

Chunquan Wu

Curriculum Vitae

Geophysics Group
Los Alamos National Laboratory
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LANL, Los Alamos, NM, 87545

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Education

Ph.D. in Earth and Atmospheric Sciences, August 2011
Georgia Institute of Technology, Atlanta, GA
Thesis: Fault Zone Damage, Nonlinear Site Response, and Remote Triggering Associated with Seismic Waves.
Advisor: Professor Zhigang Peng

M.S. in Earth and Atmospheric Sciences, August 2007
Georgia Institute of Technology, Atlanta, GA

B.S. in Geophysics, June 2005
Peking University, Beijing, China

Research Interests

Nonlinear Ground Motion, Fault Zone Damage
Temporal Changes of the Earth's Properties
Dynamic Triggering of Earthquakes
Spatio-Temporal Seismicity Patterns
Repeating Earthquakes
Non-volcanic Tremor

Research Experience:

Research Associate, Feb 2012–present: Geophysics Group, Los Alamos National Laboratory.
Postdoctoral Fellow, Aug 2011–Feb 2012: Dept. of Earth and Atmospheric Sciences, Georgia Institute of Technology.
Research Assistant, Aug 2005–Aug 2011: Dept. of Earth and Atmospheric Sciences, Georgia Institute of Technology.

- **Seismic Monitoring of Fault Zone Damage (Jan. 2007-August. 2011)**

Analyzed the spatial/temporal evolutions of the damage along the North Anatolian fault that ruptured during the 1999 Izmit and Duzce earthquake sequences in Turkey; Developed an innovative sliding-window spectral ratio method in faults zone imaging & monitoring.

- **Nonlinear Site Response (May. 2008-Oct. 2012)**

Performed a systematic survey of nonlinear site response vs. site conditions at 69 sites in Japan and 3 sites in California; Improved the geophysical/geological profiles for each site; Identified a refined

threshold of soil nonlinearity, which is crucial in earthquake hazard mitigation & geotechnical/structural engineering.

- **Dynamic Triggering (Oct.2009-present)**

Identified and located the local seismicity triggered by stress perturbations of passing seismic waves in intraplate region & geothermal fields; Modeled a triggering mechanism based on friction failure for the dynamically triggered seismicity.

- **Foreshock Activities (August.2011-present)**

Detected 12 times more foreshocks than listed in the catalog in the source region of the 1999 Duzce earthquake using the match-filter technique.

- **Non-volcanic Tremor (August.2011-present)**

Found triggered Non-volcanic Tremor in Taiwan and Identified spatial-temporal pattern of low-frequency earthquakes in Parkfield, CA

- **Repeating Earthquakes (June.2012-present)**

Identified evidence of dynamic triggering of repeating earthquakes by passing seismic waves using a statistical approach.

Teaching Experience

Lectured courses to graduate students in the Geophysics Group, Dept. of Earth and Atmospheric Sciences, Georgia Institute of Technology Fall 2010–Spring 2011:

- HYPO71 program to locate local earthquakes.
- HYPODD program to do double-difference relocation of earthquakes.
- Beta value to characterize seismicity rate changes

Teaching Assistant, Spring 2006–Fall 2007: Dept. of Earth and Atmospheric Sciences, Georgia Institute of Technology

- Introduction to Environmental Science
- Habitable Planet
- Earth Processes

Enrolled in CETL “Graduate Student Professional Development” program (3-month workshops for developing academic teaching and communication skills), September 2008 – November 2008

Enrolled in *On the Cutting Edge* workshop “Preparing for an Academic Career in the Geosciences” (workshop for graduate students and postdoctoral fellows who want to pursue a future academic career in geosciences, sponsored by NSF), June 2011.

Field Experience

Semblance based imaging of near-surface heterogeneities in Panola Mountain, Atlanta, GA

09/2005

Monitor changes of near-surface S-wave velocity caused by water level change, Atlanta, GA

03/2006

Exploration of tectonic history of the southern Appalachians, GA, SC, TN

Exploration of geology of the central Wasatch Mountains, Snowbird, UT	03/2008
Responsible for testing of various seismometers and data loggers, Atlanta, GA	06/2010
	08/2006-02/2012

Publications

Peer-reviewed:

1. Wu, C., Z. Peng, and Y. Ben-Zion (2009), Non-linearity and temporal changes of fault zone site response associated with strong ground motion, *Geophys. J. Int.*, 176, 265-278, doi:10.1111/j.1365-246X.2008.04005.x.
2. Wu, C., Z. Peng, and D. Assimaki (2009), Temporal changes in site response associated with strong ground motion of 2004 Mw6.6 Mid-Niigata earthquake sequences in Japan, *Bull. Seism. Soc. Am.*, 99(6), 3487-3495, doi:10.1785/0120090108.
3. Wu, C., Z. Peng, and Y. Ben-Zion (2010), Refined thresholds for nonlinear ground motion and temporal changes of site response associated with medium size earthquakes, *Geophys. J. Int.*, 183, 1567-1576, doi:10.1111/j.1365-246X.2010.04704.x.
4. Peng, Z., C. Wu, and C. Aiken (2011), Delayed triggering of microearthquakes by multiple surface waves circling the Earth, *Geophys. Res. Lett.*, 38, L04306, doi: 2010GL046373.
5. Wu, C., Z. Peng, W. Wang, and Q. Chen (2011), Dynamic triggering of shallow earthquakes near Beijing, China, *Geophys. J. Int.*, 185, 1321–1334, doi:10.1111/j.1365-246X.2011.05002.x.
6. Wu, C. and Z. Peng (2011), Temporal changes of site response during the Mw9.0 off the Pacific coast of Tohoku earthquake, *Earth Planets Space*, 63, 791-795.
7. Chao, K., Z. Peng, C. Wu, C.-H. Lin and C.-C. Tang (2011), Remote triggering of non-volcanic tremor around Taiwan, *Geophys. J. Int.*, 188, 301-324, doi:10.1111/j.1365-246X.2011.05261.x.
8. Wu, C. and Z. Peng (2012), Long-Term Change of Site response after the Mw9.0 Tohoku Earthquake in Japan, *Earth Planets Space*, 64, 1259-1266.
9. Wu, J., Z. Peng, W. Wang, X. Gong, Q. Chen, and C. Wu (2012), Comparison of dynamic triggering near Beijing, China following recent Sumatra earthquakes, *Geophys. Res. Lett.*, 39(21), L21310.
10. Wu, C., D. Shelly, J. Gomberg, Z. Peng, and P. Johnson (2013), Long-term changes of earthquake inter-event times and low-frequency earthquake recurrence in central California, *Earth Planet. Sci. Lett.*, 144-150, doi:10.1016/j.epsl.2013.03.007.
11. Gong, X., Q. Chen, Z. Peng, W. Wang, C. Wu, and J. Wu (2013), Remotely Triggered Seismicity around the Fangshan Pluton near Beijing Following the 2010 Mw 8.8 Chile Earthquake, *Chinese Journal of Geophysics*, 57(1), 115-128, doi: 10.6038/cjg20140111.

12. Wu, C., X. Meng, Z. Peng, and Y. Ben-Zion (2014), Lack of spatio-temporal localization of foreshocks before the 1999 Mw7.1 Duzce, Turkey earthquake, *Bull. Seism. Soc. Am.*, 104(1), doi:10.1785/0120130140.
13. Xie, J., X. Li, Z. Wen, and C. Wu (2014), Characteristics of near-source vertical and horizontal strong ground motion from the 20 April 2013 Mw 6.8 Lushan earthquake in China, *Seism. Res. Lett.*, 85(1), 23-33.
14. Wu, C., J. Gomberg, E. Ben-Naim, and P. Johnson (2014), Triggering of repeating earthquakes in central California, *Geophys. Res. Lett.*, doi: 10.1002/2013GL059051.

Manuscripts in review:

15. Trugman, D., C. Wu, R. Guyer, and P. Johnson, Synchronous Low Frequency Earthquakes and the Elastic Nature of the Deep San Andreas Fault, manuscript submitted to *Geophys. Res. Lett.*, in review.
16. Liu, J., J. Xie, M. Gao, and C. Wu, Spatial variability and attenuation of Arias Intensity with fault distance during the Mw9.0 Tohoku earthquake in Japan, manuscript submitted to *Soil. Dyn. Earthq. Eng.*, in review.

Manuscripts in preparation:

17. Wu, C., R. Guyer, D. Shelly, W. Frank, J. Gomberg, and P. Johnson, Spatial-temporal variation of low-frequency earthquake bursts near Parkfield, CA, manuscript in preparation for *Geophys. Res. Lett.*
18. Chao, K., Z. Peng, C. Wu, K. Obara, A. Wech, H.-C. Pu, Y. Chuang, C.-C. Tang, K. Chen, C.-H. Lin, T.-C. Hsin, Non-volcanic Tremor Activities in Taiwan before and after the Local 2010 Mw6.3 Jiashian Earthquake, manuscript in preparation for *Geophys. Res. Lett.*
19. Aiken, C., Z. Peng, and C. Wu, Dynamic triggering of microearthquakes in geothermal regions in California, manuscript in preparation.

Non-peer-reviewed:

1. Wu, C. (2007), Temporal change of seismic velocity and site response for different scales and implications for nonlinearity, Master Thesis, Georgia Institute of Technology, Atlanta, GA.
2. Wu, C. (2011), Fault zone damage, nonlinear site response, and remote triggering associated with seismic waves, PhD Thesis, Georgia Institute of Technology, Atlanta, GA.

Invited Department Seminars:

1. School of Earth and Space Sciences, University of Science and Technology of China, Hefei, China, January, 2014: “Remote triggering near Beijing, China”.
2. Los Alamos National Laboratory, NM, February, 2012: “Dynamic triggering of small earthquakes near Beijing, China”.
3. Department of Earth Sciences, University of Southern California, CA, September, 2009: “Temporal changes in the shallow crust from spectral ratio analysis”.

4. School of Geophysics and Geoinformation Systems, China University of Geosciences, Beijing, China, May, 2009: “Systematic analysis of temporal changes in the shallow crust from spectral ratio analysis”.

Abstracts (regular and invited talks marked):

1. Wu, C., R. Guyer, D. Trugman, D. Shelly, P. Johnson (2014), Slip characteristics of the deep portion of the San Andreas fault inferred from low-frequency earthquakes, *Seism. Res. Lett.*, 85, 278 (**Talk**).
2. Wu, C., R. Guyer, D. Shelly, W. Frank, J. Gomberg, and P. Johnson (2013), Spatial-temporal variation of low-frequency earthquake bursts near Parkfield, CA, presented at 2013 Fall Meeting, AGU, San Francisco, Calif., 9-13 Dec.
3. Shapiro, N., W. Frank, V. Kostoglodov, A. Husker, E. Daub, M. Radiguet, C. Wu, R. Guyer, R. Nadeau, M. Campillo, J. Payero, G. Prieto, D. Shelly, and P. Johnson (2013), Burst, background, and triggered low-frequency earthquakes and non-volcanic tremors, presented at 2013 Fall Meeting, AGU, San Francisco, Calif., 9-13 Dec.
4. Wu, C., J. Gomberg, E. Ben-Naim, and P. Johnson (2013), Testing delayed triggering of repeating earthquakes in central California, 2013 SECE Annual Meeting, Palm Springs, CA.
5. Wu, C., X. Meng, Z. Peng, and Y. Ben-Zion (2013), Non-accelerating foreshock activity of the 1999 Mw7.1 Duzce, Turkey earthquake, *Seism. Res. Lett.*, 84(2), 354.
6. Peng, Z., C. Wu, D. Yao, and X. Meng (2013), Dynamic and delayed triggering of moderate-size earthquakes in East Asia, *Seism. Res. Lett.*, 84(2), 374 (**Invited Talk**).
7. Wu, C., D. Shelly, P. Johnson, J. Gomberg, and Z. Peng (2012), Long-term changes in regular and low-frequency earthquakes recurrences near Parkfield, CA, presented at 2012 Fall Meeting, AGU, San Francisco, Calif., 3-7 Dec (**Talk**).
8. Wu, J., W. Wang, Z. Peng, X. Gong, Q. Chen, and C. Wu (2012), Continuing studies of dynamic triggering near Fangshan, Beijing, presented at 2012 Fall Meeting, AGU, San Francisco, Calif., 3-7 Dec.
9. Wu, J., Z. Peng, W. Wang, X. Gong, Q. Chen, and C. Wu (2012), Comparisons of dynamic triggering near Beijing, China following the recent Sumatra earthquakes, *2012 IRIS Workshop, Boise, ID*
10. Peng, Z., C. Wu, and D. Assimaki (2012), Long-term change of site response and high-frequency radiations associated with the Mw9.0 Tohoku-Oki Earthquake in Japan, *Seism. Res. Lett.*, 83, 278.
11. Peng, Z., K. Chao, C. Wu, B. Fry, B. Enescu, and C. Aiken (2012), Global Observations of Triggered Tectonic Tremor, *Seism. Res. Lett.*, 83, 278.

12. Wu, C., Z. Peng, and Y. Ben-Zion (2011), Analysis of accelerated failure process before the 1999 Mw7.1 Düzce earthquake based on near-fault seismograms, *Eos Trans. AGU*, 92(52), Fall Meet. Suppl., Abstract T23G-05 **(Talk)**.
13. Peng, Z. and C. Wu (2011), Temporal changes of site response and high-frequency bursts during the 2011 Mw 9.0 off the Pacific coast of Tohoku Earthquake sequence, *Eos Trans. AGU*, 92(52), Fall Meet. Suppl., Abstract S23D-07 **(Talk)**.
14. Chao, K., Z. Peng, B. Enescu, C. Wu, and B. Fry (2011), Global Search of Deep Triggered Tremor, *Eos Trans. AGU*, 92(52), Fall Meet. Suppl., Abstract S26D-08 **(Talk)**.
15. Wang, W., X. Gong, Z. Peng, Q. Chen and C. Wu (2011), Dynamic Triggering around Fangshan Pluton near Beijing, China, *Eos Trans. AGU*, 92(52), Fall Meet. Suppl., Abstract S21D-15 **(Talk)**.
16. Chao, K., Z. Peng, B. Enescu, C. Wu, and B. Fry (2011), Global Search for Deep Triggered Tremor, *2010 SCEC Annual Meeting, Palm Springs, CA*.
17. Wu, C. and Z. Peng (2011), Temporal changes of site response during the Mw9.0 Tohoku earthquake in Japan, *4th IASPEI / IAEE International Symposium, Santa Barbara, CA*.
18. Wu, C., Z. Peng, W. Wang and Q. Chen (2011), Remote triggering of earthquakes in China, *2011 Bi-lateral Workshop under the Sino-US Earthquake Studies Protocol in Chengdu, China* **(Talk)**.
19. Wu, C. and Z. Peng (2011), Temporal changes of site response during the M9.0 Tohoku earthquake sequence in Japan, *Seism. Res. Lett.*, 82, 278.
20. Peng, Z., C. Kevin, C. Aiken, D. Shelly, D. Hill, C. Wu, B. Enescu, and A. Doran (2011), Remote triggering following the 2011 M9.0 Tohoku, Japan earthquake, *Seism. Res. Lett.*, 82, 278 **(Invited Talk)**.
21. Wu, C. and Z. Peng (2011), Remote triggering of moderate earthquakes in east Asia, *Seism. Res. Lett.*, 82, 290.
22. Aiken, C., Z. Peng, and C. Wu (2011), Dynamic triggering of microearthquakes at three geothermal regions in California, *Seism. Res. Lett.*, 82, 290.
23. Sullivan, B, Z. Peng, C. Wu, and C. Aiken (2011), Delayed triggering of earthquakes by multiple waves circling the Earth, *Seism. Res. Lett.*, 82, 278 **(Talk)**.
24. Doran, A., Z. Peng, X. Meng, C. Wu and D. Kilb (2011), Dynamic triggering of earthquakes in the Salton Sea region of southern California from Large Regional and Teleseismic Earthquakes. *Seism. Res. Lett.*, 82, 290.
25. Wu, C., Z. Peng, W. Wang and Q. Chen (2010), Dynamic triggering of shallow earthquakes near Beijing, China. *Eos Trans. AGU*, 91(52), Fall Meet. Suppl., Abstract S33C-2114.

26. Aiken, C., Z. Peng, and C. Wu (2010), Dynamic triggering of microearthquakes in the Long Valley Caldera and Coso Geothermal Field. *Eos Trans. AGU*, 91(52), Fall Meet. Suppl., Abstract No. S33B-2103.
27. Doran, A., Z. Peng, X. Meng, C. Wu and D. Kilb (2010), Dynamic triggering of earthquakes in the Salton Sea region of southern California from Large Regional and Teleseismic Earthquakes. *Eos Trans. AGU*, 91(52), Fall Meet. Suppl., Abstract No. S33B-2104.
28. Wu, C., Z. Peng, W. Wang and Q. Chen (2010), Dynamic triggering at Babaoshan fault and Huangzhuang-Gaoliying fault near Beijing, China, *2010 Earthscope Fault Slip Behaviors workshop, Portland, OR*.
29. Wu, C., Z. Peng, and Y. Ben-Zion (2010), Nonlinear ground motion and temporal changes of site response associated with medium-size earthquakes in Japan and California, *2010 SCEC Annual Meeting, Palm Springs, CA*.
30. Wu, C., Z. Peng, W. Wang and Q. Chen (2010), Dynamic triggering at Babaoshan fault and Huangzhuang-Gaoliying fault near Beijing, China, *2010 SCEC Annual Meeting, Palm Springs, CA*.
31. Doran, A., Z. Peng, C. Wu and D. Kilb (2010), Dynamic triggering of shallow earthquakes in the Salton Sea region of southern California, *2010 SCEC Annual Meeting, Palm Springs, CA*.
32. Wu, C., Z. Peng, and Y. Ben-Zion (2010), Refined thresholds for nonlinear ground motion and temporal changes of site response associated with medium size earthquakes, *2010 IRIS Workshop, Snowbird, UT*.
33. Wu, C., Z. Peng, W. Wang and Q. Chen (2010), Dynamic triggering at Babaoshan fault and Huangzhuang-Gaoliying fault near Beijing, China, *2010 IRIS Workshop, Snowbird, UT*.
34. Wu, C., Z. Peng, and Y. Ben-Zion (2009), Systematic analysis of nonlinear ground motion and temporal changes of material properties produced by small and medium earthquakes, *Eos Trans. AGU*, 90(52), Fall Meet. Suppl., Abstract S24A-03 **(Talk)**.
35. Jiang, T., Z. Peng, W. Wang, Q.-F. Chen, and C. Wu (2009), Remotely triggered seismicity in Continental China, *Eos Trans. AGU*, 90(52), Fall Meet. Suppl., Abstract S51C-1441 **(Talk)**.
36. Wu, C., Z. Peng, and D. Assimaki (2009), Systematic analysis of temporal changes in site response associated with strong ground motion in Japan, *2009 SCEC Annual Meeting, Palm Springs, CA*.
37. Wu, C., Z. Peng, and D. Assimaki (2009), Temporal changes in site response associated with strong ground motion of 2004 Mw6.6 Mid-Niigata earthquake sequences in Japan, *Neustadt Workshop on Noise and Diffuse Wavefields in Neustadt, Germany (Talk)*.
38. Wu, C., Z. Peng, and D. Assimaki (2009), Nonlinear site response associated with strong ground motion of 2004 Mw6.6 Mid-Niigata earthquake sequences in Japan. *EAS Graduate Symposium 2009. Georgia Institute of Technology, Atlanta, GA (Talk)*.

39. Wu, C., Z. Peng, and D. Assimaki (2008), Systematic analysis of temporal changes in site response associated with strong ground motion in Japan, *Eos Trans. AGU*, 89(53), Fall Meet. Suppl., Abstract S51E-08 (**Talk**).
40. Wu, C., Z. Peng, and D. Assimaki (2008), Systematic analysis temporal changes of site response associated with strong ground motion in Japan, *2008 IRIS Workshop, Vancouver, OR*.
41. Wu, C., Z. Peng, and Y. Ben-Zion (2008), Non-linearity and temporal changes of fault zone site response associated with strong ground motion, *2008 IRIS Workshop, Vancouver, OR*.
42. Wu, C., Z. Peng, and Y. Ben-Zion (2008), Temporal changes of fault zone site response associated with strong ground motion, *EAS Graduate Symposium 2008. Georgia Institute of Technology, Atlanta, GA (Talk)*.
43. Wu, C., Z. Peng, and Y. Ben-Zion (2007), Rapid temporal changes of fault zone site response associated with strong ground motion, *Eos Trans. AGU*, 88(52), Fall Meet. Suppl., Abstract T51C-0681.
44. Wu, C., Z. Peng, and Y. Ben-Zion (2007), Temporal changes in fault zone site response caused by strong ground motion of the 1999 Mw7.1 Düzce, Turkey, earthquake, *Seism. Res. Lett.*, 78, 278.

SKILLS

Computers:

- Language: C/C++, Unix shell script, Matlab, Fortran
- Software packages: Seismic Unix, Seismic Analysis Code (SAC), Antelope, Generic Mapping Tools (GMT), ArcGIS/ArcView, Latex, Microsoft Office (Word, Excel, PowerPoint), Adobe (Photoshop, Illustrator, Acrobat), HYPO71, HYPO2000, HYPODD/TOMODD.
- Platforms: Unix (SUN), Linux, MS-DOS, Windows 98/2000/NT/XP/VISTA/7/8, Mac OS
- Web: HTML, XML

Languages:

- Bilingual in English and Mandarin

PROFESSIONAL AFFILIATIONS

American Geophysical Union (AGU), 2005 – present
 Seismological Society of America (SSA), 2006 – present
 Society of Exploration Geophysicists (SEG), 2006 – present

HONORS & AWARDS

Top Cited Paper of Geophysical Journal International, 2009
 EAS Best Paper Award, Georgia Institute of Technology, 2012
 Earthscope Institute Traveling Scholarship, 2010
 Incorporated Research Institutions for Seismology (IRIS) Traveling Scholarship, 2008, 2010
 Georgia Institute of Technology Graduate Traveling Scholarship, 2007-2011

Graduate Research Scholarship, Georgia Institute of Technology, 2005 – 2011
Undergraduate Research Scholarship, Chinese Academy of Science, 2004

SERVCIES & LEADERSHIP

Session Convener and Chair

Special Session (S11) “Earthquake Triggering and Interaction”, AGU Fall Meeting, 2013.
Special Session “Triggering of Seismic and Volcanic Events”, SSA Annual Meeting, 2013
Special Session (S21) “The Static vs. Dynamic Earthquake Triggering Debate: What’s New and What’s Next?”, AGU Fall Meeting, 2011.

Manuscript Referee

Earth and Planetary Science Letters (1), Journal of Geophysical Research (2), Geophysical Research Letters (2), Geochemistry Geophysics Geosystems (2), Geophysical Journal International (3), Pure and Applied Geophysics (1), Bulletin of the Seismological Society of America (3), Seismological Research Letters (1), Tectonophysics (1), Earthquake Science (1), Chinese Science Bulletin (1), Terrestrial, Atmospheric and Oceanic Sciences (1).

Judge

AGU Outstanding Student Paper Awards, AGU Fall Meeting, 2011-2013.

Organizer

Geophysics Seminar, Dept. of Earth and Atmospheric Sciences, Georgia Tech, Spring, 2010

Team leader

Teaching undergraduate course “Earth Processes”, Dept. of Earth and Atmospheric Sciences, Georgia Tech, Fall 2006, Spring 2008