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


SSS01-P01 会場:コンベンションホール 時間:5 月 24 日 18:15-19:30

# 2011 年東北地方太平洋沖地震後の日本内陸における地震活動変化の概観とその解釈
# Overview of Widespread Seismicity Changes inland Japan Following the 2011 Tohoku-Oki Earthquake and Its Interpretation

石辺 岳男 [1*]
ISHIBE, Takeo[1*]

[1] 東京大学地震研究所
[1]Earthquake Research Institute, the University of Tokyo

This paper overviews the widespread changes in seismicity rate and distribution of focal mechanism after the Tohoku-Oki earthquake ($M$w9.0) and summarize possible contributing factors.

In the Tohoku region, significant increases in seismicity rate were observed in N. and S. Akita, SW off Oga peninsula, and Yamagata/Fukushima boundary area as well as other surrounding areas. The most activated area was the Ibaraki/Fukushima boundary area where shallow normal-faulting earthquakes abruptly began to occur. On the other hand, swarm-like activity in the south of Lake Inawashiro suddenly terminated following the Tohoku-Oki earthquake. In addition, aftershock activities in the source regions of recent large earthquakes such as the 2008 Iwate-Miyagi earthquake ($M_{JMA}$7.0) have been suppressed. Focal mechanism distributions also showed significant changes in the shallow crust of the Tohoku region; strike-slip and normal-faulting earthquakes were activated following the Tohoku-Oki earthquake, while thrust-faulting earthquakes, which had been predominant due to the compression in the E-W direction, were deactivated.

In the Kanto region, abrupt increases in seismicity rate of the shallow crustal areas were typically observed in the Tochigi/Gunma and Ibaraki/Chiba boundary areas, SE Chiba near Choshi City, N. Tokyo Bay area, SE part of Boso peninsula, Tanzawa, Hakone, and Izu areas. Furthermore, two moderate earthquakes (the earthquake near the prefectural boundary between Nagano and Niigata ($M_{JMA}$6.7) on March 12th and the earthquake in the E. Shizuoka prefecture ($M_{JMA}$6.2) on March 15th) occurred. At intermediate depths, interplate earthquakes associated with the subduction of the Philippine Sea Plate (PHS) and the Pacific Plate (PAC) were activated, especially in SW Ibaraki, NE, NW, and SE Chiba areas. Belt-like seismicity that extended from the S. Miura Peninsula to the SW off Chiba area through the S. Boso peninsula, at a depth of 60-70 km, was also activated.

The most plausible factor which caused the changes in seismicity is the static changes in the Coulomb stress transferred by the Tohoku-Oki earthquake which make it possible to retrospectively forecast the changes in seismicity on some level. However, some activated seismicity showed clear counter-evidence. A typical example is a thrust-faulting earthquake sequence which started one week after the mainshock in Yamagata/Fukushima boundary area. The calculated stress changes were negative for most of focal mechanisms of post-Tohoku earthquakes.

Many remotely triggered local events, whose origin times are well coincided with the arrival of seismic waves from the Tohoku-Oki earthquake, suggest that dynamic stress changes due to the passage of seismic waves also contribute seismicity changes. Some swarm-like activities induced by the Tohoku-Oki earthquake such as those in the Yamagata/Fukushima boundary clearly show temporal expansion of the focal area, which is attributed to fluid diffusion. It suggests that pore fluid pressure changes are another possible factor because decreases in failure strength due to increases in pore fluid pressure can also enhance the faulting. The contribution of indirectly triggered earthquakes might be very important in some areas because stress changes imparted by neighboring indirect aftershocks could be comparable with or larger than those from a distant mainshock. Postseisimc slip now observed by GEONET and viscoelastic effect would play an important role for long-term seismicity rate change.

Acknowledgements

This study was supported by the Special project for reducing vulnerability for urban mega earthquake disasters from the Ministry of Education, Culture, Sports, Science and Technology of Japan.

キーワード: 2011 年東北地方太平洋沖地震, 地震活動変化, 静的・動的応力変化, 間隙流体圧変化, 余効すべり, 粘弾性効果
Keywords: 2011 Tohoku-Oki earthquake, Seismicity change, Static and dynamic stress changes, Pore fluid pressure change, Postseismic slip, Viscoelastic effects

SSS01-P02 会場:コンベンションホール 時間:5 月 24 日 18:15-19:30

# 首都圏の地震発生予測モデルの構築に向けて：レトロスペクティブテストによる予測条件の探索とプロスペクティブテストの経過報告
# Three-dimensional earthquake forecasting model for the Kanto district:Results of retrospective and prospective tests

横井 佐代子[1*] ; 鶴岡 弘[1] ; 平田 直[1]
YOKOI, Sayoko[1*] ; TSURUOKA, Hiroshi[1] ; HIRATA, Naoshi[1]

[1] 東京大学地震研究所
[1]Earthquake Research Institute, Univ. Tokyo

関東地方は本州弧の地殻内からフィリピン海スラブ、太平洋スラブに関連した浅発および稍深発地震の活動が活発であり、地震発生頻度の高い「深さ」が存在する。そこで私達は、地震活動の評価に基づく地震発生予測検証実験の「関東領域」と比較可能な予測領域で発生する地震の経度・緯度・深さを精度よく予測する三次元地震発生予測モデルを構築することを目的として 2012 年から研究を開始した。これは、Relative Intensity モデル（以下、RI モデルとする。Nanjo, 2011）[EPS, 63 (3) 261-274] を土台とし、三次元地震発生予測モデルを作成するものである。RI モデルは過去の地震活動から将来の地震活動を予測する統計モデルなので、その予測は使用するデータ（地震カタログ）の質の影響を受ける。そこで、Maximum curvature method (Wiemer and Wyss, 2000) [BSSA, 90 (4) 859-869] により地震カタログの品質評価を行い、気象庁一元化地震カタログの下限マグニチュード（Mc）が 1980 年以降は 2 以下で時間的に安定していることを確認した。そこで、Mc の品質が良く、かつ 2011 年東北地方太平洋沖地震の直前である 1998 年 1 月 1 日から 2011 年 2 月 1 日の気象庁一元化地震カタログを使用してレトロスペクティブテスト（遡及的予測実験）を行い、三次元予測空間の分解能を 0.05°x0.05°x 5km とした。この空間分解能において RI モデルは二次元予測空間よりも良い予測成績を示した。次に、プロスペクティブテスト（事前予測実験）を開始した。第 1 回目の予測実験は、2015 年 2 月 1 日から 3 ヶ月間（5 月 1 日まで）の M 4.0 以上の地震とした。学習条件は、M 2.5 以上、平滑化半径は 7.5、10、20、50 km とし、期間は以下の 3 種とした。1) 1998 年 1 月 1 日－ 2011 年 1 月 1 日：2011 年東北地方太平洋沖地震前の気象庁一元化地震カタログの確定値。2) 1998 年 1 月 1 日－ 2014 年 8 月 1 日：気象庁一元化地震カタログの確定値のみ。3) 1998 年 1 月 1 日－ 2015 年 1 月 1 日：気象庁一元化地震カタログの確定値と暫定値。予測期間終了後（2015 年 5 月 1 日以降）に『地震活動の評価に基づく地震発生予測検証実験』（三次元地震発生予測モデル用に改良したもの）と同様の方法で評価する。本発表では、レトロスペクティブテストでの二次元と三次元予測空間における RI モデルの成績の比較、及びプロスペクティブテストの第 1 回目の予測を気象庁カタログの暫定値で検証した結果を示す。気象庁地震カタログを使用しました。記して感謝します。なお本研究は文部科学省受託研究「都市の脆弱性が引き起こす激甚災害の軽減化プロジェクト」の一環として行われています。

キーワード: 三次元地震発生予測モデル, 関東地方, レトロスペクティブテスト, プロスペクティブテスト, 地震活動の評価に基づく地震発生予測検証実験
Keywords: Three-dimensional forecasting model, Kanto district, Retrospective forecasting, Prospective forecasting, Collaboratory for the Study of Earthquake Predictability

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


SSS01-P03 会場:コンベンションホール 時間:5 月 24 日 18:15-19:30

# Collaboratory for the Study of Earthquake Predictability & Global Earthquake Model - Testing Center Software Development

Collaboratory for the Study of Earthquake Predictability & Global Earthquake Model - Testing Center Software Development

BEUTIN, Thomas[1*] ; LIUKIS, Maria[2] ; MAECHLING, Philip[2] ; MAK, Sum[1] ; SCHORLEMMER, Danijel[1] ; YU, John[2]
BEUTIN, Thomas[1*] ; LIUKIS, Maria[2] ; MAECHLING, Philip[2] ; MAK, Sum[1] ; SCHORLEMMER, Danijel[1] ; YU, John[2]

[1]GFZ German Research Centre for Geosciences, 14473 Potsdam, Germany, [2]Southern California Earthquake Center, University of Southern California, Los Angeles CA 90089, USA
[1]GFZ German Research Centre for Geosciences, 14473 Potsdam, Germany, [2]Southern California Earthquake Center, University of Southern California, Los Angeles CA 90089, USA

The Collaboratory for the Study of Earthquake Predictability (CSEP) aims to improve our understanding about the physics and predictability of earthquakes through rigorous and prospective testing of earthquake forecast models. CSEP operates four testing centers in California, New Zealand, Japan, and Europe running prospective, automated evaluations of more than 430 models. These testing centers are the technical infrastructure of CSEP and implement all procedures and protocols for rigorous testing and evaluation of earthquake prediction experiments. These experiments run in various testing regions and comprise forecast periods of one day to many years. The CSEP testing center software system is the general infrastructure of all CSEP testing centers and is now being used for earthquake early warning systems and geodetic transient detectors. The Testing and Evaluation Group of the Global Earthquake Model project at GFZ Potsdam is expanding the system to test intensity prediction equations and ground-motion prediction. We present the recent developments, the ongoing experiments, and introduce the structure of the software system.

キーワード: Earthquake forecasting, Seismic hazard, Statistical seismology, Earthquake statistics, Forecast testing, Software
Keywords: Earthquake forecasting, Seismic hazard, Statistical seismology, Earthquake statistics, Forecast testing, Software