YINGDI LUO

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RESEARCH INTERESTS

Tremor and Slow-Slip Events	**Mega-thrust Earthquakes**	**Fault Heterogeneity**
Earthquake Scaling Relations	**Earthquake Mechanics**	**Rate-and-State Friction**

EDUCATION

CALIFORNIA INSTITUTE OF TECHNOLOGY — Pasadena, CA
Ph.D. Program in Geophysics — September 2010 – July 2017
Seismological Laboratory

UNIVERSITY OF SCIENCE AND TECHNOLOGY OF CHINA — Hefei, CHINA
Bachelor of Science in Geophysics — September 2006 – June 2010
School of Earth and Space Sciences, Cumulative GPA ranked: 1/85

RESEARCH EXPERIENCE

JET PROPULSION LABORATORY — Pasadena, CA
Postdoctoral Scholar, advisor Dr. Zhen Liu — August 2017 – Present
- Modeling of non-volcanic tremor and slow-slip events
  - Studied the slow-slip events pattern variations with intrinsic model of interaction between slow-slip region and megathrust earthquake region, and effects of external stress perturbations towards slow-slip pattern changes and implications towards mega earthquake super-cycle
  - Studied tremor-less slow-slip phenomena and various tremor activities with asperity models varying stressing condition

CALIFORNIA INSTITUTE OF TECHNOLOGY — Pasadena, CA
Graduate Research Assistant, advisor Prof. Jean-Paul Ampuero — September 2010 – July 2017
- Modeling of non-volcanic tremor and slow-slip events
  - Developed two end-member multi-asperity models: slow-slip driven and self-cascading tremors
  - Showed that multi-asperity models reproduce large-scale tremor migration and Rapid Tremor Reversals
- Multi-cycle (dynamic and quasi-dynamic) modeling of mega-earthquake processes
  - 2011 Tohoku: high-frequency radiation during M9+ ruptures on deep M6+ earthquake asperities
  - 2014 Chile: extended nucleation process and comparison to repeating earthquake activity
  - 2015 Nepal: effect of non-planar fault geometry on earthquake super-cycles
- Mechanical behavior of faults with heterogeneous rate-and-state friction properties
  - Numerical characterization of conditions for slow to fast slip and regular to irregular cycle behavior
  - Numerical study of the role of heterogeneity in the frequency-magnitude distribution of events
  - Analytical study of fault stability through linear stability and dimensional analysis
  - Re-normalization and homogenization of fault friction
- Earthquake scaling relations
  - Developed earthquake models consistent with empirical Moment-Area scaling relations used in Japan
  - Identified and analyzed surface rupture effects on scaling relations through earthquake cycle simulations, analytical dislocation models and numerical crack models
- Earthquake back-projection, collaborative work with Lingsen Meng

- Worked on fundamentals of earthquake back-projection technics, analyzed and mitigated artifacts of "swimming effect" from non-stationary signals
- Utilized back-projection technics to study rupture properties of mega-earthquakes: the complex rupture paths of the 2012 Sumatra, and the depth-frequency-dependent rupture of 2011 Tohoku

CALIFORNIA INSTITUTE OF TECHNOLOGY   Pasadena, CA
Graduate Research Assistant, co-advisor Prof. Donald V. Helmberger   September 2010 - September 2011
- Studied basin effect using local and regional earthquake data in Southern California
- Modeled earthquake waveforms in 2D layered model with low-velocity structures in Southern California
- Refined the Southern California velocity model

UNIVERSITY OF SCIENCE AND TECHNOLOGY OF CHINA   Hefei, CHINA
Undergraduate Research Assistant, advisor Prof. Xiaofei Chen   July 2009 - June 2010
- Studied absorbing boundary effects in earthquake waveform modeling
- Analyzed the differences between elastic and acoustic waves of artificial sources in numerical simulations
- Developed finite-difference code for arbitrary free-surface geometry and improved PML boundary condition in MATLAB/C.

PUBLICATIONS & MANUSCRIPTS IN PREPARATION
[T8] Luo, Y., & Liu, Z. Investigate episodic tremor and slow slip variability due to stress variation. *Manuscript in preparation*

[T7] Luo, Y., & Liu, Z. Slow-Slip recurrent pattern changes: perturbation responding and possible scenarios of precursor towards a megathrust earthquake. *Manuscript in preparation*

[T6] Luo, Y., & Ampuero, J. P. Tremor migration patterns and the collective behavior of deep asperities. *Manuscript in preparation*

[5] Luo, Y., & Ampuero, J. P. (2018). Stability of faults with heterogeneous friction properties and effective normal stress. *Tectonophysics, 733, 257-272*

[4] Luo, Y., Ampuero, J. P., Galvez, P., Ende M., and Idini B.(2017) QDYN: a Quasi-DYNamic earthquake simulator (v1.1) *Zenodo. doi:10.5281/zenodo.322459*

[3] Luo, Y., Ampuero, J. P., Miyakoshi, K., & Irikura, K. (2017). Surface rupture effects on earthquake moment-area scaling relations. *Pure and Applied Geophysics, 174(9), 3331-3342.*

[2] *Meng, L., Ampuero, J. P., Stock, J., Duputel, Z., Luo, Y., & Tsai, V. C. (2012*). Earthquake in a maze: Compressional rupture branching during the 2012 Mw 8.6 Sumatra earthquake. *Science*, *337*(6095), 724-726.

[1] Meng, L., Ampuero, J. P., Luo, Y., Wu, W., & Ni, S. (2012). Mitigating artifacts in back-projection source imaging with implications for frequency-dependent properties of the Tohoku-Oki earthquake. *Earth, planets and space*, *64*(12), 1101-1109.

SELECTED CONFERENCE PRESENTATIONS
[6] Luo, Y., & Ampuero, J. P. (2015). Analytical and numerical studies of slow and fast earthquakes on faults with mixed velocity-weakening / velocity-strengthening rheology. *SSA Annual Meeting, Pasadena, CA*

[5] Luo, Y., & Ampuero, J. P. (2014). A model of spontaneous complex tremor migration patterns and background slow-slip events via interaction of brittle asperities and a ductile matrix. *AGU Fall Meeting* S52B-01, *San Francisco, CA*

[4] Luo, Y., & Ampuero, J. P. (2013). Patterns of seismic and aseismic slip on heterogeneous faults. *AGU Fall Meeting* T43A-2631*, San Francisco, CA*

[3] Luo, Y., & Ampuero, J. P. (2013). Numerical study of fault zone heterogeneity: scaling and more. *CIG-QUEST-IRIS workshop, Fairbanks, AK*

[2] Luo, Y., & Ampuero, J. P. (2012). Simulation of complex tremor migration patterns. *AGU Fall Meeting* S44B-02*, San Francisco, CA*

[1] Luo, Y., & Ampuero, J. P. (2011). Numerical simulation of tremor migration triggered by slow slip and rapid tremor reversals. *AGU Fall Meeting* S33C-02*, San Francisco, CA*

RECENT HONORS & AWARDS

- Chair of 2014 AGU fall meeting session S52B "Recent advances in slow slip and tremor: implications for fault mechanics and slip processes II"
- Invited speaker at 2014 AGU fall meeting "A model of spontaneous complex tremor migration patterns and background slow-slip events via interaction of brittle asperities and a ductile matrix"
- Invited speaker at Institute of Geodesy and Geophysics, Chinese Academy of Sciences (2015) "Stability of slip on heterogeneous faults"
- Guo-Moruo scholarship (2010), the highest honor for undergraduate students at USTC, first scholarship established in PR China
- Student grants from NMEM workshop in Bratislava, Slovakia (2015); APEC-ACEs workshop in Chengdu, China (2015); International Slow-earthquake workshop in Kyoto, Japan (2014); CIG-QUEST-IRIS workshop Fairbank, AK (2013); SCEC-ERI International summer school, Hakone, Japan (2013); CIG workshop in Golden, CO (2012); Material Deformation workshop in Les Houches, France (2012)

TEACHING EXPERIENCE

CALIFORNIA INSTITUTE OF TECHNOLOGY   Pasadena, CA
Teaching Assistant, Ge 166, Hydrology   2014
Teaching Assistant, Ge 261, Advanced Seismology   2013
Teaching Assistant, Ge 111b, Applied Geophysics Field Course   2012
Teaching Assistant, Ge 111a, Applied Geophysics   2012

SOFTWARE DEVELOPMENT

QDYN (https://github.com/ydluo/qdyn/), a Quasi-DYNamic earthquake simulator.
QDYN is a boundary element code to simulate earthquake cycles on faults with rate-and-state friction under the quasi-dynamic approximation. It includes an interface to SPECFEM3D for fully dynamic earthquake cycle modeling.

TECHNICAL SKILLS & LANGUAGES

- Programming: FORTRAN, C/C++, MATLAB, Mathematica, R, BASIC, Python, Assembly Language
- Technical Software: QDYN, SPECFEM, Cubit, GMT, ArcGIS, SQL, Illustrator, Latex
- Operating Systems: Linux/Unix, OS X, Windows
- Field Skills: Caltech GPS certified fieldtrip vehicle operator, Experienced UAV/Drone pilot, Trained foot/radio orienteering
- Languages: English (fluent), Mandarin (native), Japanese (novice)