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Strengthening the California Earthquake Clearinghouse Through Improved Data Collection, Management and Dissemination: Collaborative Research with California Geological Survey (CGS) And Earthquake Engineering Research Institute (EERI)

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Abstract

This report describes progress on the four tasks funded under the NEHRP grant. Building on technology advances implemented by the state of California using a federally-developed Uniform Incident Command and Decision Support (UICDS) framework of cores, the California Clearinghouse has greatly improved how it can share and use data. Many state agencies and organizations are choosing to contribute information through applications connected to an existing UICDS core. During this grant period Cal OES has agreed to host the UICDS core for the Clearinghouse, and other agencies and organizations are sharing their data through this core. These organizations all support the idea of getting data into a framework where those agencies that want it can grab it easily, but where individual cores for each organization are not necessary. After several exercises testing and refining this approach (described below), it has been established that the Clearinghouse will share field data through the core that Cal OES will maintain. This grant period saw a series of exercises and a training workshop where state agencies and other participating organizations had the opportunity to use various mobile data collection and visualization tools, and to understand the types of data that each agency will be contributing to the Clearinghouse. Significant outreach was undertaken to familiarize agencies with the options for contributing data as well as for using data coming in from the scientific and engineering communities. The Clearinghouse website was enhanced and a prototype site to be used in an event was developed.

Background

After the next damaging California earthquake, the California Earthquake Clearinghouse will be the contact point for researchers, scientists, and practitioners conducting reconnaissance. The Clearinghouse will facilitate the coordination of post-earthquake field investigations and help to share observations and knowledge among the community. Established in 1972, the Clearinghouse has activated a physical location more than ten times. The last major clearinghouse activation was after the Northridge earthquake in 1994.

The Clearinghouse is managed by representatives from five core groups: the California Geological Survey (CGS), the U.S. Geological Survey (USGS), the Earthquake Engineering Research Institute (EERI), the California Office of Emergency Services (Cal OES) and the California Seismic Safety Commission. This final report summarizes activities of two of the managing partner organizations of the Clearinghouse—the California Geological Survey and the Earthquake Engineering Research Institute—under a grant to improve data collection, management and dissemination.

There were 4 major tasks under this grant:

1. Work with Clearinghouse agencies to fully test the UICDS framework and make appropriate revisions in the Clearinghouse plan
2. Develop and test various field tools, data management protocols and how they integrate with UICDS
3. Develop a focused outreach strategy for the scientific and engineering communities, state agencies and local jurisdictions.
4. Develop/enhance Clearinghouse website to accommodate needs for information sharing among researchers, government agencies and the public.

The following sections report on progress under each of these tasks.

Task 1. Testing the UCIDS Framework (Lead: CGS)

Technology has enabled major breakthroughs in how organizations can collect and share information, and the Clearinghouse has been building on these changes during this grant period. A particularly significant break-through has been the state of California's commitment to using the Unified Incident Command and Decision Support (UICDS) middleware to support its emergency response activities. In brief, UICDS allows agencies to share data that can come in different formats without going through a cumbersome conversion process. Large data sets that are maintained by Caltrans, for example, can be shared directly and automatically with the California Office of Emergency Services, and vice versa, directly through this middleware, without converting databases into a common software. UICDS also allows agencies to specify levels of sharing—so, for example, the state Department of Public Health can control what state agencies can have access to various levels of their data.

The California Clearinghouse benefits from this UICDS framework and the data-sharing agreements, specifically to enhance the scientific and engineering understanding of earthquake events. The scientific and engineering partners in the Clearinghouse are also able to use the UICDS middleware to share their data easily and automatically. The Clearinghouse made this decision to pursue the UICDS technology after a meeting in September 2011 where the State of California Geographic Information Officer Scott Gregory informed the Clearinghouse that as part of Cal OES's Response Information Management System (RIMS) re-build, all components would have to be UICDS compliant. Working from this state-mandated requirement, the Clearinghouse has been coordinating with state agencies and organizations that are developing UICDS cores and/or UICDS compliant data structures.

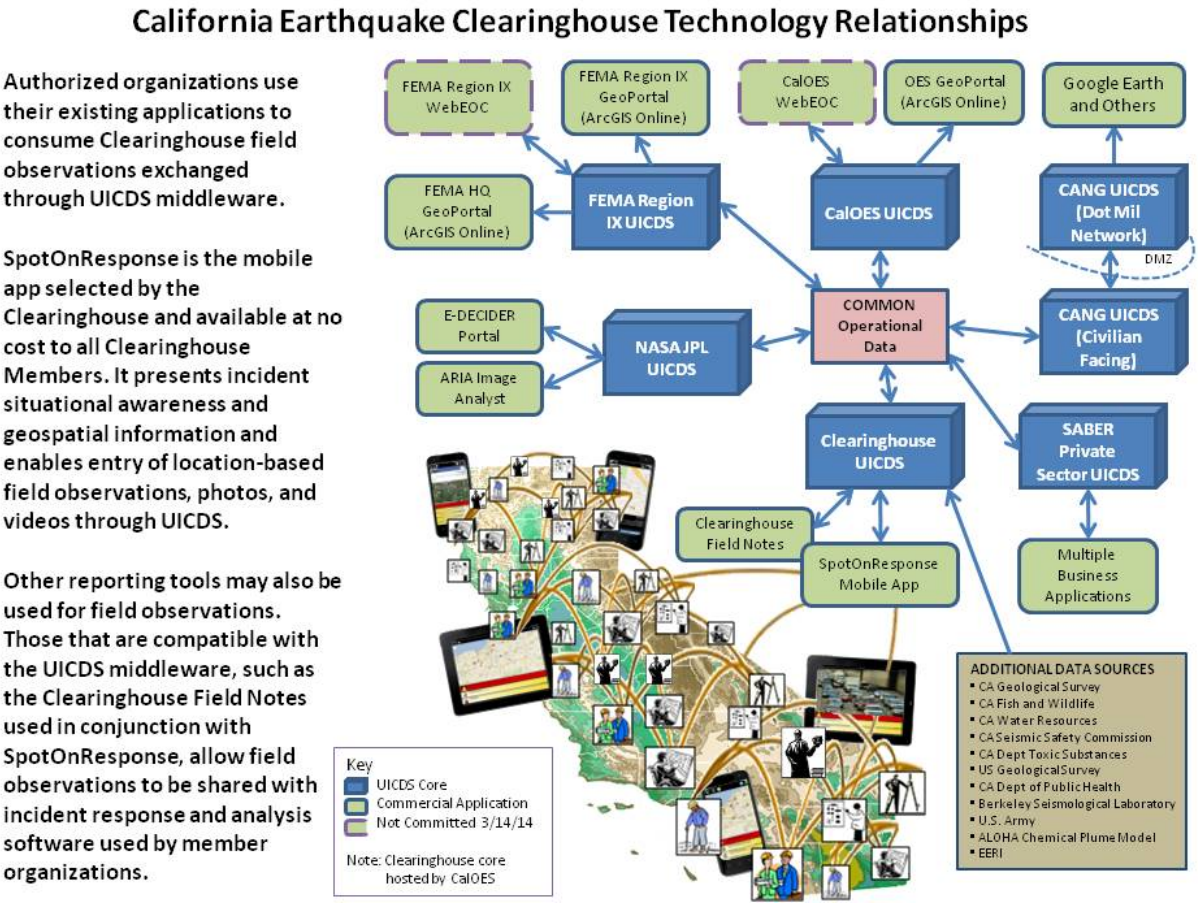

***Figure 1**. Clearinghouse Technology Relationships*

Particular strengths of the UICDS system include the facts that it is a large, robust, well-developed system, and that data are shared securely and immediately, among agencies and organizations with a UICDS core or an application connected to a UICDS core. Clearinghouse partners represent a broad spectrum of organizations that participate in and support post-earthquake activities. Many of these individual Clearinghouse partner organizations are developing custom work flows leveraging the tools and technologies used by their organization. The UICDS technology offers a flexible architecture that supports the technologies (geospatial and non-geospatial) and custom workflows of scientific, engineering and emergency response organizations.

UICSD Framework

The Clearinghouse, using its UICDS core, can pull information from agencies and organizations that can be used to direct Clearinghouse researchers in the field. And reciprocally, emergency management agencies can grab data from the Clearinghouse core in a faster, more automated manner. Data in the Clearinghouse core can be used to populate a virtual clearinghouse website. Data coming from the mobile UICDS device, SpotOnResponse, as well as some of the other mobile tools now being used by Clearinghouse partners, can be used to track all field investigators.

Only a few state agencies have developed their own UICDS cores at this point. However, many other agencies and organizations are choosing to contribute information through applications connected to an existing core. During this grant period Cal OES has agreed to host the UICDS core for the Clearinghouse, and other agencies and organizations are sharing their data through this core. These organizations all support the idea of getting data into a framework where those agencies who want it can grab it easily, but where individual cores for each organization are not necessary. After several exercises testing and refining this approach (described below), it has been established that the Clearinghouse will share field data through the core that Cal OES will maintain.

The Clearinghouse has closely coordinated UICDS implementation efforts with Cal OES. Between 2011 and 2013, Cal OES was engaged in replacing their emergency management RIMS software with WebEOC, while the Clearinghouse took the lead on UICDS implementation efforts. The Clearinghouse leveraged the fact that the annual spring state-level preparedness exercises, named Golden Guardian, between 2011 and 2014 were earthquake themed, and that in the fall there is the annual earthquake awareness event, the Great California ShakeOut exercise. The Clearinghouse treated these annual events as opportunities to test and learn by conducting two exercises with support from the NEHRP funding in this grant.

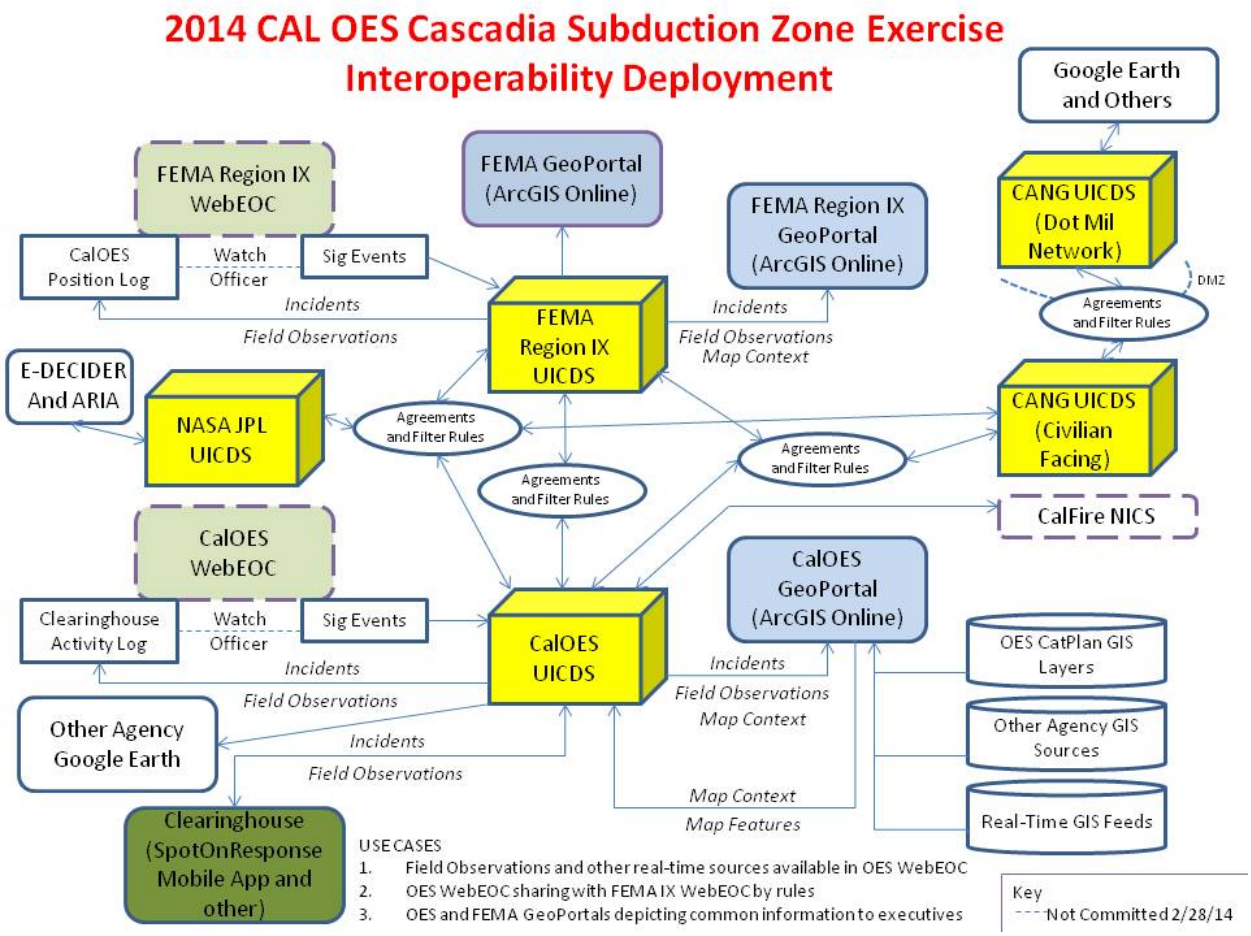

***Figure 2**. Interoperability Deployment*

2012 Exercises

The first exercise was held on May 30, 2012, concurrent with the 2012 Golden Guardian California state-level planning exercise. This exercise focused on testing twelve mobile data collection applications and a demonstration of how UICDS middleware technology can be used to share data. As the first exercise in the series it was a great starting point and the Clearinghouse engaged four partner organizations as well as close to 50 individual participants. The exercise also provided concrete examples of data flow that were leveraged in outreach efforts to engage other partner organizations in future exercises.

The second Clearinghouse exercise was held on October 17, 2012 one day ahead of the Great California ShakeOut. Building on lessons learned from the Golden Guardian Exercise, this second exercise had a better defined scope and more focused objectives. The objectives for this exercise were: 1) Introduce the concept of operations for the virtual Clearinghouse through a technology demonstration of UICDS middleware to

enable electronic data sharing between Clearinghouse member organizations and 2) Introduce the new field data collection tool being developed for the Clearinghouse by SpotOnResponse.

SpotOnResponse (SOR), a web application for situational awareness, began development in collaboration with the Clearinghouse after the 2012 Golden Guardian exercise and was featured prominently in this exercise. The number of mobile data collection applications being tested during this exercise was decreased significantly to only include the best and easiest to use, as determined during Golden Guardian. During the exercise, there were 109 unique IP addresses of which there were 48 end-users. The number of partner organizations who participated increased to twelve in addition to the five managing Clearinghouse organizations. The numbers showed an increase in participation and showed significant progress in moving from demonstration to operational mode since the May 2012 Golden Guardian Exercise.

This exercise provided much useful information, which was provide in the exercise After Action Report. Suggested improvements for future exercises included: refining UICDS sharing agreements; additional improvements to the SOR application; additional outreach to increase participation by emergency response organizations; a test of overflight capabilities; and establishment of the Clearinghouse at a physical location.

Golden Guardian 2013

Building on the first two exercises in 2012, the third exercise testing the UICDS middleware took place on May 15, 2013 and the Clearinghouse was an official participant in the State Golden Guardian Exercise. This allowed for more sophisticated data collection and the sharing of scenarios during the exercise. Simulated reports of damage by participating counties provided points of interest for Clearinghouse participants who then submitted simulated observations about these points. This exercise represented an important step in improving coordination between the Clearinghouse and Cal OES.

ShakeOut 2013

The second exercise in 2013 was held a day ahead of the Great California ShakeOut on October 16, 2013. The exercise included a live webinar and also a physical clearinghouse location and represented the first time that Clearinghouse data was being pulled by Cal OES and displayed in the State Operations Center (SOC). This exercise led to further refinements in how data are collected using various mobile devices, and how data are provided by the various Clearinghouse partners.

The October 2013 ShakeOut exercise successfully demonstrated interoperability between a number of tools and technologies (SpotOnResponse, Next-Generation Incident Command System, Web EOC) and based on that success, additional cores were

added, including OES, FEMA Region IX and California National Guard two cores in addition to a NASA JPL core (Figure 2).

March 28, 2014, M5.1 La Habra Earthquake

An additional opportunity to test the UICDS middleware arose this year following the M 5.1 La Habra Earthquake in southern California. Following protocols in the Clearinghouse Plan, real earthquakes between M5-6 are used as training opportunities; at a minimum, a virtual Clearinghouse is activated. The Clearinghouse issued a notice of low-level activation through the Clearinghouse website and an email to Clearinghouse partners encouraging volunteers in or near the affected region to report incidents and situation reports through the Clearinghouse. A CGS geologist living in the epicentral region was deployed the morning after the earthquake and successfully used a smart phone to upload reports and photographs that were viewable by Clearinghouse partners in near-real time on the Clearinghouse website SOR viewer. In addition, the Southern California Earthquake Center (SCEC) acted in support of the Clearinghouse effort and issued a similar notification to all SCEC volunteers. A total of 31 incident reports, 5 with media attached, were posted to SOR and displayed on the SOR map on the Clearinghouse website.

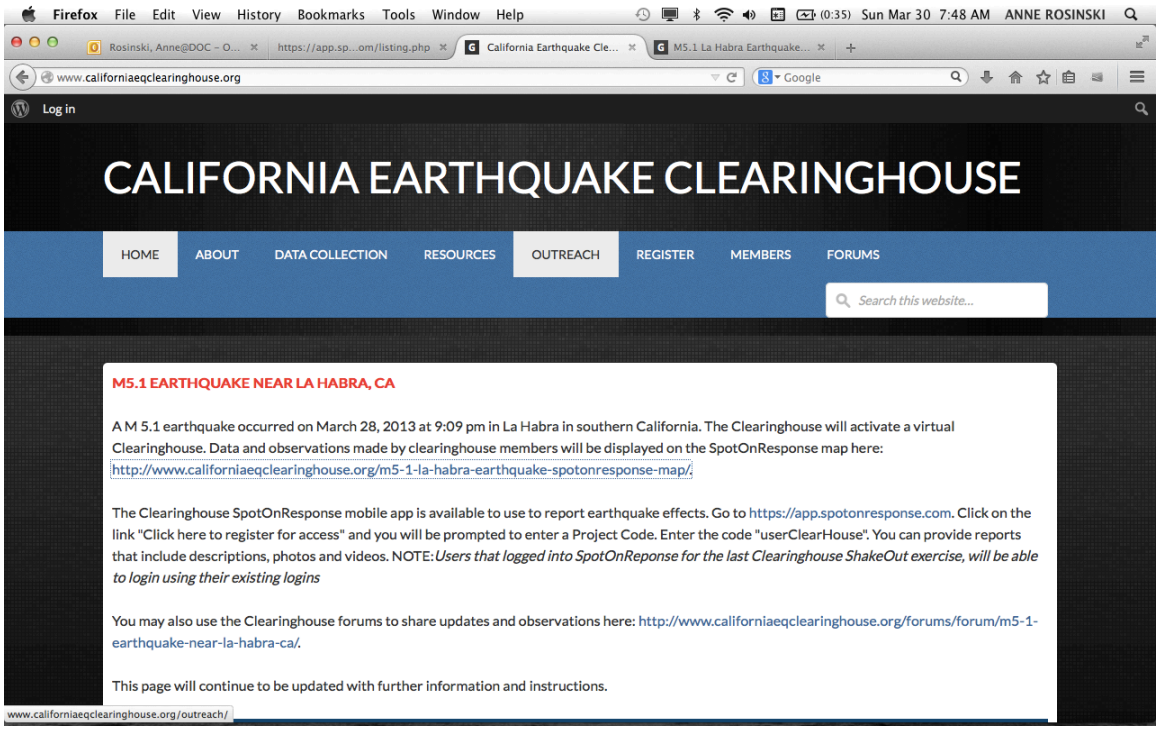

***Figure 3**. Clearinghouse website with activation notification for the March 28, 2014 La Habra earthquake*.

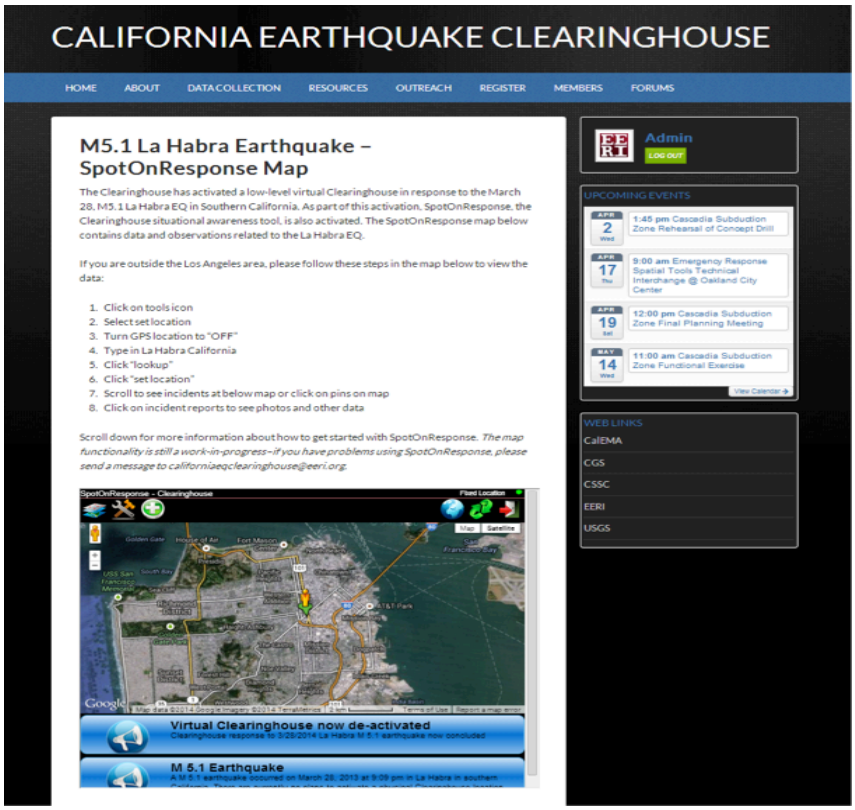

***Figure 4**. SpotOnResponse map on the Clearinghouse website for the La Habra earthquake.*

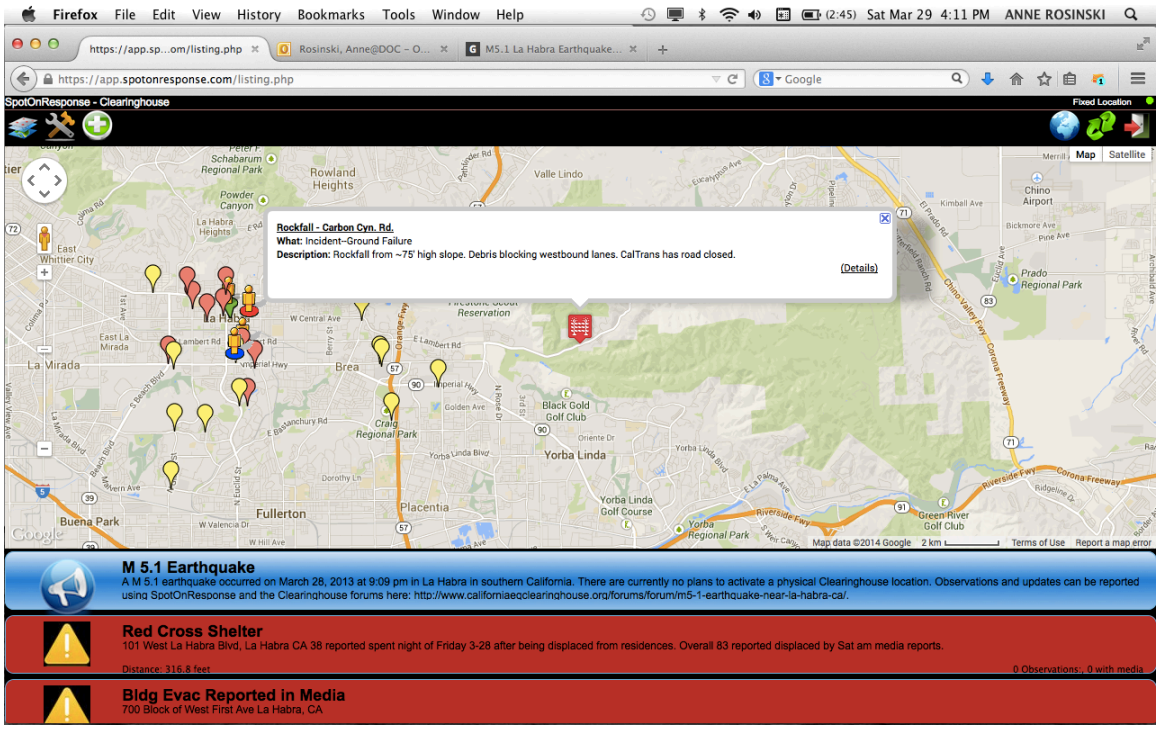

Figure 5 *Clearinghouse SpotOnResponse mobile field data collection tool main map showing Clearinghouse team member locations in the epicentral region of the La Habra earthquake and detail for the Carbon Canyon slide incident. This earthquake-triggered rockfall hit a moving passenger vehicle and closed the road for several days.*

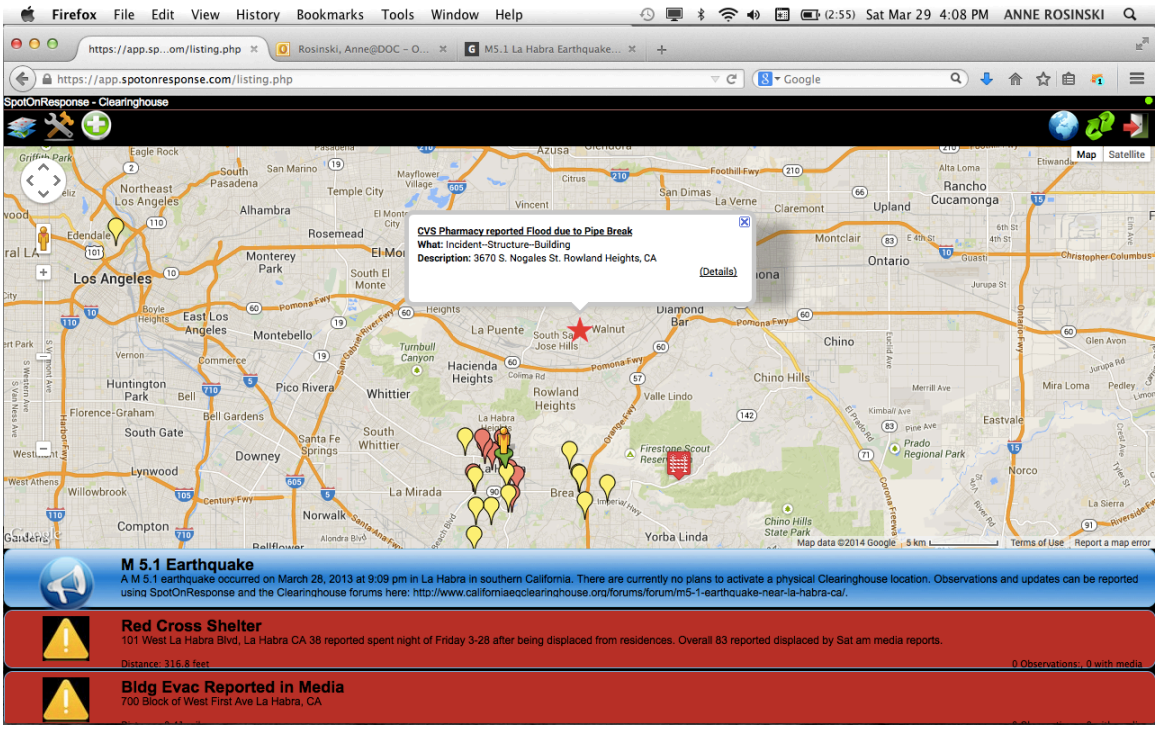

***Figure 6**. Clearinghouse SpotOnResponse mobile field data collection tool main map showing CVS pharmacy incident detail and partial list of reported incidents for the La Habra earthquake.*

Task 1 Summary of Accomplishments

Because of the Clearinghouse efforts with the UICDS middleware technology, in close coordination with Cal OES, the Clearinghouse has succeeded in accomplishing the goal of expanding operations to include a virtual Clearinghouse in addition to hosting a Clearinghouse at a physical location. For the first time, Clearinghouse partner organizations and volunteers are able to collect information in the field, and share it with each other and the State Operations Center, in real-time. The ability to share information amongst and between people and technologies in different locations allows Clearinghouse subject-matter experts to contribute Essential Elements of Information for decision support.

In addition, the Clearinghouse call-down procedures in the Clearinghouse Plan have been revised. All M5-M6 earthquakes will be used as training opportunities; at a minimum, a virtual Clearinghouse will now be activated.

Task 2. Developing and Testing Various Data Collection Tools and Management Protocols (Lead: CGS and EERI)

It is a priority of the Clearinghouse to use technology to aid in the collection and distribution of important information after an earthquake in California. The use of mobile devices for data collection is helping the Clearinghouse move towards near-real-time sharing of field observations. Many of the Clearinghouse partners have been exploring various mobile options for data collection. During this grant period the Clearinghouse identified the UICDS-compliant tool SpotOnResponse as the "primary" data collection tool for scientists and engineers participating in field investigations through the Clearinghouse. However, after testing in the various exercises, described above, it has become clear to Clearinghouse management that there is no one mobile tool or incident management application that meets all the needs of the diverse organizations who participate in such investigations. The focus now is on understanding how, through a variety of UICDS Connectors, commercial incident management applications (including WebEOC, ETeam, SpotOnResponse, and Digital Sandbox, among others), dispatch systems, and other software programs can exchange operational data with each other and provide geospatial outputs to ArcGIS Online, Google Earth, and other Shared Situational Awareness and Common Operating Picture tools.

Mobile data collection applications provide a streamlined and user-friendly way for Clearinghouse participants to send updates to the Clearinghouse. Developing protocols for mobile data collection requires an understanding of the types of data being recorded by participants and identifying the desired functionality of applications while at the same time recognizing possible limitations.

Types of Data

Clearinghouse members will be conducting reconnaissance efforts with different objectives and in different ways. It is the goal of the Clearinghouse to be able to handle different data formats and display them in a universal way. As part of the workshop in July 2013, the Clearinghouse conducted a survey of 12 partner organizations to learn about data collection methods and data formats. The most common data formats and the considerations for their collection are described in the following sections.

Photographs

The most basic and common form of data collected by partner organizations are digital photographs. Digital photography allows for instant viewing and sharing of images, but for the photos to be truly useful, care must be taken to provide appropriate and important metadata. With the potential for thousands of photos to be shared with the Clearinghouse after a very large earthquake, the context for each photo becomes more important. Important metadata identified for each photograph includes latitude and

longitude, a detailed caption, photographer, and a time and date stamp. Having this information stored as metadata ensures that the context of each picture will not be lost as it is shared among participants via different sharing methods.

Field Observations

At its core, the value of the Clearinghouse comes from the large number of experts expected to participate. Having a group of highly regarded experts reporting on field conditions means that observations can be trusted as expert opinion. With the traditional physical clearinghouse, these observations are shared at end-of-day meetings, but through mobile data collection applications with note-taking abilities, observations have the potential to be shared shortly after they are made. Field notes in text files that include basic information (name, email, area of expertise, etc.) about the observer can be shared quickly through the virtual clearinghouse to provide situational awareness to all members.

Basic Measurements

In addition to photographs and observations made by quick-moving reconnaissance teams, measurements from small research teams who conduct systematic data collection will be of interest to other members. These measurements can inform groups in a different discipline of an issue and can help groups with similar interests plan their days in the field. Providing a mobile platform for recording this information means that these measurements will be shared in a timely manner.

Selected Tools

Important Features

Changing the way Clearinghouse volunteers and researchers think about collecting field data is the first step in moving toward near-real-time sharing of observations. Pen and paper will always remain a valid method of data collection. However, use of mobile devices for data collection greatly enhances rapid hazard assessment and situational awareness capabilities in support of response and recovery efforts for a major earthquake. In order for a mobile application to be recognized as a viable alternative to traditional methods of recording observations, it must be well-developed without any bugs and have a shallow learning curve. This discussion focuses on essential features, including: the ability to geotag photos, videos, and notes taken within the applications; ability to take multiple photos; a space to make free-form notes; and full data collection functionality without internet or cellular service. Additional features like photo annotation, forms for systematic data collection, and an internal display to view observations make an application more versatile.

Just as the Clearinghouse partners represent expertise across a broad range of subjects, so too do they exhibit a broad range of skill with technology. CGS and USGS have many geologists that are also skilled GIS users and have access to tools such as Arc GIS, which require a license to access and use. Many consultants, who are licensed geologists, engineers or other professional earthquake subject-matter experts, are likely to become spontaneous Clearinghouse volunteers. However, these experts may not have advanced GIS skills and/or access to spatial data tools. For this reason, the Clearinghouse strategy is to identify and provide, at no cost, a variety of tools to share information.

Suite of Tools

In order to collect the types of information mentioned above, the Clearinghouse has assembled a suite of field tools that take advantage of the latest mobile device features and make it easy to collect and share information. Mobile data collection applications with sufficient functionality to capture and share all desired data forms are considered and evaluated for inclusion in the suite of tools. Tutorials and user guides for each tool in the suite are made available on the Clearinghouse website, and users are encouraged to use the tools during exercises to learn how to use the tools efficiently before the next earthquake.

The current suite of Clearinghouse field tools for mobile data collection includes four applications that together provide all the desired features listed in the previous section. These applications include native and web applications and their features are summarized in Table 1. Each of these tools have been evaluated by the Clearinghouse and tested by volunteers during the Clearinghouse exercises to test the usability and functionality of each application.

Table 1. Features of mobile data collection applications in the Clearinghouse suite of field tools.

Application	**Geo-location**	**Photos**	**Audio**	**Video**	**Form**
SpotOnResponse	X	X	X	X	Free form text box
Clearinghouse Field Notes	X	X	X	X	Pre-loaded discipline specific forms
FieldNotes *LT & Pro*	X	X	X	X	Free form text box
FotoNotes	X	X	X	X	User-defined forms

Data Sharing

In addition to data capture capabilities, mobile data collection applications must also facilitate the sharing of collected data. Most applications allow for exporting of data in a limited number of formats. Table 2 shows the data formats for each of the applications in the suite of field tools.

Table 2. Features of mobile data collection applications in the Clearinghouse suite of field tools.

Application	Data Formats
SpotOnResponse	RSS feed
Clearinghouse Field Notes	JSON file
FieldNotes LT & Pro	PDF, zipped .txt &.jpg files, and KMZ
FotoNotes	PDF Report

Applications that use standard data formats like kml/kmz and pdf are preferred because these files can be hosted online and served through standard web mapping applications. Most applications allow for exporting of data in a limited number of ways. Examples of data exported from Field Notes Pro and Clearinghouse Field Notes can be viewed in Figs. 7 and 8.

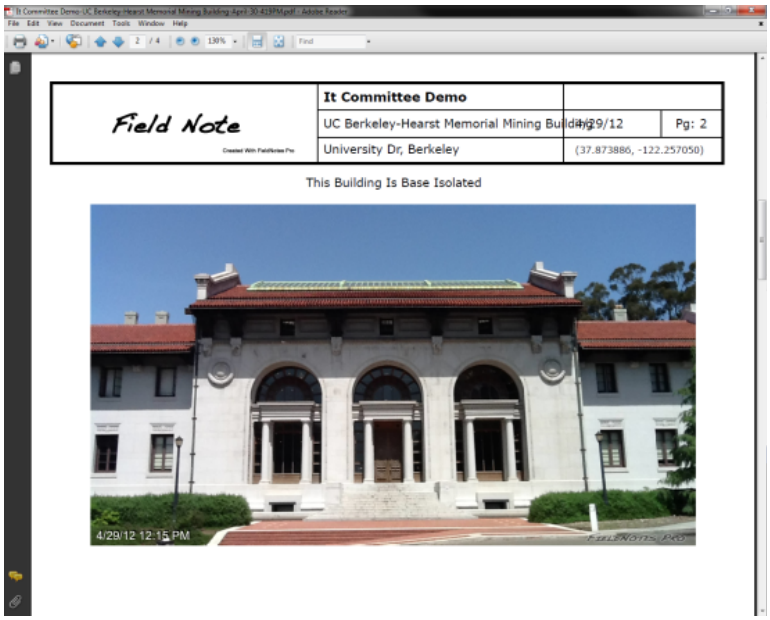

***Figure 7**. Sample PDF report created with Field Notes Pro.*

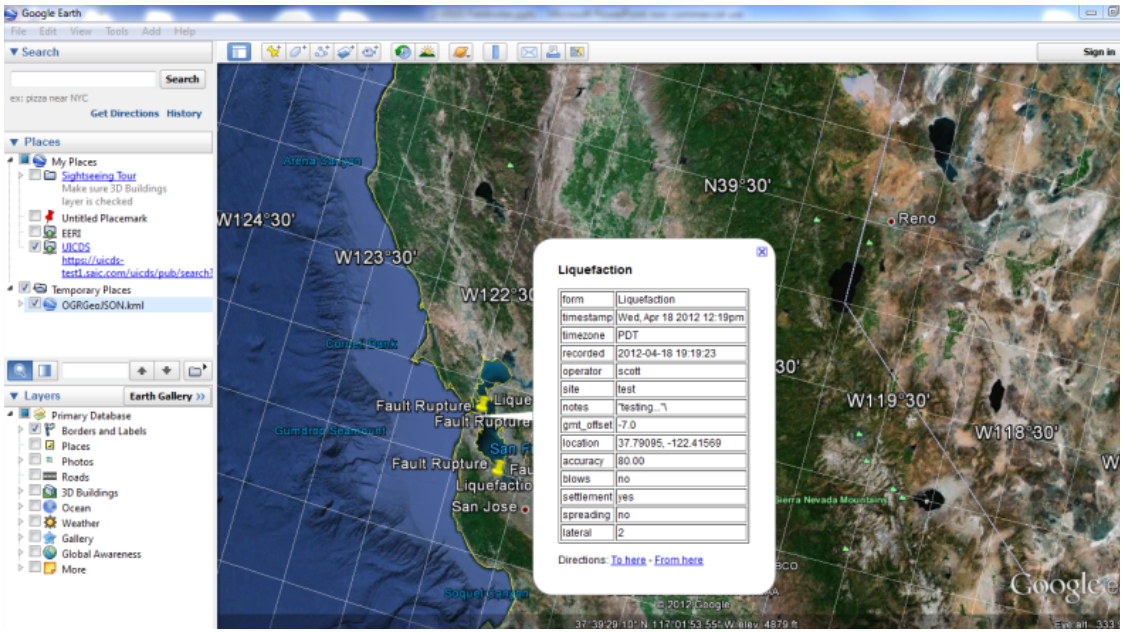

Figure 8. *Sample KMZ file created with Clearinghouse Field Notes viewed in Google Earth.*

Displaying Data

Once data is exported from each application, the next step is to display the data in a single viewport. Currently, the SpotOnResponse application is functioning as this viewer. Using the UICDS middleware technology, this application can receive and display data from multiple sources that use different formats. Figure 9 shows a screenshot of the SpotOnResponse map during the 2013 Golden Guardian Exercise. Updates to this application are ongoing to improve situational awareness at a glance and add functionality. The data from SpotOnResponse can also be displayed in other applications such as Google Earth and WebEOC (the incident command software used by Cal OES).

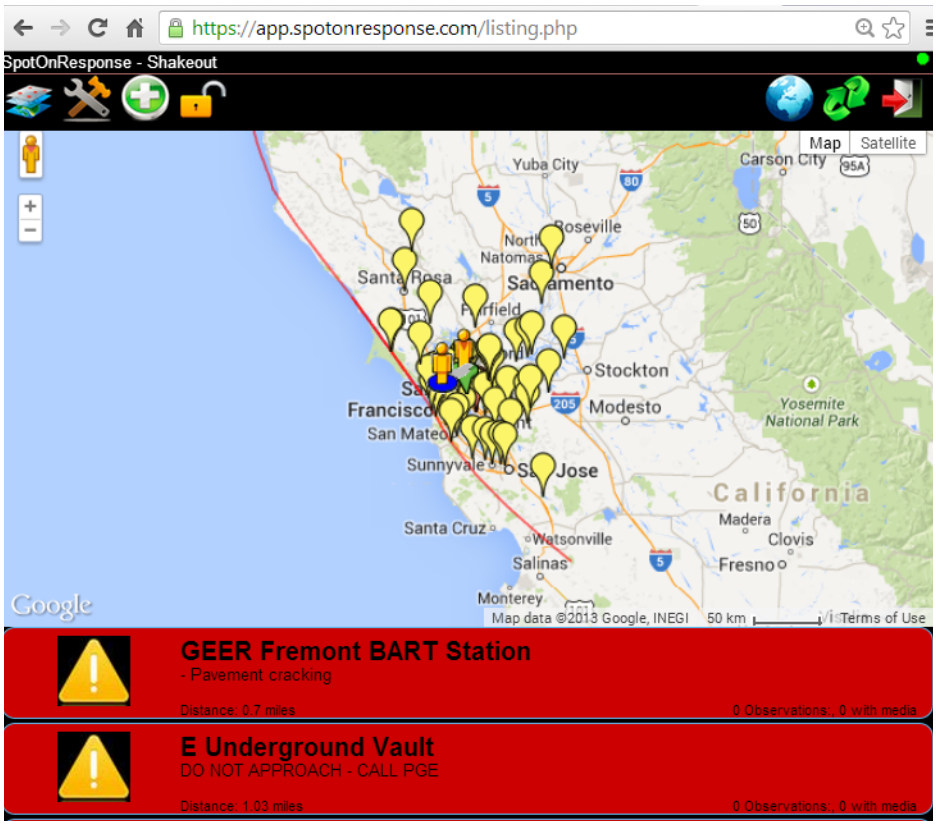

Figure 9. *Observations made during the 2013 Clearinghouse ShakeOut Exercise displayed in SpotOnResponse.*

Synthesis Products

While the Clearinghouse and its partners are NOT First Responders, our partners support the emergency response community (Cal OES, FEMA, military, local jurisdictions, etc) by providing information about the damaging effects of the earthquake. It is critical for key decisionmakers to maintain a situational awareness (i.e., to be knowledgeable of potential and current conditions, possible impacts on populations and infrastructure, and other key indicators of the situation). In any major earthquake event, the degree to which key decisionmakers at all levels of government and within interagency structures are able to gain and maintain a situational awareness on the scene determines, to a great degree, their ability to anticipate requirements and provide appropriate resources. Generally, the most accurate information is obtained from those on the ground, closest to the potential or actual incident site and emergency managers rely on information and analysis from authoritative sources, such as Clearinghouse partners. The information provided is used by decision makers to prioritize activities and the deployment and employment of critical, but often limited, resources. These concepts are summarized from the *California Catastrophic Incident Base Plan: Concept of Operations (Annex B.2 Essential Elements of Information),*

available here:http://www.calema.ca.gov/TrainingandExercises/Pages/State-Level-Exercise.aspx

Developing options for providing such synthesis and rapid summaries is an ongoing effort of the management group of the California Clearinghouse. Clearinghouse partners are exploring both SpotOnResponse and ArcGIS Online as data display tools. To help improve the understanding of an event, the Clearinghouse is developing synthesis products that can quickly provide an overall picture of the event as well as display subsets of information that will be of interest to Clearinghouse participants. During the Fall 2013 ShakeOut exercise, these synthesis products were assembled and posted on the Clearinghouse website using a Google Earth Widget, see Figure 10.

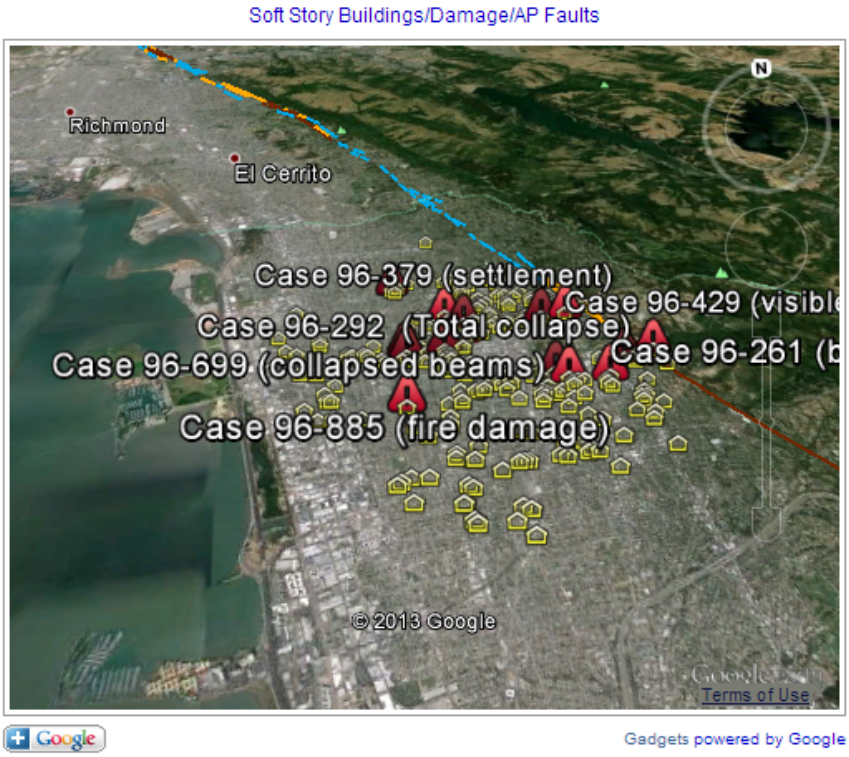

Figure 10. *Google Earth widget map showing three layers of data: soft-story buildings in Berkeley, faults, and simulated observations for some of the soft-story buildings. This map was posted on the Clearinghouse website during the 2013 Clearinghouse ShakeOut exercise.*

Task 3. Focused Outreach Strategy (Lead: CGS and EERI)

Several activities occurred during this grant period to improve communication with and participation by the scientific and engineering communities, state agencies and local governments, and are described in more detail below.

July 2013 Workshop

The management organizations of the Clearinghouse organized a workshop in July, 2013 with various organizations that play a role in post-earthquake data collection and management, as well as emergency response, to identify how they can all more effectively work together. The need for this workshop grew out of recognition that various agencies have overlapping roles and responsibilities and can benefit by coordinating their efforts. The two-day meeting focused on data collection and management and strategies for improving coordination. The list of participants and agenda for this meeting are in Appendix A.

Communication with Emergency Managers

Part of the overall mission of the Clearinghouse is to use information coming into the Clearinghouse to provide situational awareness to emergency managers. After an earthquake, damage estimates and requests for aid are made based upon HAZUS estimates that arrive before the physical Clearinghouse can mobilize. However, taking advantage of the virtual clearinghouse concept means that field observations coming in from the field hours after an earthquake can be shared with emergency managers. These observations will not likely come in soon enough to affect aid requests, but ground-truthing of HAZUS estimates can help emergency managers direct aid to the most affected regions and thereby speed up the response and recovery processes. The Clearinghouse has a strong relationship with the California Office of Emergency Services and efforts to feed clearinghouse data into the State Operations Centers in near-real-time are ongoing. Incremental progress toward this goal is being made each year through the Clearinghouse exercises described above.

The Clearinghouse has also been working specifically with the branch of Cal OES that will manage overflights after an earthquake. This new OES Air Operations Branch is willing to work with the Clearinghouse to identify the types of data that could be collected in an overflight and the equipment necessary to gather and share such data.

Technology Interoperability Project

Growing out of the success of the October 2013 Clearinghouse ShakeOut exercise, the Clearinghouse has been spearheading an effort called the Technology Interoperability Project. This project is attempting to identify the various technologies and data that will be available after an earthquake, and how such information will flow among agencies and organizations. Many individual Clearinghouse partner organizations are developing custom work flows leveraging the tools and technologies used by their organization. As each organization provides more details, the Clearinghouse Technology Relationships diagram shown in Figure 1 is updated.

This project also tracks those organizations that have UICDS cores, as they may function as hubs of data and/or exchange data quickly with the CA OES and Clearinghouse core. Recent UICDS cores that have been added include:

- CA National Guard (CANG). The CANG is establishing two cores, one on the .mil network isolated from public access and one on a server with public access.
- NASA JPL core. In 2012 the NASA JPL ARIA and E-DECIDER teams became active Clearinghouse partners. Like all Clearinghouse partners, they are self-directed. They independently developed several tools in accordance with their own mission to support emergency response efforts. They elected to stand up their own UICDS core to publish their tools and data. The Clearinghouse and the NASA JPL teams continue to work very closely and the relationship is represented by the rules and sharing agreements between the NASA JPL core and the Cal OES core.

As part of this project, an Interoperability Workshop was organized during this grant period, and conducted in a subsequent period. The workshop will be described in a subsequent report.

Task 4. Develop/enhance Clearinghouse website (Lead: EERI)

With technological advances and the now widespread use of GIS, the Clearinghouse management is establishing procedures for a Virtual Clearinghouse Concept. A virtual clearinghouse will supplement a physical clearinghouse location after an earthquake with online maps showing collected data, real-time updates posted to the Clearinghouse website, and moderated discussion boards allowing remote communication with Clearinghouse management and other Clearinghouse participants. This concept of operations includes identifying available data, outlining data capture procedures, and establishing data sharing methods. The objectives of a Virtual Clearinghouse are to: 1) move towards near-real-time sharing of field observations made by Clearinghouse members, 2) improve timely coordination between groups and individuals, and 3) provide relevant information to emergency managers to improve situational awareness soon after an earthquake.

There are two main components of the virtual clearinghouse concept of operations: a lightweight and user-friendly website and a system to collect and share data in near-real time. The virtual clearinghouse website will be integrated into the existing Clearinghouse website. This means that users will already be familiar with the website navigation before an earthquake. A lightweight website is important to reduce page load times as bandwidth may be severely limited in heavily damaged areas. A prototype of such a virtual clearinghouse has been developed, modeled after other EERI virtual clearinghouses, and is available here: http://www.eqclearinghouse.org/scenario-earthquake/. Work is continuing on this prototype site during the current grant period.

The virtual Clearinghouse site after an event will be linked to the existing California Clearinghouse website, which features a user management system that allows interested individuals to register and receive important updates from the Clearinghouse management. After an earthquake, users will be directed to the virtual clearinghouse site where they can find updates about the location of the physical clearinghouse, summaries of observed damage, and daily reports from those in the field. It is anticipated that there will be a protected section of the Clearinghouse site where more sensitive or secure information can be distributed to all registered Clearinghouse members. These updates will reach an audience beyond those who are able to reach the physical clearinghouse location. Moderated discussion boards will provide direct communication with Clearinghouse members who are unable to reach the physical location of the Clearinghouse and also allow clearinghouse members to coordinate efforts with each other to prevent duplicated efforts. The linkage between the virtual clearinghouse for an event, and the Clearinghouse website that also functions as a management or administrative site is under continuing discussion. The Clearinghouse Management group recognizes that better coordination of these two sites, and/or complete integration, is necessary.

As discussed above, the Clearinghouse is also developing tools and protocols to facilitate the collection of data and displaying it through the virtual clearinghouse. Many mobile data collection applications are being explored and multiple web mapping services are being tested to display information in a way that communicates situational awareness at a glance, but also allows users to view detailed reports for individual observations.

In addition to field data collection tools, the Clearinghouse website hosts discussion forums http://www.californiaeqclearinghouse.org/data-collection/. There are permanent sub-groups established for on-going Clearinghouse matters such as overflight and, for professional disciplines e.g. seismology, structural engineering, etc. New forums may be established as necessary during activation based on need e.g. hotspots, coordinating field teams, discipline-specific emerging themes, itinerary exchange.

Conclusions

The USGS grant has allowed CGS and EERI to make major developments of the virtual clearinghouse concept, including the testing of various field tools and data viewing and management protocols. CGS and EERI activities have led to improved visibility of the Clearinghouse and increased coordination with a wide range of agencies and organizations in the state. This increased visibility and coordination continue to grow at a rapid rate. Participating in the continuing series of exercises has brought in new partner organizations and individual participants. Organizations and agencies from other states have also started following the Clearinghouse in order to start developing their own Clearinghouse protocols. A well thought out concept of operations for the physical and virtual clearinghouses is helping the community capture important scientific and

engineering data after the next California earthquake and has the potential to play a role in the response and recovery process through automated information sharing with the California Office of Emergency Services.

APPENDIX A

California Earthquake Clearinghouse Meeting
Post-event Information Coordination
July 30 and 31st, 2013
Alaska Conference Room, Building 3
U.S. Geological Survey Campus, Menlo Park, CA

AGENDA

Meeting Goals:

- Introduce agencies and organizations with roles in post-earthquake information coordination in CA to each other
- Familiarize agencies and organizations with role of CA Earthquake Clearinghouse
- Understand what information local, state and federal agencies may provide and what information they need to do their jobs better
- Understand what information the research community may provide and what information they need to do their jobs better
- Understand the role of UICDS in improving information flow among agencies
- Identify gaps, issues, needed coordination, training, testing opportunities in next exercise
- Identify action items for participation in ShakeOut in fall 2013

JULY 30th

10:00 am **Introductions**

10:30 am **Purpose of Meeting**/Goals for the two days: focus on outcomes and recommendations for actions (*Anne Rosinski, CA Geological Survey and chair, California Earthquake Clearinghouse*)

10:45 am **Presentation**: Overview of Clearinghouse—its structure, how it anticipates coordinating and facilitating scientific and engineering investigations after a damaging earthquake, and quick look at Survey Monkey results (*Maggie Ortiz, Earthquake Engineering Research Institute*)

11:15 am **Presentation**: Integration of scientific and engineering information in emergency response (*Kevin Miller, CA Office of Emergency Services*)

11:30 am **Presentation and demonstration**--Displaying and Sharing data-- WebEOC (*Carla Simmons and Bernie Schultz, CA Office of Emergency Services)*

12:00 pm **Presentation**--Plans for Fall 2013 ShakeOut. (*Moderator: Anne Rosinski*, *CA Clearinghouse Chair)*

12:30 pm Lunch on own

1:30 pm **Panel of federal agencies**—each panelist will answer questions posed by moderator, followed by open discussion with group. (*Moderator: Luke Blair, US Geological Survey)*

Tom Holzer, U.S. Geological Survey
Michael Hornick, Federal Emergency Management Agency
Maggi Glasscoe, NASA—Jet Propulsion Laboratory
Eric Letvin, National Institute of Standards and Technology

2:30 pm **Panel of state agencies**— each panelist will answer questions posed by moderator, followed by open discussion with group.
(*Moderator: Anne Rosinski, CA Geological Survey)*

Tim McCrink, CA Geological Survey
Carol Walker, CA Office of Emergency Services
Don Hoirup, Water Resources
Sang Le, Caltrans

3:15 pm Break

3:30 pm **Panel of local governments**— each panelist will answer questions posed by moderator, followed by open discussion with group.
(Moderator: Chuck Real, CA Geological Survey)

Phil Beilin, City of Walnut Creek
Patrick Otellini, City of San Francisco

4:00 pm **Panel of research organizations**— each panelist will answer questions posed by moderator, followed by open discussion with group. (*Moderator: Fred Turner, CA Seismic Safety Commission)*

Jonathan Bray, Geotechnical Extreme Events Reconnaissance
Curt Edwards, Technical Council on Lifelines Earthquake Engineering
Vesna Terzic, Pacific Earthquake Engineering Research Center
Marjorie Greene, Earthquake Engineering Research Institute
Jeffrey Hunt, Structural Engineers Association of California—Post-Disaster Performance Observation Committee

4:45 pm **Discussion**: Gaps, overlaps, needs. How can we coordinate better? What are things we all agree on in terms of information collection, protocols? Data ownership? Data standards? Options for coordinating access to sensitive data? (*Moderator: Jay Berger, EERI)*

5:30 pm Adjourn

(There will be a no-host dinner for those interested at a nearby restaurant)

JULY 31st

9:00 am **Discussion**: Clearinghouse/Field Investigations Protocols—building on previous day's discussion, identify options for improvement. (*Co-moderators: Jonathan Bray, UC Berkeley; Jeff Hunt, Exponent; Tim McCrink, CGS)*

Need for standards, taxonomies, best practices
Issues of Access
What to do with data (archiving, repository)

10:30 am Break

11:00 am **Presentation and Discussion**: Displaying, Sharing and Archiving Data—(*Moderator: Charlie Huyck, ImageCat*)

Resources Agency & Google Earth Viewer
Representative, Resources Agency
FEMA Modeling Task Force, *Scott McAfee, FEMA*
NIST Earthquake Damage Data Repository, *Santiago Pujol, Purdue University*

12:30 pm Lunch (on own)

1:30 pm **Presentation and demonstration:** Displaying and Sharing data—UICDS/SpotOnResponse/WebEOC *James Morentz, SAIC*

2:30 pm **Discussion:** Moving Forward--actions for next exercise, formation of working groups, needed trainings, gap identification, engaging other partners—discussion (*Moderator: Anne Rosinski*)

3:30 pm Adjourn

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