

SCG011-01

会場:304

時間:5月25日 08:30-08:45

ULF seismo-magnetic phenomena in Izu and Boso Peninsula, Japan during 2000-2010 ULF seismo-magnetic phenomena in Izu and Boso Peninsula, Japan during 2000-2010

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Earthquakes are one of the most destructive of natural hazards, and it has been long a dream of scientists to achieve effective prediction. Recently electromagnetic phenomena have been considered as a promising candidate for short-term earthquake prediction. In order to clarify the earthquake-related ULF (ultra low frequency) magnetic phenomena, a sensitive geomagnetic network has been installed in Japan and plenty of data associated with moderate-large earthquakes have been accumulated. In this study, we have analyzed geomagnetic data observed during the past decade in Izu and Boso Peninsula, Japan.

First, the ULF magnetic signals at the frequency 0.01Hz have been investigated. We have applied wavelet transform analysis to the 1Hz sampling data observed at three magnetic observatories in Boso Peninsula (Kiyosumi, Uchiura, and Fudago) and Izu Peninsula (Seikoshi, Mochikoshi, and Kamo), respectively. The signature at the 0.01Hz frequency band has been revealed and daily average energy has been computed. In order to minimum artificial noise, we only use the midnight time data (LT 0:00~3:00). And to remove influences of global magnetic perturbations, three standard geomagnetic stations (Memambetsu, Kakioka, and Kanoya) operated by the Japan Meteorological Agency have been selected as reference stations and PCA method has been applied to the yearly energy variation of the 0.01Hz signals at the three stations. The first principal component which contains more than 95% energy is considered to be global background.

After comparing the results at the stations in Boso and Izu Peninsula with global background, it is found that there are several local energy enhancements which only appear in Boso or Izu area. Statistical investigation has also been carried out and detailed results will be presented in our presentation.

Second, we have investigated the geomagnetic diurnal variation observed at each station in both Boso and Izu Peninsula from 2000 to 2010. Usually for a region that is not large, diurnal variation in magnetic stations should be stable and quite similar to each other. However, the situation could be changed if there were some strong local underground activities such as earthquakes and volcanoes which may cause electromagnetic emissions and/or underground resistivity changes. In this study, we have applied PCA method to the diurnal variation hoping to extract information about local underground resistivity and electromagnetic anomalies.

It is found that the contribution of the second principal components, which may relate with the local underground conductivity structure and/or the local electromagnetic disturbance, has some significant anomalous behaviors during the past ten years. Especially before the 2005 M6.1 and M6.0 earthquake, very clear anomalies have appeared.

キーワード: ULF seismo-magnetic phenomena, Wavelet transform, Principal component analysis (PCA)

Keywords: ULF seismo-magnetic phenomena, Wavelet transform, Principal component analysis (PCA)

SCG011-02

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Examinations of seismo-magnetic signals using the Morlet wavelet method Examinations of seismo-magnetic signals using the Morlet wavelet method

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Ratios of geomagnetic daily variation ranges between two stations in Taiwan are approximately equal to 1, due to that magnetic latitude difference is less than 4° . When one station is located nearby epicenters, the ratios depart and recover the original constant few days before and after earthquakes, respectively. Although the anomalous changes of the ratios have been considered to be seismo-magnetic anomalies, a frequency band of them is still not fully understood. We apply the wavelet coherence as a numerical index to compare amplitude distributions in this study. When data recorded by two stations both away from epicenters are used, the wavelet coherence often approaches 1 suggesting that geomagnetic fields are dominated by changes in the ionosphere and/or magnetosphere. If one station located near epicenters is added into the analytical process, the small wavelet coherence (about 0.2) can be observed at the period of approximately 0.5 day during earthquakes. Analytical results and seismo-magnetic ratio changes yield a good agreement either in the time or frequency domain. Notably, the results also shed light on locating epicenters before earthquakes occur.

キーワード: Geomagnetic field, Earthquake prediction, Wavelet transform
Keywords: Geomagnetic field, Earthquake prediction, Wavelet transform

SCG011-03

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Electromagnetic pre-seismic anomalies induced by intermediate depth earthquakes (Vrancea zone-Romania)

Electromagnetic pre-seismic anomalies induced by intermediate depth earthquakes (Vrancea zone-Romania)

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Recent studies show that before the earthquake initiation, the high stress level reached within the seismogenic volume may generate dehydration of rocks and fluids migration along surrounding faulting systems and could be reflected by electrical conductivity changes. In this paper we investigate these changes of conductivity using ULF electromagnetic and geomagnetic data recorded at both Geodynamic Observatory Provita de Sus, located on the Carpathian electrical conductivity anomaly (CECA), at about 100km distance of Vrancea epicentral zone, and Geophysical Observatory Surlari taken as reference station. Using ground-based monitoring system (GMS 06 and MAG03 DAM electromagnetic and geomagnetic equipments, respectively), possible anomalous variations of the electromagnetic normalized function (EMNF) have been surveyed, on the ULF range ($f < 0.0166$ Hz), in correlation with earthquakes with $M_w > 4.0$ triggered at the intermediate depth interval 70-160km, in seismic active Vrancea zone. Subsequently, a methodology based on the correlation of the EMNF values ($B_{zn} = B_z/B_{perp}$ and $R_{on} = R_{opar}/R_{oz}$) selected according to temporal invariability criteria for a 2D geoelectric structure, in terms of non-seismicity, taking into consideration just their deviations from the electromagnetic pattern initially calculated, was elaborated. To have a comprehensive view on the applied methodology, the daily mean distribution of the B_{zn} and R_{on} parameters in correlation with the Vrancea deep seismic events taken from the seismic bulletin of the National Institute for Earth Physics, occurred simultaneously, in 2010 year, are revealed. Finally, we have to conclude that with 7-10 days before an EQ with $M > 4.0$ occurred, the daily mean variation of the EMNF had anomalous behavior marked by a significant increase versus its standard deviation ($EMNF > 2.5$ STDEV), and the results illuminate triggering mechanism and may represent an important step toward earthquakes forecasting.

キーワード: EM pre-seismic anomaly, Intermediate depth earthquakes

Keywords: EM pre-seismic anomaly, Intermediate depth earthquakes

SCG011-04

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ULTRA LOW FREQUENCY (ULF) ELECTROMAGNETIC ANOMALOUS VARIATIONS RELATED TO EARTHQUAKES IN JAVA ISLANDS, INDONESIA ULTRA LOW FREQUENCY (ULF) ELECTROMAGNETIC ANOMALOUS VARIATIONS RELATED TO EARTHQUAKES IN JAVA ISLANDS, INDONESIA

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The tectonic setting of Indonesia is very complex, because it is a meeting point of several tectonic plates: the Eurasian Plate, the Australian Plate, the Indian Plate, and the Pacific Plate. Such condition makes Indonesia become one of the most seismically active regions in the world. Therefore, to minimize such disasters, the research on the short-term earthquake (EQ) prediction is an important issue. One of the most promising approaches is the study of ultra low-frequency (ULF) electromagnetic anomalies preceding large earthquakes. ULF is the frequency range of electromagnetic wave less than 100 Hz. Because of deeper skin depth, ULF electromagnetic waves can penetrate through the Earth crust. In this paper, we focus on the frequency of 0.01 Hz band and would like to evaluate whether there is ULF geomagnetic anomalies preceding large earthquakes happened in Indonesia or not. Our group has installed the three components fluxgate magnetometer at Pelabuhan Ratu, West Java, Indonesia since September 2007. I have analyzed data from September 1, 2008 to October 31, 2010. There are twelve moderate-large earthquakes (M_{7.5}) during the analyzed period. The largest earthquake occurred during the analyzed period is M7.5 EQ (depth=57 km, epicenter distance =135 km, Sept. 2, 2009) according to Indonesian Meteorological, Climatological and Geophysical Agency (BMKG) earthquakes catalog. To clarify the ULF geomagnetic variations preceding all the earthquakes, spectral density based on Fast Fourier Transform (FFT) and wavelet transform (WT) as well as the analysis of spectral density ratio have been performed. The results of spectral density ratio analysis unveil clear enhancements before the largest EQ which occurred on Sept. 2, 2009 (M=7.5). These facts suggest that the spectral density analysis would be useful for seismo-electromagnetic study.

キーワード: ULF electromagnetic variation, Spectral density ratio analysis, Java Island earthquakes

Keywords: ULF electromagnetic variation, Spectral density ratio analysis, Java Island earthquakes

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SCG011-05

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地震に関連する ULF 帯の磁場変動 ULF geomagnetic anomaly possibly associated with earthquake

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The southern part of Kanto District, Central Japan is one of the seismically active regions in Japan because of three plates (Pacific, Philippine Sea, and Eurasia). In order to investigate the electromagnetic phenomena associated crustal activity, the precise ULF electromagnetic measurement network has been established for these 10 years. At each station, three magnetic components and two horizontal electric components are observed in general. There are two arrays with interstation distance of 5 km in Izu and Boso Peninsulas and 10 years data have been we accumulated. During this periods, we had the 2000 Izu islands earthquake swarm, the 2002 and 2007 Boso slow slip events and so on. Signal associated with crustal activity are very weak in comparison with other noise such as geomagnetic pulsations and artificial noise, therefore advanced signal processing is required. In my presentation, I would like to show some methodologies and related results. In this paper, some case studies and statistical study on ULF electromagnetic changes possibly associated with crustal activities will be presented.

キーワード: ULF 帯の磁場変動, 地震, 地殻活動

Keywords: ULF geomagnetic anomaly, earthquake, crustal activity

SCG011-06

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地中励起の電磁波パルスの確認に向けての観測研究 Observations for confirming earth-origin electromagnetic pulses

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地中で励起しているだろうと考えている電磁波パルスを確認するための観測研究を続けているが、ここではその観測の変遷について紹介する。

1995年に発生した阪神淡路大震災の直前に様々な人や研究者がラジオや専用受信機に電磁波雑音が混入した事を報告していた。

我々はこれらの雑音が地中で発生したのかどうかを確認するために、京都産業大学構内に深さ100mのボアホール(穴)を掘り、そこに研究室で製作した垂直ダイポールアンテナを挿入し、1999年から観測を開始した[1]。その観測の経験から、検出された電磁波パルスの到来方位を求める事的重要性を痛感し、そのため新たな観測装置を開発した[2]。2004年1月6日14時49分50秒に熊野灘沖で発生したM5.3の地震と同時に、開発した観測装置は電磁波パルスを検出すると同時にその到来方位をコンピュータ画面の地図上に表示した。我々は電磁波パルスの伝搬理論[3]から伝搬距離を求めて、それを到来方位線上に当てた結果、その波源位置は地震の震源域内ある事を突き止めた[4]。

この成功を土台として、地中起源の電磁波パルスの波源位置を実時間で特定すべきであると考え、名古屋大学の美杉地震観測施設を利用して頂いて、京都産業大学構内の観測点との間で3角測量方式で波源位置特定のための観測を始めた。しかし、観測結果に現れた波源位置と思われる点は近隣の送電線から放射された電磁波パルスを解析しており、2観測点に共通した点では無い事が判明し、この種の観測ではそれらの成分を除外しなければならない事を痛感した[5]。

上記2地点観測と並行して、送電線の影響の少ない環境に観測点を確保する事を進めてきて、2008年7月に京都大学の瀬戸臨海実験所(白浜町)の敷地の一部を借用し、そこに深さ100mのボアホールとその上部の観測ブースを完成させた。この場所は幅が約300mの半島状内にあり、そこで検出された電磁波の内、上空から垂直に入射した約5kHzの電磁波パルスはボアホールの底では振幅は大きく減小しており、位相も反転する程度に遅れている事が確認でき、これらのデータから媒質の電気伝導度や電磁波に対する表皮の厚さ、媒質中での伝搬速度をも求める事が出来た。この様に静穏な環境下でも検出される電磁波パルスの殆どは雷放電に伴うものである事が確認された。

殆どが雷放電パルスである中から磁界振幅が小さく、繰り返し周期が2サイクル程度の電磁波パルスを見つけた。そこで、その電磁波パルスの地中媒質中での上下の伝搬方向を見つけるために、ボアホールの底と地上に設置していた水平磁界サーチコイルで検出した磁界波形の位相比較を行った。その結果、一部のデータでは上向き伝搬を示唆する位相差を示していたが、別のデータには下向き伝搬を示唆するデータもあった。この曖昧さの原因を調べるために、地上とボアホール底部での磁界測定として、3軸サーチコイルシステムに入れ替えて、磁界の偏波状況を調べた。その結果、地上でのこの種の電磁波パルスは直線偏波であるのに対して、地中では垂直面内で楕円を描いている事が判明した。この事実と、それらのパルスの発生時刻の定量的調査の結果とを合わせて、この種の電磁波パルスは電源線から放射され、水平に伝搬してきた人工雑音であるとの結論に至った。

この事から、今後の地中励起電磁波パルスの確認のための観測では、検出した電磁波パルスのポインティングベクトルを厳密に求め、その伝搬方向を決定する必要があるとの結論に達し、その為のセンサーの開発を始めた。最近になって、それをほぼ完成させ、現在はその観測準備を進めている。

[1] M. Tsutsui, Detection of earth-origin electric pulses, *Geophys Res Lett*, 29, 1194, doi:10.1029/2001GL013713, 2002

[2] M. Tsutsui, S. Konagaya, T. Kagawa, A method of direction finding for dispersive electromagnetic pulses, *Electronics and Communication in Japan*, Part 1, 90, 23-32, 2007.

[3] S. Yano, T. Ogawa and H. Hagino, Dispersion characteristics and waveform analysis of tweek a atmospherics, in: *Environmental and Space Electromagnetics*, edited by H. Kikuchi, New York, Springer, pp. 227-236, 1991.

[4] M. Tsutsui, Identification of earthquake epicenter from measurements of electromagnetic pulses in the earth. *Geophys Res Lett*, 32, L20303, doi:10.1029/2005GL023691, 2005.

[5] M. Tsutsui, Method of Pointing Source Locations of Earth-origin Electromagnetic Pulses as a Precursor of Earthquakes, *IEEJ Trans. FM*, 129, No. 12, 840-844, 2009.

キーワード: 地中励起電磁波パルス, 電磁波センサーの開発, 観測と波源位置特定, 地殻活動との関連

Keywords: earth-origin electromagnetic pulses, developement of EM sensors, EM detections and their soruce locations, Relation between erath-origin EM pulses and earthquakes

SCG011-07

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ナチュラルタイムの概念による日本の地震活動解析 Natural time analysis for seismicity in Japan

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The VAN method has been the only working short term earthquake prediction system for more than two decades. The indeterminacy of a few weeks for the occurrence time of main shocks has been a drawback.

If earthquake is a critical phenomenon as defined in statistical physics, prediction is synonym for identifying the approach to criticality. Varotsos and colleagues proposed that by analyzing the seismicity in a newly introduced time frame called "natural time", the approach to criticality can be clearly identified. In natural time, based on the premise that a system has its own clock, the time is assumed to proceed only when an event takes place. It was found empirically that if the analysis is started at the time of SES (Seismic Electric Signals in the VAN method) appearance, the main shock occurs a few days after the criticality has been recognized. This means, seismic catalogs can play an amazing role in short term prediction to reduce the prediction lead time when combined with SES data.

We made a statistical analysis on seismicity in both natural and conventional times and confirmed that natural time is more efficient and the order and magnitude of earthquakes do play an important role in recognizing criticality. We also tried the natural analysis on major $M > 7$ earthquakes in Japan, including 1995 M7.3 South Hyogo Pref. (Kobe), 2000 M7.3 Western Tottori Pref., 2003 M8.0 Tokachi Oki, 2004 M7.1 Off Kii Peninsula, 2005 M7.0 West-off Fukuoka Pref., 2008 M7.2 Iwate-Miyagi Nanbu earthquakes for which no SES data exists and 2000 earthquake swarm in Izu island region. Some positive results were obtained except for Tokachi and Iwate-Miyagi cases.

キーワード: ナチュラルタイム, 地震活動, 臨界現象

Keywords: Natural Time, Seismicity, Critical phenomena

SCG011-08

会場:304

時間:5月25日 10:15-10:30

地震に関連する地電位差変化の定量的および統計的研究

A study for the quantitative and statistical evaluation of geoelectric potential changes associated with earthquakes

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We would like to present the pre-seismic telluric current anomalies in Japan and their statistical significance. By the author's knowledge, it is only Greek-VAN group who has been successfully predicting earthquakes for more than a couple of decades. However, the reproducibility of their method has so far been barely verified elsewhere.

In Japan, VAN-like telluric current measurements were intensively conducted after the devastating 1995 Kobe earthquake. At the Kozu-shima volcanic island, we observed 19 anomalies for 23 $M > 3$ earthquakes which occurred within 20 km of the station from May 14, 1997 to June 25, 2000. It has also been demonstrated that the correlation between the observed anomalous changes and the subsequent earthquakes is statistically very high. Our observations also indicate the existence of extremely high degree of heterogeneity in the subterranean electrical structure of the volcanic islands. Therefore, the high heterogeneity under Kozu-shima Island has been studied, though only for the shallow depth, by a VLF-MT survey. The apparent resistivity was found to range in three orders of magnitude. Current injection into the ground was also conducted for the resistivity survey. It was verified that various features of the observed anomalous changes were different from those of changes caused by artificial sources and induction of geomagnetic disturbances.

The author considers that this thesis presents the first convincing demonstration of the existence and statistical significance of VAN-type pre-seismic telluric current anomalies in Japan (or outside Greece).

キーワード: 先行現象, VAN 法, 地電位差

Keywords: precursor, VAN method, telluric current

SCG011-09

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時間:5月25日 10:45-11:00

地震に先行する力学的現象と電磁現象の関係は? —地震静穏化現象に伴う電磁現象の探求—

Relationship between the precursory mechanical properties and electromagnetic properties

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There are a number of reports on the seismic quiescence phenomena before large earthquakes. We proposed new RTM algorithm. RTM algorithm is a kind of weighted coefficient methods in the time, distance and size of an earthquake. We test it by applying to three large earthquakes in Japan, namely the Hyogo-ken Nanbu Earthquake in 1995, the Noto Hanto Earthquake in 2007 and the Iwate-Miyagi Nairiku Earthquake in 2008. The results show that the RTM algorithm is more sensitive to the seismic quiescence phenomena than the current RTL algorithm. At this moment, whole surveyed parameters (R, T, M and so on) are empirically selected. We have to consider the physical meaning of the "best fit" parameter e.g., the relation of delta CFS, etc. Furthermore, the most important issue is the relationship between electromagnetic precursory phenomena and seismicity changes. We would like to solve this problem in the future.

キーワード: 静穏化, 電磁現象

Keywords: Quiescence, EM phenomena

岩石破壊に伴うマイクロ波の検出実験の方法と得られたデータのエネルギー考察 Experiment Method of Microwave Detection in Association with Rock Fracture and Energy Consideration of the Obtained Data

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岩石を圧縮・破壊する時、マイクロ波が発生することが以前発見された。当初圧電効果による派生的現象と思われたが、種々の岩石について実験した結果、発生電力が必ずしも石英含有量に比例していない。

本論文では、まず岩石破壊する時発生するマイクロ波の検出・測定法について述べる。次いでこれまで得られている実験データについて、発生エネルギーの観点から考察を加える。

種々の岩石をコンプレッサで加圧し、破壊した。石英、花崗岩、斑禰岩、玄武岩を用いた。受信系において、信号はまず低雑音増幅器で増幅した後、観測周波数にたいし十分高い標準化周波数でデジタル化して、データを取り込む。観測周波数としては、2.2 GHz、2 GHz、300 MHz、1 MHzを選んだ。

本測定 of the difficulty is, the following points are.

1. 極めて高い周波数を扱う。これまでの実験では、300 MHzから2.0 GHz帯にわたるマイクロ波周波数である。これは地球物理で通常扱う周波数より、はるかに高い。

2. マイクロ波の測定には、インピーダンス整合が必要である。これは電気測定の中でも難しい部類に入る。

3. 破壊に伴う瞬発現象であり、大体1msec程度の時間長を有する。そのためデータレコーダは、正確なトリガーによるデータ取得・蓄積機能を要する。これは通常のマイクロ波測定に比べ、さらに難しい点である。

4. これまでの実験結果から、信号は極めて広い周波数帯域を有している。そのため単一の広帯域受信機で受信することは難しく、狭いサブバンドに切って受信することになる。かつレコーダの容量が足りなければ、ヘテロダイン受信する必要がある。

5. 上記マイクロ波がパルス状包絡線の中に含まれるので、波形と電力を測る時注意が必要である。

6. 上記受信機を通すと、帯域制限された信号となるので、全エネルギーを考える時換算が必要となる。

得られたマイクロ波は、いずれも断続的なパルス状である。個々のパルス幅は極めて狭いが、最も高い周波数2.2 GHzにおいては2 nsecである。岩石の種類によらず300 MHzと2 GHzは観測されたが、2.2 GHzは観測されないものもあった。また破壊直後に出るパルス群とその後散発的に出るパルス群とは、発生時間間隔や発生エネルギー量が大きく異なっているようである。

このようにして得られた波形は、パルス内ではほぼ正弦波状なので、受信系を通して電力校正が可能である。その結果から各周波数帯において、単位周波数当たりの放射電力を求める。まず破壊直後に出るパルス群についてもとめた結果、石英においては2GHz帯で最大になる。それに対し、斑禰岩では300MHzが最大である。次に観測時間(1msec)全体で平均してみると、石英において300 MHzが大きく伸びて最大となる。それに対し斑禰岩では、300MHzが最大であることは変わらない。

本発見は世界で初めてのことであり、今後種々のパラメータへの依存性など特性を、明らかにする必要がある。

キーワード: 岩石破壊, マイクロ波発生, パルス状, 検出実験, 受信機, エネルギー考察

Keywords: Rock fracture, Microwave emission, Pulse, Detection experiment, Receiver, Energy consideration

SCG011-11

会場:304

時間:5月25日 11:15-11:30

The correlation between lower ionospheric perturbations as seen by VLF/LF propagation and EQs

The correlation between lower ionospheric perturbations as seen by VLF/LF propagation and EQs

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The subionospheric VLF/LF propagation is extensively used to investigate the lower ionospheric perturbation in possible association with earthquakes. An extensive period of data over 7 yr from January 2001 to December 2007 and a combination of different propagation paths in and around Japan are used to examine the statistical correlation between the VLF/LF propagation anomaly (average nighttime amplitude, dispersion, and nighttime fluctuation) and earthquakes with magnitude >6.0. It is then found that the propagation anomaly exceeding the 2s (standard deviation) criterion indicating the presence of ionospheric perturbation is significantly correlated with earthquakes with shallow depth (<40 km). Finally, the mechanism of seismoionospheric perturbations is discussed.

Keywords: Earthquakes, VLF/LF propagation, correlation study

SCG011-12

会場:304

時間:5月25日 11:30-11:45

電離圏トモグラフィーによる2007年南スマトラ地震に先行する電離圏変動の3次元構造解析

Tomographic Analysis of Ionospheric Anomaly Preceding the 2007 Southern Sumatra Earthquake (M8.5)

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近年、地震に先行する電離圏異常が多くの研究者により報告されている。特にGPSによって観測されるTotal Electron Content (TEC)の解析では大地震の数日前に顕著な異常が検出され、VLF帯電波の伝播状態の監視や衛星観測でも有意な先行異常が報告されている。このように多くの地震に関連する電離圏異常が報告されながらも、その物理機構については未だに解明されていない。また、これまでに行われた研究の多くは、特定高度やTECのような積分量について解析したものであり、電離圏電子密度分布の3次元構造を明らかにした例はほとんど存在しない。しかしながら、物理機構の解明において電離圏の3次元構造を知ることは重要であると考えられる。

よって本研究では地震に先行する電離圏異常について、Ma et al. (2005)によって提案されたResidual Minimization Training Neural Network (RMTNN) トモグラフィーを適用し、その3次元構造を調査した。RMTNNは地上受信機データと、イオノゾンデによって観測される最大電子密度およびその高度データを使用し、比較的少数のデータからの再構成が可能である。トモグラフィーはCenter for Orbit Determination in Europe (CODE)が公開するGlobal Ionosphere Map (GIM)、あるいは地上GPS受信機によるGPS-TECデータの解析で異常が検出された地震について適用する。

2007年南スマトラ地震(M 8.5)について本手法を適用したところ、地震の3日前に震央周辺の高度250 - 450 km、特に約330 kmにおいて顕著な電子密度の低下が確認された。また検出された電子密度の減少領域には高度とともに東方向へ傾く構造が見られた。このような特徴は、FORMOSAT-3/CやGIM, GPS-TECによる解析結果とも概ね一致するものであった。講演では2007年南スマトラ地震に加え、他の地震についての適用例についても詳しく紹介する。

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SCG011-13

会場:304

時間:5月25日 11:45-12:00

衛星による地震電磁気観測の現状と近年の成果 Present status and results: Satellite observation of seismo-electromagnetics

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今世紀に入り、ロシアが世界初の地震電磁気観測衛星：Kompass の打上げを実施するなど、様々な国が地震電磁気現象の観測を目的とした衛星を運用及び計画している。

マグニチュード7以上の大地震は、全球で年間平均16回発生しており、衛星を用いれば短期間に大地震とのイベントデータが取得できるため、これが各国で衛星や宇宙ステーションからの観測を実施・計画している大きな理由となっている。

発表では近年の宇宙からの地震電磁気観測の成果と、今後の計画について発表する。

キーワード: 地震電磁気, 電離圏, 電子密度, 電子温度, 衛星, 宇宙ステーション

Keywords: seismo-electromagnetics, ionosphere, electron density, electron temperature, satellite, International Space Station

SCG011-14

会場:304

時間:5月25日 12:00-12:15

地震に関連する地磁気強度変化の有無の検討

Localized changes in the geomagnetic total intensity values prior to or associated with major earthquakes

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Changes in total geomagnetic field intensity, of 2?3 nT, were reported to be observed prior to the 1995 Hyogo-ken Nanbu (Kobe) earthquake at the Amagase (AMG), located approximately 70 km from the epicenter. We examined whether the observed variations are local signals arising from the Earth's crust, or global variations that are unlikely to originate from the crust. To remove global-scale variations in total geomagnetic intensity data, we employed a regional geomagnetic field model. Using data recorded at five reference sites in Japan, we estimated global-scale variations in total geomagnetic intensity, and removed them from the observed total geomagnetic intensity at the AMG site. The remainder still showed variations during the period prior to the Kobe earthquake. In addition, these pre-seismic variations include two of the largest shifts recorded during the entire observation period at the AMG site, raising the possibility that these variations were indeed related to the earthquake (Yamazaki and Sakanaka, 2011, J. Geodyn.).

These variations cannot be interpreted as signals arising from the area close to the seismic source because of the large distance between the epicenter and the site. Therefore, our results raise the possibility that the physical state of the Earth's crust shows marked changes over a wide region in the lead-up to a seismic event. However, we cannot exclude the possibility that large noises were recorded at this time by chance. These uncertainties are inevitable given the reliance on data collected at only one site. To overcome this difficulty, we apply the similar approach to data obtained at difference sites in Japan during 1997?2010, which are recorded by the Geographical Survey Institute of Japan and the Japan Meteorological Agency. The results will be presented at the conference.

キーワード: 地磁気全磁力, 地震, 局所性

Keywords: geomagnetic total intensity value, earthquake, locality