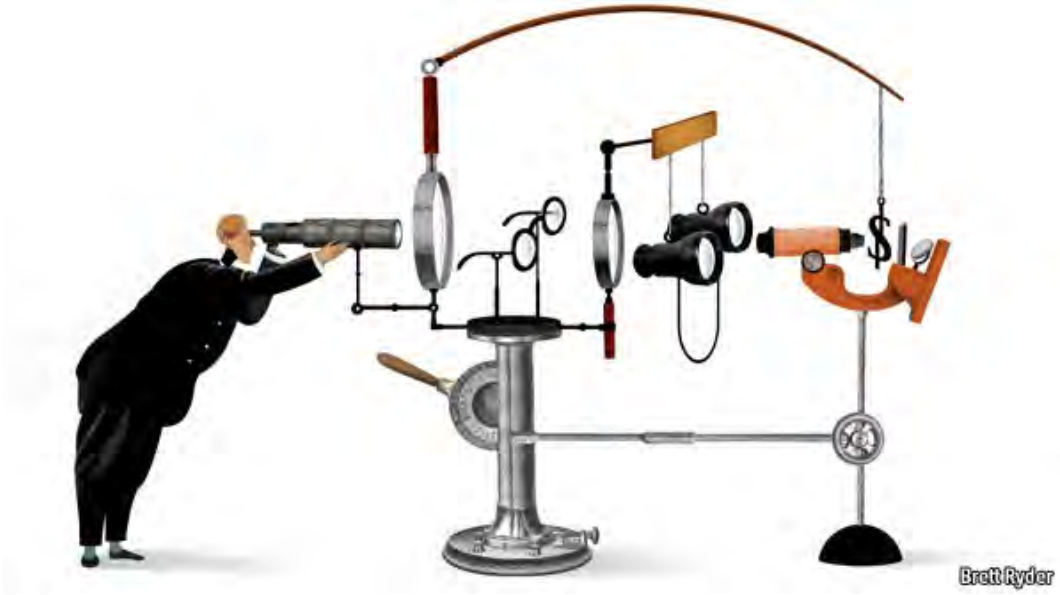
Vision for SCEC

John E. Vidale

View of SCEC
(in tweet-length format)



- SCEC, with many partners, supports earthquake risk reduction by comprehensive geophysical modeling, cutting-edge science, and outreach.

Vision of SCEC

- SCEC is powerful and aimed at fundamental science and crucial societal problems. We have tough challenges and the capability to crack them.

Real view of SCEC

- Great team, rewarding goals, with exciting challenges.

My PNSN topics

- Basin structure
- Subduction zones
- Strong motions
- Seismograms in buildings
- Tremor
- Volcanoes
- Landslides
- Glaciers
- Seismic hazard
- Regional seismic networks
- Off-shore monitoring
- Football noise
- Arguing with cranks
- Informing agencies and the public
- Advocating with elected officials

My older topics

- Basin structure
- Fault zone structure
- Mantle discontinuities
- Core-mantle boundary
- Inner core

- Earthquake rupture
- Swarms
- Tides and quakes
- Nuclear testing
- Numerical methods

Founding director Keiiti Aki (1991-1995)

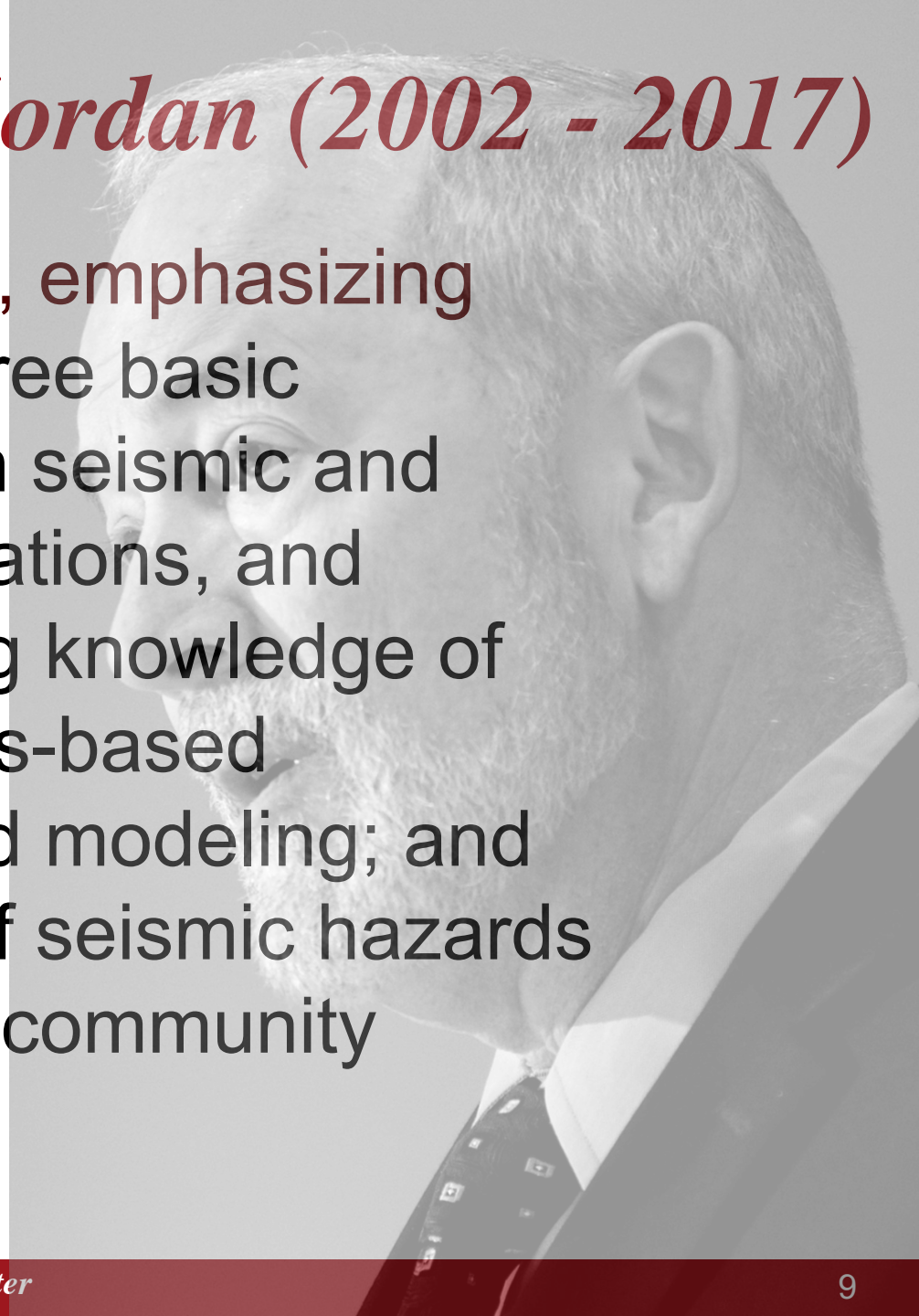
- His original Master Model goal remains inspiring: “to develop a model of the Earth's lithosphere in which we predict the occurrence of earthquakes on the basis of the space-time distribution of tectonic stress calculated using various geophysical observables, as the atmospheric scientists forecast weather by computer on the basis of observed pressure, temperature, wind speed”.

Former director Tom Henyey (1995 - 2002)

- adds: “SCEC was conceived with the idea that a better understanding of earthquakes in Southern California will help protect the lives and property of the more than 15 million people living here”.

Nearly-current director Tom Jordan (2002 - 2017)

- refined, evolved and intensified efforts, emphasizing "*earthquake system science* through three basic activities: (a) gathering information from seismic and geodetic sensors, geologic field observations, and laboratory experiments; (b) synthesizing knowledge of earthquake phenomena through physics-based modeling, including system-level hazard modeling; and (c) communicating our understanding of seismic hazards to reduce earthquake risk and promote community resilience."



My interests in SCEC

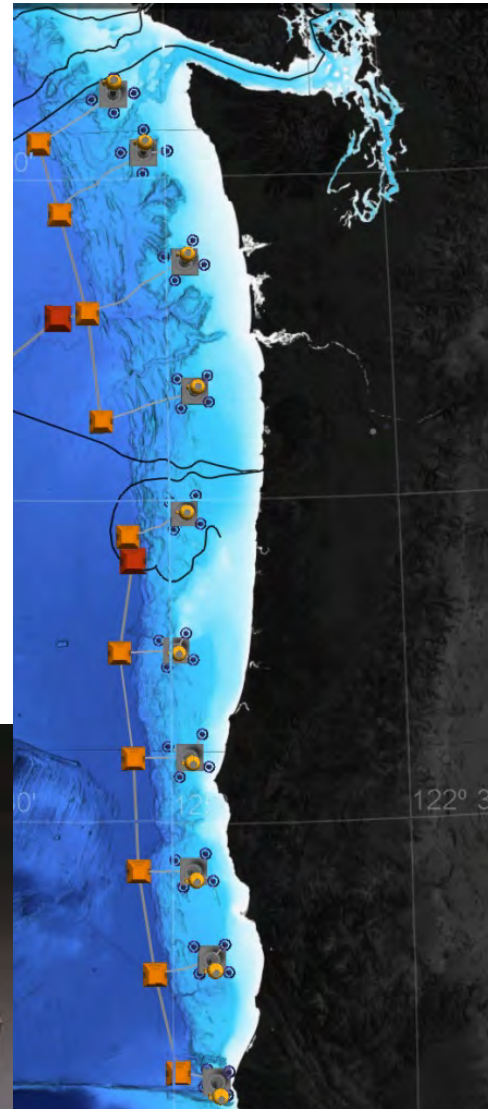
- **Everything**
- (but I'm a generalist here lecturing the cognoscenti.)

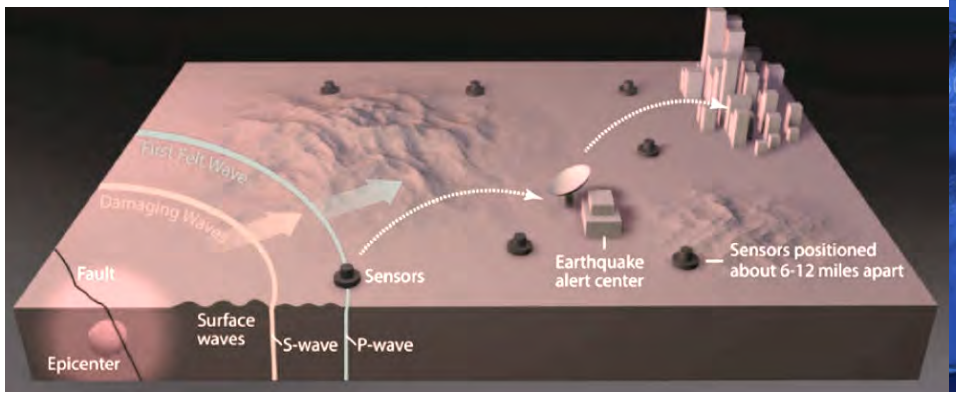
- Large simulations
  - Basic rupture physics
  - Many earthquake cycles
- Slow as well as fast slip
- Temporal changes
- Large datasets
  - Seismicity from template matching
  - Dense deployments

- Induced seismicity
  - Calibrated studies of earthquakes
  - Mitigation issues
- Multi-disciplinary data
  - Basin structure
  - Fault structure

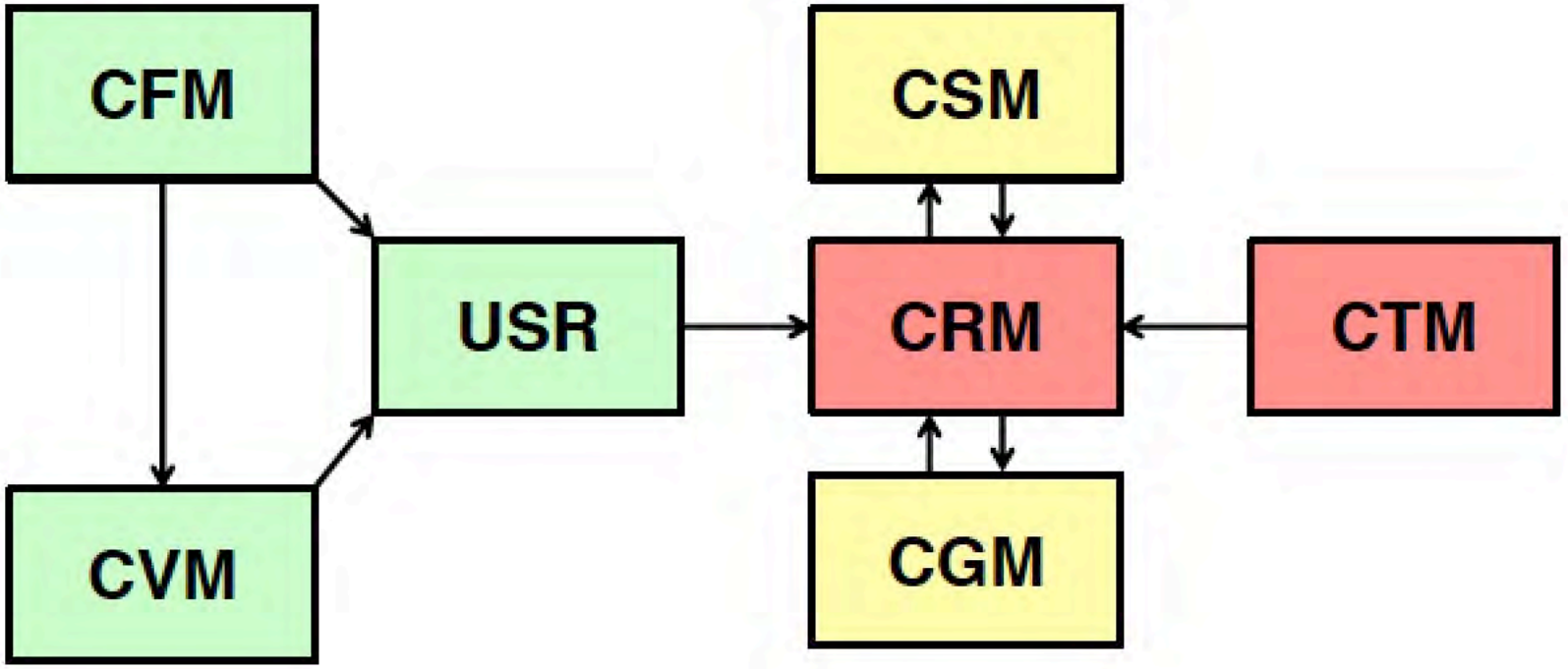
My tendencies – take opportunities teamwork

- **PNSN accomplishments**
- M9 project
- Started iMUSH
- Early warning
- Trying to get instruments on the seafloor
- Still doing reconnaissance across SCEC





Core product #1
Community models and the science they enable

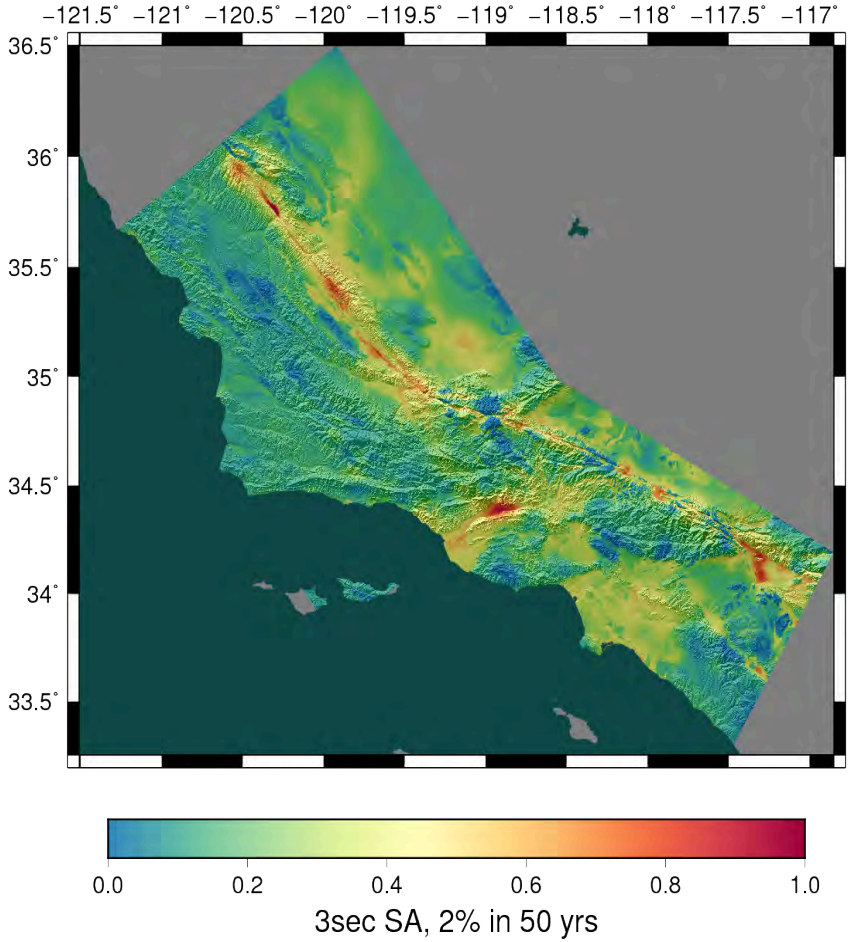


Model key:

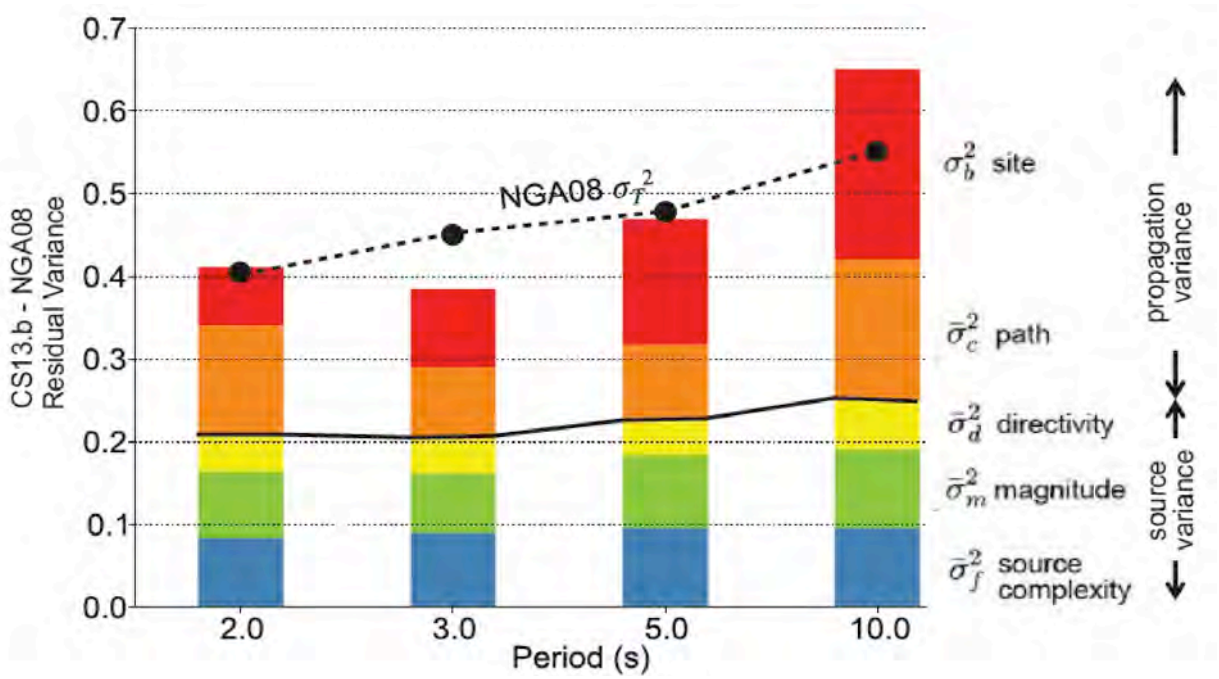
F = Fault S = Stress
G = Geodetic T = Thermal
R = Rheology V = Velocity
USR = Unified Structural Representation

Core product #2

Reduced hazard uncertainty (enabling safety and savings)



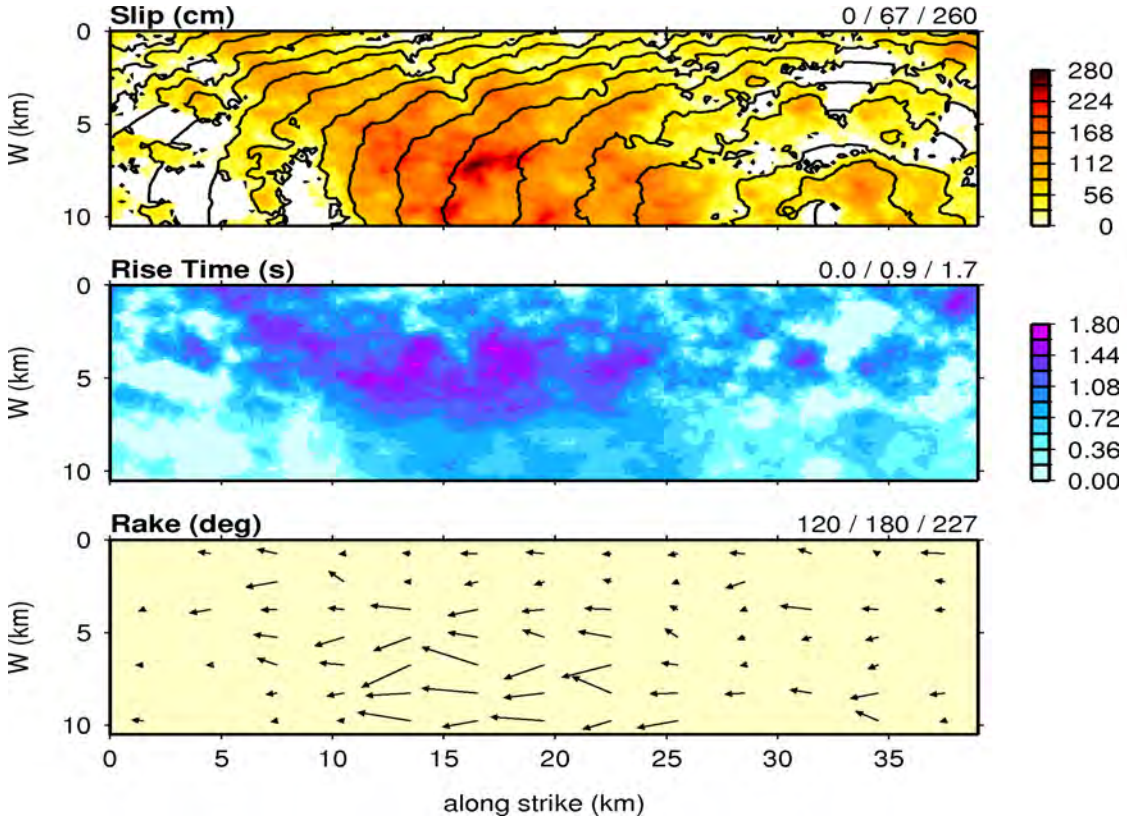
Combined CyberShake Map

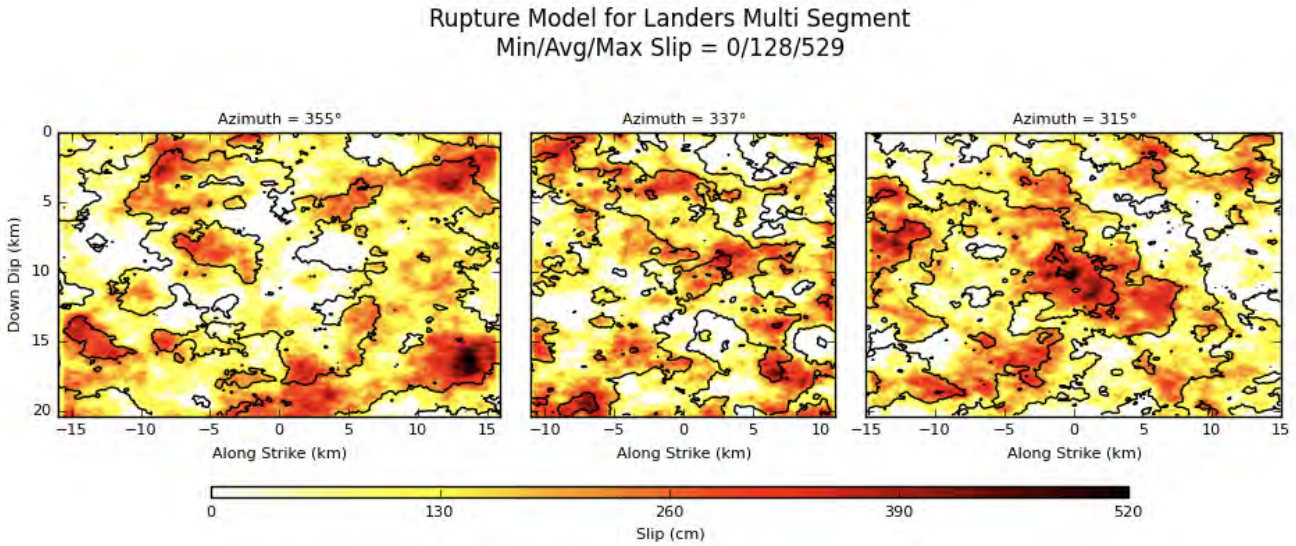


After Wang & Jordan, 2014

Core structure: Collaboration

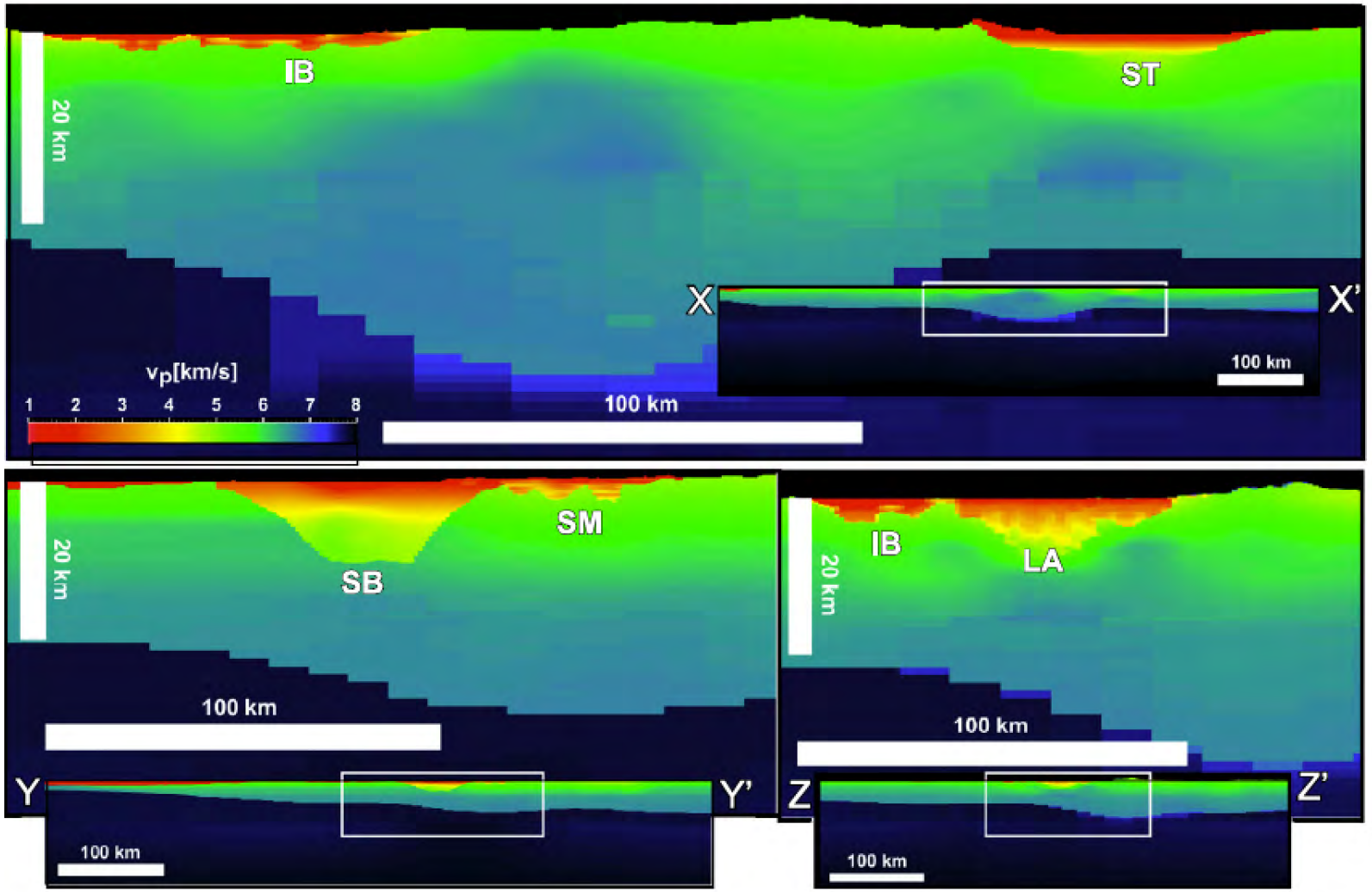
Source models that are more realistic and efficient





Graves & Pitarka, 2016

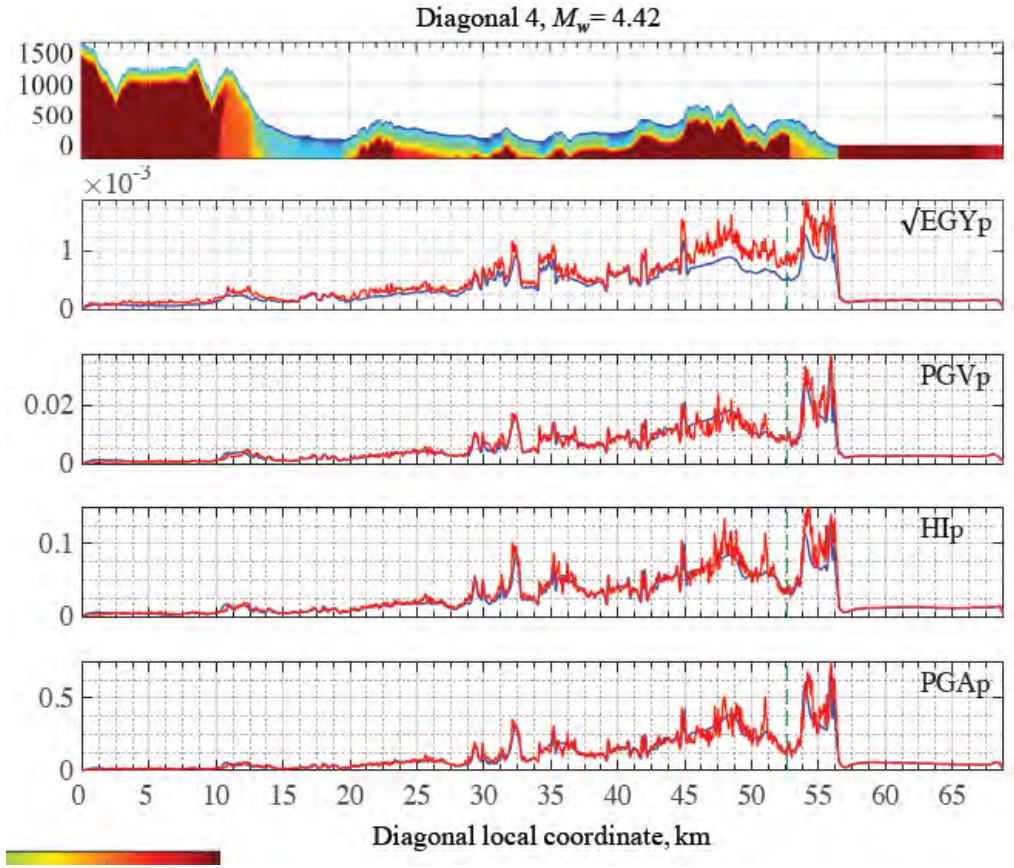
Accurate structural models with known uncertainty



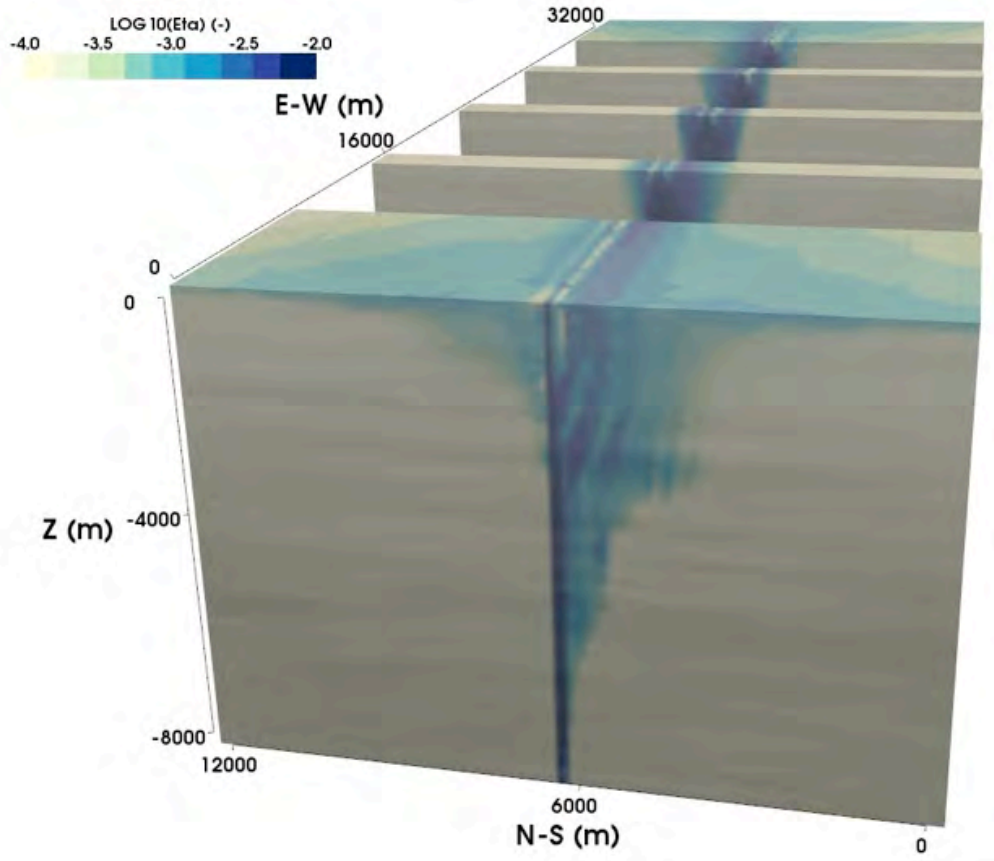
- Edges
- Shallowest 100m
- Heterogeneity
- Attenuation

Shaw et al., 2015

Simulations with more complete inelastic physics, topography

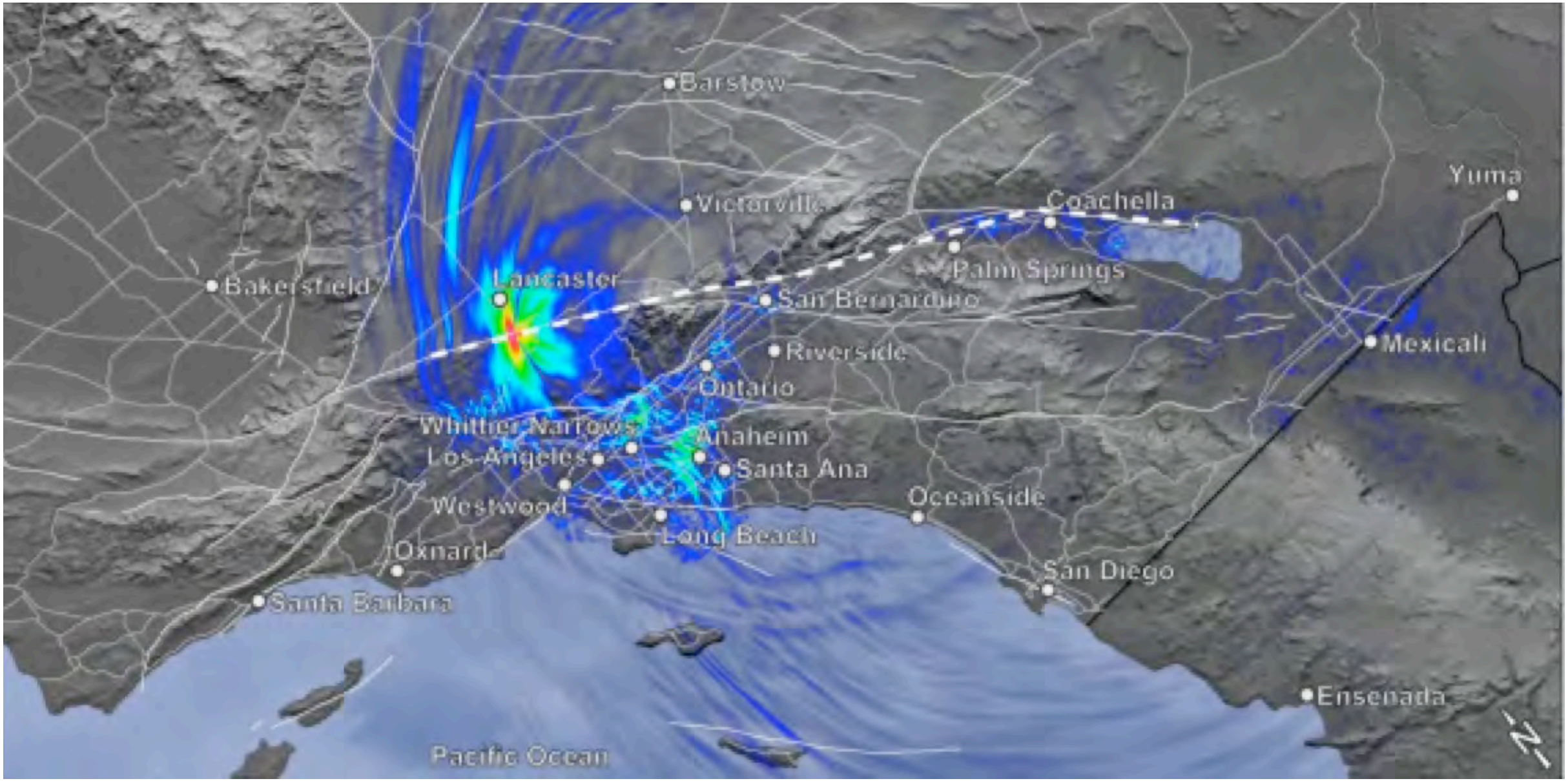


Riano et al., 2016



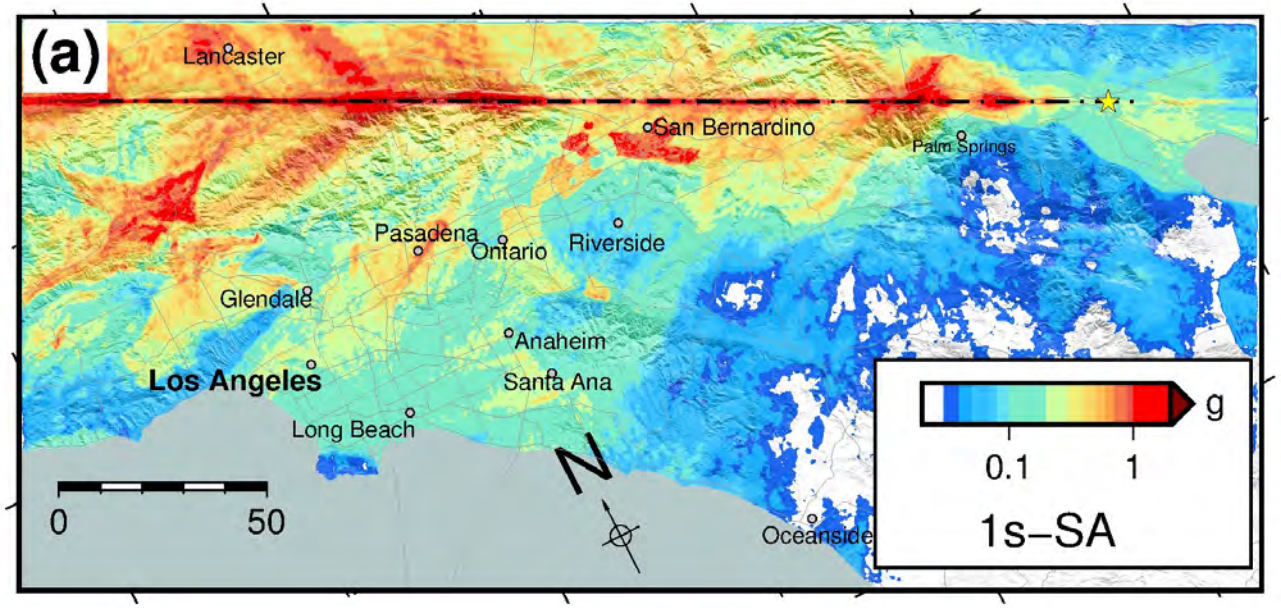
Roten et al., 2017

Simulations that are accurate and efficient

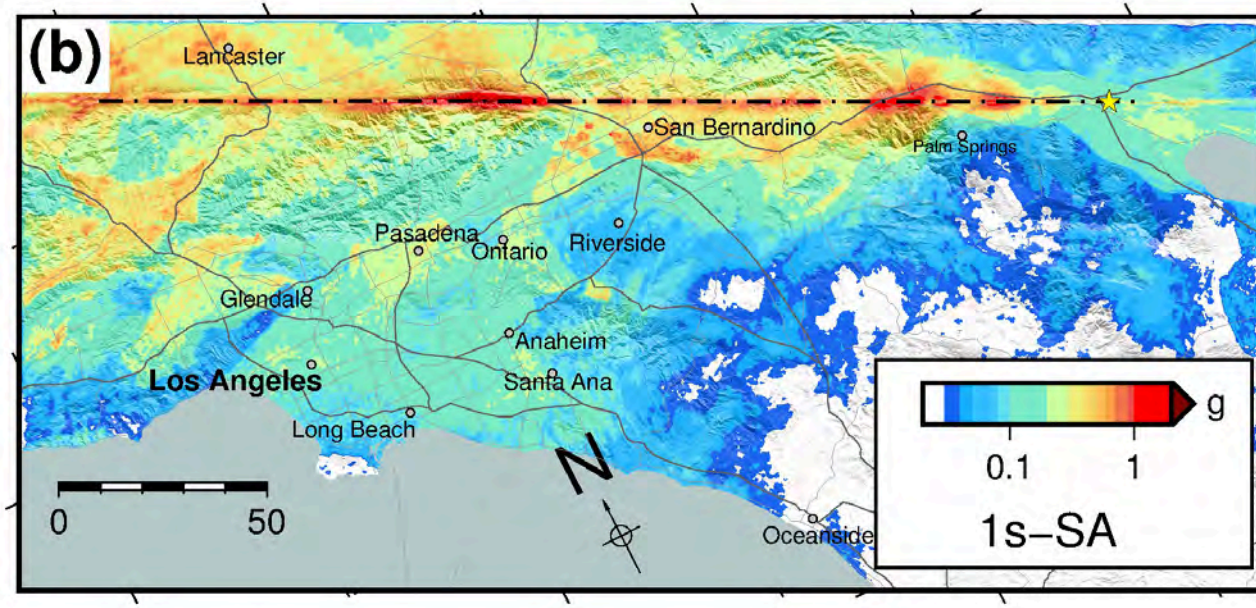


Without and with plasticity

Spectral Acceleration at 1s (1s-SAs): **Linear**

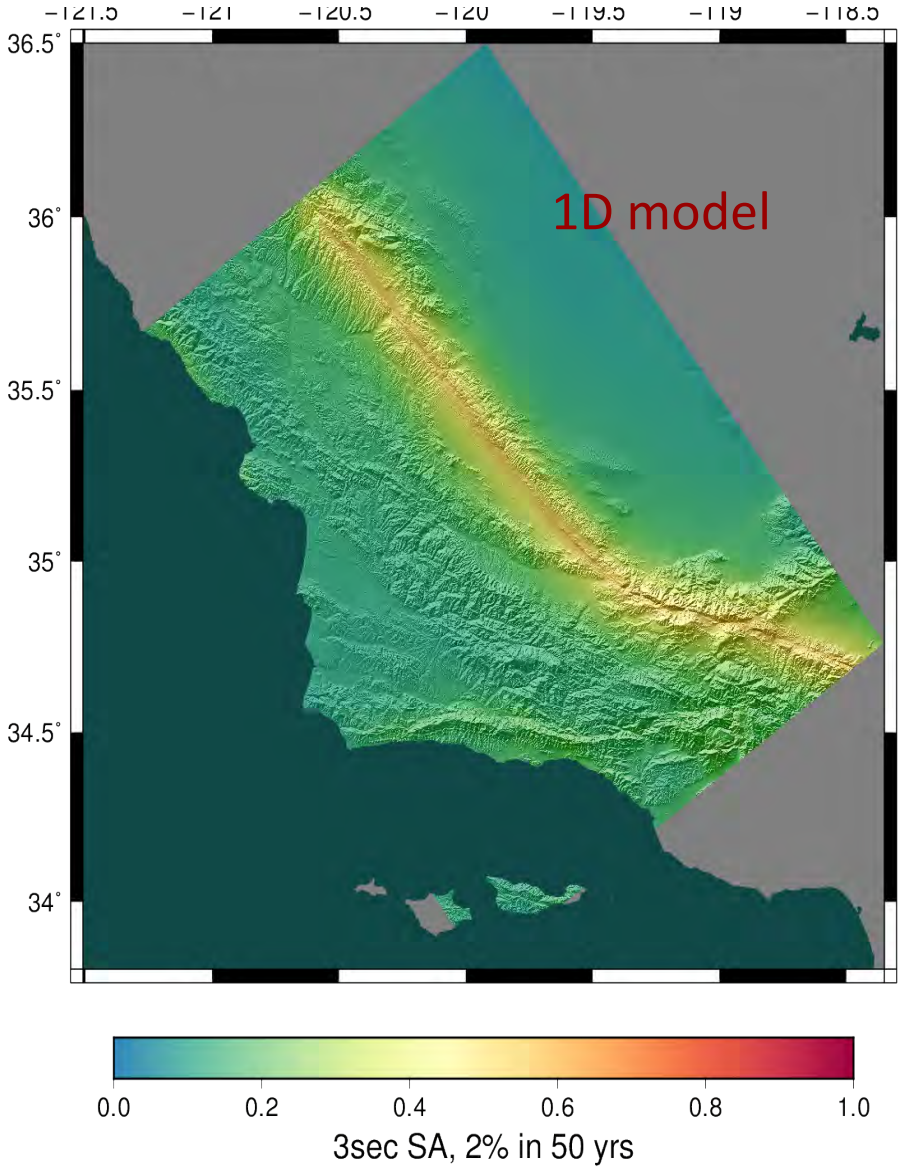


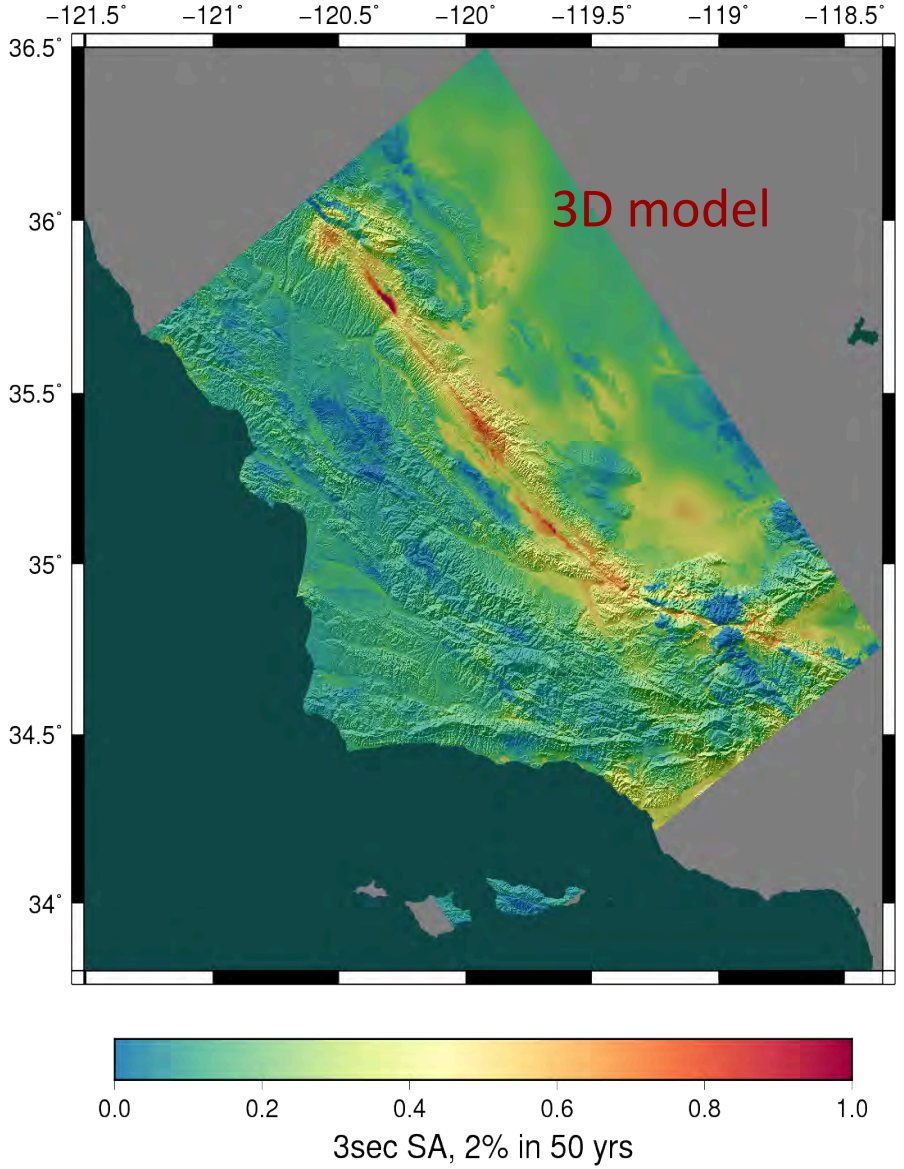
1s-SAs: **Nonlinear**, Good—Average Quality Rock



Kim Olson, yesterday

Accurate hazard models with less uncertainty

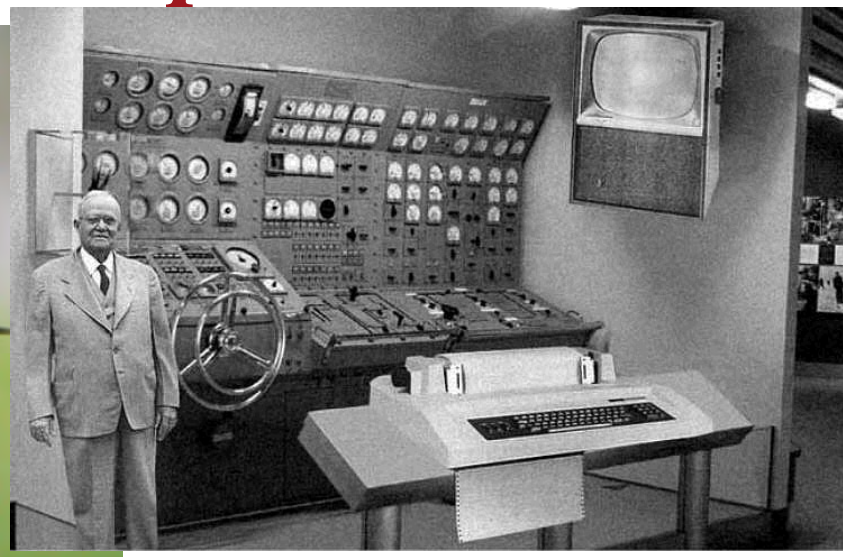


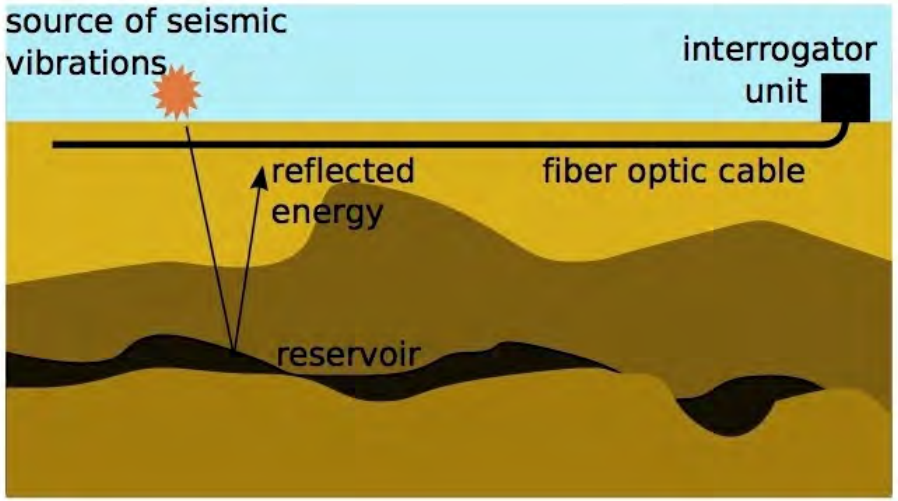


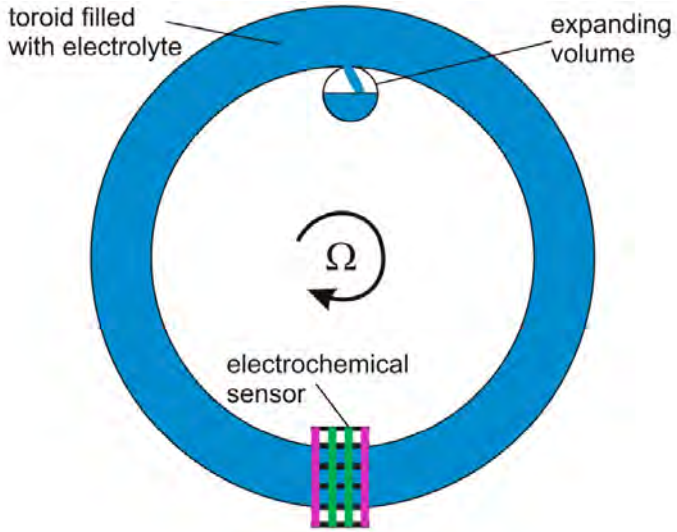
CyberShake 17.3,
3s SA,
2% in 50 years

New tactics and tools can help

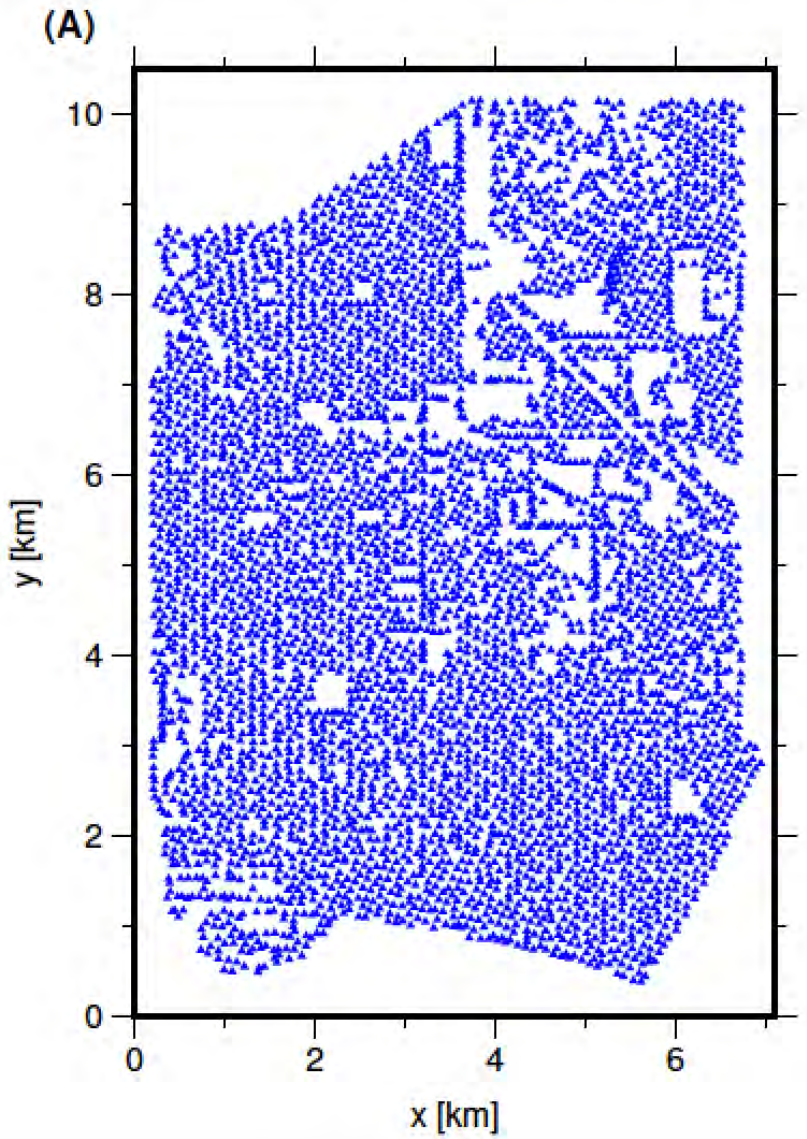
- Drones
- Nodal arrays
- Rotation sensors
- Cell phone networks
- Joint seismic-EM inversion
- High-resolution seismic reflection
- Distributed Acoustic Sensing
- High-performance computing
- …
- but science and risk mitigation goals are paramount.

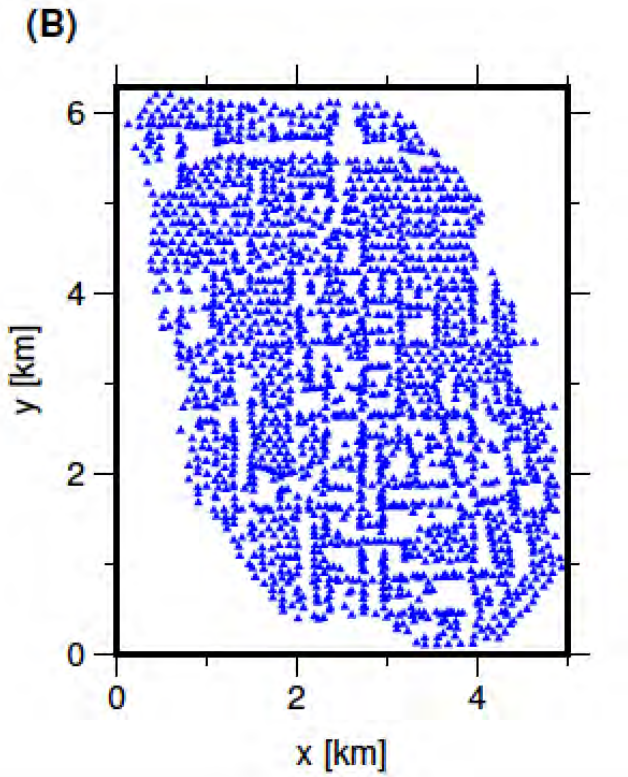






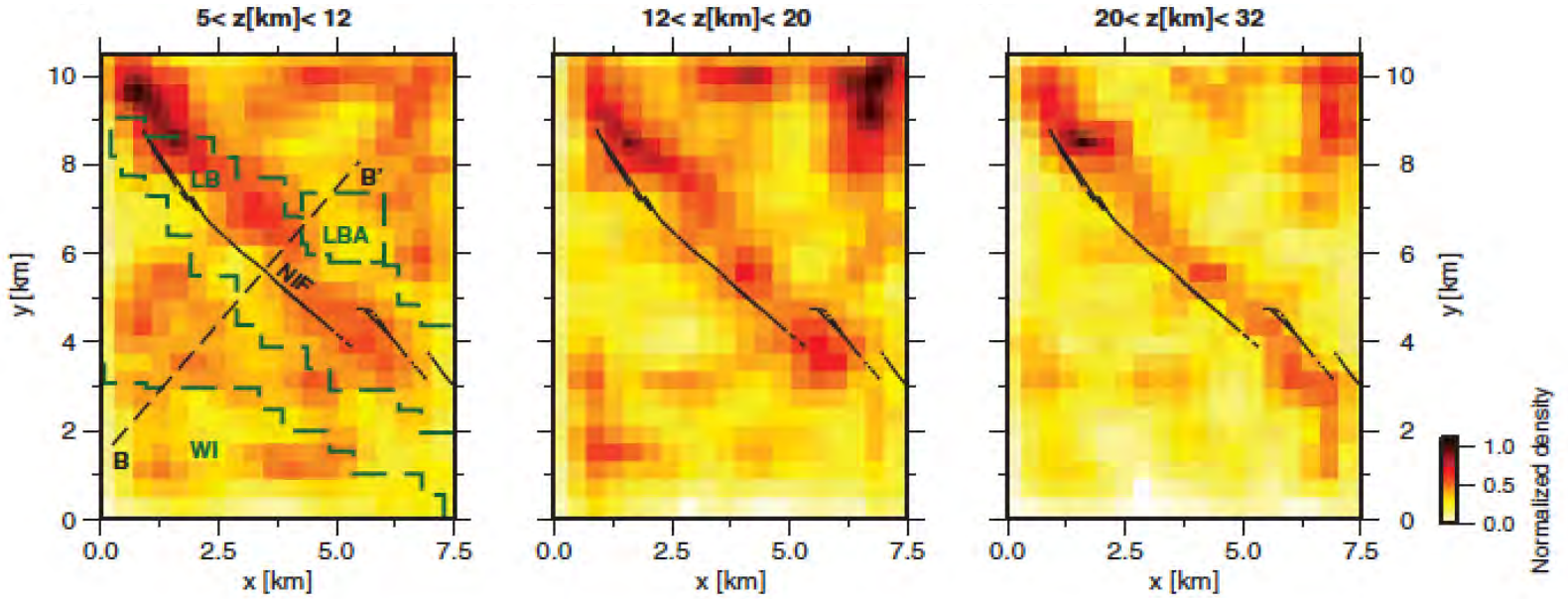
Very dense arrays!



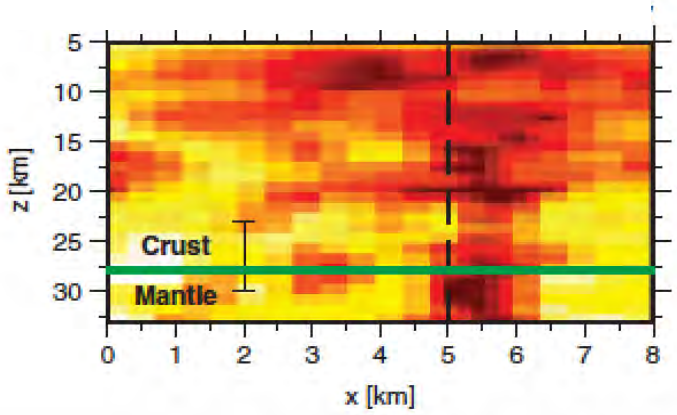


Inbal, Ampuero, Clayton, *Science*, 2016

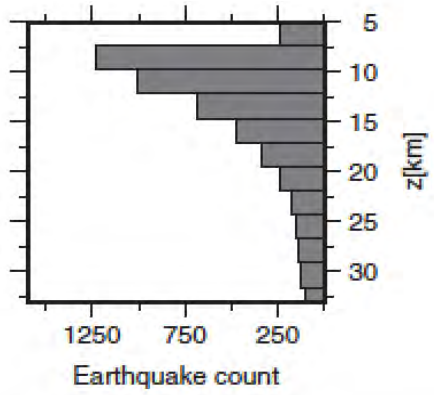
Map views of Long Beach seismicity



Cross-section of events

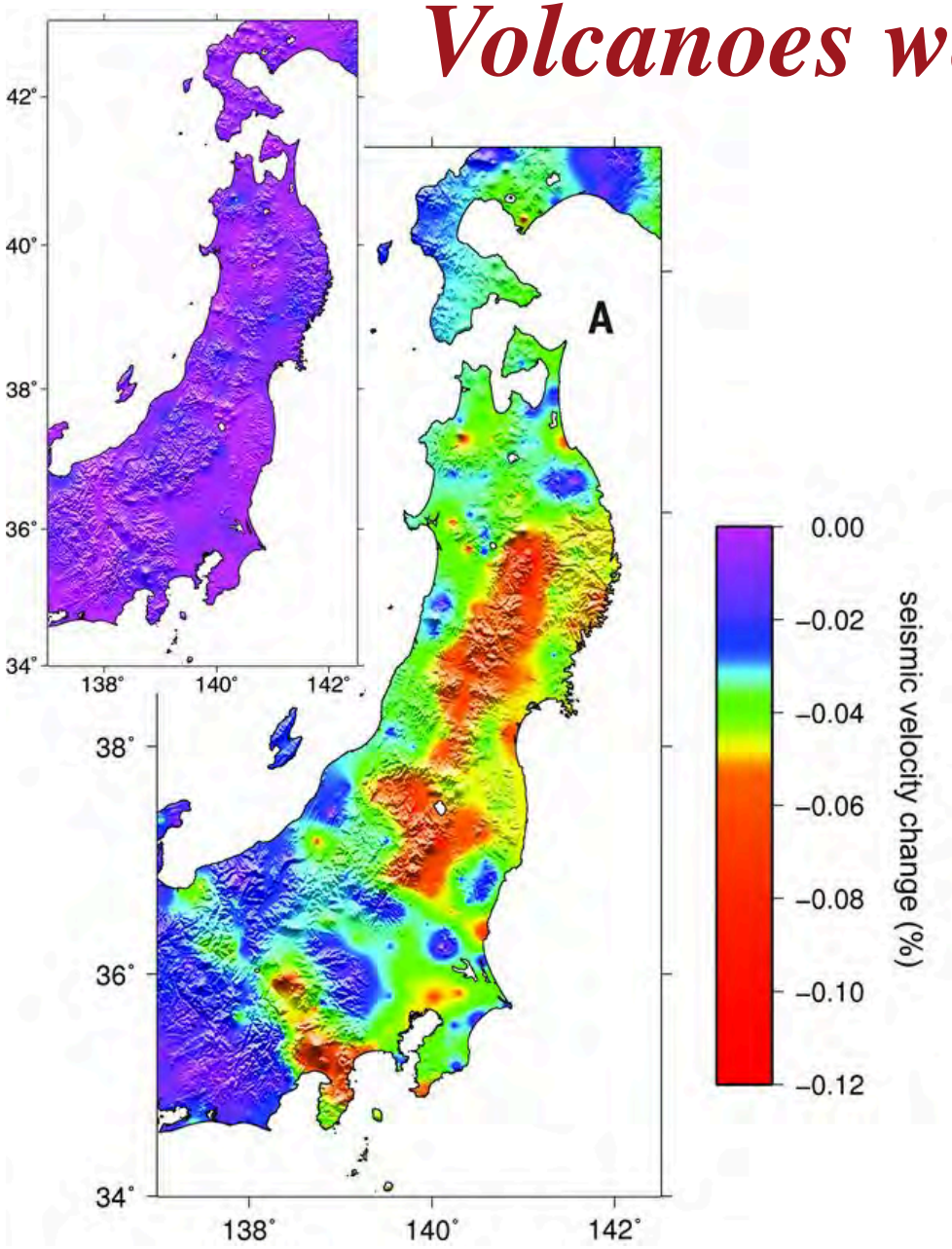


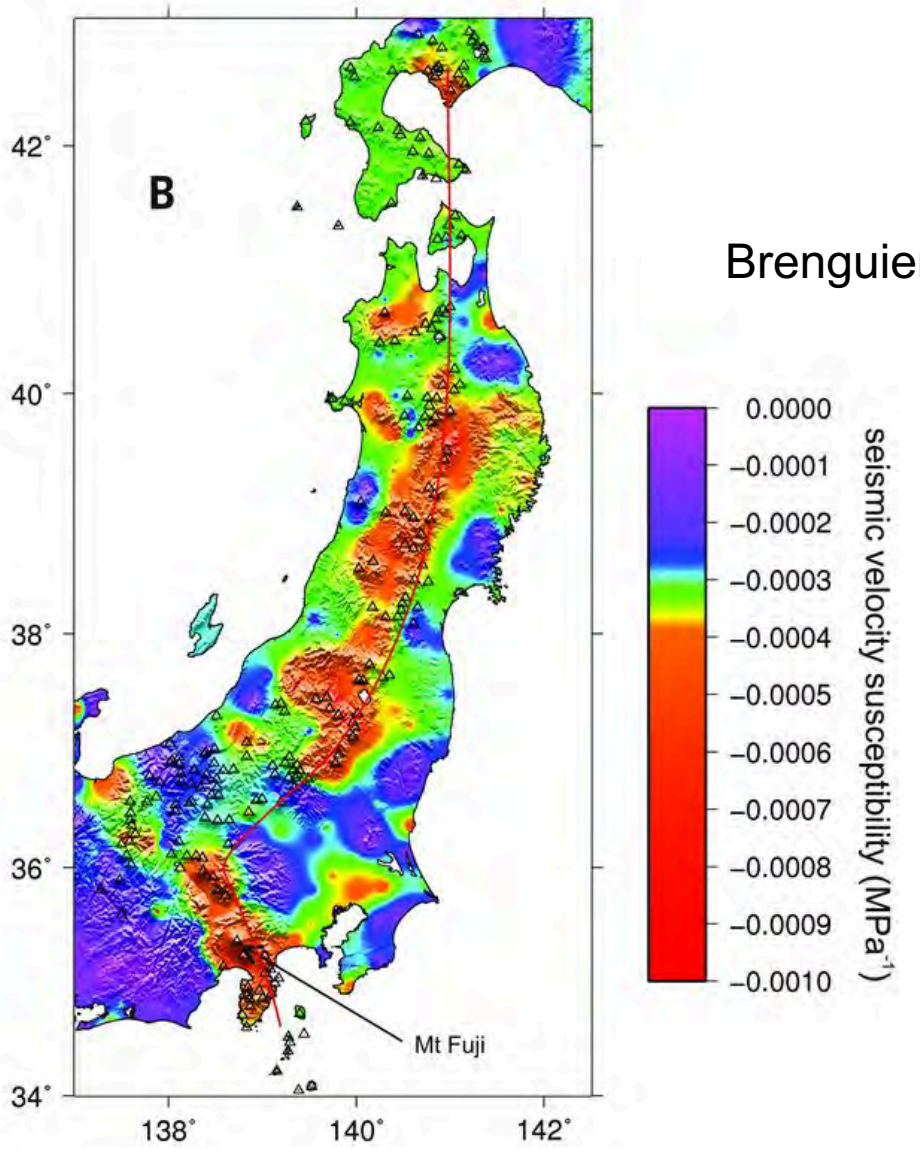
6 month catalog



Inbal, Ampuero, Clayton, *Science*, 2016

Volcanoes weakened by shaking

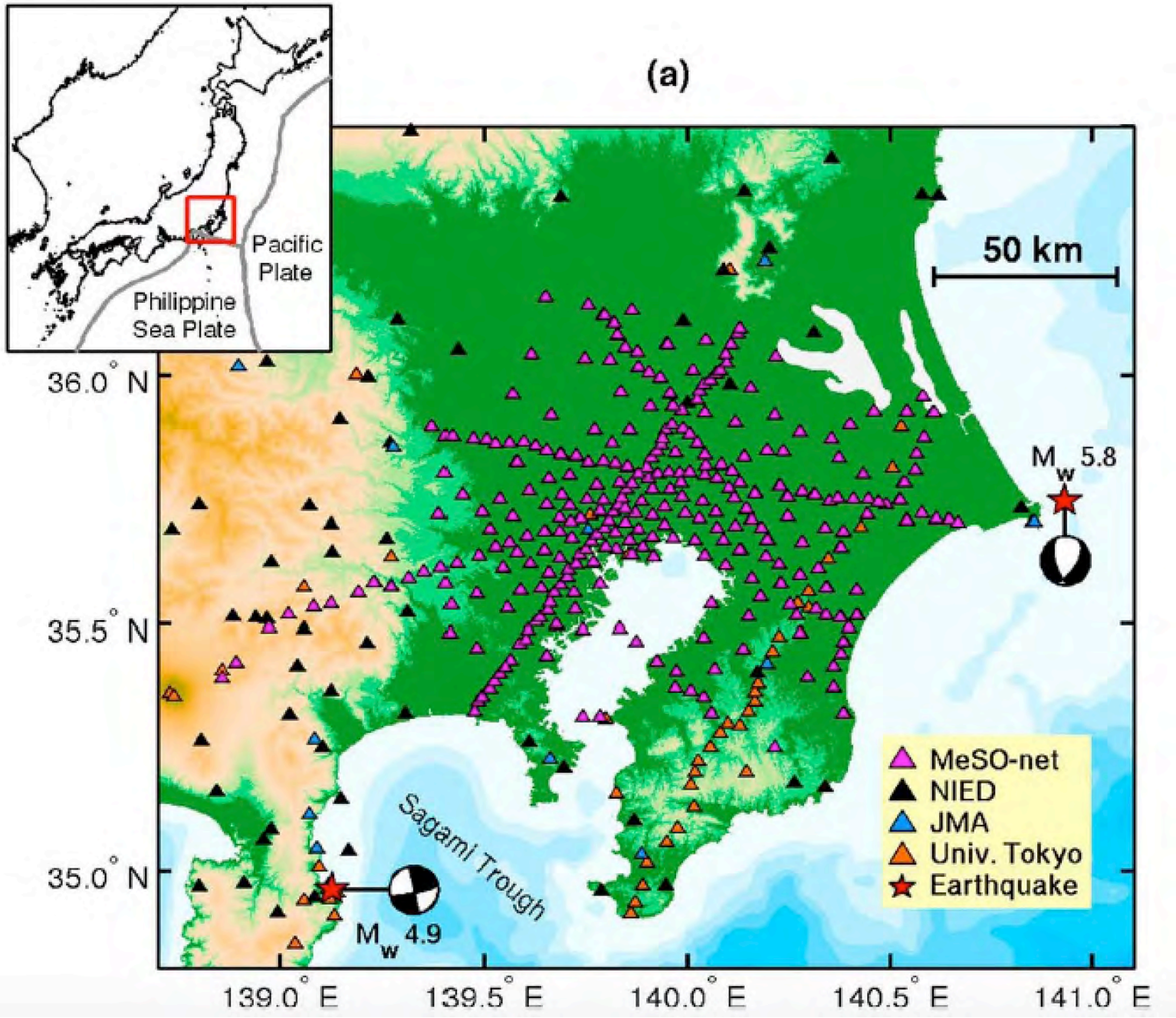




Brenguier *et al.*, *Science*, 2014

Green's function propagation observations

- 300+ sensors
- 20m boreholes
- MeSO-net, Kanto Plain
- 2007-2011 deployment



Viens et al., 2016

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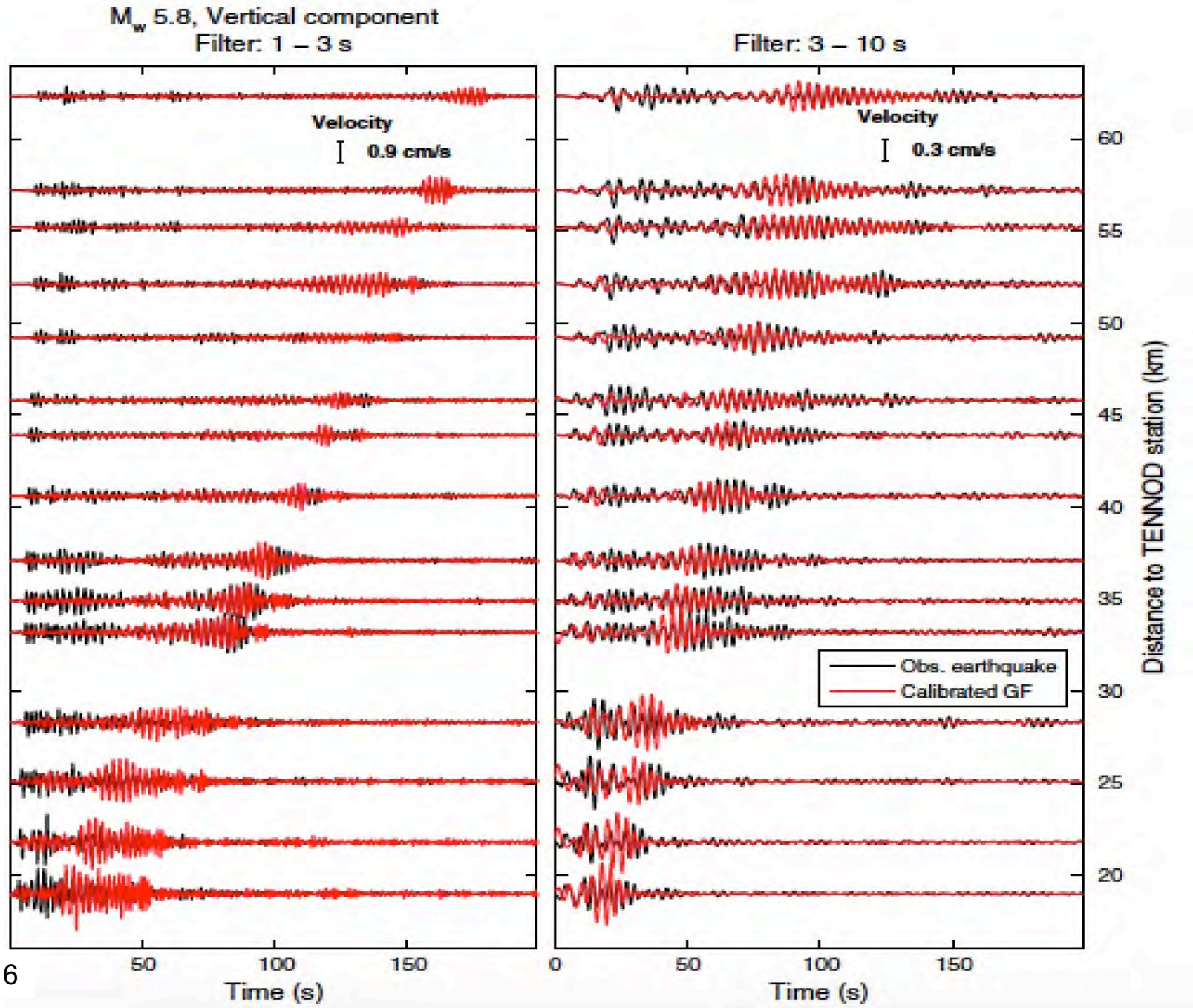
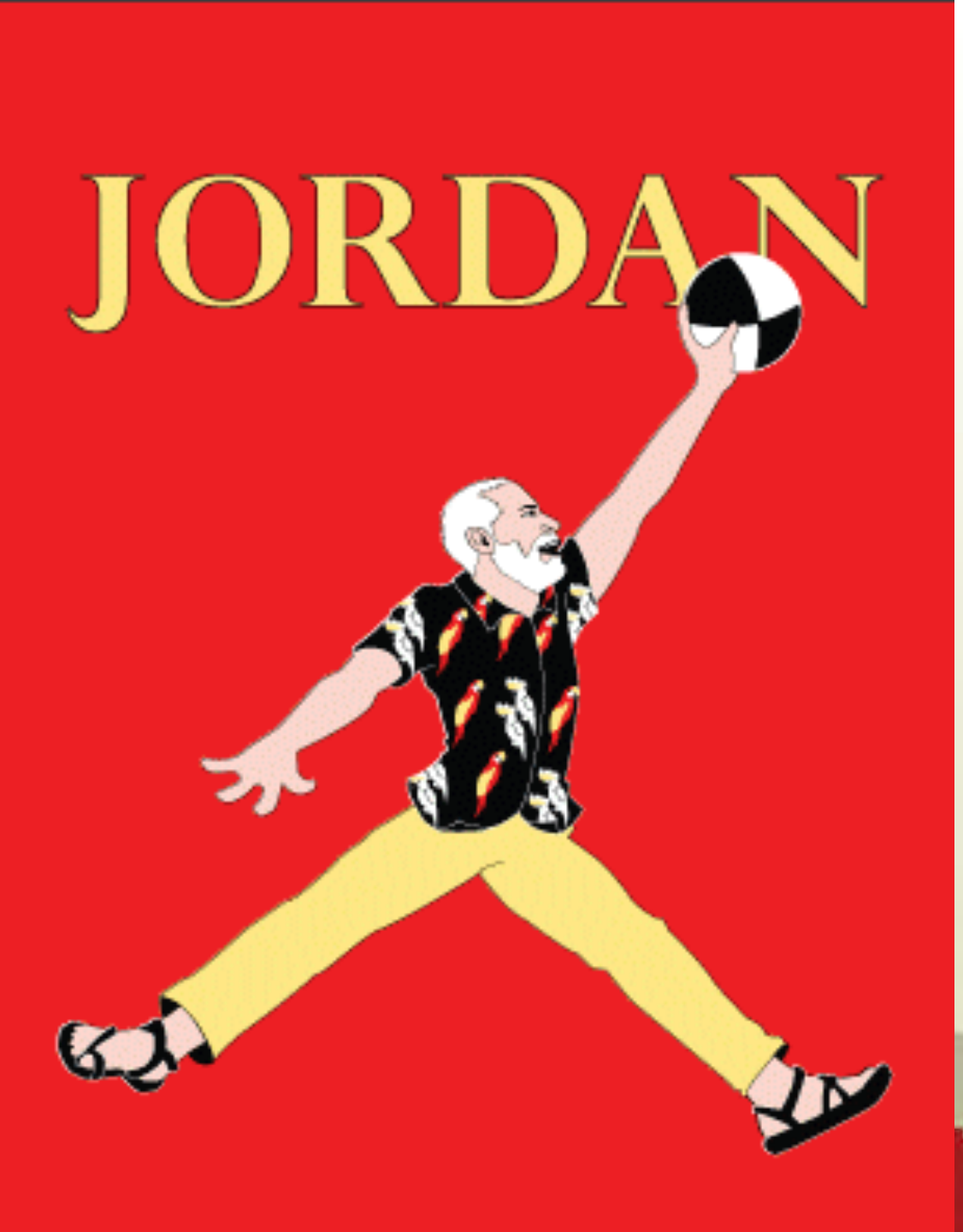


Viens et al., 2016

Plus the rest of SCEC

- Engineering interface
- Geology
- Paleoseismology
- Lower crust and mantle
- CEO activities
- Earthquake response
- …

- SCEC5 roadmap is now broad and excellent, with serious challenges.
- Move toward dense instrumentation to attack source and structural problems.
- Explore collaborations to extend SCEC methods to the west coast and the country (and world).



Many thanks, Tom!