Report on visit to ERI: from 21 May to 20 June, 2010

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During my one month stay at the Earthquake Research Institute and, I worked with Dr. Kazuyohsi Nanjo and engaged in the following research-related activities:

For academic exchanges: (1) JpGU 2010 meeting from May 22~27, I contributed an invited talk in the session "Global Collaborative Earthquake Predictability Research" which chaired by Prof. Naoshi Hirata and Dr. Nanjo etc.; (2) and the "International Workshop on Statistical Seismology" organized by Prof. Yosi Ogata and Dr. Jiancang Zhuang at the Institute of Statistical Mathematics (ISM) on May 31. I have an oral presentation titled "The background seismicity of Ordos block in China" in this workshop.

We focused on Accelerating Moment Release (AMR) case study due to it has not been discussed so far in Japan. Actually, whether seismic moment release before great earthquakes exhibits accelerating or quiescence behavior is still one of the controversial topics in the study of intermediate-term earthquake forecast or time-dependent seismic hazard. For the criteria of cases selection we considered the focal mechanism, the depth distribution of main shock and pre-shocks, characteristics of regional seismic activity and the tectonic background. As the typical cases in this study, the 2005 Miyagi M_w7.2 and 2008 Iwate-Miyagi Nairiku M_w6.9 earthquake which happened in Iwate region were investigated. We fit the cumulative Benioff strain with a linear function and a power law function, respectively. The power law function is expressed by $\Sigma S = A + B(t_0 - t)^m$, similar to Bufe and Varnes (1993). In this equation, m is the scaling coefficient and if it is less than 1, then the curve is accelerating-like. We consider the distribution of m-coefficient in the (T, R, M_C) space (see Figure 1), to explore the variation of moment release behavior with temporal window length T and spatial window radius R centered at the nucleation point, and cutoff magnitude M_C of the catalogue in use. The result shows that the 2005 Miyagi M_w7.2 earthquake have a significant and stable AMR before it happened, and also shows the critical-point-like process clearly when sliding a 10 yrs fixed time window with different failure time t_f as shown in Figure 2. But the 2008 Iwate-Miyagi Nairiku Mw6.9 earthquake shows a negative result, maybe it can be attribute to the significant difference in regional seismic activity and tectonic background compared to 2005 Miyagi earthquake. We also discussed the scaling law of AMR spatial range versus mainshock magnitude by investigating the previous study results, the position of 2005 Miyagi M_w7.2 earthquake as shown in Figure 3. In summary, our results revealed that maybe a significant regional feature related to AMR can be observed before strong earthquake in Iwate region, but still needs more investigation.

Additionally we shared the experiences and ideas of testing forecast models under global collaboration and the construction of CSEP testing center in Japan and China. I am looking forward to further cooperation in this field.

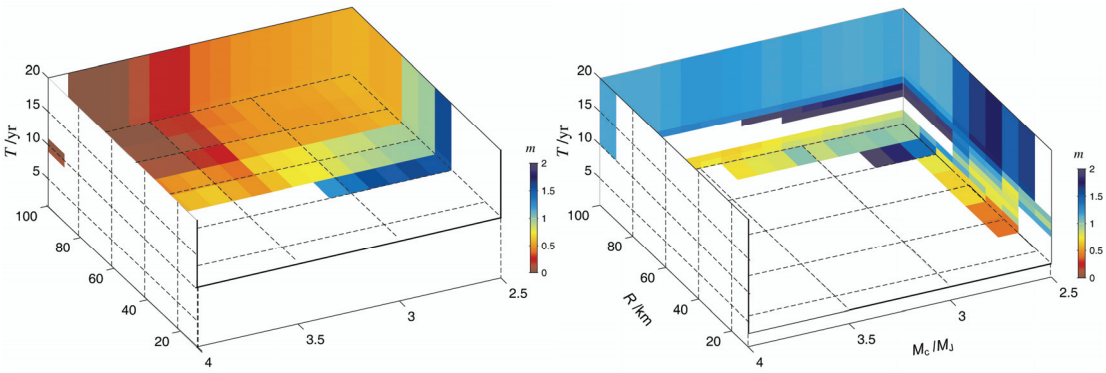

Figure1: Distribution of m value over the (T, R, M_c) space for 2005 Miyagi M_w7.2 earthquake (left) and 2008 Iwate-Miyagi Nairiku Mw6.9 earthquake (right). The blanks denote that the number of earthquakes within the spatial-temporal range is less than 5 or RMS residuals exceeding the limitation.

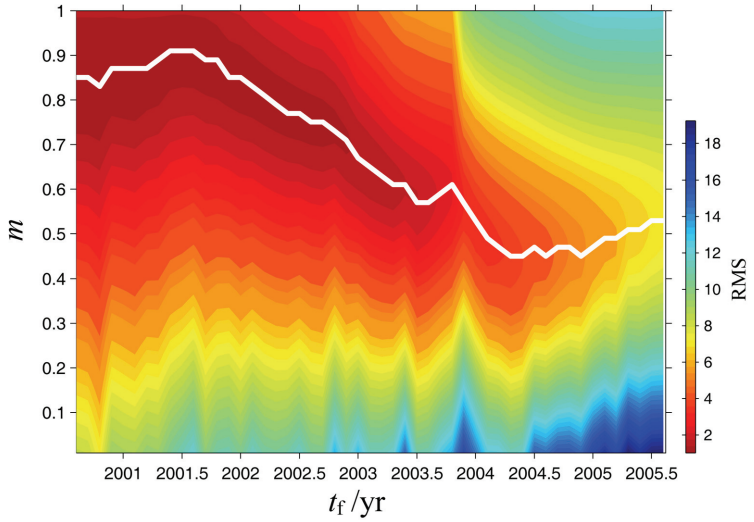

Figure 2: RMS residuals of the power law fit over the (t_f, m) space with T=10yr, R=100km and M_c fixed as M_L3.0 for 2005 Miyagi M_w7.2 earthquake. The white curve shows the track of the minimum RMS when sliding with different t_f.

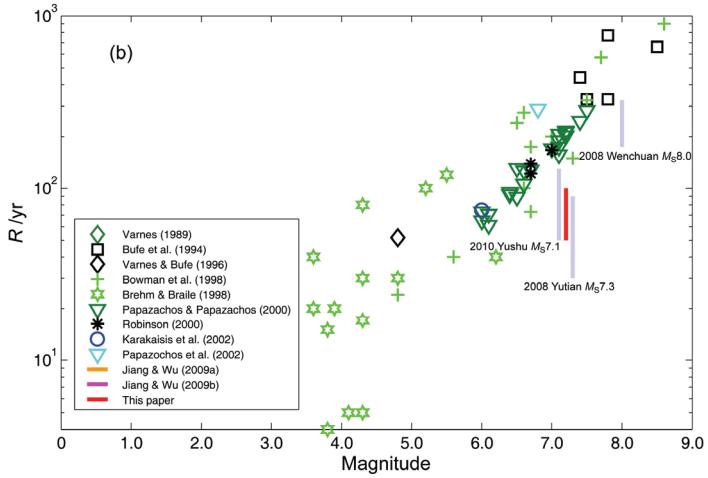

Figure 3: AMR spatial range and Magnitude Distribution of 2005 Miyagi M_w7.2 earthquake compare to other cases.