Post- and Co-Tsunami Science Teams: Cascadia Planning, Northern California

15-357

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http://www.tsu.cascadiageo.org/

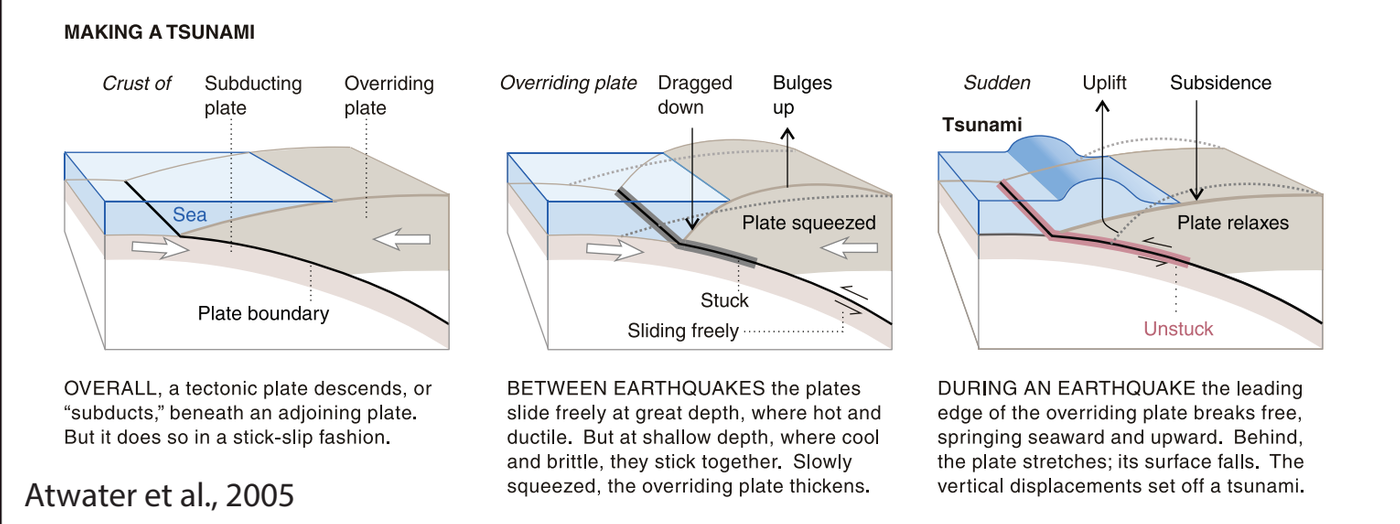
HUMBOLDT STATE UNIVERSITY

Cascadia GeoSciences

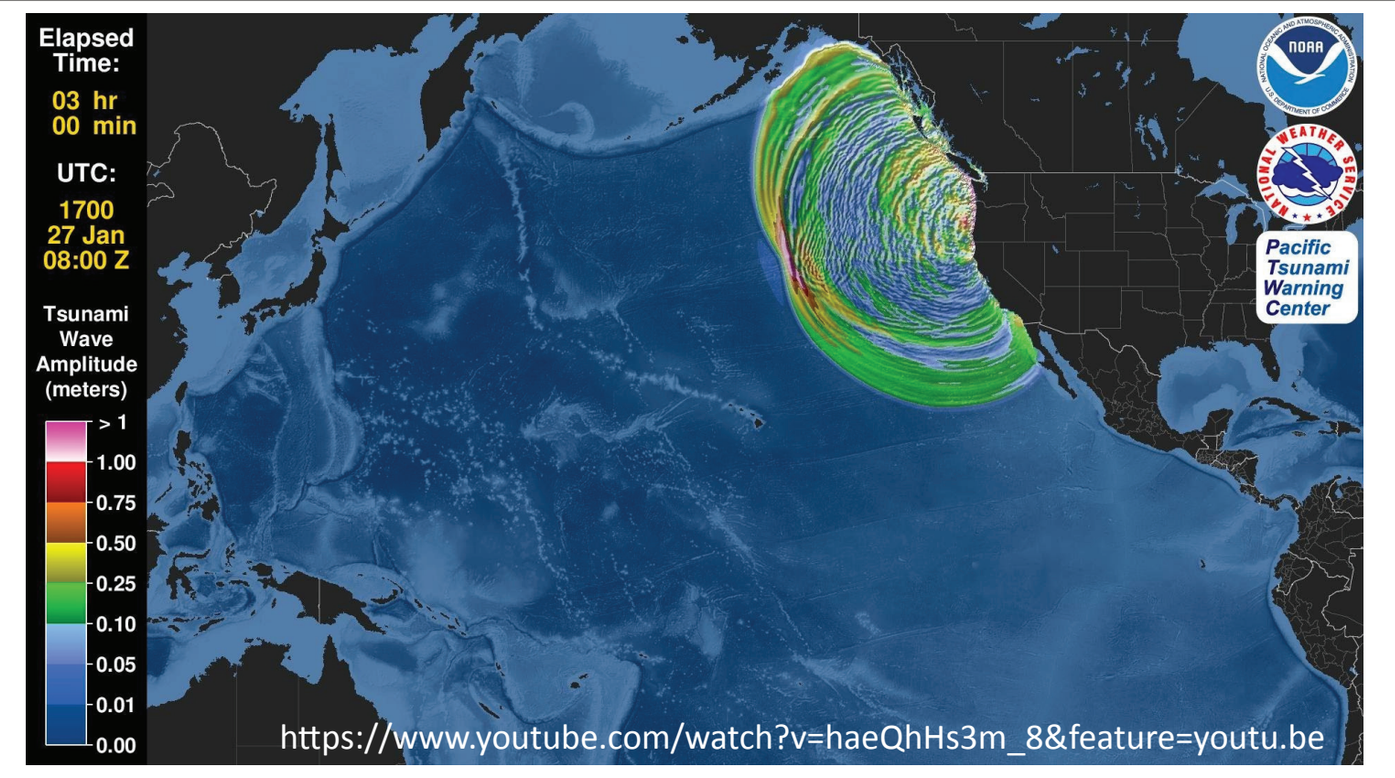
California Earthquake Clearinghouse
2014 Cascadia Earthquake and Tsunami Exercise Series
May 14, 2014

Cascadia subduction zone

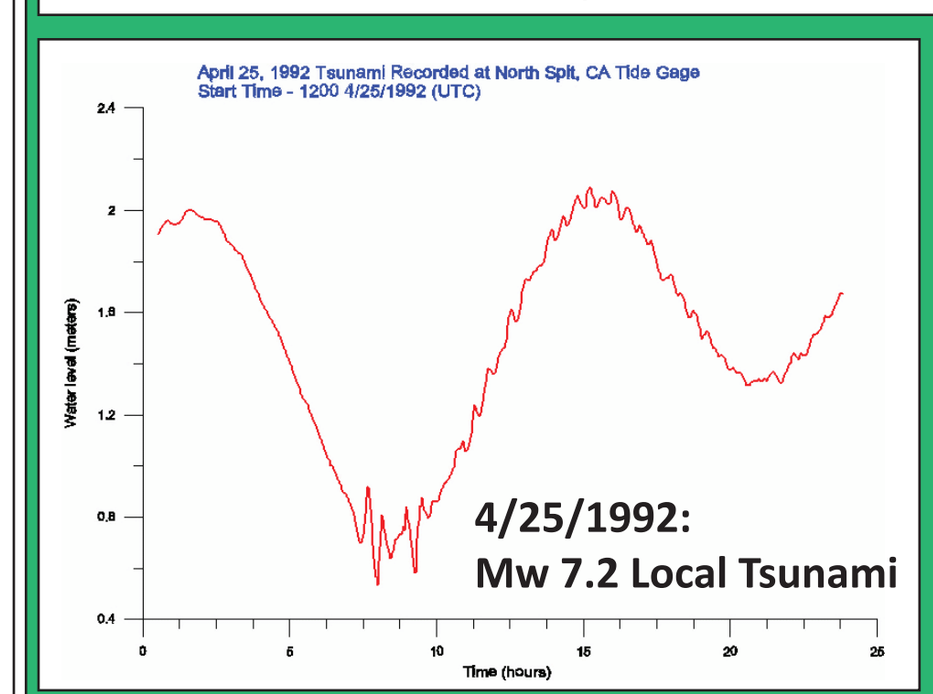
Plate configuration for the Cascadia subduction zone (CSZ). Juan de Fuca and Gorda plates are subducting northeastwardly oblique beneath the North America plate at ~36 mm/yr in the Humboldt Bay region. Paleoseismic core sites (marine and terrestrial) are plotted as circles. Chaytor et al. (2004) Nelson et al. (2004)



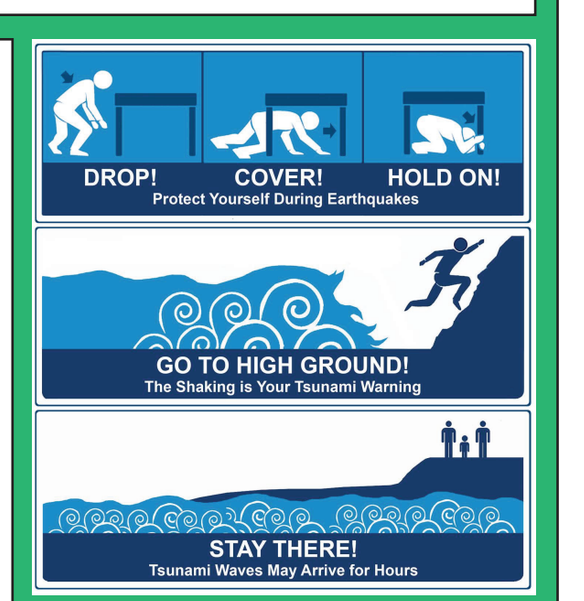
Atwater et al., 2005



RIFT Tsunami Forecast Model Animation: M = 9.2 Earthquake, Cascadia subduction zone, 26, January 1700

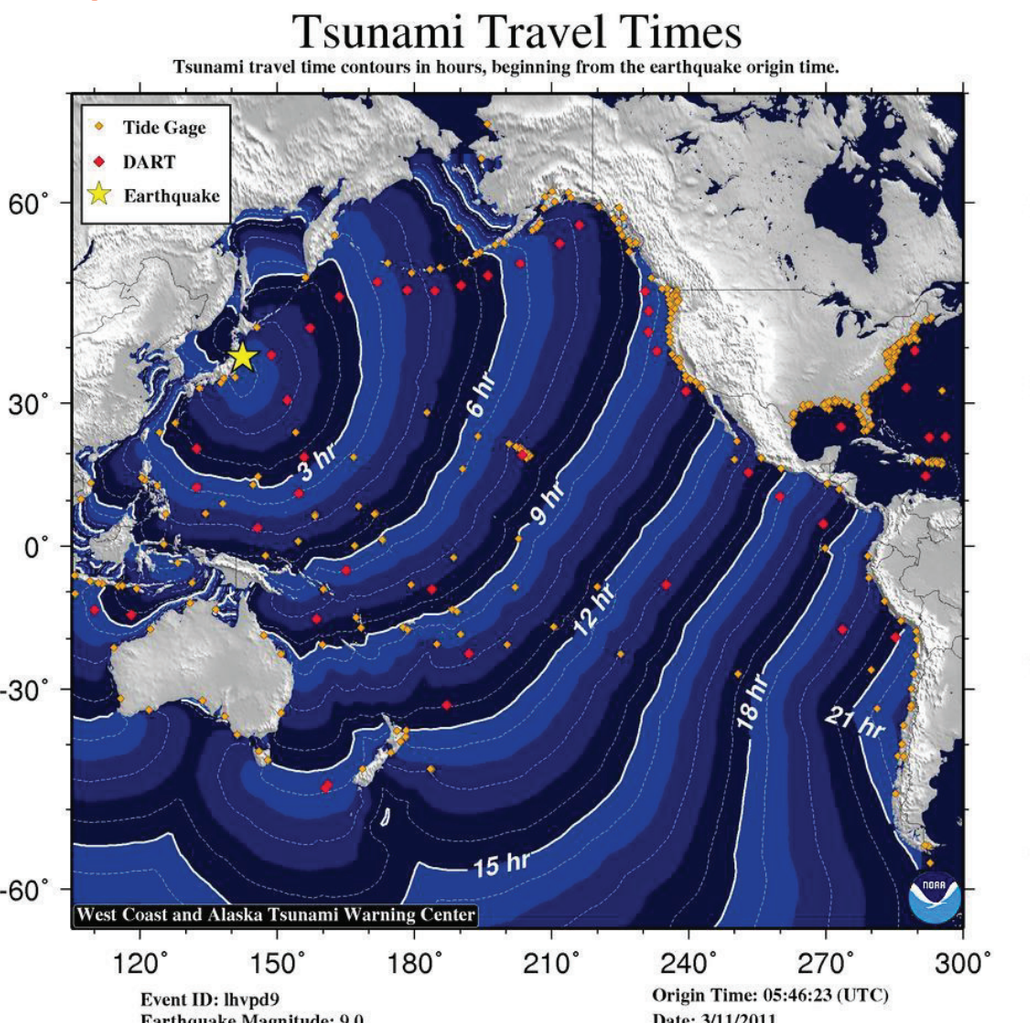


4/25/1992: Mw 7.2 Local Tsunami

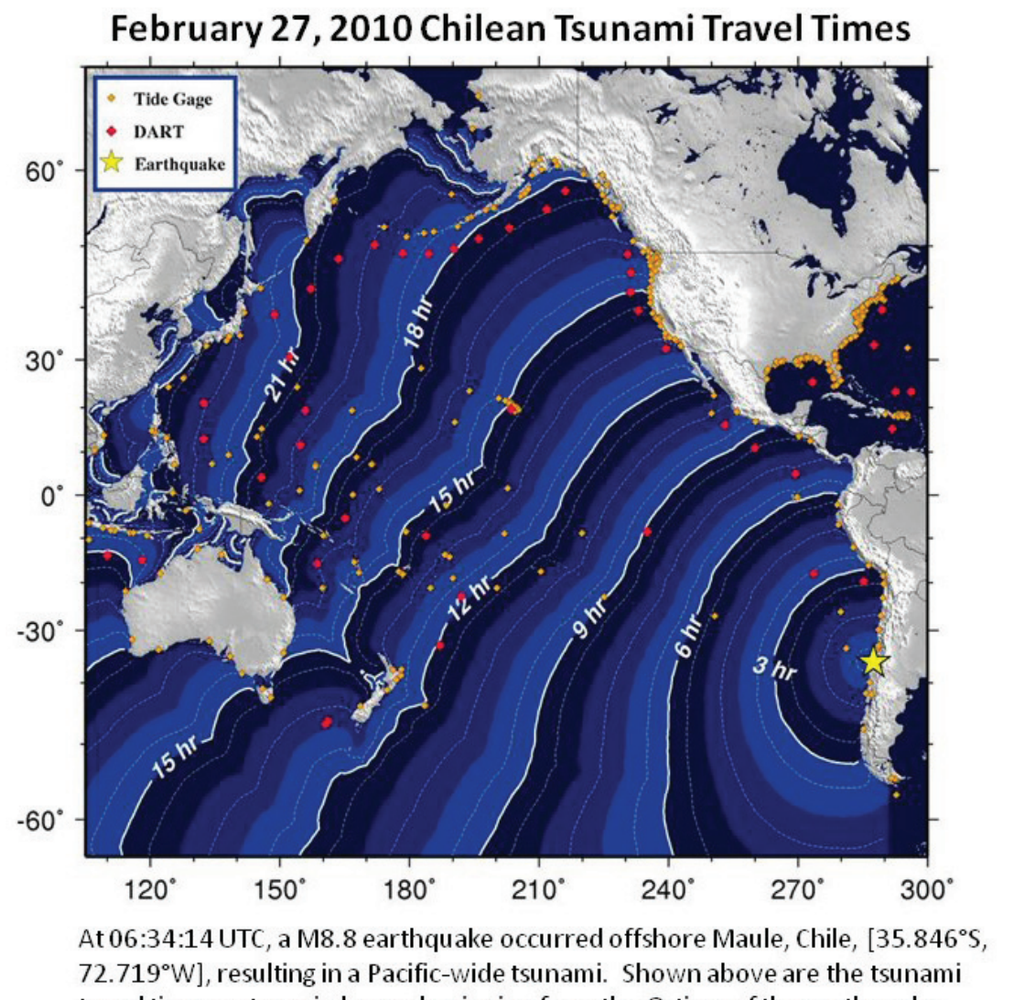


Tsunami Travel Time Maps: Distant Tsunami

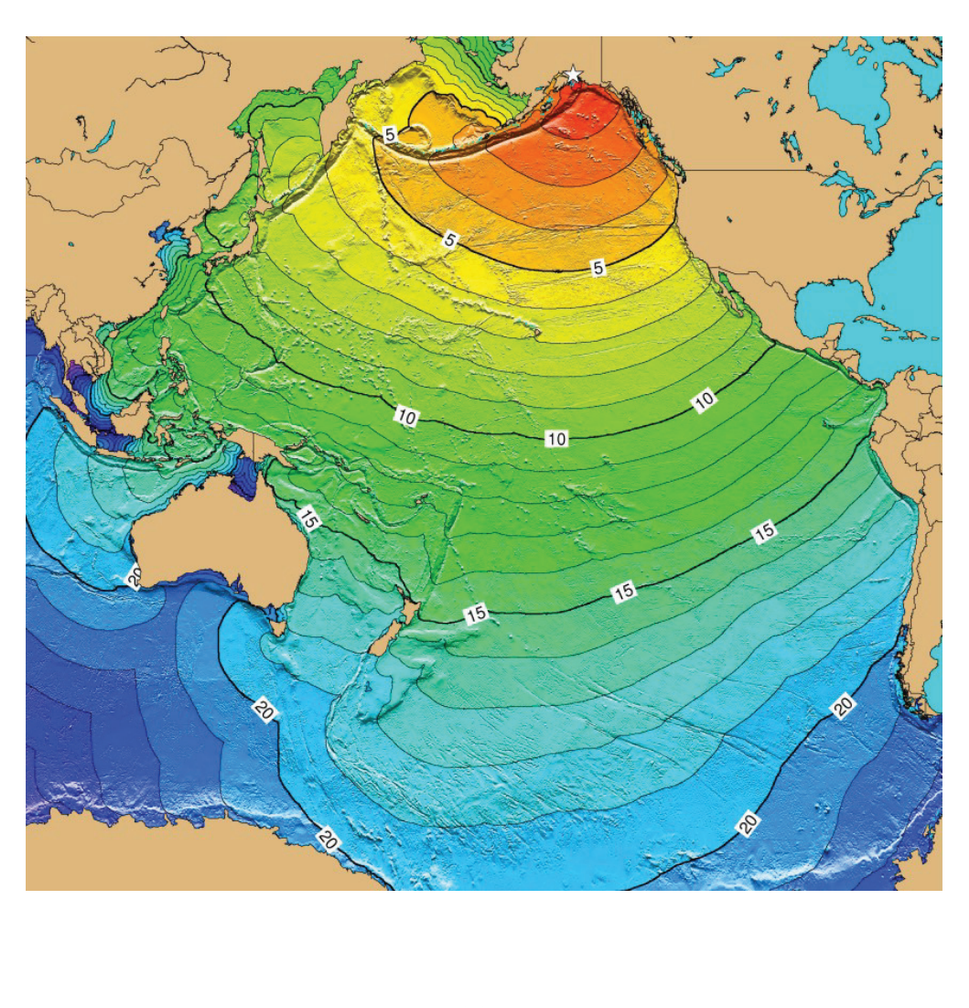
Japan 2011



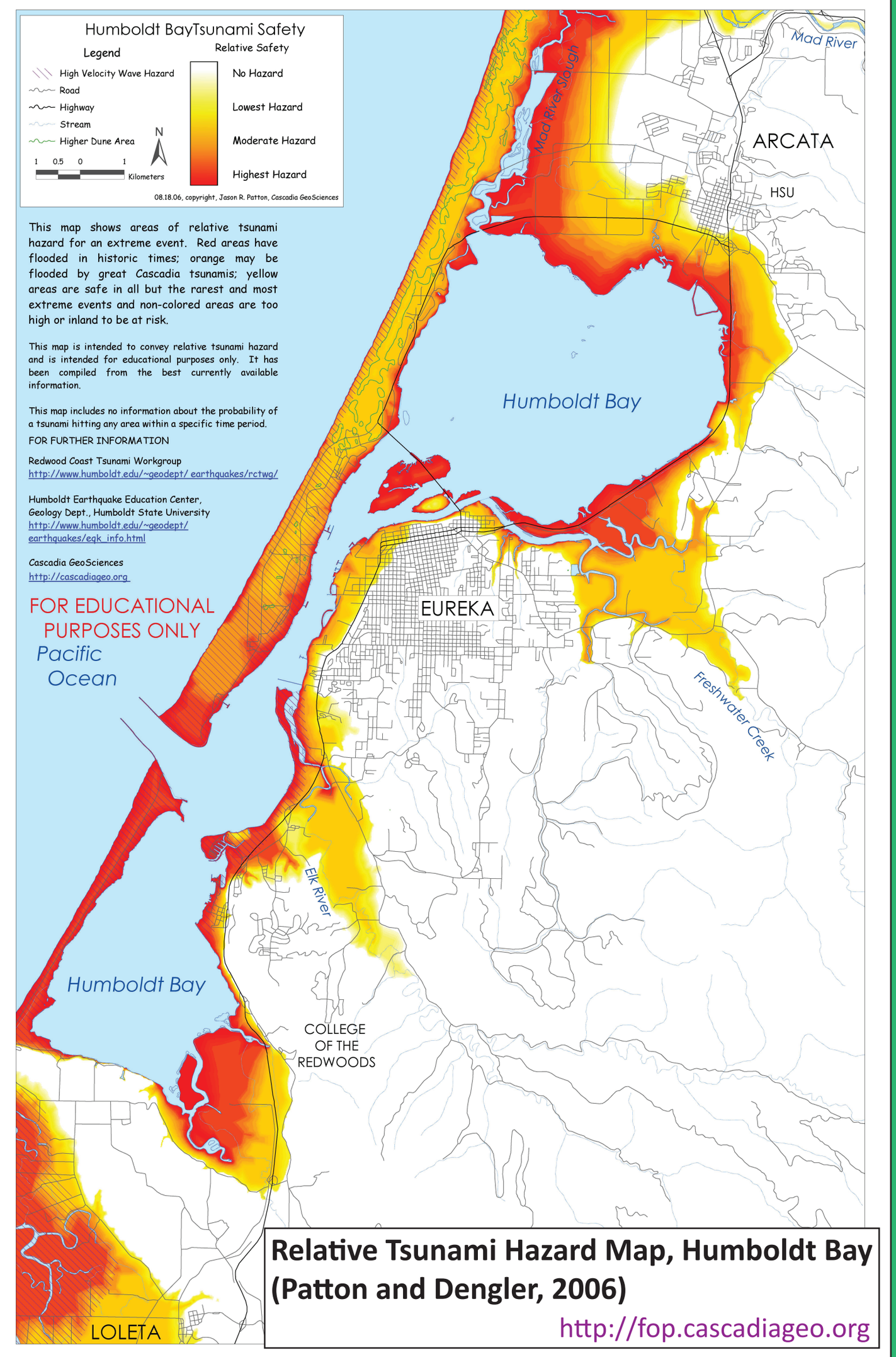
Chile 2010



Alaska 1964

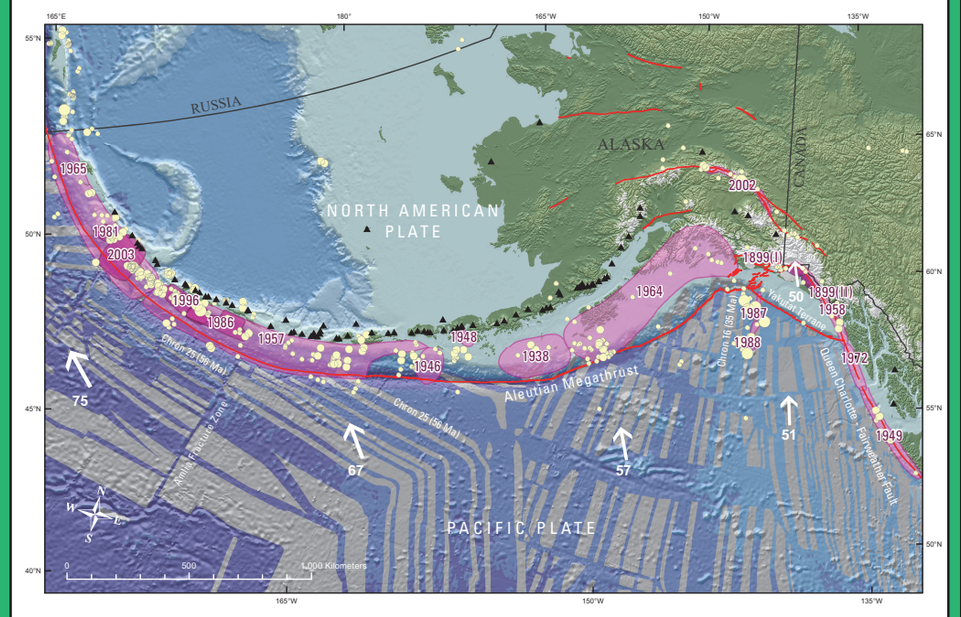


http://ntwc.arh.noaa.gov/about/

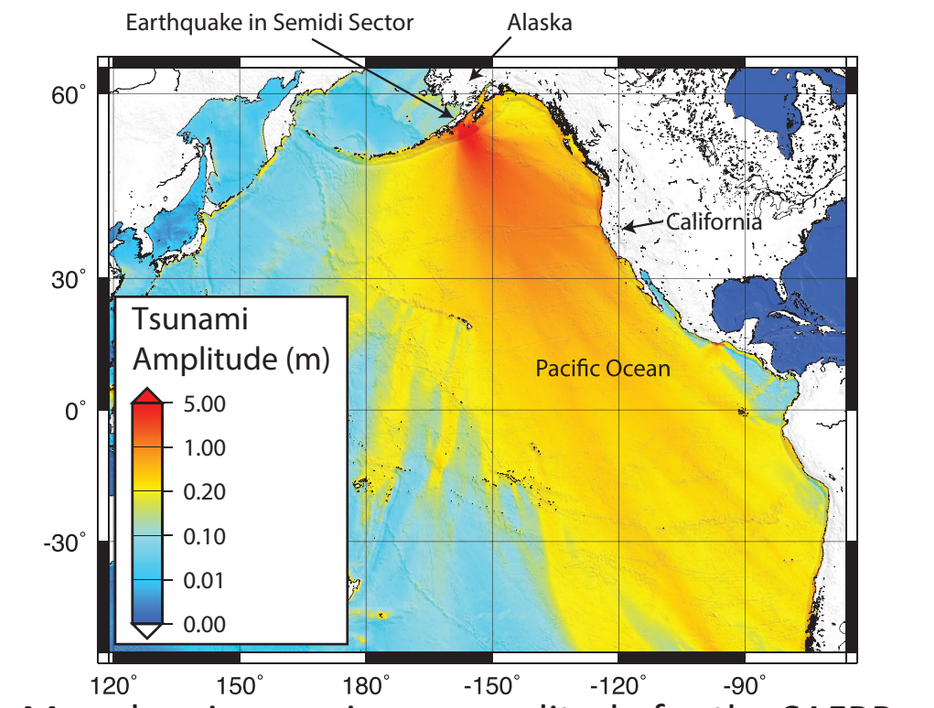


Relative Tsunami Hazard Map, Humboldt Bay (Patton and Dengler, 2006)

http://fop.cascadiageo.org



Historic subduction zone earthquakes along the Alaska-Aleutian subduction zone system. (Peter Haeussler, USGS)

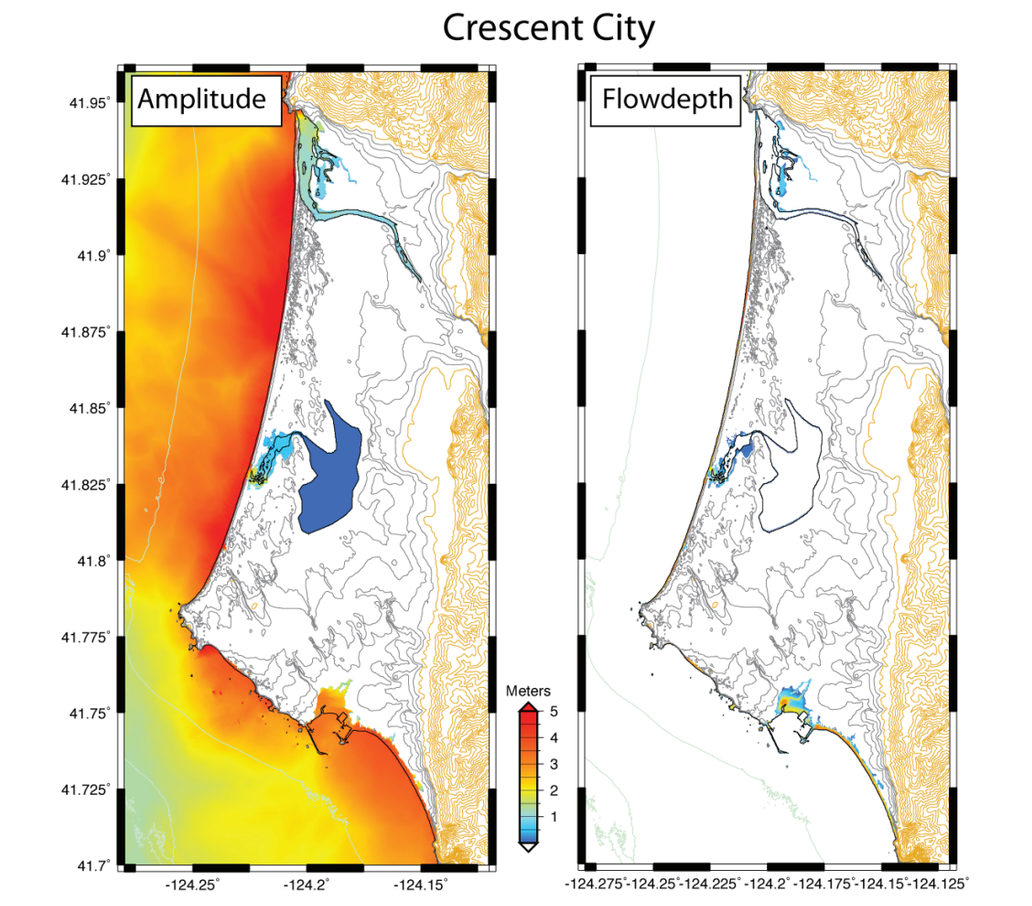


Map showing maximum amplitude for the SAFRR Tsunami Scenario. (Ross et al., 2013)

Real Time observations of local and distant tsunami impacts provide data for calibration and validation of models used by emergency managers and tsunami scientists to forecast and plan for tsunami hazards and risks. Self-selected researchers formed a Tsunami Science team in order to develop standard operating procedures (SOPs) to document potential earthquake and tsunami impacts in Humboldt and Del Norte counties, California. The SOPs utilized various forms of data collection and data sharing strategies including the California Office of Emergency Services (CalOES) Earthquake Clearinghouse, the SpotOnResponse online "app" and website, and the California Geological Survey (CGS) Basecamp online geospatial databases. The field team represented the northern region of the state-wide Earthquake and Tsunami Field-Team Clearinghouses run by CGS and CalOES. The Tsunami Science team conducts annual exercises.

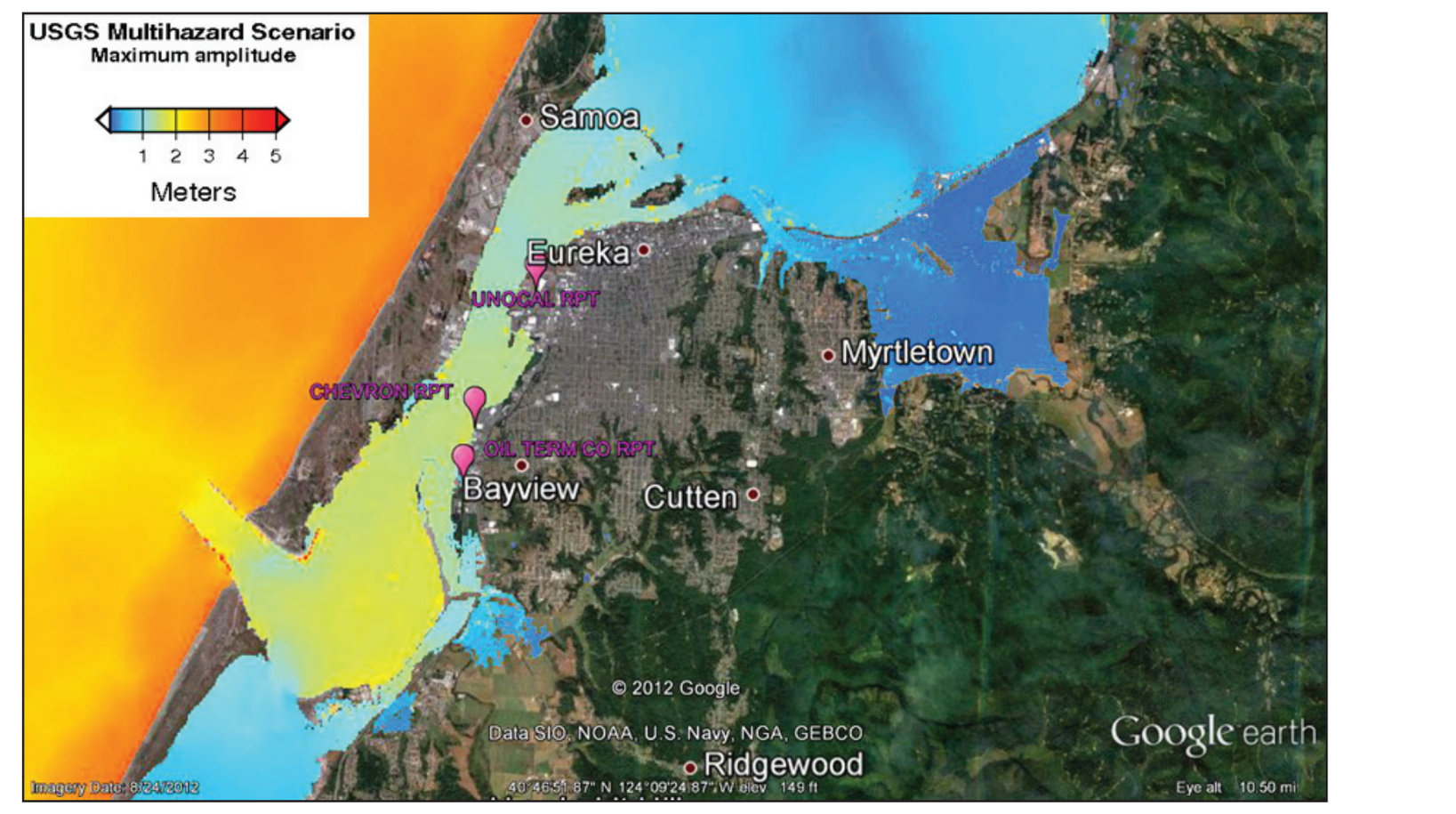
In conjunction with the May 2014 Federal Emergency Management Agency Cascadia subduction zone exercise, our team conducted a tabletop exercise where we provided pre-event situation reports to CalOES as injects. During the exercise, we collected and uploaded observations and interacted with upstream and downstream consumers of simulated real time tsunami. Based on the team's initial observations, CalOES was able to direct team members to collect additional data. Through this exercise, our team, CalOES, CGS, USGS, and other partners identified weaknesses and ways to create a more seamless and operational emergency response process. The Tsunami Science team hopes to build an inventory of data collection and support equipment, recruit new team members, and to further develop relationships with emergency managers to more efficiently operate during a real emergency response operation. Supporting material is posted to our website: http://www.tsu.cascadiageo.org/

Crescent City



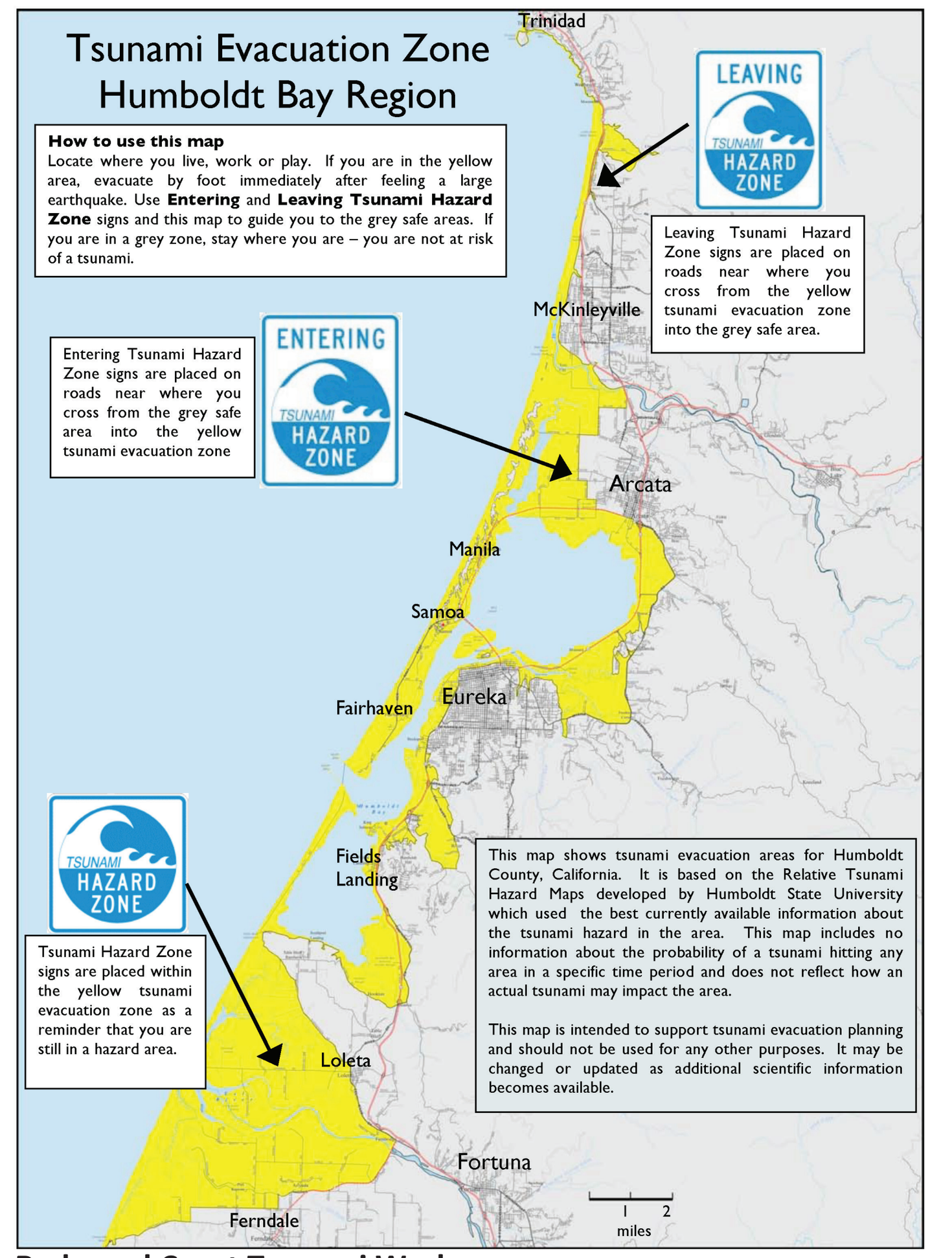
Maps showing maximum amplitude and flow depth of the scenario tsunami around Crescent City, California. (Ross et al., 2013)

Maximum amplitude of the scenario tsunami, SAFRR.



Humboldt Bay, California, showing the three oil facilities in the area and annotated with tsunami flood depths for the SAFRR tsunami scenario. (Ross et al., 2013)

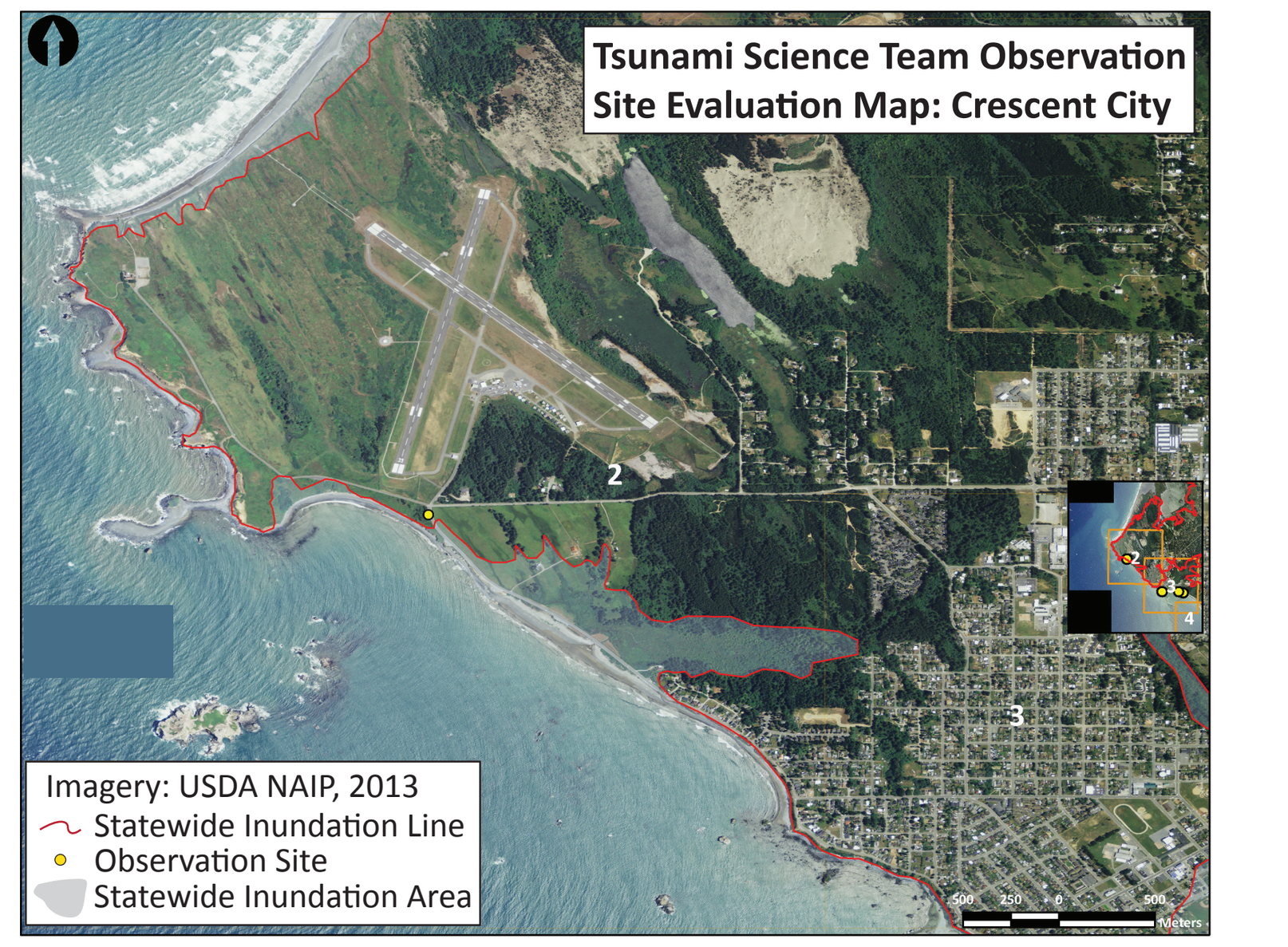
Tsunami Evacuation Map Humboldt Bay



Redwood Coast Tsunami Workgroup

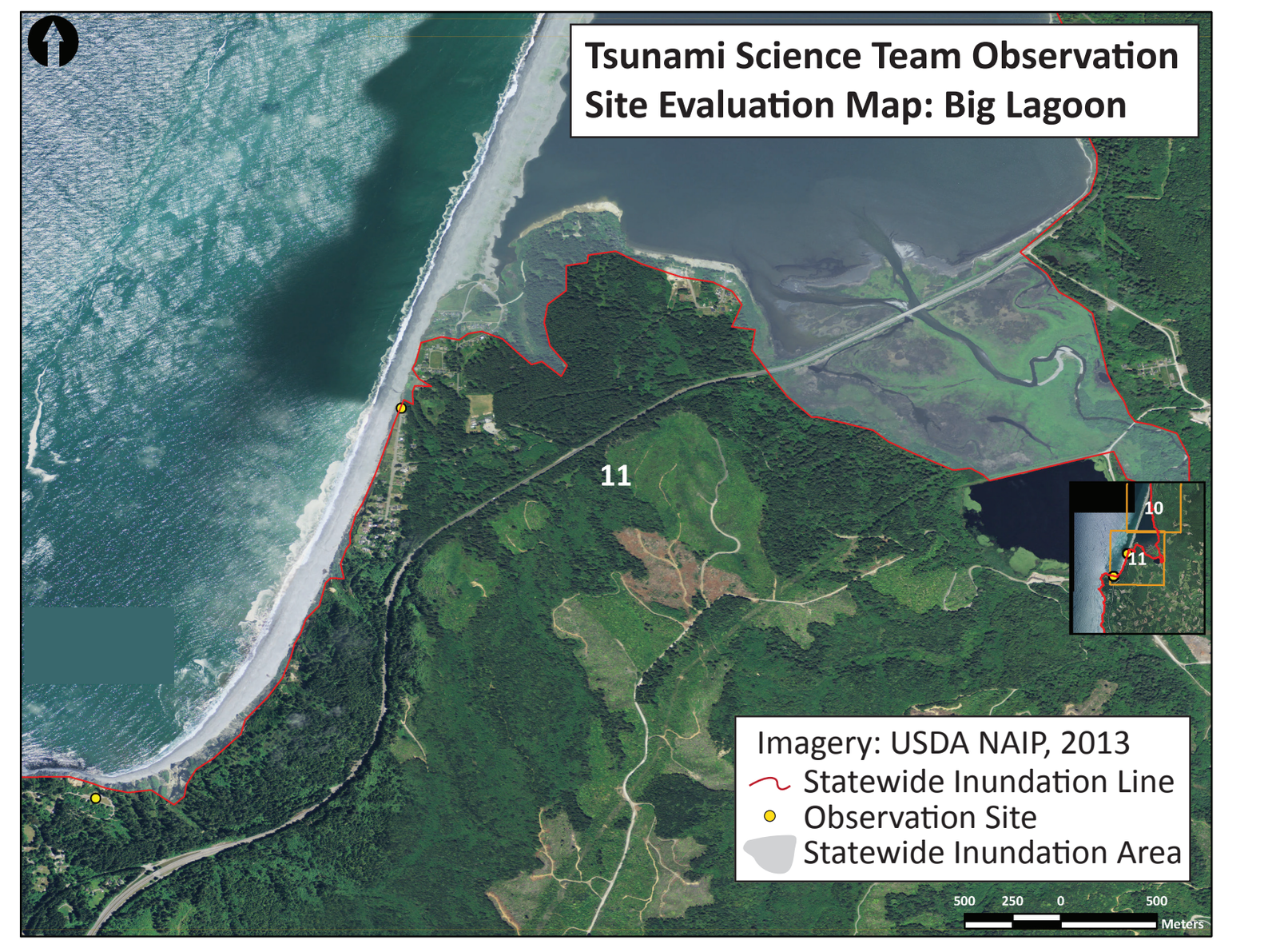
http://www2.humboldt.edu/rctwg/

Tsunami Science Team Observation Site Evaluation Map: Crescent City



Imagery: USDA NAIP, 2013
Statewide Inundation Line
Observation Site
Statewide Inundation Area

Tsunami Science Team Observation Site Evaluation Map: Big Lagoon



Imagery: USDA NAIP, 2013
Statewide Inundation Line
Observation Site
Statewide Inundation Area

2014 Cascadia Earthquake and Tsunami Exercise

2012

- RCTWG Meeting: (1/12)
- Planning Meeting: (3/27/2012)
  - Team Formation
  - Participate in PacificEX2012: Distant Tsunami
- First Draft: (10/26/2012)
  - Field Team Subject Matter Expert Guide
- Planning Meeting: (11/27/2012)
  - Observation Sites
  - Plan for Distant Tsunami Observations

2013

- Planning Exercise: (1/19/2013)
  - Observation Sites
  - Plan for Distant Tsunami Observations
- Planning Meeting: (3/12/2013)
  - Distant Tsunami Observations
- Tsunami Awareness Week: (3/27/2013)
  - Distant Tsunami Observations
  - Field Team Deployment

2014

- Planning Meeting: (5/9/2014)
  - Local Tsunami Observations
- Field Exercise: (5/14/2014)
  - Local Tsunami Observations
    - Mainshock
    - Day 1: Summary
    - Day 2: Update
    - Day 2: Summary
    - Local Response
      - Open Earthquake Clearing House
      - Send People to Field
      - Upload Field Observation to EQCH
      - Observation Interpreted
      - Upstream Request for additional OBS
      - Upload Field Observation to EQCH
      - Aftershock
      - Del Norte Site Responds to OBS
      - Post-Exercise Telereview
- Post Exercise Report: (6/26/2014)

2015

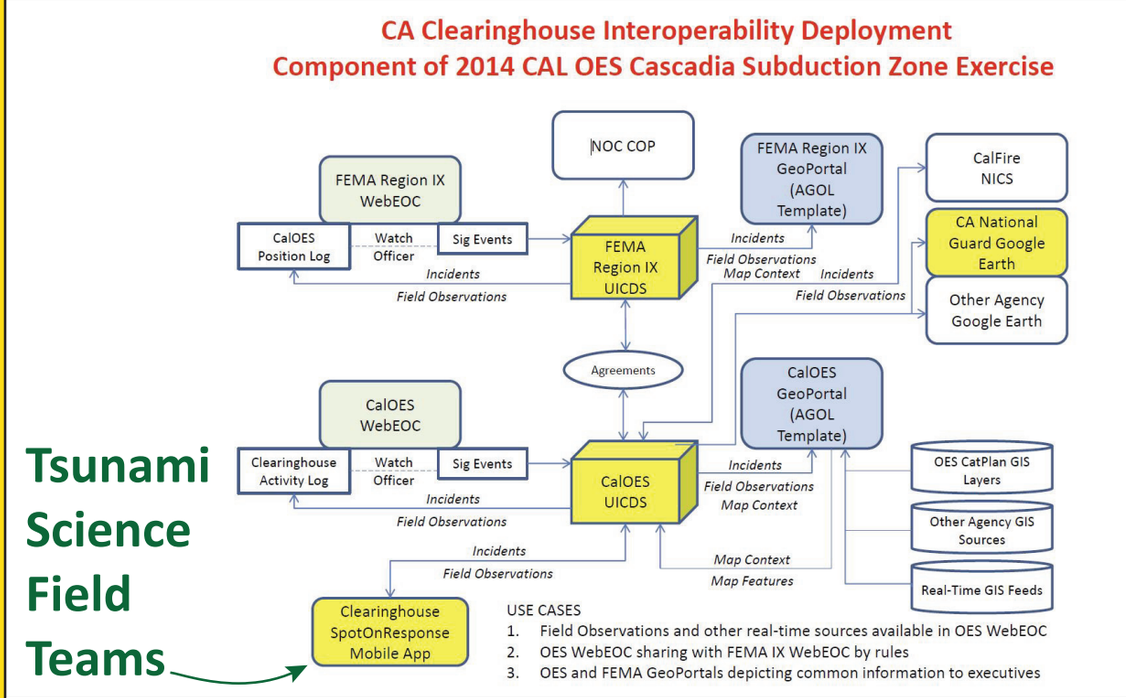
- Planning Meeting: (April 2015)
- Local Exercise: (May 2015)

Objectives:

Objective 1. Test the ability of the Tsunami Science Subject Matter Expert Field Team to mobilize successfully.

Objective 2. Test communication between the Field Teams and the California Earthquake and Tsunami Clearinghouse (EQCH) and the California Geological Survey Basecamp (CGS/BC) website via multiple submission methods.
e.g. Are team members successful with electronically uploading their observations (written and photo or video)?
We will be using three main tools: the clearinghouse spot on app, email (by phone or computer) to basecamp, and sms texting submission to basecamp.

Objective 3. Test the comprehension and response of the SOC to field team posts to the EQCH and CGS/BC information systems.
e.g. Can people upstream in hierarchy contact team members to ask questions about their observations (or to ask them to make additional observations)? Or, can field team members interact with members of other teams or levels in the UICDS?

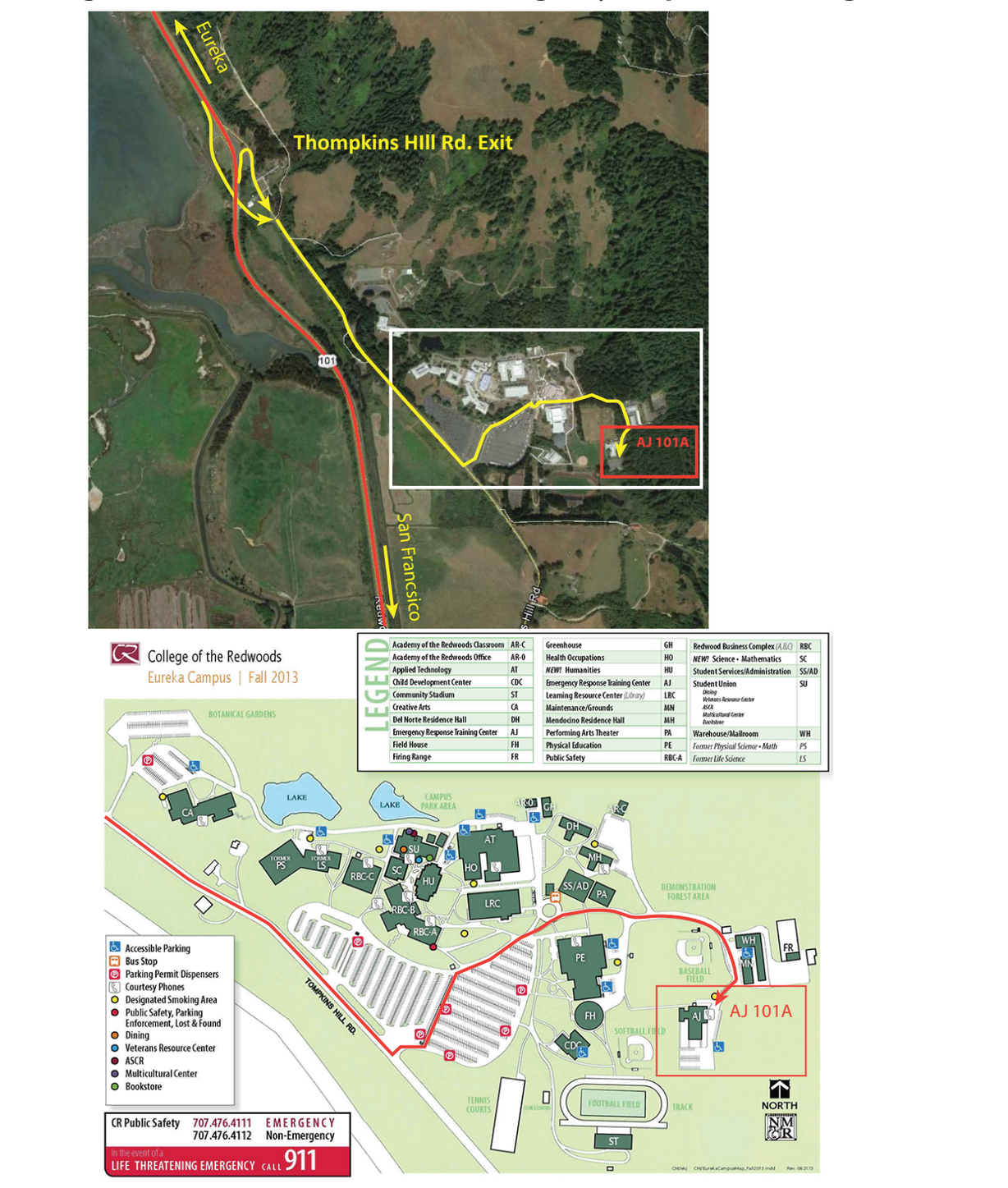


CA Clearinghouse Interoperability Deployment
Component of 2014 CAL OES Cascadia Subduction Zone Exercise

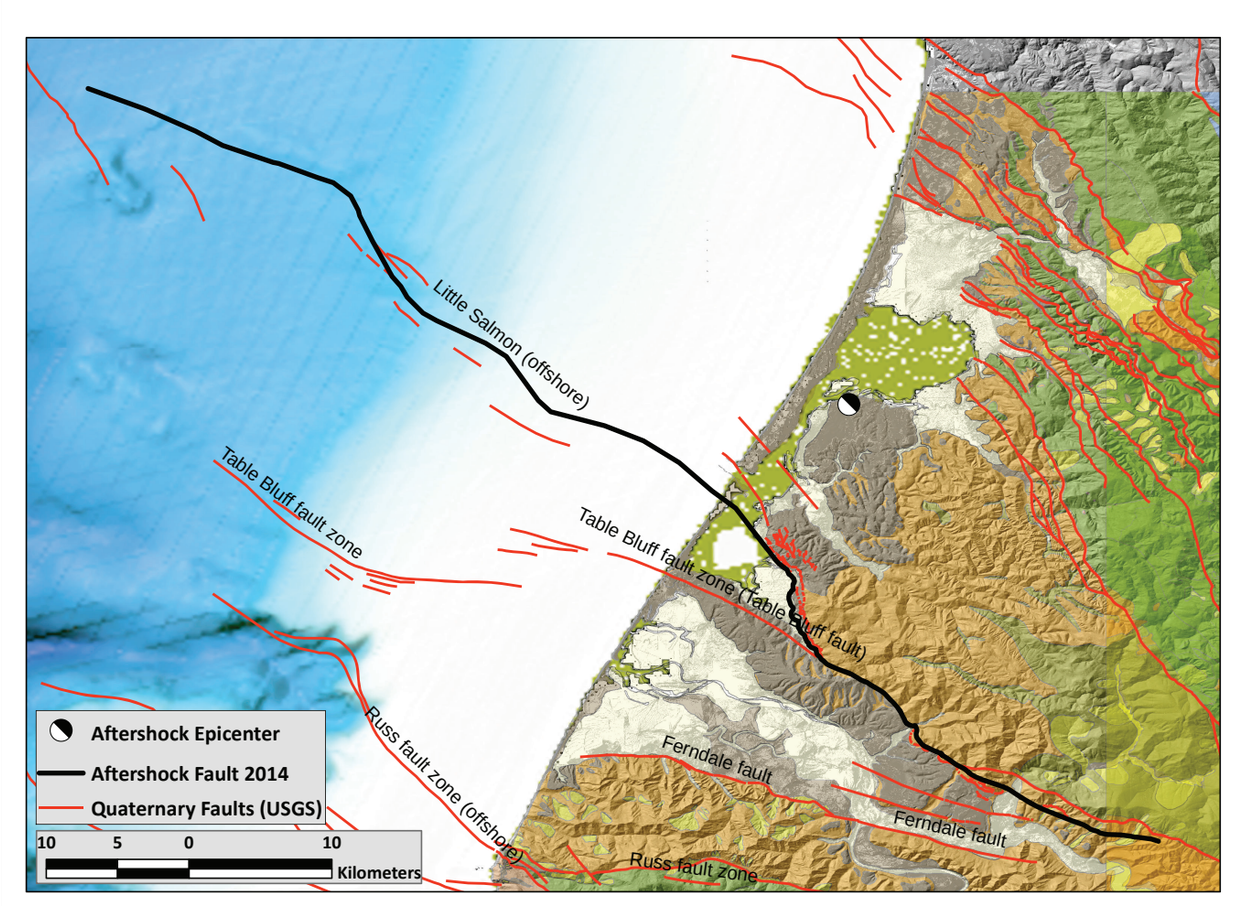
Tsunami Science Field Teams

Earthquake Clearinghouse: College of the Redwoods

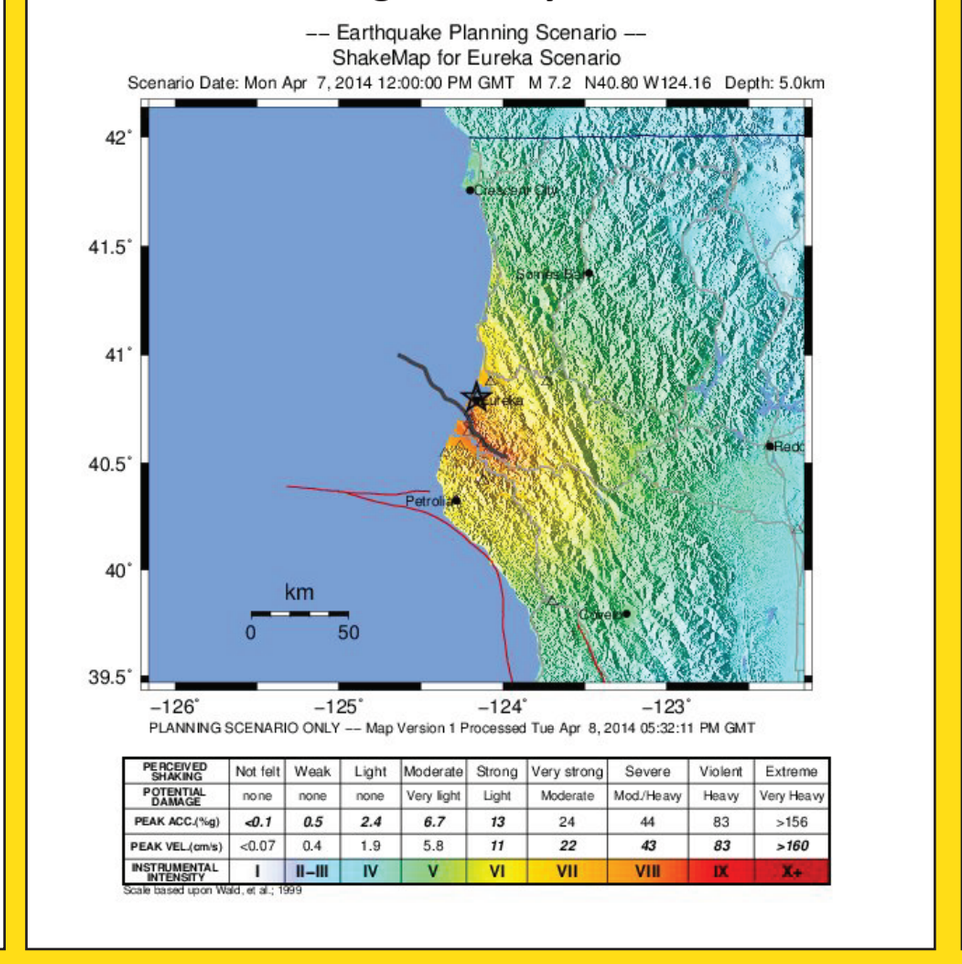
College of the Redwoods, AJ 101A Emergency Response Training Center



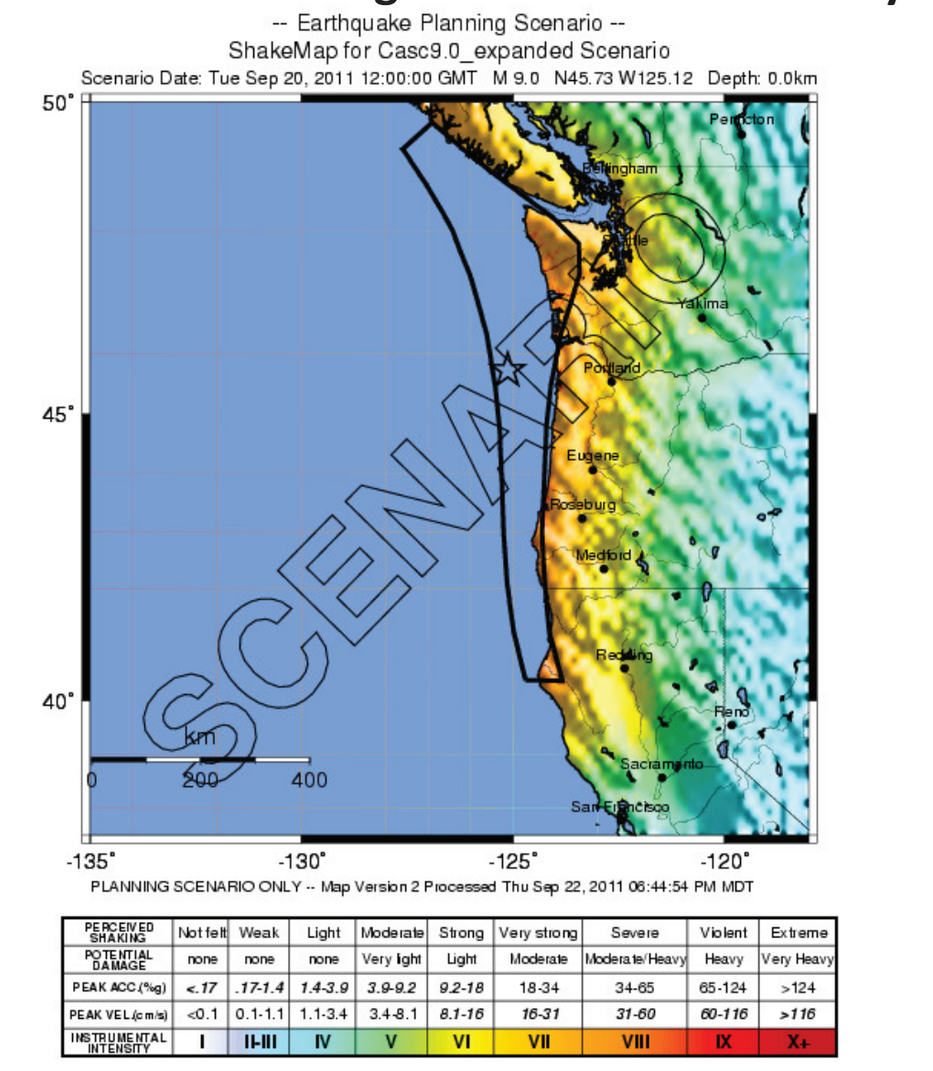
Aftershock Location: Little Salmon fault



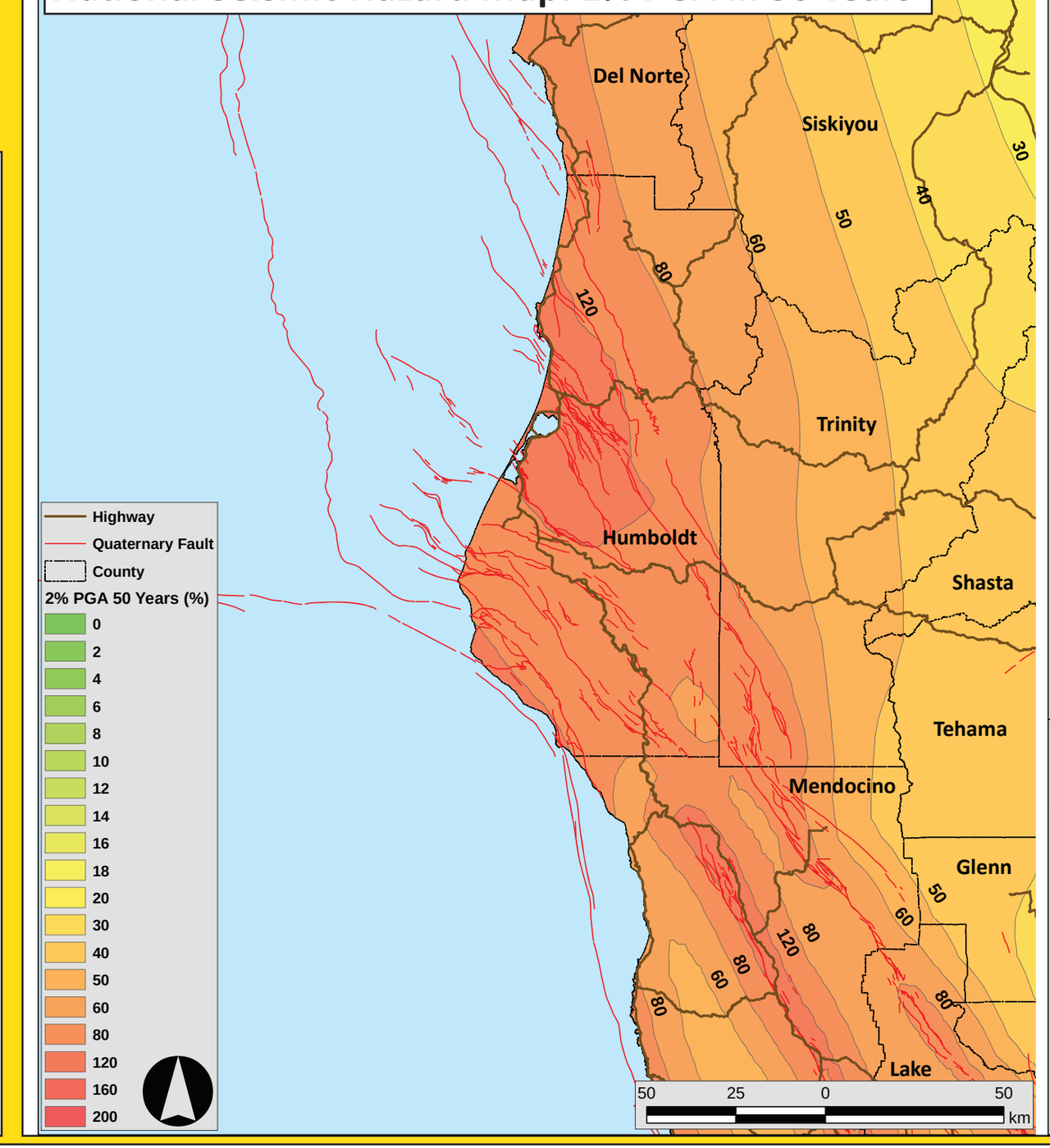
Aftershock Shaking Intensity: Little Salmon fault



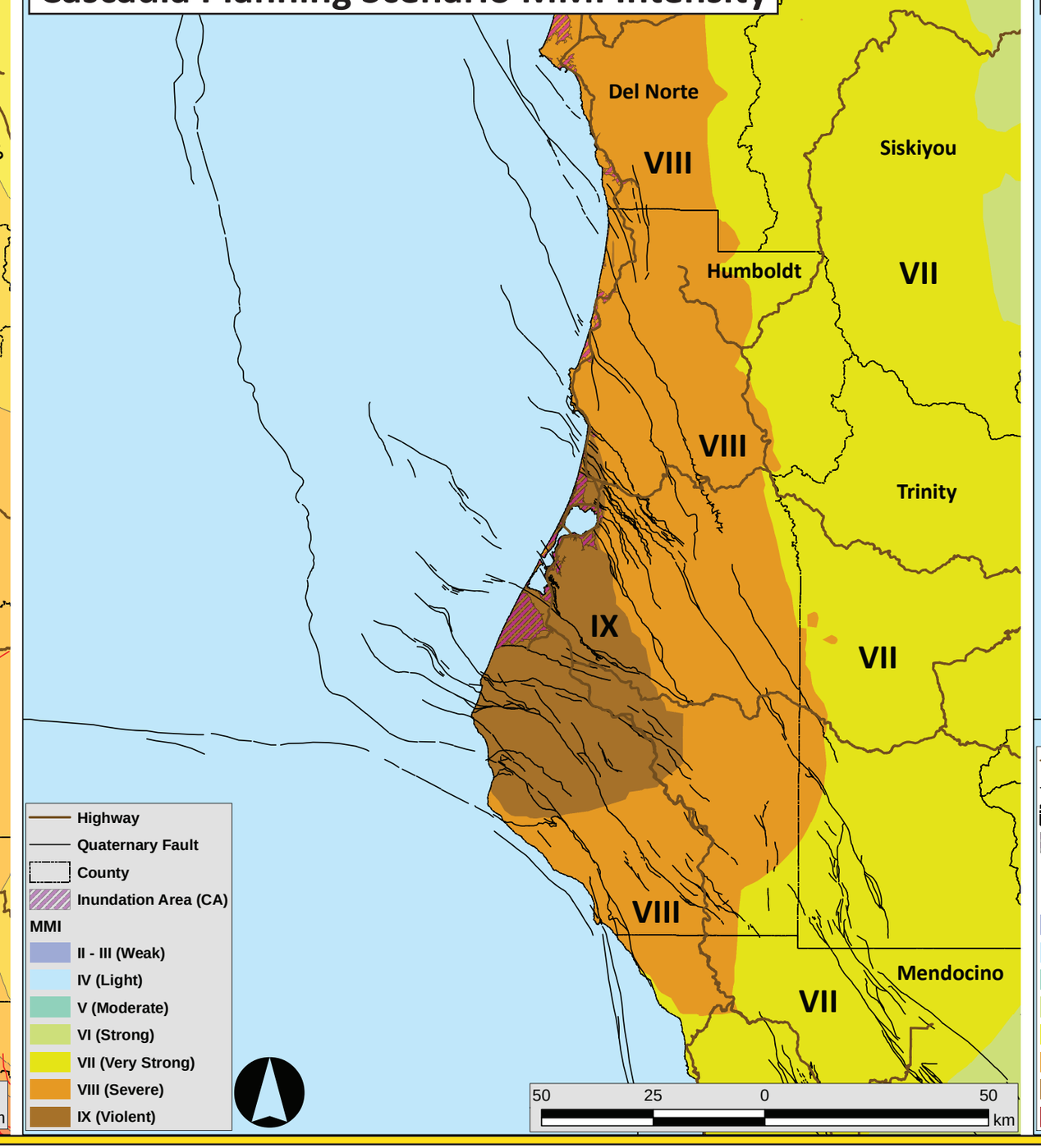
Cascadia Planning Scenario MMI Intensity



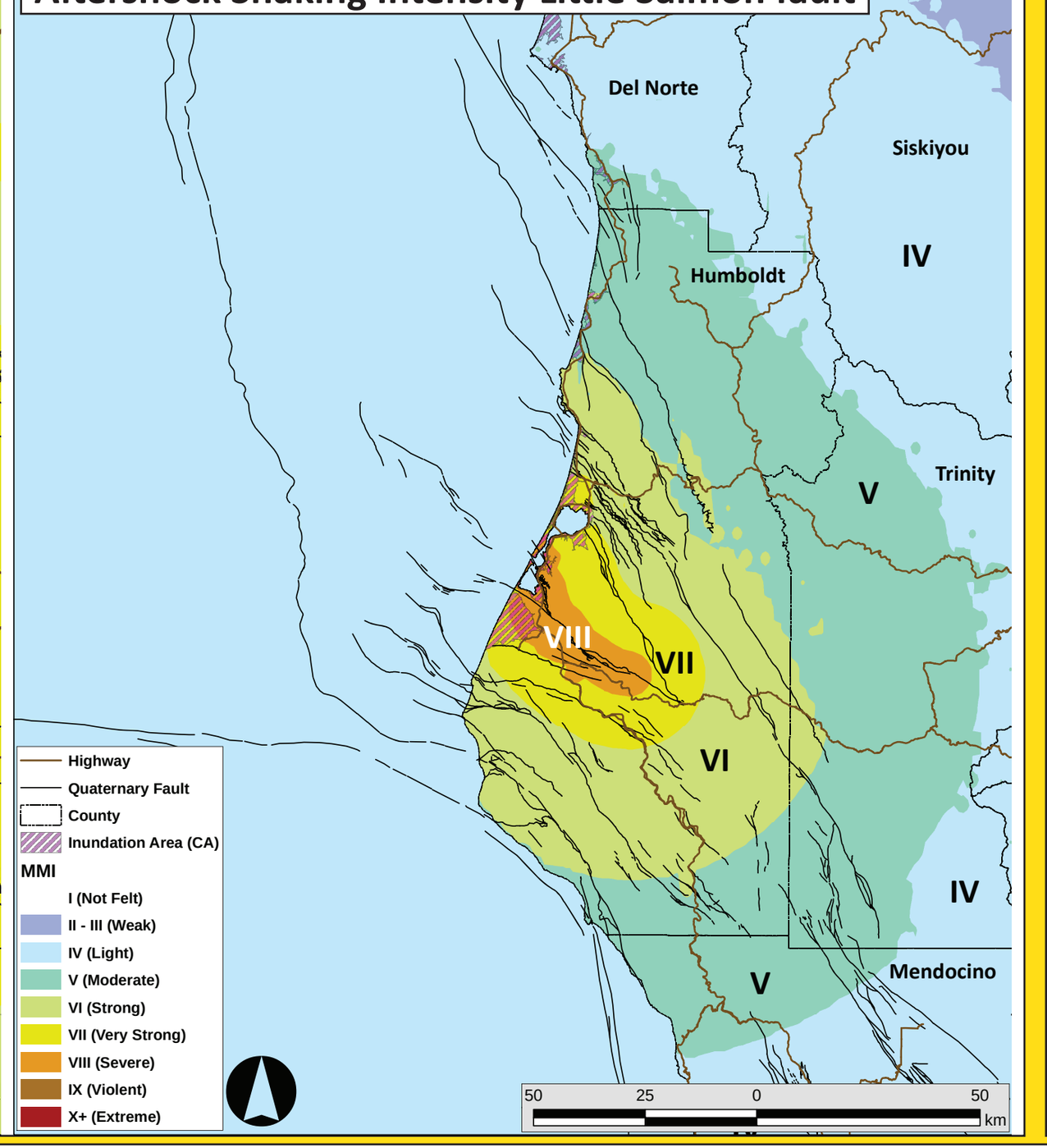
National Seismic Hazard Map: 2% PGA in 50 Years



Cascadia Planning Scenario MMI Intensity



Aftershock Shaking Intensity Little Salmon fault



Order of Operations

- Prior to the exercise, we prepared pre-exercise daily summary reports for days one and two. These reports described hypothetical observations made by subject matter expert field team members on days 1 and 2 following the hypothetical earthquake.
- On the day of the exercise, we initiated our live exercise by calling the field team members and requesting them to head to the field to make observations. On the day of the exercise, the field team members were contacted by the regional coordinators and they were provided some basic instructions. The field team members were instructed to head to the field to make observations and provide those observations to the clearinghouse/basecamp information system. The field may be their office or a real field location, whichever worked best for them. They were contacted during this exercise, by people to ask you about your observations. They were also contacted by their regional coordinator to ask a series of questions designed to assess this exercise so we can improve our response in the future.
- Following the exercise, we participated in a post-exercise call down phone call. Afterwards, regional coordinators provided post-exercise questionnaires to the field teams. The responses to these questions are summarized in this report as support for the objectives.

Expert Field Team: Tsunami Science
Situation Report: Daily Summary 5/13/14 18:00
Summary: 30 new incidents have been reported: Total incidents: 70

Following the earthquake and tsunami and our field team members assessed their personal safety and ability to participate, our field teams responded to the SOC activation by collecting observations in **seven regions:** Loleta, Eureka, Crescent City, Trinidad, McKinleyville, Manila, and Field's Landing, CA. Field teams created incidents and uploaded photos to the EQCH and SpotOnResponse. Field teams used the tsunami field notes form to submit contextual information related to their observations.

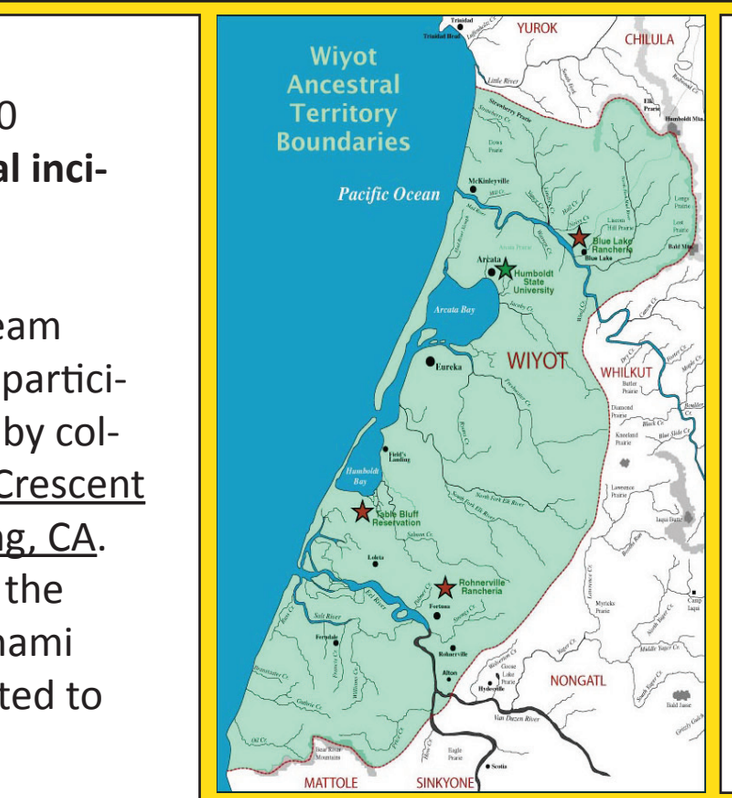
Communication streams have been established between the field team coordinators and the subject matter expert field team members in Crescent City, Trinidad, McKinleyville, Manila, and Field's Landing, CA. Also, field team coordinators have established communications streams with the local OES, Harbor Managers in Crescent City, Noyo Harbor, and Humboldt Bay.

Expert Field Team: Tsunami Science
Situation Report: Mid-Day Update 5/13/14 12:00
Summary: 30 new incidents have been reported: Total incidents: 40

Following the earthquake and tsunami and our field team members assessed their personal safety and ability to participate, our field teams responded to the SOC activation by collecting observations in five regions: Crescent City, Trinidad, McKinleyville, Manila, and Field's Landing, CA. Field teams created incidents and uploaded photos to the EQCH and SpotOnResponse. Field teams used the tsunami field notes form to submit contextual information related to their observations.

Communication streams have been established between the field team coordinators and the subject matter expert field team members in Crescent City, Trinidad, McKinleyville, Manila, and Field's Landing, CA. Also, field team coordinators have established communications streams with the local OES, and Harbor Managers in Humboldt Bay.

SOC requests for observations in some "zones of investigation" have been received and field teams deployed to collect information in response to those requests.



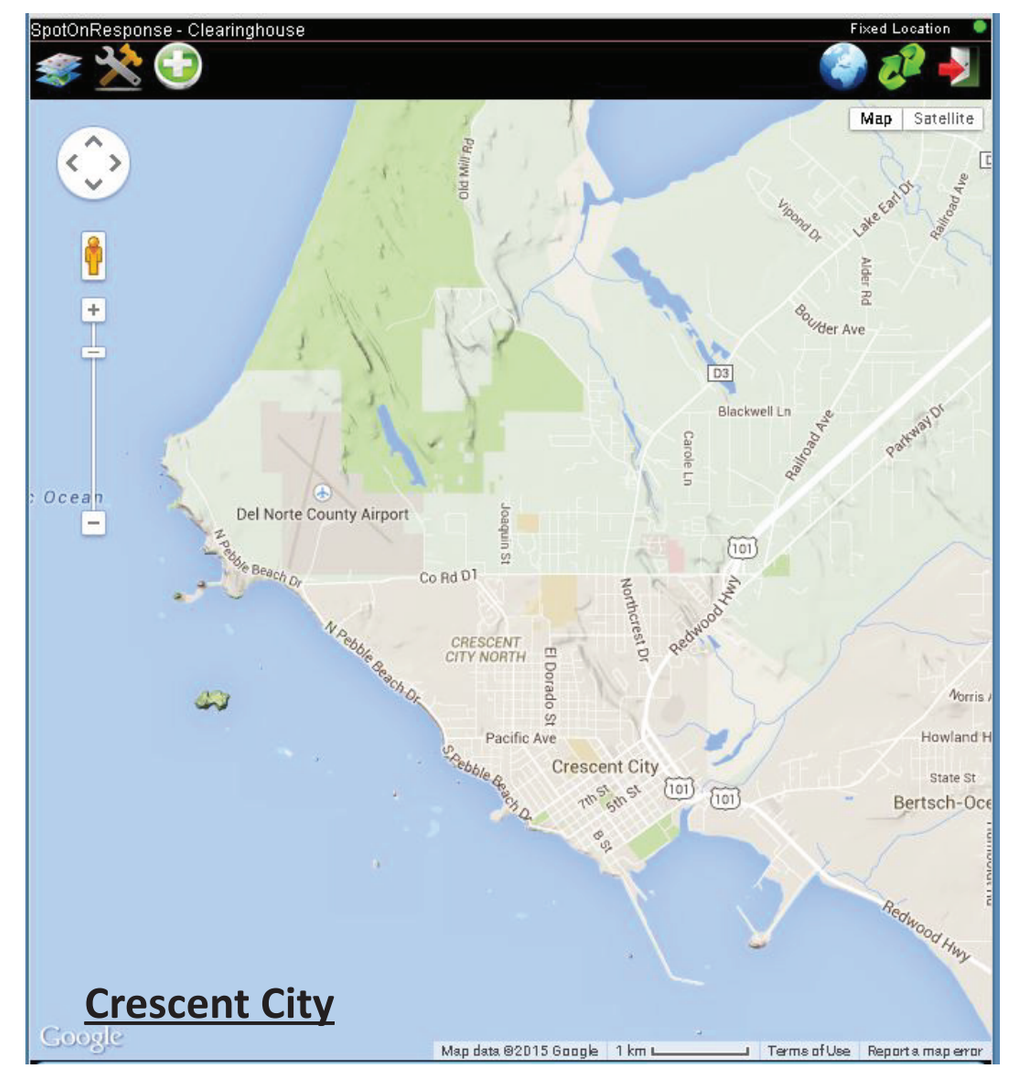
Wiyot Ancestral Territory Boundaries

Regional coordinators:
Jason R. Patton (Cascadia GeoSciences)
Jim Falls (California Geological Survey)
Subject Matter Field Team Members:
Eileen Hemphill-Haley (Humboldt State University)
Kathy Moley (Pacific Watershed Associates)
Amanda Admire (Humboldt State University)
Robert C. McPherson (Humboldt State University)
CGS Basecamp
Rick Wilson (California Geological Survey)
California Earthquake Clearinghouse
Anne Rosinski (California Geological Survey)
Technical Advisor
Lori Dengler (Humboldt State University)

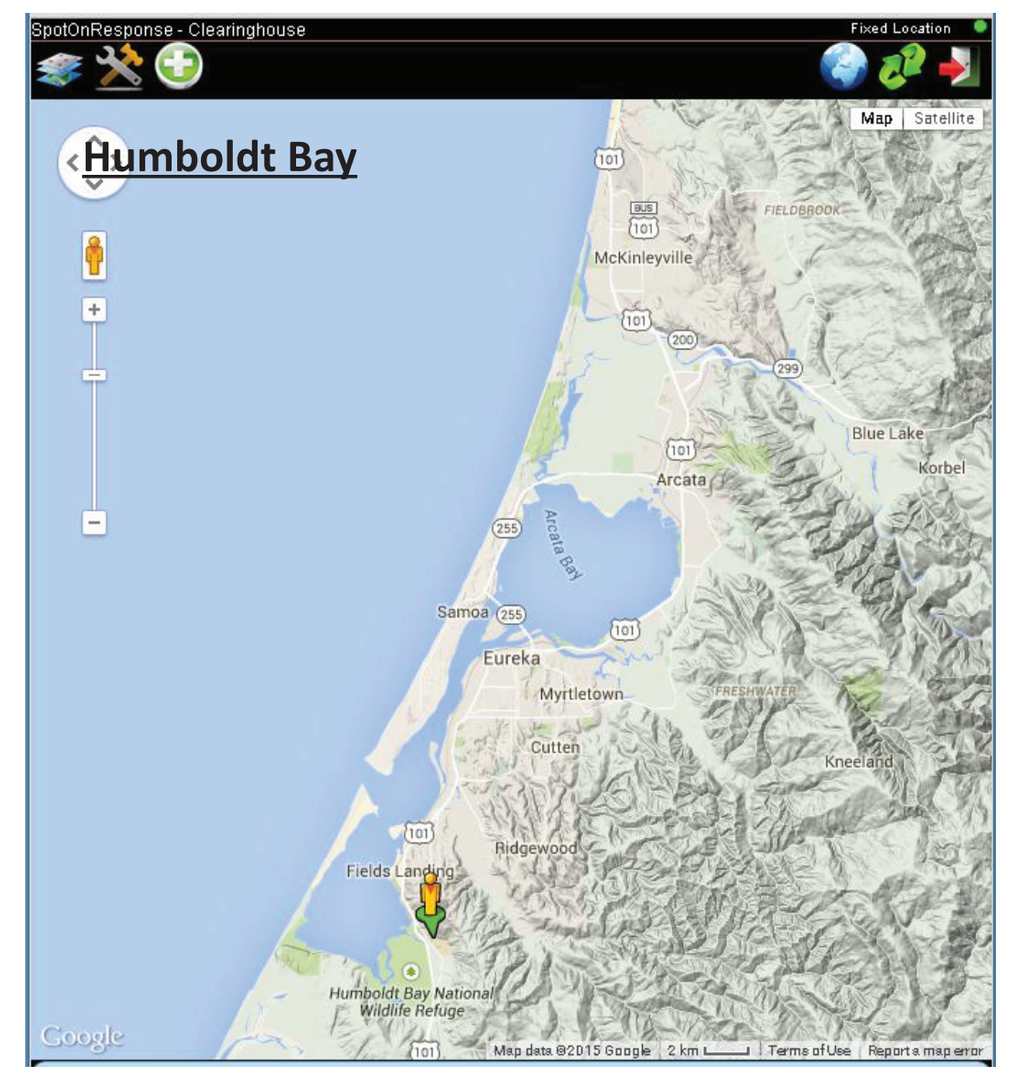
May 15, 2014 – Tsunami Science – Tsunami Field Team Call-down Exercise Questionnaire

Name:		
email:		
	Question	**Answer**
	Regional Coordinator Primary Activation:	*** If there is text in the cell below, those are example answers you could use. Please replace them with your answer.**
1	Where were you when were activated? (street Address)	HSU Dept of Geology, Van Matre Hall, Room 110B
2	Were you working or on personal time?	Personal time
3	Were you available to go into the field?	No
4	What location (or simulated location) did you go to?	Simulated: Central Avenue of McKinleyville; Overlook of Clam Beach (McKinleyville, off Hwy 101); Woodley Island Marina
5	Did you have your "Go Kit" ready?	No (:(
6	Were you able to understand your assigned task?	yes
7	How many observations did you make as a result of the initial activation?	(simulated): 3 non-scientific/emergency response; 1 scientific observation/field measurement
8	Did you upload to CGS Bascamp (BC)?	yes
9	What did you upload to BC?	(BC website, email, list your device, operating system, browser version)Mac laptop, OS10.7, Firefox browser; uploaded text in message command, plus photos
10	What mode(s) did you use to upload to BC?	typed message online, uploaded photos from hard drive of computer
11	Was the upload successful?	yes
12	If NO, what was the problem/error message?	no problems (but was hardwired into HSU network)
13	Did you upload to the EQCH?	(SOR website, SOR app, list device, operating system, browser version)SOR website, Mac Laptop, OS10.7, Firefox
14	What did you upload to EQCH?	Same text message and photos as to BC
14	Was the upload successful?	yes
16	If NO, what was the problem/error message?	(no problem)
	"Upstream" SOC (Sacramento) Secondary Requests:	
17	Did you get a secondary request from the SOC in Sacramento to make secondary observations related to one of your primary observations?	yes
18	How did you find out about the secondary request?	phone
19	Did you understand the secondary request?	yes
20	Were you able to conduct this secondary observation?	yes (well -- simulated -- did not actually travel to site)
21	Were you able to upload your data?	yes -- but was still on HSU internet system
22	**Field Team Secondary Request:**	
23	Did you get secondary requests from other field team members to make secondary observations?	yes -- but did not notice request (a reply via Basecamp) until after the exercise was over and I was scanning back through the email communication
24	How many secondary requests did you get?	1 (as far as I know)
25	How did you find out about the secondary request?	email -- reply to Basecamp posting
26	Did you understand the secondary request(s)?	yes (but did not see at time -- would have responded if I had noticed the message)
27	Were you able to conduct this/these secondary observation(s)?	did not notice message -- did not complete secondary request
28	Were you able to upload the digitial record of your secondary observation(s)?	N/A
	Regional Coordinator Aftershock Request:	
29	Did you get a request to respond to the aftershock?	yes
30	How did you find out about the aftershock?	phone
31	Were you able to respond to the observation request following the aftershock?	yes
32	Did you understand the request?	yes
33	Were you able to conduct this observation?	yes (simulated)
34	Were you able to upload the digitial record of your aftershock observation?	yes
	Summary	
35	Do you have any suggestions about how to improve our system/methods?	One problem that I encountered was that I did not notice a request for more information from Troy regarding one of my posting. I posted that some autos had been trapped in the tsunami inundation zone on Hwy 101 at Clam Beach, and Troy replied asking if I thought that emergency services should be called in. I didn't notice the request for more information. Perhaps a useful thing would be to have such a reply be labeled "MORE INFORMATION NEEDED" or something like that, to get the attention of the observer. As it is, a series of messages might just line up under the original posting on Basecamp, without the obvious instruction that a response is really needed.
36	Any other comments or questions about this exercise?	It was interesting, but I think showed that we need a lot more trained participants. I submitted several simulated "observations", but realistically probably would have required a lot more time to travel to each location, and more than likely (in the event of a real disaster) would not have been able to travel as far as Woodley Island from the north end of McKinleyville. There would likely have been enough issues just in the McKinleyville area to require a trained team of observers. -- Many thanks to the organizers of this drill!!

SpotOnResponse Application



Crescent City



Humboldt Bay

References:

Atwater, B.F., Musumi-Rokkaku, S., Satake, K., Tsuji, Y., Ueda, K., and, Yamaguchi, D.K., 2005. The Orphan Tsunami of 1700—Japanese Clues to a Parent Earthquake in North America, USGS Professional Paper 1707, 144 p.

Chaytor, J.D., Goldfinger, C., Dziak, R.P., and Fox, C.G., 2004. Active deformation of the Gorda plate: Constraining deformation models with new geophysical data: Geology v. 32, p. 353-356.

Nelson, A.R., Kelsey, H.M., and Witter, R.C., 2004. Great earthquakes of variable magnitude at the Cascadia subduction zone: Quaternary Research, doi:10.1016/j.yqres.2006.02.009, p. 354-365.

Patton, J. R., Dengler, L. A. 2006. Relative Tsunami Hazard Mapping for Humboldt and Del Norte Counties, California. Proceedings of the 8NCEE/EERI Eighth Earthquake Engineering Conference

Patton, J. R. and Dengler, L. A., 2006. Relative Tsunami Hazard Mapping for Humboldt and Del Norte Counties, California, in Hemphill-Haley, M.A., McPherson, R., Patton, J.R., Stallman, J., Leroy, T., Sutherland, D., and Williams, T., eds., 2006 Pacific Cell Friends of the Pleistocene Field Trip Guidebook, The Triangle of Doom: Signatures of Quaternary Crustal Deformation in the Mendocino Deformation Zone (MDZ) Arcata, CA.

Ross, S.L., Jones, L.M., Miller, Kevin, P., K.A., Wein, A., Wilson, Ri.I., Bahng, B., Barberopoulou, A., Borrero, J.C., Brosnan, D.M., Bwarie, J.T., Geist, E.L., Johnson, L.A., Kirby, S.H., Knight, W.R., Long, K., Lynett, P., Mortensen, C.E., Nicolsky, D.J., Perry, S.C., Plumlee, G.S., Real, C.R., Ryan, K., Suleimani, E., Thio, H., Titov, V.V., Whitmore, P.M. and Wood, N.J., 2013, SAFRR (Science Application for Risk Reduction) Tsunami Scenario—Executive Summary and Introduction: U.S. Geological Survey Open-File Report 2013–1170–A, in Ross, S.L., and Jones, L.M., eds., The SAFRR (Science Application for Risk Reduction) Tsunami Scenario: U.S. Geological Survey Open-File Report 2013–1170, 17 p., http://pubs.usgs.gov/of/2013/1170/a/.