As a first step in addressing this, the PDS should provide a census of private spectral data sets and links to data bases that have online accessibility. The census will aid access while resources are grown to prepare the data for submission to PDS. This, however, does not provide for a common interface or cross-collection searches. That capability requires a centralized location and a single interface. For a more long-term solution, the PDS should implement a user-friendly interface to transfer private spectral data bases into the public domain and provide easy access to the data. Facilitation requires a transfer that is not overly burdensome on the submitting or receiving ends. The community needs a mechanism to regularly review and recommend which spectroscopy data bases should be prepared for inclusion in the PDS to prioritize the resources needed to accomplish the task. In the near-term, the PDS plans to focus on laboratory and telescopic data, since field/airborne spectroscopic data are considerably more challenging to manage.

Three additional means to motivate and facilitate the transfer of data into the public domain were identified: making it a condition of funding, ensuring that credit for data-set authors is provided and maintained, and providing funding specifically for importing data sets. Easing the transfer of laboratory and telescopic data into the public domain is being addressed in two ways: the PDS is developing guidelines for laboratory data, and the NASA Applied Information Research Program is funding the development of a user-friendly, Web-based submission interface. Lack of funding to transfer existing data sets continues to be a bottleneck, though it is hoped that better submission guidelines and user interfaces may reduce this expense. The absence of a referencing capability for new data sets continues to act as a disincentive for potential submitters.

Visible-Infrared Spectroscopy of Mars: Laboratory and Field Community Data Sets was held 9 December 2002, in San Francisco, California.

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SECTION NEWS

OCEAN SCIENCES

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World Data Center for Marine Environmental Sciences Provides Lessons in Marine Geosciences Data Management

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World Data Centers (WDCs) provide scientific data and information systems that help transfer comprehensive knowledge among researchers in a straightforward manner and under a sensitive data policy. However, use and acceptance of a WDC within the scientific community depends on respective knowledge and individual scientific needs. For that reason, the staff of the World Data Center for Marine Environmental Sciences (WDC-MARE) (www.wdc-mare.org) is providing lessons in information and data management in marine geosciences at the University of Bremen in Germany. Recently, WDC-MARE expanded this service to scientific programs outside of Germany.

A four-semester master's program for applied polar and marine sciences (POMOR; see www.pomor.de) began at St. Petersburg State University in Russia in October 2002. It is the most recent example for a series of lessons that are available, with minor modifications, to any scientific organization or individual interested in learning about information and data management in marine geosciences.

Master's-level program lessons are grouped around the use and protection of marine and polar regions, building on three main research disciplines: oceanography, marine biology, and marine geosciences. Basic knowledge in natural, engineering, economic, information, and communication sciences is conveyed as well. Among these courses, one titled "Information and Data Management in Marine Geosciences," is covered by WDC-MARE staff, who teach all aspects of modern, relational scientific data management by means of its operation platform, PANGAEA (Network for Geological and Environmental Data; see www.pangaea.de).

The lessons are organized around the following questions: What is data management in a (geo-) scientific environment? What automatisms exist to make data available for science? How can we retrieve data from science? What is the potential profit of data management in science?

Lessons include, among other things, the historical background of data management; the principal types of technical, structural, and administrative data organization and architecture; software and hardware resources; rules of good scientific practice; practical aspects of data management from availability through acquisition, preparation, quality check, import, archival, visualization, and publication to the dissemination of scientific data; as well as data policy and legal aspects.

As in most early stages of apprenticeship, all varieties of "why" questions are popular with the students, yet they are feared by the teaching staff. Most educational success is achieved by searching for an appropriate answer for the question, Why data management and data publication? Finding the answer puts one on the front lines of one of the digital age's most volatile legal battles—the dispute between user rights and copyright protection [*Brumfiel*, 2002]—and shows how essential scientific data publication is a prerequisite for the verification of research results.

An interactive game of answering, "What are data?" opens students' eyes to the significance of analytical data, meta-information, and geocoding of data; for example, latitude/longitude, depth/elevation/altitude, and age/date-time. Students are amazed at the huge expenses for data production—including campaign and laboratory work, and data reproduction for lost data; and the relatively small budget needed for appropriate data management—which includes acquisition, homogenizing, and archiving of data; plus hardware, software, and networking maintenance—and data publication. Indeed, data management requires just 2–5% of a typical proposal budget.

The World Data Centers system is a scientific non-governmental organization that is affiliated with the International Council for Science (ICSU; see www.icsu.org). Since the ICSU strengthens international science for the benefit of society, it is crucial to know how to use the some 50 interdisciplinary WDCs of the WDC system. These practical geoscientific aspects are discussed in detail in the lessons as well.

More and more funding organizations (cf. NSF-ESH data management policy; www.nsf.gov/pubs/2002/nsf02005/nsf02005.htm) point out the added value of data management services and products to local, regional, national, and multi-national projects. Acting for all the other World Data Centers, WDC-MARE maintains communication between international data centers (infrastructure, standards); builds a backbone of analytical data in any geoscientific discipline; ensures long-term archiving of data; publishes data sets; homogenizes, standardizes, and checks scientific data for quality; provides access to data online by standard browser software independent of computer system and location; develops specific working contexts; offers a professional information management service; plays a pivotal function before, during, and after a project's funding period; and sustains good scientific practice.

Any short course is accompanied by practical exercises related to the subject to reinforce the new theoretical knowledge. Consequently, small groups of two to four students elaborate upon topics such as data acquisition, preparation, quality check, import, archival, visualization, publication, and dissemination as well as work out SQL and HTML software solutions. All exercises are systematically conducted by the teaching staff. Usually, the most promising highlights come up as students start to prepare their own scientific work based on what they learned during the lessons and make their own project information and scientific data available through WDC-MARE.

Scientific organizations and individuals interested in courses in data and information management should address inquiries to WDC-MARE (ndittert@wdc-mare.org; mdiepenbroek@wdc-mare.org).

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—Nicolas Dittert, IUEM – LEMAR, Technopôle Brest-Iroise, Plouzané, France; and Michael Diepenbroek and Robert Huber, WDC–MARE – MARUM, Bremen, Germany

BOOK REVIEWS

Global Environmental Change: Modelling and Monitoring

Kirill Ya. Kondratyev, Vladimir F. Krapivin, and Gary W. Phillips

Springer-Verlag; Heidelberg, Germany; ISBN 3-540-43373-2; xiv + 316 pp.; 2002; 99.95 EU.

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The second half of the 20th century was a period of unprecedented and rapid change in the global population, the biosphere, the world economy, and society. Recent inquiry related to the environmental effects has focused on the complexities of how the Earth behaves as a system, with connectivity linking its oceans, land, atmosphere, living, and non-living components. The search for delineation of natural and human causes and effects of global change has ushered in new mathematical approaches to the pursuit of a global environmental system science. Judging from the reports of several international conferences—for example, The Amsterdam Declaration on Global Change, 2000—a consistent theme has emerged, calling for the development of an effective ethical framework of global stewardship and strategies (modeling and monitoring) for Earth system management.

The quest to understand and describe how human processes act on the environment has taken several pathways, including recognition of the need for a unified planetary-scale Geoinformation Monitoring System (GIMS). Attempts to create a GIMS global model have not, as yet, been fulfilled, despite the ever-increasing capacity of modern computers. The authors of *Global Environmental Change: Modelling and Monitoring* recognize that environmental change very often happens suddenly and unexpectedly, and cannot be reliably predicted by the projections of smooth, gradual change that computer models produce. Predicting future socio-economic and ecological dynamics will prove more difficult, but forecasting offers great value when faced with the growing need to minimize risk.

The basic approach proposed in this book is a combination of Geographical Information Technology (GIS) techniques with modeling technology to estimate the functioning of the nature/society (N/S) system. This new global modeling information technology approach will depend on a data base of information of various quality and many different types of mathematical and physical models.

A Geoinformation Monitoring System (GIMS = GIS + Model) is presented that focuses on the use of systematic observation data and evaluation of changes attributable to human impacts on the environmental subsystems. The nature/society system is very complex. The problem is to seek methodologies that will reliably simulate the dynamic tendencies of this system. This is accomplished by developing a biocomplexity indicator as a function of time and space.

Global Environmental Change: Modelling and Monitoring has an excellent introduction, including useful tables relating to environmental and social change. It defines and sets the stage for development of a GIMS based on the interaction of society and nature. Following the introduction are three chapters describing a proposed GIMS structure and biocomplexity model. This structure involves the interaction of the atmosphere with the land, and ocean impacts with regard to actual trends of human-induced stresses in all regions of the world. The model incorporates units describing biogeochemical cycles, water cycles, ocean and soil-plant formations, demographic processes, climate, and anthropogenic changes.

Chapters 5 through 9 present applications of GIMS technology to specific case studies: Arctic Basin pollution, Peruvian current and Okhotsk Sea ecosystems, and pollutant dynamics in the Angara-Yenisey River systems. Chapter 10 provides a very useful discussion about the problem of collecting and processing data related to the design of an ecological monitoring system for marine oil and gas extraction zones.

Chapter 11 describes the components of GIMS technology relevant to decision-making procedures in environmental monitoring systems. New methods are proposed for making decisions using fragmentary time and space data.

This book effectively presents the theoretical basis for assessments of global change with application examples. Researchers working in all disciplines of science, mathematics, and engineering will find it useful. The ideas and mathematical treatment are clearly developed and presented. However, greater care could have been exerted in the editing, as there are occasional spelling errors and missing references or dates of references in the text.

Despite these minor flaws, this volume is an excellent presentation of theoretical and practical aspects of simulation associated with environmental and human systems, and it accomplishes the goals the authors set forth in the preface of their book.

—John J. Kelley, University of Alaska, Fairbanks