The Analysis of Celestial Tectonics-generating Force’s Inducing Effect to the M7.3 Japan Earthquake on 9th, March 2011

Zhou Bo a*, Liu Xuejun a, Ma Weiyu2b

aKey Laboratory of Virtual Geographic Environment, Ministry of Education, Nanjing Normal University, Nanjing, CHINA
bChina University of Mining & Technology, Beijing, China
bo_lei_123@tom.com

Abstract

The paper studies the relationship between the earthquake and spatio-temporal changes of the addictive tectonics stress caused by the celestial tide-generating force (ATSCTF) about the M7.3 earthquake of Japan at 38.5ºN, 142.8ºE, and extracts the abnormal temperature increment before and after the earthquake by using the National Centers for Environmental Prediction (NCEP) data according to the ATSCTF’s time cycle. The analysis reveals that the time when the ATSCTF’s absolute value on P-axis and N-axis reached peak is same to the time of the earthquake’s occurrence, the abnormal temperature increment before the earthquake is obvious and the area of abnormal temperature increment mostly locates to the east of the epicenter, the minimum values’ spatial distribution of the ATSCTF on P-axis and N-axis mostly focused to the east of epicenter on the day earthquake occurred, at the same time, the unbalanced spatial distribution was similar to the abnormal temperature increment distribution, this phenomena testifies the ATSCTF’s inducing effect to the earthquake’s occurrence from another perspective.

Keywords: astro-tidal-triggering; abnormal temperature increment; imminent earthquake.

I . Introduction

An M7.3 earthquake occurred in Japan offshore (38.5ºN, 142.8ºE) at local time 11:45 on 9th, March 2011. The focal depth of the earthquake is about 35 kilometers. Temblor was felt hundreds of kilometers away in Tokyo. Although it only caused small damage and a small tsunami, as the precursor of the major earthquake on 11th, March, it has great significance to research on it.

Earthquake is the release of the earth's interior energy. When the plate’s tectonic stress reaches focus system’s critical state of the broken of rock, any external factor change may cause the earthquake’s...
occurrence. The celestial tide-generating force (CTF) is considered as an important one [1]. Based on this theory, the paper analyses the Japanese earthquake on 9th, March 2011 by calculating the ATSCTF before and after it about 60 days with the ATSCTF’s computing model and comparing the ATSCTF’s spatio-temporal distribution with abnormal temperature increment around the epicenter. It turns out that the time when the earthquake occurred is same to the time when the absolute value of CTF on P-axis and N-axis reached peak, the abnormal temperature before the earthquake is obvious and the spatial distribution of the CTF’s minimum values on P-axis and N-axis has the similar features with the abnormal temperature’s.

The Analysis of the Addictive Tectonic Stress of the Earthquake

The relation between the earthquake and the CTF has been studied for a long time [2]. According to the rock mechanics’ experiment result [3] that during the process of the solid rock’s cracking under the stress loading in different ways, some specific waves have the different distribution on the rock’s surface and the different evolution of periodicity in time, Weiyu Ma [4] proposed a CTF’s computing method which had the similar time cycle with the plate’s cracking.

According to the method, we decompose the CTF respectively along the direction of the focal mechanism (http://www.usgs.gov/): the main pressure (P-axis), the tension stress (T-axis) and the vertical position (N-axis). The three additive tectonic stress: \( w_P \) (correspond to P-axis), \( w_T \) (correspond to P-axis) and \( w_N \) (correspond to N-axis) can be worked out as showed in Fig.1.

The fluctuation of the CTF’s value on P-axis and N-axis is bigger than the value on the T-axis, it indicates that the CTF on P-axis and N-axis may be the dominant factors of the earthquake. The values of CTF on P-axis reached peak on 4th, March, and then decreased rapidly; on 7th, into negative; on 9th, in minimum value; the change of the CTF on N-axis is just opposite to P-axis’s. There is little change of the CTF on T-axis, the majority of the value is exactly zero. So we inferred that the CTF on P-axis and N-axis played a leading role in this earthquake’s occurrence.

The Evolution of Abnormal Temperature Increasing in Earthquake Region of Japan Trench

The abnormal temperature increment had been studied [5], the Russian Scholar Gorny [6] reported the thermal abnormal phenomena (10.5~12.5\( \mu \)m) before moderate earthquakes’ occurrence, Ouzounov and Freund [7] studied the abnormal temperature before the earthquake with MODIS data. But the infrared waves cannot penetrate clouds and the abnormal temperature may be affected by the terrain [8], so we use the NCEP data above sea level (1000hPa) to get the abnormal temperature increment. On the other hand, Tronic et al, studied the earthquake with statistics method [9], but the earthquake’s occurrence is only an incidental trifle, it can’t be studied with the routine statistics in strict data perspective.
Heaton T H [1] proposed that the change of CTF played a triggering role in the earthquake’s occurrence, when the tectonic stress reached the critical state of broken. Based on his theory, we use an analytical method subtracting the normal background image from a series of temperature images according to the CTF’s cycles (where the CTF values goes through maximum, a minimum and a maximum again) based on NCEP data. In this paper, on 4th,March 2011 (UTC 18:00) as normal background (the CTF value being at maximum), we subtract it from day by day the temperature values of 5–10,March for the same time, the same area and altitude. Thus we obtain a series of images showing the variations temperature (Fig. 2).

According to the theory of plate tectonics, the pacific plate rushes towards the bottom of Eurasian plate. The subduction zones formed Japan trench [10] and the Eurasian plate was uplifted then formed Japan island arc. Violent earthquakes usually happen at the subduction zones and the epicenter of this earthquake is at Japan trench. The pacific plate of Japan’s northeast region moves towards the mainland at a rate of 8~10cm every year, and the region of the Japan trench submerges towards the North America tectonic plates, when the motion reaches a certain limit, the partial plates will crack and the earthquake will occur [11].

In figure 2, some areas’ abnormal temperature could be observed near the epicenter on 5th,March, but temperature rise was very faint; On 6th,March, the area of abnormal temperature increment started to increase and the value of the abnormal temperature rose to 10°C, the phenomena started to enhance; On 7th,March, the area above 10°C expanded and moved towards the northeast, the phenomena reached peak; On 8th,March, the area of abnormal temperature suddenly reduced and focused at the epicenter, the phenomena of abnormal temperature increment decayed; On 9th,March, the abnormal temperature increment re-rose; On 10th,March, because the earthquake occurred and the energy released, the phenomena of abnormal temperature mostly disappeared. During the whole process, the temperature changing went through such stages as: initial growth (on 5th) →enhanced temperature increase (on 6th) →reaching peak (on 7th) →attenuation (on 8th) →earthquake occurred (on 9th) →return to normal (on 10th).

The Analysis of the Celestial Tide-generating Force’ Spatiotemporal distribution

In this paper’s section 2, we analyzed the ATSCTF’s changing on the time-axis, but how did the relation between the earthquake and the spatial distribution of ATSCTF? The values of ATSCTF on 28°N–48°N, 132°E–152°E are computed in order to study its characters of spatiotemporal distribution.
As showed in figure 3, the most minimum values of $w_P$ were on the area of $38\degree N \sim 48\degree N$, $141\degree E \sim 150\degree E$ and strip-shaped, but be more centralized on 8th, March. In figure 5, the minimum values of $w_N$ were also strip-shaped on 5th, March and 6th and started to change on 7th, March; On 8th, March, the minimum values were more centralized and the shape were rounder than the last day. In figure 4, the values near the epicenter obviously grew bigger but the shape didn’t have obvious character as the day earthquake approached. The temporal and spatial distribution of $w_P$ and $w_N$ had the same result with the result we got from the figure 2, the CTF on P-axis and N-axis played a leading role in the earthquake’s occurrence.

Conclusions

(1) This earthquake occurred at the time when $\partial P$ and $\partial N$’s absolute value of the epicenter reached the peak, the CTF has the biggest affection on the plate because the CTF’s components-$\partial P$, $\partial N$, $\partial T$ all had the
biggest value at this time. These phenomena testified the CTF’s inducing effect to the earthquake’s occurrence, and also showed that it was a successive accelerating progress.

(2) The images extracted from the NCEP data correspond well with the period of the CTF, the abnormal temperature rise process goes through: initial rise → enhanced temperature increase → reaching peak → attenuation → earthquake occurred → return to normal, the process may reveal the earthquake’s general process: micro crack → expand and crack → adjust structure → earthquake occur → return to normal. At the same time, the abnormal temperature images extracted with the CTF’s time period before the earthquake is obvious, it may indicate that the abnormal temperature rise before the earthquake is caused by the plate’s movement triggered by the changing of CTF, and the conjecture needs more evidence.

(3) The additive tectonics stress on P-axis and N-axis played a leading role in this earthquake’s occurrence, when the ATSCTF lost its balance on macro-distribution, the less symmetrically the ATSCTF exerted on plates, the easier it triggered earthquake to occur; the result implies that the $\vec{c}P$ and $\vec{c}N$ played a leading role in this earthquake’s occurrence is matched with the result we got from the curved line that the CTF changed with time, also matches with the tsunami’s occurrence soon after the earthquake. The $\vec{c}N$ is the force on the vertical direction, it implies that the ATSCTF did not only trigger the plate’s movement on the vertical position, but also enhanced the sea level upper of tsunami, the result needs more evidences to support.

(4) $\vec{c}P$ and $\vec{c}N$’s spatial distribution were similar to the abnormal temperature’s spatial distribution, the values to epicenter’s east of $\vec{c}P$, $\vec{c}N$’s spatial distribution was obviously shrink from 5th, March to 9th, March and especially on 6th, March and 7th, March, the phenomena reinforces the view that the CTF’s spatial distribution has some positive connection with the earthquake’s occurrence and the earthquake’s abnormal temperature increment before the earthquake.

References