Detecting Pre-Earthquake Anomalies by PI Method, from Crust to Space

Zhang, Y. [1], Song, C.[2], Zhang,X. [1], Xia, C.,[3], Maimaitusun N.[4], Wu, Y.[1]

1 *China Earthquake Networks Center, Beijing 100045, China*
2 *Tianjin Earthquake Agency, Tianjin 300201, China*
3 *Liaoning Earthquake Agency, Shenyang 110031, China*
4 *Earthquake Agency of Xinjiang UygurAutonomous Region, Urumqi 830011, China*

Seismic anomaly usually behaves as seismic quiescence or seismic activation. In order to detect pre-earthquake anomaly from earthquake catalogue, Pattern Informatics method was developed by Rundle et al. (2002). The subsequent studies in many regions of the world show that PI could be a positive method for detecting seismic anomalies prior to big earthquakes in time scale of several years to ten years, which indicating itself as a medium-term to long-term earthquake forecasting method. In this study, PI method was modified and applied to ionospheric data observed by DEMETER satellite. The objective is to see if ionospheric perturbation could be detected by PI method and if PI method could be a short-term earthquake forecasting method.

Pattern Informatics was modified and applied to ionospheric data observed by DEMETER satellite. In order to construct the ionospheric data such as the total electronic content (TEC) in each grid, the observed data was preprocessed by Kriging Interpolation. The residual error between observed data and the fitting data by Kriging Interpretation were used as the input data of modified PI method to detect the ionospheric perturbation before large earthquakes such as Wenchuan M8.0 earthquake.

The result shows that ionospheric perturbation detected by modified PI method occurred several months before Wenchuan M8.0 earthquake, and the perturbation process lasted for tens of days, which indicates that the modified PI method could also be a positive short-term forecasting method for large earthquake. On the other hand, seismic anomaly detected by PI method occurred about ten years before Wenchuan M8.0 earthquakes, and the PI anomaly lasted for several years.

PI method could be applied to many kinds of observed data for detecting pre-earthquake anomalies. The results of seismic anomaly detected by PI method and ionospheric perturbation detected by modified PI method before Wenchuan M8.0 earthquake show that PI method is a positive method for not only a long-term earthquake forecasting method but also a short-term earthquake forecasting method, depending on the observed data.