ACTIVITIES OF THE WORLD DATA CENTER IN EARTHQUAKE ENGINEERING

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SUMMARY

The World Data Center system was established in 1957 to accommodate the data that would be collected in the International Geophysical Year. This paper describes the activities of World Data Center A (WDC-A) for Solid Earth Geophysics, which, in addition to being operated by the National Geophysical Data Center (NGDC) in Boulder, Colorado, also has access to NGDC facilities and technical files. WDC-A collects, archives, and disseminates to the scientific community several types of engineering data. Data products and computerized data files available through WDC-A include: strong-motion records (digital and analog); intensity data; epicenter data; and earthquake/tsunami photographs.

STRONG-MOTION RECORDS

Digital Strong-Motion Records

This file contains 4,289 strong-motion records from the U.S. Strong-Motion Network (representing 354 earthquakes), and 1,217 records from 19 foreign countries (representing 194 earthquakes). It includes the most significant records from 1933 through 1983. The data are available on magnetic tapes that can be duplicated in industry-compatible format to run on most computers; further, individual records or components of records are available in many digital formats, including tape copies, punched cards, computer printouts, and microfiche. Digital records are available from the following regions:

1. Western Pacific Ocean: Japan, Taiwan (SMART-1 data), Australia (New Britain), and Papua-New Guinea.

2. Western Hemisphere: United States, Mexico (Mexicali Valley), Costa Rica, El Salvador, Nicaragua, Peru, and Chile.

3. Europe: Italy (Friuli; Campania Lucania), USSR (Uzbek). Rumania (Bucharest), and Yugoslavia.

Some of the earthquakes represented by these records are: Friuli, Italy, 1976; Campania-Lucania, Italy, 1980; Uzbek, USSR, 1976; Bucharest, Rumania, 1977; Niigata, Japan, 1964; and Managua, Necaagua, 1972.

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The most significant records produced in the United States have been further corrected and processed to obtain Fourier response spectra by California Institute of Technology, University of California (La Jolla), and the U.S. Geological Survey. The most recent U.S. (California) records available are: Oroville (1975); Santa Barbara (1978); Coyote Dam (1978); Coyote Lake (1979); Imperial Valley (1979); Mount Diablo (1980); Mammoth Lake swarm (1980); and Westmorland (1981).

An important recent addition to the strong-motion database is a file of 354 components (two magnetic tapes) of Japanese digital accelerograph data, compiled by Ertec Western for EXXON Corporation and processed in the formats developed by California Institute of Technology. This collection is especially important where engineering data are needed for construction in areas of tectonic subduction zones.

Strong-motion data are contributed to WDC-A by many foreign and domestic groups, including:

U.S. Geological Survey, California Division of Mines and Geology, California Institute of Technology, University of California, University of Southern California, Universidad Nacional Autonoma de Mexico, Academia Sinica of Taiwan, Strong-Motion Accelerometer Committee (SMAC) of Japan, ENEA-ENEL Commission of Italy, University "Kiril and Metodij" of Yugoslavia, Technical Research and Standard Bureau of Iran, Academy of Sciences of the USSR, Institutul Central de Fizica of Rumania, and many others.

Analog Strong-Motion Records

The analog data consist only of uncorrected, preliminary records. These records are available in the following formats:

Microfilm: The most significant preliminary strong-motion records in the United States and Latin America between 1933 and 1971 have been copied on 8 reels of 35-mm microfilm (12X reduction) and 70-mm microfiche (about 8X reduction).

Paper records: Only a few preliminary U.S. records are available.

Figure 1 summarizes the total number of records held by the data center.

EARTHQUAKE INTENSITY FILE

This digital file consists of 137,000 Modified Mercalli (MM) intensities (covering about 20,000 earthquakes) reported for individual U.S. communities in "United States Earthquakes," "Earthquake History of the United States," and several other U.S. seismic histories. The file is available in its entirety on magnetic tape, or as area searches about a geographic point, searches by time interval or intensity value, computer

Figure 1. -- Strong-Motion Data Available at the National Geophysical Data Center
Boulder, Colorado

Digital and Analog Records

Country	No. Stations	No. Events	No. Records	Source
Australia	9	30	42	Bureau of Mineral Resources
Chile	2	2	3	*Universidad de Chile
Costa Rica	1	2	2	*Meteorological Observatory
El Salvador	1	4	14	U.S. Geological Survey
Guatemala	1	1	1	*National Observatory
Italy	46	7	52	Commissione CNEN/ENEL
Japan	200	73	460	Strong Motion Accelerometer Committee
Mexico	12	41	118	Universidad Nacional Autonoma-Univ. of California at San Diego
New Zealand	4	2	4	Department of Science & Industry Research
Nicaragua	5	6	28	U.S. Geological Survey
Panama	1	1	1	U.S. Geological Survey
Peru	6	12	52	*Instituto Geofisico
Rumania	1	1	2	Geophysical Institute
Taiwan	37	9	103	SMART-1 (Univ. of California and Academia Sinica, Taiwan)
United States	561	354	5600	U.S. Geological Survey, California Division of Mines and Geology, et al.
USSR	6	9	15	Academy of Sciences
Yugoslavia	4	4	4	Univ. Kiril & Metodij
TOTALS	897	558	6501	

* These institutions operate stations in cooperation with the U.S. Geological Survey (USGS). The records are furnished by the USGS.

EARTHQUAKE INTENSITY FILE

SEARCH FOR ALL EFFECTS IN NEW YORK CITY (40.71N, 74.00W)

STATE	CITY	MM INT	N LAT	W LONG	DISTANCE FROM SOURCE (KM)	REF. CODE	EARTHQUAKE SOURCE									
			COORDINATES				UTC						N LAT	W LONG		
							YEAR	MO	DA	HR	MN	SEC	COORDINATES		MAG	DEPTH (KM)
NEW YORK	NEW YORK	VIII	40.71	74.00	0	H	1737	12	19	04	00		40.7	74.0		
NEW YORK	NEW YORK	IV	40.71	74.00		H	1783	11	30	01	00					
NEW YORK	NEW YORK	IV	40.71	74.00		H	1783	11	30	03	00					
NEW YORK	NEW YORK	III	40.71	74.00		H	1783	11	30	07	00					
NEW YORK	NEW YORK	III	40.71	74.00	158	H	1791	05	19	03	00		41.5	72.5		
NEW YORK	NEW YORK	III	40.71	74.00	630	H	1870	10	20	16	25		47.4	70.5		
NEW YORK	NEW YORK	III	40.71	74.00	8	H	1884	08	10	19	07		40.6	74.0		
NEW YORK	NEW YORK	VI	40.71	74.00	1090	H	1886	09	01	02	51		32.9	80.0		
NEW YORK	NEW YORK	V	40.71	74.00	0	H	1893	03	09	05	30		40.7	74.0		
NEW YORK	NEW YORK	IV	40.71	74.00	877	H	1925	03	01	02	19	18.0	48.25	70.75	7.0	
NEW YORK	NEW YORK	III	40.71	74.00	434		1929	08	12	11	24	48	42.87	78.35		
NEW YORK	NEW YORK	III	40.71	74.00	1611		1929	11	18	20	31	54	44.5	55.0		
NEW YORK	NEW YORK	IV	40.71	74.00	787		1935	11	01	06	03	40	46.8	79.1	7.2	
NEW YORK	NEW YORK	III	40.71	74.00			1935	11	02	14	32					
NEW YORK	NEW YORK	III	40.71	74.00	409		1940	12	20	07	27	26.0	43.8	71.3	5.6	
NEW YORK	NEW YORK	III	40.71	74.00	35		1951	09	04	01	26	28	41.2	74.1		
NEW YORK	NEW YORK	IV	40.71	74.00			1953	08	17	04	22	50				

Figure 2.—Computer search of Earthquake Intensity File for all effects at a specific city

listings, and map plots. Much of the basic source material (mainly earthquake questionnaires and newspaper accounts) is available on 16-mm microfilm. The file was designed with the following objectives:

1. to compile a comprehensive list of historical U.S. earthquakes;

2. to digitize the file, and to write software that would provide area searches and statistical compilations;

3. to include MM intensities for all cities that reported effects of the earthquakes; and

4. to include the names and geographic coordinates of all reporting cities, as well as ancillary information such as earthquake origin time, magnitude, depth, coordinates of the epicenter, and source reference.

Specifically, searches of the earthquake intensity file (see example in Fig. 2) can provide in any combination:

- earthquakes reported "felt" in a given city or State;
- cities affected by a particular earthquake;
- earthquakes that occurred in a given time interval;
- earthquakes of specific MM intensity or range of intensity;
- earthquake effects within a given radius of a specific point.

EARTHQUAKE EPICENTER FILE

This file contains locations on more than 365,000 seismic events dating from 1899 through 1982 including: earthquakes, known or suspected explosions, rockbursts, quarry blasts, and other recorded disturbances worldwide. The file includes for each earthquake: epicenter, origin time, depth, magnitude, effects code (several codes indicating occurrence of damage, fatalities, tsunami, volcanics), and source reference. The file is available on magnetic tape, or printouts of the data can be provided as listed below.

This epicenter file was formed by data furnished by the U.S. Geological Survey, California Institute of Technology (Pasadena), University of California (Berkeley), and about 20 other sources worldwide. Some information from as early as 2100 B.C. is available for large earthquakes in China. The file can be provided in the following formats:

Computer printouts (search of file by any combination of these parameters; see sample in Fig. 3):

1. geographic coordinates (specific point in latitude and longitude; within radius of specific point);
2. time interval;
3. date and origin time;

EARTHQUAKE EPICENTER FILE

AREA 50 - 75 N., 140 - 180 W., MAGNITUDE 5.0+, 1980 83/08/25

SOURCE	YEAR	MO	DA	HR	MN	SEC	LAT	LONG	DEPTH (KM)	MAGNITUDES BODY	SURF	OTHER	LOCAL	INT MAX	PHENOM DTSVNO	RN	CE
GS	1980	01	19	07	02	35.0	51.317N	178.888W	050	5.8 MB	5.7MS	5.70BRK	5.00MLPMR			7	F
GS	1980	02	06	10	43	39.9	51.794N	173.187W	032	5.2 MB	4.6MS					7	
GS	1980	02	12	08	42	29.0	52.289N	173.346W	075	5.2 MB						7	
GS	1980	02	18	11	15	02.2	51.247N	178.307W	053	5.0 MB	4.5MS					7	
AGS	1980	02	20	18	21	30.4	57.120N	156.640W	090S				5.00MLAGS			12	
GS	1980	03	11	03	47	02.8	52.188N	169.030W	020	5.2 MB	4.6MS					9	
GS	1980	03	12	23	04	35.4	52.146N	168.984W	040D	5.4 MB	5.2MS			II		9	F
GS	1980	03	24	03	59	51.3	52.969N	167.670W	033N	6.2 MB	6.9MS	7.10BRK		V		9	D
GS	1980	03	24	04	02	19.3	52.600N	167.453W	033N	6.1 MB						9	
GS	1980	03	24	04	41	59.1	52.886N	167.714W	033N	5.0 MB						9	
GS	1980	04	03	03	46	04.3	63.149N	149.567W	092	5.0 MB				IV		1	F
GS	1980	04	06	14	47	43.2	61.377N	147.824W	049	4.9 MB	5.2MS			IV		2	F
GS	1980	04	13	02	08	32.2	55.044N	160.308W	057D	5.4 MB						12	F
GS	1980	04	15	07	50	19.5	51.871N	175.964W	069	5.1 MB						7	F
GS	1980	05	07	03	06	16.0	62.985N	150.796W	118	5.0 MB				I		1	F
GS	1980	06	30	18	07	39.0	60.010N	141.047W	013D	5.0 MB			5.10MLPMR	IV		19	F
GS	1980	06	30	18	59	31.7	60.061N	141.109W	015D	4.9 MB	4.8MS		5.20MLPMR	IV		19	F
GS	1980	07	05	15	19	22.8	51.466N	178.426W	051	5.1 MB	4.9MS	4.90BRK				7	
GS	1980	07	06	18	45	30.8	56.561N	154.235W	026	5.2 MB	4.9MS		5.40MLPMR			13	F
GS	1980	07	27	09	05	35.0	63.719N	152.790W	021D	4.7 MB	3.7MS		5.00MLPMR			1	
GS	1980	08	01	23	07	14.7	59.617N	148.937W	026	5.4 MB	5.1MS		5.70MLPMR	IV		14	F
GS	1980	08	02	07	07	17.3	52.112N	169.365W	033N	5.3 MB	5.2MS		4.80MLPMR			9	
GS	1980	09	04	10	53	59.6	59.534N	143.885W	033N	5.0 MB	5.4MS		5.00MLPMR			15	

Figure 3.—Computer search of Earthquake Epicenter File for 1980 events at 50–75 N., 140–180 W, magnitude 5.0+

4. maximum MM intensity;
5. depth of focus; and
6. magnitude or range of magnitude.

Magnetic tape or microfilm (16-mm) in:

1. chronological sort;
2. geographical sort (9-track, 1,600 bpi ASCII or EBCDIC only).

Computer-drawn map plots, customized (on mylar).

Punched cards:

1. by monthly subscription; or
2. yearly (all data in one shipment).

EARTHQUAKE PHOTOGRAPH FILE

This collection consists of over 1,700 photographs, many of which depict the effects of earthquakes and tsunamis on different structures (see Fig. 3). Collected from many private and governmental sources, the photographs cover events in 37 countries over a period approaching two centuries (from 1811 through 1981). The file also includes over 300 photographs of volcanoes and volcanic features (e.g., pyroclastic flows).

The "Natural Hazards Photograph Catalog," available free through WDC-A, describes all photographs in the file by giving brief captions of each photograph and providing several examples of dramatic or unusual damage effects. The catalog organizes the photographs in chronological order by date of event occurrence; it includes an index that provides easy reference to the photographs according to:

(1) type of building damaged (e.g., high- and low-rise buildings; steel-frame and masonry buildings; private dwellings; schools; mobile homes);

(2) structural damage (e.g., ceilings; chimneys and stacks; elevators; foundations; roofs; stairs; storage systems; towers; walls);

(3) transportation systems damage (e.g., airports; railroads; streets and highways);

(4) utilities damage (e.g., electrical systems; gas and water lines; sewage systems);

(5) ground effects (e.g., ground fractures; displacement/subsidence/slumping; earthflows; faults/scarps; landslides; sand blows); and

(6) tsunami damage (e.g., bridges; culverts; dams; water mains and aqueducts; wharfs).

The following formats are provided for each photograph:

1. 35-mm color (or black and white) slides; and
2. 8 X 10 black and white photographs.

Special earthquake and tsunami damage slide sets have been prepared from the main photograph collection. The earthquake slide set contains 20 of the best photographic examples, which illustrate damage caused by 11 earthquakes in 7 countries from 1959-1980. The tsunami slide set, which contains 20 of the best tsunami photographs, depicts events the past century in the Pacific region, including Alaska, Hawaii, Japan, and Midway Island.