Development of a Post-Reconnaissance Geotechnical Data Repository

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2001 Southern Peru Earthquake

M_w = 8.4 - the largest earthquake of the previous 25 years

~150 casualties, 2800 injuries

37,000 homes damaged, affecting ~ 220,000 people

2001 Southern Peru Earthquake

Drexel/WSU/Utah St. team secondary field investigation in 2003

NSF unsolicited proposal

Field data collection: subsurface investigation and SASW

Work focused on development of case histories related to:

- Site and topographic effects
- Seismic compression
- Seismic performance of dams

2001 Southern Peru Earthquake

Successes and limitations

- Development of high quality case histories
- Good collaboration with local partners
- A second visit reveals subtle phenomena and new insights
- Data resolution and quality (e.g. manual surveys)
- Focus on the site-specific rather than the regional-scale
- Analog data legacy

2007 Pisco Peru Earthquake

GEER lead: Adrian Rodriguez-Marek

Subduction event affecting coastal and inland mountainous regions (implications for Pacific NW)

~560 fatalities, 1,900 injured

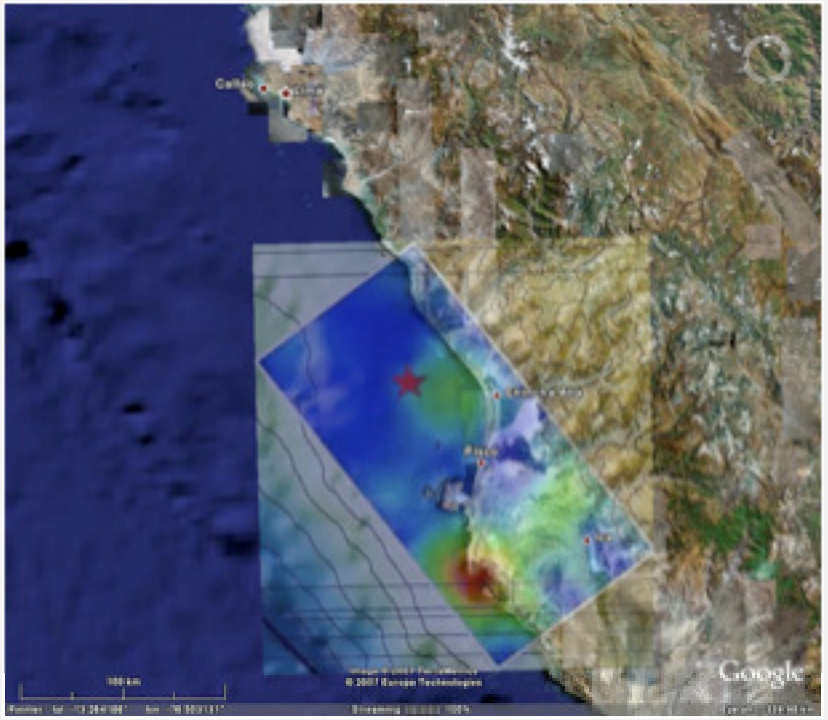
55,000 buildings destroyed

Extensive damage to transportation infrastructure

Recorded at 16 stations within 150 km of the fault

PGA = 0.5g at ~40 km

Key geotechnical aspects: landslides, liquefaction



2007 Pisco Peru Earthquake

Second investigation: *The Mw8.0 Pisco Earthquake: a Benchmark Event for Remote Sensing and Data Archiving*

NSF unsolicited proposal

U. Ark./Drexel/WSU team

Focus on ground failure

Field investigation: Remote sensing, LiDAR, SASW, subsurface investigation, geologic field mapping

The Mw8.0 Pisco Earthquake:

A Benchmark Event for Remote Sensing and Data Archiving

Project Overview

Case studies at the site-specific scale have lead to key advancements

Subduction events have vast mesoseismal areas

Highly networked nature of modern infrastructure systems (potential for cascading failures, and sensitivity to extreme events) – suggests consideration within a larger spatial framework

The Mw8.0 Pisco Earthquake:

A Benchmark Event for Remote Sensing and Data Archiving

Vision

Establish the Pisco Earthquake as a fully documented, permanently archived “benchmark” ground failure event

This is a NEHRP-cited key priority

New model for post-earthquake investigations that will increase opportunities for collaboration within the earthquake research community

Data will be uses in ways that extend beyond the imaginations of those in the traditional reconnaissance community

Serve as a model for future post-earthquake investigations by others - consistent information structure and more efficient, timely, lower cost database development

The Mw8.0 Pisco Earthquake:

A Benchmark Event for Remote Sensing and Data Archiving

Why the Pisco Earthquake?

- Effects were documented by GEER team

- Mesoseismal region spans a range of land uses and geomorphic settings: rich and varied “living laboratory” of earthquake effects

- Availability of multiple strong ground motion recordings, ground failure-related building damage inventories, and road closures have been collected and made available by local agencies

The Mw8.0 Pisco Earthquake:

A Benchmark Event for Remote Sensing and Data Archiving

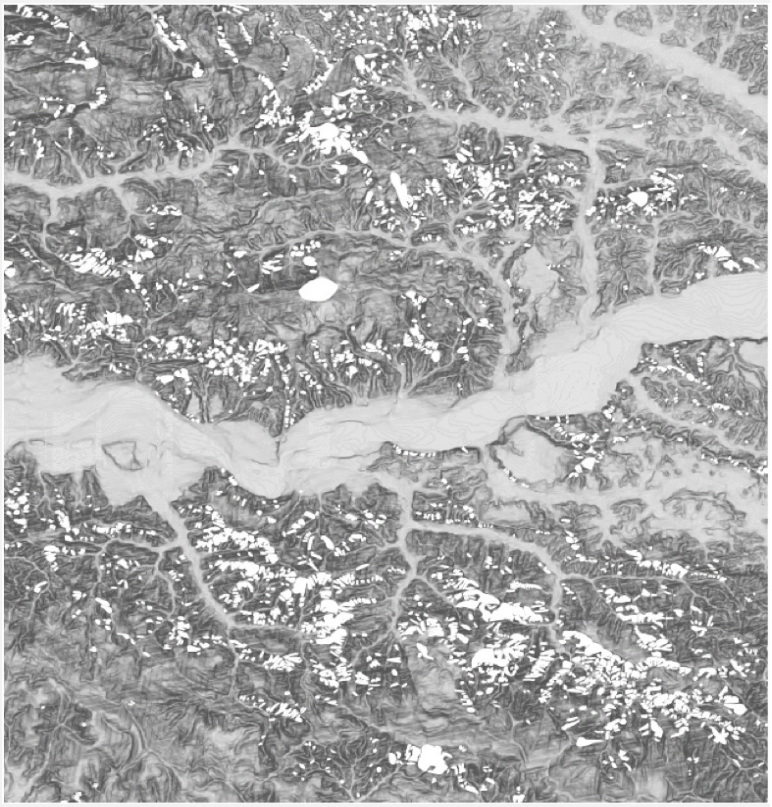
Landslide databases

Currently there are two openly available, comprehensive geospatial databases

Northridge: over a decade old yet continues to be used today by researchers around the world
- Topographic amplification
- Regional hazard models
- Landslide model development
- Public health

Collectively, these two databases have been cited in journal articles dozens of times

Limitations: sole focus on landslides and lack of event-specific tagging or details



The Mw8.0 Pisco Earthquake:

A Benchmark Event for Remote Sensing and Data Archiving

Pisco database

- Hosted by NEEScentral
- Geospatial (geo-referenced data, observations and photographs)
- Searchable
- Open-use/open-source
- Professionally curated

One of the first to leverage the capabilities of NEESit (evolution of the data repository)

Supports NEES mission "to foster the open exchange of (earthquake engineering) data and information among researchers and practicing engineers."

The Mw8.0 Pisco Earthquake:

A Benchmark Event for Remote Sensing and Data Archiving

Pisco database

NEESit data model: classes of entities to store information, attributes of that information, and relationships among these entities and attributes

Facilitates development of a relational database

Geospatial data will be organized in KML format (XML for the visualization of geospatial data) - standard maintained by the Open Geospatial Consortium

(i) maps can be annotated, overlaid and linked to other data
(ii) data can be visualized using both desktop and mobile devises using free software
(iii) OGC committed to promoting proper life-cycle management
(iv) NEESit has an interest in using Google Earth as a tool for exploring spatial data.
(v) KML language files can be created using Google Earth, ArcGIS (ArcMap), a text editor, or an XML editor.

The Mw8.0 Pisco Earthquake:

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Partial inventory of data to be archived

Category	Description	Example data
Project	General	Title, research team and contact information, research objectives, roles of individual team members, sponsoring agency, dates of project and field activities.
Literature	Published reports, papers, maps, and data	Geologic maps of region, highway maps, post-earthquake reports from local agencies.
Sensors	Surface wave geophones, LiDAR unit	Owner, manufacturers, model, serial number, calibration dates and data.
Field data	Topographic, geologic, and observational data	Ground failure inventory, Lidar surveys, geologic characterizations data (e.g. rock type, discontinuity orientations and spacing), subsurface data (e.g SPT and Vs), field notes, photographs, witness accounts (all with GPS coordinates and time stamps)
Remote Sensing data	Unprocessed images	Metadata provided by the vendor and developed by the research team including satellite orientation parameters (both delivered and adjusted), date and time of acquisition, and the full image processing chain, and control/check point measurements in image coordinates.
Processed Data	Processed images	Delineated ground failure locations, description of processing techniques, accuracy analysis of orthoimages based NSSDA guidelines. Geotiff format in Google Earth, Google Maps, Microsoft Virtual Earth compatible tiling structure.
Derived data	KML files	KML geospatial files, locations of control and check points, 3D pre- and post-earthquake DEM's.
Educational modules	Movie files	"Fly through" narrated videos.
Other data	Other measured data	Earthquake ground motion files

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Examples of potential applications of database

Topic	Potential Application
Risk Assessment	Use of the Canchamana lateral spread as a benchmark case history for current research activities focused on the role of water films in lateral spreading
Asset loss modeling	Development of fragility curves relating ground failure responses to impacts on infrastructure systems and buildings
Natural Hazards	Validated and calibration of loss models used by the insurance industry
Geomorphology	Study and contrast behavior under differing land uses to identify the human contributions to extreme events and better understand societal vulnerability
Paleo-seismology	Quantify the geomorphic consequences of the event: increased rates of erosion and greater sediment yields from debris
	Quantify the morphological signature of the Canchamaná lateral spread and link this to similar but ancient deposits to estimate earthquake recurrence rates

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Educational modules

Youtube.com videos

- Reaches a vast audience

- Successful past use of video-sharing network (~2000 views to date)

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Pisco database

Beta testers needed!

We would appreciate your feedback