S51B -1272

Reality Check: Using the 1906 Simulations to Assess Performance of Northern California Networks

Peggy Hellweg[1] (peggy@seismo.berkeley.edu), Jack Boatwright[2] (boat@usgs.gov),
Howard Bundock[2] (bundock@usgs.gov), Hamid Haddadi[3] (hhaddadi@consrv.ca.gov),
Pete Lombard[1] (lombard@seismo.berkeley.edu)

[1]Berkeley Seismological Laboratory, UC Berkeley; [2]US Geological Survey, Menlo Park; [3]California Geological Survey

Abstract: Emergency responders depend on realtime seismic systems to map ground shaking in earthquakes. Products such as ShakeMap are critical tools for estimating the impact of large and great earthquakes on society. Using synthetic ground motions from the 1906 simulations performed by Graves et al (2006), we simulate the performance of the Northern California Seismic System (NCSS) of the California Integrated Seismic Network (CISN), and investigate its ability to determine the magnitude of the event and to produce reliable ShakeMaps. Among the many factors that influence the robustness of the system are reliability of telemetry from individual stations and nodes, as well as of the data center. By bootstrapping the synthetic data, we can explore how the failure of different elements of the system can influence estimates of event location, magnitude, and ground shaking. Even given the it is still critical to estimate the fault length to produce a usable ShakeMap. Moreover, we find that the attenuation relation must be appropriately calibrated for great earthquakes, particularly at distances from 70 to 120 km from the fault.

A Boatwright & Bundock's ShakeMap from the Lawson Report Boatwright and Bundock compiled intensities from the Lawson report (1908) to produce a shakemap for the 1906 San Francisco earthquake. This map provides a baseline against which to assess the initial shakemaps which would be computed from the ground motion which would be measured in a similar earthquake, if it were to occur today has occurred. These stations belong to the BK, NC, and NP networks. A number of CE stations provide data after a short delay.

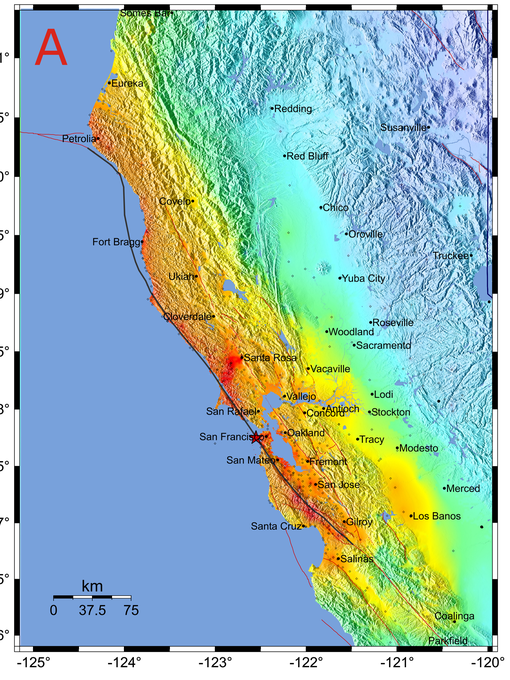
B shakemap for realtime stations in Northern California Data from 160 seismic and strong motion stations in Northern California from the BK, NC and NP networks with realtime telemetry may be used to calculate a Shakemap within 10 minutes after an earthquake occurs. Data from some CE stations may arrive a short time later. For the ShakeMap B, we assume that hypocenter and magnitude are the same as the 1906 earthquake, however the length of the fault rupture is not known. In this map, shaking in the Bay Area and Sacramento Delta are overestimated compared to A, while shaking along the Coast is only "correct" where there are stations.

C Shakemap for realtime stations with fault Data from the same 160 realtime stations in B are used to produce a Shakemap assuming that the hypocenter, magnitude and fault rupture is also known. Strong shaking is now also predicted along the Coast, although intensities are unexpectedly high, as the attenuation relationship does not appear to be calibrated well.

D Ground motions from the BK network Maps B and C represent "best cases" for realtime reporting. For a M 7.8, telemetry to and from USGS Menlo Park, which collects data from the NC and NP stations may be interrupted. If so, Shakemaps would be based only on the 25 stations the sparse BK network. These stations are mostly on hard rock sites, so the shaking they report will be low compared to basin or sedimentary sites. Thus, near Eureka only slightly elevate shaking is reported at the station JCC. While, as in map A, strong shaking is only predicted in the Bay Area. This can be improved by adding the fault rupture.

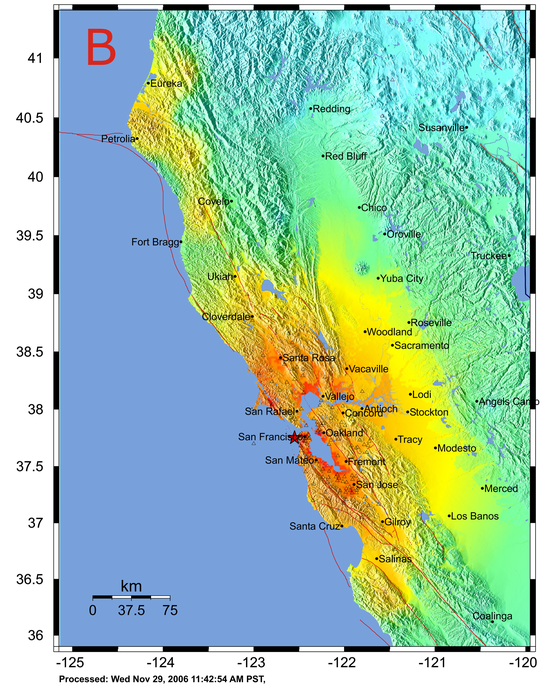
Conclusions:

1906 Earthquake, M7.8, Depth 10 km, Epicenter N37.75 W122.55



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

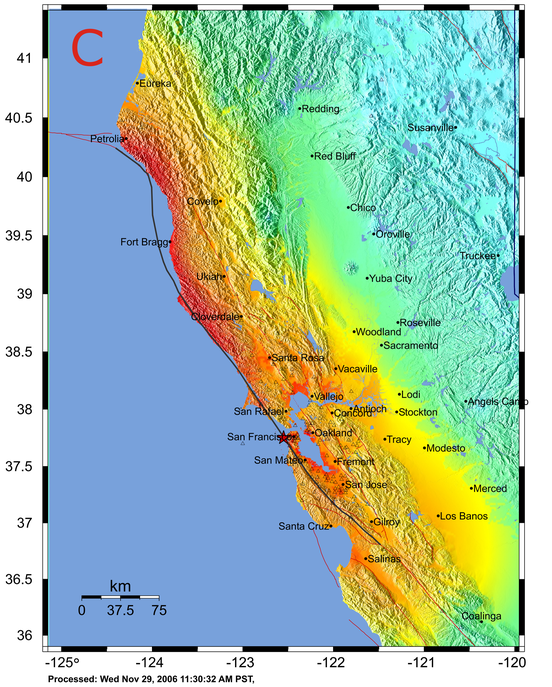
CISN Rapid Instrumental Intensity Map Epicenter: 1906_in_2006 San Francisco Earthquake
Wed Nov 15, 2006 05:12:00 AM PST M 7.8 N37.75 W122.55 Depth: 10.0km ID:1906_in_2006



Processed: Wed Nov 29, 2006 11:42:54 AM PST,

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

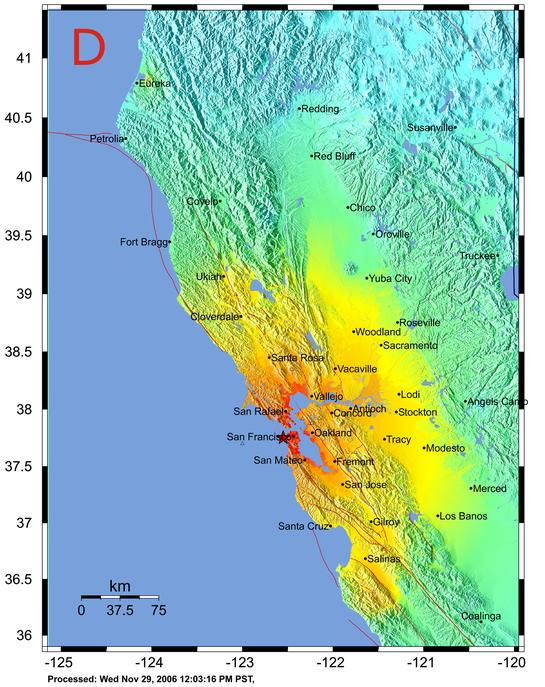
CISN Rapid Instrumental Intensity Map Epicenter: 1906_in_2006 San Francisco Earthquake
Wed Nov 15, 2006 05:12:00 AM PST M 7.8 N37.75 W122.55 Depth: 10.0km ID:1906_in_2006



Processed: Wed Nov 29, 2006 11:30:32 AM PST,

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

ISN Rapid Instrumental Intensity Map Epicenter: 1906_in_2006_BK San Francisco Earthquak
Wed Nov 15, 2006 05:12:00 AM PST M 7.8 N37.75 W122.55 Depth: 10.0km ID:1906_in_2006_BK



Processed: Wed Nov 29, 2006 12:03:16 PM PST,

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+