Retrospective Study on the Predictability of Pattern Informatics to the Wenchuan M8.0 and Yutian M7.3 Earthquakes

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Two large earthquakes occurred in the western part of China in 2008, one of them is the Yutian (35.6°N, 81.6°E) M7.3 earthquake which occurred on Mar. 21 (BJT), the other is the Wenchuan (31.0°N, 103.4°E) M8.0 earthquake which occurred on May 12 (BJT). In this paper, the West Continental China (included in the region of 20.0° ∼ 50.0°N, 70.0° ∼110.0°E) was taken as the studied region to verify the predictability of the Pattern Informatics (PI) method (Rundle, 2000) by the Receiver Operating Characteristic (ROC) test and R Score test. The different forecasting maps with different calculating parameters were obtained. The calculating parameters are the grid size Δx, base time t_b, reference interval t_b to t_1, change interval t_1 to t_2, and forecasting interval t_2 to t_3. In this paper, the base time t_b is June, 1971, the ending forecast time t_3 is May, 2008, and the forecasting interval t_2 to t_3 changing from 1 year to 10 years, and the grid sizes are chosen as 1°×1° and 2°×2°, respectively. The following conclusions are obtained:
(1) PI method has much higher forecast efficacy than the random forecast under quantitative ROC test and R Score test. It is really an optimal method for long term earthquake forecast.
(2) For large earthquakes like Yutian M7.3 and Wenchuan M8.0 earthquakes, taking the grid size of 2°×2° and forecast window of 8-9 years could raise the forecast efficacy, and Yutian M7.3 and Wenchuan M8.0 earthquakes could drop in the hotspots. The essence of this conclusion may be that larger earthquake has bigger critical seismogenic size and longer seismogenic time. For example, Bufe et al. (1993) give the relationship between the critical seismogenic size R and the magnitude M as $\log R = -0.2 + 0.36M$. By this formula, when $M \geq 5$, $R \geq 40$km, and when $M \geq 7$, $R \geq 209$km. So models with 2°×2° grid size are better in forecasting larger earthquake than those with 1°×1° grid size. In Holliday's model (Holliday et al., 2005) with grid size of 1°×1°, the Yutian M7.3 and Wenchuan 8.0 earthquakes did not dropped in the hotspot map. According to our systematically retrospective study, the hit rate of Holliday's may be raised by modulating the grid size from choosing 1°×1° to 2°×2°. Further study is valuable to undergo to verify if Rundle's model with 0.1°×0.1° box in forecasting $M \geq 5.0$ earthquakes in California region (Rundle et al., 2002, Tiampo et al., 2002, Holliday et al., 2005) could be improved by modulating the grid size from choosing 0.1°×0.1° to 0.4°×0.4°.