U.S. GEOLOGICAL SURVEY NATIONAL COMPUTER TECHNOLOGY MEETING: PROGRAM AND ABSTRACTS, MAY 7-11, 1990

Compiled by Barbara H. Balthrop and Eva G. Baker

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DEPARTMENT OF THE INTERIOR

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FOREWORD

The Water Resources Division of the U.S. Geological Survey has made major advancements in the use of computer technology to meet the Survey's mission of providing the hydrologic information and understanding needed for the optimum use and management of the Nation's water resources. The Division requires substantial computer technology to process, store, and analyze data from about 60,000 sites. To meet this workload, the Division organized its computer resources in 1982 through the Distributed Information System (DIS) Program Office, which manages the Division's national network of computers. The DIS is designed to provide computer resources in support of the Division's current and future activities – acquisition and storage of hydrologic information, hydrologic data analysis, geographic information systems, reports and electronic report processing, and administration.

The Water Resources Division sponsored the first DIS Site Administrators' Meeting in March 1984 in Denver, Colorado, and a second meeting in October 1985 in Hyannis, Massachusetts. The thrust of the first two national meetings was the training of Water Resources Division personnel in the use and administration of the Division's computer hardware and software. Starting with the third meeting, which was held in Atlanta, Georgia, in May 1987, the name was changed to the National Computer Technology Meeting because the format evolved to include presentation of papers prepared by computer and scientific personnel in the Division. These papers document work done in the field of computer science as applied to hydrology, including the design and use of geographic information systems, use of nationally distributed software, the development of procedures for data-base management, and research papers on the expanding field of computer technology.

Training continues to be a major part of the National Computer Technology Meeting. This year's meeting includes training on the use of UNIX operating system, UNIX system administration and security, the C programming language, local area networking, as well as a publication seminar. This report includes abstracts for papers and posters that have been accepted for presentation at the Fifth National Computer Technology Meeting.

Colleen Babcock

Colleen A. Babcock
Technical Cordinator

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SYSTEM ADMINISTRATOR'S INFORMATION SESSION
Moderator, Gail E. **Kalen**, WRD, Reston, VA

Tuesday Morning, May 8, 1990

PLENARY SESSION
Moderator, Gary **Cobb**
Chief, Branch of Computer Technology,
WRD, Reston, VA

Tuesday Afternoon, May 8, 1990

HYDROLOGIC APPLICATIONS SESSION
Moderator, Charles (Bill) **Boning**
Chief, Office of Surface Water, WRD, Reston, VA

CONCURRENT TRAINING SESSIONS

1:00- 5:00 p.m. Computer Security Awareness Training - A Video Presentation
Moderator, Sandra S. **Hite**, WRD, Reston, VA (This is a 40-minute presentation and will be given several times during the afternoon)

1:00- 5:00 p.m. Seminar on the Design and Use of Reusable Software Tools
Moderator, James L. **Fulton**, WRD, Reston, VA

Wednesday Morning, May 9, 1990

PLENARY SESSION

Moderator, James E. **Biesecker**, Assistant Director for Information Systems, USGS, Reston, VA

8:00- 8:10 a.m. Announcements

8:10- 8:20 a.m. Introduction of Guest Speaker

VIDEO TRAINING SESSIONS

The following video training sessions will be presented multiple times during NCTM 90:

FUNDAMENTALS OF THE UNIX SYSTEM - BASIC LEVEL ($2^1/2$ hours)

The Structure of the UNIX System
Basic User Communications
The File Structure
The vi Screen Editor - Part 1

FUNDAMENTALS OF THE UNIX SYSTEM - INTERMEDIATE LEVEL ($2^1/2$ hours)

The Interactive Shell and Shell Commands
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The vi Screen Editor - Part 2

FUNDAMENTALS OF THE UNIX SYSTEM - ADVANCED LEVEL ($1^1/2$ hours)

Shell Procedures and Background Processing
Searching, Sorting, and Comparing Files
Introduction to Text Processing

UNIX SYSTEM ADMINISTRATION (2 hours)

Daily Tasks of a UNIX System Administrator
Administrative Files
Managing File Systems
Utility Package Administration

C LANGUAGE FOR PROGRAMMERS - PART 1 (2 hours)

Getting Started - Part 1
Getting Started - Part 2
Arrays and Flow Control

C LANGUAGE FOR PROGRAMMERS - PART 2 (2 hours)

Formatted Input/Output
Operators and Precedence
Functions and Storage Classes

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Structures and Unions

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File Input/Output
Advanced Pointer Use and Special Topics
Style and Debugging

CONVERSION FACTORS

For readers who may prefer to use metric units rather than the inch-pound units used herein, the conversion factors are listed below:

Multiply inch-pound unit	By	To obtain metric unit
inch (in.)	2.540	centimeter (cm)
	25.40	millimeter (mm)
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer (km^2)
acre	0.4047	square hectometer (hm^2)

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OPTICAL SCANNING OF GEOLOGIC MAPS FOR INPUT TO A GEOGRAPHIC INFORMATION SYSTEM

ATWOOD, John W., USGS, WRD, 821 E. Interstate, Bismarck, ND 58501

A Tektronix 4991 optical line scanner was used to digitize several 1:250,000-scale maps that depict the surface geology of Oklahoma. The optical line scanner reduced the time and the cost of producing polygon coverages of geologic contacts for the geographic information system ARC/INFO. The project demonstrated that optical line scanning of maps may be an alternative to digitizing maps manually. The purpose of this poster is to illustrate one method of producing an acceptable polygon coverage using an optical line scanner as the primary digitizing device. Line and polygon features of any map may be digitized using this method.

The optical line scanner senses only contrasting light and dark areas of maps and does not discriminate colors. Scanned images are converted to and stored in a data file as a series of vectors or lines. Therefore, line separates of the desired map features must be used to produce an acceptable vector file. Both positive and negative line separates were used successfully for the project. All line separates were on a scale-stable mylar base.

The optical line scanner produces a flat file containing the coordinates of points that define each vector. A vector file was produced for each map scanned. A Fortran program was written to convert the vector files to a format acceptable to ARC/INFO's GENERATE routine, and each of the vector files was converted using the Fortran program. The converted vector files were stored in ARC/INFO line coverages using the GENERATE command. The line coverages then were transposed into new line coverages with real-world coordinates. Unwanted vectors were deleted, and the line coverages were converted to polygon coverages. Geologic formation names were added as attributes to each polygon coverage to complete the project.

The final coverages were adequate for the project, and the time required to digitize the maps by optical line scanning was less than the time required to digitize the maps manually.

PROXIMITY ANALYSIS: A TOOL FOR COMPARING DATA BASES

AUGENSTEIN, Todd W., USGS, WRD, 3600 W. Broad St., Rm. 606, Richmond, VA 23060; TERZIOTTI, Silvia, Virginia Council on the Environment, 202 N. 9th St., Suite 900, Richmond, VA 23219; HOM, Penny J., USGS, WRD, 3600 W. Broad St., Rm. 606, Richmond, VA 23060

In 1989, a review committee was established to evaluate data stored in the U.S. Geological Survey's Ground Water Site Inventory (GWSI). Part of the evaluation included the development and application of methodology and supporting software to compare data for sites in GWSI to data for other sites in GWSI and to data contained in the Survey's New Site Specific Water-Use Data System (NEWSWUDS). The purpose of this comparison was to estimate the number of duplicate sites entered into GWSI, the number of sites common to both data bases, and the number of sites present in one data base but missing from the other. Sites were first compared on the basis of geographic location (proximity analysis). Then sites were compared on the basis of similiar data elements (data-element comparison) and information obtained from proximity analysis.

This paper describes the proximity-analysis component of the comparison and its use by personnel from the Virginia Cooperative Water-Use Program [a cooperative program between the Commonwealth of Virginia and the U.S. Geological Survey]. Proximity analysis is conducted by retrieving latitude, longitude, and other selected data elements from GWSI and NEWSWUDS, entering these data into a geographic-information system (GIS), and then applying the computer software to identify site locations within a user-specified distance. A distance file is created during the proximity analysis. The distance file is used along with the selected data elements entered into the GIS to generate a report of selected data for potential sites duplicated within or between data bases. In addition, the distance file and the selected data elements are combined in a single file. This file is used by software that performs data-element comparison and generates reports for the evaluation of GWSI.

As part of the Virginia Cooperative Water-Use Program, proximity analysis was used to compare data from GWSI and NEWSWUDS. The comparisons in the generated report were then manually reviewed. The proximity analysis aided in identifying different data sets for the same site.

A COMPUTER PROGRAM FOR DETERMINING STREAMFLOW AVAILABILITY

BAXTER, Carmen R., USGS, WRD, 2301 Federal Office Bldg., Little Rock, AR 72201; TERRY, J.E., USGS, WRD, 2301 Federal Office Bldg., Little Rock, AR 72201

A hydrologic investigation of the Little Red River in Arkansas was conducted in 1983 and 1984 to obtain information that can be used by State regulatory agencies in making streamflow allocation decisions. This investigation led to the development of a mass balance procedure used to estimate the amount of streamflow available for diversion at any point along a given reach with a minimum instream flow requirement. This procedure was coded into an interactive computer program.

The streamflow availability computer program requires control data at the upstream and downstream ends of a stream reach to be analyzed and flow data for intervening tributaries and existing diversions. The computation interval is selected by the user on the basis of number of subdivisions per mile. Tables output from the program include total flow, quantity of water available for diversion, and minimum flow required at each computation interval. An additional option is output of a hydrograph comparing amounts of total flow, minimum flow, and available flow at reach locations.

AUTOMATED DATA COLLECTION FOR DETECTION OF FLOOD HAZARDS IN CLARK COUNTY, NEVADA

BLACKSTUN, David E., USGS, WRD, 1500 E. Tropicana, Suite 201, Las Vegas, NV 89119; COX, Elaine A., USGS, WRD, 705 N. Plaza, Room 227, Carson City, NV 89701

The Las Vegas Valley in Clark County, Nevada, is vulnerable to high property damage and loss of lives from flash floods. The U.S. Geological Survey and Clark County Regional Flood Control District have begun an Automated Local Evaluation in Real Time (ALERT) network to collect streamflow and weather data to aid early detection of impending floods. The network consists of three main parts: (1) remote stations to collect and transmit data; (2) transmission repeater stations to relay the data and extend the range of the network; and (3) a base station to receive and process the data on a real-time basis.

Seventeen streamflow gaging stations, 11 precipitation stations, and 6 weather stations are operational. Each station is equipped with a precipitation gage, transmitter, solar panel, storage battery, and antenna. Streamflow gaging stations also have a water-stage sensor and data logger, and weather stations have wind-run, wind-direction, relative-humidity, and temperature sensors. Water stage is measured and transmitted in increments of 0.05 foot, precipitation in increments of 0.04 inch, wind run in increments of 4 kilometers and wind direction at the time of transmission, relative humidity in increments of 1.2 percent, and temperature in increments of 3 degrees Fahrenheit.

Three transmission repeater stations have been installed at elevated locations throughout Clark County to relay data from remote sites to the base station. Each repeater station is equipped with a radio transceiver, solar panel, storage battery, and antenna.

The base station has a receiving antenna, a receiver, a decoder, and a desktop computer for receiving, storing, and processing data. The operating software is a multitasking operating system that allows for continuous data reception, storage, and simultaneous data plotting, reporting, and table generation.

SYSTEM MONITORING AT THE HYDROLOGIC INSTRUMENTATION FACILITY

BOYES, David L., Sverdrup Technologies Inc., Bldg. 2101, Stennis Space Center, MS 39529; FORD, Edward L., USGS, WRD, Bldg. 2101, Stennis Space Center, MS 39529

A procedure for monitoring the operation of a computer system is required by the system administrator to ensure the reliability of the system and to make the most efficient use of the computer. A monitoring system captures data that provide a historical basis for capacity planning of computer resources. System-monitoring data are needed for evaluation and testing of new equipment and programs. These data provide timely information for status reports to management.

The major part of the system monitoring procedure at the Hydrologic Instrumentation Facility is accomplished through three steps: the Prime USAGE utility, used as a base; a reduction program that generates statistical data; and daily graphs of the minimum, maximum, and average for selected variables. The plots and printed output generated as part of the system monitoring provide a means of observing the computer's performance. Other utilities are used to investigate specific operations. System monitoring is an extremely valuable and necessary tool used by the system administrator to ensure uninterrupted, high-quality performance of computer resources.

THE APPROACHING RETIREMENT OF THE PRESENT NATIONAL WATER INFORMATION SYSTEM OF THE U.S. GEOLOGICAL SURVEY

BRIGGS, John C., USGS, WRD, MS437, Reston, VA 22092

The National Water Information System (NWIS-I) of the U.S. Geological Survey, which is implemented on minicomputers, is nearing the end of its life cycle. Its replacement, NWIS-II, which is designed for a computer network using workstations operating under Unix, is under development. NWIS-I is composed of four subsystems, the Ground-Water Site Inventory (GWSI), the Water-Use Data System (WUSE), the Quality of Water System (QW), and the Automated Data Processing System (ADAPS). The early versions of NWIS-I software did not meet all of the users' needs or expectations. However, as NWIS-I matured, scheduled releases of revised software and system improvements enabled the system to meet more of the user needs for processing hydrologic data.

The procedures used in the operations and maintenance phase of the NWIS-I software life cycle have been modified in preparation for the retirement of the software. A data-base administrator for each subsystem handles user problems, and is responsible for the implementation, release, and maintenance of the subsystem's software and documentation. Development of new programs or major enhancements to existing programs has stopped. Maintenance continues but is limited primarily to correcting reported software errors and preparing the system to transfer data to NWIS-II. A limited number of enhancements to NWIS-I that are deemed critical by technical or program offices are being made, but resources to make these enhancements are supplied by the requesting office. Releases of revised software are scheduled twice yearly, usually in January and July. Additional software systems, such as the Survey's DECODES system, which are not part of NWIS-I but are dependent on compatibility with NWIS-I software, are distributed with each software release. NWIS-I data-base administrators will be increasingly involved in the development of NWIS-II, particularly in the conversion of NWIS-I data format to NWIS-II format.

INTEGRATING TEXT AND GRAPHICS BY USING A WORD-PROCESSING SOFTWARE PACKAGE

BUNCH, Robin L., USGS, WRD, 705 N. Plaza St., Room 227,
Carson City, NV 89701

Text and graphics can be combined on a single page by using a word-processing software package available for Prime computers and that is capable of proportional spacing, graphics importation, and Postscript output. This is accomplished without the addition of separate desktop report processing software and specialized hardware, such as a full-page monitor or a mouse.

The draft text is changed from double-spaced to single-spaced and from nonproportionally spaced to proportionally spaced. Multiple sizes and styles of type (fonts) are selected and stored with each report file.

Next, graphics that have been produced by a separate software package in Encapsulated PostScript format are incorporated with the text. The graphics can be positioned almost anywhere on a page. The proportionally spaced text may precede, flow next to, and follow the incorporated graphics. An output file of the entire document is then created and printed.

The final product is professional in appearance, with the inclusion of computer-generated graphics and multiple sizes and styles of type. On the average, the printed report has about 25 percent fewer pages than if produced with nonproportionally spaced type.

DIGITAL SYSTEMS DEVELOPMENT AT THE U.S. GEOLOGICAL SURVEY

CALLAHAN, George M., USGS, NMD, 525 National Center, Reston, Virginia 22092

The National Mapping Division of the U.S. Geological Survey (USGS) has begun a major new system development effort called Mark II that will implement advanced technologies and production procedures to satisfy National Mapping Program requirements through the year 2000. By 2000, the National Digital Cartographic Data Base (NDCDB) should contain digital data representing the content of primary map series and other smaller scale series. This data base will serve two major functions--as a central archive for the dissemination of digital data and as a working data base for production of standard USGS graphic products.

To accomplish this ambitious data-base goal, a series of development tasks are being implemented to (1) expand and improve mass digitization capabilities, (2) modify data structures to support increased content and access requirements, (3) develop digital revision capability, (4) develop product generation capability for standard, derivative, and digital products, (5) improve quality control, and (6) support advanced analysis and applications.

To evaluate the existing systems and to facilitate the identification of new and improved capabilities, Mark II was divided into four functional components, each addressing a specific portion of the production process.

The data production component addresses all phases of data collection, editing, data processing, and quality control prior to entry into NDCDB. The data-base component is designed to develop two levels of data bases: (1) an operational data base to support ongoing mapping center production, and (2) an archival data base to provide a central repository for data to support the operational data bases. The product generation component is designed to produce the cartographic products required to support the National Mapping Program. The production management component is designed primarily as an interface between the Mark II production system and the National Mapping Program production requirements and authorization systems.

Implementation of both digital revision and maintenance of primary quadrangle mapping through digital techniques will produce major changes in the National Mapping Program production process. A production strategy was developed to meet the Mark II goals, but the strategy was constrained by anticipated resources and staffing levels, anticipated user requirements, and limitations imposed by developmental activities.

ILLUSTRATION CAPABILITIES OF A COMPUTER GRAPHICS SYSTEM

CALLAHAN, J.L., USGS, WRD, 300 W. Congress St., Federal Bldg., FB-44, Tucson, AZ 85701

In 1989, the Arizona District of the U.S. Geological Survey began using a computer graphics system for illustration design consisting of an Apple Macintosh II with 5 megabyte random-access memory, 40 megabyte hard-disk drive, 13-inch high-resolution color monitor, Apple Laser Writer II NT Postscript printer, and Dest PC scanner. Adobe Illustrator 88 is the primary software used on the system. Other software used includes Cricket Graph, Aldus Pagemaker, Publish Pack, and Adobe Streamline.

Flexibilty of the system permits rapid and accurate preparation of maps, graphs, and diagrams and easy accommodation of review comments. Author-supplied computer graphics or rough conceptual sketches can be brought to the system and modified to conform to U.S. Geological Survey publication standards and page-size requirements. The system has been used successfully to produce documents that can be converted into slides. In addition to an improvement in the final product, the use of the system has increased productivity and decreased the time the author spends drafting figures.

THE DEVELOPMENT OF A GEOGRAPHIC AND USER-ORIENTED SYSTEM FOR ACCESSING INFORMATION IN THE NATIONAL WATER DATA EXCHANGE DATA BASE

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The National Water Data Exchange (NAWDEX) was established to function as a clearinghouse to assist in processing public requests for water-resource information. The NAWDEX system resides at the U.S. Geological Survey headquarters office in Reston, Virginia, on an Amdahl computer and has been in operation since the mid 1970s. The NAWDEX data base contains information on almost one-half million sites throughout the United States and Puerto Rico. Nineteen Federal and more than 300 State and local agencies contribute information to NAWDEX.

A geographic information system was interfaced to the NAWDEX system in 1989 because there was a need for a spatial and user-oriented access system to the NAWDEX data base. The prototype geographic-information-system design allows users to retrieve or display information at sites specified by the user through the use of on-screen menus and maps. Through the use of these menus, the user can select NAWDEX sites on the basis of spatial location and (or) some other specified criteria, perform frequency analysis on the data items associated with the sites, and then select a subset of the sites on the basis of a smaller area or a more limited set of criteria. In addition, digitized maps can be saved as plot files and can include NAWDEX site location, reference features, and annotation. Reports for selected site retrievals can include any number of NAWDEX identifiers and associated items. On-line help is provided to guide the inexperienced computer and (or) NAWDEX user. The prototype geographic-information-system design is being tested at the U.S. Geological Survey office in Portland, Oregon, and may eventually be available at other NAWDEX centers.

PROCESSING OF BATHYMETRIC DATA FOR PEND OREILLE LAKE, IDAHO

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In late 1988, the U.S. Geological Survey began an investigation of nutrient enrichment in north Idaho's Pend Oreille Lake, the Nation's twenty-first largest (surface area) and fifth deepest freshwater lake. Objectives of the 3-year investigation include quantification of hydrologic and nutrient budgets, characterization of limnology, and development of a computer-based nutrient load/lake response model. Water-resource managers will use the model to simulate limnological responses to alterations in the quantity of nutrients received by Pend Oreille Lake.

Extensive use has been made of geographic information system tools and techniques because this investigation requires detailed hydrologic and water-quality data from numerous subbasins within the 24,000 square-mile study area, as well as depth-layered limnological data from the 170 square-mile lake. One example of the use of geographic information system tools is the processing and display of bathymetric data for use in the model. A major attribute of the model is the ability to simulate water quality for several hydrologically connected spatial segments instead of for a single water body. ARC/INFO was used to compute volumes and surface areas of numerous depth layers within each spatial segment of Pend Oreille Lake. The model will use the data to compute the mass of nutrients contained in each depth layer of the lake segments.

A COMPUTER PROGRAM TO CALCULATE SEDIMENT-DISCHARGE RECORDS

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Sediment-Record Calculations (SEDCALC), an interactive program, was developed to facilitate calculations of sediment records. Techniques used by the U.S. Geological Survey to provide the Nation with sediment data have not changed substantially for almost 50 years. The program is a compilation of programs developed independently by several district offices of the U.S. Geological Survey to meet their respective computational needs and to minimize the intensive labor associated with sediment-record calculations.

The stand-alone program accepts unit or daily discharge data either from the Automatic Data Processing System, which is a subsystem of the National Water Information System or from an external file. Suspended-sediment concentration data are obtained from either the Quality of Water Data subsystem of the National Water Information System or an external file. Unit values of suspended sediment may be obtained by any or all of the following methods:

1. By digitizing a manually drawn suspended-sediment concentration trace for input to the program.
2. By linear interpolation and (or) extrapolation with suspended-sediment concentration data.
3. By nonlinear interpolation using a quasi-hermite spline function from the IMSL[1] library that approximates a hand-drawn curve.
4. By simple or multiple linear regression (transport curve).

Suspended-sediment load is calculated and then stored in unit and daily value files.

The program has options for calculating daily total sediment loads. Plots and tables of data and calculated loads can be generated from the program. Discharge and sediment data from the external files can be loaded into the Automatic Data Processing System unit or daily value files for permanent storage.

The program also can be used to estimate periods of missing record and can be used for estimating historic sediment-discharge data. Records calculated from linear, nonlinear, and regression techniques to estimate sediment concentrations need to be compared to traditionally calculated records to evaluate the adequacy of these automated techniques in sediment-record calculations.

A METHOD FOR EVALUATING POTENTIAL WATER-SUPPLY-WELL SITES BY USE OF A GEOGRAPHIC INFORMATION SYSTEM

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Evaluation of factors that affect the selection of potential public-water-supply-well sites for features such as ground-water quality and quantity requires the analysis of large volumes of hydrogeologic and water-quality data, which typically are in map and tabular form. Compiling and reviewing these data can be time-consuming and tedious. In 1988 the U.S. Geological Survey, in cooperation with the New York State Department of Environmental Conservation, designed, constructed, and evaluated a geographic information system data base to manage and analyze data pertinent to potential well sites within a 166-square-mile pilot study area on eastern Long Island, New York. To describe ground-water conditions around a potential site, 27 data layers consisting of hydrogeologic and water-quality information were entered into the geographic information system. Well-siting criteria supplied by the Department of Environmental Conservation were reviewed, and the two most important measures of site suitability were identified: (1) proximity of the proposed site to features that may affect the quality and (or) quantity of available ground water, such as hazardous-waste sites and existing public supply wells, and (2) hydrogeologic and water-quality characteristics beneath and surrounding the proposed site, such as water-transmitting properties and results of ground-water nitrate analyses. A series of computer programs was developed to provide a menu-driven, user-friendly interface to access these data and enable users unfamiliar with the geographic information system to extract stored data and display spatial relations among multiple data layers. The geographic-information-system software and the computer programs have demonstrated their utility in increasing the efficiency of well-siting evaluation procedures.

CONSOLIDATION AND UPGRADE OF THE DISTRIBUTED INFORMATION SYSTEM OF THE U.S. GEOLOGICAL SURVEY, WATER RESOURCES DIVISION

HALL, Angela E., USGS, WRD, 12201 Sunrise Valley Drive, Reston, VA 22092

From 1982 through 1987, the U.S. Geological Survey, Water Resources Division (WRD), implemented a Distributed Information System and installed 71 large minicomputers in Survey offices across the United States to support its mission of making public the results of its hydrologic investigations. These minicomputers are moderately-sized computers that are used by multiple users interactively as compared to personal computers that are small and are used only by single users, and to the large, mainframe computers that generally are operated on a batch job basis. The computers consisted of Prime 50 series Central Processing Units (CPUs) that ranged from 1 to 5 million instructions per second in processing capability, 8 to 32 megabytes in memory, and from 1,200 to about 4,800 megabytes in disk storage. These computers are linked through a wide-area telecommunications network that permits information to be shared among the computers in each office.

In 1988, the Division implemented a consolidation plan to allow multiple minicomputer-system sites to upgrade the processing capability, memory, and storage of their systems. Although the consolidation plan resulted in sites having fewer minicomputers, their overall capability was significantly increased. The upgraded Distributed Information System consists of Central Processing Units that range from 1 to 23 million instructions per second in processing capability, 8 to 48 megabytes in memory and from about 1,500 to 13,000 megabytes in disk storage; the total number of minicomputers in the Distributed Information System was reduced from a total of 71 to 55.

EVOLUTION OF A MICROCOMPUTER-BASED LOCAL AREA NETWORK FOR REPORTS PROCESSING

HAWES-BOUR, Betty J., USGS, WRD, 12201 Sunrise Valley Drive, MS435, Reston, VA 22092

The Water Resources Division, Publications Management Unit (PMU), of the U.S. Geological Survey National Center in Reston, Virginia has implemented a microcomputer-based local area network (LAN). The network was established to centralize and to enable cost-effective sharing of word processing capabilities, budgeting operations, and printers among office personnel. The network contains Disk Operating System local area network software, an 80386-based microcomputer server, 80286-based microcomputers designated as workstations that access the server, and a shared laser printer. Each microcomputer on the network is connected through communications boards to thick Ethernet coax cable.

Software is installed on the microcomputer designated as the server to provide resource sharing, storage of applications programs, and files that perform activities requested by the users. Software installed on the workstations allows users to request applications programs and files from the server for processing. After installation, the LAN software allows the network administrator to register users, organize directories and files on the server's hard disk, and permit workstations to access assigned printers connected to the server.

Distributed Information System-II, the Water Resources Division's new 32-bit super-microcomputer network, will be based on the Unix operating system which uses transaction control protocol/internet protocol (TCP/IP). The data communications protocol of the current network in PMU uses Xerox Network Services (XNS). Therefore, the basic communication protocols of the PMU network and Unix are incompatible. A cost effective solution is to abandon PMU's current LAN and convert to a network file system based personal computer software package. The network file system software establishes a communications link between the microcomputer workstations and Unix and provides access to both Disk Operating System and Unix applications.

A PROCEDURE FOR CHOOSING CLASS INTERVALS FOR COUNTY CHOROPLETH MAPS

HITT, Kerie J., USGS, WRD, 407 National Center, Reston, VA 22092

A new procedure for displaying pesticide-use data by county was needed because presentation of the data in tabular form did not communicate the spatial distribution of pesticide applications. Choropleth maps that used class intervals chosen such that equal numbers of counties fell into each class did not permit ready comparison of the different pesticides because different class intervals resulted for each map.

A procedure that would allow the maps to be used as an analytical tool in examining the spatial distribution of pesticide use was sought. A procedure was developed to account for both the intensity of pesticide use within individual counties and the relative contribution of use in each county to the total amount applied in all counties. The procedure ranks the counties in descending order of amount of use, then assigns the counties to class intervals based on the percentage of total cumulative use. Initially devised for pesticide-use data, the procedure has been generalized to apply to other types of data, such as water-use estimates. The procedure is currently (1990) being implemented in an automated geographic information system, ARC/INFO, but the software could be modified for other programming systems.

USING AN AUTOMATED GEOGRAPHIC INFORMATION SYSTEM TO PRODUCE GRAPHICS FOR A PAGE DESCRIPTION LANGUAGE

HITT, Kerie J., USGS, WRD, 407 National Center, Reston, VA 22092

The automated geographic information system, ARC/INFO, contains a "PostScript post-processor," which is software that converts Calcomp plot files to PostScript page-description language. The resulting PostScript code can produce graphics on any PostScript-compatible device ranging from low-resolution 300 dot-per-inch laser printers to high-resolution publication-quality devices, such as the Linotype L300. A tutorial that describes the use of the geographic information system and the post-processor software has been prepared. The tutorial describes how to generate a Calcomp plot file that can be converted to PostScript; how to set up a table for translating the symbols in a Calcomp plot file to lines, area tints, and text in a PostScript plot file; how to use the PostScript post-processor to convert a Calcomp plot file to PostScript code; and how to output the PostScript code to several hard copy devices.

USING A STATISTICAL ANALYSIS SYSTEM AS A GEOGRAPHIC INFORMATION SYSTEM

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The Statistical Analysis System, SAS (SAS is a registered trademark of the SAS Institute Inc., Cary, N.C.) has long been used by administrators and scientists throughout the U.S. Geological Survey for statistical and mathematical data analysis, applications development, report writing, and presentation graphics. This software system runs in a variety of computer environments: mainframe, minicomputers, and microcomputers.

Graphic capabilities of this software system can be used to provide powerful mapping features which can be used in confunction with other capabilities of this system such as data management, file manipulation and merging, statistics/mathematics, gridding, and three-dimensional portrayal to simulate functions that are found in full-fledged geographic information systems. Such functions can be especially useful for spatial data analysis, exploration, and transformation. Outputs from such functions of the statistical system can be used for direct input to other powerful GIS-specific software systems which are available in USGS geographic information system laboratories.

Projects of the Information Systems Division of the U.S. Geological Survey have used this statistical analysis system as a tool in the collection, management, analysis, and display of spatially referenced data. In this sense, the statistical analysis system has been used to assist in automating the manual process of gathering and analyzing a wide variety of data needed to make land-use and resource management decisions and solve earth-science problems.......the traditional definition of GIS.

Some of the statistical analysis system functions are: (1) storing digitized spatial data; (2) computing spatial statistics and statistically/mathematically transforming data; (3) combining and overlaying multiple layers of spatial data; (4) operating upon vector and raster data; (5) gridding and multiple methods for interpolating surface response data; and (6) producing line, chloropleth, contour maps, and other geographic representations, such as three-dimensional perspectives.

DIGITIZING TIME-SERIES DATA FROM CONTINUOUS-RECORD CHARTS

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In hydrologic data collection, there is a continuing need for the use of continuous strip-chart recorders in field applications. Manual reduction of data from these charts is tedious and prone to error, and typically does not extract all available information from the paper record.

A flexible, interactive computer program has been developed that allows digitizing and storing of data from time-series charts for further processing. A Fortran program called STRIP is used with the common configuration of a Prime computer and an Altek digitizing table in eavesdrop mode. Output produced by the program includes unit-values data, in standard card images, and a summary of daily information, such as noon value, peak value, and time of peak. The time interval for unit values can range from 1 minute to 4 hours. The program is coded as a set of subroutines that have been used as the basis for other computer algorithms involving digitized input or time-series data. The program has been extensively tested and already is used in many Survey offices for reducing strip-chart data of ground-water levels and sediment records.

Many features have been incorporated into the program to address the difficulties of data reduction from paper charts. Date and time are automatically adjusted to correct for fast or slow clockwork or paper distortion. Interpolation and sorting routines allow the user to enter as many or as few points as deemed necessary, in any order. The program recognizes and adjusts for the different Altek output formats, and can be easily modified for other digitizer formats. The user can back delete unwanted data points. Complications such as gaps in the record, scale reversals, multiple wrap-arounds, and other unusual or changing scales can be handled easily.

INTEGRATED APPROACH TO DEVELOPING DIGITAL DATA BASES FOR STREAM NETWORKS AND DRAINAGE BASINS

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In water-resources investigations conducted by the U.S. Geological Survey, there is a need for detailed, standardized, digital data bases of stream networks and drainage basins of the United States. These data bases would be useful for every facet of surface-water investigations, yet no national program or guidelines have emerged. Digital line graph hydrography at 1:100,000 scale (100K DLG) contains much information, but requires processing, simplification, and attribute coding to reach full utility. Digital elevation data presently are inadequate for automatic generation of detailed basin boundaries over large areas due to incomplete coverage, lack of precision, occasional inaccuracies, and software limitations. Labor-intensive methods for digitizing basins, although time consuming, are reliable and can be designed to maximize both the existing digital data and the capabilities of the processing software.

In Kentucky, the U.S. Geological Survey is applying an integrated approach that will result in compatible data layers, or coverages, of hydrography and drainage basins. A one-to-one correspondence between hydrography arcs and basin polygons is maintained. First, the 100K DLG hydrography is processed and edited to produce a "skeleton" set of arcs that form a simple dendritic pattern. Each stream segment that is named on the 100K paper map is represented by one arc. This typically results in about 400 arcs per 30- by 60-minute map. Then drainage boundaries for each stream segment are delineated on 1:24,000 scale topographic maps and digitized. Drainage boundaries are snapped to the hydrography so that stream junctions are precisely registered with basin junctions. Specialized software commands are used to establish upstream-downstream relations and to group sets of arcs into larger basin units. Because of the one-to-one correspondence, attributes can be transferred easily between stream arcs and basin polygons. An extension of the hydrologic unit numbering system is planned.