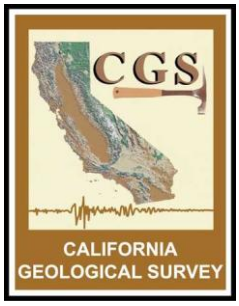
Golden Guardian Exercise

After-Action Report/Improvement Plan

May 2013



ACKNOWLEDGEMENTS

We gratefully acknowledge the technical and logistical support provided by James Morentz through the U.S. Department of Homeland Security, Science and Technology Directorate. We also appreciate the participation and assistance of the following: Timothy Stough, Susan Owen, Sang-Ho Yun and Margaret Glasscoe (NASA-JPL, E-DECIDER and ARIA-EQ); Marjorie Greene, Maggie Ortiz (EERI); Fred Turner, (CA Seismic Safety Commission); Luke Blair, Eleyne Phillips, Scott Haefner and Tim McDonald (USGS); Bradley Rogers and Ramez Gerges (Caltrans FiRST); Diane Vaughan, Kris Higgs and Kevin Miller (Cal EMA); Don Hoirup California Department of Water Resources); Judd Muskat (CA Dept. of Fish and Wildlife); Jennifer Strauss (Earthquake Early Warning System); Quinn Hart (UC Davis); David Harris (California Natural Resources Agency); Marlon Pierce and Jun Wang (Indiana University), and SpotOnResponse.

STATE OF CALIFORNIA
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GOVERNOR

THE RESOURCES AGENCY
JOHN LAIRD
SECRETARY FOR RESOURCES

DEPARTMENT OF CONSERVATION
MARK NECHODOM
DIRECTOR

CALIFORNIA GEOLOGICAL SURVEY
JOHN G. PARRISH, PH.D.
STATE GEOLOGIST

EXERCISE OVERVIEW

During an emergency, the California Geological Survey (CGS) operates according to the State Emergency Plan of 2005. Agency-specific functions are further defined in an Administrative Order developed by the Governor's Office of Emergency Services (OES) established under the authority of Executive Order No. W-9-91. The order states CGS will provide geotechnical data and advice regarding natural hazards to support emergency planning and information support as required during State disaster response operations. CGS coordinates its emergency response with federal, state, local, and other agencies and organizations.

Since 1972, CGS has been tasked to establish and coordinate the operation of an information clearinghouse to coordinate post-event seismological and geologic investigations (First Report of the Governor's Earthquake Council). In the same report, the council also recommended that the Earthquake Engineering Research Institute (EERI) should function in a similar capacity for coordinating structural engineering investigations. Since then, these two clearinghouses have evolved into a single multi-organization information clearinghouse, now referred to as the California Earthquake Clearinghouse (Clearinghouse). The Clearinghouse is now coordinated by CGS and managed by representatives of Cal OES, CGS, EERI, U.S. Geological Survey (USGS) and California Seismic Safety Commission (CSSC).

The Clearinghouse is a location where, after a damaging earthquake, engineers, geologists, seismologists, sociologists, economists, and other professionals who arrive in the affected area to investigate such things as ground failure, structural damage, social or financial impacts of devastation, or simply to lend a hand can become part of a larger, temporary organization (the Clearinghouse) to facilitate the gathering of information, maximize its availability, and better use the talents of those present.

In addition to California's efforts in emergency response at the state level, the National Earthquake Hazards Reduction Program (NEHRP) directs the U.S. Geological Survey (USGS), FEMA, and EERI to jointly develop a general procedure for establishing technical information clearinghouses within 24 hours following significant earthquakes in the United States. The NEHRP requires the procedure to be formulated in collaboration with state agencies that manage emergency response and with the state geological surveys. The degree of responsibility of these Federal entities for specific events depends on the level of involvement of an affected state in operating a clearinghouse. In cases where states have emergency response plans and the resources to operate a clearinghouse, as California does, the state commonly takes the lead in establishing and operating them, with the Federal agencies taking on the role as partners. In California, the USGS and EERI, are two of four managing organizations that oversee emergency response operations of the California Earthquake Clearinghouse. The two managing state agencies are Cal OES and CGS, the latter serving as the primary Clearinghouse coordinating agency. Other agencies, such as the Seismic Safety Commission (CSSC) are active participants.

The Clearinghouse's principal functions are to: 1) coordinate the field investigations of earth scientists, engineers, and other participating researchers; 2) facilitate the sharing of observations

through daily briefings and the Clearinghouse website; 3) notify disaster responders of any crucial observations or results; 4) Collect and verify ephemeral reconnaissance information; 5) Convey that information to the Intelligence function to the State Operations Center; 6) Serve as the "check-in" and "check-out" point for technical volunteers, researchers, and officials; 7) Provide updated pertinent information to all investigators, through daily briefings and reports; 8) Track where investigators are in the damaged area; 9) Coordinate what are otherwise random field assessments by assigning investigators to cover areas not yet sufficiently assessed. These functions are performed in accordance with procedures outlined in the Clearinghouse Operations Plan.

The Clearinghouse is not intended to act as a "gatekeeper," rather it is meant to channel researchers and observers away from overburdened local government officials and toward the specific damage areas. Arrangements for access into secured areas will be made by the clearinghouse through Cal OES Law Enforcement Branch, including the provision of letters of passage and contacts with local governments.

The Clearinghouse is expanding operations from solely a bricks-and-mortar operation to support a virtual institution as well. To accomplish this, the Clearinghouse is implementing the Unified Incident Command & Decision Support (UICDS) data sharing middleware developed through the U.S. Dept. of Homeland Security's Science and Technology Directorate (http://www.uicds.us/). "UICDS is information-sharing middleware for … incident management that continuously receives and shares standardized data among many agencies during an incident. Your everyday application gets from UICDS exactly the data you need to use, visualize, process, improve, decide, and then share back through UICDS to keep everyone informed." The Clearinghouse is implementing UICDS because UICDS compliance is a requirement for Web EOC, the Cal OES operations center software replacement for the Response Information Management System (RIMS). California established communications support procedures and systems to provide information links for elements of the California Emergency Organization; specifically between the Operational Area (OA), the Office of Emergency Services Regional Emergency Operations Center, the State Operations Center (SOC), and other state agencies; RIMS is a key element in that infrastructure.

During the 2013 Golden Guardian exercise, the Clearinghouse and its member organizations successfully employed UICDS to share information between Clearinghouse partner organizations and the SOC (see Figure 1). Nearly 500 incidents were generated and transported through UICDS, with 260 unique end-users of ten connected applications. More than 125 field observations were submitted with narrative, photos, videos, documents and even voice narration.

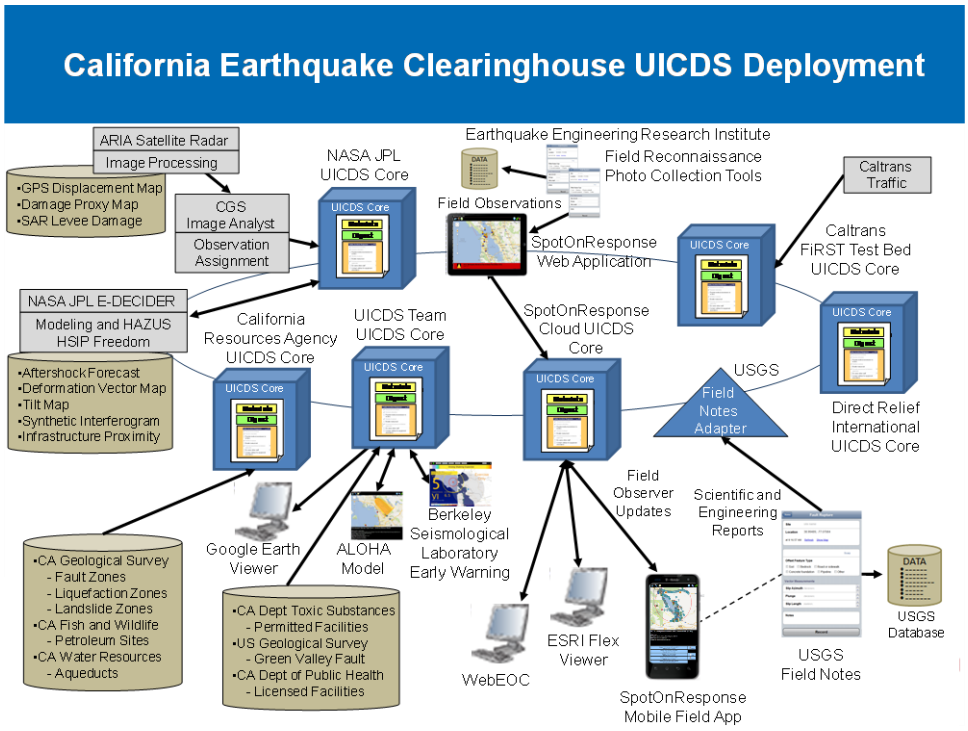

Figure 1. California Earthquake Clearinghouse UICDS deployment diagram showing the configuration of six UICDS cores and connected applications.

Full capability level for Clearinghouse activation procedures was not achieved because CGS and USGS Clearinghouse representatives were not allocated space in the SOC. CGS and USGS technical staff (one or more from each organization) need to work together to review reported incidents to filter out the insignificant and pass forward the significant to the SOC managers See Figure 2. There needs to be some human dynamics in play to gather, analyze, and interpret information - then physically disseminate it to the proper authorities. For example: a.) The May 15 aftershock at 11:09 a.m. was missed by most on the SOC floor, b.) Translating a shakemap and landslide susceptibility maps (not every geologist even knows they exist) could provide important information to Caltrans and the utilities related to landslide potential. However, this information would likely not find its way to the authorities without human effort at the SOC. Future exercises should be treated more like a real event in that CGS and USGS personnel should be deployed to the SOC when the exercise begins, not just when the geoscience/Clearinghouse activities begin.

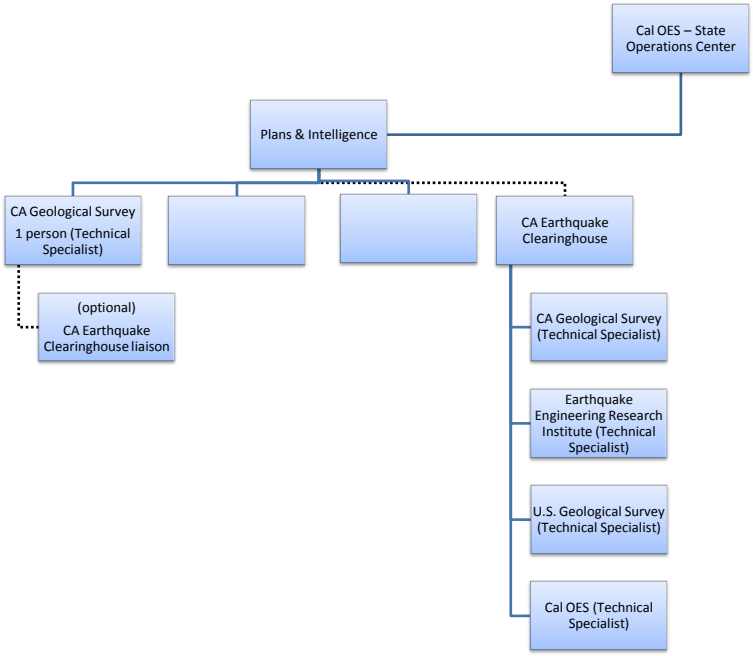

Figure 2. Suggested changes for Cal OES State Operations Center Organizational Chart

In addition, twice in previous preparedness exercises the Clearinghouse has demonstrated the capability of the UICDS technology to successfully deliver information automatically into Web EOC operations center application, however, Cal OES did not have a functional UICDS core set up for Web EOC. Cal OES should follow through on their requirement that all Web EOC components be fully UICDS compliant. In addition, Cal OES should provide detailed technical documentation describing Web EOC and UICDS compliance requirements and conduct regular tests of data interoperability with and between state, federal and private organizations, which will be performing the role of earthquake Technical Specialist.

Finally, The Clearinghouse and its partner organizations are in the process of implementing the UICDS technology. Although the technology is relatively easy to deploy, it takes time and effort to devise optimal level of precision in sharing agreements between UICDS cores. The Clearinghouse and its partner organizations should continue to develop and refine sharing agreements between partner UICDS cores, and conduct regular tests to determine whether or not a satisfactory level of data interoperability has been achieved.

PURPOSE OF FUNCTIONAL EXERCISE

During the Golden Guardian exercise, the Clearinghouse tested activation procedures and asked participating volunteers to log into the Clearinghouse website and use the SpotOnResponse (SOR) mobile application to collect simulated data representing surface fault rupture, earthquake-induced landslide and/or liquefaction ground failure, or engineering/structural data. Testing activation procedures and the simulated collection and uploading of data would help the Clearinghouse and its partner organizations develop and refine the concept of expanded operations made possible through the addition of the Virtual Clearinghouse and UICDS

middleware. The data collected using the SOR tool was uploaded to the newly-established Clearinghouse UICDS test core hosted by the California Natural Resources Agency and then shared out to Cal OES, the emergency response community and other trusted Clearinghouse partners interested in post-earthquake data and displayed on the SOR viewer embedded into the new Clearinghouse website.

Timeline

Preparation

The SOR developer hosted a total of 4 one-hour webex training sessions during the week prior to the exercise to introduce the application and how it is used to those not already familiar with it, as well as the latest features and functions of the tool. Clearinghouse volunteers who had not yet done so were asked to create a user profile in SOR prior to May 15, the day of the Clearinghouse functional exercise. In addition to logging in to the SOR tool, participants were also invited to observe the operation of the Virtual Clearinghouse though hosted web collaboration called *Earthquake TV,* which ran concurrent with the exercise. Participants were able to tune in to hear the information sharing action narrated live, ask questions, and hear featured discussions with many of the Clearinghouse partners about sharing information through UICDS and the applications they are using to develop, share, and analyze earthquake information.

Prelude

May 13-14

On May 13, 2013, at 9:00 a.m. PDT, the Clearinghouse conducted a calldown of the Clearinghouse managing organizations to test activation procedures. In addition, shortly after 09:00 on May 13, an email notification was sent to Clearinghouse volunteers registered on the Clearinghouse website that a virtual clearinghouse had been established for the exercise. Clearinghouse members were encouraged to log in to the Clearinghouse website periodically throughout May 13-14 to see simulated reports of damage appear on the new SOR viewer embedded into the Clearinghouse website and for instructions and updated situation reports. Then, on May 15, volunteers were instructed to log in to SOR to actively participate in the exercise, create incidents, test tools, etc.

Functional exercise for Clearinghouse volunteers

May 15, 10:00 – 13:00 PDT

The Clearinghouse functional exercise took place over a 3-hour period of time on May 15, between 10:00 a.m. and 1:00 p.m., PDT. Clearinghouse members were provided the opportunity to use data collection tools to share information through the Clearinghouse UICDS core with the various Clearinghouse partners:

California Geological Survey
California Natural Resources Agency
California Emergency Management Agency (subsequently changed to Cal OES as of July 1, 2013)
US Geological Survey
National Aeronautics and Space Administration Jet Propulsion Laboratory
Earthquake Engineering Research Institute

Berkeley Seismological Laboratory
Caltrans FiRST testbed
SpotOnResponse

At the end of the three-hour exercise participants were asked to fill out an online survey to provide feedback about the exercise and the tools provided.

Exercise Name	Golden Guardian Exercise, California Earthquake Clearinghouse (Clearinghouse)
Exercise Dates	May 13 through May 15, 2013
Scope	This exercise is a functional exercise and preparedness exercise planned for three days in the San Francisco Bay Area. Exercise play is limited to on-line participation for three hours, from 10:00 a.m. to 1:00 p.m., on May 15
Mission Area(s)	Mitigation, Response, and/or Recovery
Core Capabilities	1. Execute activation procedures in the course of catastrophic earthquake event. 2. Facilitate data collection and information sharing between Clearinghouse partner organizations, in both real and virtual environments. 3. Coordinate field data investigations of earth scientists, engineers, and other participating researchers. 4. Automatically deliver authoritative information from Technical Specialists about the effects of damaging earthquakes to the State Operations Center (SOC), through the Unified Incident Command and Decision Support middleware, directly into the Cal OES Web EOC operations center software application.
Objectives	The California Earthquake Clearinghouse is seeking to: 1. Test Clearinghouse post-earthquake activation procedures 2. Test the ability of the Clearinghouse to automatically deliver authoritative information from Technical Specialists about the effects of damaging earthquakes, through the Unified Incident Command and Decision Support (UICDS) middleware, directly into the Cal OES Web EOC operations center software application 3. Test the precision and functionality of sharing agreements between the Clearinghouse UICDS core, and, UICDS cores and connected applications of Clearinghouse partners. 4. Test the functionality of the newly upgraded Clearinghouse website to effectively communicate data collection coordination information to Clearinghouse partners.

	5. Test latest features added to the SpotOnResponse (SOR) tool for mobile field data collection activities
Threat or Hazard	Catastrophic M 7.9 earthquake in the San Francisco Bay Area
Scenario	The exercise began at 9:05 a.m. on Monday, May 13, 2013 with a magnitude 7.9 earthquake striking the San Andreas Fault with an epicenter located just outside the mouth of the San Francisco Bay approximately 6 miles outside of the Golden Gate Bridge and ruptures the San Andreas fault for approximately 300 miles from the San Juan Bautista area in the south to the Mendocino Triple Junction in the north. The earthquake generated severe ground shaking and damage in 19 central California counties, extending from Monterey to Humboldt, and into the San Joaquin Valley, with the greatest amount of damage affecting the urban areas of Oakland, San Francisco, San Jose, and Santa. Initial reports of the simulated earthquake went to the Cal EMA State Operations Center (SOC). Due to the catastrophic nature of the simulated earthquake, the President calls the Governor to assure the State that Federal assistance is activated and provides an Emergency Declaration. In addition, the Clearinghouse exercise included a M 6.5 aftershock on Wednesday, May 15, centered on the Green Valley Fault near the Napa-Solano county line.
Sponsor	N/A
Participating Organizations	See Appendix B
Point of Contact	Anne Rosinski (Senior Engineering Geologist, California Geological Survey) Chair, California Earthquake Clearinghouse, 345 Middlefield Road, MS-520, Menlo Park, CA 94025; 650-688-6373; anne.rosinski@conservation.ca.gov Marjorie Greene (Earthquake Engineering Research Institute) California Earthquake Clearinghouse Vice-Chair, 499 14th Street, STE 220, Oakland, CA 94612; 510-451-0905; mgreene@eeri.org

ANALYSIS OF CORE CAPABILITIES

Aligning exercise objectives and core capabilities provides a consistent taxonomy for evaluation that transcends individual exercises to support preparedness reporting and trend analysis. Table 1 includes the exercise objectives, aligned core capabilities, and performance ratings for each core capability as observed during the exercise and determined by the evaluation team.

Objective	Core Capability	Performed without Challenges (P)	Performed with Some Challenges (S)	Performed with Major Challenges (M)	Unable to be Performed (U)
Objective 1: Test post-earthquake activation procedures	1. Execute activation procedures in the course of catastrophic earthquake event.			X	
Objective 2: Test the ability of the Clearinghouse to automatically deliver authoritative information from Technical Specialists about the effects of damaging earthquakes through the Unified Incident Command and Decision Support (UICDS) middleware directly into the Cal OES Web EOC application	4. Automatically deliver authoritative information from Technical Specialists about the effects of damaging earthquakes to the State Operations Center (SOC), through the Unified Incident Command and Decision Support middleware, directly into the Cal OES Web EOC operations center software application. .			X	
Objective 3: Test the precision and functionality of	1. Facilitate data collection and information		X		

Objective	Core Capability	Performed without Challenges (P)	Performed with Some Challenges (S)	Performed with Major Challenges (M)	Unable to be Performed (U)
sharing agreements between the Clearinghouse UICDS core, and, UICDS cores and connected applications of Clearinghouse partners	sharing between Clearinghouse partner organizations, in both real and virtual environments 2. Coordinate field data investigations of earth scientists, engineers and other participating researchers 3. Automatically deliver authoritative information from Technical Specialists about the effects of damaging earthquakes to the State Operations Center (SOC) through the Unified Incident Command and Decision Support middleware directly into the Cal OES Web EOC application				
Objective 4: Test the functionality of the newly upgraded Clearinghouse website to effectively communicate data collection coordination information to	2. Facilitate data collection and information sharing between Clearinghouse partner organizations, in both real and virtual environments		X		

Objective	Core Capability	Performed without Challenges (P)	Performed with Some Challenges (S)	Performed with Major Challenges (M)	Unable to be Performed (U)
Clearinghouse partners					
Objective 5: Test latest features added to the SOR tool for mobile field data collection activities	2. Facilitate data collection and information sharing between Clearinghouse partner organizations, in both real and virtual environments 3. Coordinate field data investigations of earth scientists, engineers and other participating researchers		X		

Ratings Definitions:

- Performed without Challenges (P): The targets and critical tasks associated with the core capability were completed in a manner that achieved the objective(s) and did not negatively impact the performance of other activities. Performance of this activity did not contribute to additional health and/or safety risks for the public or for emergency workers, and it was conducted in accordance with applicable plans, policies, procedures, regulations, and laws.
- Performed with Some Challenges (S): The targets and critical tasks associated with the core capability were completed in a manner that achieved the objective(s) and did not negatively impact the performance of other activities. Performance of this activity did not contribute to additional health and/or safety risks for the public or for emergency workers, and it was conducted in accordance with applicable plans, policies, procedures, regulations, and laws. However, opportunities to enhance effectiveness and/or efficiency were identified.
- Performed with Major Challenges (M): The targets and critical tasks associated with the core capability were completed in a manner that achieved the objective(s), but some or all of the following were observed: demonstrated performance had a negative impact on the performance of other activities; contributed to additional health and/or safety risks for the public or for emergency workers; and/or was not conducted in accordance with applicable plans, policies, procedures, regulations, and laws.
- Unable to be Performed (U): The targets and critical tasks associated with the core capability were not performed in a manner that achieved the objective(s).

Table 1. Summary of Core Capability Performance

The following sections provide an overview of the performance related to each exercise objective and associated core capability, highlighting strengths and areas for improvement.

Objective 1

Test Clearinghouse post-earthquake activation procedures

Core Capability 1

Execute activation procedures in the course of catastrophic earthquake event.

Strengths

The partial capability level can be attributed to the following strengths:

Strength 1: Soon after arriving at the SOC, the CGS Clearinghouse representative was approached by a Cal OES Operations staffer who explained that there was a general lack of understanding of what to expect from earthquakes in terms of damage, what liquefaction was, and how long an actual earthquake event lasts. She requested someone from CGS give a presentation/training session on earthquakes and earthquake damage at some point in the future. This is an opportunity that should be promoted to Cal OES management.

Strength 2: Dale Cox serves as the Chair of the Department of Interior (DOI), Regional Emergency Response Coordination Council (I-RECC). This group maintains communication between DOI agencies before and during emergencies. Through this group, Cox was able to get U.S. Bureau of Reclamation (BOR) interested in the Golden Guardian and Earthquake Clearinghouse. Andre Leamons of BOR is motivated, seeing the Clearinghouse as absolutely essential to their emergency response operations. Both Cox and Leamons will likely discuss participation in future Clearinghouse activities, including the upcoming ShakeOut exercise in October 2013 at the next I-RECC meeting. In particular, Cox and Leamons are recommending all our DOI agencies in Region IX to participate in the Clearinghouse.

Areas for Improvement

The following areas require improvement to achieve the full capability level:

Area for Improvement 1: Because CGS, USGS and Clearinghouse activities only really commenced on the third day of full exercise, by the time CGS and USGS representatives arrived all seats on the SOC floor were already occupied. This significantly limited their ability to participate in the exercise and opportunities to report several injects to the SOC managers were missed. In future exercises that involve delayed participation, CGS and the USGS should respond as if it were a real event and send representatives immediately to the SOC, and be prepared to provide geoscience information about the event to SOC managers. This would allow those managers to recognize that they have that expertise in-house from the beginning, and when field team reports start arriving the managers have the established channels to accept that information and the context in which to interpret its significance.

Area for Improvement 2: CGS needs to have at least 2, but more likely 4, Sacramento Office staff trained and familiar with SOC procedures. During a major earthquake event, the SOC will be running for several days to weeks, and staff will need relief. Many of CGS staff took FEMA

and OES training classes in 2006 but several new employees have not had that training. It is time for CGS staff to take the training again or for the first time.

Area for Improvement 3: There should be a small table or place set aside at the SOC for scientists to collaborate and translate data and information from the Clearinghouse. However, this room for science should not be the Break Room. Time spent on informal communication should have been used coalescing information from the Clearinghouse and elsewhere and communicating it to FEMA and others. Hence, the USGS will need to shadow the appropriate FEMA operations person, while having eyes (and ears – Cal OES facilitation valuable and necessary) on the Clearinghouse, being on the phone with USGS staff and management, and in communication with the other scientists at the SOC. This will not be an easy task to accomplish. FEMA suggested that the USGS should have two people at the SOC (in two shifts if it were a real event).

Area for Improvement 4: CGS should offer to provide training to Cal OES staff (and management) on earthquakes and other geologic hazards; damage/conditions to be expected and where; CGS field response efforts; and the relationship of CGS to the Clearinghouse and the SOC.

Area for Improvement 5: The Clearinghouse should update call down and activation procedures. The Clearinghouse should develop a list of state agencies and other organizations that could serve as one of the locations for bricks and mortar locations for the Clearinghouse. Locations of universities and private organizations should be developed on a regional basis for the various earthquake scenarios.

Analysis: Full capability level for Clearinghouse activation procedures was not achieved because CGS and USGS Clearinghouse representatives were not allocated space in the SOC. CGS and USGS technical staff (one or more from each organization) need to work together to review reported incidents to filter out the insignificant and pass forward the significant to the SOC managers. There needs to be some human dynamics in play to gather, analyze, and interpret information - then physically disseminate it to the proper authorities. For example, a.) the May 15 aftershock at 11:09 a.m. was missed by most on the SOC floor, b.) translating a shakemap and landslide susceptibility maps (not every geologist even knows they exist) could provide important information to Caltrans and the utilities related to landslide potential. However, this information would likely not find its way to the authorities without human effort at the SOC. Future exercises should be treated more like a real event in that CGS and USGS personnel should be deployed to the SOC when the exercise begins, not just when the geoscience/Clearinghouse activities begin.

Objective 2

Test the ability of the Clearinghouse to automatically deliver authoritative information from Technical Specialists about the effects of damaging earthquakes through the Unified Incident Command and Decision Support (UICDS) middleware directly into the Cal OES Web EOC application

Core Capability 1

Automatically deliver authoritative information from Technical Specialists about the effects of damaging earthquakes to the State Operations Center (SOC) through the Unified Incident Command and Decision Support middleware directly into the Cal OES Web EOC application

Strengths

The partial capability level can be attributed to the following strengths:

Strength 1: The close and long-standing working relationship between the Clearinghouse and Cal OES, one of the founding partners of the Clearinghouse, has helped guide Clearinghouse efforts to implement the UICDS technology to enable data sharing and establish data interoperability.

Strength 2: The Clearinghouse has successfully demonstrated the ability of the UICDS middleware technology to perform data sharing operations between state, federal and private organizations in two previous preparedness exercises.

Strength 3: Cal OES provided screenshots of draft Web EOC boards.

Areas for Improvement

The following areas require improvement to achieve the full capability level:

Area for Improvement 1: The Clearinghouse and Cal OES need to work together more effectively to establish working UIDCS sharing agreements so that information from Clearinghouse Technical Specialists will be automatically fed directly into the Cal OES Web EOC operations center software application.

Analysis: Twice in previous preparedness exercises the Clearinghouse has demonstrated the capability of the UICDS technology to successfully deliver information automatically into Web EOC operations center application, however, Cal OES did not have a functional UICDS core set up for Web EOC. Cal OES should follow through on their requirement that all Web EOC components be fully UICDS compliant. In addition, Cal OES should provide detailed technical documentation describing Web EOC and UICDS compliance requirements and conduct regular tests of data interoperability with and between state, federal and private organizations, that will be performing the role of earthquake Technical Specialist.

Objective 3

Test the precision and functionality of sharing agreements between the Clearinghouse UICDS core and UICDS cores and connected applications of Clearinghouse partners.

Core Capabilities 2, 3 & 4

2. Facilitate data collection and information sharing between Clearinghouse partner organizations, in both real and virtual environments.
3. Coordinate field data investigations of earth scientists, engineers and other participating researchers.

4. Automatically deliver authoritative information from Technical Specialists about the effects of damaging earthquakes to the State Operations Center (SOC) through the Unified Incident Command and Decision Support middleware directly into the Cal OES Web EOC application.

Strengths

The partial capability level can be attributed to the following strengths:

Strength 1: The California Earthquake Clearinghouse use of UICDS to create a Virtual Clearinghouse resulted in:

- California Resources Agency hosting a UICDS Core and coordinating sharing of information from the California Geological Survey, California Department of Fish and Wildlife, and California Department of Water Resources
- Earthquake Engineering Research Institute connecting its field reconnaissance photo collection
- U.S. Geological Survey being the source of field observations, fault data, and earthquake sensor information
- University of California, Berkeley Seismological Laboratory providing a simulated Earthquake Early Warning transmitted through UICDS
- NASA Jet Propulsion Laboratory ARIA satellite program providing space-based radar imagery and a UICDS Core
- NASA Jet Propulsion Laboratory E-DECIDER program providing multiple modeling results and Homeland Security Infrastructure Protection data
- Direct Relief International using its UICDS Core to share updates on donated medical and pharmaceuticals to clinics
- California Department of Toxic Substances providing information on hazardous facilities
- California Department of Public Health providing baseline information on licensed healthcare facilities
- California Department of Transportation FiRST Test Bed UICDS Core providing simulated traffic sensors
- Connected applications including WebEOC, SpotOnResponse (including Cloud-hosted UICDS Core), ESRI Flex Viewer, Google Earth, and the ALOHA chemical plume model.

UICDS enabled significant information sharing during the three days of the Golden Guardian exercise, but especially during the half-day, full operations, Clearinghouse exercise. The volume of data through UICDS during Golden Guardian accomplished nearly 500 incidents created and transported through UICDS with 260 unique end-users of ten connected applications.

More than 125 field observations were submitted with narrative, photos, videos, documents, and even voice narration. Figures 3 through 9 provide examples of these observations

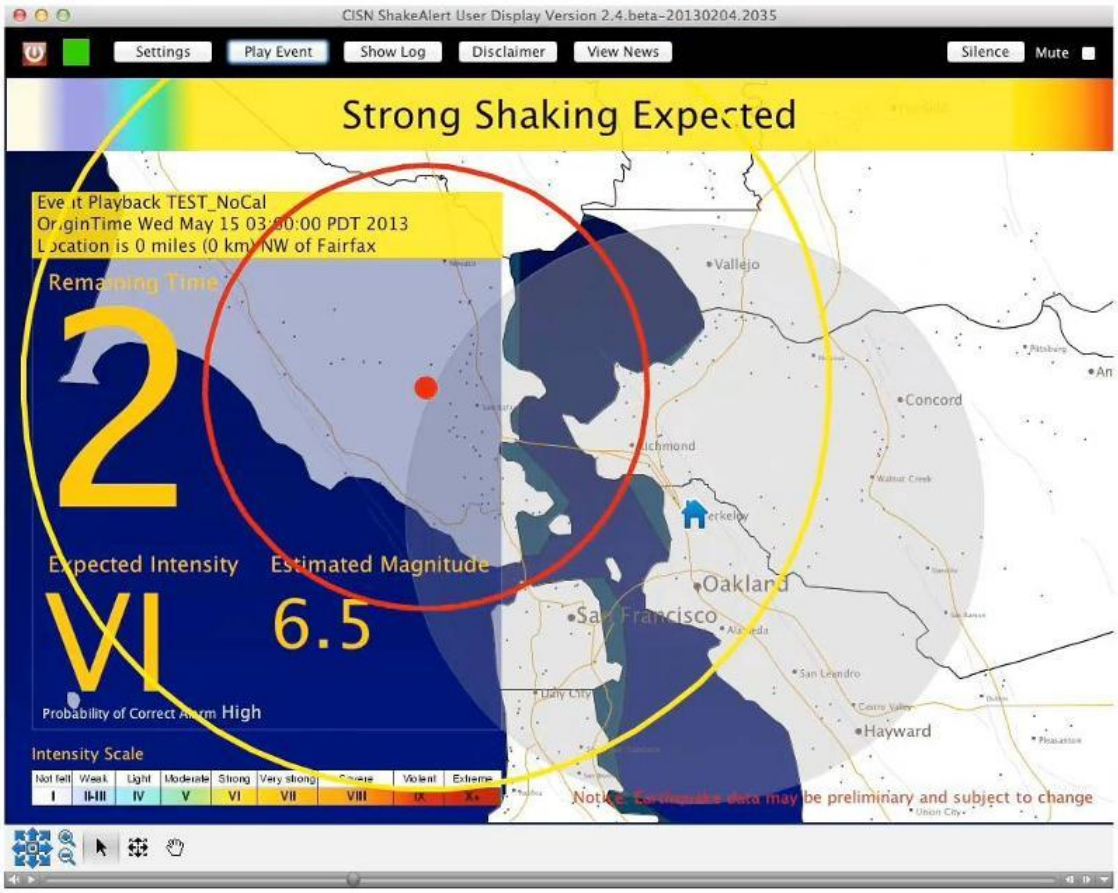

Figure 3. University of California, Berkeley Seismological Laboratory providing a simulated Earthquake Early Warning transmitted through UICDS

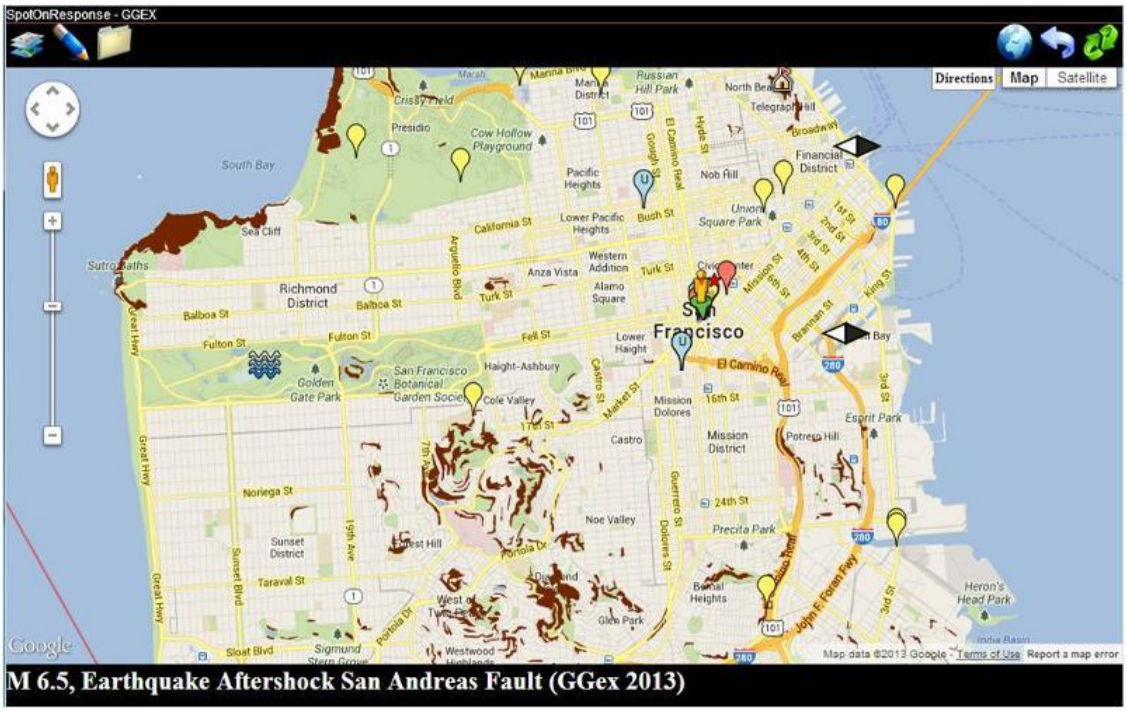

Figure 4. California Resources Agency hosting a UICDS Core and coordinating sharing of information from the California Geological Survey, California Fish and Wildlife, and California Water Resources, here showing the results of hazard analysis of earthquake risk as it is displayed in the SOR mobile application

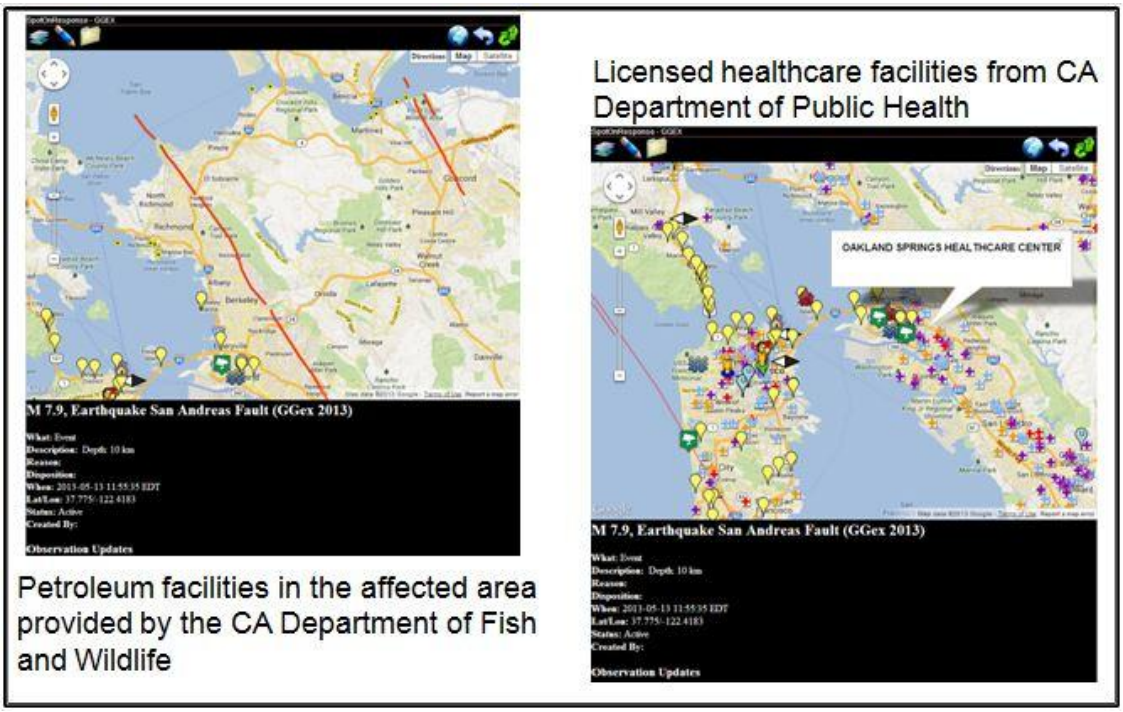

Figure 5. Many agencies were able to share their static GIS information about facilities through UICDS which associated specific GIS information to incidents in the impacted area, including

the California Department of Public Health providing baseline information on licensed healthcare facilities, and the California Department of Fish and Wildlife providing information on petroleum facilities

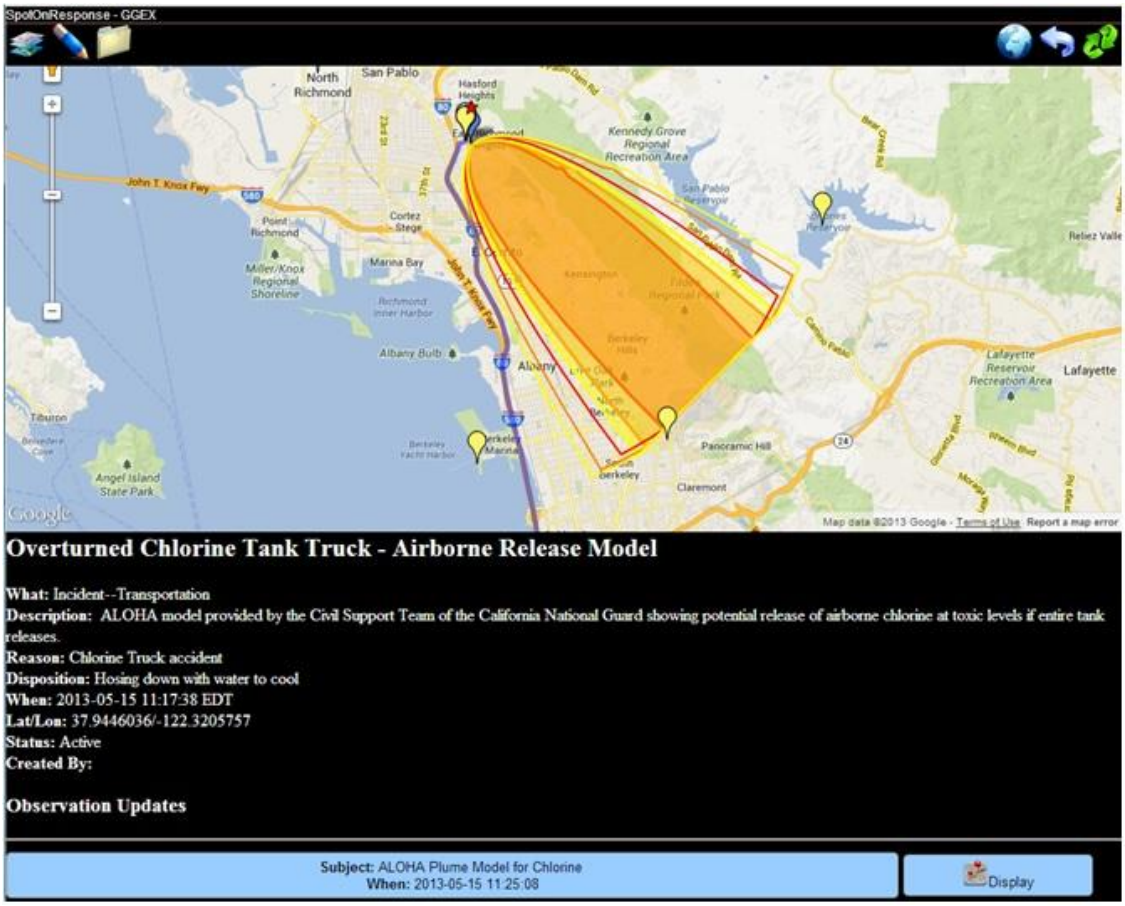

Figure 6. Showing the interaction between the California Department of Toxic Substances information on location and risk at hazardous facilities, an ALOHA chemical plume was simulated as a result of a potential release from transportation related to one of those toxic substance facilities and shared through UICDS to connected applications including WebEOC, SpotOnResponse, ESRI Flex Viewer, and Google Earth

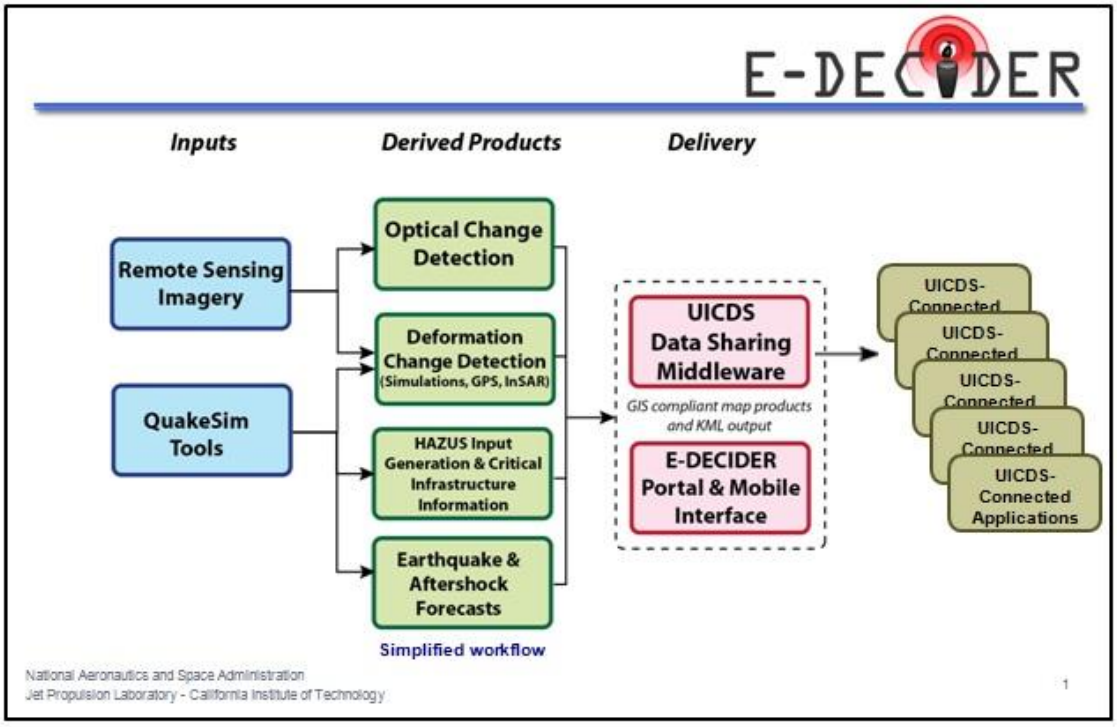

Figure 7. NASA Jet Propulsion Laboratory's E-DECIDER program delivers numerous models and analytic results through UICDS to support responders and managers in response and recovery

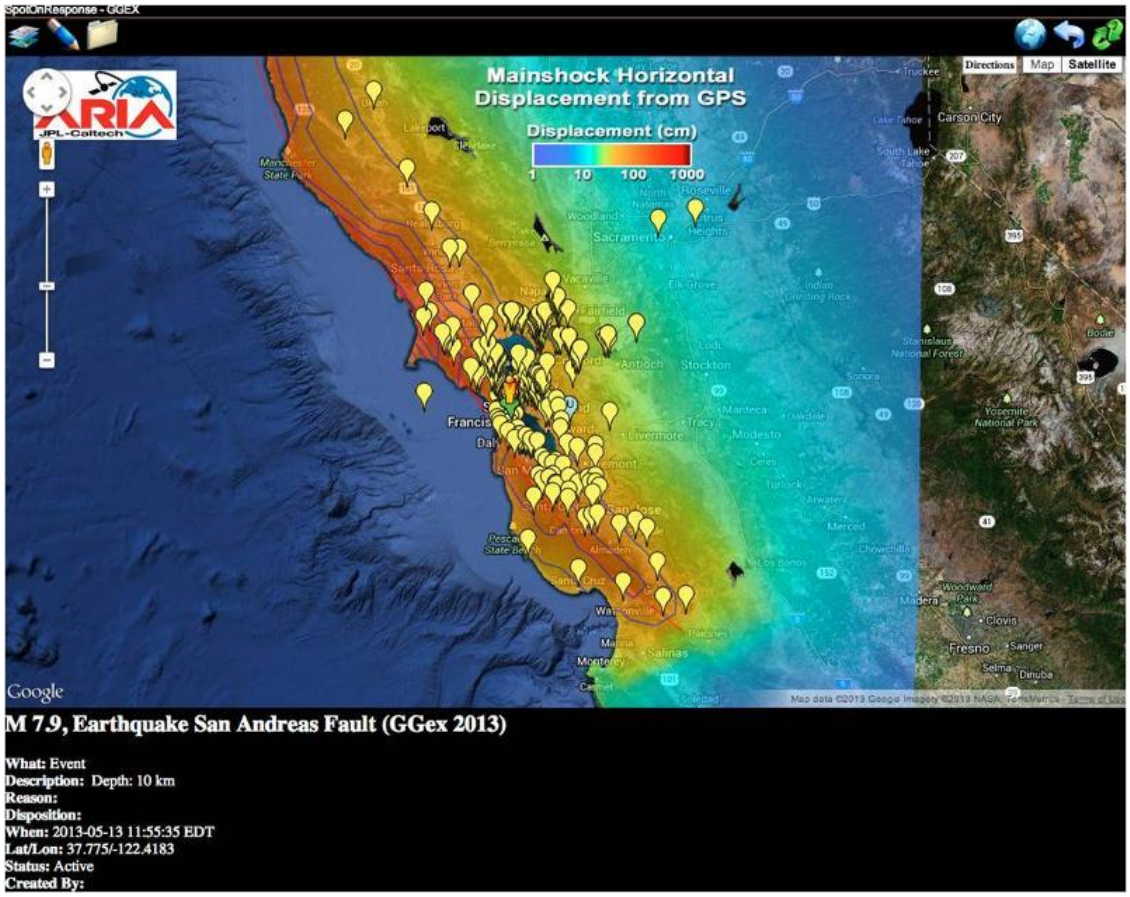

Figure 8. NASA Jet Propulsion Laboratory ARIA program provides space-based radar imagery and Unmanned Aerial Vehicle-based imagery through their own UICDS Core, sharing core-to-core to other California agencies results as shown above indicating centimeters of ground displacement following the earthquake

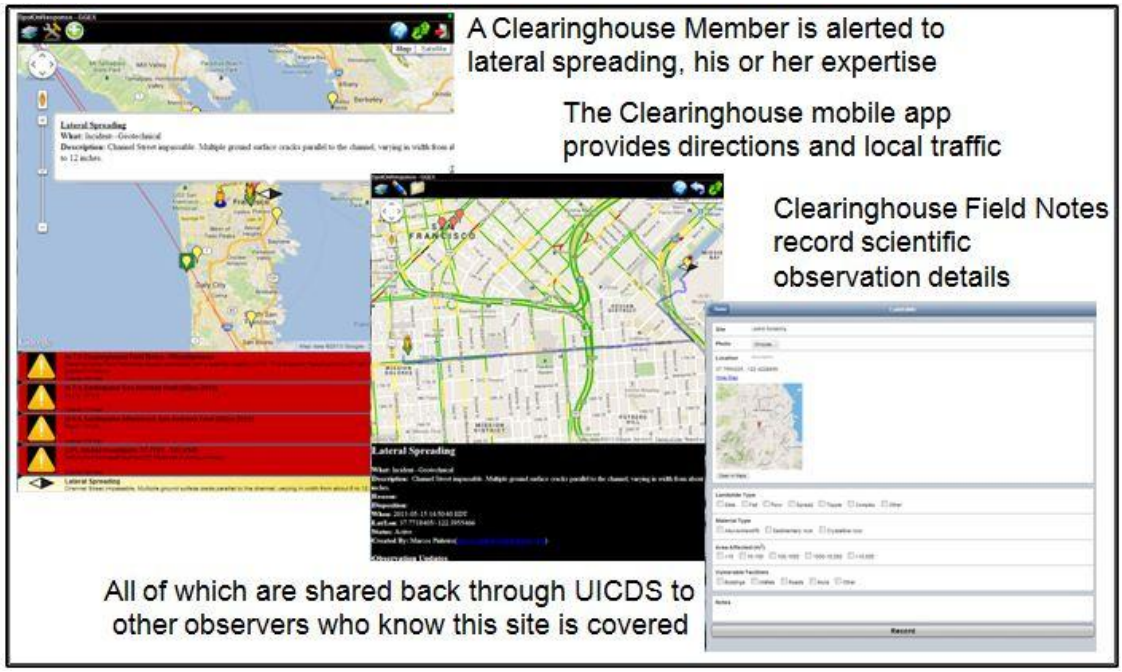

Figure 9. The key to the Virtual Clearinghouse operations and improved efficiency in applying scientific and engineering resources is to be able to drive information into the hands of observers through UICDS. Here, the SpotOnResponse mobile app used by Clearinghouse Members integrates with the Clearinghouse Field Notes mobile app created by the U.S. Geological Survey to provide event information and location, an indication of what events are nearest to a scientist or engineer, travel directions to the event, and the scientific recording details, all of which are shared through UICDS.

Strength 2: California Natural Resources Agency Golden Guardian Implementation showed how the UICDS system can be used to create, share, and manage information during an emergency event. During an earthquake, various agencies will respond to the event and provide additional information about its effects. Various visualization tools were used to show the real time monitoring of the earthquake event.

Event	Service	Description
Initial Earthquake	uicds@uicds.spotonresponse.com	This event is the original incident that describes the earthquake event
Earthquake Aftershock	uicds@uicds.spotonresponse.com	This follow-on event comes several days after the initial incident.
JPL shake model	uicds@JPL	JPL gets notice of the incident and responds with a KML that shows a model of predicted activity based on the original incident.

Seismic Zones Map Service	uicds@CRA	The CNRA core reads the Incident, and responds with a map service that centers on the event, and shows to about 30 mi radius, the seismic zone hazards
Seismic Reports	Deferred	The CNRA core may optionally include a point layer of seismic reports for schools and hospitals.

Initial Earthquake Event
The initial earthquake incident was generated by SpotOnResponse. The other incidents (landslide, tanker truck) were also be generated by SpotOnResponse. For testing purposes, the resources agency, UICDS.resources.ca.gov, core launched CAP incidents. CAP incidents allow test incidents to be clearly identified.

Processing Overview
Figure 10 shows the overview of the message passing involved in the CERES UICDS wrapper. This wrapper is known on the OpenFire server as *sumbot*. Before the event a new ResourceInstanceService is created, and an XMPP endpoint is associated with that ResourceInstanceService. Then, when new incidents are created, the UICDS core sent a Notification record to that XMPP endpoint. On reception of the Notification, *sumbot* created a GetIncident SOAP request back to the UICDS core. The client then parsed that incident request, and prepared a URL based on the type of incident, and the location. This was sent back to the core as a linked resource to the incident.

The client also added some summary information on the XMPP chat connection. There is some additional utility that is added to the openfire server on the resources agency core. When any user joins the OpenFire chat, they are automatically joined with the CERES UICDS client (sumbot). This allowed users to be notified of new incidents as they became available. Currently, the best client to use is OpenFire's Spark chat tool. This is because real certifications are not yet available in the OpenFire XMPP connection, and other clients to not like to connect to uncertified XMPP servers, understandably.

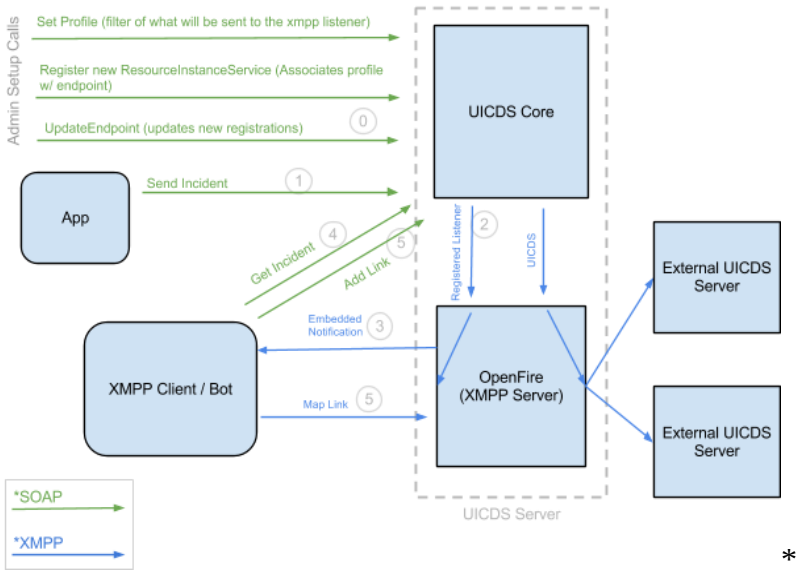

Figure 10: Overview of the UICDS processing workflow.

Figure 11 shows the CERES Maps client as utilized by the sumbot client. The sumbot adds layers as appropriate. The initial version does not use a categorization of the incident to determine the layers to include, but instead uses earthquake layers as a default set of incidents.

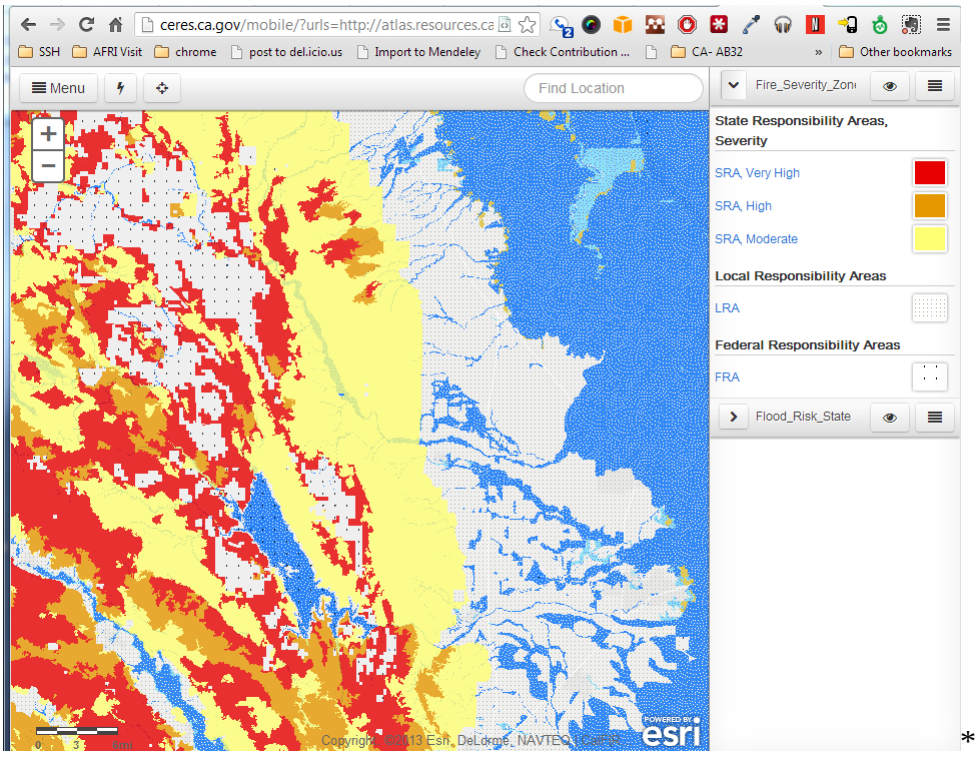

Figure 11: Example Mapping product from the UICDS wrapper.

http://ceres.ca.gov/mobile/?urls=http://atlas.resources.ca.gov/arcgis/rest/services/GeoScience/Fire_Severity_Zone/MapServer;http://atlas.resources.ca.gov/arcgis/rest/services/GeoScience/Flood_Risk_State/MapServer&center=38.58,-121.48,10

Strength 3: The NASA Jet Propulsion Laboratory provided satellite based deformation products, deformation modeling products, and aftershock forecasts for earthquake response and delivered these to the Clearinghouse in partnership through a sharing agreement between UICDS cores. Two projects in particular have teamed with the Clearinghouse in these response exercises, E-DECIDER, a collaboration between JPL, Indiana University, UC Davis, and the USGS funded by the NASA Applied Sciences Program that provides earthquake disaster decision support, and ARIA, a JPL/Caltech collaboration funded by several NASA programs that provides an end-to-end data system to deliver rapidly processed geodetic data and actionable data products in the event of an earthquake and other natural disasters.

The goal of E-DECIDER (Earthquake Data Enhanced Cyber-Infrastructure for Disaster Evaluation and Response) is integrating Earth science data and information for disaster forecasting, mitigation and response, specifically for earthquakes and post-disaster response and recovery. It will also contribute to providing hazard and disaster information when and where it is needed and recognizing vulnerability of interdependent critical infrastructure. E-DECIDER provides decision support for earthquake disaster management and response utilizing remote sensing data in conjunction with NASA modeling software and delivers products through a web-based infrastructure designed for ease-of-use by decision makers.
JPL's plan for the Golden Guardian was to provide geodetic deformation products and deformation modeling and aftershock forecast products and critical infrastructure information through our UICDS core to the Clearinghouse through core sharing agreements and SpotOn Response.

E-DECIDER provided deformation modeling results, aftershock forecasts, and FEMA critical infrastructure database information (See Figure 12 for examples). Specifically, the E-DECIDER team produced slope change (tilt) maps that showed the areas of greatest vertical change and direction, deformation magnitude maps that showed areas of greatest deformation, deformation vector maps, and synthetic interferograms from simulations based on the fault models of the earthquakes from the exercise scenario. These maps could be overlaid with critical infrastructure information from the FEMA HAZUS database provided through the E-DECIDER project to identify potentially exposed areas of damage. Additionally, aftershock forecast maps based on the ETAS model were provided to show where potential areas might be exposed to additional aftershock events. These were simulated based on the mainshock and aftershock events and produced on a 12-hour basis (with an additional forecast produced one hour after each event).

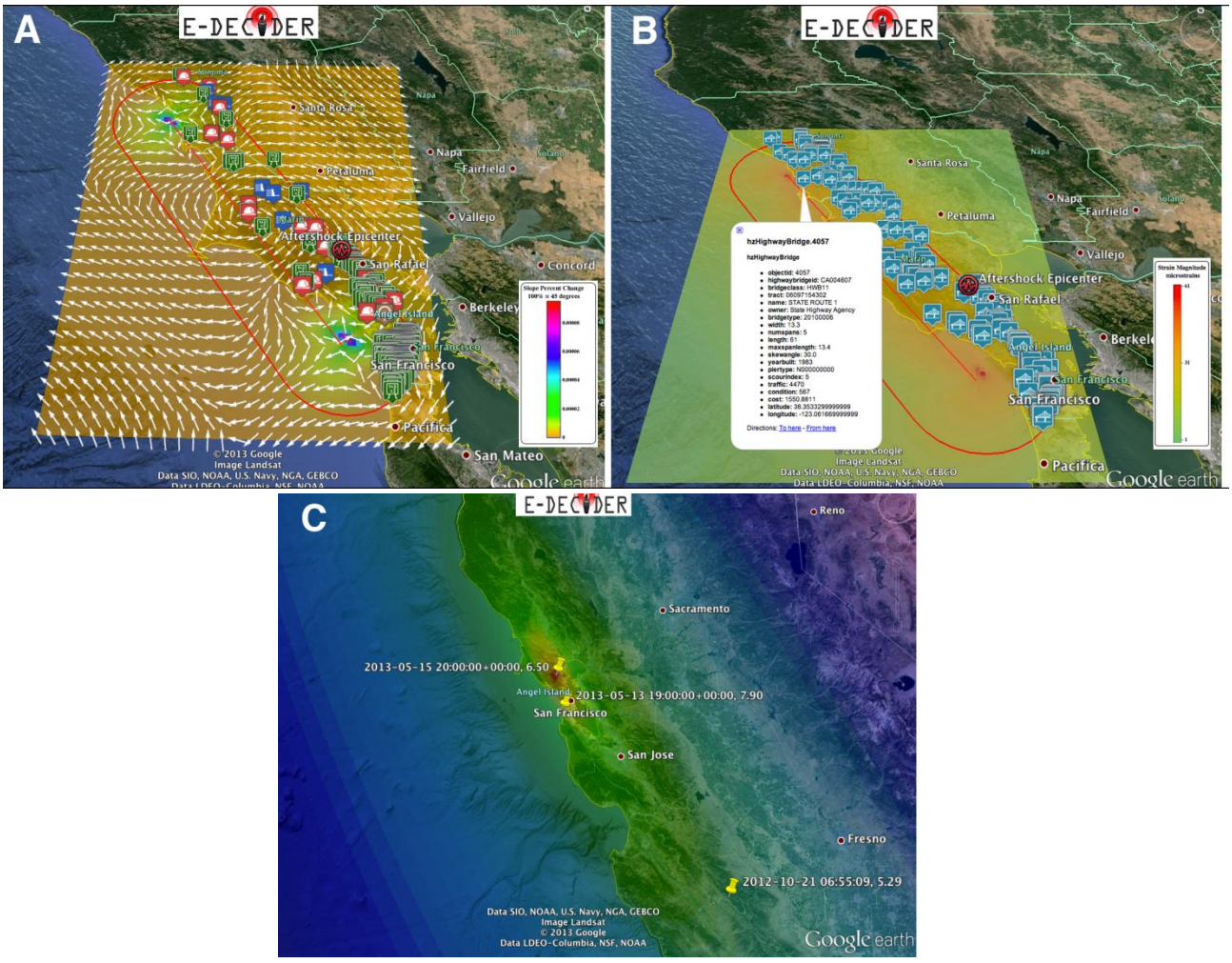

Figure 12. E-DECIDER provided products for the scenario aftershock including: (A) slope change map with magnitude of vertical change and direction produced from deformation simulation and refined with ARIA GPS data (latency: minutes for initial simulation, hours for refined model); (B) strain magnitude map with magnitude of total deformation from deformation simulation and refined with ARIA GPS data (latency: minutest for initial simulation, hours for refined model); Both of these maps show FEMA HAZUS infrastructure information overlaid with the area of interest defined by a line (the fault) and a 10 mile radius, sites such as fire stations and schools (left) and highway bridges (right) can be identified within the radius of interest and investigated in case of potential exposure to damage as a result of the earthquake; (C) Aftershock forecast map produced one hour after the scenario aftershock event showing area of higher likelihoods for aftershocks in warm colors and lower risk areas in cooler colors. Forecasts were generated in 12 hour intervals starting just prior to the mainshock event and for two days following.

ARIA provided information based on GPS and satellite data that would be available following an earthquake in the Bay Area. The ARIA team provided maps showing displacement and shear strain from GPS - these identify extent of the fault rupture and the region most affected by the earthquake. They also provide information on surface changes for agencies with infrastructure in the region. In addition, ARIA team provided satellite-based information on deformation and damage assessment. These products have greater spatial details than the GPS data, and clearly identify the section of the fault that ruptured. The damage assessment maps are sensitive to

building damage, landslides, and liquefaction caused by earthquakes and can be overlain with critical infrastructure, landslide susceptibility and other layers to identify locations that have been damaged by an earthquake (See Figure 13).

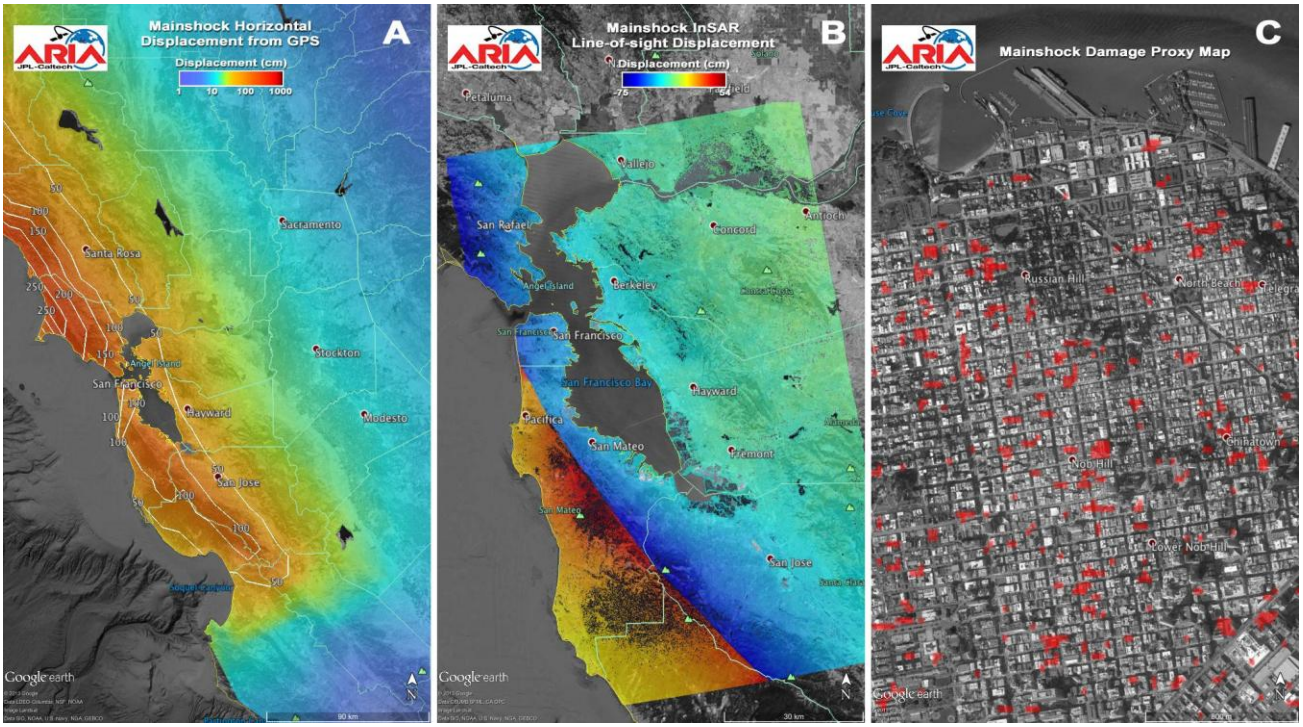

Figure 13. ARIA products for the main shock (A) Horizontal displacement map derived from continuous GPS network (latency: hours), (B) Satellite radar line-of-sight range change that reveals surface rupture of the earthquake (latency: days), (C) Building damage - red pixels - detection map derived from satellite radar data (latency: days)

The following is a list of data products that the ARIA team to provided for the exercise:
For Mainshock Events (2 days prior to functional exercise):

1) Damage Proxy Map of San Francisco Bay Area (focus on major cities: SF, Berkeley/Oakland, San Jose) - synoptic maps of building damage, liquefaction, landslides and other earthquake-induced damage that causes ground surface to change

The following products based on repeat of 1906 rupture of San Andreas Fault (based on Thatcher et al, 1997 JGR):
2) Strain Incidents List & Map - identifies regions that have experience large strains, likely to have fault rupture disrupting roads, bridges, lifelines, quantifies strain.
3) GPS Displacement Map - observed permanent earthquake displacements (horizontal and vertical maps)
4) Tilt Incident List & Map - identifies regions where permanent earthquake displacements have caused significant change in vertical datum, provide observation of tilt change.

For Aftershock event (see above for detailed description):

1) Damage Proxy Map of San Francisco/Marin (focus on major cities: San Francisco, Santa Rosa?)
2) SAR-based map of levee damage & displacement
3) Strain Incidents List & Map
4) GPS Displacement Map
5) Tilt Incident List & Map
6) Fault Model - Estimate of fault rupture based on GPS data, seismic data.

For future Clearinghouse exercises, the ARIA team plans to put Mainshock products into UICDS ahead of Clearinghouse exercise, and make the aftershock data sets all available within 10 minutes of the event.

Strength 4: Because the UICDS middleware uses an open source format data feeds instead of proprietary data formats, the staff in the Cal EPA EOC found the UICDS application easy to use even though the incidents were not the same ones they were using in their exercise and Cal EPA did not conduct a field exercise.

Areas for Improvement

The following areas require improvement to achieve the full capability level:

Area for Improvement 1: The list in Figure 14 constitutes a list of suggested actions to transition the CNRA-hosted Clearinghouse UICDS core to fully-operational status.

TASKS FOR GOING OPERATIONAL WITH CLEARINGHOUSE UICDS IMPLEMENTATION		
#	Responsible Organization	Task
1	Resources Agency	UICDS Core at operational memory specs
2	SpotOnResponse	Establish new operational project linked to RA Core
3	SpotOnResponse	Move all/selected (?) un/pw to operational SOR project
4	SpotOnResponse	Provide SOR test project linked to NASA Core
5	UICDS Team	Best practices document for Human Sensors
6	NASA JPL	Revise SOI Adapter to meet best practices
7	Resources Agency	Revise SOI Adapter to meet best practices
8	USGS	Test JSON feed of Field Notes
9	USGS	Assume responsibility for Field Notes Adapter operation
10	UICDS Team	Coordinate Field Notes Adapter transfer
11	EERI/SpotOnResponse	Test EERI photo display capabilities
12	EERI	Evaluate development of SOI adapter for photos
13	UICDS Team	Develop weekly system test plan
14	ALL	Weekly system during Tuesday call
15	Resources Agency	Flow for collecting & uploading arial recon video data
16	CGS	Develop workflows for staff/UICDS interaction in real emergency response
17	CGS/Resources Agency	Develop plan for developing data sharing agreements

Figure 14. List of suggested tasks to accomplish to transition the CNRA-hosted UICDS core to fully-operational status.

Area for Improvement 2: It was not entirely clear that the UICDS middleware transferred the CAP requests with enough information to unambiguously relate these tests to additional cores.

Area for Improvement 3: In concert with the development of new datasets and tools, the Clearinghouse should continue to work on understanding the strengths and limitations of the protocols involved. The Clearinghouse should continue to investigate the development of more tools, specifically UICDS bots. This accomplishes two goals, it helps build knowledge of the system, and it also establishes a base to begin to streamline human interaction and decision making into the system.

Area for Improvement 4: The Clearinghouse should start to develop Standard Operating Procedures (SOPs) that are expressed with UICDS in mind. Basically, this means should refine workflows that describe what type of messages will be created for particular scenarios, what those messages should look like exactly, and how they should be responded to, (probably with formulating new messages). This includes more attention to the fields within the messages, what sort of standard vocabulary will be used, and how these can be categorized and managed.

Area for Improvement 5: The Clearinghouse may need to either request updates on UICDS, or add a restful layer to expose more search and filter functionality. This information should be provided to our end users as well, either with the tool or with the roles they are taking in the core. It is of particular concern that this isn't more tightly integrated into any of the clients the Clearinghouse has seen so far. For example, with a UICDS mobile client, it should be possible to log into a system, that system should know the operator fills a small number of roles, and then the operator should have a set of messages tailored for that role. If the operator's only role for example is to respond to earthquake generated structural damage, then there should be a stream that only shows the operator that information.

Area for Improvement 6: The Clearinghouse should need to think about its users and defining better roles for them in the Clearinghouse UIDCS core. This is a key component of the UICDS idea and the Clearinghouse should make it an important part of its framework.

Area for Improvement 7: The Clearinghouse should continue to coordinate with Cal OES more, and see that the Clearinghouse partners are on the same page with best practices. There are few benefits to be achieved from the California Natural Resources Agency adopting UICDS for example, if Cal OES does not follow through on their requirement that all components of Web EOC, the RIMS replacement, are UICDS compliant.

Area for Improvement 8: The Clearinghouse should continue to investigate and understand the level of buy-in for UICDS is on a wider level.

Area for Improvement 9: A brief crash of one of the NASA cores early on in exercise led to some disruption in ability to communicate with Clearinghouse core. It was not clear if this was an internal issue or instability with UICDS. After extensive test data was entered, in an effort to clean the UICDS Core manually rather than allowing its automatic data deletion process to take place, the Tomcat database became corrupted. The UICDS technical support staff talked the end-user through restoration of the Tomcat database and UICDS returned to operation. The UICDS team had never seen this before but has a task to try to replicate the problem to avoid it in the future either programmatically or through operator instructions.

Area for Improvement 10: Issues with the posting of events to SOR related to formatting issues, resolved by end of exercise but would have been nice to have been made clear prior to exercise; this was cleared up with Resources Agency the day before but may not have been communicated to JPL.

Area for Improvement 11: There should be some clarification on why the Clearinghouse exercise is separate from the larger state exercise and how the Clearinghouse information fits into the state drill (the Cal OES workflow). How does an incident such as "60 houses on fire" in the Clearinghouse exercise get handled by an incident commander? What or who has the "incident commander" type role to synthesize the information and act accordingly? How do incidents that are reported fit into emergency operations so that volunteers are not investigating potentially dangerous situations (think unstable landslide + thunderstorm, etc.). How does this fit into the emergency operations command structure?

Area for Improvement 12: It should be possible to list new or updated incidents by time posted rather than distance, but this feature either doesn't exist or is not intuitive to find. Whoever ("incident commander" etc) synthesizes this information would certainly have reason for that feature.

Area for Improvement 13: The feed of GeoRSS data should be documented to be more user friendly in a similar way to the Homeland-Defense Operations Planning System. https://www.llnl.gov/news/newsreleases/2012/Oct/NR-12-10-12.html Figure 15 shows metadata, legends and links to data feeds in many formats and note that the data has restrictions on sharing data and terms of use. When the user clicks on Rest or WMS, the data can be connected to ArcGIS or GoogleEarth easily with standard legends and the metadata are easily readable. DTSC is working towards having a similar data feed connected to the California Geoportal. Currently DTSC resort to email, FTP and the sneakernet to share GIS data.

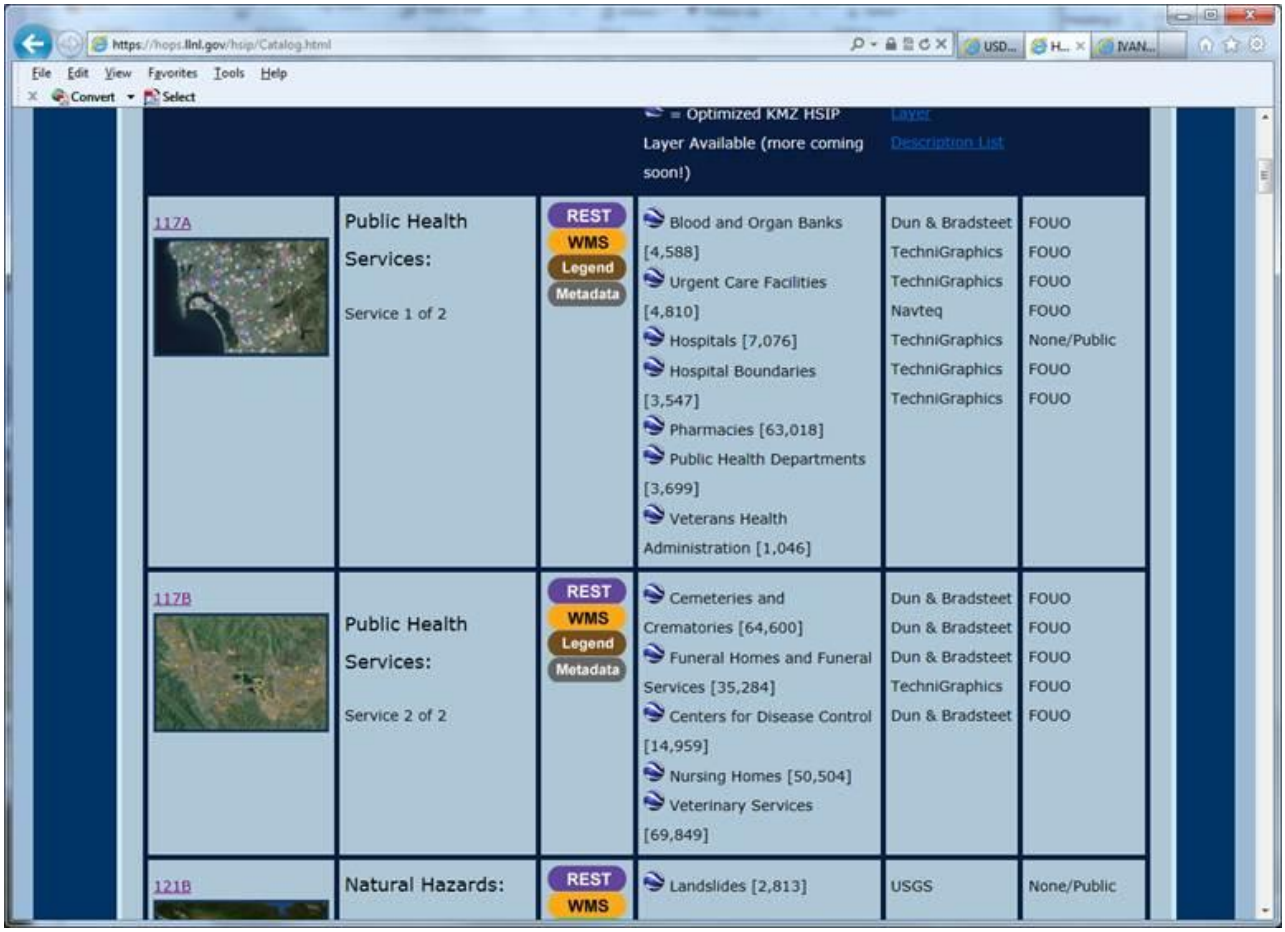

Figure 15. Metadata, legends and links to data feeds in many formats

Area for Improvement 14: The Clearinghouse should develop the ability to share aerial overflight data via streaming video through UICDS. Such a capability would be extremely valuable for sharing results of geoscience and damage aerial recons. Essentially anyone participating in the response on the ground could view what those in the aircraft see.

There are two methods for accomplishing this goal, one for photos and one for video. With regard to photos, each photo has metadata giving its land coverage (four lat/long points). The use case would be that somebody wants to see a photo of an area. All of the photos will be loaded onto a server. Next, a UICDS adapter is created that reads the metadata and puts each photo coverage into an OGC Map Context Layer document; that document is what gets published, so 1000 pictures X 1000 characters = 1 MB document. Anybody connected to UICDS can access that document, search the layers for photo coverage(s) that contain that lat/long point (or polygon, line), retrieve the URL to access the photo(s), and do so. How the application displays the photo is up to the application – a picture is one option, draped over a Digital Elevation Model is high-end. The storage of the photos is separated from UICDS (just like the design for GIS and other big data) and what is shared is access to the photos/big data. For aerial video, the workflow would be a bit different from the workflow for photos. For video, it all depends on the metadata. UICDS wouldn't actually host or display the video; that would be a parallel process (could be done right along UICDS, but not an internal function). UICDS, much like described above for photos, would use the metadata to point applications to the right

place in the video for a location they desired. One option would be to use outputs that tag the lat/long of the point on the ground of the fly-over as well as the bounding box for the field of view. Then an app like SpotOnResponse would know where the device is, request the relevant overhead video view, and show the video using the device's video display capabilities.

To accomplish these tasks, from design through testing, it is estimated that it would require 60-90 days with maybe 1.5 FTE working on it. The actual amount of time to accomplish the tasks would depend on the photos, metadata, etc., and, how much additional effort is required for catalog development, access control, and other related tasks.

Analysis: The Clearinghouse and its partner organizations are in the process of implementing the UICDS technology. Although the technology is relatively easy to deploy, it takes time and effort to devise optimal level of precision in sharing agreements between UICDS cores. The Clearinghouse and its partner organizations should continue to develop and refine sharing agreements between partner UICDS cores, and conduct regular tests to determine whether or not a satisfactory level of data interoperability has been achieved.

The ARIA (Advanced Rapid Imaging and Analysis) project is a collaboration between JPL and Caltech that builds on the technological and scientific capabilities at each institution to provide space geodetic data for hazard response and science applications. In order to provide geodetic imaging rapidly and reliably enough for response, ARIA is developing the infrastructure necessary to generate images in near real-time that can improve situational awareness for disaster response. The ARIA team is also building on its expertise in space geodetic data to develop new damage assessment techniques based on radar data, which can image regions around the globe, during both day and night as well as through clouds. ARIA will engage and inform the monitoring and response communities to transmit the most critical information from the rich source of space geodetic data.

Objective 4

Test the functionality of the newly upgraded Clearinghouse website to effectively communicate data collection coordination information to Clearinghouse partners.

Core Capability 2

Facilitate data collection and information sharing between Clearinghouse partner organizations, in both real and virtual environments.

Strengths

The partial capability level can be attributed to the following strengths:

Strength 1: In a California earthquake, because of its position as one of the managing agencies of the Clearinghouse, EERI's role includes hosting and managing the Clearinghouse website and posting situation updates to the site as necessary. For the Golden Guardian exercise, the Institute delivered a new website with integrated SpotOnResponse Viewer.

Overall, EERI was successful in the objectives set for this exercise. Three different data collection tools (FieldNotes, Clearinghouse Fieldnotes, and Fotonotes) were used and data in four formats (KMZ/KML, pdf, geotagged pictures, and text files) were collected. More than 50 observations were simulated before and during the 3 hour exercise. During the exercise, a group of eight people used the tools mentioned above to make real-time observations. All simulated observations were visible in SpotOnResponse.

Areas for Improvement

The following areas require improvement to achieve the full capability level:

Area for Improvement 1: Ahead of the exercise, EERI was aware of certain data formats that could not be viewed properly in SpotOnResponse. This issue is being addressed for future exercises. In previous exercises, EERI has sent data to the UICDS and SpotOnResponse teams for them to feed into SpotOnResponse. For this exercise, EERI took the next step towards automatic data sharing by directly uploading data into SpotOnResponse. While this is still a manual process, EERI will be working with the SpotOnResponse team to achieve a fully automated system for the next exercise.

Analysis: Full capability of the Clearinghouse website was not achieved because the technologies embedded into the site are still under development. The Clearinghouse and its partner organizations are still in the process of developing UICDS sharing agreements, which are the source of information displayed on the SOR viewer. The SOR viewer and field data collection tools are custom applications being developed specifically for the Clearinghouse for earthquake data collection. With each preparedness exercise conducted by the Clearinghouse, additional upgrades are incorporated into the SOR tool and subsequently into the website. Further, the Clearinghouse is in the process of developing a volunteer database which will make it possible to track knowledge, skills and abilities, of Clearinghouse volunteers.

Objective 5

Test latest features added to the SOR tool for mobile field data collection activities

Core Capability 2 & 3

2. Facilitate data collection and information sharing between Clearinghouse partner organizations, in both real and virtual environments
3. Coordinate field data investigations of earth scientists, engineers and other participating researchers

Strengths

The partial capability level can be attributed to the following strengths:

Strength 1: The following are the main features added to SOR since the Clearinghouse October 2012 Shakeout Exercise:

- Registration code required to allow Clearinghouse to control login

- Delete of Items of Interest (IOI) and Observations of Interest (OOI) enabled; only own entered items able to be deleted except for Administrator privileges
- User access now includes (a) read only, (b) read/write/delete (own entries), (c) Admin privileges (delete any entry, manage registration)
- Website integration – no login required, view only Items of Interest (IOI) in list and on map and IOI details (no viewing of Clearinghouse Member Observations)
- Dynamic, personal filters allow selection of IOI by any word(s) or phrase(s) or date(s)
- Several new icons
- Organizations customized to represent Clearinghouse Member skills
- IOI types customized for Clearinghouse definition of incidents and other items
- Traffic added as available layer
- Weather added as available layer
- Announcements created as new data type that displays without regard for geographic proximity to provide information to all Clearinghouse Members
- Google Street View enabled to provide access to photo visualization of streets, buildings
- Updated users guide
- Online video training
- Session tracking and Log Out feature for security

Areas for Improvement

The following areas require improvement to achieve the full capability level:

Area for Improvement 1: Spot on Response should consider adding advice to users on how they can reduce latency and reduce screen refresh delays. A suggested screen refresh rate adjusted in the individual user's profile to 300 seconds and an Area of Interest adjusted to 10 miles was reported as sufficient for some users.
Area for Improvement 2: Spot On response should be revised to revert to the last screen view when refreshing rather than reverting to a high altitude view. It is currently disruptive when users are forced to re-zoom to a prior view level after making a change from a zoomed-in view in SpotonResponse.
Area for Improvement 3: In the Set Location dialogue box, describe how users can establish custom preset locations. Consider reformatting the rectangular buttons to reduce clutter and embolden or otherwise emphasize the "Set Location" button.
Area for Improvement 4: In IOI dialogue or as a preference in the user's profile, add an option that if fields of information such as "Reason" or "Disposition" are not filled in, they will not be published. Find ways to cut down on the text to eliminate clutter and repetition.
Area for Improvement 5: In the IOI dialogue many had blank fields that users should have filled in, such as the user's name. Consider setting a requirement that some fields must be filled in before an IOI or an update can be filed.
Area for Improvement 6: In the IOI dialogue, consider adding a field to alert the Clearinghouse Management Committee that the Item or Observation appears to have urgent Life Safety or public exposure aspects that should be brought to the attention of emergency managers in a timely manner or confirmed that emergency managers are already aware of them and to ensure that they are being addressed by others responsible for Emergency Operations. Clarify that participants in the Clearinghouse are participating in a Planning and Intelligence activity and

should avoid engaging or impeding in Emergency Operations activities such as conducting safety assessments, posting ATC-20 placards, rescuing victims in hazardous settings that involve endangering Clearinghouse personnel. On the other hand, Clearinghouse personnel should be encouraged to have current training and credentialing in First Aid/CPR and to provide that as warranted.

Area for Improvement 7: Consider scaling the colored pins on the maps so that in most views they are much smaller in size or adjustable by the user. Replace the background on several of the custom pins so that background is transparent. Increase the variety of pin colors and provide a legend describing the pin types.

Area for Improvement 8: Encourage the Clearinghouse Management Committee to use information gathered to identify trends, gaps in information types, gaps about sub-regions where information appears to be lacking and to communicate that via announcements and synthesis reports to Clearinghouse participants to encourage them to address those when setting their priorities for later investigations. Coordinate gaps identified by reading situation reports from RIMS/WebEOC with information and gaps generated by the Clearinghouse.

Area for Improvement 9: Consider developing the Clearinghouse's subject matter team approach so that coordination and communication can be encouraged on more technical matters primarily within individual teams without engaging others who are not on a particular team. Team Leaders and the Clearinghouse Management Committee should be on the lookout for cross-cutting, multi-disciplinary or safety-related developments that should be shared with other teams or all participants.

Area for Improvement 10: Cal OES is asking for participants to follow-up and confirm other's observations or report on various locales, so the Clearinghouse should develop protocols to enable that, and test it out in future exercises. Consider informing participants that they may be called upon to assist if feasible and to respond to such requests in a timely manner.

Area for Improvement 11: For future exercises, EERI recommends a second viewer that will allow for controls for layer and dataset visibility. With a large number of users, the SpotOnReponse application often did not load properly. For future exercises and earthquakes, the application should be more robust. The EERI web team also recommend the establishment of an EERI Virtual Clearinghouse, linked to the California Earthquake Clearinghouse website, to house and archive collected data.

Analysis: Full capability of the Clearinghouse field data collection tool was not achieved for the same reasons the Clearinghouse website did not achieve full capability; the SOR and UICDS technologies are still under development. The Clearinghouse and its partner organizations are still in the process of developing UICDS sharing agreements, which are the source of information displayed on the SOR viewer. The SOR viewer and field data collection tools are custom applications being developed specifically for the Clearinghouse for earthquake data collection. With each preparedness exercise conducted by the Clearinghouse, additional upgrades are incorporated into the SOR tool and subsequently into the website. Further, the Clearinghouse is in the process of developing a volunteer database which will make it possible to track knowledge, skills and abilities, of Clearinghouse volunteers.

APPENDIX A: IMPROVEMENT PLAN

This IP has been developed specifically for the California Earthquake Clearinghouse as a result of the Golden Guardian exercise conducted on May 13-15

NOT APPLICABLE AT THIS TIME.

Core Capability	Issue/Area for Improvement	Corrective Action	Capability Element[1]	Primary Responsible Organization	Organization POC	Start Date	Completion Date
Core Capability 1: [Capability Name]	1. [Area for Improvement]	[Corrective Action 1]					
		[Corrective Action 2]					
		[Corrective Action 3]					
	2. [Area for Improvement]	[Corrective Action 1]					
		[Corrective Action 2]					

[1] Capability Elements are: Planning, Organization, Equipment, Training, or Exercise.

APPENDIX B: EXERCISE PARTICIPANTS

Participating Organizations
Federal
United States Geological Survey
National Aeronautics and Space Administration Jet Propulsion Laboratory
United States Department of Homeland Security, Science and Technology Directorate
State
California Natural Resources Agency
California Geological Survey
California Department of Water Resources
California Department of Fish and Wildlife
California Office of Emergency Services
California Department of Transportation
California Seismic Safety Commission
California Department of Public Health
California Department of Toxic Substance Control
Not for Profit
Earthquake Engineering Research Institute
Direct Relief International
Academic
Berkeley Seismological Laboratory Earthquake Early Warning
Private
SpotOnResponse