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

SSS30-01 Room:106 Time:May 20 16:15-16:30

Seismic cloud of past and present

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Seismic Cloud of Past and Present

[Introduction] Recent observation from the space shows that the prediction from the cloud has been expected to have the success rate of 100%. About one week before S Hyogo Pref. Eq. (1995/01/17 M:7.2), the column of cloud like a small tornado, shown by the attached photo, was observed, and the cloud make us possible to predict the earthquake, because the cloud does not drift but remains at the same point, though the other clouds are drifting with wind. But even though the success rate is high, the alarm rate is low, because the seismic cloud is generated only when the atmosphere is saturated by water vapor, and even if the cloud is generated, it is observed only when it is neither raining nor cloudy.

[Mechanism of generating seismic cloud] Water drops in cumulonimbus change into ice crystals in the area of -10 degs. The melting temperature of the solid is lower on the surface than the inside, and at -10 deg. the crystals are covered with water film. The inside of crystals there are free electrons and positive holes, and the electrons can move to the surface water, but the holes can't, so the water is negatively charged, and the solid part of crystals is positively charged. In the clouds crystals collide with each other. Where lower than -10 deg., the collision approximates to elastic one, and the change of speed of smaller crystals is more significant than that of bigger ones. Then the negative surface water on the smaller crystals moves to the bigger ones, and smaller ones become smaller and positive. On the other hand, the bigger crystals become negative, bigger, and drop down on the ground.

The positive smaller crystals are blown up by an ascending air current. At the cloud top of about 10 km high, the voltage becomes up to about 30 MV. As the conductivity between the cloud top and the ionosphere is not small, and as the potential at the cloud top is much higher than at the ionosphere, so electrons and negative ions flow from the ionosphere into the cloud top, and the ionosphere gets a few MV. This negative current generated by cumulonimbus is compensated by the current between the ionosphere and the ground, which is about 1.8 kA.

The current between the ionosphere and the ground flows, like lightning, along the trace of cosmic ray showers, which is usually invisible, as the registance in the lower atmosphere is high.

When the seismic cloud was observed before the Eq., the density of Radon (Rn) increased in the spring water and low atmosphere on the source region. This increase makes the conductivity higher locally and tentatively there, and the current increases between the ionosphere and ground. The current density becomes high enough by Pinch Effect to generate the tornado-like cloud, which is similar to the cloud in Wilson cloud chamber. This current is pulsating current, as the cosmic shower changes rapidly in time and space, so the current radiates wide band radio-waves, which are observed as precursory seismic electric fields.

Rn and Radium (Ra) are generated by decay of Uranium (U), and U exists not in the crystal but in the boundary. If micro-cracks run in the source, U, Rn and Ra dissolve into pore water, which mixes in spring water. So, the micro-cracks are essential for the short-term prediction.

[End Remark] Like the seismic cloud, some macroscopic anomalies may become new tools for highly reliable prediction. The observing electric fields, for example, may become to predict the place and magnitude when the source regions are located, much more precisely and reliably than the observing crustal movement which are currently adopted now.

[Reference] Japan Geoscience Union Meeting 2010 S-SS012-08 Mechanism of Generating the Earthquake Cloud just before Shallow Great Earthquakes, Kozo Takahashi

Keywords: seismic cloud, earthquake prediction, short-term prediction, precursory electric fields, locating source regions

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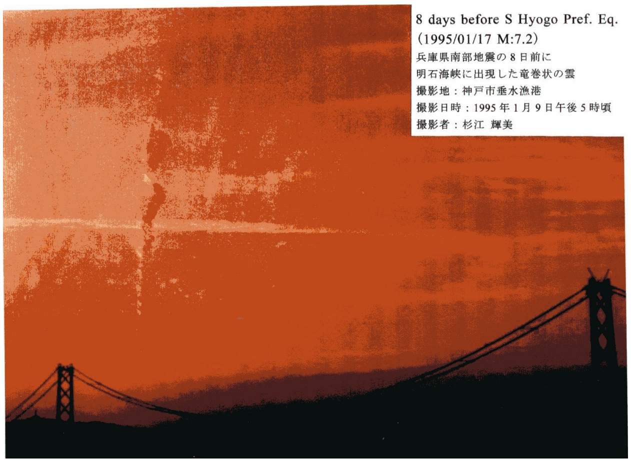

SSS30-02 Room:106 Time:May 20 16:30-16:45

Numerical simulation to test and evaluate the forecast probabilities by BPT distribution model

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Numerical simulation was conducted to test and evaluate the performance of Brownian Passage Time (BPT) distribution model on the renewal process which is used by the Earthquake Research Committee of Japan (2001) to compute the probabilities for the forthcoming event in repeating earthquake sequence.

1000 sets consist of N random numbers corresponding to the interevent time following BPT distribution with parameters, the mean of 100 and coefficient of variation of 0.24 were compiled and 1000 random numbers larger than the elapsed time, Tp, since the last event to the forecast were collected from the same BPT population.

The probabilities for relevant event in the forecast period were computed by the BPT distribution model in which the two parameters are determined by the maximum likelihood method from each sequential N data, and they are compared with the hypothetical time interval between the last event and forthcoming one. Log-normal distribution model based on the small sample theory, LN-SST is also used to calculate the probabilities which are compared with those by the BPT distribution model.

In the case of N=4, Tp=75, and forecast period of 25, the probabilities distribute widely and ones larger than 0.99 appeared abnormally many times. Scores on the mean log-likelihood, MLL and Brier, BS are shown in following table which shows that LN-SST is superior to the BPT distribution model for small sample data.

N	Tp	period	PP	MLL	BS
4	50	25	0.135	-0.585(-0.443)	0.135(0.131)
4	75	25	0.475	-0.969(-0.789)	0.302(0.282)
4	100	40	0.862	-0.867(-0.530)	0.156(0.171)
7	50	25	0.135	-0.476(-0.434)	0.130(0.128)
7	75	25	0.475	-0.755(-0.734)	0.272(0.266)
7	100	40	0.862	-0.611(-0.498)	0.151(0.155)

The N: number of interval data, Tp: elapsed time from the last event to forecast, period: forecast length, and PP: probability calculated from BPT population.

MLL and BS are calculated by the BPT distribution model and those by LN-SST are listed in the parentheses.

Keywords: repeating earthquake, earthquake forecast, BPT distribution, numerical simulation, Bayesian approach, log-normal distribution

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SSS30-03 Room:106 Time:May 20 16:45-17:00

Spatiotemporal stability of seismic quiescence 2

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In the last meeting of the seismological society of Japan we have reported spatiotemporal stability of the seismic quiescence before the 2011 Tohoku Earthquake. As a result, it became clear that the seismic quiescence had continued to appear stably in the northern part of the source region which became clear around 2001. And also that in some cases the appearance of quiescence area is not directly connected to a large earthquake. This phenomenon is likely to be artificial ones caused by way of parameter setting. We report the results to verify if the behavior of the apparent quiescence is captured by the method of parameter setting.

The method for analysis is the eMAP (Aketagawa and Ito, 2008; Hayashimoto and Aketagawa, 2010), a detection tool of activation and quiescence of seismicity, as it has been used before. It is possible to adjust various kinds of parameters to earthquake detection capability and characteristics of the seismic activity in every area for grasp of spatial pattern of seismicity with this tool.

Seismic quiescence is thought to be caused by a reduction in stress due to localized slip at the contact surface between the fault plane with relatively weak strength. That seismic activity did activated in the southern half, while the quiescence was observed only in the northern half of the focal region in Tohoku Earthquake, seems to reflect that the stress decreased in the northern half, while it increased in the southern half. Although there are cases where apparent quiescence occurs from temporary fluctuation of seismic activity, a most probable seismic quiescence area can be extracted by proper selection of parameters. A possible method for judgment of true seismic quiescence is a so-called doughnut pattern (Mogi, 1969). This phenomenon is thought to be universal to reflect the physical property of the focal region, because the activation area of the seismic activity appears in the asperity where strength is comparatively high in the surrounding of seismic quiescence area.

Keywords: Seismic activity, Quiescence

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SSS30-04 Room:106 Time:May 20 17:00-17:15

Dynamic model of hypocenter vibration based on time reversal and prevision of earthquake

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Previously, a hypocenter vibration was analyzed by using time-reversal process for the seismic waves in Suruga Bay. A dynamic model of the hypocenter vibration has proposed from these results. This dynamic model is consistently approved to premonitory symptoms of an earthquake, the main shock, and the aftershock. This model is verified about four earthquakes of M5 or more caused in the vicinity of Mt. Fuji between 2009 and 2012 and the effectiveness is confirmed. The pulse formed at the hypocenter position, that is, time reversal pulse (TRP) was obtained by processing the time reversal to P wave signals received at the observation station in 44 places that enclosed the hypocenter for the earthquake that had occurred in the central part of Suruga Bay in August, 2009. The TRP corresponds to the equivalent sound source that the hypocenter radiates. The clear azimuthal dependency was confirmed to the obtained TRP. To clarify the origin of this azimuthal dependence, the frequency spectrum of the TRP to the azimuth was obtained. The frequency spectrum has changed greatly according to azimuthal. Then, the distribution of the maximum amplitude frequency to azimuthal was obtained. As a result, the maximum amplitude frequency rises greatly as the azimuth changes from west to east and it has descended. The rise of the frequency is due to the movement of the sound source. The moving direction concentrated on the Nishiizunishi station. The head part only of the received signal in the Nishiizunishi St. has expanded though the received signals in Ito and Kawazu St. near the Nishiizunishi St. ware usual waveforms.

The point where the beam of narrow angle radiated from the active fault reaches surface of the earth is called a parametric spot, and the head of the pulse to which the head observed here increases is called a parametric head.

The precursor earthquake of M2 or more had occurred 17 times before earthquake of Suruga Bay (2009/8/11). The waveform to accompany the parametric head in that was observed seven times. These parametric heads suggest that the crack begin to move in the active fault by the high-speed. Therefore, it is thought that it is effective to observe the seismic wave of about M2 in a peculiar parametric spot to each active fault, and to examine the change as the prevision of earthquake.

Keywords: Prevision of earthquake, Time reversal, Hypocenter vibration, Seismic wave propagation

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Scenario for imminent prediction of strong subduction-zone earthquake via ocean-floor geomagnetic observation network

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Ionospheric electron enhancement around the focal region has been observed from about 40 min. before the 2011 Tohoku-Oki earthquake (Heki 2011). On the other hand, ground-level geomagnetic variations prior to the earthquake were as not clear (Minato 2011, Utada et al. 2011). A possible mechanism to explain those electromagnetic anomalies was proposed in terms of coupled interaction of earthquake nucleation with deep Earth gases, where the interaction causes a negatively electrified gas flow due to an exo-electron attachment reaction, as the gases pass through fractured asperities (Enomoto 2012). The pressure-impressed current I in the model is expressed as

$\log I = 0.5M + \log (5.1x10^2 kenh^2 D_c/v_i)$ (1),

where e is the electronic charge, n is the density of negatively charged gas molecules, k is a constant of proportionality, M is the earthquake magnitude, h is crack-open gap, v_i is the gas viscosity, D_c is the focal depth. The factor ken could be determined from the laboratory experiments

For earthquake prediction, it is desired to detect clear and identifiable pre-seismic signal. There maybe a possible way to satisfy the condition for subduction-zone earthquake; that is, Fig. 1 showed pre-seismic geomagnetic variation caused by the current estimated from eq.(1) as a function of distance from the epicenter to the geomagnetic observation site with various dip values: the results suggest that clearly identifiable signals attributed to the imminent occurrence of an offshore strong earthquake with a low angle thrust focal mechanism might be observable if geomagnetic measurements are made continuously near the ocean floor epicenter, say within a distance of 20?30 km. Using the observed precursor geomagnetic signals, detected at least three different points on the scenario ocean-floor of subduction-zone earthquake, one could estimate the focal zone (the position of current source), the amount of current, and thus the magnitude. Since both the pre-seismic geomagnetic variation and ionospheric electron enhancement are induced by the same source mechanism, the precursor period might be around several tens minutes as caused by the 2011 Tohoku-Oki earthquake. The net-work observation of geomagnetic fields using submarine cables on the seafloor of scenario subduction-zone earthquake; e.g. the Nankai Trough earthquake, may, therefore, make it possible to predict earthquake occurrence.

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Keywords: Subduction-zone earthquake, Earthquake prediction, Seismo-electromagnetics, Seafloor geomagnetic observation, Exo-electron emission, Fractoemission

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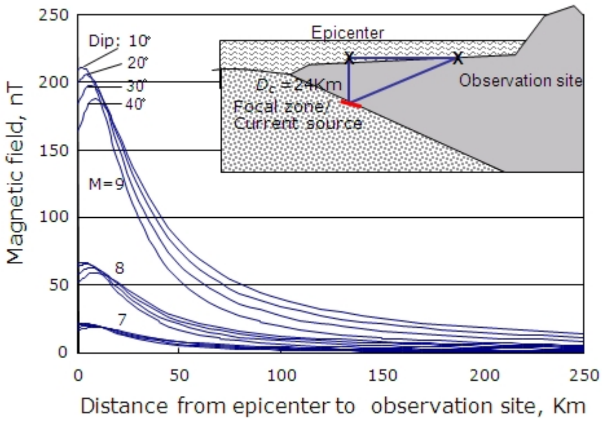

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SSS30-06 Room:106 Time:May 20 17:30-17:45

On the sea level changes that were witnessed before the 1946 Nankai earthquake on the Pacific coast of Shikoku(2)

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Just before the 1946 Nankai earthquake, there are the witness testimonies which the sea level have decreased by 2m~3m at Susaki and Usa bay on the Pacific coast of Shikoku, Japan. To confirm the large amplitude of sea level change before the main shock, the sea level observations were carried out at 7 stations around the Susaki bay from November 2010 to March 2012. The tsunami caused by the 2011 off the Pacific coast of Tohoku earthquake was observed. The tsunami amplitude in Susaki bay has a larger 8 and 20 times than that observed about at 100m (Terada et.el., 2010) and 2300m(JAMSTEC) depth. The spectrum peaks of tsunami are about 85, 50 and 37 minutes. Almost same spectral peaks were observed at the storm and the stable weather. This fact suggests that the same spectra at Susaki are generated by the small vertical movements which occur repeatedly at different sea bottom.

Keywords: Nankai earthquake, sea level change, witness testimony, tsunami