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

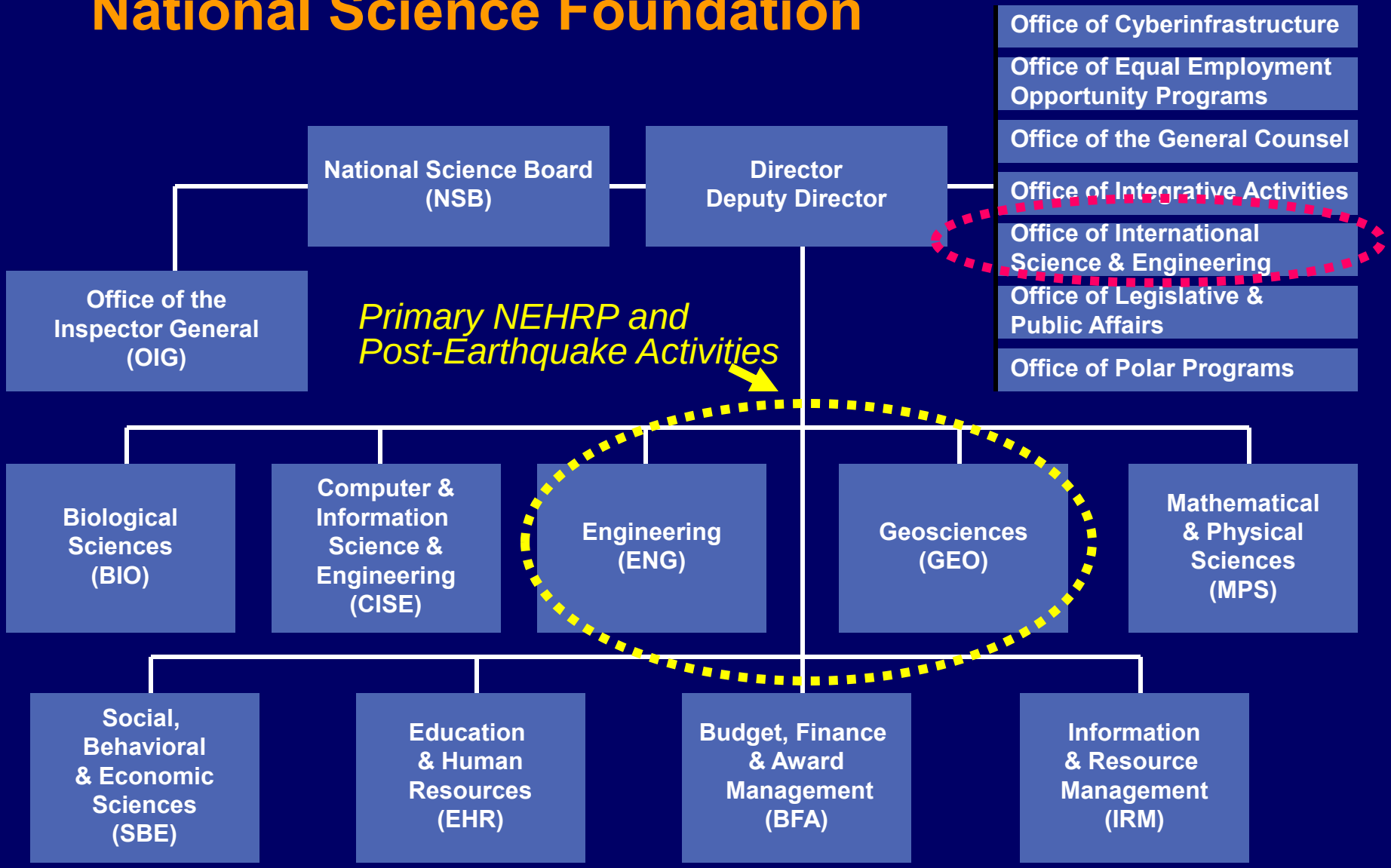
Presented to the
NEHRP Advisory Committee for Earthquake Hazards Reduction (ACEHR)
November 9-10, 2010
Memphis, TN

Joy M. Pauschke, Ph.D., P.E.
Program Director
George E. Brown, Jr. Network for Earthquake Engineering Simulation Operations & Research
Division of Civil, Mechanical and Manufacturing Innovation
National Science Foundation
4201 Wilson Boulevard
Arlington, VA 22230
Voice: 703-292-7024
Email: jpauschk@nsf.gov

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)	▪ 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	▪ Geological and geotechnical field observations ▪ Report: http://www.geerassociation.org/GEER_Post%20EQ%20Reports/Haiti_2010/Cover_Haiti10.html
Feb 28-March 6	EERI	▪ 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	▪ Several quick response studies for social scientists to capture perishable research data
March and beyond	**Teams supported through NSF RAPID awards**	**NSF 10-024: Engineering/International "Dear Colleague Letter"** **In-depth field studies to gather perishable research data** **http://www.nsf.gov/pubs/2010/nsf10024/nsf10024.jsp?WT.mc_id=USNSF_33&WT.mc_ev=click** **ENG w/OISE co-funding made 29 RAPID Awards**
Sept 30-Oct 1	Haiti Earthquake RAPID Awards Workshop	Dissemination of field observations and research findings http://www.eqclearinghouse.org/20100112-haiti/haiti-rapids-and-research-needs-workshop

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

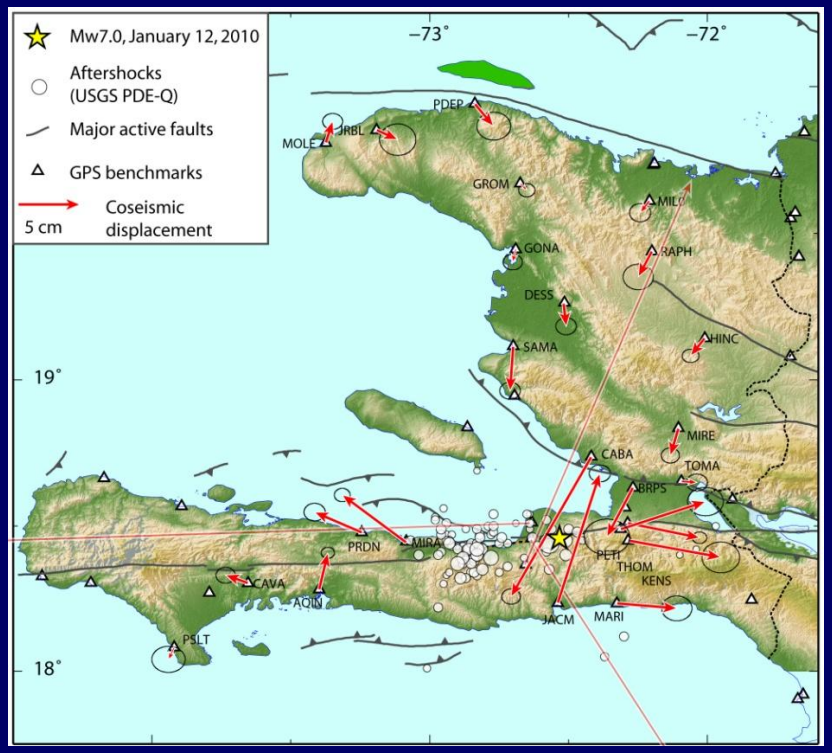
RAPID Award to Dr. Eric Calais, Purdue University

- 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 National Autónoma in Mexico
- October 2010 in Costa Rica

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

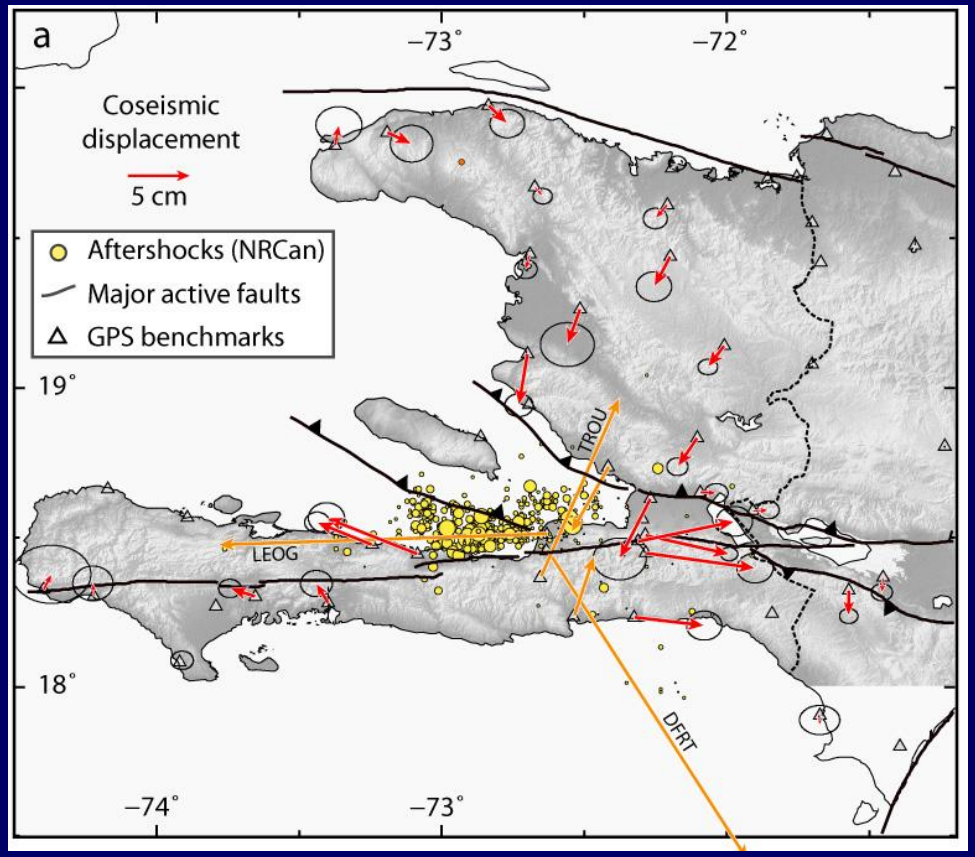


GPS Coseismic Offsets (courtesy E. Calais)

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

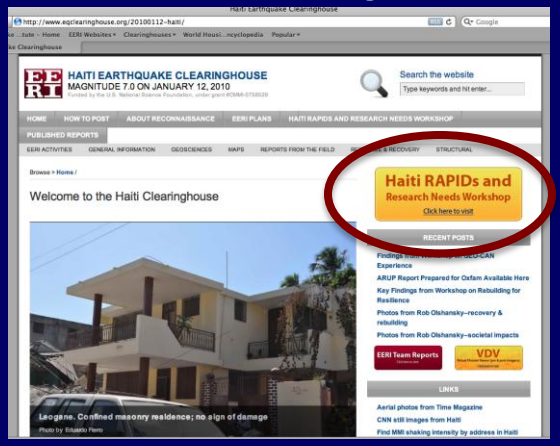
Prompt post-event GPS response shows coseismic ground displacements: 0.8 m (near field), measurable up to ~150 km away



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/



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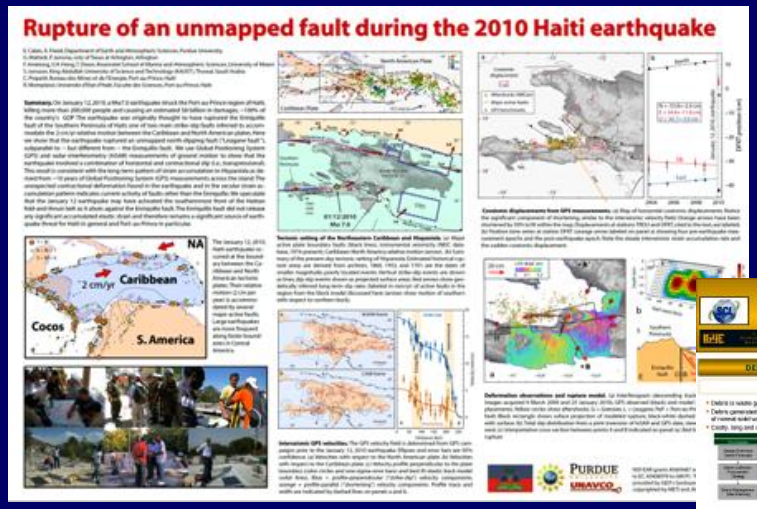
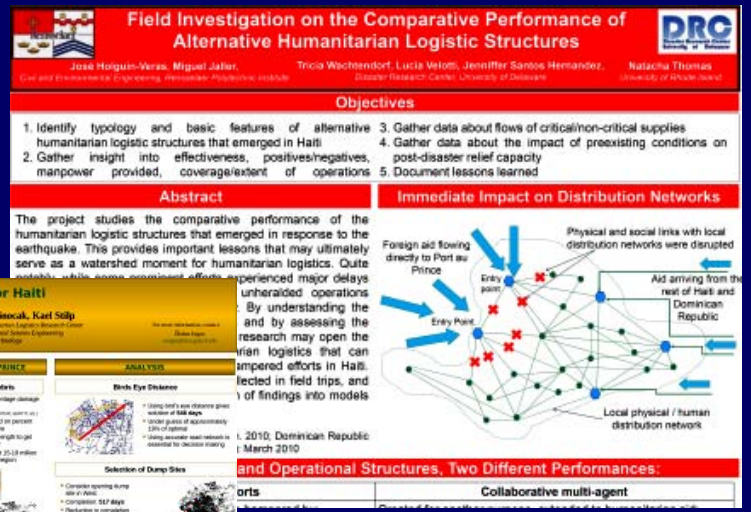
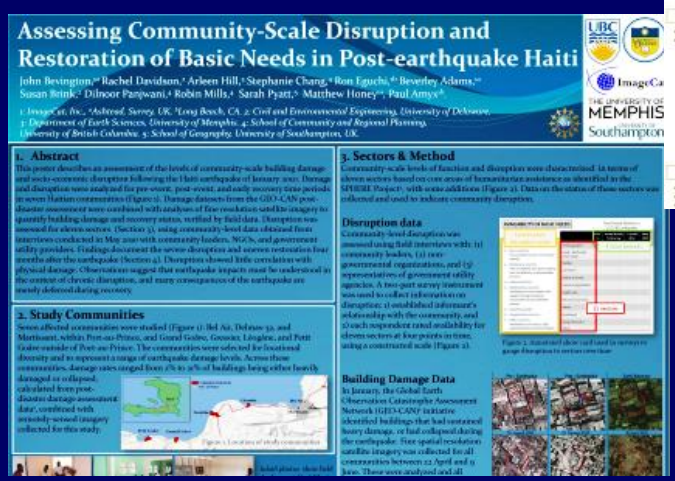
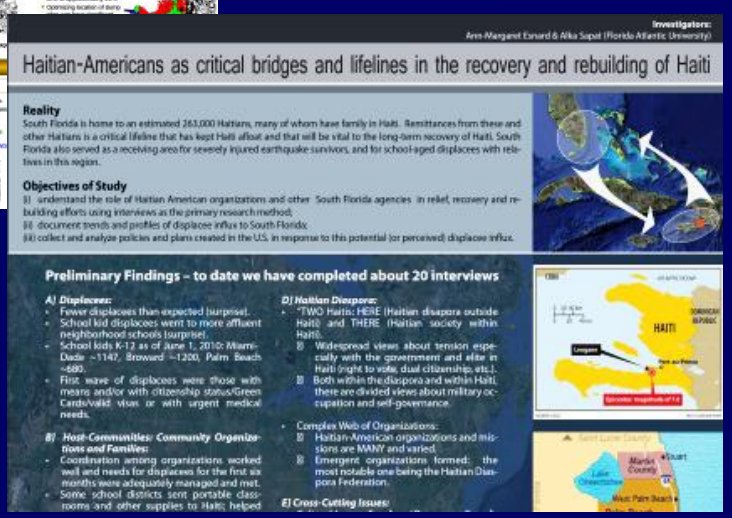








nehrp

national earthquake hazards reduction program

NSF

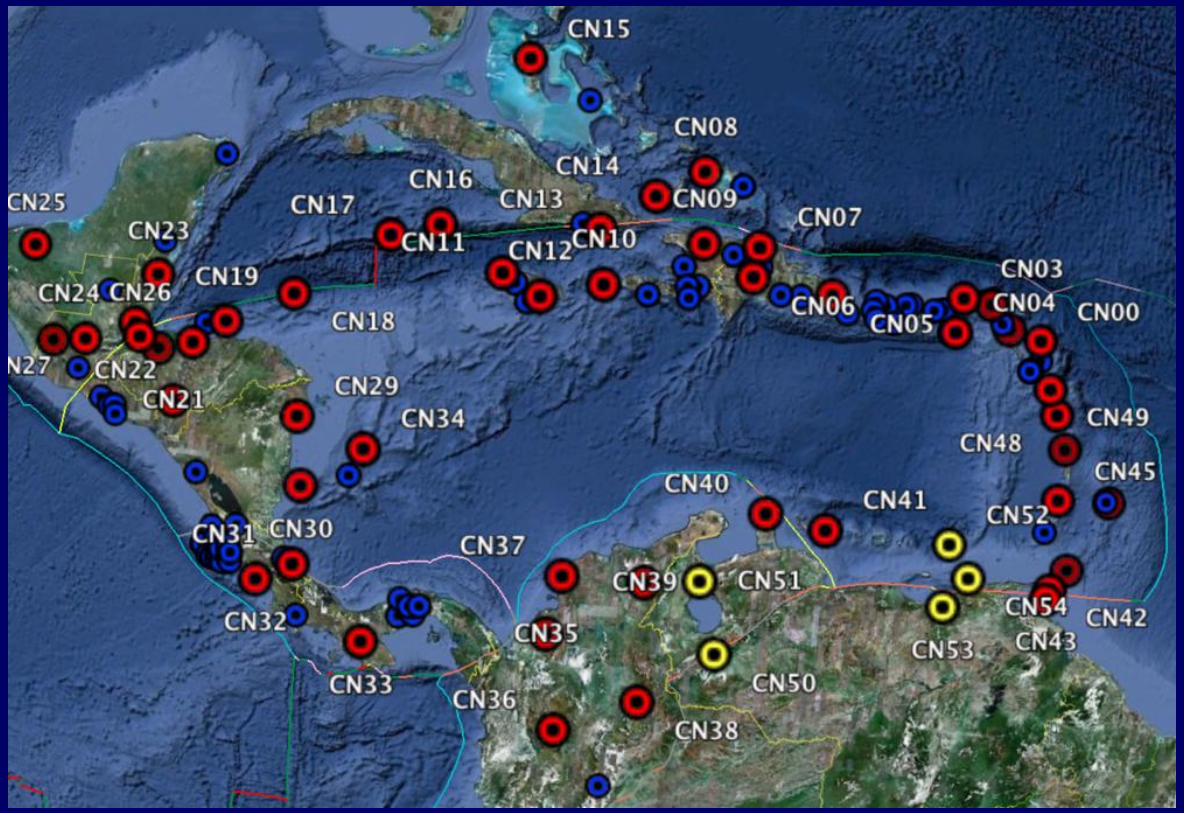
Rebuilding Needs - 2010 Haiti Earthquake

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/

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

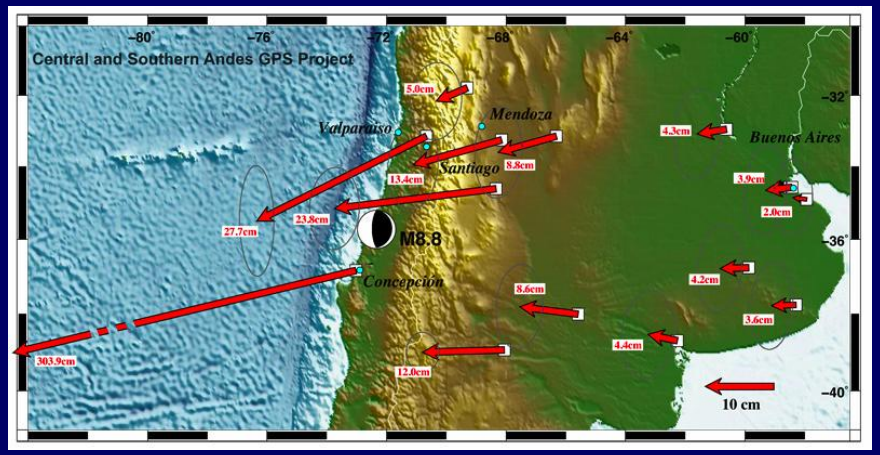
27 February 2010 Chile Earthquake
NSF GEO/EAR- and OISE- Supported

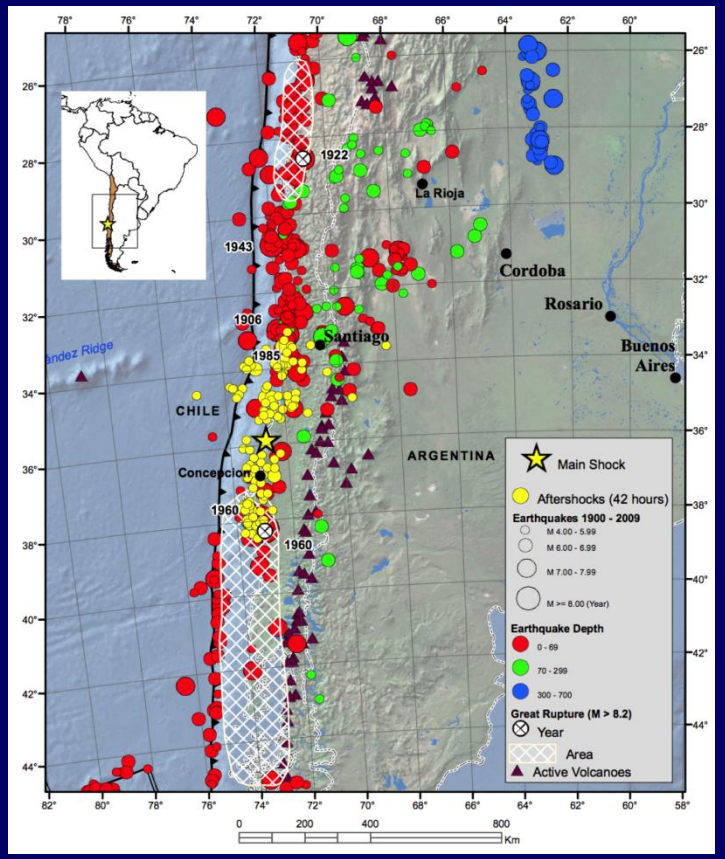
RAPID awards

- 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





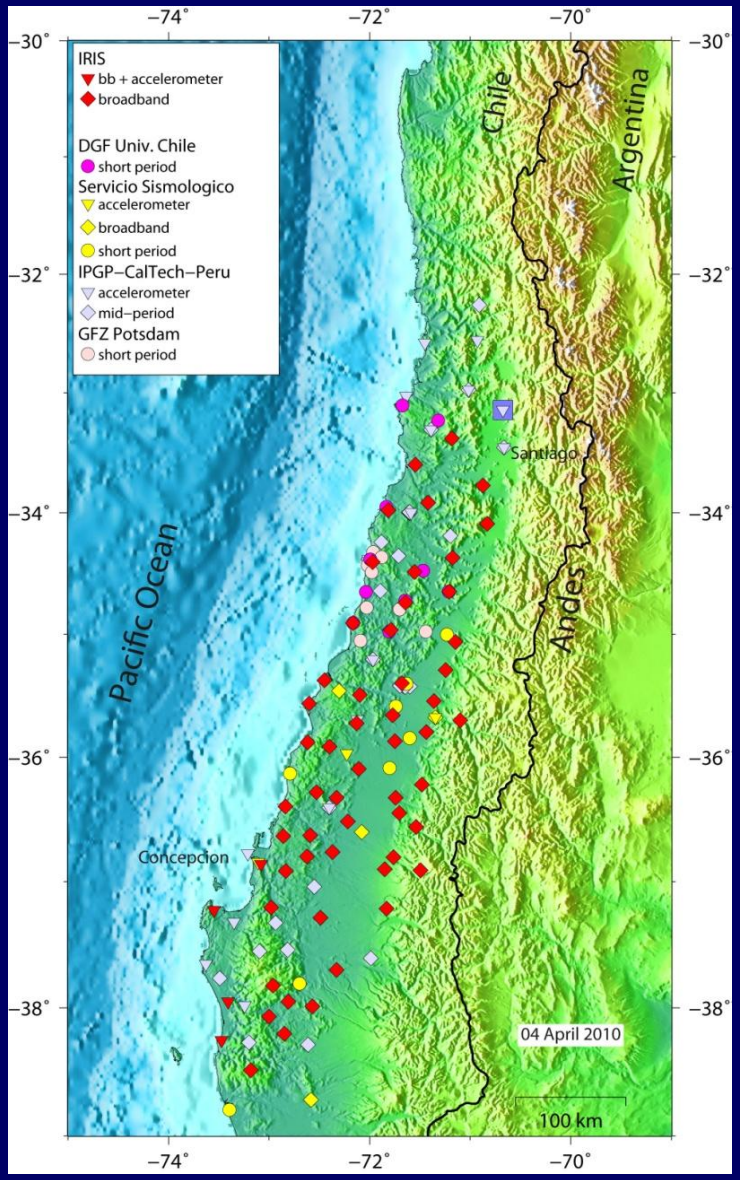
Map showing relation of 2010 Chile earthquake and its aftershocks (yellow) to historic earthquakes (red and green). Figure by Susan Rhea, USGS

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

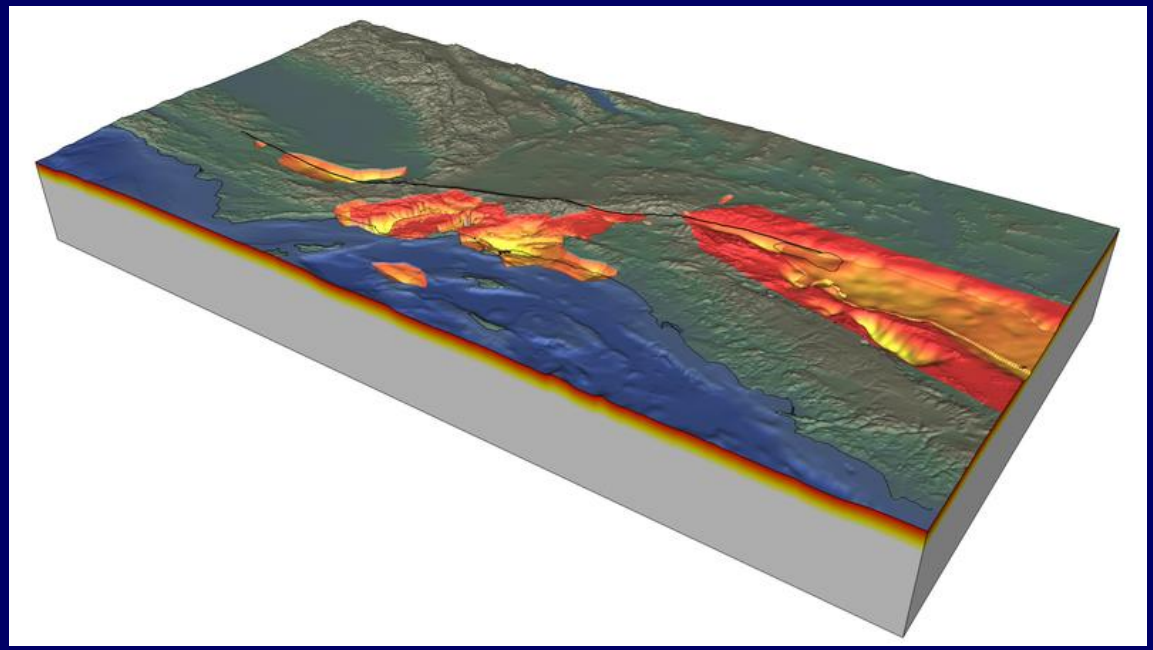
Research Needs Emerging from the 2010 Chile Earthquake Workshop August 19, 2010 at NSF

- 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)

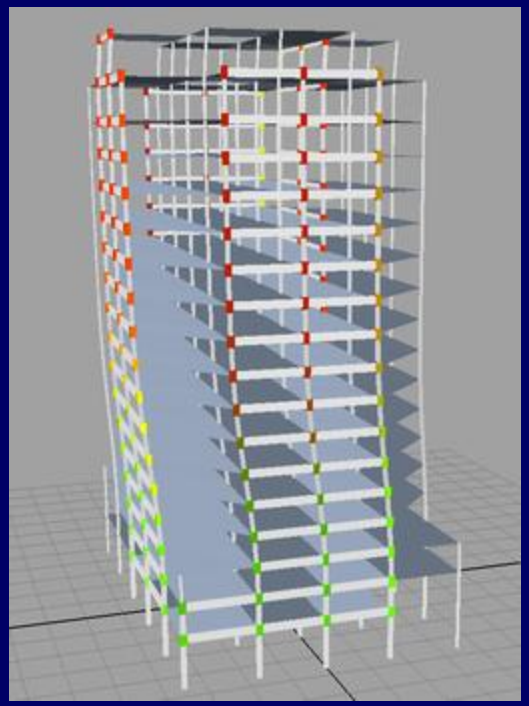
SCEC's M8 simulation of a Magnitude 8.0 rupture on southern San Andreas modeled wave propagation throughout the large simulation volume (810km x 600km x 85km) in Southern California shown in this image. (Image Credit: Geoff Ely)

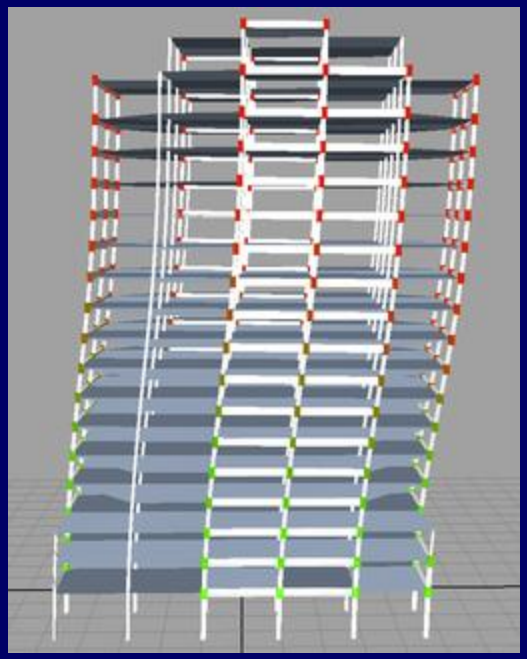


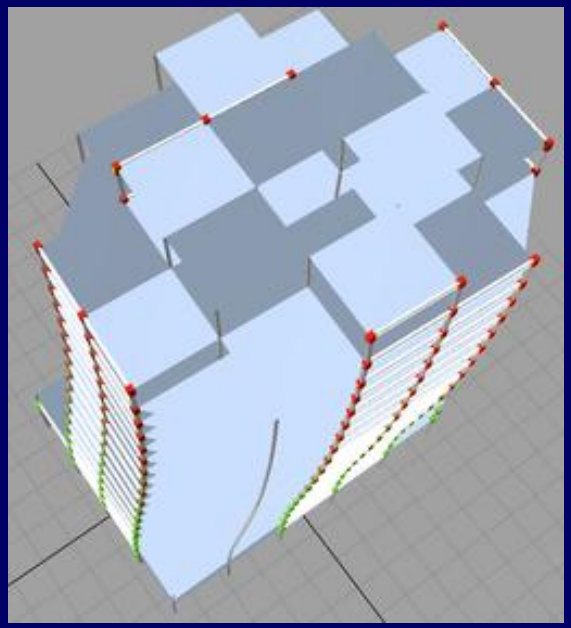
SCEC M8 Simulation

- 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)







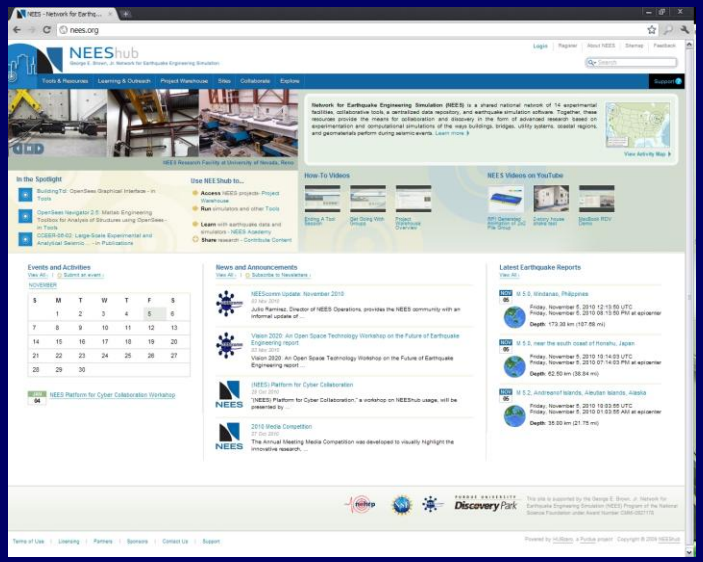
CME team at SCEC can produce forward wave propagation data – ground motion time-histories (seismograms) for simulated earthquakes of various magnitudes. The largest, full dynamic earthquake simulation of magnitude 8 on southern San Andreas fault was led by SCEC last year. The seismograms produced by 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)

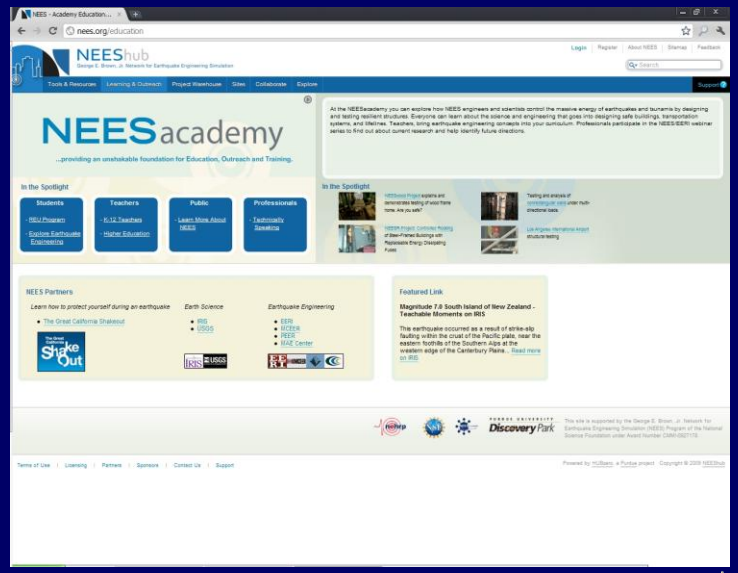
George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES)

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

http://www.nsf.gov/news/newsmedia/neeswood/

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/