

Accessing Natural Hazards Data from CD-ROM and on the Web

by

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ABSTRACT

The National Geophysical Data Center and its collocated World Data Center-A for Solid Earth Geophysics acquires, processes, and analyzes technical data that are useful in natural hazards risk assessment. These data sets include information on earthquakes, tsunamis, topography, and global ecosystems. Personnel at NGDC are continually researching new technologies for disseminating these data. This paper presents several examples of seismicity, earthquake strong motion, hazards images, and ecological characterizations available on CD. Interactive search and retrieval capabilities via the World Wide Web of NGDC hazards data are also described.

KEYWORDS: earthquake; environmental data; geophysical data; GIS; GeoVu; seismicity; strong motion; topography; tsunami; World Wide Web

1. INTRODUCTION

The National Geophysical Data Center (NGDC) and its collocated World Data Center-A (WDC-A) for Solid Earth Geophysics acquires, processes, and analyzes technical data that are useful in natural hazards risk assessment. These data sets include information on earthquakes, tsunamis, topography, and global ecosystems. Personnel at NGDC are continually researching new technologies for disseminating these data. For example, many NGDC hazards data sets have been published on CD-ROM. Although CDs are a convenient distribution media, the data are in a variety of formats and difficult to access. The multiplatform GeoVu software was developed at NGDC to provide a versatile data access system. GeoVu allows users to quickly and easily browse, compare, and make selections from large data sets using intuitive menu files (an ASCII file developed by the data

producer). These menu files help navigate through complex directory structures and integrate documentation. As a result of the increasing popularity of the World Wide Web, NGDC has developed tools to use these menu files to provide online access to data and metadata from the CDs. Interactive search and retrieval capabilities via the Web are also available for several natural hazards and digital elevation data sets. The following sections describe examples of NGDC natural hazards data published on CD, and online access to natural hazards data and information via our Internet site (<http://www.ngdc.noaa.gov>).

2. SEISMOLOGY PROGRAM

NGDC and its predecessors have been archiving earthquake data for the past century and currently hold the largest archive of historical earthquake event and strong motion data in the world. These data have been grouped into subsets by region, date, and theme; and disseminated on CD and via the World Wide Web. Two CD collections of earthquake data were recently released: Seismicity Catalogs and Earthquake Strong Motion.

2.1 Seismicity Catalogs

In June 1996, NGDC published a CD-ROM of earthquake catalogs which is a comprehensive compilation of the collections of the NGDC and National Earthquake Information Center of the U.S. Geological Survey. The CD-ROM set contains data for more than 4 million earthquakes dating from 2100 B.C. to 1996 A.D. The data contain information on epicentral time of origin, location, magnitudes, depth and other earthquake-related parameters. Three types of

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catalogs are included on the CDs: (1) Local (containing data from single stations or local networks), (2) Regional (containing data from regional networks, such as CALNET in central California), and (3) Teleseismic (containing data from around the world). Catalogs have been contributed from various worldwide industrial, academic, governmental, and private sources. The CDs also contain auxiliary data bases which aid in earthquake investigations. These data include: world stress, tsunami, volcanic and fault parameters, digital elevation models, the Summary of Earthquake Data Base, and a bibliography of earthquake-related materials at NGDC. Format information, a data dictionary, and statistical information are also included.

The data on the Seismicity Catalog CDs can be accessed through the GeoVu browse and visualization software included on the CDs. This software allows visualizations such as x-y plots of the data and pre-computed histograms, as well as reformatting of data files to a format specified by the user. Figure 1 shows an example of an x-y plot of latitude vs. longitude for the Beijing, China, State Seismological Bureau earthquake catalog.

In addition to the CD collection, NGDC performs seismic hazard and site analysis upon request. Data retrievals from the earthquake data base may be made according to any number of combinations of parameters such as geographic area, time period, magnitude range, or maximum intensity.

2.2 Significant Earthquake Database and U.S. Earthquake Intensity Database

Two of NGDC's most popular earthquake catalogs are the Significant Earthquake Database and U.S. Earthquake Intensity Database. The Significant Earthquake database that was developed at NGDC. It is a global database containing information on more than 5,000 destructive earthquakes from 2150 B.C. to the present. The events in the file must meet at least one of the following criteria: moderate damage (approximately \$1 million or more), 10 or more deaths, magnitude 7.5 or greater, or

Modified Mercalli Intensity X or greater (for events lacking magnitude). This database is available as a soft cover book. The U.S. Earthquake Intensity Database is a collection of damage and felt reports for over 22,000 U.S. earthquakes dating from 1638 to 1985. The digital database contains information regarding epicentral coordinates, magnitudes, focal depths, names and coordinates of reporting cities, reported intensities, and the cities' distances from the epicenter. These catalogs are included on the Seismicity Catalogs CD collection and are also available for searching or downloading via the World Wide Web. Users can search on any combination of earthquake and intensity parameters. The results are displayed in a dynamically created HyperText Markup Language (HTML) page based on user-specified criteria.

2.3 Strong Motion Accelerograph Records

The NGDC earthquake strong motion archive, the largest collection of digitized and processed accelerograph records in the world, is available on CD. This CD collection contains more than 15,000 digitized and processed accelerograph records, dating from 1933 to 1994. The data represent a broad range of structural and geologic recording environments. Three types of processed records are included on the CDs: uncorrected (raw), corrected (filtered), and response spectra (includes Fourier spectra). Records were contributed to the archive from various worldwide industrial, academic, and governmental sources. Over 2,000 pages of documentation containing information on the triggering earthquakes, recording stations, record processing procedures, and data format (when available) were digitally scanned (in PCX files) and included on the CDs. These files can be accessed and displayed with the GeoVu software.

Most of the strong motion archive consists of records obtained from various man-made structures. These sites include structures of engineering importance such as dams, bridges, utilities, and large buildings. These records represent a comprehensive collection of

accelerograph data suitable for the analysis of dynamic structural response and soil-structure interaction.

Approximately 5,000 records in the collection are available from ground response sites. Obtained from a wide variety of geologic environments, these records comprise an important subset useful for the study of seismic attenuation in a wide variety of regional geologic media ranging from young alluvium to hard rock. Several near-source records included in the database are useful for source mechanism studies. Also included in the archive are records from several accelerograph instrument arrays which are used to study specific problems in strong ground motion.

2.3.1 Strong Motion Catalog (SMCAT) data inventory software package

The Strong Motion CATalog (SMCAT) data inventory software package for IBM-compatible personal computers is included on the CDs. It contains a comprehensive database which summarizes the characteristics of each accelerogram and facilitates retrieval of records for specific applications from the CDs. The SMCAT database is also available for searching via the World Wide Web. Users can search on any combination of earthquake, station, or accelerograph record parameters; the results are displayed in a dynamically created HTML page. An example of the search parameters page and the search results are shown in Figure 2. The SMCAT database will continue to be updated as additional accelerograph records are added to the NGDC archive.

2.4 Spitak Earthquake CD-ROM

The Spitak Earthquake CD-ROM is another example of natural hazards data distributed on CD. It was a cooperative project between the Russian Academy of Sciences and NGDC. The CD contains a wide variety of information useful in seismic hazard analysis such as information on the geology and geophysics of the area, data for the mainshock and aftershocks, topography data, as well as societal information

such as population agriculture, and industry. This CD is also accessible with the GeoVu software. GeoVu allows users to browse data layers using an intuitive menu (an ASCII file developed by the data producer). This menu file is also used in conjunction with Web-based browsers, providing online access to metadata and data from the CD. The online user interface and a data display from the CD is shown in Figure 3.

3. TSUNAMI PROGRAM

NGDC and the WDC-A help to compile, catalog, and synthesize available information on tsunami sources and effects to support modeling, engineering, planning, and educational purposes. These products include historic tsunami data, technical publications, and photographs.

3.1 Pacific Tsunami Database

The Pacific Tsunami Database provides detailed information on the tsunami source and effects. It includes more than 2,000 events since 2,000 B.C. and more than 5,800 tsunami locations. This database is included on the Seismicity Catalogs CD collection and is available via our Internet site.

3.2 Tsunami Publications

Tsunami publications available from NGDC include tsunami catalogs for the United States, the western coast of Mexico, the Pacific, and Peru-Chile. A catalog of submarine volcanoes and hydrological phenomena associated with volcanic events is also available. The latest publication, *Tsunamis Affecting Alaska, 1737-1996*, describes all known tsunamis which have affected Alaska in historic times. In the future, the digital files used in preparing the publications will be converted to HTML pages and accessible on the World Wide Web.

4. HAZARD PHOTOGRAPH COLLECTION

In the interest of hazard education, NGDC routinely collects post-disaster photographs of

geologic hazards for the development of educational slide sets. The goal of the hazard photograph program is to promote a greater understanding of geologic hazards throughout the world and their effects on man and the environment. The sets depict the characteristics and effects of hazards such as earthquakes, volcanoes, landslides, and tsunamis. Of the 35 sets in distribution, 19 relate to earthquake damage, eight to volcanism, three to tsunamis, and five to geologic processes. A recent release is a set on the Great Hanshin-Awaji (Kobe) Earthquake of January 17, 1995. A slide from the Kobe set is shown in Figure 4.

4.1 Geologic Hazards Photos CD-ROM

As part of a data preservation effort, the geologic hazards slide sets were digitally scanned and replicated on a three-volume CD collection. The images (and their companion documentation with credits) are accessible with GeoVu. These images are also available for viewing and downloading via the World Wide Web.

5. TOPOGRAPHY PROGRAM

Topography is an important data layer in many Geographic Information System (GIS) applications for hazards assessment and emergency response. In addition to earthquake and tsunami programs, NGDC also has an active topography program. Numerous national, regional, and global digital elevation models (DEMs) are provided on CD.

5.1 TerrainBase CD-ROM

The TerrainBase CD provides a new global 5-minute mosaic using improved source materials. These data files can be downloaded via the World Wide Web. The data on the CD can be easily imported into any geographic information system and are accessible with the GeoVu software. Using the same technology described in the Spitak Earthquake CD-ROM section 2.5, GeoVu allows users to browse data layers using an intuitive menu file. This menu file also

provides online access to metadata and data displays from the CD.

5.2 Global Land One-kilometer Base Elevation Project

NGDC is a participant in the Global Land One-Kilometer Base Elevation (GLOBE) project. GLOBE originated as an ad-hoc international cooperative effort between several organizations interested in creating a global digital elevation model (DEM) on a nominal 1-kilometer grid. GLOBE has been endorsed by the Committee on Earth Observation Satellites (CEOS) subgroup on Auxiliary Data Sets. The International Geosphere-Biosphere Programme's Committee on Data and Information Systems (IGBP-DIS) is a major participant. NGDC is responsible for dissemination of GLOBE data and thus far has released two prototype data sets (version 0.1, 1995; version 0.5, 1997). By the end of 1997, the GLOBE Project hopes to make available its first complete hybrid global 1-km grid. These data will be distributed on CD-ROM and will be formatted so that the data can be easily imported into a geographic information system. The data and metadata will be accessible with the GeoVu software and eventually available via the Internet.

6. COASTAL RESOURCE MANAGEMENT

The world's coastal areas are particularly vulnerable to natural and manmade hazards. Intelligent management of these resources requires the identification of risks from climate, geophysical events, environmental change, ecological events, and societal pressures to these areas. NGDC and the Cooperative Institute for Research in Environmental Sciences (CIRES) are collaborating with the NOAA Coastal Services Center (CSC) to meet NOAA goals in coastal resource management and information services. Through these collaborative efforts, improved methods for synthesis of ecosystem information and application to current-day problems are being formed.

6.1 Otter Island CD-ROM

As part of its collaboration with CSC, NGDC is pioneering coastal characterization studies to support the needs of regional planners and coastal zone managers. The first CD, an ecological characterization of Otter island, South Carolina, has been produced. The CD contains extensive text and a large bibliography presented in HTML pages accessible with Web browsers. This CD also features an index and a glossary that were created using the tool MetaDex. MetaDex was developed at NGDC to make metadata more accessible by automatically generating indexes and glossaries from HTML, menu, and plain text files. In addition to the large amount of metadata, many GIS data layers are also included. These data are accessible with the ArcView geographic information system software. Videos showing some of the animal species found on the island can also be viewed.

7. CONCLUSION

The future offers many exciting challenges and opportunities for NGDC and the WDC-A. Rapidly changing Web technologies will allow NGDC to provide quick and easy access to data and information in user-specified formats. Users will be able to access information on CDs as well as update data as it becomes available on the Web. New multiplatform programming languages will make data accessible via Web browsers regardless of operating system, network software, or hardware. Multimedia applications will enable data and information to be presented in new and innovative ways. Higher resolution graphics and new higher precision data streams from satellites will provide new insight into many areas of research. Technologies will provide online links to GIS data layers and applications allowing users to not only access data, but to perform online analyses. The future for NGDC definitely holds unprecedented opportunities, limited only by our imaginations.

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Figure 1: An example of a GeoVu x-y plot of latitude vs. longitude for the Beijing, China, State Seismological Bureau earthquake catalog.

Figure 2: An example of the SMCAT search parameters page and the search results

Figure 3: The online user interface and a data display from the Spitak CD.

Figure 4: A slide from the Kobe slide set.

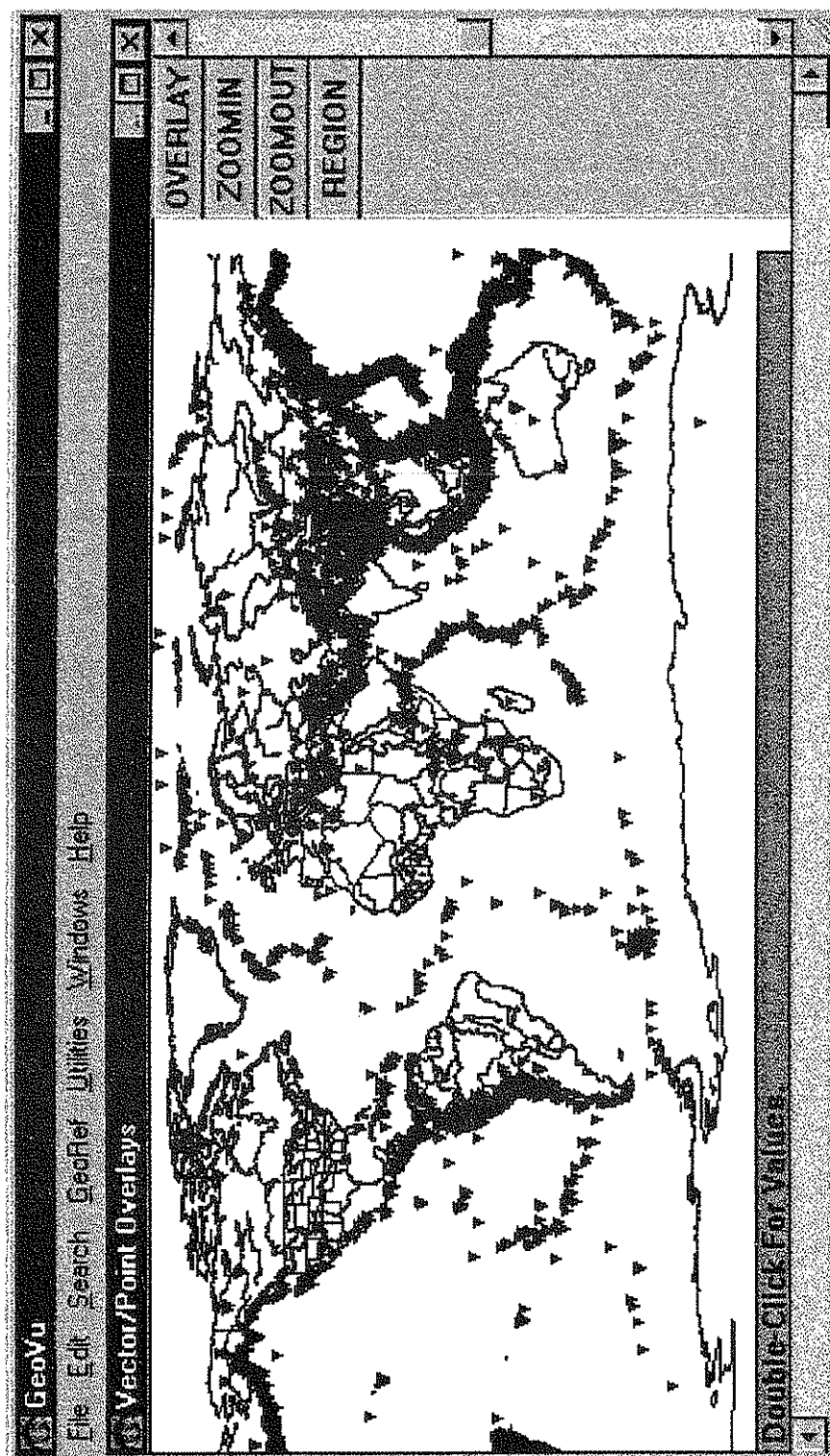


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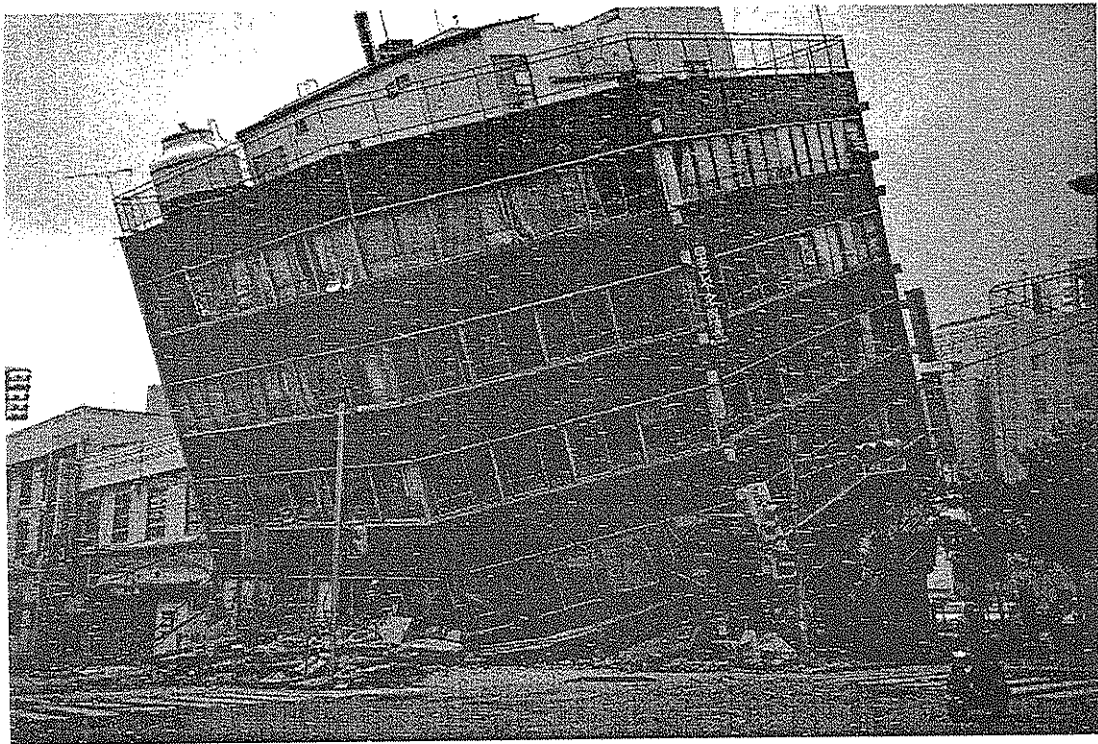


Figure 4: A slide from the Kobe slide set.

