Report of Research Activity

Earthquake Research Institute (ERI), University of Tokyo, July 11 – August 8 /2017
Osvanny Ramos, University of Lyon 1, France.
ERI host: Prof. Takahiro Hatano

The work during the first week focused on several discussions with Hatano-san with the aim of identifying the specific projects where we can build a fructiferous collaboration. Given the fact that Hatano's main expertise is simulations while mine is experiments, tackling a common question with both experiment and simulations was an easy choice. One question to study corresponds to understanding the *evolution of the b-value* both prior to large events and when the pressure between the plates is modified. Both research teams have already obtained preliminary results in these subjects. Understanding the presence of *quiescence* in our experiments was another question to work on.
Trying to simulate our experimental system, which is able to reproduce the main laws of seismicity, was another point of discussion. However, the non-spherical shape of our particles requires other algorithms that the one used by Hatano-san, so this may be a future joint work.
Focusing exclusively on simulations, the *influence of dissipation on the b-value* is well illustrated in the OFC cellular automata model of earthquakes. It is also known that the spatial correlation function does not give a right measurement of the correlation length, which may diverge if the system is critical. We plan to find a proper way to calculate the correlation length in the system in order to analyse its critical properties. As criticality may imply intrinsic unpredictability, we would like to *understand the relations between dissipation, exponent values, critical properties and predictability* in this simple model, but also in a more general scenario.

The morning of the 20th of July I gave a seminar at the ERI with the title "Modelling earthquakes with a granular experiment" where I introduced our experiment, which is able to reproduce the main laws of seismicity. Professors and students both from Geophysics and Physics communities were present and the discussion was very rich. Professors from the Nihon University (Akio Nakahara) and Aoyama Gakuin University (Hiroshi Matsukawa) also attended and stayed later for a more detailed discussion of our respective works. The gathering was the opportunity to visit the experimental facilities of Hatano-san and discuss his experimental works in collaboration with Osamu Kuwano and related to granular friction.
The afternoon of the same day I attended the "Slow Earthquakes Café" with the seminar of Kevin Chao (Northwestern University, USA). The discussions continued in the "Slow Earthquakes Bar" where I had the opportunity of having informal discussions with the speaker, but also with Prof. Kazushige Obara (director of the ERI) and other young researchers from the institute (Akiko Takeo and Yoshiyuki Tanaka). Both the seminar and the discussions were essential to my introduction into the nature of slow earthquakes but also into the current interest and works of a relevant advancing front of the Geophysics community.

My knowledge about slow earthquakes (but also ordinary ones) got a lot richer from studying recent papers and daily discussions with Hatano-san, but also thanks to two events: a second "Slow Earthquakes Café" and the open-doors event at the ERI. The first one took place at the University of Kobe the 29th of July and the speaker was Prof. Chris

Marone (Pennsylvania state University, USA). The subject was experimental efforts trying to simulate the nature of slow earthquakes. The open-doors event at the ERI (August/02) was a nice opportunity to discuss with geophysicist and geologist were I focused my questions on the capabilities of measurement apparatus (resolution of GPS data, seismometers, data analysis, etc).

The rest of the time was mainly devoted to advance the work related to simulations on the OFC model and trying to understand the results in a more general scenario. The necessary steps to reach our goals were identified as well as a work plan related to the work of Victor Levy Dit Vehel (PhD under my supervision), which will work both in the experimental tasks and in the OFC simulations. Victor, who was spending his summer holidays in Tokyo, visited the ERI the afternoon of the 28th of July where we discussed the future work and possibilities of future stays at the ERI, in order to reinforce our collaboration with Hatano-san. Discussions with Subhadeep Roy (postdoc with Hatano-san) were also very interesting. His expertise is simulations on fibre-bundle models; and besides the discussions of his former and current work, we discussed the possibilities of analysing how disorder may affect the crack speed in a subcritical scenario, where we have some experimental results.

Besides the work at the ERI, this invitation was also a springboard to visit other labs in Japan: the Akio Nakahara lab at the Nihon University (Chiba) and Tetsuo Yamaguchi lab at the University of Kyushu (Fukuoka).

The stay at the ERI was extremely valuable from a scientific perspective and soon we will have publications acknowledging it. From a personal point of view it was also a wonderful experience. Many thanks to Hatano-san for his invitation and welcoming and to the ERI for supporting it. Many thanks also to Yuko Yamada for all the help, as well as Yukiko Okuno from the Oiwake residence. Thanks also to the organisers of the “Slow Earthquake Cafés” and all the researchers I had the opportunities to discuss with.