Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

STT59-01 Room:106 Time:May 21 13:45-14:00

Development of new EEW seismographs for Shinkansen based on international standards (IEC-61000, 62236)

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1. Introduction

Railway Technical Research Institute (RTRI) has been studied seismic observation method to detection P-wave and developed EEW system for Shinkansen. Seismograph in railway must observe seismic wave and judge train control whether electric power and communication lines in the state of disconnect. Therefore, Seismograph in railway essential that a single observation point processing capabilities.

Every seismograph needs to have high observation accuracy and reliability. Two years ago, we made a draft of EMC test menu and evaluated seismograph for Shinkansen using a draft EMC test menu (Sato: Japan Geoscience Union meeting 2010). We developed new EEW seismographs for Shinkansen based on IEC-61000, 62236.

Keywords: Seismograph, Shinkansen, IEC, EMC

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STT59-02 Room:106 Time:May 21 14:00-14:15

Evaluation on detectability of teleseismic events by FDSN stations in Antarctica

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Phase identifying procedure for teleseismic events at Syowa Station (69.0S, 39.6E), East Antarctica have been carried out since 1967 after the IGY period. From the development of INTELSAT telecommunication link, digital waveform data have been transmitted to NIPR for utilization of phase identification. Arrival times of teleseismic phases, P, PKP, PP, S, SKS have been reported to USGS, ISC, and published as "JARE Data Reports". In this presentation, hypocentral distribution and time variations for detected earthquakes was studied in 21 year period from 1987 to 2007. Characteristics of detected events, magnitude dependency, spatial distributions, seasonal variations, together with classification by focal depth are demonstrated. Obtained b values (Magnitude-number relation factor) for various focal depth groups took in 0.89-1.03 which was comparable with those by regional arrays and ISC data. Variations in teleseismic detectability in longer terms have possibly associated with meteorological environment and sea-ice spreading area in terms of global worming. Moreover, several kind of ice signals (sea-ice movement, tide-crack shocks, ice-berg tremor, basal sliding of ice-sheet) are demonstrating in the vicinity of the Station. Broadband array deployments, moreover, were carried out on the outcrops around the Lutzow-Holm Bay (LHB). Recorded teleseismic and local signals have sufficient quality for various analyses of dynamics and structure of the crust and mantle. Teleseismic passive seismic studies such as receiver functions and shear wave splitting were carried out; indicating heterogeneous structure along the coast in LHB. The obtained data can be applied not only to lithospheric studies but also to Earths deep interiors, as one of the major contribution to POLENET during the IPY 2007-2008.

Keywords: Syowa Station, teleseismic events, detection capability, monitoring observation, global network

Japan Geoscience Union Meeting 2012
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STT59-03 Room:106 Time:May 21 14:15-14:30

Improvement of Automatic Hypocenter Determination in JMA

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Estimating spatial and temporal hypocenter distributions in swarms and aftershocks quickly is essential for taking a measure to mitigate earthquake disaster. The automatic hypocenter determination method is important to grasp seismic activities in real time, especially after the 2011 off the Pacific coast of Tohoku Earthquake.

JMA can usually determine 90% or more hypocenters automatically compared with JMA catalog (M >= 2.0). However their determination rate fall to 10-30% in swarms and aftershocks due to rise of a trigger level and wrong pickings. We examined several approaches to solve these problems.

First, we examined to pick phases every second by AR-AIC method, without using trigger by STA/LTA. This approach increased wrong pickings, but also increased correct pickings.

Second, we examined the particle filter method [Yamada (2011)] and the pattern matching method [Tsukada and Ohtake (2001)]. These methods can separate earthquakes that occurred at the same time. We applied these methods for some swarms and aftershocks activity, including the 2011 off the Pacific coast of Tohoku Earthquake.

In addition, we examined the stacking algorithm [Sakai (1998), Tamaribuchi et al. (2011)] and the scanning method [Nakagawa and Hirata (2000)] for swarms. We also applied the envelope correlation method [Obara (2002)] for detect low-frequency earthquake swarms.

References:

Nakagawa and Hirata, 2000, Abstr. of SSJ 2000 Fall Meeting, 144.
Obara, 2002, Science, 296, 1679-1681.
Sakai, 1998, Abstr. of SSJ 1998 Fall Meeting, 140.
Tamaribuchi et al., 2011, JpGU Meeting 2011, STT055-P03.
Tsukada and Ohtake, 2001, Zisin 2, 53, 273-280.
Yamada, 2011, Abstr. of ERI 2011 Workshop on EEW.

Keywords: automatic hypocenter determination, particle filter, pattern matching, scanning method, envelope correlation method

Japan Geoscience Union Meeting 2012
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STT59-04 Room:106 Time:May 21 14:30-14:45

Designing a martian broadband seismometer system under surface wind environment.

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The surface of Mars has been extensively investigated and huge amount of data have been acquired such as high resolution images. On the other hand interior of the Mars has been only weakly constrained by the mean density, the moment of inertia and gravity data. A major purpose of seismic observation on the planet is to detect the distribution of seismic velocities. Using the seismic velocity data, we provide the primary evidence for the process of differentiation whereby material within planets became compositionally segregated during their evolution. But the current available Mars interior models based on indirect and insufficient data, since we have no seismic information about Mars. Melos project is Japan Mars exploration project. It is now under consideration. It will launch about 2020s. This project includes seismic observation plan. The plan is to install broadband and high sensitivity seismometer. The purposes of this presentation are to reveal relationship of frequencies of the Mars planetary free oscillation to it’s core states, by considering several set of 1 dimension models of elastic velocity and density. In addition to the calculation, we designed a martian seismometer wind shelter with a small torque (a large torque makes large noisy data) by using wind tunnel tests and computation fluid dynamics simulations.

Keywords: Mars, broadband seismometer, internal structure, wind shelter, planetary free oscillations, CFD

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STT59-05 Room:106 Time:May 21 14:45-15:00

Design of a broadband accelerometer for the observation of slow earthquakes

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Slow earthquakes, which include LFEs, VLFs, Short-term or Long-term SSEs, have a scaling law (Ide et al, 2007) that the moments of them are proportional to their duration. Certain types of slow earthquakes with the characteristic duration of about 10 seconds and about 10^3 to 10^4 seconds can be predicted to exist by the scaling law, but have not been measured yet. It is difficult to observe those with the characteristic duration of 10 seconds because of microseisms caused by the oceanic waves. On the other hand, with a certain device, it becomes possible to observe those of 10^3 to 10^4 [s] duration. We have considered building equipment intended to be used for observing them. The calculated spectrum of the acceleration or strain of the ground caused by them is compared with that of the noise of equipment and the natural ground motion and we estimate feasibility of detection. Moreover, it is difficult with conventional equipment and methods, so we suggest the new methods of observations matching with the characteristics of slow earthquakes. Then we propose a design of a broadband accelerometer optimized to the methods.

Keywords: accelerometer, slow earthquake

Japan Geoscience Union Meeting 2012
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STT59-P01 Room:Convention Hall Time:May 21 15:30-17:00

An experiment of seismic waveform recording by using ready-made IC recorders

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In order to conduct a high-density seismic observation for analyses of focal mechanisms and coda waves, we present a very-low-price recording system for high-frequency seismic waveforms. The system consists of a geophone with a vertical component and a ready-made IC recorder. The purpose of this study is to show that the IC recorder is able to record seismic waveforms with a frequency lower than the voice band from 60 to 3400 Hz. We compare two IC recorders: Voice-Trek V-75 (OLYMPUS) and ICD-UX512 (SONY). The price of ICD-UX512 is about 10,000 yen. We use a geophone (CDJ-Z10) made in China with a natural frequency of 10 Hz and a sensitivity of 2.8 V/cm/s. The price of CDJ-Z10 is about 10,000 yen. As a result of recording tests, we find that the two IC recorders are able to record waveforms from local micro-earthquakes with a frequency of around 10 Hz.

Keywords: IC recorder, seismic observation, seismometer, datalogger

Japan Geoscience Union Meeting 2012
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STT59-P02 Room:Convention Hall Time:May 21 15:30-17:00

Compact and highly sensitive tiltmeter 2

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R&D status of a compact and highly sensitive tiltmeter and results of test observation taken with a prototype instrument located in a shallow borehole will be presented.

Keywords: tiltmeter, folded pendulum, optical transducer, ocean bottom, borehole

Japan Geoscience Union Meeting 2012
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STT59-P03 Room:Convention Hall Time:May 21 15:30-17:00

Beginning of automatic Wphase analysis and Improvements of automatic CMT analysis in JMA

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JMA operate auto-CMT analysis using STS-1 and STS-2 seismometers. However, when ”The 2011 off the Pacific coast of Tohoku Earthquake” was occur, auto-CMT analysis did not work, Because almost all domestic seismometers ware clipped.

For this problem, JMA has taken the following measures.
(1) Using velocity type strong-motion seismograph in auto-CMT analysis.
(2) Beginning of auto-Wphase∗ analysis.
∗Wphase is long period body wave.
In the poster, we will present their methods and results.

Additionally, when the centorid location is far from the epicenter (used as the initial value of the analysis), the result of auto-CMT analysis is not good. So we are developing grid search method to obtain the appropriate initial value.

Keywords: Wphase analysis, CMT analysis, mechanism analysis, moment magnitude, automatic processing

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STT59-P04 Room:Convention Hall Time:May 21 15:30-17:00

Crustal deformation data is available via WWW server in real-time

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We started to operate real-time crustal deformation data exchange system between institutions concerned. You can access strain, tilt, barometric pressure, groundwater, gravity, and seismogram data. This system can accept any kind of time-series data including above examples. Only IP connection with a free port is required to send data to our system. Please access to following address, and pass your comments to us for improvements. Any data which can join our system are welcome.

http://crust-db.sci.hokudai.ac.jp/db/login.php

You can access this from anywhere in the world with internet connection and web browsers. ID and password will be issued after your application via above web site. Data is basically open for researchers, and no permission is required for personal use, for example, watching and temporal preliminary analysis. If users try to make public presentation, analysis and/or publication, they should apply to get permission for data usage to institutions which have responsibility for station operation and data production.

Data format is win-packet (Urabe, 1992). JDXnet (Takano et al., 2005), which have been stably used for nationwide real-time seismic waveform data exchange, is also used for our system. Users who have direct connection to JDXnet can receive packet data in real-time using channel-table information. We also offer a unified crustal deformation database system (Yamaguchi et al., 2010) to users who have no direct connection to JDXnet. This database is collecting and storing all exchanging data in real-time, and provides following functions; drawing on any time and sensitivity windows, filtering of high-pass, low-pass and band-pass window (Saito, 1985), tidal and trend analysis using Baytap-G (Tamura et al., 1991), strain analysis, streaming strain analysis (Okubo, 2005), detrending and auto-zero, cumulative amplitude of long duration seismogram, fault mechanisms information archive based on Global-CMT and JMA catalogues.

Strain sensors have follow advantages; having linear response from several Hz to DC component, records represent physical value directly, do not require instrumental response correction operation, no mechanical saturation, and having ultra-high sensitivity. These positive facts suggest real-time operation is preferable than GPS or broadband seismographs which require lead time for pre-analysis and deconvolution.

Real-time Mw estimation is required for effective tsunami warning for Mw>8.5 mega earthquakes and tsunamigenic slow earthquakes. The 2011 Tohoku earthquake revealed current magnitude estimations, including earthquake early warning system, are not proper. Near-field strain seismograms, which contain transient static strain change and dynamic strain waveform, represent strain release due to faulting directly. We are challenging to apply our nationwide strain observation network data to real-time Mw estimation especially for Mw>8.5 mega-events for robust quantitative tsunami warning.

Keywords: Crustal defornation data, Strain meter, Tilt meter, Real-time data exchange, Data open for researchers

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STT59-P05 Room:Convention Hall Time:May 21 15:30-17:00

Broadband seismic observation on the Greenland ice sheet

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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. National Institute for Polar Research and Japan Agency for Marine-Earth Science and Technology are members of GLISN project. We have installed the ice sheet station, called ICE-S, in 2011 in collaboration with IRIS PASCAL project. The station equipped with CMG-3T broadband seismometer and Quanterra Q380 data logger. We will introduce a settlement of broadband seismometer on the ice and data transmission from the mid of Greenland ice sheet.

Keywords: icequake, broadband seismic observation, GLISN