

Establishment of NPO Japan Earthquake Precursor Comprehensive Observation Center and Experiment of earthquake prediction

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NPO JEPCOC has been established on January 7 2015.

NPO JEPCOC is operated by hardware engineers who develop observation system, software engineers who develop data collection and display system and ordinary people who observe various phenomena.

Multi-method at multi-point observation is performed; first of all, we inspect correlation between actual occurred earthquake and observed anomaly.

We start from Tree Bio-electric Potential (TBP) observation and dual frequency observation at multi-frequency band and we try prediction of earthquake occurrence in the near future.

We plan to cooperate with other groups which are observing tidal level deviation, air ionization, and so on.

Frequency band of EM observation is VLF (3~30kHz, under development), LF (30~300kHz), MF (300~3MHz),

VHF (30MHz~300MHz) and UHF (300MHz~3GHz, under development)

TBP and dual frequency EM are being observed at 9 posts in Japan at this moment.

Plants are found to have instinct to catch precursor from huge earthquake as well as animals. It is known that animal's anomalous action before huge earthquake i.e. alignment to one direction of earthworm before Taiwan Chi-Chi EQ and rapid escape action of elephants at Sumatra EQ.

In the other hand, plants shows anomalous action sometimes, for example, Mimosa Pudica reacts when it is touched by hand, vent down before typhoon and anomalous action before EQ. Those anomalous actions were reported to plant physiologist Toriyama since middle of 1970 age.

Toriyama started to observe Tree Bio-electric Potential (TBP) since 1977 as tree is much easier than grass to measure TBP. The way of measuring TBP is put an electrode on the surface of tree and another electrode into ground, then measure electric potential between two electrodes.

28 EQs with magnitude of about 7.0 occurred between 1977 and 1989 around Japan, obvious anomaly was observed at 17 EQ of those. 5 patterns of anomalous potential were found in this period and more one pattern was found after then.

These anomalous actions may be caused by receiving electric magnetic (EM) signal through ground via root or ion through atmosphere at leaves or some other cause. As mechanism is not solved yet, possibility to predict the 3 elements of earthquake occurrence i.e. when, where and magnitude is very low, however, we can say that possibility to know occurrence of huge earthquake soon is very high.

In order to predict EQ occurrence with high probability, it is important to combine data obtained from several methods. We are trying to observe EM signal at several frequency band with adjacent dual frequency from VLF to UHF, Aero ion concentration, Animals anomalous action and Tidal level deviation as well.

Frequency band of EM signal from EQ focus is known to be emitted from DC to SHF. We wait at various frequencies at VLF, LF, MF, VHF and UHF at adjacent dual frequency, if a signal received at only one frequency, it may not be seismic, it may be some signal which has some meaning, if two signals received at both frequencies simultaneously, and it may be seismic signal.

As it is known radon and ion is emitted before big EQ, air ionization concentration is being observed at 17 observation posts in Japan.

Daily action of fishes and snakes are observed numbers to across optical sensor, mouse action is observed by rotation motion, cat action is observed number of steps by walking counter on neck.

Tidal level deviation is measured at 187 points along cost line by Japan Meteorological Agency (JMA) and other public organization. It is able to know deviation in sigma by software processing.

It may be possible to judge huge EQ will occur soon, when anomalies are observed by some of those methods simultaneously. We will report anomaly data prior to great EQ observed by above mentioned 5 methods.

Keywords: prediction, bio potential, EM, tidal, ion, radon

MT survey and its preliminar result at Boso Peninsula, Japan

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A magnetotelluric (MT) survey is one of the methods to understand the underground electric properties. In Boso area, Japan, there are three main topic to perform the MT survey; (1) to estimate underground resistivity structures related to the plate boundaries, seamount, asperities, and slow slip events, (2) to obtain a regional realistic resistivity structure for the numerical simulation in generation and propagation mechanisms of electromagnetic precursors, and (3) to develop a new MT technique to reduce the cultivated noises such as DC driven trains. In these aims, we decided to carry out the MT survey in Boso area, Japan during 2014-2016. Due to sensing down to 100 km depth, we use induction and fluxgate magnetometers. The first MT survey in 2014-2015 had 21 and 6 stations for induction and fluxgate type magnetometer, respectively. We checked the observed data and analyzed the local midnight time (02:00-04:00(JST)) data because of noises and performed 1D inversion.

The preliminarily results show that we can presume the resistivity structure about 80 m-2 km depth from the surface. A typical resistance down to 200 m depth was 1-10 ohm-m and below 200 m depth, a specific resistance was estimated at 0.1-1 ohm-m at many stations. This suggests that there is a geological boundary around 200 m depth. In comparison with the geologic structure interpreted by the reflection seismology data, the upper part seems to be the Shimousa Group, and the lower, the Kazusa Group (Earthquake Research Committee, 2005).

To presume resistivity structure at the deeper depth, it is necessary to remove the artificial noises from observed MT data. These observed noises have characteristics of transient signals and processes in time domain are required such as singular spectrum analysis and neural network analysis. Further preprocessing will be essential.

Keywords: MT method, Boso Peninsula

investigations of geomagnetic diurnal variations associated with the 2011 off the Pacific coast of Tohoku earthquake

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As one of the most promising candidates for short-time earthquake forecasting, the seismo-electromagnetic phenomena have been intensively studied for several decades. Recently, Xu et al. (2013) have reported unusual behaviors of geomagnetic diurnal variations in the vertical component prior to the 2011 off the Pacific coast of Tohoku earthquake (Mw9.0). In this study, we carry out further studies by investigating the spatial distribution of the anomalous geomagnetic diurnal variations associated with the Tohoku earthquake.

Ratios of Z component diurnal variations between the target station and the remote reference station Kakioka have been computed. After removing seasonal variations revealed by wavelet transform analysis, the 15days running mean of the ratio shows a clear anomaly exceeding the statistical threshold about 2 month before the mega event in Esashi and Mizsawa stations, which are close to the Mw9.0 earthquake epicenter. These results indicate that the location of the anomalies is consistent with the epicenter. Moreover, other independent geophysical parameter such as seismicity and crustal deformation also show clear unusual changes simultaneously, which suggests these anomalies might be related with the mega event.

Visualization of Groundwater Motion Using Self-Potential Tomography for Indoor Rainfall-Induced Landslide Experiment

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As it increases in the frequency of the local heavy rain in recent years, the occurrence number of the landslide also increases. It's an important problem to elucidate the process of the landslide caused by rainfall and monitor the slope and forecast the occurrence time to reduce damages. To achieve this, we need to monitor groundwater movement. In this study, we try to develop the early warning system with SP method to predict/monitor rainfall-induced landslide.

The relationship between the SP fluctuation, the movement of water, and the displacement of soil is confirmed by the former interior flume experiments. We adopt the PRESS-aided Philips-Tikhonov regularization to develop the SP tomography and sand-box experiments to apply the tomography successfully show the water levels and flows. To expand the SP tomography approach to the flume tests, we perform the numerical simulation to visualize the underground water condition. The size of the slope is depth 9.0 m, height 4.8 m and width 1.0 m. And the height of the soil stratum is 0.7 m. We assume a rectangular reconstruction area and we divide the area into a 0.2 m x 0.1 m pixel, and compute the value of electric charge every pixel. In addition we assume the electric charge outside of the slope area is 0 and the permittivity in the analyzed area is uniform. Checkerboard-like positive and negative electric charges are generated and the number of electrodes was changed with 16-85. An error of 10% of the observation value has been added to data observed at electrodes.

We found the following results; (1) it's possible to reconstruct the structure of charge distribution with scale of 1.2 times greater than the inter-electrode distance. (2) the objective selectivity of the optimal reconstructed image with minimum PRESS criterion fails in the case of sparse electrodes.

Keywords: Self-Potential Tomography, PRESS-aided Philips-Tikhonov regularization, visualize underground water condition

Multiple geophysical observations for earthquake monitoring in Kanto, Japan

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In order to understand the preparation process of large earthquakes and clarify the mechanisms of Lithosphere-Atmosphere-Ionosphere (LAI) coupling, an observation network are established in Kanto, Japan. Multiple geophysical parameters such as geomagnetic field, geoelectric field, radon concentration, ion concentration, and atmospheric electric field are monitored. The meteorological data at each station are also recorded. These data may provide some new knowledge of earthquake process. We will demonstrate the observation system and some recent data in our poster.

Keywords: multiple geophysical observations, earthquake monitoring, preparation process of large earthquakes, mechanisms of Lithosphere-Atmosphere-Ionosphere coupling