Earth science CD-ROMs: a collection buyer's guide

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Non-bibliographic CD-ROMs in the earth sciences are diverse in origin and features. Datasets on disc can be numeric and/or images and usage of those datasets ranges from basic to sophisticated. An earth science CD-ROM may represent a mastering of datasets onto disc and the recipient simply copies the dataset or portions of it onto a hard disc for analysis with user-written programs. In this instance, the earth science CD-ROM distributes large datasets to scientists through a low startup cost mechanism -- a CD-ROM player; the alternative for accessing large datasets are expensive workstations, large hard discs, and tape drives. An earth science CD-ROM may have complementary software that can be an end in itself in manipulating and examining the datasets on disc. Sophisticated manipulation of datasets on disc with subsequent image creation and/or data subsetting is possible on some CD-ROMs. The earth science community has a long history with CD-ROM and is very active in CD-ROM technology. An interesting 1988 article detailed one application of CD-ROM technology to the research and discovery process in earth science wherein a CD-ROM was used to discover a previously unreported correlation between magnetic field variations at the geomagnetic pole and the strength of the ring current in the Van Allen radiation belts around Earth (Herbst, 1988).

DIVERSE DATA

Non-bibliographic earth science CD-ROMs cover the range of disciplines in earth science: geology, oceanography, meteorology, astronomy, geophysics, and geochemistry. Earth science CD-ROMs present a diversity of data to the user including satellite images of planets, polar icecaps, ocean color, and land forms; sonar seafloor images; seafloor drilling; streamflow, temperature and precipitation; geologic, topographic and hydrographic maps; seismic reflection profiles; seismic history; photographs; geomagnetic; gravity; atmospheric gases; clouds; snow cover and sea ice; mineral data; ocean temperature and salinity; and, sunspots and solar irradiance. Several earth science CD-ROMs are featured in "CD-ROMs" sidebar below. Some earth science CD-ROMs are produced with the intention that the datasets on CD-ROM can be copied to hard or floppy disk for subsequent analysis. CD-ROM is an inexpensive media for distributing datasets of a size appropriate to CD-ROM. These CD-ROMs may include browsing software to view the

datasets that will be subsequently downloaded. Some earth science CD-ROMs are produced with the intention that the datasets be manipulated to display tables, produce graphs, or display images produced from data. Images are typically stored on CD-ROM in a compressed format and are decompressed for display. Images can then be altered to highlight important details or increase the contrast between features.

MANY PRODUCERS

Earth science CD-ROMs are issued by agencies, institutions, and companies largely in the US but increasingly worldwide. The US Geological Survey, National Oceanic and Atmospheric Administration, National Aeronautics and Space Administration, US Bureau of Land Management, Geological Survey of Japan, New South Wales Department of Water Resources, US Navy, US Defense Mapping Agency (in cooperation with the Australian Directorate of Military Surveying, Canadian Directorate of Geographic Operations of the Department of National Defense, United Kingdom's Directorate of Military Surveying of the Ministry of Defense), WeatherDisc Associates, EarthInfo, Hydrosphere Data Products, Chadwyck-Healey, and several universities are producers of earth science CD-ROMs.

FINDING OUT

It is nearly impossible to be fully informed of all new earth science titles being produced. Finding out about earth science CD-ROMs is best accomplished by monitoring the journals, newsletters, and bulletin boards used by the scientific community rather than the library community. Announcement of new earth science CD-ROMs is scattered through a variety of publications and electronic mail forums; networking among colleagues with similar interests is especially useful for hearing about new releases. Serendipity is a major factor in learning about the release of new CD-ROM titles in the earth sciences. Scientific interest in global change is spurring production of CD-ROMs with relevant datasets. Useful alerting resources for earth science CD-ROMs are many (see "alerting" sidebar below) and there are certain to be others of which the author is unaware. Research journals in the earth sciences that print news and reviews occasionally carry notices and reviews of new CD-ROMs as do the CD-ROM oriented journals like CD-ROM PROFESSIONAL and CD-ROM LIBRARIAN.

The most useful compilation for surveying earth science CD-ROMs is the SIGCAT CD-ROM COMPENDIUM. The SIGCAT CD-ROM COMPENDIUM complements the coverage of earth science CD-ROMs found in the standard CD-ROM directories published by Gale Research, Learned Information, Meckler, and TFPL Publishing. The SIGCAT CD-ROM COMPENDIUM is compiled by the US Geological Survey Library in cooperation with SIGCAT, the Special Interest Group on CD-ROM Applications and Technology. The SIGCAT CD-

ROM COMPENDIUM is so useful because the compilers are much closer to the earth science community producing CD-ROMs than can be the compilers of general CD-ROM directories. The SIGCAT CD-ROM COMPENDIUM can be scanned to discover earth science CD-ROMs missed through the ongoing effort of scanning other sources. Listings and reviews of multiple earth science CD-ROMs are cited in the bibliography.

MICROCOMPUTER NEEDS

Earth science CD-ROMs tend to be DOS-oriented in their retrieval/display software though the datasets themselves are usually accessible from the CD-ROM by other machines eg Macintosh, Unix due to CD-ROM standardization. Microcomputing power is important; performance will be highly undesirable with a low-end microcomputer. Graphic screen displays are drawn from large data or image files on CD-ROM; screen drawing is agonizingly slow without sufficient power. Even on a fast 486 microcomputer, high resolution image creation from very large files can be slow. A recommended equipment configuration is a fast 486DX2 microcomputer, four megabytes minimum of RAM, a large hard disk (at least 100 megabytes), 16 inch minimum non-interlaced 1024X768 VGA monitor with 0.28 minimum dot pitch, 1 megabyte 1024X768 VGA card, and, a double-speed CD-ROM drive. Many CD-ROMs require math coprocessing capability so a 486DX microcomputer with its built-in math coprocessing is desirable. Images displayed onscreen are best viewed on large diagonal-measure monitors with a small dot pitch. A standard low-end 14 inch, 0.39 dot pitch monitor will make image viewing a low-resolution microscopic process. VGA cards supporting higher resolutions using one megabyte on-board memory are desirable, though only a few earth science CD-ROMs offer high resolution display due to the diversity in video drivers (Orchid and Paradise were supported on some early CD-ROMs). Hard disk space requirements vary tremendously among CD-ROMs. Some earth science CD-ROMs take up minimal hard disk space while others build large index files on the hard disk consuming several megabytes of disk space. These index files enhance the speed of the CD-ROM retrieval software so it is desirable to dedicate hard disk space to such a purpose.

PRINTING

Printer selection deserves careful consideration; printer requirements depend on needs. The earth science CD-ROMs that are a vehicle to distribute datasets do not require printing capability. However many earth science CD-ROMs display spectacular screen images and users may wish a paper copy of what they see onscreen. Depending on the screen image, a black/white copy with grayscale shading may be sufficient, or, a color copy may be deemed mandatory for differentiating several features. Screen images usually cannot be printed with the display software included with the CD-ROM. Pressing the SHIFT and PrtSc keys

will not print a graphic image onto the printer. Graphic screen displays from these CD-ROMs have to be captured with image or screen capture software and then subsequently printed (Allen, 1993; Grunin, 1993). Screen images can be zoomed, cropped, and rotated before printing. If a downloaded image file is needed for subsequent image manipulation or incorporation into a manuscript, then the screen capture software has to create an file in an image file format (eg PCX, TIFF) that can be read by the software that will subsequently manipulate or incorporate the image.

Color inkjet printers are affordable and offer 300 dots-per-inch or better resolution (Ellison, 1992; Miller, 1992). Thermal color printers offer even better color printing but are too expensive for most users. Offering color printing from earth science CD-ROMs is not trivial for those on a tight budget. Color inkjet cartridges cost a lot. Printing grayscale images with a black ink printer may be a reasonable alternative for those on a tight budget. For some CD-ROMs, grayscale printing offers sufficient contrast between onscreen data elements. The decision to offer color printing depends on the CD-ROMs involved and the ultimate use of the images displayed from the CD-ROMs. If the scientist uses an image display to preview data and then subsequently downloads that data for incorporation into customized programs, then color printing is not necessary. If the scientist enduser is likely to expect to walk away with color printouts after viewing images from a CD-ROM, then a color printer should be considered.

Consider carefully the method whereby a color inkjet printer prints the color black. More expensive color inkjet printers have separate ink cartridges for each primary color (green, yellow, and red) as well as black eg Hewlett Packard DeskJet 550C, HP PaintJet. Less expensive color inkjet printers mix black from a combination of green and red inks with the color black actually being a very dark green eg Hewlett Packard DeskJet 500C. Since the color black can be a heavily-used color in printing CD-ROM images, it may be economic to have a separate black ink cartridge rather than exhausting green and red ink cartridges. To save on consumption of black ink, many screen capture software eg Pizzazz Plus offer black/white reversal to reduce consumption of black ink. Onscreen displays have a black background while the printed page has a white background; black is swapped for white before printing. If print volume is low, however ink consumption may not be a great concern.

The per-page cost of black-ink printing with a dot-matrix, inkjet, or laser printer has been noted (Spanbauer, 1992). If the budget is tight, consult the specifications of a color printer before purchase to see the estimated number of pages that can be printed from its inkjet cartridges. Color printers have draft and high-quality outputs; high-

quality printing consumes more ink. Spanbauer lists the following ranges of per-page costs for black-ink printing: dot-matrix printers $0.004 -$0.010; inkjet printers $0.034 -$0.040; laser printer $0.027 - $0.031. Determine the inkjet cartridge costs of the color printer being considered and divide that cost by the number of estimated pages that can be printed. Compare with Spanbauer's figures for black-ink printing to relate color printing to common budgetary experience with black-ink printers.

High-volume printing locations may wish to avoid lower-priced color printers like the HP DeskJet 500C with its tri-chambered print cartridge. Since more expensive color inkjet printers have separate cartridges for each primary color including a separate cartridge for black, they will be more cost-effective in ink consumption. A one-cartridge model has to have its cartridge replaced as soon as one color runs out. A more expensive color printer with separate ink cartridges for each color including black has to have only one of its cartridges replaced when a color runs out.

Color printing from earth science CD-ROMs can be an adventure. Frequently the image seen onscreen has to be manipulated with the screen capture software to swap colors so that the color printout is clear and legible in addition to being merciful on black ink consumption. Color swapping is also useful to enhance the contrast and clarity of numbers and letters against a colored background. Sometimes what is seen onscreen is reduced in clarity in the color printing process; color swapping with the screen capture software will overcome it. White lettering may need to be swapped to a color so that the lettering stands out on the page (see figure one). Color swapping can be an iterative process involving successive color printouts (running up the costs and ink consumption) as one swaps colors trying to improve image clarity of the printout. Considerable time is consumed waiting for one page to print so engaging in an iterative process to obtain a clear printout consumes considerable time. For example, if a black background is reversed to a white background for printing to reduce black ink consumption, then white lettering or lines onscreen have to be swapped to another color so that they will stand out against a white background. However the white lettering or lines cannot be changed to a color already existing onscreen or the resulting printed image will lose clarity when the lettering or lines disappear into portions of the image with the same color. It may take several printouts to discover an adequate representation of the image displayed onscreen.

MEMORY & AUTOEXEC.BAT

A necessary component of a DOS microcomputer used for earth science CD-ROMs is memory management. Some earth science CD-ROMs require considerable free RAM memory so RAM memory will have to be managed

efficiently to leave conventional memory open as much as possible. Memory management software like QEMM or 386Max make the job simple; DOS version 6's automatic memory optimization should be sufficient. If screen printing images onto paper, efficient memory management will be required. Screen capture software is RAM-resident thereby consuming memory. For example, Pizazz Plus screen capture software loads into 40K of memory. Screen capture software will consume memory in the critical 640K area unless it is loaded high into upper or extended memory to conserve memory for the CD-ROM display software itself.

Each CD-ROM typically has its own requirements for configuring the AUTOEXEC.BAT file and establishing its own directory or directories on the hard disk. Keep an extra copy of the CONFIG.SYS and AUTOEXEC.BAT files stashed away from the root directory for referral after installation of each new CD-ROM. The installation process of some titles may modify the CONFIG.SYS and AUTOEXEC.BAT files in ways that need revisions so that the newly installed CD-ROM coexists with other previously installed CD-ROMs on the same microcomputer. AUTOEXEC.BAT's PATH statement tends to become lengthy as more earth science CD-ROMs are loaded onto one microcomputer. Each CD-ROM usually need their own SET statement(s) in AUTOEXEC.BAT; numerous SET statements will accumulate as more CD-ROMs are installed on one microcomputer. Use a REM remark before each SET statement to identify the CD-ROM owning each SET statement. DOS' environment size may have to be increased to accommodate this increasing number of SET statements.

READ THE DOCUMENTATION

Implementing earth science CD-ROMs requires considerable tolerance for reading documentation and trial-and-error. Documentation tends to be ample and proficiency in DOS will be helpful. Earth science CD-ROMs are improving in their ease of installation and use but many require considerable effort for familiarity. A common software used with many earth science CD-ROMs offering images is IMDISP, a freely-distributed image display software (Baalke, 1992). IMDISP is a command-driven software for displaying and manipulating images. Though IMDISP has a learning curve, it offers the user a free tool to display and manipulate earth science images without having to undertake customized programming to view the images.

INSTRUCTIONAL IMPLICATIONS

Committing to instructional support for earth science CD-ROMs in a library setting deserves careful consideration. Offering earth science CD-ROMs for public use in a library setting may involve considerable skill acquisition and time commitment in order to answer the unavoidable questions. Since IMDISP is regularly used for image-based earth science CD-ROMs, IMDISP will become an old friend. Should each

earth science CD-ROM owned by a library have its search and display software loaded on a library microcomputer and available for on-site use? Simply implementing earth science CD-ROMs on a microcomputer for public access is not enough. Putting out documentation is not enough. Questions will inevitably arise. The instructional resource person will have to scan documentation file(s) on CD-ROM to gain beginning-level familiarity with datasets and software on the CD-ROM. Expertise is not needed (since that is the scientist's area) but familiarity is needed to get someone off to a fast start. Staffing constraints may be such that checking out the CD-ROMs to interested users for use outside the library may be more appropriate than having them mounted on a CD-ROM players are very affordable and scientists increasingly have them. The nature of some earth science CD-ROMs is that usage makes more sense outside a library setting. Extended analysis may be necessary of the data available on CD-ROM; this analysis may be more comfortable in an office setting. A library may wish to implement on-site only those earth science CD-ROMs that it expects to use on a regular basis as part of its reference services. Earth science CD-ROMs that are infrequently used need not be pre-installed and ready for use at a moment's notice; they can be installed and available within a reasonable turnaround time.

COLLECTION DEVELOPMENT

A library should carefully consider the collection development implications of acquiring these CD-ROMs; there are many questions that have to be considered. Some products are available for free while others can cost several hundreds of dollars. There will be a considerable financial outlay over time if a library plans to acquire all earth science CD-ROMs within its interests. Some earth science CD-ROMs can be viewed as enhancements to an existing collection of maps and atlases. Some libraries can expect to utilize these CD-ROMs due to past service experience with maps and atlases. Other earth science CD-ROMs are largely oriented to distribution of datasets and subsequent extensive analysis of the data by scientists. Is this a new direction for the library as a data archive? At many institutions the scientists or the institution pays the cost of acquiring datasets on magnetic tape. How are datasets archived at one's institution? If considering spending library material funds on earth science CD-ROMs strictly distributing datasets, does the library currently expend its material funds archiving datasets distributed on magnetic tape or floppy disk? When it comes to expenditure of library material funds, is CD-ROM worthy of special consideration compared to these other media? Do library users expect the library to spend material funds archiving CD-ROM datasets while simultaneously dropping expensive journal subscriptions? Answers will vary among libraries but careful consideration is warranted since library material funds and library staffing will be impacted.

As a group, earth science CD-ROMs have undergone considerable change since introduction. Many of the first ones lacked user-friendly interfaces to the datasets or had minimal interfaces. Users needed to change directories on the CD-ROM to get to the data wanted. The documentation was a constant companion in using the CD-ROM. Many earth science CD-ROMs now display the results of considerable effort in development of their user interface. One can sit down and intuitively begin to use the basic features of many of them without an initial reading of the documentation. As a group, earth science CD-ROMs have progressed tremendously in their features and ease-of-use since their introduction. Future developments that would be worthwhile include greater use of high VGA resolutions, anything to speed up drawing of data-intensive images, Windows implementation for background drawing of data-intensive images, and, software for multiple platforms.

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Kuntz, Lynda, Janice Beattie and Alvetta Pindell. 1991. Directory of U.S. Marine CD-ROMs. NOAA Central Library, Rockville, Maryland, 1991. 48p. [covers 17 non-bibliographic marine CD-ROMs with many illustrations]

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Shuler, John. 1993. Democracy on disc, the Earth abides. CD-ROM WORLD 8(5):45-47, June 1993. [covers first seven CD-ROMs in the USGS Digital Data Series].

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Zihlman, F.N. and M. P. Pantea. USGS explores CD-ROM technology. GEOTIMES 38(7):17-19, July 1993. [covers three USGS Open-File Report CD-ROMs and USGS Digital Data Series #5 CD-ROM].

ALERTING SIDEBAR

* SIGCAT Newsletter
  Special Interest Group on CD-ROM Applications and Technology. $25. Contact: SIGCAT Foundation, PO Box 3706, Reston VA 22090.

* Omnet ScienceNet bulletin boards, particularly SCIENCE and OCEAN
  Omnet runs a commercial electronic mail service using SprintMail. Omnet is used by the worldwide oceanographic community and some of the non-oceanographic earth science community. Contact: Omnet, 154 Wells Ave, Newton Centre, Massachusetts 02159. Phone: 617/244-4333.

* Information Systems Newsletter, NASA Office of Space Science and Applications
  Contact: Sandy Dueck, Jet Propulsion Laboratory, 4800 Oak Grove Dr, M/S 168-514, Pasadena Ca 91109. Phone: 818/354-5073.

* EEZ News
  EEZ News follows activities in the continental shelf surrounding the US. Contact: USGS-NOAA Joint Office for Mapping and Research, 915 National Center, Reston, Virginia 22092. Phone: 703/648-6525. Fax: 703/648-5464.

* New Publications of the US Geological Survey
  Lists CD-ROMs issued as part of USGS Open File Report and other USGS series. Lists USGS Digital Data Series CD-ROMs (GPO Depository Item #0621-K) starting with May 1993 issue. Contact: US Geological Survey, 582 National Center, Reston VA 22092.

* National Geophysical Data Center Data Announcement
  Contact: National Geophysical Data Center, NOAA E/GC/4, 325 Broadway, Boulder CO 80303-3328. Phone: 303/497-6761. Fax: 303/497-6513. Internet: info@mail.ngdc.noaa.gov.

* Digital Data Digest
    Contact: US Army Topographic Engineering Center, Attn: CETEC-LO, Fort Belvoir, VA 22060-5546.

* NODC Environmental Information Bulletin
* Earth System Monitor
    For both, contact: Richard Abram, National Oceanographic Data Center, User Services Branch, NOAA/NESDIS E/OC21, 1825 Connecticut Avenue NW, Washington DC 20235. Phone: 202/606-4561. Fax: 202/606-4586. Omnet: NODC.WDCA. Internet: services@nodc2.nodc.noaa.gov

CD-ROMs SIDEBAR

MARINE CLIMATIC ATLAS OF THE WORLD

The Marine Climatic Atlas of the World compact disc contains summarized worldwide marine climatological elements. Produced by the US National Climatic Data Center and the Naval Oceanography Command Detachment, the Atlas includes analysis and display software for climatological averages of atmospheric and oceanographic data observed within 1 degree (see figure one) and 5 degree grid areas covering the global marine environment. Available elements include air and sea temperature, dew point temperature, scalar wind speed, sea-level pressure, wave height, wind and current roses, and probability of icing and gale force winds. The summary statistics are derived from NCDC's marine database covering the period 1854-1969. Runs on DOS system. Cost is US $61.00. Letter orders with a check as payment can be sent to: National Climatic Data Center, Federal Building, Asheville, NC 28801, USA, or, call to order by credit card to 704/259-0682. Fax orders by credit card to 704/259-0876.

TROPICAL OCEAN GLOBAL ATMOSPHERE

Tropical Ocean Global Atmosphere (TOGA) CD-ROM contains tropical oceanographic and meteorological data. Produced by the Jet Propulsion Laboratory/NASA Ocean Data System, TOGA CD-ROM is available, free of charge, from the International TOGA Project Office. This disc is the first in a planned series of TOGA data and World Climate Research Programme data. TOGA CD-ROM includes both selected observations and selected numerical model results for 1985 and 1986.

TOGA Observations : tropical ship surface data; tropical ship subsurface data; global drifting buoy data; tropical Pacific moored current meter and temperature data; tropical Pacific sea level data; tropical Pacific island meteorological data;

TOGA Fields : global surface meteorological fields (analyzed parameters and model-derived flux fields); global sea surface temperature monthly analyzed (see figure two) and climatology fields; surface pseudo-stress fields over tropical Indian, Pacific and Atlantic oceans.

Runs on DOS system and needs 3 megabytes hard disk space. Contact: International TOGA Project Office, World Meteorological Organization, CP 2300 CH-1211 Geneva 2 Switzerland. Tel 44-22-730-8430. Omnet: INTL.TOGA.

GEOPHYSICS OF NORTH AMERICA CD-ROM

Geophysics of North America (GNA) compact disc provides data and imagery of topography, magnetics, gravity, seismicity, heat flow, crustal stress, and satellite AVHRR imagery (eg vegetation index). GNA CD-ROM covers the Northern Hemisphere from approximately the Prime Meridian to the International Date Line. Users can view data, overlay it with other data and select portions for output. Graphical browse facilities support viewing data as images with geographical references as overlays (data values at any location can be displayed). A palette painting facility supports customization of the color representations of the gridded data (see figure four). Geophysical data can be presented as contours and points overlain on background images; many overlays can be stacked as the user builds one's own view (see figure three). Data profile plots can be generated along any line defined by the user. The high, low, and end-point values are labeled; the zero datum line is displayed. Runs on DOS system, math coprocessor recommended, needs 3 megabytes hard disk space. Available for $580 plus $10 handling from National Geophysical Data Center, NOAA E/GC, 325 Broadway, Boulder, CO 80303-3328. 303/497-6958. Fax: 303/497-6513.

SEAFLOOR IMAGERY AND BATHYMETRY FOR CONTINENTAL SHELF OF WASHINGTON, OREGON, AND CALIFORNIA

GLORIA Imagery and Bathymetry US West Coast EEZ compact disc contains bathymetric data and GLORIA seafloor imagery (see figure five) for the US northwest exclusive economic zone. GLORIA sonar images are available from 40 degrees North to 49 degrees North latitude in a full-resolution, processed binary file format as well as a compressed format for display (17 2-degree by 2-degree image files). Bathymetric data is available from 30 degrees North to 49 degrees North latitude in an ASCII file format as well as a format used for display. Display software is provided for DOS microcomputers. The GLORIA Imagery and Bathymetry, US West Coast EEZ CD-ROM is numbered as US Geological

Survey Open-file Report 91-396 and is available for $32 from USGS Book and Open-FIle Report Sales, Box 25425, Denver CO 80225. Phone: 303/ 236-7476.

GLOBAL OCEAN TEMPERATURE & SALINITY PROFILES CD-ROM

Global Ocean Temperature/Salinity Profiles (GOTSP) compact disc contains global temperature and salinity profiles taken between 1900 and 1990. Produced by the National Oceanographic Data Center, GOTSP Volume 1 contains 1.62 million profiles from the Atlantic, Indian, and Polar Oceans totaling 451 MB of data. GOTSP CD-ROM Volume 2 contains 1.57 million profiles from the Pacific Ocean totaling 474 MB of data. The GOTSP CD-ROMs contains: (1) Oceanographic Station Data, (2) CTD/STD Data, (3) Expendable Bathythermograph (BT) Data, (4) Mechanical BT Data, (5) Radio Message BT Data, and (6) Selected Level BT Data.

Data can be retrieved and plotted to compare temperature-depth, salinity-depth, and temperature-salinity profiles. Users can run simple data inventories (counts of observations by one-degree squares) and determine names of ships and institutions from which data were submitted. Runs on DOS systems. Priced at $80 each or $124 for both, contact: National Oceanographic Data Center, NOAA/NESDIS E/OC21, 1825 Connecticut Avenue NW, Washington, DC 20235. Telephone: 202/606-4549. Omnet: NODC.WDCA.