2002 ANNUAL REPORT
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This report summarizes the purpose, methods, progress and preliminary results for two SCEC-funded projects in 2002: 1) New San Andreas Fault Paleoseismic data for the RELM Fault Activity Database, and 2) Effective risk mitigation for SCEC target audiences.

I. NEW SAN ANDREAS FAULT PALEOSEISMIC DATA FOR THE RELM FAULT ACTIVITY DATABASE (FAD)

Submitted by Lisa B. Grant, Dept. Environmental Analysis and Design, UC Irvine

Purpose

The San Andreas fault is the primary source of seismic hazard for California (Working Group on California Earthquake Probabilities, 1989 and 1995). Seismic hazard assessments for the San Andreas fault have relied heavily on paleoseismic observations for providing data on average recurrence intervals for large ruptures, long-term slip rate, and slip-per-event as a proxy for rupture magnitude. Incompleteness of paleoseismic data sets is a major source of uncertainty in seismic hazard assessments. A significant body of new research on the San Andreas fault system will be published in late November or early December 2002 in a special issue of *BSSA* on "Paleoseismology of the San Andreas fault system". As a coordinated body of work comprising 14 papers by a total of 74 authors, the special issue will be a significant contribution toward understanding the spatial and temporal rupture history of the San Andreas fault system over the last few hundred to few thousand years. This is the time scale of greatest interest for seismic hazard assessment and modeling of multiple ruptures.

Summary Of Project Work and Accomplishments to date

As lead Editor of the *BSSA* Special Issue, I have been intimately involved in publishing this new body of research on the San Andreas fault. I have been summarizing the new San Andreas paleoseismic data for the Fault Activity Database (FAD) in consultation with Sue Perry, the FAD Coordinator. This has involved filling out relevant portions of the online database form posted on the RELM/FAD website to bring the database up to date with the new work to be published in BSSA. I proposed to complete the summaries by the time the special issue was published, and to be available to the FAD Coordinator (Sue Perry) for consultation on the San Andreas paleoseismic data throughout the project year.

To date, I have finished most of the compilations through the on-line form, and the remainder should be done by the time the special issue arrives in the mail in early December. (I am still awaiting page proof corrections to some of the papers). Highlights of the issue are summarized below, in tables excerpted from the Introduction to the special issue by Grant and Lettis. *An important contribution is the inclusion of study site coordinates, which are needed for numerical modeling but have not traditionally been included in paleoseismology publications.*

I have also worked with Sue Perry to iron out some of the wrinkles in the on-line data entry form. To the best of my knowledge, I am so far the *only* person who has entered data on-line, and therefore I have contributed substantially to development of the FAD through this project. I have encouraged other paleoseismologists to contribute their data, and I will continue to solicit their contributions to the FAD. I expect to continue this work informally in the future through my involvement in SCEC's Seismic Hazards Interdisciplinary Focus Group and other database compilation efforts.

TABLE 1a (From: Grant and Lettis, Introduction to BSSA Paleoseismology Special Issue)

Reference	Site	Latitude (N) Longitude (W)	Dates A.D.	Average Recurrence, yrs
Knudsen *et al.*	Bodega Harbor	38°18'49'' 123°1'50''	1906 After 1600 980 - 1300	
	Bolinas Lagoon	37°56'2'' 122°41'51''	1906 ~1250	
Lienkaemper *et al*	Tyson's Lagoon, *Hayward fault*	37°33'21'' 121°58'28''	1868 1730 (1650-1790) 1630 (1530-1740) 1470 (1360-1580)	130 ± 40
Young *et al*.	LY4	35°28'9'' 120°1'8''	After 1857 1857 (1390-1865) 1030 - 1460	
Lindvall *et al*.	Frazier Mountain	34°48'44'' 118°54'7''	1857 1460 - 1600	
Biasi *et al*.	Pallett Creek (after Sieh *et al.*)	34°27'19'' 117°53'14''	1857 1812 (1758-1837) 1496 - 1599 1343 - 1370 1046 - 1113 1031 - 1096 914 - 986 803 - 868 749 - 775 614 - 666	135
Fumal *et al*.	Wrightwood	34°22'11'' 117°40'04''	1857 1812 1647 - 1717 1508 - 1569 1448 - 1518 1191 - 1305 1047 - 1181 957 - 1056 800 - 881 736 - 811 695 - 740 657 - 722 551 - 681 407 - 628	105
McGill *et al*.	Plunge Creek	34°06'57'' 117°08'15''	1510-1730 ~1450	
Fumal *et al*.	Thousand Palms	33°55'11'' 116°18'27''	>1520-1680 1450-1555 1170-1290 840-1150 770-890	215±25
Shifflett *et al*.	Stone Ring Gullies	33°34'23'' 115°58'45''		260±100

TABLE 1b (From: Grant and Lettis, Introduction to the Special Issue on Paleoseismology of the San Andreas Fault System)

Reference	Site	Latitude (N) Longitude (W)	Event Dates, A.D.	Slip per Event, m	Slip Rate, mm/yr
Lienkaemper *et al*	Tyson's Lagoon, *Hayward fault*	37°33'21'' 121°58'28''	1868 1730 (1650-1790) 1630 (1530-1740) 1470 (1360-1580)	>0.1-0.2 >0.3 >0.2 >0.45	
Runnerstrom *et al.*	N-boundary S-boundary	35°32'11'' 120°5'13'' 35°31'35'' 120°4'30''	1857	16.2 ± 6.0	
Young *et al.*	LY4	35°28'9'' 120°1'8''	After 1857 1857 (1390-1865) 1030 - 1460	Fractures 3.0 ± 0.7	
Weldon *et al.*	Wrightwood	34°22'11'' 117°40'04''	1857 pre-1857	1 - 2 2 - 4	20 - 40
Kendrick *et al.*	*Northern San Jacinto fault*	34° 117° 15'			≥ 20
Fumal *et al.*	Thousand Palms	33°55'11'' 116°18'27''			4 ± 2
Shifflett *et al.*	Holocene paleo-fan Pleistocene lagoon	33°34'23'' 115°58'45'' (approx.)			12 5 - 8

II. EFFECTIVE RISK MITIGATION FOR SCEC TARGET AUDIENCES

Lisa B. Grant (PI) and Eric E. Runnerstrom (Graduate student researcher)

Purpose of the project

Scientific research in support of mitigation can reduce vulnerability to seismic hazards (Committee on the Science of Earthquakes, 2002). The Southern California Earthquake Center (SCEC) is positioned to advance knowledge transfer and risk communication about seismic hazard. To strengthen risk communication between SCEC and target audiences, such as local governments, it is necessary to establish a baseline understanding of current efforts and their effectiveness at risk communication and risk mitigation.

Summary of project

We are designing and conducting a study of the type and level of earthquake hazard mitigation efforts employed in selected Orange County communities. Results will provide an overview of local mitigation practices and identify areas where seismic risk communication activities may be most effective. The study is focused on evaluating the effectiveness of previous SCEC activities and products in communicating seismic risk. We are currently studying cities in Orange County, but the study is designed so that it can be replicated in other areas with minor modification.

Methodological Approach

We are surveying the use of SCEC products by local jurisdictions in Orange County by compiling data from city documents and conducting informational interviews with representatives of 27 of 34 Orange County cities. Orange County is well suited for this study because it contains diverse sociologic, geologic, and seismic conditions, which may influence other cities' use of SCEC products**.** Orange County ranks second in California counties ordered by total population or population density. Approximately 40% of the housing stock was built before 1970, which is prior to substantial upgrades in seismic building practices. Using the HAZUS methodology, the CDMG estimated that Orange County's expected annualized total loss due to earthquake activity is among the highest in the state.

Evidence of Progress

We have established a framework for understanding local mitigation practices and assessing whether or not they were influenced by SCEC products. The framework was developed following a review of refereed literature on risk communication. To date, we have conducted interviews with representatives from twenty-seven cities and compiled data from Safety Elements and their associated geotechnical background reports. Some of this data is summarized in Table 1, below. We have also corresponded with officials from CGS (Calif. Geological Survey, formerly CDMG) to inquire about relevant unpublished studies or surveys in their archives. We presented our preliminary findings at the 2002 SCEC Annual Meeting, and discussed our methodological approach with representatives from FEMA, state geological surveys, practicing professionals and researchers at the Western States Seismic Policy Council 2002 meeting last month.

Preliminary Findings

Our preliminary observations reveal substantial variation in the treatment of seismic hazard assessment, planning, and mitigation among Orange County cities. *Approximately half of Orange County cities' safety elements are based on seismic hazard assessments that do not consider research newer than 1997. These cities have not fully utilized many of SCEC's products to date, but they may be the best targets for future seismic risk communication and mitigation efforts. Based on CA Governor's Office of Planning and Research recommendations, we expect approximately half of Orange County cities will be addressing seismic safety issues within the next few years.* Safety element revisions represent windows of opportunity for promoting effective mitigation techniques and seismic policies to city officials and general public.

Looking ahead

New opportunities to establish linkages between seismic hazards and other natural hazards may emerge due to the requirements of FEMA's new Pre-Disaster Mitigation Program. On average, cities are unaware of documentation that outlines the ways SCEC can improve hazard and risk assessment by local government. In some circumstances, SCEC products and research are nested within other resources that are non-exclusive to SCEC (e.g., HAZUS). Consequently, some substantial SCEC contributions are not easily recognized by end-users. For the cities that are using SCEC for seismic hazard mitigation, we expect that the types of products and extent of usage will be better understood following our analysis of geotechnical background reports to safety elements. To date, our review of refereed literature suggests that this methodology will contribute to a better understanding of risk communication between a scientific center and non-technical government decision-makers.

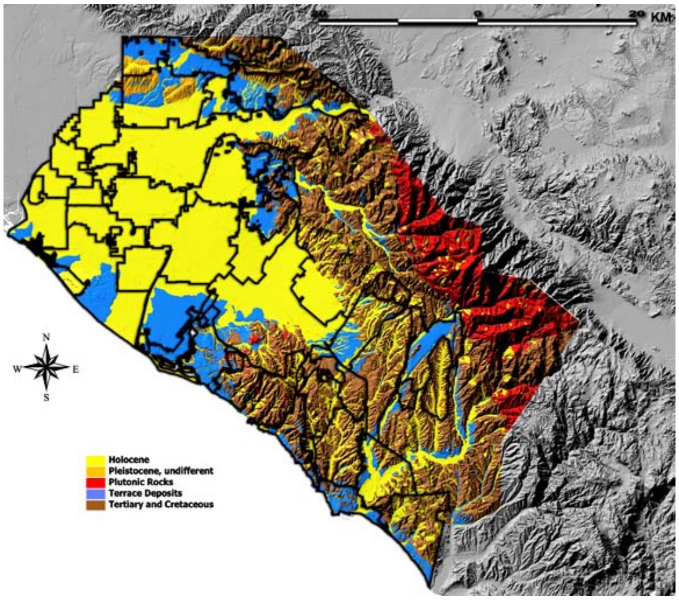

Figure: Multiple geologic, topographic, and seismic conditions are represented in the relatively small geographic area of Orange County, CA (see area of color) and vicinity (see area of grayscale). The county's 34 cities are indicated by black outlines. Orange County's physiography includes mountains, flood plains, coastal bluffs, soft soils, liquefaction and landslide hazard, surface rupture potential, and sources of potentially strong ground shaking such as the Newport-Inglewood, Whittier - Elsinore, Palos Verdes, San Joaquin Hills and San Andreas faults.

Table2: Status of Safety Elements for Orange County's Thirty-Four Cities, August 2002

Year of incorporation	City	Population (2000)	Date of adoption for current Safety Element	Status for adopting an updated Safety Element	Year of incorporation	City	Population (2000)	Date of adoption for current Safety Element	Status for adopting an updated Safety Element
1876	**Anaheim**	328,000	1984	in revision; planned adoption in mid-2003	1956	**Stanton**	37,000	1992	response pending
1886	**Santa Ana**	338,000	2002	not on agenda	1957	**Fountain Valley**	55,000	1995	response pending
1888	**Orange**	130,000	1989	revision scheduled for 2003	1957	**Westminster**	88,000	1996	not on agenda
1904	**Fullerton**	127,000	1997	not on agenda	1960	**Los Alamitos**	11,000	1999	not on agenda
1905	**Newport Beach**	69,000	1975	in revision; planned adoption in 2004	1961	**San Juan Capistrano**	34,000	1999	not on agenda
1909	**Huntington Beach**	190,000	1996	not on agenda	1962	**Villa Park**	6,000	1991	response pending
1915	**Seal Beach**	24,000	1998	not on agenda	1963	**Buena Park**	79,000	1994	not on agenda
1917	**Brea**	35,000	1986	in revision; planned adoption in early 2003	1967	**Yorba Linda**	59,000	1993	not on agenda
1925	**La Habra**	59,000	1990	not on agenda	1971	**Irvine**	142,000	1999	not on agenda
1926	**Placentia**	46,000	1975	in revision; planned adoption in 2004	1988	**Mission Viejo**	93,000	1990	in review; planned adoption in early 2003
1927	**Laguna Beach**	23,000	1995	response pending	1989	**Dana Point**	35,000	1995	response pending
1927	**Tustin**	67,000	2001	not on agenda	1989	**Laguna Niguel**	61,000	1992	response pending
1928	**San Clemente**	50,000	1993	not on agenda	1991	**Laguna Hills**	31,000	1994	not on agenda
1953	**Costa Mesa**	109,000	2002	not on agenda	1991	**Lake Forest**	59,000	2000	not on agenda
1955	**La Palma**	15,000	1998	not on agenda	1999	**Laguna Woods**	17,000	2001	in review; planned adoption in 2003
1956	**Cypress**	46,000	1993	revision scheduled for 2003	2000	**Rancho Santa Margarita**	47,000	2002	in review; planned adoption in late 2002
1956	**Garden Grove**	166,000	1995	response pending	2001	**Aliso Viejo**	40,000	in revision	response pending