Building Scientific and Technical Capacity in Developing Countries to Support Disaster Risk Reduction

Tuna Onur[1] and Rengin Gök[2]

[1]Onur Seemann Consulting, Inc.

[2]Lawrence Livermore National Laboratory

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344.

This is LLNL-PRES-730118

Earthquake Resilience: From Science to Policy

Research

Decision Making

Data

Knowledge

Policy

Big Gaps in Each of These in Developing Countries

Seismic Cooperation Program (SCP)

- Seismic Cooperation Program of the Lawrence Livermore National Laboratory (LLNL)
- Long-Term Support for Local Seismologists and Engineers (Middle East, Central Asia, Caucasus)
- All Elements of Building Code Development

Capacity Building

Education & Training
Equipment & Instrumentation
Measurements & Data

Science & Engineering

Probabilistic Hazard
Engineering Design & Analyses
Disaster Risk Research

Codes & Regulations

Construction Codes
Earthquake Design Loads
Building Code Compliance

Building Code Development – Challenges

Developing Countries

- Coordination
  - Government
  - Private Sector
- Modernization
  - Science and research
  - Code updates
- Enforcement
  - Responsibility
  - Consequences

Developed Countries

- Overarching Policy
  - Consistency among construction codes
- Expectations
  - Code developers
  - Public
- Performance-based codes
  - Explicit criteria

Building Code Development – Challenges

Developing Countries

- Coordination
  - Government
  - Private Sector
- Modernization
  - Science and research
  - Code updates
- Enforcement
  - Responsibility
  - Consequences

Developed Countries

- Overarching Policy
  - Consistency among construction codes
- Expectations
  - Code developers
  - Public
- Performance-based codes
  - Explicit criteria

Coordination of Building Codes

Building codes are typically developed at the national level but enforced at the local level.

- Formal process
  - Broad-based code committee (national and local governments, researchers, practicing engineers, ...)
  - Clear performance goals for the code; tied to public-safety policy
  - Development lifecycle and public review process

Earthquake Resilience: From Science to Policy

Research

Decision Making

Data

Knowledge

Policy

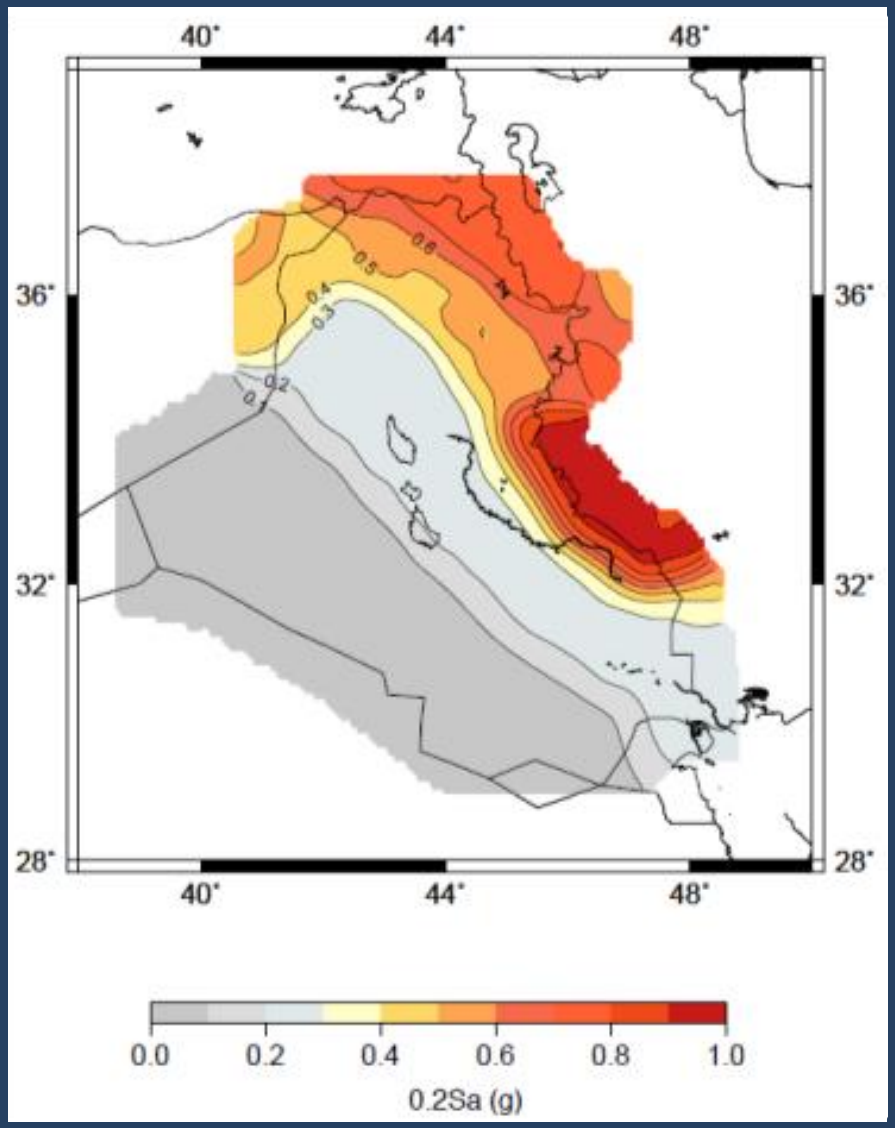
Big Gaps in Each of These in Developing Countries

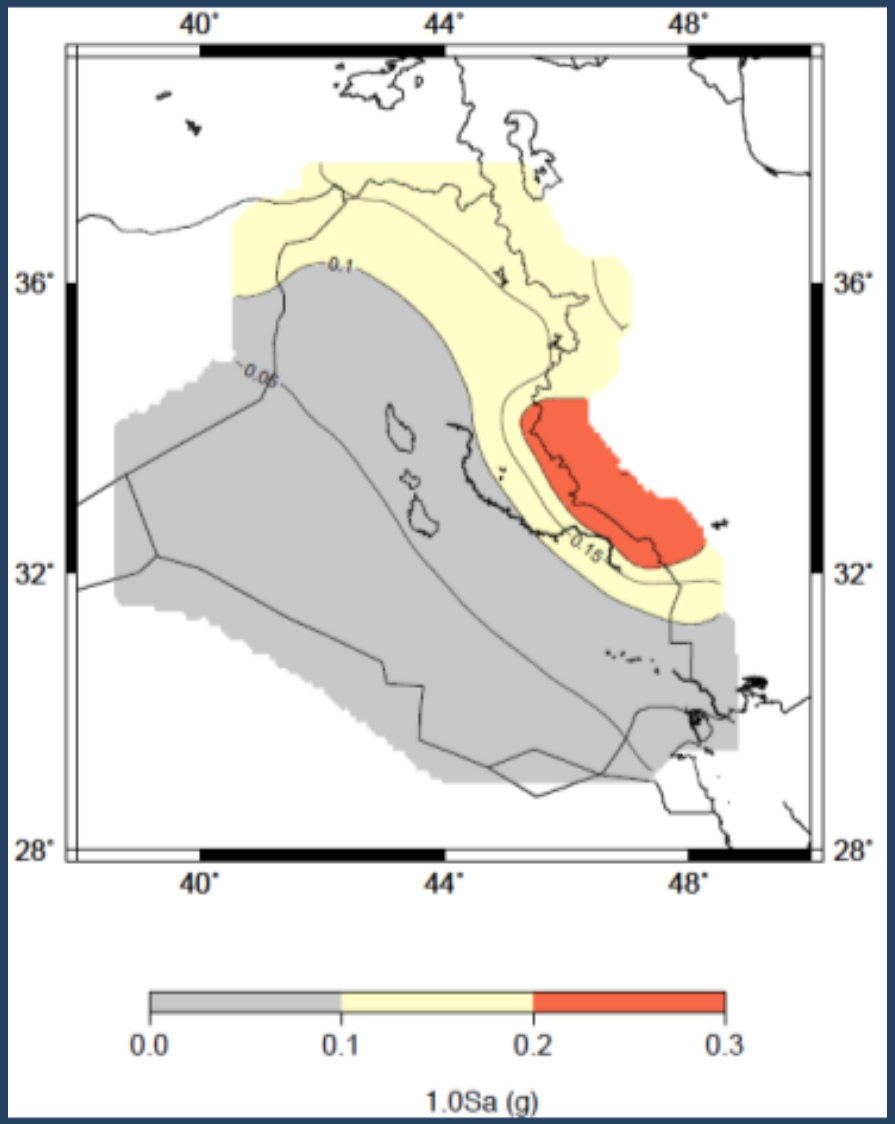
SCP PSHA Project Regions

Example Project 1: Iraq (Completed)

- Probabilistic seismic hazard studies conducted over a three-year period
- Intensive training program: One in Erbil, Iraq (2014) and two in the US (2015, 2016)
- Resulting hazard maps used in Iraq's building code update
- Through continuing collaboration and support, locals have taken over the work

Example Project 1: Iraq (Completed)



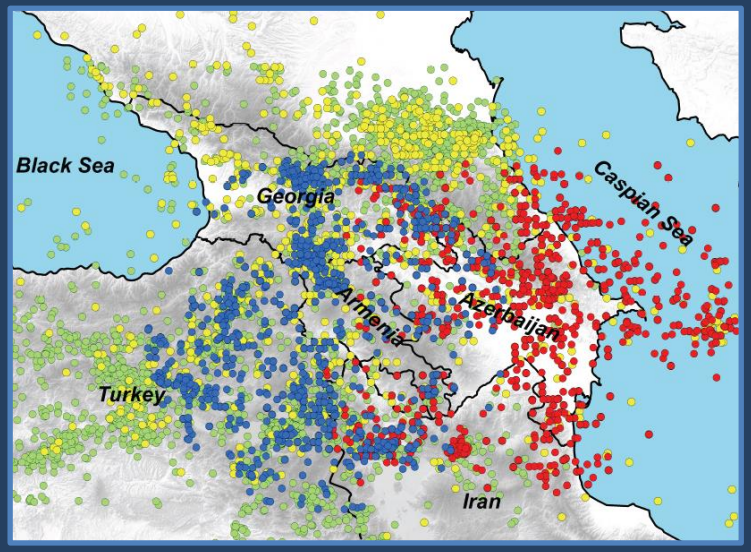


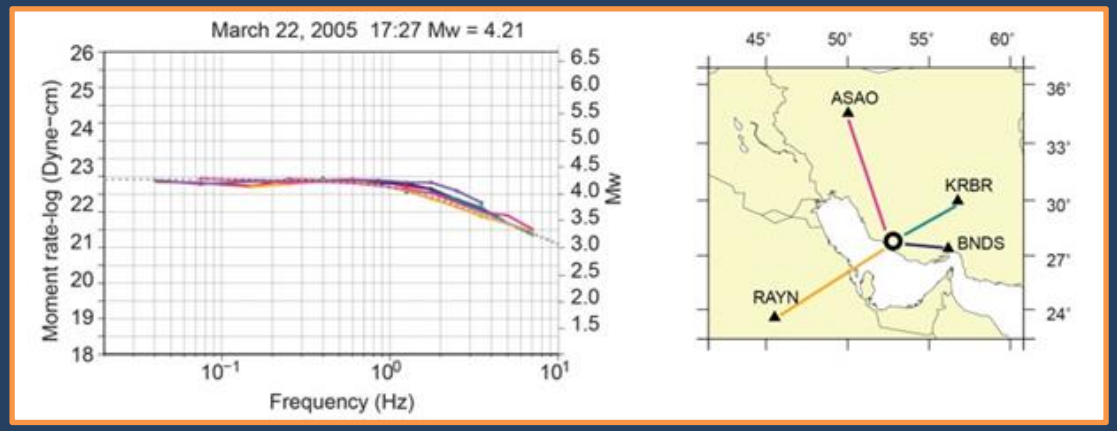
Example Project 2: Caucasus (In Progress)

- Overview of PSHA in a workshop in Georgia (2016) with attendees from Georgia, Armenia, Azerbaijan and Turkey.
- A non-technical half-day symposium attracted interest of government officials in downstream uses of PSHA results.
- First in-depth hands-on workshop next month in Georgia.

Seismic Source Characterization

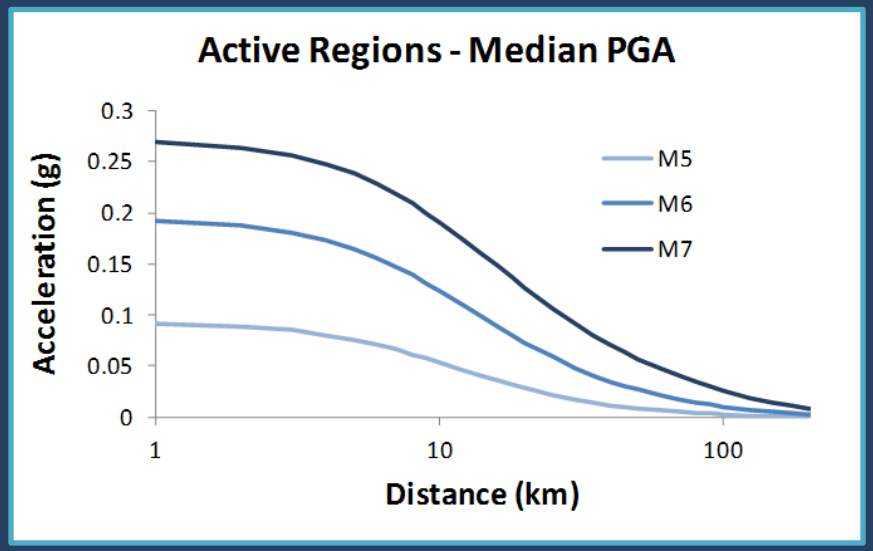
- Earthquake catalogue
  - Reliable earthquake location and Mw calculations
- Active fault database
  - Fault geometry & activity rates

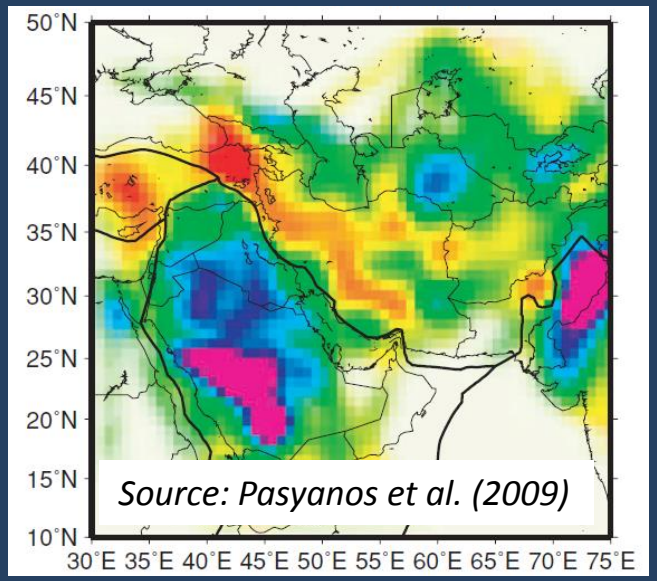




Ground Motion Characterization

- Strong ground shaking characterization
  - Compilation of recorded strong motion data
  - Regional attenuation characteristics
  - Empirical and/or simulation-based ground motion models





Example Project 3: Central Asia (In Planning)

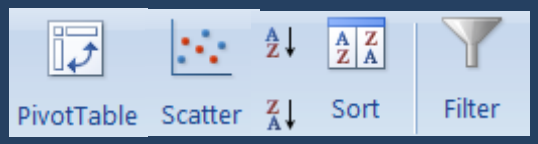
- Planning meeting in Kazakhstan (2016) with participants from Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan.
- Earthquake bulletin/catalogue digitization, revision and unification and their use in PSHA
- Local interest in downstream benefits:
  1. Modernization and possibly harmonization of building codes in the region, and
  2. Understanding risk in the region

Computational Framework

$$p_e = 1 - e^{-\lambda X}$$

- Probability and statistics
  - Return periods, exceedance probabilities, Poisson distribution, etc.
- Software tools
  - Signal processing, calculation of response spectra
  - Development of PSHA components, running analyses
- GIS capability
  - Source characterization, mapping hazard

SEISMOSIGNAL



CRISIS2008

OPENQUAKE

OSGeo

EqHaz

Outcomes for the Countries

Data

- Weak- and strong-motion instrument deployment, data collection and processing
- Robust earthquake catalogue including earthquake relocations & newly calculated Mw

Outcomes for the Countries

Knowledge

- Long-term training, capacity building and support for local seismologists and engineers

  → local ownership

- Probabilistic assessment of seismic hazard with local input

Enabling building code modernization

Road to Disaster Resilience…

- Risk mitigation through retrofitting buildings and infrastructure...
- Build back better...
- Risk resilient infrastructure...
- First step: Robust building codes!

Thank you!

Questions/Comments?

tuna@onurseemann.com