CALIFORNIA EARTHQUAKE CLEARINGHOUSE

After-Action Report: South Napa Earthquake

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INTRODUCTION

ABOUT THE CALIFORNIA EARTHQUAKE CLEARINGHOUSE

In accordance with California Public Resources Code Section 2201 and National Earthquake Hazard Reduction Program (NEHRP) guidelines, when a major earthquake occurs in California, the California Geological Survey (CGS) is mandated, along with its managing partners EERI, the United States Geological Survey (USGS), the California Office of Emergency Services (CalOES), and the California Seismic Safety Commission (CSSC), to establish a clearinghouse where timely information and data are shared by researchers, engineers and scientists conducting reconnaissance after an earthquake.

Additionally, the NEHRP guidelines state "Depending on ability and capability, the affected state(s) may take the lead in organizing the clearinghouse. " The NEHRP guidelines go on to acknowledge "California already has formalized the process for establishing a Clearinghouse." The state of California has demonstrated the ability and capability to take the lead in coordinating a clearinghouse in California. As Chair, CGS serves as permanent, lead coordinating organization of the California Earthquake Clearinghouse and the Earthquake Engineering Research Institute (EERI) serves as vice chair. In its role as chair, CGS leads the coordination of geologic hazard information from state agencies and facilitates communication with emergency managers. As vice chair, EERI provides logistical support at the physical clearinghouse location and leads the coordination of individuals and teams conducting field reconnaissance after an earthquake.

The Clearinghouse is a cooperative organization with partner organizations that have similar roles and tasks to perform, but in California, it is the responsibility of the California Earthquake Clearinghouse to support the state's response efforts. By providing resources for the South Napa Earthquake Clearinghouse activation and making these resources available to all partner organizations, the state met both the Statutory and NEHRP requirements to organize and operate a Clearinghouse. Two important benefits of the resources provided by the state to the California Earthquake Clearinghouse are: (1) improved coordination of teams and individuals in the field through administered access to restricted areas and by providing a location to share findings and make plans for teams in the field each day; and (2) linking the scientific and engineering communities with agencies and organizations responsible for emergency response and recovery so that their findings can inform the response and recovery efforts.

This after-action report has been prepared to capture the successes, lessons and recommendations from the California Earthquake Clearinghouse South Napa Earthquake Activation. While the Physical Location of the California Earthquake Clearinghouse was deactivated on August 26, 2014, the Clearinghouse partners continue to respond to the earthquake and as a result this report will be updated as new lessons and recommendations surface.

ACKNOWLEDGEMENTS

While the California Earthquake Clearinghouse has historically operated without a budget, funding from the U.S. Geological Survey (USGS) and the Federal Emergency Management Administration (FEMA) in recent years has allowed CGS and EERI to devote staff time towards managing the Clearinghouse. Through this funding, exercises, trainings, workshops, and continued development of data collection and visualization methods were possible and key in preparing the Clearinghouse to respond to the South Napa earthquake. This support is greatly appreciated.

Immense gratitude goes to the Caltrans team (Herby Lissade, Tim Shaw, Carlos Gutierrez, Neil Hayes, Rene Garcia, Gerald Kracher, John Schmidt) who supported the Physical Location during activation.

Additionally, the USGS, the California State Seismic Safety Commission, and the California Office of Emergency Services also support the involvement and time of Clearinghouse representatives from their respective organizations to participate in Clearinghouse activities and management meetings.

EERI also would like to acknowledge several of its working groups over the last several years. These working groups have helped refine reconnaissance approaches and procedures and provided guidance for the development and improvement of EERI field data collection and visualization tools that were used by EERI members and other Clearinghouse participants after the South Napa earthquake. These working groups and committees include the Clearinghouse Management Group, EERI IT Committee, EERI LFE Committee, and the EERI Clearinghouse Advisory Committee.

CALIFORNIA EARTHQUAKE CLEARINGHOUSE ACTIVATION FOR THE SOUTH NAPA EARTHQUAKE

The current threshold for California Earthquake Clearinghouse activation is a minimum magnitude of 6.0 with likely impacts upon urban communities. The South Napa Earthquake reached this threshold. Within 4 hours of the South Napa earthquake, the California Earthquake Clearinghouse was activated by the managing partners. Efforts quickly were put into place to establish a physical clearinghouse location that became operational by 3:00 pm on August 24th. The California Geological Survey provided all coordination with the state for all state resources required for Clearinghouse activation. The Clearinghouse was located at the Caltrans Maintenance Facility on Jefferson St. in Napa with the support of a Caltrans mobile satellite communications truck, providing phone and internet connectivity. The Clearinghouse was operational from Sunday August 24 - Tuesday August 26.

Despite being the first activation of the California Earthquake Clearinghouse since the 1994 Northridge Earthquake, the activation process was swift and effective, due largely to the fact that damage was centralized, moderate, and communications were uninterrupted. A timeline of the California Earthquake Clearinghouse Activation/Deactivation for the South Napa Earthquake is shown below, followed by more details about each event in the following subsections.

SOUTH NAPA EARTHQUAKE ACTIVATION TIMELINE

- August 24, 2014
  - 3:20 AM: Earthquake and earthquake notification from USGS
  - 4:16 AM: CA Clearinghouse Management Committee notified of earthquake
  - 5:16 AM: Conference call scheduled for 7:00 AM
  - 7:00 AM: Clearinghouse activated during conference call
  - 8:16 AM: Mission Task request to Caltrans and CalOES Air Coordination Group
  - 10:00 AM: Physical Clearinghouse location selected
  - 11:00 AM: Overflight scheduled
  - 2:00 PM: Virtual Clearinghouse website launched by EERI
  - 3:00 PM: Physical Clearinghouse location operational
- August 26, 2014
  - 8:00 PM: Physical Clearinghouse deactivated

EARTHQUAKE AND EARTHQUAKE NOTIFICATION – *AUGUST 24, 2014 AT 3:20 AM (PDT)*

The magnitude 6.0 South Napa Earthquake occurred on August 24, 2014 at 3:20a.m. (PST) at a location of 38.215°N 122.312°W and depth of 11.3km (7.0mi). The earthquake was located in the San Francisco Bay Area region, north of San Pablo Bay between two major active fault systems: the Hayward-Rodgers Creek Fault system on the west and the Concord-Green Valley Fault system on the east. The earthquake occurred near the well-known West Napa Fault, and the less well known Carneros-Franklin Faults, which juxtapose different suites of rocks. More information can be found at:
http://comcat.cr.usgs.gov/earthquakes/eventpage/nc72282711#summary &
http://earthquake.usgs.gov/earthquakes/eqarchives/poster/2014/20140824.php

Notification was received at 3:20 a.m. via text from USGS Earthquake Notification Service of M6.0 earthquake in the vicinity of American Canyon in northern California. The initial report magnitude was subsequently confirmed on USGS website. Initial USGS Pager Alert Level was Yellow, and eventually revised upward to Red. The cities exposed to the highest intensity shaking were Napa (VIII), Yountville(VII), and American Canyon (VII). A list of selected cities with 1,000 or more residents and exposed to strong shaking is available from the USGS here: http://comcat.cr.usgs.gov/earthquakes/eventpage/nc72282711#pager.

CA CLEARINGHOUSE MANAGEMENT COMMITTEE NOTIFIED OF EARTHQUAKE – *AUGUST 24, 2014 AT 4:16 AM (PDT)*

Shortly after the USGS ENS text was received, Clearinghouse personnel began assessing the preliminary information regarding the reported earthquake. At 4:16 a.m., all Clearinghouse management team members were notified via email and text message that an earthquake had occurred and further information would be forthcoming. SpotOnResponse (SOR) notified of activation 7:00 a.m. eastern, 8/24, and mobile app made accessible to report earthquake related observations.

CONFERENCE CALL SCHEDULED FOR 7:00 AM – *AUGUST 24, 2014 AT 5:16 AM (PDT)*

At 5:16 a.m., Clearinghouse management committee members were notified via email that a briefing call was scheduled for 7:00 a.m.

CLEARINGHOUSE ACTIVATED DURING CONFERENCE CALL – *AUGUST 24, 2014 AT 7:00 AM (PDT)*

Representatives of CGS, EERI, Cal OES, USGS, and FEMA Region 9 participated on the call at 7:00 am. Reports of major structural damage, fires, widespread power outages and utility failures were discussed. During the call, the Clearinghouse management committee officially authorized activation of a virtual Clearinghouse and a physical Clearinghouse location.

MISSION TASK REQUEST TO AND CALOES AIR COORDINATION GROUP – AUGUST 24, 2014 AT 8:16 AM (PDT)

At 8:16, on behalf of the Clearinghouse, CGS submitted a Mission Task request, including list of desired amenities (power, phone, internet connection, etc.), to Caltrans and Cal OES Operations Branch, requesting assistance in finding a suitable location to host a physical Clearinghouse in the vicinity of the affected region.

In addition, on behalf of the Clearinghouse, CGS contacted the Cal OES Air Coordination Group to request support for overflight of the affected region.

PHYSICAL CLEARINGHOUSE LOCATION PROVIDED BY CALTRANS – *AUGUST 24, 2014 AT 10:00 AM (PDT)*

By approximately 10:00 a.m., Caltrans identified two alternatives suitable for the needs of the physical clearinghouse location. A maintenance yard near central Napa was selected as the best alternative due to its proximity to the region of most damage. The site was also equipped with a Caltrans satellite communications truck.

OVERFLIGHT SCHEDULED – *AUGUST 24, 2014 AT 11:00 AM (PDT)*

By 11:00 a.m. an overflight was coordinated for 2:00 p.m., with California Highway Patrol out of Napa County Airport. One earth scientist and one geotechnical engineer participated in the August 24 overflight.

VIRTUAL CLEARINGHOUSE WEBSITE LIVE – *AUGUST 24, 2014 AT 2:00 PM (PDT)*

By approximately 2:00 pm a Virtual Clearinghouse website was established and made live by EERI. This website served as the primary place for updates and information and continues to be updated (http://www.eqclearinghouse.org/2014-08-24-south-napa/).

PHYSICAL CLEARINGHOUSE LOCATION OPERATIONAL – *AUGUST 24, 2014 AT 3:00 PM (PDT)*

By 3:00 p.m. on Sunday, August 24, the Clearinghouse physical location was officially opened at the Caltrans maintenance facility located at 3161 Jefferson Street, in Napa, and the Caltrans mobile satellite communications truck was operational.

Figure 1. Caltrans mobile satellite communications equipment at the Caltrans maintenance facility on Jefferson Street in Napa where the physical Clearinghouse was located.

EMAIL NOTIFICATION OF CLEARINGHOUSE ESTABLISHMENT – *AUGUST 24, 2014 AT 3:15 PM (PDT)*

At 3:15 p.m. on Sunday, August 24, EERI notified its members of the establishment of the virtual clearinghouse, California Earthquake Clearinghouse website, and plans for reconnaissance. For future events, a procedure should be clarified for sending similar messages to all clearinghouse partners, and any collaborating organizations to distribute to their contacts.

This notification did not include the location/address of the physical clearinghouse due to worries about exceeding the capacity of the venue. In this future, this should be reconsidered.

EMAIL NOTIFICATION OF CLEARINGHOUSE NIGHTLY BRIEFING – *AUGUST 24, 2014 AT 6:25 PM (PDT)*

At 6:25 p.m. on Sunday, August 24, EERI notified its members of the upcoming 8:00pm California Earthquake Clearinghouse nightly briefing and physical clearinghouse location. For future events, a procedure should be clarified for sending similar messages to all clearinghouse partners, and any collaborating organizations to distribute to their contacts.

This notification did not include the briefing conference call information due to concerns of exceeding the capacity of the conference call service. In this future, this should be reconsidered to allow all of those in the field to stay informed (who couldn't make it back to the physical location) and consider supporting the efforts underway.

EMAIL TO SEEK ADDITIONAL RECONNAISSANCE PARTICIPANTS – *AUGUST 25, 2014 AT 12:05 PM (PDT)*

At 12:05 a.m. on Monday, August 25, EERI solicited members to contribute to the reconnaissance efforts, encouraging them to check-in at the clearinghouse physical location at 8:00 am to create a reconnaissance

plan for the day. EERI noted six areas that members could focus on in the field: Performance of Retrofitted URM buildings, Lifelines: Mapping water main breaks, power outages, and fires, Comprehensive Study of Downtown Napa's Buildings and Bridges, Non-structural damage at Napa County Airport, Performance of mobile homes and residential buildings with cripple walls, and Wineries.

EMAIL TO SEEK ADDITIONAL RECONNAISSANCE PARTICIPANTS – *AUGUST 26, 2014 AT 5:45 PM (PDT)*

At 5:45 a.m. on Tuesday, August 26, EERI sent a notification to EERI members with a summary of observations to date. The message also notified members about briefing number 3 and that the Physical Clearinghouse Location would be deactivated after the briefing.

PHYSICAL CLEARINGHOUSE DEACTIVATED – *AUGUST 26, 2014 AT 8:00 PM (PDT)*

The Physical location remained active through the evening of Tuesday, August 26, 2014. After August 26, the state decided to de-activate the physical location after three days because the scientific and engineering contribution to the response effort started to level off, and because the state underwrites the cost of Clearinghouse operations, there lacked sufficient justification to support the continued expense of keeping the location open longer. Clearinghouse Management no longer staffed the location, but through coordination with CGS, Caltrans continued to provide access to the site for several days to allow USGS personnel to stage data collection equipment used for on-going field data collection. Additional remote activities by EERI continued to facilitate coordination of field teams for an additional week.

DAILY OPERATIONS AT THE PHYSICAL CLEARINGHOUSE LOCATION

COORDINATION AND COMMUNICATION WITH STATE AGENCIES

Constant communication was maintained with various state agencies throughout the activation of the Physical Location. This included keeping track of CGS and USGS field teams and having open communications with the CalOES GIS staff at the State Operations Center (SOC).

ORIENTATION OF FIELD TEAMS AND INVESTIGATORS

Beginning at 3 pm on August 24 and at 8 am on August 25 and 26, Clearinghouse personnel were present at the Physical Location each day of the activation to greet and orient field teams and investigators before they headed into the field. Individuals were asked to provide their name, affiliation, and email address on a sign-in sheet to help Clearinghouse personnel track who was in the field.

In many cases investigators checking-in to the Physical Location did not have specific objectives for their field visit. In this case, Clearinghouse personnel would provide a status update of what others had seen in the field or identify gaps in observations that would be helpful for them to investigate. Anyone who checked-in at the physical location also received a quick demonstration of the Clearinghouse mobile data collection tools and were encouraged to submit their observations in the field to the Clearinghouse in real-time. Finally, if requested, teams and individuals were provided with a letter of introduction explaining that they were conducting earthquake reconnaissance as part of the California Earthquake Clearinghouse.

At the end of the day most teams came back to the Physical Clearinghouse to provide an update of what they saw in the field to a disciplinary leader who worked jointly with them to develop slides of observations for the nightly briefing.

CONFERENCE CALLS

After the initial conference calls on the morning of August 24, 2014, conference calls continued until the deactivation of the Physical Clearinghouse location. These calls were open to all Clearinghouse partners and were attended by representatives from the Clearinghouse managing partners and other scientific and engineering organizations.

Three conference calls were held each day – one in the morning, one in early afternoon, and one in mid-afternoon. These calls were an important communications channel between personnel at the Physical Location, who were tracking teams and investigators in the field, and other organizations conducting investigations who did not check-in at the Physical Location. These calls also served as the only link to the local emergency managers, through Kevin Miller, CalOES, who was present at the Regional Emergency Operations Center (REOC) in Walnut Creek.

NIGHTLY BRIEFINGS

In addition to conference calls, the California Earthquake Clearinghouse also organized and hosted nightly briefings at the Physical Location. Briefings were an opportunity for 1) teams and individuals who checked-in at the Physical Location to report back on what they had seen during their time in the field; 2) teams and individuals who did not check-in at the Physical Location to report-out on what they had seen in the field; and 3) to inform the broader community of observations being made in the field.

Briefing #1 was held on Sunday, August 24 at 8:00 pm. Topics covered in Briefing #1 included:

- Geosciences (Team members: Ben Brooks and Steve Delong, USGS)
- Geotechnical (Team Members: Julian Weber, GEER/UC Berkeley)
- Buildings: (Team members: Marko Schotanus, R+C; Bill Tremayne, Holmes Culley; Janiele Maffei, CEA, Jeff Kovach, Bevier Structural Engineering,)

Being the first briefing, the agenda and content were organized on the fly and depended on which investigators were available to come back to the Physical Location that evening. Briefing #1 was purely oral presentations, no presentation slides, and was broadcast via Caltrans webcast. Approximately 30 people attended Briefing #1 in person and the number of remote attendees is unknown. However, the broadcast video and sound was presented at the SOC and observed by FEMA, National Guard, Cal OES, CGS, and other emergency management personnel.

Learning from the experience of coordinating Briefing #1, logistical improvements were implemented for subsequent briefings. First, on subsequent days, Clearinghouse personnel encouraged all teams and individuals checking-in to come back to the Physical Location 1-2 hours before the briefing start time so that they would have time to prepare summaries of their observations for the briefing. Secondly, using Google Drive Slides each team was able to develop summary presentation slides in the same presentation file simultaneously, which streamlined the briefing preparations. Finally, a Webex was set-up for other briefings which provided improved audio for remote attendees and allowed them to see the presentation slides.

Briefing #2 was held on Monday, August 25 at 8:00 pm. Topics covered in Briefing #2 included:

- Geosciences (Team members: Cooper Brossy, David Trench, and Mike Buga, Fugro Consultants)
- Geotechnical (Team Members: Keith Kelson, USACOE, and John Wesling, California Office of Mine Reclamation)

- Buildings: Residential, Single Family (Team members: Veronica Crothers and Karl Telleen, Maffei Structural Engineering; Betsy Mathieson, Exponent; and Simpson Strongtie Team)
- Buildings: Residential, Mobile Homes (Team Members: ABAG Team with Danielle Mieler, Mike Mieler, Michael Germeraad, and Dana Brechwald)
- Business Interruption in Downtown Napa (Team Members: RMS Team with Pooya Sarabandi and Petros Keshishian)
- Transportation: Bridges (Team Members: Kleinfelder Team with Zia Zafir and Bill McCormick)
- Nonstructural Damage (Team Member: Glen Granholm, ETC Building & Design, Inc.)

Approximately 60 people attended Briefing #2 in person and the number of remote attendees is unknown.

Briefing #3 was held on Tuesday, August 26 at 6:00 pm. Topics covered in Briefing #3 included:

- Buildings: Commercial, Unreinforced Masonry Team1 (Team Members: Jonas Houston and Adam Azofeifa, Holmes Culley; and Brian Olson, Tipping Mar)
- Buildings: Commercial, Unreinforced Masonry Team 2 (Andre Barbosa and Ben Mason, OSU; Alex Julius and Erik McAdams, EERI; and Badri Prasad, TTG)
- Geosciences (Team Member: Wayne Haydon, California Geological Survey)
- Geosciences II (Team Members: Jennifer Thornburg and Jeremy Lancaster, California Geological Survey)

Approximately 20 people attended Briefing #3 in person and the number of remote attendees is unknown.

Presentations from each briefing can be downloaded from the virtual clearinghouse at: http://www.eqclearinghouse.org/2014-08-24-south-napa/preliminary-reports/.

Figure 2. Photograph of the physical Clearinghouse during an evening briefing.

CALIFORNIA EARTHQUAKE CLEARINGHOUSE WEBSITE AND THE SOUTH NAPA EARTHQUAKE VIRTUAL CLEARINGHOUSE WEBSITE

In the first hours of the Clearinghouse activation, two websites were being updated in parallel with information about the earthquake and the Clearinghouse activation. The first was the California Earthquake Clearinghouse website (www.californiaeqclearinghouse.org) and the second was South Napa Earthquake Virtual Clearinghouse website (http://www.eqclearinghouse.org/2014-08-24-south-napa/).

Initially, both websites were updated with the latest information in parallel, however, it was soon clear that, with limited personnel support, it was too difficult to maintain both websites. The decision was made by Clearinghouse personnel to make the South Napa Earthquake Virtual Clearinghouse website the primary source of information for the South Napa Earthquake. The South Napa Earthquake Virtual Clearinghouse website was selected as the primary site because it is better suited for posting updates and organizing data. As a result, a notification was posted on the homepage of the California Earthquake Clearinghouse website directing people interested in the Clearinghouse activities or the general updates about the earthquake to the South Napa Earthquake Virtual Clearinghouse website.

Moving from two websites with duplicate, but sometimes inconsistent information, to one website simplified online communications and improved ease of operation which was crucial given the limited personnel staffing the Clearinghouse. For the South Napa Earthquake, the Virtual Clearinghouse website will exist as a long-term data repository for the earthquake. Going forward, the California Earthquake Clearinghouse website will serve as an informational site about the Clearinghouse and its activities. For future, larger earthquakes, other arrangements may be made to manage and update both a Virtual Clearinghouse website and the California Earthquake Clearinghouse website.

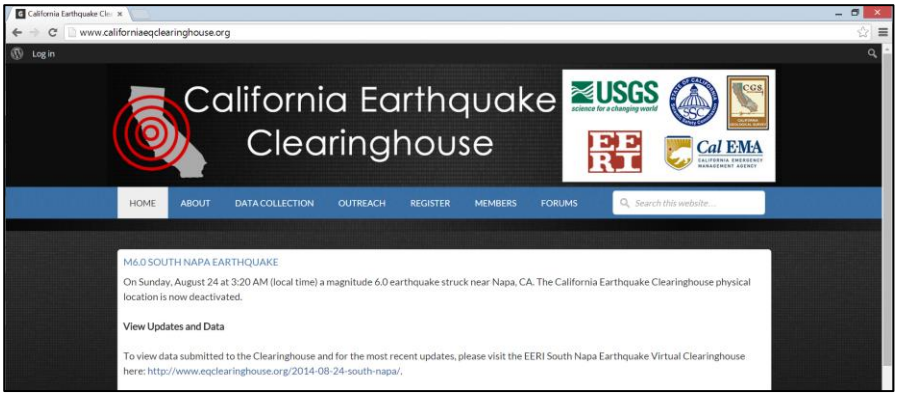

Figure 3. Screen capture image of the California Earthquake Clearinghouse Website. Maintenance of earthquake information on this site was dropped for efficiency and users were directed to the South Napa Earthquake Virtual Clearinghouse website.

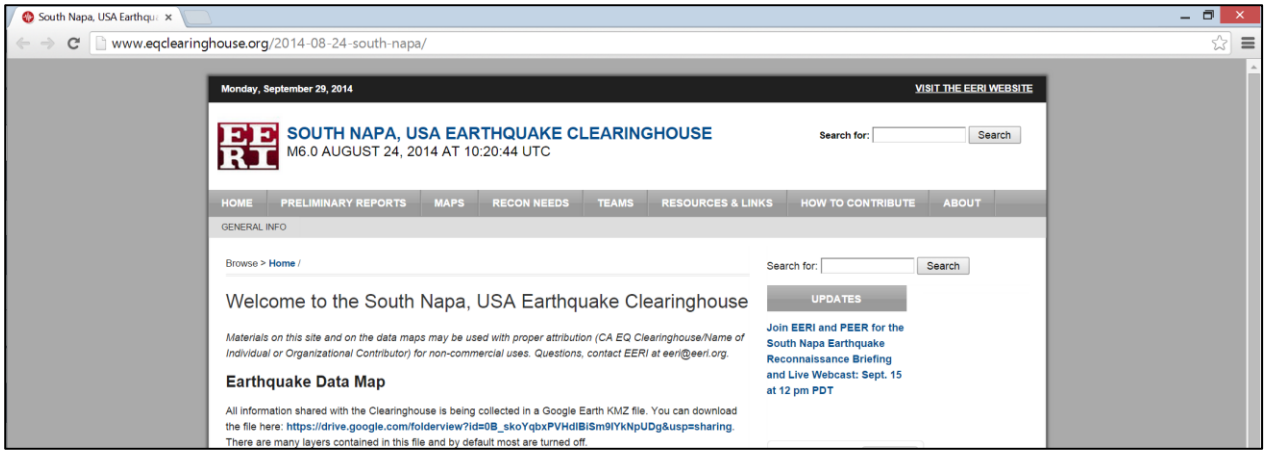

Figure 4. Screen capture image of the South Napa Earthquake Virtual Clearinghouse Website. This site will remain the long-term repository of information for this earthquake.

DATA COLLECTION AND MANAGEMENT

Data were collected by investigators in the field using various methods and shared in real-time. In addition, data that were post-processed by individuals once they were back at a computer were also shared. Real-time data from EERI members and other Clearinghouse participants were submitted through the Clearinghouse Fieldnotes application. Post-processed data came in many forms, but most common were KMZ files containing geolocated photos and captions. After the Physical Location was deactivated, additional tools from EERI, the Online Interactive Photo Map and Batch Upload Tool, were also available for people to submit their geo-tagged or non-geotagged photos.

All data collected were aggregated into an ArcGIS Online map which made the data publicly available online within hours of being collected. However, the KMZ file-types proved challenging to display as embedded photos in the compressed files made them very large and prevented them from being uploaded to the ArcGIS Online map. To reconcile this problem, photos were hosted online and then the KMZ files were edited to link to the online location of the photos. In some cases, ArcGIS Online did not display datasets in a clean way and so the Clearinghouse personnel began to maintain a static KMZ file that was updated regularly and hosted online in a Google Drive folder. In addition to displaying KMZ layers in a better format, the KMZ file also allowed users to view the map offline.

Using Google Drive proved an excellent way to manage, store and track datasets that were being shared with the Clearinghouse.

In addition to data from teams and individuals in the field, map data products, including a rapid damage and loss estimate, deformation magnitude and slope change, and aftershock forecasts were also provided to the Clearinghouse within 24 hours of the event via the XchangeCore Web Service Data Orchestration sharing with California Office of Emergency Services and other partners.

EERI continues to add datasets to the data map. Existing datasets are also being cleaned, and symbology is being improved to make the map easier to interpret. The map contains over 30 datasets from field teams and also data products from the NASA Jet Propulsion Laboratory (JPL) E-DECIDER and ARIA teams that were important for identifying fault rupture features and regional ground deformation. See Appendices 2-A and 2-B for a complete list of datasets from field teams and a list of the data products provided by JPL, respectively.

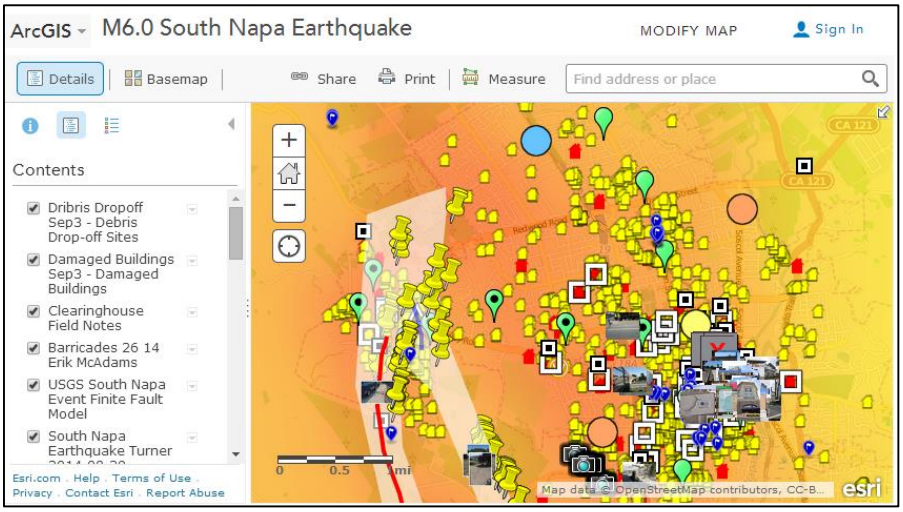

Figure 5. Screen capture image of the ArcGIS Online data compilation map.

The real-time sharing of information marked a huge step for the Clearinghouse, however, additional work is required to ensure that these data are shared with CalOES through the Clearinghouse Technology Interoperability Project. In future earthquakes, using the AGOL XchangeCore Connector, the Clearinghouse will be able to push data from the ArcGIS Online data map to WebEOC, where CalOES personnel can view the data .

The Interoperability Project is driven by the contractual mandate of the CalOES incident management software project, CalEOC, which uses a commercial product, WebEOC. The contractual requirement of CalEOC is to integrate through XchangeCore (formerly UICDS) in order to effect data exchange among disparate software and data sources. XchangeCore was operational throughout the earthquake with the following capabilities and gaps.

- The CalOES XchangeCore pilot was operational from the beginning of the earthquake. XchangeCore personnel were in the CalOES SOC for several hours on Monday, August 25, during which time they helped validate connectivity and assisted the CalOES GIS group with the relatively new (released in May) XchangeCore Connector to ArcGIS Online.
- The CalOES XchangeCore pilot was connected to the FEMA Region IX XchangeCore which operates on the FEMA Cloud. FEMA was not activated for the earthquake so there is no report of data use by the primary FEMA application connected through XchangeCore, ArcGIS.
- The CalOES XchangeCore pilot was connected to the California National Guard XchangeCore. The National Guard operations center was not activated for the earthquake so there is no report of data provided through XchangeCore.
- The CalOES XchangeCore pilot was reconnected to the NASA Jet Propulsion Laboratory XchangeCore operated by Indiana University in the hours after the earthquake. Reconnection was necessary because following routine maintenance no check was made of the agreements for exchange of data between the two XchangeCores. When discovered, this was remedied and NASA JPL began extensive use of XchangeCore, providing more than 20 model results distributed through XchangeCore. (See Appendix 1-C, Figures 1-14.) Applications connected to XchangeCore were able to use this data, including ArcGIS Online (See Appendix 1-C, Figures 3-5), SpotOnResponse (See Appendix 1-C, Figures 6-8), and Google Earth (See Appendix 1-C, Figures 9-11).
- The CalOES XchangeCore pilot was connected to the Clearinghouse Fieldnotes, referenced elsewhere as a principle data entry tool for EERI members and other Clearinghouse participants. The CalOES XchangeCore pilot periodically polled the Clearinghouse Fieldnotes data source, a process that is currently activated manually, thus at irregular intervals. By August 27th, more than 80 Fieldnotes observations were available through XchangeCore, however, two problems were identified in the earthquake:
    - First, prior to the earthquake, the USGS developers of Clearinghouse Fieldnotes had altered the data structure at the request of EERI to accommodate the collection of data in additional disciplines, including buildings and lifelines. These changes to the Fieldnotes data structure broke the connection with XchangeCore and this had not been communicated to the CalOES XchangeCore pilot team, thus for the first day and a half limited data were being ingested into XchangeCore. When the CalOES XchangeCore pilot team discovered the problem, it was remedied within hours and all the Fieldnotes entries were then available with each subsequent polling of the Fieldnotes database to connected applications which included ArcGIS Online, Google Earth (See Appendix B, Figures 15), and SpotOnResponse (See Appendix B, Figures 16-18).
    - Second, the design of the Fieldnotes use in previous exercises by the Clearinghouse had trained operators to enter Fieldnotes through the SpotOnResponse mobile app for the

purpose of creating and associating Fieldnotes observations with incidents. This process, however, was not followed during the earthquake as learning to use the Fieldnotes application on its own was a challenge for many people. As a result, Fieldnotes observations were all categorized as "Miscellaneous" when viewed in XchangeCore applications. Future work to implement the XchangeCore AGOL Connector in the earthquake data map should help address this problem without requiring individuals to use the Fieldnotes application through SpotOnResponse. Additionally, it was difficult for individuals to associate their observations with incidents for the following reasons:

  - Because CalEOC Significant Events data has not yet been integrated with XchangeCore, CalOES was not identifying incidents for field observers as had been simulated in previous exercises; thus, there were very few incidents to which Fieldnotes could be associated.
  - As noted earlier, Clearinghouse personnel would provide a status update of what others had seen in the field or identify gaps in observations that would be helpful to arriving investigators. Investigators were given general guidance about areas of interest to explore, however, specific assignments of sites to visit were rarely made as all investigators were self-directed. While specific assignments could have been recorded through SpotOnResponse, as in previous exercises, the limited Clearinghouse personnel staffing the physical location did not have the time to make these assignments. An opportunity was missed to make "assignments" in the mobile tools which would have (1) created the incident locations missing in (a) above, and (2) provided investigators with driving/walking directions and a mobile reporting tool that would have integrated the subsequent observations with those assignments. Additional personnel or GIS support at the physical location could have made it possible to incorporate data-entry into SpotOnResponse into the workflow at the physical location.

- The CalOES XchangeCore pilot was connected to the ArcGIS Online (AGOL) through the XchangeCore Connector to ArcGIS Online application that was used in CalOES' State Operations Center (SOC) to provide XchangeCore data into AGOL and to extract AGOL data to XchangeCore for subsequent use in other applications. This process is illustrated with NASA JPL data in See Appendix B, Figures 3-5.
- The CalOES XchangeCore pilot was connected to SpotOnResponse, a mobile data collection and situational awareness app developed with significant input from Clearinghouse members. SpotOnResponse was effective in displaying all of the aforementioned data from Fieldnotes and NASA JPL (See Appendix B, Figures 6-8, 12-14, 16- 18). In previous exercises, SpotOnResponse had been used by the Clearinghouse to visualize simulated incidents that merited investigation. These incidents represented implied "assignments." Because CalEOC Significant Events data has not yet been integrated with XchangeCore, CalOES was not providing incidents for field observers to be displayed in SpotOnResponse (or any other tool) as had been simulated in previous exercises; thus, there were very few incidents to help direct or motivate investigator observations. Additionally, SpotOnResponse was not included in the "quick demonstration of the Clearinghouse mobile data collection tools." Additionally, mixed experience with multiple applications in previous exercises led to reticence that investigators regarding which tools would be most successful in the field.
- The CalOES XchangeCore pilot was not connected to the EERI Online Interactive Photo Map and Batch Upload Tool described earlier. As a result, the Photo Tool data was used only in the ArcGIS Online. As illustrated with all of the above descriptions of the Clearinghouse Interoperability Project and the use of the CalOES XchangeCore pilot, there is no technical reason that data from these tools could not have been incorporated into XchangeCore. Steps to make this connection have been initiated previously, but a connection was never made successfully. These data were published

through ArcGIS Online, and with future implementation of the XchangeCore ArcGIS Online connector, these data will be shared with CalOES to support them in the identification of incident locations from the field. The EERI Photo Upload Tool is regularly updated therefore making it difficult to establish an "unbreakable" connection with XchangeCore, therefore, using the XchangeCore Connector for ArcGIS Online would ensure that data would have populated not only the EERI ArcGIS Online but also the CalOES ArcGIS, Google Earth, SpotOnResponse, and any other application connected to XchangeCore. Then these data would have constituted field reports on "incidents" and filled the gap created by the missing CalEOC Significant Events. In short, EERI data would have been exchanged with other applications and spurred further investigations by Clearinghouse members.

The Recommendations section includes specifics on improving the seamless interoperability of earthquake data through training and completion of technology requirements.

SUCCESSES

The California Earthquake Clearinghouse activation yielded numerous successes which are outlined below.

- Coordinating Field Investigations
    - Over 100 visitors, from over 40 different organizations visited the physical Clearinghouse location in Napa.
- Nightly Briefings
    - Briefings were well attended, with about 20-30 people in attendance each night and many more people attending remotely for the second two briefings.
- Overflight
    - Further, in addition to the overflight on August 24, a second overflight mission was conducted on Monday, August 25, to collect high resolution still-frame imagery.
- LiDAR
    - Following de-activation of the Clearinghouse, a multi-agency, state-federal, cost-sharing agreement was reached to acquire airborne LiDAR of the affected region. The California Geological Survey (CGS), U.S. Geological Survey (USGS), California Department of Water Resources (DWR) each contributed $10,000, and Geotechnical Extreme Event Response (GEER) and Pacific Earthquake Engineering Research Center (PEER) each contributed $5,000, for a total of $40,000. In addition, DWR served as contracting agent with the LiDAR vendor. Clearinghouse partners exhausted available resources to collect airborne LiDAR of the most critical Areas of Interest but there are additional priorities that were not included in because sufficient funding was not available.
- South Napa Earthquake Virtual Clearinghouse Website
    - The virtual clearinghouse website was live within 12 hours of the earthquake and had 1500 visits within the first four days of the earthquake.
- Data Map
    - Data compiled by field investigators resulted in more than 30 data sets with greater than 5000 point observations compiled into the map. These data have had 3,772 views as of 9/26/2014.
- Multidisciplinary Data Sharing & Integration
    - Multi-disciplinary data sharing and integration was also supported through the on-going Clearinghouse Technology Interoperability and Information Sharing efforts supported by XchangeCore.

RECOMMENDATIONS

Many lessons were learned through activation and operation of the Physical Clearinghouse. Below is a summary of key lessons.

- Internet Connectivity
    - WiFi connectivity through Verizon personal hotspot – Clearinghouse EERI volunteers provided WiFi connectivity by creating personal hotspots. The ability to set up a personal hotspot is an option for most carriers, however, Verizon appeared to be easier than AT&T.
    - Recommend Caltrans reconfigure satcom truck security settings to enable WiFi – Caltrans Satellite Communications truck had the ability to provide WiFi, however, the configuration required security settings that were not practical. Clearinghouse should work with Caltrans Office of Communications to resolve this issue
- Mapping and GIS Support
    - GIS support – Clearinghouse does not have a dedicated GIS team. The Clearinghouse should actively advertise and recruit volunteers with GIS skills with the goal of having a team of volunteers able to support Clearinghouse GIS needs during an activation. In addition, Clearinghouse should reach out to vendors for support, e.g. ESRI, capable of dispatching personnel to assist in-person during emergency operations.
- Communications
    - Combine EERI and Clearinghouse email lists for notification to streamline communications.
    - Develop best practices for basic communication (calls, texts, emails). What is the hierarchy of importance? Too many emails CC'ing multiple people who didn't need them. Email groups that included and excluded the wrong people. No clear plan for when new data is received, e.g. who needs/wants to know? Do field crews want texts or emails?
- Staffing
    - Add message to Clearinghouse website that organizations are welcome not just to visit Clearinghouse, but to send representatives to Clearinghouse and set up their own field office with/through Clearinghouse.
    - Create new position to manage volunteers as per CalOES' Disaster Service Worker (DSW) Program.
    - Develop a process for identifying volunteers to staff clearinghouse who are not field researchers.
- LiDAR
    - Develop list of LiDAR resources (e.g. Fugro, Towill) with contacts in place with DWR and Caltrans.
    - Password management - Cloud-based sharing was an important way to manage files with staff at the Physical Location, but passwords should be posted for ease of access.
- Data: In the process of collecting and sharing data, a few observations for the overall data management can help inform management of data in a future earthquake.
    - What worked:
        - XchangeCore provided exchange of data that included incident data, Clearinghouse Fieldnotes, and NASA JPL model results among XchangeCores hosted by CalOES pilot project, NASA JPL, FEMA Region IX, and the California National Guard (although no use of the data was reported by the last two because they did not activate) with connectivity provided to ArcGIS Online, SpotOnResponse, Clearinghouse Fieldnotes, and Google Earth.

        - Improvements are needed in training on investigator mobile applications so that the data they produce are better integrated through XchangeCore.
        - Training is needed and more widespread distribution and awareness of the XchangeCore Connector for ArcGIS Online.
        - The EERI Photo Upload Tool should be integrated with the XchangeCore Connector for ArcGIS Online so that data collected is more generally available.
        - Both EERI Photo Upload Tool data and Clearinghouse Fieldnotes data should be automatically associated with incidents in XchangeCore through geospatial analytics so that data are not categorized as "Miscellaneous," thus providing a more coherent data set for CalOES and other decision-makers.
- ArcGIS Online
    - Plan to change to FEMA's GeoPlatform for long-term and reliable storage and improved functionality.
- Google Earth KML: Some field crews were sending location data as KML. USGS prepared pre-made information in KML format, including live earthquake feeds, geologic maps, faults locations, etc. Google Earth is visually intuitive, fast, and accepted as a standard for viewing geographic data.
- Google Earth Pro: There are several functions of Google Earth Pro ($400/year) that are not provided in the free version. The following were used at the Clearinghouse:
    - The city of NAPA listed the red-tag buildings on it's website as addresses (no Lat, long). Google Earth Pro can ingest a list of addresses and convert them to point locations on the map (called Geocoding). It was then possible to share the locations as KML files to those people looking to investigate structure failure.
    - Parcel information. The Pro version supplies outlines of parcels across the U.S. With the Pro version, one can click on a parcel and obtain the address and assessors number, which can assist in contacting landowners.
- Google Earth App
    - It was possible to email small KML files, such as red tagged buildings, and fault rupture, to people with smartphones running the Google Earth app, which they used to navigate to the locations of interest.
- Global Mapper; (~$400-$500) - it can import and export multiple file formats. Used to import and export GPS files, shapefiles, georeferenced images, KML, you name it. Example; Multiple USGS geophysicists requested location data (fault rupture lines and points) in Matlab format - which could be provided from the Clearinghouse in minutes.
- KMLer extension to ArcGIS ($50) - ArcGIS tool capable of exporting GIS data to KML with pop-up label functionality.
- Xtools extension to ArcGIS ($250) - Easily export GIS in ArcMap as excel files and KML files. Both KMLer and Xtools were used to make visually "clean" KML files at the clearinghouse.
- GeoSetter - Able to take overflight photographs and marry them to the GPS tracklog to georeference the photo locations. Exported to KMZ with photo thumbnails.

- What didn't work:
  - Shapefiles could not be uploaded to ArcGIS Online (AGOL) and therefore it was not possible for EERI staff to publish shapefiles as web services. AGOL can be used to provide field researchers large GIS data, but effort is needed to prepare, serve and administer the system.
  - Sharing data and processing KMZ's with photographs. A more robust hosting location needs to be established to make hosting high resolution easier.
  - During South Napa earthquake response, data from the State Operations Center did not reach the Clearinghouse through Cal EOC incident management system. In addition, Cal EOC is intended to be used to coordinate with the Air Coordination Group, but that was not possible.
  - The first Nightly Briefing #1 was held on Sunday, August 24 at 8:00 pm. so broadcast via Caltrans webcast, with less than optimal audio support provided through use of a mobile phone.
  - In the future, recording of all nightly briefing presentations should be considered for posting to the virtual clearinghouse website.

CONCLUSION

The California Clearinghouse activation for the South Napa Earthquake was very successful and helped identify areas for improvement that will allow the Clearinghouse to be better prepared for a future damaging earthquakes in California.

APPENDIX 1-A: DATA SUBMITTED TO THE CALIFORNIA CLEARINGHOUSE BY TEAMS IN THE FIELD

Data Category	Data Sub-Category	Description	Data Source
Aerial Imagery	Overflights	August 24, 2014 Overflight	Steve DeLong
Aerial Imagery	Overflights	August 24, 2014 Overflight Path	Jon Bray
Aerial Imagery	Overflights	August 25, 2014 Overflight	Steve DeLong
Aerial Imagery	UAVSAR		NASA JPL
Geologic Maps		Quaternary Faults	USGS
Geologic Maps		Landslide Susceptibility	USGS
Geologic Maps		Shaded Relief	USGS
Geologic Maps		Liquefaction Susceptibility OFR 00-444	USGS
Geologic Maps		Cuttings Wharf Geology	Chris Wills, CGS
Geologic Maps		Napa Geology	Chris Wills, CGS
Geotechnical		Napa Photo Observations from August 25 2014	Fugro
Geotechnical		EERI Photo Upload Map	
Ground Deformation	Surface Rupture	Napa EQ rupture1300hrs 8-22	Mike Oskin
Ground Deformation	Ground Deformation	Ground Deformation at Old Sonoma Rd.	Donald Wells
Ground Deformation	Unknown	Dry Creek Report August 26 2014	Mike Oskin

Data Category	Data Sub-Category	Description	Data Source
Ground Deformation	Fault Rupture	Clearinghouse Fieldnotes Application	
Ground Deformation	Liquefaction	Clearinghouse Fieldnotes Application	
Ground Deformation	Landslide	Clearinghouse Fieldnotes Application	
Ground Motion, Instrumentation, and Seismology	Ground Motion	Shakemaps - mmi, pga, pgv (nc72282711)	USGS
Ground Motion, Instrumentation, and Seismology	Instruments	Strong Motion Recording Stations	CESMD
Ground Motion, Instrumentation, and Seismology	Instruments	Seismic deployment	USGS
Ground Motion, Instrumentation, and Seismology	Instruments	WNapa 2014 Alinement Arrays	USGS
Ground Motion, Instrumentation, and Seismology	Seismology	South Napa Event Finite Fault Model	USGS
Ground Motion, Instrumentation, and Seismology	Seismology	Relocated Hypocenters	Jeanne Hardebeck
Ground Motion, Instrumentation, and Seismology	Instruments	EERI Photo Upload Map	
Lifelines		Mare Island Water Leak	GEER
Lifelines		water leaks,	City of Napa

Data Category	Data Sub-Category	Description	Data Source
Lifelines		Clearinghouse Fieldnotes Application	
Social Impacts	Emergency Response	Study of Barricades around Tagged Buildings	Erik McAdams
Social Impacts	Emergency Response	Red tagged buildings, yellow tagged buildings,	City of Napa
Social Impacts	Emergency Response	debris drop-off sites	City of Napa
Social Impacts	Population Exposure	Pager	USGS
Social Impacts	Population Exposure	Did you feel it	USGS
Social Impacts		EERI Photo Upload Map	
Structural		Napa Photo Observations from August 25 2014	Marko Schotanus and Bill Tremayne
Structural		Napa Photo Observations from August 24 2014	Marko Schotanus
Structural		Napa Photo Observations from August 25 2014	Betsy Mathieson
Structural		Downtown Napa Photo Observations from August 25 2014	Betsy Mathieson
Structural		Mare Island Non-ductile concrete frame damage	Pooya Sarabandi
Structural		Geotagged Photo Observations	Fred Turner
Structural		Known Retrofitted Buildings	Fred Turner
Structural		Initial list of Redtagged Buildings	Compiled by Luke Blaire

Data Category	Data Sub-Category	Description	Data Source
Structural		EERI Photo Upload Map	
Structural	Nonstructural	EERI Photo Upload Map	
Structural	Buildings	Clearinghouse Fieldnotes Application	
Transportation		Observations of CalTrans bridges	Mark Yashinski, Caltrans
Transportation		EERI Photo Upload Map	
Unknown		Napa River and slough shoreline	Chris Wills and Tim McCrink
Unknown		Cuttings Wharf Observations	Keith Kelson

APPENDIX 1-B: DATA PRODUCTS PROVIDED BY NASA-JPL

NASA JPL Products. All products shared out, viewable and accessible on a number of different platforms, including Google Earth and Clearinghouse SOR tool, through XchangeCore.

NASA JPL E-DECIDER DATA PRODUCTS

Title	Description	URL
NASA JPL E-DECIDER Tilt Map (elastic forward model)	NASA JPL E-DECIDER Tilt Map - vertical slope change magnitude and direction based on disloc elastic forward model	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/NapaFM_slope.kmz
NASA JPL E-DECIDER Strain Magnitude Map (elastic forward model)	NASA JPL E-DECIDER Strain Magnitude Map - highlights areas where greatest deformation (motion) has occurred based on disloc elastic forward model	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/NapaFM_strainmag.kmz
NASA JPL GeoGateway Deformation Vector Map (elastic forward model)	NASA JPL GeoGateway Deformation Vector Map - vector deformation field based on disloc elastic forward model	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/NapaFM-1471887108-Output.kml
NASA JPL GeoGateway Synthetic Interferogram (elastic forward model)	NASA JPL GeoGateway Synthetic Interferogram - modeled displacement as might be viewed from an imaging radar based on disloc elastic forward model	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/NapaFM.output-insar-175.0-45.0.kml
NASA JPL GeoGateway Fault Model (elastic forward model)	NASA JPL GeoGateway Fault Model - modeled fault used in disloc elastic forward model	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/NapaFM-1471887108-Fault.kml
NASA JPL E-DECIDER HSIP Infrastructure KMZ Layers (5 mi radius)	NASA JPL E-DECIDER HSIP layers for potentially exposed infrastructure (5 mi radius)	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/HSIP_CA_Napa6.0_5miles.kmz
NASA JPL E-DECIDER HSIP Infrastructure KMZ Layers (10 mi radius)	NASA JPL E-DECIDER HSIP layers for potentially exposed infrastructure (10 mi radius)	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/HSIP_CA_Napa6.0_10miles.kmz

Title	Description	URL
NASA JPL E-DECIDER HSIP Infrastructure KMZ Layers (25 mi radius)	NASA JPL E-DECIDER HSIP layers for potentially exposed infrastructure (25 mi radius)	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/HSIP_CA_Napa6.0_25miles.kmz
NASA JPL E-DECIDER Preliminary Damage/Loss Estimation Infrastructure KML Layers (5 mi radius)	NASA JPL E-DECIDER Preliminary HSIP layers for potentially exposed infrastructure with HAZUS damage functions calculated for loss estimation (5 mi radius)	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/nc72282711_5.0.kml
NASA JPL E-DECIDER Preliminary Damage/Loss Estimation Infrastructure KML Layers (10 mi radius)	NASA JPL E-DECIDER Preliminary HSIP layers for potentially exposed infrastructure with HAZUS damage functions calculated for loss estimation (10 mi radius)	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/nc72282711_10.0.kml
NASA JPL E-DECIDER Preliminary Damage/Loss Estimation Infrastructure KML Layers (25 mi radius)	NASA JPL E-DECIDER Preliminary HSIP layers for potentially exposed infrastructure with HAZUS damage functions calculated for loss estimation (25 mi radius)	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/nc72282711_25.0.kml
NASA JPL E-DECIDER Aftershock Forecasts KMZ	NASA JPL E-DECIDER ETAS based model of aftershock likelihoods on 2014-08-24(KMZ)	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/forecasts/norcal.kmz
NASA JPL E-DECIDER Aftershock Forecasts PNG	NASA JPL E-DECIDER ETAS based model of aftershock likelihoods on 2014-08-24 (PNG)	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/forecasts/napa-2014-m6.png
NASA JPL E-DECIDER Aftershock Forecasts Shapefile	NASA JPL E-DECIDER ETAS based model of aftershock likelihoods on 2014-08-24 (Shapefile)	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/forecasts/norcal-contshapes.txt
InLET (Internet-based Loss Estimation Tool) Results (PDF)	InLET (Internet-based Loss Estimation Tool) Results provided by CSN and ImageCat via E-DECIDER (PDF write-up)	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/InLET_result_72282711.pdf

Title	Description	URL
InLET (Internet-based Loss Estimation Tool) Results (PNG)	InLET (Internet-based Loss Estimation Tool) Results provided by CSN and ImageCat via E-DECIDER (PNG image of output)	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/Napa_INLET_results.png
NASA JPL GeoGateway Fault Inversion (based on ARIA GPS rapid solutions)	NASA JPL GeoGateway Fault Inversion (based on ARIA GPS rapid solutions). The interferograms represents modeled observations for existing repeat pass UAVSAR flights with heading 55°. The red line is for the modeled (inverted for) fault. The blue arrows are the observed GPS displacements and the red arrows are the modeled GPS displacements.	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/WestNapaInversion055.jpg
NASA JPL GeoGateway Fault Inversion (based on ARIA GPS rapid solutions)	NASA JPL GeoGateway Fault Inversion (based on ARIA GPS rapid solutions). The interferograms represents modeled observations for existing repeat pass UAVSAR flights with heading 235°. The red line is for the modeled (inverted for) fault. The blue arrows are the observed GPS displacements and the red arrows are the modeled GPS displacements.	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/WestNapaInversion235.jpg
NASA JPL E-DECIDER Tilt Map (based on fault inversion from ARIA GPS rapid solutions)	NASA JPL E-DECIDER Tilt Map - vertical slope change magnitude and direction based on based on fault inversion from ARIA GPS rapid solutions	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/WestNapa_slope.kmz
NASA JPL E-DECIDER Strain Magnitude Map (based on fault inversion from ARIA GPS rapid solutions)	NASA JPL E-DECIDER Strain Magnitude Map - highlights areas where greatest deformation (motion) has occurred based on based on fault inversion from ARIA GPS rapid solutions	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/WestNapa_strainmag.kmz
NASA JPL GeoGateway UAVSAR Results Showing Multiple Fault Offsets	NASA JPL GeoGateway UAVSAR results showing multiple fault offsets from the earthquake. Each color band is 12 cm displacement toward the instrument.	http://e-decider.org/sites/e-decider.org/files/staging-area/napa/SouthNapaUAVSARV2.jpg

NASA JPL ARIA DATA PRODUCTS

Title	Description	URL
NASA JPL ARIA GPS Coseismic Displacement Map	NASA JPL ARIA GPS Coseismic Displacement Map - Map of observed values of horizontal surface displacement caused by the earthquake. Used to identify areas with large displacement. Map shows vectors at the location of the GPS stations that provided data.	http://aria-share.jpl.nasa.gov/events/20140824-south_napa/gps/20140824_Napa_ARIA_RapidOffsets.pdf
NASA JPL ARIA GPS Coseismic Displacement Values	NASA JPL ARIA GPS Coseismic Displacement Values - Observed values of horizontal surface displacement caused by the earthquake. Used to identify areas with large displacement.	http://aria-share.jpl.nasa.gov/events/20140824-south_napa/gps/20140824_Napa_ARIA_RapidOffsets.txt
NASA JPL ARIA GPS Coseismic Displacement Map - Version 2	NASA JPL ARIA GPS Coseismic Displacement Map - Map of observed values of horizontal surface displacement caused by the earthquake. Used to identify areas with largedisplacement. Map shows vectors at the location of the GPS stations that provided data. Map also has surface rupture identified by Mike Oskin (red line). This version includes offsets from more GPS sites.	http://aria-share.jpl.nasa.gov/events/20140824-south_napa/gps/20140824_Napa_ARIA_RapidOffsets.v2.pdf
NASA JPL ARIA GPS Coseismic Displacement Values - Version 2	NASA JPL ARIA GPS Coseismic Displacement Values - Observed values of horizontal surface displacement caused by the earthquake. Used to identify areas with large displacement. This version has displacements from additional GPS sites in the region.	http://aria-share.jpl.nasa.gov/events/20140824-south_napa/gps/20140824_Napa_ARIA_RapidOffsets.v2.txt
NASA JPL ARIA GPS Coseismic Displacement Map - Comparison of Offsets	NASA JPL ARIA GPS Coseismic Displacement Map - Map of observed values of horizontal surface displacement caused by the earthquake based on results from first 13.5 hours after the earthquake and comparing to results based on GPS data from Monday, August 25, 2014. Used to show that increase in surface rupture offset between Sunday, August 24th and Monday August 25th was not seen in GPS data. This is consistent with the additional offsets at surface rupture being caused by very shallow slip.	http://aria-share.jpl.nasa.gov/events/20140824-south_napa/gps/20140824_Napa_ARIA_RapidOffsets.compare.pdf

Title	Description	URL
NASA JPL ARIA InSAR Coseismic Displacement Map from Descending Orbit (wrapped Interferogram)	NASA JPL ARIA InSAR Coseismic Deformation Map (wrapped interferogram) - The JPL/Caltech ARIA team in collaboration with ASI/CIDOT have generated a coseismic interferogram for 2014/08/24 M6.0 South Napa Earthquake, California. The image is derived from COSMO-SkyMed data acquired on 2014/07/26 and 2014/08/27. One color cycle represents 1.56 cm of LOS displacement. LOS for this observation is 29 degrees from vertical and roughly west. The epicenter indicated with the red star is from USGS NEIC. The white line indicates California Aqueduct #2 (North Bay Aqueduct). COSMO-SkyMed data (c) ASI 2014.	http://aria-share.jpl.nasa.gov/events/20140824-south_napa/interferogram/ARIA_NapaEQ_CSK_D74_coseis_ifg.kmz
NASA JPL ARIA SAR Damage Proxy Map	NASA JPL ARIA SAR Damage Proxy Map - The JPL/Caltech ARIA team in collaboration with ASI/CIDOT have generated a Damage Proxy Map for 2014/08/24 M6.0 South Napa Earthquake, California. Red pixels indicate areas affected by the earthquake - potentially due to building collapse, landslides, or liquefaction. This Damage Proxy Map is preliminary and has not been validated with any optical imagery or observations from the field.	http://aria-share.jpl.nasa.gov/events/20140824-south_napa/dpm/ARIA_CSK_DPMs_th0.02.kmz
NASA JPL ARIA InSAR Coseismic Displacement Map from Descending Orbit (unwrapped interferogram)	NASA JPL ARIA InSAR Coseismic Deformation Map (unwrapped interferogram) - Interferometric Synthetic Aperture Radar (InSAR) map of coseismic displacement in the radar line-of-sight (LOS, 29 degrees from vertical and roughly west) caused by the 2014/08/24 M6.0 South Napa Earthquake, California. Derived from COSMO-SkyMed data acquired on 2014/07/26 and 2014/08/27. Processed by ARIA team at JPL-Caltech in collaboration with the Italian Space Agency (ASI) and University of Basilicata. The epicenter indicated with the red star is from USGS NEIC. The blue line indicates the North Bay Aqueduct. COSMO-SkyMed data (c) ASI 2014.	http://aria-share.jpl.nasa.gov/events/20140824-south_napa/interferogram/ARIA_NapaEQ_CSK_D74_coseis_unw.kmz
NASA JPL ARIA InSAR Coseismic Displacement Data from Descending Orbit (unwrapped interferogram)	NASA JPL ARIA InSAR Coseismic Deformation Map (unwrapped interferogram) - Interferometric Synthetic Aperture Radar (InSAR) map of coseismic displacement in the radar line-of-sight (LOS, 29 degrees from vertical and roughly west) caused by the 2014/08/24 M6.0 South Napa Earthquake, California. Derived from COSMO-SkyMed data acquired on 2014/07/26 and 2014/08/27. Processed by ARIA team at JPL-Caltech in collaboration with the Italian Space Agency (ASI) and University of Basilicata. The epicenter indicated with the red star is from USGS NEIC. The blue line indicates the North Bay Aqueduct. COSMO-SkyMed data (c) ASI 2014.	http://aria-share.jpl.nasa.gov/events/20140824-south_napa/interferogram/ARIA_NapaEQ_CSK_dsc_coseismic_unw.zip

Title	Description	URL
NASA JPL ARIA InSAR Coseismic Displacement Map from Ascending Orbit (wrapped interferogram)	Interferometric Synthetic Aperture Radar (InSAR) map of coseismic displacement in the radar line-of-sight (LOS, 40 degrees from vertical and roughly east) caused by the 2014/08/24 M6.0 South Napa Earthquake, California. Derived from radar data of COSMO-SkyMed satellite in ascending orbit acquired on 2014/06/19 and 2014/09/03. Processed by ARIA team at JPL-Caltech in collaboration with the Italian Space Agency (ASI) and University of Basilicata. The epicenter indicated with the red star is from USGS NEIC. COSMO-SkyMed data (c) ASI 2014.	http://aria-share.jpl.nasa.gov/events/20140824-south_napa/interferogram/ARIA_NapaEQ_CSK_A126_coseis_wrapped.kmz
NASA JPL ARIA InSAR Coseismic Displacement Map from Ascending Orbit (unwrapped interferogram)	Interferometric Synthetic Aperture Radar (InSAR) map of coseismic displacement in the radar line-of-sight (LOS, 40 degrees from vertical and roughly east) caused by the 2014/08/24 M6.0 South Napa Earthquake, California. Derived from radar data of COSMO-SkyMed satellite in ascending orbit acquired on 2014/06/19 and 2014/09/03. Processed by ARIA team at JPL-Caltech in collaboration with the Italian Space Agency (ASI) and University of Basilicata. The epicenter indicated with the red star is from USGS NEIC. COSMO-SkyMed data (c) ASI 2014.	http://aria-share.jpl.nasa.gov/events/20140824-south_napa/interferogram/ARIA_NapaEQ_CSK_A126_coseis_unw.kmz
NASA JPL ARIA InSAR Coseismic Displacement Data from Ascending Orbit (unwrapped interferogram)	Interferometric Synthetic Aperture Radar (InSAR) map of coseismic displacement in the radar line-of-sight (LOS, 40 degrees from vertical and roughly east) caused by the 2014/08/24 M6.0 South Napa Earthquake, California. Derived from radar data of COSMO-SkyMed satellite in ascending orbit acquired on 2014/06/19 and 2014/09/03. Processed by ARIA team at JPL-Caltech in collaboration with the Italian Space Agency (ASI) and University of Basilicata. The epicenter indicated with the red star is from USGS NEIC. COSMO-SkyMed data (c) ASI 2014.	http://aria-share.jpl.nasa.gov/events/20140824-south_napa/interferogram/ARIA_NapaEQ_CSK_A126_coseis_unw.zip

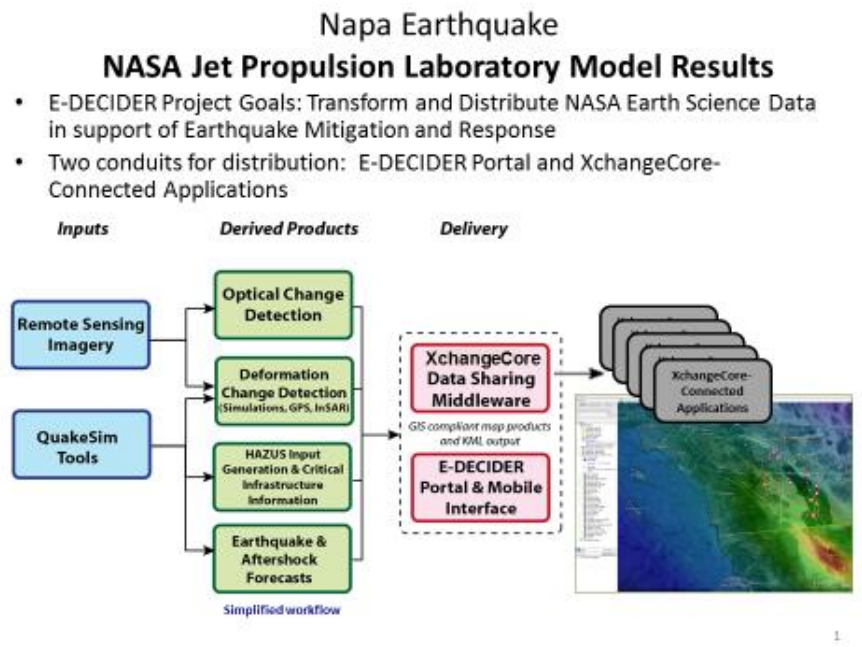

Figure 1. Screen capture image of the NASA JPL model results

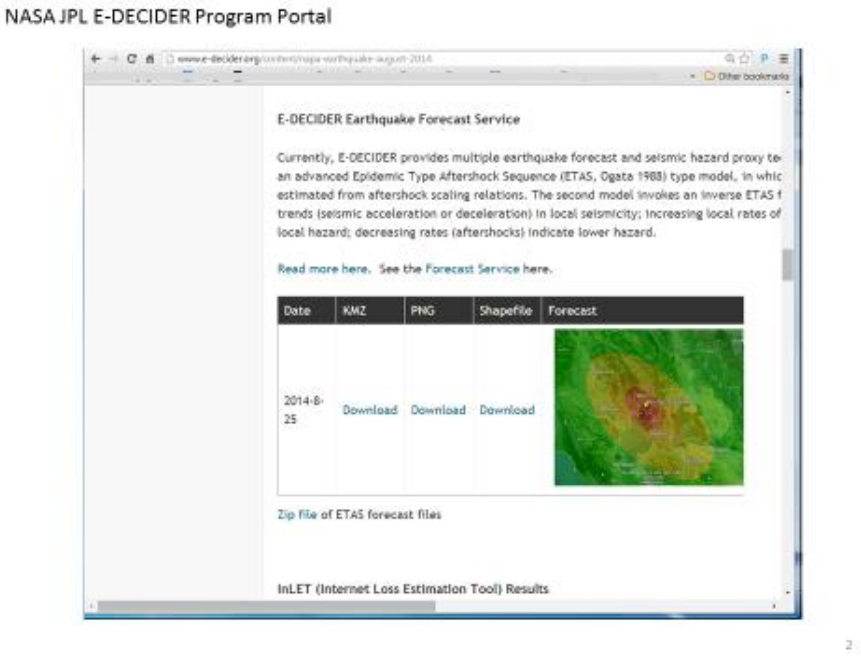

Figure 2. Screen capture image of the NASA JPL E-DECIDER program portal

XchangeCore-Connected Application 1: ArcGIS Online

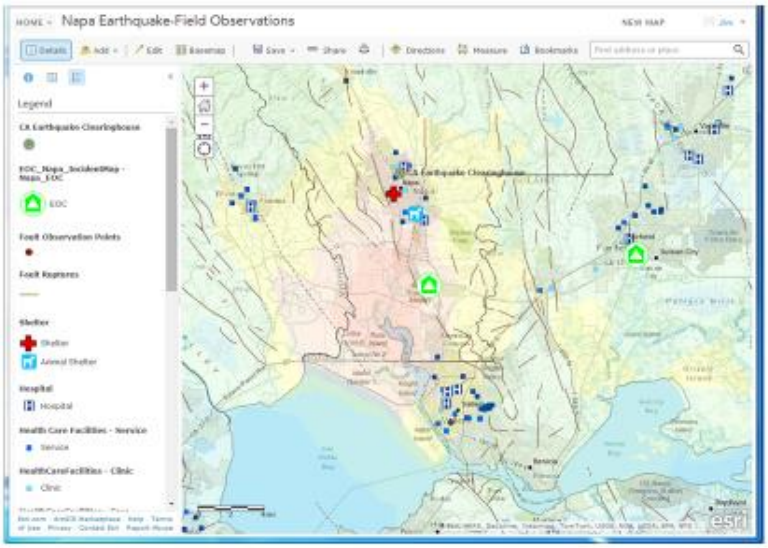

Figure 3. Screen capture image of XchangeCore connected application 1: ArcGIS Online

XchangeCore-Connected Application 1: ArcGIS Online Connector to XchangeCore

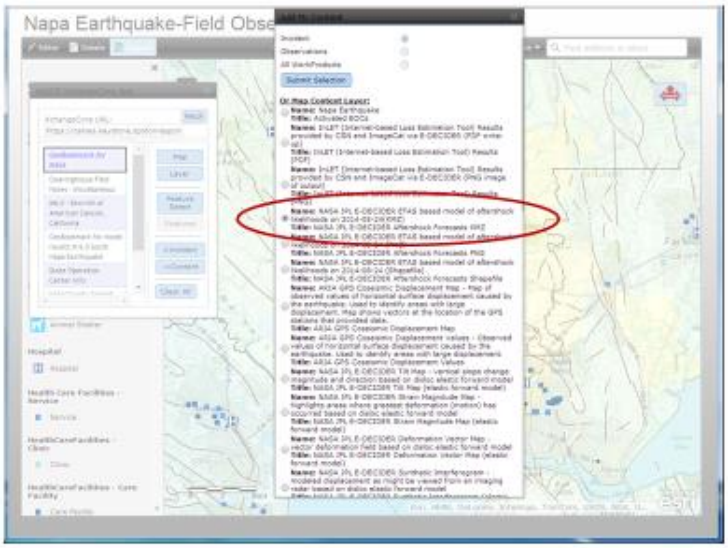

Figure 4. Screen capture image of XchangeCore-connected application 1: ArcGIS Online connector to XchangeCore

XchangeCore-Connected Application 1: ArcGIS Online with NASA JPL Model Results

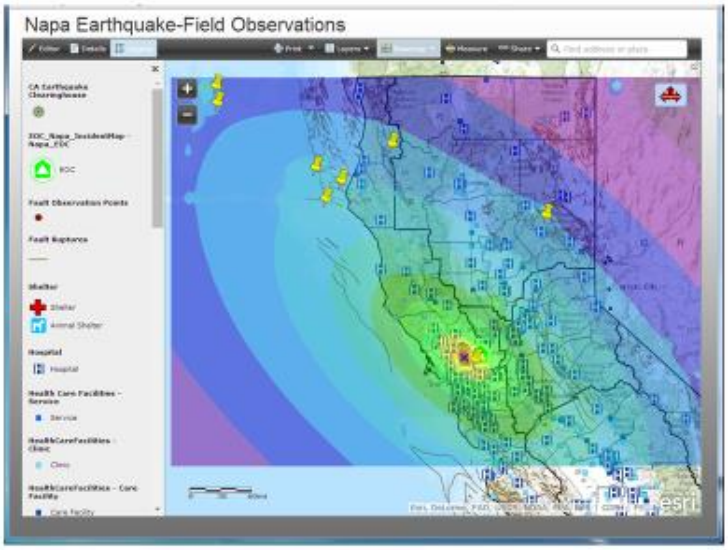

Figure 5. Screen capture image of XchangeCore-connected application 1: ArcGIS Online with NASA JPL model results

XchangeCore-Connected Application 2: SpotOnResponse

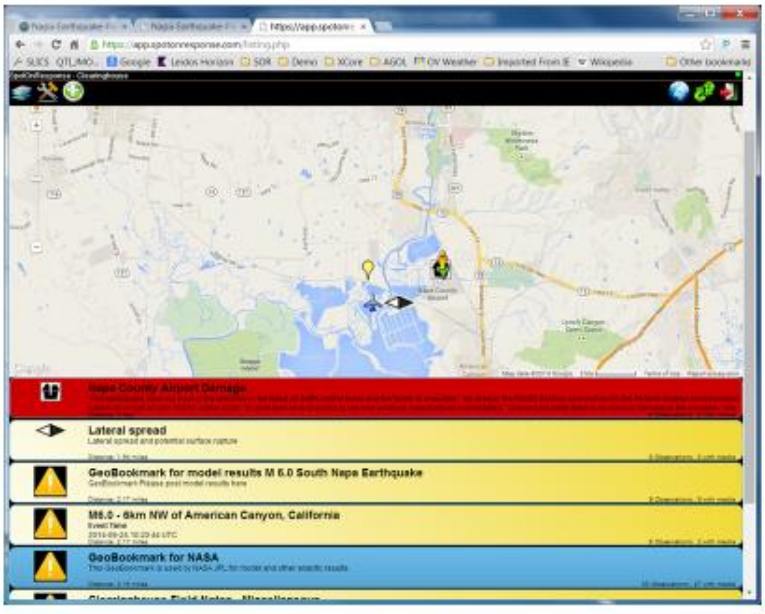

Figure 6. Screen capture image of XchangeCore-connected application 2: SpotOnResponse

XchangeCore-Connected Application 2: SpotOnResponse with NASA JPL Model Results

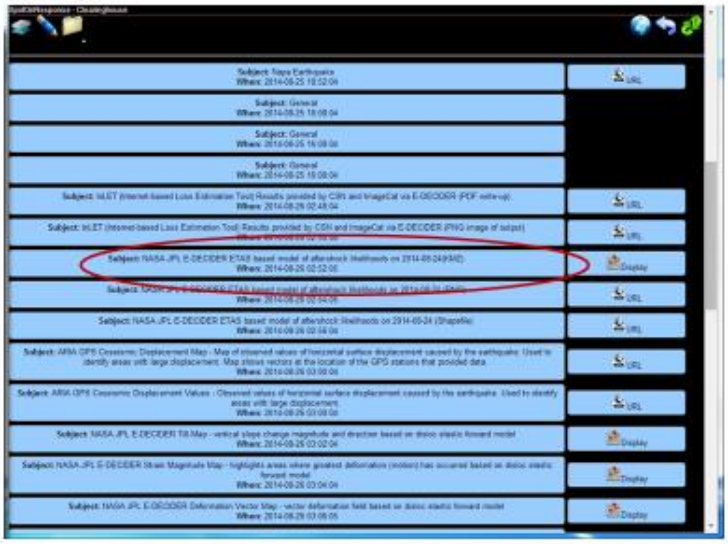

Figure 7. Screen capture image of XchangeCore-connected application 2: SpotOnResponse with NASA JPL model results

XchangeCore-Connected Application 2: SpotOnResponse with NASA JPL Model Results

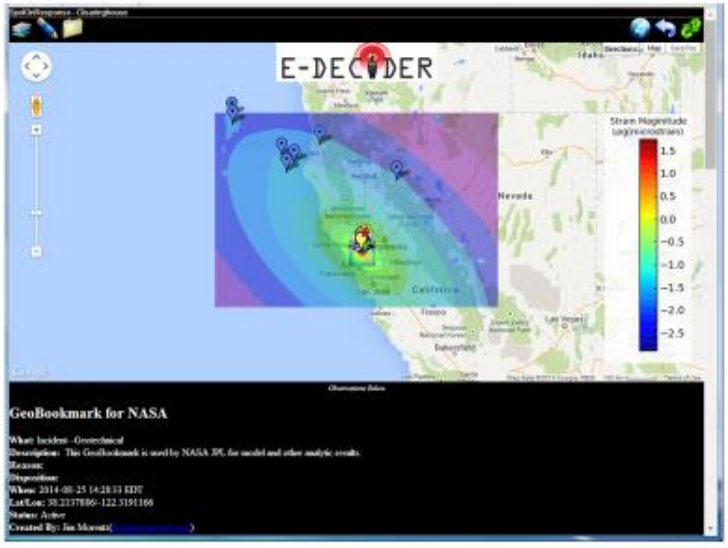

Figure 8. Screen capture image of XchangeCore-connected application 2: SpotOnResponse with NASA JPL model results

XchangeCore-Connected Application 3: Google Earth

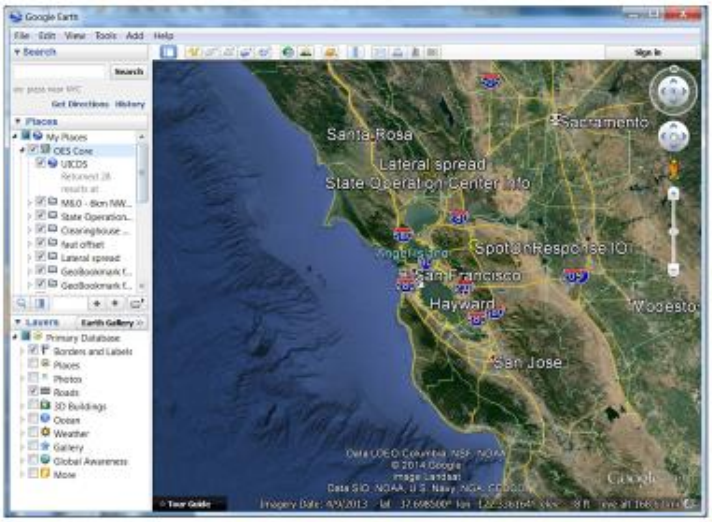

Figure 9. Screen capture image of XchangeCore-connected application 3: Google Earth

XchangeCore-Connected Application 3: Google Earth with NASA JPL Model Results

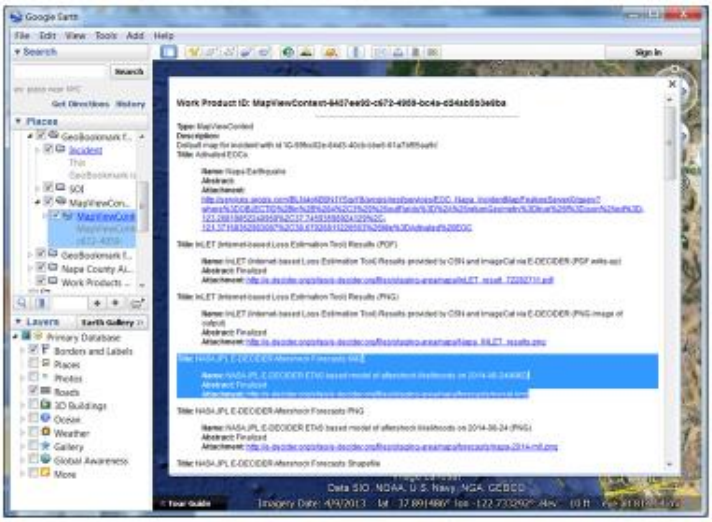

Figure 10. Screen capture image of XchangeCore-connected application 3: Google Earth with NASA JPL model results

XchangeCore-Connected Application 3: Google Earth with NASA JPL Model Results

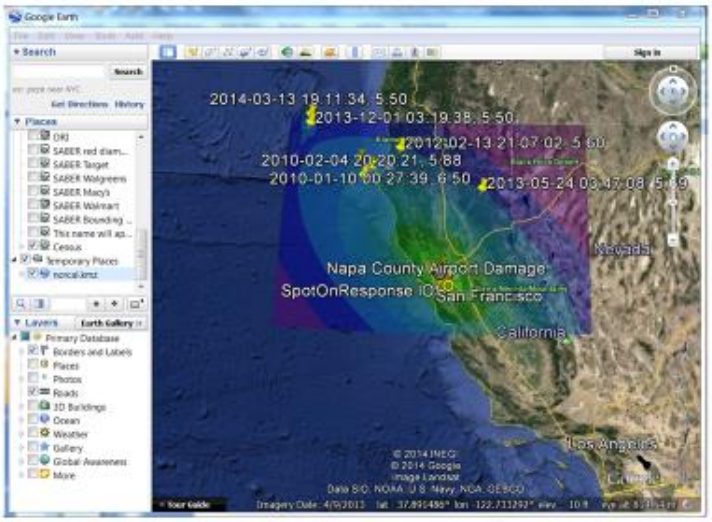

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Figure 11. Screen capture image of XchangeCore-connected application 3: Google Earth with NASA JPL model results

NASA JPL HAZUS Model Results through XchangeCore

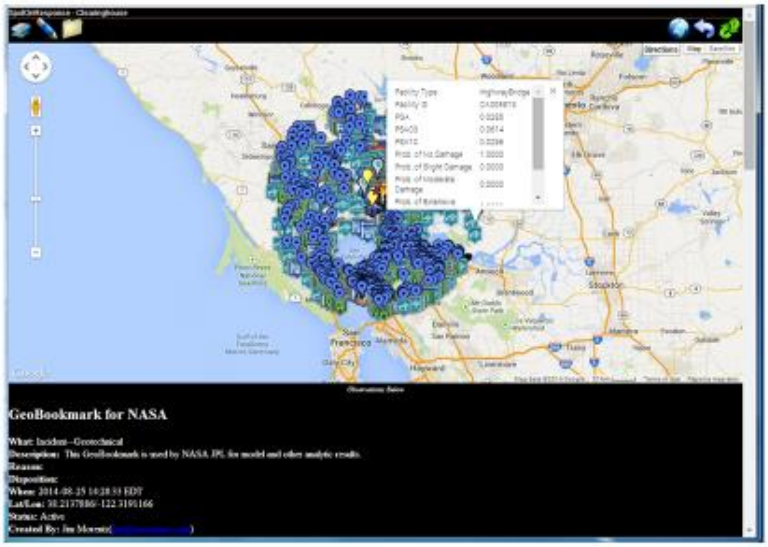

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Figure 12. Screen capture image NASA JPL HAZUS model results through XchangeCore

NASA JPL HAZUS Model Results through XchangeCore

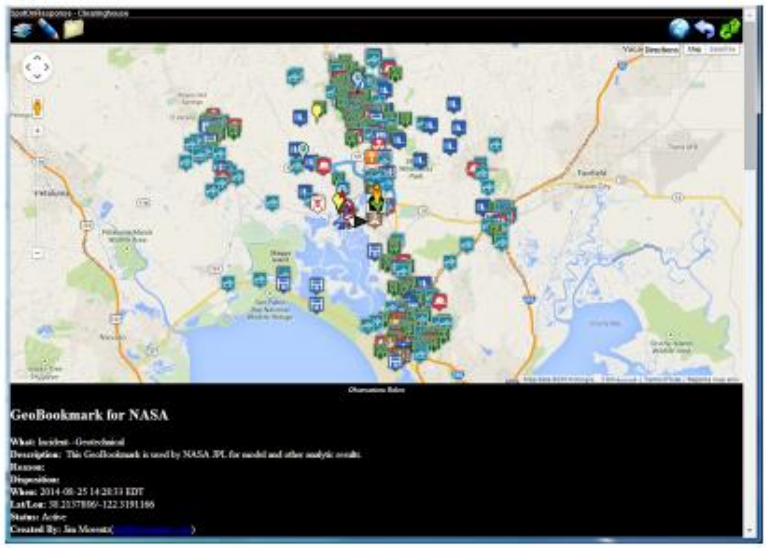


Figure 13. Screen capture image NASA JPL HAZUS model results through XchangeCore

Partial listing of NASA JPL HAZUS Model Results through XchangeCore as appeared in SpotOnResponse

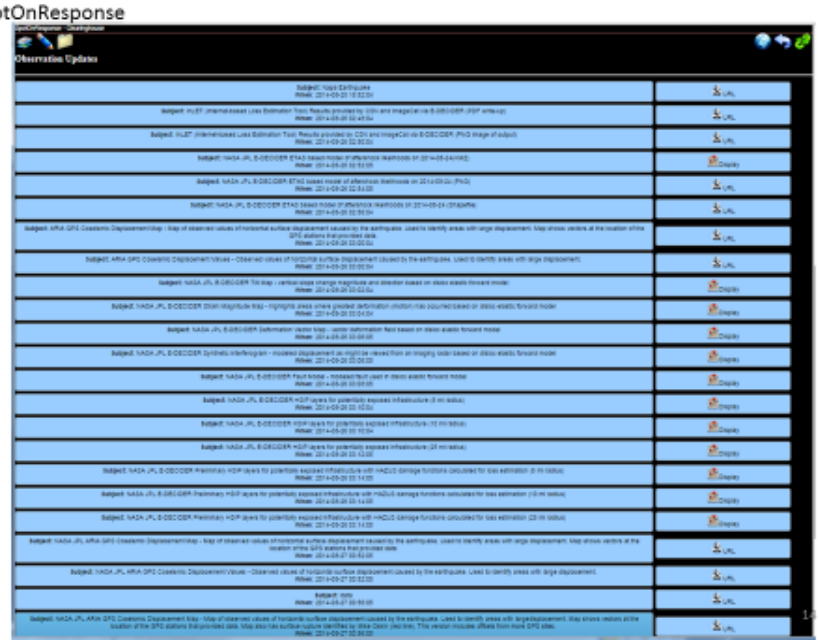
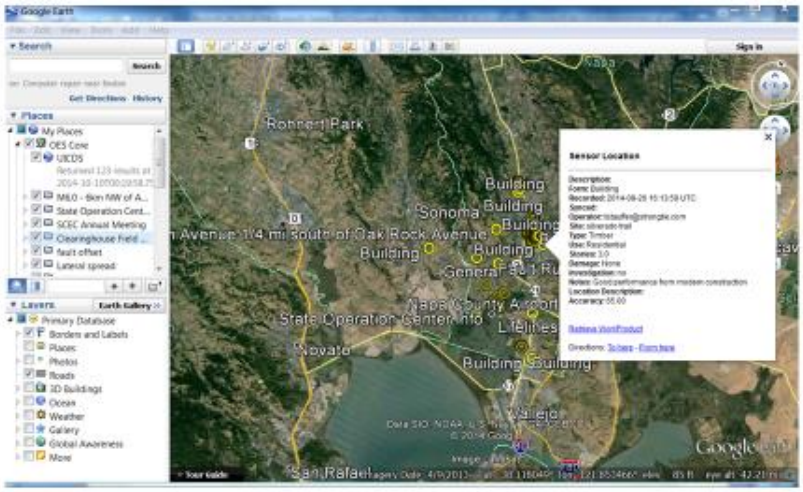


Figure 14. Screen capture image partial listing of NASA JPL HAZUS model results through XchangeCore as appeared in SpotOnResponse

Clearinghouse Field Notes through XchangeCore visualized in Google Earth



15

Figure 15. Screen capture image Clearinghouse Fieldnotes through XchangeCore visualized in Google Earth

Clearinghouse Field Notes through XchangeCore visualized in SpotOnResponse

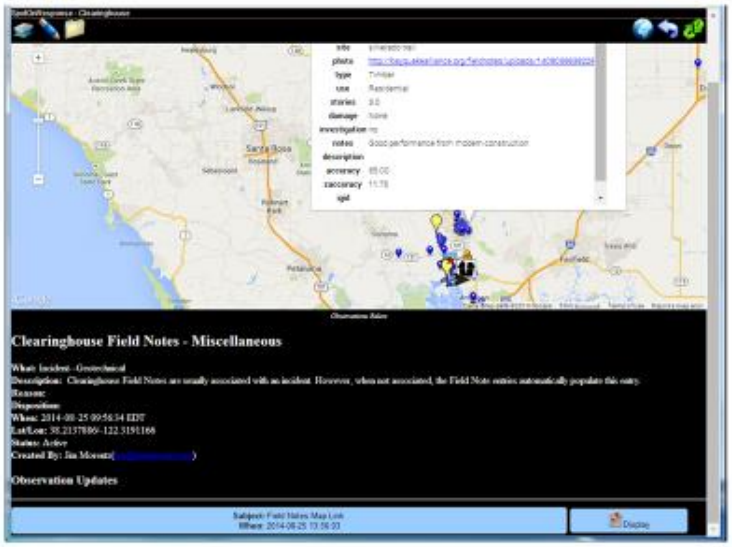


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Figure 16. Screen capture image Clearinghouse Fieldnotes through XchangeCore visualized in SpotOnResponse

Partial listing and location map display of Clearinghouse Field Notes available through XchangeCore as appeared in SpotOnResponse

Figure 17. Partial listing and location map display of Clearinghouse Fieldnotes available through XchangeCore as appeared in SpotOnResponse

Clearinghouse Field Notes integrated with overlay of NASA JPL model results available through XchangeCore as appeared in SpotOnResponse

Figure 18. Clearinghouse Fieldnotes integrated with overlay of NASA PL model results available through XchangeCore as appeared in SpotOnResponse