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Steering Team of the Oceans Information Technology Pilot Project (ST-OIT)

First Session

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Abstract
The 1st Session of the Steering Team of the Oceans Information Technology Pilot Project (ST-OIT) was held in Brussels, Belgium on 29 November 2002. The Session members discussed the origins of the OIT Pilot Project initiative and presented an overview of current national and programme activities. The session discussed the specific components of the OIT Pilot project (metadata systems; data circulation and communication; data assembly, quality control and quality assurance; data archival; and the user interface). The Session developed an Action Plan based on the agreed action items arising from the meeting and assigned tasks to each member of the Group.

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1 OPENING OF THE SESSION

The Session started with introductory words by Mr Peter Pissierssens, Technical Secretary for the Session. He recalled that the objectives of this Session were to (i) share information on new approaches to applying information technology to managing and exchanging ocean data and information; (ii) to identify OIT pilot project components; (iii) to agree on the OIT project management structure and team; and (iv) to define the way forwards (action plan and team leaders). He then invited the participants to elect a Chair for the Team.

The Session unanimously elected Dr Neville Smith as its Chair.

2 BACKGROUND INFORMATION RELEVANT TO OIT

2.1 Origins of the OIT Pilot Project initiative

Dr. Smith recalled the history of the Oceans Information Technology (OIT) initiative:

- Late 2000: Dr Smith circulated an e-letter raising concerns that were partly based on GOOS and WCRP frustrations, partly on need, partly opportunistic
    - 95% of the responses were positive and enthusiastic
- April 2001: Dr Smith sent a "Prospectus" to GOOS and related experts
    - These experts gave a qualified "yes" to the initiative
- June 2001: Presentation at JCOMM-I
- May 2002: Dr Smith presented a more detailed prospectus to the GOOS Steering Committee
    - The GSC gave strong support and made a few changes to the document. The GSC recommended the formation of a Steering Team and identified core members
- May 2002: Prospectus and GSC recommendations presented to First Session of the JCOMM Data Management Coordination Group. The DMCG expresses strong support for the initiative.

Dr Smith summarized the rationale of the OIT PP as follows. The OIT should be developed based upon:

- The demand for effective telecommunications;
- The need for common standards, practices and protocols (metadata management);
- The need for data and product service matched to the participants and users of GOOS data;
- The need for innovative data inquiry, access and delivery mechanisms;
- The need for intra-operability and interoperability.

He stated that the OIT PP should include the following components:

- Improved telemetry
- Metadata Management
- Data assembly, data set integrity, quality control
- Data circulation and transport
- Archives and archaeology
- Applications and user interfaces
- Capacity enhancement, training
- Governance, oversight, metrics

The Session noted that, if the OIT Pilot Project was to be a JCOMM initiative it should then be established under the JCOMM Pilot Project definition: "A pilot project is defined as an organized, planned set of activities with focused objectives designed to provide an evaluation of technology, methods, or concepts within a defined schedule and having the overall goal of advancing the development of the JCOMM programme."

The Session agreed that the following questions should be answered prior to embarking on the Pilot Project:

- Do we need an OIT PP at all?
  - Yes, if we are convinced that it will have an order 1 impact on capacity, functionality, global requirements, and investment, and we are certain there are the people willing to do it.
  - No, if we have doubts on any of the above or we believe there are existing, alternate mechanisms to achieve the same goals
  - At this point, the views of GOOS, JCOMM are not important
- Can we agree on the scope, rationale?
  - The present concept is broader than JCOMM
  - It embraces the experimental, but with a firm view to sustained, robust outcomes
- Can we agree the basic elements?
  - The start of the How and What parts
  - Identify the leading contributors, partners
- What is a reasonable schedule?
- How should the OIT be managed?

2.2 Perspectives from GOOS and its Panels

Mr Thorkild Aarup (GOOS Project Office) recalled that International agreements and conventions call for safety at sea, effective management of the marine environment, and sustainable utilization of its resources. Achieving the goals of these agreements depends on the ability to **rapidly detect** changes in the status of marine systems and to **provide predictions** of such changes so actions can be taken in a timely manner for the public good. Such capabilities do not exist today and is the background for establishing a Global Ocean Observing System (GOOS).

GOOS is envisioned as an operational, global network that systematically acquires and disseminates data and data products on past, present and future states of the marine environment. The observing system is being developed in two related and convergent modules:

- A <u>global ocean module</u> concerned primarily with changes in the ocean-climate system and improving marine services (led by the Ocean Observations Panel for Climate, OOPC), and;
- A <u>coastal module</u> concerned with the effects of large scale changes in the ocean-climate system and of human activities on coastal ecosystems (led by the Coastal Ocean Observations Panel, COOP).

The coastal module is intended to provide the early warnings and predictions required to more effectively control and mitigate the effects of human activities and climate to serve the needs of many user groups from governments and industries to scientists, educators, non-governmental organizations and the general public.

COOP has been charged by the international community to formulate plans for the establishment of the coastal module of GOOS which will provide the data and information required to achieve six goals:

1. Improve the safety and efficiency of marine operations;
2. More effectively control and mitigate the effects of natural hazards;
3. Improve the capacity to detect and predict the effects of global climate change on coastal ecosystems;
4. Reduce public health risks;
5. More effectively protect and restore healthy ecosystems; and
6. Restore and sustain living marine resources.

Achieving these goals depends on developing the capability to rapidly detect and predict a broad spectrum of coastal phenomena from changes in sea state, coastal flooding and sea level rise to increases in the risk of disease, habitat modification, harmful algal blooms and declines in fisheries.

Rapid detection and timely prediction require establishment of an **operational** observing system that routinely and continuously provides required data and information in the form, and on time scales, specified by the users.

In the COOP strategy plan such a system is seen as consisting of three essential subsystems to ensure the timely and routine delivery of data and information to users: (1) a monitoring (sensing) subsystem, (2) a subsystem for data acquisition, management and dissemination, and (3) a subsystem for data assimilation and analysis.

The coastal module of GOOS will include both regional and global scale components. This may be established through a federation of regional systems that are nested in a global coastal network of observations and data management. In this scheme, the global network:

- Measures and manages a set of common variables that are required by most, if not all, regional systems;
- Provides a network of reference and sentinel stations;
- Establishes international standards and protocols for measurements, data exchange & management;
- Links coastal observations to global observations; and
- Facilitates capacity building.

Regional observing systems (of which some have already been established) are critical building blocks of the coastal module.

One important key (if not the most important key) to implementation of the coastal module of GOOS is <u>development of the subsystem for data acquisition, management and dissemination.</u>

Reducing the time required to acquire, process and analyze data of known quality is a major goal that requires the development of an integrated data management and communications subsystem. The objectives are to serve data in both real-time and delayed mode and to enable users to exploit multiple data sets from many different sources (the one stop shopping concept). This will require a hierarchical distributed network of national, regional and global organizations that function with common standards, reference materials and protocols for quality control; enable rapid access to and the exchange of data ; and long-term data archival. Such a network is envisioned to develop in an incremental way by linking and integrating existing national and international data centres and management programmes. IODE and the data management program area of JCOMM have the potential to oversee the coordinated development of the integrated data management subsystem.

The coastal GOOS data management and communications subsystem will be implemented in a manner consistent with that of the GOOS data and information management strategy and plan of GOOS (Wilson, 2001).

In conclusion the GOOS Steering Committee has given its support to the further development of the OIT initiative. COOP sees the OIT initiative as beneficial to the implementation of the coastal module of GOOS, and many of the suggested ideas for OIT pilot projects listed in Chapter 4 of the OIT document appear very relevant to implementation of the coastal module (i.e. real-time data acquisition, telecommunication, all aspects data management of non-physical data, integration of multidisciplinary data sets and streams, standards, end-to-end data systems, and data mining).

Turning to other GOOS background information concerning data issues in regards to the OIT initiative then two items should be mentioned.

The first is the Data and Information Management Strategy and Plan of the Global Ocean Observing System, edited by Ron Wilson, 2001; which came out of JDIMP (GOOS Report No. 103). This plan provides basic design information, guiding principles, typical responsibilities for data and information centres and a strategy to be used for scientific and technical panels in planning the development and implementation of the data and information systems for GOOS. The Wilson plan is intended to be kept up to date as GOOS develops. However, since JDIMP no longer exists GOOS does not have a specific policy setting panel concerning data issues that could feed into JCOMM and its data management panel (as implementation). The policy setting hence comes from the principal GOOS design panels and perhaps in the future also from some body under the OIT initiative.

The second item is the Global Observing Systems Information Centre (GOSIC) which provides a metadata window into GOOS, GCOS and GTOS data; access to distributed directory of climate data and information; information on observing system programs, plans data centres, sources and experts; documentation on observing system data networks; a bulletin board to facilitate communication about data plans; and dissemination of information about standards..

2.3 Flagship initiatives of IODE

Mr Peter Pissierssens (Head Ocean Services, IOC) gave an overview of the evolutions within the IODE programme since the IODE-XVI Session in 2000. He recalled that the IODE Committee, at its 16th Session had made a few core decisions and recommendations that were of crucial importance for its collaboration with other programmes such as GOOS and JCOMM: (i) IODE should give more attention to non-traditional data types; (ii) IODE should collaborate more closely with the ocean science and observation communities; (iii) IODE should move towards more a flexible structure allowing for decentralized national networks of specialized data centres (often linked to research and observation programmes); (iv) IODE should collaborate closely with GOOS and play an active role in JCOMM.

With regard to new technologies Mr Greg Reed (Consultant, IODE) reported on the following initiatives relevant to OIT:

1. Study Group on the Development of Marine Data Exchange Systems Using XML (SG-XML)
   This Group was jointly established by ICES and IOC. The Terms of Reference for the Group are to:

   - Develop a framework and methodology for the use of XML in marine data exchange in close consultation with IOC and the Marine XML Consortium;
   - Develop a workplan that within 4 years will lead to published protocols for XML use in the marine community;
   - Explore how to best define XML tags and structures so that many ocean data types can be represented using a common set of tags and structures;
   - Test and refine these common tags and structures using designated case studies i.e.:
     - Point (physical/chemical) data (profile, underway, water sample);
     - Metadata (cruise information, building from the ROSCOP/Cruise Summary Report);
     - Marine Biology data (integrated tows, e.g., zooplankton-phytoplankton tows, demonstrate the use of taxonomy).

The first meeting of the Group was held in April 2002. The Group identified the following action plan:

- Parameter Dictionary. Create, evaluate and discuss intersessional work on SGXML parameter dictionary including the population of the dictionary for distribution via a defined XML structure.
- Point Data Investigation. Evaluate the generalised brick approach with application to various point data types. Evaluate the point data structure from the perspective of the IODE data centres. Provide biological and taxonomic input to the bricks.
- Metadata Investigation. Evaluate linkages to other metadata standards and the implications of a generalised metadata model to existing models.

By May 2003 the Group should have come up with results. Work on the parameter dictionary has started. To support the project and easily disseminate progress information a dedicated web site was developed at the IODE Secretariat (http://www.marinexml.net). This site covers both XML initiatives involving IOC.

The OIT Session expressed its appreciation for the initiatives take by IODE related to the development of a marineXML. However, the Session was concerned about the possible existence of other marineXML related initiatives and thus the risk that a ‘standard’ proposed by the IODE initiatives may not be applied globally, thereby defeating the initiative. It was noted in this regard that also WMO and service provider communities are active in the XML domain.

The Session suggested a broad-based project on the use of XML and development of metadata models within oceanography needs to be established with the purpose of bringing together related initiatives. It was stated that this could then serve as a federating mechanism enabling better coordination of the many existing initiatives. [See Section 4.1.]

2. MEDI (Marine Environmental Data Inventory)

MEDI is a directory system for marine related datasets and data inventories within the framework of the IOC’s International Oceanographic Data and Information Exchange (IODE) programme. The MEDI authoring tool has been developed to encourage data collectors and scientists to produce metadata descriptions for their datasets. The MEDI authoring tool is browser-enabled and operates in a client-server configuration. Clients can access MEDI on a local network or over the internet. MEDI uses the Directory Interchange Format (DIF) developed by NASA's Global Change Master Directory. A DIF is a collection of fields which detail specific information about the data which are necessary for users to decide whether a particular dataset would be useful for their needs.

The MEDI authoring tool has the following technical specifications:

- Metadata are stored as DIF-XML files
- XML is used to transfer DIF records
- Operates as a service under Apache Tomcat 4.0.4 using HTML
- Uses standard HTTP protocol, hence can be accessed via internet or intranet
- Spatial functionality is delivered using Scalable Vector Graphics (SVG)
- Data can be transferred using XML

The development of MEDI is managed by the IODE Steering Group for MEDI, established during IODE-XVI. A dedicated web site has also been established on http://ioc.unesco.org/medi

3. Global Ocean Surface Underway Data (GOSUD) Pilot Project

The objective of the Global Ocean Surface Underway Data (GOSUD) Pilot Project is to organise surface salinity data that are currently collected and to work with data collectors to improve data collection to meet the benchmarks of spatial and temporal sampling and data accuracies set out by the Ocean Observations Panel for Climate (OOPC).

The GOSUD pilot project is managed by a Steering Group established during IODE-XVI. The Group had its 2nd meeting in Ottawa, September 2002 and developed a workplan. The final report is available at http://ioc.unesco.org/iode/contents.php?id=117.

4. IODE Group of Experts on Technical Aspects of Data Exchange (GETADE)

The 9th Session of the IODE Group of Experts on Technical Aspects of Data Exchange was held in Helsinki, Finland, from 20–22 April 2002. They discussed the development of a Marine XML and collaboration with the ICES/IOC Study Group on the Development of Marine Data Exchange Systems using XML (SGXML), the development of an end-to-end data management framework and cooperation with other programmes concerned with marine data management, in particular the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM). The Group adopted a comprehensive work plan for the next intersessional period that includes:

- Develop a prototype of cruise-station-profile XML structure, with emphasis on metadata for each level of granularity;
- Compare ODAS metadata format to MEDI/DIF format and ROSCOP, noting that they are conceptually at different levels of granularity; and

- Develop a limited pilot project to demonstrate an activity within the E2EDM framework.

The GETADE-IX session report is available at http://ioc.unesco.org/iode/contents.php?id=118.

Dr Efstathios Balopoulos in his capacity as IODE Chair wrapped up the presentation on IODE initiatives by recalling that IODE, for many years, has served the marine community not only through the exchange of data but also in developing formats, standards, protocols, etc.

Advances in oceanography, marine science and technology, especially during the last decade, have led to a rapid expansion in the volume and the variety of ocean data. To serve these requirements IODE has used up-to-date data systems, methods and techniques for data management.

During IODE-XVI the need was expressed for an efficient and effective data and information management system based on leading information technology and on serving the oceanography community (and beyond). In addition, at IODE-XVI, views were presented towards advanced technology that goes beyond traditional methods and standards. As such an OIT initiative, undertaken jointly with GOOS and JCOMM will be clearly within the interest and scope of IODE.

2.4 Flagship initiatives of JCOMM

Prof. Shaohua Lin (Chair JCOMM Data Management Coordination Group) recalled that the First Session of the JCOMM DMCG had discussed and agreed on the need to implement the OIT Pilot Project. DMCG-I had further agreed that the JCOMM Expert Team on Data Management Practises (ET-DMP) would prepare a few concrete project proposals within the framework of the OIT project.

Prof. Lin also recalled that the JCOMM ETDMP had completed a preliminary study of the different metadata standards used by a variety of projects and organizations. This study had concluded: (i) the emphasis on content of metadata is different; (ii) the emphasis on the description of parameters is different; (iii) degrees of limitation to the metadata are different; (iv) degrees for the access limitation to the dataset and acquisition ways are different. Further work is required on the metadata format standard. Prof. Lin called for urgent action on this matter and pledged full support to OIT from the JCOMM DMCG.

Dr Nick Mikhailov (Chair ETDMP) provided some information on the proceedings of the informal Session of the ETDMP that had taken place the previous day (28 November 2002). Dr Mikhailov recalled that the JCOMM DMCG-I had identified 4 components that should be developed as OIT "pilots":

- common protocols
- data serving
- data standards for SML and the study of relevant related technologies
- telecommunication

Some concrete proposals had already been received. The ETDMP had been invited to plan and realize two work packages: on data standards and data serving.

(i) Data serving. Objective is to examine and demonstrate one solution to product and data servers by examining the technology available ranging over such solutions as DODS, to object request systems. To test solutions for "pushing" data to users, meeting requests for "directory level" information, and identification of different "levels of processing" of data.

(ii) Data standards for XML and study of relevant technology. Objective is to work closely with ICES, IODE and CBS to explore and test XML for data exchange, to examine OpenGIS and US Navy uses of XML, to examine WMO experience and requirements and to collaborate in the definition of IOC/ICES XML "bricks".

The Session concluded that OIT will need to work closely with the ETDMP as well as with similar groups within IODE.

3 MAJOR NATIONAL AND/OR PROGRAM INITIATIVES

3.1 The Data Management and Communications Subsystem of the U.S. Integrated and Sustained Ocean Observing System

Dr Charles Hakkarinen (Member, ISOOS Data Management and Communication Subsystem Steering Committee) provided an extensive presentation on the Implementation Plan for the Data Management and Communications Subsystem of the U.S. Integrated Ocean Observing System.

The goals of the US-ISOOS are:

- Detecting and forecasting oceanic components of climate variability
- Facilitating safe and efficient marine operations
- Ensuring national security
- Managing resources for sustainable use
- Preserving and restoring healthy marine ecosystems
- Mitigating natural hazards
- Ensuring public health

A workshop was held in Airlie, VI (March 2002) that had identified the need to have expert teams (on metadata & search; data transport; applications and products; archive) and outreach groups (users; facilities managers).

A detailed timeline for the development of the Data Management and Communication Subsystem (DMACS) had subsequently been developed (Fig 1):

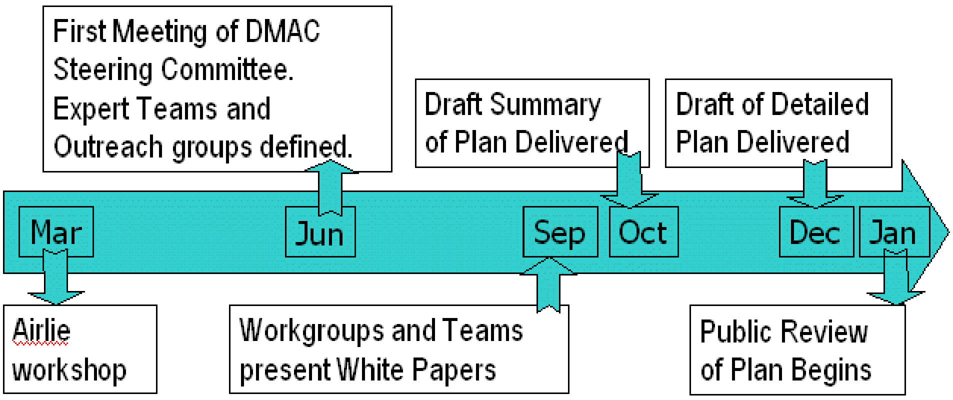

Fig 1: Timeline for DMACS plan development

Members of the Steering Committee include:

- Steve Hankin (Chair) NOAA-OAR Pacific Marine Environmental Laboratory
- Lowell Bahner NOAA Chesapeake Bay Office
- Landry Bernard, NWS National Data Buoy Center
- Peter Cornillon, Graduate School of Oceanography, University of Rhode Island
- Fred Grassle, Institute of Marine and Coastal Sciences, Rutgers University
- Chuck Hakkarinen, Belmont, California
- David Legler, U.S. Climate Variability and Predictability (CLIVAR)
- John Lever, Naval Oceanographic Office
- Phil Mundy, Exxon Valdez Oil Spill Trustee Council
- Worth Nowlin, Department of Oceanography, Texas A&M University
- Susan Starke, National Coastal Data Development Center (NESDIS, NOAA)
- Steven J. Worley, Data Support Section, National Center for Atmospheric Research

The ‘vision’ statement of the DMACS is as follows:

- ISOOS data will be available through a broad range of current and future computer applications, unencumbered by traditional barriers of data format, location, and size;
- Users will be able to browse and compare any of the data through a standard Web browser;
- For data suppliers, small and large, their efforts to make data available will be minimized;
- Data Management and Communications Subsystem (DMACS) will be a “free market” of ocean science information -- easy to compare official ISOOS products with outside results;
- DMACS will engage the private sector in the development of value-added products for special user groups -- commercial fishermen, recreational sailors, shipping, etc.;
- Outreach mechanisms will ensure that the needs of users are recognized and acted upon.

The DMACS Steering Committee had concluded that the greatest challenges are in the area of community outreach and organizational behaviour, rather than in technology! With regard to ‘community building issues’ the Steering Committee had stated that, to succeed, the perceived benefits of participation must exceed the costs: (i) Ensure very low barriers to participation for both data suppliers and users; (ii) Follow an evolutionary path; (iii) Sustain a program of vigorous outreach.

Components of DMACS: Data Transport

Data Transport: “middleware” is the foundation:

- Networking infrastructure for connecting heterogeneous clients and servers;
- Data providers must translate from “native” formats and databases (DMACS must provide tools). Applications adapted to read from middleware.

The Data and Communication Subsystem (DMACS) will be as follows (Fig 2):

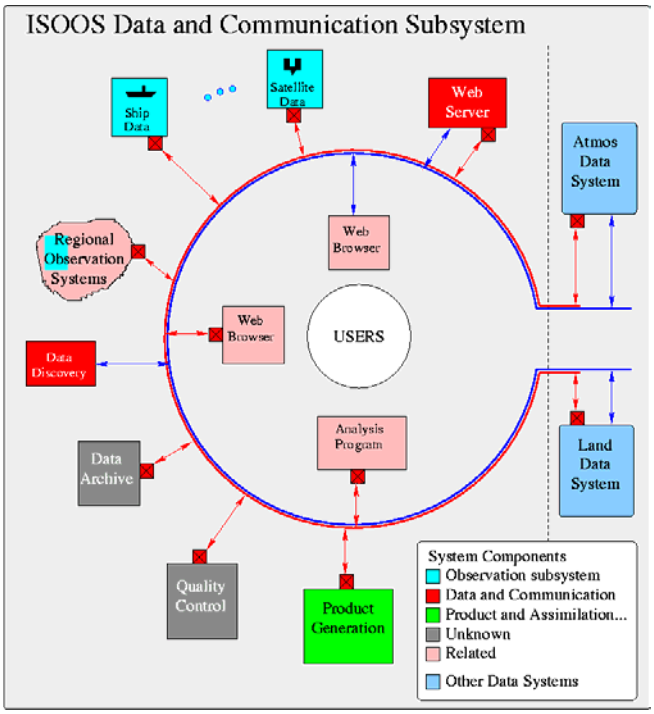

Fig 2: ISOOS Data and Communication Subsystem

OPeNDAP (DODS) is an ISOOS “pilot” activity. It is discipline-neutral with a low entry barrier, it can immediately begin building DMACS. It must develop the “ocean data model” (standards) in parallel.

Components of DMACS: Archival

Data archival is considered as an essential component of DMACS. Irreplaceable observations, data products of lasting value and associated metadata must be preserved in perpetuity. Data will be accessible using DMACS standards and will be acquired at Archive Center(s) using DMACS standards.

Archival Issues: (i) how to phase in new techniques? ("don't look back"?); (ii) how to partition responsibilities among existing facilities, new operational product centers and new facilities?; and (iii) relationship between archive centers and "delayed-mode (climate) data assembly centers".

Components of DMACS: Metadata management and search

- We need complete, consistent and searchable metadata.
- Metadata must be inseparable from data.
- Create/adopt standardized, shared vocabularies (not as easy as it sounds!).
- Supply training and tools to data providers.
- How to make a human-dominated (inherently flawed) approach more automated?
- "Web portal" is just one way to do searches.
- How to do highly effective search in distributed systems?

Components of DMACS: User Outreach, Products and Applications

User needs will drive how ISOOS evolves:

- DMACS already has an incipient ISOOS User Outreach Committee (Phil Mundy): *ad hoc* committee of users exists already.
- Most feedback focuses on needs for products – not something that DMACS controls.
- A mechanism for sharing the User Outreach Committee among all components of ISOOS?

Components of DMACS: Administration and Operations

The Plan will convene a Working Group to define the DMACS Administration policies, working closely with Ocean.US

- Day-to-day DMACS operations.
- Monitoring system performance / correcting problems.
- Liaison with Product, Archival facilities and Observing Subsystem.
- Liaison with regional systems.
- A "help desk".
- Assure compatibility with related national and international data systems.

Pressing Technical Issues

- <u>Scalable metadata management.</u> The Plan essentially calls for data providers to "write good metadata" – OK for core ISOOS observation, but a flawed approach for small scale activities. Training and metadata QC professionals are costly. ISOOS needs to investigate approaches that increase automation and/or harness the expertise of data users: XML Semantic Web, "3rd party metadata".
- <u>Version tracking.</u> Lacking adequate techniques for defining citations to data, there is continual confusion about the versions of data sets that were used for particular purposes. Methods of uniquely tagging and tracking the version of data sets must be developed.
- <u>Data mining.</u> As the size and resolution of data sets grow, the data discovery process must include the ability (automatically) to identify and retrieve "features" (e.g. an El Nino event or a harmful algal bloom) interior to a data set.
- <u>Data volumes generated by satellite (and sonar) measurements.</u> Projections of the volumes of remote-sensed measurements will stress future software and hardware networking capabilities. We need creative solutions both to improve delivery (bandwidth, compression) and to reduce the "centralized demand" (develop options like server-side subsetting, analysis).

Less Difficult Technical Issues

- Blending "data push" and "data pull". Data push is never sufficient alone. Requiring both data push and pull adds complexity. Blended push and pull is needed.
- Comprehensive geo-spatial/temporal data model. "Machine-to-machine interoperability with semantic meaning" requires a comprehensive geo-spatial/ temporal model with standard vocabularies, consistent with both GIS ("geographic information system") and SIS ("scientific information system") outlooks.
- Aggregation of distributed data. e.g., to achieve seamless access between assembly centres and archives.

Management Issues

- ISOOS is destined to become a "standards-generating organization" (like IEFT? like WMO? like IEEE?) The formalities and public review process will need to be well defined.
- Can ISOOS make the promises that online data will be provided at no cost, and offline data will be provided at the cost of reproduction?
- How should ISOOS best provide User Outreach services for DMACS, Products, and the Observing Subsystem? Should User Outreach be an independent activity within DMACS?
- Creating a "value-added retailer" market: The success of ISOOS at meeting the needs of highly specialized user groups may depend upon building a value-added product market. The economics of how to succeed at this without unduly restricting general access to the same information must be explored.
- Will there be restricted-access classes of data? Do the restricted-access classes need to be made "invisible" to searches? If so, what priority should be assigned to implementing access control in DMACS?
- Some elements of the DMACS Implementation Plan require new R&D activities. How will these needs be translated into action (RFPs – request for proposals)? From which funding agency? NOPP? NSF? NASA? ONR? NOAA?
- OPeNDAP (a.k.a. DODS a.k.a. NVODS) has been identified as a "pilot" activity with strategic importance to the DMACS Implementation Plan. Uncertain funding to cover OPeNDAP until ISOOS funding becomes available is a vulnerability.
- What public review process would serve best for the DMACS Plan?

Additional:

- "Responsibility versus authority": The current DMACS Steering Committee has planning responsibility for some areas over which it has little direct influence, such as:
    - Real-time QC standardization
    - Information products produced by ISOOS (graphics, text forecasts, ...)
    - Modelling products produced by ISOOS (assimilation model outputs)

Discussion points:

The OIT Session welcomed the DMACS initiative and stated that it was very compatible and to a large extent, similar to the objectives of OIT. Telecommunications is not included with DMACS (it is bundled with the observations component).

There were questions regarding how DMACS might work with OIT - some important differences, but also many opportunities. Hakkarinen did not believe the number of "connections" (points in and out of the system) was a technical limitation. There was also some discussion of the difficulty of synchronisation and of navigating around the system – they are looking for R&D pilot projects. It was noted that the middleware discussed by DMACS is relevant to JCOMM ETDMP.

DMACS is placing considerable emphasis on "selling" the benefits of the ISOOS project.

The Session noted that DMACS will share some of the difficulties and issues that IODE and JCOMM-DMCG are addressing in the framework of decentralized data systems such as duplicates and version control. The Session commended ISOOS with their approach to stressing the social relevance of data management by giving substantial attention to ‘outreach’.

The Session agreed on the need to develop DMACS with international participation and invited DMACS to collaborate closely with the OIT Pilot Project.

3.2 Argo

Dr Sylvie Pouliquen (IFREMER) provided a comprehensive overview of data management in the Argo project. Argo is an international program. It focuses on the deployment by individual PIs of floats measuring temperature and salinity profiles. Data processing is implemented at the national level. Quality controlled data are made available within 24 hours to the meteorological and oceanographic community. Scientifically quality-controlled data will be available within 5 months through the internet.

The requirements for Argo data are:

(i) All Argo data must be easily accessible;
(ii) Data must be homogeneously quality controlled;
(iii) Global delayed-mode value added datasets and products are generated to meet ocean and climate scientists needs.

Argo data management concepts

- Argo data are distributed in three modes: (i) via the GTS for the real-time user community; (ii) in delayed mode via the Internet for scientific and other users of high quality datasets; and (ii) by regional centres who assemble regional datasets with, as appropriate, additional quality control and screening. All data are public.
- A unique dataset format (based on NetCDF) is used for distribution of delayed-mode data (TESAC messages are used for the GTS).
- Standardized quality control procedures are being developed for real-time and delayed mode data.
- Distributed data processing among the national and regional data assembly centres.

Argo opted for a centralized data distribution system because:

- Data volume is small, i.e. all data can be put on one disk;
- They wish to provide a rapid and secure way to access to data from a unique portal (two mirror sites for security purposes);
- The Project was not confident enough in network reliability in 2002;
- Efficient and unambiguous data exchange between Centres and the Global Data centres: Unique Id for a float and a float cycle;
- Exchanges based on the Internet are able to exchange data and metadata; this is not possible yet on the GTS.

The Argo data network architecture is shown in Fig 3:

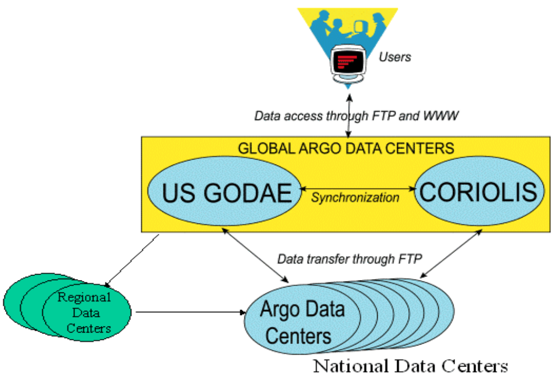

Fig 3. The Argo data network

The Argo Data Management "Actors" are shown in Fig 4:

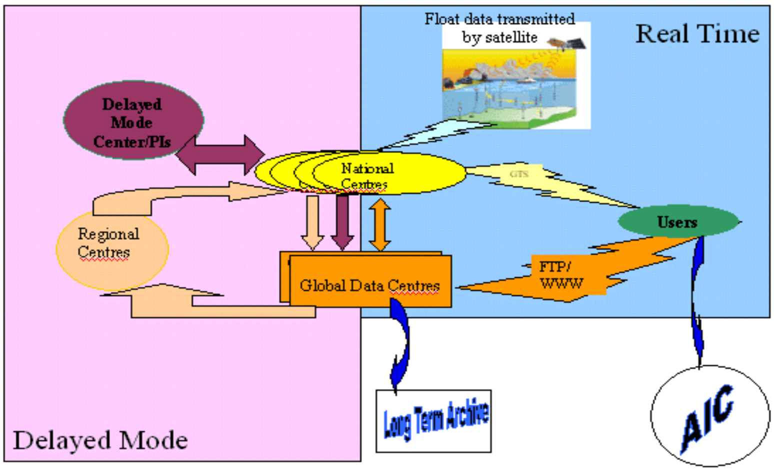

Fig 4. Argo Data Management Actors

The Argo Data Flow is reflected in Figure 5:

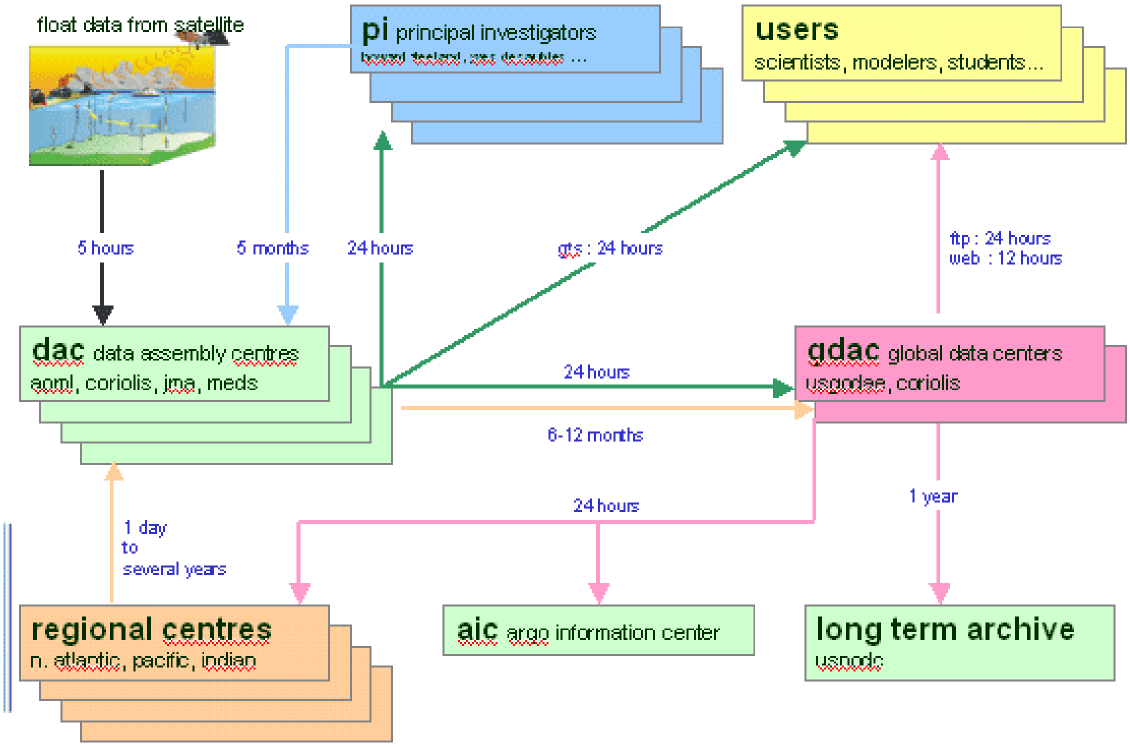

Fig 5. Argo Data Flow

Argo Global FTP servers

- Provide FTP sites containing the best profiles for all the Argo floats.
- Centralized access to float metadata and trajectories.
- Coriolis data-center delivers all the vertical profiles controlled during the week through the ftp site.
- About 4000 vertical profiles (temperature, salinity) are controlled and disseminated every week.

Argo Data Format

Information regarding one float is divided into four files on the FTP site:

- metadata information: general information on the float that does not change a lot during float life.
- Profile file(s): A file can contain either one or more profiles.
- Trajectory file: one file containing the complete trajectory of the float as well as the measurements collected while drifting.
- Technical file: one file containing the technical information provided by the float.

On the WWW site the user will be able to aggregate some of this information into one or more files according to the options the user selects.

WWW server: data visualization tools

- Global display of platforms
  - Lists of floats, cruises
  - Detailed description of floats and performed measurements
  - Global and individual geographic maps
- Display any Temperature and Salinity data in an area
  - Real-time QC standardization
  - Individual profiles
  - Multi-profile graphics
  - Time-series parameter evolution (depth-time contour plot)
  - Temperature-Salinity diagrams
- Display float trajectories: Maps with trajectories or surface/depth displacements or profile positions, option to colour-code deep arrows with deep T or S;
- Manipulation tools for graphics: Choose subsets/groups, only live floats or all, set axes/zoom, control contour/colour map, merge "historical" data as background, colour coding for trajectories (e.g. by PI/country/project, by date, by drift depth, ...)
- Statistics on data coverage and its evolution: Example: float/performance statistics

Several examples were shown of innovative web interfaces and visualization tools. Dr Pouliquen concluded with a number of lessons that were already learned from Argo:

- Relying on professional Data Centres helps a lot in standardizing procedures and exchanges;
- A unique identificator for each piece of data is essential (simplify duplicate handlings);
- A simple solution can be as efficient as a complicated one even if less exiting to implement;
- Both real-time and delayed mode data streams must be envisaged from the beginning even if implemented in different steps;
- Internet is an efficient way to distribute the data even in real time.

The Session noted that Argo had agreed on a netCDF format for exchange of datasets. in order to provide continuity for those that had participated in the WOCE programme. NetCDF makes it easier to transmit metadata and data at the same time. It had been decided not to use XML at this time because it was felt that scientists were not ready for this yet.

3.3 The WOCE Data System

Dr Katherine Bouton (ICPO) provided an overview of the data management system of WOCE. There is now a DVD with 15 years of WOCE work. WOCE started in the late 1970s. Field phase started in early 1990s and a final conference was held last week in Texas. WOCE constituted an internationally distributed system (see Fig 6)

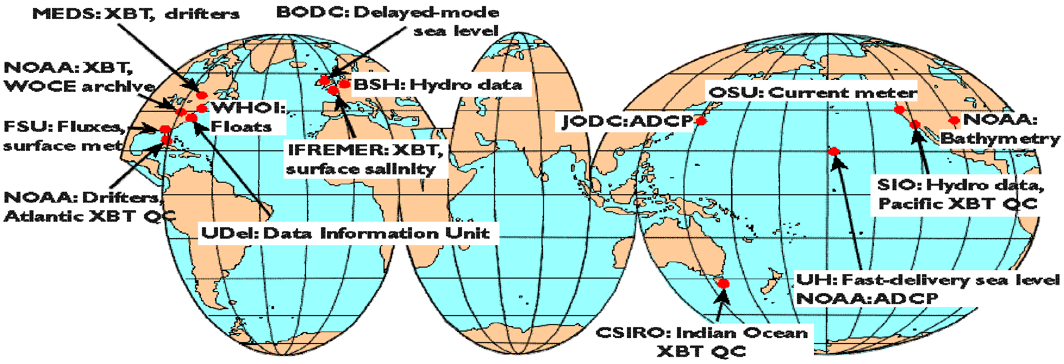

Fig 6. WOCE Data System

The WOCE Data Information Unit (DIU)

The WOCE Data Information Unit (DIU) acted as the central hub for information about the WOCE distributed data system. It:

- Gathered information needed to build the data directories and data summaries;
- Maintained and distributed this directory and summaries of WOCE datasets;
- Assists the WOCE DACs in the location and acquisition of datasets.

During the WOCE field program, the primary task of the Data Information Unit was to keep track of science plans, cruises, and data recovery. The chart shows the success of WOCE in obtaining a high percentage of the various types of data collected by the many nations participating in the experiment.

Why WOCE netCDF Convention?

WOCE defined its netCDF convention to ensure consistency across all WOCE data and to enhance the integration of the data sets by those wishing to combine several data sets, the WOCE Data Products Committee (DPC) required all WOCE netCDF data files to comply with the conventions. These conventions are a superset of the Cooperative Ocean/Atmosphere Research Data Service (COARDS) netCDF standard which has received significant support from many research and institutional centres.

The process used for determining netCDF conventions was as follows: (i) the DIU examined a data file from each DAC for variable name and attribute naming consistency; (ii) variable names and attributes were then compared between DACs; (iii) other netCDF conventions (EPIC, COARDS, CDC, GDT) examined; and (iv) proposed a WOCE netCDF conventions. Some WOCE netCDF variables were required by all DACs, for example, woce_date (WOCE legacy), woce_time (WOCE legacy), time, latitude, longitude, depth or pressure, whereas others were DAC specific (temperature, sst, salinity, u, v, sea_level, wind_speed).

The WOCE Integrated Inventory

Additionally, the WOCE Data Products Committee specified the composition of WOCE Global Data Resource inventory files. Each WOCE Data Assembly Center (DAC) was required to provide one row/entry in its inventory table for each netCDF file produced for the final WOCE Global Data Resource (V3). These inventory files are the cornerstones for the search/integration tools released in concert with the V3 datasets, allowing for cross platform searches by time, location and parameters.

The WOCE Integrated Search Tool: WIST

- Search for WOCE data by location, parameter and time: The DIU assembled, with input from the DACs, an inventory of every netCDF data file on the WOCE DVDs. This inventory includes fields which are common to all WOCE data - file path to the data, date, position, and depth ranges (minimum and maximums) and fields which are common only to specific DACS such as temperature, salinity, wind speed etc. *These inventories proved very useful in recognizing outliers and errors in the data.*
- Find all WOCE data from specific countries or cruises. WIST uses this inventory when it searches for WOCE data that meet the given date, position, and parameter criteria. The main component of WIST is the search tool shown. The next example will shown using EXPOCODES to search on all SADCP measurements by Australian ships south of Australia.
- Selection of the geographic area is done through manual entry of coordinates or by dragging a 'rubber band' box around the desired area as in the example above, and to the right.

WIST allows the user to access WOCE data directly from the DVD, the hard drive or the Internet. Other outputs such as .txt and .lis are useful for example as inputs to Matlab applications. WOCE experience suggests that this tool can be very usefully adapted to widespread use in other Programs and Data Center applications. netCDF files with standardized file names and attributes allow the creation of an inventory where an integrated search can be conducted across all observation platforms and the requested subset of data can be returned directly to the user.

In her concluding remarks Dr Bouton stated that the WOCE Data System provides a foundation for OIT as an example of:

- The management of physical oceanographic datasets through a distributed Data Assembly Center (DAC) system;
- The use of a single point of entry to the data system through a centralized hub of information (the DIU);Building an integrated inventory based on a WOCE standard and format compliant with existing standards/formats. However in the WOCE Data System:

- The audience was the WOCE research scientist,
- Most of the data was 'delayed' mode,
- The 'easy' agreement on standards and formats was a result of the DACS worked together closely for 10+ years.

The Session noted the considerable achievements under WOCE. However, NODCs have to deal with many projects including data from WOCE, JGOFS etc. and that all have developed their own method for consolidating and distributing data, including agreement on a "standard" format. This is understandable from a pragmatic viewpoint but does represent a challenge for the future The Session also warned about archiving the data on "today's" media, in this case DVD and commended WOCE for identifying the US-NODC as its designated archive.

3.4 GODAE

In the interests of time, the Chair suggested the Session skip over the oral presentation on GODAE (available from the OIT web site at …). He noted that GODAE had a fundamental requirement for efficient and effective transport of data, from GODAE and other data servers to the model assimilation centres, and of products to users and applications centres (see Figure). GODAE has initiated a project to develop standards and protocols for access to and exchange of products. The volume and complexity of the model products dictates that only a subset of the model analyses and forecasts will be exchanged. Further details of this and related projects can be found at http://www.bom.gov.au/GODAE/.

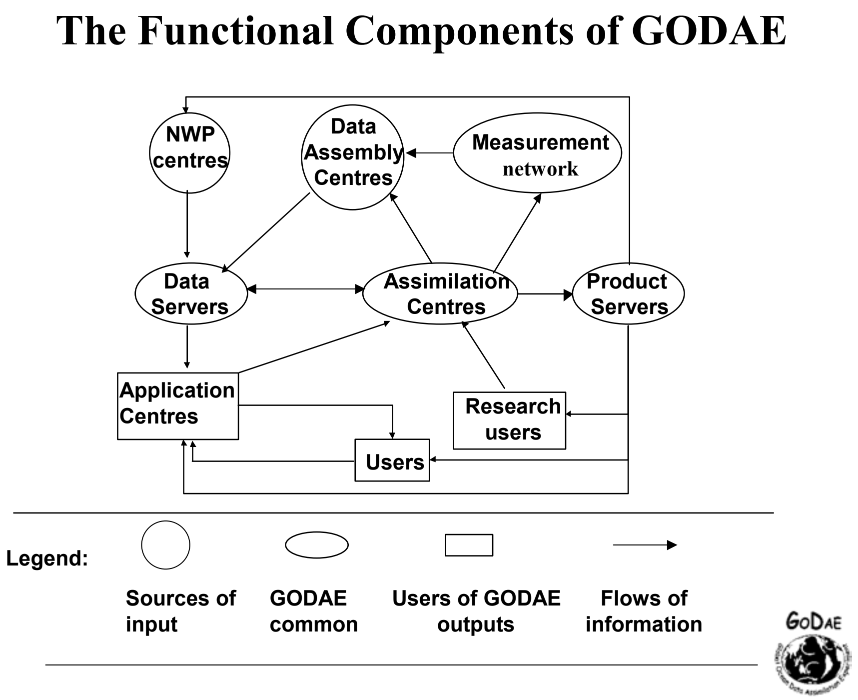

Fig 7: Functional components of GODAE

3.5 General discussion

- The DMACS presentation emphasised the importance of developing strong links between national/regional initiatives and the OIT. At the moment there is one confirmed member of the OIT from DMACS (Hankin); *the meeting agreed that there should, if possible, be two members.* ***Action: Secretariat and Chair to liaise with the Chair of DMACS.***
- In developing a strategy and implementation plan for OIT, we should take advantage of existing national activities (e.g., DMACS) and related international activities (e.g., Argo, WOCE).
- In terms of leadership and building on strengths,
    1. DMACS is at the leading edge of data transport and communications and possibly provides a basis for OIT;
    2. Argo and WOCE have been path-finding in terms of data assembly and quality control and could provide a basis for this theme in OIT; and
    3. There are several sources of experience for metadata management (WOCE, Argo, DODS/OPenDAP and other DMACS partners), together with groups like SGXML.

4 SPECIFIC COMPONENTS OF THE OIT PILOT PROJECT

4.1 Metadata management

The Session noted that there are now various groups and activities that are working on aspects of marine/ocean and related metadata models and management. These include:

- The Global Change Master Directory;
- The IOC/ICES SG-XML activity, including glossaries;
- The MEDI project and its authoring tool;
- The ETDMP actions in relation to an XML standard;
- The European Marine XML project;
- Discussions within various WMO Expert Teams including (see recent meeting reports at http://www.wmo.ch/web/www/reports.html - WDM)
    - The Inter-Programme Task Team on Future WMO Information Systems

  - o The Expert Team on Integrated Data Management, including discussions on an XML representation of a WMO Core Metadata Standard and keywords for describing WMO datasets; and
  - o The Expert Team on Data Representation and Codes
- At the international level, ISO provides standards for metadata
  - o The US Federal Geospatial Data Standard is an example of national standards
  - o Not all of these are routinely adhered to or useful for the purposes of this group

The syntactic standard is mostly defined; challenges are mainly to do with semantic metadata.

The OIT Session came to the following general conclusions and specific decisions.

(i) Metadata management has been a prominent theme through the week. ***This meeting confirmed the high priority that is attached to developing a standard for ocean/marine data.*** All participants recognized that the standard ("metadata model") required regional and global consensus, as well as consensus among the different disciplines. It was also agreed that it was important this process start quickly.

(ii) ***The meeting agreed to immediately initiate an OIT Metadata Management Project. Leadership for the project would be drawn from the ETDMP and relevant IODE projects and, to the extent possible, would be consolidated under a single joint initiative.*** It would establish links to other projects (as listed above), as appropriate.

(iii) ***The short-term goal is to bring together a Team to develop this Project (order 4-6 months).*** Agreement will need to be reached on the specific goals and likely schedule of the project. The participants would be drawn from:

- o Nic Mikhailov, Catherine Maillard, Lesley Rickard, Tony Rees, Greg Reed, Bob Keeley - IODE/JCOMM
- o WOCE (Leslie to cover?)
- o DODS/OPenDAP (Susan Starke is the initial contact);
- o The SGXML group (overlaps with above – Anthony Isenor/Greg Reed)
- o The European marine XML group
- o GCMD - Lola Olsen
- o Bruce Sumner to test WMO interest
- o ...

(iv) ***The medium term goal is to convene a Workshop around 12 months from now*** at which point initial agreement would be reached on the “standard”. Several separate Task Teams examining different aspects and features of the “standard” and issues related to compatibility would precede this workshop.

- o The Chair noted that there had been discussions with T. Karl (NCDC), S. Hankin (PMEL) and the NOMADS group regarding a Workshop that would tackle metadata issues for climate model products, among other things.
- o The Workshop should have 4-6 months preparatory time in order to get important work completed.
- o There has already been considerable work done within IODE - mappings between GCMD DIF and ISO, DIF and the Dublin Core, DIF and FGDC, etc.; Glossaries, etc. This should provide a foundation for the work plan.

4.2 Data circulation and communication

The Session referred back to the presentation of Charles Hakkarinen and noted that much of the leadership in this area is emanating from the US. ***The Session also concluded that issues of efficient and timely data distribution, interoperability between data and product providers, and efficient and effective serving of products were of a high priority.*** GODAE and operational and experimental climate prediction systems provided examples where data circulation and transport issues were prominent. The scientific community is also demanding in terms of efficient and rapid access.

The Session agreed that, in this case, it would be appropriate to seek a partnership with DMACS in order to make rapid progress. The Session noted the discussion in the ETDMT session on data serving (see Section 2.4) and the fundamental link between progress on the metadata model and efficient data circulation and communication.

Further Action: The Chair agreed to liaise with DMACS (Peter Cornillon and Steve Hankin) and discuss a method that will allow international progress, either in parallel with DMACS or in an expanded group. Sumner agreed to investigate possible connections with relevant WMO groups such as the Future Information Systems group**.**

4.3 Data assembly, quality control and quality assurance

These issues have been prominent in TOGA and WOCE and are prominent in GOOS, JCOMM and IODE. GTSPP provided the initial focus for real-time systems and at least some of this experience is now being embraced within the practices of JCOMM and the on-going work of IODE. GOSUD provides an example of extension of this work.

As noted previously, Argo has provided a convenient mechanism for developing a more robust approach to data assembly and real-time and delayed mode quality control (see Figure 5 in Section 3.2). The Chair noted that, in essence, the challenge was to both consolidate and extend this experience so that we had homogeneous treatment of data types, irrespective of the originating platform, and an ordered approach to processing data so that value added would not be lost and expert attention would be recognized. He also referred to some of the discussions at the Colour of Ocean Data meeting where the idea of peer-reviewed data management was put forward.

The Session noted that in this area it was more likely that the OIT, with its direct links to IODE and JCOMM initiatives, would be in a prime position to provide leadership. ***The Session concluded that these issues were both challenging and of high priority and that, therefore, a third project should be initiated under the overall lead of the OIT.*** The building blocks would be provided by the experiences of WOCE and GTSPP, and on-going projects of IODE and JCOMM. The Data Assembly Centres created by WOCE, which CLIVAR has recommended should be continued in the short-term, might be a source of expertise and capacity.

The Session further decided that a small Task Team should be created to develop an outline and plan for the project. The Team would include

- Thierry Carval (IFREMER)
- Lesley Rickards (BODC)
- Vladimir Vladimirov (COOP panel member)
- Bob Keeley (MEDS)
- Neville Smith (lead)

4.4 Archival

The Session noted that data archival was traditionally within the realm of IODE. In order to bring the data management activities of the different IOC programmes together, the JCOMM Management Committee had recommended that a draft resolution be prepared for the 35th session of the IOC Executive Council calling for the development of an IOC integrated data management strategy, encompassing all IOC programmes. In order to assist with this task, the Management Committee had further requested IODE to carry out an assessment of data and data product requirements of existing oceanography and marine meteorology programmes/projects, and evaluate whether the various groups of data centres currently met these. It had been recommended also to use the experience gathered in the preparation of the GOOS Data Management Plan (1998-1999) and possibly the GCOS Data Management Plan as examples. The IOC Executive Council had adopted Resolution EC-XXXV.2: “IOC Strategic Plan for Oceanographic Data and Information Management” and established a Task Team on the development of a unified, comprehensive approach to data management within IOC. This Task Team will be composed of: (a) the chairperson or vice-chairperson of IODE; (b) the chairperson of the GOOS Steering Committee; (c) the coordinator of the JCOMM Data Management Programme Area; (d) a representative of the WMO Commission for Basic Systems; (e) one co-president of JCOMM; (f) the chairperson of the IOC Working Group on Data Policy; (g) two additional experts nominated respectively by IODE and I-GOOS, taking into account the need for multi-disciplinary expertise. The Task Team will meet for its First Session in June 2003.

The Session therefore agreed that the OIT should delay any initiatives and look into this matter again when the review has taken place.

4.5 The User interface

The Session noted that a lot of work has been carried out and is ongoing in the development of user interfaces. The presentation on ISOOS and DMACS (Section 3.1) highlighted the importance of making access to information easy and for the presentation of information to be in a form that promotes use and uptake. Within DMACS, specific actions were being recommended to ensure the user interface was appropriate and effective but, as noted by Hakkarinen, there was some debate as to where responsibility lay for developing the appropriate products and content (within JCOMM, this probably resides with the Services area.

The Session concluded that, at this time, there did not appear to be a case for the OIT project to take the initiative. There are many innovative interfaces being developed, from the Live Access Server developed by PMEL, to the GIS systems that are now being widely used in both research and operations. The EASy system presented at the Colour of Ocean Data meeting is typical of innovation at this time. The multiple user interfaces do not pose a threat at this time and it seems appropriate to let the *user community* drive and sponsor developments.

The Session noted however that OIT might at some later time need to define the big goals for user interfaces and related analysis tools. We need to understand that different users need. Another part of outreach is communication outside scientific data delivery: communicating to decision makers. We also need to educate the younger generation. As part of OIT we may need to produce some tools that can be used for teaching purposes.

4.6 Discussion

The Session discussed the issue of ‘ownership’ of the OIT Pilot Project. It was stated that OIT will be co-sponsored by GOOS, JCOMM, IODE. It was recalled that both GODAE and Argo were developed as Pilot Projects with the implication that they retain a level of independence and autonomy while they remain in their “pilot” phase. Such projects take advice from parent bodies but work relatively independently. Establishing OIT in this mode would allow it to develop its own agenda and be innovative – take some chances.

The OIT was initially ‘born’ as a pilot project of the JCOMM DMPA. At some future time, JCOMM may see it as a Pilot Project in its own right but for now it seems appropriate to retain the explicit link to the JCOMM DMPA and to ETDMP who have the overall responsibility for data management practices and methods. IODE has a number of activities that are relevant to OIT and we should use these. The Session recommended that IODE-17 should try to consolidate various IODE activities with OIT.

In developing the OIT, the Chair noted that it would be critical that everyone shares the vision and agreed on the overall importance of the Project. Strong support was critical. Each of the Session participants was given an opportunity to present their views and to highlight those aspects which they felt were critical. The following points were clear.

Mandate. The mandate to proceed with the OIT Pilot Project was unanimous and strong. The Session agreed the project would have a first order impact in terms of capacity and functionality and that the OIT approach was an appropriate way to attract investment and action.

Focus and Common Framework. It was essential that the OIT remained focussed and did not try to directly embrace all activities. To do this it would need to work with a common framework with IODE, JCOMM and GOOS.

Metadata. Consistent with the previous conclusions, metadata was repeatedly mentioned as one of the highest priority and most pressing need.

Integrated data service. In terms of requirements, it is critical that we move to a mode where the data stream is integrated and loses any strong dependence on the originating platform. Most users want all the temperature data (as one example), not separate streams from each platform. QC and QA must also be uniform.

Resources were also a common theme, in terms of people and investment in systems. It is critical that our systems are regarded as innovative and worthy of investment and part of the leading edge, not an optional extra. Good people are essential. Technology was not regarded as a first order limitation.

Participation. Regional participation was seen as important. The OIT must reach out and be willing to work both from and to regional initiatives. Open source systems will be important for interoperability.
The participants also identified several aspects that were overlooked in the discussions thus far.

- ***Biodata.*** There was little discussion of non-physical data. The Chair noted this was an omission and that the OIT would need to decide whether it could add value and leadership. Coastal GOOS was almost certainly looking for such leadership.
- ***Instrument standards.*** The Commission for Measurement and Observation (CMO) of WMO provided a focus for instrument standards, including metadata. This is a facet that has not been discussed in detail.
- ***Scope.*** The assumption has been that the scope is defined by the intersection of GOOS, JCOMM and IODE activities. Some consideration needs to be given to extension into research (e.g., in support of CLIVAR) and whether a relationship needs to be established with meteorology and climate.
- ***Capacity enhancement.*** Though regional participation has been mentioned, little attention has been paid to the more general issue of capacity enhancement.

These items would be discussed at a future meeting.

5 OVERSIGHT AND MANAGEMENT OF THE SYSTEM

The Session recalled that the GOOS Steering Committee in 2002 had recommended that a Pilot Project Steering Team be formed to take the project forward. The GSC further recommended that, initially, this Team should be composed of:

- GSC member,
- JCOMM DMPA Chair,
- Chair/Vice Chair IODE,
- OOPC representative,
- COOP representative,
- representatives of regional GOOS programmes,
- other experts

It was noted that the First Session of the OIT Steering Team had been organized based upon the above-mentioned list. The Session also noted that the IODE Committee had not yet had the opportunity to discuss OIT and IODE-XVII might have some useful suggestions with regard to the membership of the Steering Team. In addition it was remarked that the current membership did not sufficiently include representatives from the meteorological community.

The Session recommended that work would be started with the current membership (as recommended by the GSC) but also that additional experts be considered (including from IODE, JCOMM, Argo) on the basis of the work plan and its requirements.

6 ACTION PLAN

The Session developed an Action Plan based on the agreed action items arising from the meeting and assigned tasks to each member of the Group.

Metadata systems. Establish a group with the objective of setting up a model for metadata. This Group should take into consideration the work of DMACS, GCMD, ISO and SG-XML. The JCOMM ETDMP should take the lead together with the IOC/ICES SG-XML. The Secretariat will check with WMO on their interest in this matter. Neville Smith will check with climate and modelling people in the US. List of group members should be ready in 6 months. The group will set out a work plan for a meeting in late 2003.

Data circulation and communication. Neville Smith to contact Peter Cornillon and Steve Hankin to discuss a method to expand their DMACS group or have another group work in parallel and call in some connection with the WMO group responsible for the GTS.

Data assembly, quality control and quality assurance. Establish a group to prepare an outline of the requirements of the Pilot Project. The group will comprise Thierry Carval (IFREMER), Lesley Rickards (BODC), Vladimir Vladimirov (COOP panel member), Bob Keeley (MEDS), Neville Smith (lead).

ANNEX I

AGENDA

1. Introduction
2. Background
3. Major national and/or program initiatives
4. Specific Components of the OIT
    5.1 Metadata system
    5.2 Data circulation and communication
    5.3 Data assembly, quality control, and quality assurance
    5.4 Archival
    5.5 The User Interface
6 Oversight and management of the system
7 Actions
8 Closure

ANNEX II

LIST OF PARTICIPANTS

Efstathios BALOPOULOS
Acting Chairman, IODE
National Centre for Marine Research
Hellenic National Oceanographic Data Centre
Anavyssos, Athens
GREECE
Tel: +30 22910 76367
Fax: +30 22910 76323
Email: efstathios.balopoulos@hnodc.ncmr.gr

Katherine BOUTON
International CLIVAR Project Office
Southampton Oceanography Centre
Email: bouton@bouton.plus.com

Murray BROWN
Phoenix Training Consultants
834 Elysian Fields Avenue
New Orleans, Louisiana,
USA
Email: murraybr@bellsouth.net

Aldo DRAGO
MedGOOS Secretariat
IOI-Malta Operational Centre
University of Malta
36 Old Mint Street
Valletta VLT 12
MALTA
Tel: +356 21 232493
Fax: +356 21232493
Email: aldo.drago@um.edu.mt

Chuck HAKKARINEN
2308 Cipriani Blvd
Belmont CA 94002-1416
USA
Tel: +1 650 593 9122
Fax: +1 650 631 3922
Email: chakkarinen@attbi.com

Shaohua LIN
National Marine Data & Information Service
93 Liuwei Road, Hedong District
Tianjin 300171
CHINA
Tel: +86 22 2401 0803
Fax: +86 22 2401 0920
Email: shlin@mail.nmdis.gov.cn

Catherine MAILLARD
SISMER
Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER)
Centre de Brest, B.P. 70
29280 Plouzané
France
Tel: +33 (0)2 98 22 42 79
Fax: +33 (0)2 98 22 46 44
Email: catherine.mailllard@ifremer.fr

Nickolay MIKHAILOV
Russian National Oceanographic Data Centre/RIHMI-WDC
6, Korolev St.
Obninsk, Kaluga Region 024020
RUSSIAN FEDERATION
Tel: +7 08439 74907
Fax: 7 09525 52225
E-mail: nodc@meteo.ru

Savi NARAYANAN
Co-president, JCOMM
Marine Environmental Data Service
W082, 12th floor
200 Kent Street
Ottawa, Ontario
CANADA K1A 0E6
Tel: +1 613 990 02 65
Fax: +1 613 993 46 58
Email: narayanans@dfo-mpo.gc.ca

Sylvie POULIQUEN
IFREMER Department d'Oceanographie Spatiale
Centre de Brest
BP 70
29280 Plouzane
FRANCE
Tel: +33 (0) 2 98 22 44 92
Fax: +33 (0) 2 98 22 45 33
Email: Sylvie.Pouliquen@ifremer.fr

Tony REES
CSIRO Marine Research
Castray Esplanade
Hobart, Tasmania 7000
AUSTRALIA
Tel: +61 3 6232 5318
Fax: +61 3 6232 5000
Email: tony.rees@csiro.au

Lesley RICKARDS
British Oceanographic Data Centre
Bidston Observatory
Bidston Hill, Prenton
Merseyside CH43 7RA
UNITED KINGDOM
Tel: +44151 653 1514
Fax: +44 151 652 3950
Email: ljr@bodc.ac.uk

Ricardo ROJAS
CENDOC-SHOA
Servicio Hidrográfico y Oceanográfico de la Armada de Chile
Errazuriz 232, Playa Ancha
Valparaíso
CHILE
Tel: +56 32 266674
Fax: +56 32 266542
Email: rrojas@shoa.cl

Neville SMITH (Chair)
BMRC
GPO Box 1289K
Melbourne Vic 3001
AUSTRALIA
Tel: +61 3 9669 4434
Fax: +61 3 9669 4660
Email: n.smith@bom.gov.au

Edward VANDEN BERGHE
Chair, IODE GE-BCDMEP
Flanders Marine Institute
Vismijn, Pakhuizen 45-52
B-8400 Oostend
BELGIUM
Tel +32 59 342130
Fax +32 59 342131
Email: ward.vandenberghe@vliz.be

Volker WAGNER
Deutscher Wetterdienst
FE26
PO Box 301190
D-22 304 Hamburg
GERMANY
Tel +49 40 66901430
Fax: +49 40 6690 1499
Email: volher.wagner@dwd.de

JOINT SECRETARIAT

Thorkild AARUP
Intergovernmental Oceanographic Commission (IOC)
1 rue Miollis
75732 Paris Cedex 15
FRANCE
Tel: +33(1) 45 68 40
Fax: +33(1) 45 68 58 12
E-mail: t.aarup@unesco.org

Peter PISSIERSSENS
Intergovernmental Oceanographic Commission (IOC)
1 rue Miollis
75732 Paris Cedex 15
FRANCE
Tel: +33(1) 45 68 40
Fax: +33(1) 45 68 58 12
E-mail: p.pissierssens@unesco.org

Greg REED
Intergovernmental Oceanographic Commission (IOC)
1 rue Miollis
75732 Paris Cedex 15
FRANCE
Tel: +33(1) 45 68 39 60
Fax: +33(1) 45 68 58 12
E-mail: g.reed@unesco.org

Benjamin SIMS
Intergovernmental Oceanographic Commission (IOC)
1 rue Miollis
75732 Paris Cedex 15
FRANCE
Tel: +33(1) 45 68 39 92
Fax: +33(1) 45 68 58 12
E-mail: b.sims@unesco.org

Bruce SUMNER
Ocean Affairs Division
World Weather Watch-Applications Dept.
World Meteorological Organization (WMO)
7bis rue de la Paix
Case postale No 2300
CH-1211 Geneve 2
SWITZERLAND
Tel: +41 22 730 80 04
Fax: +41 22 730 80 21
Email: brucesumner@hotmail.com

[end]