Wrap-Up Session

Convener Geoffrey Holland

The Wrap-up session of the Workshop was convened by Mr. Holland who announced that rather than form a panel of a few participants this session would be open to all. The purpose of bringing them to the Workshop was to use their expertise in deciding how to proceed in the future. Since the great majority of attenders were at this session, there was an opportunity for a good discussion of all relevant topics. In some cases it was decided that the topics were too complex to be concluded at this Workshop and that further discussions among specialists is needed. Presented in this section is a summary derived from floor discussions. Although statements and recommendations are not attributed to individuals, the collaborative effort of this work is recognized.

A volume of the Proceedings of the OCDW will be prepared by the host country for distribution by the IOC (and others, if requested). The overall goal of establishing a dialogue between data managers and scientists was achieved. In addition, a number of issues were discussed. Many of these will require action by the IOC and other groups represented at the OCDW. These issues are listed in the order they were discussed (not prioritized or ranked) and are summarized below.

Issues

A. Continuing Liaison Between Data Managers and Scientists

Listening to the case studies that were presented it became quite evident that the best data management systems were the ones where data managers and research scientists worked as a team developed in the early stages of project planning. Examples that were given included WOCE Data Assembly Centres e.g., Drifters, the Global Temperature Salinity Pilot Project (GTSPP) collaboration with Joint Analyses Centres in the U.S. and Australia, and JGOFS/BOFS development of Topical Centres. While each of these has some elements unique to the project, each had brought together "teams" of Principal Investigators (PI's) and data management experts at an early stage of project development. Conversely, projects which had considered data management as a totally separate activity with lower priority often failed to provide the service required to meet scientific objectives. Therefore, the following actions should be brought to the attention of relevant groups within the IOC and other international organizations:

1. Publicize, at the national and international level, underway data/scientist collaborations that may be used as models in planning for the future.

2. Reduce adversarial situations where data managers and scientists appear to be in competition.
3. Colocation and other forms of collaboration often results in very high quality data sets and more timely data submission. Improved timeliness of data submissions was a common theme throughout the workshop and must be considered an important element in all future plans. Improvements in timely submission of data were noted. In order to continue this trend the advantages of timely submission of data must be stressed to those planning new ocean science projects.

B. Importance of Historical Data

While the ocean climate related work that has been done to date has yielded significant results, it was apparent that there is a growing need to fill spacial and temporal gaps in the present data set. There is no other way to study long term ocean climate changes and the present global set is not adequate for all the work that needs to be done. At present there is an ongoing multilateral effort known as Data Archeology. The discussion on historical data highlighted the following issues:

1. There is a need to expand the current ad-hoc multilateral effort to an international data rescue and recovery project.
2. The support of member states is required for this work.
3. It has been demonstrated that cost-benefit is high. The cost of data recovery is quite small when compared to the initial cost of data collection, while the benefits accrued when using these data for global studies are quite dramatic.
4. Some of these data are in danger of being lost because of deterioration in their present state and an immediate rescue effort is needed.
5. Not only do the numerical values need to be recovered, but the auxiliary data (metadata) needs to be recaptured as well.
6. A continuously updated data set will require high quality historical data as well as contemporary observations.

C. Role and Importance of World Data Centers (WDC's)

The consensus of OCDW participants was that the World Data Centers plays an important role internationally in the sharing of scientific data and information. Furthermore, that this role would increase in importance as global change problems such as climate change begin to grow in number and complexity. The following actions were recommended:

1. There needs to be a reexamination of the World Data Centre System's role and responsibilities in light of present plans for climate and global change experiments. For WDC's, Oceanography this is of special importance because of work currently underway in planning for a Global Ocean Observing System (GOOS).
2. WDC's A, B, & D for Oceanography should undertake a project to harmonize data holdings so that any data user, anywhere in the world, will know the total data available from the WDC's. It was understood that such a project has been started and workshop participants endorsed this work. In order to meet

requirements for more timely access to data, the oceanographic WDC's have begun a project to have a unified semi-annual catalogue available and, if possible, have this catalogue available on an electronic bulletin board.

3. The WDC's should continue to promote free access to data and a policy of freely exchanging data. The sharing of data is of growing importance to ocean climate programmes. In addition to traditional data types it was noted that satellite derived data or data products are of growing importance and working arrangements for access to these data should be investigated.
4. Although oceanography was of prime concern to workshop participants, it was recognized that ocean data is only part of the total system and that multi-disciplinary data sets will be need to be considered.

D. Evolution of Data

A full range of technical matters associated with the collection and dissemination of data and metadata were discussed. It was recognized that many of these items will require assembling, relatively small, expert groups who would make specific recommendations aimed at solving a particular problem. Issues under this subject include:

1. Problems associated with the increasing size of data sets:
   - Techniques for storage and retrieval of these data.
   - Study of compression techniques and of data products associated with these data sets.
   - Training of data managers in handing of large data sets
2. Increasing complexity of data
   - New data types especially in Chemistry and Biology
   - Growing importance of metadata and problems associated with the cost, formatting, storage and retrieval of this information.
3. Need for correlation of data sets across disciplinary lines.
   - Techniques for format interchange
   - Flexibility of data (and metadata) recording
   - Development of a common georeference system
4. Technical problems associated with the storage and retrieval of satellite-derived observations.
5. Development of an overall IOC strategy focussed on the orderly development of data systems required for an operational ocean observing system. This development must be done in cooperation with the WMO as well as other international bodies and might be the subject of another follow-on workshop.

E. Participation of Developing Countries in Ocean Climate Programmes

In discussing the ways in which developing countries might participate in research and operations associated with ocean climate projects, it was quite clear that some, if not all, developing countries cannot get the access they need to data and data products. Computer tools shown at the OCDW demonstrated that many tools are available today at very low cost. The problems are associated with getting hardware and software to the right place with adequate training to the users. The

Ocean-PC approach was noted with interest. The following summarizes issues that were addressed by participants:

1. Need for an improved dialogue between developing and developed countries. There is a need for ICSU to work with non-governmental organizations in developing countries in order to provide data access for these groups.
2. Supply of modern tools is important only if accompanied by training data.
3. Technology development has reached a point with CD/ROMs, user friendly software and low cost computers that the present situation should be eased considerably with the cooperation of member states.
4. Developing countries and regions should develop their own data management strategies in order to maximize technology and data access.
5. Developing countries should be asked to play a role in data rescue where data are available and need to be put in digital form.

F. Model Data

Discussion at the OCDW made it abundantly clear that air-sea interaction models and forecasting models are of growing importance to ocean climate projects. These models are both a user of data and a generator of data (or pseudo-data). This subject evoked enough discussion that it is an excellent candidate for a follow-on meeting sometime in the future. Issues that were discussed include:

1. Modelers need data input and generate data output. Output is now considered a research product but may be needed by others. Should it be archived, for how long, where?
2. Further discussion is needed on the usefulness and complexity of storing model output. Do you archive all model output or just selected products?
3. Should model output be considered as part of a data set or complementary to it?
4. How important is the metadata that accompanies model output and what should it contain?
5. There is a need to organize model generators & users in order to determine what is available, whether there is a need to exchange these internationally or only exchange information about models that are under development. This problem needs reconciliation by those directly involved.

G. Data Quality

The importance of data quality was a repeated theme in workshop talks and discussions. Many of the ongoing climate related projects e.g. WOCE, have very high quality standards. While some modelers may have ways of filtering data of lesser quality, others require data that has been fully processed and quality assured. Some of the issues discussed were:

1. Quality assurance must be developed in such a way that the best quality data are obtained without duplication of effort from the time data are acquired until they are made available for general dissemination. This will require full coordination throughout the process.

2. The GTSPP was noted as an excellent example of how data centres and researchers may collaborate in order to produce a high quality data set available for the international community. This type of government-university collaboration to produce high quality data sets is encouraged.
3. While there is much to learn from the meteorological example, participants felt that oceanography does not have the "forecasting" base used by that community and must develop its own strategy for building data sets needed by climate change projects.

H. Funding

There were a number of items related to how things would get done and how funding could be obtained to perform these tasks. This discussion was a wide ranging one and may be summarized as follows:

1. Oceanography has traditionally received research funds. As we move toward an operational system, how do countries receive funding for these operational systems, while still maintaining the strong research base that will be required? The OCDW could not answer this question, but was quite aware that it is critical to the future development of an observing system.
2. Other funding actions that were suggested:
   - Set up a trust fund within the IOC specifically for data management activities such as those proposed by this workshop.
   - Cosponsors should consider funding follow-on activities suggested in this report.
   - Member States should fund data archeology activities as noted in this report.
   - Bring national attention to the need for ocean monitoring. Also bring to national attention the need to match financial support of World Data Center's to their increasing responsibilities.

I. The Global Ocean Observing System (GOOS)

While many of the items above contained elements related to GOOS, there were several points made that were specifically aimed at that programme. Speakers involved in the development of GOOS stated that a strong, effective data management programme is at the heart of a successful ocean observing system. It was also pointed out that GOOS requires coordination and interactions among a number of IOC groups and between IOC and a number of other international organizations such as WMO, SCOR, ICSU, and the UN Environmental Programme (UNEP). Some of the issues discussed were as follows:

1. There is a need to have a well staffed operations office with at least one member of that office responsible for coordination of data management activities.
2. GOOS will require an efficient communications system linking the observational network, data centres, and users.
3. A GOOS data management plan will need to take into account the fact that regional and global products will need to be disseminated in a timely fashion.
4. Standards will need to be adopted for all GOOS systems.

5. Some IOC elements that currently exist may need to be redirected into a coherent organization, serving GOOS.

J. Communications

Concern was expressed over the adequacy of communication networks as required by both present research programs and potential monitoring activities. Workshop attendees suggested a study of the following items:

1. Interactive transfers of data collections.
2. International data networks which could link data centres.
3. Rapid data dissemination to users worldwide.
4. Investigate regulatory policies that may hinder the use of the wider bandwidths needed to carry out current and planned programmes.
5. All participants agreed that the electronic mail used widely by the oceanographic community has been, and will continue to be, an essential part of the international communication system.

V. Conclusion

There seemed to be enthusiastic support for the concept of the OCDW. Comments received both publicly and privately were supportive of the form and substance of the meeting. The issues and actions cited above should provide very important guidelines to the IOC and other sponsors. Just as important as these recommendations is the bonding that occurred between data managers and scientists during the course of the OCDW. It should be noted that some of the data managers are also highly qualified research scientists and that this may set some sort of a trend. This workshop differed markedly from those where a data manager was invited to a science meeting, or where a token scientist was invited to a data meeting. This seemed to truly be an interaction where there was mutual benefit derived by most, if not all, participants. Although the workshop recommended a meeting like this one in 2-3 years, it is believed that too much was crammed into this first meeting and that the next should be more narrowly focussed with more specific recommendations. An example would be a workshop centered on the preparation of data sets that are required for experimental GOOS models. A number of other subjects are mentioned in the body of this report.

Appendix I

The following is a reproduction of notes used by Roy Jenne of the U.S. National Center for Atmospheric Research.

Some Types of Data

- An XBT in some reasonable format
- A grid in GRIB format
- A compressed pix of Mars at JPL
- A non-regular cloud grid

- A picture format on PC's
- A field of data in F 6.1 characters

What is common for all the above?

- Each is a string of bits
- The lengths usually vary
- each has a known structure

Formats

- Organize the data for computers
- ell users variables and precision

What is the data sSituation?

- We have common formats—lots of them
- We have bright ideas on other formats - some of them
- There are simple formats - Need almost no learning time
- There are junk formats
- PIs make calculations
  - with models
  - with data
  - with both
- There are many data cultures
  - Groups with regular formats
  - Codes for Data Types e.g. COADS, NODC XBTs
  - GF 3
  - Bufr, GRIB
  - CDF, not CDF,HDF
  - DBMS (Oracle, Empress etc.)
  - SASS
- There are many display systems
  - Each has an internal structure
  - And display operators

Data systems of the future

- Must handle some format diversity
- Don't make it hard for the PIs
- Users will choose their software
  - Some from various science groups
  - Some from commercial packages
- Users will use data for calculations

New developments

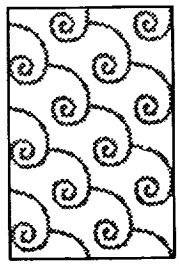
- Format descriptions
- Translate on demand
- PC Formats - may make the de facto standard

Appendix I

Program

OCEAN CLIMATE DATA WORKSHOP

Goddard Space Flight Center, Greenbelt, Maryland, USA
February 18 - 21, 1992



A dialogue between data managers and scientists

Host U.S. National Oceanic and Atmospheric Administration
National Aeronautics and Space Administration

Purpose This workshop is intended to begin discussions which may lead to the improved data delivery systems that are needed by scientists studying the oceans role in climate change.

Objectives

- *Identify opportunities* for improving data management for ocean climate research;
- Find ways to *improve access* to marine data;
- Outline the characteristics of data management systems needed to *support ocean monitoring and prediction;*
- Provide guidelines for *improved data services.*

Audience The workshop is primarily intended for those who are working on and planning ocean related climate projects. However, the workshop will welcome anyone with an interest in the subject matter.

Publication Proceedings of the workshop will be published and distributed to those attending. The proceedings will also be made available to sponsoring organizations for their distribution.

Fees Speakers and other invited guests will not be assessed any fees. Others who attend will be asked to pay a registration fee of $75 which includes the proceedings and the evening seminar.

Language English only

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Hotel Accommodations

A block of rooms has been set aside for the Workshop at the:
Courtyard by Marriott
6301 Golden Triangle Drive
Greenbelt, MD
Telephone: (800) 321-2211 or (301) 441-3311
Bus transportation from the hotel to the meetings will be available

PROGRAM

OCEAN CLIMATE DATA WORKSHOP

Goddard Space Flight Center, Greenbelt, Maryland, USA
February 18 - 21, 1992

February 18
8:45-9:30am

Registration

9:30am - 12:30pm
GSFC Building #3
Auditorium

Introduction to the Workshop

In addition to logistics of the workshop, speakers will talk about future programs related to understanding how the oceans affect climate and how climate changes affect the oceans.

Subject	*Speaker*
Introductory remarks	Sponsors and hosts
The Constancy of the Ocean	J. Knauss
Role of the Earth Observing System	S. Wilson
Global Observations & Operational Oceanography: a Decade of Transition	J. Baker
The Role of Ocean Climate Data in Naval Oceanography	G. Chesbrough
International Organization of Ocean Programs - Making a Virtue of Necessity	A. McEwan
World Ocean Climate Change Investigations under the "Sections" Programme	S. Gulev
The Role of the WDC's in Handling Ocean Climate Data	F. Webster

12:30-2:00pm LUNCH

2:00-3:20pm
GSFC Building #3
Auditorium

3:30-5:30pm
GSFC Building #26
Room 205

Computer Systems

This session will include talks and hands-on demonstrations of new computer systems which are (or soon will be) available to oceanographers and others studying climate change and the oceans. The objective will be to familiarize attendees with these systems and to invite them to return individually or in small groups during the course of the workshop for a hands-on experience on these systems.

Convener: L. Olsen

Subject	*Speaker*
NASA's Climate Data System and its Evolution as Goddard's Distributed Active Archive Center (DAAC)	L.Olsen
SEAPAK An Oceanographic Analysis Software Package	C. McClain
Oceanographic Data Analysis in the Goddard Laboratory for Hydrospheric Processes	T. Busalacchi
Project POSEIDON, the NODC On-line Database	P. Topoly
ATlast for PC & OceanAtlas for Macintosh	E. Smith

February 19
9:00am - 4:30pm
GSFC Building #3
Auditorium

Monitoring Changes in the Ocean and Atmosphere

The object of this day will be to look at what has been done, and what needs to be done to create data sets that can be useful to scientists who require data on a more timely basis.

Convener: R. Wilson

Subject	*Speaker*
Operational Seasonal and Interannual Predictions of Ocean Conditions	A. Leetmaa
The World Circulation Experiment (WOCE)	A. Clark
The Global Ocean Observing System	D. Kester
Global Temperature Salinity Pilot Project	B. Searle
Indian Ocean Analyses	G. Meyers
Monitoring Global Ocean Surface Variations	D. Halpern
The Use of Remotely Sensed Data for Operational Fisheries Oceanography	A. de Fiuza
Ocean PC and a Distributed Network for Ocean Data	D. McClain

6:30pm/7:30pm
GSFC Recreational Center

COCKTAILS/DINNER
Guest Speaker: G. Holland

February 20
9:00am - 1:00pm
GSFC Building #3
Auditorium

Data Archaeology

The objective of this session will be to demonstrate the usefulness of historical data. There will also be a panel discussion on other uses of historical data and on data sets that are not currently available to the international community.

Convener: S. Levitus

Subject	*Speaker*
Ocean Climate Diagnostic Studies	S. Levitus
Satellite Altimetry	R. Cheney
High Resolution GCM Modeling of the Thermohaline Structure of the World Ocean	A. Semtner
Data Archaeology at ICES	H. Dooley
Data Availability and Data Archaeology from the Soviet Union	Y. Sychev
Ocean Climate Data for the User Community in West and Central Africa; Needs and Opportunities	S.O. Ojo

2:00 - 6:00pm
GSFC Building #3
Auditorium

Effect of Change in the Ocean and on the Life Cycle

This session will include a case study of the 1989 N. Atlantic Bloom Study (NABE), as well as time-series operations and other programs related to biogeo-

chemical global change, from the perspective of the field scientist, analyst, modeler, and data manager. Different approaches to Data Management and Archiving of resulting studies will be included which we hope will stimulate a panel discussion on techniques to be considered. Discussion will also cover QC techniques and what can be done to improve input to analysts and modelers. The session will focus on chemical and biological data.

Introduction to JGOFS
Convener: H. Ducklow

Subject	*Speaker*
Scientist's View of the NABE, a JGOFS Process Study	H. Ducklow
Data Management for JGOFS: Theory and Design	G. Flierl
Data Management in the UK BOFS Program, a JGOFS Case Study	R. Lowery
Management and Assimilation of Satellite Data for JGOFS	R. Evans
The Continuous Plankton Recorder Survey: Long-term, Basin-scale Oceanic Time Series	J. Gamble
BATS and Station S: Time Series Operations in JGOFS	T. Michael
Automated Observations of Upper Ocean Biogeochemistry and Optics for JGOFS	T. Dickey

February 21
9:00am - 12:00pm
GSFC Building #3
Auditorium

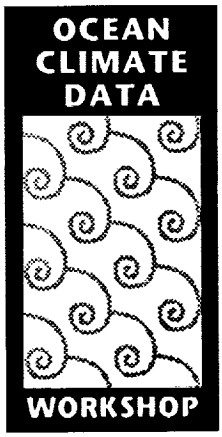
Wrap-up Panel

Representatives from each of the sessions plus some other speakers will form a panel to conduct discussions on recommendations to the IOC, WMO and other scientific groups conducting international data exchange and dissemination of data required for climate studies.
Convener: G. Holland

12:00 - 1:00pm

Closing Remarks

This will be a summing up of the Workshop.
Convener: Chairman



HOSTS:
U.S. National Oceanic Atmospheric Administration (NOAA)
U.S. National Aeronautics and Space Administration (NASA)

recycled paper

SPONSORS:
Commission of European Communities (CEC)
International Council for the Exploration of the Sea (ICES)
International Council of Scientific Unions (ICSU)
Intergovernmental Oceanographic Commission (IOC)
Scientific Committee on Oceanic Research (SCOR)
World Meteorological Organization (WMO)

Appendix II

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