Distinguish Mainshock from Foreshock with Polarity of Stress Field

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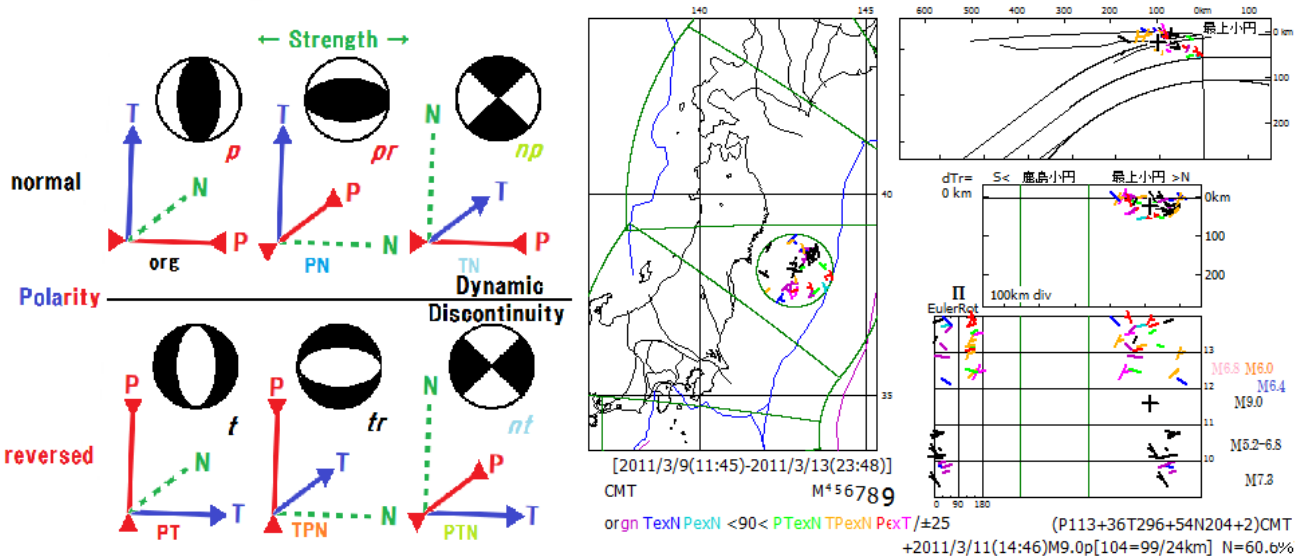
This presentation formalizes “Polarity of Stress Field” and points out the importance in dynamics, relating to distinguish Mainshock from Foreshock.
Focal mechanisms are important to understand dynamic process of seismic activities and available from Japan Meteorological Agency, around Japanese Islands.
Latteral changes in the type of focal mechanism can be observed, for example, normal fault type to lateral fault type in the Pacific Slab along Japan Trench after 2011/3/11East Japan Megaquake M9.0. The change can be explained by the axes change between neutral N axis & conpressive P axis, casued by reducing of vertical compressive stress less than horizontal N component with shallowing. We have to consider the axes exchange for the analysis on focal mechanism.
The difference of the focal mechanism can be quantified with Euler Rotation to fit the 3 orthogonal principal axes between reference and testing focal mechanisms. We can analyse focal mechanism with consideration on axes exchange, to compare not only original but also axes exchanged testing mechanism with reference.

Focal mechanism has 6 cases of principal axes position for fixed directions. The 4 cases can be realized with direct axes exchange. However exchange between compressive P and tensile T Axes reverses the polarity of stress field from the other direct exchange cases. Additional 2 cases need two-step axes exchange and have reversed polarity of stress field.
In the case of the axes exchange with the minimum Euler rotation angle is normal polarity of stress field, we use the Euler rotation angle as stress field polarity angle, but in the case of reversed polarity we use the subtraction of the Euler rotaion anagle from 180.
The reversal of stress field polarity represents dynamic discontinuity in space and time.The polarity might be kept until main rupture, corresponding to Mainshock of Earthquake.
Reversals of the polarity have been recognized just after the East Japan Mega M9.0, Hamadohri M7.0, Kumamoto M7.4 and Tottori M6.6 Earthquakes.
We conclude the polarity of stress field can be used to distinguish Mainshock from Foreshock.

Keywords: Polarity of Stress Field, Foreshock, Mainshock, Focal Mechanism, Principal Axes Exchange, Euler Rotation



Quantitative Analysis of Seismicity before Large Taiwanese Earthquakes Using G-R Law

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Since the seismicity was identified as one example of natural nonlinear systems of which the distribution of frequency and earthquake magnitude follows a power law called “Gutenberg-Richter (G-R) law”, the parameters of power law, i.e. the *b*- and the *a*-value, have been widely used in many researches about seismic hazards, earthquake forecasting model and many other topics. The plausibility of power-law model, or the applicability of parameter correspondingly, is crucial in these researches and is mainly verified by the statistical error σ of *b*-value in past, however, the effectiveness of σ remains doubtful. In this research, we used “*p*-value”, which was derived from an approach developed by Clauset et al. (2009), to deal with the problems mentioned above and had verified its effectiveness as a reliable plausibility index of the power-law model. Furthermore, we also verified the effectiveness of the K-S statistics as a goodness-of-fit test in estimating another crucial parameter, cut-off magnitude, which must be determined before estimating the parameters of power-law model.

Keywords: G-R law, Kolmogorov-Smirnov statistic, K-S test

Different performance of an earthquake model for different types of earthquakes?

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An earthquake probability model may perform differently for different types of earthquakes (shallow or deep, interplate or intraplate, fault types, etc.). Imoto et al. (2016) reported that the model for moderate earthquakes in Kanto, central Japan with the parameters of a and b values in the Gutenberg-Richter formula have been tested and resulted in a probability gain exceeding five for interplate earthquakes, but this is not the case for intraplate earthquakes. In this paper, we examine a model with the a-value parameter. We selected about 60 targets of moderate size that occurred in a zone between 5km above and 20km below the Pacific plate surface from 2000 to 2014. The a value is defined as the number of earthquakes with magnitude of 2. and larger that occurred within 20km in radius and ten years of the point of interest. Comparing two distributions of a-values, the conditional (point of a target earthquake) and the background distributions, the model may pass the L-test. However, the conditional distribution of interplate earthquakes differs from the expected distribution, suggesting that our model performs better for interplate earthquakes than for intraplate ones.

Keywords: Interplate earthquake, Moderate earthquake, a-value, Earthquake probability, Kanto, Japan

Earthquake recurrence parameters along Chile: zone and zone-less approach

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Chile is one of the most tectonically active countries in the world, where earthquakes of magnitude Mw>8.0 occur, on average, every 10 years. Estimating the probability of earthquake occurrence in time and space represents one of the most relevant steps for assessing probabilistic seismic hazard and other associated hazards. The aim of this study is to use different statistical techniques to assess earthquake recurrence parameters in Chile for apparent low frequency crustal events and higher frequency interplate and intraslab seismicity. In this work we study the relevance and effect of using different methods to fit the earthquake data assuming seismo-tectonic segmentation models or instead the zone-less approach based on a spatially smoothed seismicity. Based on a seismic catalog that spans over 100 years, we propose earthquake recurrence rates that can be used to assess seismic and tsunami hazard along Chile.

Keywords: Earthquake rates, Seismotectonic models, Spatially smoothed seismicity , Chile

Joint algorithm of multiple forecast models

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Complexity process and indirect observation make earthquake forecast difficult, but it is an important issue for the lives and property. Many theories are proposed to forecast earthquake, but they are more or less still under debate. However, probability is the most popular mode to describe what cannot predict deterministically such as weather. Through the probabilistic way, this study combines three different forecast models to improve performance. The first model is Pattern Informatics (PI) which analyzes the changing of seismic activity nearby epicenter before great earthquake occurs. The second one based on seismic recurrence considers seismic activity changing to discuss the probability for quiescence state by non-homogeneous Poisson forecast model. The third model is GEMSTIP algorithm that applies the time of increased probability (TIP) concept on the geoelectric monitoring system (GEMS). This model suggests that there are statistical correlations between the geoelectric system and earthquakes. Each model has its own property of resolution on space or time, and therefore we try to capture the merits from different models to increase the ability of forecast.

Keywords: forecast, Pattern Informatics, quiescence, geoelectric, seismic activity

Gravity effect before Lijiang 7.0 earthquake In 1996

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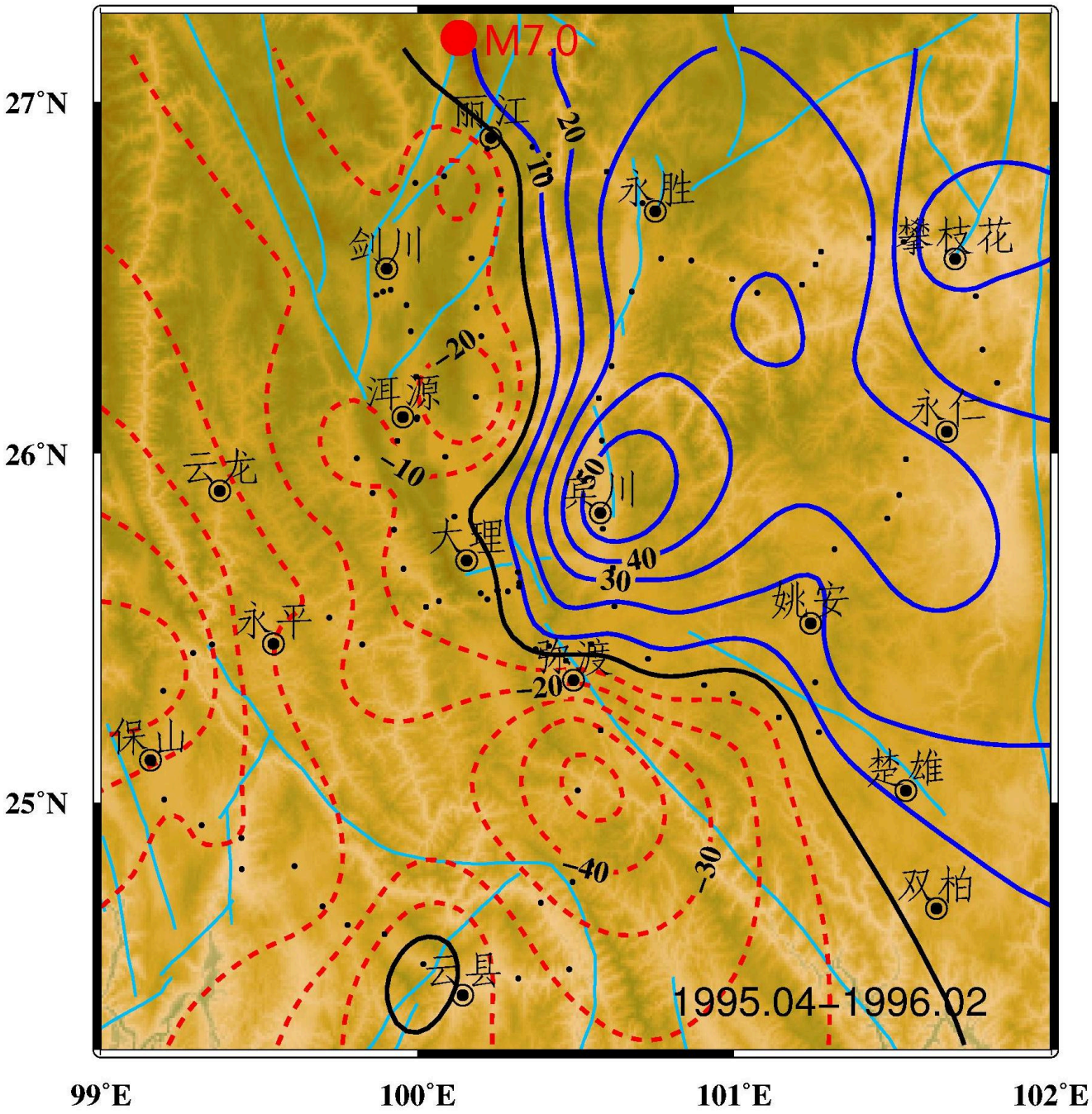
In this study, gravity data before Lijiang 7.0 earthquake in 1996 are adjustmented to a unified benchmark, gravity change image before the earthquake are analyzed, the results show: before the earthquake, during 1989.02-1992.04 (figure a), gravity cumulative changes smoothly, and within 30 x 10^{-8} ms^{-2}; During 1992.04-1995.04 (figure b), gravity cumulative change is very severe, in the process of that gravity changes from positive to negative from south to north, by the trend in the northern part of the studied area appeared $70\times10^{-8}ms^{-2}$ local gravity anomaly zone, abnormal zone diameter greater than 150 km. From the perspective of a 6 years scale 1989.02-1995.04 (figure c), the gravity accumulation of positive - negative differences still exist, gravity cumulative change is more intense, and along the line crossing Eryuan, Dali, and Midu, the gravity change with positive and negative differences, positive and negative difference maximum $150\times10^{-8}ms^{-2}$; During 1995.04-1996.02 (figure d), the gravity changes reverse, the earthquake occur in the process of reverse gravity changes.

Keywords: gravity change, Lijiang, earthquake



The Comprehensive Analysis and Research of Recent gravity and the Crustal Deformation in Northeastern edge of the Tibetan Plateau

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In this study, we systematically analyzed the relationship between regional gravity changes, 3D crustal deformation, regional tectonic environment and strong earthquakes based on the relative gravity measurements (2011-2014), GPS data and the background vertical deformation from the leveling measurements conducted from 1970 to 2011. Subsequently, we further characterized the temporal-spatial patterns and discussed the mechanism of regional gravity changes and the crustal deformation. It can be summarized in the following: 1) The regional gravity changes, the GPS-derived horizontal deformation and the vertical deformational obtained from leveling data showed a intense spatial relationship: the gravity increasing along with the direction of horizontal movement, and the gravity decreasing with the crustal uplift and vice versa, which reflected the inherited characteristics of neotectonic activities. 2) The crustal deformation was closely related to the active faults. The contour lines of gravity changes and vertical deformation were generally along with the Qilian-Haiyuan fault (strike is NWW), and the crustal horizontal deformation showed left-lateral strike slip motion near the Qilian-Haiyuan fault. 3) The strong earthquakes usually occur in the active faults where the gravity changes intensely, as well as the vertical and/or horizontal deformation is intensely. The extrusion deformation, surface compression rate and gravity changes were obvious near the epicenter of 2016 Menyuan Earthquake. The 2013 Minxian M*s*6.6 earthquake occurred in the direction-turning area of intense gravity gradient, and the transitional area of surface compression and vertical deformation. The first author of this paper has made a medium-term forecast before the Minxian and Menyuan earthquakes, especially the location of the earthquake. Based on the above understandings, we emphasized that: there are still possibilities of strong or huge earthquakes within medium-long term in parts of crustal deformation anomalies in the study area.

Keywords: Northeastern edge of the Tibetan Plateau, gravity change, leveling measurement, Tectonic activity

