

Update
Role of the National Science Foundation (NSF)
in the
National Earthquake Hazards Reduction Program (NEHRP)

Presented to the
NEHRP Advisory Committee for Earthquake Hazards Reduction (ACEHR)
November 9-10, 2010
Memphis, TN

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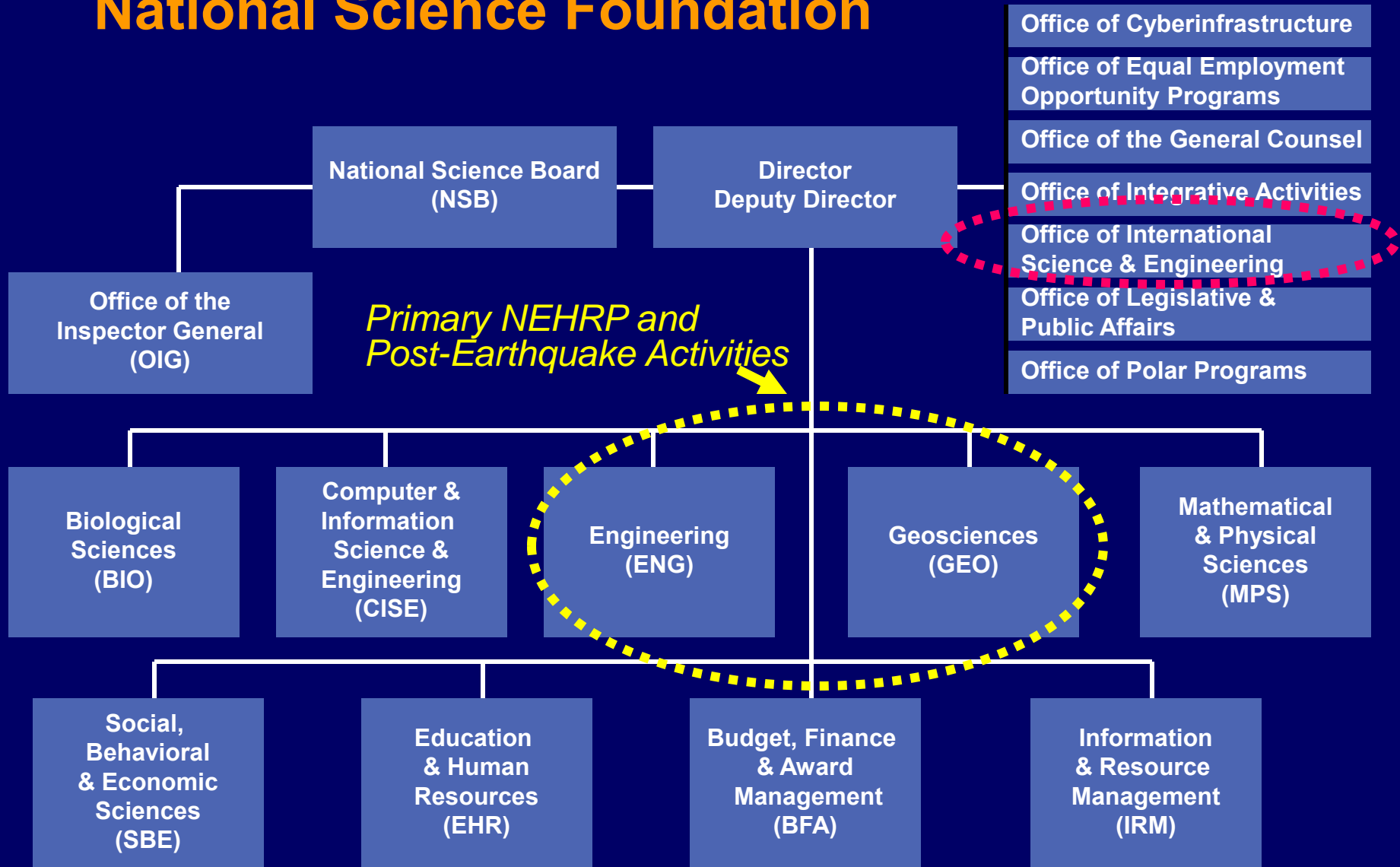
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Presentation Outline

- NSF post-earthquake rapid research support
 - 12 Jan 2010 Haiti earthquake
 - 27 Feb 2010 Chile earthquake
- Southern California Earthquake Center (SCEC)
- George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES)

National Science Foundation



NSF Post-Earthquake Rapid Research Support

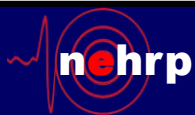
(e.g., 2010 Baja CA, Mexico; Haiti; Chile; New Zealand earthquakes)

- Ongoing (“standing”) awards
 - Earthquake Engineering Research Institute (EERI)
Learning from Earthquakes Program (CMMI-0758529)
<http://www.eeri.org/site/projects/learning-from-earthquakes>
 - Geo-Engineering Extreme Events Reconnaissance (GEER)
(CMMI-0825760, -0825734, -0825507)
<http://www.geerassociation.org>
 - Natural Hazards Center (CMMI-1030670)
<http://www.colorado.edu/hazards>
- NSF RAPID awards
 - Supported through a Dear Colleague Letter and/or ad hoc proposal submissions



12 Jan 2010 Haiti Earthquake – NSF ENG-Supported Awards

2010	Team	Purpose
Jan 26-Feb 3	USGS/EERI/NEES/GEER, with assistance from U.S. Military Southern Command (SOUTHCOM)	<ul style="list-style-type: none"> Advance field reconnaissance and four portable seismographs installed Report: http://www.eqclearinghouse.org/20100112-haiti/wp-content/uploads/2010/02/USGS_EERI_HAITI_V1.pdf
Jan 31-Feb 5	GEER	<ul style="list-style-type: none"> Geological and geotechnical field observations Report: http://www.geerassociation.org/GEER_Post%20EQ%20Reports/Haiti_2010/Cover_Haiti_10.html
Feb 28-March 6	EERI	<ul style="list-style-type: none"> Team of architects, engineers, planners, and social scientists for broader coverage/study of earthquake effects (e.g., hospitals, schools, port, lifelines) http://www.eeri.org/site/images/eeri_newsletter/2010_pdf/Haiti_Rpt_1.pdf http://www.eeri.org/site/images/eeri_newsletter/2010_pdf/Haiti_Rpt_2.pdf
Varies by project	Individual Investigators Natural Hazards Center	<ul style="list-style-type: none"> Several quick response studies for social scientists to capture perishable research data
March and beyond	Teams supported through NSF RAPID awards	<p>NSF 10-024: Engineering/International “Dear Colleague Letter”</p> <p>In-depth field studies to gather perishable research data</p> <p>http://www.nsf.gov/pubs/2010/nsf10024/nsf10024.jsp?WT.mc_id=USNSF_33&WT.mc_ev=click</p> <p>ENG w/OISE co-funding made 29 RAPID Awards</p>
Sept 30-Oct 1	Haiti Earthquake RAPID Awards Workshop	<p>Dissemination of field observations and research findings</p> <p>http://www.eqclearinghouse.org/20100112-haiti/haiti-rapids-and-research-needs-workshop</p>



12 Jan 2010 Haiti Earthquake

NSF GEO-, CISE-, and OISE- Supported Awards

NSF Award Number	Directorate	Project Title, PI and Institution
1030002	CISE/IIS	RAPID: Supporting Family Reunification for the Haiti Earthquake and Future Emergencies PI: Chen Li, University of California-Irvine Project web site: http://fr.ics.uci.edu/haiti
1028001	GEO/OCE	RAPID: Collaborative Research: Off-shore Coseismic Effects of the Port au Prince Earthquake, Haiti PI: Sean Gulick, University of Texas at Austin
1028045	GEO/OCE	RAPID: Collaborative Research: Off-shore Coseismic Effects of the Port au Prince Earthquake, Haiti PI: Cecilia Gonzalez-McHugh, Columbia University
1024990	GEO/EAR	Geodetic and Geologic Field Response to the January 12, 2010, Magnitude 7.0 Haiti Earthquake PI: Eric Calais, Purdue University



12 Jan 2010 Haiti Earthquake NSF GEO/EAR- and OISE- Supported Activities

RAPID Award to Dr. Eric Calais, Purdue University

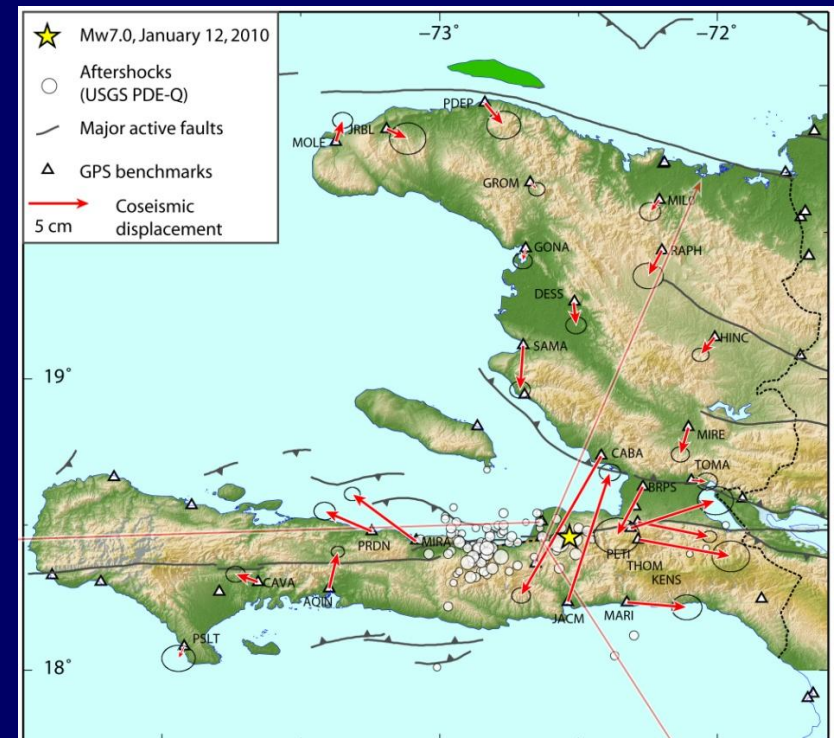
- Research team from Purdue University, University of Texas, University of Arkansas, Haitian Bureau of Mines and Energy
- Mapping and precisely measuring the displacement on the fault
- Re-measuring existing network of 30 GPS benchmarks in Haiti and the Dominican Republic to determine coseismic deformation
- Installing continuous GPS instruments in key locations to measure post-seismic deformation

Regional Caribbean-Central America Workshop on Geophysical Hazards and Plate Boundary Processes

- Joint funding NSF-OISE, NSF-EAR, USAID, USGS
- (NSF Award OISE-1014558)
- Organized by IRIS, Universidad Nacional in Costa Rica, University of the West Indies in Trinidad and Tobago, and Universidad Nacional Autónoma in Mexico
- October 2010 in Costa Rica



Checking GPS receiver on roof of Jacmel's police station (courtesy E. Calais)



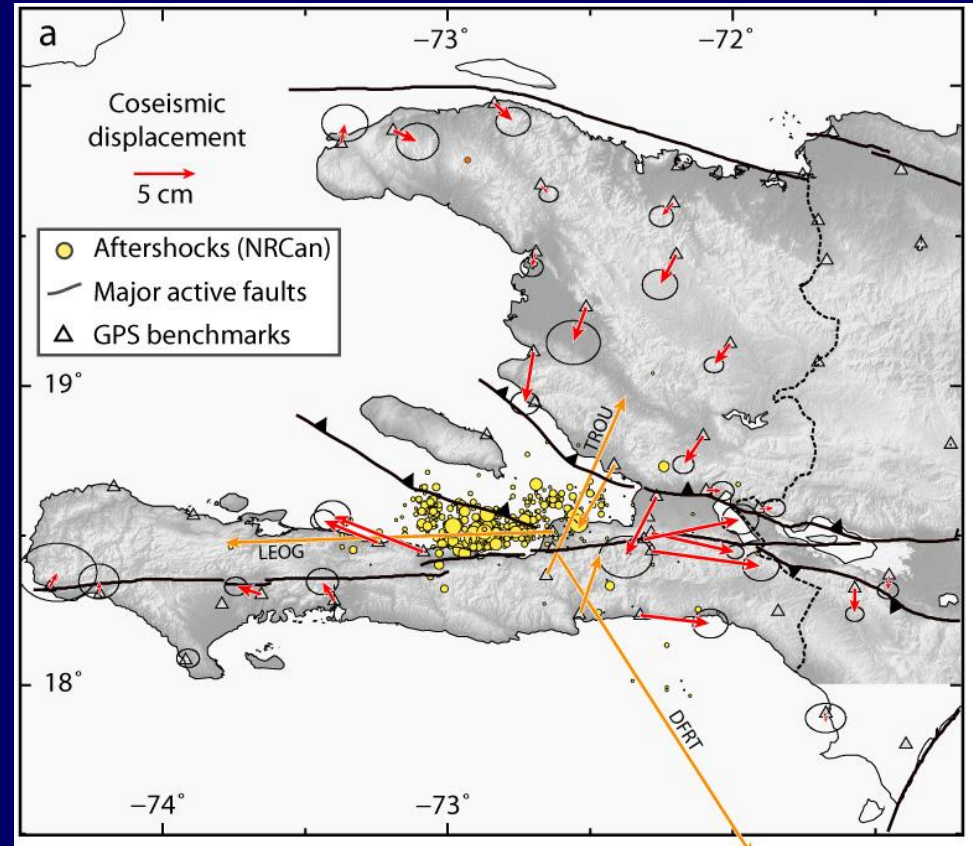
GPS Coseismic Offsets (courtesy E. Calais)

12 Jan 2010 Haiti Earthquake

NSF GEO- and OISE- Supported Activities

Calais, Freed, Mann, & Mattioli: map the fault rupture, resurvey 30 existing GPS benchmarks, and install 10 new continuous GPS sites

Prompt post-event GPS response shows coseismic ground displacements: 0.8 m (near field), measurable up to ~150 km away



Outreach to Haitian communities



“Research Needs Emerging from Haiti Earthquake” Workshop September 30-October 1, 2010 at NSF

- Organized by EERI under Award CMMI-1045037

- Participants

- 40 RAPID award participants
- NSF Program Officers
- 4 Haitian researchers/government officials
- NEHRP and international agency representatives

- Summary presentations on RAPID awards

- Posters on NEEShub site

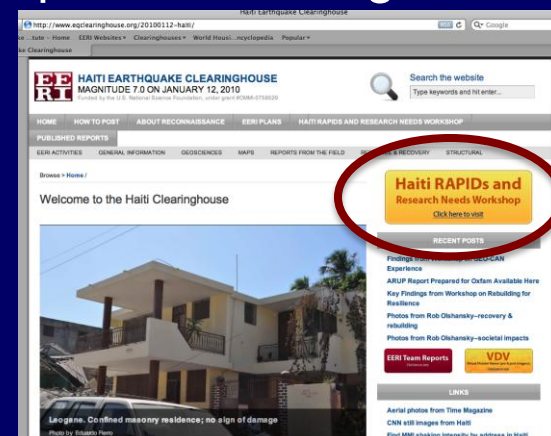
<http://nees.org/topics/haitirapidsandresearchworkshop/wiki/MainPage>

- 16 break-out sessions, organized by

- Discipline
- Time frame
- Cross-cutting themes

- Report drafted – to be posted at

<http://www.eqclearinghouse.org/20100112-haiti/>



"Research Needs Emerging from 2010 Haiti Earthquake" Workshop

September 30-October 1, 2010 at NSF

Rupture of an unmapped fault during the 2010 Haiti earthquake

1. **Abstract**
 The January 12, 2010 earthquake in Haiti was a major seismic event, killing more than 200,000 people and causing an estimated 1 million in damage. It was the largest earthquake since the 1909 earthquake in the Caribbean. The rupture of an unmapped fault during the earthquake is a key finding of this study. This study uses Global Positioning System (GPS) and satellite interferometry (InSAR) measurements of ground motion to show that the earthquake involved a combination of horizontal and vertical slip on a horizontal fault. This result is consistent with the long-term pattern of plate convergence in the Caribbean. It also provides a new perspective on the tectonic evolution of the Caribbean region. The study also shows that the earthquake involved a combination of horizontal and vertical slip on a horizontal fault. This result is consistent with the long-term pattern of plate convergence in the Caribbean. It also provides a new perspective on the tectonic evolution of the Caribbean region.

Disaster Debris Management for Haiti

Regional DeProches: Orlan Ergun, Pinar Kiskisek, Karl Sölp
 City of Environment Engineering, Georgia Institute of Technology

DEBRIS MANAGEMENT

Background

- Debris is a major hazard after an earthquake
- Debris generated during an earthquake can be equivalent to years of normal waste
- Debris is a major hazard after an earthquake
- Debris generated during an earthquake can be equivalent to years of normal waste
- Debris is a major hazard after an earthquake
- Debris generated during an earthquake can be equivalent to years of normal waste

CREATING NETWORK DATA SET FOR PORT AUTHORITY

Background

- Create a network data set for port authority
- Create a network data set for port authority
- Create a network data set for port authority
- Create a network data set for port authority
- Create a network data set for port authority

ANALYSIS

Block Eye Database

- Create a block eye database
- Create a block eye database
- Create a block eye database
- Create a block eye database
- Create a block eye database

Selection of Dump Sites

- Select dump sites based on various criteria
- Select dump sites based on various criteria
- Select dump sites based on various criteria
- Select dump sites based on various criteria
- Select dump sites based on various criteria

Field Investigation on the Comparative Performance of Alternative Humanitarian Logistic Structures

DRG

Josef Hognin-Veras, Miguel Jaller, Tarcis Wachendorf, Lucia Veloso, Jennifer Santos Hernandez, Natacha Thomas

Objectives

1. Identify typology and basic features of alternative humanitarian logistic structures that emerged in Haiti
2. Gather insight into effectiveness, positives/negatives, manpower provided, coverage/extent of operations
3. Gather data about flows of critical/non-critical supplies
4. Gather data about the impact of preexisting conditions on post-disaster relief capacity
5. Document lessons learned

Abstract

The project studies the comparative performance of the humanitarian logistic structures that emerged in response to the earthquake. This provides important lessons that may ultimately serve as a watershed moment for humanitarian logistics. Outcomes include a better understanding of the impact of preexisting conditions on post-disaster relief capacity, and of findings into models and operational structures.

Immediate Impact on Distribution Networks

Physical and social links with local distribution networks were disrupted. Foreign aid flowing directly to Port au Prince. Aid arriving from the rest of Haiti and Dominican Republic. Local physical / human distribution network.

and Operational Structures, Two Different Performances:

Collaborative multi-agent

Investigators: Ann Margaret Emard & Alka Sapat (Florida Atlantic University)

Assessing Community-Scale Disruption and Restoration of Basic Needs in Post-earthquake Haiti

John Bevington¹, Rachel Davidson², Aileen Hill³, Stephanie Cheng⁴, Ron English⁵, Beasley Adams⁶, Susan Ruttle⁷, Dilnoor Panjwani⁸, Robb Mills⁹, Sarah Pyatt¹⁰, Matthew Honeye, Paul Amey¹¹

1. Abstract
 This paper describes an assessment of the levels of community-scale building damage and socio-economic disruption following the Haiti earthquake of January 12, 2010. Damage and disruption were analyzed for 100+ towns, post-event, and during recovery time periods in seven Haitian communities (Cap-Haïtien, Gonaïves, Les Cayes, Port-au-Prince, Port-de-Paix, Port-au-Prince, and Les Cayes). Damage data from the GEO-CAD post-disaster inventory were combined with analysis of flow residuals and the survey to quantify building damage and recovery status, verified by field data. Disruption was measured for eleven sectors. Data on 100+ towns were analyzed to identify trends. Interviews conducted in five towns with community leaders, NGOs, and government utility providers. Findings document the socio-economic and service restoration time periods after the earthquake (Section 4). Disruption showed little correlation with physical damage. Our results suggest that earthquake impacts must be understood in the context of chronic disruption, and more consequences of the earthquake are likely defined during recovery.

2. Study Communities
 Seven affected communities were studied (Figure 1): Port-au-Prince, Les Cayes, Gonaïves, and Port-de-Paix. The communities were selected for geographic diversity and to represent a range of earthquake damage levels. Across these communities, damage was ranged from 25% to 80% of buildings being either heavily damaged or collapsed.

3. Sectors & Method
 Community-scale levels of function and disruption were characterized in terms of eleven sectors based on core areas of humanitarian assistance as identified in the STRIKE Project, with some additions (Figure 2). Data on the status of these sectors were collected and used to indicate community disruption.

4. Disruption Data
 Community-scale disruption was assessed using field interviews with 100+ community leaders, 100+ government organizations, and 100+ representatives of government utility agencies. A two-part survey instrument was used to collect information on disruption. It included information on community-scale disruption and on each respondent's local availability for relevant services of key agencies in their being a community scale (Figure 2).

5. Building Damage Data
 In January, the Global Earth Observation Catalogue Assessment Network (GEO-CAD) initiative identified buildings that had sustained heavy damage, or had collapsed during the earthquake. This spatial resolution satellite imagery was analyzed to identify local correlations between physical damage and disruption. These were collected and analyzed.

Baseline Solution to Rationing Problem

Clearance

- Clear roads and remove debris
- Clear roads and remove debris
- Clear roads and remove debris
- Clear roads and remove debris
- Clear roads and remove debris

Restoration

- Restore basic services
- Restore basic services
- Restore basic services
- Restore basic services
- Restore basic services

Relief

- Provide relief supplies
- Provide relief supplies
- Provide relief supplies
- Provide relief supplies
- Provide relief supplies

Disposal

- Dispose of debris
- Dispose of debris
- Dispose of debris
- Dispose of debris
- Dispose of debris

Baseline Solution to Rationing Problem

Assumptions

- 100+ towns were studied
- 100+ towns were studied
- 100+ towns were studied
- 100+ towns were studied
- 100+ towns were studied

Collection Times

- Data collected in 100+ towns
- Data collected in 100+ towns
- Data collected in 100+ towns
- Data collected in 100+ towns
- Data collected in 100+ towns

Dispensing Sites

- Identify dispensing sites
- Identify dispensing sites
- Identify dispensing sites
- Identify dispensing sites
- Identify dispensing sites

Haitian-Americans as critical bridges and lifelines in the recovery and rebuilding of Haiti

Reality
 South Florida is home to an estimated 263,000 Haitians, many of whom have family in Haiti. Remittances from these and other Haitians is a critical lifeline that has kept Haiti afloat and that will be vital to the long-term recovery of Haiti. South Florida also served as a receiving area for severely injured earthquake survivors, and for school-aged displaced with relatives in this region.

Objectives of Study

1. Understand the role of Haitian American organizations and other South Florida agencies in relief, recovery and rebuilding efforts using interviews as the primary research method.
2. Document trends and profiles of displacement influx to South Florida.
3. Collect and analyze policies and plans created in the US in response to this potential for perceived displacement influx.

Preliminary Findings – to date we have completed about 20 interviews

A) Displacees:

- Fewer displacees than expected (surprise).
- School kids displacees went to more affluent neighborhoods schools (surprise).
- School kids K-12 as of June 1, 2010: Miami-Dade – 1147, Broward – 1200, Palm Beach – 400.
- First, more of displacees were those with means and/or with citizenship status/Green Cards/volunteer status or with urgent medical needs.

B) Host-Communities: Community Organizations and Families:

- Community organizations worked well and needs for displacees for the first six months were adequately managed and met. Some school districts used portable classrooms and other supplies to Haiti; helped

C) Haitian Displacees:

- TWO Haitians HERE (Haitian displacees outside Haiti) and THREE (Haitian society within Haiti).
- Widespread views about tension especially with the government and elite in Haiti (right to vote, dual citizenship, etc.).
- Both within the diaspora and within Haiti, there are divided views about military occupation and self-governance.
- Complex Web of Organizations:
 - Haitian-American organizations and missions are MANY and varied.
 - Emergent organizations formed; the most notable one being the Haitian Diaspora Federation.
- Cross-Cutting Issues:

Rebuilding Needs - 2010 Haiti Earthquake

Key Findings of Workshop on Rebuilding for Resilience: How Science and Engineering Can Inform Haiti's Reconstruction

- March 22-23, 2010
- University of Miami, Coral Gables
- Convened by US NSTC SDR, co-sponsored by State Dept, USAID, UNISDR, and organized by IRIS (NSF supplement) with support from NASA, NSF, and USGS
- Participants: Approx 100 scientists, engineers, planners and policy makers from government; NGOs; development agencies; business, engineering, and science communities; and academia; delegation of Haitian government officials and academia
- Informed the March 31 International Donors' Conference towards a New Future for Haiti
- Key findings: <http://www.state.gov/p/io/rls/fs/139155.htm>
 - Rebuilding requirements related to hazard assessment
 - Adequate engineering of buildings and critical infrastructure
 - Long-term data needs (monitoring natural hazards)
 - Capacity building



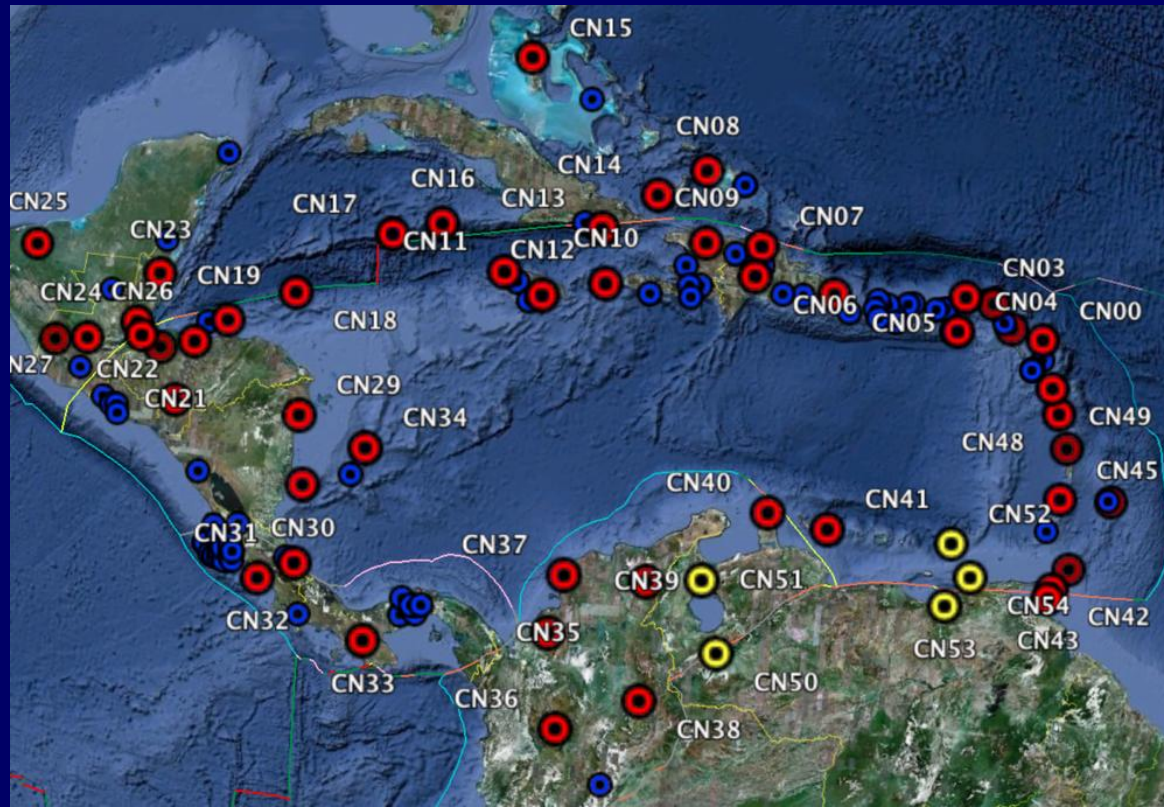
NSF Special Report Learning from Haiti Rapid Response Research

http://www.nsf.gov/news/special_reports/haiti2010/

The image shows a screenshot of the National Science Foundation (NSF) website. At the top left is the NSF logo with the text "National Science Foundation WHERE DISCOVERIES BEGIN". To the right is a search bar with the word "SEARCH" above it. Below the logo and search bar is a navigation menu with links: HOME | FUNDING | AWARDS | DISCOVERIES | NEWS | PUBLICATIONS | STATISTICS | ABOUT | FastLane. Underneath this menu is a secondary navigation bar with links: News | For News Media | Special Reports | Speeches & Lectures | Multimedia Gallery. The main content area features a large banner with the text "special report: LEARNING FROM HAITI Rapid Response Research". Below the banner is a video player with a play button. The video player has a title "Learning From Haiti Rapid Response Research Webcast Tuesday April 27, 2010" and a list of speakers: Reginald DesRoches (Associate Chair and Professor, Georgia Tech), Eric Calais (Professor of Geophysics, Purdue University), Liesel Ritchie (Assistant Director for Research, The Natural Hazards Center, Univ. of Colorado at Boulder), and Dennis Wenger (Program Director, Infrastructure Systems Management and Extreme Events, National Science Foundation). The video player also includes a progress bar and a close button.

COCONet

(Continuously Operating Caribbean GPS Observational Network)



NSF Awards 1042906 & 1042909:
UNAVCO and UCAR lead
institutions, with Purdue
University and University of
Puerto Rico

- 50 new & 50 existing stations, continuous GPS & weather network for Caribbean multi-hazard science
- Multiple international partnerships between U.S. and Caribbean scientists on research, network design and operations, and use of data for societal needs
- Five-year, \$6.7M project conceived in response to 2010 Haiti earthquake



27 February 2010 Chile Earthquake – NSF Support

- GEO and SBE Directorates & OISE
 - RAPID awards
- ENG Directorate & OISE
 - Ongoing awards
 - EERI Learning from Earthquakes
 - GEER
 - RAPIDs for Chilean tsunami
 - Costas Synolakis, University of Southern California
 - Solomon Yim, Oregon State University
 - RAPID to deploy NEES instrumentation to monitor building performance during aftershocks
 - John Wallace, University of California, Los Angeles
 - RAPID to gather further building performance data
 - Jack Moehle, University of California, Berkeley



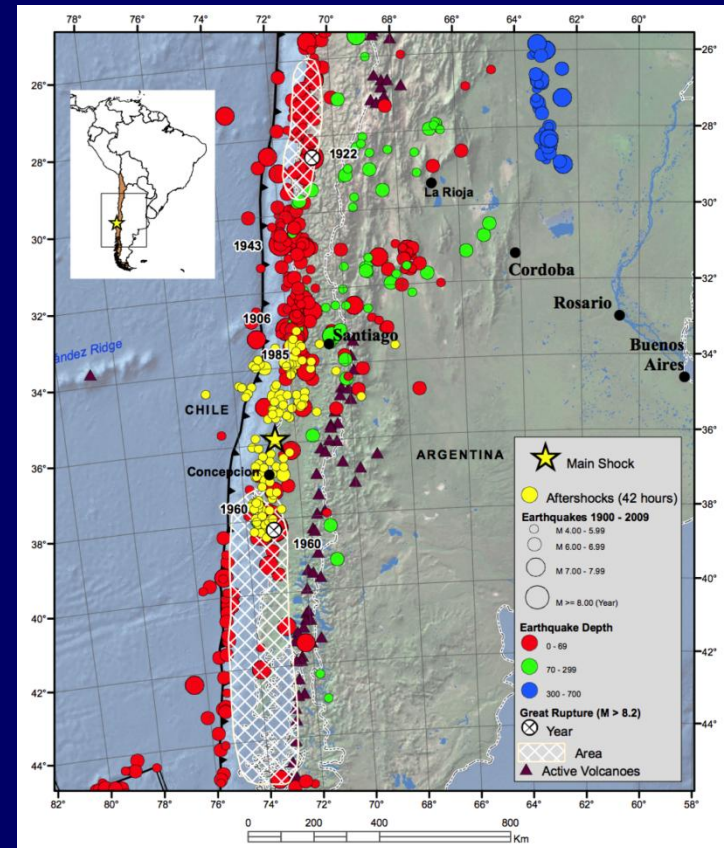
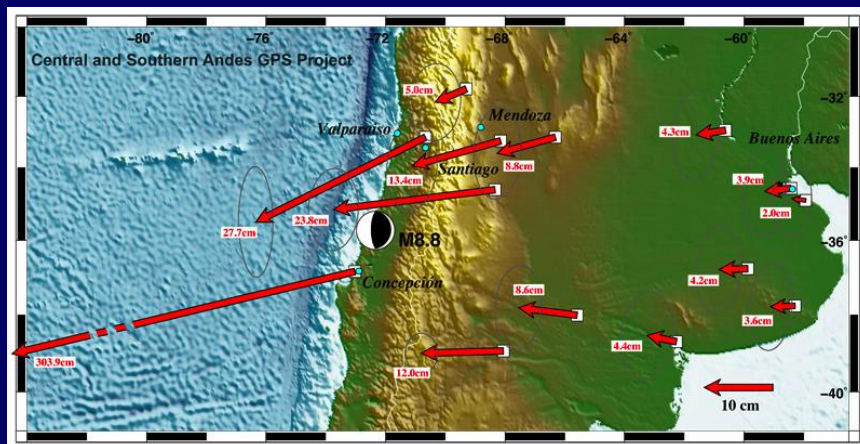
27 February 2010 Chile Earthquake NSF GEO/EAR- and OISE- Supported

RAPID awards

- Strong motion instruments (EAR)
- Tsunami mapping (OCE, OISE, ENG)
- Tsunami mapping and coastal uplift (EAR, OISE)
- GPS and seismic investigations (EAR, OISE)

Instrument deployments

- 20 GPS instruments to Chile
- 5 GPS instruments to Argentina
- 60 seismic instruments to Chile
- GPS includes 15 from EarthScope-PBO pool
- Seismic includes 50 from EarthScope-USArray pool



Map showing relation of 2010 Chile earthquake and its aftershocks (yellow) to historic earthquakes (red and green). Figure by Susan Rhea, USGS

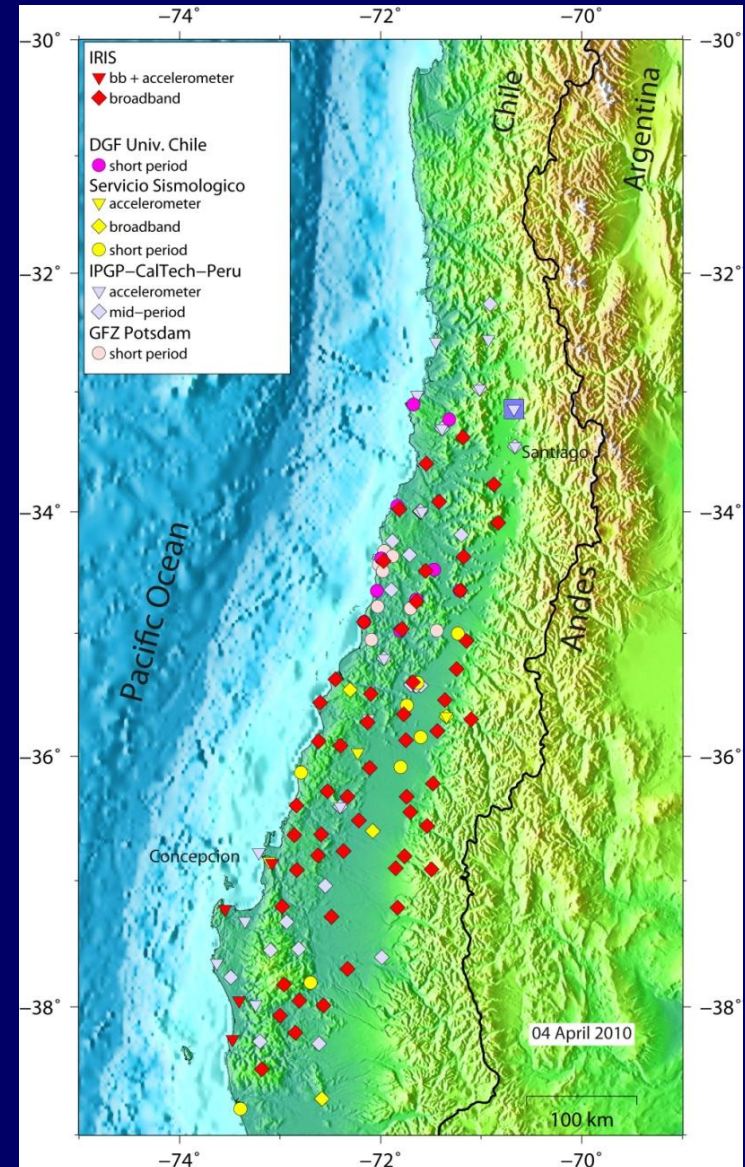
Coseismic offsets estimated by Central & Southern Andes GPS Project (courtesy M. Bevis, Ohio State)

27 February 2010 Chile Earthquake

Russo, Beck, Roecker & IRIS: deployment of 55 portable broadband seismic instruments from IRIS PASSCAL and EarthScope USArray along the rupture zone for about 6 months; done in less than 12 days by 3 teams of U.S. and Chilean seismologists with PASSCAL field engineers; Open data sharing with Chilean, French, German, and British scientists



Lawrence: Quake-Catcher Network to study strong ground motions for large aftershocks shortly after mainshock



NSF ENG- and OISE- Supported RAPID

27 Feb 2010 Chile Earthquake

Post-Earthquake Monitoring of Buildings in Chile using NEES@UCLA Resources

- Instrumentation team
 - NEES@UCLA
 - Faculty and students
 - Pontificia Universidad Católica de Chile
 - University of Chile, Santiago
- Instrumented three buildings – recorded aftershocks (March 2010)
 - 23-story reinforced concrete office building, – no structural damage
 - 10-story reinforced concrete residential building – structural damage
 - 10-story reinforced concrete office building – no structural damage

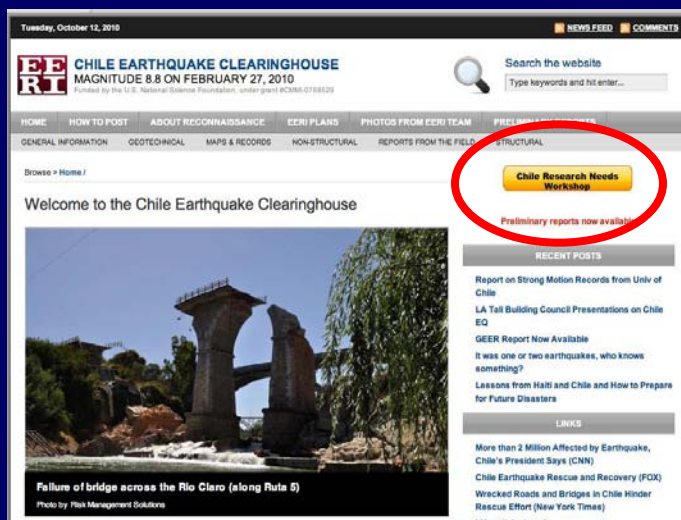


23-story RC building, Santiago, no structural damage,
recorded M5.1 aftershock
Credit: nees@ucla web site

Research Needs Emerging from the 2010 Chile Earthquake Workshop

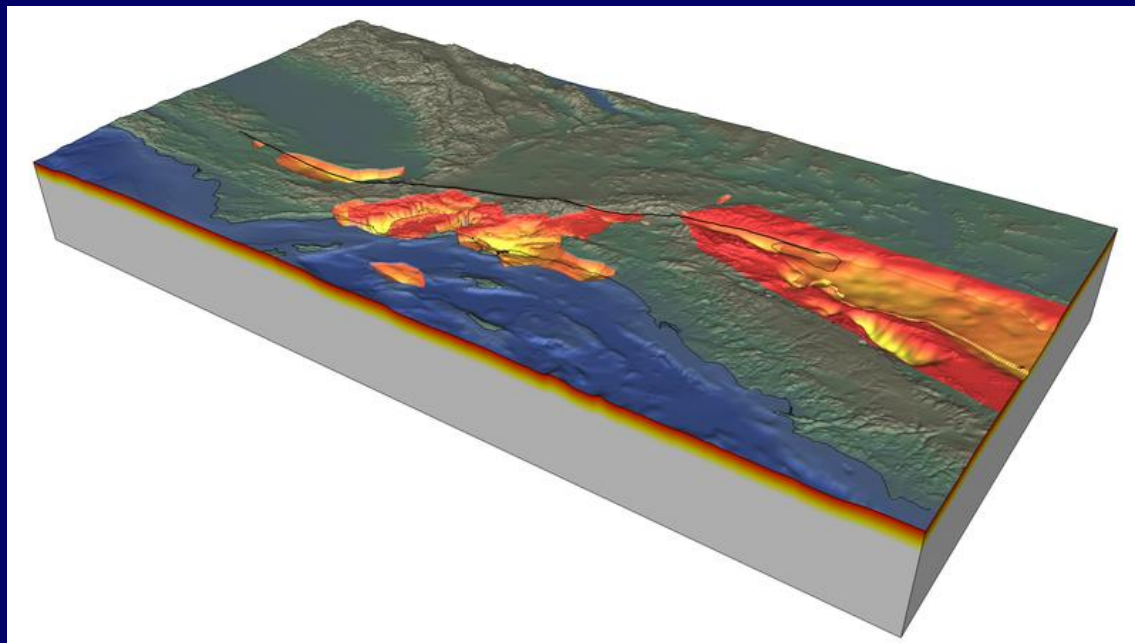
August 19, 2010 at NSF

- Organized by EERI under CMMI-1045037
 - 44 participants, research community, NSF and NEHRP
 - 4 Chilean researchers
- Summary presentations on RAPID awards
- Report drafted - to be posted at www.eeri.org
- Participants and presentations posted on Chile Clearinghouse
<http://www.eqclearinghouse.org/20100227-chile/>



Southern California Earthquake Center (SCEC) (jointly supported by NSF and USGS)

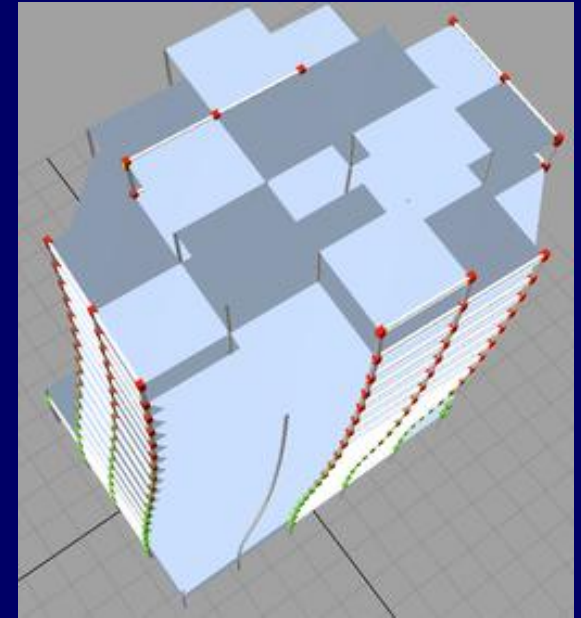
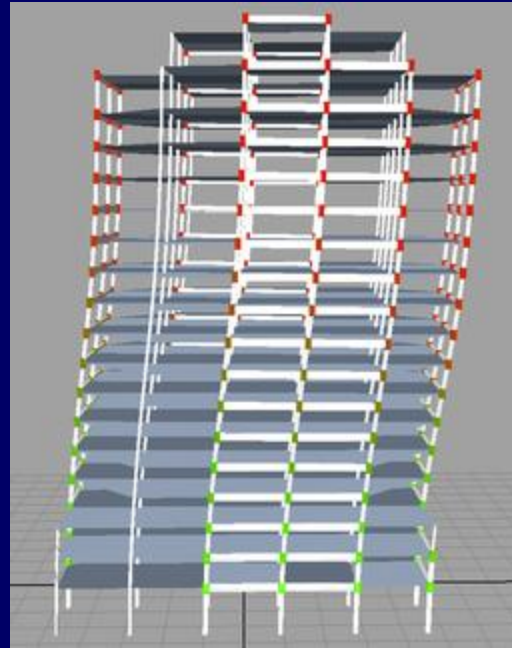
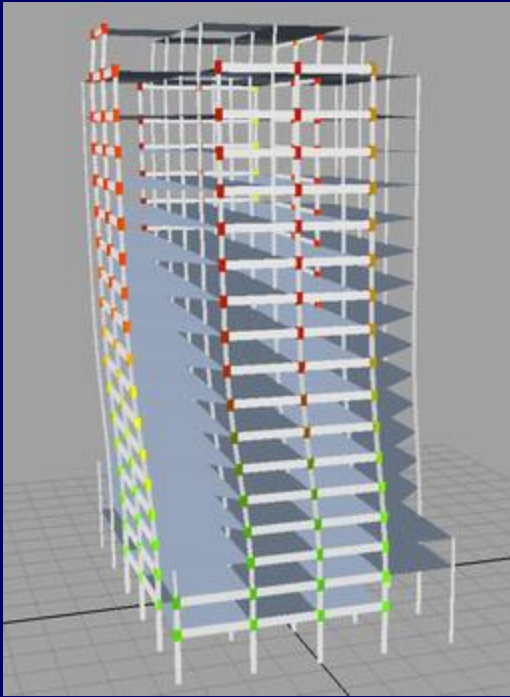
SCEC's M8 simulation of a Magnitude 8.0 rupture on southern San Andreas modeled wave propagation throughout the large simulation volume (810km x 600km x 85km) in Southern California shown in this image. (Image Credit: Geoff Ely)



SCEC M8 Simulation

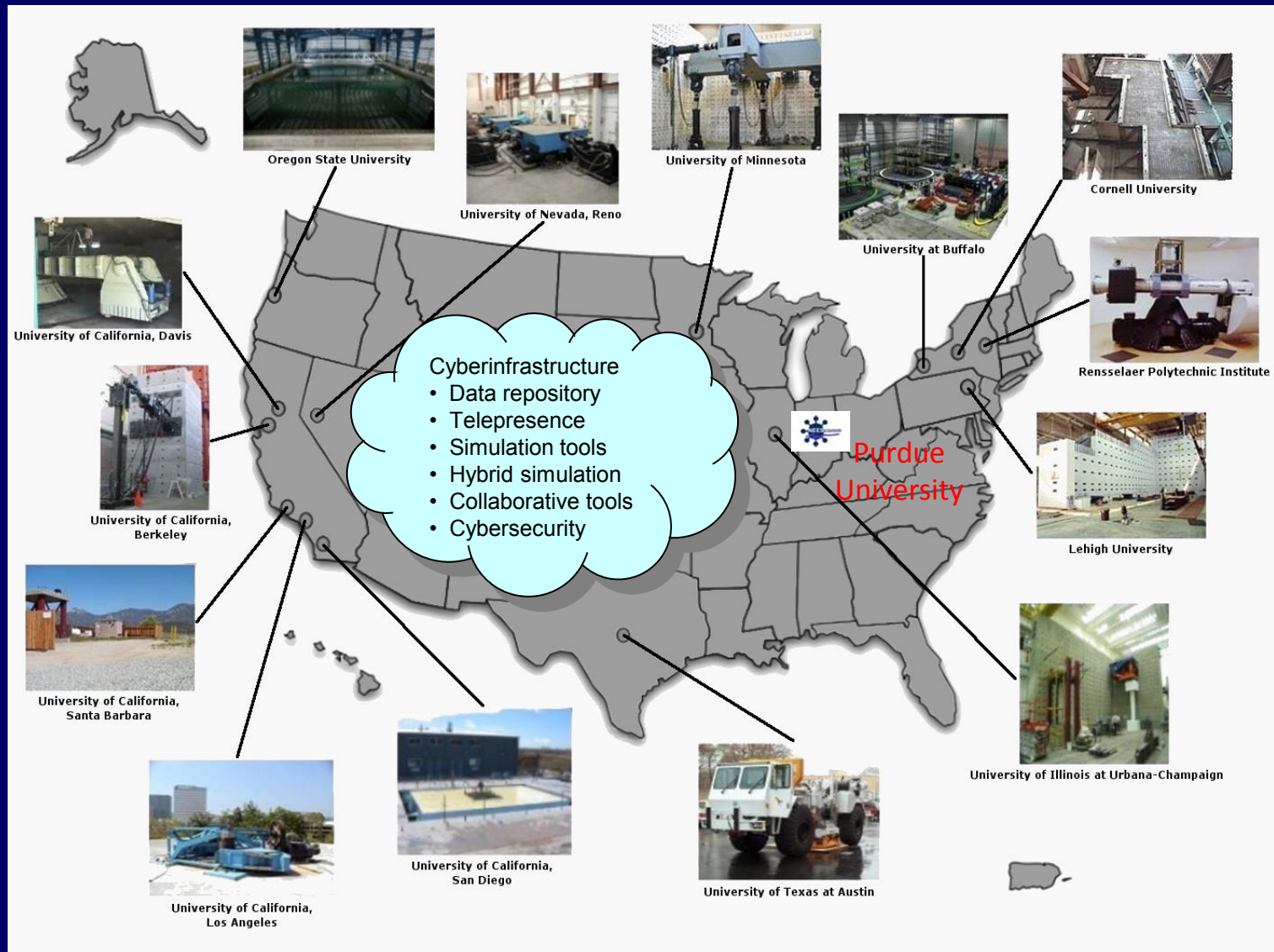
- NSF TeraGrid (NICS Kraken) in March 2010, and a very large earthquake wave propagation simulation, run on DOE INCITE (NCCS Jaguar) in April 2010.
- No other seismic wave propagation application has been used on real science runs using more cores than M8.
- The M8 input velocity mesh required 435 billion grid points, more than any wave propagation simulation at the time M8 was run.
- <http://scec.usc.edu/scecpedia/M8>

SCEC Virtual Shaker (VShaker)



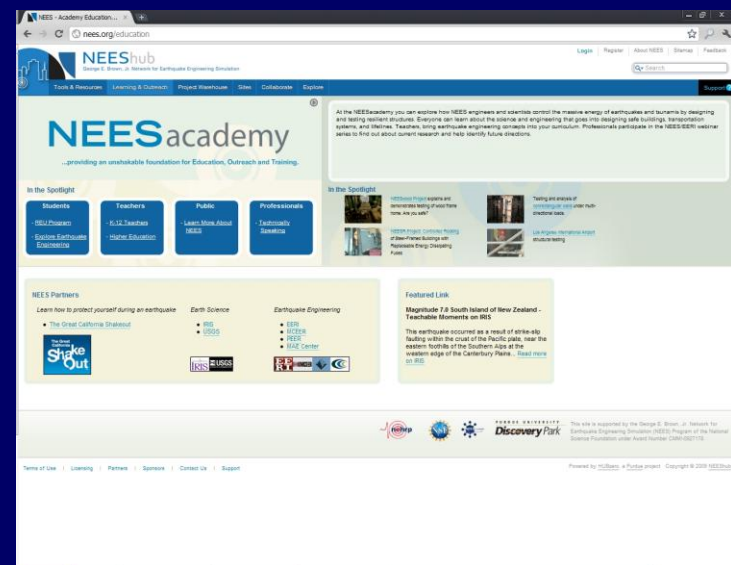
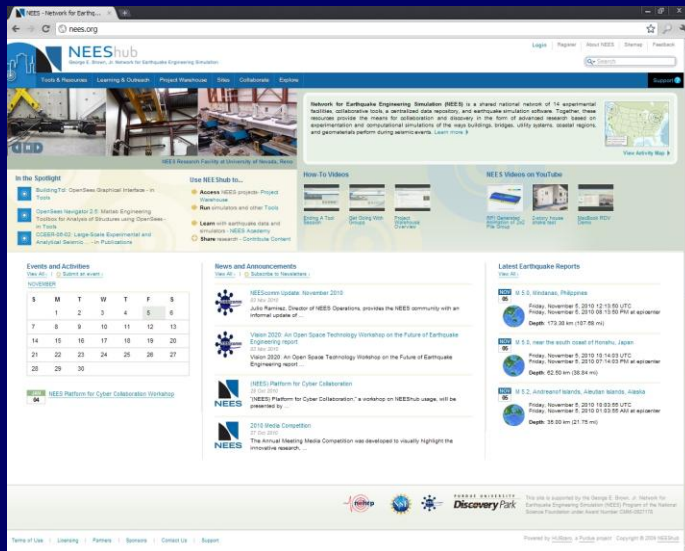
CME team at SCEC can produce forward wave propagation data – ground motion time-histories (seismograms) for simulated earthquakes of various magnitudes. The largest, full dynamic earthquake simulation of magnitude 8 on southern San Andreas fault was led by SCEC last year. The seismograms produced by this simulation included frequency components up to 2 Hz. These seismograms can be applied to steel buildings models in virtual environment with Frame3D software, a building analysis program developed by Swaminathan Krishnan at California Institute of Technology (Source: <http://scec.usc.edu/scecpedia/VShaker>)

George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES)



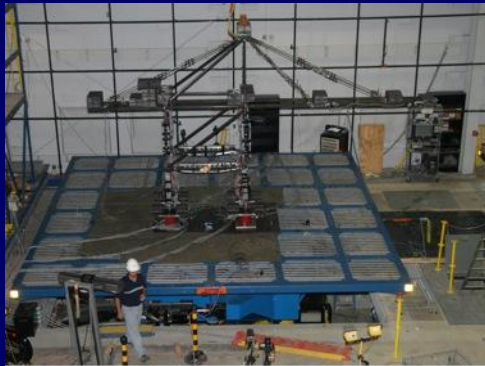
NEES Updates/Highlights

- NEES Operations
 - NSF equipment upgrades
 - UCLA - mobile shaker capacity upgrade
 - Oregon State – removable/reconfigurable beach system
 - UIUC – coordinate measurement machine with integrated 3D scanner
 - Network – coordinate measurement machine with integrated 3D scanner
 - U Texas, UCLA, UCSB – trillium compact sensors
 - U Nevada, Reno – three large stroke actuators
 - NEEShub/NEES Academy web site releases in July 2010



NEES Updates/Highlights

- NEES 2010 REU Program
 - 7 NEES facilities, 29 students, 18 institutions
 - Papers/posters: <http://nees.org/neesreuprogramsummer2010>
- NEES Research
 - Popular Mechanics 2010 Breakthrough Award
<http://www.popularmechanics.com/technology/engineering/news/breakthrough10>
Innovation: The Earthquake-Proof Building that is Built to Collapse (Replaceable Structural Fuses)
Gregory Deierlein, Stanford University and Jerome Hajjar, Northeastern University (Award CMMI-0530756)
 - Shake Table Test of Container Cranes at nees@Buffalo



1/10 scale container crane test at nees@Buffalo in 2009 as part of the Seismic Risk Mitigation of Ports Grand Challenge Project (Award CMMI-0530478)
Photo Credit: Glenn Rix, Georgia Tech

NEHRP NEESR Award Success Stories

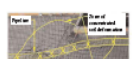
Seismic Waves

<http://www.nehrp.gov/plans/index.htm#success>

Seismic Waves May 2007
How NEHRP is Advancing Earthquake Safety

Strengthening Pipeline Survivability to Avoid Post-Quake Devastation

When earthquakes impact urban areas, the resilience of underground utilities can have a tremendous effect on what happens after the shaking stops. Broken water pipes led to the spreading fires that consumed more than 100 homes in San Francisco the days following the quake. The city's water supply is supported by the in- by broken gas connector or water line. Large department had virtually



the tests to simulate earthquake fault rupture. The forces exerted on the pipe and

Seismic Waves November 2007
How the National Earthquake Hazards Reduction Program is Advancing Earthquake Safety

Ensuring That When the Ground Starts Shaking, Bridges Can Bend Without Breaking

"The bridge fell like it was colliding with a little bit, and I saw the road rise up in front of us before we fell."

"The falling is kind of a free-fall falling at [an] unanticipated rate."

At each end of the bridge), These interactions determine the performance of the entire bridge system, which is the

to a large extent the road case a cooling firm "to get us back to a normal level to be safe."

Over the bridge, steel cables, steel deck, and steel piers.

A similar tragedy unfolded earthquake shook. Ribs, cables stretched out about 10 and collapsed may occur more than 100 feet high. The lack of water in the construction of horizontal material gas liquid fuel, d

The research, led by Cor supported by a 4-year National Science Foundation participating in NEHRP's unrepresented fact Brown, Jr. Network for (NEES) under NSF award which comprise 15 awards by an information behind Large Earthquake 1st Geological Conference 1

At the current site, O'Brien following full-scale test to simulated earthquake. Sited with about 100-ton sections, one of which is

For

Discipline identification of various state risk reduction products, a

Since the 1970s, however, engineers have made considerable progress in learning how to reduce the vulnerability of the nation's more than 600,000 bridges to earthquake damage. Now a major research project funded by the National Science Foundation (NSF), a NEHRP agency through grant award CMMI-0400347 is further advancing these efforts (<http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0400347>).

A Groundbreaking Investigation

This project is being carried out by the University of Nevada, Reno (UNR) in cooperation with several other universities in the United States and abroad. It is sending researchers to test, for the first time ever, the seismic performance of entire five-span bridges along with the performance of individual bridge components.

During an earthquake, the parts of a bridge interact in complex ways with each other and with the foundation soils surrounding the footings and abutments (the supports

* Quotes from Billy Balle and Melissa Hughes, respectively ABC News on August 6 and <http://www.wgn.com/CDM/Story/07060701> on October 1, 2007.



are relatively inexpensive to construct and because of the reduced story heights and open floor plans that are possible with such framing. However, their vulnerability to punching shear failure has caused structural engineers to rethink the design of slab-column connections in new flat-plate frames constructed in areas of high seismicity. Several ways have been found to make these connections stronger, but shear stud reinforcement has become the method most commonly used. This type of reinforcement



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Thin-plate frames have nevertheless remained popular, primarily for office and residential buildings, because they

Seismic Waves January 2007
How NEHRP is Advancing Earthquake Safety

Bringing Down the House

NEESWood Project Shakes Full-Scale Wood Townhouse in Northridge Simulation

Goals shattered and the walls shook. In an unprecedented recreation of the 1994 Northridge earthquake, NEESWood, a multi-year research project (CMMI-0400347) funded by the National Science Foundation (NSF), created a truly very successful public test of the largest wood structures to undergo seismic testing in the world.

If you live anywhere in the United States, there's a very good chance, about 60 to 80 percent, that your home is constructed with wood-frame. For the NEESWood test conducted on November 14, 2006, researchers built a three-bedroom, two-bath, 1,300-square foot wood-frame townhouse on the twin shale tables at the University of Buffalo's Structural Engineering and Earthquake Simulation Laboratory one of the NSF's George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) equipment sites. The townhouse was completely furnished, down to the car in the garage, two water heaters (one anchored according to earthquake protection measures, and one not anchored), and dishes on the dining room table.



Photo is courtesy of the NEESWood project web site, www.neeswood.org/Photo/07010701.

The test made the first year of the 4-year, \$1.04 million NEESWood project. Led by Colorado State University, the NEESWood research is based on the premise that if more were known about how wood structures react to earthquakes, then larger and taller wood structures could be built in seismic regions worldwide, providing economic, engineering, and societal benefits. The NEESWood project will culminate with the validation of the new seismic design processes early in 2009, when a six-story wood-frame structure, pre-fabricated in the United States, will be shipped to Mito City, Japan, and tested on the world's largest shale table.

In addition to showcasing the NEESWood project's research, the test highlighted the equipment, IT capabilities and staff at the University of Buffalo NSF NEES site. There were 56 simultaneous webcast connections during the test and more than 1,000 hits in the first 24 hours after the video of the test and photos of the connections were made available on the University at Buffalo-NEES web site, <http://www.buffalo.edu/projects/NEESWood/index>.

NEESWood includes researchers from Colorado State University, the lead institution, Cornell University, Tennessee Polytechnic Institute, Texas A&M University, and the University at Buffalo. NSF's NEES, which is authorized and funded by the National Earthquake Hazards

Unlike most seismic tests which are conducted on small models, the NEESWood simulates a full-scale structure and very severe directions. Andre Filiatrault, Professor of civil, structural, and soil and foundation engineering at the test site, said that the dramatic way how much damage four 1/2" diameter rebar's don't do. Detailed evaluation of the data centers will take about 6 months.

Standing Strong: The 2009 NEESWood Capstone Test Webcast

July 14, 2009




Recent NEES Workshop Reports

- *Vision 2020: An Open Space Technology Workshop on the Future of Earthquake Engineering, St. Louis, Missouri, January 2010*
https://nees.org/resources/1637/download/Vision_2020__Final_Report.pdf
- *Workshop on NEES/China Collaboration for Earthquake Engineering, Purdue University, August 23-24, 2010*
<http://www.nees.org>
- *Coordinating Workshops for the NEES/E-Defense Collaborative Research Program in Earthquake Engineering (Phase 2)*
http://peer.berkeley.edu/publications/peer_reports/reports_2010/web_10_109NEES_Edefense.pdf



NSF 10-071 Dear Colleague Letter

Future of Earthquake Engineering Research Infrastructure

Support beyond FY 2014

<http://www.nsf.gov/pubs/2010/nsf10071/nsf10071.pdf>

- Fall 2010 – Spring 2012: Two studies underway
 - National Academy of Sciences, CMMI-1047519 (Early 2011 Workshop)
 - Grand Challenges in basic earthquake engineering research that require a network of earthquake engineering experimental facilities and cyberinfrastructure
 - Networked experimental and cyber infrastructure needed to address the Grand Challenges
 - Focus is on requirements, rather than reference to existing or anticipated specific facilities
 - Workshop report completed early 2011
 - Science and Technology Policy Institute, AST-1045173
 - Priorities and scenarios for integrated experimental and cyber facilities needed to address the Grand Challenges in basic earthquake engineering research
 - Community input <https://collab.ida.org/eeforum>
 - Study to be completed by spring 2012
- Fall 2012: NSF informs the earthquake engineering community of its plans beyond 2014 for multi-user earthquake engineering research infrastructure



NSF 11-1, PAPPG effective January 18, 2011

A revised version of the NSF Proposal & Award Policies & Procedures Guide (PAPPG), NSF 11-1, was issued on October 1, 2010 and is **effective for proposals submitted, or due, on or after January 18, 2011.**

Data Management Plan: The PAPPG contains a clarification of NSF's long standing data policy.

- All proposals must describe **plans for data management and sharing** of the products of research, or assert the absence of the need for such plans. FastLane will not permit submission of a proposal that is missing a Data Management Plan.
- The Data Management Plan will be **reviewed as part of the intellectual merit or broader impacts** of the proposal, or both, as appropriate.
- Links to data management requirements and plans relevant to specific Directorates, Offices, Divisions, Programs, or other NSF units are available on the NSF website at:
<http://www.nsf.gov/bfa/dias/policy/dmp.jsp>



Further Information

National Science Foundation

<http://www.nsf.gov>

CMMI Grantees Conference

January 4-7, 2011

Atlanta, GA

<http://www.cmmigranteeconference.org/>

