BATS and Broadband Seismology in Taiwan

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“A decade+ of research on earthquake science at Taiwan Earthquake Research Center: Now and Beyond”
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Seismology is a science based on data called seismograms. The great progress made in seismology in the past hundred years has been stimulated principally by the availability of steadily improving data.
It all started in the 1992 IRIS/SSA meeting...

• Prof. Wang-Ping Chen, Francis T. Wu, and Ta-Liang Teng started the discussion of establishing a broadband seismograph network in Taiwan.

• Prof. Wang-Ping Chen took the main responsibility of preparing a document that was formally approved by the IES’s Advisory Committee Meeting in June 1992.

• Dr. Honn Kao joined IES in 1993, and headed a group of technicians to begin the construction of a broadband seismograph network in Taiwan, later known as the Broadband Array in Taiwan for Seismology (BATS).
High-Quality Site Condition and Construction

- Inside caves or abandoned tunnels
- Rock sites
- Low natural and cultural noise
High-Quality Instruments and Data

Streckheisen STS-1

3-comp STS-1 at TDCB

1 day

1996/5/02 – 1996/5/05 at TDCB

Streckheisen STS-2

24-bit Quanterra Data Logger (Q630 and Q4120)
High-Quality Data Service

- BATS data distribution service began in 2001 via the Data Management Center of IES (DMC-IES).

- BATS data service was later expanded to include other seismological products (e.g., BATS QCMT).

- With the establishment of TEC Data Center in 2006, seismological data service in Taiwan has become even more comprehensive and efficient.
Regional Moment-Tensor Solutions and Seismotectonics of Taiwan

Kao and Chen (2000)

Kao et al. (2001)
Real-Time RMT Solutions

http://tecws1.earth.sinica.edu.tw/AutoBATS/
Jian et al. (2018)

http://rcs.earth.sinica.edu.tw/
Lee et al. (2014)
Coulomb Stress and local Seismicity Rate
(Ma and Chan, 2005)

Non-volcanic Tremors and Low-frequency Earthquakes
(Peng and Chao, 2008; Tang et al., 2010, Sun et al., 2015)
Earthquake Physics (2)

Repeating Earthquakes
(Chen et al., 2007, 2009)

Rupture Process
(Lee et al., 2016)
Crustal and Lithospheric Structures

- **3D tomography**
  - (Wang et al., 2006; Huang et al., 2014)

- **Receiver function inversion and Moho depth**
  - (Wang et al., 2010)

- **Inference of a subducted slab beneath central Taiwan from waveform and travel time anomalies**
  - (Chen et al., 2004)

- **3D tomography**
  - (Wang et al., 2006; Huang et al., 2014)
Surface Wave Dispersion and Ambient Noise Tomography

Hwang and Yu (2005)  
You et al. (2010)  
Huang et al. (2012)
Seismic Anisotropy

SKS splitting (Huang et al., 2006)

SKS/SKKS splitting (Kuo-Chen et al., 2009)

Huang et al. (2015)
Geohazard Monitoring

Landslide modeling
*(Lin et al., 2010)*

Near-real-time landslide monitoring
*(Kao et al., 2012)*

Studies of the Tatun Volcano Group
*(Lin et al., 2005; Konstantinos et al., 2007)*
Some Final Remarks

• Innovation has nothing to do with how many R & D dollars you have. When Apple came up with the Mac, IBM was spending at least 100 times more on R & D. It's not about money. It's about the people you have, how you're led, and how much you get it. -- Steve Jobs

• As scientists, we step on the shoulders of science, building on the work that has come before us - aiming to inspire a new generation of young scientists to continue once we are gone. -- Stephen Hawking

• Good luck is when opportunity meets preparation, while bad luck is when lack of preparation meets reality. -- Eliyahu Goldratt


References