
# Geo-engineering Extreme Events Reconnaissance

*Turning Disaster into Knowledge*

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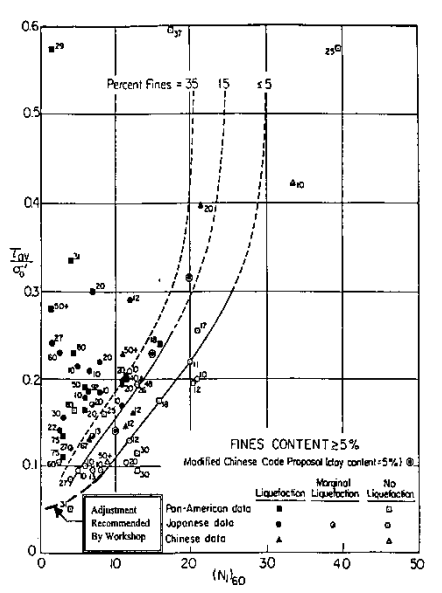
**NSF-Sponsored Geo-engineering Extreme Events Reconnaissance Association**

# NEED

Geo-engineering is an experience-driven field.

The importance of detailed mapping and surveying of damaged areas relative to general surveys cannot be overemphasized.

They provide the hard data of the well-documented case histories that drive the development of many of the empirical procedures used in practice and shape our understanding.

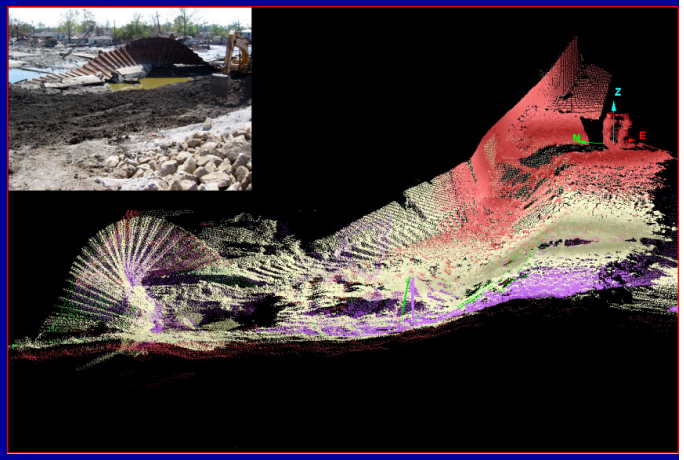



# OBJECTIVES

GEER has developed an effective approach to conducting NSF-sponsored post-events reconnaissance.

Continue to develop and implement new technologies

Document the geo-engineering effects of extreme events to advance the profession's understanding



Geo-engineering Extreme Events Reconnaissance
Turning Disaster into Knowledge

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GEER RECORDER: Ben Mason, UCB / Katherine Jones, UCB


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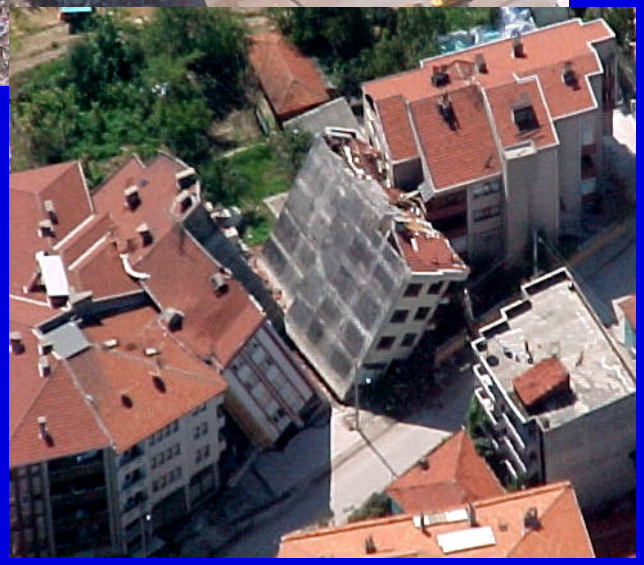
## & GROWING

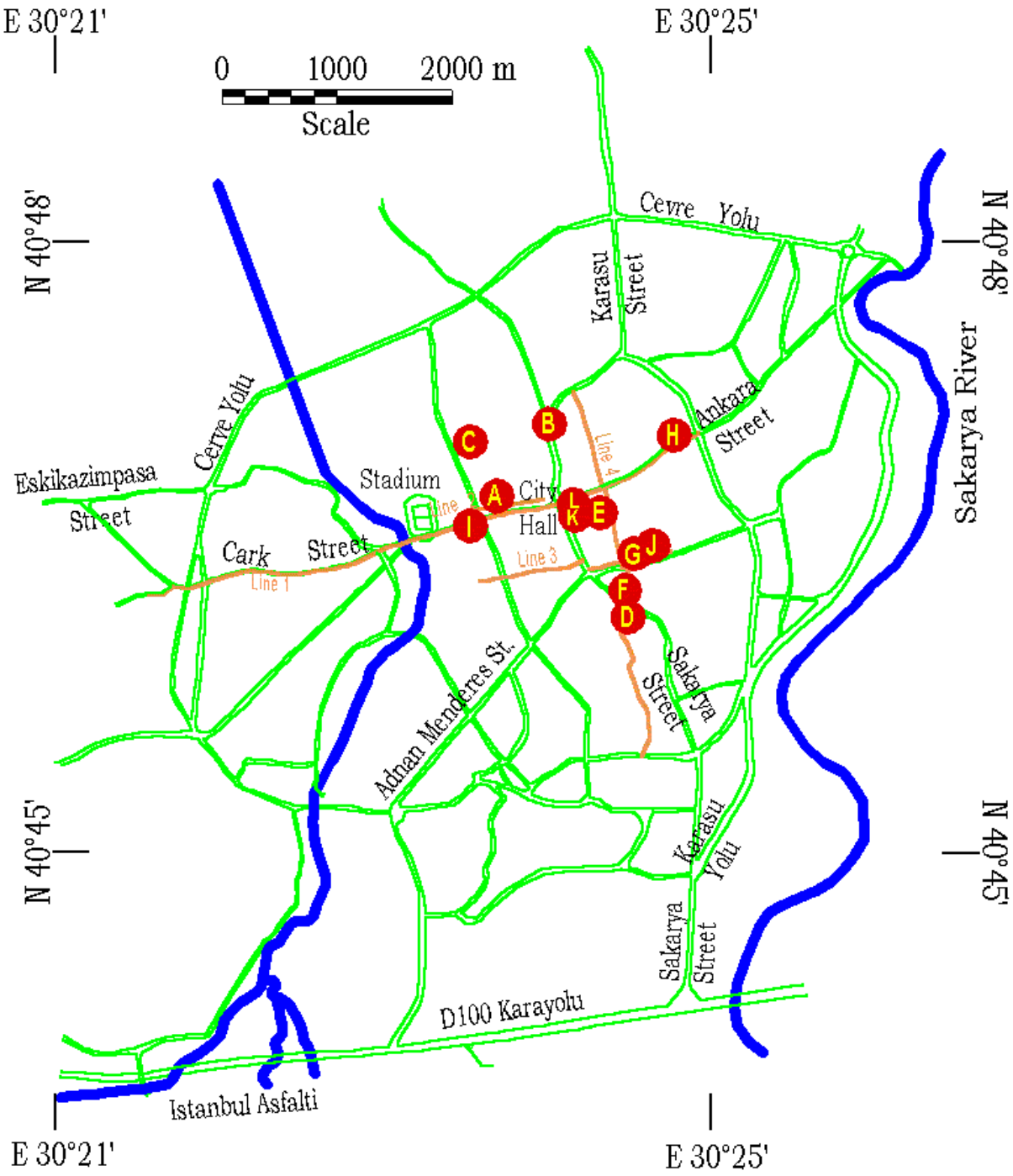
http://www.geerassociation.org/index.html

# NSF-Sponsored Geotechnical Engineering Reconnaissance

1999 Kocaeli, Turkey EQ (Ansal et al. 1999)
1999 Chi-Chi, Taiwan EQ (Abrahamson et al. 2001)
1999 Duzce, Turkey EQ (Ansal et al. 1999)
2001 Bhuj, India EQ (Jain et al. 2002)
2001 Nisqually EQ (Bray et al. 2001)
2001 Southern Peru EQ (Wartman et al. 2002)
2002 Denali EQ (Kayen et al. 2003)
2003 Tecoman, Mexico EQ (Wartman et al. 2003)
2004 Niigata-ken Chuetsu, Japan EQ (Bardet et al. 2004)
2006 Island of Hawaii, EQ (Medley 2006)
2007 Niigata-Chuetsu Oki, Japan EQ (Kayen et al. 2007)
2007 Ica-Pisco, Peru EQ (Rodriguez-Marek et al. 2007)
2008 Sichuan, China EQ (Frost et al. 2009)
2008 Achaia-Ilia, Greece EQ (Margaris et al. 2008)
2008 Iwate-Miyagi Nairiku, Japan EQ (Kayen et al. 2008)
2008 Hurricanes Gustav & Ike, U.S. (Wooten et al. 2009)
2009 L'Aquila, Italy (Stewart et al. 2009)

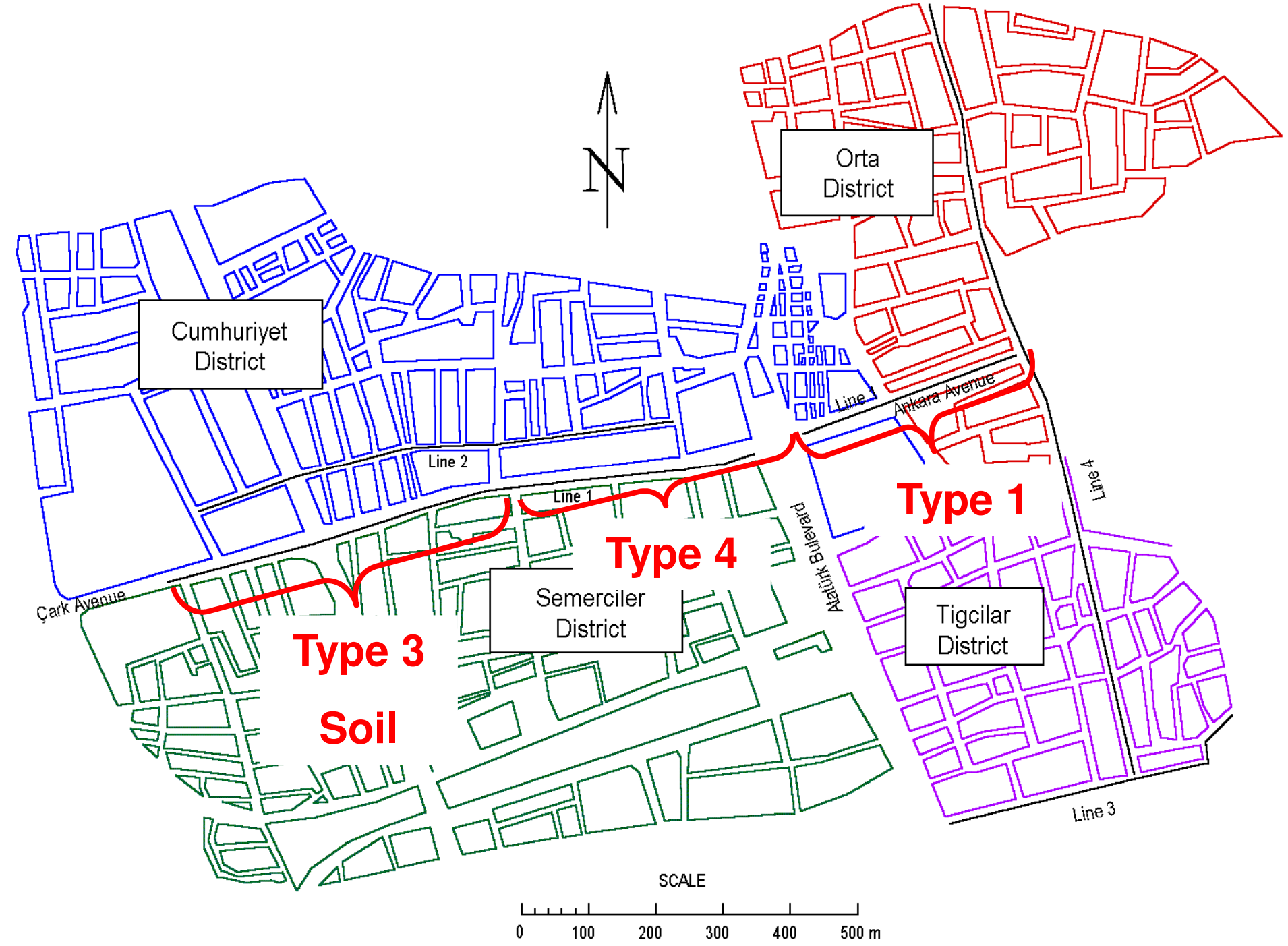


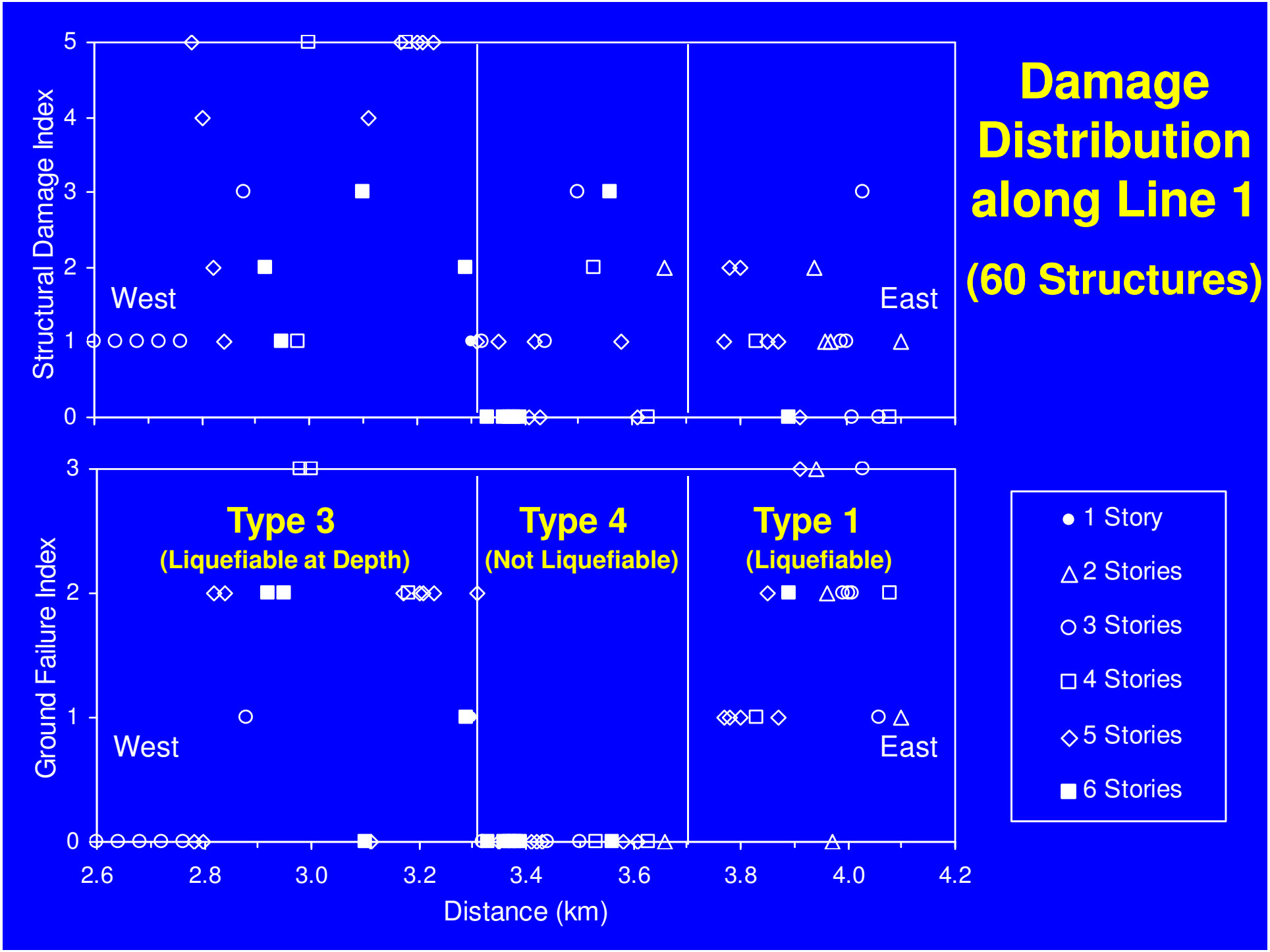
**1999 Kocaeli Earthquake:** A. Ansal, N. Abrahamson, J. Bachuber, J. P. Bardet, A. Barka, M. Baturay, M. Berilgen, R. Boulanger, J. Bray, O. Cetin, L. Cluff, T. Durgunoglu, D. Erten, M. Erdik, D. Frost, I. M. Idriss, T. Karadayilar, A. Kaya, W. Lettis, J. Martin, J. Mitchell, G. Olgun, A. Onalp, T. O'Rourke, W. Paige, E. Rathje, C. Roblee, R. Sancio, W. Savage, R. Seed, P. Somerville, J. Stewart, B. Sunman, B. Swan, C. Synolakis, S. Toprak, D. Ural, R. Witter, M. Yashinski, T. Yilmaz, L. Youd

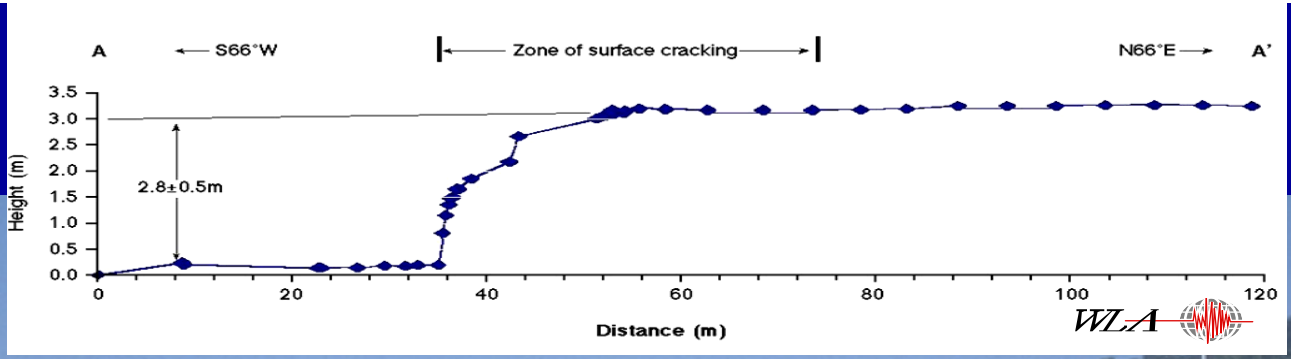


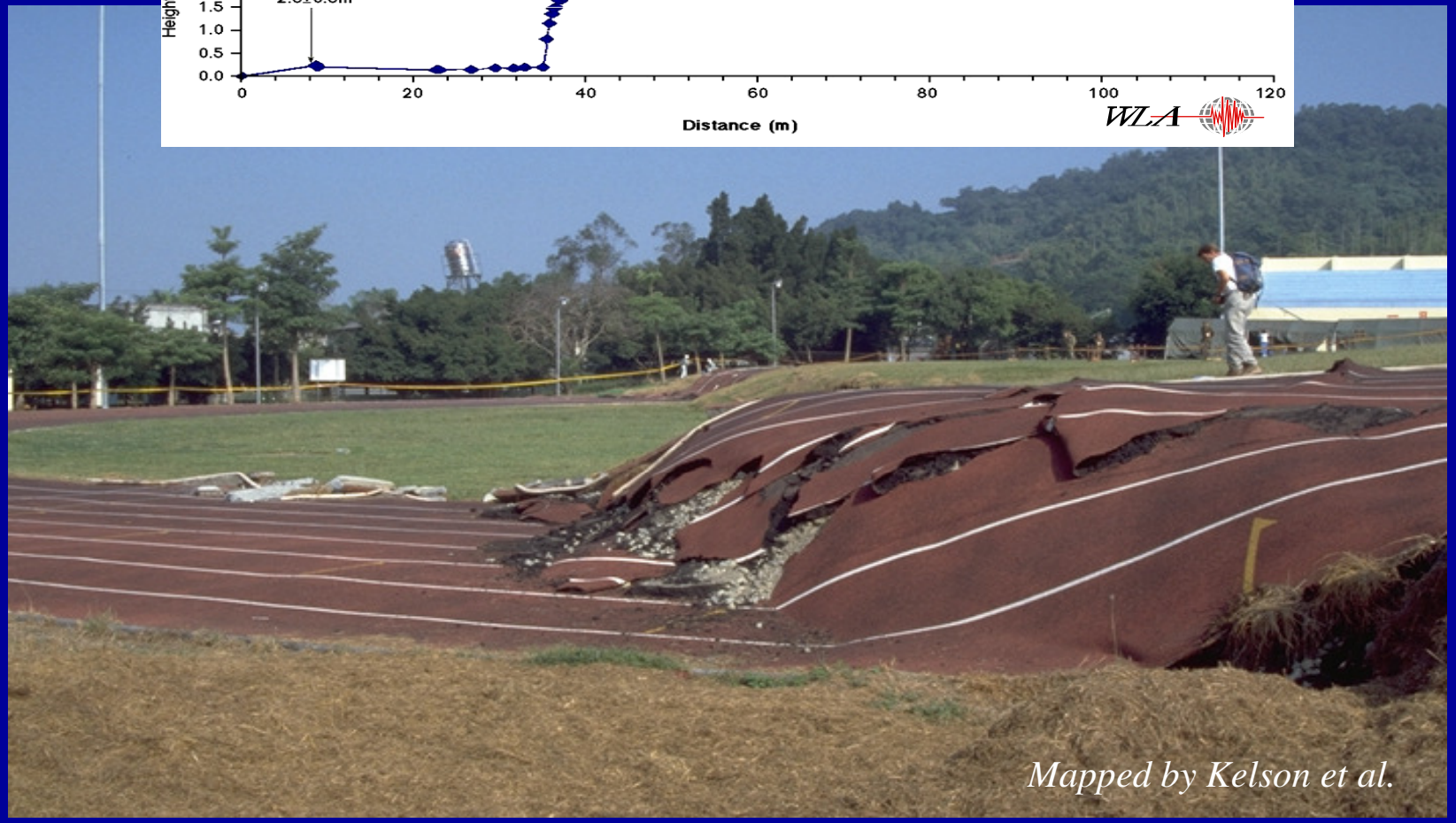

***City of Adapazari***

**Post-EQs Surveys**

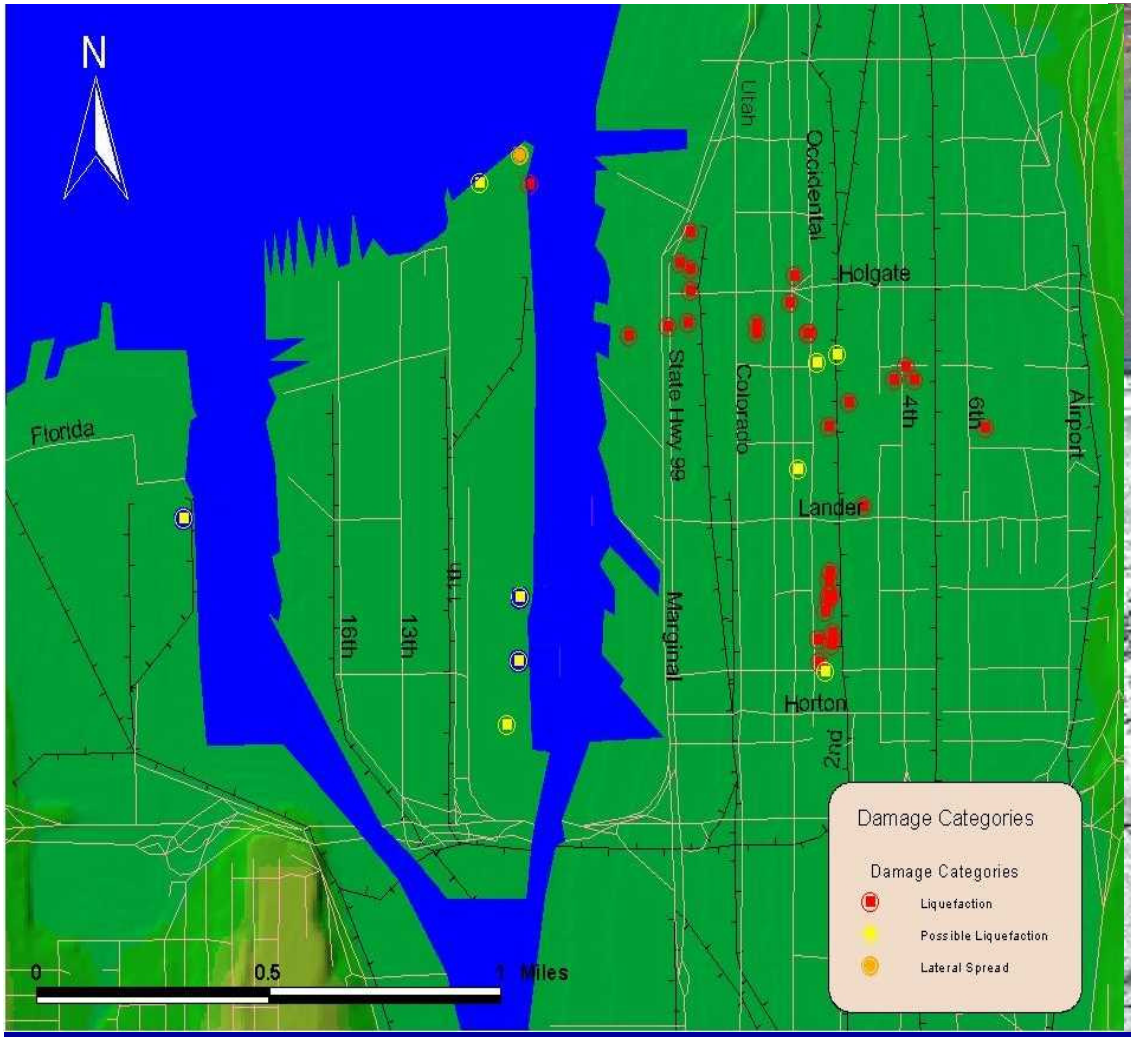

N
Orta
District
Cumhuriyet
District
Semerciler
District
Tigcilar
District
Line 1
Ankara Avenue
Line 2
Line 1
Line 4
Atatürk Bulevard
Çark Avenue
Line 3
Type 1
Type 4
Type 3
Soil
SCALE
0
100
200
300
400
500 m


Damage Distribution along Line 1
(60 Structures)
Structural Damage Index
Ground Failure Index
West
East
Type 3
(Liquefiable at Depth)
Type 4
(Not Liquefiable)
Type 1
(Liquefiable)
1 Story
2 Stories
3 Stories
4 Stories
5 Stories
6 Stories
Distance (km)




**1999 Chi-Chi EQ: N. Abrahamson, J. P. Bardet, R. Boulanger, J.D. Bray, Y.-W. Chan, C.-Y. Chang, S. Chang, C.-H. Chen, L. Cluff, L. Harder, A-B. Huang, S. Huang, J.W. Ju, K. Kelson, S. Kieffer, S. Kramer, M.-J. Kuo, W. F. Lee, H-L. Lin, C-H. Loh, M. McRae, C-Y. Ou, W. Perkins, G. Rix, C. Roblee, R.B. Seed, J.-D. Shen, N. Sitar, J. Stewart, L. Teng, J. I. Sun, D. Wells, R. Wright and M. Yashinsky**

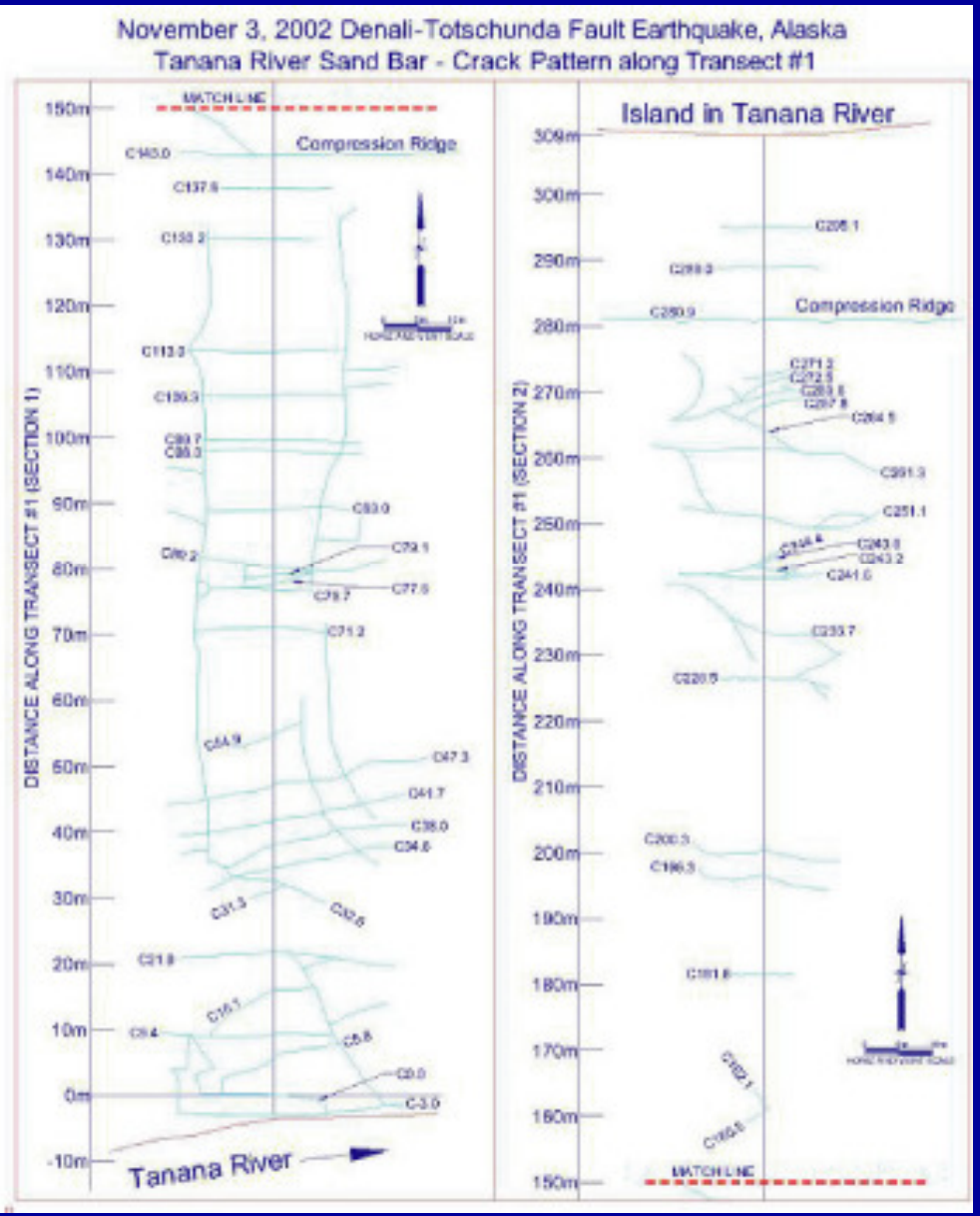



**2001 Nisqually EQ:** J. Bray, R. Sancio, A. Kammerer, S. Merry, A. Rodriguez-Marek, B. Khazai, S. Chang, A. Bastani, B. Collins, E. Hausler, D. Dreger, W. Perkins, & M. Nykamp; with J. Arnold, D. Booth, W. P. Grant, J. Hagedorn, M. Hamm, J. Hubbell, R. Hudson, S. Kramer, R. Mitchell, B. Muhunthan, S. Palmer, M. Vendetti, M. Wallinger, B. Topolski, K. Troost

*http://peer.berkeley.edu/nisqually/geotech/*

# 2002 Denali Earthquake: Detailed Surveying

DGPS & Line-drawn mapping of polygon-shaped lateral spreads: 1.6%-3.8% shear strain toward Tanana river



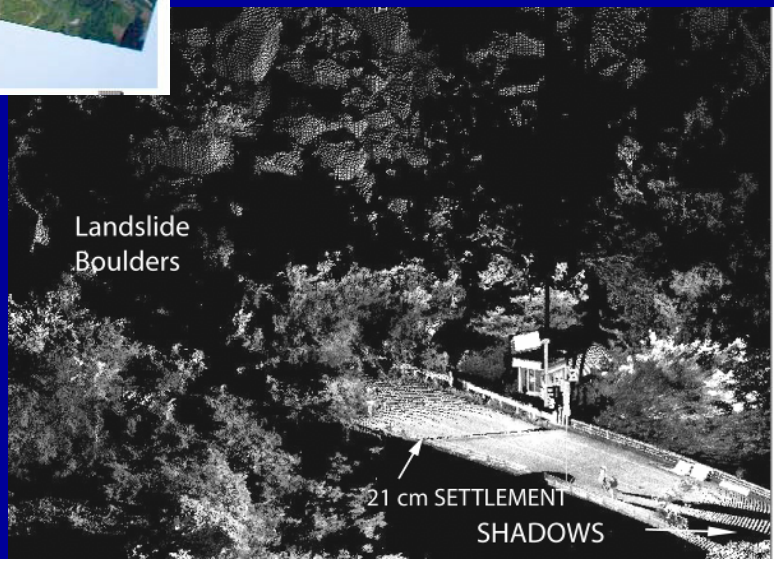

Mapped by Sitar, Kayen, Collins, and others

# 2008 & 2004 Japan EQs: Remote and Advanced Sensing



Remote Sensing: Kayen et al. 2008

LiDAR:
Rathje et al. 2004



# GEER Research Accomplishments

1. Use of new technologies for reconnaissance
2. Use of existing technologies in an improved coordinated manner to document performance
3. Better training of those involved in reconnaissance efforts, both in terms of effectiveness and safety; provide access to equipment required for state-of-the-art surveying
4. Timely and accurate results for the post-EQ survey efforts in terms of web-based short reports, data files, and final reports
5. A systematic mechanism for geo-engineers to respond effectively to extreme events through NSF support

# SOME KEY ISSUES

## - Opportunities and Challenges:

- Coordination with EERI-LFE, USGS, ASCE, USACE, and other organizations
- Advanced reconnaissance tools: LiDAR, GIS integration, GoogleEarth, GPS/video/picture, satellite and remote sensing, digital topographic and geologic maps, & electronic collection
- Role of the practitioner
- Rapid dissemination of post-event reconnaissance data
- Development of quantitative data
- Systematic collection and archiving of post-event data
- GEER response plan and funding
- Site access
- ***Multi-hazards***