Open-File Report 94-52

USGS
science for a changing world

U.S. Geological Survey National Computer Technology Meeting: Program and Abstracts, New Orleans, Louisiana, April 10-15, 1994

NCTM '94

New Orleans, Louisiana

U.S. Geological Survey

AUTOMATING REGRESSION AND PERFORMANCE TESTING OF NATIONAL WATER INFORMATION SYSTEM-II SOFTWARE

LENFEST, Leslie W., *BRIGGS*, John C., and *MERK*, Charles F., USGS, WRD, 12201 Sunrise Valley Drive, Reston, VA 22092

An automated software testing tool, preVue-X, is being used to support testing of the U.S. Geological Survey new storage and retrieval system for hydrologic data, the National Water Information System-II (NWIS-II). Automating testing can save time and provide an accurate and reproducible evaluation of the success of software and data-base modifications. The test tool provides support for regression and performance testing of NWIS-II. As configured for NWIS-II, preVue-X can emulate up to 16 simultaneous users performing tasks in either a designated or random pattern.

Thorough software testing during system development and maintenance consumes significant human resources. When software is modified to correct "bugs" or enhance functionality, many of the tests applied during development must be rerun after each change to ensure that errors were not introduced; this process is called regression testing.

Automated testing is initiated when preVue-X records user activities (keystrokes, and mouse movements and clicks) and system responses (including time) during a test session. Test scripts are generated from the recorded user activities and system responses at the end of the test session and can be modified to facilitate re-use and analysis of the session. Once test scripts have been prepared, they are replayed for system functional and performance analysis.

Evaluation of system responses following any software modification is accomplished by replaying scripts and utilizing preVue-X post-analysis utilities. Output from post-test analysis utilities are used by software developers to identify errors following each modification. The preVue-X graphical differencing utility is used to compare expected and actual system response from the NWIS-II user interface. Post-test analysis data are used to refine the data base and software by observing changes in performance through succeeding reruns of the test. Comprehensive testing of future versions of software can be applied indefinitely by building, updating, and maintaining the suite of recorded test sessions.

COMPREHENSIVE APPROACH TO PRODUCTION OF MAP ILLUSTRATIONS BY COMPUTER

LIEBERMANN, Timothy D., *STONE*, J. Christopher; and *PELTZ*, Lorri A., USGS, WRD, 333 W. Nye Lane, Carson City, NV 89706

The U.S. Geological Survey (USGS), Nevada District, has developed an efficient, comprehensive approach to producing map illustrations for its publications. This approach uses geographic-information-systems (GIS) technology, an extensive geospatial data base, standardized plotting macros, and an active, evolving collaboration between GIS specialists and scientific illustrators.

Methods of producing map illustrations within the USGS are changing rapidly. Geographic information systems and sophisticated graphics software are replacing manual drafting and photographic techniques. Publications staff in many USGS offices are producing printer-ready copy for complex, full-color plates. Each office—whether by design or default—has adopted its own approach, based on its local mix of personnel, expertise, inertia, available data, equipment, and software.

In the Nevada District, a structured, extensive set of geospatial data bases, referred to herein as coverages, has been assembled and is used routinely for map production. Statewide coverages include latitude/longitude graticules, geographic names, digital line graphs from 1:100,000-scale maps, and digital-elevation data (all Nevada at 1:250,000 scale and part of the State at 1:24,000 scale). Thematic coverages, such as surface geology, mines and gaging sites, also have been compiled or obtained. The base material for all digital maps is derived from this GIS "master" data base.

A plotting macro called STATE_PAGE.AML is used as a standard template for the creation of almost all map illustrations. This macro may be used for interactive display and query, production of line plots and Postscript prints, or transfer of graphics files to the scientific illustrators. The macro is an evolving set of code that reflects the collective programming expertise of the GIS staff. It also documents the location and usage of master coverages. For specific study areas or project boundaries, the macro is customized for specific map extent, scale, and projection. Project-based coverages simply are added to the macro menu. This approach eliminates effort spent on redundant programming and creation of coverages and also results in rapid production of consistent, accurate maps.

The division of labor between GIS and illustrations staff is evolving as new methods are developed and as new software becomes available. For a specific project, a GIS specialist customizes STATE_PAGE.AML and produces a series of map layers, one layer per digital file. Coverages that contain multiple plotting symbols generally are split into multiple files. A shaded relief coverage, derived from digital-elevation data, can be a useful surrogate for traditional topographic contours and is transferred in image (raster) format. Complex polygon coverages, such as surface geology, also are transferred in image format. Text, such as place names or well numbers, is transferred as nonstroked "hardware" text. The illustrator makes most decisions regarding fonts, symbology, text placement, layering of data, map rotation, and overall layout. Finished illustrations normally are sent in digital form to a commercial service bureau for conversion to high-resolution film separates. In short, the collaborators each do what they do best—the GIS specialists compile accurate digital map data, and the scientific illustrators create informative, clear maps that meet the standards for USGS publications.

A USER'S MAP OF THE DATA IN THE U.S. GEOLOGICAL SURVEY NATIONAL WATER INFORMATION SYSTEM

LOPP, Lari E., *KIRK*, James R., and *ARROYO*, Ileana E., USGS, WRD, 12201 Sunrise Valley Drive, Reston, VA 22092

The U.S. Geological Survey (USGS) second-generation National Water Information System (NWIS-II) is significantly different from NWIS-I. NWIS-I included four subsystems—ground water, surface water, water quality, and water use— and processed data on minicomputers within a distributed information system. These subsystems were logically and physically independent of one another except for one principal, shared file, the Site File. NWIS-II is an interdisciplinary system that integrates all hydrologic data and data processing for the USGS, and is designed around hydrologic features and activities. This integration in NWIS-II requires the users to change the way they physically process their data as well as how they conceptually view their data. To the user, these data may be named differently and may appear different in NWIS-II. This paper is an attempt to facilitate the user's shift from NWIS-I to NWIS-II, help clarify the complexity of data in NWIS-II, and to supplement the NWIS-II user's documentation.

The transfer of historical data from NWIS-I to NWIS-II was a complicated process; one that required an understanding of the NWIS-I rules and procedures and the NWIS-II model. In the process of defining the transfer of hydrologic data from the old to the new logical model, it was necessary to interpret and define the physical and conceptual differences of the two models and translate existing data to populate the NWIS-II data base. Two examples of the differences: First, establishing a site in NWIS-I meant describing the basic data about a site and storing the site in one record, whereas establishing a site in NWIS-II includes establishing a station, a reference location, a location offset, an event point, and the feature associated with the event point, with all of the locational data related to each other. Second, quality-assurance data in NWIS-I were logically associated with environmental data, but quality-assurance data in NWIS-II are logically and physically related to the measurements and samples. The new data and relations created during transfer are critical to maintaining the integrity of the data base with some additional data becoming mandatory in NWIS-II. To help users recognize and use their data in NWIS-II, a map has been developed that shows how the data are reorganized and related. The transfer map indicates where NWIS-I data appear in NWIS-II; how new, mandatory data elements were inferred from the NWIS-I data; how the data may have been reformatted; and what relations were built to connect conceptually related data that were structurally separate in NWIS-I. The transfer map will help the users in their transition from NWIS-I to NWIS-II.

USE OF REMOTELY SENSED DATA TO CHARACTERIZE VEGETATION IN THE RED RIVER OF THE NORTH BASIN, MINNESOTA, NORTH DAKOTA, AND SOUTH DAKOTA

LORENZ, David L., USGS, WRD, 2280 Woodale Drive, Mounds View, MN 55112

Remotely sensed data were processed by cluster analysis to evaluate vegetative cover in the Red River of the North Basin. This information provided a general classification of vegetation that was used to interpret regional water-quality data collected as a part of the National Water Quality Assessment Program of the U.S. Geological Survey.

Vegetative index data, available from the EROS Data Center of the U.S. Geological Survey, are biweekly composites of advanced very-high-resolution radiometer data from the NOAA-11 satellite. The trans-mitted data are corrected for reflectance, calibrated for receiver sensitivity, and registered to a Lambert Azimuthal Equal-Area projection. The data in the near infrared and visible bands are normalized to repre-sent green vegetation and termed the Normalized Difference Vegetation Index.

The Normalized Difference Vegetation Index data from twelve 2-week periods (April 27 to October 11, 1990) were classified on the basis of the timing of the greenness of the vegetation through a two-step cluster analysis. In the first step, the data from each of the 259,521 pixels were put into 128 disjoint clusters. In the second step, the data from the 128 clusters were put into 13 hierarchical clusters. Visual inspection of the 13 clusters produced 8 distinct groups (4 agricultural groups, 2 water groups, 1 forested group, and 1 wetland group).

Based on the timing of vegetation greenness, three 2-week periods appeared to be critical for discerning the groups. The 2-week periods were May 25-June 7, June 8-21, and September 14-27, 1990. Classification based on these 3 periods gave sharper, better defined groups than that based on all 12 periods.

ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY HYDROLOGIC ANALYSIS SUPPORT SECTION

LUMB, Alan M., USGS, WRD, 12201 Sunrise Valley Drive, Reston, VA 22092

The U.S. Geological Survey (USGS), Hydrologic Analysis Support Section (HASS), has obtained or developed, quality checked, tested, and distributed more than 40 hydrologic analysis programs to more than 90 site administrators. Specialists have been identified for each to provide software and technical support. Libraries of Fortran subroutines has been standardized and made centrally available for software developers.

To meet the full range of the USGS hydrologic processing needs and gain efficiency in meeting those needs, object-oriented design and graphical user interfaces must be well understood and appropriately used. These two technologies are being used to develop a framework for hydrologic process modeling. A process action team has been created to develop the user requirements, which have been distributed for comments, and to oversee the development of the software products.

Other needs being addressed by the HASS, in cooperation with the National Water Information System (NWIS), the Distributed Information System, and the District offices, are more efficient and effective ways to move data from NWIS to applications and to assist the Districts with software products for cooperators. One example of the latter is work with the Texas District to develop an interactive PC version of the flood-frequency program, J407, which provides tables and frequency plots for stations selected from a Texas peak-flow data file. Another example involves an interactive program that allows input of hypothetical or proposed land-use changes, translates these to surface-water model-parameter changes, runs the calibrated/validated model, the produces graphics and tables of the hydrologic effects of the land-use changes for management decisions. HASS worked with the Washington and Maryland Districts on these projects. A final example is the support provided the South Carolina and Nevada Districts for further development and support of the Real-Time Mapping (RTMAP) software.

USE OF CONDITIONAL TEXT AND HYPERTEXT IN THE USER'S MANUAL FOR THE U.S. GEOLOGICAL SURVEY NATIONAL WATER INFORMATION SYSTEM-II

MATHEY, Sharon B., and *BRIGGS*, John C., USGS, WRD, 12201 Sunrise Valley Drive, Reston, VA 22092

The U.S. Geological Survey is developing a National Water Information System-II (NWIS-II) that will replace the existing water-data information systems and integrate them into one system. FrameMaker, the report-processing system, is being used to develop the user's manual. Through features available on FrameMaker, one book file will provide a printed copy of the user's manual, an online hypertext help, and ASCII text for the "help" feature built into each window in the NWIS-II software. Although NWIS-II will have several releases before it is fully implemented, the same book file can be used for all releases of the software using the conditional text feature of FrameMaker.

Five types of conditional text are currently being used for the user's manual: printed and online, printed only, ASCII text, ASCII marker, and release 2. **Printed and online** prints and displays all text and graphics included in the printed, to-be-published version and the hypertext help document for NWIS-II. **Printed only** excludes graphics from the hypertext document that take a long time to display on the screen and are not necessary to include; for example, an input form that already is on the user's screen. **ASCII text** produces the text used for online help on individual windows. **ASCII marker** marks the beginning and ending of the text for online help on an individual window. **Release 2** identifies text that describes functions not included in the first release and is neither printed nor displayed in the first-release document.

The hypertext capability of FrameMaker links and displays related information on different pages or in different documents. The user selects a topic of interest from a main list by clicking on the topic with the mouse. This displays the appropriate page of the user manual on the screen as a view-only FrameMaker document. Icons on the screen allow the user to page forward or backward through the document, go back to a previous topic, go to the main list of topics, or exit the hypertext document.

Use of the conditional text feature of FrameMaker simplifies the task of keeping the user's manual up to date for multiple releases and for multiple purposes. With one document serving many uses, one edit updates what in the past would have been multiple documents. Use of conditional text and hypertext features allows the software developers to easily meet the user's requirement for online documentation.

A MICROCOMPUTER-BASED PERSONNEL SYSTEM DEMONSTRATION USING TOUCHSCREEN TECHNOLOGY

MATTHEWS, R. William, USGS, ISD, 12201 Sunrise Valley Drive, Reston, VA 22092

The U.S. Department of the Interior Automated Vacancy Announcement Distribution System, AVADS, was developed by the U.S. Geological Survey (USGS), on the Amdahl mainframe computer in 1987. Subsequently, a microcomputer version was developed in 1989. Both versions are currently available around the country. TouchScreen Micro AVADS was designed in 1993 to demonstrate the convenience of using a touchscreen with a microcomputer for an administrative application. In addition, the new system highlights the advantage of migrating to the Windows environment with a TouchScreen interface.

In TouchScreen Micro AVADS, the user interface was designed to enhance the information exchange. The TouchScreen version of Micro AVADS simplifies the human/computer interface. By touching the screen, the customer selects any combination of four categories: State, Series, Grade, and/or Bureau with up to six choices for each category. The computer searches the current vacancy announcements and chooses the announcements that fit the selection criteria. The computer responds with a one-line summary for each matching vacancy announcement. Based on this information the user can select an announcement to view and then decide whether or not to print a copy. This simple method of locating vacancy announcements combined with a graphical interface (point and touch) have made TouchScreen Micro AVADS an efficient means for generating rapid responses to customer queries.

The system is being used by the USGS Personnel Office in Reston, Virginia, and by the National Park Service in Denver, Colorado. The system is also available using a mouse instead of a TouchScreen at the USGS in Denver.

AN INFORMATION-REQUEST MANAGEMENT AND ACCOUNTING SYSTEM

McFADDEN, Keith W., USGS, WRD, 3039 Amwiler Road, Suite 130, Atlanta, GA 30360-2824

The large volume of hydrologic data requests from public and private sectors received by the Georgia District of the U.S. Geological Survey prompted personnel in the District to develop an information management system to monitor and document the number of requests received, action taken to respond to requests, and costs associated with filling requests. This system, designated the Information Request Management and Accounting System (IRMA), allows entry of data elements, such as the name and organization of the requestor; type of data requested; data base searched, and the name of the individual handling the request; as well as a narrative description of the request. The system also can be used for documenting processing costs and billing and for accounting purposes. Summaries of data-request activities for the month, quarter, or year can be easily prepared using IRMA. IRMA was developed in January 1991, and as of September 1993, it has been used to monitor and document nearly 2,000 requests for information from almost 500 individuals and organizations. Since IRMA was initiated, about $54,000 has been billed to the private sector for processing data requests. IRMA was developed using INFO software on the PRIME minicomputer. Future plans are to port IRMA to the UNIX environment on Data General workstations.

MICROLINK/FFS (FEDERAL FINANCIAL SYSTEM) FOR UNIX AND U.S. GEOLOGICAL SURVEY ADMINISTRATIVE INFORMATION SYSTEM

McKINNEY, Philip, USGS, AD-OSM, 12201 Sunrise Valley Drive, Reston, VA 22092

The need to migrate certain frequently used functions of the U.S. Department of the Interior Federal Financial System (FFS) to the desktop was recognized some time ago and had resulted in the development of a PC—or desktop—version of FFS. The advantage of this approach—fast response, local access to financial data, independence from the mainframe and intervening communication connections—made the need for a UNIX version obvious. A new enhancement to the FFS, Generic Microlink/FFS, provides this capability within the Data General DG/UX and Ingres environments. This FFS enhancement, available for the first time in April 1994, combines the financial processing capabilities of Microlink/FFS with the U.S. Geological Survey Administrative Information System (AIS), with Microlink/FFS providing the means to prepare, process and transmit expenditure transactions to the mainframe FFS.

Specifically, financial data is entered and edited by Microlink/FFS operating on the local DG server, uploaded periodically to the mainframe FFS, and processed. The results are returned, along with centrally generated financial data, to the local site for reconciliation. The result is more accurate information at all levels and closer integration of local expenditure transaction processing with the official bureau accounting system.

IMPLEMENTATION OF A UNIX-BASED INVENTORY APPLICATION AT THE ROCKY MOUNTAIN MAPPING CENTER

McKINNEY, Philip, USGS, AD-OSM, 12201 Sunrise Valley Drive, Reston, VA 22092

The Administrative and National Mapping Divisions are engaged in a joint effort to modify the Federal Financial System (FFS) Inventory Subsystem to replace the order processing and inventory management system (Distribution Sales System, DSS) used by the Rocky Mountain Mapping Center in Denver, Colorado, for sales of map and book products. The project is scheduled to be implemented in April 1994.

The application will operate in a DG/UX environment in Denver. All inventory processing (order entry, inventory management, shipping, and reporting) will be performed on the local server, with accounting data to be transferred daily to the FFS official accounting system located on the Amdahl mainframe in Reston, Virginia. The data transfer will be performed with the use of FFS Microlink software. The presentation will describe the effort to develop this major business application, integrating the U.S. Department of the Interior mainframe based accounting application with the Data General capabilities.

ADMINISTRATIVE BUSINESS PROCESS RE-ENGINEERING

McKINNEY, Philip, USGS, AD-OSM, 12201 Sunrise Valley Drive, Reston, VA 22092

Administrative systems and processes are common to all organizations, and concerns about their performance and efficiency are equally common. Business process re-engineering (BPR) is a systemic approach to radically change for the better how these common functions support program activities. The U.S. Geological Survey (USGS) has begun several pilot efforts to adopt BPR and achieve its benefits. Factors compelling change include the National Performance Review findings of widespread bureaucratic inefficiencies, the USGS Chief Financial Officers' Council recommendations for streamlining the business of administration, budget compression across the bureau, internal management concerns about possible overlapping functions and duplicative systems, and quantum improvements in information technology, which provide opportunities for drastic changes in the way work is being done.

A discussion of the BPR process and how it is being applied in the USGS will be presented: The Administrative Division is leading an effort involving all divisions to review administrative processes throughout the USGS. The goal is to make significant improvements at all levels through business process re-engineering. This project initially reviews the core administrative functions of personnel, procurement, finance, facilities, and systems management. It specially focuses on the flow of work, the flow of information, the use of information technology and application systems in the course of conducting administrative business activities, and reviews as well as associated costs, risks, organizational issues, and timeliness and quality of end products and services. The next step is to design new administrative approaches and processes, determine their cost, effect, and degree of improvement, and finally to implement a selected new process as a prototype. Following a postimplementation review of the prototype, other administrative business processes will be similarly re-engineered and implemented.

SCIENTIFIC VISUALIZATION AT FLAGSTAFF IMAGE PROCESSING FACILITY, U.S. GEOLOGICAL SURVEY: PAST, PRESENT, AND FUTURE

McMACKEN, Dennis, and *BELLISIME*, Lynda, USGS ISD, 2255 North Gemini Drive, Flagstaff, AZ 86001

The term Scientific Visualization has become prominent recently in the jargon of the computer industry, but the U.S. Geological Survey, Flagstaff Image Processing Facility, has been exploring this technology for more than 20 years. The Flagstaff Image Processing Facility is a cross-divisional group. This paper presents the history, current capabilities, and future plans for Scientific Visualization at the Flagstaff Image Processing Facility.

The Flagstaff Image Processing Facility had its beginnings in the early 1970's. Early efforts were in the processing of Mariner and Viking Orbiter images in support of the Viking mission to Mars. Since that time computer scientists have worked with planetary scientists to develop specialized algorithms to get the maximum information from spacecraft images and other scientific data sets. One of the techniques pioneered in Flagstaff produces simulated true color from spectrally limited image data sets. Another program developed at Flagstaff creates shaded relief images from digital elevation model data. Throughout, one of the hallmarks is the emphasis on cartographic accuracy.

One major project involves producing image mosaics for atlases of the ocean floor using Gloria sonar data. Another prominent effort is to design and provide software tools for the widespread distribution of Viking and Voyager raw data images on CD-ROM. Part of the team is developing a map modernization package using digital methods to speed the process of getting geologic maps from the scientist into print. Another project creates CD-ROM's of image data so that teachers in schools on the Navajo-Hopi Indian reservations can introduce digital technology and stimulate student interest in Earth sciences. Flagstaff produces Landsat image maps on request for regions such as Antarctica. Flagstaff also continues to support planetary programs, such as Magellan, Voyager, Galileo, Clementine, and so forth. A sophisticated hardware and software image-display system assists users in producing the best in image processing products.

The goal for the future at the facility is to provide the user with a package of sophisticated tools that will run on UNIX workstations. A Scientific Visualization Lab will provide an advanced environment for the development, experimentation, and use of visualization software. The available software will include commercial packages, public domain software, for example, Khoros, and programs developed in-house as part of the Integrated Software for Imaging Spectrometer (ISIS) system. Lab users will be able to manipulate data to produce images and mosaics for map production and presentation graphics. Under development is a prototype of a specialized display system, which will run in a generic X-windows environment. Animation software and hardware will allow users to analyze geologic and geographic data in which change over time is an important factor.

A CENTRALIZED CONFIGURATION MANAGEMENT BOARD IN THE U.S. GEOLOGICAL SURVEY

MERK, Charles F., and *FLYNN*, Kathleen M., USGS, WRD, 12201 Sunrise Valley Drive, Reston, VA 22092

Organization and control of hardware, software, and documentation can be achieved within the U.S. Geological Survey by implementing a configuration management process and a Centralized Configuration Management Board (CCMB). Configuration Management (CM) is a baseline management system that can provide managers control of the phases of design, development, testing, review, and system integration for the production and maintenance of software and hardware systems. Within each of these phases and throughout the life cycles of the software and hardware, there will always exist the need to make changes and enhancements.

The USGS has groups that produce software for Water Resources Division (WRD) use and groups that support the platforms and networks on which this software operates. The major groups identified within the WRD are: the Distributed Information System, which includes the Applications Assistance Unit and the System Programming Unit; the Hydrologic Instrumentation Facility; the Administrative Information System; the Hydrologic Analysis Support Section; the National Water Information System; and the National Water Quality Laboratory. Changes that affect only the software and users within the individual groups would be handled by CM processes within the control of the individual group. Each of these groups should have a configuration management plan, a configuration manager, and a Configuration Management Board (CMB).

Changes or enhancements that affect more than one individual group will need to be centrally managed at a higher level. A CCMB would be formed to address issues of common concern, such as the operating system, coordinated release schedules, shared data tables, data exchange formats, and shared applications. The CCMB will consist of a regional hydrologist, a regional computer specialist, an area hydrologist or district chief, a district administrative officer, a data chief, a studies chief, a thrust project chief, a site or data-base administrator, and a district or national research program programmer. The manager of each CMB will facilitate communication among the CMB's and the CCMB and act as a technical resource to the CCMB. The CCMB will forward recommendations for changes that affect policy or require changes in resource allocations to the WRD Senior Staff. Appeals of CCMB decisions will be compiled and submitted for consideration at regularly scheduled Senior Staff meetings.

SLIDE MAKING IN A MULTIPLATFORM ENVIRONMENT

MIRZAD, S.H., and *DANSKIN*, W.R., USGS, WRD, 5735 Kearny Villa Road, San Diego, CA 92123

Selected hardware and software for making slides from the MS-DOS, MacOS, and UNIX platforms were evaluated by the San Diego office of the U.S. Geological Survey.

In 1988, in-house slide-making capabilities were procured to aid project personnel in rapidly producing inexpensive slides. In contrast to using an outside film laboratory, the in-house capability—using a Montage FR1 film recorder developed by Presentation Technologies—encouraged easy revisions and facilitated creation of a slide presentation in 1 to 2 days, even over a weekend. As computer equipment diversified, it became necessary to enhance the interaction of the film recorder with the MS-DOS, MacOS, and UNIX platforms and with the ethernet network.

The initial configuration of the film recorder required a parallel connection to a single MS-DOS machine. Later, a SCSI port was added to the film recorder so that a single MacIntosh IIci computer also could be used to process slides. Images from both the MS-DOS PC and Macintosh platforms were processed with relative ease, but only from the respective computers directly connected to the film recorder. No networking capability was present. Images created on the UNIX Data General environment were saved as postscript files, downloaded via the network onto the MS-DOS computer, and sent out the parallel port to the film recorder.

Advanced slide-making equipment was investigated in order to improve slide-making capability on all three platforms (MS-DOS, MacOS, and UNIX) and to take advantage of the ethernet network. The goal was to find a way to use the slide maker from multiple machines without changing cables, transferring floppy disks, or becoming overly frustrated at the logistics.

A product called SlideScript, which met these criteria, was procured and evaluated. The device essentially is a postscript interpreter. It interprets the postscript file from each of the three platforms, and translates it into the native language of the FR1 Montage film recorder, and turns the FR1 Montage into a simple postscript printer.

Postscript is a page-description language designed to communicate a description of a printable document from a computer to a raster output printing device. Because Postscript language is independent of any specific software or output devices, it can provide input to any output device that has a postscript interpreter. The SlideScript receives the postscript information and generates three high resolution images (red, green, and blue components) that the film recorder recombines to produce a full color slide. The final resolution is 4,000 lines per inch (lpi), which is sufficiently dense to obtain service-laboratory-quality slides; for comparison, the resolution is about 70 lpi on a video screen, and 300 to 600 lpi on a laser printer.

The SlideScript was connected to the MS-DOS PC's parallel port by means of a standard centronics parallel cable, to the MacIntosh by an AppleTalk LocalTalk connector, and to the Data General (Aviion 6220) server's RS-232 serial port by a straight cable. The serial port provides baud rates ranging from 2400 to 19200, although no improvement in processing time was noticed using either the 9600 or 19200 rates. Transfer time seems to be negligible in comparison with processing time for complicated slides.

The SlideScript doesn't have its own spooling utility; rather it uses the queuing system of the host computer. SlideScript polls its ports (parallel, AppleTalk, and serial) and services on a first-come, first-served basis.

Processing of postscript and encapsulated postscript files was tested successfully from MS-DOS, MacOS, and UNIX platforms using a variety of software applications. The processing time depends on the complexity of the slide as well as on the software application and computer generating the postscript file. Most slides took about 5 minutes (for simple charts) to about 20 minutes (for fairly complicated drawings). Terga high-resolution raster images were tested, but each required at least 15 minutes to process. Dumping of the screen image in X-Windowing environment on the Data General UNIX was tested; but for some unknown reason, the processing was very slow—some slides taking hours to process.

The quality of slides in most cases was similar to that obtained from a slide-service laboratory. Additional testing is being done in an attempt to correct two remaining problems. First, some slides created using Adobe Illustrator software on a MacIntosh have either poor resolution of highlighted text or a poor color match with slides processed by a service-laboratory. Second, an image that fills the entire slide can be difficult to produce from some software. The underlying reason for this problem seems to be that some software recognize the SlideScript device as a postscript printer. Therefore, some scaling is required because the dimension of a printer page typically is 8.5 by 11 inches, whereas a slide image is 1 by 1.5 inches. This scaling can be cumbersome, depending on the sophistication of the software generating the postscript file. Despite these unresolved problems, the San Diego office is routinely using the device for rapid creation of slides from multiple platforms and software applications.

Cost of the system varies with the type of hardware used, but a total investment of about $15,000 is needed for the multiple-platform slide-making equipment described above. A SlideScript Turbo, 25 MHz AMD RISC processor, 22MB RAM, and 42MB hard disk costs about $7,000; a Montage FR2 Desktop Film Recorder (the faster, newer model) costs about $7,000; and miscellaneous hardware items may cost a few hundred dollars.

GEONET II INTERNET ROUTING

MURPHY, Patrick, W., USGS, ISD, 275 Middlefield Road, Menlo Park, California 94025

The U.S. Geological Survey (USGS) maintains a wide-area telecommunications network known as GEONET. In April 1993, with the award of a new telecommunications contract, GEONET II, the second generation wide-area network, began to take full form. Initially six new nodes were added to the backbone of GEONET, and were integrated with dozens of existing nodes from old GEONET, forming a heterogeneous mixture of networking devices and hosts, relying on a marriage of old GEONET I and GEONET II transports. Over today's GEONET II, a complex integration of networking protocols traverse various transport layers over diverse networking hardware platforms. The old GEONET I mainstay transport, X.25, is yesterday's technology, but still has its place in this new era. Complex networking devices called routers integrate multiple protocols such as Internet Protocol (IP), Government Open Systems Interconnect Profile (GOSIP), Novell Internet Protocol Exchange (IPX), AppleTalk, and Banyon Vines with standards based transports, such as frame relay, X.25, and point-to-point protocol (PPP), supporting high speed connectivity between the USGS sites.

The new GEONET II interfaces with the new global Internet at numerous sites, such as Menlo Park, California, Denver, Colorado, Reston, Virginia, and Sioux Falls, South Dakota, at T1 speeds and greater. The sheer number and size of the new GEONET II/Internet topology create the potential for complex and interesting anomalies requiring sophisticated and intricate management tools. Configuration of these links utilize the integration of new standards based routing algorithms based on link state concepts, such as the Open Shortest Path First (OSPF), and Intermediate System to Intermediate System (IS-IS) routing protocols. These protocols converge quickly following topological changes in the network, are stable, and use very little bandwidth to effect efficient routing. A blend of old standbys, such as static routes, Routing Internal Protocol (RIP), and Exterior Gateway Protocols (EGP), as well as vendor specific interior gateway routing protocols, mix to provide the road maps that guide this intricate web, allowing networking packets to find connectionless routes to their final destinations.

The recipe that glues GEONET II together, including variable length subnet addressing, the distribution of the IP network numbers, and the interworkings of OSPF and how it interacts with other routing protocols like RIP, are the foci of this talk. The concepts of link state routing protocols and distance/vector based protocols like RIP will be compared along with a short discussion of the advantages and disadvantages of both. The GEONET II topology, past, present, and future will be summarized, and the integration of the GEONET II address space into this topology will be presented. The concept of default network will be introduced and discussed in terms of global Internet routing.

The talk will conclude with some thoughts on the much discussed topic, "What is the future of IP," and how the USGS is positioned to deal with the changing Internet, necessitated by the predicted exhaustion of the IP address space in the next 5 years.

DIGITAL MAPPING OF THE NATIONAL RIVERS INVENTORY

MURTAUGH, Peter H., USGS. NMD, 12201 Sunrise Valley Drive, Reston, VA 22092

The National Wild and Scenic River System was created by Congress in 1968 (Public Law 90-542) to preserve rivers with outstanding natural, cultural, or recreational features. Approximately 153 river segments are included in the system. In addition, there are 2,600 candidates for inclusion in the system. The National Mapping Division, U.S. Geological Survey, has developed a national rivers inventory called the river reach data base on a geographic information system to digitally manage and identify these candidates. A descriptive name, field attributes, hydrologic unit codes, and basin data were merged and tagged to the river segments creating a digital spatial product with corresponding attribute data. An interactive process identifies the extent of each file with its name, administrative area, outstanding qualities and values, and related basin data. The river reach data base uses an ARC/INFO coverage as the primary base map, overlain by the Public Lands Survey System and Federal lands boundary coverages. The combination of spatial data with river attributes make the river reach data base widely applicable, especially in the National Park Service, the Bureau of Land Management, and the Forest Service. Rivers targeted for protective measures [including one-quarter mile (just over 400 meters) on each side of the river] can be easily identified in the data base. Hydrologic attribute information obtained from this data base will assist biological research by providing a link to related field data tables and by supplying qualitative information for modeling.

USE OF WIDE-AREA INFORMATION SERVER SOFTWARE TO SUPPORT THE NATIONAL GEOSPATIAL DATA CLEARINGHOUSE

NEBERT, Douglas D., USGS, WRD, 12201 Sunrise Valley Drive, Reston, VA 22092

The Federal Geographic Data Committee (FGDC) created a Clearinghouse Working Group in 1992 to develop an on-line inventory of digital spatial data held by the Federal Government and other interested organizations. Rather than create a centralized warehouse for data, the working group is pursuing a distributed approach to data access by creating and populating a distributed, on-line inventory system. The goals of the working group are to establish telecommunications network connectivity between participants, identify digital spatial data sets, document the quality, geographic coverage, and content of the data sets, and to make this information available to all other participants. The U.S. Geological Survey has been experimenting with on-line spatial data discovery and retrieval services using a spatially enhanced public-domain version of the Wide-Area Information Server (WAIS) software to disseminate digital spatial data useful to regional or national hydrologic investigations. This software was selected by the FGDC for use in a proof-of-concept test which began in July 1993. The proof-of-concept test evaluation provides user comments on the WAIS indexing process, the client interface, and the spatial data documentation—metadata—standard guideline proposed by the FGDC to handle the information provided through the WAIS server.

THE USE OF COMPACT DISC-READ ONLY MEMORY (CD-ROM) FOR THE STORAGE OF DATA AND RELATED PROGRAMS FOR UNIX COMPUTER OPERATING SYSTEMS

NEGRI, Mark, USGS, WRD, 12201 Sunrise Valley Drive, Reston, VA 22092

With ever increasing demands for data and program storage space on magnetic disk, the need exists for an alternative means of storage. Recent developments in Compact Disc-Read Only Memory (CD-ROM) technology have made data and program storage possible on CD-ROM for use on UNIX computer operating system platforms. It is now cost effective to copy a UNIX file-system image to a CD-ROM using a stand alone write-once CD recording system. Unfortunately, Disc Operating System (DOS) limitations of eight-character file names are incorporated into the International Standards Organization (ISO) 9660 CD standard and does not fully support UNIX file names. UNIX applications using file names longer than eight-characters require the creation of a UNIX compatible "non-standard" CD. With a standard CD, data and program access speeds through a CD-ROM reader have been relatively slow compared to other means of access, such as off magnetic disk, because of the driver software. If a non-standard CD, with a UNIX file-system image on it, is mounted as a read only magnetic disk, the CD-ROM driver is bypassed making data and program access speeds comparable to access speeds directly off magnetic disk. However, a non-standard CD is not desirable for archiving purposes because the media could well outlast the ability to read it. This development in data access technology makes it feasible to distribute data or software in native UNIX format on CD-ROM.

IMPLEMENTATION OF THE U.S. DEPARTMENT OF THE INTERIOR ELECTRONIC ACQUISITION SYSTEM (IDEAS)

PALMQUIST, Donald A., USGS, AD-OPC, 12201 Sunrise Valley Drive, Reston, VA 22092, Reston, VA 22092

The U.S. Geological Survey will be the first U.S. Department of the Interior (DOI) bureau to implement the Interior Department Electronic Acquisition System (IDEAS). Although IDEAS will initially affect the internal operations of the Administrative Division procurement offices, it will ultimately reach throughout the organization. The effect of IDEAS will include everything from electronic requisitioning to status reporting to improved contract closeout.

IDEAS provides a more efficient means of operating, managing, and reporting on the procurement process in the DOI by establishing a standard, Department-wide acquisition support system capable of: permitting data entry at the source, thereby eliminating input and processing redundancies; automating the generation of requisition, solicitation, contract, and related procurement documents; actively tracking events from the beginning of a procurement to its closeout; and exchanging procurement information with the Department's financial and other administrative systems.

An overview of IDEAS features and capabilities, as well as progress towards IDEAS implementation with the U.S. Geological Survey, will be presented.

AUTOMOUNTING DAEMON PROGRAM

PRICE, Ken C., USGS, WRD, National Water Quality Laboratory, 5293 Ward Road, Arvada, CO 80002; and ***TOWNSEND***, Scott, USGS, WRD, Bldg. 53, Denver Federal Center, Lakewood, CO 80225

The intent of this paper is to give an overview of the Automounting Daemon (AMD) program and present techniques for its installation and management. An automounter makes it easier to manage networks that use the Network File System (NFS) protocol.

Automounter runs as a UNIX daemon (background) process that mounts a file system whenever a file or directory within that system is referenced, and unmounts the file system after a pre-defined period of inactivity (5 minutes by default). The daemon monitors attempts to access directories that are associated with an automount map. When a user references a directory defined in an automount map, the AMD program mounts the appropriate file system for that directory.

The AMD program was developed at the London Imperial College of Science, Technology and Medicine, in conjunction with the University of California at Berkeley. It has two features that give it an advantage over traditional file system automount programs. First, the AMD program allows software-related file systems and directories to be duplicated and to have these duplicate file systems on backup software servers. As a result, if the main software server crashes, a backup server automatically will be mounted after a 5-minute delay. Thus, users only have a 5-minute wait for software to be re-served to their workstations. Second, the AMD program reduces the number of NFS file-system requests over the local network, improving network performance.

AN APPLICATION FOR THE GRAPHICAL EDITING AND ANALYSIS OF HYDROLOGIC DATA

RAEL, Patrick M., USGS, WRD, 700 West Capitol Avenue, Little Rock, AR 72201; and
TRAPANESE, Susan M., USGS, WRD, 12201 Sunrise Valley Drive, Reston, VA 22092

The U.S. Geological Survey is developing a second-generation National Water Information System (NWIS-II) that will provide the functionality of current systems plus more sophisticated software applications to manage and analyze hydrologic data. One of these applications is HYDRA, an interactive application for graphically editing and analyzing hydrologic time-series data. The development of HYDRA originated from the NWIS-II requirements specification and continues to evolve through prototyping and reviews with user groups. HYDRA, which has been written utilizing Motif and the X-Window System libraries, will be available as an integrated application in the second release of NWIS-II.

HYDRA utilizes multiwindowing capabilities to display data curves in different contexts. One window allows users to display and edit up to 10 sets of time-series values as individual curves plotted on the same graph. From this window, the user can select part of the graph to enlarge in the zoom window. This zoom window allows users to see the data curves in more detail, which allows more accurate editing of the data points and curve segments using the mouse. Another window provides a tabular listing of the data points for a selected curve and allows for some simple editing of the values using the keyboard and mouse.

HYDRA provides estimating capabilities through hydrographic and climatic data curve comparisons. Each curve is obtained from user-specified selections of constituent time-series data from the NWIS-II data base. Once the data curve has been defined by selecting the study site location and constituent to be edited, users can select additional constituents at the same location or other locations to display as support data curves. Any of the support curves can be used as a template to reshape or fill in missing periods in the data curve by moving the support curves in a manner similar to overlaying individual graphs on a light-table. Parts of a support curve can be copied into a data curve to fill in missing data. Finally, HYDRA provides visual and numeric comparisons of data for verification and quality assurance. Additional measurement data, miscellaneous observations, and threshold values can be displayed and used to check for possible erroneous values in the data curve. Once the study site curve has been edited, the revised data can be stored in the NWIS-II data base.

GUIDELINES FOR CREATING USER DOCUMENTATION FOR SOFTWARE IN THE U.S. GEOLOGICAL SURVEY

REGAN, R.S., USGS, WRD, 12201 Sunrise Valley Drive, Reston, VA 22092

User documentation for software shows how the software functions from the user's viewpoint. Key elements of the documentation describe what the software does, how it works, how to use it, how to enter and edit data, how to avoid common problems, and how to review and judge the results. The purpose of user documentation is to (1) enhance usability and (2) provide quality assurance and accountability for the software. Successful documentation presents this information in a well-organized, concise, easily understood format.

As part of the U.S. Geological Survey effort to implement Total Quality Management concepts in accomplishing its mission—to provide geologic, topographic, and hydrologic information needed for the wise management of the Nation's natural resources and for the benefit of the public—the Water Resources Division has established a Process Action Team on Software Documentation to define the process for creating successful user documentation. This document will present guidelines for the design, preparation, review, distribution, and maintenance of user documentation, with the goal of introducing standard methodologies and processes to improve and promote more consistent user documentation of software in the Water Resources Division. The user documents include Software Summary Sheet, Installation Manual, Tutorial, User Guide, Quick Reference Guide, System/Programmers Manual, and Reference Manual.

COMPUTER NETWORKING OF U.S. GEOLOGICAL SURVEY FIELD OFFICES IN THE DIS-II ENVIRONMENT AS AN ALTERNATIVE TO LEASED COMMUNICATION LINES

ROGERS, David W., and *SWEAT*, Michael J., USGS, WRD, 6520 Mercantile Way, Suite 5, Lansing, MI 48911-5971

The U.S. Geological Survey, Michigan Wide Area Network (WAN) integrated 20 workstations of the Lansing District Office Local Area Network (LAN) with the Grayling and Escanaba Field Offices, each consisting of a two workstation LAN. As a means of connecting the Grayling and Escanaba LAN's to the Michigan District WAN, Nethoppers modem/routers were installed instead of dedicated phone lines and a router. This connection reduced operating expenses because the Nethopper uses telephone services only when needed to connect to the outside world, or when information comes to a field office LAN from the outside world.

One Nethopper is required on each end of a telephone line; therefore, two Nethoppers are used in Lansing and one is used in both Grayling and Escanaba. The Nethopper requires use of one telephone line in each office. Each Nethopper has one 3.5-inch floppy drive and can be programmed by direct connection to a personal computer or dumb terminal. The Nethopper can be programmed to time out and to terminate the telephone connection after a set interval if no data transmission has occurred. Once the Nethopper is configured and running properly, virtually no maintenance is needed.

Nethoppers have been an effective means of connecting our field offices to the Internet at a cost lower than that of dedicated telephone lines. Annual cost of a dedicated telephone line between a field office and the District Office in fiscal year 1993 was quoted as $15,000. Actual cost of two Nethoppers in fiscal year 1993 was $3,590, and FTS telephone line charges averaged about $200 per month, for a first year cost of $5,990. Net savings for a first-year installation will be about $9,010; savings in future years are estimated to be about $13,600 per year less maintenance costs associated with the Nethopper.

DATA-BASE LOGGING AND JOURNALING SYSTEMS

SCHLESINGER, Mark J., USGS, WRD, 375 S. Euclid Avenue, Tucson, AZ 85719

The U.S. Geological Survey has developed several new applications using the INGRES data-base management system to control the storage of data. Among these applications are the Administrative Information System (AIS) and the National Water Information System-II (NWIS-II). Because many system administrators are unfamiliar with the INGRES system, corruption, recovery, and verification of data has become a concern. An understanding of the INGRES logging and journaling systems is helpful in relieving unnecessary worries about the integrity of the data stored.

The logging system uses a file to keep track of all open transactions, which allows rollbacks (removal of unwanted transactions) when needed. Knowledge of key parameters in the logging system can help with possible problems that may arise. The parameters include consistency points, log-file buffers, log-full limit, and force-abort limit. Modifications to these parameters without an understanding of what they control can lead to more problems than they will solve.

The journaling system uses a set of files to keep a record of all completed transactions. The journaling system is used when it is necessary to restore data added since the last backup of the system. Key concepts in the journaling system include when does journaling occur, the difference between table and data-base journaling, and how to use the journal to aid in data-base recovery and integrity.

Additional concepts to be considered include controlling integrity and reducing data loss in case of emergency. The issues involved are the number of buffers the logging system should keep, what size to make the log file, what is a consistency point and how does it effect both logging and journaling, and the difference between raw and regular log files. With proper care and knowledge, data-base maintenance and recovery is easy to manage.

INGRES PERFORMANCE ISSUES INVOLVING THE LOGGING AND LOCKING SYSTEMS

SHANK, Gregory L., USGS, WRD, 840 Market Street, Lemoyne, PA 17043-1586

The issue of performance has become increasingly important with the distribution of the Administrative Information System (AIS) and the National Water Information System-II (NWIS-II). Both use Ingres as their data-base management system. A discussion of the Ingres logging and locking parameters and their relation to system performance will help system administrators better understand how Ingres works within the DIS-II environment.

The Ingres system configuration can be customized in numerous ways, so it is extremely important to understand the ramifications of modifying the configuration files. The Ingres logging and locking systems parameters are defined in the file $II_SYSTEM/ingres/files/rcp.par (where II_SYSTEM is typically set to /usr/opt). This file contains values for 13 logging and locking parameters, 8 of which pertain to the logging system and 5 of which pertain to the locking system.

The logging parameters that have an immediate effect on system performance when changed are: (1) the transfer block size, (2) the number of log buffers in shared memory, (3) the percentage of the log to be used for consistency points, and (4) the number of consistency points taken before invoking the archiver. The locking parameters that can effect performance when altered are (1) the number of locks per transaction, and (2) the size of the locks hash table.

INCORPORATING ELECTRONIC MAPS INTO U.S. GEOLOGICAL SURVEY REPORTS

SIWIEC, Steven F., and *SOUTHERS*, Kim L., USGS, WRD, 840 Market St., Lemoyne, PA 17043-1586

Recent advances in two areas of computer technology—electronic reports processing (ERP) and geographic information systems (GIS)—have dramatically affected the way in which many U.S. Geological Survey (USGS) employees do their jobs. ERP technology has all but replaced typewriters and word processors as the standard report-processing tool in the USGS, allowing authors and report specialists to create professional reports that integrate text, graphics, tables, and mathematical formulas into a single electronic document. Sophisticated GIS tools now allow USGS scientists and engineers to conduct complex spatial analyses of their data and display a variety of geographic information with high-quality cartographic products. The recent emergence of GIS as a viable cartographic production tool has virtually eliminated the need for the time-consuming process of manual drafting of maps for USGS reports. Because of the analytical capabilities of GIS, the number and frequency of maps being developed for publication within USGS reports is increasing as the use of GIS technology increases.

In 1990, FrameMaker, an ERP package from Frame Technology Corporation, was procured as part of the Distributed Information System-II (DIS-II) contract procurement. More recently, a new GIS contract (GIS-II) has been signed with Environmental Systems Research Institute, Inc., for the ARC/INFO GIS software package. Both of these new software tools are now widely used in USGS offices nationwide. As a result, a need has developed to integrate these tools and incorporate electronic maps from GIS into reports to further automate and streamline the report preparation and publication process. This integration has been made possible recently, through use of the binary Computer Graphics Metafile (CGM), an industry-standard graphics file format that is supported by both FrameMaker and ARC/INFO.

A step-by-step procedure has been developed in the Pennsylvania District by which electronic maps are created with the ARC/INFO GIS software, exported into binary CGM format, and imported into FrameMaker to become report figures. Once maps are in FrameMaker, some editing is possible, such as the addition of text annotation or graphical objects, and scaling and positioning of the map on the physical page, using FrameMaker graphical editing tools. If it is known in advance that an electronic map is destined for FrameMaker, it is important to give consideration to the drawing order, grouping, annotation, and symbology of cartographic map elements, as these characteristics determine the degree of editing that is possible in FrameMaker.

STATISTICAL AND GEOGRAPHIC INFORMATION SYSTEM ANALYSIS OF EARTH-SCIENCE INFORMATION FOR DECISIONMAKING

SOLLER, David R., and *BERNKNOPF*, Richard L., USGS, GD, 12201 Sunrise Valley Drive, Reston, VA 22092

Societal decisions on issues, such as the siting of public facilities, are based on political and economic considerations, and are commonly supported by environmental and natural hazard information provided in map form. Because geographic information system (GIS) technology allows spatial display and analysis of various map data sets, it can be used as a tool to support the decisionmaking process. However, in support of this process, analytical capabilities of GIS are limited to spatial query (for example, distance to a feature or between features) and rudimentary statistical analysis.

Many authors have noted that current GIS software does not allow for true spatial statistical analysis. In certain applications, this limitation may not be serious—for example, if map data are available only in qualitative form, and if a regulation stipulates that urban areas underlain by a specific highly permeable geologic material be excluded from consideration for siting a landfill, then traditional GIS overlay techniques are application. If, however, a mathematical probability of slope failure due to earthquake shaking is needed to evaluate the efficiency of an earthquake mitigation strategy for a community, new techniques that rely on quantitative map attributes are needed. These new techniques form part of a fundamentally new approach that integrates traditional GIS data management, spatial analysis, and display capabilities with advanced spatial statistical methods. The advanced analytical techniques include statistical testing of multivariate data (for example, using qualitative choice regression analysis), calculation of spatial autocorrelation and its use as a guide to sample selection and grid cell size, estimation of statistical uncertainty of data, and testing for similarity of data sets (for example, through statistical comparison of means and variances).

The U.S. Geological Survey has developed analytical GIS techniques that perform the statistical functions mentioned above to support research on the utility of geologic map data in an economic decision framework. The basis for the research involves estimating the probability of occurrence of a natural hazard (for example, slope failure, ground-water contamination, or earthquake-induced liquefaction). This estimate is incorporated into the decision framework that examines the economic viability of choices (for example, on where to site a waste-disposal facility) faced in a future decision (the *ex ante* approach).

These techniques rely on quantitative Earth-science information because such data can be used with a measurable level of confidence in the decision process. Qualitative measures of the same Earth-science attributes cannot. As a consequence, qualitative map information cannot be evaluated statistically in conjunction with economic information. For example, in a waste-disposal siting decision, a dollar value for environmental costs cannot be estimated from a map that rates the likelihood of ground-water contamination as low, medium, or high; this information cannot then be evaluated and compared with information for which an economic value can be estimated (such as the transportation costs associated with selection of sites located at different distances from the waste generator). Qualitative Earth-science information can serve only a limited role in such decisions, for example as a preliminary screening tool to identify those areas obviously off-limits for waste siting. Incorporating quantitative data and rigorous statistical tests into the traditional GIS framework offers the potential of a more significant role for Earth-science information in environmental and land-use decisionmaking.

This research is conducted with ARC/INFO software (versions 5.0 to 6.1) on networked UNIX-based workstations and file servers. Operating in the vector environment, all map data are intersected with a grid composed of equal-sized square polygons that retain map information in the polygon attribute file. Our methods rely on relational data-base concepts for spatial comparison of map attributes and for integration of GIS and statistical analyses. Data and cell-ID number are output from the coverage to a file, and the data are statistically analyzed by using the Shazam and Statit software packages. Statistical computations can be transferred to INFO and related to the grid coverage for further analysis or plotting. New revisions to ARC/INFO include a raster-like component, GRID, which may offer a more efficient approach for large data sets (for example, 100,000 grid cells). The vector-based approach, however, may be preferred for the initial phase of research, perhaps involving only a subset of the map area, because it seems to offer more flexible means of querying and comparing data.

COMPUTER-SCIENCE GUEST-LECTURE SERIES AT LANGSTON UNIVERSITY SPONSORED BY THE U.S. GEOLOGICAL SURVEY

STEELE, Karen S., USGS, WRD, Building 7, 202 N.W. 66 Street, Oklahoma City, OK 73116

Langston University, a historically Black university located at Langston, Oklahoma, has a computing and information science program within the Langston University Division of Business. Since 1984, Langston University has participated in the Historically Black College and University program of the U.S. Department of the Interior, which provides education, training, and funding through a combined Earth-science and computer-technology cooperative program with the U.S. Geological Survey (USGS)

USGS personnel have presented guest lectures at Langston University since 1984. The objectives of the guest-lecture series are (1) to assist Langston University in offering state-of-the-art education in the computer sciences, (2) to provide students with an opportunity to learn from and interact with skilled computer-science professionals, and (3) to develop a pool of potential future employees for part-time and full-time employment by the USGS.

Langston University students have been enthusiastic about the lectures, and, as a result, 13 university students have been hired by the USGS as part-time employees. The USGS expanded the lecture series by increasing the number of guest lectures at the university, and by inviting professionals throughout the country to participate.

DEVELOPMENT OF DIGITAL HYDROGEOLOGIC MAP SYMBOLS FOR THE U.S. GEOLOGICAL SURVEY

TAGGART, Bruce E., and *MENOYO*, Luis E., USGS, WRD, P.O. Box 4424, San Juan, PR 00936-4424

Illustrations in publications of the U.S. Geological Survey (USGS) contain many standard map symbols. These area, line, and point symbols are not presently available in a digital format in the computer graphics programs and platforms used. To meet this need, a committee, the Digital Symbolization Working Group, was established in August 1993 to develop a standard set of digital hydrogeologic area pattern, line type, and point symbols that conform to USGS technical standards. This digital library will improve the consistency and accuracy of published illustrations, whether they are page-size maps or plates. This project has been divided into three phases: hydrogeologic point symbols, area patterns, and line types. Hydrogeologic point symbols development began in August 1993, using specifications extracted from scribing templates used by the USGS in the creation of maps and plates. This graphics software library of hydrogeologic symbols is being generated in a format compatible with ARC/INFO, FrameMaker, CorelDRAW!, Adobe Illustrator, G2, and AutoCAD, as well as other computer platforms. The area pattern and line type symbols development phases began in December 1993.

REFERENCE LISTS FOR THE U.S. GEOLOGICAL SURVEY NATIONAL WATER INFORMATION SYSTEM-II

THORNBERG, Ruth E., and *SARGENT*, B. Pierre, USGS, WRD, 12201 Sunrise Valley Drive, Reston, VA 22092

The U.S. Geological Survey is designing and developing a new system to store, analyze, and display water-resources information for the Nation. This new system, the National Water Information System-II (NWIS-II) replaces the existing water information systems.

One of the many tools built into NWIS-II is a network of reference lists. A reference list consists of allowable entries for a particular data field. For example, if entering a State code, a user can select the correct code from a reference list by simply using the mouse. By selecting data from established reference lists, data are consistent and automatically verified, and online help for entering data is provided.

Approximately 250 reference lists have been incorporated in the NWIS-II design. They range from short and simple, such as permit types (for water rights, well, or drilling), to large and complex, such as hydrogeologic units, parameter sets, or taxonomic data. Reference lists are categorized into three major groups: user-defined, user-appendable, and system. The responsible parties for updating each reference list were identified by the Strategic Planning Group (the senior staff) and the National Water Information System (NWIS) Program section chiefs. Once the NWIS-II software has been fully distributed, the personnel given the authority to update the reference lists are also responsible for reviewing the lists prior to the release and distribution of the software.

The update process for the reference lists will first depend on the category of the lists. A request for a change to a system reference list is submitted to the NWIS headquarters office in Reston, Virginia, recorded, sent to the appropriate authority for approval, returned to the NWIS office for updating, and distributed with the next release of NWIS-II. If the change involves a user-defined reference list, which is maintained at the District-level, there is no authority approval needed other than the protocol established by the District office. User-appendable reference lists are initialized at the time of transfer from NWIS-I to NWIS-II using national-level data fields that have been assigned a number ranging from 1 to 10,000,000. These lists are maintained as system-level reference lists. The unused numbers within this range are reserved for future additions of system-level information, while numbers greater than 10,000,000 are available for District-level additions and are maintained as user-defined reference lists. Therefore, any changes to user-appendable reference lists will be based on the unique numbering schema and must follow the protocol of either system reference lists or user-defined reference lists, respectively.

LABORATORY ANALYTICAL DATA SYSTEM

TURNER, Sandra L., *FEIST*, Oliver J., *LEWIS*, James A., and *HUSBAND*, Richard A., USGS, WRD, National Water Quality Laboratory, 5293 Ward Road, Arvada, CO 80002

The U.S. Geological Survey National Water Quality Laboratory (NWQL) is implementing a new Laboratory Analytical Data System (LADS) in coordination with the National Water Information System (NWIS-II) and the Administrative Information System (AIS). The design of the NWIS-II data base incorporates the tables and data elements required by LADS so that the two systems can share data and applications. Several applications developed for LADS will be used by NWIS, including the following: (1) on-line NWQL Services Catalog, (2) on-line documentation of the approved methods of analysis, (3) interactive sample login and sample tracking using bar codes, (4) quality-control review of analyses in the laboratory using the same techniques as those used in the Districts, and (5) timely transmission of data reports from the NWQL to the Districts. Several applications developed for LADS will be incorporated in AIS, including (1) project planning to allow the Districts to budget for analytical requirements, (2) financial income projections at the NWQL on the basis of District estimates for analytical requirements, (3) workload planning at the NWQL on the basis of projected analytical requirements, and (4) electronic billing that will be current, accurate, and convenient. Major improvements from the previous laboratory information management system include (1) provision for storing sample quality-management information on-line with the data to which it applies, and (2) a more accurate description of sample-processing methods in the Organic Chemistry Program.

PARALLELIZATION OF A COASTAL CIRCULATION AND TRANSPORT COMPUTER MODEL

WANG, Pearl, George Mason University, Computer Sciences Department, Fairfax, VA, 22030; and *JENTER*, Harry L., USGS, WRD, 12201 Sunrise Valley Drive, Reston, VA 22092

A three-dimensional, time-dependent, finite-difference hydrodynamics model of circulation in the coastal ocean is being used to study dissolved constituent transport on a variety of spatial and temporal scales. At present, a 68 x 68 x 11 model of Massachusetts Bay and Boston Harbor provides spatial resolution of 600-6,000 meters horizontally and 30 centimeters-14 meters vertically. Simulations of 18 months with a 400-second timestep take roughly 5 days to complete on an IBM RISC 6000 model 580. In order to make calculations on finer grids and over longer simulation periods without extending the length of time that runs take to complete, new techniques for solving the model equations are being explored. The most promising technique for speeding up the model at this time appears to be parallelization of the FORTRAN code. A variety of options for parallelization exist, including both the use of high performance multi-processor computers and the use of workstation clusters acting in coordination on the same program. A version of the model for a Thinking Machines Connection Machine has been implemented and tested.

APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS AND STATISTICS SOFTWARE TO A LARGE DATA BASE FOR PRODUCING PUBLICATION-QUALITY FIGURES

WARNER, Kelly L., ***ARNOLD***, Terri L., and ***NAZIMEK***, John, USGS, WRD, 102 E. Main St., 4th Floor, Urbana, IL 61801

Output files from the software ARC/INFO, STATIT, and CorelDRAW have been combined to produce publication-quality figures for a STOP format U.S. Geological Survey (USGS) Water-Resources Investigations Report. A large data base containing concentrations of 16 inorganic constituents for ground-water samples from 2,216 public-supply wells was used to develop statistical displays and maps. This large data set was processed for baseline statistics, boxplots, and bar graphs in STATIT. Computer programs were used to transfer from the USGS water-quality data base (QWDATA) directly into ARC/INFO, a geographic information system (GIS), on Data General computers. The GIS was used to develop maps of wells in which water samples had constituent concentrations exceeded regulatory limits. Boxplots, bar graphs, text of statistics information, and maps were transformed to computer graphics files and brought into CorelDRAW for producing publication-quality color figures of combined data. Problems in converting data and output to CorelDRAW were due to format and size of graphics files.

REAL-TIME MONITORING OF A HYDROLOGIC SENSOR NETWORK

WIERDA, Clark B., USGS, WRD, 700 West Capitol Avenue, Little Rock, AR 72201

Personnel of the U.S. Geological Survey maintain networks of sensors that continually monitor the opening of the gates that control flow at several lock and dam facilities on the Arkansas River in Arkansas. At each facility, the local sensor network is connected to a Data Collection Platform that continually transmits the data by satellite. The data collection is part of an ongoing project with the U.S. Army Corps of Engineers.

Flow through the gates at each lock and dam facility is controlled by the dam operators. Dam operators have not been able to use the data provided by the sensor networks, which are able to monitor gate openings to the nearest hundredth of a foot, because these data have not been available at the damsites. The dam operators have depended upon analog dials that are graduated to whole feet. Any gate openings between whole feet must be interpolated from the dial reading.

The U.S. Army Corps of Engineers want to display the sensor readings to the dam operators at each facility. The U.S. Geological Survey has developed a prototype signal intercept and display system for the Murray Lock and Dam at Little Rock, Arkansas. This system consists of a dedicated personal computer connected to the local sensor network by an interface converter. The computer is programmed to retrieve the sensor readings and to compute the individual gate openings and flows, and the total flow for the facility. The results are displayed on the computer monitor and on a remote display terminal.

U.S. DEPARTMENT OF THE INTERIOR HAZARDOUS-WASTE SITES GEOGRAPHIC INFORMATION SYSTEM

WINGARD, Norman E., USGS, WRD, 12201 Sunrise Valley Drive, Reston, VA 22092

A geographic information system (GIS) locates and identifies the toxic or hazardous waste sites listed on the U.S, Environmental Protection Agency (USEPA) docket, for which the U.S. Department of the Interior (DOI) has management responsibility. The system has been prepared for the DOI, Office of Environmental Affairs, to be used as a management tool for tracking and monitoring the locations of hazardous-waste facilities.

The centerpiece of the system is the computer projection of all DOI sites within the conterminous 48 States. A map projection can be selected to display all sites for the conterminous States, an individual State, a selected Water Resource Region, or a user-defined area of the country. Each site is identified on screen by a colored symbol, indicating the agency with management responsibility for that site. Each site can be further identified, by means of a mouse-driven pointer to produce a look-up table with site data, including the site name, location, and so forth.

To enhance the use of the hazardous-waste site information system, a series of additional topical overlays have been incorporated that provide collateral information. These additional projections show the geographic relationships to State and county boundaries, Federal land ownership, proximity to rivers, water bodies, dams and reservoirs, the locations of NASQAN stations, land use-land cover areas, CERCLA and RCRA sites, and U.S. Geological Survey surface-water sites.

The program was developed in ARC/INFO, on the Data General (DG) Aviion Workstation. Being on this platform, it can be operated from any DG server or individual station with an ARC/INFO license.

This system was designed specifically for use as a management tool for the DOI. It is intended, however, that any Federal agency or office with ARC/INFO capabilities may make use of this system.

A COLLABORATIVE APPROACH TO ELECTRONIC REPORT PRODUCTION

WINTERSTEIN, T.A., and ***MILLER***, R.A., USGS, WRD, 2280 Woodale Drive, Mounds View, MN 55112

The Minnesota District of the U.S. Geological Survey, in cooperation with the Minnesota Pollution Control Agency (MPCA), used a collaborative, team approach to electronically produce a data report containing 71 maps and 22 graphs within 5 months. Work on the report began in February 1993; the printed copy of the report was delivered to the cooperator on July 7, 1993. The report summarizes bedrock hydrogeology, quaternary geology and hydrogeology, geomorphic regions, soil landscape units, land use, wetlands, ecoregions, and climatic data for the 17,000-square-mile Minnesota River basin.

The Minnesota District was able to produce the report within the 5-month deadline because of three factors. First, a project team was formed. The core project team was composed of four persons: two hydrologists, a geographic information systems specialist, and later, a cartographer. Seven other persons from the District (cartographers, a word-processist, a geographer, and an editor) completed the team. The project team adopted a collaborative approach from the initial negations with the MPCA through final report review and project evaluation. Second, the project team and the MPCA set clear and workable objectives. Because project members were involved early in the project, they accepted responsi-bility for it and made a commitment to meeting its goals. Third, electronic data were accessible in readily usable forms to produce the required maps and graphs, and the District had the software (ARC/INFO, CorelDRAW, and G2) and the expertise to rapidly process these data into illustrations.

The collaborative, team approach was essential for the success of this project. Project members were committed to the success of the project, worked together to identify problems, reached consensus about decisions that affected the entire report, and had clearly defined roles and deadlines. Most importantly, each project member knew that working together was the only way the project would be completed on time.

AUTHOR INDEX

*USGPO 1994-550-223/80022