

Report on Sigurjón Jónsson's stay at the Earthquake Research Institute, University of Tokyo, from 10 October to 19 November, 2005

Following an invitation from Prof. Kato and Dr. Miyazaki I stayed at the Earthquake Research Institute (ERI), University of Tokyo, from 10 October to 19 November, 2005, when I returned back to ETH Zurich, Switzerland. Below is a short report on my activities during my visit to the ERI.

Research Activities

During my stay at the ERI, University of Tokyo, I mostly worked on three different research projects. All these studies are still in progress and below I briefly describe them.

In the first project I was actively collaborating with Dr. Shinichi Miyazaki (ERI) on studying the 20 March 2005 Fukuoka earthquake. The aim of this project is to estimate the source parameters of the earthquake using both Interferometric Synthetic Aperture Radar (InSAR) data and 1-Hz GPS data, but such data combination has never been tried before. In more detail, the co-seismic data consist of two radar interferograms from the Envisat satellite, co-seismic offsets measured by continuous GPS stations of the Japanese GEONET network, and co-seismic displacements of campaign GPS stations (these data were provided by the Geographical Survey Institute). These data provide constraints on the fault location, geometry, and the distribution of slip on the fault plane. In addition, waveforms from 1-Hz GPS data sampling will be used to constrain the rupture process of the earthquake. One of the pressing questions that we hope to address in this project is on the level of stress increase that this earthquake caused on the eastward continuation of the co-seismic fault, which lies beneath the city of Fukuoka, and could potentially be a source for a future earthquake.

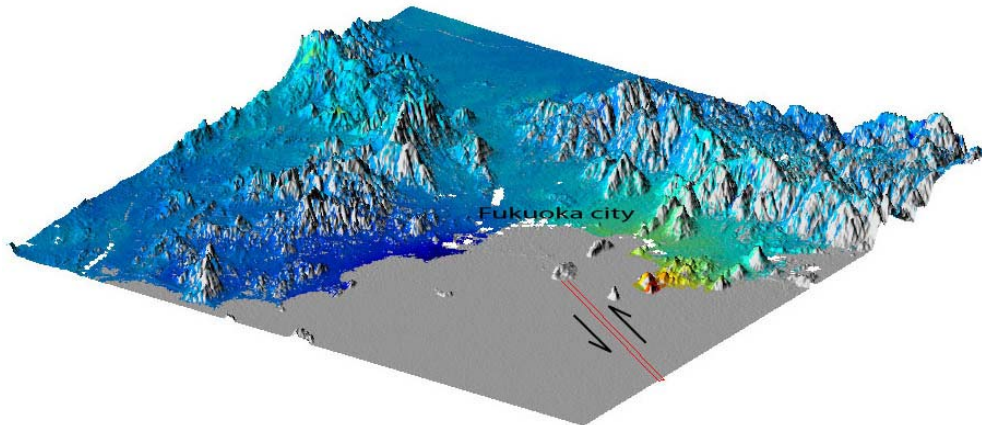


Figure 1. InSAR data showing the Fukuoka co-seismic deformation draped over a digital elevation model, view from northwest towards the southeast. Yellow-red colors indicate uplift towards the radar satellite (maximum is ~10 cm), while dark-blue is subsidence.

The second project that I worked on during my stay at the ERI deals with errors in InSAR data. Most scientists using InSAR data ignore spatial correlations in the data, which leads to biased model parameter estimations. Therefore, it is important to study how large this bias can be and how we can estimate these spatial data correlations in praxis. I carried out multiple simulations of simple fault model inversions, both with and without the inclusion of data covariances. Preliminary results show that including the full covariance matrix of InSAR data can result in up to 40% improvement in model parameter estimations.

The third and final project I worked on during my stay at ERI is a study on the Sierra Negra volcano, Galápagos. This volcano erupted during 22-30 October, 2005, for the first time since a large eruption took place in 1979. In this project I'm investigating deformation observations from InSAR and a small continuous GPS measurement network which have revealed an extraordinary pre-eruption activity. The recorded uplift during the last decade before the eruption amounts to several meters and rates of up to 20 cm/month were detected. The inflation appears to be caused by magma accumulation at only 2 km depth under the caldera floor

of Sierra Negra. The long duration of pre-eruption uplift was punctuated at least two times by trapdoor faulting, where the caldera floor “popped” upward, decreasing the magma pressure and possibly delaying the eruption. However, a new eruption did start on October 22 and the detected co-eruption deformation is also very impressive, showing several meters of relative displacements between the continuous GPS stations spaced only 5-6 km away from each other.

Meetings and Presentations

During my first week in Tokyo I gave a presentation at the ERI's Friday seminar entitled “Do InSAR and teleseismic data agree on the source parameters for the 2003 Bam (Iran) earthquake?”. The talk was well attended and many questions from the audience sparked a fruitful discussion after the presentation.

I attended three scientific meetings during my stay in Japan. The first meeting was the annual conference of the Seismological Society of Japan (SSJ). It was held in Sapporo during 18-20 October. The second meeting was the “2nd International workshop on strong ground motion prediction and earthquake tectonics in urban areas” organized by the ERI and the Southern California Earthquake Center (SCEC). This workshop took place during 25-27 October at the ERI. In addition to these two meetings I attended a one-day workshop at the Japanese aerospace exploration agency (JAXA) on the Japan's ALOS radar satellite that will be launched soon. The title of this workshop was “InSAR technology workshop in Japan: Foresight of InSAR toward the ALOS/PALSAR” and it was held on 18 November at JAXA's Earth Observation Research and Application Center (EORC) in Tokyo.

Private Experience

For me personally it was a very exciting experience to be able to spend several weeks in Tokyo. I originally come from a small village of 120 people in northern Iceland, so spending time in Tokyo can hardly be more different than staying in my small village. In my spare time I explored many different neighborhoods of Tokyo, including Asakusa, Akihabara, and Shinjuku, and visited many interesting places within the city, such as the Senzo-ji shrine, the Tsukiji central fish market, and the Hama Rikyu Onshi-teien garden. After attending the SSJ meeting in Sapporo, I also had the chance to visit Daisetsuzan national park and climbed the highest peak in Hokkaido, Ashidake (2290m). Finally, I really enjoyed exploring the various aspects of Japanese culture and traditions, including some of the excellent specialties of the Japanese cuisine, such as sukiyaki, okonomiyaki, Genghis Khan BBQ, sushi, udon, etc.

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