WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

JOINT WMO/IOC TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY

FIRST TRANSITION PLANNING MEETING

ST PETERSBURG, RUSSIAN FEDERATION, 19-23 JULY 1999

STATUS REPORTS FROM JCOMM COMPONENT BODIES AND ACTIVITIES

JCOMM Technical Report No. 1

C O N T E N T S

REPORT BY THE CHAIRMAN OF IGOSS

Introduction

The Integrated Global Ocean Services System (IGOSS) which is jointly run by the Intergovernmental Oceanographic Commission (IOC) of UNESCO and the WMO is the long-standing programme to collect and distribute, through the Global Telecommunication System (GTS) of the WMO, oceanographic *in-situ* data on an operational basis.

Data are collected on fixed platforms, drifting buoys, research ships, fishing vessels, and merchant ships. The variables presently measured are sea level as well as surface and sub-surface temperature, -salinity and -currents. There is still an urgent need for more data from extended ocean areas, and there is a general need for more salinity data. Member States are urged to put more data onto the GTS and to contact their navies for declassifying historical data sets, for declassifying their actual XBT and CTD data within 30 days after its collection, so that they can also be entered onto the GTS.

Data and information access

Data sets derived from IGOSS observations and associated products can be accessed and even down loaded on-line from the World Wide Web (WWW) within the framework of the Global Temperature and Salinity Profile Programme (GTSPP). Direct connection through the WWW under the USA's National Oceanographic Data Centre's (NODC) server NODC Online Data Access is achieved at the following Uniform Resource Locator (URL or Internet address):

http://www.nodc.noaa.gov/GTSPP/gtspp-home.html

For detailed information on WOCE activities, data and information, contact the WOCE Data Information Unit (DIU) through the OCEANIC system. Access can be obtained through the WWW at:

http://www.cms.udel.edu/

or via internet e-mail at: *woce.diu@delocn.udel.edu*

There is an IGOSS Home Page on the WWW that contains information about the Ship of Opportunity Programme (SOOP) and IGOSS in general and it contains tables and reports, many of which can be down loaded by file-transfer protocol. From the main page, a list of IGOSS topics and keywords contains numerous links to IGOSS-related information. The URL of the page is:

http://ioc.unesco.org/IGOSSweb/igoshome.htm

Another web site was created by the IGOSS Operations Coordinator, under the GOOS Home Page, which gives information on XBT-related topics and contacts for national XBT programmes. The URL of the page is:

http://ioc.unesco.org/IGOSSweb/xbt.htm

The new SOOP Coordinator, Etienne Charpentier, is in the process of creating a complete new SOOP web site. In the meantime, he has made the SOOP resources survey available on the DBCP server, at:

http://dbcp.nos.noaa.gov/dbcp/soop/soop19983.html

Ship of Opportunity Programme

The IGOSS Ship of Opportunity Programme (SOOP) is an existing operational component which contributes directly to the implementation of the common GOOS/GCOS ocean climate module. In addition, many of the SOOP lines also serve or contribute to other aspects of GOOS, including in particular the coastal and services modules.

In 1998, an estimated total of 33,617 unique BATHY messages (temperature versus depth profiles) using expendable bathythermographs (XBT) and 3.464 TESAC (temperature, salinity and conductivity measurements) were taken with Conductivity-Temperature-Depth (CTD) instruments. 2.424 track line data, known as TRACKOB messages were also exchanged. The exchanged drift and stationary buoy data (1005), known as BUOY messages comprise only a small percentage of the total data exchanged.

Since 1976, almost 885,000 BATHY and over 119,000 TESAC messages have been exchanged through the IGOSS. IGOSS messages are transmitted in less than 30 days from the time of observation and so are considered near-real time data. Their applications are varied with particular emphasis on determining boundary conditions for ocean modelling, validation of satellite data, and for use in atmosphere-ocean climate modelling.

Data transmitted or submitted after the 30-day period are considered to be delayed mode data and typically contain many more data points per profile than a typical BATHY message. BATHY messages are constructed by selecting significant data points in a temperature-depth profile to characterize an entire profile. This is necessary at present because of limitations in satellite data transmission capabilities. The present accepted terminology for BATHY messages and delayed mode data are low- and high-resolution, respectively. Both types of data are archived as they are received by data centres, with BATHYs containing low-resolution data ultimately being replaced whenever possible by the higher resolution delayed mode data. The archiving responsibilities internationally fall under the purview of IOC's International Oceanographic Data and Information Exchange (IODE).

The field acquisition phase of the ten-year World Ocean Circulation Experiment (WOCE) was completed at the end of 1996. This major oceanographic research programme was the driving force along with the Tropical Ocean Global Atmosphere (TOGA) experiment for the XBT Ship of Opportunity Programme. The Joint Committee for IGOSS assumed the responsibility for maintaining the TOGA-WOCE low-density XBT network for operational purposes. At IGOSS-VII in November of 1995, the joint committee approved a plan that created a management structure for the SOOP that relied on the continuing expertise of countries that had formed the TOGA-WOCE SOOP and is steered by scientific input from the operationally-oriented Ocean Observations Panel for Climate (OOPC) of the Global Ocean Observing System (GOOS) and the research-oriented Upper Ocean Panel (UOP) of the Climate and Variability (CLIVAR) programme of the World Climate Research Programme (WCRP).

A more comprehensive and up-to-date report about SOOP has been prepared by Mr Rick Bailey, Chairman of the SOOP Implementation Panel. His report is given in Appendix A.

The SOOP Management Committee (SMC)

The SOOP Management Committee (SMC) has terms of reference that direct it to coordinate resources from participating countries so that XBT probes and equipment and available ships are deployed optimally in a concerted global effort. At its first Session (Toulouse, May 1996) the SMC reviewed background to and rationale for the end-to-end plan as well as details of the two main SOOP bodies, namely the SMC and the SOOP Implementation Panel (SOOPIP). The following points were felt as being particularly important:

a. A primary objective of the SMC is to maintain a commitment to a basic operational network for global climate studies following the scientific design as set out by design bodies such as OOSDP and the CLIVAR Upper Ocean Panel (UOP). In this context ways must be found to identify resources for an operational SOOP and to make the most effective use of these resources in satisfying as much as possible the scientific requirements.
b. The development and long-term maintenance of an operational SOOP network is an iterative process, involving SMC, the SOOPIP and the science design bodies, as well as input from national decision-making and funding bodies for international programmes such as GOOS.
c. While any total SOOP network will always involve a mix of both operational and research activities, it is nevertheless essential that the basis of future networks should be operational funding.

The SMC agreed to continue to use the TOGA/WOCE low-density network as the basic design for its initial operational network. It also underlined the need to develop and maintain a basic commitments status document to include agreed SOO lines, international programme requirements as well as existing and expected national future contributions. This table will serve as the basic programme-planning document for SOOPIP, the SMC and science bodies, as well as a form of an XBT resources commitment document for national agencies.

The Joint IOC/WMO IGOSS SOOP Implementation Panel (SOOPIP)

The Joint IOC/WMO IGOSS SOOP Implementation Panel reviewed the detailed SOOP resources survey result, which is an essential element in overall SOOP management, both internationally and at the national and agency level. The meeting undertook a line-by-line analysis of the network, based in the first instance on the detailed resources survey tabulations. The summary tables were revised on the basis of this analysis, and it was agreed that these revised tables should constitute the next resources survey.

Approximately 120 ships (both research and volunteer merchant ships) contributed to the collection of IGOSS data in 1997. The XBT Resources survey yielded many interesting summaries of the distribution of XBT probes by ocean and country. The net result is that approximately 61 % of the required number of XBT needed to fully cover the low-density XBT network were deployed. A summary of coverage for each track line defined in the network is provided for each ocean. Corresponding figures are given in GOOS Report No. 59 (IOC/INF-1113).

IGOSS Data Processing and Services System (IDPSS)

The IDPSS consists of national, specialized and world oceanographic centres for the processing of observational data, and the provision of products, services and operational data exchange activities to various marine user groups. Seventeen countries have established a National Oceanographic Centre (NOC) and there are twelve Specialized Oceanographic Centres (SOC) and/or World Oceanographic Centres (WOC), distributed among six member states. A total of 62 countries prepare over 700 surface and sub-surface IGOSS products. Addresses for the oceanographic centres can be found beginning on page 45 of publications IOC/INF-998, Composition of IGOSS, dated 19 May 1995.

IGOSS products are disseminated through various media including the Global Telecommunication System (GTS), the Internet, by radio and even radio facsimile. The IGOSS Products Bulletin (IPB), established in 1991, is a showcase for many of the IGOSS global and regional products as a service to the scientific community. Hard copies of the IGOSS Bulletin can be obtained through the electronic version of the IPB on the following WWW URL:

http://rainbow.ldeo.columbia.edu/igoss/productsbulletin/

Questions about the IPB can be sent via e-mail to the bulletin editor, Dr Yves Tourre at: *tourre@ldeo.columbia.edu*. A report of the Scientific Adviser to IGOSS, in more detail, is contained in

IGOSS Telecommunications Arrangements (ITA)

The ITA continues to consist mainly of the facilities of the Global Telecommunications System (GTS) of WMO and other arrangements necessary for the rapid collection and distribution of observational data and processed information. At present there are 62 unique bulletin headers authorized by the World Meteorological Organization (WMO) for the transmission of BATHY, TESAC, BUOY and TRACKOB messages. A list of these bulletin headers can be found in the Catalogue of Meteorological Bulletins, Volume C, edition April 1999 as well as on the IGOSS Home Page.

The Argos System

The ARGOS system is used for the acquisition and transmission of oceanographic data from fixed or floating platforms equipped with Platform Transmitter Terminals (PTT), as well as for locating the geographic position of the PTT. It has proved particularly useful for the transmission of data from automatic stations such as buoys. In May 1999, the Argos service was handling reports from 1170 drifting buoys, 317 moored buoys, 2 balloons, 624 fixed stations and 702 miscellaneous platforms.

IGOSS Plan and Implementation Programme (PIP)

One of the strengths of IGOSS is its PIP, which describes its overall strategy and provides a basis to develop more precise action plans. The IGOSS Bureau, at its first session, decided that the new PIP should cover at least two intersessional periods of the Joint Committee, i.e. 8 years. IGOSS-VII approved the PIP for 1996 to 2003 (Rec. JC-IGOSS-VII-6). Member States are urged to participate more actively in IGOSS through the implementation of the various components of the system as detailed in the PIP.

Cooperation with IODE

The major joint IGOSS-IODE programme is the Global Temperature/Salinity Profile Programme (GTSPP). The general task of GTSPP is to improve real-time capture of ocean data, to quality control both real-time and non-real-time data, to monitor the data flow, and to prepare and distribute data products. A full report on the GTSPP is presented in a separate document for the meeting. The data flow monitoring techniques developed by GTSPP have proved successful in identifying significant differences in the receipt of data reports between centres all over the world. As IGOSS and IODE are complementary it was agreed that both systems should pursue their collaboration through, for example, making a common use of an IGOSS-IODE Home Page, with the view to promoting together the real-time and delayed-mode aspects of global observing systems such as GOOS and GCOS.

To raise the awareness of national decision-makers to the value of joint IGOSS-IODE activities and to the many users of data managed under IGOSS and IODE, the Committees have published a joint IGOSS-IODE brochure.

Future requirements and developments

The first session of the Joint IOC/WMO IGOSS SOOPIP (April 1997, Cape Town) approved revised terms of reference of the IGOSS Task Team on Quality Control of Automatic Systems and decided that its name should be changed to SOOP Task Team on Instrumentation and Quality Control (STT/IQC). This Task Team is presently reviewing fall-rate and other data problems encountered with XBT and expendable conductivity-depth-temperature (XCDT) probes.

The Team expressed the need to also investigate the feasibility and accuracy of new sampling technology to supplement the XBT network, such as thermosalinographs, ALACE and PALACE drifting floats and CTDs that can be deployed underway. IGOSS and GOOS will eventually require a full instrument intercomparison and intercalibration programme, as an integral part of an operational ocean observing system. Such a programme, similar to that now in place for the World Weather Watch, will require additional resources. The STT/IQC however lack the necessary resources to do the work extensively which totally depends on voluntary contributions: (1) planning and implementing intercomparison exercises, (2) provision of ship time, (3) sponsoring of instruments by the manufacturers. The capacity of STT/IQC is too small to do the whole spectrum of quality assurance work. SOOPIP should therefore make the requirements known to both IGOSS and GOOS, and request the action be taken to identify the resources needed, bearing in mind that the task team is the appropriate body to organize and implement intercomparison tests, provided the necessary resources are available.

IGOSS successfully implemented a change to the old JJXX BATHY code (now called JJYY) that includes important information on equipment used and fall-rate equations applied to the data. Similar modifications have been made to the existing TESAC code which will come into effect in the early part of the year 2000. Normally this would have been November 1999, but it was deemed prudent to wait until after the transition to 2000 and the potential software disruptions that may go with this.

There is a growing need to better coordinate oceanographic and meteorological recording systems onboard voluntary observing ships (VOSs) and ships of opportunity (SOO), aiming at an interference with the operations on the navigational bridge as low as possible. A mutual handling and maintaining of recording systems onboard VOS and SOO should be pursued by the Meteorological Services and Oceanographic Agencies.

There is a great challenge for JCOMM in the years to come. Mechanisms must be established to get CTDs from research projects included in the flow of operational data. Deliberations with the research community, and with CLIVAR in particular, must be initiated in order to clarify the conditions under which research data will be released for operational purposes. IGOSS should assist the research institutes in providing the software required for real-time data processing.

Finally, the SOOP monitoring work, as well as support for the SOOP Implementation Panel, formerly undertaken by the seconded IGOSS Operations Coordinator at IOC, recently has been done on a temporary basis by the WMO Secretariat. However, Etienne Charpentier is now formally the SOOP Coordinator who is regarded as the focal point for international coordination of all technical and management aspects of SOOP. It is suggested that, in future, the SOOP/DBCP Coordinator office might coordinate and monitor all the operational components which will fall under JCOMM, i.e. CMM, IGOSS, DBCP, GLOSS, TAO Array and PIRATA (JCOMM Operations Coordinator).

IGOSS References

More detailed information on IGOSS activities and procedures can be found in the following references:

IOC/INF-998, Composition of IGOSS
IOC Manuals and Guides No. 1 - Guide to IGOSS Data Archives and Exchange (BATHY and TESAC), 1993
IOC Manuals and Guides No. 3 - Guide to operational Procedures for the Collection and Exchange of IGOSS Data, Second Revised Edition, 1988
IOC Manuals and Guides No. 19 - Guide to Specialized Oceanographic Centres (SOC), 1988
IOC Technical Series No. 43 - IGOSS Plan and Implementation programme, 1996-2003
WOCE Data Handbook, 6th Edition, 1995

Appendix A

SHIP-OF-OPPORTUNITY PROGRAMME (SOOP) STATUS REPORT

Observing network

Upper ocean thermal data is collected along approximately 70 lines by approximately 80-100 merchant vessels. The programme is global in scope, but it is supported mainly by five core countries. Although most of the measurements concern upper ocean temperature collected by eXpendable Bathy Thermographs (XBTs), there are also increasing measurements of surface and subsurface salinity along a number of lines, and proposals are in place for increased biological and chemical sampling.

The XBT component of SOOP continues to sample as many of the major designated lines to the TOGA/WOCE sampling requirements as is logistically possible. Efforts continue to find alternative shipping on presently hard to cover lines in the South Atlantic, SE Pacific, and South Indian Ocean. Problems have arisen due to commercial rationalisation of shipping on previously maintained lines in these areas. Often the main problem is obtaining regular shipping on which to deploy the data acquisition equipment. The majority of the Pacific Ocean, North and equatorial Atlantic Ocean, north and eastern Indian Ocean continue to be well covered. Logistical constraints continue to naturally restrict sampling in the Southern Ocean to mainly the summer months. SOOPIP is continuing to coordinate and focus resources to ensure those well-sampled lines are maintained to meet the OOPC and previous TOGA/WOCE recommendations.

The thermosalinograph (SST and SSS) network continues to grow. This network in the past has been mainly maintained by the French (IRD/formerly ORSTOM), who have concentrated in the western Pacific, although the US (NOAA) and Australia (CSIRO) have in recent times begun expanding their efforts in the Atlantic, Southern and Indian Oceans. Efforts are being made to coordinate these activities in support of collaborative scientific goals.

Capabilities for obtaining other observations form ships-of-opportunity continue to grow. Efforts are being made in the US and Australia to equip XBT ships with meteorological sensor packages (e.g. IMET, Vaisala systems, etc). Biological sampling (fluorescence, phytoplankton counts, etc) and pCO2 monitoring has been undertaken by France for many years from merchant vessels, with similar programmes being implemented by Australia during 1999. The US has also undertaken pCO2 monitoring from ships-of-opportunity for several years.

Coordination and monitoring

Extensive programme monitoring and data quality activities continue to be implemented in conjunction with the Global Temperature Salinity Profile Programme (GTSPP). Feedback mechanisms have been instigated to ensure data flow and quality, and these have proven to be effective in increasing the amount of real-time data flow and data quality. Delayed mode data submissions are also being tracked to increase the amount of high-resolution data being made available to the global archives in a timely manner. Six-monthly detailed analyses of XBT line operation are helping to keep the international programme focused on meeting the scientific requirements wherever possible. Monthly maps of "pseudo" data density information are being produced to provide a guide to the true data coverage being provided (taking into account decorrelation-scales, etc.).

After withdrawal of support for the IGOSS Coordinator position during 1997, new arrangements and funding have been made to support the coordinator position from 1999 onwards. This has been a crucial step for the successful coordination of the programme. The Coordinator for the programme is now Etienne Charpentier, who will also continue his work as coordinator for the DBCP. Support for the position is provided by member nations.

Plans are underway between the new coordinator and the chairman of the SOOPIP to thoroughly revise the SOOP web page. Without a designated coordinator, this page has not been kept up-to-date in recent times, nor totally effective. It is planned to use this as a much more powerful tool for coordination and communication of the programme's activities in the future.

A report on SOOP was provided to the Voluntary Observing Ship (VOS) Programme Committee meeting of the Commission for Marine Meteorology (CMM), which was held in March 1999. This was in an effort to increase coordination between SOOP and VOS (who both use merchant shipping as a platform). The meeting proposed that a general VOS/SOOP coordination body be formed under the new Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) to further coordination of these two related programmes.

SOOPIP is developing its Strategic Implementation Plan, based on GOOS and GCOS requirements with scientific input from OOPC. This plan will be available for the planned IIAG meeting in St Petersburg in July.

Data management

The data management activities of the programme continue to be undertaken in collaboration with GTSPP and the WOCE Upper Ocean Thermal Data Assembly Centre (UOT/DAC) Program. GTSPP continues to support the real-time data exchange and quality control (mainly via MEDS). This is the data provided for operational applications, such as ENSO prediction. The Science Centres (AOML, SIO, CSIRO/BMRC JAFOOS), which are jointly operated by the GTSPP and the WOCE UOT/DAC Program, are responsible for the scientific quality control and delivery of products from the high-resolution, delayed mode data set. This data set is managed by the global archive for both programmes (NODC), as is used for scientific research and Climatology development.

Memorandum of Understanding (MOU) is presently under negotiation between the main centres to ensure the ongoing data management support for upper ocean programmes, such as SOOP.

Programme evaluation

The SOOP Task Team on Instrumentation and Quality Control (STT/IQC) continues to evaluate instrumentation and quality control procedures. Current studies include an ongoing evaluation of the XCTD, and continued monitoring and investigation of the XBT fall rate and adherence to specifications.

The GCOS/GOOS/WCRP Ocean Observations Panel for Climate (OOPC), CLIVAR Upper Ocean Panel (UOP) and the Ship-of-Opportunity Programme of the IOC/WMO Integrated Global Ocean Services System (IGOSS SOOP) have agreed to convene a study of the upper ocean network with the support of NOAA and the Australian Bureau of Meteorology. The aims of this study are:

a. To compile a consolidated account of the existing UOT database, using WOCE, Levitus and whatever other data bases that are available. The attributes that we seek to quantify are:

   (i) The sampling as a function of space and time, extending back to at least the early 1980's. These statistics should be by long, lat bins ($2^\circ \times 2^\circ$) as well as by traditional lines/regions (as defined in WOCE). The statistics should give some measure of the vertical sampling and depth.

   (ii) A measure of the continuity for specific lines/regions, including the relative information content of low-density, frequently repeated and high-density lines.

   (iii) A measure of the quality (level of QC that the data have been subjected to).

   (iv) Availability - delayed mode versus real-time; gaps in delivery systems; public versus private; etc. permanent archives

   (v) Availability of metadata

(vi) Logistical considerations with particular tracks

(vii) Any other political/technical attributes which might impact/qualify the attributes.

The analysis will include all forms of sampling (broadcast, high-density, frequently-repeated, ad hoc, etc.)

b. Produce consolidated "maps" of information level/content based on the dominant scales of climate signals. The raw distribution statistics do not take account of the actual information content so it is useful to seek some consolidation of the information in (a) even if it does depend on certain assumptions. The SOOP contribution will be identified.

c. Document the existing practices for assembling, quality control and distribution of upper ocean data, working from existing material of GTSPP, WOCE UOT/DPC and IGOSS SOOP.

d. Document to the extent possible the "value adding" of thermal data process chains, be they automated assimilation (e.g., NCEP, BMRC, UKMO, ECMWF), quick-look/semi-automated quality control (e.g., GTSPP, AOML) or higher-level scientific quality control and assembly (e.g., CSIRO, AOML, Levitus, NODC).

e. Provide quantitative assessment of all SOOP lines. This will include an assessment of relevance/impact against scientific objectives including seasonal-to-interannual prediction, environmental/ocean prediction, improved climatologies and climate change monitoring, scores against key attributes (continuity, quality, etc.), notes on extenuating circumstances, and the existence of proxies in the event of gaps/discontinuities in the lines. The broad-scale sampling should also be assessed as a precursor to Argo with a view to maintaining the temporal and spatial integrity of resolved signals such as the global ENSO wave, the Antarctic Circumpolar Wave, decadal variability, etc.

f. On the basis of (e), provide a renovated SOOP plan including broadcast and high-density strategies, taking account of, as far as is practical:

(i) The existence (or potential) of other direct sampling networks (e.g., TAO, Argo);

(ii) The indirect information available from remote sensing, particular altimetry; and

(iii) The indirect information available from models, e.g. wind-forced equatorial.

g. Produce a Report based on the above which will form the background for a Workshop to be convened in the 3rd quarter of 1999. The Executive Summary from this process will constitute a key paper for the OCEANOBS 99 Conference, 18-22 October 1999. The Report will be published jointly under the joint auspices of the GCOS/GOOS/WCRP OOPC, CLIVAR UOP and IOC/WMO IGOSS SOOPIP.

Next SOOPIP meeting

The next proposed meeting of SOOPIP is for San Diego in March/April of 2000.

Country	Operator	Ocean	Good drops
Australia	BOM	Indian	846.00
Australia	BOM	Pacific	605.00
Australia	CSIRO	Indian	789.00
Australia	CSIRO	Pacific	529.00
France	IRD	Atlantic	1 214.00
France	IRD	Indian	46.00
France	IRD_NOUMEA	Atlantic	24.00
France	IRD_NOUMEA	Indian	111.00
France	IRD_NOUMEA	Pacific	1 840.00
Germany	BSH	Atlantic	1 150.00
Japan	JMA	Indian	379.00
Japan	JMA	Pacific	910.00
USA	NOAA	Atlantic	4 593.00
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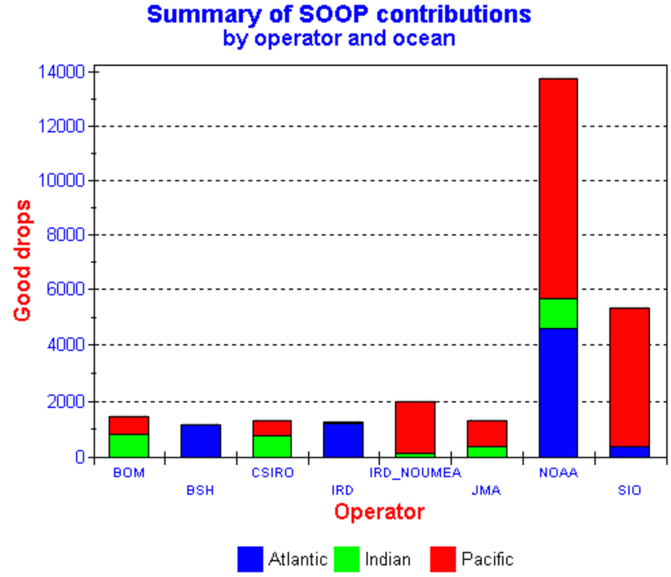
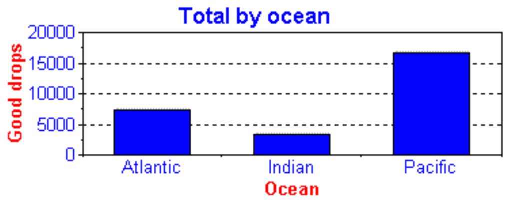
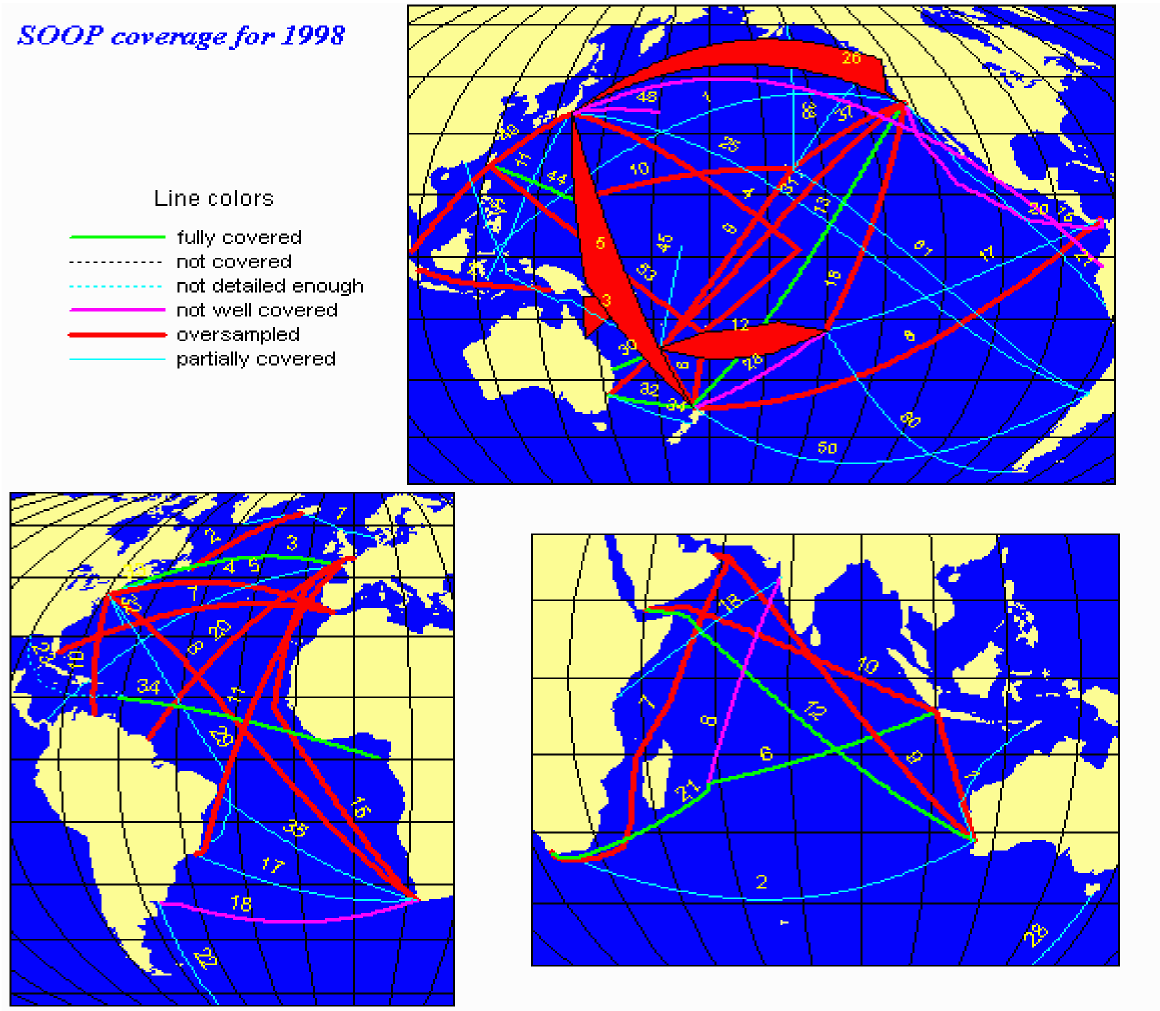






Appendix B

REPORT FROM THE IGOSS SCIENTIFIC ADVISOR

During the last three years I am pleased to announce that the IGOSS Electronic Products Bulletin (EIPB):

a. has evolved quite considerably;

b. is getting an average of 15000 hits per day.

Evolution of the EIPB

Within the LDEO/IRI structures of Columbia University, close collaboration with SIO of UCSD and under the supervision of the IGOSS Scientific Advisor, new real-time and climatological ocean products, datasets (including animated datasets) and on-line tools have been implemented. A full access to the EIPB is at the following URL:

http://iri.ldeo.columbia.edu/climate/monitoring/ipb

The EIPB has been tested successfully all over the world, using regular modems as well as dedicated communication lines, including Africa, Australia, Japan (COP 3) and Portugal.

Because of the EIPB powerful interactivities, users linked to the World Wide Web can:

a. Compute on-line SST and Heat Content time series anywhere in the global oceans;
b. Animate they're own part (GIF animations) of the ocean as desired.
c. Make an effective presentation using EIPB products in color (color scale) or black and white (labeled contours).

In order to expedite data access and data exchanges, ways and means for creating EIPB "mirror sites" in Japan, South America, Europe and Australia are still being investigated. It should be noted that most of activities of the IGOSS Scientific Advisor have been on a "Pro Bono" basis.

In Japan, during COP 3, EIPB products were used (as a powerful example) to re-inforce the now passed resolution concerning continuous needs for Global Observing Networks. The IGOSS Scientific Advisor gave fifty-four presentations to official delegations in four days.

During OCEAN EXPO 98 in Lisbon, 3000 people visited daily and for 4 months, the UN pavilion where a special WMO/IOC exhibit displayed key products from the EIPB describing the ENSO 1997-98. A full access to the display is at the following URL:

http://members.tripod.com/~xorama

During the past year, there have been collaboration and exchanges of ideas with Drs Johannes Guddal and Colin Summerhayes on how to expand EIPB and make it a part of GOOS, at least for real-time physical oceanography, monitoring and educational purposes. This is an exciting perspective to be pursued within the JCOMM concept.

REPORT BY THE PRESIDENT OF CMM

Two years have passed since CMM-XII in Havana, Cuba. These years have shown significant achievements within the area of responsibility of CMM, as well as new developments that are likely to assume significance in the years to come. There are, however, concerns regarding the coherence of the marine forecasting community that I will comment upon at the end of the report.

Achievements

As president I have been proud to observe the full global implementation of the WMO part of the Global Maritime Distress and Safety System, in cooperation with IMO, IHO and Inmarsat. WMO and its members, working through CMM, were able to accomplish full implementation of the new marine broadcast system for the GMDSS in advance of the planned final implementation date of 1 February 1999.

Along the same lines, I note with pleasure the achievements within MPERSS, VOS, MCSS, as well as the ongoing specialization and improvements of Members in operational skills regarding marine meteorological and oceanographic forecasting and hindcasting.

New initiatives and other on-going activities

Members will be aware of the GOOS programme, and the rapidly increasing CMM engagement in GOOS, in particular in issues related to physical oceanography. Some aspects of CMM-GOOS cooperation need to be emphasized. In order to exploit the most and the best of common WMO/CMM resources and IOC resources, for the benefit of climate studies and assessments, it was proposed to merge CMM and IGOSS into one Commission. This process has now been completed with the new JCOMM.

The second important aspect is the GOOS activities in coastal areas, where WMO Members already have well developed, operational services targeting users' needs in fields such as coastal environmental protection, wave and current forecasting, etc. Services to coastal management and industry are multidisciplinary in nature, and it will be required that National Meteorological Services to work together with other coastal related agencies and institutes.

The use of numerical models for oceanographic forecasting is not new to National Meteorological Services, and there are as well in many places well conducted programs to assist in implementation of operational models. New measurement techniques are also finding their way into operational marine forecasting, such as space based sensing and coastal radars. Simultaneously the ongoing programs conducted by DBCP and IGOSS have been consolidated.

In summary, I think it is right to say that the major challenges for National Meteorological Services in the years to come will include to understand and implement a multidisciplinary approach (to combine meteorology with physical, chemical, and even biological oceanography) and to develop interactions with both the marine user communities and also suitable partners in related disciplines. The concept of multidisciplinarity will reach even wider, into e.g. cartography and city developments. There is no better guidance to follow in this process than the programmes and activities of the international organizations.

The President`s activities

Three specific and personally promoted activities, as adopted by CMM-XII, have been carried through, and I mention these only to give you an idea of my personal interests:

a. Publication of a *WMO Handbook on Offshore Forecasting*;

b. Publication of proceedings from the COST conference *Provision and Operational/Engineering Application of Ocean Wave Spectra;*

c. Establishment of the **ad hoc** ROSE group.

I am in the lucky situation that my domestic working scene coincides very well with the duties of a CMM president, thanks also to the goodwill of my institute. As president of CMM I am invited to a series of marine forecasting related conferences and workshops, ranging in theme from remote sensing to data management issues and user interactions. The most prominent role, however, has been to take part in the CMM - GOOS cooperation. The president is a member of the GOOS Steering Committee and the Coastal Panel for GOOS. Since the goal of GOOS is ‘operational oceanography’, my mission is mostly to promote ‘operational skills’ within academic societies, and in particular to suggest transfer of CMM members’ operational skills into GOOS. I have also taken the initiative to establish a GOOS Services and Products Bulletin on Internet, showing users what can be provided in marine forecasting services, and what the quality and user satisfaction can be. My engagement in GOOS has convinced me of the necessity of JCOMM, which I support wholeheartedly. Another important element of GOOS is capacity building, where there is a potential comprehensive role for CMM members.

I have represented CMM at two WMO Executive Council sessions and WMO Congress XIII. I have presented there the achievements of and likely future priorities for CMM, the past year with strong emphasis on JCOMM. I have on these occasions supported JCOMM without reservation, and received strong support from the national delegations. In meetings with the other presidents of Technical Commissions we discussed the reduction of the number of commissions. So far this has not resulted in any other outcome than JCOMM, although the possible merging if CIMO and CBS is still considered. I have also represented WMO/CMM at workshops being held by the Commission for Sustainable Development. This seem to me to become an arena where ocean matters must be more strongly promoted, and in particular where JCOMM/GOOS can assist and work together with coastal management bodies and policy makers.

Concerns

There is a gap between the enthusiasm and engagement observed at CMM sessions, and the intersessional work. With significant exceptions: some appointed chairpersons of working groups and working group members seem to disappear until they surface again at the next session. I realize that not everybody has the lucky situation that their domestic work coincides with international work, but if the international commitment becomes too hard to live up to, this must be brought to the consideration of the PR in the light of general commitments to WMO.

The other concern is commercialization, in particular for CMM members performing marine forecasting services. Since many such services are new and not part of the traditional *core services*, they automatically become commercial and fragmented. This means they will lack the necessary infrastructure for a service to benefit from international cooperation and to assist others. The latest reference to this problem is the Geneva Declaration from Congress XIII.

Every CMM member has the opportunity and power to promote infrastructure within her/his country, and the most powerful common vehicle for this process will be GOOS with strong participation from JCOMM.

WORKING GROUP ON MARINE METEOROLOGICAL SERVICES

The Working Group on Marine Meteorological Services was established by Resolution 2 (CMM X), which includes the terms of reference of the working group. The working group is open, but includes:

a. A subgroup of experts on sea ice;

b. A subgroup of experts on wave modeling and forecasting;

c. An ad hoc group on the Global Maritime Distress and Safety System;

d. A subgroup of experts on marine climatology.

Marine Pollution Emergency Response Support Services

A workshop on the WMO Marine Pollution Emergency Response Support System (MPERSS) was held July 16-17, 1998, in Townsville, Australia, to review requirements for meteorological and oceanographic services to support marine pollution emergency response operations, and to review the existing WMO specifications for MPERSS. The workshop recommended a number of amendments to the specifications, including introducing the concept of *centres of excellence* in metocean support, and investigating adjustments to areas of responsibility presently defined. A number of recommendations and proposed specific actions to enhance MPERSS implementation worldwide were made by the workshop. In addition, the workshop participants modified the contents of the Status Review Questionnaire for redistribution and subsequent compilation of responses into a comprehensive database on MPERSS implementation. It is noted with the appreciation that work continues within the various MPERSS Area Meteorological Coordinators to implement and improve the MPERSS.

Marine Climatology

The Global Collecting Centres in Germany and the United Kingdom continued to collect marine climatological data, ensure that minimum quality control procedures were applied, and generate and provide complete data sets to Responsible Members under the Marine Climatological Summaries Scheme (MCSS). During 1998, about 1.4 million observations were collected, down about 3% from 1997. Contributions came from 17 countries, which represents less than one half of contributing Members. The Climar99 Workshop is planned to be held in September 1999, in Vancouver, British Columbia (Canada). Mr. Joe Elms (USA), chairman of the subgroup, has outlined member assignments for work to be accomplished during the remainder of the intersessional period.

Sea Ice

An informal session of the Subgroup on Sea Ice was held in conjunction with the Steering Group for the Global Digital Sea Ice Data Bank (GDSIDB) August 10-12, 1998, in Boulder, Colorado (USA). The subgroup continued to provide support and supervision of the GDSIDB. Newly digitized data for 1950-1992 in WMO format for international sea ice data exchange (SIGRID) were prepared at the Arctic and Antarctic Research Institute (AARI). Data on sea ice total concentration for the Sea of Okhotsk was prepared at the Japan Meteorological Agency in SIGRID-2 format for the 1996/1997 winter period. The USA National Snow and Ice Data Center (NSIDC) converted the Russian part of the SIGRID database into the EASE-grid projection. Several activities have been undertaken to update guidance material for mariners on marine meteorological services in the area of sea ice. The abbreviated version of the Handbook on Sea Ice Navigation in the Southern Ocean was published in the Marine Meteorology and Related Oceanographic Activities report. It is noted with appreciation the progress of Dr. V. Gavrilov (Russian Federation) and Dr. W. Weeks (USA) to prepare the Handbook on the Analysis and Forecasting on Sea Ice. Work is underway to revise WMO No 574 Sea Ice Information Services in the World. Work was completed on the operational exchange of sea-ice data through the Internet, including the establishment of home pages devoted to historical sea-ice data by the AARI and NSIDC. Future activities of the subgroup include a possible workshop on mapping and archiving sea ice data derived from radar data, possibly including sea ice information into GDSIDB from the Black, Azov and Caspian seas, and preparing recommendations on archival and operational formats for sea ice data based upon the recommendations of the ad-hoc data format working group.

Global Maritime Distress and Safety System

On February 1, 1999, the Global Maritime Distress and Safety System (GMDSS) was successfully implemented world-wide. Prior to this implementation, the second session of the ad hoc group on the GMDSS met at Meteo France, in Toulouse, September 14-18, 1999, to finalize plans and transmission schedules. The maps of subdivisions of the Metareas and transmission schedule are found in Volume D of WMO-No. 9. In November of 1997, a questionnaire was circulated to members of the International Chamber of Shipping, ship owners and masters to obtain user feedback on meteorological content of the GMDSS broadcasts. Of the 690 questionnaires returned, 625 were analyzed with regard to the quality of warnings and forecasts issued for the Metareas. Both the numerical analysis and a review of the comments indicated a very high degree of user satisfaction with the meteorological content of GMDSS SafetyNET services. Around 81% of the respondents indicated that for the Metareas they navigated the warnings and forecasts were good, about 16% indicated they were fair, and around 3% indicated they were poor. The ad hoc group found the questionnaire worthwhile and recommended that another one be undertaken in about 2 years. Mr. M. Ziemianski (Poland) successfully undertook the difficult task to develop guidelines for NAVTEX broadcasts in the Baltic Sea. While the guidelines will be submitted to RA VI and CMM for formal adoption, it is urged that operational implementation not be delayed following the formal agreement by the Permanent Representatives concerned. The ad hoc group considered other areas where requirements may exist for international coordination of forecasts and warnings broadcast through NAVTEX. It was generally noted that such coordination was already taking place, or plans existed to move towards this coordination. Several substantive amendments to the WMO Regulations related to GMDSS are proposed for consideration of CMM-XIII/JCOMM-I.

WORKING GROUP ON MARINE OBSERVING SYSTEMS

Subgroup on the Voluntary Observing Ships

The first session of the Subgroup on the VOS took place in Athens, 8-13 March 1999, hosted by the Hellenic National Meteorological Service and chaired by George Kassimidis (Greece). There were a total of 29 participants in the meeting, including representatives from 19 VOS operators. This first formal meeting of experts representing the operators of a large majority of the global VOS was particularly significant and timely in view of the growing importance of VOS observations to studies of global climate and climate change.

The primary issues for discussion at the meeting, within a very full agenda, included expanded requirements for VOS data; implementation of the results of the VSOP-NA; automation of shipboard instrumentation and data transmission facilities; and development of a concrete set of actions to enhance VOS development. A detailed set of action items resulting from the session is given below for information. Amongst these, the main ones include:

a. Development of recommendations on standardized observing practices;

b. Widespread implementation of the new TurboWin software for message compilation, archival and transmission;

c. Implementation of a project for a VOS subset for climate; a first planning meeting for this project is to take place in November 1999;

d. Publication of the VOS Framework Document, and preparation of a brochure on global VOS;

e. Continuation of the PMO workshop series;

f. Possible merger of all VOS-based activities (meteorological VOS, SOOP, ASAP) into a single VOS working group under JCOMM.

In the context of this ongoing work programme and of the critical importance of the VOS to many applications, it is strongly recommended that the group continue under JCOMM, and that consideration be given to the recommendation (vi) above.

Action items from VOS-I

Subgroup

a. Try to arrange interaction with shipping companies at the national level, with a view to ensuring that automated and recommended sensors and communications facilities for meteorological and oceanographic purposes are installed on all new ships during construction. (**Action**: all members)

b. Arrange for tracking of the use of TURBO and similar software among national VOS. (**Action:** all members and PMOs)

c. Make every effort to ensure that national services prepare, and QC, delayed mode observational data sets and submit these to the GCCs according to the WMO regulations. (**Action**: all members and Secretariat)

d. Prepare and distribute to operators a questionnaire relating to observing practices and instrumentation. (**Action:** R. Fordyce, V. Zegowitz and Secretariat)

e. Analyze submissions and prepare recommendations relating to standardized observing practices. (**Action**: R. Fordyce and V. Zegowitz)

f. Prepare questionnaire, analyse submissions and prepare recommendations relating to formulae used in computational algorithms for automated and semi-automated systems. (**Action:** P. Taylor)

g. Endeavour to enhance national coordination and mutual support among PMOs, and SOOP and ASAP "ship greeters". (**Action:** all members with PMOs)

h. Where possible, arrange for national ship lists to be accessible, for reading and download, on national web sites. (**Action**: all members)

i. Ensure submission of national updates to No. 47 on a quarterly basis, with the correct information and in the correct format. (**Action**: all members)

j. Enhance automation of all aspects of shipboard procedures, from observation through to message transmission, using already available software and hardware wherever feasible. (**Action**: all members)

k. Prepare survey for a catalogue of available software packages for shipboard observations and data management, analyse results and prepare catalogue; this survey may be combined with that in 6 above. (**Action**: D. Evans with Secretariat)

l. Undertake international testing of the TurboWin software and propose refinements as appropriate. (**Action**: F. Koek, operators from Australia, Canada, France, Germany, Greece, South Africa, U.K., USA, with P. Taylor)

m. Develop and implement plan for a VOS Subset for Climate. (**Action**: Operators from Australia, Canada, France, Germany, Japan, Netherlands, U.K., USA, with P. Taylor and Secretariat)

n. Prepare VCP proposals for both shipboard equipment and PMO training and submit to WMO. (**Action**: Operators from Kenya, Tanzania and other countries as appropriate)

o. Support preparation and testing of CD-ROM for shipboard observations and training. (**Action**: Japan, Netherlands, U.K. USA with Secretariat and A. Fuller)

p. Prepare questionnaire, analyse results and propose standards for expressing visibility at sea in forecasts and warnings. (**Action**: I. Hunter with Secretariat)

q. Bring Y2K question to the attention of PMOs, and work with maritime authorities to ensure uninterrupted flow of meteorological and oceanographic data from ships over the period December 1999/January 2000. (**Action**: all members)

r. Submit updates and additional contributions to automation report to Secretariat by mid-April 1999. (**Action**: all members)

Secretariat

a. Prepare a paper for the relevant IMO bodies relating to the installation of automated, recommended meteorological instrumentation and communications during ship manufacture.

b. Arrange for a new IMO/MSC circular on the VOS, in particular referring to the revised SOLAS Chapter V.

c. Liaise with RSMC Bracknell regarding possible inclusion of additional variables in real time monitoring, as well as preparing the monthly and six monthly reports using more user-oriented terminology.

d. Provide operators and users with the IMO ship number list, and include these numbers, together with the relevant Inmarsat numbers also in No. 47.

e. Develop and distribute to operators a software package for the preparation of submissions to WMO-No. 47, in the correct format.

f. Consider the possibility of having available on the WMO web site, if possible associated with the Ship Catalogue, a facility for the submission of updates to the catalogue via Internet

g. Implement a procedure to archive all metadata information relating to VOS, past and present, on the basis of call sign or other appropriate identifier.

h. Finalize and publish rapporteur study on automated systems, updated with information to be provided by subgroup members by early April.

i. Publish catalogue of available software systems for VOS observations, either as an additional annex to the automated systems technical report (8. above) or separately.

j. Arrange for revision of the VOS Framework Document, its further review and publication.

k. Arrange for preparation, review and publication of a concise document for decision makers on the achievements, operations and potential of the VOS, in particular to support global climate studies, to be available for SBSTA (August), CLIMAR 99 (September) and COP-V (November).

l. Together with chairman, keep under review developments with JCOMM and the GOOS/GCOS Action Plan, and inform members as appropriate.

m. Continue to organize and run regional PMO workshops, in particular for RA I in 2000.

n. Publish presentations made to regional PMO workshops as a WMO technical report.

o. Liaise with CLS/Argos with a view to ensuring that all meteorological reports, in particular made by yachts in long-distance races and transmitted through Argos, are made available on the GTS.

Other groups

a. Develop an international standard code for historical VOS data. (**Action**: Subgroup on Marine Climatology)

b. Finalize project to prepare a software package for application of minimum QC procedures, for distribution to and use by operators. (**Action:** SG/MC)

c. Develop changes to BUOY code to enable all moored buoys to report on GTS in this code rather than SHIP. (**Action**: DBCP)

d. Expand code tables relating to the revised WMO-No. 47 to cover additional instrument and ship types. (**Action**: SG/MC)

e. Consider the possibilities to establish, within the context of JCOMM, a working group on VOS-based observations, to cover but not subsume, SG/VOS, SOOPIP and ACC. (**Action**: JCOMM Transition Planning Group, Secretariat and chairs of SG/VOS, SOOPIP and ACC)

f. Develop a methodology and format for including ship diagrams and/or digital ship imagery in WMO-No. 47. (**Action**: SG/MC with Secretariat)

g. Consider inclusion of an indicator in IMMT for type of software used in onboard observation and message compilation. (**Action**: SG/MC)

h. Publish Framework Document and publicity document on the VOS in appropriate place in ALRS. (**Action**: I. Spurway)

The *ad hoc* ROSE group

This group was established during CMM-XII with a mandate to stimulate the development and applications of high frequency radars for the purpose of coastal-to shelf monitoring of waves and currents. The chairman is professor Hans Graber, University of Miami, and the group is composed in one part of members nominated by WMO Permanent Representatives, and a second part consisting of HF system providers and experts. The group intend to have bi-annual meetings seeking contacts also with potential customers, such as within coastal management and port and harbour management and navigation safety.

A European based project, EuroROSE, has been funded by the EU and will carry out two major field experiments in the years 2000 and 2001, in Norway and Spain respectively. During these experiments, the radar data will be assimilated into corresponding numerical models for waves and coastal currents, and supplementary **in-situ** data will be provided to verify the radar data.

In US there will be an organized series of workshops focussing on HF radar developments and applications in close collaboration with potential users. There are also other regional or national HF expert groups around the world addressing the same issues, such as in Australia, France, Japan and Russia.

The ROSE group has started planning its next bi-annual workshop, to take place provisionally in Geneva during early 2000. The purpose of this will be to assess the worldwide applications and the potential of HF systems within the coastal framework of GOOS, and to achieve close communication with users. In particular, results from the first EuroROSE field experiment are expected to be presented at this workshop.

WORKING GROUP ON EDUCATION, TRAINING AND IMPLEMENTATION SUPPORT

PMO Workshops

The first regional workshop for PMOs, for RAs III/IV was held in Valparaiso, Chile in 1997. This workshop was to assist national Meteorological Services in maritime countries to further develop and improve efficiency and quality of their PMO services through the exchange of experiences, ideas and techniques, both with other national Meteorological Services with well-established PMO services and also with user representatives at operational and management levels. Additional workshops are planned for RA II and V in Melbourne, Australia in November 1999 and Capetown, South Africa in November 2000.

Western Indian Ocean Marine Applications Project (WIOMAP)

The First Implementation Planning Meeting of the Western Indian Ocean Marine Applications Project (WIOMAP) was held in Mauritius, May 20 –22, 1997. 8 countries and 2 organizations were represented by 23 individuals. The objective of this meeting was to explore the interest in and possibilities for a regional cooperative project, involving both meteorological and oceanographic communities, as a cost-effective means of developing improved meteorological and oceanographic data and services in support of the safety of life at sea, global climate studies and a range of other marine user interests in the Western Indian Ocean.

The meeting reviewed the present status of marine observing networks and other marine data collection activities of agencies and institutions in the region based on a survey questionnaire distributed in advance of the meeting. The meeting agreed that a detailed analysis of regional user requirements for marine data and products was absolutely essential to the success of any future regional marine project. A revised survey was prepared for this purpose.

The meeting strongly agreed on the need for such a regional cooperative project to enhance the provision of services in support of a diversity of national, regional and global users, based on improved marine data collection and exchange, data management and modeling. The concept of a specialized marine modeling and product preparation centre was noted as being relevant to the project, perhaps with various regional marine centres coexisting as part of a distributed data management and processing concept.

With regard to eventual external funding for project development and establishment, the meeting recognized the need first to develop a short project brief, which would be the basis for fostering interest among potential donors in the project concept, and obtaining funding to undertake the detailed survey and prepare the full project proposal.

The meeting supported the concept of reformulation of the proposed Nairobi course on marine meteorology on the basis of the use of modern learning techniques such as CAL. The meeting agreed that the long term specialized training in the region was directly relevant and essential to the future success of the overall project and that any future regional modeling centre would have an important training function in providing on the job training.

Wave Modelling and Forecasting

The Second Workshop on Wave Modeling and Forecasting was held in Miami in May 1997.

WMO Marine Pollution Emergency Response Support System (MPRESS)

The Workshop on the WMO Marine Pollution Emergency Response Support System (MPRESS) was held in Townsville, Australia July 16-17, 1998. The primary purpose of the workshop was to prepare specific recommendations and actions to enhance the implementation of MPERSS worldwide. The workshop carefully reviewed requirements for meteorological/oceanographic services to support marine pollution emergency response operations. The workshop also reviewed the existing WMO specifications for MPERSS and recommended a number of amendments to the specifications which were passed to the president of CMM and eventually to the Commission itself for consideration and adoption. However, many of the recommendations could be implemented directly, by AMCs and/or Supporting Services, and therefore the Secretariat was requested to contact the countries concerned in this regard.

Marine Climatology

CLIMAR 99 – WMO Workshop on Advances in Marine Climatology is planned for Vancouver, Canada from September 8-15 1999. The objectives of this workshop are to receive appropriate input for the dynamic part of the new version of the WMO Guide to the Applications of Marine Climatology, with particular emphasis on new technologies; to review the requirements of users for new marine climate products and enhanced climate information; to provide guidance and technical support for those national Meteorological Services with responsibilities under the Marine Climatological Summaries Scheme (MCSS); and to make a further contribution to the data and metadata of COADS.

Future Activities

Plans are developing for a Coastal Zone Meteorological Workshop, as well as, some specialized workshops on Marine Meteorology to be conducted in the next 2 years.

WIND WAVE PROGRAMME

The WMO Wave Programme proposed at CMM-VIII in 1981 came into existence in 1984 and its general objective is to help WMO Members in provision of high quality data as well as wave analysis and forecast services to a large variety of applications including highly specialized activities.

The Subgroup on Wave Modelling and Forecasting was re-established within CMM Working Group on Marine Meteorological Services by Resolution 2 of the Twelfth Session of CMM held in Havana in March 1997. The overall task of the Subgroup on Wave Modelling and Forecasting is support and development of the WMO Wave Programme. The subgroup was first established by Resolution 3 of the Eleventh Session of CMM held in Lisbon in April 1993. It continued the activities of the Ad Hoc Group on Wave Modelling established by the CMM-X. During the current inter-sessional period the subgroup membership is open for WMO Members. At present there are 27 members of the subgroup from 26 countries.

The subgroup terms of reference are:

a. To keep under review the implementation of the WMO Wave Programme, to assist in its implementation, as required, and to propose amendments to the programme, as appropriate;
b. To refine and assist in the implementation of the project for verification of operational wave model outputs;
c. To keep under review and propose a methodology for future updating of the Guide to Wave Analysis and Forecasting (WMO-No. 702);
d. To keep under review and provide technical advice, as necessary, on all aspects of wave modelling and forecasting;
e. To provide support to Members, as required, on operational wave modelling and forecasting, including possible preparation of appropriate software packages;
f. To provide technical advice, as required, on storm surge modelling and forecasting;
g. To liaise with IOC and other international bodies and programmes on matters within the terms of reference of the subgroup.

The work plan of the subgroup includes the following actions/activities:

a. Development of the Wave Forecast Verification Scheme and review of its implementation;

b. Provision of support and advice to Members on the development and implementation of marine meteorological services in the area of wave forecasting;

c. Review and development of a methodology for future updating the Guide to Wave Analysis and Forecasting;

d. Survey on storm-surge models, their applications and use in conjunction with other forecasting techniques, particularly in relation to the IOC/WMO storm surge project for the northern Indian Ocean;

e. Examination of the requirements for the continuation of the subgroup within JCOMM;

f. Preparation of the report to the CMM-XIII (or JCOMM-I).

Several reports are to be prepared by the subgroup on new types of data on winds and waves, on estimation of the parameters of the highest waves in a series of storms, on the status of storm surge prediction, and, possibly, some others.

The following activities related to the subgroup area of concern took place during the current intersessional period. A training workshop on Numerical Wave Analysis and Forecasting was conducted jointly with COMET, UCAR, USA, in Miami (May 1997). In 1999 the subgroup chairman provided consultations for initiation of a storm surge prediction project in Vietnam. A publication summarising lectures presented at the WMO/COMET training seminars on wave analysis and prediction (Boulder, USA, December 1995, and Miami, USA, May 1997) is being prepared by the WMO Secretariat. IOC ,WMO, and UNESCO-IHP proposed a large scale project on “Storm surge disaster reduction for the Northern Part of the Indian Ocean”.

The Twelfth Session of the CMM adopted a recommendation 4 “Wave forecast verification scheme”, in which it recommended :

a. That the wind wave model forecast verification scheme … should be further developed and formally implemented;

b. That all Members operating global or basin-scale wave forecast models should be urged to participate.

The session requested the Subgroup on Wave Modelling and Forecasting:

a. To develop further details of the scheme, for eventual consideration and adoption, on a trial basis, by interesting Members;

b. To review the implementation and operation of the trial scheme and to report on progress to CMM-XIII.

At present five centres namely ECMWF, UKMO, FNMOC, AES, and NCEP participate in the numerical wave forecasts verifications. On a monthly basis they exchange predicted wave height, wave period, and wind speed data and compare the predictions with observations made at a number of moored buoys and fixed platforms, which data are available on the WMO GTS. The basic idea of the work is to co-locate analysed, predicted and observed wave heights, 10 m winds, and wave spectral peak periods and to derive various statistical parameters describing the quality of their analysis and forecasting in different regions, during different seasons, etc. The initial results revealed some common and specific features of operational numerical wave forecasts. They confirmed, *inter alia*, strong seasonal variation of forecast errors. The comparison was instrumental in that it pointed out some weaknesses of operational model set-up that led to deterioration of forecasts. The results also have shown limitations in forecasting of wind waves associated with tropical cyclones, which were related to low quality of meteorological forcing.

At present the buoy data on wind waves is not included in the wave data assimilation scheme. Therefore it can serve as independent source of reference. If in future both surface-based and remote observations are included in the assimilation, it will be possible to increase considerably the geographical coverage of the verifications. However, additional efforts will be required to obtain unbiased and fully independent comparisons.

The centres engaged in the exchange of verification data benefited considerably from these activities because they learnt the actual skill of their forecasts and sources of most significant errors. Therefore, it is possible to state that the first trials of the scheme were successful. It is important to make the information about the wave forecast verification scheme widely known, because it will facilitate corresponding activities of the interested Members and, in parallel, will stimulate more intensive insertion of wave observations on the WMO GTS.

In the recent circular letter distributed by the WMO to the subgroup the members were asked to provide their views on the need to continue the subgroup work during the next intersessional period and after JCOMM had been established. All the subgroup members who answered the circular agreed that the subgroup work should continue. Specific recommendations were to reflect in the subgroup title that its terms of reference include storm surges and to conduct a meeting of the subgroup.

During the previous intersessional period the subgroup on waves was quite small. It was made of eight experts from seven countries. They were nominated by their respective PRs in consultation with the CMM President. The subgroup worked actively. Lack of response to a circular letter from a member used to be a rare exception rather than a rule. The Twelfth CMM session commended the subgroup work and re-established it as an open one. During the current intersessional period the subgroup is made up of 27 members from 26 countries. Unfortunately, the subgroup became considerably less active. The average response to circular letters is less than 20%. It is important to note that the terms of reference of the subgroup are mostly of technical nature, and its main function is to provide expertise and assistance in maters related to implementation of the WMO Wave Programme. Therefore the subgroup composition should be organized accordingly. The current subgroup composition mostly reflects the intention of Members to build their capacity in the area of wind wave forecasting. However, the ability of the subgroup to solve technical problems is limited. Thus, for better organization of future activities it will be useful either to modify the terms of reference of the subgroup expanding them into the area of capacity building or to come back to present scheme for nomination of the subgroup members.

Summarizing the above information and noting that the present IGOSS structure does not contain any group that would specifically take care of wind wave /storm surge data, analysis and forecasting, it is possible to make the following conclusions. For further development of the activities related to wave and storm surge data services under the JCOMM umbrella it will be instrumental to:

a. Re-establish the subgroup as a working group (or subgroup depending on the JCOMM structure) and to include the words “storm surge” in its future title;

b. Include in the terms of reference of the working group (subgroup) all aspects of wind wave and storm surge related data/services in relation to GOOS;

c. To change the title and, probably, the content of the WMO Wave Programme taking into account that it should be co-sponsored by the IOC and include aspects related to storm surges;

d. In case the essence of the subgroup terms of reference remains unchanged, it is desirable to restore the rule that the working group (subgroup) members will be experts in wind wave and storm surge modelling and forecasting who will be nominated by the WMO Permanent Representatives in consultation with the JCOMM President;

e. Reflect the specific need of many countries in development of their wave analysis and forecasting capabilities in the new JCOMM structure. If this function is associated with the group (subgroup) on wind waves and storm surges, it can be kept open.

WESTERN INDIAN OCEAN MARINE APPLICATION PROJECT (WIOMAP)

Background

It is widely recognized that a regional cooperative project, involving both meteorological and oceanographic communities is a cost effective way of developing capabilities of many countries in the provision of routine, good quality ocean data and services to meet the basic requirements of the marine users communities. This is particularly relevant to countries located in or bordering the region of the Western Indian Ocean which, on account of limited capabilities, if acting alone, cannot provide efficient and effective services for sustainable development and protection of marine resources.

Following progress in the development of a regional project in the South-East Asian region (SEACAMP), CMM-XII (Havana, Cuba, March 1997) agreed to the development of a similar project for the Western Indian Ocean. This recommendation was supported by the Twelfth Session of Regional Association for Africa (Arusha, Tanzania, October 1998).

First Implementation meeting (Mauritius, May 1997)

A first WMO/IOC Implementation Planning meeting of WIOMAP was held in Mauritius (20-22 May 1997) with the participation of Comoros, France, Kenya, Mauritius, Mozambique, Seychelles, South-Africa, Tanzania and representatives from ORSTOM and RECOSCIX. Both the Meteorological and oceanographic communities were well represented at the meeting.

The main conclusions were:

a. The need for a regional project as a regional contribution to GOOS to enhance the provision of services for the benefit of a diversity of national, regional and global users;

b. The development of a specialized marine modeling and product preparation centre with various regional marine centres for the preparation and distribution of marine products;

c. The need to undertake a detailed survey and prepare a full project proposal for submission to potential funding agencies.

Submission to GEF

A project brief, a project outline and a project time-table were subsequently prepared and forwarded to:

The Regional Coordinator for Global Warming
Global Environmental Facility
Regional Bureau for Africa, New York

by UNDP (Mauritius) in June 1997 for views and endorsement for financing under GEF with a request to provide initially some seed money for the preparation of a full project document in accordance with the GEF "Operational Criteria".

WMO also contacted in July 1997 the Coordinator for Biodiversity and International Waters of GEF to support the project. However, no response has been received so far.

Regional support

Besides RA-1, WIOMAP has also received support from other regional groupings:

a. The Southern African Development Community (SADC) during the Director's meeting of SADC Meteorological Services (Mauritius, 5-8 May 1998);

b. The Meeting of Meteorological Services of the Indian Ocean Commission (Reunion , 28-29 May 1998)

SATCC Committee of Ministers

WIOMAP was approved by the SADC Southern Africa Transport and Communications Commission (SATCC) Committee of Ministers (January 1999) as a subproject of the Meteorological project No. AAA 6.0.1 "Integration of weather and climate data, products and Information in Weather Sensitive Socio-Economic activities".

Action required

SATCC has been informed (March 1999) that funding to the tune of US $ 20,000 would be required to conduct a survey in the region and formulate a full project proposal for submission to potential donors.

This project document has to be prepared.

A regional contribution to GOOS in the Western Indian Ocean

Purpose

To support the protection and sustainable utilization of the marine environment, integrated coastal area management and the safety of life and property at sea, through the enhanced provision of operational marine products and services in the region based on greater accessibility to and operational exchange of marine data.

Objectives

a. Provide meteorological and oceanographic products and advice (sea surface and sub-surface temperature, waves, wind, currents, upwelling etc) for the sustainable utilization of the marine environment and integrated coastal area management, including in particular marine pollution and climate change response and mitigation.;

b. Promote safety of life and property in the marine environment;

c. Provide services for ocean commerce and industry, such as for the weather routeing of ships and for offshore oil production;

d. Enhance fisheries monitoring for sustainable development.

Activities

a. Coordinate existing national and regional data bases and maintain directories of data and expertise;

b. Coordinate and enhance national observational efforts in the expansion of data collection arrays, in conformity with WMO/IOC requirements;

c. Facilitate the establishment and upgrade of electronic communications for data and product exchange;

d. Design and implement an overall regional data management facility, to include existing internationally agreed data quality control procedures and guidelines;

e. Improve regional marine modeling capabilities, preparation and dissemination of meteorological and oceanographic products, to enhance prediction services;

f. Organize and implement appropriate regional marine training and capacity building programmes.

REPORT OF THE DATA BUOY CO-OPERATION PANEL

Present status of buoy programmes

During the last two weeks of April 1999, a total of 1327 drifting buoys reported through the Argos system. 740 of the buoys reported their data onto the GTS (i.e. about 56%). The remaining buoys (44%) do not report on GTS for the following reasons:

a. GTS distribution not effective yet: 15%;

b. Confidential: 8%;

c. Not relevant (tests, short duration, oil spill tracking, fishing buoy): 10%;

d. Unknown: 10%;

e. Other (technical obstacle, poor quality, ending programme): 1%

Those 1327 drifting buoys belong to operators from 20 countries, namely:

Country	Drifting buoys	GTS
Argentina	2	0
Australia	18	17
Brazil	17	9
Canada	13	3
China	4	0
France	54	34
Germany	65	10
Iceland	12	9
India	12	5
Italy	10	0
Japan	46	10
Korea	2	0
Netherlands	5	2
New Zealand	18	6
Norway	8	7
Portugal	4	0
South Africa	46	38
Taiwan	2	0
United Kingdom	89	15
USA	950	575

Moored buoy programmes for buoys deployed in the high seas are taken care of mainly by the following programmes (data are being distributed on GTS):

a. The TAO array (http://www.pmel.noaa.gov/toga-tao/home.html) ;

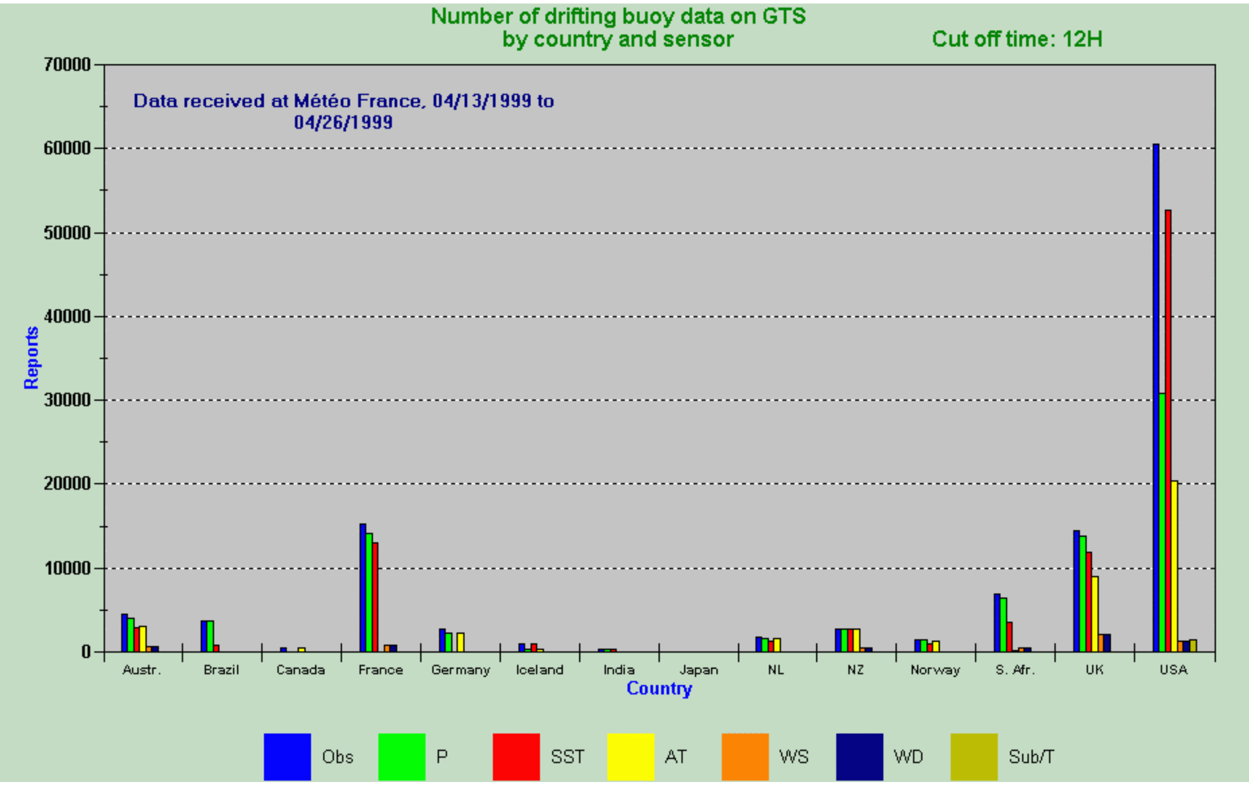
b. The PIRATA Programme (http://www.ifremer.fr/orstom/pirata/piratаus.html);

c. The TRITON Programme (http://www.jamstec.go.jp/jamstec/OCEAN/TRITON/index.html)

Among the drifting and moored buoys which are reporting on GTS, the following variables are being measured (valid for buoy data received from GTS at Météo France during the period 13-26 April 1999):

Variable	Buoys	Reports/day	Remark
Air pressure	286	5137	
Sea Surface temperature	757	6012	
Air temperature	201	2612	
Wind	91	532	Mainly moored buoys
Air pressure tendency	225	2270	
Air relative humidity or dew point temperature	70	182	
Sub-surface temperatures	88	153	Mainly TAO array moored buoys; small number of drifting buoys with thermistor strings plus
Waves			Small number of buoys

Distribution by country is summarized in the graphic below:



The DBCP supports the following Action Groups:

a. The **European Group on Ocean Stations** (EGOS, deployments in the North Atlantic): http://www.shom.fr/meteo/egos;

b. The **International Arctic Buoy Programme** (IABP): http://iabp.apl.washington.edu;

c. The **International Programme for Antarctic Buoys** (IPAB): http://www.antcrc.utas.edu.au/antcrc/buoys/buoys.html;

d. The **International South Atlantic Buoy Programme** (ISABP): http://dbcp.nos.noaa.gov/dbcp/isabp;

e. The **International Buoy Programme for the Indian Ocean** IBPIO): http://www.shom.fr/meteo/ibpio;

f. The **Tropical Atmosphere Ocean (TAO) Implementation Panel** (TIP): http://www.pmel.noaa.gov/toga-tao/home.html;

g. The **Global Drifter Programme** (GDP): http://www.aoml.noaa.gov/phod/dac/gdp.html.

DBCP session and workshop

The 14th DBCP session was held in Marathon, Florida, 12-16 October 1998. A scientific and technical workshop was organized during the first 1-1/2 day of the DBCP session. More than 50 people attended the workshop and 20 presentations were made covering subjects such as (i) innovative concepts in moored and drifting buoy design and application, (ii) applications of and scientific results deriving from buoy data in research or operations, and (iii) buoy data as a complement to remote sensing, modelling, and other disciplines. The workshop's proceedings will be published in 1999 within DBCP document series.

The 15th DBCP session will be held in Wellington, New Zealand, 26-30 October 1999.

GOOS GCOS implementation plan

The DBCP was informed of the proposals within WMO and IOC to merge the existing WMO Commission for Marine Meteorology (CMM) and the IOC/WMO Integrated Global Ocean Services System (IGOSS) into a new Joint Commission for Oceanography and Marine Meteorology (JCOMM). The Commission would be the reporting and coordinating mechanism for the DBCP and other existing bodies such as TIP, SOOPIP, etc. The panel gave its full support to the concept of JCOMM, and agreed that it should eventually use JCOMM as the overall coordinating and management mechanism for its input to and support for GOOS and GCOS.

DBCP implementation plan

The panel recognized the importance of the Workshop on the Implementation of Global Observations for GOOS/GCOS (Sydney, March 1998), of the actions taken there, and of the follow-up mechanisms put in place, to the development of a fully coordinated approach to the implementation of GOOS/GCOS and ultimately to the development of truly operational oceanography. In the context of the proposed GOOS/GCOS Implementation Action Plan, the panel recognized the value of its own implementation strategy. It therefore reviewed the most recent draft of the strategy, prepared by Mr David Meldrum on the basis of comments offered at DBCP-XIII and of the results of the Sydney workshop. It approved this draft and requested that it should be published as a report in the DBCP technical document series, as well as made available on the DBCP web site.

DBCP web server

The DBCP operates a web site (http://dbcp.nos.noaa.gov/dbcp/) which includes information regarding DBCP activities, global implementation mechanisms, status reports, quality control issues, technical developments, how to practically insert buoy data onto the GTS, data collection and location systems, application of buoy data, list of buoy manufacturers, points of contact, etc.

DBCP brochure

A brochure advertising the DBCP and its activities has been drafted and will be published in 1999.

DBCP internet forum

In May 1999, the DBCP did open an Internet forum (http://www-dbcp.cls.fr/) as a means of debating on technical issues, answering technical questions, and exchanging information among buoy operators or actors. The forum is a good complement to the DBCP web site and is directly linked to it. Documents, questions and answers can be exchanged over the forum while being accessible to anybody in the buoy community.

New DBCP publications:

The DBCP recently published the following documents within its technical document series:

a. No. 11: DBCP annual report for 1997;

b. No. 12: October 1997 DBCP Workshop's report (La Réunion).

The following documents will be published soon:

a. DBCP annual report for 1998;

b. October 1998 DBCP Workshop's report (Marathon);

c. DBCP Document No. 4 (SVPB construction manual) is being updated. The new version will be published as a DBCP publication and will be available via the web;

d. DBCP implementation plan will be published as a DBCP publication.

Argos Joint Tariff Agreement

The 18th session of the Argos Joint Tariff Agreement (JTA) was held in Marathon, Florida, USA, 19-21 October 1998. The following important decisions were taken:

a. A bonus system is still accepted. About 16% of the 35% bonus had actually been used by countries in 1998. An additional 35% (compounded) bonus is granted for 1999 if applicable;

b. Basic Tariff for standard location and data collection is maintained at 26,000 FF;

c. Maintain Argos revenues in 1999 at least at the level of 1998. Commitments to the 1999 JTA, as of 15 January 1999, should be at least equal to 1130 (1% inflation included based upon original JTA-17 bid). If below, difference will be made up through a pro rata assessment based upon percentage of bonus usage for those countries having taken advantage of this bonus;

d. A fixed monthly fee per active platform is to be enacted in the 2000 JTA and onwards;

e. A penalty charge introduced for 1999 contract for usage above 35% compounded bonus in case bonus applies and above contracted figure if no bonus applies.

REPORT ON THE STATUS OF THE GLOBAL SEA LEVEL OBSERVING SYSTEM

This report summarizes the status of the Global Sea Level Observing System (GLOSS) following the sixth meeting of the Group of Experts (GE) in Toulouse 12-14 May. The list of achievements during the past two years, following the acceptance of the GLOSS Implementation Plan (GIP) by the IOC Assembly in 1997, is an impressive one, although much remains to be done. The reader will recall that the GIP called for the development of a GLOSS Core Network (GCN) of 287 stations, a network of several 10's of sites for ongoing altimeter calibration (GLOSS-ALT), a programme of investment in gauges with geodetic equipment (especially GPS) at sites with long records (the –LTT, or long term trends, set), and the use of gauges at straits and other strategic locations for ocean circulation monitoring (the –OC set).

GCN status from a PSMSL viewpoint (October 1988)

For the last few years, the PSMSL has provided a summary of the status of the GCN from its viewpoint. An 'operational' station from a PSMSL viewpoint means that recent Mean Sea Level (MSL) monthly and annual values have been received at Bidston, have been checked as far as possible, and have been included in the databank. For each of the GLOSS stations, we have used the year of the last data entered into the databank, if any, to place the station into one of four categories:

a. Category 1: 'Operational' stations for which the latest data is 1994 or later;

b. Category 2: 'Probably operational' stations for which the latest data is within the period 1984-1993;

c. Category 3: 'Historical' stations for which the latest data is earlier than 1984;

d. Category 4: For which no PSMSL data exist.

The numbers in categories 1, 2, 3 and 4 as of October 1998 were 183, 48, 20 and 36 respectively, representing a slow but steady improvement over previous years. Figure 1 demonstrates that further investment is required in remote areas (e.g. Antarctica), Africa and South America.

GCN operational and non-operational Stations Survey (December 1998)

In December, a detailed survey was conducted of the 287 stations of the GCN to determine which gauges were operational or not as of the previous February, the deadline for receipts of questionnaire replies from national authorities as part of 'GLOSS Handbook' updating. The replies were supplemented by 'PSMSL general knowledge' in the case of non-replies.

Of the 287 sites in the GCN (defined by 'GLOSS97'), only 42 are claimed to be non-operational (Figure 2). It is clear that action must be taken by national authorities to instrument the sites in order to complete the network. If national resources are limited, the authorities should be endeavouring to install equipment through bilateral links or possibly by making requests for second-hand equipment through IOC. Alternatively, if a site cannot feasibly be instrumented, perhaps owing to environmental conditions, then IOC should be notified so that it can be reviewed for removal from the definition of the GCN at the next revision of the network.

Reconciliation of the statistics of the previous two sections

It is clear that Figure 2 presents a more optimistic view of GLOSS status than do the statistics compiled from the PSMSL in Figure 1, a situation which requires investigation. One reason is that at some 'operational' locations (e.g. Tristan da Cunha and some Antarctic sites), the gauges take the form of simple pressure transducers which provide useful information for oceanography (e.g. for the World Ocean Circulation Experiment) but which do not supply MSL data, as conventionally defined, which can subsequently be submitted to the PSMSL. This situation is understandable and tolerable if there are good environmental or technical reasons for such a choice of technology.

However, a second reason is that while an ‘operational’ gauge might exist and be providing data of some kind, the expertise or facilities or manpower do not exist in order to process those data routinely and deliver them to the international community. This situation is not an acceptable one, as it clearly requires some kind of investment in hardware, software or training. The job of IOC/GLOSS is to remedy such situations as far as possible.

Higher Frequency Data (HFD) Availability and Real Time HFD

A survey by Dr. Lesley Rickards on the availability of HFD (typically hourly values) from the GCN, available either at international centres or on national servers as required by Chapter 7 of the GIP, was presented to the GE6 meeting. Altogether, there are approximately 200 tide gauge sites which have some form of HFD on-line. For some of these, real-time plots of the data are available, but not the data values themselves. Most of the remainder have hourly values available on the web from one or both of the WOCE Sea Level Data Assembly Centres (at UHSLC and BODC/PSMSL), but obviously some of these are duplicated at national sites. Eighty-five GLOSS stations report to the WOCE ‘Fast Delivery’ DAC at the UHSLC (see below), with data usually available within one to two months of data collection.

GLOSS-ALT status

During the GE6 meeting, a review was given of the use of tide gauges equipped with GPS or DORIS geodetic equipment as ‘tide poles’ for the ongoing calibration of altimeters (GLOSS-ALT). This work has been led in particular by Dr. Gary Mitchum with contributions from several other groups. The developments are so significant that to a great extent we may call GLOSS-ALT operational. A journal paper is in preparation.

GPS at tide gauges

Two of the three workshops held in Toulouse prior to the GE6 meeting were concerned with the development of GPS at gauge sites for use by GLOSS-ALT and –LTT. This important topic has been led by Dr Mike Bevis, following the PSMSL/IGS GPS Workshop in Pasadena in 1997. Much has been learned over the past two years on how to operate GPS at gauges, and a ‘Manual’ on how to conduct such operations will be produced before the end of the year, including a number of case studies.

GLOSS Fast Delivery

The GE6 discussed in some detail the work of the two World Ocean Circulation Experiment (WOCE) Sea Level Centres (Fast Delivery and Delayed Mode), and congratulated them on their work during the WOCE programme. It recognized that the model of two centres working together had been a successful one, and the meeting recommended that the Fast Centre at the University of Hawaii continue and extend its work as the ‘GLOSS Fast Delivery Centre’. The Group further urged the two WOCE Centres, and other international and national sea level centres, to work towards as far as possible a ‘seamless’ GLOSS scientific sea level data set in line with Chapter 7 of the GIP.

The need for real time data, for science programmes (e.g. assimilation or altimeter calibration) but also for more efficient data gathering and quality control, was a special theme at GE6. Experiments in South Africa and the UK have established the utility of relatively inexpensive shaft encoders attached to modems for the digitization of information from conventional float gauges, and a special effort will be made to arrange all authorities to go ‘real time’ in the near future.

IOC/GLOSS training courses

Two IOC/GLOSS training courses have been held in the last two years. The first was at the Proudman Oceanographic Laboratory (POL) during June 1997 for sea level scientists from Mediterranean and Black Sea countries. The second larger GLOSS training course was held at the University of Cape Town (UCT) during November 1998. The opportunity was taken to also discuss plans for action in east, south and west Africa as part of GLOSS and of the Global Ocean Observing System (GOOS) for Africa. This topic formed a large part of the discussion during GE6. A further training course is planned at the University of Sao Paulo, Brazil in September 1999.

GLOSS training materials

Several sets of tidal analysis software continue to be widely distributed and play a major role in improving data quality and timely delivery. The IOC Manuals and Guides No.14 on methods for operating gauges will be re-written and updated during 1999. Several GLOSS-related CDROMs have been produced over the last few years and data products continue to be made available via the web.

Newsletters and brochures

There have been six issues of the GLOSS Bulletin on the web and a seventh is in preparation. The Afro-American GLOSS News (AAGN) also continues to be produced regularly. This newsletter has articles mostly in Spanish and Portuguese, and has been produced by the University of Sao Paulo on paper and on the web. At GE6, it was recommended that the AAGN be co-produced with the UCT so as to represent African interests the more. An updated two page brochure advertising GLOSS has been produced by the PSMSL with 2000 copies printed for circulation in the UK. We hope that others will be printed by UNESCO and that GLOSS National and Regional Contacts will arrange for printing in their own countries.

Sea level requirements of the GOOS Coastal Module

Dr E. Marone (GOOS Coastal Module Vice Chairman) reviewed during the GE6 meeting the status of C-GOOS and in particular the concept of a GOOS network being developed by Prof K. Thompson which would have major sea level requirements for hardware and training. Joint training was suggested throughout GLOSS/C-GOOS with representation on each other group's panel. The possibility was suggested into the use of data loggers at gauges to record other parameters of interest.

GLOSS GE and Subgroup developments

Also during the GE6 meeting, the Group endorsed the 'ex officio' right to membership of the GE by the Directors PSMSL, UHSLC, NTF, WOCE Centres, IAPSO/CMSLT, IGS and other future appropriate bodies, although it was emphasized that this list was not exclusive or exhaustive. This extension of the GE could have the benefit of increasing the number of people well-briefed about GLOSS who will be able to represent the programme at international meetings.

In addition, discussion took place on a proposal that a subgroup of the GE be formed as a source of scientific advice, especially for climate, with the subgroup potentially a joint committee with (at present) OOPC, CLIVAR/UOP and IAPSO/CMSLT. The Group endorsed the concept, and recommended that a second subgroup be considered in consultation with C-GOOS with regard to coastal sea level aspects.

More information

The reader is referred to the meeting report of the GE6 meeting in May 1999, which provides a good overview of current GLOSS activities. Copies should be available in St Petersburg. The report contains an excellent set of recommendations and intended actions for the next two years which should carry GLOSS forward into the next decade.

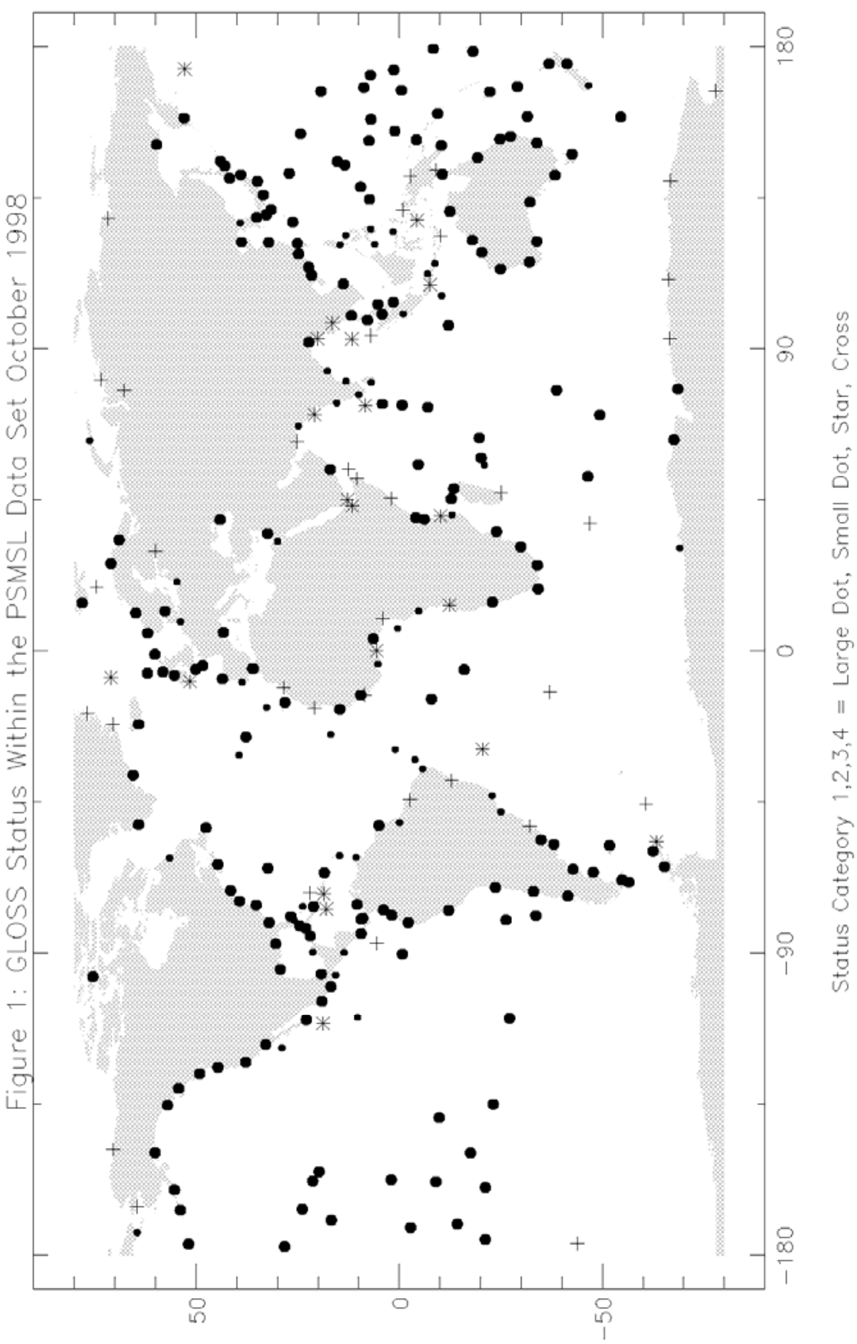


Fig 1: GLOSS Status Within the PSMSL Data Set

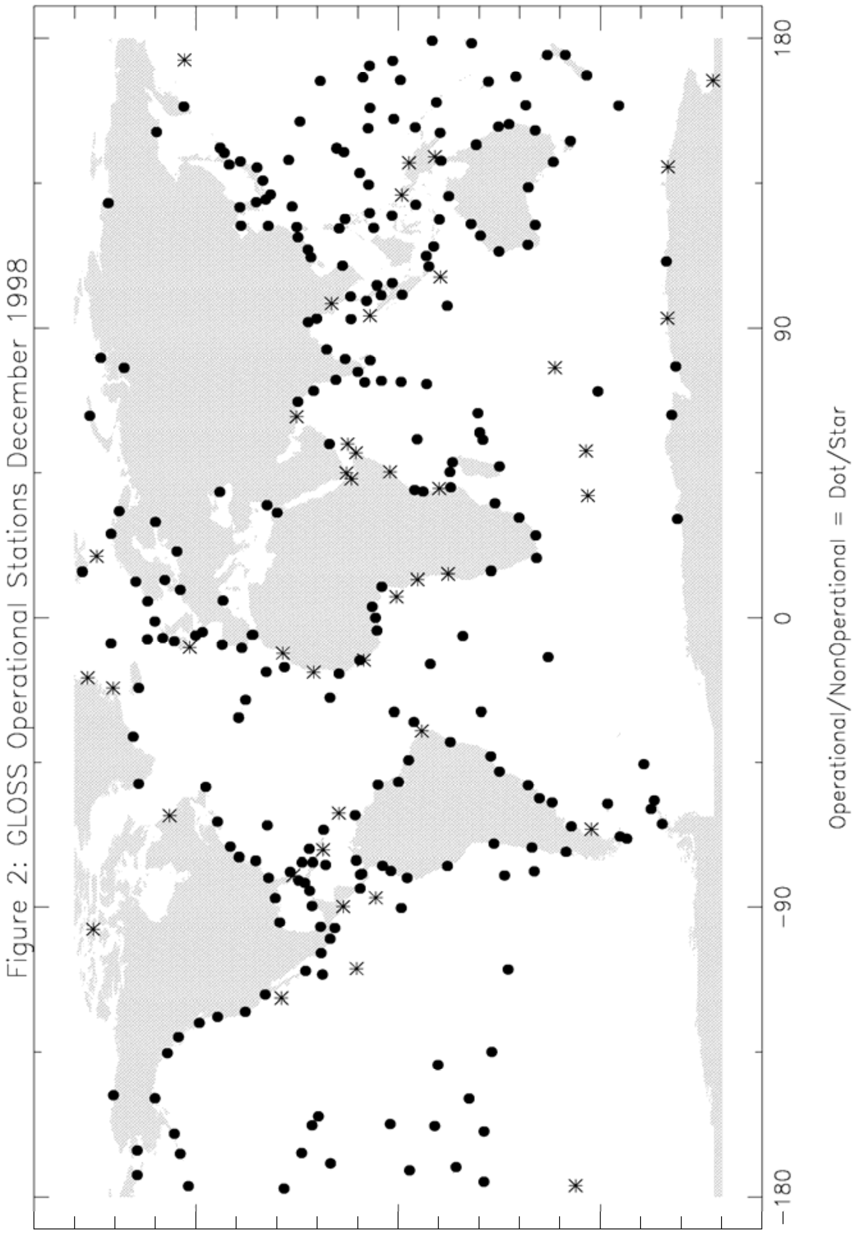


Figure 2: GLOSS Operational/Non-Operational Stations

REPORT ON THE STATUS OF THE GLOBAL TEMPERATURE SALINITY PROFILE PROGRAMME

Present status of the programme

The Global Temperature Salinity Profile Programme (GTSPP) was planned and developed in 1989 and 1990 as a pilot project of the IOC Committee on International Data and Information Exchange (IODE) and the Joint IOC/WMO Committee on the Integrated Global Ocean Services System (IGOSS). The pilot project became operational in November 1990. In January 1996 the Fifteenth Session of the IODE concurred with a similar decision by the Seventh Session of the IGOSS, and GTSPP became a permanent programme of the two committees. The most recent version of the GTSPP Programme Plan was published by the IOC in 1998. The plan describes the status of GTSPP and plans for future development.

GTSPP was designed to serve both operational and research needs. It was designed as an end-to-end system that serves users at all time scales from a few hours to years and decades. The first users of the temperature and salinity data are the numerical weather prediction (NWP) centres. NWP centres receive most of their data from the GTS. GTSPP is not involved in this data flow. The GTSPP contribution here is to increase the amount of data available by encouraging the submission of data to the GTS by national and international organizations. GTSPP receives operational data from the GTS as does the NWP centres, and provides services to users within time frames of a few days rather than a few hours. This enables these users to take advantage of the improved quality control offered by the GTSPP centres and of the duplicates identification and management algorithms that provides the best quality and most complete databases at any point in time after the first few days after the observations were taken. For more details of these and other innovations see the GTSPP Programme Plan.

In fact the GTSPP was designed to be the model of the type of end-to-end data management system that it was anticipated would be required by the Global Ocean Observing System (GOOS). GOOS was being planned at the time GTSPP was being developed. Since then the GTSPP has been identified as an element of GOOS and has also been accepted as a model for GOOS end-to-end data management systems.

Since the start of GTSPP, WOCE has moved to the assimilation and modeling stage, SOOP is being expanded to extend coverage of the WOCE lines, the initial operational system (IOS) for GOOS has been defined, and CLIVAR and GODAE are being planned. All of these programmes have requirements for temperature and salinity profile data. GTSPP is an important contributor to SOOP and is recognized as having an important role to play in support of several GOOS activities. It is also likely that GTSPP will provide support to the GODAE and CLIVAR programmes. Representatives of GTSPP are currently discussing the role it can have in the ARGO programme.

Fundamentally, GTSPP provides the infrastructure to move observations from platforms at sea to users. It provides support services such as data tracking, data quality assessment, and feedback to data suppliers on recurring data errors. It also provides a suite of data products, largely through the work carried out by the science partners. GTSPP ensures that the data reaches the archives of the IOC/World Data Centre Systems for future users.

At present GTSPP concentrates its efforts largely on temperature and salinity profile data. Other measurements are managed if they accompany temperature and salinity observations. However these other observations are not passed through quality control and products are not prepared from them. GTSPP has concentrated on temperature and salinity because that was the WOCE and initial GOOS requirements. As other data flows are developed to include other variables there will be the option of implementing additional separate data flows or of expanding the expertise and participation in the GTSPP to fully manage these other variables as for temperature and salinity. Choices between the two options will depend on the benefits of each of the choices.

For example benefits for expanding GTSPP could include maintaining an integrated data set that would not have to be recombined later, minimizing software development for decoding data, QC, analysis, communications, taking advantage of existing operational flows, etc. As new requirements for data flows are identified, the pros and cons of new flows versus expanding existing ones will have to be examined, decided, and implemented.

GTSPP depends on the active support of IOC member states and WMO members. Annex A contains a figure of the GTSPP data flow. There is a hyperlinked version of the figure available at the web address http://www.gos.udel.edu/goos/GTSPP.htm The boxes and ovals on the hyperlinked version can be clicked for detailed information on the centres, users, or the data streams.

Canada manages the real-time data flow. The United States supports the main database for the GTSPP and two of the three science centres are in the United States. Australia provides support as a science centre for GTSPP. Germany and Japan provide real-time data that augments the data flow received directly by Canada. Other member states of IOC, such as China, are involved by providing data to the delayed mode archives. The strength of this approach is the division of labour to share the workload and achieve efficiencies by moving the data to where the expertise and software exists to perform the task that is required at that point in the data flow. The weakness is the need for coordination and the problems that can arise if one of the participants leaves the programme. A certain degree of redundancy is needed if a programme is to be resilient to changing participation.

The data flow diagram in Annex A shows contributors of data, data flows, the participating centres, and has some information about products and users. It demonstrates the principles of an end-to-end data management system, the exploitation of expertise where it exists, and the sharing of a workload among a number of centres.

Further development of the GTSPP

GTSPP will continue to concentrate efforts on expanding the capture and improving the management of temperature and salinity profile data. The success that it has had is partly because of this sharp focus.

Where other variables are measured in conjunction with T and S, GTSPP manages these in a prudent way, being sure that no information is lost. If profiles of new variables start to be exchanged in real-time, GTSPP will take the view that the new variables should become part of GTSPP unless there are very strong reasons why this should not happen. Handling new variables may require GTSPP to expand its area of expertise, but the mode of management of the variable is likely to be sufficiently similar to that needed for T and S that the extension will need incremental resources rather than a significant influx of new resources.

There is still work to be done to make sure that all of the delayed, high resolution data reach the GTSPP archives. Improvements can be made in actively reviewing real-time receipts and pursuing the original high resolution data. GTSPP will encourage more IOC member state participation and adherence to the IODE principles of data exchange to ensure the timely availability of more profile data. In particular, this improved cooperation will have a positive impact on the acquisition of more high resolution profiles. The revised project plan contains a number of suggestions.

GTSPP will also continue efforts to demonstrate the value of improved quality assessment. Scientific guidance at the start of the project strongly endorsed the manual inspection of profiles as part of the QC methods. GTSPP needs to implement newer techniques that will relieve the resource costs of the manual scrutiny by developing automated QC procedures that perform more reliably than current procedures.

GTSPP will not take on new variables, or T and S measurements from instrumentation that provides data in substantially different structures from data managed as profiles. An example would be satellite SST fields. Different measurement techniques require significantly different handling, quality assessment techniques, data tracking, and generate different products. In other words the development of a whole new suite of software and perhaps expertise will be required. Rather than load these large new demands on an existing project, it is wiser to initiate a new project. This will allow other member states to play a role.

The GTSPP strategy was to develop a comprehensive plan to manage a particular data type, then to seek participants with the expertise and resources to share the work. The result has been good cooperation between data centres and researchers. A closer working relationship between data managers and scientists has meant a better appreciation by each of the other's role. It also meant direct influence on how each other carries out their tasks. This cooperation is essential to a smoothly operating GTSPP and must be maintained.

GTSPP will work with new science and operational oceanography programmes, and in particular with the GOOS modules and regional programmes, and with CLIVAR. The new programmes will have requirements different from existing clients, but for GTSPP to continue to be relevant and active, it must continue to be useful and responsive. This may mean adjustments in the kinds of tools needed, and perhaps some extensions to the data handled. At the same time, care will be taken to ensure that the focus of GTSPP is not lost nor are resources too few to properly meet requirements.

GTSPP will continue as a discernible IOC-WMO programme whose function is to provide the infrastructure for moving data from observers to users, as quickly as possible, at the highest possible resolution and quality and, with its participating science centres, to provide scientifically valid products based on the data. Both the provision of data and the creation of products are results from GTSPP that need more visibility.

Management of the GTSPP

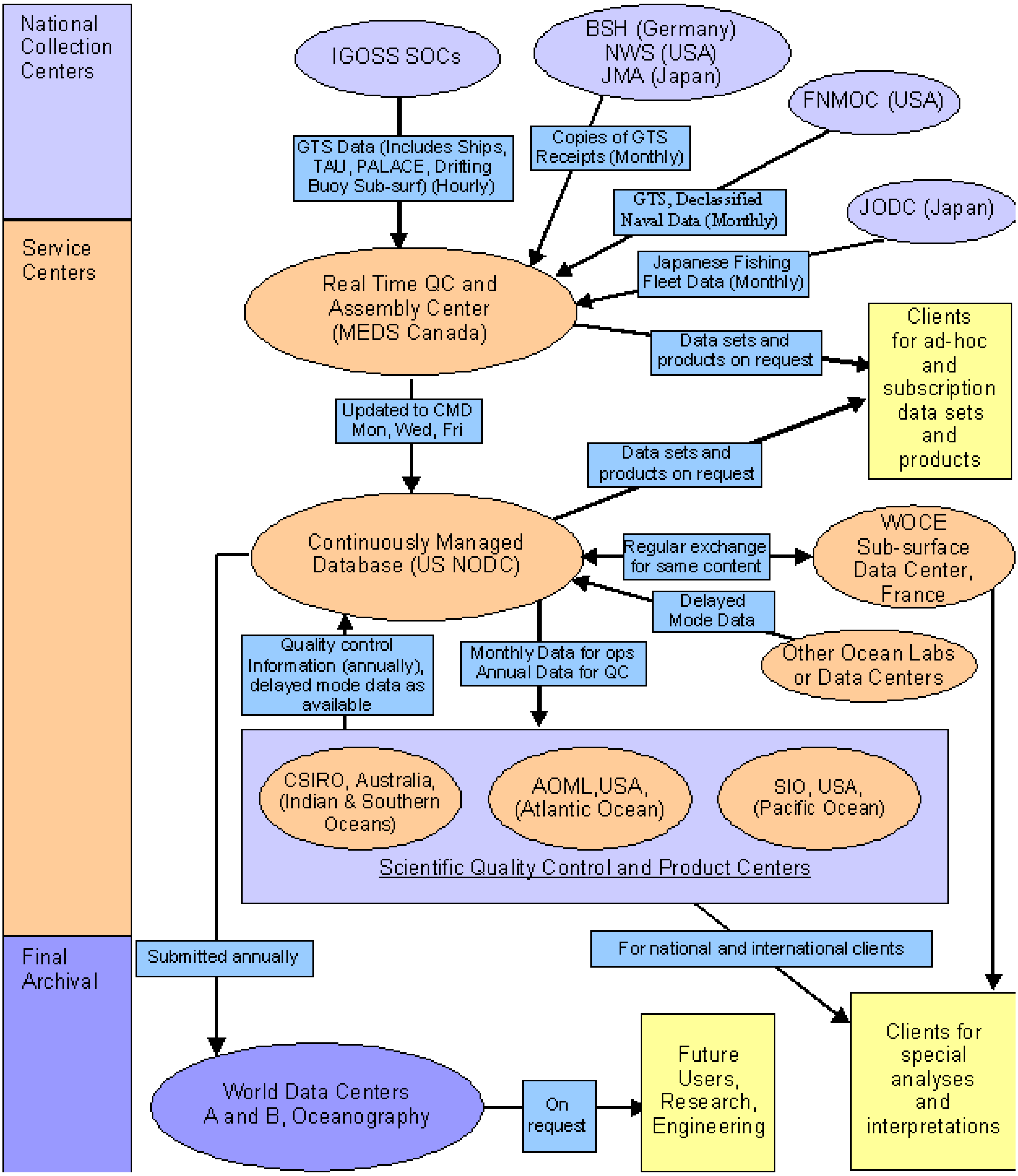
The development and implementation of the GTSPP was overseen by a Steering Group established for that purpose. The fourth session of this Steering Group was held in Washington in April 1996. At that session it was noted that implementation of the programme had progressed to the point where it no longer needed the full attention of such a steering group. At the same time there was a need to implement other end-to-end data management systems in IGOSS and IODE for other variables and for other modes of data collection such as sea surface temperature. It was therefore recommended that the Steering Group for the GTSPP become the Steering Group for IGOSS-IODE End-to-End Data Management Systems.

This recommendation has been accepted by the IODE Officer's Meeting, and by the IGOSS Bureau. The consultant's report that resulted in the establishment of the JCOMM noted the establishment of the new Steering Group and recommended that it become a joint IODE-JCOMM body reporting to IODE and JCOMM. This new body has not yet met. The transition meeting on JCOMM to be held in St Petersburg should review the situation and make a decision on an agenda, participation, and location for a first meeting of the IODE-JCOMM Steering Group on End-to-End Data Management Systems.

In the meantime GTSPP participants have held two ad-hoc meetings taking advantage of attendance at other meetings to address day-to-day problems with the data flows. These types of meetings do not require resources or staffing by IOC or WMO and can be very useful to address problems with operational systems. They should continue and be encouraged.

Annex: A

The GTSPP Data Flow



REPORT OF THE AUTOMATED SHIPBOARD AEROLOGICAL PROGRAMME COORDINATING COMMITTEE

For the first time, the number of radiosoundings taken in the frame of the Automated Shipboard Aerological Programme (ASAP) has dramatically decreased in 1998, by approximately 13%. The total number of ASAP units operated dropped from 24 in 1997 to 20; the operators are: Denmark (2 units), France (4 units), Germany (4 units), Japan (6 units), Russia (2 units), Sweden-Iceland (1 unit) and the United States (1 unit).

The operational statistics provided by the operators for 1998 and the previous years are summarized in Table 1 and Figure 1. This report consists of the individual national reports and of reports provided by ECMWF and EUMETSAT.

The ASAP Co-ordinating Committee (ACC), which consists of a group of national operators along with ECMWF and EUMETSAT, held its annual meeting, ACC-X, in Copenhagen, Denmark, 30 September-2 October 1998. The operators were represented by five countries, Denmark, France, Iceland, Sweden, and the United Kingdom. Both ECMWF and EUMETSAT participated in the meeting.

The total number of ASAP soundings in 1998 corresponds approximately to the number of soundings which could be performed annually by 6 ocean weather ships. Their geographical distribution is presented in Figure 2. It displays the location of all the TEMP SHIP messages which were received in Toulouse, France, last year. Clearly, most of the soundings were taken in the northern Atlantic Ocean.

Within the North Atlantic a further expansion is expected in the coming years. The United Kingdom will start operating an ASAP on a route between London and Montreal. Under EUMETNET, which is a network grouping of 18 European national meteorological services, it is planned to start an optional pilot programme on ASAP, called E-ASAP. Its purpose is to establish two ASAPs, one on a route within the Mediterranean, the other on a route between the English Channel or the Irish Sea and the Eastern Seaboard of North America. E-ASAP will be funded by the EUMETNET members taking into account existing activities providing upper-air profile data from the oceans.

In order to expand the ASAP globally, the future work programme of the ACC includes promotional visits to selected countries in the Southern Hemisphere to encourage and assist implementation of ASAP in these data sparse ocean areas, possibly under some sort of joint funding scheme.

Table 1. Statistics on ASAP units operated during 1998

Operator	ASAP units	Number of soundings	Average terminal sounding height (gpkm)	Percentage of data on the GTS
Denmark	2	701	19.9	98%
France	4	1364	22.4	99%
Germany	4	1139	20.2	72%[1)]
Japan	6	956	22.0	100%
Russia	2	209	24.1	89%
Spain	1	[4)]		
Sweden-Iceland	1	265	20.9	84%
United Kingdom	1	[4)]		
United States	1	167	21.6	[3)]
Total or average	22	4801	21.4	91%

1. Data only partially available
2. Based upon reports received at ECMWF as published in the monthly ECMWF report (only those also reaching 100 hPa)
3. Information not available as of May 1999
4. No activity reported

(2nd final version, KH/DMI, 3 June 1999)

REPORT ON PROGRESS WITH COASTAL GOOS

The following paragraphs report on progress in C-GOOS. Given the importance of capacity building to the successful design and implementation of C-GOOS, the C-GOOS Panel decided at its first meeting to conduct its business in developing countries and to begin each panel meeting with a 1 day stakeholders' workshop. The stakeholders' workshops have enjoyed limited success to date, but through them the panel has developed a much greater appreciation of what will be required for developing nations to participate in and gain from C-GOOS. C-GOOS-II was held in Curitiba, Brazil (October 29-November 1, 1998), and C-GOOS-III was held in Accra, Ghana (12-15 April, 1999).

Stakeholders' Workshops

The stakeholders's workshop in Curitiba was organised around two general issues: (i) social and economic needs, and (ii) operational oceanography.

These discussions set the stage for the development of two C-GOOS Pilot Project proposals: (i) a storm surge forecasting system for the east coast of South America and (ii) a coastal current forecasting system for the west coast of South America.

The stakeholders' workshop in Accra was organised in three main sections: background, regional issues, and discussion. Presentations covered coastal hazards, oil and gas exploration, fisheries, the Gulf of Guinea Large Marine Ecosystem (LME) project, sustainable management of the west Adrian coastal ocean, and GOOS-AFRICA.

Recommendations stemming from the meeting included the following:

a. involve stakeholders, NGOs, and scientists in the design and implementation of C-GOOS;
b. network nations and institutions to collate and disseminate existing data relevant to C-GOOS (e.g. SST data);
c. build capacity to collect and analyse basic information on tides and SST;
d. improve electronic communications including access to Internet and to data on regional and global scales including satellite down-links;
e. assist GOOS-AFRICA to standardise measurements, and procedures for develop procedures for quality assurance and data management;
f. support GOOS-AFRICA to enable it to promote development of GOOS in Africa.

The GSC recognised the importance of involving stakeholders in the design process from the beginning, but acknowledged that in practice it was proving less easy to get participation from industry than from government users.

Panel Meetings

Much the C-GOOS-II meeting was taken up with briefings on programmes relevant to the terms of reference of C-GOOS. Although these were informative they raised concerns among panel members that C-GOOS might be redundant. It was agreed that there is a real need for coordination and focus which C-GOOS can provide. The Panel began to develop a strategic design plan. The design envisages the global coastal ocean observing system as a sustained integrated measurement programme monitoring a core set of key properties and processes common to a significant number of issues or indicators of change. The purpose of the system would be to:

a. resolve patterns of variability on scales relevant to the problems of interest (eg bottom water hypoxia, HABs, loss of tidal wetlands, decline in fish stocks, coastal erosion, etc);
b. document the global extent of local to regional patterns in these indicators of change;
c. provide the larger scale perspective required to distinguish between locally generated patterns and those generated by regional to global scale forcings;

d. enable more robust, global interpretation of results from research programs like LOICZ, GLOBEC and GEOHAB), by providing the larger scale spatial and temporal context needed to interpolate among sample sites and extrapolate to other systems.

The global observing system provides a framework for pilot projects which are intended to be the building blocks of a fully integrated and sustained C-GOOS. The Panel identified a set of pilot projects and a pilot project format incorporating the C-GOOS design process. Pilot projects must serve at least one of the following purposes:

a. develop and refine the C-GOOS design process;
b. identify core variables for the global network;
c. carry out enabling research to develop new technologies for the operational observing system;
d. develop models needed to translate data into useful products;
e. show the utility (proof of concept) of the GOOS, end-to-end, user-driven approach.

The Panel recognised that much of what is required for an integrated observing system in coastal waters is not yet operational. It was recognised that research programmes (like LOICZ) provide the scientific basis for C-GOOS and are important to its design, implementation and evolution, through identifying core variables and through enabling research.

At the C-GOOS-III meeting in Accra the Panel reviewed and evaluated the global network design and agreed on a preliminary design strategy. It also reviewed and evaluated the pilot project proposals and identified a short list of proposals to take to the full proposal stage. It identified high priority joint projects with other groups like OOPC, GLOSS, GTOS and LOICZ. And it agreed on the content and organisation of the strategic C-GOOS plan.

The elements of the Initial Global Network will be: (1) satellite remote sensing; (2) an enhanced global network of tide gauges (GLOSS +); (3) enhanced arrays of instrumented moorings and fixed platforms; (4) voluntary observing ships (VOS), like ferries; (5) Coastal Ocean Watch (a network of coastal laboratories).

Key properties and processes to be monitored by C-GOOS include: winds; air-pressure and temperature; waves; freshwater inputs; ambient noise; atmospheric deposition; water level; bathymetry; currents; sea temperature and salinity; colour (proxy for phytoplankton biomass); nutrients; suspended solids and turbidity; pCO2 and oxygen; plankton species; zooplankton biomass; benthic species and biomass; recruitment indices; stock assessment; and chemical contaminants.

The operational system will address the key issues defined by the Panel in consultation with users. Measurements will be routine, sustained and systematic. The system will be multi-disciplinary and multi-scale. It will commonly require observations that extend beyond national boundaries, thus involving multi-national coordination and collaboration. It will integrate data collected on different space and time scales and from disparate sources, including remotely sensed and **in-situ**. It will meet the requirements of multiple users and be adaptable to changing needs. Finally, it will be reviewed periodically to ensure cost-effective delivery of useful products.

C-GOOS will use indices to provide quantitative measures of the current states of coastal systems and of their vulnerability to change, and of likely future change. The following indices are under consideration: (1) A Risk Index - to assess the probability that a particular event will occur or have a certain impact; (2) A Vulnerability Index - to assess the capacity of an ecosystem or region to "bounce back" following natural perturbation or anthropogenic stress; and (3) An Ecosystem Health Index - to assess the extent to which an ecosystem or region has been degraded or stressed by anthropogenic activities. More detail will be available in the report of the meeting.

Review of the 12 pilot projects identified at C-GOOS-II led to agreement that 6 projects in two categories should be developed to full proposals for implementation. In the biodiversity and habitat category they are: (i) Western Pacific biodiversity, and (ii) PhytoNet. In the coastal circulation and natural hazards category they are (iii) eastern South Pacific coastal currents, (iv) western South Atlantic coastal hazards, (v) west Africa, and (vi) Vietnam coastal hazards.

At its Accra meeting the Panel agreed on the basic ingredients of a strategic plan for the Coastal Module. Inter-sessional actions focus on (i) fleshing out the design of the Global Network; (ii) finalising the design of the 6 selected pilot projects; (iii) developing key collaborations (with GLOSS, OOPC, GTOS and LOICZ; and (iv) developing mechanisms for sustaining and enhancing C-GOOS.

Coordination and Interaction Among Modules

During the GSC-II meeting representatives of the C-GOOS, HOTO and LMR Panels met to agree on steps towards the eventual merger of HOTO, LMR and C-GOOS. From the reports of the three panels to GSC-II, they identified some cross cutting issues that should be addressed through joint inter-sessional panel activities in preparation for the integration of the three panels, and they developed a timetable for the merger.

Contaminant transport

Contaminant transport from coastal drainage basins to coastal waters must be addressed before an integrated implementation plan can be formulated. The HOTO Panel will take the lead in addressing this issue.

Coastal fisheries and habitat

The LMR Panel will expand its effort to include the fisheries of coastal seas (estuaries, sounds, seas, EEZs). The C-GOOS Panel is currently addressing habitat issues in terms of habitat loss and modification and the cause of such changes.

Indices of stress and response status

The HOTO Panel will take the lead on this issue. The first step is to formulate guidelines for the identification and development of indices.

Timetable for the Integration of HOTO, LMR and C-GOOS

a. Fall-winter 1999: LMR and C-GOOS complete strategic design plans;
b. Winter 2000: chairs and technical secretaries meet to develop a framework for merging the 3 panels;
c. Spring 2000: LMR and C-GOOS Panels meet individually to formulate preliminary implementation plans and evaluate merger plans;
d. Spring 2000: preliminary merger plan presented to GSC-III for discussion and guidance;
e. Fall 2000: GOOS Integrated Plan for the Coastal Ocean (GIPCO) meeting to formulate integrated design and implementation plans for GSC review.

Report on the Second LMR GOOS Panel Session

One year after its first session, the Living Marine Resource Panel met on 22-24 March 1999 at the facilities of the Institut de Recherche pour le Developpement (IRD) in Montpellier, France.

The Panel has established links with a variety of organizations and programs whose activities bear upon development of a global monitoring system for living marine resources. Those which reported included the International Council for Exploration of the Sea (ICES), the North Pacific Marine Science Organization (PICES), the Sir Alister Hardy Foundation for Ocean Science (SAHFOS), the

Census of the Fishes program of the Alfred P. Sloan Foundation, and the Global Ocean Ecosystems Dynamics Program (GLOBEC) of the International Geosphere-Biosphere Programme (IGBP).

A principal task for the Panel was to move beyond the generic list of ecosystem components and conditions for which information is desired toward the design of an operational monitoring system and identification of the products that could be derived therefrom. Since the first meeting, panel members had submitted information on regional monitoring protocols, and task groups at the meeting reviewed the submissions and prepared what might be called a Phase 2 listing of observables and products (attached). The next step in progressing towards Phase 3 will be to apply the Phase 2 protocol in selected regions, based on the experience of panel members. An example, for the oceanic region off Chile, will be included in the meeting report.

The development of products from observations is effected by means of simple or complex models. At present there are no generally accepted models whereby observations of relevant physical; and biological variables can be used to forecast abundance and availability of living marine resources. The development of such models is a prerequisite for the success of an LMR monitoring system that is to generate products desired by users. The ability to apply such models is an important element in the capacity building necessary for achievement of LMR goals.

Reports were made on several retrospective experiments in which the use of available monitoring information was tested to see if major ecosystem changes could have been predicted. These included work in the Black Sea, northwest Pacific, and the coastal upwelling system off California and Mexico. Particular attention was given to such an experiment on the eastern Scotian Shelf where major changes in cod stocks occurred; a report on this experiment will be included in the meeting report. Other experiments are still in progress, and the possibilities of additional experiments, for example off Chile and in the Gulf of Alaska, are under consideration.

Two on-going monitoring projects, the SAHFOS Continuous Plankton Recorder (CPR) survey and the ICES International Bottom Trawl Survey, both in the North Atlantic, were recommended for incorporation in the GOOS Initial Observing System (IOS). Other such projects, such as the California Cooperative Oceanic Fisheries Investigations (CalCOFI) and Southern Ocean monitoring in connection with the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) will be considered at the next meeting. Other possibilities may become apparent when IOC has completed its compilation of significant monitoring and assessment programs requested by LMR-GOOS at its last meeting.

The Panel was informed of development of the FAO Fisheries Global Information System (FIGIS) which could do much to answer the Panels concern about the need to bring together national and regional analyses of fisheries data in order to assess population changes in the upper trophic levels of marine ecosystems.

Pilot projects have been proposed in order to demonstrate the concept of monitoring from the living marine resource point of view. Those in connection with the Global Environment Facility (GEF)-funded Large Marine Ecosystem (LME) monitoring and assessment projects and with large scale GLOBEC projects, such as those concerned with small pelagics and with the Southern Ocean, seemed promising. In the PICES region, work was described in the northwest Pacific that could constitute an LMR pilot project, as could a northeast Pacific plan being developed for use of the CPR.

The Panel agreed that a third meeting, in late 1999, would be required to bring its work to the point where coordination with that of C-GOOS and HOTO, proposed for April 2000, would be practicable.

Health of the Oceans (HOTO)

The HOTO strategy is well developed, and has been well reviewed externally. Individual countries are now asking HOTO for help in designing national monitoring plans based on the strategy. HOTO continues to have strong links with the GIPME (Global Investigation of Pollution in the Marine Environment) programme.

There has been no HOTO meeting since HOTO-IV in Singapore in October 1997. A HOTO meeting, on sustainable development indicators, is planned for later in 1999; its focus will be on human health, so further meetings will be required to develop a wider range of indicators. The meeting on modelling proposed by HOTO-IV has been postponed until 2000.

The main HOTO Pilot Project, which the GSC agreed should be adopted as a GOOS Pilot Project, is RAMP (Rapid Assessment of Marine Pollution), which is being trialled in Brazil and will soon spread to other areas (see GOOS News 6 for a description).

There have been no significant developments on implementing the blueprints for the HOTO regional pilot projects described in the report of the Singapore meeting. Of these projects, the Arctic, the Caribbean, the Black Sea and N.E.Asia seem to be favourites for further development, resources permitting. The Panel now needs to make efforts to prioritise and implement its pilot projects.

HOTO is already dealing with the major Conventions, such as the London Dumping Convention, where the main concern is the quality of marine sediments.

In discussion, the Members indicated a need for close linkage between HOTO pilot projects and UNEP's Regional Seas programme, so as to exploit effectively the existing infrastructure and government support implicit in that programme.

Members questioned whether a full-scale HOTO Panel meeting is needed in the year 2000, bearing in mind the impending 'merger' of the HOTO, LMR and Coastal Panels. While HOTO does not need to meet for further discussions on design, the design phase having been completed with publication of the HOTO Strategic Plan in 1996, HOTO activities continue with increasing involvement in implementation and the definition of indicators.

THE STATUS OF THE IOC COMMITTEE ON INTERNATIONAL OCEANOGRAPHIC DATA AND INFORMATION EXCHANGE

Introduction

The IOC's Committee on International Oceanographic Data and Information Exchange (IODE) was established in 1961 by the IOC to improve the management and exchange of marine data. Today, IODE consists of over 65 member countries, with more than 40 National Oceanographic Data Centres and Designated National Agencies providing data management services to their countries and assisting the global exchange of data.

Responsibilities

IODE was established to:

> "enhance marine research, exploration, and development by facilitating the exchange of oceanographic data and information between participating Member States."

With the advance of oceanography from a science dealing mostly with local processes to one that is also studying ocean basin and global processes, researchers depend critically on the IODE international data exchange system to provide data and information from all available sources. Additionally, scientists studying local processes benefit substantially from access to data collected by other Member States in their area of interest. IODE also plays an essential role in the long term archival of oceanographic data for use by future generations.

The success of the IODE program depends on the support of participating Member States, and the involvement of many individual institutions and marine scientists, who contribute not only data, but also the necessary expertise to maintain and further develop the IODE system. Without this national support funded by the Member States themselves, the system could not exist.

Structure

The IODE Committee provides management direction and coordination for the operation of the IODE program. The Committee is supported by the IODE Officers who manage the various programs and activities. IODE is composed of a network of agencies, data centres, expert groups and specific projects that provide a framework for the management and exchange of oceanographic data. While each member state has a National IODE Coordinator, the level of participation in member countries varies. The different levels of participation are described below.

Designated National Agencies

Some Member States have not yet established National Oceanographic Data Centres. Instead they have officially assigned the responsibility of international exchange of oceanographic data and information to a specific agency which is referred to as Designated National Agencies (DNA). DNA's are generally smaller agencies with few resources but with an interest in the coordination of marine data management

(NODC)

National Oceanographic Data Centres

National Oceanographic Data Centres are funded agencies with an endorsed government responsibility for the management, exchange and archival oceanographic data in the national interest.

NODC's actively exchange data within their region and with other centres within the IODE program such as the World Data Centres.

A National Oceanographic Data Centre (NODC) is a centralised facility for providing ocean data/information in a suitable form to a wide user community. The NODC acquires, processes, quality controls, inventories, archives and disseminates data in accordance with national objectives and following the processes described in the IOC Manuals and Guides No. 5 "Establishing a National Oceanographic Data Centre".

In addition to disseminating data and data products nationally, NODC's are responsible the international exchange of marine data. IODE centres (NODC's) are required to submit data to the relevant Responsible National Oceanographic Data Centre or the World Data Centres in a timely fashion. In return, the NODC can request and receive from the WDC's for Oceanography or RNODC's similar data or inventory information which they need for their own national requirements.

Responsible National Oceanographic Data Centres (RNODC)

Some countries operate Responsible National Oceanographic Data Centres in association with the NODC's. RNODC's assist the World Data Centres in a specific area, such as a specific type of data, with data exchange formats or they may cover a specific geographic region such as the RNODC Southern Ocean.

Existing RNODC's include:

a. RNODC-Southern Oceans
b. RNODC for Drifting Buoys Data
c. RNODC for IGOSS (BATHY and TESAC)
d. RNODCS for Marine Pollution Monitoring (MARPOLMON)
e. RNODC for IOC Sub Commission for the Western Pacific (WESTPAC)
f. RNODC for JASIN
g. RNODC-Formats
h. RNODC-Acoustic Doppler Current Profiler (ADCP)

World Data Centres (WDC)

The WDC's form part of the network of data centres established by the International Council of Scientific Unions (ICSU) and play a crucial role in the management of global marine data. World Data Centres for Oceanography (WDC's) receive oceanographic data and inventories from NODC's, RNODC's, marine science organisations, and individual scientists. These data are collected and submitted voluntarily from national programmes, or arise from international co-operative programs.

On request, the WDC's provides copies of data, inventories and publications to NODC's/DNA's, to RNODC's and to international co-operative programmes, as appropriate, in exchange, or with a charge not to exceed the cost of providing the service.

Another major responsibility of the WDC's for Oceanography is to monitor the performance of the international data exchange system and report their findings to the IOC Secretariat and the IODE Committee. The Committee can use this information to take appropriate action to correct deficiencies in the international oceanographic data exchange system.

There are 3 World Data Centres (Oceanography):

a. WDC-A: United States (Silver Spring);

b. WDC-B1: Russian Federation (Obninsk);

c. WDC-D: China (Tianjin)

Activities

The IODE program undertakes a wide range of activities and projects. Some of the more significant of these include: -

Global Ocean Data Archaeology and Rescue (GODAR)

One of the most successful projects within IODE recently has been the Global Ocean Data Archaeology and Rescue (GODAR) project. GODAR involves the location of oceanographic data (predominantly temperature and salinity) that could possibly be lost or destroyed. This data is 'rescued' and goes through a process of quality control and conversion to provide compatibility with the evolving World Ocean Database developed under the supervision of Sydney Levitus at the World Data Centre A (Oceanography).

The efforts of GODAR have resulted in over two million historical temperature observations being added to the World database. This consists of data that was previously unavailable to the international community. The most recent release of the World Ocean Database was in 1998. A meeting is to be held in Washington, DC in early July, 1999 to discuss the future of GODAR and the possible expansion of the project into other marine data parameters

Global Temperature and Salinity Profile Program (GTSPP)

Global Temperature and Salinity Profile Program (GTSPP) was established by IODE and the Integrated Global Ocean Services System (IGOSS) as a pilot project in 1990. After a successful period as a pilot project it became an operational program in 1996. It is now co-managed by the IODE and J-COMM.

GTSPP serves as an ideal model for data management within GOOS and GCOS and is widely recognised as an innovative and highly successful data management program.

The Marine Environmental Data Inventory (MEDI)

Recommendation IODE-XV.1 created the MEDI Pilot Project that aims to develop a global inventory of marine data sets. The Pilot Project system is based on two existing marine metadata directory systems and the pilot project has merged the data fields from these two systems. MEDI pilot project is based on the the European Commission sponsored EDMED data directory system developed by the British Oceanographic Data Centre and the Australian Marine and Coastal Data Directory of Australia (Blue Pages) developed by the Australian Oceanographic Data Centre (AODC) and the Environmental Resource Information Network (ERIN).

The resulting MEDI Pilot system contains metadata fields that are compatible with the evolving ISO metadata standard arising from the ISO Technical Committee 211, the NASA Global Change Master Directory and the US Federal Geographic Data Committee's metadata fields. The MEDI Pilot Project is also compatible with the metadata pilot project being developed by the G3OS Joint Data and Information Management Panel (J-DIMP).

The pilot project has developed a prototype that consists of a Microsoft Access database data entry tool. This system facilitates the entry of a metadata record by providing pull down checklists for certain fields and enables users to quickly enter a description of the data set. The prototype software also includes the ability to retrieve records from the database using a spatial or geographic retrieval interface.

The MEDI Pilot system software is now being distributed to a number of countries and has been used in recent IODE training courses and adopted by many of the countries attending these courses. The pilot project system will be demonstrated at IODE XVI in April 2000. It is intended to re-develop the MEDI pilot project software in Java and provide a flat file structure and database connectivity capabilities so that the application can run on any computer and be attached to any database management system. The additional benefit of Java based software is that the application can also be web enabled, providing a distributed capability when connected to the Internet and linked via Z39.50 protocols.

IODE Resource Kit

IODE has developed a general science program model that aims to provide data managers with basic tools for marine data and information management with a focus on coastal information management. The pool of applicable information management techniques in the wider community of global ocean programs has been surveyed to identify specific methods, tools, and systems (principally concerned with databases and software) that can be applied to all types of coastal programs. These have been brought together forming the IODE Resource Kit. The Kit also provides an important training tool. IODE operates a web version of this, which is a demonstration model of the full version that is being made available on CD-ROM.

Ocean Data and Information Network for Africa (ODINEA)

The ODINEA project is responsible for developing oceanographic data management capabilities in Africa, through a combination of training and the provision of resources to enable the establishment of national oceanographic data centres or designated national agencies. The Flemish Government is supporting this project with Phase One of the project that includes 7 countries nearing completion. Phase two is now being proposed and funding is being sort from IOC and the Government of Flanders. This will see an expansion to 32 African countries, significantly improving the marine data and information management capabilities of the region.

Publications

IODE produces a range of publications and other material in support of marine data and information management and data exchange processes. These range from Manuals and Guides on the creation of National Oceanographic Data Centres through to data quality control procedures, data exchange formats.

IODE Information Projects

IODE undertakes a wide range of marine information projects and activities. Some of these are listed below: -

a. Development of Standards for Marine Information Management
b. Development of Marine Information Management Networks in developing regions
c. Development of Global Directory of Marine (and Freshwater) Scientists
d. Development of Ocean Pilot database
e. Development of Marine Bibliographic Tools: Cooperation in ASFA Cooperation with IAMSLIC and its regional groups Information Technology know-how sharing
f. Development Electronic Information Services

IODE Future Directions

IODE operates a strong program covering many areas of marine data and information management. However, for the next decade, IODE will be looking at ways of further strengthening its activities.

The areas that IODE can focus on include: -

a. The Use of the Internet and Its Associated Technologies;

b. Data Management and Data Exchange Standards;

c. Strategic Alliances.

The Internet and Associated Technologies

The Internet is changing the fundamental way of doing business in many developed countries. However, its use in many developing countries has not become common. As a consequence, the concept of Internet based developments receive little support from most developing countries. However, Internet based developments can in fact assist these countries. One of the great strengths of Internet capable software is its ability to operate on many different computers with different operating systems. More importantly, Internet technologies can also operate on stand-alone computers that are not even connected to a local area network or the Internet.

IODE will be looking at the use of Internet technologies to help bridge the gap between developed and developing countries.

Data Standards

IODE will look at playing a stronger role in the development of data standards to support both management and exchange functions. One concept being discussed is the possibility of extending the International Hydrographic Organisation's standard for navigation data to support a broader range of marine data types. There are a number of benefits in this approach and this is an area that IODE will be watching closely.

Alliances

One of the strengths of the IODE system is its linkages with other programs. The creation of additional linkages with relevant scientific and intergovernmental activities will further strengthen IODE's support of the marine community. IODE can gain from the experience other groups have and in return provide them with the benefit of our extensive knowledge of marine data management.

Late last year IODE hosted a meeting in Paris of the IODE Strategy Group, inviting representatives of a number of international programs and agencies. These included NASA, the IGBP Program's LOICZ and DIS, UNEP, MAST and the US Navy. The participants saw the benefit of closer cooperation in the marine data and information area and saw that IODE should play a major or lead role in this area. The Strategy Group will further develop this concept.

IODE-J-COMM Issues/Proposals

Metadata Directory Systems

Recommend that J-COMM use the developing IODE MEDI metadata directory system for the tracking and location of marine data.

Data Archiving

Recommend that J-COMM use the IODE data networks for the management and final archival of relevant delayed mode ocean data

End-to-End Data Management

Recommend that J-COMM follow the model established by GTSPP for the end-to-end management of marine data, incorporating both real-time (operational) systems and the delayed mode systems including IODE.

GCOS STATUS REVIEW

In September 1998, the GCOS Memorandum of Understanding (MOU) was renewed by the four sponsors: the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC) of UNESCO, the United Nations Environment Programme (UNEP) and the International Council of Scientific Unions (ICSU). The revised MOU emphasizes the transition in GCOS from planning to implementation to ensure establishment of the right mix of observing systems for climate. This implementation phase is being led by the GCOS Steering Committee under its new chairman, Dr Kirk Dawson, and the recently appointed Director of the GCOS Secretariat, Dr Alan Thomas. The Steering Committee met most recently in Geneva (9-12 February 1999), focussing on the status of implementation and the needs of its clients including the IPCC, WCRP, IGBP, the climate prediction community and the United Nations Framework Convention on Climate Change (UNFCCC).

GCOS is showing the importance to policy-making of what is collected (e.g. the relation to needs identified by the UNFCCC). In this way GCOS can help national agencies gain additional resources for implementation at the national level and assist in making research observing systems operational. At the same time it is continuing to identify missing pieces in the G3OS (for example, things not being done by WWW, GOOS or GTOS) as well as important gaps in geographic coverage. The IPCC and WCRP have reiterated that they need GCOS to ensure the availability of long term, systematic data sets. GCOS must demonstrate that progress has been made, and a set of performance measures will be designed to facilitate this and to enable GCOS to work towards improving the performance of the system. GCOS is also working on short range predictions associated with El Niño and, with others, on the El Niño retrospective as a response to UN Resolution 52/200.

In 1998, GCOS played a lead role in developing the response by the Subsidiary Body for Scientific and Technological Advice (SBSTA) to the request by the Third Conference of the Parties (COP-3, Decision 8/CP.3) for assessing and reporting on the adequacy of the global climate observing systems for meeting the needs of the UNFCCC. The report presented to COP-4 (Buenos Aires, 2-14 November 1998) led to its decision (14/CP.4) urging Parties to undertake and strengthen programmes of systematic observation of the atmosphere, oceans and land and requesting Parties to submit information on national plans and programmes relating to their participation in such systems as an element of their national communications to the COP. COP-4 also requested SBSTA, in consultation with agencies participating in the Climate Agenda, to inform COP-5 (Bonn, 25 October-5 November 1999) of developments regarding observational networks and options for financial support to reverse their decline, and invited those agencies, through the GCOS Secretariat, to initiate an intergovernmental process for addressing priorities for action.

The GCOS Steering Committee in February 1999 considered the response to this decision on behalf of the global observing systems for climate. It proposed the development of guidelines to assist countries in submitting information as part of their national communications to COP, and the undertaking of steps to encourage and assist countries to develop and implement national plans for GCOS. It requested the GCOS Secretariat, with advice from IACCA and others, to explore various intergovernmental mechanisms for addressing the priority issues, including the concept of establishing an intergovernmental board for GCOS, perhaps in concert with WCRP. It recommended that there be a detailed investigation of the problems of funding global observing systems for climate with emphasis on identifying the barriers to the use of bilateral and multi-lateral funds such as the GEF and possible steps to address those barriers. It also requested the Secretariat to prepare a progress report on actions taken to address the adequacy of global observing systems for climate for presentation to the next meeting of the COP in October 1999. The Steering Committee acknowledged, however, that the current budgetary allocations available to the GCOS Secretariat are totally inadequate for it to address these recommendations in the required timeframe and urged the sponsors and interested nations to address these resource constraints as a matter of urgency. This problem has been highlighted at presentations aimed at progressing some of these tasks, including the Third Meeting of IACCA (11-12 March 1999), the SBSTA Workshop on Reporting Guidelines (17-19 March 1999), WMO Congress and Executive Council (May 1999), the tenth session of SBSTA (June 1999) and the IOC Assembly

(29 June-9 July 1999).

On the implementation side, the GCOS/WCRP Atmospheric Observations Panel for Climate has made good progress on establishment and monitoring of the GCOS Upper Air Network (GUAN) and the GCOS Surface Network (GSN), although difficulties remain in ensuring smooth and consistent data flow into the GCOS archive. The GUAN consists of 150 stations operated by national agencies and for which ECMWF performs regular monitoring of performance. Most recent results show up to 35% of stations not reporting as expected, depending on the region, with a global average of 14% not reporting. The GSN currently consists of 988 surface stations for which the Deutscher Wetterdienst (DWD) and the Japan Meteorological Agency (JMA) have agreed to carry out performance monitoring. A meeting to establish this activity was held at Offenbach, Germany, in January 1999. Most recent statistics show a global average of 22% of SYNOP reports and 44% of CLIMAT reports not being received from GSN stations, thus demonstrating a clear need for improvement in the implementation of the GSN. On the more positive side, the AOPC arranged, in conjunction with the OOPC, a very successful workshop on Global SST Data Sets (Columbia University, USA, 2-4 November 1998) as well as a Workshop on Climate Extremes in the Asia-Pacific Region. A follow-on to the latter workshop will be aimed at contributing to the IPCC Third Assessment Report. The AOPC is also very actively assessing and updating the current list of GCOS needs for atmospheric observations for climate and ensuring that those needs from space-based platforms are properly incorporated into the database maintained by the WMO and CEOS (Committee on Earth Observation Satellites). These results will also form part of the initial AOPC Plan, which is nearing completion.

The GCOS/GTOS Terrestrial Observations Panel for Climate (TOPC) completed its most recent review of satellite data requirements at its meeting in May 1998 for inclusion in the WMO/CEOS database of user needs. It has facilitated the establishment of the Global Terrestrial Network for Glaciers (GTN-G) and is in the process of inaugurating a GTN for Permafrost (GTN-P). Preliminary efforts are also underway for the establishment of an ecology network (GTN-E) and a hydrology network. The TOPC is actively involved in two demonstration projects (Net Primary Productivity and Global Observations of Forest Cover) and will assist in progressing them in the coming year.

Activities of the GCOS/GOOS/WCRP Ocean Observation Panel for Climate (OOPC), the GCOS/GOOS/GTOS Global Observing Systems Space Panel (GOSSP) and the GCOS/GOOS/GTOS Joint Data and Implementation Panel (JDIMP) will be reported separately at the present meeting. The OOPC is focussing on the Global Ocean Data Assimilation Experiment (GODAE) and its Argo initiative and activities leading to the first International Conference on the Ocean Observing System for Climate (St. Raphaël, 18-22 October, 1999). GOSSP is concentrating on ensuring the accuracy and reliability of the information on user needs and satellite observation capabilities in the WMO/CEOS database and is carrying out adequacy or 'gap' analyses of the planned observations using the concept of 'themes' as a framework, under the leadership of its new chairman, Dr Francis Bretherton. The first agreed theme area is Oceans, which will incorporate the work of the Long Term Ocean Biology and GODAE pilot projects initiated under the Strategic Implementation Team of CEOS as a step in the establishment of an Integrated Global Observing Strategy (IGOS). GOOS is a co-leader of the Oceans theme team and will work closely with GOSSP and the CEOS agencies involved. JDIMP has been active in developing mechanisms for the identification and exchange of global climate data and information such as the Global Observing Systems Information Centre (GOSIC) and is in the process of finalizing a joint G3OS Data and Information Management Plan.

RESEARCH PROGRAMMES

The Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) was proposed as a mechanism for implementing and maintaining observing system elements relevant to the climate module of GOOS (and ocean component of GCOS) and the marine meteorology program of WMO. Most physical oceanographic measurements have been included using the argument that all such measurements are relevant to climate. In practice, no firm outer bound has been placed on JCOMM in order to allow some flexibility for the Commission.There are also several research programs and pilot projects that will contribute to, and benefit from, the JCOMM. This document provides a brief overview of those connections and their relevance.

THE WCRP RESEARCH PROGRAM CLIVAR

The Climate Variability and Predictability Programme of the WCRP is the research counterpart of the physical aspects of GCOS ocean and atmosphere. It encompasses intraseasonal (e.g., monsoon), seasonal-to-interannual and decadal-to-centennial climate variations and climate change. The Tropical Oceans-Global Atmosphere experiment (TOGA) and World Ocean Circulation Experiment (WOCE) provide much of the scientific foundation for CLIVAR, just as they do for the design of the ocean climate observing system of GCOS/GOOS.

Figure 1 shows schematically the relationship between the “operational” components of the observing system of interest to JCOMM and the sustained and process study measurements of CLIVAR. The research observations are implemented in the presence of a basic/operational network. The over-riding imperative for CLIVAR is the quest for understanding and knowledge of the climate system, as described by the CLIVAR science plan. The observations of GCOS/GOOS are also undertaken scientifically and according to best practice but they exist for long-term applications, not just science. It can be expected that some elements needed by CLIVAR will be managed and implemented within the framework of JCOMM. Yet other elements will need expert, research facility capabilities. Some parts of the sustained observing system for CLIVAR may progress to operational support over time.

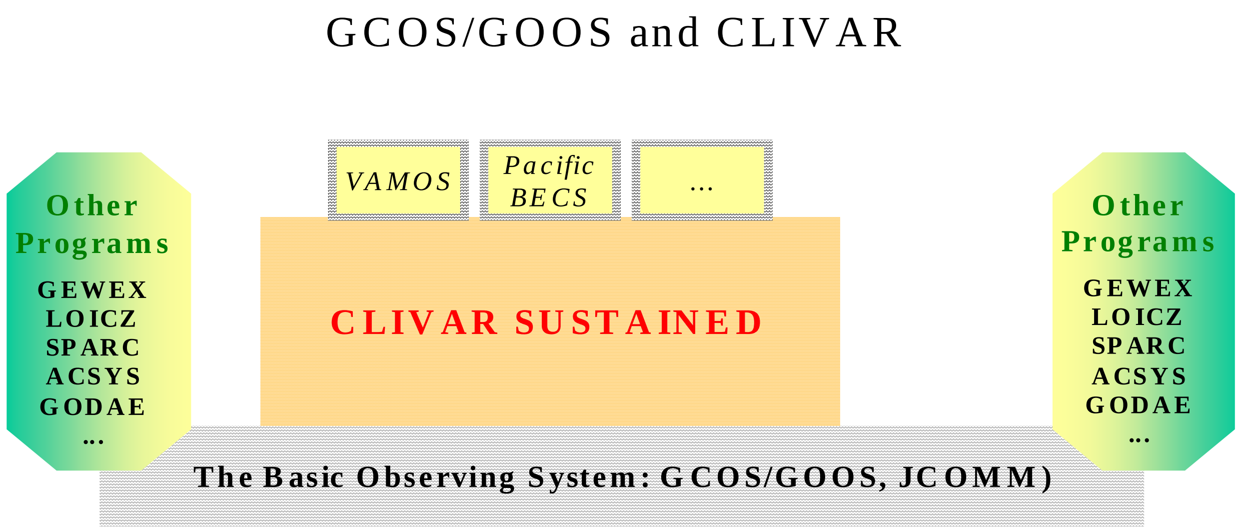


Figure 1. Schematic of the relationship between the (operational) ocean observing system for climate of GCOS/GOOS and the research program CLIVAR and other research programs and pilot projects. The CLIVAR sustained observing in turn provides a foundation for short life-time process studies, for example, within the Variability of the American Monsoon System (VAMOS) experiment.

Joint Projects

Over the last several years, the OOPC has worked hard with CLIVAR and its Upper Ocean Panel in order to establish an observing system that would jointly satisfy both research and operational needs (see Figure 2). This collaboration is vital for GCOS/GOOS since it provides access to scientific guidance and advice as the observing system develops and evolves.

The International Sea Level Workshop (GOOS Publication No. 55) was the first example of such cooperation. Both groups believed it was an effective strategy. Argo, the global array of profiling floats, was also developed as a joint pilot project. The first International Conference on Ocean Observing Systems for Climate (OCEANOBS99) was conceived to draw the oceanographic community into this new way of working.

The Upper Ocean Thermal Review and Workshop will be the next instance of collaboration, with the OOPC and SOOP IP providing the lead. For the time-series stations, where POGO might be needed for implementation, the lead will probably start with CLIVAR since it is mainly research imperatives and objectives that are setting the agenda.

The overall structure

Figure 3 is adapted from the structural diagram for JCOMM. CLIVAR is a Programme of the World Climate Research Programme that is in turn one of the sponsors of OOPC. GODAE and Argo are two pilot projects that are seen to be directly working toward the development of an operational ocean observing system for oceanography and climate.

The OOPC must take the lead role for scientific advice to JCOMM, but it also has a responsibility to ensure that scientific and technical advance in CLIVAR is used to improve the systems of JCOMM. The capacity-building projects like GODAE and Argo are an alternative way of enhancing the capabilities of JCOMM in collaboration with research.

Additional research requirements

The development of the CLIVAR Implementation Plan followed the development of the requirements for the Action Plan (for JCOMM) by the OOPC. These requirements were initially drafted for the Sydney Workshop based on the OOSDP Report (1995) and subsequent developments by OOPC. The Upper Ocean Panel of CLIVAR which, at that time, was mainly focussed on ENSO issues and the ENSO observing system, also made an early decision to use the OOSDP report as the basis for development of its plan.

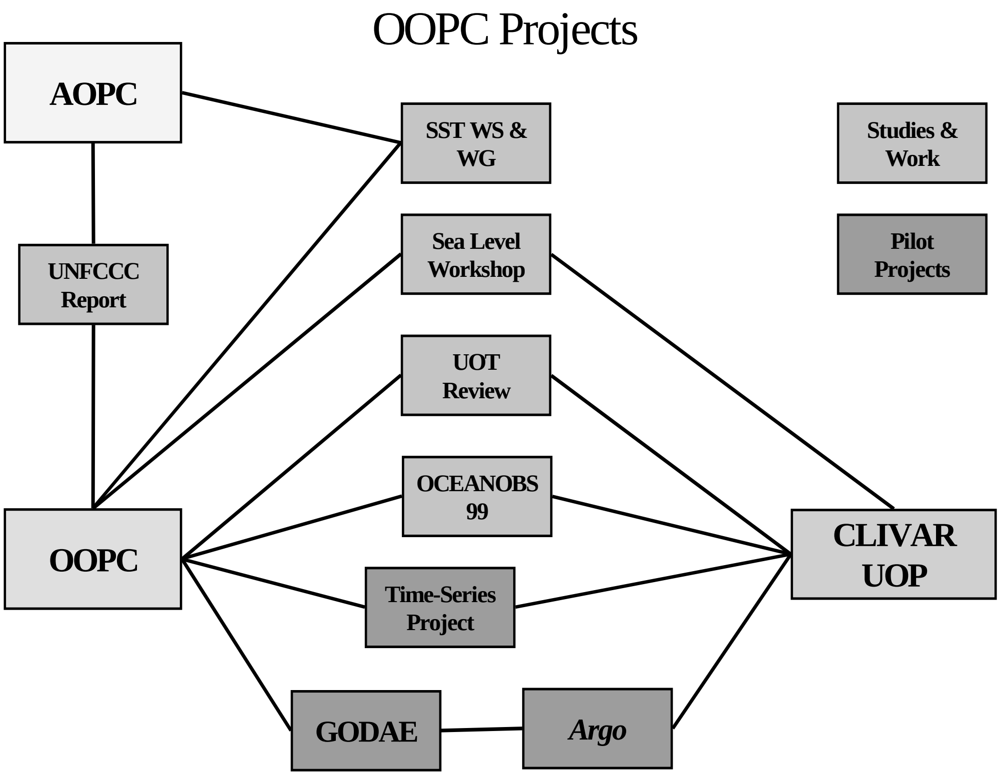


Figure 2. **Schematic showing projects of the OOPC and their relationship to CLIVAR and its Upper Ocean Panel**

It made sense then to use the Action Plan, with enhancements as appropriate to the research objectives of CLIVAR, as the basis for the CLIVAR Implementation Plan. This process was aided by the fact that much of the work writing the CLIVAR Plan was done by people familiar with the JCOMM process. At this same time the plans for Argo were emerging from GODAE and the CLIVAR UOP.

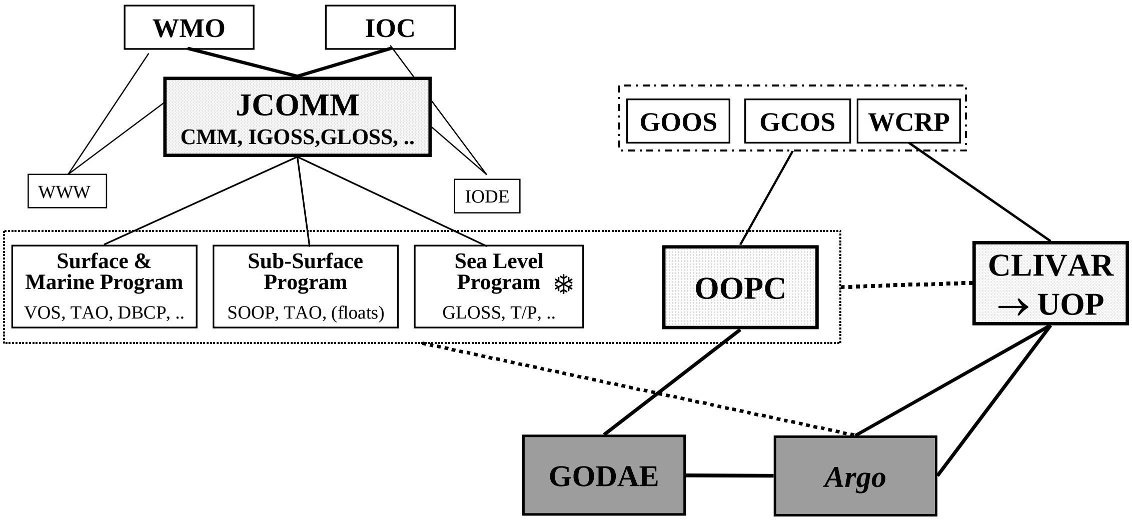


Figure3. Structural diagram showing the functional relationship between JCOMM and its Programs, the OOPC and its parent groups, GCOS, GOOS and WCRP, and the research program CLIVAR. Argo is an example of a shared pilot project.

The CLIVAR IP goes beyond the Action Plan in several areas. First, the emergence of Argo provided a means to sample subsurface salinity, a key variable for longer period climate studies and other research within CLIVAR. The Action Plan noted the possibility of using profiling floats but properly treated it as a pilot project rather than as an existing capability. The CLIVAR IP also discusses the need for hydrographic data in more detail (inventories and transport) and the role of time-series stations. One might expect that aspects of each of these sustained programs/projects would in time transition to some sort of operational footing. The case for operational support of some of the high-density XBT lines is also strengthening though, in this case, the above-mentioned study on the upper ocean thermal network may directly recommend support within GCOS/GOOS.

There are several differences between the scientific remit of OOPC and its research counterpart, the CLIVAR Upper Ocean Panel (note that CLIVAR has informally agreed that the latter panel should consider all observations relevant to the global sustained ocean observing system). First, the OOPC, like its predecessor the OOSDP, has a charge to consider biogeochemical observations and, in particular, strategies for monitoring the oceanic carbon budget. It is likely such measurements will become more common on platforms within the remit of the JCOMM. The Joint Global Ocean Flux Study (JGOFS) and the SCOR/IOC Panel for CO_2 are the groups most relevant in terms of scientific research. Second, OOPC has been asked to consider the ice-covered ocean that, within WCRP, is the interest of the Arctic Climate System Study (ACSYS). OOPC has opened up a dialogue with ACSYS with a view to strengthening this aspect. Finally, through GODAE and decisions of the GOOS

Scientific Committee (in its former guise as J-GOOS), OOPC has been taking a more active interest in ocean estimation (independent of its relevance to climate) and, in particular, ocean forecasts. WOCE is the relevant scientific group for ocean estimation though its interests are limited. For other aspects, there is no research program counterpart, which raises difficulties for both the OOPC and GODAE.

We are entering a new era for management of resources for sustained ocean observations, both in the in situ domain and for remote sensing. JCOMM will need to adapt to and learn to benefit from this new mode of business. Pilot projects are one way to engineer an orderly transition from research to operational, long-term (sustained) support. But this will not be the only mode and JCOMM will have to exercise both discipline and vision in dealing with a research community whose attention is more often on the exciting, leading edge and less often on the proven, robust long-term elements.

THE GLOBAL OCEAN DATA ASSIMILATION EXPERIMENT

Remote sensing was always going to be a critical element of the ocean observing system for climate. But to take advantage of the possibilities, we needed a more integrated approach with respect to remote sensing; vastly improved cooperation and integration of remote and direct data streams; and ocean models and data assimilation to exploit this information. The Global Ocean Data Assimilation Experiment (GODAE) was conceived as a necessary step towards achieving those aims. Excellent progress has been made with respect to defining remote sensing requirements, thanks in part to CEOS and GOSSP (see Document 10), and with the Argo initiative, we are about to see a small revolution in direct observation of the ocean (Section 5). The schedule for GODAE is however quite daunting and it faces major challenges to attract the intellectual involvement and modelling/data assimilation expertise and investment that will be necessary to make it work.

GODAE has devoted considerable time to the definition and goals of GODAE. The experience of the Global Atmospheric Research Programme and its FGGE were used extensively for this discussion. The revised are:

a. The application of state-of-the art ocean models and assimilation methods for short-range open-ocean forecasts, for boundary conditions to extend predictability of coastal and regional subsystems, and for initial conditions of climate forecast models;

b. To provide global ocean analyses and re-analyses for developing improved understanding of the oceans, improved assessments of the predictability of ocean systems, and as a basis for improving the design and effectiveness of the global ocean observing system.

Existing SST products are limited for the purposes of GODAE. Present products are generally of modest resolution (typically greater than 100 km for global products) and do not capture higher-frequency details. GODAE resolved to develop a specific project related to high-resolution SST products. It was assumed that the AOPC/OOPC SST WG would be brought into existence to focus on climate aspects and that, as far as is practical, any global high-resolution product would reduce to the "best" global climate product when averaged over the appropriate space and time scales. The GODAE project will push as far in temporal and spatial resolution as is deemed practical. We want it to be useful for coastal and regional/mesoscale applications but it may not be practical to push down to the km scale globally. High resolution will probably mean at least 10 km and at least daily (not just produced daily), and perhaps some attempt to resolve the diurnal cycle. This product will be made available as a first guess for very-high resolution (~ 1 km coastal products).

There was also considerable debate at the most recent GODAE meeting concerning Pilot Projects. To realize the goals and ambitions of GODAE, Pilot Projects must have goals and outcomes that conform with GODAE objectives and integrally lead to the better conduct and/or execution of the primary global experiment. A Project will normally have

a. A set of objectives/goals;
b. A strategy;
c. An implementation plan;
d. A schedule;
e. Defined outcomes.

A GODAE Pilot Project develops capacity by engaging a section of the community in an activity that contributes in a non-trivial way to GODAE. It swells and enriches the GODAE Common. Argo is an example of a GODAE Pilot Project. The Pilots will normally embrace a particular sector of GODAE, be that the development of a specific observational capability or regional prototype of GODAE itself.

An alternative, and complementary approach, is to set in motion actions (tasks, work) that focus on the commonalities across dispersed activities. These might be called cross-cutting initiatives and are usually undertaken through working groups. Three areas were identified as high-priority in terms of developing infrastructure:

a. Data and information management/flow practices;

b. Linkages into the community beyond GODAE;

c. Developing metrics for assessing progress.

A boost for the first of these activities has been provided by the announcement of support for a GODAE data server at the Fleet Numerical Meteorological and Oceanographic Center. This server will provide international access to most of the critical data sets and products and boundary conditions needed for operational oceanography. For the regional activities, GODAE concluded it was best to form a Working Group that would examine the generic issues, with an initial focus on the North Atlantic. The initial work program would focus on intercomparison exercises for models and data assimilation. The WG would look at skill evaluation, develop GODAE-generic impact studies and look at activities that linked with the non-GODAE community.

An initial draft of the GODAE Strategic Plan has been prepared. Like many other activities in 1999, the OCEANOBS99 Conference is seen as the most appropriate target for this Plan.

ARGO, A GLOBAL ARRAY OF PROFILING FLOATS

In the first half of 1998 both GODAE and CLIVAR passed resolutions supporting the idea of a global array of profiling floats, about 2-3000 in all, measuring T and S to 2000 m every 10 days. This initiative is now known as Argo. A Workshop was convened to examine the feasibility of this idea (in conjunction with the 2nd meeting of the International GODAE Steering Team). The Workshop concluded that Argo was most definitely worth doing and feasible. Initial estimates suggested the per-profile cost (of T and S to 2000m) could be as low as US$100. Certain technical challenges were identified but none of these were deemed insurmountable.

An Argo Science Team was formed with a target date of October 1 for the first draft of an implementation plan drawing on the Prospectus and the initial proposals. This draft was circulated for non-advocate review in October and drew around 30 responses. None questioned the need for Argo or the technical feasibility. The majority of the comments targeted the scientific and operational rationale, deployment, sampling strategies, and the need for integration within the global observing system. The GODAE Office published the Initial Plan in early November 1998 and distributed it to delegates at the CLIVAR Conference in the 1st week of December.

In parallel with the scientific development, a major campaign was initiated to encourage international participation, led by NOAA. This has clearly been very successful and GODAE (and GOOS and JCOMM) should be extremely grateful for the energy that has been expended by this group on our behalf.

The 1st meeting of the Argo Science Team was held in Easton prior to the third meeting of GODAE. Estimated national contributions are [1]:

Australia	30-50 floats per year
Canada	35
EU	50
France	50
Germany	?
Japan	
- design study	70
- frontiers, etc	?
UK	50
US	300

Conclusion: it is realistic to expect 600 deployments per year by around 2001. The main obstacle to global distribution is the Southern Ocean. The basin-by-basin requirements are (in units of total operating floats)

Indian	440
Pacific	1303
Atlantic	629
Southern Ocean	970

Achieving global distribution remains a top priority for Argo. There had been significant discussion on technical issues:

1 These are not national 'commitments' and should not be interpreted as final target numbers. They are seen as what is practical in the next few years.

Salinity	Presently have demonstrated capability of around 2 years. New CTD sensors are being developed which promise more accuracy, better quality and greater lifetimes. Seeking a demonstration of 4 year lifetimes (due 2003!)
Communications	Argos, Orbcomm and Iridium are the leading candidates. Argo needs increased bandwidth cf the present and 2-way communications to minimise surface time (alleviating energy drain and fouling)
Power	General good news. Improved power efficiency should enable > 200 cycles and permit deep profiles without impacting longevity
Deployment	VOS and air are the leading candidates. The ability of VOS to achieve even global coverage is its main limitation. Air deployment is potentially cost-effective. Access to hours on a suitable aircraft is the key element for air deployment; there is no reason to suspect at the moment that air deployment will more troublesome (in terms of instrument damage and failure) than VOS.
Parking depth	Remains unresolved with arguments for both thermocline and deep.
Profile depth	Deep 2000m preferred (and doable independent of parking depth).
Cycle time	Around 10 days

There was also significant discussion also data flow issues (Figure 4).

There is unanimous agreement that ALL data will be distributed in real-time. The data acquisition/assembly centres are likely to be modelled on the WOCE Upper Ocean Thermal Data Assembly Centres. The Argo ST noted that retaining the interest and enthusiasm of the present float community may depend on attention to the openness of the total data and information system (e.g., the GODAE Common). While in principle this is so (e.g. models, products should be as freely exchanged as data), in practice it may need some explicit demonstrations that this will be the case. The data originators, assemblers, processors (modellers, assimilators) and service originators should all be equal in terms of identity with GODAE output. There must be explicit feedback and interactions amongst this constituency. This might also be a consideration for GOOS.

The Argo ST is now concentrating on the development of an implementation plan. OCEANOBS99 is as a key target in this process. Various initiatives are being taken to address the globalization issue. The issue of floats entering EEZ's and the potential for violation of Ocean Dumping Conventions are significant concerns.

In summary, Argo is at or ahead of the schedule that was established 12 months ago. Indeed, the international interest, derived from interests ranging from climate change to operational ocean forecasting, is impressively strong and suggests that we can confidently plan toward the initial targets. The climate change applications perhaps need to be exploited (explained) somewhat better than perhaps we are at present.

For JCOMM, it is important to remember that Argo remains a Pilot Project; it has many issues that must be resolved before we can claim it is a stable, robust method worthy of long-term support. Insofar as the OOPC is concerned, questions remain about the "optimum" sampling and the ability of Argo to cover the global ocean. Nevertheless, Argo data will be available in real-time and will impact on other elements of JCOMM in a non-trivial way. The OOPC/CLIVAR/SOOP thermal network study is a first attempt to assay what that impact might be. Argo also has many things in common with the early days of TAO; it is critically dependent on improved communications and it is delivering a data stream that is for most intents and purposes novel. We have little experience in dealing with such detailed, deep randomly distributed temperature data, and for salinity there are many outstanding technical and scientific issues. The decision to exchange all data in real-time is a bold initiative to entrain a larger community in the study of the data and development of Argo. JCOMM would be wise to consider and plan for the impact of Argo. However it would also be wise to let Argo develop and mature at its own pace and avoid unnecessary interventions and interference, no matter how well intentioned they might. Let Argo come to JCOMM, do not try and "capture" it.

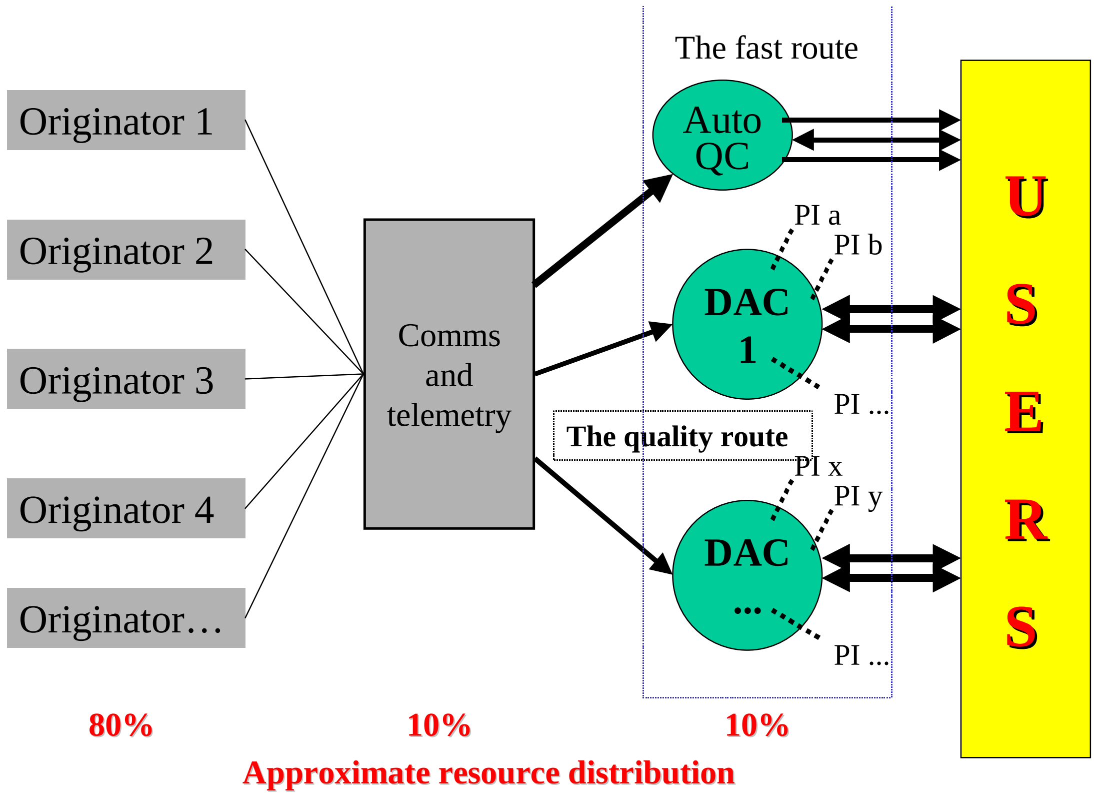


Figure 4. Schematic of the data flow for Argo, from several originators (collectors/operators) through some advanced communications system, and ultimately to the user community (scientists and operational centres and others). Two paths will be supported: one a fast, automated route, the other with more considered quality control and processing procedures. *Argo* estimates that around 10% of the total resources should be devoted to this latter component.
