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The Global Resource Information Database

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Abstract

The United Nations Environment Programme (UNEP) is responsible for initiating and stimulating environmental action and awareness at all levels of society worldwide and for coordinating the environmental work of all United Nations organizations and agencies.

Within this framework, UNEP has established the Global Resource Information Database (GRID) to provide the world community with access to timely, usable environmental data and access to the geographic information system, satellite image processing, and telecommunication technology necessary for each data recipient to make the best use of these data and for global science applications, wise resource management, and sustainable development planning. Through GRID, UNEP will address environmental issues at global, regional, and national levels to bridge the gap between scientific understanding of earth processes and sound management of the environment.

The long-term objectives of the GRID activity are to ensure that (1) all pertinent global and regional environmental data are available through the GRID network to a range of users from students to scientists to politicians; (2) all United Nations specialized agencies and most major intergovernmental organizations will have access to modern technology and the opportunity to provide the necessary information-management support within their own organizations for the description, understanding, and solution of environment-related problems; (3) all countries will have access to GRID data and technology, with most having functioning GRID-compatible monitoring and assessment centers for national environmental assessment and management support.

The GRID is designed to become a network of cooperating centers in various regions of the world. At present there are GRID centers in Geneva, Switzerland; Warsaw, Poland; Arendal, Norway; Nairobi, Kenya; Bangkok, Thailand; Kathmandu, Nepal; Tsukuba, Japan; and Sioux Falls, United States. Soon there will be GRID centers in Brazil, Russia, Germany, the Caribbean, and the South Pacific. Each of these centers has specific functions within the network. Certain centers deal with sectorial or discipline-specific information; other centers have responsibility for specific geographic areas; still others deal with new technology and general data services.

INTRODUCTION

The United Nations Environment Programme (UNEP) is responsible for initiating and catalyzing environmental action and awareness at all levels of society worldwide and for coordinating the environmental work of all United Nations (UN) organizations and agencies. UNEP has the mandate to marshal, coordinate, bring to bear, catalyze, and occasionally underwrite science in support of the Environment Programme. Thus, within the identified concentration areas for UNEP activities—cli-

mate change, biological diversity (including deforestation), fresh water resources (particularly shared watersheds), land degradation, man's impact on oceans and coastal areas, and hazardous wastes—UNEP is concerned with providing the necessary information for assessments of the state of the environment, for structuring environmental plans of action, and for giving teeth to the protocols of international conventions. Within this framework, UNEP has established the Global Resource Information Database (GRID) to provide the world community with access to timely, usable environmental data and with the necessary geographic information system

(GIS), image processing, and telecommunication technology to make best use of such information for global science applications, wise resource management, and sustainable development planning.

GRID's main tasks are data collection and dissemination. In collaboration with UN organizations, national governments, environmental groups, and scientific bodies, GRID also supports scientific research, training, and technology transfer. GRID uses images, maps, and tables derived from data acquired by satellite sensors, aerial reconnaissance, and ground surveillance. GRID processes and stores data in a way that makes them easily accessible and comparable, using several complementary computer hardware and GIS and image-processing software systems.

BACKGROUND

In 1983 the management of Global Environment Monitoring System Program Activity Center (GEMS/PAC) of UNEP headquarters in Nairobi, Kenya, requested assistance from NASA to develop and implement a spatial data-management system for recording, processing, and distributing environmental data and information on a global scale. A user study had been completed by a UNEP chartered expert group. NASA personnel conducted a review of the data types held by several United Nations and intergovernmental organizations. Included in the review were the United Nations Educational, Scientific, and Cultural Organization (UNESCO), Food and Agricultural Organization (FAO), UNEP, International Union for the Conservation of Nature (IUCN), United Nations Disaster Relief Organization (UNDRO), and elements of the European Economic Commission (EEC). Based on the results of the data review, a system was designed; and a prototype system was developed. In late 1984, the Executive Director of UNEP reviewed the prototype system and approved the pilot phase of the GRID activities. He also requested continued NASA assistance to provide equipment and technical personnel to support the pilot phase.

In September 1985, the first of the NASA-built prototype systems was placed in service in Geneva, Switzerland; and a few months later, a second prototype was placed in service in Nairobi, Kenya. The NASA systems were raster based, employing a NASA software known as ELAS. The Prime Computer Company also contributed computers to both centers, and the Environmental Systems Research Institute (ESRI) donated the necessary ARC/INFO software to

accommodate the vector-based processing needs.

The initial plan for GRID was to establish a rather large operating unit in Geneva to serve as the global distribution center and archive, with a small unit at the UNEP headquarters in Nairobi to serve the countries of Africa. The first three years were devoted to the development of policies, procedures, and processing techniques, to the initial organization of data in the archive, and to developing a training program for users. By the end of the pilot phase (1988), it had become obvious that the plan for one central distribution and user-training center and archive would have to give way to a distributed network; and a third center was opened in Bangkok, Thailand, in 1988 to serve the Asia and Pacific region. Other centers were added to the network to cover specific countries or geographic regions and still others to provide specific disciplinary expertise or sectorial data or information. At the present, there are eight active GRID centers with four others scheduled to begin operation during 1992. Thus, the mechanism for developing a distributed global network of environmental databases is well into the implementation phase.

It is appropriate here to mention the supporters of the GRID system over the past seven years. They are

1. The United States Government, NASA, and USGS/EDC-GRID Center operations, plus computer hardware and software and technical and scientific personnel to support numerous GRID Center Operations around the world
2. Prime Computer Co. (computer hardware and software)
3. Concurrent Computer Co. (computer hardware and software)
4. IBM Computer Corp. (computer hardware and software)
5. SUN Microsystems Inc. (computer hardware and software)
6. ESRI (GIS software systems)
7. ERDAS (image-processing software systems)
8. Government of Switzerland (funds for training programs)
9. Canton of Geneva (facilities and scientific personnel)
10. Government of Australia (image-processing system hardware and software)

11. Government of Norway (GRID Center operations)
12. Government of Japan (GRID Center operations)
13. ICIMOD (GRID Center operations)
14. Government of Poland (GRID Center operations)
15. Asian Institute of Technology (GRID Center operations)
16. UNITAR (training program development and implementation)
17. Numerous institutions and individuals for specialized data, specialized software, training support, and advice

THE PRESENT NETWORK

The present network was shaped by many forces and events. There are three institutional requirements necessary for the success of any global environmental information network. The first and foremost requirement is the cooperation among scientists and resource managers that promotes the sharing of data and information, both local and regional, that can add up to global coverage. This cooperation is by far the most difficult part to achieve because it involves long-term efforts by both diplomats and scientists. During the first three years of the GRID activities, this element received the primary attention of the project management. Almost every existing global-regional data set was acquired by GRID and processed to common format and projection. By the end of the pilot project in 1988, the GRID database was beginning to gain significance in the data and information world.

The second most important requirement must be the organizational mechanism to carry out the mission of data acquisition and distribution and user training. In 1988 at the end of the pilot project, UNEP management made a decision to abandon the one-central-center concept for GRID and to proceed to develop a distributed network of GRID centers around the globe.

Many factors entered into this change in plans, but the primary factor was pressure from the developing countries through the UNEP Governing Council to bring GRID technology closer to their countries by establishing GRID centers to serve each region of the world. In this time frame, UNEP's total annual

budget was less than 30 million dollars; therefore, a very austere plan to establish regional centers was developed.

The Asia Pacific Center was opened in late 1988 on a shoestring budget, which allowed for minimal staffing and little facility and equipment budget. The center was opened using shared facilities at the Asian Institute of Technology (AIT) in Bangkok, Thailand, and instantly came face-to-face with the reality that it was to serve 56 percent of the world's population, more than 80 percent of whom were living in developing countries with very few resources to devote to environmental concerns. It was immediately obvious that other mechanisms would have to be brought to bear in the Asian region. Contacts were made with the International Center for Integrated Mountain Development (ICIMOD) in Kathmandu, Nepal; the South Pacific Regional Environment Program (SPREP); the Indian Ocean Commission; and the governments of Japan and Australia to support the GRID effort through subregional and national organizations. In 1990 an agreement was signed with ICIMOD in which UNEP/GRID would provide training for fifteen ICIMOD scientists and technical personnel plus assistance in hardware/software system design. ICIMOD would in return provide training and assistance to its eight member countries plus data capture and data dissemination for the entire Hindu-Kush Himalaya mountain range. ICIMOD received a grant from the Asian Development Bank in 1990 for both equipment and training courses and became a cooperating GRID Center in 1991.

A similar initiative was started with SPREP in 1990 for the twenty-two island countries embraced by the South Pacific Commission. Plans call for the opening of a GRID/SPREP center in 1992. The center would be funded by both UNEP and the Asian Development Bank and would be responsible for data capture, data dissemination, and training in the South Pacific.¹ Also, in 1990 contacts were made with the government of Japan requesting its assistance with the GRID mission. The Japanese responded in 1991 by opening the GRID/TSUKUBA at the National Institute for Environmental Studies, an element of the Japanese Environment Agency. This center, funded entirely by Japan, provides access to Japanese satellite data, socioeconomic data in spatial format, super-computer processing, and scientific and technical expertise for the GRID systems in general and neighboring developing countries in particular. Other subregional organizations in Asia are also candidates for GRID cooperation. These include the Mekong Secretariat, Indian Ocean-Marine Action Plan, and the ASEAN organization.

¹ In 1992 a GRID cooperating center opened in Western Samoa as part of the South Pacific Regional Environment Program. *Ed.*

In Europe, the network began with GRID/Geneva, which served all of Europe until 1989 when the government of Norway provided funding to open and operate a GRID center in Arendal, Norway. The Arendal Center serves the country of Norway and provides specialized data and information for the Arctic Region. The center also provides assistance to the developing countries through special projects. The third GRID center in Europe was opened in 1991 in Warsaw, Poland. This center, known as GRID/Warsaw, is operated by the government of Poland with assistance from Norway, serving the country of Poland and providing expertise to assist in regional problems in Eastern Europe. Discussions are under way with the Federal Republic of Germany (FRG) and also with Russia, both of which plan to open GRID centers sometime in 1992 or early 1993. There is also talk of a GRID center for the countries of the Baltic Basin.

In Africa the GRID Center in Nairobi remains the primary GRID activity. Through active participation in regional and national projects and through training programs, small centers at the national and intergovernmental levels are being established. National capabilities now exist in Kenya, Senegal, Ghana, Lesotho, and Uganda; and others are under development. The trend in Africa appears to be more toward national capabilities, perhaps due to the lack of strong subregional organizations.

In Latin America, progress has been very slow due primarily to the lack of strong regional or subregional ties among the countries and possibly due to lack of strong UNEP ties in the region. The UNEP regional office is located in Mexico City, which is certainly not a central location, and activities seem to be stronger in Central America and in the Caribbean. In 1990 a GRID center was opened at the Mexico City location for a short time; however, it was closed within two months due to a funding restriction imposed by the UNEP Governing Council. The restriction was imposed on all UNEP funds and was unrelated to GRID, and GRID/Mexico City was only one of the victims. In late 1991, contacts were made to the government of Brazil; and the Brazilian Space Agency, Instituto de Pesquisas Espaciais (INPE), has made a positive response. The agreement to establish GRID/Sao Jose dos Campos at INPE Headquarters will be signed at UNEP's World Environment Day celebration in Rio de Janeiro on June 6, 1992.² The center will be operated with funds provided by Brazil and will provide data and information on the Amazon forest and climate change information for the Amazon basin. The door has also been left open for cooperative projects with neighboring countries. Technical

assistance and training have been offered. A second Latin American center is also being discussed with member countries of the Caribbean Action Plan; and the present thinking is that the center should be located at the University of the West Indies, a regional academic institution similar to the University of the South Pacific in Suva, Fiji. The new center may be opened in late 1992, but more likely it will open in early 1993 due to budget constraints.³ While progress has been slow in Latin America in the past, it does appear to be moving rather well at the present.

While a number of U.S. organizations, both government and nongovernment, have provided support to the GRID activity since its inception (see Background section), the first GRID Center in North America was not opened until January 1, 1991. The center, identified as GRID-Sioux Falls and located at the U.S. Geological Survey's (USGS) Earth Resources Observation Systems (EROS) Data Center, is supported by both the USGS and the National Aeronautics and Space Administration. The University of California at Santa Barbara and the University of New Hampshire are also active partners in the North American operations of GRID. GRID-Sioux Falls addresses all three of GRID's long-term objectives:

1. It is a major contributor of regional and global data sets and, therefore, plays a significant role in making environmental data available to the world community through the GRID network.
2. It supports the transfer of technology via the GRID networks to other United Nations agencies, intergovernmental organizations, and national governments by sharing its in-house technology development results with UNEP.
3. It provides specialized training, supported by the United Nations, in remote sensing applications for environmental assessment and monitoring programs to developing-country personnel.

The center in Sioux Falls, unlike other centers that are funded by individual countries, does have a resident full-time liaison officer on assignment from UNEP to coordinate the many activities in data-set production, technology development, and scientific studies that are provided by the U.S. consortium.

Thus, the institutional mechanisms for data capture and distribution, while incomplete from a global perspective, are certainly developing at an increasing pace; this does not appear to be the limiting factor

² The agreement was signed as scheduled. *Ed.*

³ The establishment of the center is in progress following the signing of the above-referenced accord. *Ed.*

various centers. This requirement was recognized in the beginning and was included in the initial plan by NASA. In 1986 NASA contributed six C-band ground stations to UNEP/GRID with a network design that would have used two of the stations for the GRID centers in Geneva and Nairobi and a third at a selected NASA center. The remaining three stations were to be used as the network expanded. After much negotiation with the Public Telephone and Telegraph (PTT) authorities in Switzerland and an agreement with Intelsat for a one-year experiment, the entire project was lost due to the unexpected failure of the Intelsat IV satellite series. The ground stations were not upgradable to the Intelsat V series, and the NASA communication program was suspended for new projects in this time frame. The idea was not lost, however, and the European Space Agency (ESA) has over the past four years developed a project called "MERCURE" that will provide two-way data transmission among the GRID centers in Geneva, Nairobi, and Bangkok and low-cost receive-only stations for subregional and national centers. In addition NASA has a 1992/93 initiative for a data transmission link between GRID/Sioux Falls and GRID/Geneva, which would complete the primary data network.

The GRID Programme was initiated in 1985 as a pilot project with no line-item funding within the UNEP/GEMS budget. It has struggled against many elements of funding, personnel, and political constraints over the past seven years; and today it is one of the major Programme Activity Centers (PAC) of UNEP, fully institutionalized with its own budget. The first three years were used to develop policies and procedures, with some significant efforts on building the data holding to an initial critical level. The next four years were spent developing the institutional mechanism for data capture and distribution. Through both of these periods, far too much time was lost struggling with obtaining and maintaining adequate hardware and software systems to record, process, and distribute the data. Now that some sort of institution exists in most regions of the world and the data transmission network is being implemented, it is time for GRID to turn its attention to a more intense data capture activity that will cause accurate high-resolution data to flow from the locals in every country to form more precise data sets for global studies and to cause the data sets from all sources to be readily accessible to scientists and resource managers around the world. This data flow along with a flow of appropriate technology to make best use of the data for improvement of the world's environment continues to be the ultimate objective of the GRID activity.

Persons interested in contacting elements of the

SUMMARY

GROWTH HISTORY OF GRID

Figures are approximate

Biennium	86/87	88/89	90/91	92/93
Funding (UNEP Only)	900K	1800K	2600K	6950K
Professional Staff	10	20	28	31
Participating Centers *Some UNEP funding †Staff included in above numbers	Geneva*† Nairobi*†	Geneva*† Nairobi*† Bangkok*† Arendal†	Geneva*† Nairobi*† Bangkok*† Arendal† Sioux Falls*† ICIMOD Tsukuba Warsaw	Geneva*† Nairobi*† Bangkok*† Arendal† Sioux Falls*† ICIMOD Tsukuba Warsaw SPREP* Moscow CAP/CRU Brazil FRG Baltic Basin
Organizational Status Within UNEP	Pilot Project Hidden in GEMS/PAC Budget No Line Funding	Pilot Project in GEMS/PAC Budget Line Funding	Project in GEMS/PAC Budget (implementation phase) Line Funding	GRID/PAC Program PAC Funding

best use of the data for improvement of the world's environment continues to be the ultimate objective of the GRID activity.

Persons interested in contacting elements of the present GRID network should use the following information:

1. GRID/PAC Director - Nairobi, Kenya
Dr. Harvey Croze
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Fax: 254-2-226491
2. GRID/NAIROBI Facility Manager - Nairobi, Kenya
Dr. Norberto Fernandez
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Fax: 254-2-226491
3. GRID/GENEVA Facility Manager - Geneva, Switzerland
Mr. Ole Hebin
Telephone: 41-22-438660
Fax: 41-22-438662
4. GRID/BANGKOK Facility Manager - Bangkok, Thailand
Dr. Gary Johnson
Telephone: 66-2-5162124
Fax: 66-2-5162125
5. GRID/ARENDAL Facility Manager - Arendal, Norway
6. GRID/ICIMOD Facility Manager - Kathmandu, Nepal
Mr. Surendra Shrestna
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Fax: 907-1-524509
7. GRID/TSUKUBA Facility Manager - Tsukuba, Japan
Dr. Shuzo Nishioka
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Fax: 81-298-582645
8. GRID/WARSAW Facility Manager - Warsaw, Poland
Mr. Marek Baranowski
Telephone: 48-22-264231, Ext. 331
Fax: 48-22-270328
9. GRID/SIOUX FALLS Facility Manager - Sioux Falls, United States
Dr. Ashbindu Singh (after June 15, 1992)
Telephone: 605/594-6107
Fax: 605-594-6589
10. GRID NEWS (for GRID Newsletter)
P.O. Box 30552
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