Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

SSS30-P01 Room:Convention Hall Time:May 20 18:15-19:30

The increase in missing waveform images of the F-net broadband seismograph network preceding the 2011 Tohoku earthquake

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1. Introduction

The F-net is a broadband seismograph network constituted of 73 STS-1 and 2 seismometers. Natural frequency of the seismometers is 120 seconds (STS-2) and longer, thus they can detect long-period ground motion.

On its website, waveform images are provided. The analyses on them so far have shown the following. The Daily Spectral Plot, even on a quiet day, shows existence of vibration with frequency in 2-5 seconds. On days of large fluctuation, the amplitude increases, and the vibrations of 5 seconds and longer are added. The Daily Plot shows fluctuations with the period of several days to 2 weeks, and the Hourly Plot shows those for several hours to several days (Sue, 2010).

2. Analysis

Since seismometers detect ground vibrations, meanwhile their operations might be affected. Thus operational status is investigated. There are two sources on it.

a. Data acquisition trouble log: It is the formal information covering from instantaneous to long-lasting loss of data. Reasons for troubles are shown. While, update of the information is irregular.

b. Missing of waveform images: The website displays the message: "Waveform image is not found". It is surmised that this situation is caused by continuous troubles exceeding 1 day or 1 hour. The reasons are not shown. Update of the information is daily with 2 days delay.

The two sources do not coincide, while overlap partially. At the captioned earthquake, both showed increase before the main shock. Thus analysis on the latter, by counting number of stations with missing images from June 1, 2010 to May 15, 2011, is carried out.

3. Results

As shown in Fig. 1, for 6 months from June 15, 2010 to December 14, 2010, the average number of the stations with missing images = 0.33 with the standard deviation (Sigma) = 1.11 (Notes: For total loss, 10 (1/7 of total) is used for the calculation). It was stable with the daily missing number of less than 1.

There was the first increase from December 22, 2010 to January 18, 2011, and reached the number of 4. Then there was the 2nd increase from February 16, 2011 to March 2, 2011. Especially from February 19 to March 2, it again became 4 stations (Sapporo (Code:HSS), Yamagata (IYG, Iwate pref.), Kesennuma (KSN) and Shiramine (SRN)) as shown in Fig. 2. At the main shock, the number was 2, which was still more than usual. It returned to 0 on May 2. Missing of 4 was 3.3 Sigma, meaning that the state was far from stable. Yamagata and Kesennuma stations are located close to the epicenter, and the distance between them is short. The period of 2nd increase overlapped seismically active period of February 13 to March 2 when M5 earthquakes occurred continuously in the epicentral region.

The data acquisition trouble log shows that "electric power supply trouble" and "data logger restart recording" are the causes of troubles for long and short respectively.

For the Sapporo station, reason of the trouble was "observatory set up", thus the cause might be other than ground motion. In such a case, the missing = 3, meaning 2.4 Sigma. Still it was in a rare state.

4. Discussions

It is assumed that increases of the missing waveform images preceding the big earthquake was because that the F-net could not withstand possible long-period intense vibrations of the earth's surface. For the seismometers, they could be big motions like landslides.

"Electric power supply trouble" might be a good index showing excessive vibration. And rapid increase of "Data logger restart recording" might show the system becoming unstable.

Such phenomena are not observed for the Hi-net seismograph network, probably because of its characteristic (Natural frequency = 1 second).

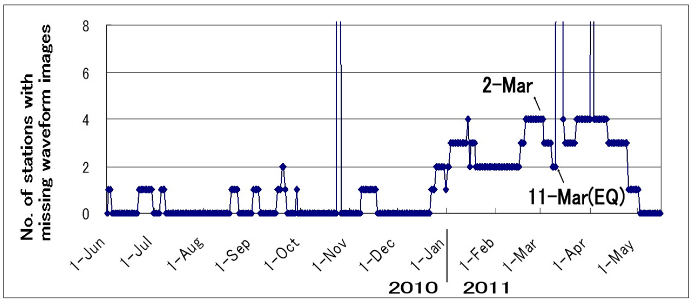
The author realizes that further studies to increase number of evidences are necessary.

Acknowledgement

The author thanks NIED for using the data of the F-net.

References
Yoshiki Sue, 2010, Long-period vibration recorded by waveform images of the F-net Broadband Seismograph Network, Part 1, SSJ Fall meeting, D31-12. (In Japanese)

Keywords: F-net, broadband, seismograph network, long period, waveform



HOKKAIDO region			
HID	HSS	IMG	KMU
KNP	KSR	NKG	NMR
NOP	SHR	URH	
TOHOKU region			
GJM	HRO	IYG	KSK
KSN	MMA	TMR	TYS
KANTO region			
AOG	ASI	HJO	KZS
ONS	OSW	TSK	YMZ
CYUBU region			
ADM	FUJ	JIZ	KNM
KNY	KZK	NAA	SBT
SGN	SRN	TTO	WJM
KINKI region			
ABU	KIS	KMT	NOK
TGA	WTR	YAS	YZK
CYUGOKU region			
NRW	NSK	SAG	YSI
YTY			
SHIKOKU region			
ISI	OKW	TGW	TSA
UMJ			
KYUSYU region			
AMM	FUK	IGK	INN
IZH	KGM	KYK	SBR
SIB	STM	TAS	TKD
TKO	TMC	YNG	ZMM

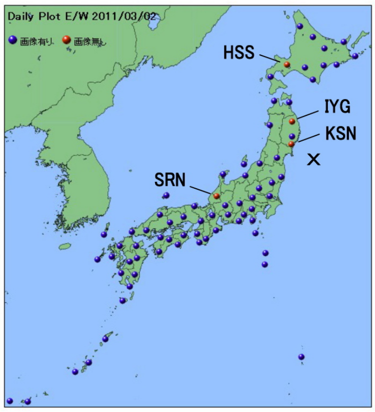


Fig. 1. No. of stations with missing waveform images from June 1, 2010 to May 15, 2011.

Fig. 2. Arrangement of stations with missing waveform images on March 2, 2011 (Source: NIED).

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Earthquake prediction from peak gust(8)-Earthquake prediction from cause of earthquake-

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1. Cause of earthquake

It is necessary to verify the hypothesis. It exactly had the doubt in the mantle convection theory that had not been verified yet based on this idea and it searched for the cause of earthquake.

And, it has been understood for the strong wind of a large kinetic energy when the time that becomes an extratropical cyclone from the typhoon and the low-pressure develop, downdraft to collide from a lot of current large earthquakes (After 2000, it is a large earthquake because weather information is necessary) with the earth's crust, and to cause the large earthquake after a while in the collision point.

As for the time lag from the collision to the earthquake generation, it is an artificial earthquake (earthquake that man caused).

(1)The earthquake occurs after storing water begins in a big dam.

(2)The earthquake occurred when a radioactive wastewater was thrown away to underground deep. When abandonment was stopped, it gradually installed.

It is proven. In addition, it was proven dynamically from the wind direction agreement with the axis of the mechanism solution. Moreover, it is thought it is unquestionable by being presumed that the energy of the wind is larger than the energy of the earthquake.

The strong wind of this downdraft can be seen as a dry slot (cloudless area) in the satellite image. It has been understood that the point (Or, it is fundamental) is an epicenter. It is presumed M6.5 or less when there is no dry slot remarkable as for M6.5 or more when there is a remarkable dry slot.

The occurrence time is after for seven months one week later. It is on average after for three months.

The above is announced in the seismology association in October, 2010.

And, it is proven to be able to do the earthquake prediction due to the Tohoku region Pacific Ocean coast earthquake by the above-mentioned method, and announces with JPGU in May, 2011.

http://www2.jpgu.org/meeting/2011/yokou/MIS036-P85.pdf

The satellite image chart of 15 o'clock December 3, 2010 and the hypocenter fault chart (From Kyoto University HP) were shown. The tip of the dry slot is corresponding to the source region from those figures, and it is shown that the force of the wind is exactly a cause of earthquake. It is shown to be able to foresee the earthquake occurrence place, the size, and the mechanism solution.

The occurrence of the massive earthquake in Philippine Sea Plate where Nankai Trough is composed is limited in February in August and, in addition, seasonality of abounding is reported in December. This is proof of a lot of coming of a huge typhoon in September, and occurrences of the earthquake in about three months. It is not possible to explain by the mantle convection theory.

The hypothesis with "Energy was liberated when the energy of the swerve accumulated in the plate by the mantle convection exceeded a certain limit and the earthquake occurred" was proven to be a mistake.

2. Recent prediction example

(1)February 18, 2011 low-pressure
M6.4 in east part of Shizuoka Prefecture on March 15, 2011

(2)September 22, 2011 Typhoon No.15 (satellite image at five o'clock)
M6.9 of Sanriku Coast on March 14, 2012.

(3)June 07, 2012 Typhoon No.03 (satellite image at three o'clock)
M7.4 of Sanriku Coast on December 07, 2012

Keywords: peak gust, earthquake prediction, dry slot, satellite image, cause of earthquake

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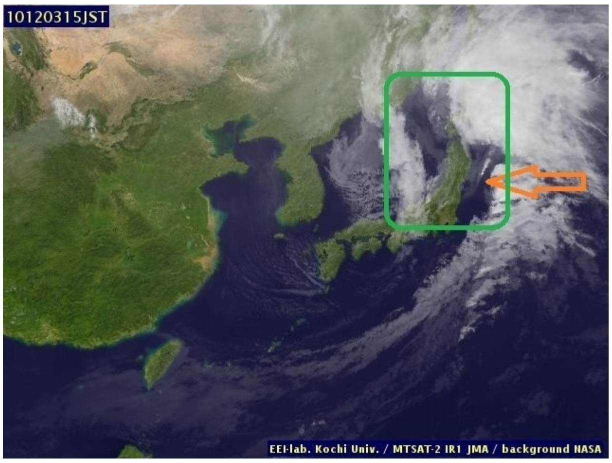

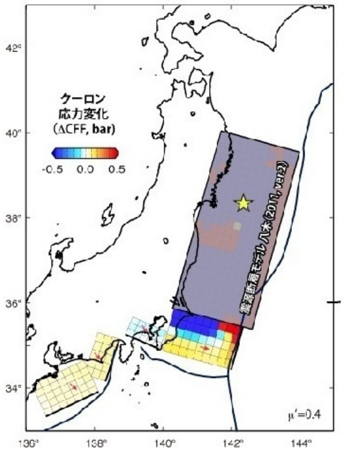

Japan Geoscience Union Meeting 2013
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A basic theory for earthquake prediction

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Earthquakes are generated by the anisotropic principal stress regime in the rock medium. In the preparing process of a large earthquake, the medium would be deformed generating regions of contraction and dilatation around the nucleus of the shearing stresses. A theory for earthquake prediction should be based on an elastic medium model with contraction and dilatation adjacently occuring within and around the seismogenic domain of the medium. The evolution of the medium changes should be monitored in a long time interval: long-, intermediate-, and short-term. The short-term and intermediate-term precursors will be detected when the shearing stress grows as high as the strength of the medium, of which condition we call it a critical state in the preparing process of a large earthquake.

Contraction of the medium should cause high pressures, and dilatation result in low pressures. Such changes in stresses may induce various precursors for an inpending large earthquake. The primary precursors are changes of the strain field and micro-seismic activity changes, which are directly related to the elastic changes of the medium. Secondarily, migration of fluid within the crust in response to changes of stress level would bring about various precursors. The fluids would transport heat energy, electric charges, and radioactive materials and so on, and, through a preexisting crack network, would incidentally emerge at the ground surface and bring about a variety of precursory phenomena on the ground surface and in the air.

Keywords: earthquake prediction, shearing strain, dailatation, contraction, precursor

Japan Geoscience Union Meeting 2013
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Radio wave emission due to rock fracture in various modes and its application to earthquake/volcanic activity detection

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1. Introduction

Formerly, the microwave emission due to rock fracture was found at the frequency of 300 MHz to 22 GHz [1]. Later, we studied the radio wave emission phenomenon experimentally changing the destruction condition: destruction speed, moisture, and the existence of a thermally shrinkable tube.

This paper describes the measurement system and experimental results. Then, we discuss the availability of the obtained results to the detection of earthquakes and volcanic activities.

2. Measuring system

The measuring system handles 1 MHz-, 300 MHz-, 2GHz-, and 18 GHz-bands. For each frequency band, an antenna, a low noise amplifier and a filter are installed.

We calibrated the measuring system beforehand so that we can estimate the received power from the received waveform height. The 1 MHz receiving system was calibrated as a whole by receiving a broadcasting signal [2]. The phenomenon of a target is instantaneous so that a special recorder and a triggering system to activate a main memory are inevitable.

3. Measured results

In the reference status, a rock is destroyed abruptly in a short time less than 1 sec. The trigger signal was obtained from the highest frequency of 18 GHz with the discrimination level slightly higher than the noise level.

By virtue of this contrivance, the 18 GHz signal was successfully recorded as well as the other frequencies. In the total observation time of 20 msec, signal pulses exist. After expansion, we can see that the radio wave component is included inside the envelope of a pulse shape. There is hardy difference among gabbro, granite, and basalt.

In slow destruction, a rock is destroyed slowly in a long time of several minutes. The obtained waveforms are shown in Fig. 1. In the coarse time scale, we can see a fewer pulses than the reference status. However, more pulses were probably distributed after the recorded time. The pulse height is almost the same as the reference status. The expanded waveform is similar to the case of the reference status.

For dstruction with moisture existence, we immersed a rock in water, and then wiped off droplets to use it as an experiment material. There existed hardly a difference from the reference status, but the pulse number is rather increased.

When a rock was destroyed with a thermally shrinkable tube, the signal was received, but weaker than the reference status.

4. Applicability to the detection of earthquakes and volcanic activities

In an earthquake, rock is destroyed around a plate boundary, a fault area, or an asperity. The power of emitted radio wave in a slow destruction was close to the reference status. Therefore, instantaneous power level in an earthquake may be close to the reference status though the average power level is decreased due to a longer destruction time. Accordingly, a sensor to detect radio wave should have an integration capability matched to signal emission circumstance.

A rock is esteemed to coexist with underground water. However, we can obtain the same signal power if the radio wave is generated in the inside of a rock, as indicated experimentally. It was revealed that a radio wave could propagate underground in a gap of several wavelengths [3]. Therefore, a shorter wavelength or a higher frequency is preferred for this application.

5. References

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[3] K. Saegusa, et al., A fundamental study on microwave propagation loss through a ground crack (in Japanese), Trans. of Institute of Electronics, Information and Communication Engineers, Vol.J95-B, No.10, pp. 1364-1371, 2012.

Keywords: Radio wave emission, rock fracture, various modes, earthquake, volcanic activity, detection application

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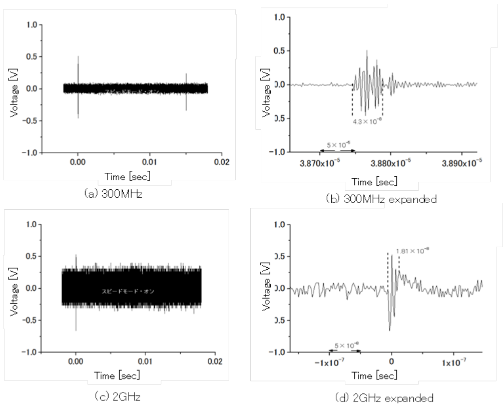

Fig. 1 Measured results in slow destruction of basalt. The trigger signal is from 2GHz channel with a discrimination level of 500 mV. The sampling frequency is 500 MS/s.

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Seismicity models of forecasting future M7-class earthquake epicenters in the southern Kanto region, central Japan

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The Earthquake Research Committee, Government of Japan, reported that there is a 70% chance of an earthquake with a magnitude of around 7.0 (M7) in southern Kanto in the next 30 years, as estimated based on the past five earthquakes in the region. Probable hypocenters of M7 earthquakes are crucial factors for refining seismic hazard maps for the region.

We take an empirical approach to the problem by deriving probability models of M7 epicenters based on reliable evidence. In the present study, we attempt to employ focal mechanism solutions. First, we calculate the Kagan angle between an observed mechanism and an expected one, which can be estimated by assuming configurations of plate interfaces and relative motions between them. Inter-plate events with Kagan angles below a certain threshold are assigned. We estimate the ratio of the number of inter-plate events to the total number for every 0.1 by 0.1 grid space. After applying smoothing with Akaike's Bayesian information criterion, we obtain statistically significant ratios at every grid. We incorporate this ratio into a model to produce the following different catalogues. 1. Original catalogue of earthquakes exceeding M5.0. 2. Pacific plate earthquakes (Inter-plate and within Pacific plate). 3. Philippine and North American plates. 4. Inter-plate between Philippine and North American plates. 5. Intra-plate (Philippine or North American). We then apply smoothing kernels of different wavelengths to these catalogues and obtain dozens of models.

The likelihood of each model is tested with sixteen past M7 earthquakes. The best model performs 1.3 times better in average probability gain than does the model used in the current national seismic hazard maps for Japan.

Keywords: M7-class earthquakes, Southern Kanto, Earthquake forecasting model, Seismic hazard