district. In this region, it is considered that complicated temperature and flow fields associated with subduction of the two oceanic plates are formed. Since the contact zone between the Philippine Sea and the Pacific plates exists beneath the Kanto district, low temperature field is considered to be realized. In fact, observed heat flow data which represent the underground temperature field is low in the Kanto district, which is remarkable in the Japanese islands.

In this study, we performed numerical simulations of temperature distribution associated with subduction of the plates along profiles parallel to the convergence direction of the Pacific or the Philippine Sea plates. By comparing heat flow estimated from thus obtained temperature distribution with the observed one, we focused on what kinds of features are brought by subduction of the two plates.

2. Models and Methods

In this study, using a 2-D box-type thermal convection model developed by Torii and Yoshioka (2007), we constructed a model in which the Philippine Sea plate subducts from 15Ma into the model region where the Pacific plate has already been subducting. We gave subduction velocity, referring to Sella et al. (2002). For the Pacific plate, we changed the age of the subducting plate according to Sdrolias et al. (2006). In addition, based on Nakajima et al. (2007, 2009) and Hirose et al. (2008), we gave the shape of the upper surface of the two oceanic plates and fixed it in the model as indicator of guides for the two subducting plates. We set a profile passing through the Kujukuri-hama for the direction of the Pacific plate subduction. On the plate boundary between the Philippine Sea and the North American plates, the 1923 Kanto earthquake (M7.9) occurred. Moreover, aseismic slow slip events off the east coast of the Boso Peninsula have been reported (Ozawa et al., 2003). So, to estimate the temperature field at the plate boundary is important. Then, we took three profiles passing through the areas of east and west asperities of the 1923 Kanto earthquake and the region of the aseismic slow slip events in the convergence direction of the Philippine Sea plate. For these four profiles, we calculated the temperature fields and heat flow, and compared the latter with the observed heat flow in each of these profiles. We used heat flow data of bore holes & heat probe (Tanaka et al., 2004; Yamano, 2004), BSR (Ashi et al., 1999, 2002), and Hi-net on the wells (Matsumoto, 2007).

3. Results

In our model, when the Philippine Sea plate subducts, where hot material associated with subduction of the Pacific plate is flowing into a mantle wedge, temperature decreases there. Furthermore, since the Philippine Sea plate plays a role as an obstacle, flow with high temperature yields near the upper surface of the Pacific plate at the down dip of the contact zone of the two oceanic plates, and the temperature rises there. Heat flow gradually decreases over time in association with subduction of the Philippine Sea plate, which fits the spatial distribution of the observed heat flow data well. In this presentation, we will also discuss the difference between the temperature fields in the areas of the two asperities of the 1923 Kanto earthquake and aseismic slow slip events on the plate boundary.

Keywords: subduction, temperature distribution, flow field, heat flow, Kanto earthquake, aseismic slow slip event

Japan Geoscience Union Meeting 2011
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SSS026-07 Room:302 Time:May 27 11:30-11:45

A hypocenter determination method with travel time difference between observation points

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A hypocenter determination problem from observed seismic wave data has been one of the most important issues for seismology. In the hypocenter determination process, model errors originated from earth model uncertainty should be most important, because it is well recognized that errors due to uncertainty of velocity structure model can severely bias the result in the hypocenter determination. Considerable efforts were made to obtain more precise velocity structure, and then accuracy of hypocenter determination has been improved. However, we never obtain the true velocity structure model, and never calculate a theoretical travel time with the true velocity structure model. So in this study, we developed new hypocenter determination method so as to mitigate the model errors due to uncertainty of velocity structure model.

In general, the model errors correlate with not only location of hypocenter but also location of observation point. Taking the difference between the observation equations for a pair of observed points, we mitigate the effect of the model error. First, we constructed an observation equation for each station with the model error term, obtained an equation for location of hypocenter by taking the difference between the observation equations for a pair of observed points, and then determined location of hypocenter using the difference equation. The model error correlations among observation points should be mitigate in the difference equation.

We first made a synthetic test to compare the new formulation with the traditional formulation. We computed the synthetic travel time with 2.5 D structure model, and then determined location of hypocenter with simplified layered structure model. The results show that the estimation errors significantly mitigated under the new formulation. We next applied the new formulation to the JMA unified data of aftershocks of the 2004 Mid-Niigata prefecture earthquake, and to travel time observed MeSO-net in aftershocks of the 2010 northeast Chiba prefecture earthquake. From distribution of the 2004 Mid-Niigata prefecture earthquake, the fault plane dipping into southeastward was confirmed. This fault plane is not identified in JMA catalogue and relocation with HypoDD, though same observation data was used. And, from distribution of the 2010 northeast Chiba earthquake, it is revealed that reverse fault earthquakes are focused near plate boundary, whereas other earthquakes are located inside of subducting slab, deeper than plate boundary.

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SSS026-08 Room:302 Time:May 27 11:45-12:00

Initial development of the Matsushiro Earthquake Swarm and Influence of Tidal Strain on its Occurrence, the 2nd Report

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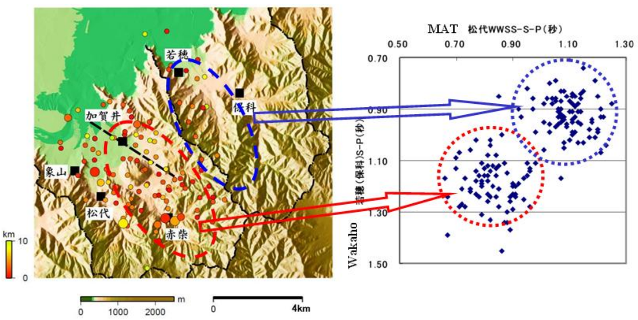
Initial development of the Matsushiro earthquake swarm that started in early August of 1965 was investigated in detail by analyzing seismograms of Akashiba and Wakaho, temporarily operated stations of JMA, and we found that the initial stage of the swarm consists of two phases. In the initial stage, the swarm occurred in a small area north of the estimated Matsushiro earthquake fault and a month later in the next stage, a new activity occurred in a wider area south of the fault. To make the result more clear, we re-investigated WWSS-SP seismograms of Matsushiro(MAT) station. S-P times were picked from three component seismograms and averaged for each event to obtain a precision of about 1/20s. The new data and existing data suggested that a transition from the first phase to the second phase of the activity occurred rapidly in early September and S-P histograms of each station and comparison of them indicate that the northern area of the initial phase and the southern area of the second phase are defined and separated in each other clearly.

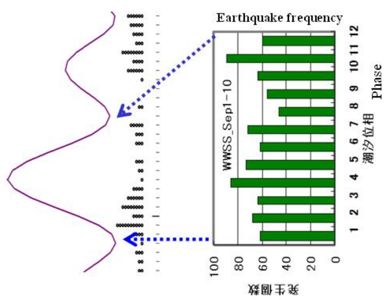
To relate the areas of the swarm in the initial stage to the geography, we studied hypocenters in October and November of 1965 after deployment of temporal seismic station network of the Earthquake Research Institute(ERI) and incorporated 6 stations data of JMA and ERI into hypocenter location. Preliminary location suggests that hypocenter distribution well correspond to the areas of initial development of the swarm.

We analyzed relation between tidal strain changes and earthquake swarm occurrence.

Among several tidal strain components, weak relation between volume, aerial tidal strains and occurrence of the swarm earthquake were found. In the first stage in 1965 August, earthquakes seemed to be occurring during tidal volume strain was in contraction stage and in the next stage in September, many earthquakes were occurring during tidal volume strain in dilatational phase. Volume strain may be related to the change in pore pressure and affected the occurrence of earthquake.



Hypocenters and comparison of S-P times for the initial stage of the Matsushiro Earthquake swarm (in the blue circles) and those in the second stage (in the red circles)



Volume tidal strain change and Earthquake Occurrence

Keywords: Matsushiro Earthquake Swarm, Tidal Strain, Pore Pressure

Japan Geoscience Union Meeting 2011
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SSS026-09 Room:302 Time:May 27 12:00-12:15

Earthquakes triggered by tides in Iwo-jima island, Japan

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We investigate dynamic and tidal triggering of earthquakes in Iwo-jima, a south small volcanic island 1250 km away from Tokyo. After seismic waves of four far-distant huge earthquakes including 2004 Sumatra earthquake reached Iwo-jima, a local seismicity was activated. At the time of largest amplitude of arrival seismic waves, in particular, triggered earthquakes occurred in south - west area of Iwo-jima for all of huge earthquakes. From spectrum analysis of time-series of earthquake number per hour, M2 and K1 components of ocean tides significantly enhanced. In the presentation, we discuss the triggered mechanism.

Keywords: Seismicity, Triggering, Tide, Dynamic triggering

Japan Geoscience Union Meeting 2011
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SSS026-10 Room:302 Time:May 27 12:15-12:30

Hypocenter relocation of M7-class earthquakes and comparison with the interplate quasi-static slip in the Hyuga-nada

Yusuke Yamashita[1*], Hiroshi Shimizu[1], Kenji Uehira[1], Mikio Fujii[2]

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In the Hyuga-nada region, the Philippine Sea Plate subducts northwestward beneath the Eurasian Plate an approximate rate of 5 ~ 7 cm/year, and M7-class interplate earthquakes have repeatedly occurred at decade years interval. We relocate the hypocenters of the main shock and aftershocks for the major interplate earthquakes which occurred in 1931 (Mjma7.1), 1941 (Mjma7.2), 1961 (Mjma7.0), and 1970 (Mjma6.7), and compare them with the quasi-static slip rate estimated by the analysis of small repeating earthquakes.

We used the smoked-paper records and the Seismological Bulletin of the Japan Meteorological Agency (JMA). All the hypocenters were relocated using S-P time instead of P or S arrival time for reducing the error caused by inaccuracies of the clock. We assumed that the hypocenters located on the plate boundary from *Uehira et al*. (2010). Theoretical S-P times were calculated by 3D ray trace with 3D velocity structure model.

The hypocenter relocation showed that the hypocenter of 1961 event locates at about 20km west of the hypocenter by JMA. The relocated hypocenter coincides with the area in which the interplate quasi-static slip rate is small [*Yamashita et al*., 2010]. This implies that the area corresponds to an asperity on the plate boundary, which is consistent with the results of stress tensor analysis by *Uehira* (2007).

Acknowledgement
We thank Dr. Yakiwara (NOEV, Kagoshima University) who provided 3D ray trace program. We also thank the members of the Fukuoka District Meteorological Observatory, Kagoshima, Miyazaki, Kumamoto, Oita, Saga, Shimonoseki Local Meteorological Observatory, and Nagasaki Marine Observatory for collecting the smoked-paper records of Hyuga-nada earthquakes.

Keywords: Hyuga-nada earthquake, Interplate quasi-static slip, Hypocenter relocation

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-11 Room:302 Time:May 27 12:30-12:45

Remotely triggered seismicity in Yunnan, Southwestern China following the 2004 Mw9.3 Sumatra earthquake

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Following the 2004 Mw9.3 Sumatra earthquake, seismicity increased sharply over a wide area of up to ~2,500 km away in Yunnan province, southwestern China. Raised seismicity lasts for approximately 14 days. During this period, more than 800 events having a magnitude of >=1.5 were observed, including at least 7 M4 class events and a M5.1 event. This is perhaps the most impressive example of remotely triggered seismicity yet observed. Major events were clustered at several sites that exhibit complex fault geometries, such as step-overs and junctures. We use statistic approaches including the Beta-statistics to examine the statistical significance of the seismic rate increases associated with the Sumatra mainshock and conclude that there is a reasonable probability that the raised seismicity was remotely triggered by the Sumatra earthquake.

Both rapid-onset dynamic triggering and delayed response were well established. During the first hour of event time (time from the origin time of the Sumatra earthquake), we can identify and locate at least 7 M1.5+ earthquakes. These events are embedded in the body waves and surface waves from the Sumatra earthquake. However, clear records at some stations are obtained by applying a high-pass filter to the original seismograms. The first identified event is a M4.6 earthquake occurred during the passage of the surface waves from the Sumatra earthquake. However, major clusters likely demonstrate significant delays in the onset of triggering seismicity, with the dominant energy releasing a few hours to a few days after the surface wave passed.

We use the epidemic-type aftershock sequence (ETAS) model to examine seismicity in the study in 2004 through 2005. Two major changing points and thus three phases (I through III) of activity pattern, are well determined. The second phase (II) corresponds to the period of seismic activity remotely triggered by the Sumatra earthquake. The ETAS models show great p0 (>30%) and small Alfa, which are 1.368, 0.804, and 1.328 for phases I, II, and III, respectively. Therefore, the triggered activities show earthquake swarm-like characteristics such as that indicated by the epidemic-type aftershock sequence (ETAS) modeling results (large percentage of random components and less magnitude dependence in Omori law type self triggering).

Multiple sources of evidence, including intensive hydrothermal activities, and low velocity and high Vp/Vs zones in the lower to middle crust suggests that magma/mantle-generated fluids have a role in the region. High fluid pressure in branched fault zones weakened the faults, making them sensitive to external disturbances and leading to fluid-driven seismicity.

Keywords: Remote triggering, ETAS, Fluid-driven seismicity, Yunnan, Sumatra Earthquake

Japan Geoscience Union Meeting 2011
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SSS026-P01 Room:Convention Hall Time:May 27 14:00-16:30

JUNEC Focal Mechanism Catalog Using P-wave First Motion Polarities and Its Characteristics

Takeo Ishibe[1*], Hiroshi Tsuruoka[1], Kenji Satake[1], Kunihiko Shimazaki[1]

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We determined about 14,000 focal mechanisms which occurred in and around Japan from July 1985 to December 1998 by using P-wave first motion polarities of the Japan University Network Earthquake Catalog (JUNEC) and HASH algorithm (Hardebeck and Shearer, 2002), and compiled a focal mechanism catalog. The Earthquake Information Center, Earthquake Research Institute (ERI), the University of Tokyo has compiled observed data with the cooperation of universities and determined hypocenters amounting to about 190,000 (magnitude 2.0 or above).

The JUNEC P-wave first motion focal mechanism catalog includes abundant small-magnitude earthquakes and it is applicable to various analyses. As an example of such analyses, we investigated the temporal change of probability distributions of the earthquakes against the static changes of the Coulomb Failure Function (dCFF) due to the 1995 Kobe earthquake. The dCFF was calculated on nodal planes of focal mechanisms. The probability distribution after the mainshock clearly sifts to the positive dCFF side relative to that prior to the mainshock. This supports the seismicity rate changes due to the dCFF discussed in the previous studies (e.g. Stein et al., 1992; Toda et al., 1998).

The distribution of focal mechanism solutions is spatially and temporally heterogeneous, and it clearly reflects both the development of observation station network and spatial variation of first motion polarity report rate (i.e. first motion polarity report number / the number of picked onsets). Focal mechanism solutions determined in this study are basically consistent with previously reported ones such as F-net moment tensor solutions by the National Research Institute for Earth Science and Disaster Prevention (NIED) or P-wave first motion focal mechanisms observed by the Kanto-Tokai seismic observation network though some focal mechanisms are significantly different from them.

Acknowledgments

We used the program modified from HASH (Hardebeck and Shearer, 2002) for estimating focal mechanisms and the program by Okada (1992) to calculate the dCFF, as well as pick files observed by the Hokkaido University, Hirosaki University, Tohoku University, Earthquake Research Institute (ERI) University of Tokyo, Nagoya University, Disaster Prevention Research Institute (DPRI) Kyoto University, Kochi University, Kyushu University and Kagoshima University. We also used focal mechanisms determined by NIED and Japan Meteorological Agency (JMA). We thank all of these organizations and individuals. This study is partially supported by the Special Project for Earthquake Disaster Mitigation in the Tokyo Metropolitan Area from the Ministry of Education, Culture, Sports, Science, and Technology of Japan.

Keywords: Japan University Network Earthquake Catalog (JUNEC), Focal mechanism, P-wave first motion

SSS026-P02 Room:Convention Hall Time:May 27 14:00-16:30

Objective Repeating-earthquake Analysis beneath Japan

Koji Tamaribuchi[1*], Masaki Nakamura[1], Yasuyuki Yamada[1]

[1]JMA

The long-term earthquake prediction has usually used the characteristic earthquake model, which has an almost constant recurrence interval time. We detected some repeating earthquake sequences (that is, those seismic waves are similar at the same stations between each other quake) to find characteristic earthquakes (JMA, 2010, Nakamura et al., 2010), including the case of off Kushiro (M4.8; Sakoi et al., 2010), the cases of off Iwate Prefecture (M6.1 and M6.0; JMA, 2009a), the case of off Fukushima Prefecture (M5.7; JMA, 2009a), the cases of off Okinoerabujima Island (M5.3 and M5.2; JMA, 2009b, Tamaribuchi et al., 2009) and the case of near Miyakojima Island (M5.1; Tamaribuchi et al., 2010). However, it was not objective that all of them were detected by human on a case-by-case basis. Therefore, we attempted an objective and comprehensive analysis to find repeating earthquakes, using digital records of the type 87 and type 95 seismographs.

Our method is as follows. First, we searched a relation between magnitude and frequency which has high coherence value within a band of 0.1-10Hz as a preliminary step. As a result, we obtained the following, f_{lower} = log a - b M (a=22.4, b=0.86), where f_{lower} is the lower frequency in calculating coherence value and M is the magnitude by JMA. The upper frequency is the following, $f_{upper} = 4*f_{lower}$. Second, we computed coherences for three components using the above relational expression. We chose earthquake pairs whose median coherences were 0.95 or more. Finally, we classified those pairs into groups on the basis of cluster analysis.

We found many repeating earthquakes of M4-6 beneath Japan. Most of groups located on the plate boundary, including beneath the Hidaka region, beneath the east coast of Ibaraki Prefecture and beneath the northwest of Chiba Prefecture. No repeating earthquake was detected near the major asperities such as off Sanriku, off Tokachi, the Tokai and the Nankai. On the other hand, there are some candidates of repeating earthquakes in aftershocks and swarms. We wondered that the same asperities were actually ruptured in those cases.

In this study, we used the type 87 and 95 seismographs, but there was not enough data to grasp the characteristic earthquake sequences of M5-6. By using the type 59 analog seismographs, we would detect more characteristic earthquake sequences.

References: JMA, 2009a, Report of the Coordinating Committee for Earthquake Prediction . Japan, 82, 84-90; JMA, 2009b, Report of the Coordinating Committee for Earthquake Prediction, Japan, 82, 417-422; JMA, 2010, Report of the Coordinating Committee for Earthquake Prediction, Japan, 83, 613-632; Nakamura et al., 2010, Abstr. 2010 Japan Earth Planet. Sci. Joint Meeting, SSS013-P05; Tamaribuchi et al., 2009, Abstr. 2009 Japan Earth Planet. Sci. Joint Meeting, S149-P005; Tamaribuchi et al., 2010, Zisin2, 62, 193-207; Sakoi, 2010, Abstr. of SSJ 2010 Fall Meeting, D11-06.

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SSS026-P03 Room:Convention Hall Time:May 27 14:00-16:30

Disagreement of first motion polarities of P wave with the focal mechanism solution

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We frequently observe disagreement of the polarity data of P wave first motions with the focal mechanism solutions obtained from a high density and wide coverage observation network like Hi-net. It would be acceptable that the opposite polarities at stations around the nodal plane of the mechanism solution are observed since the model of the velocity structure used in determination of the solution is different from the real Earth. However, we sometimes find the polarity data inconsistent with the solution around the anti-node of the radiation pattern even in the catalog data compiled with human inspection. In this report we discuss this phenomenon from a viewpoint of the non-double couple earthquakes occurring in the subducting slab.

Mechanism for the intraslab seismicity is generally explained by a dehydration embrittlement, which is caused by mechanical instability associated with dehydration of hydrated minerals in the slab. Because the dehydration occurs in the serpentinized slab mantle as well as in the oceanic crust being direct contact with ocean water, the existence of the double seismic zone observed in the northeast Japan arc may also be explained by this mechanism.

Instability due to volumetric change or heating associated with a phase change of the minerals occurring in the mantle has also been a plausible hypothesis to explain the deep seismic activity under the condition of large confining pressure. Previous studies on deep earthquakes by waveform analysis, however, have hardly succeeded to resolve any evidence of the volumetric change, which would be observed as an isotropic component of a CMT solution. The volumetric change in the seismic source is, therefore, considered to be negligibly small to radiate detectable seismic energy. On the other hand, we might expect the first motion data obtained from high sensitivity seismograph network to bring us important information for the initial status of the source process with detectable signals.

We used the Hi-net event catalog to analyze the polarity data inconsistent with the mechanism solution, which is given from the F-net moment tensor catalog to avoid possible bias of the first motion solution in a case with many inconsistent polarities. We selected the events deeper than 40 km to focus on the intraslab seismicity and to avoid head wave first arrivals. From the analysis we found that there are not a small amount of earthquakes which could not be explained by a simple double couple source and that the number of polarities with negative inconsistency is slightly larger than that with positive inconsistency. The latter result might reflect the volumetric change in the seismic source.

Keywords: focal mechanism solution, first motion polarity, non-double couple model

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-P04 Room:Convention Hall Time:May 27 14:00-16:30

Low frequency earthquakes in aftershock activity

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What is aftershock? The problem is old one but still unsolved problem. Redistribution of stress field around main shock area causes main role for the understanding. Reduction of aftershock activity may be caused by relaxation process. On the process relative low stress field may excite somewhat specific seismic event. We monitor very broadband seismic data as for aftershock activity of large scale earthquakes around Japan. Ishigaki (ISG) and Ogasawara (OGS) of OHP seismic network are used in this analysis. They had large earthquakes, magnitude of greater than 7, and had high aftershock activities nearby these stations. We applied to distribute earthquakes some classes by their spectrum and/or dominant frequency of signal. In our applications, low and very low frequency earthquakes are identified in these activities. And the beginnings of these events are originated about one to some days delayed from main shock. The delay of very low frequency seismic events' activation is also known in 2004 SE off Kii-hanto earthquake. The time history is related with stress relaxation indirectly. The fine monitoring of aftershock expects to be new view for aftershock activity.

Keywords: Low frequency earthquake, aftershock activity

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-P05 Room:Convention Hall Time:May 27 14:00-16:30

Seismic activity of the December 2, 2010 Sapporo earthquake(MJMA4.6)

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Shallow seismic activity including felt earthquakes had started in southern Sapporo region since October 22, 2010. Largest earthquake with M4.6 occurred on December 2, 2010. JMA issued earthquake early warning for this event. This activity indicated foreshock, mainshock and aftershock sequence. One temporal seismic station with mobile-phone realtime telemetering system was installed just after foreshock occurrence, and two more stations were deployed just same day of largest event. Precise hypocenters of 86 earthquakes by using above dense network were determined. Aftershock distribution concentrated on an eastward dipping plain with 60 degrees, which is agree with one of nodal plains of focal mechanism determined by P-wave polarities in this study. Foreshocks were distributed on deeper extend of aftershock region. Geometry of total hypocenter distribution is consistent with an estimated active fault beneath Sapporo urban region.

Keywords: Hokkaido, Aftershock Distribution, Active fault

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-P06 Room:Convention Hall Time:May 27 14:00-16:30

Hypocenter distribution before and after in the source region 2008 Iwate-Miyagi Nairiku Earthquake

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Koshika et al.(2011) relocated the hypocenters of earthquakes that occurred before the 2008 Iwate-Miyagi Nairiku Earthquake using the Hi-net data, and studied whether the source fault form could be estimated from hypocenter distribution before the main shock. As a result, the hypocenters relocated were not distributed on a plane corresponding to the source fault, and it was difficult to estimate the source fault form. Comparing with aftershock distribution by Okada et al.(2008), the hypocenters were not located in the aftershock region, but they were distributed surrounding aftershocks. However a method and a velocity structure used for locating hypocenters were different between Okada et al.(2008) and Koshika et al.(2011). It is necessary that aftershocks and earthquakes before the occurrence of the main shock are determined in the same manner for comparing hypocenter locations.

Therefore in this study, aftershock and earthquakes before the main shock occurrence were located simultaneously by using the DD method. Earthquakes before the main shock were the same as those used by Koshika et al.(2011). They occurred in about 60km$*$35km region covering the aftershock area in 2006-2007. We selected aftershocks that occurred from 8:43 to 23:59 on the same day of the main shock. We used 40 stations whose epicentral distance was within about 50km from the main shock. We displayed waveforms on the computer screen, and picked P- and S- wave arrival times. The number of earthquakes before the main shock and aftershocks was 383 and 324, respectively (total: 707).

A vertical cross section showed that hypocenters were not located within 3km from the main shock hypocenter while aftershocks were distributed in this area. In the north and south parts of the aftershock, aftershocks seemed to occur in the region where hypocenters were not distributed before the main shock, though it was not as remarkable as around the main shock hypocenter. From a WNW-ESE vertical cross-section of S-wave velocity perturbation around the main shock by Okada et al.(2008), both main shock and aftershocks were distributed in a high-velocity zone that extended in WNW-ESE direction. Hypocenters before the main shock were also included in this high velocity zone. Hypocenter distribution relocated in this study may indicate a small scale heterogeneity that can be estimated by velocity perturbation.

Acknowledgment
We appreciate having used the hypocenters by Japan Meteorological Agency (JMA) and waveform data of JMA, Tohoku University, and the National Research Institute for Earth Science and Disaster Prevention (Hi-net).

Reference
Koshika et al., 2011, Zisin2, 63(4), in press.
Okada et al., 2008, Kagaku, 78(9), 978-984.

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-P07 Room:Convention Hall Time:May 27 14:00-16:30

Microearthquake observation in the Hokuriku region for these 35 years

Fumiaki Takeuchi[1*], Takuo Shibutani[1], Kin'ya Nishigami[1], Norio Hirano[1], Kazuo Matsumura[2], Fumio Ohya[2], Takuo Okamoto[3]

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We have been observing the Microearthquakes in the Hokuriku region, by the telemetering system from 1976 to the present. At the beginning, the observation points were set about 30 km apart from each other. Nowadays, the number of the points grew up several times as big before, particularly after 1997, when the Kishouchou Ichigenka started. We will show some features of the earthquake occurrence in this region in these 35 years. And we also will show you the data of the extensometers set in the tunnel of the Hokuriku observatory

Keywords: microearthquake, Hokuriku region, 35 years

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-P08 Room:Convention Hall Time:May 27 14:00-16:30

Observation of low frequency seismic events in the Nankai Trough region by broadband ocean bottom seismometers

Kazuo Nakahigashi[1*], Yuya Machida[1], Takehi Isse[1], Tomoaki Yamada[1], Kimihiro Mochizuki[1], Hajime Shiobara[1], Masanao Shinohara[1], Toshihiko Kanazawa[1], Kenji Uehira[2]

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Recently, low-frequency earthquakes and slow slip events are recognized in deep region of the plate boundary between the landward plate and the subducting Philippine plate below the southwestern Japan [e.g., Obara, 2002; Kawasaki, 2004]. The very low frequency earthquakes (VLFEs) occurring close to the Nankai Trough are also reported by using the broadband seismograph data obtained in the land area [e.g., Obara and Ito, 2005]. Such unusual seismic events might reflect coupling properties at the plate boundary. It is important to understand such events for consideration of the subduction process and estimation of generation mechanism of the interplate earthquake in the Nankai Trough. Because the VLFEs in the Nankai Trough region occurred far from land seismic stations, observations using broadband Ocean Bottom Seismometers (BBOBSs) near the trough are needed to understand such VLFE activities.

In December 2008, we started an observation campaign off Kii Peninsula. For the first observation, three BBOBSs with Guralp CMG-3T sensors, and six 1Hz type Long-term OBSs were used. The spatial intervals among OBSs were about 20km. In 2009, we recovered them. The data recorded by each OBS were merged and continuous records were reproduced. VLFEs with predominant frequency of 0.01-0.1 Hz were found from continuous records in March 2009. The occurrence of the VLFE has a temporal change. In addition, seismicity of ordinary micro-earthquakes became high simultaneously during the VLFE activities. In November 2009, we started the second observation off Cape Muroto, the westward of the first observation, using three BBOBSs with pressure gauge, and five Long-term OBSs. The subducting seamount was found by an OBS survey in this region [Kodaira et al., 2000]. In February 2011, all the OBS were retrieved, and we deployed five BBOBSs in the same region to continue the observation. In this presentation, we will report the new analysis results using the seismic and the pressure gauge data.

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-P09 Room:Convention Hall Time:May 27 14:00-16:30

Characteristics of shallow seismic activity in the Beppu-Shimabara area, Kyushu, Japan

Hiromi Chikura[1*], Satoshi Matsumoto[2], Takahiro Ohkura[3], Hiroshi Shimizu[2], Hiroyuki Inoue[3], Shin Yoshikawa[3], Yuki Abe[4], Yoshihiro Masaki[4], Masahiro Miyazaki[1], Kenji Uehira[2]

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In the middle part of Kyushu Island, Japan, called the Beppu-Shimabara graben, there are active volcanoes: Tsurumi, Kuju, Aso, and Unzen. Most of historical large earthquakes occurred in this area. In addition, seismic activity of microearthquake is also high in this area. We investigated the cause of high seismic activity in this region from seismological analysis. Temporal seismic stations were deployed in this area in order to determine hypocenters of microearthquakes with high accuracy because their depth provided us with important information about thickness of seismogenic layer. We carefully determined hypocenters of microearthquake and focal mechanisms from the observed data.

Focal depths in Beppu-Shimabara area are shallower than 15 kilometers, especially become shallow in the vicinity of Kuju volcano. While focal mechanism of strike-slip fault type dominates in Kyushu Island, many earthquakes in normal fault type occur in Beppu-Shimabara area. It means that the stress field in the area changes from strike-slip fault regime to normal fault one. In other words, the maximum horizontal principal stress drops and becomes moderate principal compressive stress from maximum. Generally, high seismic activity under a condition of lower compression stress can result from low strength of the medium. Our results suggest that the strength of the crust in Beppu-Shimabara area is weak. As an interpretation, high fluid pressure in the crust can be attributed to high volcanic activity in the area.

Japan Geoscience Union Meeting 2011
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SSS026-P10 Room:Convention Hall Time:May 27 14:00-16:30

Characteristics of repeating earthquake activirt in Hyuga-nada and east off the northern part of Nansei-shoto, Japan

Kazuhiko Goto[1*], Hiroshi Yakiwara[1], Syuichiro Hirano[1]

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Earthquake family composed of more than 4 repeating earthquakes in Hyuga-nada and east off the northern part of Nansei-shoto, Japan is classified into three types by its activity. First is R-type; the event occurs regularly over a long period of time. Second is C-type; the events occur closely in a short period. Third is O-type: the family belongs to not only R-type but C-type. In the middle of Hyuga-nada and east off Tanegashima, almost all earthquake families are O-type. On the other hand, east off Toi-misaki and Tokara islands, the R-type families occur predominantly. The shallow large earthquakes more than M7.0 from 1923 (according to JMA) occurred only in the O-type predominant regions. It may suggest that the existence of asperity of large earthquake controls the type of earthquake family. East off Amami-ooshima is also the O-type predominant region, where earthquakes more than M7.0 did not occur from 1923. However, it is noticeable that the large earthquake of M8.0 occurred in this region in 1911 (a common opinion of depth of this event being 100km).

Keywords: repeating earthquake, earthquake family, asperity, plate boundary, Hyuga-nada, Nansei-shoto

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-P11 Room:Convention Hall Time:May 27 14:00-16:30

Relocation of earthquake swarm distribution in the south Okinawa Trough using double-difference method

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The south Okinawa Trough is distributed at the 100 km northwest of the Ryukyu arc, which is in the rifting stage with extension. The earthquake swarms with the maximum earthquake magnitude of 6 frequently occur along the axis of the south Okinawa Trough. The accuracy of the hypocenter distribution is not good along the axis of the Okinawa Trough because the hypocenters are about 100 km far from the local seismic network of the Japan Meteorological Agency (JMA).

I determined the locations of the hypocenters along the axis of the south Okinawa Trough using the combination of local and tele-seismic network data. The hypocenter determination was employed using the double-difference technique. The catalogued data of the local seismic network (JMA) and tele-seismic network (ISC catalogue) were used. The P and S arrival time at the station whose epicentral distance is within 90 degrees were used for the hypocenter determination. The earthquakes which occurred between January 1st, 2002 and October 31, 2020 and whose magnitudes are over 3.5 were used for the relocation.

The results show that the each strike and dip of the earthquake swarm along the south Okinawa Trough is complicated. The seismic plane of the earthquake swarm of July 2002 are striking east-northeast direction and dipping northward, while the seismic plane of the earthquake swarm of October 2002 is striking east-west direction and dipping southward. These are consistent with the strike and dip of the normal faults estimated from seafloor topography.

Keywords: Okinawa Trough, hypocenter determination, earthquake swarm

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-P12 Room:Convention Hall Time:May 27 14:00-16:30

Focal depth distribution using depth phase in the south Ryukyu trench

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Focal depth distribution using depth phase in the south Ryukyu trench
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Determination of accurate hypocenter distribution is important for the investigation of stress field and geometry of the plate near the locked zone of Ryukyu trench. Recently, the locked zone, very low frequency earthquake and slow slip evens have been detected along the Ryukyu trench region. However errors of the hypocenters are large because seismic stations are far from the Ryukyu trench. Then we determined the focal depths of earthquakes along the Ryukyu trench. using depth phase

Total 15 JMAs seismological stations are employed in this study. We used the events which occurred near 24.3N,125.3E between January 2005 and December 2006, where magnitudes are over 3.5.Most of them were the thrust type event from the CMT catalogue by NIEDs F-net. In their wave pattern, large amplitude phase is confirmed between P phase and S phase. The phase is dominant with vertical component, These suggest that the phases are the converted sP phase from S phase at seafloor. Then we determined the focal depth using the phase.

The time difference between sP phase and P phase are distributed from 8 to 14 seconds at the epicentral distance of 100 km. The estimated depths using the sP-P difference time range from 20 to 40 km. In consequence, it is clear that earthquake is occur 20 to 40 km in south Ryukyu trench. This result compare with JMAs depth distribution of 16 to 40 km, Its range is more smaller than JMAs.Most of hypocenter is about 20 km, as a result. Philippine plate depth is estimated 20 km.

Keywords: hypocenter determination, Ryukyu trench, Philippine sea plate, depth phase

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-P13 Room:Convention Hall Time:May 27 14:00-16:30

Generation mechanism of the swarm activity following the 2004 Sumatra-Andaman earthquake

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A swarm activity occurred east off Nicobar Islands about a month after the 2004 Sumatra-Andaman earthquake. We discussed three problems of the swarm activity, i.e.,(1) How could the spatial distribution of strike-slip events and normal fault events be explained? (2) Why was the swarm activity triggered east off Nicobar Islands? (3) What is the cause of the swarm activity that started about a month later? In order to answer these problems, we relocated the hypocenters of the swarm activity using the Modified Joint Hypocenter Determination (MJHD) method and investigated the spatial distribution of fault plane solutions. As results, we found that the spatial distribution of strike-slip events and normal fault events can be explained by the activation of Riedel shears in the region between West Andaman Fault (WAF) and Sumatra Fault System (SFS). Normal fault events may have been triggered by the increase in tensional stress associated with injection of magma into tension fractures. Moreover, we calculated the change of the Coulomb Failure Function (dCFF) due to the mainshock and afterslip of the Sumatra-Andaman earthquake. Based on the results of these analysis, we found that the spatial pattern of dCFF due to mainshock could explain why the swarm activity occurred east off the Nicobar Islands. The delay of the swarm activity may be due to the afterslip or the injection of magma into tension fractures.

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-P14 Room:Convention Hall Time:May 27 14:00-16:30

Seismicity of Eastern Turkey: A Case Study

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The March 8, 2010 Basyurt-Karakocan Earthquake (MlISK=6.0 ; 04:32 L.T.) occurred on the East Anatolian Fault (EAF) in Elazig Province. 42 People were killed and 137 people were injured. Over 100 villages and hamlets which were closely located to the epicenter were affected by the earthquake. The Basyurt, Gokdere and Kovancilar were the most affected villages and in general this area falls within the deformation field in the East Anatolian Fault Zone. It was observed that the aftershocks were densely distributed in SW-NE direction. In this study, we have analyzed the faulting mechanism solutions of 14 earthquakes (M>4.0) in the region and their source characteristics. The fault plane solution of the main shock revealed that the earthquake occurred with a left lateral strike slip faulting. The March 8, 2010 Basyurt-Karakocan Earthquake demonstrated that the region sustains the earthquake activity under the effect of strike slip tectonic regime. When the regional faulting structure is taken into account, it can be considered that the Basyurt-Karakocan Earthquake has occurred in Bingol-Palu fault system with the fracture of NE-SW main direction fault segments in the East Anatolian Fault Zone. The estimated intensity distribution map was prepared and delivered to the relevant public institutions immediately after the earthquake by KOERI. The earthquake intensity was estimated as Io=VII around the epicenter, and this was confirmed by field studies. The estimated PGA distribution map, the loss and damage maps were also prepared in a short time after the earthquake and sent to the relevant public institutions as well.

Keywords: seismicity, fault plane solutions, aftershock, Elazig earthquake

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SSS026-P15 Room:Convention Hall Time:May 27 14:00-16:30

Observation of glacial earthquakes by GreenLand Ice Sheet monitoring Network (GLISN)

Seiji Tsuboi[1*], Masaki Kanao[2], Yoko Tono[1], Tetsuto Himeno[2], Genchi Toyokuni[2]

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The GreenLand Ice Sheet monitoring Network (GLISN) is a new, international, broadband seismic capability for Greenland being implemented through the collaboration of Denmark, Canada, France, Germany, Italy, Japan, Norway, Poland, Switzerland, and USA. Glacial earthquakes have been observed along the edges of Greenland with strong seasonality and increasing frequency since 2002 (Ekstrom et al, 2003, 2006) by continuously monitoring data from the Global Seismographic Network (GSN). These glacial earthquakes in the magnitude range 4.6-5.1 may be modeled as a large glacial ice mass sliding downhill several meters on its basal surface over duration of 30 to 60 seconds. The detection, enumeration, and characterization of smaller glacial earthquakes are limited by the propagation distance to globally distributed seismic stations, i.e., the Global Seismographic Network (GSN) with the International Federation of Digital Seismograph Networks (FDSN). Glacial earthquakes have been observed at seismic stations within Greenland (Larsen et al, 2006), but the current coverage is very sparse. In order to define the fine structure and detailed mechanisms of glacial earthquakes within the Greenland Ice Sheet, a broadband, real-time seismic network needs to be installed throughout Greenland's Ice Sheet and perimeter. The GreenLand Ice Sheet monitoring Network (GLISN) should complemet the station distribution in Greenland and become useful to study activities of glacial earthquakes.

Keywords: Greenland ice sheet, glacial earthquake, broadband seismograph, GLISN