第 39 回統計地震学セミナー
2014/1/14(火), 13:00 – 17:40
セミナー室４　D312B

13:00 – 14:00

1. **Inversion of GPS Data using ABIC**
   Mitsuhiro Matsu'ura (The Institute of Statistical Mathematics)

14:10 – 15:10

2. **Detecting the regional tectonic stress variations in background seismicity data through statistical earthquake modeling**
   Shiyong Zhou (Peking University, China)

15:30 – 16:30

3. **Estimating the likelihood of volcanic eruptions with incomplete eruption record**
   Wang Ting (University of Otago, New Zealand)

16:40 – 17:40

4. **Foreshocks and short-term forecasting: comparisons between in real seismicity and synthetic catalogs**
   Yosihiko Ogata (The Institute of Statistical Mathematics)

Abstracts

Inversion of GPS Data using ABIC

Mitsuhiro Matsu'ura
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To monitor crustal movements of the Japanese Islands, a nation-wide dense GPS network (GEONET) has been operated by Geographical Survey Institute of Japan (now Geospatial Information Authority of Japan) since 1996. We developed an inversion method to estimate unbiased interseismic slip-deficit rates at plate interfaces from GPS displacement rate (velocity) data with an elastic dislocation model. In this method, first, we subtract theoretical surface velocities due to known steady relative plate motion from the observed GPS data, and presume the residuals to be caused by slip deficit at plate interfaces. However, the observed GPS data always include rigid block translation and rotation, which cannot be explained by the elastic dislocation model. We treated the

rigid block translation and rotation as systematic errors in the analysis, and removed them by transforming the velocity data into the average strain rates of triangle elements composed of adjacent GPS stations. By this transformation, original information about intrinsic deformation is preserved. Applying a general inversion formula using ABIC to the GPS strain data, we can obtain unbiased slip-deficit rate distribution. We demonstrate the applicability of the GPS strain data inversion method through the analyses of coseismic and interseismic GPS data in the Japan region, where the North American, Pacific, Philippine Sea, and Eurasian plates are interacting with each other in a complicated way.

Detecting the regional tectonic stress variations in background seismicity data through statistical earthquake modeling

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Large earthquakes could perturb the stress field in regions even thousands of kilometers away, leading to abrupt changes in background seismicity. We have developed a probability based approach, based on the epidemic-type aftershock sequence model and the stochastic declustering method, to invert the smoothed temporal variation of background seismicity rate and to extract useful physical signals from complex seismicity patterns. An iterative algorithm is constructed to estimate the background seismicity simultaneously by using a combination of maximum likelihood estimate and weighted variable kernel estimate. We verify this approach through simulations and confirm that it can sensitively recover the onset of dynamic triggering.

The algorithm is applied to an earthquake catalog in Yunnan Province, China, and successfully identifies a rapid increment of background seismicity rate following the occurrence of the 2004 Sumatra Mw 9.2 earthquake, whereas no remote triggering effect is detected following the occurrence of the 2005 Sumatra Mw 8.7 earthquake. This phenomenon agrees with GPS observations. It is found that the elevated seismic activity within 15 d after the Sumatra earthquake is mostly composed by shallow events, and direct triggering relationship is well established.

We also studied the possible dynamic triggering effect in Northern China, including Tangshan area, when the Japan Tohoku Mw 9.0 earthquake happened at March 11th,

2011 and found out whether the area with large co-seismic displacement would have sudden abnormal seismicity increase. As a result, the Japan Tohoku earthquake has little effect on the total and background seismicity of Tangshan area, which means that the seismic structure of Tangshan area is fundamentally stable.

Foreshocks and short-term forecasting: comparisons between in real seismicity and synthetic catalogs

Yosihiko Ogata and Koichi Katsura (*The Institute of Statistical Mathematics*)

Some statistical characteristics of foreshocks in the JMA earthquake catalog are quantitatively different from those in the catalogs simulated by the space-time epidemic-type aftershock sequence (ETAS) model associated with the Gutenberg-Richter (GR) law. Also, the information gain of a foreshock probability forecasting in the real seismicity is significantly large in comparison with in synthetic catalogs.