Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS27-01 Room:201A Time:May 26 15:15-15:30

Correlation between strandings of marine mammals at the Kashima-Nada beach and earthquakes

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A mass stranding of Melon-headed whales (Peponocephala electra) occurred at the Kashima-Nada beach, Japan, seven days before the 2011 M9.0 Off the Pacific coast of the Tohoku Earthquake (Tohoku EQ). Kashima-Nada beach is located 300 km southwest of the epicenter. Some people said that the mass stranding might be a precursor of the Tohoku EQ. In this study, we performed statistical analyses to determine the level of correlation between strandings at the Kashima-Nada beach and EQs. We concluded that the mass stranding was not correlated with the Tohoku EQ.

Keywords: Stranding, Earthquake, Kashima-Nada, Geomagnetic disturbance

Japan Geoscience Union Meeting 2015
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MIS27-02 Room:201A Time:May 26 15:30-15:45

Excitation mechanism and detection of electromagnetic pulses prior to earthquakes

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We have been observing electromagnetic (EM) pulses generated by earthquake, and recently clarified behaviors of EM waves excited by seismic waves, in which EM pulses can be easily excited due to piezo-electric effect in the earth crust by vibrations of seismic S-waves [1]. On the other hand, we could not detect EM pulse at the rupture time of earthquake. Furthermore, even in laboratory experiment, we could not confirm intense EM noise excitation in frequency ranges of MHz-kHz. Therefore we have concluded that EM pulse cannot be generated in the situations of cracking of earth crusts.

In order to clarify behaviors of EM pulses which would be excited prior to earthquakes. We speculated a generation mechanism of EM pulse in the earth that a kind of resonance in the earth crust by the vibrations of the seismic P-wave propagation in it is important. So we conducted a laboratory experiment in order to inspect EM radiation from crusts. The experimental setup consists of ranging two granite pillars of 10 cm x 10 cm in cross section and 50 cm in length. A small glass ball is pinched between the cross sections of interface of the ranging granite pillars. By increasing external pressure given to the cross sections at the both ends of the ranging pillars, the small glass would be fractured. Then a negative stress impact is given to the interface of the ranging two pillars, and seismic P-waves propagate in the granites. EM pulse excited in the granite pillar due to piezo electric effect can be radiated out. So the stress impacts and following seismic P-wave propagations in a crust with some scale are key point for generating an EM pulse. We will show the experimental result.

Under the speculation based on the experimental result, we have been looking for the observation result. We finally found an EM pulse detected at about 7 hours prior to a rather large earthquake (M3.9), whose waveforms are similar to those obtained in the laboratory experiment.

[1] Minoru Tsutsui, Behaviors of Electromagnetic Waves Directly Excited by Earthquakes, IEEE Geoscience and Remote Sensing Letters, Vol. 11, No. 11, pp. 1961-1965, 2014.

Keywords: observation of electromagnetic pulses, earthquake precursor, excitation mechanism

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS27-03 Room:201A Time:May 26 15:45-16:00

Anomalous phenomena of Schumann resonances in possible association with earthquakes

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The anomalous behaviour in Schumann resonances was observed at a Japanese station, Nakatsugawa (geographic coordinates: 35.45 degree N, 137.3 degree E), which appeared as an enhancement in the fourth harmonic about one week before the 1999 Chi-chi earthquake (EQ) in Taiwan (Hayakawa et al., 2005). Schumann resonance is a global resonance phenomenon triggered by global lightning activity in the tropic (Nickolaenko and Hayakawa, 2014). A mechanism to explain this anomaly has been proposed with a model in terms of the wave interference between the direct ELF signal from one of the world-lightning centers and that scattered by the seismo-ionospheric perturbation above Taiwan (Hayakawa et al., 2005; Nickolaenko et al., 2006). This case study was extended statistically by using the ELF data observed at Nakatsugawa during 6 years (1999 to 2004) with special reference to EQs in Taiwan (Ohta et al. (2006)). With the criterion of magnitude greater than 5.0, there were observed 33 EQs in and around Taiwan, and the Schumann resonance anomaly is observed for 9 EQs (so that the anomaly percentage is 9/29 (because no observation at Nakatsugawa due to some malfunction of the equipment for 4 EQs)). 29 EQs included 7 EQs in the land, while other 22 EQs took place in the sea. As the result of analysis, anomalous Schumann resonances are observed for all inland EQs. 2 sea EQs from the 22, had the anomalous Schumann resonances, but these two EQs had the following characteristics: one was the largest magnitude and the other the shallowest. This paper discloses the causative link between EQs in Taiwan and anomalous behaviour in Schumann resonance in Japan, and also suggests the land/sea asymmetry in generating the seismo-ionospheric perturbation closely associated with the mechanism of lithosphere-atmosphere-ionosphere coupling.

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Keywords: Schumann resonance, earthquakes, Nakatsugawa observatory

Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

MIS27-04 Room:201A Time:May 26 16:30-16:45

A statistical study for relationship between anomalous transmission of VHF band waves and earthquakes at Hidaka area

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Electromagnetic precursors associated with the impending earthquake, such as variations of geoelectric current, total electron contents in the ionosphere, and anomalous transmission of radio waves in the VLF or VHF band, have been observed (ex. Hayakawa, 1996). Recently, some researchers have discussed how these precursory phenomena relate statistically to the impending earthquake (Le et al., 2010; Orihara et al., 2012, Hattori et al., 2013, Han et al. 2014).

The observation of anomalous VHF-band radio-wave propagation beyond the line of sight prior to earthquakes is one of candidate method to predict an earthquake. It is considered that the anomalous propagation events were the result of scattering of VHF-band radio waves in preparatory process of immediately prior to earthquakes occurring around the observation area (Kushida and Kushida, 2002, Moriya et al.,2010). And, quantitative correlation between logarithm of the total duration of scattered wave transmission and the magnitude, or maximum seismic intensity has been proposed (Moriya et al., 2010).

Nevertheless, statistical relationship between anomalous radio wave intensities defined by clear threshold, and occurrence time of impending earthquakes have not been investigated yet. We carried out statistical investigation by using received radio-wave intensity data from a FM station beyond the line of sight between 1st January, 2012 and 31st December, 2013, observed at Erimo observatory, Hokkaido. The sporadic E layer appears frequently in summer, and it affects to the anomalous transmission of FM wave data. We removed the anomalous radio-wave intensity data affected by the sporadic E by the simultaneous appearance of anomalous intensity at the other observatory far away.

During this period, we calculated the success rate (the ratio of number of intensity anomalies that an earthquake observed within certain days to total number of intensity anomalies) and the alarm rate (the ratio of number of earthquakes that observed intensity anomaly within certain days to total number of earthquakes) in case of earthquakes (M>3.0) that occurred at the epicentral distance with in the radius of 100km and 150km from the Erimo observatory.

As a result, the earthquakes M>4.5 that occurred within 100km from Erimo observatory showed higher the success rate than that of an random occurrence case. The maximum gain of the success rate between the present case and the random occurrence case was obtained within 10 days after anomalous reception.

The results also indicated that the success rate by the anomalous radio-wave propagation was related with the earthquake (M>4) that occurs within 10 days with probability of approximately 30%.

We classified earthquakes occurrence into northern and southern area based on the latitude of the Erimo observatory, and considered success rate gains and alarm rate gains respectively. The results indicate that the gain is tend to be higher the earthquakes occurring in northern area than the southern area.

Keywords: precursory phenomena, statistical study, success rate, alarm rate

Japan Geoscience Union Meeting 2015
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MIS27-05 Room:201A Time:May 26 16:45-17:00

On the GPS-TEC and geomagnetic declination precursors

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Details will be elsewhere (Enomoto & Heki submitted in GJI)

Keywords: 2011Tohoku-Oki earthquake, ionosphere total electron content, geomagnetic declination, precursorb

Japan Geoscience Union Meeting 2015
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MIS27-06 Room:201A Time:May 26 17:00-17:15

Statistical characteristics of the Ionsopheric TEC disturbances over Japan area

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To reduce the effect of strong geomagnetic activities such as geomagnetic storms, the TEC data of 2 days after Dst index exceed -60 nT were excluded in previous statistical studies of earthquake related TEC anomalies. Actually, the influences of a magnetic storm on TEC variations depend on the intensity and onset time of the storm. In this study, to clarify such dependences, we applied classification analysis method to the storm data (Dst) and discussed the response of TEC variation to each type of storm.

We picked out all the 294 geomagnetic storms during 1998-2013, and classified them into 3 types according to its magnitude and 4 types according to the onset time (local time). We checked the TEC data from 2 days before till 5 days after the onset of each geomagnetic storm. A bootstrap method (10000 times extraction) is used to calculate the average variation of the TEC for each type of storm. The average variation can be regarded as an average response of TEC to the related type of storm. If the average value of TEC exceeds the mean$\pm 2\sigma$ threshold, we consider it being affected by the storm. By this mean, we could find the accurate period affected by each type of storm.

Keywords: statistical analysis, geomagnetic storm, Ionsopheric TEC disturbances, bootstrap method, earthquake

Japan Geoscience Union Meeting 2015
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MIS27-07 Room:201A Time:May 26 17:15-17:30

The role of earthquake source parameters in the subionospheric VLF/LF anomalies before main shock

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Although subionospheric VLF/LF anomalies have been observed for some of the major earthquakes, their generation mechanisms are still unclear. In this paper, we focus on the detailed earthquake source parameters such as centroid moment tensor (CMT) solution in addition to traditional earthquake magnitude and depth information to study the occurrence relationship between earthquake types and corresponding ionospheric anomalies. As a result, we found that the ionospheric anomalies are observed prominently in association with thrust type earthquakes.

Keywords: ionospheric perturbation, VLF/LF transmitter, earthquake, CMT solution

Japan Geoscience Union Meeting 2015
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MIS27-08 Room:201A Time:May 26 17:30-17:45

Statistical study of pre-seismic subionospheric disturbance observed by the DEMETER and ground-based measurements

SUTO, Yushi[1] ; TOGO, Shoho[1*] ; KAMOGAWA, Masashi[1] ; BERTHELIER, Jean-jacques[2] ; KODAMA, Tetsuya[3]

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The atmospheric and the ionospheric disturbance have been reported as an electromagnetic phenomenon related to the earthquakes in the 1980s. These phenomena have been expected to be useful for the short-term earthquake prediction. Motivated by this background, we statistically investigate pre-seismic subionospheric disturbances by using the VLF electric field data of the DEMETER.

Keywords: Earthquake, Subionospheric disturbance, DEMETER

Japan Geoscience Union Meeting 2015
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MIS27-09 Room:201A Time:May 26 17:45-18:00

Development of Early Warning System for Crustal Activity: Detection of Preparation Process using Multiple-Observation

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[1]Graduate School of Science, Chiba University

New observations from ground and space have provided multiple evidences of pre-earthquake signals and the latest studies show their statistical significance, repeatability, and universality. To understand the preparation process of large earthquakes and slow-slip events in subduction zone, especially to clarify the nucleation stage of the earthquake cycle, we plan to establish observation network in Boso, Japan, where large subduction earthquakes are expected soon. Since the subsurface fluid flow may play an important role in the preparation process of subduction activities, we intend to employ electromagnetic approaches. Geophysical monitoring such as ULF geomagnetic and geoelectrical observations, radon measurements, ocean bottom pressure measurements, and inland GPS movements, will be incorporated to help to understand the preparation process and evaluate the applicability of various pre-earthquake signals towards short term earthquake forecasting.

Japan Geoscience Union Meeting 2015
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MIS27-P01 Room:Convention Hall Time:May 26 18:15-19:30

The earthquake trigger which I understood by electromagnetic wave observation

KUNIHIRO, Hidemitsu[1*]

[1]JYAN meeting for the study

I performed electromagnetic wave observation in broadband to catch an earthquake harbinger and studied an electromagnetic wave and pulsing electromagnetism and the fluctuation phenomenon in the V/UHF Zone, but, from direct wave observation of the FM broadcast, the abnormal data of the electromagnetic pulse understood that there was a constant regularity.

Therefore I discovered that the fluctuation direction of the electromagnetism pulse almost agreed with high and low tide of the ebb and flow by the observation graph of the FM electric wave when I investigated ebb and flow and an earthquake record similar to a rule and the relations of the electromagnetic wave pulse thoroughly.

Thus an earthquake of approximately 20% occurred in the vicinity of approximately 60%, a high tide in the vicinity of the ebb tide of the big tide when I inspected earthquake statistics and ebb and flow and the electromagnetism pulse of the observation place neighborhood, and the ebb and flow async part of the electromagnetism pulse understood what I concentrated on before and after an earthquake.

Therefore, it may be said that the ebb and flow is earthquake trigger because most electromagnetic phenomena show the deep connection with the earthquake, and it can be the circumstantial evidence.

When ebb and flow increases a huge gravity change in the earth crust, the mechanism that an electromagnetism pulse synchronizes with ebb and flow has concentration and dispersion of the pressure in the earth crust, and piezoelectricity and electromagnetism occur, and an electromagnetism pulse occurs by friction or whit destruction when it is in the vicinity of critical point.

When this electromagnetism pulse arrives to the surface of the earth; from the ground radiation is spread, and can receive it as a noise to last for broadband.

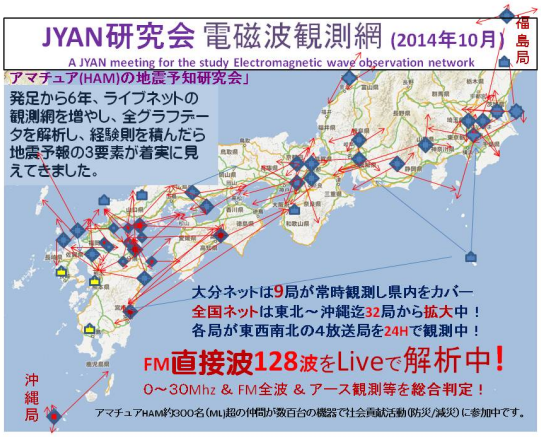
On the other hand, the electromagnetism generated by addition and subtraction pressure in the earth crust collects in the earth surface and forms the electromagnetic fields such as plus and minuses.

When an electromagnetic wave passes the earth surface of this electromagnetic field, with the electron beam design of the cathode-ray tube, I receive action such as winding or the refraction depending on the strength, and the strength of the electromagnetic wave shakes, and a steep changing design comes out to a record graph as a curve and a pulsing line in the plus and minus direction.

Therefore, I expect it that the direct wave observation of the electromagnetic wave is shaken by ebb and flow synchronization, and valuable data of crustal movement and the foretelling an earthquake are provided by the discovery of the phenomenon.

As a document, I show a fluctuation phenomenon and the ebb and flow of the FM broadcasting electric-wave and an earthquake and an electromagnetism pulse phenomenon.

Keywords: An earthquake, A harbinger, Trigger, A pulse, Ebb and flow



Japan Geoscience Union Meeting 2015
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MIS27-P02 Room:Convention Hall Time:May 26 18:15-19:30

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

SAITO, Yoshiharu[1*]

[1]NPO Japan Earthquake Precursor Comprehensive Observation Center (JEPCOC)

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 phenomenons.

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

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MIS27-P03 Room:Convention Hall Time:May 26 18:15-19:30

Investigation of preseismic- ionospheric disturbance observed by the DEMETERs

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We investigate pre-seismic- ionospheric disturbance observed by the DEMETER. The data was ISL (Electron density and temperature) and IAP (Ion density and temperature). Since there are several papers concerning the pre-seismic ionospheric disturbance by using the data of electron/ion densities and temperature, we verify the reported pre-seismic anomalies by means of superposed epoch analysis.

Keywords: Earthquake, Ionosphere, DEMETER

Japan Geoscience Union Meeting 2015
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MIS27-P04 Room:Convention Hall Time:May 26 18:15-19:30

Construction of multi-parameter EM stations in Kochi under the national program and its scientific background

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IUGG inter-association working group on Electromagnetic Studies of Earthquakes and Volcanoes organized biennial general assembly in Konstancin Jeziorna, Poland in September 2014. During the meeting one of the major conclusion was that the combination of multi-parameter survey is only the way to achieve a practical earthquake forecast. However, we dare to say, the most important point is that each parameter must be clarified scientific substantial clue. Otherwise, the forecast itself has no meaning.

We installed electromagnetic observation devices in ULF and VHF bands in February 2015 in Kuroshio town, western part of Kochi Prefecture under the, what we call, national earthquake prediction research project. We will install VLF device in the future.

The reason why we select Kuroshio town is as follows:

1)According to the official statement of Cabinet Office, the highest tsunami height is reported (the worsted case; 34m) impending mega-quake along the Nankai trough.

2)Last Nankai Earthquake in 1946, clear macroscopic anomalies such as underground water changes, crustal deformations were reported.

In the presentation, we would like to present the latest data and future plan for the tactics of the short-term earthquake prediction research.

Keywords: Electromagnetics, Kochi, Kuroshio town, Earthquake prediction